

COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General for Research, Science and Education

Inventory of 1976-1978

**ENERGY RESEARCH, DEVELOPMENT
AND DEMONSTRATION PROGRAMMES
AND EXPENDITURES**

of the Member States and the European Communities

Prepared by

the Energy R & D Subcommittee of CREST

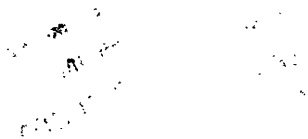
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FOREWORD

The Scientific and Technical Research Committee (CREST), having discussed the first report on the confrontation and co-ordination of the energy research and development policies and programmes of the Member States and of the European Communities (Report EUR 5911), asked its energy research and development Subcommittee to continue improving and keeping up-to-date the inventory of energy research and development programmes and activities. With the preparation of the present 1976-78 edition, the Subcommittee confidently hopes to have fulfilled its task. The nomenclature - in which the whole of energy R&D activities may be sub-divided - has been revised, the scope has been widened and now covers not only R&D activities, but also demonstration ones.

The Subcommittee considers the inventory - in its present factual form - as a useful element of information and recommends that it be circulated widely to the interested quarters. I wish to express my gratitude to all members of the Subcommittee for their willing co-operation in preparing this document and to the Commission of the European Communities - in particular to Mr. G. Valentini and Mr. M. Francini - for its active support in preparing and publishing it.

Prof. Paul De Meester
President of the Energy
Research and Development Subcommittee
of CREST

Brussels, October 1979

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1. SECTION 1

1.1. INTRODUCTION

The present inventory, by reference to the previous ones realized in the framework of the energy R&D Subcommittee of CREST - the first referring to expenditures 1973/estimates 1974 (doc. XII/648/74) and the second referring to expenditures 1974/75/estimates 1976 (doc. EUR 5911) - differs rather substantially from them.

Firstly, its scope has been broadened to cover not only research and development, but also demonstration activities and - in general - even financial support of energy technologies.*

Secondly, its nomenclature (sub-division in sectors and sub-sectors) has been changed: while maintaining its technology-oriented structure, it is now more homogeneous and can be compared more easily to the structure adopted in the IEA's reviews by reference to which, however, shows a more detailed sub-division between the items in which the different aspects of a given energy technology can be split.

It cannot be compared with other reviews carried out for more general statistical purposes, as that realized by the R&D Statistics Subcommittee of CREST; not only the nomenclature of the present inventory differs greatly from the NABS' one, and any effort in realizing their mutual compatibility would alter substantially the nature of one or other or both, but also the kind of expenditures taken into account differ basically: while the NABS covers the R&D allocations of central governments, the present one adds to them the demonstration funds of central governments and the RD and D allocations of the undertakings of the public sector.

1.2 EXPLANATORY NOTES

Section 2.1

- All figures of the summary tables are expressed in millions European Units of Account (EUA) and are rounded up to the second decimal.
- Only figures pertinent to the years 1976 and 1977 are expenditures; those pertinent to 1978 are, in general, only estimates.
- Table I gives the RD&D expenditures of Member States altogether and of the E.C. in each of the sectors and for the period 1976-1978.
- Tables IIa, IIb, and IIc give the summary expenditures of each Member State and of the E.C. in each of the sectors for the years 1976, 1977, and 1978 respectively; Tables IIIa, IIIb, and IIIc give the per head expenditures (in EUA) in each Member State and in the E.C. (considered as EUR-9); the population data have been taken from the report CREST/51/78 and are the following (in thousand units):

	B	D	DK	F	IRL	I	NL	UK	EUR-9
1976	9818	61531	5073	52921	3162	56169	13773	56001	258449
1977	9830	61400	5089	53084	3192	56462	13856	55967	259226
1978	9850	61317	5111	53239	3222	56740	13937	55894	259310

* See Item 1.3 "Qualification Statements".

- Tables IVa, IVb, and IVc give the summary expenditures of each Member State and of the E.C. for the years 1976, 1977 and 1978 respectively for each sector and sub-sector. When examining these tables, the reader should be aware of the fact that only figures pertinent to the totals of the sectors 0, 1, 2 ... 6 are exact; figures pertinent to each sub-sector 1.1, 1.2, etc. - as those of columns 9 and 11 - are only approximate and indicative; the abbreviation "p.m. (pour mémoire)" which appears in some squares of the tables, means that, although activities exist in the concerned sub-sector so that the (horizontal) additions referring to single sub-sector, as are in particular the squares of columns 9 and 11, cannot help being approximate.

Section 2.2

Each table in section 2.2 gives a summary of the expenditures (in millions EUA) of each Member State and of the E.C. for the period 1976-78 as well as a comparison of the main lines of activity for each sub-sector.

Section 3

Each sub-section of section 3 refers to a Member State or to the E.C.; for each sub-section are given:

- A summary table with 1976 and 1977 expenditures and 1978 estimates in each sector and sub-sector (in millions EUA);
- A qualification statement;
- A summary of national energy RD and D policy and of priorities;
- Single sheets -one for each sub-sector- giving a summary description of national programmes and activities: the expenditures are expressed in both national currencies and EUA). Expenditures in national currencies have been converted into EUA by applying the exchange rates given below:

	BF	DM	DKr	FF	UK/IR £	Lit	Fol
1976	43.165	2.815	6.761	5.345	0.622	930	2.955
1977	40.882	2.648	6.856	5.606	0.654	1007	2.800
1978	40.358	2.573	6.969	5.645	0.672	1061	2.759

1.3 QUALIFICATION STATEMENTS

Qualification statements to each Member State are included in sub-sections of section 3.

As for the European Communities, it should be noted that expenditures given here refer to the totality of the appropriations earmarked in the Community budget in the sector of energy research and technology; the estimation of the pure R&D fraction, where exists, is indicated for each item on the corresponding sheet.

SECTION 2

SUB-SECTION 2.1 SUMMARY TABLES OF THE RD&D EXPENDITURES OF
MEMBER STATES AND EUROPEAN COMMUNITIES IN
THE PERIOD 1976-1978.

Table I

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES
IN THE PERIOD 1976-1978
(in million EUA)

SECTORS	EUR - 9			EC			EUR - 9 + EC		
	1976	1977	1978	1976	1977	1978	1976	1977	1978
0. General heading	6.19	6.76	7.89	-	-	-	6.19	6.76	7.89
1. Rational use of energy	101.87	118.24	170.45	0.52	3.10	4.12	102.39	121.34	174.57
2. Fossil fuels and derivatives	187.65	281.62	423.07	32.35	47.27	42.69	220.00	328.89	465.76
3. Nuclear power	998.34	1077.55	1123.62	48.05	61.11	69.58	1046.39	1138.66	1193.20
4. New energy sources and vectors	120.39	153.23	200.78	34.15	52.68	72.03	154.54	203.91	272.86
5. Electricity	126.84	129.91	137.62	-	-	-	126.84	129.91	137.62
6. General studies	27.20	36.46	37.16	1.86	3.72	4.60	29.06	40.19	41.76
TOTALS	1568.48	1.803.77	2100.59	116.93	167.88	193.07	1685.41	1971.65	2293.66

Table II a

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES

(in million EUA)

YEAR : 1976

SECTORS	COUNTRY											EUR-9 + EC	
	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC			
0. General heading	-	-	-	-	-	-	-	6.19	6.19	-	-	6.19	6.19
1. Rational use of energy	n.a.	16.88	1.29	38.03	0.01	11.89	4.91	28.86	101.87	0.52		102.39	
2. Fossil fuels & derivatives	n.a.	35.21	-	74.94	0.40	9.24	3.25	64.61	187.65	32.35		220.00	
3. Nuclear power	49.80	356.66	8.04	262.19	-	97.36	36.99	187.30	998.34	48.05		1046.39	
4. New energy sources and vectors	1.04	38.62	0.86	39.58	0.08	15.69	12.62	11.90	120.39	34.15		154.54	
5. Electricity	-	5.68	-	50.33	0.42	33.76	0.75	35.90	126.84	-		126.84	
6. General studies	-	0.07	0.15	10.77	0.08	5.74	1.08	9.31	27.20	1.86		29.06	
T O T A L S	50.84	453.12	10.34	475.84	0.99	173.68	59.60	344.07	1568.48	116.93		1685.41	

Table II b

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES

(in million EUA)

YEAR : 1977

SECTORS	COUNTRY											EUR-9 + EC	
	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC			
0. General heading	-	-	-	-	-	-	-	6.76	6.76	-	-	6.76	6.76
1. Rational use of energy	5.24	14.73	2.17	44.29	0.18	15.76	7.41	28.46	118.24	3.10		121.34	
2. Fossil fuels & derivatives	4.03	67.62	0.23	88.78	23.39	10.51	5.50	81.56	281.62	47.27		328.89	
3. Nuclear power	51.65	363.86	9.87	287.92	-	130.27	38.72	195.26	1077.55	61.11		1138.66	
4. New energy sources and vectors	3.27	43.82	2.79	50.66	0.20	19.51	16.32	16.66	153.23	52.68		205.91	
5. Electricity	1.48	6.04	0.02	53.17	0.42	31.10	2.61	35.07	129.91	-		129.91	
6. General studies	0.86	0.04	0.45	16.91	0.12	6.13	1.43	10.52	36.46	3.72		40.18	
T O T A L S	66.53	496.11	15.53	541.73	24.31	213.28	71.99	374.29	1803.77	167.88		1971.65	

Table II c

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES

(in million EUA)

YEAR : 1978 (estimates)

SECTORS	COUNTRY											EUR-9 + EC	
	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC			
0. General heading	-	-	-	-	-	-	-	7.89	7.89	-	-	7.89	7.89
1. Rational use of energy	3.62	40.03	3.43	57.40	0.23	18.20	7.54	40.00	170.45	4.12		174.57	
2. Fossil fuels & derivatives	5.96	115.44	1.16	115.90	74.90	13.77	5.54	90.40	423.07	42.69		465.76	
3. Nuclear power	56.01	398.64	11.18	275.55	0.37	136.35	38.67	206.85	1123.62	69.58		1193.20	
4. New energy sources and vectors	4.19	55.59	6.05	62.81	0.48	32.48	18.16	21.02	200.78	72.08		272.86	
5. Electricity	0.72	7.77	0.80	63.15	0.45	27.30	1.74	35.69	137.62	-		137.62	
6. General studies	1.97	0.04	1.11	14.22	0.06	6.80	1.63	11.33	37.16	4.60		41.76	
TOTALS	72.47	617.51	23.73	589.03	76.49	234.90	73.28	413.18	2100.59	193.07		2293.66	

Table III a

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES

IN EUROPEAN COMMUNITIES AND MEMBER STATES

YEAR : 1976 (in EUA per head)

SECTORS	COUNTRY	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC	EUR-9 + EC
0. General heading		-	-	-	-	-	-	-	0.111	-	-	-
1. Rational use of energy		n.a.	0.274	0.255	0.719	0.003	0.212	0.356	0.515	0.394	0.002	0.396
2. Fossil fuels & derivatives		n.a.	0.572	-	1.416	0.127	0.165	0.236	1.154	0.726	0.125	0.851
3. Nuclear power		5.072	5.796	1.588	4.954	-	1.733	2.686	3.345	3.863	0.186	4.049
4. New energy sources and vectors		0.106	0.628	0.170	0.748	0.025	0.279	0.917	0.212	0.466	0.132	0.598
5. Electricity		-	0.092	-	0.951	0.133	0.601	0.054	0.641	0.491	-	0.491
6. General studies		-	0.001	0.030	0.204	0.025	0.102	0.078	0.166	0.105	0.007	0.112
T O T A L S		5.178	7.363	2.043	8.992	0.313	3.092	4.327	6.144	6.069	0.452	6.521

Table III b

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES

YEAR : 1977
(in EUA per head)

SECTORS	COUNTRY											EUR-9 + EC	
	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC			
0. General heading	-	-	-	-	-	-	-	0.121	-	-	-	-	-
1. Rational use of energy	0.533	0.240	0.426	0.834	0.056	0.279	0.535	0.509	0.456	0.012	0.468		
2. Fossil fuels & derivatives	0.410	1.101	0.045	1.672	7.328	0.186	0.397	1.457	1.086	0.182	1.268		
3. Nuclear power	5.254	5.926	1.939	5.424	-	2.307	2.794	3.489	4.157	0.236	4.393		
4. New energy sources and vectors	0.333	0.714	0.548	0.954	0.063	0.346	1.178	0.298	0.591	0.203	0.794		
5. Electricity	0.151	0.098	0.004	1.002	0.132	0.551	0.188	0.627	0.501	-	0.501		
6. General studies	0.087	0.001	0.088	0.319	0.038	0.109	0.103	0.188	0.141	0.014	0.155		
T O T A L S	6.768	8.080	3.050	10.205	7.617	3.778	5.195	6.568	6.958	0.647	7.605		

Table III c

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES

YEAR : 1978

(in EUA per head)

SECTORS	COUNTRY	B	D	DK	F	IRL	I	NL	UK	EUR-9	EC	EUR-9 + EC
0. General heading		-	-	-	-	-	-	-	0.141	-	-	-
1. Rational use of energy		0.368	0.666	0.671	1.078	0.071	0.321	0.541	0.716	0.660	0.016	0.676
2. Fossil fuels & derivatives		0.605	1.883	0.227	2.177	23.246	0.243	0.398	1.617	1.632	0.165	1.797
3. Nuclear power		5.686	6.501	2.187	5.176	0.115	2.403	2.775	3.701	4.333	0.269	4.602
4. New energy sources and vectors		0.425	0.907	1.184	1.180	0.149	0.572	1.303	0.376	0.774	0.278	1.052
5. Electricity		0.073	0.127	0.157	1.186	0.140	0.481	0.125	0.639	0.531	-	0.531
6. General studies		0.200	0.001	0.217	0.267	0.019	0.120	0.117	0.203	0.143	0.018	0.161
TOTALS		7.357	10.085	4.578	11.064	23.740	4.140	5.259	7.393	8.101	0.746	8.847

Table IV a

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES
(in million EUA)

YEAR : 1976

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
<u>0. GENERAL HEADING</u>		-	-	-	-	-	-	-	<u>6.19</u>	<u>6.19</u>	-	<u>6.19</u>
1.0. General		-	-	-	-	-	-	-	8.04	8.04	-	8.04
1.1. Industry		n.a.	1.34	0.14	15.90	-	6.73	1.59	7.54	33.24	p.m.	> 33.24
1.2. Resid. & commercial		n.a.	4.70	0.56	8.36	0.01	2.13	1.49	9.45	26.70	p.m.	> 26.70
1.3. Transportation		n.a.	4.26	0.22	8.89	-	2.50	1.49	1.72	19.08	p.m.	> 19.08
1.4. Low-grade eny utilon		n.a.	6.58	0.37	4.88	-	0.32	0.34	0.66	13.15	p.m.	> 13.15
1.5. Others		n.a.	-	-	-	-	0.21	-	1.45	1.66	p.m.	> 1.66
<u>1. RATIONAL USE OF ENERGY</u>		<u>n.a.</u>	<u>16.88</u>	<u>1.29</u>	<u>38.03</u>	<u>0.01</u>	<u>11.89</u>	<u>4.91</u>	<u>28.86</u>	<u>101.87</u>	<u>0.52</u>	<u>102.39</u>
2.1. Coal expl. & extracton		n.a.	5.51	-	13.13	0.24	-	-	24.52	43.40	14.93	<58.33
2.2. Coal prep., va.l.& transp.		-	3.84	-	2.56	-	n.a.	-	1.95	8.35	p.m.	> 8.35
2.3. Coal liquefaction		-	1.71	-	p.m.	-	-	-	2.59	4.30	p.m.	> 4.30
2.4. Coal gasification		n.a.	10.23	-	0.21	-	n.a.	0.17	0.66	11.27	p.m.	> 11.27
2.5. Coal combustion		-	9.66	-	p.m.	0.16	0.34	-	4.26	14.42	-	14.42
2.6. Oil & gas ass.t & explon		-	3.06	-	16.82	-	p.m.	1.69	0.53	22.10	p.m.	> 22.10
2.7. Oil & gas production		-	0.60	-	26.04	-	1.08	p.m.	15.64	43.36	17.42	<60.78
2.8. Refining & deriv.es		-	-	-	12.57	-	0.56	p.m.	3.62	16.75	-	16.75

Table IV a (cont.)

YEAR : 1976

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
2.9. Transport of oil		p.m.	-	-	1.03	-	7.26	0.34	-	8.63	p.m.	> 8.63
2.10. Transport of gas		p.m.	-	n.a.	1.70	-	p.m.	0.34	9.60	11.64	p.m.	> 11.64
2.11. Storage of oil		p.m.	-	-	-	-	-	-	-	-	p.m.	> 0.00
2.12. Storage of gas		p.m.	-	-	0.28	-	-	0.34	0.55	1.17	p.m.	> 1.17
2.13. Others		n.a.	0.60	-	0.60	-	-	0.37	0.69	2.26		2.26
2. FOSSIL FUELS & DERIVATIVES		n.a.	35.21	-	74.94	0.40	9.24	3.25	64.61	187.65	32.35	220.00
3.1. Proven reactors		10.12	p.m.	3.83	41.83	-	19.83	9.48	43.25	> 128.34	2.12	>> 130.46
3.2. High temp. reactors		0.31	p.m.	-	17.03	-	-	0.88	0.96	> 19.98	0.39	>> 20.37
3.3. Breeders		29.70	p.m.	-	94.11	-	31.32	11.57	90.03	> 256.73	p.m.	>> 256.73
3.4. Fuel cycle		1.44	p.m.	1.60	55.43	-	14.00	14.15	p.m.	> 86.62	9.13	>> 95.75
3.5. Nuclear safety		6.14	p.m.	1.21	35.83	-	13.86	0.10		> 57.34	8.18	>> 65.52
3.6. Waste treat. & disposal		2.09	p.m.	1.10	3.74	-	3.57	0.10		> 10.60	5.85	> 16.45
3.7. Radon prot. & decommissioning		p.m.	p.m.	0.30	9.92	-	7.77	p.m.	37.30	> 17.99	5.75	>> 23.74
3.8. Fissile matl. control		p.m.	p.m.	p.m.	-	-	-	0.30		> 0.30	2.02	> 2.32
3.9. Others		p.m.	p.m.	p.m.	4.30	-	7.01	0.34	15.76	> 27.41	14.62	>> 42.03
3. NUCLEAR POWER		49.80	356.66	8.04	262.19	-	97.36	36.99	187.30	998.34	48.05	1046.39

Table IV a (cont.)

YEAR : 1976

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
4.1. Thermonucl. fusion		1.04	30.20	0.49	14.41	-	11.16	4.88	10.61	72.79	25.36	98.15
4.2. Geothermal energy		-	0.53	0.03	4.42	-	4.13	0.10	0.24	9.45	1.78	11.23
4.3. Solar energy		-	6.04	0.25	14.78	0.05	0.40	1.93	-	23.45	2.94	26.39
4.4. Ocean		-	-	-	0.09	-	-	-	1.05	1.14	-	1.14
4.5. Wind		-	0.07	0.09	0.04	0.03	-	0.98	-	1.21	-	1.21
4.6. Hydrogen		-	1.78	-	5.84	-	-	-	-	7.62	4.07	11.69
4.7. Others		-	-	-	-	-	-	4.74	-	4.74	-	4.74
<u>4. NEW ENERGY SOURCES & VECTORS</u>		<u>1.04</u>	<u>38.62</u>	<u>0.86</u>	<u>39.58</u>	<u>0.08</u>	<u>15.69</u>	<u>12.62</u>	<u>11.90</u>	<u>120.40</u>	<u>34.15</u>	<u>154.55</u>
5.1. Electry gener. ing equip.		-	5.68	n.a.	17.68	0.28	33.43	0.68	23.57	<81.32	-	<81.32
5.2. Transport of elecY		-	p.m.	-	22.71	0.10	p.m.	-	7.73	>30.54	-	>30.54
5.3. Control & instrum.		-	-	-	4.77	-	-	-	4.21	8.98	-	8.98
5.4. Fuel cells		-	p.m.	-	1.50	-	0.04	-	-	> 1.54	p.m.	> 1.54
5.5. Electrochem. storage		-	p.m.	-	3.03	-	0.07	-	0.23	> 3.33	p.m.	> 3.33
5.6. Other storage techn.		-	-	-	0.64	0.04	0.22	0.07	0.16	1.13	p.m.	> 1.13
<u>5. ELECTRICITY</u>		-	<u>5.68</u>	-	<u>50.33</u>	<u>0.42</u>	<u>33.76</u>	<u>0.75</u>	<u>35.90</u>	<u>126.84</u>	-	<u>126.84</u>

Table IV a (cont.)

YEAR : 1976

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
6.1. Anal. studies		n.a.	0.07	0.15	0.80	0.08	0.14	1.08	-	2.32	0.50	2.82
6.2. Socio-econ. studies		-	-	n.a.	0.60	-	0.01	-	1.64	2.25	-	2.25
6.3. Environm. effects		-	p.m.	n.a.	9.37	-	5.59	p.m.	5.58	>20.54	1.36	>21.90
6.4. Safety		-	-	-	-	-	-	-	2.09	2.09	-	2.09
6. GENERAL STUDIES		-	0.07	0.15	10.77	0.08	5.74	1.08	9.31	27.20	1.86	29.06
T O T A L		<u>50.84</u>	<u>453.12</u>	<u>10.34</u>	<u>475.84</u>	<u>0.99</u>	<u>173.68</u>	<u>59.60</u>	<u>344.07</u>	<u>1568.48</u>	<u>116.93</u>	<u>1685.41</u>

Table IV b

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES
IN EUROPEAN COMMUNITIES AND MEMBER STATES
(in million EUA)

YEAR : 1977

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
0. GENERAL HEADING		-	-	-	-	-	-	-	6.76	6.76	-	6.76
1.0. General		-	-	-	-	-	-	-	6.12	6.12	-	6.12
1.1. Industry		0.51	0.76	0.14	19.35	-	1.55	3.22	8.12	33.65	p.m.	> 33.65
1.2. Resid. & commercial		1.97	2.64	0.95	9.94	0.18	2.98	2.64	8.88	30.18	p.m.	> 30.18
1.3. Transportation		0.16	4.53	0.25	8.92	-	9.38	0.71	2.26	26.21	p.m.	> 26.21
1.4. Low-grade energy utilization		2.60	6.80	0.83	6.08	-	1.56	0.84	1.57	20.28	p.m.	> 20.28
1.5. Others		-	-	-	-	-	0.29	-	1.51	1.80	p.m.	> 1.80
1. RATIONAL USE OF ENERGY		5.24	14.73	2.17	44.29	0.18	15.76	7.41	28.46	118.24	3.10	121.34
2.1. Coal expl. & extraction		1.06	20.02	0.06	13.47	0.23	-	-	29.02	63.86	15.02	< 78.88
2.2. Coal prep., val. & transp.		-	7.93	-	2.46	-	0.16	0.07	2.09	12.71	p.m.	> 12.71
2.3. Coal liquefaction		-	2.64	-	p.m.	-	-	-	2.46	> 5.10	p.m.	> 5.10
2.4. Coal gasification		2.26	16.62	-	0.93	-	0.18	0.18	0.70	20.87	p.m.	> 20.87
2.5. Coal combustion		-	15.11	0.01	p.m.	0.23	0.31	1.07	8.12	> 24.85	-	> 24.85
2.6. Oil & gas ass't & explon		-	3.78	0.16	19.39	22.93	p.m.	1.82	0.60	> 48.68	p.m.	> 48.68
2.7. Oil & gas production		-	0.76	-	33.91	-	1.19	p.m.	20.64	56.50	32.25	< 88.75
2.8. Refining & derivatives		0.71	-	-	13.34	-	0.63	p.m.	3.52	> 18.20	-	> 18.20

Table IV b (cont.)

YEAR : 1977

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
2.9. Transport of oil		p.m.	-	-	1.21	-	8.04	0.39	-	9.64	p.m.	> 9.64
2.10. Transport of gas		p.m.	-	n.a.	2.25	-	p.m.	0.39	12.95	>15.59	p.m.	>15.59
2.11. Storage of oil		p.m.	-	-	-	-	-	-	-	> 0.00	p.m.	> 0.00
2.12. Storage of gas		p.m.	-	-	1.64	-	-	0.97	0.64	> 3.25	p.m.	> 3.25
2.13. Others		-	0.76	-	0.18	-	-	0.61	0.81	2.36	-	2.36
<u>2. FOSSIL FUELS & DERIVATIVES</u>		<u>4.03</u>	<u>67.62</u>	<u>0.23</u>	<u>88.78</u>	<u>23.39</u>	<u>10.51</u>	<u>5.50</u>	<u>81.56</u>	<u>281.62</u>	<u>47.27</u>	<u>328.89</u>
3.1. Proven reactors		10.08	p.m.	4.14	47.29	-	26.97	11.43	46.79	146.70	0.19	146.89
3.2. High temp. reactors		0.24	65.71	-	12.67	-	-	0.11	0.31	79.04	-	79.04
3.3. Breeders		28.89	118.96	-	103.96	-	51.94	11.28	90.21	405.24	p.m.	>405.24
3.4. Fuel cycle		1.65	102.72	2.96	66.05	-	22.16	14.68	p.m.	>210.22	10.88	>221.10
3.5. Nuclear safety		7.85	54.76	1.33	37.69	-	9.56	0.11		>>111.30	18.73	>>130.03
3.6. Waste treat. & disposal		2.94	p.m.	1.11	4.46	-	4.09	0.43		>> 13.03	9.96	>> 22.99
3.7. Radon prot. & decommissioning		p.m.	6.04	0.33	10.70	-	8.25	p.m.	35.63	>> 25.32	7.55	>> 32.87
3.8. Fissile matl. control		p.m.	2.27	p.m.	1.71	-	-	0.36		>> 4.34	3.99	>> 8.33
3.9. Others		p.m.	13.40	p.m.	3.39	-	7.30	0.32	22.32	> 46.73	9.81	> 56.54
<u>3. NUCLEAR POWER</u>		<u>51.65</u>	<u>363.86</u>	<u>9.87</u>	<u>287.92</u>	-	<u>130.27</u>	<u>38.72</u>	<u>195.26</u>	<u>1077.55</u>	<u>61.11</u>	<u>1138.66</u>

Table IV b (cont.)

YEAR : 1977

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
4.1. Thermonucl. fusion		1.63	26.81	0.72	17.48	-	11.99	6.78	11.16	76.57	31.94	108.51
4.2. Geothermal energy		-	0.76	0.32	5.16	-	6.22	0.07	0.46	12.99	3.67	16.66
4.3. Solar energy		1.14	8.69	0.79	22.46	0.17	1.25	2.07	2.37	38.94	9.50	48.44
4.4. Ocean		-	0.76	-	0.12	-	-	-	2.35	3.23	-	3.23
4.5. Wind		-	1.89	0.96	0.07	0.03	0.05	1.75	0.32	5.07	-	5.07
4.6. Hydrogen		0.50	4.91	-	5.37	-	-	0.29	-	11.07	7.57	18.64
4.7. Others		-	-	-	-	-	-	5.36	-	5.36	-	5.36
4. <u>NEW ENERGY SOURCES & VECTORS</u>		<u>3.27</u>	<u>43.82</u>	<u>2.79</u>	<u>50.66</u>	<u>0.20</u>	<u>19.51</u>	<u>16.32</u>	<u>16.66</u>	<u>153.23</u>	<u>52.68</u>	<u>205.91</u>
5.1. Electry gener. ing equip.		0.30	6.04	n.a.	20.71	0.31	30.23	2.50	24.08	<84.17	-	<84.17
5.2. Transport of elecY		0.45	p.m.	-	20.26	0.11	p.m.	-	6.77	>27.59	-	>27.59
5.3. Control & instrum.		-	-	-	7.40	-	-	-	3.76	11.16	-	11.16
5.4. Fuel cells		0.73	p.m.	-	1.98	-	0.07	-	-	> 2.78	p.m.	> 2.78
5.5. Electrochem. storage		p.m.	p.m.	-	1.93	-	0.21	-	0.31	> 2.45	p.m.	> 2.45
5.6. Other storage techn.		p.m.	-	0.02	0.89	-	0.59	0.11	0.15	1.76	p.m.	> 1.76
5. <u>ELECTRICITY</u>		<u>1.48</u>	<u>6.04</u>	<u>0.02</u>	<u>53.17</u>	<u>0.42</u>	<u>31.10</u>	<u>2.61</u>	<u>35.07</u>	<u>129.91</u>	<u>-</u>	<u>129.91</u>

Table IV b (cont.)

YEAR : 1977

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
6.1. Anal. studies		0.66	0.04	0.45	1.55	0.12	0.38	1.43	-	4.63	1.43	6.06
6.2. Socio-econ. studies		0.20	-	n.a.	0.70	-	0.05	-	1.85	2.80	-	2.80
6.3. Environm. effects		p.m.	p.m.	n.a.	14.66	-	5.70	p.m.	6.53	>26.89	2.29	>29.18
6.4. Safety		-	-	-	-	-	-	-	2.14	2.14	-	2.14
6. GENERAL STUDIES		0.86	0.04	0.45	16.91	0.12	6.13	1.43	10.52	36.46	3.72	40.18
T O T A L		66.53	496.11	15.53	541.73	24.31	213.28	71.98	374.29	1803.77	167.88	1971.65

Table IV c

SUMMARY OF ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURES

IN EUROPEAN COMMUNITIES AND MEMBER STATES

(in million EUA)

YEAR : 1978 (estimates)

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
0. GENERAL HEADING		-	-	-	-	-	-	-	7.89	7.89	-	7.89
1.0. General		-	-	-	-	-	-	-	8.93	8.93	-	8.93
1.1. Industry		0.34	3.89	0.16	28.21	0.04	1.51	2.65	11.26	48.06	p.m.	> 48.06
1.2. Resid. & commercial		0.54	5.05	1.49	11.85	0.19	3.94	3.15	10.18	36.39	p.m.	> 36.39
1.3. Transportation		0.35	4.66	0.27	10.44	-	9.59	0.47	4.79	30.57	p.m.	> 30.57
1.4. Low-grade eny utilon		2.39	26.43	1.51	6.90	-	2.64	1.27	1.71	42.85	p.m.	> 42.85
1.5. Others		-	-	-	-	-	0.52	-	3.13	3.65	p.m.	> 3.65
1. RATIONAL USE OF ENERGY		3.62	40.03	3.43	57.40	0.23	18.20	7.54	40.00	170.45	4.12	174.57
2.1. Coal expl. & extracton		1.17	46.25	0.26	15.05	0.25	-	-	34.35	97.33	12.69	< 110.02
2.2. Coal prep., vaL & transp.		-	11.66	-	2.28	-	0.22	0.07	2.13	16.36	p.m.	> 16.36
2.3. Coal liquefaction		-	3.50	-	p.m.	-	-	-	3.24	6.74	p.m.	> 6.74
2.4. Coal gasification		4.79	19.04	-	3.33	-	0.22	0.18	1.15	28.71	p.m.	> 28.71
2.5. Coal combustion		-	27.21	0.23	p.m.	0.25	0.32	1.45	5.40	34.86	-	34.86
2.6. Oil & gas ass.t & explon		-	6.22	0.67	24.94	74.40	p.m.	1.96	0.61	108.80	p.m.	> 108.80
2.7. Oil & gas production		-	0.78	-	49.45	-	1.46	p.m.	22.32	74.01	30.00	< 104.01
2.8. Refining & derives		-	-	-	14.56	-	0.90	p.m.	3.54	19.00	-	19.00

Table IV c (cont.)

YEAR : 1978 (estimates)

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9 + EC (11)
2.9. Transport of oil		p.m.	-	-	0.96	-	10.56	0.36	-	11.88	p.m.	> 11.88
2.10. Transport of gas		p.m.	-	n.a.	3.29	-	p.m.	0.18	16.03	19.50	p.m.	> 19.50
2.11. Storage of oil		p.m.	-	-	-	-	-	-	-	> 0.00	p.m.	> 0.00
2.12. Storage of gas		p.m.	-	-	1.86	-	-	0.18	0.39	2.43	p.m.	> 2.43
2.13. Others		-	0.78	-	0.18	-	0.09	1.16	1.25	3.46	-	3.46
2. FOSSIL FUELS & DERIVATIVES		5.96	115.44	1.16	115.90	74.90	13.77	5.54	90.40	423.07	42.69	465.76
3.1. Proven reactors		12.66	p.m.	4.49	43.46	-	39.86	12.07	51.79	164.33	-	164.33
3.2. High temp. reactors		0.19	81.62	-	8.67	-	-	-	0.15	90.63	-	90.63
3.3. Breeders		27.21	103.77	-	96.00	-	48.32	12.36	92.86	380.52	p.m.	> 380.52
3.4. Fuel cycle		1.90	127.09	3.65	68.06	-	22.06	12.87	p.m.	> 235.63	14.59	> 250.22
3.5. Nuclear safety		10.90	61.80	1.46	37.57	-	11.79	0.18		>> 123.70	21.45	>> 145.15
3.6. Waste treat. & disposal		3.15	p.m.	1.22	4.42	-	0.49	0.22		>> 9.50	9.95	>> 19.45
3.7. Radion prot. & decommissioning		p.m.	6.61	0.36	12.03	-	7.92	p.m.	41.22	>> 26.92	8.73	>> 35.65
3.8. Fissile matl. control		p.m.	3.11	p.m.	2.33	-	-	0.54		>> 5.98	4.39	>> 10.37
3.9. Others		p.m.	14.64	p.m.	3.01	0.37	5.91	0.43	20.83	> 45.19	10.47	> 55.66
3. NUCLEAR POWER		56.01	398.64	11.18	275.55	0.37	136.35	38.67	206.85	1123.62	69.58	1193.20

Table IV c (cont.)

YEAR : 1978 (estimates)

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
4.1. Thermonucl. fusion		1.96	29.15	0.93	19.49	-	17.07	7.25	11.90	87.75	45.90	133.65
4.2. Geothermal energy		0.09	3.50	1.72	7.85	-	10.15	0.11	0.65	24.07	4.90	28.97
4.3. Solar energy		1.21	12.44	1.03	30.35	0.39	5.08	2.28	2.47	55.25	12.09	67.34
4.4. Ocean		-	0.78	-	0.42	0.03	0.03	-	5.55	6.81	-	6.81
4.5. Wind		0.15	3.89	2.37	0.19	0.06	0.15	2.14	0.45	9.40	-	9.40
4.6. Hydrogen		0.78	5.83	-	4.51	-	-	-	-	11.12	9.19	20.31
4.7. Others		-	-	-	-	-	-	6.38	-	6.38	-	6.38
<u>4. NEW ENERGY SOURCES & VECTORS</u>		<u>4.19</u>	<u>55.59</u>	<u>6.05</u>	<u>62.81</u>	<u>0.48</u>	<u>32.48</u>	<u>18.16</u>	<u>21.02</u>	<u>200.78</u>	<u>72.08</u>	<u>272.86</u>
5.1. Electry gener. ing equip.		-	7.77	n.a.	23.84	0.33	11.10	1.60	24.38	69.02	-	69.02
5.2. Transport of elecY		0.10	p.m.	-	23.77	0.12	13.48	-	6.50	> 43.97	-	> 43.97
5.3. Control & instrum.		-	-	-	9.52	-	-	-	4.06	13.58	-	13.58
5.4. Fuel cells		0.62	p.m.	-	1.68	-	0.06	-	-	2.36	p.m.	> 2.36
5.5. Electrochem. storage		p.m.	p.m.	0.16	3.33	-	0.41	-	0.60	4.50	p.m.	> 4.50
5.6. Other storage techn.		p.m.	-	0.64	1.01	-	2.25	0.14	0.15	4.19	p.m.	> 4.19
<u>5. ELECTRICITY</u>		<u>0.72</u>	<u>7.77</u>	<u>0.80</u>	<u>63.15</u>	<u>0.45</u>	<u>27.30</u>	<u>1.74</u>	<u>35.69</u>	<u>137.62</u>	<u>-</u>	<u>137.62</u>

Table IV c (cont.)

YEAR : 1978 (estimates)

SECTORS	COUNTRY	B (1)	D (2)	DK (3)	F (4)	IRL (5)	I (6)	NL (7)	UK (8)	EUR-9 (9)	EC (10)	EUR-9+EC (11)
6.1. Anal. studies		0.79	0.04	1.11	1.68	0.06	0.60	1.63	0.15	6.06	1.93	7.99
6.2. Socio-econ. studies		1.18	-	n.a.	0.81	-	0.07	-	1.96	4.02	-	4.02
6.3. Environm. effects		p.m.	p.m.	n.a.	11.73	-	6.13	p.m.	6.99	>24.85	2.67	>27.52
6.4. Safety		-	-	-	-	-	-	-	2.23	2.23	-	2.23
6. GENERAL STUDIES		1.97	0.04	1.11	14.22	0.06	6.80	1.63	11.33	37.16	4.60	41.76
<u>T O T A L</u>		<u>72.47</u>	<u>617.51</u>	<u>23.73</u>	<u>589.03</u>	<u>76.49</u>	<u>234.90</u>	<u>73.23</u>	<u>413.18</u>	<u>2100.59</u>	<u>193.07</u>	<u>2293.66</u>

SECTION 2

SUB-SECTION 2.2 COMPARISON OF MEMBER STATES AND EUROPEAN
COMMUNITIES EXPENDITURES AND MAIN PROGRAMME'S
ACTIVITIES IN THE DIFFERENT SUB-SECTORS.

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 1. RATIONAL USE OF ENERGY
SUB-SECTOR : 1.1. INDUSTRY

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES														
	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77	78												
n.a.	0.51	0.15	0.13	0.15	0.16	0.16	1.34	0.76	3.89	15.90	19.35	28.21	-	-	0.04	6.73	1.55	1.51	1.59	3.21	2.65	8.04	6.12	8.13	~0.30	~1.8	~2.5		
- Heat transfer							- Analytical studies on energy flows - Energy recovery from existing installations			- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Analytical studies on energy flows - Heat recovery & energy cascading		- Improvement of RUE in different production technologies		- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Specific energy consumption of equipment, processes and techniques			
- Reduction of energy consumption in metall. industry - cement industry - chemical industry							- Analytical studies on energy flows - Improvement of existing technologies (processes & equipment) - central power sources - heat exchange - heat recovery burners, boilers, combustion - thermal insulation - process parameters optimization			- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Specific energy consumption of equipment, processes and techniques			
- food & agriculture - gas industry							- Analytical studies on energy flows - Improvement of existing technologies (processes & equipment) - central power sources - heat exchange - heat recovery burners, boilers, combustion - thermal insulation - process parameters optimization			- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Analytical studies on energy flows		- Improvement of RUE in different production technologies		- Energy audits - Improvement of existing technologies - central power sources - heat exchange - heat recovery burners, boilers, combustion - electric equipment		- Specific energy consumption of equipment, processes and techniques			

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 1. RATIONAL USE OF ENERGY

SUB-SECTOR : 1.2. RESIDENTIAL AND COMMERCIAL

figures in MEUA

BELGIUM	DENMARK			FED. REP. OF GERMANY			FRANCE			IRELAND			ITALY			NETHERLANDS			UNITED KINGDOM			EUROPEAN COMMUNITIES				
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78		
n.a.	1.97	0.54	0.56	0.95	1.49	4.70	2.64	5.05	8.36	9.94	11.85	~0	0.12	0.13	2.13	2.98	3.94	1.49	2.64	3.15	9.45	8.88	10.18	~0.2	~1.0	~1.44
<ul style="list-style-type: none"> - Low temperature heating - Heat balance and energy consumption in buildings - Low-energy houses <ul style="list-style-type: none"> - exptl. low-energy houses - zero energy house - Air tightness & ventilation <ul style="list-style-type: none"> - moisture & heat transport - Thermal insulation and insulating materials <ul style="list-style-type: none"> - Insulation techniques & materials <ul style="list-style-type: none"> - cavity wall - sandwich structures - windows - Pulsed combustion 	<ul style="list-style-type: none"> - Analysis of energy needs & patterns - Thermal performance of buildings 	<ul style="list-style-type: none"> - Analysis of heating patterns - Thermal performance of buildings 	<ul style="list-style-type: none"> - Analysis of existing building/heating systems <ul style="list-style-type: none"> - Thermal behaviour characterization of building <ul style="list-style-type: none"> - existing heating systems - degree of occupancy - Design of future systems - Hot water plants 	<ul style="list-style-type: none"> - Analysis of future potentials 	<ul style="list-style-type: none"> - Surveys of heating and lighting requirements <ul style="list-style-type: none"> - Cost/effective measures in existing buildings - Building services <ul style="list-style-type: none"> - heating systems - lighting - ventilation - Thermal design of buildings 	<ul style="list-style-type: none"> - Development of high efficiency boilers for hot water - Reliability components <ul style="list-style-type: none"> - burners - control systems - radiators valves - Effects on energy conservation of how heating systems are used - Use of heat pumps 	<ul style="list-style-type: none"> - Insulation techniques - Heating systems 	<ul style="list-style-type: none"> - Combined heat/power installation 	<ul style="list-style-type: none"> - Improved insulation of buildings & insulation materials 																	
<ul style="list-style-type: none"> - Use of heat pumps 	<ul style="list-style-type: none"> - Use of heat pumps - Heat recovery and storage - Central heat supply and optimization of heat distribution - Application of solar energy 	<ul style="list-style-type: none"> - Use of heat pumps - Heat recovery - Application of new energy sources <ul style="list-style-type: none"> - solar - geothermal - wind 	<ul style="list-style-type: none"> - Heating systems and components <ul style="list-style-type: none"> - combustion - heat transfer 	<ul style="list-style-type: none"> - Use of heat pumps - Heat recovery 	<ul style="list-style-type: none"> - Heating systems and components <ul style="list-style-type: none"> - heat transfer 	<ul style="list-style-type: none"> - Use of heat pumps - Heat pumps systems and components - Heat storage 	<ul style="list-style-type: none"> - Combined heat/power system and its potential for district heating 	<ul style="list-style-type: none"> - Heat pumps systems and components - Heat storage 																		
<ul style="list-style-type: none"> - Application of solar energy 	<ul style="list-style-type: none"> - Application of solar energy 	<ul style="list-style-type: none"> - Application of solar energy 	<ul style="list-style-type: none"> - Heating systems and components <ul style="list-style-type: none"> - heat transfer 	<ul style="list-style-type: none"> - Use of heat pumps - Heat recovery 	<ul style="list-style-type: none"> - Heating systems and components <ul style="list-style-type: none"> - heat transfer 	<ul style="list-style-type: none"> - Use of heat pumps - Heat pumps systems and components - Heat storage 	<ul style="list-style-type: none"> - Combined heat/power system and its potential for district heating 	<ul style="list-style-type: none"> - Heat pumps systems and components - Heat storage 																		

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES

SUB-SECTOR : 2.1. COAL EXPLORATION AND EXTRACTION

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES		
	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77	78
76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78
n.a.	1.06	1.27	5.51	20.02	46.25	13.13	13.47	15.05	0.24	0.23	0.25	-	-	-	24.32	29.02	34.35
- Evaluation of coal reserves - Development of new exploration methods	- Coal exploration in Greenland	- Prospection techniques	- Gallery driving - increased efficiency blasting techniques - drilling machines - high performance drive systems - mechanical roads driving - support techniques - hydraulic haulage systems - full face tunneling machines	- Coal getting and face support	- Face support - Roof pressure	- Peat - deposits survey - bog drainage & preparation - production of raw peat fuels - drying, storage, processing & use	- Roadways driving - hard rockcutting - in-seam heading machine - roadway support systems	- Coal getting techniques - chainless haulage systems for power loader - web mining systems - ranging arm shears - new shield supports - dust control and collecting systems for face ends	- Coal getting techniques - winning techniques - mechanized systems of production - special seams working - new methods of winning	- Operational management & planning - underground and surface structure - assessment of coal-reserves	- Roadways driving - cutting & driving techniques - rock mechanics - pressure & supports - new support systems - roof & floor control	- Coal getting techniques - winning techniques - mechanized systems of production - special seams working - new methods of winning					

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES

SUB-SECTOR : 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT

figures in MEUA

BELGIUM		DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES			
76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78		
-	-	-	-	-	-	3.84	7.93	11.66	-	-	0.22	-	-	1.95	2.09	2.13	p.m.*	p.m.*	p.m.*
				<ul style="list-style-type: none"> - Dressing <ul style="list-style-type: none"> • treatment of crushed coals • H₂O and ash content reduction • cleaning • computer controlled coal preparation • dry processing of dirty coals • fines separation • monitoring and control of conveyance flow (underground) - Coke production <ul style="list-style-type: none"> • thermal pre-treatment of baking pit coal • improvement of conventional vertical flue method • continuous production of formed coke • variable range of coking coals • production from lignite • use of low volatile coals - Direct combustion (see under 2.5.) 		<ul style="list-style-type: none"> - Washing of coals 		<ul style="list-style-type: none"> - Transport of coal 		<ul style="list-style-type: none"> - Transport by slurry pipeline 		<ul style="list-style-type: none"> - Evaluation of coal transport problems associated with increased imports 		<ul style="list-style-type: none"> - Coal preparation (from 2.1.) <ul style="list-style-type: none"> • automatic control systems • microprocessors • monitoring of ash, S, H₂O content • mechanical handling • extraction of fines from wet run of small coal • new methods of coal preparation 		<ul style="list-style-type: none"> - Coke production <ul style="list-style-type: none"> • improvement of the quality of blast-furnace coke • increased use of high volatile coals • blending • compatibility • coal properties and coke strength • preheating • coke properties and performance in blast furnace • reduction of pollution at coke ovens - Up-grading of coal by-products <ul style="list-style-type: none"> • alternative processes for smokeless fuel manufacture 		<ul style="list-style-type: none"> - Mechanical coal preparation <ul style="list-style-type: none"> • properties of coal & products • mechanical treatment process • desulphurisation - new methods of coal preparation - Coking and briquetting of coal <ul style="list-style-type: none"> • properties of coking coals • carbonization products • mechanism of pyrolysis • conventional coking techniques • new coking methods - environmental problems - new briquetting methods - smokeless briquettes 	
(*) included in 2.1.																			

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES

SUB-SECTOR : 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES					
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	p.m.	p.m.			
-	-	0.16	0.67	3.06	3.78	6.22	16.82	19.39	24.94	-	22.93	74.40	p.m.	p.m.	0.53	0.60	0.61	p.m.	p.m.	p.m.
	- Greenland's geological and geophysical investigation - geological studies - geochemical studies - geophysical studies - sea-bed investigation - data interpretation		- Oil & gas prospecting - seismic techniques - 3 dimensional seismic data collection and processing - modelling system for seismic anal. - combined reflection and refraction seismic methods - geophysical processes & equipment - gravity measurements - geophysical borehole surveys - magnetic surveys - organic- and isotope geophysical methods - magnetotelluric measurements	- Fields characterization (data bank) - improvement of geological prospecting methods - improvement of geophys. methods for the seismic data interpretation - Geological and geophysical exploration field tests in deep-sea waters	- Exploration activities	- Exploration technologies - data collation, retrieval and anal. - magnetic gravity, geophysical data - paleogeography of naphthogenic capacity of clays - geological complex locations	- Geological survey	- Hydrocarbon assessment especially off-shore (from 2.7.) - evaluation of exploration data from oil companies - geological studies - seismic data anal. - drilling of stratigraphic holes (on- and off-shore) to test the geological succession - Supporting techniques for gas exploration	- Support of technological activities connected with the exploration of hydrocarbons (from 2.7) - geophysics and prospecting - geophysical work - magnetic methods - gravimetry and other physical methods - stratigraphic drilling - rocks characteristics - exploratory drillings											

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES

SUB-SECTOR : 2.7. OIL AND GAS PRODUCTION

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES			
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78
-	-	-	-	0.60	0.76	0.78	26.04	33.91	49.45	1.08	1.19	1.46	15.64	20.64	22.32	17.42	32.25	30.00
			<ul style="list-style-type: none"> - Deep drilling techniques - new coring methods - super-deep wells - primary cementing work in deep and super-deep boreholes - cableless transmission systems for deep drilling wells - system analysis of alternative procedures for deep drilling techniques 	<ul style="list-style-type: none"> - On-shore technologies 	<ul style="list-style-type: none"> - Drilling equipment and techniques for very deep wells at high pressure and temperature - fluid additives for high drilling speed - optimization of drilling equipment 			<ul style="list-style-type: none"> - Technological activities in hydrocarbons exploitation - drilling - deep-sea drilling - off-shore operations - horizontal drilling - remote controlled drilling - production systems - advanced production systems - well-heads for subsea production - deep-sea production equipment - special equipment for off-shore platforms - surface controlled sub-surface safety equipment 	<ul style="list-style-type: none"> - Support of off-shore activities of supply industry - new production technologies - buoyant platforms - sub-sea equipment 									

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES
 SUB-SECTOR : 2.8. REFINING AND DERIVATIVES

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES											
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78								
- Upgrading of used oil products	-	-	-	-	-	-	12.57	13.34	14.56	-	-	-	0.56	0.63	0.90	p.m.	p.m.	p.m.	3.62	3.52	3.54	-	-	-		
- Hydrocarbons thermal cracking																										
- Carbon chemistry																										

Production of SNG from different feedstocks
 - conversion processes
 - feedstock and product gas data
 - catalytic gasification
 - gas recycle hydrogenerator
 - fluid-bed hydrogenerator
 - gas treatment & purification

Spent oil-rerefining
 - Research in assistance to refining

Utilisation of CH₂OH as automotive transportation
 - optimal mixing with hydrocarbons
 - engine performance
 - emission, toxicity, safety
 - optimal mixt. testing in real traffic conditions
 - heating systems
 - storage & transport
 - combustion safety
 - burners design

Study on the desirability of CH₂OH as autom. fuel (from 1.3.)

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES

SUB-SECTOR : 2.10. TRANSPORT OF GAS

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES			
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78
n.a.	n.a.	n.a.	n.a.	1.70	2.25	3.29	-	-	p.m.	p.m.	p.m.	0.34	0.39	-	-	p.m.	p.m.	p.m.
- Gas & liquid fuels distribution modelling	- Transport system for natural gas	- Underwater pipe-lines laying down at great depths - Materials and equipment	(see 2.10)	- Pipeline transport of gas - Safety aspects of storage and transport of LNG (from 2.12.)	- Large diameter (42 in) pipelines - effects on external loading - automatic welding - new protective layers - on-line devices for inspection of high press-pipes under operation - magnetic sensors - elastic waves - new sealants and leak detectors - materials study (steels)	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates	- Gas distribution systems - performance & safety of gas distribution - underground location - leak detection - computer aided design & operation - flow meas. at high press and high flow rates

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 2. FOSSIL FUELS AND DERIVATIVES
 SUB-SECTOR : 2.13. OTHERS

figures in MEUA

BELGIUM		DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES					
76	77	76	77	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78			
-	-	-	-	0.60	0.76	0.78	0.60	0.18	0.18	-	-	0.09	0.37	0.61	1.16	0.69	0.81	1.25	-	-	-
				<ul style="list-style-type: none"> - oil-shales - technical and economic assessment of domestic resources - low-T distillation experiments - autothermic methods - environmental pollution evaluation - pyrolysis of oil-shales 		<ul style="list-style-type: none"> - Inventory of domestic oil shales resources 				<ul style="list-style-type: none"> - Inventory and assessment of domestic oil-shales and tar-sands resources 		<ul style="list-style-type: none"> - General studies - market assessment - risk analysis - anal. chemistry on aerosols & flue gases - storage of coal - combustion residues - technology assessment of coal use 		<ul style="list-style-type: none"> - Gas explosion (see under 2.12.) 							

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 3. NUCLEAR POWER

SUB-SECTOR : 3.1. PROVEN REACTORS

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES						
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78			
10-12	10.08	12.66	3.83	4.14	4.49	41.83	47.29	43.46	-	19.83	26.97	39.86	9.48	11.43	12.07	43.25	46.79	51.79	2.12	0.19	-
<p><u>LWR</u></p> <ul style="list-style-type: none"> - Fuel studies - Pu recycling - fuel behaviour 																					
<p><u>LWR</u></p> <ul style="list-style-type: none"> - Fuel studies (from 3.4) - Pu recycling 																					
<ul style="list-style-type: none"> - transport of fuel elements - Systems & components (from 3.5) - improvement of materials quality - improvement of components fabrication - containment's dynamic stresses - pressurized components 																					
<ul style="list-style-type: none"> - Systems & components - materials (cladding) problems 																					
<ul style="list-style-type: none"> - Pressure vessels analysis 																					
<ul style="list-style-type: none"> - Reactor technology - static and dynamic reactor physics 																					
<ul style="list-style-type: none"> - Reactor technology - core physics - improvement of reliability of reactor operation 																					
<ul style="list-style-type: none"> - steam generators (thermo-hydraulics, corrosion, mechanics) 																					
<ul style="list-style-type: none"> - primary circuit cleanless 																					
<ul style="list-style-type: none"> - materials problems - metallic materials metallurgy - bi-phase compounds - water chemistry - containing structure and pressure vessel - primary circuit pumps & valves - steam generators 																					
<ul style="list-style-type: none"> - transport of fuel elements - Systems & components - metallic materials metallurgy - bi-phase compounds - water chemistry - containing structure and pressure vessel - primary circuit pumps & valves - steam generators 																					
<ul style="list-style-type: none"> - Fuel studies - Pu recycling 																					
<ul style="list-style-type: none"> - fuel/cladding interaction - development of fuel of new design - fabrication of new fuels - irradiation tests - Systems & components - materials problems 																					
<ul style="list-style-type: none"> - Fuel studies - fuel design - fuel studies, post-irradiation examination - fuel handling - Systems & components - water chemistry - structural mechanics - valves, pumps 																					
<ul style="list-style-type: none"> - Fuel studies, post-irradiation examination - fuel handling - Systems & components - water chemistry - structural mechanics - valves, pumps 																					
<ul style="list-style-type: none"> - Fuel studies - Pu recycling (from 3.4) - Systems & components - post-irradiation examination - Systems & components - water chemistry - Reactor technology - in-pile intervention & inspection 																					

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 3. NUCLEAR POWER

SUB-SECTOR : 3.2. HIGH TEMPERATURE REACTORS

figures in MEUA

BELGIUM		DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES			
76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78		
0.31	0.24	0.19	-	-	-	17.03	65.71	81.62	-	-	-	0.88	0.11	-	0.96	0.31	0.15		
- Coated particles development and irradiation tests				<ul style="list-style-type: none"> - Construction of a 300 MWe prototype power station (THTR 300) - Advanced HTR's <ul style="list-style-type: none"> - fuel element fabrication - development of new coated particles - process heat HTR (lignite & coal gasification) 		<ul style="list-style-type: none"> - Study of coal gasification processes by coal hydrogenation - Design of an HTR for methane reforming <ul style="list-style-type: none"> - reactor components - experimental circuit for reforming studies - high temperature materials 						<ul style="list-style-type: none"> - Development of coated particles - Graphite studies 		<ul style="list-style-type: none"> - Fuel particle endurance tests 				<ul style="list-style-type: none"> - Mechanical properties of metals in He - Physical studies of uranium & thorium fuel cycles 	

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 3. NUCLEAR POWER

SUB-SECTOR : 3.5. NUCLEAR SAFETY

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES												
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78									
6.14*	7.85*	10.90*	1.21	1.33	1.46	n.a.	54.76	61.80	35.83	37.69	37.57	-	-	-	-	13.86	9.59	11.79	0.10	0.11	0.18	p.m.*	p.m.*	p.m.*	8.18	18.73	21.46
<ul style="list-style-type: none"> - Safe-guards and applied research 	<ul style="list-style-type: none"> - Statistical reactor physics - Reactor design & Loop analysis - Blowing down and emergency cooling - Structural analysis of pressure vessels - Pre-stressed concrete components 	<ul style="list-style-type: none"> - LWR safety research - "emergency core cooling" project - "containment" project - in case of loss of coolant "project - "components safety" project - "burst protection" project - "core meltdown" project 	<ul style="list-style-type: none"> - Phebus tests (LWR) - depressurization accidents - fuel behaviour 	<ul style="list-style-type: none"> - Safety research for advanced reactor lines - fast breeder reactors (Na-cooled) - high temperature reactors 	<ul style="list-style-type: none"> - Safety research independent from specific reactor lines - "quality assurance" project - "external impacts" project - "fission products transport and radiation exposure" project - "risk and reliability" project 	<ul style="list-style-type: none"> - The Superheated Steam Reactor project (field tests after decommissioning) - LOCA accidents effects on pressure vessels - non-destructive tests on pressure vessels - Load carrying capability of pressure vessels in extreme conditions - earthquake simulation 	<ul style="list-style-type: none"> - Control & protection of nuclear plants by computerized systems - Advanced pressure vessels of pre-compressed reinforced concrete 	<ul style="list-style-type: none"> - LWR safety aspects - LOFT experiments 	<ul style="list-style-type: none"> - Safety studies related to specific reactor design (LMFBR, Gas-cooled, H₂O cooled reactors) and to more general safety problems - reactor core behaviour in normal & abnormal conditions - fuel-coolant interaction - components reliability - containment capability - hazard analysis, including externally induced hazards - radioactivity release and Na-fires (FBR) - S-35 release (AGR) - high activity particulates - nuclear waste incineration - Magnox flask contamination 	<ul style="list-style-type: none"> - Reactor safety and nuclear processing (see 6.4.) 	<ul style="list-style-type: none"> - Reliability and risk assessment 	<ul style="list-style-type: none"> - Out of pile and in-pile studies on LOCA in LWR - Dynamic structure Loading and response - Prevention of structural failure in reactors - Core melt-down and fuel-coolant interaction - Liquid metal fast breeder sub-assembly thermohydraulics 															
<p>* these expenditures cover also sub-sectors 3.7 and 3.8</p>																											
<p>* see summary tables and qualification statements</p>																											

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 3. NUCLEAR POWER

SUB-SECTOR : 3.6. WASTE TREATMENT AND DISPOSAL

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES						
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78			
2.09	2.94	3.15	1.10	1.11	1.22	p.m.	p.m.	p.m.	p.m.	3.57	4.09	0.49	0.10	0.43	0.22	p.m.*	p.m.*	p.m.*	5.85	9.96	9.95
<ul style="list-style-type: none"> - Treatment of low activity wastes - wastes from nuclear plants - high T. incineration - treated waste qualification 	<ul style="list-style-type: none"> - Treatment and storage of low activity wastes 	<ul style="list-style-type: none"> - LWR waste management concept (from 3.4) - waste treatment - volume reduction - chemical and physical stability of end products - vitrification of high level waste - solid wastes - stable fixation of gaseous wastes (I, T, Kr) - bituminous, concrete and polystyrene embedding of low-medium wastes 	<ul style="list-style-type: none"> - Storage of residues and clads from reprocessing processes 	<ul style="list-style-type: none"> - Handling and treatment of radioactive waste 	<ul style="list-style-type: none"> - Underground storage in salt formations 	<ul style="list-style-type: none"> - Waste separation, deep geological formations - clay, granite, salt - physical, chemical and biological properties of the medium - behaviour of geological materials under irradiation and T. gradients - Behaviour of waste containers under long-term storage conditions 	<ul style="list-style-type: none"> - Waste separation, handling and conditioning techniques for all levels of activity - Vitrification process for high level wastes 	<ul style="list-style-type: none"> - Chemical separation and nuclear transmutation of actinides - Waste processing - medium activity solids - high activity solid - conditioning - Immobilization - Pu-contaminated solids incineration - materials comparative study 	<ul style="list-style-type: none"> - Storage and disposal - geologic disposal - provisional disposal 	<ul style="list-style-type: none"> - Storage & disposal - geologic disposal - provisional disposal 	<ul style="list-style-type: none"> - Storage & disposal - assessment of long-term hazards of storage - solidified wastes in engineered structures - disposal in geological formations - Storage of gaseous wastes 	<ul style="list-style-type: none"> - Storage and disposal - assessment of long-term hazards of storage - solidified wastes in engineered structures - disposal in geological formations - Storage of gaseous wastes 	<ul style="list-style-type: none"> - Legal, administrative, financial aspects of radioactive wastes storage and disposal measures 	<ul style="list-style-type: none"> - Legal, administrative, financial aspects of radioactive wastes storage and disposal measures 							
<p>* see summary tables and qualification statements</p>																					

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 4. NEW ENERGY SOURCES AND VECTORS
 SUB-SECTOR : 4.2. GEOTHERMAL ENERGY

figures in MEUA

BELGIUM	DENMARK			FED. REP. OF GERMANY			FRANCE			IRELAND			ITALY			NETHERLANDS			UNITED KINGDOM			EUROPEAN COMMUNITIES		
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78
-	0.09	0.03	1.72	0.53	0.76	3.50	4.42	5.16	7.85	-	-	-	4.13	6.22	10.15	0.10	0.07	0.11	0.13	0.26	0.37	1.78	3.67	4.90
<ul style="list-style-type: none"> - National geological survey - Geothermal studies in Southern Scandinavia - Chemical parameters as geothermal meters in ground water in Denmark - Heat flow, T distribution, heat production & production in Denmark 	<ul style="list-style-type: none"> - Assessment of hot dry rocks resources 	<ul style="list-style-type: none"> - Resources inventory of low, medium, high enthalpy sources & hot dry rocks within the country and in overseas depts. 	<ul style="list-style-type: none"> - Projection techniques - Geological, geochemical, geophysical prospecting - equipment production & maintenance - deep drilling technology - deep reservoirs exploration & exploitation - Demo-plant for low enthalpy fluids use - Thermogravimetric exploitation of low enthalpy fluids (25 kW pilot plant) - Combined heat/electricity production - Economical exploitation of hot water - Energetic and chemical utilization of geothermal brines 	<ul style="list-style-type: none"> - Evaluation of possible significance of geothermal energy for the Netherlands - Demonstration plant near Rotterdam 	<ul style="list-style-type: none"> - Collection of data on heat flows and thermal gradients - Evaluation of geological, geophysical & hydrological at depth - Market assessment of heat flow systems - Study of complete systems 	<ul style="list-style-type: none"> - Acquisition and collation of existing and new geothermal data - Methods of exploration - Sources of hot H₂O (low enthalpy) - geothermal models compilation & verification - utilization tests for district and agricultural heating 																		
<ul style="list-style-type: none"> - Prospective studies on geothermal energy applications in Belgium 	<ul style="list-style-type: none"> - Low enthalpy sources - resource inventory (Paris, Aquitaine, Alsace) - geochemical & geophysical prospecting methods - optimal utilization of the sources - hypoconvector development - economical optimization of geothermal installations - demo-installations in several sites - Medium-enthalpy sources - 145 MW project for electricity generation (binary cycle) 	<ul style="list-style-type: none"> - Design, construction & operation of a full-scale district-heating plant 																						

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 4. NEW ENERGY SOURCES AND VECTORS

SUB-SECTOR : 4.5. WIND

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES												
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78									
-	-	0.09	0.96	2.37	0.07	1.89	3.89	0.04	0.07	0.19	0.03	0.03	0.06	-	0.05	0.15	0.98	1.75	2.14	-	0.32	0.45	-	-	-	-	-
- Wind power units	- Assessment of wind resources		- Acquisition & processing of wind data - meteorological measurements - wind condition in FRG		- Assessment studies		- Assessment of resource viability - Evaluation of aesthetic & infrastructure problems associated with wind power development - Combined wind-bio-mass systems		- Medium power wind energy conversion systems (design)		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Small scale devices for LPC, adapted to local conditions		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Advanced wind technology - medium size (100 kW) aerogenerators - environmental studies - turbine development - new concepts assessment		-		-		
-	- Large wind machines design, construction and operation of large conversion systems (> 600 kW) + wind profiles + motor design + siting studies for 1000*2000 systems		- High capacity power plants - development, construction and testing of a φ 52 m prototype (265 kW) - engineering study of a 1+2 MW power plant + design + storage systems + rotor blades + dynamic behaviour		- Assessment studies		- Assessment of resource viability - Evaluation of aesthetic & infrastructure problems associated with wind power development - Combined wind-bio-mass systems		- Medium power wind energy conversion systems (design)		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Small scale devices for LPC, adapted to local conditions		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Advanced wind technology - medium size (100 kW) aerogenerators - environmental studies - turbine development - new concepts assessment		-		-		
-	- Small wind machines - field tests of small windmills - combination of windmills and torque converters - wind power for heating agricultural estates - integrated wind power heating scheme		- Small wind power systems - development of φ 5.5 m vertical axis converter - evaluation of 15 kW power plant		- Assessment studies		- Assessment of resource viability - Evaluation of aesthetic & infrastructure problems associated with wind power development - Combined wind-bio-mass systems		- Medium power wind energy conversion systems (design)		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Small scale devices for LPC, adapted to local conditions		- Technico-economical feasibility of large scale utilization of wind energy for electricity production (grid)		- Large horizontal axis aerogenerator (φ 60 m, 3.7 MW) - design study - detailed design & components testing - Vertical axis machines - study of technical & economical problems associated with off-shore siting		- Advanced wind technology - medium size (100 kW) aerogenerators - environmental studies - turbine development - new concepts assessment		-		-		

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 5. ELECTRICITY

SUB-SECTOR : 5.1. ELECTRICITY GENERATING EQUIPMENT

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES				
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	
- Development of turbo-engines	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	23.57	24.08	24.38	
-	0.30	-	-	5.68	6.04	7.77	17.68	20.71	23.84	33.43*	30.23*	11.10	0.68	2.50	1.60	-	-	-	
- Use of back-pressure turbines (study)	n.a.	n.a.	n.a.	- Improvement of turbines - components - materials	- Direct cycle gas turbine	n.a.	- Large size steam turbines - Low pressure turbines + size reduction of H ₂ O droplets - expt. study in wind tunnel - blades/H ₂ O behaviour - turbine behaviour	- Recovery of kinetic energy power gas turbines - models : discharge profiles & recovery conditions - Improved discharge ducts - full-scale expts.	- Supraconducting generating machines - feasibility study - superconducting coils construction	- Natural convection dry cooling towers - low-cost heat exchangers - optimal pipe profiles - air-H ₂ O heat exchange - optimal flow anal. - materials study * includes expenditures covering activities of the sub-sectors 5.2 & 5.6	- Turbines - stress anal., turbine dynamics - materials studies - turbine instrument - aerodynamics and wet steam, blade profile studies - turbine site trials	- Gas turbines - mechanical properties of blades - blades corrosion resistant materials - performance anal. & fault diagnosis	- Electrical generators - electromagnetic, thermal, mechanical effects - insulation performance - advanced generators + design + materials - large power station motors, cables	- Cooling systems - cooling towers form & stresses - flow phenomena - corrosion, erosion & scaling problems - alternative systems	-	-	-	-	-
- Super conductivity	-	-	-	- Supraconducting coil machines - Improvement of efficiency in polyphasic generators	- Cryoalternating machines - cryogenics (insulating materials, He liq.) - structural materials - superconducting materials production	- Erection & operation of large capacity dry cooling tower (THR 300)(from 1.4.)	- Basic studies on thermodynamic conversion - binary cycles (NH ₃ / H ₂ O) - topping cycles (S, X)	-	-	-	-	-	-	-	-	-	-	-	-

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 5. ELECTRICITY
SUB-SECTOR : 5.4. FUEL CELLS

figures in MEUA

BELGIUM	DENMARK			FED. REP. OF GERMANY			FRANCE			IRELAND			ITALY			NETHERLANDS			UNITED KINGDOM			EUROPEAN COMMUNITIES		
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	p.m.	p.m.	p.m.
-	0.73	0.62	-	-	p.m.	p.m.	1.50	1.98	1.68	-	-	0.04	0.07	0.06	-	-	-	-	-	-	-	p.m.	p.m.	p.m.
- Hydrogen batteries	<ul style="list-style-type: none"> - Emergency power systems in the kW range (from 5.1.) - compact 20 kW unit - electrodes & diaphragms - 0.2 conducting ceramic electrolytes for high T. fuel cells and electrolyzers - Electrode structure - Behaviour & ageing of different electrodes - Catalysts - non-precious metals catalysts for alkaline H₂ fuel cells - catalyst for CH₃OH conversion 																							
	<ul style="list-style-type: none"> - Alkaline H₂ fuel cells fuelled with CH₃OH - design of 10 kW demo unit - CH₃OH/H₂O reforming system - CO₂ scrubbing - 1 MW unit (study) 																							
	<ul style="list-style-type: none"> - Storage of secondary energy - fuel cells - (from 1.4.) 																							
5.5. ELECTROCHEMICAL STORAGE																								
see above	-	-	0.16	3.03	1.93	3.33	0.07	0.21	0.41	-	-	0.23	0.31	0.60	see above									
- Electrochemical storage	<ul style="list-style-type: none"> - Light weight accumulators - Ceramic solid state ionic conductors - Improvement of present batteries - Pb - Ni/Fe - Ni/Cd - Ag/Zn - Ni/Zn - Advanced batteries for off-peak electricity and vehicle propulsion - Na-S - Li-S - Zn-Halides - materials - α-Al₂O₃ - mineral fabrics 																							
	<ul style="list-style-type: none"> - Ni/Zn battery - performance of components - Na-S battery - electrode & cell materials - pilot scale manufacture of cells 																							
	<ul style="list-style-type: none"> - Zn-BR₂ battery (5-10 kW range) - testing of stationary units - design of a 1 MW unit - study of Zn-I₂ battery 																							
	<ul style="list-style-type: none"> - batteries - batteries - batteries 																							

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 5. ELECTRICITY

SUB-SECTOR : 5.6. OTHER STORAGE TECHNIQUES

figures in MEUA

BELGIUM		DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES								
76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77	76	77							
p.m.	p.m.	-	0.02	0.65	-	-	0.64	0.89	1.01	0.04	-	0.22	0.59	2.25	0.07	0.11	0.15	0.16	0.15	0.15	p.m.	p.m.	p.m.	p.m.
- Heat storage (from 5.4.)		- Small scale storage systems - Large scale storage systems				- Hydraulic pumping - Compressed-air storage - Massive heat storage - H ₂ massive storage - artificial cavities - aquifers				- Project SESTA : compressed air in natural reservoirs for use in gas-turbines (from 5.1.) - Thermal energy storage		- Fly-wheels		- Compressed air storage coupled with packed bed heat storage (assessment study) - Heat storage (hot H ₂ O under pressure) at generating plants (assessment study)		- Storage of secondary energy (from 1.4) - pumping water - compressed air						- fly wheels		

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 6. GENERAL STUDIES

SUB-SECTOR : 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS

figures in MEUA

BELGIUM	DENMARK		FED. REP. OF GERMANY		FRANCE		IRELAND		ITALY		NETHERLANDS		UNITED KINGDOM		EUROPEAN COMMUNITIES												
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78									
n.a.	0.66	0.79	0.15	0.45	1.11	0.15	0.07	0.04	0.04	0.80	1.55	1.68	0.08	0.12	0.06	0.14	0.38	0.60	1.08	1.43	1.63	n.a.	n.a.	0.15	0.50	1.43	1.93
- Heating plan for Denmark - System dynamic anal. of energy consumption in Denmark over the next 50 years - Different modelling of the Danish system - Climatic conditions & reference year	- System studies related to single technologies (*) - Energy consumption in FRG up to the year 2000 - Long-term improvement of the structure of energy supply	- Energy & economic growth - price, supply & demand - impact of R+D on inflation, investments, employment - effect of new technologies on needs, consumption, investments, foreign exchanges - effect of alternative policies - Energy & environment - effect of new technologies on: + natural resources + human activities - Net energy production - Effect of the exploitation of new technologies on the balance-sheet	- Generalized model of the national energy economy - Energy input-output model - Forecasting of energy supply & demand - Costing of alternative systems - Environmental effects - Long-term models	- End use of energy in Italy	- Anal. of Dutch energy management and interaction with social aspects - Elaboration of scenarios in terms of investments, savings and environmental burden - Integral cost-benefit anal. on alternative energy systems - Assessment of the instruments needed for implementation of long-term energy policy	- Modelling on forecasting of energy requirements and costs - Development of a strategy for R&D in U.K. The anal. covers: - total demand - how energy is used - what forms are used - current pattern in energy use - factors matching each fuel to the covers' need - impact of new technologies	- Study of dynamic models for medium and long-term problems																				
- Energy accounting	(*) Most of the study accompany major R+B projects and are included in their funding																										

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

PROGRAMMES COMPARISON

SECTOR : 6. GENERAL STUDIES

SUB-SECTOR : 6.2. SOCIO-ECONOMIC STUDIES

figures in MEUA

BELGIUM	DENMARK			FED. REP. OF GERMANY			FRANCE			IRELAND			ITALY			NETHERLANDS			UNITED KINGDOM			EUROPEAN COMMUNITIES			
	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	76	77	78	
0.20	1.18	n.a.	n.a.	n.a.	n.a.	n.a.	0.60	0.70	0.81	-	-	-	0.01	0.05	0.07	-	-	-	3.73*	3.99*	4.19*	-	-	-	
<ul style="list-style-type: none"> - Studies on social costs of primary or secondary energy sources - Technico-economic studies of alternative sources of energy - Economical & social assessment of energy investments - Land reclamation - Environmental studies 	<ul style="list-style-type: none"> - Conservation of resources - Energy technique & organization: electricity trade in Denmark - Energy related invention evaluation programme - Nuclear power economics (from 3.9.) 	<ul style="list-style-type: none"> - Analysis of the system energy-society - Socio-economic components relevant to different energy sources - Improvement of the present system - System's control - Strategic studies 	<ul style="list-style-type: none"> - Social aspects of energy supply and demand 	<ul style="list-style-type: none"> - Legal and normative aspects of : <ul style="list-style-type: none"> - solar energy - geothermal energy - urban waste use - energy conservation + transportation + domestic sector 	<ul style="list-style-type: none"> - Social science aspects of energy : <ul style="list-style-type: none"> - utilization studies - supply technologies - supply and demand balances - potential science & market structure - North-Sea oil 	<ul style="list-style-type: none"> - Safety and health <ul style="list-style-type: none"> - medical research related to coal industry - safety in mines - explosion - safety in offshore industry - reactor safety, nuclear processing, radiological protection 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations 	<ul style="list-style-type: none"> - Safety of industrial installations
<p>* Including expenditures relevant to item 6.4. : Safety</p>																									

SECTION 3

SUB-SECTION 3.1

B E L G I U M

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	n.a.	5.24	3.62
1.1. Industry	n.a.	0.51	0.34
1.2. Residential and commercial	n.a.	1.97	0.54
1.3. Transportation	n.a.	0.16	0.35
1.4. Low-grade energy utilization	n.a.	2.60	2.39
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	n.a.	4.03	5.96
2.1. Coal exploration and extraction	n.a.	1.06	1.17
2.2. Coal preparation, valoris.& transpt.	-	-	-
2.3. Coal liquefaction	-	-	-
2.4. Coal gasification	n.a.	2.26	4.79
2.5. Coal combustion	-	-	-
2.6. Oil & gas assessment & exploration	-	-	-
2.7. Oil & gas production	-	-	-
2.8. Refining and derivatives	-	0.71	-
2.9. Transport of oil	p.m.	p.m.	p.m.
2.10. Transport of gas	p.m.	p.m.	p.m.
2.11. Storage of oil	p.m.	p.m.	p.m.
2.12. Storage of gas	p.m.	p.m.	p.m.
2.13. Others	-	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	49.80	51.65	56.01
3.1. Proven reactors	10.12	10.08	12.66
3.2. High temperature reactors	0.31	0.24	0.19
3.3. Breeders	29.70	28.89	27.21
3.4. Fuel cycle	1.44	1.65	1.90
3.5. Nuclear safety	6.14	7.85	10.90
3.6. Waste treatment and disposal	2.09	2.94	3.15
3.7. Radiation prot.& decommiss.of power pl.	p.m.	p.m.	p.m.
3.8. Fissile materials control	p.m.	p.m.	p.m.
3.9. Others	p.m.	p.m.	p.m.
4. NEW ENERGY SOURCES AND VECTORS	1.04	3.27	4.19
4.1. Thermonuclear fusion	1.04	1.63	1.96
4.2. Geothermal energy	--	--	0.09
4.3. Solar energy	--	1.14	1.21
4.4. Ocean	--	--	--
4.5. Wind	--	--	0.154
4.6. Hydrogen as an energy vector	--	0.50	0.78
4.7. Others	--	--	--
5. ELECTRICITY	--	1.48	0.72
5.1. Electricity generating equipment	--	0.30	--
5.2. Transport of electricity	--	0.45	0.10
5.3. Control & instrumentation	--	--	--
5.4. Fuel cells	--	0.73	0.62
5.5. Electrochemical storage	--	p.m.	p.m.
5.6. Other storage techniques	--	p.m.	p.m.

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	--	<u>0.86</u>	<u>1.97</u>
6.1. Analytical studies on energy systems	n.a.	0.66	0.79
6.2. Socio-economic studies	--	0.20	1.18
6.3. Studies on environmental effects	--	p.m.	p.m.
T O T A L	<u>50.84</u>	<u>66.53</u>	<u>72.47</u>

Qualification statement

The figures quoted here are those for which there is a budget heading for a state-body even if the beneficiary is private industry.

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- to moderate the increase of energy consumption through appropriate conservation efforts
- to diversify the sources of energy supply through the development of new energy technologies
- to improve the supply of coal through the underground coal gasification programme
- to increase the contribution of nuclear energy to the energy supply

2. Specific objectives

a. Short-term (1977-1985) and medium-term (1985-1995)

- nuclear energy
 - . sodium-cooled fast breeder reactors
 - . proven reactors
 - . gas reactors
 - . reactor safety
 - . fuel cycle
- energy conservation
 - . reduction of waste heat
 - . secondary raw materials recovery.

b. Long-term (2000 and beyond)

- new energy sources
 - . solar energy utilisation
 - . controlled thermonuclear fusion

3. Priorities

In decreasing order :

- nuclear energy
- energy conservation
- in situ coal gasification
- solar heating and cooling
- solar photovoltaic conversion
- low enthalpy geothermal energy

4. Ongoing and/or planned comprehensive programmes

The five year (1973-1977) nuclear energy technology R&D programme.

The four year (1975-1978) national non-nuclear R&D programme.

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : BELGIUM				
5. Programme description and budgets		II. SUB-SECTOR 1.1. INDUSTRY			DATE : 24.11.78				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Current activities</u>									
<ul style="list-style-type: none"> - heat transfer - fluidized bed heat transfer - reduction of energy consumption in <ul style="list-style-type: none"> . metallurgical industry . chemical industry . gas industry . cement industry (x) . food and agriculture - micro waves - amonium cycles 									
IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION									
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1 (x)	X			x					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	n.a.	20.7	13.8						
TOTAL (in N.C.)	n.a.	20.7	13.8						
TOTAL (in EUA)	n.a.	0.506	0.342						

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : BELGIUM				
5. Programme description and budgets		II. SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL			DATE : 24/11/78				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities</u> - thermal insulation of buildings - insulating materials - low temperature heating (x) - use of heat pumps (xx) - use of solar energy (x) - systems analysis									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
(x)				x					
(xx)					x				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	80.7	21.7					
TOTAL (in N.C.)		n.a.	80.7	21.7					
TOTAL (in EUA)		n.a.	1.974	0.538					

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : BELGIUM
	II. SUB-SECTOR 1.3. TRANSPORTATION	DATE : 24.11.78

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Current activities

- optimization of engine-fuel systems
- fuel cells
- hydrogen engines
- linear electric motors
- cavitation phenomena

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	n.a.	6.7	14.1		
					.../...
TOTAL (in N.C.)	n.a.	6.7	14.1		
TOTAL (in EUA)	n.a.	0.164	0.349		

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY					COUNTRY : BELGIUM	
	II. SUB-SECTOR 1.4. LOW GRADE ENERGY UTILIZATION					DATE : 24.11.78 revised	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Development of heat pumps</u> 2. <u>Waste heat utilization</u> - data collection on heat sources and heat demand maps - total energy systems - combined cycles. 3. <u>Recovery of urban waste</u> - processing and recovery of residential and municipal waste							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
2	X				X		
3	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1+2+3	n.a.	106,2	96,6				
TOTAL (in N.C.)	n.a.	106.2	96.6			.../...	
TOTAL (in EUA)	n.a.	2.598	2.394				

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : BELGIUM			
5. Programme description and budgets		II. SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION				DATE : Feb. 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. <u>Development of new ore exploration methods</u> 2. <u>Coal extraction techniques including secondary and tertiary recovery</u> 3. <u>Evaluation of coal reserves</u> 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X								
2	X								
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 + 2		n.a.	43.3	46.3					
		-	-	1.0					
TOTAL (in N.C.)		n.a.	43.3	47.3					
TOTAL (in EUA)		n.a.	1.06	1.17					

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : BELGIUM		
5. Programme description and budgets		II.SUB-SECTOR 2.4. COAL GASIFICATION				DATE : FEB.1979		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Underground gasification</u></p> <p>2. <u>Technico-economical studies on the possibilities to introduce in Belgium coal liquefaction and gasification technologies</u></p>								
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X							
2	X							
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1 + 2		n.a.	92.2	193.5				
TOTAL (in N.C.)		n.a.	92.2	193.5				
TOTAL (in EUA)		n.a.	2.26	4.79				

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : BELGIUM
5. Programme description and budgets	II.SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION	DATE : FEB. 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Oil drilling at important depths

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
OBJECTIVES									
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	p.m.	p.m.	p.m.		
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : BELGIUM	
5. Programme description and budgets		II.SUB-SECTOR 2.8. REFINING AND DERIVATIVES			DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u>						
<ul style="list-style-type: none"> - hydrocarbons thermal cracking - carbon chemistry - upgrading of used oil products 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		-	29.0	-		
						.../...
TOTAL (in N.C.)		-	29.0	-		
TOTAL (in EUA)		-	0.71	-		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 2.9. TRANSPORT OF OIL				DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Gas and liquid fuel distribution modeling</u>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	p.m.	p.m.	p.m.				
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUEL AND DERIVATIVES				COUNTRY :BELGIUM	
5. Programme description and budgets		II.SUB-SECTOR 2.11. STORAGE OF OIL				DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Study of energy resources storage</u>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.			
						.../...	
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : BELGIUM	
5. Programme description and budgets		II.SUB-SECTOR 3.1. PROVEN REACTORS				DATE : FEB. 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Zirconium assemblies</p> <p>2. Fuel utilization :</p> <p style="margin-left: 40px;">- performances</p> <p style="margin-left: 40px;">- fuel physics</p> <p>3. Plutonium recycling</p> <p>4. Safety</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
2	X						
3	X						
4	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1-4		437	412	511			
							.../...
TOTAL (in N.C.)		437	412	511			
TOTAL (in EUA)		10.12	10.08	12.66			

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 3.2. HIGH TEMPERATURE REACTORS			DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Thermal gas-cooled reactors</u> - fuel fabrication - coated or spherical modules development and irradiation tests						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	13.4	9.7	7.8			
						.../...
TOTAL (in N.C.)	13.4	9.7	7.8			
TOTAL (in EUA)	0.31	0.24	0.19			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : BELGIUM
	II.SUB-SECTOR 3.3. BREEDERS	DATE : SEPT. 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Fuel assemblies

- design
- fabrication

Materials development

Sodium technology

Aux. equipment

Safety and instrumentation

2. Kalkar (SNR 300)

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X					X			
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	796	783	687		
2	575	398	411		
					.../...
TOTAL (in N.C.)	1.371	1.181	1.098		
TOTAL (in EUA)	29.70	28.89	27.21		

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER		COUNTRY : BELGIUM																																																													
	II.SUB-SECTOR 3.4. FUEL CYCLE		DATE : FEB. 1979																																																													
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Reprocessing (general) :</p> <ul style="list-style-type: none"> - Gaseous effluents - Tritium removal from effluents - Conditioning of cladding waste <p>2. Reprocessing breeder fuel :</p> <ul style="list-style-type: none"> - Plutonium dissolution <p>3. Head- and semi-pilot facility</p> <p>4. Plutonium recycling (see in sub-sector 3.1.)</p>																																																																
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">IV. PROGRAMME FEATURES OBJECTIVES</th> <th colspan="5">STATUS & IMPLEMENTATION</th> <th colspan="4">INTERNATIONAL COOPERATION</th> </tr> <tr> <th>current</th> <th>planned</th> <th>extramural impl. %</th> <th>average share Gov. funding %</th> <th>European Communities</th> <th>I.E.A.</th> <th>others</th> <th>envisaged</th> <th>% of share</th> </tr> </thead> <tbody> <tr> <td>1</td> <td align="center">X</td> <td></td> <td></td> <td></td> <td align="center">X</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td align="center">X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td align="center">X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td align="right">.../...</td> </tr> </tbody> </table>						IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	1	X				X					2	X									3	X																		.../...
IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION																																																									
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share																																																							
1	X				X																																																											
2	X																																																															
3	X																																																															
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V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)																																																											
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<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : BELGIUM
5. Programme description and budgets	II.SUB-SECTOR 3.5. NUCLEAR SAFETY	DATE : SEPT. 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Safe-guards and applied research

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X									
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	265	321	440		
					.../...
TOTAL (in N.C.)	265	321	440		
TOTAL (in EUA)	6.14	7.85	10.90		

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL				DATE : FEB. 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Treatment</p> <ul style="list-style-type: none"> - radioactive effluents of nuclear plants - high temperature incineration of radioactive waste - qualification of treated radioactive waste <p>2. Storage and disposal</p> <ul style="list-style-type: none"> - geologic disposal - provisional disposal 							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X				X		
2	X				X		
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1+2		90	120	127			
TOTAL (in N.C.)		90	120	127			
TOTAL (in EUA)		2.09	2.94	3.15			

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS			DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : <p align="center">(see under 3.5)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER				COUNTRY : BELGIUM	
	II.SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL				DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Safeguards (see under 3.5.)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : BELGIUM		
5. Programme description and budgets		II. SUB-SECTOR 4.1. THERMONUCLEAR FUSION			DATE : FEB. 1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Fusion research 2. JET-Project							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X				X		
2					X		
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1 + 2	44.8	66.5	79				
TOTAL (in N.C.)	44.8	66.5	79.0				
TOTAL (in EUA)	1.04	1.63	1.96				

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 4.2. GEOTHERMAL ENERGY			DATE : FEB 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Prospective studies</u> on geothermal energy application in Belgium						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged % of share
1	X			X		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	-	-	3.7	60.0		
						.../...
TOTAL (in N.C.)	-	-	3.7	60.0		
TOTAL (in EUA)	-	-	0.09	1.49		

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS	COUNTRY :BELGIUM
5. Programme description and budgets	II.SUB-SECTOR 4.3. SOLAR ENERGY	DATE : 24.11.78 rev. FEB.79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Use of solar energy in the residential and commercial sectors (see under 1.2.1.)
2. Solar heating and cooling
 - study and modeling of solar collectors
 - technico-economical studies of solar energy utilization in Belgium
 - insolation data
 - solar energy storage
3. Photoelectric
 - photovoltaic conversion
 - . silicon and cadmium cells
 - . technology of thin films
 - photochemical processes
 - photoelectrolysis
4. Thermal electric solar power plants
5. Biomass
 - sludge and bio-industrial waste processes
 - anaerobic fermentation of organic waste
 - pyrolysis
 - waste methanisation

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X								
2	X				X	X			
3	X				X				
4						X			
5	X					X			.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
2	-	6.2	33.30		
3	-	13.6	9.2		
4	-	21.3	-		
5	-	5.4	6.2		
					.../...
TOTAL (in N.C.)	-	46.5	48.70		
TOTAL (in EUA)	-	1.14	1.21		

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : BELGIUM			
5. Programme description and budgets		II. SUB-SECTOR 4.5. WIND				DATE : 24.11.78 revised			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Wind power units									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	6.2					
TOTAL (in N.C.)				6.2					
TOTAL (in EUA)				0.154					

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS	COUNTRY : BELGIUM
5. Programme description and budgets	II. SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR	DATE : 24.11.78 revised

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Current activities

- production by thermochemical watersplitting
- production by electrolysis
- metal hydride storage of small and medium capacity
- production by photosynthesis on industrial scale (preliminary studies)

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION				
		current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X									
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		-	20.4	31.5						
TOTAL (in N.C.)		-	20.4	31.5						
TOTAL (in EUA)		-	0.50	0.78						

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : BELGIUM	
5. Programme description and budgets		II.SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE : FEB.1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :							
<p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - development of turboengines - combustion - superconductivity 							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		-	12.1	-			
						.../...	
TOTAL (in N.C.)		-	12.1	-			
TOTAL (in EUA)		-	0.30	-			

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : BELGIUM			
5. Programme description and budgets		II. SUB-SECTOR 5.2. TRANSPORT OF ELECTRICITY				DATE : FEB. 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Current activities</u>									
<ul style="list-style-type: none"> - interaction between power stations and networks - superconducting cables - solids behaviour under intense magnetic fields 									
IV. PROGRAMME FEATURES									
OBJECTIVES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
	current	planned	extranatural fincl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	18.4	4.1					
							.../...		
TOTAL (in N.C.)		-	18.4	4.1					
TOTAL (in EUA)		-	0.45	0.10					

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : BELGIUM	
5. Programme description and budgets		II.SUB-SECTOR 5.4. FUEL CELLS				DATE : FEB. 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. More generally : energy storage</p> <ul style="list-style-type: none"> - study of energy resources storage - hydrogen batteries - heat storage - electrochemical storage 							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	-	29.9	24.9				
TOTAL (in N.C.)	-	29.9	24.9				
TOTAL (in EUA)		0.73	0.62				

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : BELGIUM			
5. Programme description and budgets		II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE				DATE : FEB. 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Electricity storage methods</u> (see under 5.4)									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.					
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : BELGIUM				
5. Programme description and budgets		II. SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES			DATE : FEB. 1979				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. See under 5.4									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.					
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES			COUNTRY : BELGIUM				
5. Programme description and budgets		II. SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS			DATE : 24.11.78 revised				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Current activities</u>									
<ul style="list-style-type: none"> - national energy system modelling - establishment of an energy data bank - energy accounting (micro-and macro-economical) 									
IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION									
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1				X	X				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	n.a.	26.8	32.0						
TOTAL (in N.C.)	n.a.	26.8	32.0						
TOTAL (in EUA)	n.a.	0.656	0.792						

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES				DATE : FEB. 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - studies on social costs of primary or secondary energy sources - technical economical studies of alternative sources of energy - safety of industrial installations - land reclamation - environmental studies - economical and social assessment of energy investments 							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	-	8.2	47.8				
						.../...	
TOTAL (in N.C.)	-	8.2	47.8				
TOTAL (in EUA)	-	0.20	1.18				

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : BELGIUM	
5. Programme description and budgets		II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS				DATE : FEB. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. See under 6.2.1							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.			
						.../...	
TOTAL (in N.C.)							
TOTAL (in EUA)							

SECTION 3

SUB-SECTION 3.2

D E N M A R K

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>1.287</u>	<u>2.173</u>	<u>3.430</u>
1.1. Industry	0.133	0.146	0.158
1.2. Residential and commercial	0.562	0.948	1.492
1.3. Transportation	0.222	0.248	0.273
1.4. Low-grade energy utilization	0.370	0.831	1.507
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	-	<u>0.233</u>	<u>1.162</u>
2.1. Coal exploration and extraction	-	0.058	0.258
2.2. Coal preparation, valoris.& transpt.	-	-	-
2.3. Coal liquefaction	-	-	-
2.4. Coal gasification	-	-	-
2.5. Coal combustion	-	0.015	0.230
2.6. Oil & gas assessment & exploration	-	0.160	0.674
2.7. Oil & gas production	-	-	-
2.8. Refining and derivatives	-	-	-
2.9. Transport of oil	-	-	-
2.10. Transport of gas	n.a.	n.a.	n.a.
2.11. Storage of oil	-	-	-
2.12. Storage of gas	-	-	-
2.13. Others	-	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>8.038</u>	<u>9.873</u>	<u>11.176</u>
3.1. Proven reactors	3.831	4.142	4.491
3.2. High temperature reactors	-	-	-
3.3. Breeders	-	-	-
3.4. Fuel cycle	1.597	2.961	3.645
3.5. Nuclear safety	1.21	1.33	1.46
3.6. Waste treatment and disposal	1.10	1.11	1.22
3.7. Radiation prot.& decommiss.of power pl.	0.30	0.33	0.36
3.8. Fissile materials control	-	-	-
3.9. Others	p.m.	p.m.	p.m.
4. NEW ENERGY SOURCES AND VECTORS	<u>0.858</u>	<u>2.787</u>	<u>6.049</u>
4.1. Thermonuclear fusion	0.488	0.715	0.933
4.2. Geothermal energy	0.030	0.321	1.715
4.3. Solar energy	0.251	0.788	1.033
4.4. Ocean	-	-	-
4.5. Wind	0.089	0.963	2.368
4.6. Hydrogen as an energy vector	-	-	-
4.7. Others	-	-	-
5. ELECTRICITY	-	<u>0.015</u>	<u>0.804</u>
5.1. Electricity generating equipment	n.a.	n.a.	n.a.
5.2. Transport of electricity	-	-	-
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	-	-	-
5.5. Electrochemical storage	-	-	0.158
5.6. Other storage techniques	-	0.015	0.646

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>0.148</u>	<u>0.452</u>	<u>1.105</u>
6.1. Analytical studies on energy systems	0.148	0.452	1.105
6.2. Socio-economic studies	n.a.	n.a.	n.a.
6.3. Studies on environmental effects	n.a.	n.a.	n.a.
T O T A L	<u>10.331</u>	<u>15.533</u>	<u>23.726</u>

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- to coordinate and intensify R&D in the energy sector in support of efforts to ensure greater security of supply, curb the growth of consumption and, in the longer term, offer a variety of choice in the energy sector;
- to reduce the rate of increase in the consumption of renewable primary energy sources;
- to contribute to the development of long term solutions to the energy problem, such as by utilising renewable energy sources.

2. Specific objectives

a. Short term (1977-1985) and medium-term (1985-1995)

- Oil and gas exploration and extraction, especially in Greenland
- Uranium-ore exploration and extraction
- Energy consumption in buildings
 - . protection of buildings against the weather
 - . heating and ventilation equipment
 - . alternative heating systems
- Exploitation of wind energy
- Energy storage (mainly heat)
- Exploratory work for energy planning.

b. Long-term (2000 and beyond)

- Thermonuclear fusion
- Fast breeder reactors
- Electric power from solar cells
- Coal gasification
- Energy storage (mainly electricity).

3. Priorities

- Energy conservation (conversion and end-use)
- Domestic oil and gas
- New energy sources.

4. Ongoing and/or planned comprehensive programmes and budgets

none.

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 1.1. INDUSTRY				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Industrial processes</u></p> <ul style="list-style-type: none"> - heat-saving measures in laundries - energy conservation in drying wood - heat recovery in the plastics industry - heat recovery from tumbler dryers - energy-saving in the use of compressed air - optimization of manufacturing processes at times of energy and raw material shortages 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	Planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	100	100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.9	1.0	1.1	1.2	1.3			
TOTAL (in N.C.)		0.9	1.0	1.1	1.2	1.3			
TOTAL (in EUA)		0.133	0.146	0.158	0.172	0.187			

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY					COUNTRY : DENMARK				
5. Programme description and budgets	II. SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL					DATE : JUNE 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Low-energy dwellings</u></p> <ul style="list-style-type: none"> - construction of an experimental low-energy house - design, construction of six low-energy houses at reasonable costs. One year measurement tests - operation of a zero-energy house <p>2. <u>Insulation and heating</u></p> <ul style="list-style-type: none"> - air-tightness of buildings, building structures and building sections - cavity-wall insulation - highly insulated concrete facades - highly insulating, light, load-bearing sandwich structures - moisture and heat transport in building structures - moisture and heat conditions in highly insulated roof and wall structures - heat-controlled window glass - window design which, from heating and lighting standpoints, are optimum in summer and winter - pulsed combustion - energy consumption in a space heated in various ways - comfort control of indoor climate - effect of lighting in the heat balance and energy consumption in buildings - window's effect on the energy consumption for space heating - daylight's variations measurement 										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X		70							
2	X	100	100		X					
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		0.3	1.4	2.3	2.0	1.40				
2		3.5	5.1	8.1	10.1	7.1				
							.../...			
TOTAL (in N.C.)		3.8	6.5	10.4	12.1	8.50				
TOTAL (in EUA)		0.562	0.948	1.492	1.736	1.220				

<u>R+D&D POLICY</u>		I. SECTOR RATIONAL USE OF ENERGY				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 1.3. TRANSPORTATION				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - recovery of kinetic energy during deceleration phase (hydraulic system) - development of electric cars - internal combustion engines <ul style="list-style-type: none"> . insulated diesel pre-combustion chambers . combustion process in gasoline engines . alternative engine fuels . study on increasing the efficiency of diesel engines . mixture and heat control of gasoline engines . Stirling engines 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
	1	X	100	100					
.../...									
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		1.5	1.7	1.9	2.0	2.3			
.../...									
TOTAL (in N.C.)		1.5	1.7	1.9	2.0	2.3			
TOTAL (in EUA)		0.222	0.248	0.273	0.287	0.330			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : DENMARK
	II. SUB-SECTOR 1.4. LOW-GRADE ENERGY UTILIZATION	DATE : JUNE 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Heat transport (see under 5.1.2. : District heating)
2. Heat storage
 - storage of heat in connection with individual houses (solar energy, heat recovery, etc.)
 - heat energy storage in Denmark
 - . uninsulated heat accumulator in the earth
 - . long-term storage of heat
 - . large-scale heat storage in underground formations
3. Heat pumps
 - distribution of heat and heated mains water from heat pumps
 - heat transfer conditions and evaporation sequence in evaporators
 - mathematical model for heat transfer from the earth
 - simulation of thermal systems
 - heat-transfer conditions for air coolers
 - heat transfer conditions in the ground
 - heat pumps exploiting air's enthalpy
4. Agriculture
 - energy-savings in silage drying
 - total energy systems for greenhouses
 - low-energy greenhouse with removable night insulation

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X	50	100	X	X				
3	X	100	100		X				
4	X	100	100	X					
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 *	p.m.	p.m.	p.m.		
2	1.1	4.4	5.9	4.1	n.a.
3	0.5	0.3	n.a.	n.a.	n.a.
4	0.9	1.0	4.6	2.0	1.3
					.../...
TOTAL (in N.C.)	2.5	5.7	10.5	6.1	1.3
TOTAL (in EUA)	0.370	0.831	1.507	0.875	0.187

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- straw as a fuel for a district heating plant
- bio-gas from organic wastes (manure) (see under 4.3.3.)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)								
TOTAL (in EUA)								

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : DENMARK		
5. Programme description and budgets		II.SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION			DATE : JUNE 1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Coal exploration in Greenland							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		100				
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		-	0.4	1.8	14.7	0.8	
						.../...	
TOTAL (in N.C.)		-	0.4	1.8	14.7	0.8	
TOTAL (in EUA)		-	0.058	0.258	2.109	0.115	

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : DENMARK		
5. Programme description and budgets		II.SUB-SECTOR 2.5. COAL COMBUSTION				DATE : JUNE 1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :								
1. <u>Coal combustion</u>								
<ul style="list-style-type: none"> - laboratory scale experiments with fluidized bed combustion - establishment of a coal catalogue - utilisation of coal in smaller heating stations. 								
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X		100	100		X		
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		-	0.1	1.6	2.6	1.0		
TOTAL (in N.C.)		-	0.1	1.6	2.6	1.0		
TOTAL (in EUA)		-	0.015	0.230	0.373	0.143		

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : DENMARK
	II.SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION	DATE : JUNE 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Basic geological and geophysical investigation in Greenland

- paleontological and stratigraphical studies of the Greenland basin
- sedimentological and tectonic study of the Eastern Greenland basin
- micropaleontological studies of Eastern and Western Greenland sediments
- geochemical studies of Western Greenland sedimentary rocks
- palynological and basin studies in central Western Greenland
- geophysical studies on the Greenland shelf
- sea-bed studies off Western Greenland
- aeromagnetic study of the Eastern Greenland continental shelf
- interpretation of data and study of oil companies samples
- recent methods for locating oil
- mineralogy, geochemistry and petrology of the Ilimassaq intrusion

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X		-	100						
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	-	1.1	4.7	7.1	0.3
					.../...
TOTAL (in N.C.)	-	1.1	4.7	7.1	0.3
TOTAL (in EUA)	-	0.160	0.674	1.019	0.043

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : DENMARK
5. Programme description and budgets	II.SUB-SECTOR 2.10 TRANSPORT OF GAS	DATE : JUNE 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Transport systems for natural gas
2. Simulation model for determining the expansion rate of a natural gas grid and consumer installations in Denmark (see under 6.1.3.)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged % of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	n.a.	n.a.					
2		p.m.	p.m.	p.m.					
							.../...		
TOTAL (in N.C.)									
TOTAL (in EUA)		n.a.	n.a.	n.a.					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 2.12 STORAGE OF GAS				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p align="center">1. Storage of natural gas in underground salt domes</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	100					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	-	0.2				
TOTAL (in N.C.)		-	-	-	0.2				
TOTAL (in EUA)		-	-	-	0.029				

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : DENMARK				
5. Programme description and budgets		II. SUB-SECTOR 3.1. PROVEN REACTORS			DATE : JUNE 1979				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>LWR</u>									
<ul style="list-style-type: none"> - reactor technology (analysis of pressure vessels, economy, static and dynamic reactor physics) - development of experimentally verified computer models to assess reactor safety - radioecology, establishment of database for meteorological - climatological assessment of environmental effects of nuclear power plants - dosimetry, operation of experimental reactor, development of radiation equipment to experimental reactor 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X	-	100	X		NEA			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		25.9	28.4	31.3	34.4	37.8			
TOTAL (in N.C.)		25.9	28.4	31.3	34.4	37.8	.../...		
TOTAL (in EUA)		3.831	4.142	4.491	4.936	5.424			

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : DENMARK			
5. Programme description and budgets		II. SUB-SECTOR 3.4. FUEL CYCLE				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Uranium prospection and extraction</u></p> <ul style="list-style-type: none"> - U occurrence at <ul style="list-style-type: none"> - Kvanefjeld (2 projects) - Dalsland, Sweden - systematic U prospecting - geochemistry of U - design, construction and operation of a pilot plant in semi-commercial scale for extraction of uranium from the Greenland deposits. <p>2. <u>Fuel elements</u></p> <ul style="list-style-type: none"> - development, fabrication and examination of fuel elements - long-term development of fuel elements 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	-	100						
2	X	-	100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		10.8	20.3	20.8	18.1	8.8			
2		n.a.	n.a.	4.6	9.5	12.5			
							.../...		
TOTAL (in N.C.)		10.8	20.3	25.4	27.6	21.30			
TOTAL (in EUA)		1.597	2.961	3.645	3.960	3.056			

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 3.5. NUCLEAR SAFETY				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - structural analysis of pressure vessels and other load bearing structures - structural studies of pre-stressed concrete components - statistical reactor physics - reactor design in general and loop analysis - repair work, blowing down and emergency cooling - heat loop experiment - probabilistic fracture mechanics 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1									
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)		1.21	1.33	1.46	1.60				1.76

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : DENMARK		
5. Programme description and budgets		II. SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL			DATE : JUNE 1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :							
1. Treatment and storage of low activity wastes							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		-	100			
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1							
TOTAL (in N.C.)						.../...	
TOTAL (in EUA)		1.10	1.11	1.22	1.34	1.47	

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : DENMARK			
5. Programme description and budgets		II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS				DATE : JUNE 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. Dosimetry of people and their surroundings									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	-					
TOTAL (in N.C.)							.../...		
TOTAL (in EUA)		0.30	0.33	0.36	0.39	0.42			

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : DENMARK				
5. Programme description and budgets		II. SUB-SECTOR 3.9. OTHERS			DATE : JUNE 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. Nuclear power economics 2. Economic studies to ascertain the competitiveness of nuclear power under the conditions of Denmark 3. Development of irradiation rigs for research reactors 4. Nuclear power station dynamics <p>(see 3.7)</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)	p.m.	p.m.	p.m.						

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 4.1. THERMONUCLEAR FUSION				DATE : JUNE 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Refueling of fusion reactors									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	Planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	-	50	X				50	
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		3.3	4.9	6.5	6.9	7.3			
TOTAL (in N.C.)		3.3	4.9	6.5	6.9	7.3			
TOTAL (in EUA)		0.488	0.715	0.933	0.990	1.047			

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : DENMARK				
5. Programme description and budgets		II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY				DATE : JUNE 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. Design, construction and operation of a full scale district heating geothermal plant . Start-up of further full scale plants. 2. Theoretical and experimental geothermal studies in Southern Scandinavia. 3. Determination of heat flow, temperature distribution, heat productivity and heat production in Denmark 4. National geological survey for using geothermal energy (related to project 1) 5. The use of chemical parameters as geothermal meters in ground water in Denmark 										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current		planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others		% of share
								envisaged		
1	X	X	0	100						
2	X		100	100						
3	X	X	100	100	X					
4	X		100	100						
5	X		100	100	X					.../...
V. BUDGETS (natl. currency) OBJECTIVES			Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1			-	1.9	9.9	42.9	4.9			
2			0.2	0.3	0.3	0.3	0.3			
3			-	-	-	0.5	0.5			
4			-	-	1.6	1.6	n.a.			
5			-	-	0.15	0.15	-			
TOTAL (in N.C.)			0.2	2.2	11.95	45.45	5.70			
TOTAL (in EUA)			0.030	0.321	1.715	6.522	0.818			

R+D&D POLICY	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS					COUNTRY : DENMARK				
5. Programme description and budgets	II. SUB-SECTOR 4.3. SOLAR ENERGY					DATE : JUNE 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Heating and cooling</u></p> <ul style="list-style-type: none"> - development and testing of flat plate solar collectors - systems analysis of low temperature heat production and habitat applications of solar energy - design, construction and measurements on solar heating systems in different building categories - solar heat systems in the climatic conditions in Denmark - exploitation of solar heat to supplement the heating systems of existing dwellings - solar heat systems coupled with heat-pumps. <p>2. <u>Photovoltaic conversion</u></p> <ul style="list-style-type: none"> - solar cells for energy production <p>3. <u>Biomass</u></p> <ul style="list-style-type: none"> - design, construction and operation of biogas systems to be used in typical Danish farms - design, construction and operation of heat producing systems based on bacterial decomposition of manure - bio-gas from organic wastes, in particular domestic animal droppings <p>4. <u>Climatic conditions and reference year</u> (see under 6.1.1.)</p>										
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	...
1	X	0	100	X	X					
2	X	100	100			Sweden				
3	X	100	80							
4	X			X						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		1.4.	4.4	4.1	5.0	4.3				
2		0.3	0.6	0.6	0.6	n.a.				
3		-	0.4	2.5	2.5	n.a.				
4		p.m.	p.m.	p.m.						
TOTAL (in N.C.)		1.7	5.4	7.20	8.10	4.3				
TOTAL (in EUA)		0.251	0.788	1.033	1.162	0.617				

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : DENMARK			
5. Programme description and budgets		II. SUB-SECTOR 4.5. WIND				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>Current activities</u></p> <p>1. <u>Large windmachines</u></p> <ul style="list-style-type: none"> - design, construction and operation of 2 large wind energy conversion systems (> 600 kW) - assessment of wind resources - dimensioning of wind profiles - wind motor design - studies for the siting of 1000-2000 large windturbines <p>2. <u>Small windmachines</u></p> <ul style="list-style-type: none"> - establishment of a test site for small wind energy conversion systems - field tests of small windmills <p>3. <u>University studies on small machines</u></p> <ul style="list-style-type: none"> - combination of windmills and torque converters - wind power for heating agricultural estates - integrated wind power heating scheme 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	0	80		X	U.S.A.			
2	X	0	100						
3	X	100	100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.3	6.0	14.6	11.0	3.5			
2		-	0.3	1.6	1.9	1.2			
3		0.3	0.3	0.3	0.3	0.3			
							.../...		
TOTAL (in N.C.)		0.6	6.6	16.50	13.20	5.0			
TOTAL (in EUA)		0.089	0.963	2.368	1.894	0.717			

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : DENMARK				
5. Programme description and budgets		II.SUB-SECTOR 4.7. OTHERS			DATE : JUNE 1979				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Detailed glacial hydrological investigation of water reservoirs in West Greenland with a view to energy production									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	-	3.4	1.0			
TOTAL (in N.C.)		-	-	-	3.4	1.0			
TOTAL (in EUA)		-	-	-	0.488	0.143			

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Combined electricity and heat production</u></p> <ul style="list-style-type: none"> - diesel-steam-power district heating station - combined diesel and steam power station with district heating capability - study of combined power and heat production. <p>2. <u>District-heating</u></p> <ul style="list-style-type: none"> - study of existing underground distribution mains - study of underground distribution mains - economic dimensioning of district-heating plants - establishing large district-heating stations <p>3. <u>Analysis of economic possibilities of increasing electricity production with the use of back-pressure turbines</u></p> <p>4. <u>Improved fuel oil combustion</u></p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
4	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)		n.a.	n.a.	n.a.					

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE				DATE : JUNE 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Development of light weight accumulator Storage of electric energy using ceramic solid state ion conductors									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50	X				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	1.1	1.2				
						.../...			
TOTAL (in N.C.)		-	-	1.1	1.2				
TOTAL (in EUA)		-	-	0.158	0.172				

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : DENMARK			
5. Programme description and budgets		II. SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES				DATE : JUNE 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
<ol style="list-style-type: none"> 1. Small scale storage systems 2. Large storage systems 3. Recovery of energy from de-acceleration of cars 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	100	100						
2	X	-	100		X				
3	X	100	100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	1.5	1.2	0.3			
2		-	0.1	2.7	2.5	0.8			
3		-	-	0.3	0.2	-			
						.../...			
TOTAL (in N.C.)		-	0.1	4.5	3.900	1.1			
TOTAL (in EUA)		-	0.015	0.646	0.560	0.158			

R+D&D POLICY		I. SECTOR 6. GENERAL STUDIES				COUNTRY : DENMARK			
5. Programme description and budgets		II.SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. <u>Establishment of a heating plan for Denmark</u> 2. <u>System dynamic analysis of energy consumption in Denmark over the next 50 years</u> 3. <u>Description of the Danish energy system using different modelling techniques</u> 4. <u>Climatic conditions and reference year (solar radiation measurements)</u> 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X		0	100					
2	X		100	100					
3	X		0	100	X	X			
4	X		100	100	X				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	1.0	2.0	2.0	n.a.			
2		1.0	1.0	1.0	1.0	n.a.			
3		n.a.	1.1	4.3	4.3	4.3			
4		-	-	0.4	0.2	-			
							.../...		
TOTAL (in N.C.)		1.0	3.1	7.7	7.5	4.3			
TOTAL (in EUA)		0.148	0.452	1.105	1.076	0.617			

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : DENMARK			
5. Programme description and budgets		II. SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES				DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. Conservation of resources 2. Energy technique and organisation : electricity trades in Denmark 3. Energy related invention evaluation programme 4. Nuclear power economics (see under 3.9.1.) 5. Economic studies to ascertain the competitiveness of nuclear power under the conditions of Denmark (see under 3.9.2.) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
4	X								
5	X								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)									
TOTAL (in EUA)	n.a.	n.a.	n.a.						

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES		COUNTRY : DENMARK			
5. Programme description and budgets	II.SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS		DATE : JUNE 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. Radioecology, establishment of data base for meteorological-climatological assessment of environmental effects of nuclear power plants (see under 3.1.1.) 2. Consequences of releasing nuclear pollutants into the atmosphere 3. Physical and chemical behaviour of sulphur dioxide in the atmosphere - source identification in urban areas 4. Air pollution from motor vehicles 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
2	X					
3	X					
4	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
						.../...
TOTAL (in N.C.)		n.a.	n.a.	n.a.		
TOTAL (in EUA)		n.a.	n.a.	n.a.		

SECTION 3

SUB-SECTION 3.3

F E D E R A L R E P U B L I C
O F G E R M A N Y

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976 *	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>16.88</u>	<u>14.73</u>	<u>40.03</u>
1.1. Industry	1.34	0.76	3.89
1.2. Residential and commercial	4.70	2.64	5.05
1.3. Transportation	4.26	4.53	4.66
1.4. Low-grade energy utilization	6.58	6.80	26.43
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	<u>35.21</u>	<u>67.62</u>	<u>115.44</u>
2.1. Coal exploration and extraction	5.51	20.02	46.25
2.2. Coal preparation, valoris.& transpt.	3.84	7.93	11.66
2.3. Coal liquefaction	1.71	2.64	3.50
2.4. Coal gasification	10.23	16.62	19.04
2.5. Coal combustion	9.66	15.11	27.21
2.6. Oil & gas assessment & exploration	3.06	3.78	6.22
2.7. Oil & gas production	0.60	0.76	0.78
2.8. Refining and derivatives	-	-	-
2.9. Transport of oil	-	-	-
2.10. Transport of gas	-	-	-
2.11. Storage of oil	p.m.	p.m.	p.m.
2.12. Storage of gas	p.m.	p.m.	p.m.
2.13. Others	0.60	0.76	0.78

(*) for the 1976 figures see the qualification statements.

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>356.66</u>	<u>363.86</u>	<u>398.64</u>
3.1. Proven reactors	n.a.	p.m.	p.m.
3.2. High temperature reactors	n.a.	65.71	81.62
3.3. Breeders	n.a.	118.96	103.77
3.4. Fuel cycle	n.a.	102.72	127.09
3.5. Nuclear safety	n.a.	54.76	61.80
3.6. Waste treatment and disposal	n.a.	p.m.	p.m.
3.7. Radiation prot.& decommis.of power pl.	n.a.	6.04	6.61
3.8. Fissile materials control	n.a.	2.27	3.11
3.9. Others	n.a.	13.40	14.64
4. NEW ENERGY SOURCES AND VECTORS	<u>38.62</u>	<u>43.82</u>	<u>55.59</u>
4.1. Thermonuclear fusion	30.20	26.81	29.15
4.2. Geothermal energy	0.53	0.76	3.50
4.3. Solar energy	6.04	8.69	12.44
4.4. Ocean	-	0.76	0.78
4.5. Wind	0.07	1.89	3.89
4.6. Hydrogen as an energy vector	1.78	4.91	5.83
4.7. Others	-	-	-
5. ELECTRICITY	<u>5.68</u>	<u>6.04</u>	<u>7.77</u>
5.1. Electricity generating equipment	5.68	6.04	7.77
5.2. Transport of electricity	p.m.	p.m.	p.m.
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	p.m.	p.m.	p.m.
5.5. Electrochemical storage	p.m.	p.m.	p.m.
5.6. Other storage techniques	-	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>0.07</u>	<u>0.04</u>	<u>0.04</u>
6.1. Analytical studies on energy systems	0.07	0.04	0.04
6.2. Socio-economic studies	-	-	-
6.3. Studies on environmental effects	p.m.	p.m.	p.m.
T O T A L	<u>453.12</u>	<u>496.11</u>	<u>617.51</u>

QUALIFICATION STATEMENT

Figures come from the "Energy Research and Energy Technologies Programme 1977-1980" as revised in 1979 and refer mostly (approx. 96 %) to the Bundesministerium für Forschung und Technologie budget, the remaining part being funded by the budgets of the Bundesministerium für Wirtschaft and of the Bundesministerium des Innern. They include project funds, Institutional funding, investments for the future programme as well as Federal Government grants-in-aid for the gas centrifuge demonstration facility, and for the reactors THTR 300 and SNR 300. As States finance a fraction (10 %) of the big science research centres, a small contribution from States is included in the Institutional funding.

1976, 1979 and 1980 figures are budget allocations; 1977 figures refer to real expenditures and the 1978 ones are partly real expenditures and partly budget allocations.

COUNTRY : Federal Republic
of Germany

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- Guaranteeing the continuity of energy supply in the medium and long terms
- Supplying energy at economically favorable costs in the long term
- Due and timely consideration of the needs for environmental protection and the protection of the public and the working population from hazards arising from the conversion and application of energy
- Improving the technological performance capability of our energy technology to maintain its economic competitiveness.

2. Specific objectives

a. Short-term (1977-85) and medium-term (1985-1995)

- Support of the oil and gas industry
 - . exploration techniques
 - . enhanced recovery
 - . deep-drilling technologies
- Rational use of energy in the application and in the secondary energy sectors (recovery of waste heat)
- Coal
 - . geological exploration
 - . efficiency and safety in coal mining
 - . improvement of existing coal using processes
 - . direct utilisation of coal and coal conversion
- Nuclear energy
 - . safety aspects of all types of reactors
 - . fuel cycle
 - . environmental protection
 - . support the construction of large scale prototypes of advanced type reactors :
 - + SNR 300 (sodium cooled fast breeder reactor)
 - + THTR 300 (gas cooled high temperature reactor)

. / 2

b. Long-term (2000 and beyond)

- Thermonuclear fusion
- Alternative energy sources
 - . solar
 - . wind
 - . geothermal (hot dry rocks)

3. Priorities

- Rational utilization of energy in the application and in secondary energy sectors
- Coal and other primary energy sources
- New energy sources
- Nuclear energy

4. Ongoing and/or planned comprehensive programmes and budgets

The fourth (1973-76) nuclear programme was funded with 6127 millions DM.

The non-nuclear (1974-76) energy research and energy technology programme was funded with 545 millions DM.

The energy research and energy technology programme (1977-80) is funded with 6745 millions DM.

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : GER			
5. Programme description and budgets	II. SUB-SECTOR 1.1. INDUSTRY	DATE : March 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Improvement of existing technologies</u></p> <ul style="list-style-type: none"> - improved adaptation to the actual requirement of heating boilers - proper choice of the source of energy <ul style="list-style-type: none"> . optimisation of burners and burning-plants . gasification of LNG for turbine plants in closed cycle - reduction of resistances <ul style="list-style-type: none"> . flow (liquids) . friction (solids) . electric - thermal insulation in <ul style="list-style-type: none"> . industrial plants . office buildings <p>2. <u>Modification of production processes</u></p> <ul style="list-style-type: none"> - decrease of consumption of process heat <ul style="list-style-type: none"> . optimization of process parameters . selection of less energy-intensive processes in : <ul style="list-style-type: none"> + substitution of thermal drying with mechanical drying + vacuum evaporation + partial heating in hardening processes + use of heat recovery systems <ul style="list-style-type: none"> ++ industrial heat-pumps (MWe range) +++ regenerative heat-exchange - improvement of process flow sheets <ul style="list-style-type: none"> . integration of several processes . optimisation of plants operation (full utilization of capacity) . substitution of batch operations with continuous methods of production 					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I. E. A.	others envisaged % of share			
1	X	100 66			
2	X	100 66			
3	X	100 66			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 + 3	3.78	2	10	13	11
TOTAL (in N.C.)	3.78	2	10	13	11
TOTAL (in EUA)	1.34	0.76	3.89	5.05	4.28

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : GER
5. Programme description and budgets	II. SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL	DATE : March 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Development of materials for thermal insulation and heat storage

- new building materials, having good insulating and storage properties, from :
 - . cheap basic materials
 - . waste materials

2. Energy conserving housing and residential units schemes

- optimization of heat distribution within buildings
- use of solar energy by proper siting of buildings
- space heating systems with low feed temperatures
- multi-dwelling complexes and residential units
 - . use of solar energy
 - . waste heat utilization
 - . central heat supplies

3. Heat pumps

- development and testing of low cost heat pumps
- development of low capacity units (10 kW) for different temperature levels
- control systems
- design of compact heat pumps with combustion engines
- studies of the environmental impact

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	66						
2	X		100	66						
3	X		100	66						
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 + 6	13.22	7	13	22	24
				.../...	.../...
TOTAL (in N.C.)	13.22	7	13	22	24
TOTAL (in EUA)	4.70	2.64	5.05	8.55	9.33

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : GER				
5. Programme description and budgets		II. SUB-SECTOR 1.3. TRANSPORTATION			DATE : March 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Motor vehicles</u></p> <ul style="list-style-type: none"> - engine efficiency - size, design of vehicle - type of fuel (CH₃OH, H₂, electricity) - tyre design - electronic control systems for engines <p>2. <u>Public transport systems</u></p> <ul style="list-style-type: none"> - control systems for <ul style="list-style-type: none"> . allowing low-loss and smooth operation . minimizing transmission losses and peak loads in the grid - recovery of braking energy - light weight construction <p>3. <u>Air transport</u></p> <ul style="list-style-type: none"> - development of by-pass engines - improvement of efficiency in the subsonic range 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X	} special programme							
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 : 3		12	12	12	* Part of a special programme on transport technologies (rough estimates)				
								.../...	
TOTAL (in N.C.)		12*	12*	12*					
TOTAL (in EUA)		4.26	4.53	4.66					

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : GER	
	II.SUB-SECTOR 1.4. LOW GRADE ENERGY UTILISATION				DATE : March 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. <u>Heat pumps</u> (see 1.1.2. and 1.2.3.) 2. <u>Heat recovery</u> (see 1.2.4.) 3. <u>Heat storage</u> (see 1.2.5.) 4. <u>Coupled heat-power systems and district heating systems</u> <ul style="list-style-type: none"> - development of strategies for the design of district-heating systems <ul style="list-style-type: none"> . heat atlas for the Federal Republic of Germany . study of the possibility of using district-heating from heat/power systems from the viewpoints of economy, ecology and national economy . planning studies to investigate four model areas with different structures with respect to the supply of district heat: <ul style="list-style-type: none"> + Mannheim/Ludwigshafen/Heidelberg district + Koblenz/Bonn/Cologne district + Western Ruhr district + Berlin district - study of the "Ruhr district heat supply system" with the aim of developing supra-regional district heating systems - implementation of the integrated district heating system in the Saar region <ul style="list-style-type: none"> . compensation of peak load demand by means of the storage effect of large supply systems . possibility of feeding industrial waste heat into the integrated heat supply system - improvement of techniques of heat transport over long distances 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged % of share
1			100	66		
2			100	66		
3			100	66		
4			100	66		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		p.m.	p.m.	p.m.		
2		p.m.	p.m.	p.m.		
3		p.m.	p.m.	p.m.		
4		13.38	13	61	56	15
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- heat storage
 - . central and decentralized heat storage facilities
 - . build-up of an heat storage test pool (30.000 m³ water)
 - + techniques of heat input and output
 - . use of underground water reserves (aquifers stores) as long term heat storage systems
- development of new power plant concepts and use of gas turbines in combined power plants

5. Cooling of thermal power plants and utilization of waste heat

- erection and operation of large capacity dry cooling tower (in connection with THTR 300 prototype power plant)
- heating of the outdoor soil for agricultural purposes (AGROTHERM Project)
 - . field (7 ha) experiments on :
 - + dissipation of the heat introduced into the soil
 - + heat and water balances
 - + reliability of materials and components
 - + system behaviour under different climatic and soil conditions
 - + investigation of crops and varieties most suitable for cultivation in soil heated at different temperatures (including subtropical and tropical plants)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
5	X		100	66						
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
5		5.15	5.0	7.0	27.0	29.0				
TOTAL (in N.C.)		18.53	18	68	83	44				
TOTAL (in EUA)		6.58	6.80	26.43	32.26	17.10				

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : GER			
5. Programme description and budgets	II. SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION	DATE : March 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Gallery driving and mining systems; Logistic systems</u></p> <ul style="list-style-type: none"> - <u>prospection</u> <ul style="list-style-type: none"> . data bank . automatic measuring equipment for X-ray analysis of minerals . horizontal and vertical boring techniques - <u>gallery driving</u> <ul style="list-style-type: none"> . basic safety data for the development of blasting techniques of increased efficiency . improved performance and increased safety of support operation in drifting . rotary dry drilling . development of self-advanced drilling machines . high performance drivage system with drilling and blasting . improved drift advance with road heading machines . mechanical driving of gate and roads . support techniques <ul style="list-style-type: none"> + improved backfilling + special materials development + road support with prefabricated parts . hydraulic haulage systems . hydraulic debris disposal . full face tunnelling machines - <u>mining systems</u> <ul style="list-style-type: none"> . high pressure water-jet coal-winning machines 					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I. E. A.	others envisaged % of share			
1	X	100%			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	15.5	53	119	144	118
					.../...
TOTAL (in N.C.)	15.5	53	119	144	118
TOTAL (in EUA)	5.51	20.02	46.25	55.97	45.86

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- . steering and partial automation of winning equipment
- . integrated equipment for very thick seams
- . high performance mobile combined machine for thin seams exploitation
- . supports and impact ripper machines for coal face/roadway transition, optimisation of face supporting systems
- . rock consolidation and roof securing techniques
- . improved coalgetting
- . mining in inclined deposits
 - + high production coal fans in thick seams of inclined formation
 - + coal winning in seams in steeply inclined formations

- logistic systems

- . battery driven vehicles, diesel-driven vehicles
- . control, measure of CO and CH₄ content, ventilation
- . ventilation measuring devices and methods
- . computerized monitoring, evaluation and storage of measured values and data
- . computer controlled optimization of underground movements
- . control techniques and automation of belt conveyors
- . intercommunication systems for underground working
- . new driving systems for underground mining
- . improvement of electric power network

- design models of the operation

- . building and integration of operational planning models for the coal mining industry in the Federal Republic of Germany
- . early detection of surface damage due to mining
- . methods for technico-economic assessment of mining R-D projects

- advanced mining (great depths)

- . rock mechanics
- . drifting and expansion of underground workings

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
OBJECTIVES										
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)		Expenditures 1977 (x10 ⁶)		Estimations 1978 (x10 ⁶)		Estimations 1979 (x10 ⁶)		Estimations 1980 (x10 ⁶)	
TOTAL (in N.C.)										
TOTAL (in EUA)										

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : GER
5. Programme description and budgets	II.SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT	DATE : March 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Coke production

- thermal pretreatment of baking pit coal
- improvement of the conventional vertical flue method
- continuous production of formed coke (Prosper demonstration plant, terminated in 1978)
 - . variable range of feed coals
 - . preparation of coking coals
 - . production of formed coke from lignite
 - + optimisation of the coking process
- use of low volatile coals (Ancit Process)

2. Direct combustion

- combustion of pulverised coal in central heating systems
 - . development of automated boiler systems
- fluidized-bed combustion units at atmospheric pressure for application in :
 - . power stations
 - . heating plants
 - . industrial boilers

3. Dressing

- treatment of crushed coals; water and ash content reduction
- cleaning of coal
- fines separation; combustion of tailings with fluidized-bed firing
- computer controlled coal preparation
- monitoring and control of conveyance flow in underground working
- dry processing of dirty coals

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100			X				
2	X		100							
3	X		100							
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1+2	8,2	12	19	19	24
3	2,6	9	11	17	25
					.../...
TOTAL (in N.C.)	10.8	21	30	36	49
TOTAL (in EUA)	3.84	7.93	11.66	13.99	19.04

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : GER	
5. Programme description and budgets		II. SUB-SECTOR 2.3. COAL LIQUEFACTION			DATE : March 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u>						
- synthesis						
. basic research on						
+ selective guidance of Fischer-Tropsch synthesis						
+ catalysts and control of selectivity						
- hydrogenation						
. preliminary study of a demonstration plant for the production of coal oil in USA						
. participation in the construction and operation of a coal conversion demonstration plant in the USA (on the basis of the results of the abovementioned study) Government funding : 300 Million DM						
. laboratory studies on hard coal conversion						
. pilot plants for coal hydrogenation (with a capacity up to 200 t/d)						
. development of catalysts						
+ new type						
+ homogeneous						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X		100			U.S.A. (partial, y)
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		4.8	7	9	37	66
						.../...
TOTAL (in N.C.)		4.8	7	9	37	66
TOTAL (in EUA)		1.71	2.64	3.50	14.38	25.65

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : GER
	II.SUB-SECTOR 2.4. COAL GASIFICATION	DATE : March 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Gas generation from coal

- further development of the LURGI pressurized gasification process (at the Dorsten test facility) :
 - . increase in pressure and performance
 - . use of coals with hyper fine content
 - . crude gas splitting
 - . crude gas conversion
- development of coal dust gasification techniques
 - . Saarberg-Otto generator (30 bar)
 - . Texaco process (40 bar) } pressurized
- Winkler process for lignite
 - . fluidized-bed gasification
- gasification using nuclear process-heat (from HTR)
 - . operation of semi-technical plant for hydrogenating coal gasification unit (~ 5 ton/day)
 - . operation of semi-technical plant for coal gasification by steam (~ 5 ton/day)
 - . design and development of pilot plants with capacities 50 ± 100 tons/day
- development of components
 - . heat exchangers
 - . feeding and dosing systems
 - . high temperature fibre filters
 - . high temperature electrostatic precipitators

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	100							
2	X	100				Belgium			
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	27.9	41	46	46	49
2	0.9	3	3	5	9
					.../...
TOTAL (in N.C.)	28.80	44	49	51	58
TOTAL (in EUA)	10.23	16.62	19.04	19.82	22.54

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : GER			
5. Programme description and budgets		II.SUB-SECTOR 2.5. COAL COMBUSTION				DATE : March 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Electricity generation from coal</u>									
<ul style="list-style-type: none"> - advanced technologies <ul style="list-style-type: none"> . construction and operation of a test facility for degasification/partial gasification/desulphurisation/combustion of coal (VEW conversion process) . gas/steam turbine power plant concept with fluidized bed firing . further development of the 170 MW prototype plant at the Lünen power station operating with coal pressure gasification and combined gas/steam turbine cycle - reduction of the emissions from conventioned coal-fired power stations <ul style="list-style-type: none"> . non polluting direct combustion of coal in fluidised bed firing system development of a very compact unit for pressurized operation . desulphurization of stack gases . removal of Cl₂ and F₂ . reduction of NO_x emissions - pollution free coal fired power station (200 MW) 									
2. <u>Direct combustion of coal</u> (see 2.2.2.)									
<ul style="list-style-type: none"> - pulverised coal - fluidized-bed combustion 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100						
2	X		100			X			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		27.20	40	70	145	79			
2		p.m.	p.m.	p.m.					
						.../...			
TOTAL (in N.C.)		27.20	40	70	145	79			
TOTAL (in EUA)		9.66	15.11	27.21	56.35	30.70			

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES		COUNTRY : GER		
5. Programme description and budgets		II.SUB-SECTOR 2.6 OIL AND GAS ASSESSMENT AND EXPLORATION		DATE : March 79		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Prospection for oil and natural gas</u></p> <ul style="list-style-type: none"> - direct detection of hydrocarbons and elucidation of the lithology by means of seismic techniques <ul style="list-style-type: none"> . three-dimensional seismic data collection and processing . modelling system for continuous seismic interface analysis . wave theory applied to modeling problems in reflection seismics . combined reflection and refraction seismic interpretation methods . areal reflection seismics with high resolution - other geophysical processes and equipment <ul style="list-style-type: none"> . precision gravity measurements . improved geophysical borehole surveys . magnetic surveys . development of organic-geochemical and isotope geophysical methods for use in hydrocarbon exploration . identification of the sources of gases in geochemical anomaly areas . magnetotelluric measurements for identification of oil-geologically interesting structures 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.
1	X	90				
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	8.6	10	16	14	12	
						.../...
TOTAL (in N.C.)	8.6	10	16	14	12	
TOTAL (in EUA)	3.06	3.78	6.22	5.44	4.66	

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : GER
	II. SUB-SECTOR 2.7. OIL AND GAS PRODUCTION	DATE : March 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Extraction of oil and gas

- deep drilling techniques
 - . development of new and improvement of existing coring methods
 - . casing loads in super deep wells
 - . improvement of primary cementing works in deep and super-deep boreholes
 - . system analysis of alternative procedures for deep drilling techniques
 - . cableless transmission systems for deep drilling wells to surface
- deposit and production techniques
 - . new polymer types for tertiary oil recovery
 - . development of new methods and improvement of existing techniques for tertiary recovery
 - + with tensides
 - + with surfactants
 - + by polymer flooding
 - + by viscous flooding
 - . viscosity-pressure behaviour and compressibility of gas/oil solutions
 - . stimulation of low permeable deep seated gas reservoir
 - . S and V elimination from petroleum
- storage of oil, gas and LNG
 - . investigation of the geological and hydrogeological conditions for establishing rock caverns
 - . geological and geotechnical study for the construction of underground storage in rock for petroleum products
 - . survey of underground oil filled storage cavities
 - . inhomogeneities in salt caverns

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100						
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	1.7	2	2	3	7
					.../...
TOTAL (in N.C.)	1.7	2	2	3	7
TOTAL (in EUA)	0.60	0.76	0.78	1.17	2.72

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : GER			
5. Programme description and budgets	II.SUB-SECTOR 2.11. STORAGE OF OIL	DATE : March 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : <p align="center">(see under 2.7.1.)</p>					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I.E.A.	others envisaged % of share			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	p.m.	p.m.	p.m.		

<u>R+D&D POLICY</u> 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES II. SUB-SECTOR 2.12. STORAGE OF GAS	COUNTRY : GER DATE : March 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : <p align="center">(see under 2.7.1.)</p>					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I.E.A.	others envisaged % of share			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	p.m.	p.m.	p.m.		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : GER	
5. Programme description and budgets		II. SUB-SECTOR 2.13 OTHERS			DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Oil shales</u>						
<ul style="list-style-type: none"> - technical and economical assessment of oil-shale reserves in the Federal Republic of Germany - low temperature distillation experiments <ul style="list-style-type: none"> . autothermic methods . environmental pollution evaluation - pyrolysis of oil shales 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	X		100			
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		1.7	2	2	2	3
						.../...
TOTAL (in N.C.)		1.7	2	2	2	3
TOTAL (in EUA)		0.60	0.76	0.78	0.78	1.17

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : GER	
5. Programme description and budgets		II.SUB-SECTOR3.1. PROVEN REACTORS				DATE : March 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>LWR safety research programme</u> (see 3.5.1)</p> <p>2. <u>LWR waste management concept</u> (see 3.4.4.)</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
2	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.			
2		p.m.	p.m.	p.m.			
						.../...	
TOTAL (in N.C.)							
TOTAL (in EUA)		p.m.	p.m.	p.m.			

<u>R&D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER				COUNTRY : GER																																																									
5. Programme description and budgets	II. SUB-SECTOR 3.2. HIGH TEMPERATURE REACTORS				DATE : March 79																																																									
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Construction of THTR 300</u> (300 MWe prototype power station)</p> <ul style="list-style-type: none"> - grant-in-aid by Federal Government <p>2. <u>Advanced HTR's</u></p> <ul style="list-style-type: none"> - fuel element fabrication <ul style="list-style-type: none"> . increase of the fission products retention at high temperatures . increase of the heavy metal concentration in order to achieve higher conversion ratios . development of a particle with the proper coating suitable for future large pebble bed reactors - process heat HTR <ul style="list-style-type: none"> . "nuclear process heat prototype plant" project (gasification of lignite and hard coal) <ul style="list-style-type: none"> + draft of the concept of a large scale facility (3000 MWth) and of the 750 MWth reference facility (1975-1976) + planning of the reference facility (1976-78) <ul style="list-style-type: none"> o design of main components o safety and cost analysis o planning and construction of coal gasification plants for 1 + 2 tons/hr capacity + detailed design (from 1979 onwards) <ul style="list-style-type: none"> o tendering and licensing o operation of pilot plants for gasification - advanced HTR's for electricity generation <ul style="list-style-type: none"> + plant design criteria + design of the fuel cycle + reactor control + decommissioning studies 																																																														
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="width: 15%;">IV. PROGRAMME FEATURES</th> <th colspan="4" style="width: 35%;">STATUS & IMPLEMENTATION</th> <th colspan="2" style="width: 50%;">INTERNATIONAL COOPERATION</th> </tr> <tr> <th style="width: 10%;">current</th> <th style="width: 10%;">planned</th> <th style="width: 10%;">extramural impl. %</th> <th style="width: 15%;">average share Gov. funding %</th> <th style="width: 10%;">European Communities</th> <th style="width: 10%;">I. E. A.</th> <th style="width: 10%;">others</th> <th style="width: 10%;">envisaged</th> <th style="width: 10%;">% of share</th> </tr> </thead> <tbody> <tr> <td>1</td> <td align="center">X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td align="center">X</td> <td></td> <td></td> <td></td> <td></td> <td align="center">F, USA, CH</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td align="right">.../...</td> </tr> </tbody> </table>							IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION		current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share	1	X									2	X					F, USA, CH																							.../...
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION																																																									
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V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)																																																									
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R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER		COUNTRY : GER			
	II. SUB-SECTOR 3.3. BREEDERS		DATE : March 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Construction of SNR 300</u> (280 MWe prototype Na-cooled fast breeder reactor)</p> <ul style="list-style-type: none"> a. grant-in-aid by Federal Government b. R&D supporting activities <p>2. <u>Compact Na-cooled nuclear Reactor II</u> (KNK II)</p> <ul style="list-style-type: none"> - construction and operation of the KNK II - fuel elements irradiation - instrumentation experiments - plutonium technology (UO₂/PuO₂ core) <p>3. <u>Advances in fast breeder development</u></p> <ul style="list-style-type: none"> - oxide fuel elements and materials development <ul style="list-style-type: none"> . irradiation experiments of fuel and cladding materials . development of new cladding materials . behaviour of defective fuel elements . creep phenomena in high neutron fluxes . Na-resistant materials . reprocessing of oxide fuels - safety studies <ul style="list-style-type: none"> . simulation studies of core behaviour for KNK II and SNR 300 . analysis of heavy accidents conditions . development of instrumentation for core control . hot Na technology (aerosol, filtration, aeration systems) . heat exchange - carbide fuels <ul style="list-style-type: none"> . development of preparation methods 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A. others envisaged % of share
1	X					B, NL
2	X					
3	X					
4	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 a		n.a.	156	108	181	175
1 b		n.a.	33	43	44	44
2		n.a.	57	47	54	61
3		n.a.	61	60	73	84
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- . analysis of swelling and creep properties, compatibility with cladding material, gas release
- . basic problems in reprocessing of carbide fuels.

4. Gas cooled fast breeder reactors

- general studies of this alternative line
- safety problems
- heat transfer and pressure losses in the gas loop

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
	4	X								
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
4		n.a.	8	9	9	8				
TOTAL (in N.C.)		n.a.	315	267	365	390				
TOTAL (in EUA)		n.a.	118.96	103.77	141.86	151.57				

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : GER	
5. Programme description and budgets		II. SUB-SECTOR 3.4. FUEL CYCLE				DATE : March 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Natural uranium supply</u></p> <ul style="list-style-type: none"> - prospection work in house and abroad - study on U extraction from <ul style="list-style-type: none"> . sea-water . phosphates . low grade ores <p>2. <u>Uranium enrichment</u></p> <ul style="list-style-type: none"> - gas centrifuge method <ul style="list-style-type: none"> . construction of demoplant with capacity of 400 ton SWU/yr . exploitation of the existing development potential of the centrifuge technique for : <ul style="list-style-type: none"> + improving the economy + reducing its operating risk - separation nozzle method <ul style="list-style-type: none"> . development work - other techniques <ul style="list-style-type: none"> . assessment of the technical potential of <ul style="list-style-type: none"> + lasers + plasma rotation techniques <p>3. <u>Fuel element fabrication</u></p> <ul style="list-style-type: none"> - for LWR - work - mainly for improving safety and in-pile behaviours - is included in 3.5.1. (LWR Safety Research) - for HTR - see 3.2.2. - for LMFBR - see 3.3.3. 							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X					Brazil, Canada	
2	X					NL, UK, Brazil	
3	X						
4	X			X	X	F, UK, NEA, IAEA	
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		n.a.	37	29	25	2	
2 (R&D)		n.a.	69	79	150	116	
2 (demoplant)		n.a.	29	50	48	75	
3		p.m.	p.m.	p.m.	p.m.	p.m.	
							.../...
TOTAL (in N.C.)							
TOTAL (in EUA)							

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

4. LWR waste management concept

- reprocessing
 - . PUREX process and plants
 - + optimization and further development of components
 - + improvement of the in-line instrumentation and analytical measuring instruments
 - + minimization of waste quantities
 - + development and testing of systems for retention of radioactive I, Kr, C and H isotopes
 - . safety problems linked with construction and operation of large scale facilities
 - . HTR fuels construction of small test facility (JUPITER) for reprocessing tests of AVR fuel elements
- recycling of Pu
 - . improvement in the economy and availability of the fabrication process of Pu-based elements
 - . prevention of the increase in the present low exposure of man and environment
 - . basic studies on U²³³ in the Th-U cycle (HTR line)
- waste treatment
 - . reduction of waste volume
 - . improvement of chemical and physical stability of the end products
 - . vitrification of high level waste
 - . solid wastes (from reprocessing plants)
 - + development of decontamination techniques and compaction
 - + potential recovery of Zr
 - . stable fixation of gaseous wastes
 - + I
 - + T
 - + Kr

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
4	n.a.	137	169	183	215				
TOTAL (in N.C.)	n.a.	272	327	324.0	354.0				
TOTAL (in EUA)	n.a.	102.72	127.09	125.92	137.58				

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER					COUNTRY : GER				
5. Programme description and budgets	II.SUB-SECTOR 3.4. FUEL CYCLE (cont 'd)					DATE : March 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 4. <u>LWR waste management concept</u> (cont 'd) . bituminous, concrete and polystyrene embedding of low-medium wastes from power reactors : reduction of leaching rates and increase of time-stability. - storage . investigation of + salt formations + other geological formation; granite, clay, for suitability to accomodate storage facilities . test on ultimate storage in salt mines - transport of nuclear fuels . development of shipping containers and transport systems against incident and accident conditions										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
										.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : GER
	II.SUB-SECTOR 3.5. NUCLEAR SAFETY	DATE : March 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. LWR Safety Research

- "Emergency core cooling" and "Containment in case of loss of coolant" Projects :
 - . leakage processes
 - . thermohydraulic events in the primary circuit
 - . cooling in the reactor core during blowdown
 - . emergency core cooling
 - . mechanical behaviour of reactor core
 - + heating
 - + release of f.p.
 - . containment's dynamic stresses
 - + pipe failures
 - + integral pressure and temperature load
 - + long term leak tightness
- "Components Safety" Project
 - . improvement of the quality of materials
 - . improvement in fabrication
 - . safety reserve of pressurized components
- "Burst Protection" Project
 - . failures of pressurized pipelines and vessels
- "Core meltdown" Project
 - . thermal, chemical and mechanical effects of the failure of the emergency core cooling system
 - . determination of the extent of f.p. release from a core meltdown accident

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X						F, USA, N, J		
2	X					X	USA, J, IAEA		
3	X								
4	X								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	n.a.	94	109	119	123
2	n.a.	13	8	25	35
3	n.a.	24	27	31	28
4	n.a.	14	15	15	19
					.../...
TOTAL (in N.C.)	n.a.	145.0	159.0	190.0	205.0
TOTAL (in EUA)	n.a.	54.76	61.80	73.84	79.67

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER					COUNTRY : GER	
	II. SUB-SECTOR 3.5. NUCLEAR SAFETY (cont'd)					DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 4. <u>The Superheated Steam Reactor (HDR) Project</u> (after decommissioning) - study of the effects of LOCA accidents upon pressure vessel and containers - non-destructive testing of reactor pressure vessels - load carrying capability of the reactor pressure vessels under extreme conditions - behaviour of the plant in case of earthquake simulated conditions							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
							.../...
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u> 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER II. SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL	COUNTRY : GER DATE : March 79							
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>LWR wastemanagement concept</u> (see 3.4.4.) treatment and storage									
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION					
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	p.m.	p.m.	p.m.						
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : GER			
5. Programme description and budgets		II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS				DATE : March 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Radiation protection research</u>									
- Improvement of the radiation protection of workers in nuclear facilities									
<ul style="list-style-type: none"> . technical measures to improve the repair and maintenance capability of nuclear facilities . improvement of methods of ionizing radiation dosimetry (local and personnel dosimetry) and for incorporation monitoring . development of measuring techniques for the analysis of radiation exposures in special mines, uranium mines in particular . establishment of a central personnel dose file 									
- Development and improvement of techniques for the retention and emission control of radioactive substances									
<ul style="list-style-type: none"> . improvement of the removal efficiency of iodine filters . improvement of accident filter systems . development of techniques for the retention of ³H, ¹⁴C, and ⁸⁵Kr in reprocessing plants . improvement of measuring techniques for emission control, especially of ¹⁴C and actinide elements 									
- Studies of the ecological behavior of radioactive substances released									
<ul style="list-style-type: none"> . assessment of the atmospheric diffusion and deposition parameters . studies of the migration of radionuclides in the soil and in groundwater . studies of the mixing properties of radioactive liquid effluents in surface waters and seawater 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	x								
2	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	14	16	18	19			
2		n.a.	2	1	9	10			
TOTAL (in N.C.)		n.a.	16	17	27	29			
TOTAL (in EUA)		n.a.	6.04	6.61	10.49	11.27			

R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER	COUNTRY : GER			
5. Programme description and budgets	II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS (cont'd)	DATE : March 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ul style="list-style-type: none"> . work on the analysis of the genetic radiation risk . synergistic effects caused by the combined action of radiation and chemical pollutants . epidemiological assessments of groups of persons exposed to higher radiation levels . drafting of concepts to fix limits for radiation exposure and the uptake of radioactive substances by man <p>2. <u>Decommissioning and ultimate disposal of nuclear facilities</u></p> <ul style="list-style-type: none"> - Study of the plant condition after a major accident - Development of suitable techniques for : <ul style="list-style-type: none"> . disassembling . dismantling . decontamination . transport and storage of heavy reactor components - Demo-experiments with MZFR 					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I.E.A.	others envisaged % of share			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)					

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : GER			
5. Programme description and budgets		II. SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL				DATE : March 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Nuclear safeguards and physical protection of fissile materials</u> - drafting of the inspection systems for various nuclear facilities - early detection of diversions - development of advanced protection systems covering the whole fuel cycle by cross-linking civil engineering, electronic and administrative measures.									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	n.a.	6	8	8	8				
TOTAL (in N.C.)	n.a.	6	8	8	8				
TOTAL (in EUA)	n.a.	2.27	3.11	3.11	3.11				

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER					COUNTRY : GER	
5. Programme description and budgets		II. SUB-SECTOR 3.9. OTHERS					DATE : March 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Operation of the HFR test reactors</u> (Petten) - for technical description see item 3.9 of the European Communities)</p> <p>2. <u>Prototype and test reactors</u> (expenditures are covered by other programmes)</p> <ul style="list-style-type: none"> - Karlsruhe Multipurpose research reactor (MZFR) <ul style="list-style-type: none"> . decommissioning investigation - Niederaichbach Nuclear Power Station (KKN) <ul style="list-style-type: none"> . decommissioning research - Grosswalzheim Superheated Steam Reactor (HDR) <ul style="list-style-type: none"> . safety experiments <p>3. <u>Nuclear ship propulsion</u></p> <ul style="list-style-type: none"> - operation of N.S. "Otto Hahn" (terminating \approx 1980) <ul style="list-style-type: none"> . long time behaviour of reactor components . test of reliability of the propulsion system . materials behaviour - nuclear demonstration vessel (NCS 80) <ul style="list-style-type: none"> . specific problems for the commercialization 								
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.L.A.	others	envisaged % of share
1	x							
2	x							
3	x						x	
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		3.84(*)	4.34(*)	5.31(*)	5.42(*)			
2		p.m.	p.m.	p.m.				
3		n.a.	24	24	11	13		
					(*) in MEUA			
						.../...		
TOTAL (in N.C.)								
TOTAL (in EUA)		n.a.	13.40	14.64	9.70			

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS		COUNTRY : GER			
5. Programme description and budgets	II. SUB-SECTOR 4.1. THERMONUCLEAR FUSION		DATE : March 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Fusion oriented plasma research</u></p> <ul style="list-style-type: none"> - plasma stabilisation and confinement techniques by different techniques (Tokamak, stellarators, high-β installations) - plasma diagnostics and generation by strong pulsed lasers - plasma-wall interaction problems <p>2. <u>Technology of fusion reactors</u></p> <ul style="list-style-type: none"> - problems of the materials of the first wall - fuel inlet and fuel outlet - superconductivity - safety problems 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X			X		
2	X			X		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1+2	85	71	75	92	95	
						.../...
TOTAL (in N.C.)	85	71	75	92	95	
TOTAL (in EUA)	30.20	26.81	29.15	35.76	36.92	

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS					COUNTRY : GER				
5. Programme description and budgets	II. SUB-SECTOR 4.3. SOLAR ENERGY					DATE : March 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
1. <u>Thermal utilisation</u>										
- <u>collectors</u>										
<ul style="list-style-type: none"> . high temperature absorbing surfaces . selective absorbing coatings . improvement of thermal efficiency . flat plate collectors . low cost and plastic collector . development of test units . development of industrial manufacturing processes 										
- <u>dwellings</u>										
<ul style="list-style-type: none"> . architectural design of solar houses . modular solar houses heating systems . modular exchangers with integrated latent thermal storage . long-term energy storage tanks for residential buildings . hot water supply in prefabricated houses . hybrid systems (conventional + solar) . control systems 										
7. <u>agriculture</u>										
<ul style="list-style-type: none"> . heating of greenhouses . drying systems for green food and grain 										
- <u>demonstrations</u>										
<ul style="list-style-type: none"> . swimming pools heating . solar house (Fribourg) 										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X		100	66	X		LDC			
2	X		100	66	X	X	LDC			
3	X		100	66	X	X	LDC			
										.../...
V. BUDGETS (natl. currency) OBJECTIVES			Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1+2+3			17	23	32	57	57			
TOTAL (in N.C.)			17	23	32	57	57			
TOTAL (in EUA)			6.04	8.69	12.44	22.15	22.15			

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : GER	
5. Programme description and budgets		II.SUB-SECTOR 4.4. OCEAN			DATE : March 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Assessment studies</u></p> <ul style="list-style-type: none"> - magnitude and location of energy reserves - technico-economic evaluation of concepts - potential contribution to the energy supply up to the year 2000 - recommendations about R&D projects 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
	others	envisaged	% of share			
1	X	100	66		X	
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		-	2	2	3	5
						.../...
TOTAL (in N.C.)		-	2	2	3	5
TOTAL (in EUA)			0.76	0.78	1.17	1.94

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : GER	
5. Programme description and budgets		II.SUB-SECTOR 4.5. WIND			DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u>						
<ul style="list-style-type: none"> - acquisition and processing of wind energy data for technical application <ul style="list-style-type: none"> . meteorological measurements in coastal areas . wind conditions in the Federal Republic of Germany . standardized meteorological measurements for the verification of the specification of wind energy convertor systems - studies of the economic application of small wind power systems <ul style="list-style-type: none"> . development of a 5.5 m ø vertical axis converter . evaluation of a 15 kW power plant - studies of the economic construction of high capacity power plants and their integration in existing energy supply structure <ul style="list-style-type: none"> . development, construction and testing of a prototype converter 52 m ø, 265 kW . engineering study of a large (1 ÷ 2 MW) power plant (GROWIAN) <ul style="list-style-type: none"> + design + storage systems + rotor blades + dynamic behaviour of the complete system 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	X	100	66		X	
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		0.2	5	10	14	24
						.../...
TOTAL (in N.C.)		0.2	5	10	14	24
TOTAL (in EUA)		0.07	1.89	3.89	5.44	9.33

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : GER			
5. Programme description and budgets		II.SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR				DATE : March 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Hydrogen</u></p> <ul style="list-style-type: none"> - advanced electrolysis <ul style="list-style-type: none"> . high pressure and temperature . vapour phase electrolysis - thermochemical watersplitting <ul style="list-style-type: none"> . chemical cycles . hybrid cycles . materials problems . safety problems . evaluation of environmental impact <p>2. <u>Nuclear district heat project</u> (closed cycle CH₄/H₂O conversion)</p> <ul style="list-style-type: none"> - testing of the CH₄ splitting system - development and testing of methanisation systems (consumption) - gas transport 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	66	X	X			
2	X		90	66					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	n.a.	n.a.	n.a.	n.a.			
2		n.a.	n.a.	n.a.	n.a.	n.a.			
							.../...		
TOTAL (in N.C.)		5	13	15	19	20			
TOTAL (in EUA)		1.78	4.91	5.83	7.38	7.77			

<u>R+D&D POLICY</u>	I. SECTOR 5. ELECTRICITY				COUNTRY : GER	
5. Programme description and budgets	II. SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE: March 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. <u>Coupled heat-power systems and district-heating systems</u> (see 1.4.4. and 4.6.2.) 2. <u>Cooling of thermal power plants</u> (see 1.4.5.) 3. <u>Generation, transmission and storage of electricity</u> <ol style="list-style-type: none"> a. <u>Generators</u> <ul style="list-style-type: none"> - improvement of turbines <ul style="list-style-type: none"> . components . materials - supraconducting coils machines - improvement of efficiency in polyphasic generators b. <u>Fuel cells</u> <ul style="list-style-type: none"> - development of emergency power systems in the kW range <ul style="list-style-type: none"> . compact 20 kW unit . electrodes and diaphragms . development of oxygen conducting ceramic electrolytes for high temperature fuel cells and electrolyzers (H₂O) c. <u>Transmission</u> <ul style="list-style-type: none"> - demo-experiment with watercooled cables - underground cables - SF₆ technology - D.C. high current transmission 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	X					
2	X					
3	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		p.m.	p.m.	p.m.		
2		p.m.	p.m.	p.m.		
total 3 (a+b+c+d)		16	16	20	25	22
4		p.m.	p.m.	p.m.		
						.../...
TOTAL (in N.C.)		16	16	20	25	22
TOTAL (in EUA)		5.68	6.04	7.77	9.72	8.55

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : GER	
5. Programme description and budgets		II. SUB-SECTOR 5.2. TRANSPORT OF ELECTRICITY			DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u> (see 5.1.3c)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : GER	
5. Programme description and budgets		II.SUB-SECTOR 5.4. FUEL CELLS				DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities</u> (see 5.1.3.b)							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.			
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : GER	
5. Programme description and budgets		II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE			DATE : March 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities</u> (see 5.1.4.d)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 6. GENERAL STUDIES		COUNTRY : GER						
	II.SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS		DATE : March 79						
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. System analysis studies related to single technologies which accompany, in general, major R&D projects 2. Study evaluating the energy consumption in Germany up to the year 2000 3. Study evaluating the possibilities of a long-term improvement of the structure of energy supply 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1									
2		100	100						
3		100	100						
									.../...
V. BUDGETS (nat. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	n.a.	n.a.	n.a.	n.a.	n.a.				
2	0.2	0.1	-	-	-				
3	-	-	0.1	0.5	0.4				
						.../...			
TOTAL (in N.C.)	0.2	0.1	0.1	0.5	0.4				
TOTAL (in EUA)	0.07	0.04	0.04						

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES	COUNTRY : GER
5. Programme description and budgets	II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS	DATE : March 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Reduction of the emissions from conventional coal-fired power stations
(see 2.5.1)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X									
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	p.m.	p.m.	p.m.		
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)					

SECTION 3

SUB-SECTION 3.4

F R A N C E

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>38.03</u>	<u>44.29</u>	<u>57.40</u>
1.1. Industry	15.90	19.35	28.21
1.2. Residential and commercial	8.36	9.94	11.85
1.3. Transportation	8.89	8.92	10.44
1.4. Low-grade energy utilization	4.88	6.08	6.90
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	<u>74.94</u>	<u>88.78</u>	<u>115.90</u>
2.1. Coal exploration and extraction	13.13	13.47	15.05
2.2. Coal preparation, valoris.& transpt.	2.56	2.46	2.28
2.3. Coal liquefaction	p.m.	p.m.	p.m.
2.4. Coal gasification	0.21	0.93	3.33
2.5. Coal combustion	p.m.	p.m.	p.m.
2.6. Oil & gas assessment & exploration	16.82	19.39	24.94
2.7. Oil & gas production	26.04	33.91	49.45
2.8. Refining and derivatives	12.57	13.34	14.56
2.9. Transport of oil	1.03	1.21	0.96
2.10. Transport of gas	1.70	2.25	3.29
2.11. Storage of oil	-	-	-
2.12. Storage of gas	0.28	1.64	1.86
2.13. Others	0.60	0.18	0.18

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>262.19</u>	<u>287.92</u>	<u>275.55</u>
3.1. Proven reactors	41.83	47.29	43.46
3.2. High temperature reactors	17.03	12.67	8.67
3.3. Breeders	94.11	103.96	96.00
3.4. Fuel cycle	55.43	66.05	68.06
3.5. Nuclear safety	35.83	37.69	37.57
3.6. Waste treatment and disposal	3.74	4.46	4.42
3.7. Radiation prot.& decommis.of power pl.	9.92	10.70	12.03
3.8. Fissile materials control	-	1.71	2.33
3.9. Others	4.30	3.39	3.01
4. NEW ENERGY SOURCES AND VECTORS	<u>39.58</u>	<u>50.66</u>	<u>62.81</u>
4.1. Thermonuclear fusion	14.41	17.48	19.49
4.2. Geothermal energy	4.42	5.16	7.85
4.3. Solar energy	14.78	22.46	30.35
4.4. Ocean	0.09	0.12	0.42
4.5. Wind	0.04	0.07	0.19
4.6. Hydrogen as an energy vector	5.84	5.37	4.51
4.7. Others	-	-	-
5. ELECTRICITY	<u>50.33</u>	<u>53.17</u>	<u>63.15</u>
5.1. Electricity generating equipment	17.68	20.71	23.84
5.2. Transport of electricity	22.71	20.26	23.77
5.3. Control & instrumentation	4.77	7.40	9.52
5.4. Fuel cells	1.50	1.98	1.68
5.5. Electrochemical storage	3.03	1.93	3.33
5.6. Other storage techniques	0.64	0.89	1.01

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>10.77</u>	<u>16.91</u>	<u>14.22</u>
6.1. Analytical studies on energy systems	0.80	1.55	1.68
6.2. Socio-economic studies	0.60	0.70	0.81
6.3. Studies on environmental effects	9.37	14.66	11.73
T O T A L	<u>475.84</u>	<u>541.73</u>	<u>589.03</u>

Qualification statement

The data relate to the funding of the following bodies:

- State or public research organizations funded by the State budget, mainly:
 - . Délégation Générale à la Recherche Scientifique et Technique (DGRST).
 - . Ministère de l'Industrie
 - . Commissariat à l'Energie Atomique (CEA).
 - . Commissariat à l'Energie Solaire (COMES).
 - . Bureau de Recherches Géologiques et Minières (BRGM).
 - . Centre National pour l'Exploitation des Océans (CNEXO).
 - . Agence pour les Economies d'Energie (AEE).
 - . Institut de Recherche des Transports (IRT).
 - . Office National d'Etudes et de Recherches Aérospatiales (ONERA).
 - . Institut National de la Recherche Agronomique (INRA).
 - . Plan Construction
 - . Centre Scientifique et Technique du Bâtiment (CSTB).
 - . Centre National de la Recherche Scientifique (CNRS).

The funding of the universities, being relatively unknown, is not included.

- National companies in the energy sector:
 - . Electricité de France (EDF).
 - . Gaz de France (GDF).
 - . Charbonnages de France (CDF) et
Centre de Recherche des Charbonnages (CERCHAR).
 - . Société Nationale Elf Aquitaine (SNEA).
- Technical centres funded basically by levy (in particular):
 - . Institut Français du Pétrole (IFP).

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY1. General objectives

The goal given on the whole to RD & D is to facilitate - for the medium and long terms- the country's energy supply in sufficient quantity and at a cost which allows a reasonable economic growth rate. As indigenous energy sources are not available, this implies - in the short and medium terms- the mastery of both nuclear technology - to cover electricity needs - and oil technology - to facilitate access to world supply sources.

In the medium and long terms, this implies a sustained research effort for the diversification of energy sources (renewable energies, controlled thermo-nuclear fusion). This implies also a parallel RD&D effort, for a more rational use of energy in all forms.

Finally the extent of this effort renders not only desirable, but even necessary, the strengthening of international cooperation, and first of all in the European framework.

2. Specific objectivesa. Short term (1977-1985)

- Energy conservation (industry, residential, transportation)
- Fossil fuels
 - . off-shore hydrocarbons exploration and extraction
 - . secondary recovery
 - . direct utilization of coal
- Nuclear energy
 - . support of national electronuclear programme (PWR)
 - . realization of breeder reactors (Superphénix)
 - . reactors for heat production (residential sector)
- New energy sources and vectors
 - . application to the habitat of solar and geothermal heating

b. Medium term (1985-1995)

idem and add the following ones :

- Fossil fuels
 - . tertiary recovery
 - . heavy oils extraction and transformation
 - . coal conversion (gasification and liquefaction)
- Energy storage (Electricity and heat)
- New energy sources and vectors
 - . large scale electrolytic production of hydrogen
 - . biomass production and utilization

c. Long term (2000 and beyond)

- New energy sources and vectors
 - . solar energy (thermodynamic conversion, photovoltaic conversion, biophotolysis of water)
 - . controlled thermonuclear fusion.

3. Priorities

- Rational use of energy

- . industry
- . car vehicles
- . residential (including solar habitat) and tertiary
- . heat storage and transport
- . electricity storage

- Fossil fuels

- . deep-sea oil technology
- . oil assisted recovery
- . direct utilisation of coal

- Nuclear energy

- . fast breeder reactors
- . reprocessing of irradiated fuels
- . safety

- New energy sources

- . low-enthalpy geothermal energy
- . photovoltaic conversion
- . biomass
- . magnetic confined controlled fusion.

4. Ongoing and planned comprehensive programmes and budgets

Energy R & D is explicitly included in the priority action programme "Research" within the VIIth Plan (1976-80); demonstration is included in the "energy" priority actions programme.

These priority actions however cover only a part of the appropriations that the Government allots to the energy RD & D.

The table hereunder shows the time evolution of RD & D budgetary appropriations (in 10⁶ current francs) from 1976 to 1979

	1976	1977	1978	1979
Nuclear fission	1 297	1 495	1 463	1 605
Fusion	77	98	110	121
Fossil fuels	83	130	218	236
New energies	116	161	217	251
Conversion, storage, transport techniques	173	207	252	305
Socio-economics	6	7	8	9
T o t a l	1 752	2 098	2 268	2 532

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : FRANCE			
5. Programme description and budgets		II.SUB-SECTOR 1.1. INDUSTRY				DATE : April 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - comprehensive and detailed analyses of energy consumptions - energy recovery from existing installations - study/development of new equipment with lower energy consumption - optimization of industrial systems and processes - development of automation - setting-up of new physico-chemical treatment processes <p>2. <u>Incentive actions</u> of the DGRST (concerted actions), of the CNRS (programmed thematic action) and of the AEE (demonstration actions).</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 + 2		85	108	159.5					
TOTAL (in N.C.)		85	108	159.5					
TOTAL (in EUA)		15.90	19.35	28.21					

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : FRANCE			
5. Programme description and budgets		II. SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL				DATE : April 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Current activities</u>									
- analysis of energy needs of the residential and commercial sector (new and existing dwellings, heating systems, hot water, etc.)									
- heat recovery (waste heat from industry, from collective and individual dwellings,...)									
- study and development of insulation techniques									
- improvement of techniques of :									
. combustion									
. heat transfer									
- study and development of heat pump systems and components									
- technico-economic studies on the utilization of new energies :									
. solar									
. geothermal									
. wind									
- tuning, optimisation of the exploitation, accounting.									
2. <u>Incentive actions</u> of the DGRST (concerted actions) of the Plan Construction and of the AEE.									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extrabudgetal impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1+2		44.7	55.7	67.0					
TOTAL (in N.C.)		44.7	55.7	67.0					
TOTAL (in LUA)		8.36	9.94	11.85					

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY		COUNTRY : FRANCE						
5. Programme description and budgets	II.SUB-SECTOR 1.3. TRANSPORTATION		DATE : April 79						
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - basic research (flows, catalysis, materials including composites, ...) - car vehicles <ul style="list-style-type: none"> . new components (engines, lubricants, gear boxes, ...) . study of the possibility of utilising new energy sources . new concepts (hybrids) . car vehicle electronics - efficiency improvement of aircraft engines - infrastructure improvement - transportation socio-economics. <p>2. For car transportation, <u>incentive actions</u> of the DGRST (concerted actions), of the IRT (programmed thematic action) and of the AEE (demonstration).</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION		INTERNATIONAL COOPERATION					
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1+2		47.5	50.0	59.0					
TOTAL (in N.C.)		47.5	50.0	59.0					
TOTAL (in EUA)		8.89	8.92	10.44					

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : FRANCE				
5. Programme description and budgets		II. SUB-SECTOR 1.4. LOW-GRADE ENERGY UTILIZATION			DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - low-grade heat recovery - study of thermodynamic cycles - study and development of associated equipment (heat-transfer fluids, heat pumps, heat exchangers, ...) - energy upgrading of low calorie fuels - energy upgrading of industrial wastes - energy upgrading of urban wastes - energy upgrading of agricultural wastes (straw, vegetal alcohol, methane fermentation,...) - energy storage - study and development of new techniques (heat pumps, Peltier-effect heat pumps,...) - optimization of industrial units. <p>2. <u>Incentive actions</u> of the DGRST (concerted actions) and of the AEE (demonstrations).</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1+2	26.1	34.1	39.0						
TOTAL (in N.C.)	26.1	34.1	39.0						
TOTAL (in EUA)	4.88	6.08	6.90						

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE				
5. Programme description and budgets		II.SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION			DATE :April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities</u> on the improvement of mining technologies (face support, measures against dusts, ventilation, problems arising from roof pressure, coalgetting, electricity use for underground operations)									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		70.2	75.5	85.1					
TOTAL (in N.C.)		70.2	75.5	85.1			.../...		
TOTAL (in EUA)		13.13	13.47	15.05					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE				
5. Programme description and budgets		II.SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT			DATE : April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current technological studies</u> on coal handling (washing, transport) and on its carbonisation.									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		13.7	13.8	12.9					
TOTAL (in N.C.)		13.7	13.8	12.9					
TOTAL (in EUA)		2.56	2.46	2.28					

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES		COUNTRY : FRANCE			
5. Programme description and budgets	II. SUB-SECTOR 2.3. COAL LIQUEFACTION		DATE : April 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : (see under 2.4)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
						.../...
TOTAL (in N.C.)	p.m.	p.m.	p.m.			
TOTAL (in EUA)	p.m.	p.m.	p.m.			

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE				
5. Programme description and budgets		II.SUB-SECTOR 2.4. COAL GASIFICATION			DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Study of a process of <u>nuclear gasification</u> by the GEGN (Groupement pour l'étude de la gazéification nucléaire) - Nuclear gasification study group formed by GdF, CEA, CdF, NOVATOME and Creusot-Loire - on the</p> <ul style="list-style-type: none"> - production of hydrogen within a water steam-methane reformer coupled with HTR; - liquid-phase hydrogenation with production of rich gas and liquid by-products. <p>The programme covers :</p> <ul style="list-style-type: none"> - the realization of an experimental set-up for the liquefaction and hydrogenation of coal with a throughput of 1 kg/sec. of solvent mixture; - a test reformer with a throughput of 1 kg/sec. of steam at 900°C and 50 bar (see also under 3.2) <p>2. Feasibility study of the <u>deep-underground gasification</u> by the GEGS (Groupe d'études pour la gazéification souterraine) - underground gasification study group formed by GdF, CdF and IFP - on the</p> <ul style="list-style-type: none"> - prelinking of hydraulic fracturation borings (Laboratory and "in situ" tests are in progress) - back combustion - actual combustion 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 + 2		1.1	5.2	18.8					
TOTAL (in N.C.)		1.1.	5.2	18.8					
TOTAL (in EUA)		0.21	0.93	3.3					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 2.5. COAL COMBUSTION			DATE : April 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>(Studies on the use of coal in boilers are carried out, at a low level, by the industry.)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
						.../...
TOTAL (in N.C.)	p.m.	p.m.	p.m.			
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 2.6. OIL & GAS ASSESSMENT AND EXPLORATION			DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Oil fields characterization with the aim of setting up a data bank covering :</p> <ul style="list-style-type: none"> - improvement of the geological prospection methods with the aim of promoting oil-field detection; - improvement of geophysical methods for increasing the interpretation possibilities of seismic data. <p>2. Geologic and geophysical pre-exploration field tests in deep-sea waters under the aegis of the CEPM (Comité d'études pétrolières marines).</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 + 2		89.9	108.7	141.0		
						.../...
TOTAL (in N.C.)		89.9	108.7	141.0		
TOTAL (in EUA)		16.82	19.39	24.94		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : FRANCE			
5. Programme description and budgets		II.SUB-SECTOR 2.7. OIL AND GAS PRODUCTION				DATE : April 79.			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Current activities concerning on-shore oil and gas production.</p> <p>2. Setting-up and test of technologies for drilling, exploiting and draining-off products at large water depths (qualified equipment for exploiting fields at 300-1000 m. water depths before 1985, and at depths larger than 1000 m. before 1990).</p> <p>3. Secondary and tertiary recovery of oil :</p> <ul style="list-style-type: none"> - chemical products - setting up of processes (under the aegis of ARTEP - research association formed by SNEA, CFP, IFP) in particular for the heavy oils recovery (CO₂ injection, steam injection,...) - improvement of field knowledge by geophysical and geochemical methods - feasibility studies on different fields - pilot tests at Chateaurenard (polymers and micro-emulsions) and at Lacq Supérieur (steam). 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1+3		139.2	190.1	279.6					
TOTAL (in N.C.)		139.2	190.1	279.6					
TOTAL (in EUA)		26.04	33.91	49.45					

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 2.8. REFINING AND DERIVATIVES			DATE : April 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Refining - treatment and upgrading of residues of heavy crude oils - adjustment of motor-fuels production - improvement of the production of feed-stock for lubricating oils, paraffins and special oils 2. Utilisation of products : - additives for the combustion of heavy fuels; - additives for lubricants.						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A. others envisaged % of share
1	X					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1+2		67.2	74.8	82.3		
						.../...
TOTAL (in N.C.)		67.2	74.8	82.3		
TOTAL (in EUA)		12.57	13.34	14.56		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II. SUB-SECTOR 2.9. TRANSPORT OF OIL			DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		5.5	6.8	5.4		
						.../...
TOTAL (in N.C.)		5.5	6.8	5.4		
TOTAL (in EUA)		1.03	1.21	0.96		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 2.10 TRANSPORT OF GAS			DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Materials and equipment</p> <p>2. Methods for underwater piping laying down (in particular at great depths)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1+2	9.1	12.6	18.6			
						.../...
TOTAL (in N.C.)	9.1	12.6	18.6			
TOTAL (in EUA)	1.70	2.25	3.29			

<u>R&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : FRANCE			
5. Programme description and budgets		II. SUB-SECTOR 2.12 STORAGE OF GAS				DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - formation and dispersal of LNG clouds - injection of inert gas in underground aquifer reservoirs - rocks mechanics - mathematical models of reservoirs 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		1.5	9.2	10.5					
									.../...
TOTAL (in N.C.)		1.5	9.2	10.5					
TOTAL (in EUA)		0.28	1.64	1.86					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : FRANCE	
5. Programme description and budgets		II. SUB-SECTOR 2.13. OTHERS			DATE : April 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
<p>1. <u>Oil-shales</u></p> <p>Inventory of French resources carried out in the period 1974-77.</p> <p>No activity in progress or planned.</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	done					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	3.20	1.0	1.0			
						.../...
TOTAL (in N.C.)	3.20	1.0	1.0			
TOTAL (in EUA)	0.60	0.18	0.18			

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : FRANCE				
5. Programme description and budgets		II. SUB-SECTOR 3.1. PROVEN REACTORS			DATE : April 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>The principal objective is to sustain the nuclear electricity generating programme launched in 1974.</p> <p>The investigations are being developed along three main lines :</p> <ol style="list-style-type: none"> 1. Quadripartite research (Westinghouse, EDF, Framatome, CEA) : an agreement signed between the above four partners on 5 November 1976, concerns the improvement of industrial-scale systems, in particular with respect to reliability, choice of materials and power plant operation and maintenance. The studies undertaken are chiefly concerned with steam generators (corrosion, thermohydraulic and mechanical problems) and the reduction of radiation doses received by the personnel. 2. Bipartite or tripartite action between the CEA, Framatome and EDF, which is mainly aimed at furthering the knowledge of existing reactors and at exploring the areas where improvements are possible for future reactors such as large components and systems, primary circuit cleanliness with a view to minimizing the irradiation of personnel, surveillance and inspection, codes, core physics and studies of accident situations. 3. Fuel studies : the aim of these studies is to provide the EDF with a fuel of new design. The CEA fabricates and irradiates experimental assemblies, mainly with a view to augmenting understanding of fuel/cladding interaction mechanisms. The CEA's large installations are being used to carry out these investigations, e.g. research reactors and prototypes, high activity laboratories. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1-3		223.6	265.1	245.7					
									.../...
TOTAL (in N.C.)		223.6	265.1	245.7					
TOTAL (in EUA)		41.83	47.29	43.46					

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY :FRANCE			
5. Programme description and budgets		II.SUB-SECTOR 3.2. HIGH TEMPERATURE REACTORS				DATE :April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. In 1978 the CEA, GdF, CdF, Creusot-Loire and Novatome set up an association: the GEGN (Group for the study of coal gasification by nuclear heat) whose programme is divided into two parts:</p> <p>(a) the study of gasification processes by coal hydrogenation;</p> <p>(b) studies on an HTR reactor designed to produce the heat required to reform methane in order to supply the hydrogen required by the system.</p> <p>These reactor investigations are chiefly being carried out in cooperation with West Germany under the agreements concluded in 1976. They cover large reactor components, the construction of an experimental circuit for the reforming studies and high temperature resistant materials.</p> <p>(see also under 2.4)</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X				FRG				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		91	71	49					
TOTAL (in N.C.)		91	71	49					
TOTAL (in EUA)		17.03	12.67	8.67					

R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER			COUNTRY : FRANCE		
5. Programme description and budgets	II. SUB-SECTOR 3.3. BREEDERS			DATE : April 1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
<p>The principal work, other than the use of experimental reactors (Rapsodie and Phenix) has the following priority objectives :</p> <p>1. <u>Studies related to Superphenix</u></p> <p>This programme is being developed along four main lines.</p> <p>(a) the assistance provided by the CEA to the project;</p> <p>(b) activities concerned with the steam generator, experimental and qualification programmes concerning component prototypes, the handling of sodium and materials;</p> <p>(c) safety studies which are being carried out especially in areas where sodium is used;</p> <p>(d) fuel assembly fabrication and studies of the processes involved in industrial-scale fabrication</p> <p>2. <u>Development of the reactor line and the standard model power plants</u></p> <p>The main aim of these studies is to bring about a significant reduction in the cost of reactors.</p> <p>The further perfecting of these plants will necessitate a comprehensive research and development programme on the steam generator section and the intensive operation of the new experimental installations recently set up at Cadarache, which include :</p> <p>- the extension of the "Rapid" hall HR1 with several sodium test loops for large components of this reactor type;</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	<i>current</i>	<i>planned</i>	<i>extramural impl. %</i>	<i>average share Gov. funding %</i>	<i>European Communities</i>	<i>I.E.A.</i>
					<i>others</i>	<i>envisaged</i>
						<i>% of share</i>
1	X					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10⁶)	Expenditures 1977 (x10⁶)	Estimations 1978 (x10⁶)	Estimations 1979 (x10⁶)	Estimations 1980 (x10⁶)
1-2		503.0	528.8	542.8		
						.../...
TOTAL (in N.C.)		503,0	582.8	542.8		
TOTAL (in EUA)		94.11	103.96	96.00		

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER		COUNTRY : FRANCE																																																									
5. Programme description and budgets	II.SUB-SECTOR 3.4. FUEL CYCLE		DATE : April 1979																																																									
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. In the field of <u>isotope separation</u>, there is support for large installations, whether in operation or planned, which utilize gaseous diffusion, and also research and development work on other processes (chemical treatment , lasers, etc.). 2. As regards <u>natural uranium</u>, research and development programmes on prospection, exploitation of deposits and treatment of ores are governed by the need, in the future to make increasing use of resources which are decreasingly accessible from the technical point of view, such as deposits located at greater depths or under sizeable geological obstructions (blind deposits), under-sea deposits or ores which are difficult to concentrate or have a low uranium content. 3. For the <u>reprocessing</u> of LWR fuels, the research aims at improving operation of the existing plant at La Hague and especially at preparing the ground for the construction of large installations in the future. This work is in particular directed at the head end of the process, which involves the trickiest problems (mechanical treatments : stripping, sectioning, dissolution and clarification of solutions), and at the reduction and storage of discharges and wastes (among others claddings and residues from fuel dissolution). <p>The studies on fast reactor fuel reprocessing benefit from the work done in the field of LWR fuels. The CEA has decided to build a prototype for the treatment of fast oxides (TOR). Work on the construction of TOR was started at the end of 1978 and it should be operational around 1983. Finally, the CEA is continuing with plans for a pilot plant known as PURR (prototype for fast reactor fuel reprocessing), scheduled to go into service at the end of the 1980's.</p>																																																												
<p>IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION</p> <table border="1"> <thead> <tr> <th rowspan="2">OBJECTIVES</th> <th colspan="2">STATUS & IMPLEMENTATION</th> <th colspan="3">INTERNATIONAL COOPERATION</th> </tr> <tr> <th>current</th> <th>planned</th> <th>extramural impl. %</th> <th>average share Gov. funding %</th> <th>European Communities</th> <th>I.E.A.</th> <th>others</th> <th>envisaged</th> <th>% of share</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>.../...</td> </tr> </tbody> </table>						OBJECTIVES	STATUS & IMPLEMENTATION		INTERNATIONAL COOPERATION			current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	1	X									2	X									3	X																		.../...
OBJECTIVES	STATUS & IMPLEMENTATION		INTERNATIONAL COOPERATION																																																									
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share																																																			
1	X																																																											
2	X																																																											
3	X																																																											
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R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER	COUNTRY : FRANCE
5. Programme description and budgets	II. SUB-SECTOR 3.5. NUCLEAR SAFETY	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. In the field of water-cooled reactors, the entry into service of the Phébus installation should yield valuable results on the evolution of a depressurization accident and on its consequences for the fuel.
2. As far as fast reactors are concerned, the work is aimed notably at the Esmeralda programme, which is devoted to a study of the consequences of large sodium fires, and also at the use of the CABRI reactor, brought into service at Cadarache in 1978 with a view to studying fuel behaviour in the event of a rapid power surge due to a sudden insertion of reactivity. This study is jointly run by the CEA and the Gesellschaft für Kernforschung at Karlsruhe, West Germany, who have been joined by Japan, the UKAEA and the USA. The Scarabee programme is designed to study cooling accidents on an assembly of fresh or pre-irradiated fuel pins.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X									
2	X				FRG, UK		USA, JA			
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1-2		191.5	211.3	212.4						
TOTAL (in N.C.)		191.5	211.3	212.4						
TOTAL (in EUA)		35.83	37.69	37.57						

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : FRANCE			
5. Programme description and budgets		II. SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL				DATE : April 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>The activities of the CEA are directed notably towards :</p> <ol style="list-style-type: none"> (1) highly radioactive wastes, by means of studies on continuous fusion glassification (the first industrial-scale glassification workshop went into operation at Marcoule in 1978); (2) the development of methods for storing residues and clads originating from the reprocessing of irradiated fuels; (3) the use of a cryo-grinding process for the low-activity waste produced during fuel fabrication; (4) the continuation of EEC-sponsored studies on long-term waste storage. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
4	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1-4		20	25	25					
TOTAL (in N.C.)		20	25	25					
TOTAL (in EUA)		3.74	4.46	4.42					

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : FRANCE			
5. Programme description and budgets		II.SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING POWER PLANTS				DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Numerous studies are under way on the <u>protection of man and his environment</u> (possibility of synergetic effect of aggressions of diverse origins, nuclear or otherwise; studies of immunological factors in organ transplants applied to the treatment of irradiations; studies of radionuclide migrations in their most likely physicochemical form).</p> <p>2. The CEA are also continuing their work on the <u>decommissioning and dismantling</u> of obsolete nuclear installations and studies in preparation for the decommissioning of power plants in the future.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1-2		53.0	60.0	68.0					
TOTAL (in N.C.)		53.0	60.0	68.0					
TOTAL (in EUA)		9.92	10.70	12.03					

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL				DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	Planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	-	9.6	13.2				
						.../...	
TOTAL (in N.C.)	-	9.6	13.2				
TOTAL (in EUA)	-	1.71	2.33				

R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER	COUNTRY : FRANCE
5. Programme description and budgets	II.SUB-SECTOR 3.9. OTHERS	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

These cover the following principal subjects :

1. advanced production heating plants employing ordinary water under pressure (CAS), on which the CEA are pursuing studies mainly directed towards the fuel (behaviour and investigation of operating limits);
2. calogenic ordinary-water reactors of the swimming-pool type THERMOS. These are based on experimental piles built by the CEA. Offering very high reliability, this type of reactor is particularly suited for use as a source of low-temperature heating for urban areas. The demonstration campaign that the CEA intend to launch will serve as a reference for the system and concerns the construction of a 50 MWth THERMOS plant at Saclay. The safety file will be set up during 1979, and construction could start in 1980.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 ÷ 2		23.0	19.0	17.0					
TOTAL (in N.C.)		23.0	19.0	17.0					
TOTAL (in EUA)		4.30	3.39	3.01					

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES & VECTORS			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 4.1. THERMONUCLEAR FUSION			DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Controlled fusion by magnetic confinement</u>						
<p>These studies are being carried out by the CEA as part of the Community programme.</p> <p>The research is devoted to the operation of tokomaks and the solving of the problems inherent in the pursuit of this road to the introduction of fusion reactors, with special reference to the additional heating of the plasmas (high-frequency heating, fast neutral injection, including magnetic pumping).</p> <p>The CEA is concurrently studying a superconducting version of a new tokomak, TORE II, which in terms of size should come mid-way between TFR and JET. (In view of the operating conditions peculiar to a tokomak-configuration physical experiment, facilities have been provided for cooling the superconductors with superfluid helium at a temperature of 1.8°K).</p>						
2. <u>Fusion by inertial confinement</u>						
<p>Since 1975 a group of CNRS laboratories has been carrying out a research project (still at the embryonic stage) centred on a neodymium laser installed at the Ecole Polytechnique. Significant results have already been obtained as regards the interaction of the laser and the material as a function of wavelength.</p> <p>The DGRST is also supporting research on new lasers, in particular the iodine laser.</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1 + 2		77.0	98.0	110.2		
						.../...
TOTAL (in N.C.)		77.0	98.0	110.2		
TOTAL (in EUA)		14.41	17.48	19.49		

R+D&D POLICY	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS		COUNTRY : FRANCE			
5. Programme description and budgets	II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY		DATE : April 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
A. <u>Activities</u>						
1. <u>Low enthalpy sources (50 ÷ 70°C)</u>						
<ul style="list-style-type: none"> . resource inventory in the Paris and Aquitaine basins and in Alsace . development of geochemical and geophysical prospecting methods . study of the adequacy of the supply-demand (resources-users) for optimal utilisation of the sources . development of hypoconvectors (fitting of heating circuits to the low-heat level) . models for the economical optimization of geothermal installations . demo-installations in several potentially important sites. 						
2. <u>Medium enthalpy sources (90 ÷ 150°C) (binary cycle electricity production)</u>						
<ul style="list-style-type: none"> . realization of a 1 ÷ 5 MW project (binary fluid) in Alsace 						
3. <u>High-enthalpy (150 ÷ 300°C)</u>						
<ul style="list-style-type: none"> . resource inventory in the Massif central region . resource inventory in the overseas departments (Guadeloupe, New-Hebrids and Réunion). 						
4. <u>Hot dry-rocks</u>						
<ul style="list-style-type: none"> . resource-inventory in the Massif central region . experimental and mathematical simulation of the fracturation in vulcanic or crystalline ground. 						
B. <u>Incentive actions</u> of the DGRST and of the Ministry of Industry (demonstrations).						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I. E. A. others envisaged % of share
A + B	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
A + B		23.6	28.9	44.4		
						.../...
TOTAL (in N.C.)		23.6	28.9	44.4		
TOTAL (in EUA)		4.42	5.16	7.85		

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : FRANCE						
5. Programme description and budgets	II. SUB-SECTOR 4.3. SOLAR ENERGY			DATE : April 79						
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>A) <u>Activities</u></p> <p>1. <u>General studies</u> (3 % of the total budget)</p> <ul style="list-style-type: none"> . knowledge of solar mapping in France . fitting of the different uses of solar energy into the energy system . investigation of the export market . development of components and realisation of pilot installations for each conversion system. <p>2. <u>Habitat</u> (18 % of the total budget)</p> <ul style="list-style-type: none"> . definition of collectors characteristics . development activities on : <ul style="list-style-type: none"> - materials selection - efficiency improvement - architectural fitting of systems <p>3. <u>Thermodynamic conversion</u> (45 % of the total budget)</p> <ul style="list-style-type: none"> - <u>low-temperature systems</u> (solar engine) <ul style="list-style-type: none"> . efficiency increase by <ul style="list-style-type: none"> heat exchanger and turbine improvement higher-temperature collectors (selective surfaces) . storage systems 										
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION					
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
A + B	X									
									.../...	
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
A + B		79.0	125.9	171.6						
TOTAL (in N.C.)		79.0	125.9	171.6						
TOTAL (in EUA)		14.78	22.46	30.35						

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- Medium-temperature systems (small powers)
 - . development of lower power engines
 - . development of unsophisticated collectors.
- High temperature systems (Tower power station)
 - . development of the THEK projects (< 100 kW) with parabolic and spheric collectors;
 - . realization of the 100 kW project (Bertin) with cylindric and/or cylindric parabolic collectors;
 - . development of the THEMIS project (2 MW experimental tower power station);
 - . participation in the 1 MW European project.

4. Photovoltaic conversion (23 % of the total budget)

- Silicon cells
 - . low cost production methods
 - . construction and testing of generators with concentration.
- 2nd generation cells
 - . polycrystalline Si (preparation methods, chemical purification, amorphous Si)
 - . monocrystalline GaAs
 - . polycrystalline compounds GaAs-type
 - . polycrystalline Cd/Te and/or Cu₂S

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS	COUNTRY : FRANCE							
5. Programme description and budgets	II.SUB-SECTOR 4.3. SOLAR ENERGY (cont'd)	DATE : April 79							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>5. <u>Bioconversion</u> (11 % of the total budget)</p> <p>- <u>Basic research</u></p> <ul style="list-style-type: none"> . photobiologic decomposition of water . photosynthesis as model system of artificial collector . study of the ecological, physiological and genetic bases of terrestrial and marine biomass productivity . study of transformation technologies of biomass into energy (see also 1.4). <p>- <u>Applied research</u></p> <ul style="list-style-type: none"> . development of new agriculture or forestry techniques (new varieties, harvesting prototypes development) . study of actual performances of new production systems and of transformation techniques . socio-economic study of biomass valorisation <p>- <u>Industrial research</u></p> <ul style="list-style-type: none"> . development of burners, gasifiers and other machinery for the physical handling of straw and wood wastes . new equipment for harvesting, conditioning and storage of straw and wood wastes <p align="center">—————</p> <p>B. - <u>Incentive actions</u> of the COMES (RD&D) and of CNRS (programmed thematic action).</p>									
<p>IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION</p>									
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : FRANCE			
5. Programme description and budgets		II. SUB-SECTOR 4.4. OCEAN				DATE : April 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Assessment studies</u>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.5	0.7	2.4					
TOTAL (in N.C.)		0.5	0.7	2.4					
TOTAL (in EUA)		0.09	0.12	0.42					

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 4.5. WIND				DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Assessment studies</u>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		0.2	0.4	1.1			
TOTAL (in N.C.)		0.2	0.4	1.1			
TOTAL (in EUA)		0.04	0.07	0.19			

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : FRANCE	
5. Programme description and budgets	II. SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR				DATE : April 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>A. <u>Activities</u></p> <p>1. <u>Technico-economic feasibility of chemical watersplitting</u></p> <ul style="list-style-type: none"> . oxido-reduction chemical cycles . hybrid cycles . chemical reactor for coupling with high-temperature source (HTR) (This programme ceased at the end of 1978). <p>2. <u>Electrolysis</u></p> <ul style="list-style-type: none"> . low and medium temperature alkaline electrolytes . high-temperature vapour phase electrolysis . high-temperature acid electrolytes. <p>3. <u>Storage</u></p> <ul style="list-style-type: none"> . high capacity storage plant . hybrid storage. <p>4. <u>Utilization</u></p> <ul style="list-style-type: none"> . industrial and habitat utilization . fuel cells (see 5.4). <p>B. <u>Incentive actions</u> of the DGRST</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
A + B	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
A + B	31.2	30.1	25.4			
						.../...
TOTAL (in N.C.)	31.2	30.1	25.4			
TOTAL (in EUA)	5.84	5.37	4.51			

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIP.			DATE : April 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Thermodynamic conversion</u></p> <ul style="list-style-type: none"> - binary cycles (NH₃/H₂O) - topping cycles (S, K) - direct cycle gas turbine. <p>2. <u>Electricity production</u></p> <ul style="list-style-type: none"> - cryoalternating generating machines <ul style="list-style-type: none"> . cryogenics (He liquefiers, insulating materials) . structural materials . superconducting materials production (Nb-Ti, Nb-Sn) <p>3. <u>Pollution</u></p> <ul style="list-style-type: none"> - development of dry and dry-wet air-coolers - detection and control of atmospheric pollution. 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
	others	envisaged	% of share			
1-3	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1-3		94.5	116.1	134.8		
						.../...
TOTAL (in N.C.)		94.5	116.1	134.8		
TOTAL (in EUA)		17.68	20.71	23.84		

R+D&D POLICY	I. SECTOR 5. ELECTRICITY	COUNTRY : FRANCE
5. Programme description and budgets	II.SUB-SECTOR 5.2. TRANSPORT OF ELECTRICITY	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Transmission and distribution systems

Study of the behaviour of equipment and of line operation up to 1.200 kV :

- operation of the systems (automation, protection, automatic control, behaviour in perturbed working conditions)
- network control (systems studies, centralized control)
- forecasts (forward energy-management system for daily, weekly, monthly and annual decision making cycles)
- planning (optimization, "quality of service", production and consumption forecasting)
- equipment (short circuit current of 63 kA, forced-air-cooled underground cables, insulated extruded-polyethylene cables operating at 420 kV, shielded equipment using sulphur hexafluoride, SF₆).

2. Direct-current electricity transmission

- cables and ac/dc conversion equipment (2 000 MW France-UK Link from 1983)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1 ÷ 2									
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1 ÷ 2	121.4	113.6	134.4						
TOTAL (in N.C.)	121.4	113.6	134.4						
TOTAL (in EUA)	22.71	20.26	23.77						

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 5.3. CONTROL AND INSTRUMENTATION				DATE : April 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		25.5	41.5	53.8			
							.../...
TOTAL (in N.C.)		25.5	41.5	53.8			
TOTAL (in EUA)		4.77	7.40	9.52			

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : FRANCE			
5. Programme description and budgets		II. SUB-SECTOR 5.4. FUEL CELLS				DATE : April 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Study of electrochemical catalysts</u></p> <ul style="list-style-type: none"> . catalysts with low (or zero) content of precious metals for the H₂ fuel cells in alkaline electrolyte; . catalysts for the methanol conversion <p>2. <u>Basic study of the behaviour and ageing of different electrodes</u></p> <p>3. <u>Study of components (electrode structure)</u></p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1 ÷ 3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1 ÷ 3	8.0	11.1	9.5						
TOTAL (in N.C.)	8.0	11.1	9.5						
TOTAL (in EUA)	1.50	1.98	1.68						

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : FRANCE	
5. Programme description and budgets		II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE				DATE : April 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Development of advanced batteries for vehicle propulsion and off-peak electricity storage</p> <ul style="list-style-type: none"> - Na/S - Li/S - Zn/halides - materials (β - Al_2O_3 for Na/S batteries, mineral fabrics for Li/S batteries) <p>2. Improvement of present batteries (Pb, Ni/Fe, Ni/Cd, Ag/Zn, Ni/Zn).</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1 ÷ 2	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1 ÷ 2	16.2	10.8	18.8				
						.../...	
TOTAL (in N.C.)	16.2	10.8	18.8				
TOTAL (in EUA)	3.03	1.93	3.33				

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : FRANCE				
5. Programme description and budgets		II. SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES			DATE : April 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ol style="list-style-type: none"> 1. Improvement of hydraulic pumping stations 2. Compressed-air storage (Pre-design "Bretagne 200" achieved) 3. Massive storage of heat (see also 1.4.) 4. Massive storage of H₂ <ul style="list-style-type: none"> . artificial cavities . in aquifers 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1 ÷ 4	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 ÷ 4		3.4	5.0	5.7					
TOTAL (in N.C.)		3.4	5.0	5.7					
TOTAL (in EUA)		0.64	0.89	1.01					

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES		COUNTRY : FRANCE			
5. Programme description and budgets	II.SUB-SECTOR 6.1. ANALYTICAL STUDIES		DATE : April 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Analysis of energy systems</u>						
- <u>energy and economic growth</u>						
. price, supply and demand						
. impact of R&D on inflation, investments, employment						
. effect of new technologies on needs (industrial products, capital and labour), on the consumption and investment structure and on foreign exchanges						
. effects of alternative policies on production techniques, on consumption and on demand reduction						
- <u>energy and environment</u>						
. impact of new technologies on natural resources (soil, raw materials, water)						
. impact of new technologies on human activities (air and water pollution, health, risks)						
- <u>net energy production</u>						
. investigation of the total energy balance-sheet relevant to the exploitation of new technologies						
- <u>energy and industrial processes</u>						
. energy flow and consumption schemes for the production and consumption of goods and services						
. use and substitution possibilities of specific engines						
. optimisation of energy consumption						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		4.3	8.7	9.5		
						.../...
TOTAL (in N.C.)		4.3	8.7	9.5		
TOTAL (in EUA)		0.80	1.55	1.68		

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES			COUNTRY : FRANCE				
5. Programme description and budgets		II.SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES			DATE :April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>A. <u>Activities</u></p> <p>1. <u>Analysis of the system energy-society</u></p> <ul style="list-style-type: none"> - present structure of the French system - relationship energy-population - present and future demand structure - substitution and consumption elasticities - relationships energy-employment and energy-work conditions <p>2. <u>Socio-economic components relevant to different energy sources</u></p> <ul style="list-style-type: none"> - general studies (technology assessments, territory management, ...) - specific problems relevant to exploitation of new energy sources - risks and acceptance of nuclear energy <p>3. <u>Improvement of the present system</u></p> <ul style="list-style-type: none"> - effect of continuous effort in energy conservation - improvement of operational procedures and links of the present acting groups <p>4. <u>System control</u></p> <ul style="list-style-type: none"> - objectives and criteria of political choices - identification of constraints - institutional and statutory measures - social participation and control 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
A + B	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
A + B		3.2	3.9	4.6					
TOTAL (in N.C.)		3.2	3.9	4.6					
TOTAL (in EUA)		0.60	0.70	0.81					

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

5. Strategic studies

- models and scenarios.

B. Incentive actions of the CNRS (programmed thematic action)

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES					COUNTRY : FRANCE		
5. Programme description and budgets		II.SUB-SECTOR 6.3. ENVIRONMENTAL EFFECTS					DATE : April 79		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Effects of electricity production</u></p> <ul style="list-style-type: none"> - aerodynamic and thermal studies of the atmospheric boundary layer. Weather forecasts (micro-climates, disturbances attributable to the operation of power stations). - observation and control of atmospheric pollution - hydrology, eutrophication of waterways and lakes - hydrobiology and ecology - dispersion of radionuclides in the marine environment - toxicity of SO₂ and NO_x (discharged from conventional power stations). - toxicity of NH₃ (water-ammonia binary cycle) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		50.1	82.2	66.3					
TOTAL (in N.C.)		50.1	82.2	66.3					
TOTAL (in EUA)		9.37	14.66	11.73					

SECTION 3

SUB-SECTION 3.5

I R E L A N D

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>0.013</u>	<u>0.183</u>	<u>0.228</u>
1.1. Industry	-	-	0.040
1.2. Residential and commercial	0.013	0.183	0.188
1.3. Transportation	-	-	n.a.
1.4. Low-grade energy utilization	-	-	-
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	<u>0.402</u>	<u>23.394</u>	<u>74.897</u>
2.1. Coal exploration and extraction	0.241	0.229	0.246
2.2. Coal preparation, valoris.& transpt.	-	-	-
2.3. Coal liquefaction	-	-	-
2.4. Coal gasification	-	-	-
2.5. Coal combustion	0.161	0.229	0.246
2.6. Oil & gas assessment & exploration	-	22.936	74.405
2.7. Oil & gas production	-	-	-
2.8. Refining and derivatives	-	-	-
2.9. Transport of oil	-	-	-
2.10. Transport of gas	-	-	-
2.11. Storage of oil	-	-	-
2.12. Storage of gas	-	-	-
2.13. Others	-	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	-	-	<u>0.372</u>
3.1. Proven reactors	-	-	-
3.2. High temperature reactors	-	-	-
3.3. Breeders	-	-	-
3.4. Fuel cycle	-	-	-
3.5. Nuclear safety	-	-	-
3.6. Waste treatment and disposal	-	-	-
3.7. Radiation prot.& decommis.of power pl.	-	-	-
3.8. Fissile materials control	-	-	-
3.9. Others	-	-	0.372
4. NEW ENERGY SOURCES AND VECTORS	<u>0.080</u>	<u>0.199</u>	<u>0.481</u>
4.1. Thermonuclear fusion	-	-	-
4.2. Geothermal energy	-	-	-
4.3. Solar energy	0.048	0.168	0.391
4.4. Ocean	-	-	0.030
4.5. Wind	0.032	0.031	0.060
4.6. Hydrogen as an energy vector	-	-	-
4.7. Others	-	-	-
5. ELECTRICITY	<u>0.417</u>	<u>0.421</u>	<u>0.451</u>
5.1. Electricity generating equipment	0.281	0.306	0.327
5.2. Transport of electricity	0.096	0.115	0.124
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	-	-	-
5.5. Electrochemical storage	-	-	-
5.6. Other storage techniques	0.040	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>0.080</u>	<u>0.115</u>	<u>0.060</u>
6.1. Analytical studies on energy systems	0.080	0.115	0.060
6.2. Socio-economic studies	-	-	-
6.3. Studies on environmental effects	-	-	-
T O T A L	<u>0.992</u>	<u>24.312</u>	<u>76.489</u>

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- to explore the extent of domestic resources and to determine how and to what extent they could and should be exploited
- to investigate the availability of renewable resources and to evaluate the cost of their exploitation.

2. Specific objectives and priorities

Energy R&D is undertaken

- to overcome technological barriers to the development of indigenous energy resources where such problems are unique because of the nature of the resource, the scale of development or the climatic or other conditions in which development takes place (e.g. development of peat resources; heat pumps suitable for Irish climatic conditions, housing pattern and comfort standards);
- to permit the application in Ireland of energy efficient conversion and utilisation technologies developed in other countries but which cannot be used, unless modified, or can be more efficiently used if modified, for Irish conditions; and
- to overcome problems arising from the implementation of technologies developed in Ireland or adapted to Irish conditions in a manner which led to the development of a unique set of problems.

3. Ongoing and/or planned comprehensive programmes and budgets

none.

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : IRELAND			
5. Programme description and budgets		II. SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL				DATE : 23.11.78			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - determination of present patterns of house heating and utilisation - improvement of the thermal performance of buildings - heat pumps (see under 1.4) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X				X	X			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.008	0.120	0.126	0.630				
TOTAL (in N.C.)		0.008	0.120	0.126	0.630				
TOTAL (in EUA)		0.013	0.183	0.188	0.94				

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : IRELAND	
5. Programme description and budgets		II. SUB-SECTOR 1.4. LOW GRADE ENERGY UTILISATION			DATE : 23.11.78	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Design of heat-pumps suitable for use in Ireland</u></p> <p>a. <u>general studies</u></p> <ul style="list-style-type: none"> - literature surveys - allocated resources surveys - existing heating practices - existing load and climatic data - existing building practices <p>b. <u>technology assessment and information rates</u></p> <p>c. <u>equipment development</u></p> <ul style="list-style-type: none"> - components <ul style="list-style-type: none"> . design improvement of fans and compressors . development of heat exchangers to improve efficiency in the system . research on noise limitation on fans and compressors . examination of the effects of subcooling and superheating on heat pump performance . development of more efficient refrigerants and cycles - control systems <ul style="list-style-type: none"> . development, application and evaluation of solid state control system for smaller heat pump units for domestic space heating (2-4 year programme) <p align="right">.../...</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1		X			X	X
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	expenditures included in 1.2					
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : IRELAND				
5. Programme description and budgets		II. SUB-SECTOR 2.1 COAL EXPLORATION AND EXTRACTION			DATE : 23.11.78				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Peat</u> - deposits survey - bog drainage and preparation - production of raw peat fuel - drying, storage, processing and utilisation									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.150	0.150	0.165	0.380				
TOTAL (in N.C.)		0.150	0.150	0.165	0.380				
TOTAL (in EUA)		0.241	0.229	0.246	0.565				

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : IRELAND				
5. Programme description and budgets		II. SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT			DATE : 23.11.78				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. See under 2.1									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extrabudgetary and L. %	share in share Govt. financing %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.					
								.../...	
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES		COUNTRY : IRELAND			
5. Programme description and budgets	II. SUB-SECTOR 2.5. COAL COMBUSTION		DATE : 23.11.78			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>High ash content "crow coal"</u></p> <p>- tests on fluidized bed combustion of high ash coal</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. I. A.
						others
						envisaged
						% of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	0.100	0.150	0.165	0.100		
						.../...
TOTAL (in N.C.)	0.100	0.150	0.165	0.100		
TOTAL (in EUA)	0.161	0.229	0.246	0.149		

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : IRELAND			
5. Programme description and budgets		II. SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION				DATE : 23.11.78			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current exploration activities</u>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		?	15	50	20				
TOTAL (in N.C.)		n.a.	15	50	20				
TOTAL (in EUA)		-	22.936	74.405	29.762				

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER				COUNTRY : IRELAND	
5. Programme description and budgets	II. SUB-SECTOR 3.9. OTHERS				DATE : 23.11.78	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Support activities relating to planning for first nuclear-electricity generating station</p> <p> a. Site Surveys and investigations</p> <p> b. Staff training</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A. others envisaged % of share
1						
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	-	-	0.250	0.350		
						.../...
TOTAL (in N.C.)	-	-	0.250	0.350		
TOTAL (in EUA)	-	-	0.372	0.521		

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : IRELAND		
5. Programme description and budgets		II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY			DATE : 23.11.78		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Survey activity</u>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		-	-	-			
							.../...
TOTAL (in N.C.)		-	-	-			
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : IRELAND		
5. Programme description and budgets		II.SUB-SECTOR 4.3. SOLAR ENERGY				DATE : 23.11.78		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :								
1. <u>Heating and cooling</u>								
- development of solar heating systems								
- panel testing								
- optimisation of building construction and orientation								
- systems analysis								
2. <u>Photoelectric</u>								
- current activities								
3. <u>Biomass</u>								
- short rotation forestry								
- treatment of forest residues								
- biomass information service								
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged % of share
1	X				X			
2	X				X			
3	X			X	X			
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		0.010	0.050	0.053				
2		0.005	0.010	0.010				
3		0.015	0.050	0.200				
							.../...	
TOTAL (in N.C.)		0.030	0.110	0.263	0.331			
TOTAL (in EUA)		0.048	0.168	0.391	0.493			

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : IRELAND			
5. Programme description and budgets		II. SUB-SECTOR 4.4. OCEAN				DATE : 23.11.78			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Wave power</u></p> <ul style="list-style-type: none"> - analysis of past wave measurements - new measurements programmes - resources assessment - converter test programme 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X					X			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	-	-	0.02	0.047					
TOTAL (in N.C.)	-	-	0.02	0.047					
TOTAL (in EUA)	-	-	0.030	0.07					

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : IRELAND	
5. Programme description and budgets		II. SUB-SECTOR 4.5. WIND			DATE : 23.11.78	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
<p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - assessment of the resource viability - evaluation of aesthetic and infrastructural problems associated with wind power development - analysis of combined wind-biomass energy systems 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
						others
						envisaged
						% of share
1	X				X	
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		0.020	0.020	0.040	0.023	
						.../...
TOTAL (in N.C.)		0.020	0.020	0.040	0.023	
TOTAL (in EUA)		0.032	0.031	0.060	0.034	

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : IRELAND			
5. Programme description and budgets		II. SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE : 23.11.78			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	0.175	0.200	0.220	0.242					
TOTAL (in N.C.)	0.175	0.200	0.220	0.242					
TOTAL (in EUA)	0.281	0.306	0.327	0.360					

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : IRELAND	
5. Programme description and budgets		II.SUB-SECTOR 5.2. TRANSPORT OF ELECTRICITY			DATE : 23/11/78	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Current activities</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	0.060	0.075	0.083	0.091		
						.../...
TOTAL (in N.C.)	0.060	0.075	0.083	0.091		
TOTAL (in EUA)	0.096	0.115	0.124	0.135		

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : IRELAND	
5. Programme description and budgets		II. SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES				DATE : 23.11.78	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : <p align="center">1. <u>Current activities</u></p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		0.025	-	-			
						.../...	
TOTAL (in N.C.)		0.025	-	-			
TOTAL (in EUA)		0.040	-	-			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 6. GENERAL STUDIES					COUNTRY : IRELAND			
	II. SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS					DATE : 23.11.78			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Current activities</u>									
<ul style="list-style-type: none"> - energy input-output model - development of a generalized model of the national energy economy - studies on <ul style="list-style-type: none"> . an energy input/output table . forecasting energy supply and demand . costing alternative energy systems . finding the implications for industrial structures, qualified manpower, e.g. engineers . environmental effects, risks, safety, etc. . analysis of energy substitute possibilities with dynamic model, technological development, development of demand . programme for long term model: evaluation of ultimate limits, assessment of alternative scenarios 									
IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION									
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X				X	X			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	0.050	0.075	0.040	0.051					
TOTAL (in N.C.)	0.050	0.075	0.040	0.051					
TOTAL (in EUA)	0.080	0.115	0.060	0.076					

SECTION 3

SUB-SECTION 3.6

I T A L Y

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>11.89</u>	<u>15.76</u>	<u>18.20</u>
1.1. Industry	6.73	1.55	1.51
1.2. Residential and commercial	2.13	2.98	3.94
1.3. Transportation	2.50	9.38	9.59
1.4. Low-grade energy utilization	0.32	1.56	2.64
1.5. Others	0.21	0.29	0.52
2. FOSSIL FUELS AND DERIVATIVES	<u>9.24</u>	<u>10.51</u>	<u>13.77</u>
2.1. Coal exploration and extraction	-	-	-
2.2. Coal preparation, valoris.& transpt.	n.a.	0.16	0.22
2.3. Coal liquefaction	-	-	-
2.4. Coal gasification	n.a.	0.18	0.22
2.5. Coal combustion	0.34	0.31	0.32
2.6. Oil & gas assessment & exploration	p.m.	p.m.	p.m.
2.7. Oil & gas production	1.08	1.19	1.46
2.8. Refining and derivatives	0.56	0.63	0.90
2.9. Transport of oil	7.26	8.04	10.56
2.10. Transport of gas	p.m.	p.m.	p.m.
2.11. Storage of oil	-	-	-
2.12. Storage of gas	-	-	-
2.13. Others	-	-	0.09

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>97.36</u>	<u>130.27</u>	<u>136.35</u>
3.1. Proven reactors	19.83	26.97	39.86
3.2. High temperature reactors	-	-	-
3.3. Breeders	31.32	51.94	48.32
3.4. Fuel cycle	14.00	22.16	22.06
3.5. Nuclear safety	13.86	9.56	11.79
3.6. Waste treatment and disposal	3.57	4.09	0.49
3.7. Radiation prot.& decommiss.of power pl.	7.77	8.25	7.92
3.8. Fissile materials control	-	-	-
3.9. Others	7.01	7.30	5.91
4. NEW ENERGY SOURCES AND VECTORS	<u>15.69</u>	<u>19.51</u>	<u>32.48</u>
4.1. Thermonuclear fusion	11.16	11.99	17.07
4.2. Geothermal energy	4.13	6.22	10.15
4.3. Solar energy	0.40	1.25	5.08
4.4. Ocean	-	-	0.03
4.5. Wind	-	0.05	0.15
4.6. Hydrogen as an energy vector	-	-	-
4.7. Others	-	-	-
5. ELECTRICITY	<u>33.76</u>	<u>31.10</u>	<u>27.30</u>
5.1. Electricity generating equipment	33.43	30.23	11.10
5.2. Transport of electricity	p.m.	p.m.	13.48
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	0.04	0.07	0.06
5.5. Electrochemical storage	0.07	0.21	0.41
5.6. Other storage techniques	0.22	0.59	2.25

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>5.74</u>	<u>6.13</u>	<u>6.80</u>
6.1. Analytical studies on energy systems	0.14	0.38	0.60
6.2. Socio-economic studies	0.01	0.05	0.07
6.3. Studies on environmental effects	5.59	5.70	6.13
T O T A L	<u>173.68</u>	<u>213.28</u>	<u>234.90</u>

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- Identify national energy resources and study and develop their optimum utilisation; to evolve technologies for the efficient and safe exploitation of nuclear energy and of subsidiary energy sources;
- Investigate very thoroughly the losses involved in all energy transformation processes with a view to reducing the amount of energy needed to meet final demand requirements;
- Reduce the environmental effects of primary energy conversion processes and of final energy consumption; and
- Participate in international energy R & D.

2. Specific objectives

a. Short term (1977-85) and medium-term (1985-1995)

- Energy conservation
- Nuclear energy
- Optimal utilization of indigenous energy sources (solar, geothermal, etc.)
- Reduction of environmental effects of conversion processes and of end-uses

b. Long term (2000 and beyond)

- Solar energy
- Thermonuclear fusion

3. Priorities

- Energy conservation
- Nuclear energy
 - . proven reactors and heavy water reactors
 - . fuel manufacture
 - . breeders reactors
- Geothermal energy
- Thermonuclear fusion

4. Ongoing and/or planned comprehensive programmes and budgets

- a. The 5-years (1974-78) nuclear programme is funded with Lit 750 000 000 000.
- b. The 5-years (1976-1980) "Progetto Finalizzato Energetica" (PFE) of the CNR (National Research Council) is funded with Lit 39 436 000 000(*)

(*) Figures pertinent to the years 1979-1980 are subject to revision; it is estimated that Lit 70 000 000 000 will be spent at the end of 1980.

Qualification statement

The data relative to the State enterprises (ENEL, ENI, IRI), which self-finance research in their own field of competence, are included.

The data relative to CNEN refer to the 5-year plan 1974-1978.

The fundings, which in the framework of the CNR's "Energetica" programme are granted to the private industry, are included. When dealing with cooperation between the public sector and the private one, only the public sector's share is given.

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : ITALY		
5. Programme description and budgets		II.SUB-SECTOR 1.1. INDUSTRY				DATE : FEB. 1979		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>ENI current activities</u></p> <p>- energy cascading</p> <p>2. <u>FIAT current activities</u></p> <p>Energy saving in industrial plants and office buildings (analysis of energy flow, design and testing of new energy saving equipment, total energy systems, heat pumps, waste heat recovery, etc.)</p> <p>3. <u>CSM current activities</u></p> <p>- steel industry</p>								
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	x							
2	x							
3	x							
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		6 220	1 561	400				
2		n.a.	n.a.	1 200	1 300			
4		40	-	-				
							.../...	
TOTAL (in N.C.)		6 260	1 561	1 600	1 300			
TOTAL (in EUA)		6.73	1.55	1.51				

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : ITALY
5. Programme description and budgets	II.SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL	DATE : FEB.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. ENI current activities

- field testing of several methods of energy saving in space heating

2. PFE - Progetto Finalizzato Energia - (CNR)

- Analytico-experimental research on some (~ 10) existing systems building/heating system (small, medium and large heating capacity)
- Numerico-experimental research on several existing systems building heating system (~ 200 units)
- Extended enquiry (2.500-3.000 units)
- Analytical and statistical research on hot water production plants
- Analytical research on future systems building/heating systems
- Research on experimental parameters determining the thermal behaviour of buildings
- Investigation on thermal characteristics of building and flats and determination of their daily degree of occupancy
- Design of two sets of popular buildings
- Climatic data collection (wind, sun radiation, temperature, etc.)
- Heating plants and components

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x									
1	x									
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	n.a.	300	1 000		
2	1 977	2 696	3 183		
					.../...
TOTAL (in N.C.)	1 977	2 996	4 183		
TOTAL (in EUA)	2.13	2.98	3.94		

R+D&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY		COUNTRY : ITALY						
5. Programme description and budgets	II.SUB-SECTOR 1.3. TRANSPORTATION		DATE : FEB.1979						
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>P.F.E. Project (CNR)</u></p> <ul style="list-style-type: none"> - Determination of mobility needs and correlation service need/means selected - Utilization system of single transportation means - Mathematical model of the transportation system - Improvement of efficiency of present vehicles <ul style="list-style-type: none"> . Recorvery of kinetic energy <ul style="list-style-type: none"> + flying wheel + elastic energy + pneumatic and hydraulic . Recovery of thermal energy . Improvement of efficiency of the propulsion system : <ul style="list-style-type: none"> - hybrid engine - hybrid bus . Improvement of the vehicles aerodynamics - New propulsion systems : <ul style="list-style-type: none"> - small power diesel engine - modular engine - optimization of the coupling engine/utilisation - Exploratory research in non-conventional field - Use of alternative fuels 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I. E. A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	2 327	3 950	3 180						
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

2. FIAT current activities

2.1. New means of transportation (improved internal combustion engines, electronically controlled cars, electric and hybrid vehicles, etc.)

2.2. Studies and experimental tests in the public transport systems (traffic analysis in selected towns, automatic traffic controls, etc.)

3. ENEL current activities

- electric car project (see under 1.4.1)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2.1	x									
2.2	x									
3	x									
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
2.1	n.a.	5 500	6 500	7 500						
2.2	-	-	500	500						
3	-	p.m.	p.m.							
TOTAL (in N.C.)	2 327	9 450	10 180							
TOTAL (in EUA)	2.50	9.38	9.59							

R+D&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : ITALY
5. Programme description and budgets	11.SUB-SECTOR 1.4. LOW-GRADE ENERGY UTILISATION	DATE : FEB.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. ENEL current activities

- Urban wastes utilisation
 - . study and design of wastes pretreatment plant
 - . combustion experiments in coal or lignite boilers
 - . design of a burner suited for wastes combustion
- CARPA project (use of waste heat from thermal and nuclear power plants in agriculture, aquaculture and mariculture)
- Water desalination project
 - . desalination thermodynamics and heat exchange problems
 - . desalination associated with thermal and nuclear plants
- Electric car project (prototype experiments; realization and operation of demonstration parks)
- TOTEM project (coopn. with FIAT)
 - . experiments on TOTEM modules for combinet heat and power generation

2. ENI current activities

- gas-driven heat-pumps

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	x								
2	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	140	790	900	900			
2		-	150	300	360	430			
							.../...		
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

3. PFE-Project (CNR)

3.1. Heat pumps systems demo-experiment

- electrically driven heat-pumps
- independently driven heat-pumps
- advanced experimental programme
- study of the system
 - . single dwelling units
 - . multi-dwelling units
 - . large multi-dwelling units, etc.

3.2. Urban wastes utilization

- preliminary study of possible alternative ways
- wastes preselection possibilities
- wastes handling for fuel preparation
- possible use of wastes for biomass feeding
- separation and classification of wastes
- possible use of wastes in the agricultural sector.

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
		current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
OBJECTIVES										
3.1	x									
3.2	x									
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
3.1		220	454	420						
3.2		80	823	1 288						
TOTAL (in N.C.)		300	1 567	2 798						
TOTAL (in EUA)		0.32	1.56	2.64						

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 1.5. OTHERS				DATE : FEB. 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>PFE-Project</u> (CNR) - supporting unit : information centre - miscellaneous problems in the rational utilisation of energy : exploratory and/or assessment studies on non-labelled research									
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x				JRC				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		194	293	557					
TOTAL (in N.C.)		194	293	557					
TOTAL (in EUA)		0.21	0.29	0.52					

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT				DATE : FEB. 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>ENI current activities</u> - slurry pipelines									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	157	235					
TOTAL (in N.C.)		n.a.	157	235					
TOTAL (in EUA)		n.a.	0.16	0.22					

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 2.4. COAL GASIFICATION				DATE : FEB.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>ENI current activities</u></p> <p>- methanation catalyts</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		n.a.	180	230					
TOTAL (in N.C.)		n.a.	180	230					
TOTAL (in EUA)		n.a.	0.18	0.22					

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES		COUNTRY : ITALY					
5. Programme description and budgets		II.SUB-SECTOR 2.5. COAL COMBUSTION		DATE : Feb. 1979					
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE-Project (CNR)</u></p> <ul style="list-style-type: none"> - design, execution, instrumentation and operation of a 1 MW fluidized-bed combustion unit <ul style="list-style-type: none"> . boiler flexibility toward load variations . pipe erosion . heat-loss in fluidized-bed . particle (dust) recovery from hot gases <p>2. <u>ENEL current activities</u></p> <ul style="list-style-type: none"> - fluidized bed combustion (design, realization and operation of a 1 MW pilot plant) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		20	87	92					
2		300	230	250					
						.../...			
TOTAL (in N.C.)		320	317	342					
TOTAL (in EUA)		0.34	0.31	0.32					

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : ITALY			
5. Programme description and budgets		11. SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION				DATE : FEB.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Exploration technologies</u> (ENI)</p> <ul style="list-style-type: none"> - data collation, retrieval and analysis <ul style="list-style-type: none"> . magnetic, gravimetric, geophysical data . paleography of tertiary deposits . petrographic investigation of naptogenic capacity of clays . geological complex locations <p>(expenditures are included in 2.7)</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.					
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : ITALY
	II.SUB-SECTOR 2.7. OIL AND GAS PRODUCTION	DATE : FEB.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. ENI current activities

1.1. Drilling

- Improvement of drilling equipment and operating techniques especially for very deep wells (> 6,500 m) at high pressure (> 1000 Atm) and temperature (> 150°C)
 - . fluid additives for increasing dwelling speed
 - . classification of rocks to optimize drilling equipment
- Platform design for off-shore operation (> 200 m depth).

1.2. Enhanced recovery

- Better utilisation of the existing deposits by means of new extraction techniques
 - . classification of rocks to optimize hydrofracturation techniques
 - . technically activated oil extraction
 - . hydrofracturation technique
 - . water additives for secondary recovery.

1.3. Exploration technologies

(see 2.6.1 for details)

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x								
3	x								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	1000 (est.)	1 200	1 550	1 860	2 230
					.../...
TOTAL (in N.C.)	1000	1 200	1 550	1 860	2 230
TOTAL (in EUA)	1.08	1.19	1.46		

R+D&D POLICY	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : ITALY							
5. Programme description and budgets	II.SUB-SECTOR 2.8. REFINING AND DERIVATIVES	DATE : FEB.1979							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE-Project (CNR)</u></p> <p>- Utilisation of methanol</p> <p>1.1. automotive transportation</p> <ul style="list-style-type: none"> + technico-economic studies + optimal mixing with hydrocarbons + analysis of engine performances + emissions evaluation + toxicity + safety + mixture standardisation + optimal mixture testing in real traffic conditions <p>1.2. heating systems</p> <ul style="list-style-type: none"> + problems analysis + storage and transport safety + combustion safety + burners' design <p>2. <u>ENI current activities</u></p> <p>2.1. Spent oils rerefining</p> <p>2.2. Research in assistance to refining (see under 2.9)</p> <p>2.3. Studies and fleet testing of methanol-gasoline blends</p>									
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION							
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1.1	x								
1.2	x								
2.1	x								
2.2	x								
2.3	x								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1.1	242	284	380						
1.2	30	51	50						
2.1	-	-	130						
2.3	250 (est. ^{on})	300	400	480	570				
						.../...			
TOTAL (in N.C.)	522	635	960						
TOTAL (in EUA)	0.56	0.63	0.90						

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 2.9. TRANSPORT OF OIL				DATE : FEB. 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>ENI current activities</u></p> <ul style="list-style-type: none"> - Research in assistance to refining, transport and commercialization of petroleum products - Studies and field tests of techniques towards deep water pipelying 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
	1	x							
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		6 750	8 100	11 200					
TOTAL (in N.C.)		6 750	8 100	11 200					
TOTAL (in EUA)		7.26	8.04	10.56					

R+D&D POLICY	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : ITALY			
5. Programme description and budgets	II. SUB-SECTOR 2.10. TRANSPORT OF GAS	DATE : FEB.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. See under 2.9					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I.E.A.	others envisaged % of share			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	p.m.	p.m.	p.m.		

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : ITALY
	II. SUB-SECTOR 2.13. OTHERS	DATE : FEB.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. ENI's current activities

- inventory and assessment of Italian oil shales and tar sands resources

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	-	-	100		
					.../...
TOTAL (in N.C.)	-	-	100		
TOTAL (in EUA)	-	-	0.09		

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER					COUNTRY : ITALY			
5. Programme description and budgets	II.SUB-SECTOR 3.1. PROVEN REACTOR					DATE : May 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>LWR and PWR (CNEN)</u></p> <p>a. <u>Core and fuel element design</u></p> <ul style="list-style-type: none"> - codes and calculation methods - core thermohydraulics in steady and transient states - in-pile LOCA experiments - optimisation of fuel cycle with Pu recycling <p>b. <u>Systems and components</u></p> <ul style="list-style-type: none"> - CNEN/AMN : <ul style="list-style-type: none"> . design studies and experiments on the recycling system . analysis of protection systems . design studies and safety evaluations with bi-phase compounds . core structure studies . containing structures and pressure vessel behaviour . water chemistry . metallic materials metallurgy - CNEN/FIAT <ul style="list-style-type: none"> . control rods . primary circuit pumps and valves - CNEN/BREDA <ul style="list-style-type: none"> . stress analysis . steam generator design . components control technologies 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1 a	X								
1 b	X								
2	X								
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 a + 1 b		5 765	6 900	10.976	24 065				
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- CNEN/FIAT/BREDA

- . analysis of radioactive releases
- . shields development
- . calculation techniques of structural integrity in accident conditions
- . auxiliary components and systems
- . fuel elements transport containers

2. HWR (CNEN)

- a. Design, erection and operation of the 40 MWe demonstration prototype reactor (CIRENE) (cooperation with ENEL)
- b. Supporting research
 - new fabrication technologies
 - water chemistry
 - critical experiments with uranium and plutonium oxide rods.

3. HWR (ENEL)

Supporting research and experiments for the CIRENE prototype reactor.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
2a + 2b	12 097	18 100	27 011	18 456						
3	580	2 160	4 300	n.a.						
TOTAL (in N.C.)	18 442	27 160	42 287	42 521						
TOTAL (in EUA)	19.83	26.97	39.86	40.08						

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 3.3. BREEDERS				DATE :May 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Within the framework of the NERSA joint venture (ENEL/ EDF/ RWE)</u> (realization of the Superphénix commercial prototype)</p> <p>- <u>CNEN supporting activities</u></p> <ul style="list-style-type: none"> . erection and operation of a reactor for testing of fuel elements (PEC ~ 120 MWth, operation planned at the end 1980) . development of prototypes of fuel elements and testing in PEC . development of systems and components for Na-circuits <p>2. <u>ENI current activities</u></p> <ul style="list-style-type: none"> - research in assistance to the production of FBR fuels 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural incl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		29 131	51 700	50 042	45 900				
2		-	600	1 224	1 460				
							.../...		
TOTAL (in N.C.)		29 131	52 300	51 266	47 360				
TOTAL (in ECU)		31.32	51.94	48.32	44.64				

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : ITALY
5. Programme description and budgets	II. SUB-SECTOR 3.4. FUEL CYCLE	DATE : May 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Uranium ore prospection (CNEN/AGIP)
 - development of U exploration advanced technologies
 - indigenous resources prospection
2. Uranium enrichment (CNEN)
 - gaseous diffusion : development of support and barrier materials (Al₂O₃ and Ni based)
 - ultracentrifugation : development and experiments of prototype apparatus
3. Nuclear fuel manufacture (CNEN)
 - research into oxide fuels manufacturing technology and basic properties of uranium and plutonium carbides
 - operation of two production lines for the manufacture of CIRENE (HWR) and PEC (fast Na-cooled) reactor cores
 - post-irradiation analysis service
4. Reprocessing of irradiated fuels (CNEN)
 - experiments in the EUREX plant with fuels with increasing burn-ups
 - experiments in the ITREC plant on advanced components and processes for recovering fission fuel from special fuels
 - supporting research (flow-sheets improvement, process control, pilot plant activities)
 - development of a new dry reprocessing process

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X								
2	X								
3	X								
4	X								
5	X								.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	-	-	-	-	
2	2.458.4	2.226.9	2.869.4	2.900	
3	1.605.8	5.353.0	1.834.8	5.500	
4	8.960.2	10.042.5	11.350.7	9.000	
TOTAL (in N.C.)					.../...
TOTAL (in EUA)					

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- in cooperation with the J.R.C. (Ispra) :
 - . correlation between different isotopes in irradiated fuels
 - . non-destructive tests of fissile elements in non-irradiated fuels
 - . determination of the burn-up rate by γ -spectrometry in irradiated fuel elements
 - . development of fuel identification techniques

5. ENI current activities

- research in assistance to the exploration and production of uranium
- uranium extraction from phosphoric acid
- research in assistance to the manufacture of LWR fuels
- development of mechanical equipment for the nuclear fuel cycle.

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
	5	X							
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
5		n.a.	4.690	7 350	8.820				
TOTAL (in N.C.)		13 024,40	22 316.4	23.404.90	26 220				
TOTAL (in EUA)		14.00	22.16	22.16	24.71				

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 3.5. NUCLEAR SAFETY				DATE : May 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>CNEN and ENEL activities</u></p> <ul style="list-style-type: none"> - control and protection of nuclear power stations by means of computerized systems - development of advanced economical and safe pressure vessels of pre-compressed reinforced concrete - definition of projected earthquake conditions for nuclear plant sites - methods of determining the efficiency of carbon filters for iodine and its organic derivatives retention <p>2. <u>Operation of the ESSOR (JRC) test reactor (CNEN)</u></p> <ul style="list-style-type: none"> - safety experiments <p>3. <u>See also under 3.1.</u></p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 + 2		12 887	9 660	12 504	1 886				
3		p.m.	p.m.	p.m.					
TOTAL (in N.C.)		12 887	9 660	12 504	1 886				
TOTAL (in EUA)		13.86	9.59	11.79	1.78				

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : ITALY	
5. Programme description and budgets		II. SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL				DATE : May 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Handling and treatment of radioactive wastes</u> - supporting research							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		3 324.7	4 120.3	522.2	1 800		
							.../...
TOTAL (in N.C.)		3 324.7	4 120.3	522.2	1 800		
TOTAL (in EUA)		3.57	4.09	0.49	1.70		

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : ITALY	
5. Programme description and budgets		II.SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANT				DATE : May 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :							
<p>1. <u>Radiation protection</u></p> <p>2. <u>Environmental protection</u></p> <p>3. <u>Health physics</u></p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others
1	X						
2	X						
3	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1 ÷ 3		7 225.5	8 303.3	8 402.2	10 100		
TOTAL (in N.C.)		7 225.5	8 303.3	8 402.2	10 100		
TOTAL (in EUA)		7.77	8.25	7.92	9.52		

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL				DATE : May 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. See under 3.4.4. (Cooperation with J.R.C. Ispra) (expenditure included in 3.4)									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural imol. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.					
								.../...	
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : ITALY
	II.SUB-SECTOR 3.9. OTHERS	DATE : May 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Applied research and development in agriculture and industry
 - radiation and isotope applications
2. Basic technological research

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X							
2	X							
								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1	2 130.1	2 442.6	2 529.7	2 900				
2	4 388.5	4 904.5	3 738.6	8 100				
						.../...		
TOTAL (in N.C.)	6 518.6	7 347.1	6 268.3	11 000				
TOTAL (in EUA)	7.01	7.30	5.91	10.37				

R+D&D POLICY		1. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : ITALY	
5. Programme description and budgets		11. SUB-SECTOR 4.1. THERMONUCLEAR FUSION			DATE : May 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Magnetic confinement</u> Construction and operation of medium-sized, Tokomak-Type toroidal machine						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X			X		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	10 382.2	12 069.4	18 112.7	23 600		
						.../...
TOTAL (in N.C.)	10 382.2	12 064.4	18 112.7	23 600		
TOTAL (in EUA)	11.16	11.99	17.07	22.24		

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES & VECTORS	COUNTRY : ITALY
5. Programme description and budgets	II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY	DATE : May 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. ENI current activities

- research in assistance to exploration and production
- demonstration of utilization of low-enthalpy geothermal fluids

2. ENEL current activities

- project CESANO 1 : demo-plant for the energetic and chemical utilization of the geothermal brines
- project CESANO exploration : exploration of CESANO's geothermal reservoir by stimulation of some wells.
- project AMIATA : combined utilization of the geothermal fluid for the production of heat and electricity;
- project SASSO 22 : deep drilling;
- project LARDERELLO ground : exploration and exploitation of deep reservoirs in the Larderello geothermal field;
- project LATERA : deep exploration; experiments on the utilization of fluids; exploitation demo-plant
- thermogravimetric plant : design, erection and demonstration operation of a pilot-plant of 25 kW; study of the 10 MW plant.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	31	1.161					
2		3.700	5.860	8.800					
							.../...		
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

3. PFE-Project (CNR)

- increase of the steam production
 - . study of the Larderello's marginal areas
 - . deep structure investigation
 - . survey and identification of new potential areas, search in areas in which there is evidence for steam production possibility

- prospection techniques
 - . geologic prospection
 - . geochemical prospection
 - . geophysical prospection
 - . data elaboration techniques
 - . development of prospection methodologies and techniques
 - . production and maintenance of equipment

- hot dry rock exploitation
 - . geological and geophysical survey
 - . development of an exploitation model for hot rocks
 - . exploitation technology
 - + thermohydraulics
 - + drilling technology and equipment
 - + well geometry
 - + drilling fluids

- technico-economical studies
 - . economical exploitation of hot waters

- heat exchange and energy conversion
 - . thermofluidodynamics
 - . thermogravimetric exploitation of low enthalpy fluids

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
3	X									
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
3		140	376	811						
TOTAL (in N.C.)		3.840	6.267	10.772						
TOTAL (in EUA)		4.13	6.22	10.15						

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS		COUNTRY : ITALY						
5. Programme description and budgets	II.SUB-SECTOR 4.3. SOLAR ENERGY		DATE :May 1979						
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>ENI current activities</u>									
1.1. development and demonstration of solar plants for hot water, space heating, agricultural and industrial uses;									
1.2. thin-film heterojunctions;									
1.3. design of a hybrid solar-thermal-electric central receiver power station									
2. <u>ENEL current activities</u>									
2.1. Solar houses project (solar heating installations)									
2.2. Photovoltaic conversion									
. design realization and testing of silicon small power sets with and without concentration									
. development of Gallian arsenide module									
2.3. 1 MWe heliothermoelectric plant									
. design									
. erection and first operation									
. demonstration operation									
IV. PROGRAMME FEATURES / STATUS & IMPLEMENTATION / INTERNATIONAL COOPERATION									
OBJECTIVES	current	Planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X				X				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1.1.	n.a.	135	330						
1.2.	n.a.	50	340						
1.3.	n.a.	85	1.030						
2.1.	-	150	140						
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

3. PFE-Project (CNR)

- insolation data survey
- thermal utilization of solar energy
 - . collectors
 - . radiators
 - . storage systems
 - . demonstration units
- conversion into mechanical energy (high temperature)
 - . technico-economic evaluation of the S. Ilario units
 - . study of two systems (10-fold and 100-fold larger)
- photovoltaic conversion
 - . realization of 10 W units with low-cost non monocrystalline cells
 - . realization of two prototypes concentration systems for simultaneous production of electricity and hot water
 - . design and cost evaluation of a 10 MWe power station
- other research
 - . small electric units (1 ÷ 2 kW)
 - . photochemical and photobiological processes

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
2.2	150	140	660							
2.3	-	30	590							
3	220	670	2 302							
TOTAL (in N.C.)	370	1.260	5 392							
TOTAL (in EUA)	0.40	1.25	5.08							

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 4.4. OCEAN				DATE : FEB.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities of ENEL</u>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
I	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
I		-	-	35					
									.../...
TOTAL (in N.C.)		-	-	35					
TOTAL (in EUA)				0.03					

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 4.5. WIND				DATE : FEB.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>P.F.E. Project</u> (CNR)</p> <p>2. <u>ENI current activities</u></p> <p>- design of a medium power wind energy conversion system</p> <p>3. <u>ENEL activities</u></p> <p>- project VELE : realisation and experimental operation of a wind electrical generator with wind motors of 50 kW; study of 1 MW power plants</p> <p>(cooperation with FIAT)</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x								
3		x							
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	51	132					
2		-	-	30					
3		-	-	-	2 300 in 1979-81				
						.../...			
TOTAL (in N.C.)		-	51	162					
TOTAL (in EUA)		-	0.05	0.15					

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT			DATE : May 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE-Project</u></p> <p>1.1. <u>Development of dry-cooling towers (natural convection)</u></p> <ul style="list-style-type: none"> - realization of an heat-exchanger, made with low-cost materials (plastics) and its optimisation toward the heat-exchange and pressure drop (losses) - experimental study of optimal pipe profiles - materials studies - air-water-exchange - optimal flow analysis <p>1.2. <u>Recovery of kinetic energy from gas-turbines</u></p> <ul style="list-style-type: none"> - experimental data collection on turbines - discharge profiles and recovery conditions : models - design criteria for improved discharge ducts - experimental verification (full scale) on turbines <p>1.3. <u>Improvement of efficiency of large size steam-turbines</u></p> <ul style="list-style-type: none"> - theoretical and experimental fluodynamic and thermodynamic investigation of thermal and/or aerodynamic systems for the size reduction of water droplets in low pressure turbines - experimental study in wind tunnel - experimental study in steam tunnel (blades/water behaviour) - studies on experimental turbine <ul style="list-style-type: none"> . design and construction of the turbine . turbine behaviour determination 								
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1.1.	X							
1.2.	X							
1.3.	X							
								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1.1.	137	170	94					
1.2.	46.5	125	89					
1.3.	172	240	239					
						.../...		
TOTAL (in N.C.) tot.1	355.50	535	422					
TOTAL (in EUA)								

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

2. ENEL current activities

2.1. Superconducting generating machine

- . feasibility study
- . setting up of the technology for the construction of the superconducting coal

2.2. Low pressure steam turbine with 1320 mm blades for nuclear plants

2.3. Alternative cooling systems : study and experimental plant of a dry tower system

3. ANSALDO current activities

- Large power turbo-alternating machines and steam turbine

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2	X									
3	X									
								(*)	includes expenditures	
									of 5.2 and 5.6	
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
2		29 830 (*)	28 906 (*)	10 285						
3		900	1 000	1 070						
TOTAL (in N.C.)		31 086	30 441	11 777						
TOTAL (in EUA)		33.43	30.23	11.10						

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 5.4. FUEL CELLS				DATE : FEB. 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE-Project</u> (CNR)</p> <p><u>Electrochemical generation of electrical power</u></p> <ul style="list-style-type: none"> - alkaline H₂-air fuel cell unit with CH₃OH (methanol) as main fuel . design of a demo-unit (220 V; 10 kW) . CH₃OH/H₂O reforming system for H₂ production . CO₂ scrubbing system . development and operation characteristics of the electrochemical system . technico-economic study of the 1 MW unit. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
I	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
I		40	75.4	62					
TOTAL (in N.C.)		40	75.4	62					
TOTAL (in EUA)		0.04	0.07	0.06					

R+D&D POLICY	I. SECTOR 5. ELECTRICITY	COUNTRY : ITALY
5. Programme description and budgets	II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE	DATE : FEB.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. PFE-Project (CNR)

Use of Br₂-Zn batteries in 5 + 10 kW storage units

- design, construction and testing of stationary units
- preliminary design of a 1000 kW unit
- laboratory study of the Zn-I₂ battery

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x									
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	65	210.4	435		
					.../...
TOTAL (in N.C.)	65	210.4	435		
TOTAL (in EUA)	0.07	0.21	0.41		

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES				DATE : May 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE - Project (CNR)</u></p> <ul style="list-style-type: none"> - Storage of energy <ul style="list-style-type: none"> . kinetic energy : fly wheels (design, materials development) . thermal energy <p>2. <u>ENEL current activities</u></p> <ul style="list-style-type: none"> - project SESTA : compressed air in natural reservoirs for the use in gas-turbine plants 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		203	591	532					
?		incl.in 5.1.2	incl.in 5.1.2	1.850					
						.../...			
TOTAL (in N.C.)		203	591	2.382					
TOTAL (in EUA)		0.22	0.59	2.25					

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES				COUNTRY : ITALY				
5. Programme description and budgets	II.SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS				DATE : FEB.1979				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>PFE-Project</u> (CNR)									
- Collection and organization of data									
. production and consumption of electrical energy									
. energy use in the transportation sector									
. industrial uses by sectors (petrochemistry, steel, cement, etc.)									
. residential use									
- Model of tariffs and allocations									
- Model for evaluation of total results of energy policies									
- Continuous data updating and management									
2. <u>ENI current activities</u>									
- end uses of energy in Italy and other studies									
IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION									
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	-	227	440						
2	133	160	200						
TOTAL (in N.C.)	133	387	640						
TOTAL (in EUA)	0.14	0.38	0.60						

R+D&D POLICY		I. SECTOR 6. GENERAL STUDIES				COUNTRY : ITALY			
5. Programme description and budgets		II.SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES				DATE : FEB. 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PFE-Project</u></p> <p><u>Research on legal and normative aspects of :</u></p> <ul style="list-style-type: none"> - Solar energy : components characteristics, building orientation recommendations, maintenance rules, etc. - Geothermal energy : max. level of impurities in ejected waters, reinjection modalities, etc. - Urban wastes utilization : plastic containers characteristics, emissions of combustion products - Energy conservation (transportation) : consumption standards, maintenance rules, etc. - Energy conservation (domestic) : automatic thermostats use, maintenance rules, new buildings insulation, etc. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	10	50	74						
TOTAL (in N.C.)	10	50	74						
TOTAL (in EUA)	0.01	0.05	0.07						

R+D&D POLICY		I. SECTOR 6. GENERAL STUDIES				COUNTRY : ITALY			
5. Programme description and budgets		II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS				DATE : FEB. 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>ENEL current activities</u></p> <ul style="list-style-type: none"> - Survey and control methods of air, oil and water pollution - Setting up a 30 stations network for the survey of SO₂ concentration in air in the Venice Region - Automotive engines air pollution <ul style="list-style-type: none"> . fuels . pilot plant design for catalyst production for silencers appliances - Control of air pollution (gases, dusts, vapours) produced in industrial processes - Ecologic consequences of waste-heat discharges in surface waters (rivers, seas) from power stations (conventional and nuclear) - Ecologic consequences of sulphur and nitrogen oxides emissions from fossil fuels fired power stations. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		5.200	5 740	6 500					
								.../...	
TOTAL (in N.C.)		5 200	5 740	6 500					
TOTAL (in EUA)		5.59	5.70	6.13					

SECTION 3

SUB-SECTION 3.7 T H E N E T H E R L A N D S



SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE
(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>4.907</u>	<u>7.410</u>	<u>7.539</u>
1.1. Industry	1.591	3.214	2.646
1.2. Residential and commercial	1.489	2.643	3.153
1.3. Transportation	1.489	0.714	0.471
1.4. Low-grade energy utilization	0.338	0.839	1.269
1.5. Others	-	-	-
2. FOSSIL FUELS AND DERIVATIVES	<u>3.247</u>	<u>5.500</u>	<u>5.544</u>
2.1. Coal exploration and extraction	-	-	-
2.2. Coal preparation, valoris.& transpt.	-	0.072	0.072
2.3. Coal Liquefaction	-	-	-
2.4. Coal gasification	0.169	0.179	0.181
2.5. Coal combustion	-	1.071	1.450
2.6. Oil & gas assessment & exploration	1.692	1.821	1.957
2.7. Oil & gas production	p.m.	p.m.	p.m.
2.8. Refining and derivatives	p.m.	p.m.	p.m.
2.9. Transport of oil	0.338	0.393	0.362
2.10. Transport of gas	0.338	0.393	0.181
2.11. Storage of oil	-	-	-
2.12. Storage of gas	0.338	0.964	0.181
2.13. Others	0.372	0.607	1.160

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>36.992</u>	<u>38.715</u>	<u>38.674</u>
3.1. Proven reactors	9.475	11.429	12.070
3.2. High temperature reactors	0.880	0.107	-
3.3. Breeders	11.574	11.286	12.360
3.4. Fuel cycle	14.146	14.679	12.867
3.5. Nuclear safety	0.102	0.107	0.181
3.6. Waste treatment and disposal	0.102	0.429	0.217
3.7. Radiation prot.& decommis.of power pl.	p.m.	p.m.	p.m.
3.8. Fissile materials control	0.305	0.357	0.544
3.9. Others	0.338	0.321	0.435
4. NEW ENERGY SOURCES AND VECTORS	<u>12.623</u>	<u>16.321</u>	<u>18.158</u>
4.1. Thermonuclear fusion	4.873	6.786	7.249
4.2. Geothermal energy	0.102	0.071	0.109
4.3. Solar energy	1.929	2.071	2.283
4.4. Ocean	-	-	-
4.5. Wind	0.981	1.750	2.138
4.6. Hydrogen as an energy vector	-	0.286	-
4.7. Others	4.738	5.357	6.379
5. ELECTRICITY	<u>0.745</u>	<u>2.607</u>	<u>1.740</u>
5.1. Electricity generating equipment	0.677	2.500	1.595
5.2. Transport of electricity	-	-	-
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	-	-	-
5.5. Electrochemical storage	-	-	-
5.6. Other storage techniques	0.068	0.107	0.145

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>1.083</u>	<u>1.429</u>	<u>1.631</u>
6.1. Analytical studies on energy systems	1.083	1.429	1.631
6.2. Socio-economic studies	-	-	-
6.3. Studies on environmental effects	p.m.	p.m.	p.m.
T O T A L	<u>59.597</u>	<u>71.982</u>	<u>73.286</u>

Qualification statement

The figures quoted include only direct Government funding of energy R&D projects, mostly carried out in 3 research organizations, but also by universities and private industry and institutions. This direct funding is considered the base for implementing Government R&D policy.

University research and R&D by the utilities and industry are not influenced to any comparable extent and have therefore been left out except for R&D carried out under contract for the Government.

Expenditures for energy R&D in private industry (in particular internationals like Shell and Philips) and utilities (in particular the electricity producers' laboratories) are not known in detail but they are very large in the fields of oil and gas (exploration, exploitation, transport and distribution). In such sectors the figures quoted therefore do not reflect the total research effort in the Netherlands.

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

The main objective of the energy R&D policy is presently to create energy options for the future by :

- expanding domestic energy supplies
- diversifying the supply of energy vectors
- minimizing energy conversion and transportation losses
- improving the efficiency of energy end-use.

To minimize the social costs of the implementation of the energy policy, R&D must also be directed at minimizing environmental impact and maximising socio-economic acceptability of the various new energy technologies.

2. Specific objectives

a. Short term (1977-1985) and medium-term (1985-1995)

- energy conservation
- coal technology excluding mining
- nuclear energy
- development of new source of energy
 - . wind energy
 - . solar energy
 - . geothermal energy

b. Long term (2000 and beyond)

- Thermonuclear fusion

3. Priorities

The priority assigned to the various technologies is as follows :
on the demand side :

- conservation in buildings
- increased industrial efficiency
- combined heat and power production

on the supply side :

- direct utilisation of coal in electricity generation and in industry
- nuclear power generation
- coal gasification
- solar heating
- wind power
- geothermal heating
- electric power conversion efficiency
- energy storage

4. Ongoing and/or planned comprehensive programmes and budgets

none

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 1.1. INDUSTRY				DATE : 25.1.79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Development of rational use of energy in different production techniques</p> <p>2. Support for identification and implementation of energy saving in industry</p> <p>3. Energy saving in agriculture</p> <p>Note : Not including increasing support of industrial investments in energy saving equipment</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		50%						
2	X		100%						
3	X		100%						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.7	5.0	3.3	2.5	2.0			
2		1.0	1.0	1.0	1.0	1.0			
3		3.0	3.0	3.0	3.0	3.0			
						.../...			
TOTAL (in N.G.)		4.7	9.0	7.3	6.5	6.0			
TOTAL (in EJA)		1.591	3.214	2.646	2.356	2.17			

R+D&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY :NETHERLANDS
5. Programme description and budgets	II.SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL	DATE : 25.1.79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Experimental and pilot projects

- improved insulation of buildings
- increased efficiency of heating systems
- use of heat/power installations in houses and buildings
 - . development of
 - + experimental models
 - + pilot projects
 - . analysis of the future potential of systems
 - + time-dependence of the insulation of buildings
 - + time-dependence of the introduction of heat/power installations or solar collectors
 - + reserve systems
 - + phase differences between supply, demand and the potential of the reserve system

2. National programme on energy conservation (residential and commercial)

items see (1.2.1.)

Note : Heat pumps, see 1.4.

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
		current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
OBJECTIVES										
1	X			80	X	X				
2		X		80	X	X				
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		4.4	7.4	8.7						
2		-	-	-	10.5	12.0				
										.../...
TOTAL (in N.C.)		4.4	7.4	8.7	10.5	12.0				
TOTAL (in EUA)		1.489	2.643	3.153	3.806	4.35				

R+D&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : 25.1.79
5. Programme description and budgets	II. SUB-SECTOR 1.3. TRANSPORTATION	DATE : 25.1.79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Current activities

- new engines and fuels (ethanol, natural gas, LPG)
- evaluation of the use of electric and diesel automobiles
- altered design of automobiles

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
	1	X		40			X			
									.../...	
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		4.4	2.0	1.3	1.3	1.5				
TOTAL (in N.C.)		4.4	2.0	1.3	1.3	1.5				
TOTAL (in EUA)		1.489	0.714	0.471	0.471	0.544				

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY					COUNTRY NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 1.4. LOW GRADE ENERGY UTILIZATION					DATE : 25.1.79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
<p>1. <u>Use of heat-pumps in the residential sector</u></p> <p>2. <u>Use of heat/power installations (residential and commercial)</u></p> <p>3. <u>District-heating projects (see 5.1.2.)</u></p> <p>4. <u>Energy storage (see 4.3.3.)</u></p>										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share	
1	X		85	X	X					
2	X		85				X			
3	X									
4	X									
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		1.0	1.9	2.9	3.0	3.5				
2		-	0.6	0.6	1.0	1.5				
3		p.m.	p.m.	p.m.	p.m.	p.m.				
4		p.m.	p.m.	p.m.	p.m.	p.m.				
						.../...				
TOTAL (in N.C.)		1.0	2.5	3.5	4.0	5.0				
TOTAL (in EUA)		0.388	0.839	1.269	1.450	1.81				

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY :NETHERLANDS	
5. Programme description and budgets		II.SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT			DATE : 25.1.79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Evaluation of coal transportation problems associated with increased imports</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X		100		X	
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		-	-	0.2	0.2	
						.../...
TOTAL (in N.C.)		-	-	0.2	0.2	
TOTAL (in EUA)		-	-	0.072	0.072	

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : NETHERLANDS	
5. Programme description and budgets		II. SUB-SECTOR 2.4. COAL GASIFICATION			DATE : 25.1.79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
<p>1. <u>Feasibility studies on coal gasification for selecting the optimal processes for the local circumstances</u></p> <p>2. <u>Increase of the integrity of heavily-stressed structures</u> (pressure vessels in coal gasification plants) (see 3.9.1.)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X		100			
2		X				
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		0.5	0.5	0.5	0.1	
2		p.m.	p.m.	p.m.	p.m.	
						.../...
TOTAL (in N.C.)		0.5	0.5	0.5	1.0	
TOTAL (in EUA)		0.169	0.179	0.181	0.362	

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY :NETHERLANDS
	II.SUB-SECTOR 2.5. COAL COMBUSTION	DATE : 25.1.79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Studies on fluidized-bed combustion

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X		100		X			
								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1	-	3.0	4.0	6.0				
TOTAL (in N.C.)	-	3.0	4.0	6.0				
TOTAL (in EUA)	-	1.071	1.450	2.175				

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY NETHERLANDS			
5. Programme description and budgets		II. SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION				DATE : 25.1.79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities in off-shore exploration of oil and gas</u> - development of systems for dynamical positioning at sea</p> <p>2. <u>Assessment by Geological survey</u></p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		40						
2	X		100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		4.0	4.1	4.4	4.6				
2		1.0	1.0	1.0	1.0				
						.../...			
TOTAL (in N.C.)		5.0	5.1	5.4	5.6				
TOTAL (in EUA)		1.692	1.821	1.957	2.030				

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY :NETHERLANDS				
5. Programme description and budgets		II.SUB-SECTOR 2.7. OIL AND GAS PRODUCTION			DATE : 25.1.79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. See under 2.6.									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.	p.m.				
TOTAL (in N.C.)						.../...			
TOTAL (in EUA)									

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY :NETHERLANDS	
5. Programme description and budgets		II.SUB-SECTOR 2.8. REFINING AND DERIVATIVES				DATE :25.1.79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Study on the desirability of using methanol as an automotive fuel</u> (see 1.3.1.)							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	p.m.	p.m.	p.m.	p.m.			
						.../...	
TOTAL (in N.c.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : NETHERLANDS	
5. Programme description and budgets		II. SUB-SECTOR 2.9. TRANSPORT OF OIL			DATE : 25.1.79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :						
1. <u>Pipeline transport of gas and oil</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A. others envisaged % of share
1			50			
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	1.0	1.1	1.0	1.0		
						.../...
TOTAL (in N.C.)	1.0	1.1	1.0	1.0		
TOTAL (in EUA)	0.338	0.393	0.362	0.362		

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 2.10. TRANSPORT OF GAS			DATE :25.1.79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Pipeline transport of oil and gas</u> 2. <u>Safety aspects of storage and transportation of LNG (see 2.12.1)</u>								
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X		100					
2	X		100					
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		1.0	1.1.	0.5	0.5			
2		p.m.	p.m.	p.m.	p.m.			
							.../...	
TOTAL (in N.C.)		1.0	1.1	0.5	0.5			
TOTAL (in EUA)		0.338	0.393	0.181	0.181			

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : NETHERLANDS		
5. Programme description and budgets		II.SUB-SECTOR 2.12. STORAGE OF GAS			DATE : 25.1.79		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Safety aspects of storage and transportation of LNG</u>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		100				
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1976 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	1.0	2.7	0.5	0.5			
						.../...	
TOTAL (in N.C.)	1.0	2.7	0.5	0.5			
TOTAL (in EUA)	0.338	0.964	0.181	0.181			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY :NETHERLANDS
	II.SUB-SECTOR 3. 1. PROVEN REACTORS	DATE : Oct. 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Light Water Reactors (see also 3.4 and 3.5)

- reactor physics
- thermohydraulic and reactor dynamic studies, computer codes and experiments
- reactor performance and safety studies
- general supporting technologies

2. Supplementary programme Euratom, HFR Petten

(expenditures indicated below include also local costs (overheads))

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged % of share
1			100					
2			100	X				
								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1	13.0	15.0	15.0	16.0				
2	15.0	17.0	18.3	18.5				
TOTAL (in N.C.)	28.0	32.0	33.3	34.5				
TOTAL (in EUA)	9.475	11.429	12.070	12.505				

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : NETHERLANDS	
5. Programme description and budgets		II.SUB-SECTOR 3.2. HIGH TEMPERATURE REACTORS				DATE :25.1.1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>High temperature reactors</u> - Research on coated fuel particles - Graphite research							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others envisaged % of share
1			100			X	
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		2.6	0.3	-			
							.../...
TOTAL (in N.C.)		2.6	0.3	-			
TOTAL (in EUA)		0.880	0.107	-			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY :NETHERLANDS
	II.SUB-SECTOR 3.3. BREEDERS	DATE : Oct. 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

Development of sodium-cooled fast breeder reactors (SNR-300/SNR-2)

1. Development of materials and large components for sodium systems (TNO)

- inspection and safety equipment
- operation of a 50 MW testbed for sodium components

2. SNR research programme (ECN)

- sodium cooled fast reactors (SNR)
 - . safety studies and use of reactor signals
 - . fission product data and carbonitrate research
 - . overpower and transient overpower experiments
 - . boiling and heat transfer phenomena
 - . behaviour of construction materials
 - . aerosol behaviour
 - . core design studies, computer codes etc.

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100			X			
2	X		100			X			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	20.0	20.0	20.0	19.4					
2	14.2	11.6	14.1	15.3					
TOTAL (in N.C.)	34.2	31.6	34.1	34.7					
TOTAL (in EUA)	11.574	11.286	12.360	12.577					

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY :NETHERLANDS	
5. Programme description and budgets		II.SUB-SECTOR 3.4. FUEL CYCLE				DATE : Oct. 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. - LWR fuel pin research - Zircaloy irradiation 2. Development of ultracentrifuge system							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others envisaged % of share
1			100			X	
2						X	
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		3.8	4.6	4.4	2.6		
2		38.0	36.5	31.1	25.8		
							.../...
TOTAL (in N.C.)		41.8	41.1	35.5	28.4		
TOTAL (in EUA)		14.146	14.679	12.867	10.294		

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY :NETHERLANDS
5. Programme description and budgets	II.SUB-SECTOR 3.5. NUCLEAR SAFETY	DATE : 25.1.1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

(see also 3.1. and 3.2.)

1. LWR safety aspects (ECN)

- Participation in LOFT-experiments (USA)
- Marine biology

2. Reactor safety in LWR (TNO)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1				100			x			
2				100						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		0.1	0.1	0.3	0.4					
2		0.2	0.2	0.2	0.2					
						.../...				
TOTAL (in N.C.)		0.3	0.3	0.5	0.6					
TOTAL (in EUA)		0.102	0.107	0.181	0.217					

<u>R+D&D POLICY</u>		I. SECTOR NUCLEAR POWER				COUNTRY : NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL				DATE : 25.1.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Studies and design of facilities for underground storage of radioactive waste in salt formations (data do not include routine management of radioactive wastes)</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	Planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	X			X		
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.3	1.2	0.6	0.9				
TOTAL (in N.C.)		0.3	1.2	0.6	0.9				
TOTAL (in EUA)		0.102	0.429	0.217	0.326				

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : NETHERLANDS	
5. Programme description and budgets		II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS				DATE : 25.1.1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Radiation protection</u> (ECN)							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		100				
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1	p.m.	p.m.	p.m.	p.m.	p.m.		
						.../...	
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY :NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL				DATE : 25.1.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Nuclear fuel safeguarding research</u>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X				X		X		
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		0.9	1.0	1.5	1.8				
TOTAL (in N.C.)		0.9	1.0	1.5	1.8				
TOTAL (in EUA)		0.305	0.357	0.544	0.652				

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY :NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 4.1. THERMONUCLEAR FUSION				DATE : 25.1.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - plasma physics <ul style="list-style-type: none"> . plasma-wall interaction . screwpinch and turbulent plasma heating - reactor technology <ul style="list-style-type: none"> . materials radiation damage . reactor systems study - superconducting magnets - lasers - relativistic electron beams 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		75	X					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		14.4	19	20	20				
TOTAL (in N.C.)		14.4	19	20	20				
TOTAL (in EUA)		4.873	6.786	7.249	7.249				

R+D&D POLICY		I. SECTOR : NEW ENERGY SOURCES AND VECTORS				COUNTRY :NETHERLANDS		
5. Programme description and budgets		II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY				DATE : 25.1.1979		
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :								
1. <u>Evaluation of the possible significance of geothermal energy for the Netherlands</u>								
2. <u>Demonstration projects near Rotterdam</u>								
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X		100					
2		X	50	X				50 %
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		0.3	0.2	0.3	1.0	1.0		
2		-	-	-	0.5	1.0		
							.../...	
TOTAL (in N.C.)		0.3	0.2	0.3	1.5	2.0		
TOTAL (in EUA)		0.102	0.071	0.109	0.544	0.725		

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY :NETHERLANDS	
5. Programme description and budgets	II.SUB-SECTOR 4.3. SOLAR ENERGY				DATE : 25.1.1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Heating and cooling</u></p> <ul style="list-style-type: none"> - hot water production - space heating <p>2. <u>Photo-electric</u></p> <ul style="list-style-type: none"> - solar cell materials - basic studies <p><u>Future activities, National Programme Solar Energy</u></p> <ul style="list-style-type: none"> - heating and cooling <ul style="list-style-type: none"> . development of solar collectors . development of technical plant suited to the heating industry . reserve systems as water heaters and specially constructed gas geysers . pilot projects - photo-electric conversion <ul style="list-style-type: none"> . evaluation of new materials for solar cells - conversion into fuel <ul style="list-style-type: none"> . biochemical, chemical, electrical engineering and agricultural aspects - energy storage 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged % of share
1	X		90	X		10
2	X		50	X		50
3	X		90	X		10
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		5.4	5.5	6.0	-	
2		0.3	0.3	0.3	-	-
3		-	-	-	8.0	8.0
4						
						.../...
TOTAL (in N.C.)		5.7	5.8	6.3	8.0	8.0
TOTAL (in EUA)		1.929	2.071	2.283	2.9	2.9

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY :NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 4.5. WIND				DATE :25.1.1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>National programme</u></p> <ul style="list-style-type: none"> - test programme with a 5 m diameter vertical axis test facility - design and fabrication of a 25 m (300 kw) horizontal axis turbine - study of the technico-economical feasibility of large-scale utilisation of wind energy for electricity production to be fed into the utility grid <p>2. <u>Wind energy for developing countries</u></p> <ul style="list-style-type: none"> - development of small scale devices adapted to local conditions 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	X		100		X			-	
2	X		100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		2.0	4.0	5.0	5.0	6.0			
2		0.9	0.9	0.9	0.9	0.5			
							.../...		
TOTAL (in N.C.)		2.9	4.9	5.9	5.9	6.5			
TOTAL (in EUA)		0.981	1.750	2.138	2.138	2.356			

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : NETHERLANDS	
5. Programme description and budgets		II. SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR			DATE : 25.1.1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Improvement of water electrolysis</u> - basic research into new electrode materials						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1		X				
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	-	0.8				
						.../...
TOTAL (in N.C.)	-	0.8	-			
TOTAL (in EUA)	-	0.286	-			

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY :NETHERLANDS				
5. Programme description and budgets		II.SUB-SECTOR 4.7. OTHERS			DATE : Oct. 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Current activities</u></p> <ul style="list-style-type: none"> - General supporting technologies - Superconductivity 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		14.0	15.0	17.6	18.0				
TOTAL (in N.C.)		14.0	15.0	17.6	18.0				
TOTAL (in EUA)		4.738	5.357	6.379	6.524				

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : NETHERLANDS		
5. Programme description and budgets		II. SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE : 25.1.1979		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>MHD research</u> (ECN)</p> <p>2. <u>MHD</u> (THE)</p> <p>3. <u>Improvement of electricity generation efficiency</u></p>								
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged % of share
1	X		100					
2	X		100					
3	X		100					
								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)		
1		-	1.0	2.3	2.5			
2		2.0	6.0	2.0	2.0			
3		-	-	0.1	0.4			
						.../...		
TOTAL (in N.C.)		2.0	7.0	4.4	4.9			
TOTAL (in EUA)		0.677	2.500	1.595	1.776			

R+D&D POLICY		I. SECTOR 5. ELECTRICITY			COUNTRY NETHERLANDS	
5. Programme description and budgets		II. SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES			DATE : 25.1.1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Studies on energy storage in flywheels</u> 2. <u>National programme</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	0.2	0.3	0.4	0.2		
2				1.2		
						.../...
TOTAL (in N.C.)	0.2	0.3	0.4	1.4		
TOTAL (in EUA)	0.068	0.107	0.145	0.507		

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES					COUNTRY :NETHERLANDS			
5. Programme description and budgets		II.SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS					DATE : 25.1.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
1. <u>System analysis; technology assessment and social studies</u>										
<ul style="list-style-type: none"> - analysis of Dutch energy management, together with interaction with social aspects - elaboration of scenarios in terms of investments, savings and environmental burden - assessment to determine what instruments in energy terms, will be required in order to implement a long-term energy policy - energy aspects of the energy intensive industrial sectors - data collection in the energy field and development of handling methodology - integral cost-benefit studies on alternative energy systems - study on the link between end-use wishes and the associated supply of primary energy sources 										
2. <u>Programme and research management of National Programmes</u>										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share	
1	X				X	X			-	
2	X									
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		2.7	3.0	3.5	3.5	5.0				
2		0.5	1.0	1.0	2.0	3.0				
TOTAL (in N.C.)		3.2	4.0	4.5	5.5	8.0				
TOTAL (in EUA)		1.083	1.429	1.631	1.993	2.900				

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : NETHERLANDS			
5. Programme description and budgets		II. SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES				DATE : 25.1.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : - Social aspects of energy supply and demand									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
	-	-	-	0.3					
TOTAL (in N.C.)	-	-	-	0.3					
TOTAL (in EUA)	-	-	-	0.109					

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY NETHERLANDS			
5. Programme description and budgets		II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS				DATE : 25.1.1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. Included in other subsectors and general system studies (see 6.1.1.)									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1		X							
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	p.m.	p.m.					
TOTAL (in N.C.)						.../...			
TOTAL (in EUA)									

SECTION 3

SUB-SECTION 3.8

U N I T E D K I N G D O M

ENERGY R+D&D POLICYSUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
0. GENERAL HEADING	<u>6.19</u>	<u>6.76</u>	<u>7.89</u>
1. RATIONAL USE OF ENERGY	<u>28.86</u>	<u>28.46</u>	<u>40.00</u>
1.0. General	8.04	6.12	8.93
1.1. Industry	7.54	8.12	11.26
1.2. Residential and commercial	9.45	8.88	10.18
1.3. Transportation	1.72	2.26	4.79
1.4. Low-grade energy utilization	0.66	1.57	1.71
1.5. Others	1.45	1.51	3.13
2. FOSSIL FUELS AND DERIVATIVES	<u>64.61</u>	<u>81.56</u>	<u>90.40</u>
2.1. Coal exploration and extraction	24.52	29.02	34.35
2.2. Coal preparation, valoris.& transpt.	1.95	2.09	2.13
2.3. Coal liquefaction	2.59	2.46	3.24
2.4. Coal gasification	0.66	0.70	1.15
2.5. Coal combustion	4.26	8.12	5.40
2.6. Oil & gas assessment & exploration	0.53	0.60	0.61
2.7. Oil & gas production	15.64	20.64	22.32
2.8. Refining and derivatives	3.62	3.52	3.54
2.9. Transport of oil	-	-	-
2.10. Transport of gas	9.60	12.95	16.03
2.11. Storage of oil	-	-	-
2.12. Storage of gas	0.55	0.64	0.39
2.13. Others	0.69	0.81	1.25

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>187.30</u>	<u>195.26</u>	<u>206.85</u>
3.1. Proven reactors	43.25	46.79	51.79
3.2. High temperature reactors	0.96	0.31	0.15
3.3. Breeders	90.03	90.21	92.86
3.4. Fuel cycle	included in 3.1. and 3.3.		
3.5. Nuclear safety	} 37.30	} 35.63	} 41.22
3.6. Waste treatment and disposal			
3.7. Radiation prot.& decommiss.of power pl.			
3.8. Fissile materials control			
3.9. Others	15.76	22.32	20.83
4. NEW ENERGY SOURCES AND VECTORS	<u>11.90</u>	<u>16.66</u>	<u>21.02</u>
4.1. Thermonuclear fusion	10.61	11.16	11.90
4.2. Geothermal energy	0.24	0.46	0.65
4.3. Solar energy	-	2.37	2.47
4.4. Ocean	1.05	2.35	5.55
4.5. Wind	-	0.32	0.45
4.6. Hydrogen as an energy vector	-	-	-
4.7. Others	-	-	-
5. ELECTRICITY	<u>35.90</u>	<u>35.07</u>	<u>35.69</u>
5.1. Electricity generating equipment	23.57	24.08	24.38
5.2. Transport of electricity	7.73	6.77	6.50
5.3. Control & instrumentation	4.21	3.76	4.06
5.4. Fuel cells	-	-	-
5.5. Electrochemical storage	0.23	0.31	0.60
5.6. Other storage techniques	0.16	0.15	0.15

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>9.31</u>	<u>10.52</u>	<u>11.33</u>
6.1. Analytical studies on energy systems	-	-	0.15
6.2. Socio-economic studies	1.64	1.85	1.96
6.3. Studies on environmental effects	5.58	6.53	6.99
6.4. Safety	2.09	2.14	2.23
T O T A L	<u>344.07</u>	<u>374.29</u>	<u>413.18</u>

QUALIFICATION STATEMENTS

1. The data are based on expenditures during the fiscal from April 1st to March 31st of the following year. This return on public sector energy RD and D in the UK is in three sections, covering :

- a) Government funded R, D & D
- b) R, D and D in the Nationalised Fuel and Power Industries in the UK
- c) UK involvement in IEA energy R & D projects

The contribution made by the nationalised fuel and power industries in the UK is a large and important element in the national programme, and it is important to distinguish it from work receiving Government support, although the programmes are well integrated in the appropriate areas.

This return will be used in parallel as a data input to IEA, and it is for this reason that IEA projects have been separately identified.

2. In the case of new programme sectors, budget information is given in the sub-sector sheets in the form of the total planned commitment over the duration of the programme. All programmes show a build-up curve in effort and expenditure : Departmental expenditure on contracted work is incurred only on completion of work in whole or, more frequently, in part. Hence commitment is considered to give the more appropriate indication of effort.
3. The budget information is collected into a single table and presented in page 385-7. This covers the three sections in which the detailed programme information is given. Where budget data is spread over a period, for this table, commitment in each year has been estimated.
4. In some areas, particularly in the programmes of the nationalised fuel and power industries, forward estimates of expenditure are not available under the sub-sector headings adopted for this review; these are not identical with headings normally used for aggregation of programme data.

5. UK GOVERNMENT expenditure on R & D in nuclear energy

United Kingdom Atomic Energy Authority expenditure, published in the Annual Report of UKAEA, is as follows and is listed against the sub-heads given. Data against other sub-heads is not available. Under these headings fuel cycle development is included under appropriate reactor heading. Expenditure in £ thousands.

	1976-77	1977-78	1978-79
1 Power Programme			
(a) Main Reactor Systems			
Advanced Gas-Cooled	6,661	7,161)	approx 17,000
Water Moderated Systems	8,658	8,913)	
Fast Systems	53,227	55,842	approx 58,000
(b) Nuclear Safety and the environment	18,209	19,677)	approx 23,000
(c) Other work in support of the nuclear power programme	4,319	2,832)	
(d) Grants to international projects	82	71)	
2 Other Nuclear			approx 14,000
(a) Applied	388	301)	
(b) Underlying	9,328	14,237)	
(c) Nuclear fusion and plasma physics	6,619	7,261	approx 8,000
	<u>107,491</u>	<u>116,295</u>	<u>118.9</u>

The estimated out-turn for 1978-79 is £ 118.9 million. The detailed information under the sub-heads is not available, but the balance between programmes is not expected to shift in any gross sense and estimates for that year have been made on that basis. Forward estimates are not available.

These headings do not correspond to the headings of the Commissions classification. The Advanced Gas Cooled and Water Moderated Systems together constitute 3.1 and Fast Systems corresponds to 3.3. However the data include expenditure for development of the appropriate fuel cycle, and expenditure equivalent to 3.4 is not separately identified. Item 3.5, 3.6, 3.7 and 3.8 are contained in items 1(b) and 1(c) above. Items 1(d) 2(a) and 2(b) are equivalent to 3.9.

The nuclear energy data do not include UK Government contributions to IAEA and NEA, nor Government contribution for design and development contracts placed with the nuclear industry which amounted to some £ 10 million per year in 1976-77 and 1977-78.

6. The totals of expenditure derived in this review, in total, in sector and in total for organisations involved, differ in detail from other statements of R D and D expenditure. This is due to differences in content appropriate to different presentations. Such differences will be reduced as standard classifications are accepted and successively applied.

TABLE 1 SUMMARY OF BUDGET DATA : ENERGY R, D AND D IN THE PUBLIC SECTOR IN UK

(Titles of the nationalised fuel and power industries are indicated as follows:)
 ()
 (British Gas Corporation BGC)
 (Electricity Council EC)
 (National Coal Board NCB)

General Heading		1976-77	1977-78	1978-79	1979-80	1980-81	
(not separated by classification)		£m	£m	£m	£m	£m	
Government		3.85	4.42	5.3	5.4	5.85	
Section 1 Rational Use of Energy							
General - all sub-sectors		5	4	6	7	9	
1.1	Industry	Government	0.79	1.42	2.56	2.16	1.79
		" (IEA)	-	0.12	0.20	0.21	-
		BGC	1.24	1.37	1.66	1.84	2.04
		EC	2.66	2.40	3.15	NA	NA
		TOTAL	4.69	5.31	7.57		
1.2	Residential etc	Government	1.27	1.14	1.05	1.62	1.62
		BGC	4.07	4.13	5.20	5.55	6.13
		EC	0.54	0.54	0.59	NA	NA
		TOTAL	5.88	5.81	6.84		
1.3	Transport	Government	0.70	1.0	2.3	3.4	3.4
		EC	0.37	0.48	0.92	NA	NA
		TOTAL	1.07	1.48	3.22		
1.4	Low Grade Energy	Government	-	0.35	0.35	0.20	0.20
		EC	0.41	0.68	0.80	NA	NA
		TOTAL	0.41	1.03	1.15		
1.5	Other	EC	0.90	0.99	2.10	NA	NA
		TOTAL	0.90	0.99	2.10		
TOTAL FOR SECTOR 1		17.95	18.62	26.88			
Section 2 Fossil Fuels and Derivatives							
2.1	Coal Exploration	NCB	15.25	18.98	23.08	NA	NA
		TOTAL	15.25	18.98	23.08		
2.2	Coal Preparation etc	NCB	1.21	1.37	1.43	NA	NA
		TOTAL	1.21	1.37	1.43		
2.3	Coal Liquefaction	Government	-	-	0.54	2.46	5.33
		NCB	1.61	1.61	1.64	NA	NA
		TOTAL	1.61	1.61	2.18		
2.4	Coal Gasification	BGC	0.14	0.18	0.42	NA	NA
		NCB	0.27	0.28	0.35	NA	NA
		TOTAL	0.41	0.46	0.77		
2.5	Coal Combustion	Government	0.50	1.95	0.60	0.60	0.60
		(IEA)	0.95	2.16	1.53	NA	NA
		NCB	0.95	2.16	1.53	NA	NA
		EC	1.20	1.20	1.50	NA	NA
		TOTAL	2.65	5.31	3.63		

TABLE 1 CONTINUED

			1976-77 £m		1977-78 £m		1978-79 £m		1979-80 £m		1980-81 £m	
<u>Section 2 (Continued)</u>												
2.6	Oil and Gas Assessment	BGC	0.33		0.39		0.41		0.45		0.52	
		<u>TOTAL</u>	0.33		0.39		0.41		0.45		0.52	
2.7	Oil and Gas Production	Government	9.73		13.5		15		16		17	
		<u>TOTAL</u>	9.73		13.5		15		16		17	
2.8	Refining and Derivatives	BGC	2.25		2.30		2.38		NA		NA	
		<u>TOTAL</u>	2.25		2.30		2.38		NA		NA	
2.10	Transport of Gas	BGC	5.97		8.47		10.77		12.99		13.74	
		<u>TOTAL</u>	5.97		8.47		10.77		12.99		13.74	
2.12	Storage of Gas	BGC	0.34		0.42		0.26		0.38		0.42	
		<u>TOTAL</u>	0.34		0.42		0.26		0.38		0.42	
2.13	Others	BGC	0.43		0.53		0.84		NA		NA	
		<u>TOTAL</u>	0.43		0.53		0.84		NA		NA	
<u>TOTAL FOR SECTOR 2</u>			40.18		53.34		59.75					
<u>Section 3 Nuclear Power</u>												
3.1	Proven Reactors	Government	15.3		16.1		17		NA		NA	
		EC	11.6		14.5		17.8		NA		NA	
		<u>TOTAL</u>	26.9		30.6		34.8					
3.2	High Temp Reactors	EC	0.60		0.20		0.10		NA		NA	
		<u>TOTAL</u>	0.60		0.20		0.10		NA		NA	
3.3	Breeders	Government	53.2		55.8		58		NA		NA	
		EC	2.80		3.2		4.4		NA		NA	
		<u>TOTAL</u>	56.0		59.0		62.4					
3.4	Fuel Cycle Included in 3.1 and 3.3		6.0									
3.5	Nuclear Safety	EC	0.7		0.8		1.2		NA		NA	
3.6	Waste Treatment etc	Government	0		0		3.5		5.3		7.0	
		Government	22.5		22.5		23		NA		NA	
3.7	Decommissioning and Radiation Protection	Government										
3.8	Fissile Material Control											
		<u>TOTAL</u>	23.2		23.3		27.7					
3.9	Others	Government	9.8		14.6		14		NA		NA	
		<u>TOTAL</u>	9.8		14.6		14					
<u>TOTAL FOR SECTOR 3</u>			115.9		127.5		138.9					

TABLE 1 CONTINUED

			1976-77 £m	1977-78 £m	1978-79 £m	1979-80 £m	1980-81 £m		
Section 4 New Energy Sources and Vectors									
4.1	Thermonuclear	Government	6.6	7.3	8	8	NA	NA	NA
		TOTAL	6.6	7.3	8	8	NA	NA	NA
4.2	Geothermal	Government	0.13	0.26	0.37	0.56	0.56	0.26	
		Government IEA		0.02	0.05				
		EC	0.02	0.02	0.02	0.44	NA	NA	
		TOTAL	0.15	0.30	0.44	0.44	NA	NA	
4.3	Solar	Government	-	1.5	1.5	1.5	1.5	1.5	
		TOTAL	-	0.05	1.55	0.16	1.66	1.5	1.5
4.4	Ocean	Government	0.55	1.34	3.3	4.5	4.5	4.5	
		Government IEA			0.13				
		EC	0.10	0.20	0.30	3.73	NA	NA	
		TOTAL	0.65	1.54	3.73	3.73	NA	NA	
4.5	Wind	Government	-	0.17	0.20	1.0	1.0	1.2	
		EC	-	0.04	0.10	NA	NA	NA	
		TOTAL	-	0.21	0.30	0.30	0.30	0.30	
TOTAL FOR SECTOR 4			7.40	10.90	14.13	14.13			
Section 5 Electricity									
5.1	Electricity Generation	EC	14.86	15.75	16.38	16.38	NA	NA	
		TOTAL	14.86	15.75	16.38	16.38	NA	NA	
5.2	Transport of Electricity	EC	4.81	4.43	4.37	4.37	NA	NA	
		TOTAL	4.81	4.43	4.37	4.37	NA	NA	
5.3	Control and Instrumentation	EC	2.62	2.46	2.73	2.73	NA	NA	
		TOTAL	2.62	2.46	2.73	2.73	NA	NA	
5.5	Electrochemical Storage	Government	0.14	0.20	0.40	0.40	0.13	0.13	
		TOTAL	0.14	0.20	0.40	0.40	0.13	0.13	0.13
5.6	Other Storage Techniques	EC	0.1	0.1	0.1	0.1	NA	NA	
		TOTAL	0.1	0.1	0.1	0.1	NA	NA	
TOTAL FOR SECTOR 5			22.53	22.94	23.98	23.98			
Section 6 General Studies									
6.1	Analytical Studies	BGC	-	-	0.10	0.10	NA	NA	
		TOTAL	-	-	0.10	0.10	NA	NA	
6.2	Socio-Economic Studies	Government	-	-	-	0.15	0.15	0.15	
		NCB	1.02	1.21	1.32	NA	NA	NA	
		TOTAL	1.02	1.21	1.32	1.32	NA	NA	
6.3	Environmental Studies	Government	0.57	0.59	0.59	0.95	0.95	0.95	
		BGC	0.18	0.17	0.19	NA	NA	NA	
		EC	2.19	2.95	3.28	NA	NA	NA	
		NCB	0.53	0.56	0.64	NA	NA	NA	
		TOTAL	3.47	4.27	4.70	4.70	4.70	4.70	
6.4	Safety	Government	1.3	1.4	1.5	1.6	1.6	1.7	
		TOTAL	1.3	1.4	1.5	1.5	1.6	1.7	1.7
TOTAL FOR SECTOR 6			5.79	6.88	7.62	7.62			
Sum for Sectors 1-6 and General Section			210	240	271	271			

COUNTRY: UNITED KINGDOM

ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION POLICY

1. General objectives

- Identify those technologies which would keep open options over a wide range of possible future conditions, and if possible, obtain broad national consent to the importance of pursuing these technologies.
- Give priority to technologies for the medium term which ensure that the United Kingdom derives maximum advantage from its indigenous reserves of North Sea oil and gas.
- Give priority to conservation, coal and nuclear technologies because they will be essential to the United Kingdom over a wide range of possible future conditions.
- Use the breathing space given to the United Kingdom by North Sea oil and gas to assess thoroughly the alternative energy technologies, and to invest in developing those selected for opening valuable options at reasonable cost; the United Kingdom would then be in a position to proceed with demonstration plants if and when appropriate.

Alternative energy sources could make a useful contribution to energy supply by the turn of the century and in the next century they could help bridge part of the gap between demand and indigenous supply. Research and development to establish their ultimate potential and economic practicabilities is important.

- To seek, where appropriate, opportunities for international co-operation on a cost-sharing basis.

2. Specific objectives

a. Short-term (1977-85) and medium-term (1985-1995)

- Support the off-shore oil and gas exploitation by oil industry
 - . safety of off-shore oil and gas operations
 - . environmental aspects
 - . enhanced recovery
 - . deep-water oil gas technologies
- Energy conservation
- Coal
 - . geological exploration
 - . efficiency in coal mining (deep mining)
 - . improvement of existing coal using processes
 - . new opportunities for coal and coal derivatives
 - . direct utilisation of coal and coal conversion

- Nuclear energy

- . support the completion and operation of advanced gas cooled reactor (AGR) stations
- . generic development work on thermal reactors
- . development work on Na-cooled fast breeder systems
- . environmental and safety aspects, including radioactive waste management
- . improved fabrication and fuel reprocessing methods

b. Long-term (2000 and beyond)

- Thermonuclear fusion

- Alternative energy sources

- . solar
- . waves
- . wind
- . tidal
- . geothermal

3. Priorities

- off-shore oil and gas
- conservation
- coal
- nuclear power
- alternative energy sources

4. On-going and/or planned comprehensive programmes and budgets

None.

<u>R+D&D POLICY</u>	I. SECTOR	O. GENERAL	COUNTRY : U.K.						
5. Programme description and budgets	II.SUB-SECTOR	-	DATE : MARCH 1979						
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. The Energy Technology Support Unit was established by the Department of Energy in 1974 to supplement the resources of the Department in non-nuclear non-marine R&D. ETSU assesses technical areas, defines R&D requirements and manages resultant R&D and demonstration programmes in the areas of energy conservation and alternative energy sources. ETSU provides the central working and coordinating effort in the formulation of a strategy for energy R & D.</p> <p>2. The Marine Technology Support Unit supplements the resources of the Department of Energy in energy related marine technology R&D. It undertakes technical supervision and management of many projects in the Department's offshore R&D programme, and reviews technical areas.</p> <p>Items 1 and 2 above are part of the R&D expenditure of the Department of Energy.</p> <p>3. The Science Research Council supports both fundamental research and applied R&D in the earlier stages of development. Support is given via research grants of 2 to 3 years' duration, placed with individual workers or groups in educational research institutes. The Council has an Energy Proposals Committee and an Energy Round Table, but energy is not listed as a separate funding heading. Definition of research having an energy content is therefore imprecise, but work funded covers the whole field of energy R&D specified in this review.</p> <p>4. The Natural Environment Research Council similarly supports by research grants research projects within its areas of responsibility. It funds work from its Science Vote within its own research institutes. Both activities include energy and energy-related projects, mostly concerned with natural resources and environmental interactions</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2	X								
3	X								
4	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1	0.66	1.02	1.60	1.60	1.60				
2	0.29	0.40	0.60	0.70	0.70				
3	app. 2.0	app. 2.0	app.2.0	app. 2.0	app. 2.0				
4	app. 0.9	app. 1.0	app.1.1	app. 1.1	app. 1.5				
TOTAL (in N.C.)	3.85	4.42	5.30	5.40	5.80				
TOTAL (in EUA)	6.19	6.76	7.89	8.04	8.63				

R+D&D POLICY	I. SECTOR	1. RATIONAL USE OF ENERGY	COUNTRY : U.K.							
5. Programme description and budgets	II.SUB-SECTOR	1.0 GENERAL	DATE : MARCH 1979							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. An allocation of £20 million over four years for Government support for demonstration projects in energy conservation was announced in December 1977. The funds allocated are £2 million in 1978-79 rising to £8 million in 1981-82. Funding for industry, building sectors, etc., has not been separately differentiated.</p> <p>The emphasis is on demonstration in full-scale working plant of technology to produce energy saving, to reduce the technical and economic uncertainties associated with its application and to encourage its wider use and appropriate investment. Projects include necessary monitoring and assessment, and publication of results. Support is given generally via shared cost contracts.</p> <p>2. A wide range of R&D in industry, building and transport includes some element of energy use, but rational use of energy or energy conservation is not the prime motive for this work. This contribution is important, but difficult to quantify. A decreasing figure is allocated to allow for identification of items as the energy interest becomes increasingly important.</p> <p>3. UK participates in the EEC programme on energy conservation R&D and UK organisations receive support from the Commission in the indirect action R&D programme.</p>										
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION					
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X									
2	X									
3	X				X					
										.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)					
1	-	-	2	4	6					
2	5	4	4	3	3					
3	-	-	-	-	-					
					.../...					
TOTAL (in N.C.)	5	4	6	7	9					
TOTAL (in EUA)	8.04	6.12	8.93	10.42	13.39					

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : U.K.
	II.SUB-SECTOR 1.1 INDUSTRY	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. R&D PROGRAMMES OF UK GOVERNMENT DEPARTMENTS

1.1. Energy Audit Studies (1975-1978)

- a programme of studies, carried out by the Energy Technology Support Unit (ETSU), for the Department of Energy and the Department of Industry Energy Unit, designed to investigate energy flows in 18 of the more energy-intensive sectors of manufacturing industry. Studies are now completed and the first two reports, giving the findings for the iron castings and building brick industry, have been published. Further selected audit studies are to be published in the future. From these studies the aim is to determine what R&D and new technology is needed by industry in order to use energy as efficiently as possible.

1.2. Demonstration Projects (started January 1977)

- demonstration projects are concerned with the practical application of the results of scientific and technological R&D. The first tranche of funds, totalling £1.5 m, was directed towards industrial demonstration projects which had as their objective the demonstration of the potential for energy saving, initially in the field of waste heat recovery. Both the UK Departments of Industry and Energy are taking part in this programme, due to last 2 years in the first instance.

Demonstration projects can involve:

- (i) instrumentation, monitoring and assessment of existing installations;
- (ii) new applications of energy-saving technology in industrial situations using equipment already available;

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IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	X							
2	X							
								.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1.1	p.m.	p.m.	p.m.		
1.2	-	0.63	0.87	←	→
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)					

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

(iii) more general R&D leading to improved or novel equipment in processes.

So far, £634K has been allocated to approved projects. Industrial participation, through shared-cost contracts let to date (November 1978) adds a commitment of £11,000 to this programme. (In December 1977, the programme was enlarged: details are given in the cover paper.)

1.3 Department of Industry R&D Activities

Operated through the Requirements Boards which exist to ensure that R&D necessary to improve industrial efficiency is carried out. Boards are specific to selected industrial sectors and, together with Industry Divisions, are engaged in a number of programmes, some of which could have an impact on improving the efficiency of energy use in industry. These programmes are given below:

1.3.1 Development and evaluation work to improve the effectiveness of moisture measurement and control in industrial processes. About 15% of the work is directed towards energy conservation. Funding is shared 50:50 by the Department and industry.

1.3.2 Operating efficiencies in foundries; raw materials and cost reduction in ceramics manufacture; studies on fuel-fired furnaces (non-ferrous metals); energy utilisation in the glass industry; utilisation of rubber and plastic resources; improving standards of heat treatment of engineering components; improved strand annealing furnaces; materials for lightweight vehicles. Funding is shared between the Department and Industry at about 50:50. In addition to the above work, studies designed to improve non-ferrous metal foundries are planned. Total funding, on a shared-out basis, is expected to be £400,000 from 1978-1981.

1.3.3 Diminishing electrical and mechanical losses of energy in industrial machinery by the substitution of centralised hydraulic power systems. Information gathering studies are already underway and these are expected to lead to demonstration projects for this type of plant. Over the period of the work, about 30% of the funds have been supplied by industry. ./...

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1.3.1.	X									
1.3.2.	X									
1.3.3.	X									
1.3.4.	X									
V. BUDGETS										
(nat. currency)	OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1.3.1.		0.010	0.01	0.01	← 0.01 →					
1.3.2.		0.02	0.10	0.89	← 0.85 →					
1.3.3.		0.02	0.02	0.03	← 0.08 →					
1.3.4.		0.30	0.30	0.30	← 0.30 →					
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : U.K.
	II.SUB-SECTOR 1.1. INDUSTRY (contd.)	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

- 1.3.4 Development of improved thermal design procedures for industrial heat exchangers. Work in support of the Heat Transfer and Fluid Flow Service (HTFFS).
- 1.3.5 Promotion of more efficient use of electric motors and electrical variable speed drives (both AC and DC). Funding from industry for this project is estimated to be 35%.
- 1.3.6 Industrial Energy Thrift Scheme with objectives:
- (a) to promote more efficient use of energy in industry through improvements in process efficiency and the adoption of "good housekeeping" practices;
 - (b) to gather information on energy-saving opportunities and the need for R&D and demonstration projects directed towards the improvement of energy utilisation.
- 1.3.7 A number of projects, some now completed, designed to make better use of energy in the textile industry: including energy saving in heat-setting and dye-fixation of textile fabrics on stenten; reduction of energy consumption in stenters through control of the humidity of the exhaust; waste heat recovery from textile washing ranges. Industry and the EEC are contributing about 67% of the funds for this work.
- 1.3.8 Productivity and energy conservation in the paper and board industry: a small programme (£25,000), completed in 1976.

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1.3.5.	X								
1.3.6.	X								
1.3.7.	X			X					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1.3.5.	NIL	0.01	0.03	← 0.01 →					
1.3.6.	0.44	0.34	0.64	1.24	1.14				
1.3.7.	NIL	0.005	0.06	← 0.05 →					
						.../...			
TOTAL (in N.C.) of 1	0.79	1.42	2.56	2.16	1.79				
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

1.4 Ministry of Agriculture, Fisheries and Food Activities

- Improvement of crop drying equipment with consequent reduction in energy consumption. (Techniques etc. for drying cereals and herbage are being studied, including the potential for use of solar energy and use of straw as a fuel.)
No expenditure figures given.

2. UK PARTICIPATION IN I.E.A. ACTIVITIES

2.1 Combustion

The UK participant is the United Kingdom Atomic Energy Authority.

Work started in March 1977 in three areas of work, broadly divided into: combustion systems modelling; development of instrumentation to study fundamental combustion processes; and information services.

2.2 Heat Transfer and Heat Exchangers

The UK participated in three tasks of the Implementing Agreement.

The UK participant is the United Kingdom Atomic Energy Authority.

UKAEA is the operating agent in all three tasks;

The three task areas are:

- (i) heat transfer from extended services, with the UK concentrating on frosting problems of industrial refrigeration units and corrosion test design equipment
- (ii) optimisation of heat-exchanger networks, including design and hand-calculation synthesis studies

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IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2.1	X					X				
2.2	X					X				
2.3	X					X				
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
2.1	-	0.031	← 0.18 →							
2.2	-	0.085	← 0.185 →							
2.3	-	-	← 0.032 →							
TOTAL (in N.C.) of 2	-	0.12	0.20	0.21						
TOTAL (in EUA)										

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- development of controls and systems, metering and improved air/gas ratio controls;
- safety standards and testing to approved standards and quality assurance.

4. R&D PROGRAMME OF THE ELECTRICITY COUNCIL

Work includes:

- metal melting and winning; design and performance of furnaces and equipment; studies of associated electrical and metallurgical technology;
- metal deformation and heat treatment; high frequency and induction heating; electron beam heating;
- chemical and allied industries, electrochemical processing and technology;
- electro-physical processes in industrial applications; drying, humidity control; magnetic separation; plasma technology; heat pumps.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
4	X								
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
4		2.66	2.40	3.15	n.a.	n.a.			
TOTAL (in N.C.)	1 ÷ 4	4.69	5.31	7.57					
TOTAL (in EUA)		7.54	8.12	11.26					

<u>R+D&D POLICY</u>	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : U.K.							
5. Programme description and budgets	II.SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL	DATE : MARCH 1979							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>R & D PROGRAMMES OF UK GOVERNMENT DEPARTMENTS</u></p> <p>1.1. <u>Energy Conservation in Buildings</u></p> <p>To provide information</p> <ul style="list-style-type: none"> - for building designs and operators in the public and private sectors, in relation to measures for reducing energy consumption - to guide legislation and policy <p>Works includes</p> <ul style="list-style-type: none"> - identification of cost-effective energy saving measures in existing buildings, especially houses - design and development of novel energy saving building features and systems - assessment of energy savings from such measures - design methods and data for district heating - thermal design of buildings - use of heat pumps <p>1.2. <u>Building Services</u></p> <p>To quantify requirements for lighting, heating and ventilating systems and develop technology consistant with minimum energy consumption.</p> <ul style="list-style-type: none"> - heating : survey of requirements, efficiency of systems, performance of controls and their use by occupants - lighting : requirements and control techniques for offices, schools, etc. <p align="right">.../...</p>									
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION		INTERNATIONAL COOPERATION						
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1.1	x								
1.2	x								
1.3	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1.1.	0.67	0.67	0.73	2.34					
1.2.	0.30	0.27	0.32	0.90					
1.3.	0.30	0.20							
TOTAL (in N.C.) ^{item 1}	1.27	1.14	1.05	1.62	1.62				
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (con*inuation)

- ventilation : study of air movements in building spaces and development of methods for predicting natural ventilation rates : studies and trials in hospitals

1.3. Combined Heat and Power

Assessment studies of CHP and its potential for district heating.

2. CURRENT ACTIVITIES AT THE BRITISH GAS CORPORATION

- effect on energy consumption of how heating systems are used
- development of high efficiency and low heat load prototype boiler for hot water production
- development of high reliability components
 - . burners without aeration adjustments
 - . rationalized spark ignition components
 - . central heating controls
 - . radiator valves, radiators, joints
 - . development of cooker market
- . environmental performance and efficiency of room heating; domestic heating market studies
- . work on service, installation and reliability engineering

3. CURRENT ACTIVITIES OF THE ELECTRICITY COUNCIL

- Domestic sector programme directed to low and efficient energy use in houses
- commercial sector programme covering heating, lighting and ventilation in commercial and industrial premises
- community sector programme including heat recovery in swimming pools; venturi aeration in effluent treatment
- associated market studies.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2	x									
3	x									
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)					
2	4.07	4.13	5.20	5.55	6.13					
3	0.54	0.54	0.59	n.a.	n.a.					
TOTAL (in N.C.)	5.88	5.81	6.84							
TOTAL (in EUA)	9.45	8.88	10.18							

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : U.K.	
5. Programme description and budgets		II.SUB-SECTOR 1.3. TRANSPORTATION			DATE : MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>RED PROGRAMMES OF UK GOVERNMENT DEPARTMENTS</u></p> <p>Gouvernement R & D on transport includes</p> <ul style="list-style-type: none"> - analysis and optimisation of consumption by vehicle weight reduction, fuel economy devices, aerodynamic drag studies - engine/fuel optimisation, test bed and field trials to develop components and systems - fuel economy and emission studies - use of alternative fuels - evaluation and development of electric vehicles and batteries - alternative engines : evolution and development of automotive and marine engines - automobile exhaust gas sensors for mixture control - studies of fuel saving in shipping - energy use in road construction <p>2. <u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>Projects underway to improve the potential for electric vehicles in transport.</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	x					
2	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1	0.7	1.0	2.3	6.8		
2	0.37	0.48	0.92	n.a.	n.a.	
						.../...
TOTAL (in N.C.)	1.07	1.48	3.22			
TOTAL (in EUA)	1.72	2.26	4.79			

<u>R+D&D POLICY</u>		I. SECTOR 1. RATIONAL USE OF ENERGY			COUNTRY : U.K.	
5. Programme description and budgets		II.SUB-SECTOR 1.4. LOW GRADE ENERGY UTILISATION			DATE :MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>R & D PROGRAMMES OF UK GOVERNMENT DEPARTMENTS</u></p> <p>Recycling and use of urban and industrial wastes :</p> <ul style="list-style-type: none"> - optimisation of burners design and conditions for suspension firing/combustion of fuel products from wastes - anaerobic fermentation of organic wastes - development of marketable solid fuel products from household and commercial wastes <p>2. <u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>The programme is aimed at conserving energy by exploring uses for the low temperature cooling water rejected from power stations. Work on heat utilisation of cooling water eg for greenhouse heating, fish culture and bacteriological processes relating to sewage treatment. Heat pump development</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
	others	envisaged	% of share			
1	x					
2	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1	-	0.35	0.35	0.4		
2	0.41	0.68	0.80	n.a.	n.a.	
						.../...
TOTAL (in N.C.)	0.41	1.03	1.15			
TOTAL (in EUA)	0.66	1.57	1.71			

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : U.K.
	II. SUB-SECTOR 1.5. OTHERS	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

As part of an ongoing programme of commercial and economic research, patterns of energy consumption on farms are being determined. Through a monitoring exercise covering a sample of farms, data is being obtained on costs of electricity supply.

2. UK PARTICIPATION IN I.E.A. ACTIVITIES

Buildings and Community Systems

The UK participated in 1 task of this Implementing Agreement.

The UK participants are Atkins Research and Development

British Gas Corporation

Electricity Council

Haden Young Ltd

Oscar Faber and Partners

Over Arup and Partners

Pilkington Bros Ltd

University of Glasgow

University of Strathclyde

University of Wales Institute of Science and Technology.

Under this heading, three projects are being sponsored with the overall aim to integrate energy management with urban planning community design and building design. Project areas are : community planning, conservation in building complexes, and building energy load determination in which the UK participates.

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1	x							
2	x				x			
								.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1	0.90	0.99	2.10	n.a.	n.a.			
2	-	-	-					
TOTAL (in N.C.)	0.90	0.99	2.10					
TOTAL (in EUA)	1.45	1.51	3.13					

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : U.K.
5. Programme description and budgets	II. SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

R & D PROGRAMME OF THE NATIONAL COAL BOARD (NCB) : MAJOR OBJECTIVES INCLUDE :

Mining technology

1. General objectives

- . the extension of remote and automatic control and monitoring, with particular emphasis on coal transport underground and ventilating systems;
- . the development of fully mechanised face end systems;
- . the improvement in the reliability of machines and equipment.

2. Coal face sector - some of the work involves international collaboration.

- . development of the chainless haulage systems for power loaders;
- . increase "tonnage/machine pass" with 1-metre web mining systems;
- . extended use of wide web working;
- . development of nucleonic automatic steering system for ranging arm shearers
- . field trials of new shield supports
- . trials with ripping at the face line
- . continuing work on dust control and collecting systems for face ends.

3. Underground roadways driving - some work involves international collaboration.

- . first trial of a test rig for cutting hard rock
- . increased use in coal fields of the in-seam heading machine
 - + thin and steep seams
 - + as a coal-getting machine with moderate output at high efficiency and low capital cost
- . ancilliary operations connected with roadway support systems.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	x								
2	x								
3	x								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1	-	-	-		
2	3.23	3.67	5.59	n.a.	n.a.
3	1.62 est ^{on}	1.47 est ^{on}	1.21	n.a.	n.a.
					.../...
TOTAL (in N.C.) 1-3	4.85 est ^{on}	5.14 est ^{on}	6.80		
TOTAL (in EUA)					

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : U.K.
	II. SUB-SECTOR 2.1. COAL EXPLORATION AND EXTRACTION (cont.d)	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

R & D PROGRAMME OF THE NATIONAL COAL BOARD (NCB). (CONTINUED)

7. Safety and health

- . CH₄ prediction and control
- . control of respirable dust, of machinery noise and of problem of heat and humidity (great depth mining)
- . Collieries
 - + prediction of strata behaviour
 - + sensing techniques to differentiate coal/stone layers
 - + underground seismic techniques for the location of faults

8. Machinery and equipment - some work involves international collaboration

- . testing of :
 - + roof supports
 - + hydraulic equipment
 - + underground machines
 - + newly developed heavy duty armoured face conveyors
 - + life reliability of power loader trailing cables
 - + method of power transmission to conveyor mounted coal cutting machines
 - + metallurgical and materials testing.

9. Future mining techniques

- . hydraulic mining
- . underground gasification

10. In addition to the funds allocated for the programmes described above, the European Coal and Steel Community (ECSC) supported R & D programmes of the NCB into the following areas: coal face studies; roadway drirage; underground transport; coal preparation; comprehensive monitoring; basic studies and testing. Separate figures for these items are not available and therefore the expenditures on underground transport and coal preparation are given here.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
7	x								
8	x								
9	x								
10	x				x				
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
7	1.50 est. ^{on}	2.19 est. ^{on}	2.37	n.a.	n.a.
8	2.5 est. ^{on}	3.00 est. ^{on}	3.10	n.a.	n.a.
9	Expenditure included in item 7.				
10	1.5	2.55	3.11	n.a.	n.a.
					.../...
TOTAL (in N.C.) 1-10	15.25	18.98	23.08		
TOTAL (in EUA)	24.52	29.02	34.35		

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES					COUNTRY : U.K.
	II. SUB-SECTOR 2.3. COAL LIQUEFACTION					DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. In May 1978 the Government announced support for the development projects on coal liquefaction. These arise from R & D conducted by the National Coal Board. The eight year programme will cost an estimated £ 31 million; up to March '83 the cost is estimated as £ 24 million, and of this the Government will provide £ 15 million. The balance will fall to the National Coal Board.

The Coal Liquefaction projects are :

1.1. Liquid Solvent Extraction : involves treating coal with a hot liquid solvent, hydrogenation of the solution to give a synthetic crude oil and product and recycled solvent. The total project cost is estimated to be £ 16 million.

1a) design phase 1b) implementation phase

1.2. Supercritical Gas Solvent Extraction : uses high pressure gas to dissolve coal. The end product shows promise as an aromatic chemical feedstock. The total project cost is estimated as £ 15 million.

2a) design phase 2b) implementation phase

2. R & D PROGRAMME OF THE NATIONAL COAL BOARD (NCB)

2.1. Pyrolysis

(a) Co-operative IEA project

- fundamentals of pyrolysis at various heating rates and in different atmospheres

(b) Current activities at N.C.B.

- study of rapid heating of coal in hydrogen at pressures up to 150 bar and 1200°K

- conversion of coal extract to acetylene in a plasma arc

. optimisation of yield and energy consumption.

.../...

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1.1.a	x							
1.1.b		x						
1.2.a	x							
1.2.b		x						
								.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1.1 (Govt. share)	-	-	0.27	1.33	3.0
1.2 (")	-	-	0.27	1.13	2.33
1.1 (N.C.B. share)	-	-	0.13	0.67	1.50
1.2 (")	-	-	0.13	0.57	1.17
					.../...
TOTAL (in N.C.) Govt.	-	-	0.54	2.46	5.33
TOTAL (in EUA)					

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

(c) N.C.B. Project

Design, construction and operation of a 20 ton/day pilot plant for the rapid heating of coal in the absence of air to give substantial quantities of liquids and gases at modest processing costs.

Total project cost : £ 17 m.

- (d) In addition to the funds allocated for current NCB activities, support for high intensity pyrolysis and aromatisation of coal derived raw materials was given from the European Coal and Steel Community (ECSC). Expenditure figures are given at (1d) below.

2.2. High pressure gas solvent extraction

- (a) construction and operation of pilot plant (120 kg coal/day) to study continuous operation :

- optimisation of the extraction conditions
- conversion of coal extracts (hydrocracking)
- development of suitable catalysts
- study of reaction mechanisms

- (b) Supercritical gas solvent extraction project (N.C.B.)

Design, construction and operation of a 20 ton/day pilot plant, in which coal is to be dissolved in a light volatile solvent, which at the temperature and pressure used in the process is in the gaseous form, to give a hydrogen-rich extract suitable for use as an aromatic chemical feedstock and for refining into liquid transport fuels.

Total project cost : £ 15 m.

3. Liquid extraction

- (a) Operation of a small scale pilot plant

- optimisation of the extraction conditions
- conversion of extracts

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2.1a	x						x			
2.1b	x									
2.1c		x								
2.1d	x							x		
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
2.1a		-	-	-	-	-				
2.1b		-	-	-	-	-				
2.1c		-	-	-	-	-				
2.1d		0.08	0.08	n.a.	n.a.	n.a.				
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY	I. SECTOR 2. FOSSIL FUELS AND DERIVATES	COUNTRY : U.K.
5. Programme description and budgets	II. SUB-SECTOR 2.3. COAL LIQUEFACTION	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY : PROGRAMME OF THE NCB (continued)

(b) Liquid solvent extraction project (N.C.B.)

Design, construction and operation of a 20 ton/day pilot plant in which coal is to be dissolved in a hot, coal-derived solvent and the solution upgraded by treatment with hydrogen to give a synthetic crude oil suitable for further refining into petrol/diesel/kerosene transport fuels for road and aviation use and for refining into chemical feedstocks.

Total project cost : £ 16 m.

4. Production of electrode coke

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
2.2a	x							
2.2b		x						
2.3a	x							
2.3b		x						
2.4	x							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
2.2.a	n.a.	n.a.	n.a.	n.a.	n.a.			
2.2.b	-	-	sec 1.2 (NCB)					
2.3.a	n.a.	n.a.	n.a.	n.a.	n.a.			
2.3.b	-	-	sec 1.1 (NCB)					
4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a./...		
TOTAL (in N.C.)	1.61 est. ^{on}	1.61 est. ^{on}	2.18 est. ^{on}					
TOTAL (in EUA)	2.59	2.46	3.24					

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATES	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 2.4. COAL GASIFICATION	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. R & D PROGRAMME OF THE NATIONAL COAL BOARD

1.1. Low BTU fuel gas (at N.C.B.)

- (a) Studies on the gasification of coal to yield low BTU fuel gas (in fluidised bed) :
- kinetics of the air, steam and CO₂ reactions (at different temperatures and pressures)
 - control of :
 - . clinkering
 - . emission of Na compounds

(b) Low BTU gasification project

Feasibility study followed by design, construction and operation of pilot plant for the steam-air gasification of coal in a fluidised bed for use in combined-cycle (gas) steam turbines electrical power generation at high efficiency.

Total project cost : £ 12 m.

1.2. In addition to the funds allocated by the National Coal Board, the European Coal and Steel Community (ECSC) is giving support to coal gasification. The expenditure figures and estimates are given below.

2. R & D PROGRAMME OF THE BRITISH GAS CORPORATION

2.1. SNG production from coal (at BGC)

- coal gasification studies
- gas treatment and up-grading processes
- effluent treatment

2.2. Entrained flow/fixed-bed composite gasifier (at BGC)

Design, construction and operation of a pilot plant for the steam-oxygen gasification of coal at high throughput and high thermal efficiency, simultaneously consuming both

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1.1.a	x								
1.1.b		x							
1.2	x								
2.1	x								
2.2									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1.1	0.11	0.12	0.16	n.a.	n.a.
1.2	0.16	0.16	0.19	n.a.	n.a.
2.1	0.14	0.18	0.42	n.a.	n.a.
2.2	-	-	n.a.	n.a.	n.a.
TOTAL (in N.C.)	0.41	0.46	0.77		
TOTAL (in EUA)	0.66	0.70	1.15		

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

lump and fine coal, to give a synthesis gas suitable for the manufacture of substitute natural gas (S.N.G.).

Total project cost: £ 12 m.

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)									

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

2. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

Major activities include :

- Coal handling and milling; slagging properties of coals, improvement of mill performance and coal classifiers, erosion problems, integrity of pulverised fuel systems. Separate expenditure figures not given.
- Combustion; model studies of furnaces, pipeline blockage studies, mixed firing techniques and disposal of residue problems, fluidised bed combustion, comparative study of coal gasification systems.

3. R & D PROGRAMME OF THE NATIONAL COAL BOARD (NCB) (Some work involves international collaboration)

3.1. Current activities at the NCB

- development of domestic heating equipment for smokeless burning of bituminous coal
- design, manufacture and operation of prototype shallow fluidised bed burners for industrial furnaces
- automatic control of coal-firing and ash-removal systems

3.2. Fluidised-bed combustion

(a) Co-operative IEA project

Design, build and operate the 85 MW(th) - nominal 28 MWe - pressurised fluidised bed combustion facility at Grimethorpe.

Total cost : £ 17 m (UK share : £ 5.7 m).

(b) Pressurised fluidised bed combustion project - NCB

Design, construction and operation of an 80 MWe (200 MWth) full-scale reference-commercial, demonstration plant for the pressurised fluidised-bed combustion of coal for use in combined cycle (gas/steam turbine) power generation, capable of operating with wide, variable grades of coal and capable of absorbing sulphur oxides in crushed limestone added to the bed.

Total project cost : £ 50 m.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
2	x									
3.1	x									
3.2a	x						x			
3.2b		x								
V. BUDGETS										
(natl. currency)		Expenditures 1976		Expenditures 1977		Estimations 1978		Estimations 1979		Estimations 1980
OBJECTIVES		(x10 ⁶)		(x10 ⁶)		(x10 ⁶)		(x10 ⁶)		(x10 ⁶)
2		1.2		1.2		1.5		n.a.		n.a.
3.2a		-		-		-				
3.2b		-		-		-				
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 2.5. COAL COMBUSTION (cont.d)				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p align="center"><u>NCB ACTIVITIES (CONTINUED)</u></p> <p>3.3. <u>Industrial boiler development</u></p> <ul style="list-style-type: none"> - design of high-intensity stoker - improving underfeed stokers - boiler testing - assessment of heat pipe air preheater performance. <p>3.4. <u>Domestic heating and fuel testing</u></p> <p>Work on the following :</p> <ul style="list-style-type: none"> . appliance development . house heating and hot water supply . fuel testing for solid fuels . appliance testing for the Domestic Solid Fuels Approved Appliance Scheme . support for technical studies related to marketing <p>3.5. European Coal and Steel Community support for combustion appliance testing.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I. E. A.	others	envisaged	% of share
3.3	x								
3.4	x								
3.5	x					x			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
3.1+3.3+3.4		0.89 est.on	2.08 est.on	1.43					
3.5		0.06	0.08	0.08	n.a.	n.a.			
TOTAL (in N.C.)		2.67	5.30	1.51					
TOTAL (in EUA)		4.29	8.10	5.37					

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES					COUNTRY : U.K.
5. Programme description and budgets	II. SUB-SECTOR 2.6 OIL AND GAS ASSESSMENT AND EXPLORATION					DATE : MARCH 1979
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE BRITISH GAS CORPORATION</u></p> <p>1. <u>Assessment of the hydrocarbon resources in UK, principally off-shore</u> (see under 2.7)</p> <p>2. <u>Supporting techniques for gas exploration and production (BGC)</u></p> <ul style="list-style-type: none"> - study of drilling cores - quality of water required for injection purposes - development and field testing of a mathematical model to simulate the depletion of gas reservoirs (enhanced gas) - gas analysis and treatment 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	x					
2	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
2	0.33	0.39	0.41	0.45	0.52	
					.../...	
TOTAL (in N.C.)	0.33	0.39	0.41	0.45	0.52	
TOTAL (in EUA)	0.53	0.60	0.61	0.67	0.77	

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES					COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 2.7. OIL AND GAS PRODUCTION					DATE :MARCH 1979
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>The Department of Energy's Offshore Technology R & D Programme has the following content.</p> <p>1. <u>Hydrocarbon assessment</u></p> <p>The acquisition and analysis of geophysical, geological and reservoir engineering data to assess UK potential hydrocarbon reserves. Currently concerned with continental shelf areas, future priorities include the examination of deep water prospects around the UK.</p> <p>Work includes</p> <ul style="list-style-type: none"> - continuous evaluation of exploration data from oil companies - geological studies, including seismic data analysis, etc. - drilling of stratigraphic holes (onshore and offshore) to test the geological succession <p>2. <u>Safety of Installations</u></p> <p>The determination of the offshore safety standards to be laid down by the Department in pursuance of its statutory responsibilities. This involves :</p> <ul style="list-style-type: none"> - determination of environmental and operational conditions offshore : prediction and understanding of wind, wave and current forces - behaviour of materials (mainly steel and concrete) in those conditions and overall performance of offshore structures and platforms - determination of appropriate design parameters to ensure long term life of offshore installations. 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1-3	x					
Part of 2				x		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1-3	9.73	13.5	15	16	17	
						.../...
TOTAL (in N.C.)	9.73	13.5	15	16	17	
TOTAL (in EUA)	15.64	20.64	22.32	23.81	25.30	

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : U.K.
	II.SUB-SECTOR 2.8. REFINING AND DERIVATIVES	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. SNG from different feedstocks (see 2.4.1) (excluding coal gasification, taken under 2.4)

R & D by BRITISH GAS CORPORATION (BGC)

Including process studies on conversion routes; feedstock and product gas data; catalytic gasification of heavy distillate feedstocks; studies on the compatibility of SNG compositions in appliances.

Non-catalytic gasification, gas recycle hydrogenator, fluid bed hydrogenator, kinetic studies.

Gas treatment and purification studies, CO₂ removal.

2. R & D BY NATIONAL COAL BOARD into coal refining was supported by the European Coal and Steel Community (ECSC). Expenditure by ECSC on this work is show below.

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x				x		ERDA		
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1	2.25	2.30	2.38	n.a.	n.a.				
2	0.25 (p.m.)	0.19 (p.m.)	0.23 (p.m.)	n.a.	n.a.				
									.../...
TOTAL (in N.C.)	2.25	2.30	2.38						
TOTAL (in EUA)	3.62	3.52	3.54						

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : U.K.				
5. Programme description and budgets		II.SUB-SECTOR 2.10. TRANSPORT OF GAS			DATE : MARCH 1979				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Maintenance and improvement</u> of the standards and methods used for the measurement of quantity and quality of transmitted and distributed gas (GSB) :</p> <ul style="list-style-type: none"> - flow measurements of natural gas at very high pressures and high flow rates; - analysis of natural gas, using and extending modern and instrumental techniques. <p><u>R & D PROGRAMME OF THE BRITISH GAS CORPORATION</u></p> <p>2. <u>Specification, testing and quality assurance</u> of large diameter (up to 42in) transmission pipes and fittings (at BGC). R & D Programme for transmission of gas :</p> <ul style="list-style-type: none"> - effects of external loading - automatic welding techniques - new protective layers (epoxy resins) - development of on-line devices for internal inspection of high pressure pipelines under operation <ul style="list-style-type: none"> . magnetic sensors . elastic waves defect detectors - development of new sealants and leak detectors - metallurgy of steel pipelines in use. <p>3. <u>R & D Programme by BGC into distribution of gas</u></p> <ul style="list-style-type: none"> - improve performance and safety of gas distribution - mains replacement, methods of underground location - leak detection - computer-aided systems design and operation 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x					x			
3	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1		0.140	0.150						
2		3.89	5.94	8.26	10.21	10.55			
3		1.94	2.38	2.51	2.78	3.19			
							.../...		
TOTAL (in N.C.)		5.97	8.47	10.77	12.99	13.74			
TOTAL (in EUA)		9.60	12.95	16.03	19.33	20.45			

<u>R+D&D POLICY</u>		I. SECTOR 2.FOSSIL FUELS AND DERIVATIVES			COUNTRY : U.K.	
5. Programme description and budgets		II.SUB-SECTOR 2.12 STORAGE OF GAS			DATE : MARCH 1979	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Current activities at the British Gas Corp</u> - development of the concept of reversible liquefied natural gas (LNG) - operational and safety aspects of LNG peak-shaving plant - improvement of the design of high pressure installations - underground storage in salt cavities (Hornsea)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	x		12			
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1	0.34	0.42	0.26	0.38	0.42	
						.../...
TOTAL (in N.C.)	0.34	0.42	0.26	0.38	0.42	
TOTAL (in EUA)	0.55	0.64	0.39	0.57	0.63	

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUEL AND DERIVATIVES				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 2.13 OTHERS				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>R & D by British Gas Corporation</u></p> <p>Technology : Gas explosion - studies in the following areas :</p> <ul style="list-style-type: none"> - explosions in plant and premises - gas dispersion and unconfined explosions - fire hazards 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities *	I.E.A.	others	envisaged	% of share
1	x					x part			
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1		0.43	0.53	0.84					
TOTAL (in N.C.)		0.43	0.53	0.84					
TOTAL (in EUA)		0.69	0.81	1.25					

SECTOR 3 NUCLEAR POWER

UK GOVERNMENT expenditure on R & D in nuclear energy

United Kingdom Atomic Energy Authority expenditure, published in the Annual Report of UKAEA, is as follows and is listed against the sub-heads given. Data against other sub-heads is not available. Under these headings fuel cycle development is included under appropriate reactor heading. Expenditure in £ thousands.

	1976-77	1977-78	1978-79
1 Power Programme			
(a) Main Reactor Systems			
Advanced Gas-Cooled	6,661	7,161)) approx 17,000
Water Moderated Systems	8,658	8,913)	
Fast Systems	53,227	55,842	approx 58,000
(b) Nuclear Safety and the environment	18,209	19,677)) approx 23,000
(c) Other work in support of the nuclear power programme	4,319	2,832)	
(d) Grants to international projects	82	71)) approx 14,000
2 Other Nuclear			
(a) Applied	388	301)) approx 14,000
(b) Underlying	9,328	14,237)	
(c) Nuclear fusion and plasma physics	6,619	7,261	approx 8,000
	107,491	116,295	118.9

The estimated out-turn for 1978-79 is £ 118.9 million. The detailed information under the sub-heads is not available, but the balance between programmes is not expected to shift in any gross sense and estimates for that year have been made on that basis. Forward estimates are not available.

These headings do not correspond to the headings of the Commissions classification. The Advanced Gas Cooled and Water Moderated Systems together constitute 3.1 and Fast Systems corresponds to 3.3. However the data include expenditure for development of the appropriate fuel cycle, and expenditure equivalent to 3.4 is not separately identified. Item 3.5, 3.6, 3.7 and 3.8 are contained in items 1(b) and 1(c) above. Items 1(d) 2(a) and 2(b) are equivalent to 3.9.

The nuclear energy data do not include UK Government contributions to IAEA and NEA, nor Government contribution for design and development contracts placed with the nuclear industry which amounted to some £ 10 million per year in 1976-77 and 1977-78.

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER			COUNTRY : U.K.		
5. Programme description and budgets	II.SUB-SECTOR 3.1. PROVEN REACTORS			DATE : MARCH 1979		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY</u></p> <p><u>OBJECTIVES</u> : Support to Central Electricity Generating Board and South of Scotland Electricity Board in operation of existing thermal reactors and in development for further stations to be installed.</p> <p>1.1. <u>Advanced Gas Cooled Reactor (AGR)</u></p> <p>Assistance to the generating board with operation of commissioned reactors and commissioning of further stations.</p> <p>Studies to further improve performance of fuel and coolant, taking account of operating experience.</p> <p>Experimental studies to reduce the reaction rate of the graphic with the coolant, by gas flow through the graphite.</p> <p>Operation of the prototype Windscale AGR.</p> <p>1.2. <u>Water cooled systems</u></p> <p>Studies of fuel design for water cooled reactors, including continued operation of the Steam Generating Heavy Water Reactor.</p> <p>1.3. Work on <u>Pressurised Water Reactors (PWR)</u> is considered in 3.5 - Reactor Safety.</p> <p>2. <u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>2.1. <u>MAGNOX REACTORS.</u> Work includes the following :</p> <p>- Studies of Magnox fuel; post-irradiation examination; improvements in reactivity limits, optimisation of fuel management procedure.</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
1	x					
2	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
1	15.3	16.1	appr. 17	n.a.	n.a.	
2	11.6	14.5	17.8	n.a.	n.a.	
					.../...	
TOTAL (in N.C.)	26.9	30.6	34.8			
TOTAL (in EUA)	43.26	46.79	51.79			

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 3.3. BREEDERS(FAST REACTORS)	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY

OBJECTIVES : Development of liquid metal cooled fast reactor technology.

Programme :

- 1.1. Operation of Prototype Fast Reactor (PFR) at Dounreay : Operation of the 250 MW(e) PFR continues to be the main element in the fast reactor programme with the emphasis on study of performance.
- 1.2. Decommissioning of Dounreay Fast Reactor (DFR) : This reactor was closed in March 1977. The liquid metal secondary heat transfer fluid has been removed, the fuel has been removed for reprocessing. The primary coolant will be removed next.
- 1.3. Work in support of the design of a Commercial Demonstration Fast Reactor (CDFR) includes investigation of fuel and component performance and reactor design concepts.
- 1.4. Technical support programme covering all aspects of fast nuclear fuel cycles including fuel performance, material studies, construction of a pilot plant for the manufacture of plutonium/uranium oxide fuel by the gel precipitation process. Engineering component development, chemical engineering, reactor physics and plant performance work. Chemical studies on coolant, instrument development.

2. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

Work includes the following :

- performance of fast reactor fuel : irradiation studies, effects of fuel failure, reprocessing studies
- sodium chemistry, active mass transport, behaviour of tritium, measurement of oxygen levels, measurement of carbon, hydrogen, oxygen in sodium

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1.1-1.4	x									
2	x									
										.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)					
1.1-1.4	53.2	55.8	appr. 58	n.a.	n.a.					
2	2.8	3.2	4.4	n.a.	n.a.					
TOTAL (in N.C.)	56	59	62.4							
TOTAL (in EUA)	90.03	90.21	92.86							

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- mechanical properties of materials, test rig facilities, behaviour of steels
- fast reactor safety and inspection. Effect and detection of blockages, interactions between fuel and coolant
- mechanical components and structural mechanics, sodium circuit structure, core structure and mechanisms
- fast reactor boiler problems, tube bundle replacement, leaks assessment of optimum boiler size
- fast reactor performance, power densities and heat removal rates

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER				COUNTRY : U.K.						
5. Programme description and budgets	II.SUB-SECTOR 3.4. FUEL CYCLE				DATE : MARCH 1979						
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :											
1. <u>PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY</u>											
OBJECTIVE : Development of efficient and reliable fuel cycle technology.											
Programme :											
Consideration of enrichment, fuel fabrication, handling, storage, reprocessing and transport of fuel for all reactor systems.											
Work includes											
- general studies on fuel processing problems											
- development of improved instrumentation											
- development of all aspects of the fast reactor fuel cycle, leading to an operational closed cycle											
- improvement in fuel transport techniques and facilities											
2. <u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u>											
Work included studies in the following areas :											
- irradiated fuel cooling ponds and transport flasks, optimum pond storage conditions, protective methods and handling devices											
Separate expenditure figures not given.											
IV. PROGRAMME FEATURES											
OBJECTIVES	STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION							
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share		
1	x										
2	x										
									.../...		
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)					
1.		expenditures included in 3.1 and 3.3									
2.		-	-	-	-						
TOTAL (in N.C.)		-	-	-	-		.../...				
TOTAL (in EUA)		included in 3.1. and 3.3									

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 3.5. REACTOR SAFETY	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY

OBJECTIVES : To develop understanding of potential fault mechanisms to facilitate design and operation of reactors at high standards of safety.

Programme :

Studies relate both to the safety of specific reactor designs and to more general safety problems applicable to several reactor types.

Work covers - liquid metal fast reactors
 - gas-cooled reactors
 - water-cooled reactors

Work includes

- studies of reactor core behaviour under normal operating conditions and under abnormal conditions
- studies of fuel-coolant interactions
- component reliability
- containment capability of specific reactor designs
- hazard analysis, including assessment of the consequences of externally induced hazards.

2. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

Work covers :

- radiological safety and health physics
- for fast breeders : radioactivity releases and model studies of sodium fires
- for AGRs : analysis of S-35 release
- detection and measurement of high activity particulates
- use of nuclear incineration for certain types of nuclear waste
- investigation of Magnox flask contamination

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x								
3	x				x				
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-89 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1	not available; see summary table				
2	0.7	0.8	1.2	n.a.	n.a.
					.../...
TOTAL (in N.C.)	-	-	-		
TOTAL (in EUA)	see summary table				

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR3.6. WASTE TREATMENT AND DISPOSAL	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY

OBJECTIVE : To demonstrate a capability to store and eventually dispose of radioactive waste in a safe manner.

Programme :

The programme aims to identify the range of preferred techniques for treating the various types of waste that arises in nuclear power to include :

1.1. Development of a vitrification process for converting high level waste to a glassy solid - development of an active 'Harvest' vitrification plant jointly with British Nuclear Fuel Ltd and Generating Boards.

1.2. Development of waste separation, handling and conditioning techniques for all levels of activity, giving minimum radiation exposure to operators.

1.3. An assessment of waste disposal into deep geological formations, which is being extended to include clay and salt formations as well as granite. Investigation of the physical/chemical/biological properties of the medium in such potential waste disposal sites might be found. Laboratory studies of the behaviour of geological materials under irradiation and temperature gradients, field and desk studies. Early conceptual designs of repositories.

1.4. Behaviour of waste containers under long term storage conditions.

2. In this area there has been a change in funding mechanism rather than in level or content of work. Programmes originally funded by the United Kingdom Atomic Energy Authority from the energy vote are now funded directly by the Department of the Environment, with relevant contractors.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
1.1	x								
1.2	x								
1.3	x				x				
1.4	x								
2	x								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1 (1.1-1.4)		not available; see summary table							
2		-	-	3.5	5.3	7.0			
TOTAL (in N.C.)		-	-	-	-	-	.../...		
TOTAL (in EUA)		see summary table							

R+D&D POLICY		I. SECTOR 3. NUCLEAR POWER				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 3.8. FISSILE MATERIAL CONTROL				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY</u></p> <p>OBJECTIVES : To improve the management and accounting procedures with regard to fissile materials.</p> <p>Programme : is concerned to identify and develop</p> <ul style="list-style-type: none"> - improved methods of identifying fissile materials - improved methods of assaying fissile materials - improved security procedures in the handling, transporting and storing of fissile materials <p>and includes</p> <ul style="list-style-type: none"> - development of improved instrumentation for all stages - analysis of management procedures 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1	not available; see summary table								
						.../...			
TOTAL (in N.C.)	see summary table								
TOTAL (in EUA)									

<u>R+D&D POLICY</u>	I. SECTOR 3. NUCLEAR POWER	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 3.9. OTHERS	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY

- OBJECTIVE : - examination of alternative nuclear power systems
 - improving basic knowledge appropriate to the development of nuclear power.
- Programme : - desk studies of alternative reactor systems and alternative fuel cycles
 - underlying studies covering applied nuclear physics, chemistry, metallurgy, etc., determined in consultation with the nuclear industry and designed to provide a scientific and technical base for both present and future programmes.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
OBJECTIVES									
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1	9.8	14.6	14						
									.../...
TOTAL (in N.C.)	9.8	14.6	14						
TOTAL (in EUA)	15.76	22.32	20.83						

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 4.1. THERMONUCLEAR FUSION	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

PROGRAMME OF UNITED KINGDOM ATOMIC ENERGY AUTHORITY

OBJECTIVES : To develop the capability of generating power from controlled thermonuclear fusion reactors.

Programme :

1. The JET project is centred at Culham, and the programme is as defined in that project.
2. Complementary studies are conducted on both the nature of plasmas and their impurities and their methods of control and confinement
 - work on control of impurities in plasma involves the use of DITE
 - improvements in confinement techniques involve the use of TOSCA
3. In addition there is work involving developments on
 - reverse-field
 - magnetic traps
 - plasma heating techniques

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
2 & 3	x								
1	x	x			x				
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
2 & 3	6.62	7.26	approx. 8	n.a.	n.a.				
									.../...
TOTAL (in N.C.)	6.62	7.26	8	n.a.	n.a.				
TOTAL (in EUA)	10.61	11.16	11.90						

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : U.K.	
5. Programme description and budgets	II. SUB-SECTOR 4.2. GEOTHERMAL ENERGY				DATE : MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Programme of technical and economic assessment (3 years) started in July 1976</u></p> <p>a) - collection of data on heat flows and thermal gradients in different parts of the country - evaluation of geological, geophysical and hydrological characteristics at depth - development of technologies for the exploitation of hot dry rocks geographical areas interested : . deep aquifers in the Hampshire basin and other similar geological structures . sources of warm springs in the Bristol-Bath area . granites of South West England (Cornwall)</p> <p>b) the programme was augmented in June 1978, on the basis of the results obtained, to allow - further geological geophysical and hydrogeological studies - additional work on heat flow - market assessment on heat-flow - study of complete systems (extraction, distribution and use of geothermal resources) - experimental work on hot dry rock technology</p> <p>The main elements of the programme have been accepted as part of the EEC's research programme and receive substantial support from the Commission, within the total expenditure quoted.</p> <p>2. <u>UK Participation in IEA Activities</u></p> <p><u>Geothermal Energy</u></p> <p>The UK participates in the Man-made Geothermal Energy Systems (MAGES) Project. The UK participant is the Natural Environment Research Council.</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
la	x			x		
lb		x		x		
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)	
la	←	0.840		→		
lb			←	0.856	→	
						.../...
TOTAL (in N.C.) 1	0.13	0.26	0.37	0.56	0.26	
TOTAL (in EUA)						

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

Work is designed to provide an assessment of the technical, economic and environment aspects of man-made geothermal energy systems. Based on this assessment, recommendations are expected for preferred approaches to systems and component design and also further R & D, hardware and field testing.

Department of Energy provides 100% support for NERC's participation.

3. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

Theoretical Studies of relevance of overseas work on exploitation of hot dry rocks for geothermal electricity production to UK conditions.

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
2	x					x			
3	x								
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 -77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980 -81 (x10 ⁶)				
2	-	0.021	←	0.049 →					
3	0.02	0.02	0.02	n.a.	n.a.				
TOTAL (in N.C.)	0.15	0.30	0.44						
TOTAL (in EUA)	0.24	0.46	0.65						

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : U.K.			
5. Programme description and budgets		II. SUB-SECTOR 4.3. SOLAR ENERGY				DATE : MARCH 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>R & D PROGRAMME OF THE UK GOVERNMENT DEPARTMENTS</u>									
<p>A four year R & D programme on solar energy was announced in Feb. 1977 with total Government expenditure over that period of £ 6 million. The programme includes :</p> <p>1.1. <u>Solar Heating</u></p> <p>The aims of the R & D programme are</p> <ul style="list-style-type: none"> - to encourage the optimisation of solar water heating systems, to define their performance and to demonstrate their value in real life situations - to determine the feasibility and long term costs of a selection of space heating systems, by design studies, laboratory trials (including test houses) and within the time scale of the present programme, by demonstration - to encourage firms to develop individual components of solar heating systems against system and cost criteria, and to estimate the long term costs of mass production and installation of these components. <p>Major items of work include a field trial of some 80 identical water heating systems installed in similar sized houses (private and public sector) to study demand pattern and system performance.</p> <p>1.2. <u>Insolation Data</u></p> <p>There is a small programme on the gathering and presentation of data in a form appropriate for solar energy users.</p> <p>1.3. <u>Photovoltaic Conversion</u></p> <p>R & D support for specialised applications, including space technology. Some basic work in universities and colleges. Close and regular monitoring and reporting of technical developments.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1.1	x								
1.2	x								
1.3	x								
1.4	x								
1.5	x								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1.1.		-	0.88	0.88	0.88	0.88			
1.2.		-	0.12	0.12	0.12	0.12			
1.3		-	0.25	0.25	0.25	0.25			
1.4		-	0.15	0.15	0.15	0.15			
1.5		-	0.10	0.10	0.10	0.10...			
TOTAL (in N.C.)		1	-	1.5	1.5	1.5			
TOTAL (in EUA)									

R+D&D POLICY	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS	COUNTRY : U.K.			
5. Programme description and budgets	II.SUB-SECTOR 4.3 SOLAR ENERGY (CONT.D)	DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>2. <u>UK Participation in IEA Activities</u></p> <p>2.1. <u>Solar Heating and Cooling Systems Performance</u></p> <p>The UK participates in 4 tasks of the Implementing Agreement. The UK participants are :</p> <p>(i) University College of Wales, Cardiff (ii) United Kingdom Atomic Energy Authority (assisted by the Meteorological Office) (iii) Faber Computing Operations Ltd.</p> <p>Objective of the programme is to improve the cost-effectiveness of solar heating and cooling systems.</p> <p>2.2. <u>Small Solar Power Plant Demonstration</u></p> <p>The UK participant is the UKAEA.</p> <p>The main objective is to demonstrate the feasibility of small solar thermal electricity generation (500 kW). Two designs are under consideration.</p> <p>2.3. <u>Biomass Technical Information Service</u></p> <p>The UK participant is the United Kingdom Atomic Energy Authority.</p> <p>The service will be a regular service providing participants with scientific and technical data on areas including harvesting and conversion.</p> <p>Department of Energy supports participation in these activities.</p>					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned			
	extramural impl. %	average share Gov. funding %			
	European Communities	I.E.A.			
	others	envisaged			
		% of share			
2.1	x				
2.2	x	x			
2.3	x	x			
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
total 2	-	0.049	← 0.165 →		
					.../...
TOTAL (in N.C.)	-	1.55	1.66	1.5	1.5
TOTAL (in EUA)	-	2.37	2.47		

R&D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : U.K.	
5. Programme description and budgets		II. SUB-SECTOR 4.4. OCEAN			DATE : MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>R & D PROGRAMME OF THE UK GOVERNMENT DEPARTMENTS</p> <p>1. <u>Wave power</u></p> <p>A £ 1.01 million R & D programme announced in April '76 was increased to £ 2.5 million in April '77, and further increased in June '78 by the addition of £ 2.6 million, in the light of results available. It is envisaged that the rate of expenditure might increase to about £ 4 million per year.</p> <p>a) <u>Salter's nodding duck system</u></p> <ul style="list-style-type: none"> - preliminary 1/50 scale experiments (test-tank) - 1/10 scale (wave) tests in Loch Ness with full scale (industrial) components <p>b) <u>Cockerell's coupled rafts</u></p> <ul style="list-style-type: none"> - small scale experiments (test-tank) - 1/10 scale trials in Solent <p>c) <u>National Engineering Lab. Oscillating Water Column Device</u></p> <ul style="list-style-type: none"> - 1/100 scale laboratory tests (test-tank) - larger scale tests under consideration <p>d) <u>Vicker's static submerged resonance based converter</u></p> <ul style="list-style-type: none"> - assessment phase <p>e) <u>Supporting studies</u> : in addition to the development of devices, technical advisory groups study the following generic areas</p> <ul style="list-style-type: none"> - wave data - structures, fluid loading, mooring and materials - generation and transmission 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
					others	envisaged
						% of share
1	x	x				
2	x				x	
3a	x					
3b	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1		0.5	1.3	3.3	4	4
2		-	-	←	0.39 →	→
3a		0.05				
3b			0.042			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

III. OBJECTIVES AND MAIN LINES OF ACTIVITY. (continuation)

- environmental impact
- new devices

N.B. Industrial participation through shared cost-contracts to date adds a commitment of £ 0.3 million to this programme.

2. UK Participation in IEA Activities

Wave Power UK chairs the executive committee.

The participant is the United Kingdom Government.

The work entails sea trials of various air turbine units, off the Japanese coastline, with the objective to find out which unit is the most efficient, reliable and economical type to warrant further development. The UK will be designing and supplying one of the two turbines to be used in the project.

3. Tidal Power

In the Severn Estuary the UK has potentially the most favourable site in Europe for exploitation of tidal energy. In 1978 the Government established the Severn Barrage Committee with responsibility for further work on assessing Severn Barrage Schemes and their feasibility, and the R & D required.

a) Preliminary studies

- pre-feasibility engineering study on the problems of closing the Severn barrage and on the geology of the estuary
- study on the effect of the barrage on the tidal range (environmental impact)

b) Gathering environmental data

- experiments with wave rider buoys to measure heights and frequencies of waves in the Severn estuary

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
3c		x								
4	x									
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
3c					1.5					
4		0.1	0.2	0.3						
TOTAL (in N.C.)		0.65	1.54	3.73						
TOTAL (in EUA)		1.05	2.35	5.55						

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : U.K.			
5. Programme description and budgets		II. SUB-SECTOR 4.4. OCEAN (CONT'D)				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>/continued...</p> <p>c) Further possible assessment studies (1.5 million provisionally allocated for work to be recommended by the Severn Barrage Committee) which might include</p> <ul style="list-style-type: none"> - conceptual studies of single and double basin schemes - improved predictions of the tidal regime - acquisition of field data on the wave and wind climate - caisson design and turbine demonstration studies - long-term geological and environmental studies - studies of novel barrage construction methods - investigation of suitable turbine design <p>4. R & D PROGRAMME OF THE ELECTRICITY COUNCIL</p> <p>Experimental and theoretical studies of feasibility of harnessing wave energy for electricity production. Theoretical studies of schemes to harness tidal energy in the Severn Estuary.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS		COUNTRY : U.K.							
5. Programme description and budgets	II. SUB-SECTOR 4.5. WIND		DATE : MARCH 1979							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE UK GOVERNMENT DEPARTMENTS</u></p> <p>1. <u>Large horizontal axis aerogenerator</u> (60 m diameter, 3.7 MW) for use on high wind-speed sites.</p> <p>Phased development programme consisting of</p> <p>a) Design study (completed)</p> <p>b) Detailed design and component testing (announced in June 1978)</p> <p>c) Possible construction, monitoring and operation evaluation of a prototype machine (3 years) yet to be approved</p> <p>2. <u>Development work in industry on a vertical axis machine</u> designed in a British University.</p> <p>3. Study of the technical and economic problems associated with offshore siting.</p> <p>4. <u>Advanced wind energy technology</u></p> <ul style="list-style-type: none"> - medium size (100 kW) aerogenerators - environmental studies - turbine development - assessment of new concepts <p>5. <u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>Assessment of feasibility and costs of electricity generation from offshore wind generators.</p> <p>N.B. Industrial participation through shared cost contracts to date adds a commitment of £ 0.075 million to this programme.</p>										
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION					
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1a+b	x									
1c		x				x				
2	x									
3	x									
4	x									
5	x								.../...	
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)		Expenditures 1977-78 (x10 ⁶)		Estimations 1978-79 (x10 ⁶)		Estimations 1979-80 (x10 ⁶)		Estimations 1980-81 (x10 ⁶)	
1a			0.075							
1b					← 0.341		← n2			
1c										
2			0.092							
3+4					← 0.465					
5			0.04		0.11		n.a.		n.a./...	
TOTAL (in N.C.)	-		0.21		0.30					
TOTAL (in EUA)	-		0.321		0.446					

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : U.K.			
5. Programme description and budgets		II. SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. Assessment studies of production, transmission and storage of hydrogen (conducted by ETSU and covered in the ETSU expenditure data).</p> <p>2. UK participates in the EEC programme on hydrogen. UK organisations receive support from the Commission for R & D studies conducted under the indirect action programme.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding%	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x			x					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1+2		p.m.	p.m.	p.m.					
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>Turbo-generators and associated plant</p> <p>1. <u>Turbines</u> : work includes :</p> <ul style="list-style-type: none"> . stress analysis, studies of turbine materials, turbine dynamics . aerodynamics and wet steam, blade profile studies . turbine site trials . turbine instrumentation applications <p>2. <u>Gas turbines</u> : work includes :</p> <ul style="list-style-type: none"> . mechanical properties of blading, blade deposition . corrosion resistance of materials for blades . performance analysis and fault diagnosis <p>3. <u>Electrical generators</u> : work includes :</p> <ul style="list-style-type: none"> . studies of electromagnetic, thermal, vibrational and mechanical effects . methods for monitoring and measuring insulation performance . advanced electrical generator design and generator materials . large power station motors, cables and conductor terminations and other power station plant <p>4. <u>Cooling systems</u> : work includes :</p> <ul style="list-style-type: none"> . investigation of cooling tower forms, cooling tower vibrational stresses . model studies of flow phenomena in vicinity of cooling water intake and outfall structures, studies of an existing power station circuit and screen systems . control of debris and mussel growth, phosphate scaling of condensers . recooling systems studies involving alternatives to the natural draught cooling tower. 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1-6	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1-6	14.86	15.75	16.38	n.a.	n.a.				
TOTAL (in N.C.)	14.86	15.75	16.38						
TOTAL (in EUA)	23.57	24.08	24.38						

R+D&D POLICY		I. SECTOR 5. ELECTRICITY			COUNTRY : U.K.	
5. Programme description and budgets		II. SUB-SECTOR 5.2. TRANSPORT OF ELECTRICITY			DATE : MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>1. <u>Transport</u> work includes studies on :</p> <ul style="list-style-type: none"> - underground transmission, investigation of stopjoint failures, new cable development including SF₆ cable, cable cooling studies - overhead lines and insulation, optimisation of line ratings, conductor clashing and vibration, improvement of insulator performance and noise generation from energised lines - circuit breakers, transformers and substations, arcing behaviour, fault diagnosis and insulation problems - system control, protection, communication and instrumentation - UHV transmission, insulation and tower window performance (international co-operation on this project) <p>2. <u>Distribution</u> work includes studies on :</p> <ul style="list-style-type: none"> - overhead lines, conductor creep, alternative insulators, corrosion studies - underground cable development, uprating of 11 kV paper-insulated cables, extruded dielectrics materials - system failure studies - personal communications - circuit hardware - detection and measurement devices - system design and operation 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
	others	envisaged	% of share			
1	x					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)
1		3.50	3.45	3.28	n.a.	n.a.
2		1.31	0.98	1.09	n.a.	n.a.
TOTAL (in N.C.)		4.81	4.43	4.37	n.a.	n.a.
TOTAL (in EUA)		7.73	6.77	6.50		

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 5.3. CONTROL AND INSTRUMENTATION				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>1. Current activities include :</p> <ul style="list-style-type: none"> - development of improved control systems for large plant <ul style="list-style-type: none"> . trials at Rugeley A (coal-fired) power station . trials at Fanley (oil-fire) power station - development of digital control systems <ul style="list-style-type: none"> . basic studies . design . small scale trials - control system studies on nuclear plant - on-line computer applications - control system hardware 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1		2.62	2.46	2.73	n.a.	n.a.			
TOTAL (in N.C.)		2.62	2.46	2.73					
TOTAL (in EUA)		4.21	3.76	4.06					

R+D&D POLICY		I. SECTOR 5. ELECTRICITY				COUNTRY : U.K.			
5. Programme description and budgets		II. SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE				DATE : MARCH 1979			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :									
1. <u>Development work supported by Department of Industry</u>									
Development of a Sodium Sulphur Battery									
Following fundamental studies on the electrochemistry and the properties of the electrode and cell materials, work is now concentrated on the pilot scale manufacture of cells for the first stage of product proving.									
Development of a Nickel Zinc Battery									
Work is concentrated on the establishment of performance of battery components made by a number of methods and the development of optimum methods.									
In addition to the Government support indicated below, there is considerable industrial interest in and support for work in these areas.									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1		0.14	0.20	0.40	0.26				
TOTAL (in N.C.)		0.14	0.20	0.40	0.13	0.13			
TOTAL (in EUA)		0.23	0.31	0.60	0.19	0.19			

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : U.K.			
5. Programme description and budgets		II.SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES				DATE :MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p><u>R & D PROGRAMME OF THE ELECTRICITY COUNCIL</u></p> <p>1. Assessment study of compressed air storage coupled with packed bed heat store (CEGB).</p> <p>2. Assessment study on heat storage (hot water under pressure) at generating plants (CEGB).</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x								
2	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1 & 2		0.1	0.1	0.1	n.a.	n.a.			
						.../...			
TOTAL (in N.C.)		0.1	0.1	0.1					
TOTAL (in EUA)		0.16	0.15	0.15					

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : U.K.			
5. Programme description and budgets		II. SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS				DATE : MARCH 1979			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. The Department of Energy conducts modelling studies in forecasting energy requirements (in total and by individual vectors) and energy costs (cf 1978 Green Paper "Energy Policy" a consultative documents" Cmnd 7101).</p> <p>2. Development of a strategy for energy R D and D in the U.K. Studies of energy R D and D requirements to match scenarios of future energy requirements are conducted by ETSU.</p> <p>Analysis involves - how energy is used - what forms are needed - total demand - current patterns of energy use - factors matching each fuel to the needs of users - impact of new technological developments</p> <p>(The costs of the work are contained in the ETSU operating costs.)</p> <p>3. Various University groups are engaged in energy modelling studies, many supported by SRC grants (costs are contained in that total).</p> <p>4. Departments of Environment, Transport and Health and Social Security, and Ministry of Agriculture, Fisheries and Food conduct limited energy modelling and analytical studies to meet policy requirements e.g. energy demand in building and transport, energy demand in hospitals and the influence of design, etc.</p> <p>5. <u>R & D PROGRAMME OF THE BRITISH GAS CORPORATION</u></p> <p>-longer term studies relevant to the gas industry.</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x				x				
2	x								
3	x				x				
4	x								
5	x								.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
1-4		p.m.	p.m.	p.m.					
5		n.a.	n.a.	0.10	n.a.	n.a.			
TOTAL (in N.C.)		n.a.	n.a.	0.1					
TOTAL (in EUA)		n.a.	n.a.	0.15					

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES	COUNTRY : U.K.
5. Programme description and budgets	II.SUB-SECTOR 6.2. SOCIO-ECONOMIC STUDIES	DATE : MARCH 1979

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. The Social Science Research Council has established an Executive Panel on Energy Research with an earmarked budget of £ 0.75 million over the next five years. The Panel will commission research on the social science aspects of energy.

The Panel will be supporting research projects, some research Fellowships and will promote at least two existing Centres with a record on energy research.

The Panel hopes to encourage further research in five areas of priority

- utilisation studies
- supply technologies
- supply and demand balances
- potential science and market structure
- North Sea oil

The Council is also funding a study of the procedures used in the recent Windscale enquiry into the fuel reprocessing proposals of British Nuclear Fuels Ltd.

2. R & D PROGRAMME OF THE NATIONAL COAL BOARD (NCB)

Safety and Health (medical research)

- . respiratory diseases, cardiovascular diseases, occupational deafness, back lesions and ergonomics

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1		x							
2	x								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1	-	-	-	0.15	0.15				
2	1.02 est ^{on}	1.21 est ^{on}	1.32	n.a.	n.a.				
									.../...
TOTAL (in N.C.)	1.02	1.21	1.32						
TOTAL (in EUA)	1.64	1.85	1.96						

<u>R+D&D POLICY</u>	I. SECTOR 6. GENERAL STUDIES				COUNTRY : U.K.					
5. Programme description and budgets	II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS				DATE : MARCH 1979					
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
1. <u>R & D PROGRAMME OF THE UK GOVERNMENT DEPARTMENTS</u>										
1.1. The Department of the Environment conducts studies of environmental problems related to energy technology, which include										
a) studies to establish the fate of oil and other marine pollutants and their effects on the environment										
b) assessments of the threat to ground water quality from contaminants leached from colliery spoil deposits										
1.2. Department of Transport conducts studies to assess the effects of pollutants from road traffic on air, water and plant life.										
1.3. Department of Energy supports a small study on the human uptake of lead from vehicle exhausts.										
1.4. Work of the UKAEA in this area is included in 3.5, 3.6 and 3.7.										
1.5. The Natural Environment Research Council conducts studies in this area which are included in the return for that Council in the overall General section. Approximately 30 % of that expenditure relates to this area.										
2. <u>R & D PROGRAMME OF THE BRITISH GAS CORPORATION</u>										
<u>Current activities include :</u>										
- environmental protection, noise control, measurement of gaseous pollutants from gas-fired equipment										
- outdoor environment, pollution studies, general consultancy services										
IV. PROGRAMME FEATURES										
OBJECTIVES	STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION						
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1.1a	x									
1.1b		x								
1.2	x									
1.3	x									
2	x								.../...	
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)				
1.1.		0.27	0.27	0.25	0.99					
1.2		0.30	0.30	0.32	0.90					
1.3		-	0.02	0.02	0.01					
2		0.18	0.17	0.19	n.a.	n.a.				
							.../...			
TOTAL (in N.C.)										
TOTAL (in EUA)										

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

3. R & D PROGRAMME OF THE ELECTRICITY COUNCIL

Work includes studies in the following areas :

- gaseous chimney emissions, penetration of plumes through the mixing layer, effects of SO₂ on vegetation, NO_x reactions, CO₂ monitoring
- particulate chimney emissions; pulverised fuel ash emission monitoring, design and high efficiency precipitator, acid smuts from oil firing, effects of additives on plume visibility
- ash utilisation and disposal, testing properties of ash for plant growth, studies of quartz particles as health risk
- effect of air pollution on soils and surface waters, studies of effects of acid rain and the effects of acidity in surface waters (international collaboration on long range pollutant transport)
- cooling water and the environment, effect of cooling water on aquatic life
- pumped storage reservoirs, improvements in appearance, maintenance of fish life
- noise, within the plant (diagnosis of noise source) externally perceived noise, active noise cancellation.

4. R & D PROGRAMME OF THE NATIONAL COAL BOARD

Current activities include :

- minimisation of emissions from coke ovens
- smokeless fuel plants
- characterisation and measurement of emissions
- incineration of colliery tailings by fluidised combustion.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged % of share
3	x								
4	x								
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)			
3		2.19	2.95	3.28	n.a.	n.a.			
4		0.53	0.56	0.64	n.a.	n.a.			
TOTAL (in N.C.)		3.47	4.27	4.70					
TOTAL (in EUA)		5.58	6.53	6.99					

<u>R+D&D POLICY</u>		I. SECTOR 6. GENERAL STUDIES				COUNTRY : U.K.	
5. Programme description and budgets		II.SUB-SECTOR 6.4. SAFETY				DATE : MARCH 1979	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. The Health and Safety Executive carries out and sponsors research to assist safety in industry and to enable it to carry out its responsibilities under the Safety at Work Act. Part of its research programme concerns the energy industries. It includes work on :</p> <ul style="list-style-type: none"> - safety in mines - explosions (gas, vapours, dusts) - safety in the offshore industry, including diving - reactor safety, nuclear processing, radiological protection <p>Approximately 1/4 of HSE's R & D expenditure is concerned with these areas.</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	x		30 %				
							.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976-77 (x10 ⁶)	Expenditures 1977-78 (x10 ⁶)	Estimations 1978-79 (x10 ⁶)	Estimations 1979-80 (x10 ⁶)	Estimations 1980-81 (x10 ⁶)		
1	approx. 1.3	approx. 1.4	approx. 1.5	approx. 1.6	approx. 1.7		
TOTAL (in N.C.)	1.3	1.4	1.5	1.6	1.7		
TOTAL (in EUA)	2.09	2.14	2.23	2.38	2.53		

SECTION 3

SUB-SECTION 3.9 E U R O P E A N C O M M U N I T I E S

SUMMARY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION EXPENDITURE

(in million E.U.A.)

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
1. RATIONAL USE OF ENERGY	<u>0.520</u>	<u>3.095</u>	<u>4.123</u>
1.1. Industry	p.m.	p.m.	p.m.
1.2. Residential and commercial	p.m.	p.m.	p.m.
1.3. Transportation	p.m.	p.m.	p.m.
1.4. Low-grade energy utilization	p.m.	p.m.	p.m.
1.5. Others	p.m.	p.m.	p.m.
2. FOSSIL FUELS AND DERIVATIVES	<u>32.347</u>	<u>47.269</u>	<u>42.691</u>
2.1. Coal exploration and extraction	14.932	15.019	12.691
2.2. Coal preparation, valoris.& transpt.	p.m.	p.m.	p.m.
2.3. Coal liquefaction	p.m.	p.m.	p.m.
2.4. Coal gasification	p.m.	p.m.	p.m.
2.5. Coal combustion	-	-	-
2.6. Oil & gas assessment & exploration	p.m.	p.m.	p.m.
2.7. Oil & gas production	17.415	32.250	30.000
2.8. Refining and derivatives	-	-	-
2.9. Transport of oil	p.m.	p.m.	p.m.
2.10. Transport of gas	p.m.	p.m.	p.m.
2.11. Storage of oil	p.m.	p.m.	p.m.
2.12. Storage of gas	p.m.	p.m.	p.m.
2.13. Others	-	-	-

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
3. NUCLEAR POWER	<u>48.052</u>	<u>61.110</u>	<u>69.587</u>
3.1. Proven reactors	2.123	0.191	-
3.2. High temperature reactors	0.389	-	-
3.3. Breeders	p.m.	p.m.	p.m.
3.4. Fuel cycle	9.131	10.885	14.592
3.5. Nuclear safety	8.179	18.725	21.455
3.6. Waste treatment and disposal	5.847	9.963	9.955
3.7. Radiation prot.& decommis.of power pl.	5.746	7.551	8.726
3.8. Fissile materials control	2.017	3.985	4.389
3.9. Others	14.620	9.81	10.470
4. NEW ENERGY SOURCES AND VECTORS	<u>34.148</u>	<u>52.683</u>	<u>72.084</u>
4.1. Thermonuclear fusion	25.355	31.941	45.902
4.2. Geothermal energy	1.780	3.671	4.897
4.3. Solar energy	2.943	9.503	12.092
4.4. Ocean	-	-	-
4.5. Wind	-	-	-
4.6. Hydrogen as an energy vector	4.070	7.568	9.193
4.7. Others	-	-	-
5. ELECTRICITY	-	-	-
5.1. Electricity generating equipment	-	-	-
5.2. Transport of electricity	-	-	-
5.3. Control & instrumentation	-	-	-
5.4. Fuel cells	p.m.	p.m.	p.m.
5.5. Electrochemical storage	p.m.	p.m.	p.m.
5.6. Other storage techniques	p.m.	p.m.	p.m.

SECTORS AND SUBSECTORS	Expenditure 1976	Expenditure 1977	Estimates 1978
6. GENERAL STUDIES	<u>1.860</u>	<u>3.725</u>	<u>4.601</u>
6.1. Analytical studies on energy systems	0.497	1.431	1.927
6.2. Socio-economic studies	-	-	-
6.3. Studies on environmental effects	1.363	2.294	2.674
T O T A L	<u>116.927</u>	<u>167.882</u>	<u>193.086</u>

Qualification statements

1. Expenditures and budget forecasts indicated in this section correspond to the total appropriations earmarked on the budget of the European Communities; where appropriate the forecast of the research and development share, evaluated in accordance with the Frascati's convention, is indicated on each sheet pertinent to the different subsectors. Consequently figures, pertinent to single subsectors or to individual topics within subsectors, can differ in some cases from those reported in other statistical reviews realized and/or published by other Community bodies (in particular by the Statistical Office of the European Communities).
2. Although actually earmarked on the research budget of the European Communities, the costs of the operation of the High Flux Reactor (HFR) of Petten, as they are financed in their totality by the two Member States participating in the programme, namely the Netherlands and the Federal Republic of Germany, have been included in their respective sections.

R&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : E.C.
5. Programme description and budgets	II. SUB-SECTOR 1.1. INDUSTRY	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. First indirect action programme (mid-1975 + mid-1979)
 - evaluation of the specific energy consumption of equipment, processes and techniques
 - residual heat recovery and energy storage (see 1.4.1.)
 - materials recycling and production of energy from waste (see 1.4.1.)

(expenditures are included in 1.4.1.)
2. Second indirect action programme (mid-1979 + mid-1983)
 - industry
 - . development of energy saving technologies
 - + heat recovery from liquid and gaseous effluents
 - + development of existing and advanced energy saving technologies
 - + improvement of the efficiency in the energy intensive industrial branches
 - + energy analysis of the most important industrial branches
 - + optimisation of the combination of components in installations
 - + materials recycling
 - . development of energy saving components and processes
 - + heat exchangers
 - + development of organic Rankine cycle engine for power production from low grade waste heat (~300°C)
 - + high temperature heat pumps and their components
 - + improvement of the efficiencies of industrial boilers (combustion and heat transfer) and furnaces (high temperature insulation)

(estimated expenditures are included in 1.4.2.)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1	X								
2		X							
3	X								
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	p.m.	p.m.	p.m.	p.m.	-
2	-	-	-	p.m.	p.m.
3	-	-	-	7*	6*
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)				* for the whole energy conservation sector	

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 1. RATIONAL USE OF ENERGY					COUNTRY : E.C.				
	II.SUB-SECTOR 1.2. RESIDENTIAL AND COMMERCIAL					DATE : April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979) (expenditures are included in 1.4.1.)										
<ul style="list-style-type: none"> - improved insulation of buildings <ul style="list-style-type: none"> . new transparent materials . new insulating materials - heat pumps <ul style="list-style-type: none"> . improvement of components and systems . advanced type heat pumps - heat storage 										
2. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983)										
<ul style="list-style-type: none"> - residential and commercial applications <ul style="list-style-type: none"> . heating and air conditioning systems <ul style="list-style-type: none"> + improvement of the efficiency of conventional heating , air conditioning and ventilation systems and their logic control systems + recovery of waste heat + improvement of the efficiency, reliability and lifetime of existing heat pumps systems, in particular of thermally driven heat pumps + advanced heat pumps; applications of mono and bivalent heat pumps in houses and buildings + environmental and energy consumption impact of large scale use of heat pumps . domestic equipment <ul style="list-style-type: none"> + improvement of efficiency (lighting, electric appliances,...) + recovery of waste heat . structure and insulation of buildings <ul style="list-style-type: none"> + heat leak detection technique + improved application techniques for insulation materials in new and existing buildings + better design of buildings and improved use of materials 										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X									
2		X								
3	X									
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		p.m.	p.m.	p.m.	p.m.	-				
2		-	-	-	p.m.	p.m.				
3		-	-	-	p.m.	p.m.				
TOTAL (in N.C.)										
TOTAL (in EUA)										

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- . heat storage
 - + development of heat storage systems and of their control equipment
 - + development of the application in domestic heating and hot water production
 (estimated expenditures are included in 1.4.2.)

3. Support for demonstration projects related to the improvement in the efficiency of energy uses

- buildings
 - . new materials or new applications of existing materials for the thermal insulation of new or existing buildings
 - . methods of resolving problems linked with efficient thermal insulation, such as ventilation, condensation, thermal inertia, vapour formation, fire and safety rules, etc.
 - . more effective methods for the heating and air conditioning of premises and for the production of domestic hot water, such as heat pumps having new technical characteristics which can improve the competitiveness and reliability, the small-scale use of solar collectors and improvements in conventional systems making for significant energy savings.
 - . methods of reducing ventilation needs, e.g. in industry or hospitals.

(for appropriations, see 1.1.3.)

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY		I. SECTOR 1. RATIONAL USE OF ENERGY				COUNTRY : E.C.			
5. Programme description and budgets		II.SUB-SECTOR 1.3. TRANSPORTATION				DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)</p> <ul style="list-style-type: none"> - urban transport <ul style="list-style-type: none"> . improvement of efficiency of vehicle motors . development of electric and hybrid engines (expenditures are included in 1.4.1.) <p>2. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983)</p> <ul style="list-style-type: none"> - transport <ul style="list-style-type: none"> . improvement of internal combustion engines <ul style="list-style-type: none"> + improved types of engines , also under part-load conditions + advanced Diesel and Otto-engines taking into account environmental constraints + alternative concepts for car traction . electrical and hybrid engines <ul style="list-style-type: none"> + electrical vehicles and high density batteries for car traction + hydrogen concept for car traction + use of CH₃OH and C₂H₅OH as alternative fuels + hybrid concepts for car traction , including recovery of brake energy . general studies on transport systems (urban conditions) . improvement of vehicle structure (streamlining, lower friction, lighter weight, automatic gear box and other components) (estimated expenditures are included in 1.4.2.). 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X								
2		X							
3	X								
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.	p.m.	-			
2		-	-	-	p.m.	p.m.			
3		-	-	-	p.m.	p.m.			
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY	I. SECTOR 1. RATIONAL USE OF ENERGY	COUNTRY : E.C.							
5. Programme description and budgets	II.SUB-SECTOR 1.4. LOW-GRADE ENERGY UTILISATION	DATE : April 79							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid 1979) *)</p> <ul style="list-style-type: none"> - improved insulation of buildings (see 1.2 for details) - use of heat pumps <ul style="list-style-type: none"> . large units for district heating and residential buildings . small units for heating individual houses and buildings - urban transport (see 1.3.1 for details) - residual heat recovery <ul style="list-style-type: none"> . development of facilities for recovering normal heat losses . development of means of transporting the recovered calories . development of combined collection/utilization systems . development of high temperature gas filters - materials recycling (sorting, processing and uses) - production of energy from waste <ul style="list-style-type: none"> . improvement of procedures for the transformation of waste into energy and into fuels . study of the various types of waste available and processing methods . determination of the most efficient processes . development of systems for the automatic sorting of waste - evaluation of the specific energy consumption of equipment, processes and techniques - development of methods for storage of secondary energy (see also 5.4,5.5 and 5.6) <p>....</p> <ul style="list-style-type: none"> . thermal (phase changes, molten salts) <p>* The budget indicated for objective 1 may be broadly subdivided as follows : 1.1. Industry 60 %; 1.2. Residential 35 %; 1.3. Transport 5 %.</p>									
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION							
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50		X			
2		X	100	50					
3		X	100	50					
4		X	100	n.a.					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	0.520	3.095	4.123		5.466				
2	-	-	-	2.664					
3	-	-	-	p.m.	p.m.				
4	-	-	-	p.m.	p.m.				
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)	0.520	3.095	4.123	2.664	5.466				

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- . coking and briquetting of coal (properties of coking coals and carbonization products, mechanism of pyrolysis, development of conventional coking techniques, production and beneficiation of by-products and gas, new coking methods, new methods of briquetting, smokeless briquettes, environmental problems)
- . new chemical and physical processes and products from coal
 - + basic research (chemical constitution of coal, petrographic analysis, physical properties of coal, high intensity chemical reactions)
 - + new products and processes from coal (gasification, liquefaction, hydrogenation hydrocracking and oxidation of coal and coal extraction products, activated carbons, electrode cokes and reducing agents from coal, improved combustion methods, by-products as construction materials, environmental problems)

2. Research programme on safety in mines (art. 55 ECSC)

- fires and underground combustion
- explosions
- rescue
- surveillance, telemetry, remote control, automation and communication
- methods of working
- electricity
- metallurgy
- accidents and accident information

IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES II. SUB-SECTOR 2.2. COAL PREPARATION, VALORISATION AND TRANSPORT	COUNTRY : E.C. DATE : April 79			
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Product beneficiation</u> (see under 2.1.1.)					
IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION	INTERNATIONAL COOPERATION			
OBJECTIVES	current planned extramural impl. % average share Gov. funding % European Communities I.E.A.	others envisaged % of share			
1	X				
		.../...			
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	p.m.	p.m.	p.m.		
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)					

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES					COUNTRY : E.C.				
	II.SUB-SECTOR 2.3. COAL LIQUEFACTION					DATE : April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
<p>1. <u>Laboratory research and pilot plants</u> (see under 2.1.1.)</p> <p>2. <u>Support for demonstration projects related to the liquefaction and gasification of solid fuels in the Community *</u></p> <ul style="list-style-type: none"> - pressurised dust gasification - underground gasification - <u>supercritical gases coal extraction</u> <p>*) 50 MEUA over 5 years (1979-83), O.J.E.C. L. 93 of 12.4.79.</p>										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X									
2		X	100	25:40						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES			Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1			p.m.	p.m.	p.m.					
2			-	-	-	5.000	4.473			
TOTAL (in N.C.)										
TOTAL (in EUA)						5.000	4.473			

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 2.4. COAL GASIFICATION			DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Laboratory research and pilot plants</u> (see under 2.1.1.)</p> <p>2. <u>Support for demonstration projects</u> (see under 2.3.2.)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
2		X				
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
2	-	-	-			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : E.C.								
5. Programme description and budgets	II. SUB-SECTOR 2.6. OIL AND GAS ASSESSMENT AND EXPLORATION	DATE : April 79								
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Support of technological activities</u> connected with the <u>exploration</u>, exploitation and storage of hydrocarbons (see under 2.7.1.)</p> <p>2. <u>Support of joint projects</u> for the <u>exploration</u> of hydrocarbons</p> <ul style="list-style-type: none"> - geophysical works <ul style="list-style-type: none"> . magnetic methods . gravimetric and other physical methods - stratigraphic drillings <ul style="list-style-type: none"> . rocks characteristics (depth, lithology, porosity, permeability, etc.) - exploratory drillings 										
<p>IV. PROGRAMME FEATURES STATUS & IMPLEMENTATION INTERNATIONAL COOPERATION</p>										
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X									
2		X								
									.../...	
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		p.m.	p.m.	p.m.						
2		-	-	-	n.a.	n.a.				
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES	COUNTRY : E.C.
	II.SUB-SECTOR 2.7. OIL AND GAS PRODUCTION	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Support of technological activities connected with the exploration, exploitation and storage of hydrocarbons

- geophysics and prospecting (seismic techniques)
- drilling
 - . deep sea drilling
 - . off-shore operations
 - . horizontal drilling technology
 - . remote controlled drilling
- production systems
 - . advanced production techniques
 - . well-heads for subsea production
 - . surface controlled sub-surface safety equipment
 - . deep-sea production equipment
 - . special equipment for off-shore production platforms
 - . submerged flares for off-shore and on-shore use
 - . new process for exploitation of heavy oil/viscous oil
- secondary recovery
 - . heavy oil-recovery
 - . polymer controlled water flooding injection tests
 - . brine soluble polymers and associated chemicals
 - . tests of improved secondary recovery methods
- ancillary ships, submersibles and navigation
 - . systems for embedding submarine pipelines in the seabed
 - . 1000 m. observation and manipulation submersible

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	30-40						
										.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	17.415	32.250	30.000	31.000	47.000
				These are total amounts spent; the R+D share is estimated at 80 %	
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	17.415	32.250	30.000	31.000	47.000

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES				COUNTRY : E.C.	
5. Programme description and budgets		II. SUB-SECTOR 2.9. TRANSPORT OF OIL				DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Support of technological activities</u> connected with the exploration, exploitation and storage of hydrocarbons (see under 2.7.1.)</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others
1	X						
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.			
TOTAL (in N.C.)						.../...	
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 2.11. STORAGE OF OIL			DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Support of technological activities connected with the exploration, exploitation and storage of hydrocarbons (see under 2.7.1.)</u>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 2. FOSSIL FUELS AND DERIVATIVES			COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 2.12. STORAGE OF GAS			DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Support of technological activities</u> connected with the exploration, exploitation and <u>storage</u> of hydrocarbons (see under 2.7.1)						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1	p.m.	p.m.	p.m.			
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

R&D&D POLICY 5. Programme description and budgets	I. SECTOR	3. NUCLEAR POWER	COUNTRY : E.C.
	II.SUB-SECTOR	3.1. PROVEN REACTORS	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Technical assistance to nuclear power plant operators (D.A. 1973-76)
 - water chemistry,
 - in-pile inspection and intervention,
 - post-irradiation examination of fuel elements,
 - methods of quality control for materials and components in stations, establishment of standard techniques, training of operators' staff.
2. Plutonium fuels and actinide research (D.A. 1973-76 and 1977-80)
(See under 3.4.2)
3. Plutonium recycling in light water reactors (I.A. 1975-78 and 1978-79)
(See under 3.4.3)

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100					
2	X		-	100					
3	X		100	≤ 50					
					* These are total amounts; the R+D share is estimated at 80 %				
					.../...				

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	2.123 *	0.191*	-	-	-
2	p.m.	p.m.	p.m.	p.m.	p.m.
3	p.m.	p.m.	p.m.	p.m.	p.m.
					.../...
TOTAL (in N.C.)	2.123	0.191	0.00	0.00	0.00
TOTAL (in EUA)					

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 3.2 HIGH TEMPERATURE REACTORS			DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Past activities</u> (Dragon Reactor)</p> <p>2. <u>High-temperature materials</u> (D.A. 1975-76 and 1977-80)</p> <p>(See under 3.9.1)</p>						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
	others	envisaged	% of share			
1	end of activity					
2	X					
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		0.389	-	-	-	-
2		p.m.	p.m.	p.m.	p.m.	p.m.
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)		0.389	0.00	0.00	0.00	0.00

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : E.C.
	II.SUB-SECTOR 3.3. BREEDERS	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Codes and standards (structural integrity of components) (I.A. 1979-83)*

- manufacturing standards and quality codes
 - . evaluation and quantification of dissimilarities
- structural analysis and design codes
 - . comparative analysis of design methods and criteria
 - . computational investigations
 - . analysis of experience with the structural behaviour of components
- materials
 - . evaluation and quantification of dissimilarities
 - . reference tests

2. Plutonium fuels and actinides research (see under 3.4.2.)

3. Safety studies (see under 3.5.1.)

*) This programme will be funded on annual basis with earmarked on the item 3370 of the research budget of the European Communities, under the title : Implementation of Council's Resolution of July 22nd, 1975 on the technological problems of nuclear safety (O.J.E.C. n° C 185 of Aug. 14th, 1975).

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	100	50						
2	X	-	100						
3	X	-	100						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	-	-	-	-	0.300				
2	p.m.	p.m.	p.m.	p.m.	p.m.				
3	p.m.	p.m.	p.m.	p.m.	p.m.				
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)	0.00	0.00	0.00	-	0.300				

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER				COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 3.4 FUEL CYCLE				DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Uranium exploration and extraction</u> (I.A. 1978-80)*</p> <ul style="list-style-type: none"> - Exploration <ul style="list-style-type: none"> . discovery of uranium provinces <ul style="list-style-type: none"> + U geology and metallogeny + study of Pb isotopes + techniques for rapid and routine geochemical analysis + remote sensing applied to prospecting + airborne geochemistry . discovery of specific targets <ul style="list-style-type: none"> + migration of gaseous derivatives of uranium + transportation and storage of uranium from solutions + direct measurement of uranium in situ . calibration of instruments - Extraction <ul style="list-style-type: none"> . technico-economic feasibility studies . development of extraction techniques <ul style="list-style-type: none"> + in situ leaching + bacterial leaching <p>*) Total funding over 3 years: 3.0 MEUA</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		100	50 est.			
2	X		-	100			
3	X		100	50 est.			
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		-	-	0.800	0.446	0.755	
2		8.339	9.822	11.890	12.527	15.037	
3		0.792	1.063	1.902	1.344	1.539	
							.../...
TOTAL (in N.C.)							
TOTAL (in EUA)		9.131	10.885	14.592	14.317	17.331	

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : E.C.
	II.SUB-SECTOR 3.5 NUCLEAR SAFETY	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Reactor Safety (D.A. 1973-76 and 1977-80)

- reliability and risk assessment
 - . codes for the analysis of the mechanism of accidents in liquid metal cooled fast reactors and light water reactors, including the whole core accident in a fast reactor;
 - . probability analysis of accident in light water reactor cores;
 - . European data bank of reliability data.
- out-of-pile and in-pile studies of accidents involving loss of coolant in light water reactors
 - . depressurization studies in a large simulation loop
- liquid metal fast breeder sub-assembly thermohydraulics
 - . theoretical analysis of the consequences of geometrical anomalies in fuel sub-assemblies under various coolant flow conditions;
 - . techniques for the early detection of anomalies by temperature noise analysis, comprising experiments both in water and sodium;
 - . the experimental study of boiling phenomena, in a sub-channel and in a sub-assembly, and the influence of channel blockage on local boiling.
- core melt-down and fuel-coolant interaction

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	x		-	100		x			
2	x		100	n.a.					
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	8.179	18.725	21.455	21.058	39.576
2	-	-	-	1.219	1.685
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	8.179	18.725	21.455	22.277	41.261

R+D&D POLICY	I. SECTOR 3. NUCLEAR POWER	COUNTRY : E.C.
5. Programme description and budgets	II.SUB-SECTOR 3.6. WASTE TREATMENT AND DISPOSAL	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Management and storage of radioactive waste (I.A. 1975-79)

- technological problems
 - . processing
 - + medium activity solid waste : coating with plastic resins;
 - + high-activity solid waste : decontamination and conditioning of irradiated fuel element cladding;
 - + high activity solid waste : immobilization of calcined waste from fission products in a metal matrix;
 - + plutonium-contaminated solid waste : incineration process;
 - + comparative study of the properties of various materials suitable for the immobilization of high-activity waste.
 - . storage and disposal
 - + storage of solidified radioactive waste in engineered structures;
 - + disposal of radioactive waste in suitable geological formations, including those formations currently being studied;
 - + storage of gaseous waste.
 - . study of an advanced management model :
 - + separation and recycling of long-life waste (actinides).
- definition of a general framework (legal, administrative, financial) for the implementation of radioactive waste storage and disposal measures :
 - . review of problems posed by the management of radioactive waste which could not be solved under existing international legal, administrative and financial provisions and proposals for solutions;

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50					
2	X		-	100					
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	3.865	4.774	4.199	5.133	12.998
2	1.982	5.185	5.756	5.797	5.645
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	5.847	9.963	9.955	10.930	18.643

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : E.C.
	II. SUB-SECTOR 3.7. RADIATION PROTECTION AND DECOMMISSIONING OF POWER PLANTS	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Reactor components decontamination

(see under 3.6.2.)

2. Transfer of Ispra-I activities (D.A. 1975-76)

- closing down of the reactor
- transfer of the Euracos converter to the PAVIA reactor
- construction of a pneumatic irradiation plant, the installation thereof in the Essor reactor and the operation thereof.

3. Decommissioning of nuclear power plants (I.A. 1979-83*)

- long term integrity of buildings and systems
- decontamination for decommissioning purposes
- dismantling techniques
- treatment of specific waste materials: steel, concrete and graphite
- large transport containers for radioactive waste produced in the dismantling of nuclear power plants

* 4.7 MEUA over a 5-year programme : O.J. L 83 of 3.4.79

OBJECTIVES	IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100					
2	X		-	100					
3	X		100						
4	X		.	.					
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	p.m.	p.m.	p.m.	p.m.	p.m.
2	p.m.	p.m.	-	-	-
3	-	-	-	0.500	0.978
4	5.746	7.551	8.726	8.190	8.262
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	5.746	7.551	8.726	8.690	9.240

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- estimation of the quantities of radioactive wastes arising from decommissioning of nuclear power plants in the Community
- influence of nuclear power plant design features on decommissioning
- identification of guiding principles in :
 - . the design and operation of nuclear power plant with a view to simplifying their subsequent decommissioning
 - . the decommissioning of nuclear power plant which could form the initial elements of a Community policy in this field.

4. Radiation protection programme (I.A. 1976-80)

- the aim of the work is to supplement, broaden and deepen the scientific and technical knowledge necessary for determining and keeping up to date the permissible radiation levels in man and the permissible level of contamination of the various components of the environment, and for the improvement of the practical organization of radiation protection by the Member States;
- this aim includes studies on the path which radioactive contaminants follow in man and the environment, on the effects of radiation on living matter, and on dosimetric methods and instruments.

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)					
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 3. NUCLEAR POWER	COUNTRY : E.C.
	II. SUB-SECTOR 3.8. FISSILE MATERIALS CONTROL	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Fissile material control (D.A. 1973-76 and 1977-80)
- conception of control systems
 - measuring methods and techniques
 - surveillance techniques
 - special problems of reprocessing plants

IV. PROGRAMME FEATURES OBJECTIVES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100					
									.../...

V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1	2.017*	3.985*	4.389*	4.240*	6.520*
			* these are total amounts spent; the R&D share is estimated at 90 %		
					.../...
TOTAL (in N.C.)					
TOTAL (in EUA)	2.017	3.985	4.389	4.240	6.520

<u>R+D&D POLICY</u>		I. SECTOR 3. NUCLEAR POWER			COUNTRY : E.C.	
5. Programme description and budgets		II.SUB-SECTOR 3.9. OTHERS			DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>High temperature materials</u> (D.A. 1975-76 and 1977-80)</p> <ul style="list-style-type: none"> - meeting point "Petten" <ul style="list-style-type: none"> . evaluation of industrial needs for advanced refractory materials . publication and continuous updating of a "white book" . information service - the effect of the operational environment on the mechanical properties of materials in high temperature applications - failure modes of high-temperature materials - the relationship between structure , impurities and properties of high-temperature materials. <p>2. <u>Materials science</u> (D.A. 1973-76)</p> <ul style="list-style-type: none"> - lattice defects - surface reactions (particle/surface interaction) - mechanical behaviour, fracture of metals and composite materials (mechanical properties and structure, physical properties, plastic deformation and fracture) - physical properties of materials at high temperatures (solid and liquid) - effects of structural changes and crystalline imperfections on the properties of materials - transport phenomena and structural behaviour in metals, polymers and other materials. 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
1	X		-	100		* These are total amounts spent; the R+D share is estimated at 95%
2	X		-	100		** Expenditures are included in the corresponding sheets pertinent to the FR of Germany and the Netherlands
3	X		-	100		
4	X		-	100		.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
1		2.062	2.330	2.605	3.680	4.051
2		4.933	0.391	-	-	-
3		7.625 *	7.085 *	7.865 *	7.960	11.564
4		p.m. **	p.m. **	p.m. **		
TOTAL (in N.C.)						.../...
TOTAL (in EUA)		14.620	9.806	10.470	11.840	15.615

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : E.C.				
5. Programme description and budgets		II. SUB-SECTOR 4.1. THERMONUCLEAR FUSION				DATE : April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : 1. <u>Thermonuclear fusion technology</u> (D.A. 1977-80) - conceptual studies on thermonuclear fusion reactors - research on materials necessary for fusion, in particular on their behaviour under irradiation, and analysis of required testing methods and equipment - problems concerning safety of the environment 2. <u>Controlled thermonuclear fusion programme</u> (1976-1980) a) <u>fusion and plasmaphysics</u> - general physics in the sector concerned, in particular studies of a basic character or relating to confinement of plasmas with suitable devices and to methods for producing and heating plasmas - research on the confinement in closed configurations of plasmas of widely varying density and temperature - production of and research on plasmas of high and very high density - improvement of diagnostic methods - investigation of technological problems connected with current research and of problems relating to thermonuclear reactor technology b) <u>JET Project</u>										
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION				
OBJECTIVES		current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100						
2a	X		100			X	S, CH			
2b	X		100	80			S, CH			
3		X	100	~ 30			S, CH			
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10⁶)	Expenditures 1977 (x10⁶)	Estimations 1978 (x10⁶)	Estimations 1979 (x10⁶)	Estimations 1980 (x10⁶)				
1		-	2.483	3.685	2.737	7.209				
2a		23.523	21.424	27.217	36.812	39.808				
2b		1.832	8.034	15.000	17.000	38.400				
							.../...			
TOTAL (in N.C.)										
TOTAL (in EUA)		25.355	31.941	45.902	56.549	85.417				

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS					COUNTRY : E.C.				
	II.SUB-SECTOR 4.2. GEOTHERMAL ENERGY					DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)</p> <ul style="list-style-type: none"> - acquisition and collation of existing and new geothermal data <ul style="list-style-type: none"> . collation of existing geothermal data . acquisition and collation of new additional geothermal data - improvement of methods of exploration <ul style="list-style-type: none"> . improvement and/or adaptation of existing prospecting methods to specific geothermal requirements and development of new methods of prospection and exploration - sources of hot water (low enthalpy) <ul style="list-style-type: none"> . compilation of geothermal models in regions concerned . full-scale experimental verification of theoretical models (operation) . utilisation tests on sources of hot water for district and agricultural heating - steam sources (high enthalpy) <ul style="list-style-type: none"> . construction of geothermal models in the areas concerned . improvement of measuring and drilling techniques for experimental work at high temperatures . study of new stimulation methods - hot dry rocks <ul style="list-style-type: none"> . studies and experiments on fracturation . studies and experiments on heat extraction - training of specialists. 										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X		100	50						
2		X	100	est.50						
3		X	100	25-49						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		1.780	3.671	4.897	2.685	3.918				
2		-	-	-						
3		-	-	-	2.250	2.000				
TOTAL (in N.C.)										
TOTAL (in EUA)		1.780	3.671	4.897	4.935	5.918				

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

2. Second indirect action programme (mid-1979 - mid-1983) *)

- integrated geological, geophysical and geochemical investigations in selected areas
 - . data concerning areas of possible geothermal interest
 - . localisation of geothermal anomalies with combined methods (geological, geochemical, geophysical, etc.) involving surface work and shallow drillings
 - . testing and intercomparison of known methods by applying them in well known areas
 - . drilling of exploration boreholes in areas of potential utilisation
 - . interpretation of data in order to determine the characteristics of reservoirs (geometry, permeability, transmissivity, porosity, water pressure, salinity, etc.)
 - . geothermal atlas of the European Community
- subsurface problems of natural hydrothermal sources
 - . drilling at high temperatures (cements, muds, packers, coring, temperature resistance of bits, etc.)
 - . development and improvement of logging equipment for high temperature and pressure applications
 - . development of methods and devices for decreasing the flow resistance around the borehole and for connecting it to the reservoir
 - . stability and destructibility of rock in the presence of hot fluids
 - . development of methods to control corrosion, erosion and scaling in production and reinjection wells and in the surrounding formations
 - . control of the phenomena related to reinjection
 - . investigation of reservoir rock and fluid properties
 - . development of well and reservoir testing equipment (pressure build-up tests, drill stem tests, interference tests, etc..).

* 18 MEUA over a 4-year programme; O.J.E.C. No. L 231 of September 13, 1979

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : E.C.			
5. Programme description and budgets		II.SUB-SECTOR 4.3. SOLAR ENERGY				DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Solar energy</u> (D.A. 1973-76 and 1977-80)</p> <ul style="list-style-type: none"> - habitat and thermal conversion <ul style="list-style-type: none"> . definition of a standardized pilot-test facility for the determination of solar collector performances . high efficiency collectors and the storage and cooling subsystems . combined heating, cooling and storage systems . applied research on materials and in particular on selective absorption surfaces . other applications of solar collectors : distillation (ethanol, sea water) . technico economic studies and project for a documentation and information centre - European solar irradiation facility <ul style="list-style-type: none"> . accelerated ageing tests . measurements of system performance . influence of extreme ambient conditions . development of standardized test procedures - orientation studies centred around direct conversion <ul style="list-style-type: none"> . electrochemical solar cells based on semiconductor/electrolyte electrodes . bioconversion of solar energy 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		-	100					
2	X		100	≤ 50		X			
3		X	100	est.50					
4	X		100	25-49					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		1.163	3.548	4.136	3.618	6.559			
2		1.780	5.955	7.956	3.308	12.336			
3		-	-	-					
4		-	-	-	2.250	2.000			
TOTAL (in N.C.)							.../...		
TOTAL (in EUA)		2.943	9.503	12.092	9.176	20.865			

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

2. First indirect action programme (mid-1975 ± mid-1979)

- solar heat collectors and their application to dwellings
 - . low temperature use of solar energy for heating and cooling buildings
 - . study of plane surface collectors
 - . pilot applications to dwellings for domestic use
- self-contained generating sets for the production of mechanical and/or electrical power
 - . the use in medium and high temperature areas of solar heat to produce mechanical and/or electrical power
 - . improvement of low-power groups
 - . pilot installation of 1 MWe
- photovoltaic conversion
 - . development of alternative cells and improvement of existing cells
 - . feasibility study on new concepts
 - . new methods of preparing semiconductor materials
 - . silicon thin film
 - . automation of panel production
 - . new or improved encapsulating materials
 - . data collection
- photochemical, photoelectrochemical and photobiological processes
 - . basic studies on photochemical, photoelectrochemical and photobiological systems

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION						INTERNATIONAL COOPERATION		
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
OBJECTIVES									
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : E.C.	
	II.SUB-SECTOR 4.3. SOLAR ENERGY				DATE : April 79	
III. OBJECTIVES AND MAIN LINES OF ACTIVITY : (cont'd - 1) <ul style="list-style-type: none"> - photosynthetic production of organic matter <ul style="list-style-type: none"> . choice and development of the most suitable energy crops for the different regions of Europe - data network relating to solar radiation <ul style="list-style-type: none"> . collection, standardization and distribution of comprehensive data on number of hours of sunshine throughout the Community . definition of the implications of the large-scale use of solar energy 3. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983) *) <ul style="list-style-type: none"> - solar energy applications to dwellings <ul style="list-style-type: none"> . heat storage . solar heating systems . standard test procedures for solar collectors . solar cooling . introduction of solar energy as an integral part of habitat - thermomechanical solar power plants <ul style="list-style-type: none"> . completion of the construction of the 1 MWe pilot plant, which has started in the first programme; testing operation and optimisation . evaluation and development of other technologies/cycles (gas cycle) as alternatives to the present steam cycle. Possible design and hardware 						
*) 46 MEUA over a 4-year programme; O.J.E.C. L 231 of September 13, 1979						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A. others envisaged % of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS		COUNTRY : E.C.			
5. Programme description and budgets	II. SUB-SECTOR 4.3. SOLAR ENERGY		DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY : (cont'd - 2)</p> <ul style="list-style-type: none"> . sylviculture: experimental studies of different wood species for different types of soil. Design of a small number of projects associated with certain European regions and climates namely for different broad-leaf species . growing of algae: assessment of their potential for the production of fuels . general studies - solar radiation data <ul style="list-style-type: none"> . organisation of measuring campaigns for the E.C. national weather services . further development of calculation methods for radiation data on inclined surfaces and for data above certain intensity thresholds and their duration . updating and formulating of comprehensive radiation data. Publication of an EC radiation atlas and data books. Preparation of reference years . improvement of the radiation measuring network : including replacement of inadequate equipment and installation of additional equipment . investigation of local microclimates . specific measurements for particular areas, e.g. the production of biomass. - wind energy <ul style="list-style-type: none"> . site evaluation . wind turbines with an increased power coefficient : development of new concepts involving megawatt-size machines . development of new machines such as the Darrieus rotor and their test under the conditions of Europe and of the developing countries . mechanical-electric conversion systems and connection to utility grids : development .../... 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
						others
						envisaged
						% of share
						.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)
TOTAL (in N.C.)						.../...
TOTAL (in EUA)						

<u>R+D&D POLICY</u>		I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS			COUNTRY : E.C.				
5. Programme description and budgets		II. SUB-SECTOR 4.4. OCEAN			DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Support for demonstration projects related to the exploitation of wave and tidal energy in the Community.*</u></p> <p>* Implementation regulation not yet adopted</p>									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	100	25-49						
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		-	-	-	-	-			
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS					COUNTRY : E.C.				
	II. SUB-SECTOR 4.5. WIND					DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Wind energy research and development</u> (See under 4.3.3)</p> <p>2. <u>Support for demonstration projects related to the exploitation of wind energy in the Community*</u></p> <p>* Implementation regulation not yet adopted</p>										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X	100	~ 50							
2	X	100	25-49							
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		-	-	-	p.m.	p.m.				
2		-	-	-	-	-				
TOTAL (in N.C.)										
TOTAL (in EUA)										

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS					COUNTRY : E.C.				
	II. SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR					DATE : April 79				
III. OBJECTIVES AND MAIN LINES OF ACTIVITY :										
1. <u>Hydrogen</u> (D.A. 1973-76 and 1977-80)										
- thermochemical processes for the decomposition of water										
. basic research										
+ theoretical studies : identification of new cycles, engineering and cost analysis of selected cycles, cycle flow-sheets, evaluation criteria, technical design of a full-scale plant, collection of industrial data, problems of interfacing with nuclear reactor										
+ experimental studies : fundamental research on chemistry and reaction kinetics, and material research										
. realisation of a laboratory test installation										
- heat source coupling										
. evaluation of different interface solutions										
. safety and risk analysis										
2. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)										
- thermochemical production of hydrogen										
. research into chemical and electrochemical reaction cycles of high potential efficiency in the conversion of heat energy into hydrogen energy										
. practical experiments on promising cycles										
IV. PROGRAMME FEATURES			STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share	
1	X		-	100		X				
2	X		100	50		X				
3		X	100	50						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		2.413	3.811	4.189	4.100	3.919				
2		1.657	3.757	5.004	2.707	2.726				
3		-	-	-						
TOTAL (in N.C.)										
TOTAL (in EUA)		4.070	7.568	9.193	6.807	6.645				

III. OBJECTIVES AND MAIN LINES OF ACTIVITY (continuation)

- electrolytic production of hydrogen
 - . improvement of existing electrolytic production technology
 - . study of the feasibility and economics of high temperature and high pressure electrolysis
- utilization of hydrogen
 - . analysis of the potential applicability of hydrogen and of synthetic hydrogen-based fuels
 - . development of safety specifications for the handling of hydrogen
 - . improvement of the small-scale storage of hydrogen
 - . studies related to the problems of industrial scale (medium-sized) storage of hydrogen
 - . studies on the possibility of using existing pipelines for the distribution of hydrogen

3. Second indirect action programme (mid-1979 - mid 1983) *)

- thermochemical production of hydrogen (complementary contributions to the JCR actions)
 - . further evaluation of new cycles leading to potential improvements over existing cycles
 - . exploitation of bench-scale experiments for technological data collection
 - . specific open or closed loop experiments for heat exchange and corrosion measurements
 - . data collection, economic assessment and perspectives evaluation
- electrolytic hydrogen production
 - . improvement of conventional electrolytic processes
 - + improved electrocatalysts
 - + new materials in acid electrolysis
 - + membranes and diaphragms, organic and inorganic solid polymer electrolytes

* 8 MEUA over a 4-year programme; O.J.E.C. L 231 of Sept. 13, 1979

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>	I. SECTOR 4. NEW ENERGY SOURCES AND VECTORS				COUNTRY : E.C.	
5. Programme description and budgets	II.SUB-SECTOR 4.6. HYDROGEN AS AN ENERGY VECTOR (CONT'D)				DATE : April 79	
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <ul style="list-style-type: none"> + design of low cost and low maintenance cells + high efficiency gas separators . advanced electrolytic cells <ul style="list-style-type: none"> + design, construction and operation of modules in the 100 kW size + data collection, elaboration and economic assessment of prototypes + system engineering optimisation . high temperature electrolysis <ul style="list-style-type: none"> + cell technology and materials + laboratory prototypes, study of scaling up strategies and alternatives + design, construction and operation of a 10 ÷ 100 kW laboratory prototype - transportation, storage and utilisation <ul style="list-style-type: none"> . general studies . safety aspects <ul style="list-style-type: none"> + data on combustion and exploration + handbook . transport and storage <ul style="list-style-type: none"> + large scale storage : auxiliary equipment and economic assessment + other storage methods; evaluation of possible methods of producing electrical energy from hydrogen + materials and components for hydrogen and transportation 						
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION	
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.
						.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
						.../...
TOTAL (in N.C.)						
TOTAL (in EUA)						

<u>R+D&D POLICY</u>	I. SECTOR 5. ELECTRICITY	COUNTRY: E.C.
5. Programme description and budgets	II. SUB-SECTOR 5.1. ELECTRICITY GENERATING EQUIPMENT	DATE: April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. Second indirect action programme (mid-1979 + mid-1983)

- energy transformation

- . energy from waste (see 1.4.2. for details)
- . LNG-gasification
 - + recovery of a part of the LNG liquefaction energy in a closed cycle turbine
- . heat power production (see 1.4.2. for details)
- . advanced engines for electricity production
 - + higher efficiency of large (up to 40 MW) diesel engines combined with waste heat utilization
 - + use of other fuels (coal, low BTU gas)
 - . energy cascading devices
 - + topping and bottoming devices for industrial processes

(estimated expenditures are included in 1.4.2.)

2. Support of demonstration projects (see 1.4.4. for details).

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION				
	OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I. E. A.	others	envisaged	% of share
1		X	100	50						
2		X	100	n.a.						
										.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1		-	-	-	p.m.	p.m.				
2		-	-	-	p.m.	p.m.				
TOTAL (in N.C.)										
TOTAL (in EUA)										

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : E.C.		
5. Programme description and budgets		II.SUB-SECTOR 5.4. FUEL CELLS			DATE : April 79		
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)</p> <ul style="list-style-type: none"> - development of methods for storage of secondary energy <ul style="list-style-type: none"> . electrical (<u>fuel cells</u>, batteries) <p>(expenditures are included in 1.4.1.)</p> <p>2. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983)</p> <ul style="list-style-type: none"> - electrochemical storage basic research <ul style="list-style-type: none"> + materials for fuel cells + development of cheap catalysts <p>(estimated expenditures are included in 1.4.2.)</p>							
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION		
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others envisaged % of share
1	X		100	50			
2		X	"	"			
							.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)	
1		p.m.	p.m.	p.m.	p.m.	-	
2		-	-	-	p.m.	p.m.	
							.../...
TOTAL (in N.C.)							
TOTAL (in EUA)							

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY				COUNTRY : E.C.			
5. Programme description and budgets		II.SUB-SECTOR 5.5. ELECTROCHEMICAL STORAGE				DATE : April 79			
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)</p> <ul style="list-style-type: none"> - development of methods for storage of secondary energy <ul style="list-style-type: none"> . electrical (fuel cells, <u>batteries</u>) (expenditures are included in 1.4.1.) <p>2. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983)</p> <ul style="list-style-type: none"> - electrochemical storage <ul style="list-style-type: none"> . advanced batteries for applications in car traction, load leveling and alternative energies (solar, waves, wind) + materials basic research on electrolytes and electrodes + applied research (seals, corrosion...) + pilot systems, (estimated expenditures are included in 1.4.2.) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION				INTERNATIONAL COOPERATION			
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50					
2		X	100	50					
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.	p.m.	-			
2		-	-	-	p.m.	p.m.			
TOTAL (in N.C.)									
TOTAL (in EUA)									

<u>R+D&D POLICY</u>		I. SECTOR 5. ELECTRICITY			COUNTRY : E.C.				
5. Programme description and budgets		II.SUB-SECTOR 5.6. OTHER STORAGE TECHNIQUES			DATE : April 79				
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>First indirect action programme</u> (mid-1975 ÷ mid-1979)</p> <ul style="list-style-type: none"> - development of methods for storage of secondary energy mechanical (compressed air, pumping water, fly-wheels) (expenditures are included in 1.4.1.) <p>2. <u>Second indirect action programme</u> (mid-1979 ÷ mid-1983)</p> <ul style="list-style-type: none"> - storage of mechanical energy . fly-wheels for hybrid traction of heavy vehicles . fly-wheels for peak power leveling in industry (estimated expenditures are included in 1.4.2.) 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50					
2		X							
									.../...
V. BUDGETS (natl. currency) OBJECTIVES		Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)			
1		p.m.	p.m.	p.m.	p.m.	--			
2		-	-	-	p.m.	p.m.			
						.../...			
TOTAL (in N.C.)									
TOTAL (in EUA)									

R+D&D POLICY	I. SECTOR 6. GENERAL STUDIES	COUNTRY : E.C.
5. Programme description and budgets	II.SUB-SECTOR 6.1. ANALYTICAL STUDIES ON ENERGY SYSTEMS	DATE : April 79

III. OBJECTIVES AND MAIN LINES OF ACTIVITY :

1. First indirect action programme (mid-1975 ÷ mid 1979)

- systems analysis : development of models
 - . collection of data and the study of static strategic-models for short-term problems
 - . study of dynamic models applicable to medium- and long-term problems

2. Second indirect action programme (mid-1979 ÷ mid-1983) *)

- energy systems analysis and strategy studies
 - . improvement and further development of the medium and long-term E.C. energy models
 - + maintenance and improvement of data bases and of the energy flow model
 - + implementation of the national model systems in local research organisation
 - + improvement in the estimation of parameters used in the different models
 - + complementary developments to existing models
 - + further developments of the long-term models (MEDEE and SLT)
 - + dynamic net energy analysis

* 6 MEUA on a 4-year programme; O.J.E.C. L 231 of September 13, 1979

IV. PROGRAMME FEATURES	STATUS & IMPLEMENTATION					INTERNATIONAL COOPERATION			
	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X		100	50		X			
2		X							
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	0.497	1.431	1.927					0.360	1.707
2	-	-	-						
									.../...
TOTAL (in N.C.)									
TOTAL (in EUA)	0.497	1.431	1.927	0.360	1.707				

R+D&D POLICY 5. Programme description and budgets	I. SECTOR 6. GENERAL STUDIES	COUNTRY : E.C.							
	II. SUB-SECTOR 6.3. STUDIES ON ENVIRONMENTAL EFFECTS	DATE : April 79							
<p>III. OBJECTIVES AND MAIN LINES OF ACTIVITY :</p> <p>1. <u>Environment and resources</u> (D.A. 1977-1980) (partim)</p> <ul style="list-style-type: none"> - atmosphere <ul style="list-style-type: none"> . formation of particles and transport of pollutants (SO₂, NO_x, car exhaust gases natural emissions) <ul style="list-style-type: none"> + physical and chemical analysis + field experiments . pathway of automobile lead - chemicals <ul style="list-style-type: none"> . mobilization of heavy metals from fossil-fueled power plants and potential ecological and biochemical implications . analysis of organic micropollutants in water and ozone depletion by halocarbons and other substances <p>2. <u>Environmental research programme</u> (I.A. 1976-80; (partim)</p> <ul style="list-style-type: none"> - heavy metals - - - air quality - water quality - waste heat; ecological and microclimatic effect - marine pollution (hydrocarbons) and decontamination methods - - - CO₂ accumulation in the atmosphere 									
IV. PROGRAMME FEATURES		STATUS & IMPLEMENTATION			INTERNATIONAL COOPERATION				
OBJECTIVES	current	planned	extramural impl. %	average share Gov. funding %	European Communities	I.E.A.	others	envisaged	% of share
1	X	-	100						
2	X	revision	100						
								* estimates	
									.../...
V. BUDGETS (natl. currency) OBJECTIVES	Expenditures 1976 (x10 ⁶)	Expenditures 1977 (x10 ⁶)	Estimations 1978 (x10 ⁶)	Estimations 1979 (x10 ⁶)	Estimations 1980 (x10 ⁶)				
1	0.855 *	1.176 *	1.165 *	1.047 *	1.342*				
2	0.508 *	1.118 *	1.509 *	1.505 *	1.727*				
TOTAL (in N.C.)									
TOTAL (in EUA)	1.363 *	2.294 *	2.674 *	2.552 *	3.069 *				

LIST OF ABBREVIATIONS IN ALPHABETICAL ORDER

AEE	Agence pour les Economies d'Energies	F
AGIP	Azienda Generale Italiana Petroli	I
AGR	Advanced Gas cooled Reactor	UK
AMN	Ansaldo Meccanica Nucleare	I
AVR	Arbeitsgemeinschaft Versuchsreaktor GmbH	GER
BGC	British Gas Corporation	UK
BRGM	Bureau de Recherches Géologiques et Minières	F
CDF	Charbonnages De France	F
CDFR	Commercial Demonstration Fast Reactor	UK
CEA	Commissariat à L'Energie Atomique	F
CEGB	Central Electricity Generating Board	UK
CERCHAR	Centre de Recherche des Charbonnages	F
CFP	Compagnie Française du Pétrole	F
CNEN	Comitato Nazionale Energia Nucleare	I
CNEXO	Centre National pour L'Exploitation des Océans	F
CNR	Centro Nazionale delle Ricerche	I
CNRS	Centre National de la Recherche Scientifique	F
COMES	Commissariat à L'Energie Solaire	F
CSM	Centro Sperimentale Metallurgico	I
CSTB	Centre Scientifique et Technique du Bâtiment	F
DFR	Dounreay Fast Reactor	UK
DGRST	Délégation Générale à la Recherche Scientifique et Technique	F
ECCS	Emergency Core Cooling System	-
ECN	Energie Centrum Nederland	NL
EDF	Electricité De France	F
ENEL	Ente Nazionale Energia Elettrica	I
ENI	Ente Nazionale Idrocarburi	I
ETSU	Energy Technology Supporting Unit	UK
FIAT	Fabbrica Italiana Automobili Torino	I
GDF	Gaz De France	F
GSB	Gas Standards Branch	UK

HDR	Heissdampfreaktor	GER
HFR	High Flux Reactor	NL
HSC	Health and Safety Executive	UK
HTR	High Temperature Reactor	-
HWR	Heavy Water Reactor	-
IAEA	International Atomic Energy Agency	-
IEA	International Energy Agency	-
IFP	Institut Français du Pétrole	F
INRA	Institut National de la Recherche Agronomique	F
IRD	International Research and Development Co. Ltd.	UK
IRI	Istituto di Ricostruzione Industriale	I
IRT	Institut de Recherche des Transports	F
JET	Joint European Torus	-
JRC	Joint Research Centre	-
KKN	Kernkraftwerk Niederaichbach	GER
KNK	Kompakte Natriumgekühlte Kernreaktoranlage	GER
LOCA	Loss of Coolant Accident	-
LMFBR	Liquid Metal Fast Breeder Reactor	-
LNG	Liquified Natural Gas	-
LPG	Liquified Propane Gas	-
LWR	Light Water Reactor	-
MAGES	Man-made Geothermal Energy System	
MZFR	Mehrzweckforschungsreaktor	GER
NCB	National Coal Board	UK
NEA	Nuclear Energy Agency	-
NERSA	centrale Nucléaire Européenne à neutrons Rapides, S.A.	-
ONERA	Office National d'Etudes et de Recherches Aérospatiales	F
PEC	Reattore di Prova Elementi di Combustibile	I
PFE	Progetto Finalizzato Energetica	I
PFR	Prototype Fast Reactor	UK
PUREX	Name of a reprocessing process	-
PWR	Pressurized Water Reactor	-

RWE	Rheinisch-Westfälisches Elektrizitätswerk A.G.	GER
SGHWR	Steam Generating Heavy Water Reactor	UK
SNEA	Société Nationale Elf Aquitaine	F
SNG	Substitute Natural Gas	-
SNR	Schneller Na-gekühlte Reaktor	GER
SRC	Scientific Research Council	UK
SWU	Separative Work Unit	-
THTR	Thorium Hoch Temperatur Reaktor	GER
TNO	organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	NL
TOTEM	Total Energy Module-system	I
UKAEA	United Kingdom Atomic Energy Authority	UK
VEW	Vereinigte Elektrizitätswerke Westfalen	GER

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