The original documents are located in Box 10, folder "FY 1977 - 11/26/75, ERDA Background Book (1)" of the White House Special Files Unit Files at the Gerald R. Ford Presidential Library.

ERDA
FY 1977

Director's
Review

SUMMARY DATA

Energy Research and Development Administration
1977 Budget

Summary Data

	(In millions) Budget authority	Outlays	Employment, end-of-year Full-time Permanent	Total
1975 actual	3586	3146	7458	7974
1976 February budget				
as amended	4592	4089	8052	8592
enacted	*	*	xxx	xxx
OMB recommendation	5194	4089	8287	8917
OMB employment ceiling	xxx	xxx	8052	8592
TQ February budget				
as amended	1271	1177	8052	8592
enacted	*	*	xxx	xxx
OMB recommendation	1271	1177	8287	8971
1977 July planning target	5490	5070	xxx	xxx
original agency request	7570	6222	9092	9903
revised planning target	N/A	5290	xxx	xxx
revised agency request	6948	5797	8659	9470
OMB recommendation	5971	5219	8543	9267
1978 OMB estimate	5693	5543	8543	9267

*not enacted as of 11/11/75

Summary of Issues

		1977 Agency req. BA	1977 Agency req. O	1977 OMB rec. BA	1977 OMB rec. O	1978 OMB estimate BA	1978 OMB estimate O
Issues:							
#1	Enhanced Recovery of Oil & Gas	59	41	37	32	to be determined	
#2	Hydrogen Pilot Plant:						
	- Pilot Plant	37	29	-	6	15	31
	- Coal R&D	336	321	307	307	427	365
#3	Solar Energy:						
	- Heating and Cooling	54	46	29	25	33	26
	- Solar Electric	120	87	78	55	92	83
#4	Geothermal Energy	60	56	49	42	50	45
#5	Conservation Programs	224	150	99	78	120	90
#6	Nuclear Fuel Reprocessing and Recycle Support	135	69	22	20	9	10
	- Contingency allowance	-	-	67	19	100	50
#7	Commercial Waste Management	120	91	85	66	75	70
#8	Light Water Reactor Technology Program	62	40	10	8	9	9
#9	Employment Levels for ERDA	209	209	200	200	204	204
#10	Nuclear Weapons Research and Testing (Classified)	582	582	507	507	507	507
#11	N-Reactor (Classified)	15	15	21	21	to be determined	

Agency Objectives and Program Evaluation Efforts

ERDA Objectives

- ERDA was established on January 19, 1975. The Federal Non-nuclear Energy R&D Act of 1974 required ERDA to submit to Congress by June 30, 1975, a comprehensive plan for energy research, development, and demonstration. Thus, from its inception, ERDA has been required to place priority on defining its objectives in energy R&D and preparing a detailed planning document on an accelerated basis.

- As discussed in the previous section on "R&D Strategy," OMB staff has been critical of the major conclusion of ERDA's June 30 plan that all national energy R&D goals must be pursued together if we are to gain and maintain energy independence by the year 2000. OMB staff's principal criticism is that ERDA has not been sufficiently selective in establishing its major priorities for energy R&D (i.e., we disagree that all technological approaches have to be pursued on a greatly accelerated basis). As outlined in the section on "R&D Strategy," OMB staff has also disagreed with specific objectives in ERDA's plan.

- ERDA has a statutory requirement to submit a new energy R&D plan to Congress each January. The timing of these submissions is more favorable to OMB than was the timing of the June 30 plan (i.e., we will be able to incorporate the results of the President's FY 1977 budgetary decisions in the January plan). Hopefully, this new timing will introduce some additional discipline in the planning and resource allocation process and will result in a more rigorous set of priorities for energy R&D.

- As outlined in Mr. Fri's transmittal letter of September 30, ERDA is also in the process of reviewing its agency objectives (all programs, not just energy R&D) and establishing a comprehensive Program Approval Document (PAD) system. For each program, the PAD will include objectives, critical milestones, and resources required. ERDA intends the PAD system to be its primary means of management control and measurement of agency performance. The PAD system is scheduled to begin operations early in CY 1976.

- Once ERDA and OMB have agreed upon major priorities and program objectives for the agency, the PAD system appears to have excellent potential for being an effective program evaluation and control system for ERDA management. This system, however, will not be effective unless there is sound "front end" planning of the programs ERDA should pursue.

ERDA Program Planning and Evaluation Efforts

- Effective program evaluation requires effective planning against which to evaluate. As indicated, OMB staff has been disappointed in ERDA's program planning efforts to date. In particular, there does not yet appear to be an overall capability within the ERDA organization to conduct penetrating analyses of program options either within or across major technologies. This was reflected in the ERDA June 30 plan and in ERDA's initial FY 1977 budget submission. Both documents were marked by a failure to identify costs and benefits of pursuing alternative technological approaches. Thus, no real program tradeoffs were made and these documents contained very high expectations for continued funding increases.

- Until now ERDA has placed most of the real responsibility for program planning with each of the Program Assistant Administrators. For example, the Assistant Administrator for Nuclear Energy has the task of developing options for plutonium fuel reprocessing, commercial radioactive waste management, Liquid Metal Fast Breeder Reactor (LMFBR) commercialization, and other areas. However, OMB staff does not believe that a satisfactory analytic basis for decision-making (independent of the AA's) has been established by ERDA for these and other programs, notwithstanding the fact that OMB has been working for months with ERDA to try to have ERDA analyze specific alternatives.

- ERDA does have an Assistant Administrator for Planning and Analysis who could provide a more critical review to counter balance the inevitable desires of the Program AA's to promote their own programs. However, until recently, the AA for Planning and Analysis has not generally challenged the Program AA's within their areas of program responsibility. The Program Evaluation staff has largely been restricted to such tasks as coordinating the preparation of the June 30 Plan (using substantive inputs from the Program AA's).

- To some extent, the inadequacy of ERDA's program planning and analysis efforts results from the fact that ERDA is so new and has so many new people in key roles. Under the circumstances, OMB's expectations for the rapid achievement by ERDA of a satisfactory program evaluation capability may have been unrealistic.

- With some OMB encouragement, top ERDA management has recently reached the conclusion that ERDA needs to establish a more effective program planning, analysis and evaluation system. The AA for Planning & Analysis has been given the task of formulating recommendations for such a system. An effective system would ensure that the AA for Planning & Analysis, the Controller, and other key staff offices would participate in the program planning process and thereby provide additional perspectives for top ERDA management. This is a key move to provide the basis for meaningful evaluation in the sense of evaluating against sound program objectives.

Energy Research and Development Administration
1977 Budget
Distribution of Budget Authority
(In millions of dollars)

	1975 Act.	1976 Feb. Budget	1976 Agency Req/ OMB Recom.	July 1 - Sept. 30 1976 Agency Req/ OMB Recom.	1977 Original Agency Req.	1977 Rev. Agency Req.	1977 OMB Recom.	1978 OMB Est.
Direct Energy R&D	(1322)	(1590)	(1684)	(434)	(3209)	(2926)	(2265)	(2575)
Non-nuclear R&D:	(442)	(540)	(636)	(168)	(1342)	(1111)	(765)	(1007)
Fossil	335	394	435	113	721	601	473	672
Solar	40	71	89	26	255	199	126	147
Geothermal	28	23	31	8	90	70	49	50
Conservation	31	42	71	18	235	223	99	120
Environmental Control	8	10	10	3	41	17	18	18
Nuclear R&D:	(880)	(1050)	(1048)	(266)	(1867)	(1815)	(1500)	(1568)
Fusion-								
Magnetic Confinement	125	156	176	56	384	321	289	307
Laser	64	74	91	23	127	110	95	101
Fission-								
Fast Breeder	488	534	490	114	706	677	655	682
Other	87	145	124	28	195	188	119	100
Nuclear Fuel Cycle	20	22	38	11	161	174	62	150
Commercial Waste Management	13	14	16	5	58	120	85	75
Reactor Safety Facilities	--	--	--	--	35	33	33	5
Nuclear Safeguards	8	19	20	4	34	34	25	25
Laser Isotope Separation	22	32	33	10	53	44	44	40
Uranium Enrichment								
Process Development	53	54	60	15	114	114	93	82
Supporting Energy R&D	(349)	(392)	(400)	(96)	(572)	(462)	(415)	(424)
Biomed & Environmental Effects	164	192	193	46	281	224	191	191
Basic Energy Sciences	185	200	207	50	291	238	224	233

	1975 Actual	1976 Feb. Budget	1976 Agency Req/ OMB Recom.	July 1 - Sept. 30, 1976 Agency Req/ OMB Recom.	1977 Original Agency Req.	1977 Rev. Agency Request	1977 OMB Recom.	1978 OMB Estimate
Production of Enriched Uranium:	(31)	(258)	(390)	(161)	(756)	(728)	(706)	(115)
Production/Capacity Expansion	593	833	982	256	1336	1308	1336	1058
Revenues	-562	-575	-592	-95	-580	-580	-630	-943
Defense Related Programs	(1493)	(1666)	(1720)	(460)	(2209)	(2100)	(1914)	(1843)
Nuclear Weapons	(1006)	(1049)	(1103)	(283)	(1437)	(1328)	(1180)	(1177)
R&D	261	293	304	85	387	380	327	317
Testing	192	219	232	66	274	258	228	220
Production	384	379	387	103	499	468	436	501
Equipment	69	63	67	15	87	87	75	74
Construction	100	95	113	14	190	135	114	65
Other								
Weapons Mat'ls Production	298	381	381	114	565	565	527	424
Naval Propulsion Reactor Dev.	189	236	236	63	207	207	207	242
All Other:	(393)	(373)	(1000)	(120)	(824)	(732)	(671)	(736)
Uranium Resource Assessment	8	19	19	6	46	46	36	40
Peaceful Nuclear Explosives	-	-	-	-	4	2	-	-
High Energy Physics	150	177	177	44	250	241	200	231
Spacecraft Power	29	38	39	9	50	40	34	33
Program Support	204	234	256	64	417	345	269	271
Operational Safety	4	6	6	1	10	11	8	6
Other Revenues	-85	-101	-101	18	-81	-81	-76	-76
Financial Adjustments	83	15	17	15	78	78	78	78
Nuclear Fuel Reprocessing Contingency							67	100
Synthetic Fuel Construction Grants			600					
Legislative Proposal		-22	-22	- 4				
Synthetic Fuels Loan Program 1/			2	2			5	3
Synthetic Fuels Price Supports 2/								
Geothermal Dev'l. Fund Contingency					50	50	50	50
Special Foreign Currency		7	7	1				
Total Budget Authority	3588	4279	5194	1271	7570	6948	5971	5693

1/ The Loan Guaranty Program is expected to receive $1.5 billion in borrowing authority in FY 1976. Revenues are collected in proportion to the outstanding guaranteed debt for the purpose of paying defaults and administrative expenses, consequently the BA and O statistics show revenues less administrative expenses.

2/ The Price Guaranty Program is expected to receive $1.0 billion in borrowing authority in FY 1976.

Energy Research and Development Administration
1977 Budget
Distribution of Outlays
(In Millions of Dollars)

	1975 Actual	1976 Feb Budget	1976 Agency Req/ OMB Recom.	July 1-Sept. 30, 1976 Agency Req/ OMB Recom.	1977 Original Agency Req.	1977 Rev. Agency Request	1977 OMB Recom.	1978 OMB Estimate
Direct Energy R&D	(1012)	(1375)	(1417)	(368)	(2514)	(2308)	(1931)	(2280)
Non-Nuclear R&D:	(207)	(467)	(514)	(105)	(1043)	(872)	(671)	(837)
Fossil	148	335	352	67	571	499	444	563
Solar	15	55	65	17	202	152	91	123
Geothermal	20	29	32	4	71	56	42	45
Conservation	17	38	55	14	166	150	78	90
Environmental Control	7	10	10	3	33	15	16	16
Nuclear R&D:	(805)	(908)	(903)	(263)	(1471)	(1436)	(1260)	(1443)
Fusion -								
Magnetic Confinement	95	142	146	43	273	235	214	306
Laser	56	72	84	22	113	99	88	94
Fission -								
Fast Breeder	462	472	429	117	609	585	575	643
Other	76	93	95	42	168	163	108	105
Nuclear Fuel Cycle	17	21	33	9	78	89	54	75
Commercial Waste Management	11	13	14	4	48	91	66	70
Reactor Safety Facilities	-	-	-	-	26	25	25	7
Nuclear Safeguards	7	14	15	4	31	31	25	26
Laser Isotope Separation	19	27	28	8	47	40	39	40
Uranium Enrichment Process Development	62	54	59	14	78	78	66	77
Supporting Energy R&D	(317)	(361)	(363)	(96)	(498)	(425)	(392)	(410)
Biomed and Environment. Effects	149	177	178	46	241	210	190	190
Basic Energy Sciences	168	184	185	50	257	215	202	220

	1975 Actual	1976 Feb. Budget	1976 Agency Req/ OMB Recom.	July 1 - Sept. 30 1976 Agency Req/ OMB Recom.	1977 Originial Agency Req.	1977 Rev. Agency Req.	1977 OMB Recom.	1978 OMB Est.
Production of Enriched Uranium	(-27)	(181)	(299)	(148)	(651)	(623)	(601)	(317)
Production/Capacity Expansion	536	756	891	243	1231	1203	1231	1260
Revenues	-562	-575	-592	-95	-580	-580	-630	-943
Defense Related Programs	(1501)	(1614)	(1647)	(447)	(1984)	(1924)	(1796)	(1911)
Nuclear Weapons:	(1010)	(1034)	(1067)	(284)	(1293)	(1238)	(1141)	(1179)
R&D	257	284	295	82	362	357	317	317
Testing	189	211	224	61	255	243	220	220
Production	377	378	379	99	466	443	419	495
Equipment	90	75	79	16	80	80	74	74
Construction	97	86	90	26	130	115	111	73
Other:								
Weapons Mat'ls Production	276	341	341	99	465	460	429	494
Naval Propulsion Reactor Development	215	239	239	64	226	226	226	238
All Other:	(344)	(345)	(363)	(118)	(575)	(517)	(499)	(625)
Uranium Resource Assessment	7	15	15	5	38	38	30	40
Peaceful Nuclear Explosives	-	-	-	-	3	2	-	-
High Energy Physics	172	178	178	44	215	201	191	195
Spacecraft Power	35	36	37	10	45	36	32	33
Program Support	206	227	245	64	328	295	266	272
Operational Safety	4	6	6	2	9	8	6	7
Other Revenues	-85	-101	-101	-17	-81	-81	-76	-76
Financial Adjustments	5	-16	--	11	13	13	13	58
Nuclear Fuel Reprocessing Contingency							19	50
Synthetic Fuels Construction Grants							7	23
Legislative Proposals			-22	-4				
Synthetic Fuels Loan 1/ Guaranty Program			2	2			5	3
Synthetic Fuels Price Guaranty Program 2/								
Geothermal Development Fund Contingency					4	4	4	19
Special Foreign Currency		3	3	1	2	2	2	1
Total Outlays	3146	3876	4089	1177	6222	5797	5219	5543

1/ The Loan Guaranty Program is expected to receive $1.5 billion in borrowing authority in FY 1976. Revenues are collected in proportion to the outstanding guaranteed debt for the purpose of paying defaults and administrative expenses, consequently the BA and O statistics show revenues less administrative expenses.

2/ The Price Guaranty Program is expected to receive $1.0 million in borrowing authority in FY 1976.

Energy Research and Development Administration
FY 1977 Budget
Five-Year Projections
(OMB Estimate in Millions of Dollars)

		1977	1978	1979	1980	1981
Direct Energy R&D	BA	(2265)	(2575)	(2460)	(2410)	(2370)
	BO	(1931)	(2280)	(2462)	(2473)	(2437)
Non-Nuclear R&D	BA	(765)	(1007)	(910)	(909)	(843)
	BO	(671)	(837)	(940)	(977)	(911)
Fossil	BA	473	672	563	601	535
	BO	444	563	645	681	601
Solar	BA	126	147	149	100	100
	BO	91	123	121	100	104
Geothermal	BA	49	50	50	50	50
	BO	42	45	48	50	50
Conservation	BA	99	120	130	140	140
	BO	78	90	110	130	140
Environmental Control	BA	18	18	18	18	18
	BO	16	16	16	16	16

		1977	1978	1979	1980	1981
Nuclear R&D	BA	(1500)	(1568)	(1550)	(1501)	(1527)
	BO	(1260)	(1443)	(1522)	(1496)	(1526)
Fusion						
Magnetic Confinement	BA	289	307	310	312	403
	BO	214	306	311	299	340
Laser Fusion	BA	95	101	106	106	86
	BO	88	94	103	103	106
Fission						
Fast Breeder	BA	655	682	645	617	572
	BO	575	643	676	650	610
Other	BA	119	100	100	90	90
	BO	108	105	100	90	90
Nuclear Fuel Cycle	BA	62	150	150	150	150
	BO	54	75	100	125	150
Commercial Waste Mgt.	BA	85	95	100	100	100
	BO	66	70	80	90	100
Reactor Safety Facilities	BA	33	5	-	-	-
	BO	25	7	6	-	-
Nuclear Safeguards	BA	25	26	26	26	26
	BO	25	26	26	26	26
Laser Isotope Separation	BA	44	40	40	40	40
	BO	39	40	40	40	40
Uranium Enrichment Process Development	BA	93	82	73	60	60
	BO	66	77	80	73	64

		1977	1978	1979	1980	1981
Supporting Energy R&D	BA	(415)	(424)	(424)	(424)	(424)
	BO	(392)	(410)	(420)	(412)	(412)
Biomed & Environmental Effects	BA	191	191	191	191	191
	BO	190	190	190	190	190
Basic Energy Sciences	BA	224	233	233	233	233
	BO	202	220	230	222	222
Production of Enriched Uranium	BA	(706)	(115)	(-123)	(-220)	(-514)
	BO	(601)	(317)	(-9)	(-215)	(-513)
Production/Capacity Expansion	BA	1336	1058	998	980	986
	BO	1231	1260	1112	985	987
Revenues	BA	-630	-943	-1121	-1200	-1500
	BO	-630	-943	-1121	-1200	-1500
Defense Related Programs	BA	(1914)	(1843)	(1887)	(1838)	(1760)
	BO	(1796)	(1911)	(1932)	(1898)	(1822)
Nuclear Weapons:	BA	(1180)	(1177)	(1261)	(1266)	(1208)
	BO	(1141)	(1179)	(1277)	(1275)	(1236)
R&D	BA	327	317	317	317	317
	BO	317	317	317	317	317
Testing	BA	228	220	220	220	220
	BO	220	220	220	220	220
Production	BA	436	501	617	634	576
	BO	419	495	600	638	604
Equipment	BA	75	74	74	74	74
	BO	74	74	74	74	74
Construction	BA	114	65	33	21	21
	BO	111	73	66	26	21

		1977	1978	1979	1980	1981
Other:						
Weapons Mtl's Production	BA	527	424	380	371	346
	BO	429	494	428	404	366
Naval Propulsion Reactor Development	BA	207	242	246	201	206
	BO	226	238	227	219	220
All Other	BA	(671)	(736)	(682)	(660)	(654)
	BO	(499)	(625)	(692)	(734)	(759)
Uranium Resource Assessment	BA	36	40	40	40	40
	BO	30	40	40	40	40
Peaceful Nuclear Explosives	BA	-	-	-	-	-
	BO	-	-	-	-	-
High Energy Physics	BA	200	231	230	208	202
	BO	191	195	217	230	212
Spacecraft Power	BA	34	33	33	33	33
	BO	32	33	33	33	33
Program Support	BA	269	271	271	271	271
	BO	266	272	271	271	271
Operational Safety	BA	8	6	6	6	6
	BO	6	7	7	7	6
Other Revenues	BA	-76	-76	-76	-76	-76
	BO	-76	-76	-76	-76	-76
Financial Adjustments	BA	78	78	78	78	78
	BO	13	58	58	58	58

		1977	1978	1979	1980	1981
Nuclear Fuel Reprocessing	BA	67	100	100	100	100
Contingency	BO	19	50	100	100	100
Synthetic Fuels Construc-	BA					
tion Grants	BO	7	23	42	71	115
Synthetic Fuels Loan 1/	BA	5	3			
Guaranty Program	BO	5	3	-5	-16	-24
Synthetic Fuels Price 2/	BA					
Support Program	BO					
Geothermal Development Fund	BA	50	50	50	50	50
Contingency	BO	4	19	19	22	23
Special Foreign Currency	BA					
	BO	2	1			
TOTAL	BA	(5971)	(5693)	(5380)	(5162)	(4744)
	BO	(5219)	(5543)	(5511)	(5308)	(4916)

1/ The Loan Guaranty Program is expected to receive $1.5 billion in borrowing authority in FY 1976. Revenues are collected by proportion to the outstanding administrative expenses, consequently the BA and O statistics show revenues less administrative expenses.

2/ The Price Guaranty Program is expected to receive $1.0 billion in borrowing authority in FY 1976.

MAJOR ISSUES

Fossil Energy

The Issue papers on Oil and Gas Enhanced Recovery (Issue #1) and the Hydrogen Pilot Plant (Issue #2) cover only a portion of the fossil energy activities in ERDA. The following overview table illustrates how these Major Issues and Other Issues relate to the fossil energy budget described previously:

Fossil Energy Program	1975		1976		T.Q.		FY 1977 Agency Req.		FY 1977 OMB Rec.		Total 1978 - 1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Coal:												
Coal R&D (Issue #2)	256	128	301	282	83	46	336	321	307	307	1653	1696
Coal Demo. Plant (Other Issue)	26	3	62	27	17	8	130	84	100	80	400	422
Hydrogen Pilot Plant (Issue #2)	14	-	15	-	3	-	37	29	-	6	42	63
Total Coal	296	131	378	309	103	54	503	434	408	393	2095	2181
Petroleum & Natural Gas:												
Enhanced Recovery Demo. (Issue #1)	23	5	28	19	6	8	44	26	28	23	112	136
Research (Issue #1)	5	5	9	9	1	1	15	15	9	9	36	36
Total PNG	28	10	37	28	7	9	59	41	37	32	148	172
In-situ Technology:												
Oil Shale (Other Issue)	4	4	14	10	2	3	21	12	21	12	99	109
Coal Gasification (Other Issue)	6	2	5	4	1	1	15	10	5	5	20	20
Research	1	1	1	1	—	—	3	2	2	2	8	8
Total In-Situ	11	7	20	15	3	4	39	24	28	19	127	137
Total Fossil Energy	335	148	435	352	113	67	601	499	473	444	2370	2490

Issue Paper
Energy Research and Development Administration
1977 Budget
Issue #1 : Enhanced Recovery of Oil & Gas

Statement of Issue

Should ERDA accelerate its cost-shared program to demonstrate technologies for the enhanced recovery of oil and gas?

Background

ERDA's "National Plan for Energy R,D&D" lists enhanced recovery technologies for oil and gas as one of three highest priority R&D areas for increasing near-term energy supplies. This conclusion stems from ERDA's projection that over the next 40 years up to one-fourth of all domestic oil and gas production could be attained through the application of enhanced recovery. This might be possible because up to now, most domestic oil fields have yielded only 30 to 50 percent of their oil.

Enhanced oil recovery techniques involve the injection of liquids or gases to push out some of the remaining oil. Although it will never be practical to extract 100 percent of the oil, some methods and combinations of procedures, could increase ultimate recovery by 10 to 20 percent. Enhanced gas recovery techniques involve fracturing the reservoir rock in order to release gas fast enough to justify the cost of drilling and distribution.

Current estimates of industry expenditures for enhanced recovery research and field demonstrations range between $100 and $200 million per year. A two year old survey indicated 100 ongoing private sector oil field projects and more recent indications are that these efforts have been greatly expanded. These projects include conventional methods in widespread large-scale use as well as the more costly advanced techniques also included in the Federal program.

By the end of FY 1976, the ERDA program is expected to involve (1) 35 to 40 cost-shared demonstration projects each of 2 to 5 year duration; (2) a $9 million per year program of research in ERDA's Energy Research Centers and National Laboratories; and (3) a small effort in gas and oil utilization research (e.g., engine testing of fuels). The total ERDA effort in FY 1976 totals $37 million (BA).

ERDA's requested budget level of $59 million for FY 1977 with a five-year runout cost of over $500 million, would provide for starting 29 new demonstration projects in FY 1977 (in addition to the 35-40 now funded) and would lead, over the next five years, to the completion of over 150 demonstration projects as well as a six-fold increase in the laboratory research program (over the current level of $9 million). Since current domestic oil and gas production is derived, almost entirely, from only 260 major oil and gas reservoirs, ERDA's demonstration effort represents a very extensive program.

Alternatives

#1. Increase the size of the enhanced recovery program for both oil and gas by initiating 29 new demonstration projects and enlarging the laboratory research effort by 60%.

#2. Continue ongoing demonstration projects and research efforts while completing a definitive program management plan before committing to new demonstration projects.

#3. Phase out demonstration program and restrict all future efforts to laboratory research.

Analysis

Budget Authority/Outlays ($ Millions)	1975 BA	1975 O	1976 BA	1976 O	July 1 - Sept. 30, 1976 BA	July 1 - Sept. 30, 1976 O	1977 BA	1977 O	1978 BA	1978 O	1979 BA	1979 O	1980 BA	1980 O	1981 BA	1981 O
Alt. #1 (Agency req.)	28	10	37	28	7	9	59	41	109	85	127	126	118	119	118	118
Alt. #2 (OMB rec.)	28	10	37	28	7	9	37	32	(TO BE DETERMINED----------							)
Alt. #3	28	10	37	28	7	9	29	29	35	40	31	40	15	18	10	10

Number of Demo. Starts:	1975	1976	July 1 - Sept. 30, 1976	1977	1978	1979	1980	1981
Alt. #1 (Agency req.)	16	22	0	29	36	37	26	5
Alt. #2 (OMB rec.)	16	22	0	(----------TO BE DETERMINED----------				)
Alt. #3	16	22	0	0	0	0	0	0

ERDA argues that its cost-shared demonstration projects will:

- Accelerate private R&D efforts by sharing the cost with industry of high-risk field tests, each costing $5-10 million;

- Increase dissemination of information about improved recovery technologies to both major companies and independents thereby reducing unnecessary duplication of R&D; and

- Provide a credible assessment of the benefits of enhanced recovery R&D and the potential of full-scale use to the public, to Government agencies, and to industrial management.

ERDA staff has asserted that private industry would eventually develop and apply these enhanced recovery technologies but that the ERDA program would accelerate this process by five to ten years. If true, such a situation would justify a substantial Federal program. However, ERDA admits that there is no hard analysis or evidence to substantiate this assertion.

The OMB recommendation, Alternative #2 - to hold the program's funding at its current level, might eventually involve starting some new demonstration projects but it presumes that further program expansion is based upon a fully developed analyzed, and justified program plan.

The need for delaying new efforts until such a plan is developed is based upon the following observation:

- ERDA is only beginning to formulate a management plan that would address where demonstrations should be conducted, what technologies should be used, and how the demonstration results should effect further program planning. Based on the rate of progress during the last year, it seems unlikely that such planning will be completed before the beginning of FY 1977.

- Based on ERDA's ongoing demonstration projects, there is some doubt whether Federal funds accelerate the undertaking of an enhanced recovery project or enlarge its size. Evidence for this conclusion comes from the history of these cost-shared projects, statements of the industry participants, and the degree of private cost sharing (as high as 80 percent). In addition, there is serious question as to whether or not there are enough qualified cost-sharing partners to utilize the FY 1977 funding request.

- All of the processes proposed for cost-shared demonstration in ERDA 1977 budget request have been researched, developed, tested, and even marketed by private industry, but their utilization is very limited. Some feel this is due to the wide range of uncertainty regarding applicability, effectiveness, and economics of different methods. Whether or not these uncertainties can be resolved on anything other than a field-by-field basis is unknown, but the Federal program presumes that an overall predictive model can be developed without conducting research on each and every oil field.

- One of the major deterrents to both research and utilization on enhanced recovery techniques is their cost. The current program only addresses the task of reducing uncertainty of enhanced recovery; there is almost no research on reducing the cost of applying different techniques (e.g., improved preparation or recycling of injected fluids). Similarly, the costs and uncertainties would not be so prohibitive if the value of oil recovered were higher. FEA is studying what impact its regulations have on enhanced recovery and this may lead to regulatory change with a much greater impact than the demonstration program.

Alternative #3, illustrates the funding that would be necessary if future program efforts were restricted to laboratory research and ongoing demonstration projects are completed. Although it may be that this alternative is consistent with the proper Federal role, it would be premature to select this alternative prior to completion of a full analysis by ERDA and OMB.

Agency Request: Alternative #1. ERDA perceives this area as having a very high near-term payoff and the response of the private sector to R&D opportunities as being insufficient.

OMB Recommendation. Alternative #2. Hold program funding level until a more definitive program management plan makes it clear as to whether or not additional funds can be effectively utilized.

Issue Paper
Energy Research and Development Administration
1977 Budget
Issue #2: Hydrogen Pilot Plant

Statement of Issue

In the context of Fossil Energy's Coal R&D Program, should ERDA fully fund a $100 million pilot plant to produce high purity hydrogen from coal at a NASA facility?

Background

In the course of securing a source of liquid hydrogen to fuel the Space Shuttle, NASA examined a range of options, including the use of coal, oil, or natural gas to produce hydrogen. A conventional process using natural gas as a feedstock was selected, and in June 1975, NASA signed a twelve year contract under which the contractor would construct an additional 30 tons per day of liquid hydrogen capacity at an existing facility. The plant's vulnerability to natural gas curtailments was one of the reasons NASA investigated coal and other feedstock alternatives.

Despite NASA's assured twelve year supply (1975-1987) of liquid hydrogen, the agency has supported an ERDA proposal to construct a pilot plant to produce pure hydrogen gas (30 ton/day) from coal (200 ton/day). Tenative plans provide that ERDA would fund construction, startup and one to three years of R&D operation at a total estimated cost of $110 million; and that NASA would provide a fifty acre site adjacent to the existing plant, would utilize its "fast-track" procurement and management capability to build the plant quickly, and possibly fund the operation of the hydrogen plant as a backup source of hydrogen until 1987, and as on-line source of hydrogen after NASA's existing contract expires in 1987.

The coal fed hydrogen pilot plant is of interest to ERDA for two reasons: (1) the facility involves several coal gasification and and gas clean-up steps that are also utilized in producing low-BTU gas and high-BTU gas from coal; and (2) hydrogen is an intermediate product in processes which convert coal to liquid fuel and some relevant R&D could be conducted in this facility.

The ERDA request involves reprogramming $32 million in funds appropriated to fossil energy for more general and small scale R&D efforts in FY 1975 and FY 1976, and providing an additional $37 million in FY 1977. These funds would cover pilot plant design and construction, but an additional $42 million would be needed for start-up, operating, and associated R&D costs over the next four years.

The ERDA Coal R&D program already contains the following efforts, totaling $62 million (BA) in FY 1976, that produce some of the same information that would result from the proposed hydrogen pilot plant: four low-BTU gasification pilot plants and process development units, five high-BTU gasification pilot plants, and one pilot plant for the production of hydrogen (which uses a method different from that of the proposed pilot plant).

The FY 1977 funding requested for the hydrogen pilot plant represents about 10% of the total Coal R&D program request which is directed at improving many different technologies for the utilization of coal. The overall program involves laboratory and pilot plant work on converting coal to liquid and gaseous fuels, on using coal-gas to run gas turbines, on burning coal with greater efficiency and low sulfur emissions, as well as basic research and system studies. This Coal R&D program is closely linked to a demonstration plant program to demonstrate high-risk advanced technology (see Other Issue) and will contribute substantially to the operation of the proposed Synthetic Fuels Commercial Demonstration Program (see Other Issue).

Alternatives

#1. Proceed with design and construction of a fully Federally funded ERDA/NASA hydrogen pilot plant at a total estimated cost of $111 million. In addition, ERDA requests a $35 million increase, over FY 1976, in the other Coal R&D program areas for a total of $336 million (BA) in FY 1977.

#2. Proceed with a cost-shared pilot plant designed and located to best complement ERDA's Coal R&D program; use NASA site if it is still suitable. This alternative also recommends funding for the remaining Coal R&D Program at a level which is $29 million below that requested, and $6 million above FY 1976 funding

Analysis

Budget Authority/Outlays ($ Millions)	1975		1976		July 1- Sept. 30, 1976		1977		1978		1979		1980		1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Coal R&D:																
Alt. #1 (Agency req.)	256	128	301	282	83	46	336	321	507	424	597	562	617	635	544	615
Alt. #2 (OMB Rec.)	256	128	301	282	83	46	307	307	427	365	433	416	437	481	356	434
Hydrogen Pilot Plant:																
Alt. #1 (Agency req.)	14	--	15	--	3	--	37	29	12	36	12	28	9	9	9	9
Alt. #2 (OMB Rec.)	14	--	15	--	3	--	--	6	15	31	12	17	5	10	5	5

ERDA presents three arguments in support of its request:

- The hydrogen pilot plant will contribute to the Coal R&D Program's objectives by providing a large-scale facility that utilizes an approach different than any currently in the Federal program. Outside of the coal demonstration program, none of ERDA's pilot plants exceeds 50 tons of coal per day in size.

- NASA procurement and management procedures are more established and could move more quickly than ERDA, thus the requested approach may result in a facility with lower total costs than might otherwise be possible.

- Beyond its R&D contribution, the hydrogen pilot plant may provide an alternate fuel supply for NASA's space shuttle program.

However, there are several arguments against proceeding with this pilot plant:

- NASA's need for hydrogen from this facility appears marginal because (1) under the terms of the June 1975 contract, Air Products, Inc., has agreed to provide all of NASA's projected liquid hydrogen requirements over the next twelve years; (2) the hydrogen pilot plant is likely to be very expensive to maintain on a standby basis for use during possible mid-winter natural gas curtailments, because of the staffing, maintenance, and inventorying (e.g., coal) costs; (3) even though pilot plant operating costs are difficult to project, no one has argued that the pilot plant's product will be inexpensive enough during the early 1980's to justify NASA abandoning its use of the natural gas-fed plant which it must pay for, whether it uses it or not, (this is a provision of the June contract); and (4) the option of using the pilot plant as an on-line source for hydrogen after 1987 must be weighed against the possibility that a more economical version of the coal-fed process will become available as a result of ERDA's other R&D efforts.
- The coal R&D objectives of this pilot plant might be better met if it were co-located with some other coal R&D activities. This would expand the possible research opportunities, and may also reduce the costs of construction and operation.

- The involvement of a private sector cost-sharing partner would not only reduce the Federal costs, but might also result in an improved pilot plant design, and a product which is more marketable than high purity hydrogen. The same equipment, differently configured, can provide a variety of fuel gases or petrochemical feedstock gases. The coal gasifier system for the hydrogen pilot plant that ERDA tentatively selected has already been extensively tested by the manufacturer (Shell-Texaco) at the 30-50 ton-of-coal/day size, and scaling up to 200 tons/day should not present a very large risk. One firm, DuPont, already appears eager to test this system with or without a Federal partner.

- The scheduling of this pilot plant is neither critical to the development of any larger device or vital to gaining a fundamental understanding that might impact on future R&D decisions. In part, this is due to the number of similar related efforts ongoing in this research area.

As a consequence of these observations, it is recommended that ERDA seek a private cost-sharing partner (at least 1/3 private funding) and consider a pilot plant with a broader range of applications. It is expected that this would obviate the need for additional funds in FY 1977 because of the funding ($32 million) provided in FY 1975 and FY 1976, could reduce the eventual cost to the Federal Government, and would delay the project by one year.

The $29 million reduction from the request in Coal R&D is recommended in order to reduce excessive pilot plant operating funds, improve phasing of the gas turbine research program, and reduce the pace of development in the low priority MHD (magnetohydrodynamics) research program. This latter area is of special concern to Senator Mansfield and it may be expected that he will carefully scrutinize the denial of any requests in this area, even though the program doubled in FY 1976 and the recommendation is for 32% growth in FY 1977. Generally, the FY 1977 Coal R&D recommendation provides for decreases in coal liquid and gaseous fuel R&D as related pilot plant construction ends, and provides for increases in gas turbines, direct combustion, and MHD.

Despite the small increase in funding that is recommended in FY 1977 over FY 1976, the Coal R&D program is viewed by the Administration as having a very high priority, and substantial program "growth" is expected to occur during FY 1977 and in subsequent years. This apparent contradiction with the funding level is due to the fact that over the last three years funding decisions have been based on projected growth rates that did not occur. Consequently, funds were unobligated in both FY 1974 and FY 1975, and the program now has over $100 million available for obligation during FY 1976 in addition to the funds shown on page 2. It is likely that some FY 1976 and transition quarter funding will be carried over into FY 1977, but this should be the last year of sizeable carryovers.

Agency Request: Alternative #1. ERDA has stated that their current plan is the most cost effective approach to providing NASA with an alternate hydrogen resource and at the same time aid in the development of new technology for the generation of hydrogen and low-BTU industrial fuel gas.

OMB Recommendation. Alternative #2. ERDA should proceed with a pilot plant project with a primary purpose of producing a hydrogen-enriched gas, but with a broader range of potential R&D applications. At least 1/3 private cost-sharing should be sought, and NASA should be urged to continue to make its site available to the program.

Issue Paper
Energy Research and Development Administration
1977 Budget
Issue #3: : Solar Energy

Statement of Issue

What should be the pace of the solar energy program?

Background

The current ERDA solar energy program is largely the result of two acts passed by the 93rd Congress, the Solar Energy Research, Development, and Demonstration Act (P.L. 93-473), and the Solar Heating and Cooling Demonstration Act of 1974 (P.L. 93-409). These acts authorize a program of research, development, and demonstration with the goal of providing the option for utilizing solar energy as a viable contributor to the Nation's future energy needs.

Energy from the sun may be converted into usable forms of energy by means of several conversion technologies which may be grouped into three principal categories: (1) direct thermal applications, involving the collection of sunlight through thermal collectors for uses such as the heating and cooling of buildings, (2) solar electric applications, in which energy from the sun is transformed into electricity, and (3) fuels from biomass, involving the production of fuels such as methane, alcohols, hydrogen, or other energy intensive products from organic materials. ERDA has estimated that the future contribution of these solar energy technologies could be:

CONVERSION TECHNOLOGY	Energy Production (Quads) 1/ 1985	2000	2020
Direct Thermal Applications	.2	3	20
Solar Electric Applications	.07	5	15
Fuels from Biomass	.5	3	10
Total Projected U.S. Demand 2/	100	150	180
Estimated % of National Demand	0.8%	7%	25%

1/ Q: Quadrillion (10^{15}) Btu's or Quads
2/ The U.S. now uses 75Q/year

ERDA has requested $199 million for the FY 1977 solar energy program (as compared to $89 million in FY 1976). Of this total, $177 million is for heating and cooling of buildings and solar electric applications. These two activities are the subject of the following major subissues. Other solar programs, which include fuels from biomass, agricultural and industrial process heating, and technology utilization and support, are described in the Other Issues section (pages 7, 8, and 9, respectively).

Subissue #1

What should be the size and pace of the solar heating and cooling demonstration program?

Background

The Solar Heating and Cooling Demonstration Act of 1974 provides for the demonstration, within a three year period, of the practical use of solar heating technology, and for the development and demonstration, within a five year period, of the practical use of combined heating and cooling technology. The Act further provides that such systems be installed in a sufficient number of different geographic areas under varying climatic conditions to constitute a realistic and effective demonstration. The legislative reports indicate that the number of installations should be set administratively, but that residential installations should be in substantial numbers, and that 2000 or more units would meet the requirement.

The demonstrations are planned to be conducted in five yearly cycles through FY 1979, with the first three cycles concentrating on solar heating and the later cycles concentrating on combined heating and cooling. The cycle begun in FY 1976 will implement approximately 22 commercial installations covering seven regions and approximately 100 residential installations covering 12 climatic regions. ERDA is in the process of completing a study of the optimum number of demonstration units considering such factors as climate, number of building starts, number of types of hardware systems available, and different building types. Although the results of their study have not been available for OMB analysis, preliminary indications are that ERDA may recommend a total program of 800-1000 total demonstration projects within the five year period, of which about 600-800 would be residential and 200 would be commercial. ERDA's FY 1977 request for the second cycle corresponds to approximately 275 demonstration units, most of which will be residential installations for solar heating.

Solar heating and cooling systems are inherently a supplemental energy source and not a total substitute for conventional heating and cooling systems because of the diffuse nature of the sun's energy, requiring large collectors, and because of residential energy needs during periods of darkness or cloudy weather. Although maintenance costs are typically low, current solar systems have an initial cost of several thousand dollars and are not economic for the homeowner today, except in areas where solar radiation is excellent and the cost of alternative energy sources is very high. ERDA has estimated that the heating and cooling program could result in energy production of 0.2Q by the year 1985 and 2Q by the year 2000.

The demonstration projects to be developed in the later cycles are expected to have advanced energy storage components as well as a cooling capacity. These systems, although probably more expensive than heating only systems, may offer greater utilization by day, week and season and prove to be more viable for both the homeowner and utility.

Alternatives

#1. Authorize a highly accelerated demonstration program of approximately 275 units for the cycle beginning in FY 1977, with a total program of 800-1000 units expected through FY 1979.

#2. Authorize an accelerated demonstration program of approximately 100 units for the cycle beginning in FY 1977, with a total program of approximately 400-500 units expected through FY 1979.

Analysis

Budget Authority/Outlays ($ Millions)	1975		1976		July 1 - Sept. 30, 1976		1977		1978		1979		1980		1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Alt. #1 (Agency req. & cutback)	12	5	27	22	8	5	54	46	61	55	61	55	10	15	10	12
Alt. #2 (OMB rec.)	12	5	27	22	8	5	29	25	33	26	33	26	5	6	5	6

Alternative #1, the Agency's request and ceiling solution, provides for highly accelerated demonstration of current technology systems, and envisions a continuing high level program through FY 1979. This alternative demonstrates uneconomic systems which may have a minimal, or even negative impact, on the far term production of energy from this source. This approach provides for 800-1000 total installations through FY 1979.

Alternative #2, provides for an accelerated but more orderly program, recognizing the potentially positive impact of successful demonstrations, but allowing for a slower pace more consistent with the economics of current technology. Because the solar heating systems now being generated are not generally economic, OMB staff believes that the number of demonstrations should be limited to that required to evaluate the technical effectiveness of candidate systems in varying environments; additional demonstrations for the purpose of achieving greater visibility with the public would not be appropriate at this time. This alternative would also place greater emphasis on research and development which may lead to lower unit costs for later demonstrations. The total number of demonstrations with this alternative may be no more than 400-500 through FY 1979.

Agency Recommendations: Alternative #1 and #2. Authorize a highly accelerated demonstration program which may require 1000 demonstrations before 1980.

OMB Recommendation. Alternative #3. Authorize an accelerated but slower demonstration program, with more emphasis on R&D and a total program of approximately 400-500 units.

Subissue #2

What should be the pace of the solar electric applications program?

Background

This subprogram involves four technological approaches to converting the sun's energy into electricity: solar thermal electric, wind energy conversion, ocean thermal conversion, and photovoltaics.

In solar thermal electric, ERDA's principal thrust will be to focus the sun's energy on a central boiler with a large field of mirrors. Though there appears to be no fundamental problems which restrict development of solar thermal electric technology, neither the engineering nor economic feasibility of this technology has been established, and its eventual application will probably be limited to intermediate load service in the Southwestern United States.

Wind conversion has been technically feasible for producing electricity for many years. However, because of high capital costs and the requirement for strong steady winds to produce maximum output, wind systems are far from economic today except in limited areas and isolated locations where strong winds are present and the cost of alternative energy sources is high.

Ocean thermal conversion is a relatively low technology in which no breakthroughs are required to demonstrate technical feasibility. In this technology, electricity is produced from a thermal gradient in the ocean. Ocean thermal systems currently suffer the high capital costs of other solar systems and the resource is limited to the United States Southeastern and Gulf Coasts, off the United States Pacific Coast, and around Hawaii and Guam. Because of the cost and difficulty of transmitting electricity from an ocean thermal electric plant to land, ocean thermal systems may not be feasible for large scale power delivery to the Continental United States

Photovoltaics involves the use of large arrays of semiconductor devices to convert the sun's energy directly into electricity. These arrays have been built for space applications at costs in excess of $30,000/KW, but large cost reductions on the order of 200:1 will be required for photovoltaics to be economic for large scale applications. While scientific breakthroughs are thought possible, ERDA's thrust is to reduce costs through the development of mass production methods. If economic, photovoltaic arrays could be widely applied in the United States.

Alternatives

#1. Establish a highly accelerated program that seeks to realize the potential contributions of all the major solar electric technologies at the earliest possible time.

#2. Continue an orderly but accelerated development of the potentially larger payoff solar thermal electric and photovoltaic technologies where engineering and technical breakthroughs are thought possible. For the wind and ocean thermal approaches, limit the program to assessing the accessible and recoverable resource base and funding of critical component development.

Analysis

Budget Authority/Outlays ($ Millions)	1975		1976		July 1 - Sept. 30, 1976		1977		1978		1979		1980		1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Alt. #1 (Agen.req.&cutback)	25	8	51	36	15	10	120	87	150	109	150	109	136	104	95	80
Alt. #2 (OMB rec.)	25	8	51	36	15	10	78	55	92	83	89	75	79	83	79	89

For alternative #1, ERDA believes that all major solar electric approaches must be greatly expanded to achieve the potential contributions of solar electric technologies at the earliest possible date. ERDA also believes that demonstration of each solar electric technology will be necessary to gain experience and generate life cycle cost data. By ERDA's estimate, this alternative could lead to the following contributions:

Estimates of Energy Supplied by Solar Electric Techologies in Quads

Technology	1985	2000	2020
Solar Thermal	0.0	1.2	4.2
Wind	negl.	1.2	3.6
Ocean Thermal	negl.	.6	2.4
Photovoltaics	negl.	1.8	4.8
Totals	.07	4.8	15.0

OMB staff is skeptical of these resource estimates by ERDA, particularly for the wind and ocean thermal approaches. However, marked improvements in the efficiency and cost-effectiveness of the solar electric technologies may eventually prove the validity of some of these estimates.

Alternative #2 (OMB Recommendation) would permit an orderly but significant acceleration of solar thermal and photovoltaic technologies, with an initial thrust towards determining the technical and engineering feasibility of the technological approaches with higher long-term payoffs. This alternative would limit the wind and ocean thermal approaches to advanced concepts that could lead to dramatic cost reductions, recognizing that costly demonstrations of uneconomic near-term technologies are not likely to lead to any significant commercialization.

Agency Recommendation. Alternative #1. Authorize a program of highly accelerated development of all major solar electric approaches leading to early, Federally-funded, demonstration of each approach.

OMB Recommendation. Alternative #2. Authorize an accelerated solar electric program in the higher long-term payoff areas of solar thermal and photovoltaics. Redirect funding for wind and ocean thermal systems from early demonstration to advanced concepts.

Summary of All Solar Programs
(In Millions of Dollars)

Program	FY 1976 BA	FY 1976 O	FY 1977 Request BA	FY 1977 Request O	FY 1977 OMB Rec. BA	FY 1977 OMB Rec. O
. Direct Thermal Applications	(29)	(23)	(61)	(51)	(33)	(27)
- Heating & Cooling	27	22	54	46	29	25
- Agricultural & Industrial Process Heat	2	1	7	5	4	2
. Solar Electric Applications	(51)	(36)	(120)	(87)	(78)	(55)
- Solar Thermal	17	13	51	33	46	34
- Photovoltaics	19	13	38	27	23	14
- Wind	12	9	22	18	6	5
- Ocean Thermal	3	3	9	8	3	3
. Fuels from Biomass	(6)	(3)	(8)	(6)	(6)	(4)
. Technology Support & Utilization	(4)	(2)	(10)	(8)	(10)	(6)
Totals	89	65	199	152	126	91

Issue Paper
Energy Research and Development Administration
1977 Budget
Issue #4: Geothermal Energy

Statement of Issue

What is the appropriate strategy and pace for developing the potential of geothermal energy?

Background

ERDA's geothermal energy program is the result of the Geothermal Energy Research, Development and Demonstration Act of 1974 (P.L. 93-410), which authorizes a program of research, development, demonstration, and loan guarantees for geothermal energy development with a goal of establishing this energy source as a viable potential contributor to the Nation's future energy needs.

Geothermal energy is the natural heat of the earth. Geothermal reservoirs have been found primarily in the Western United States and along the Gulf Coast; more than half in the Western states are on Federal land. The world's total production of electrical power from geothermal sources has reached only about 1000 MW_e, or about the output of one large nuclear plant. The U.S. leads the world in such production, generating 500 MW_e from dry steam at the Geysers in California.

The primary geothermal resources are (a) hydrothermal reservoirs (hot mineralized water or dry steam), (b) geopressured zones (zones of sand and clay saturated with methane gas and water at high temperatures and pressures), and (c) hot dry rock (hot solid rock in earth's upper crust). The United States Geological Survey has estimated the recoverable heat from these resources as follows:

Resource Type	Recoverable Energy (Quads) Known	Inferred
. Hydrothermal		
- dry steam	2	2
- hot liquids	100	360
. Geopressured	600	1730
. Hot Dry Rock	80-600	240-1900

Currently, energy extracted from geothermal resources is used primarily to generate electrical power; however, other potential energy uses include heating, refrigeration, and industrial processing requiring heat. Unlike facilities using coal, oil, or other fuels, geothermal power plants and associated facilities must be constructed at or near the well-head because transporting steam is difficult.

ERDA's current strategy is to encourage the present geothermal industry (about 20 companies) to develop the more accessible but more limited hydrothermal resources, mostly for electric power generation, so that the industry gains sufficient experience with geothermal utilization technologies to be able to adapt these technologies to exploit the less accessible but more abundant geopressured and hot dry rock resources. Development of the more abundant and geographically distributed geopressured and hot dry rocks resources has not been undertaken by industry largely because the technologies for accurate reservoir assessment and extraction have not been developed. ERDA has estimated that if their program is approved and successfully implemented, the following energy production could be achieved:

Estimated Geothermal Energy Production Given Successful Program Implementation
(Quads)

Resource	1985	2000	2020
Hydrothermal	0.6	2.5	3.1
Geopressured	negl.	1.2	9.0
Hot Dry Rock	.0	.7	6.5
Total Energy	.6	4.4	18.6

Approximately 50% of the outlays in ERDA's request are devoted to hydrothermal applications and the near-term demonstration of electric power generation. ERDA believes that much of the hydrothermal technology that it would develop would be applicable to tapping the geopressured and hot dry rock resources.

Alternatives

#1. Continue current strategy to encourage the rapid development of hydrothermal resources, including demonstration projects.

#2. Redirect the program by concentrating on the development of the much more abundant but longer-term resources. Continue hydrothermal development at approximately the FY 1976 level in order to develop key components which will have application to both hydrothermal and advanced resources.

Analysis

Budget Authority/Outlays ($ Millions)	1975		1976		July 1 - Sept. 30, 1976		1977		1978		1979		1980		1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Alt. #1 (Agency req. & cutback)	28	20	31	32	8	4	60	56	141	114	117	121	95	112	54	80
Alt. #2 (OMB rec.)	28	20	31	32	8	4	49	42	50	45	50	48	50	50	50	50

Alternative #1 calls for rapid acceleration in the development of hydrothermal resources for initial significant production in the 1985-2000 time period. The disadvantage of this alternative is that it calls for initiation of costly demonstration projects in the next several years that will focus on developing technology for tapping geothermal resources with limited potential.

Alternative #2 provides for orderly but accelerated growth in the R&D program and encourages development of those technologies (i.e., those to tap geopressured and hot dry rock resources) holding the greatest payoff. This alternative would continue some hydrothermal development in key component areas in order to stimulate the expansion of the existing industry to yield an early contribution. However, this alternative does not provide for early, federally-funded, commercial-scale demonstration of electric power generation from hydrothermal resources, but rather relies primarily on the private sector to tap these nearer-term resources.

Agency Request: Alternative #1. The agency believes that accelerated production of geothermal energy should be developed largely through the stimulation of the small existing industry towards the development of hydrothermal resources.

OMB Recommendation. Alternative #2. While the identified resources for geothermal are substantial, no analysis has been done justifying a greatly accelerated effort for the development of hydrothermal resources. The pace and strategy of the program should match the relative potential of the geothermal resources as long-term energy sources.

Issue Paper
Energy Research and Development Administration
1977 Budget
Issue #5: Conservation Programs

Statement of Issue

What should be the funding level for R&D in conservation programs, particularly those programs aimed at more efficient energy consumption in buildings, industry, and transportation?

Background

. There are two paths for achieving energy conservation through improved technologies: (a) greater efficiency of production, distribution, and storage of energy, and (b) reduced consumption of energy at the end-use.

- Projects to achieve greater efficiency fall into the areas of electricity transmission and distribution, storage of energy in more advanced batteries, creating energy from fuel cells, and utilization of garbage and other organic wastes for energy.

- Projects to achieve reduced consumption of energy at the end-use through improved technologies fall into three categories: industry, buildings, and transportation. Examples of projects proposed by ERDA include:

  .. Industrial projects, such as 2/3 ERDA funding of $30 million for a more energy efficient steel rolling mill and $1 million for a pilot plant to dry grain in a vacuum with microwave heating.

  .. Building projects such as development of data on energy consumption in residential and commercial buildings. This is to support the President's legislative proposal for energy performance standards. on residential and commercial buildings. Another project is similar to the HUD total energy plant in Jersey City.

  .. Transportation projects such as contracts with the auto industry to develop advanced engines and grants to universities to study the use of methanol fuel mixtures as substitutes for gasoline.

- Industry conducts R&D related to conservation of energy in all key program areas, although the levels of effort and commitment vary from area to area.

  - Electricity transmission and distribution: The Electric Power Research Institute, funded by electric utilities, is spending $12 million for electricity transmission and distribution for CY 1975, which is the same amount to be outlayed by ERDA in FY 1976. ERDA works closely with the Institute as evidenced by the 23 joint projects underway, with industry paying an average 75% of the costs.

  - Energy storage: Industry-wide R&D in this area has been estimated by ERDA at $10 million annually.

  - Transportation: Automotive R&D by industry has been estimated at $54 million in CY 1974 as a result of an NSF survey.

  - Buildings and industry: The same NSF study indicated $56 million was spent in these end-use areas.

- ERDA has requested a tripling in BA for conservation R&D from $72 million in 1976 to $224 million in 1977. The largest increases have been requested in the energy storage program and in the three programs concerned with reducing energy consumption -- buildings, industry, and transportation. These increases are consistent with strong congressional interest which views conservation programs as directly helping consumers in contrast to other ERDA R&D which is perceived as helping big industry. Also end-use programs tend to have short-term benefits relative to ERDA's other R&D programs.

- ERDA's proposed strategy for Federal activity in conservation R&D implies a large Federal role in order to ensure, in virtually all areas, that improved technology developments occur in a timely fashion. Specifically, ERDA argues for a strong Federal role because:

  - Some potentially high payoff technology development activities are very expensive. For example in R&D on advanced automobiles, a university research team has estimated that $1 billion should be spent over the next 5-10 years. If an advanced automobile, such as one with a Stirling or turbine engine is mass produced, the payoff could be 2 million barrels of oil per day by the year 2000.

  - Some potentially high payoff technologies are far off. For example, improvements in battery technology are being sought through studies on electrochemistry and on materials. The payoff here would be to eliminate dependence on oil for auto fuel, or store energy to meet peak power demands.

  - Some potentially high payoff research is high risk. For example, it has been estimated that 80% of the electric power outages are caused by lightning. Yet the technology does not even exist to measure lightning surges in power lines in order to develop equipment that could accommodate the surge and prevent the outage.

. The criteria for analyzing ERDA's individual R&D programs in conservation are:

- Is the program adequately justified and sized in terms of its costs, benefits, and risks of technical and commercial success?
- What is the appropriate role of the Federal Government to perform the R&D relative to the private sector?
- Should ERDA or some other agency perform the Federal R&D?
- Can ERDA effectively manage the requested program growth?

Alternatives

#1. Maintain a level program and take the chance that the private sector will perform more R&D?

#2. Allow some growth in high priority projects in transportation and energy storage.

#3. Same as #2, but with increases also in buildings and industry projects which might satisfy the criteria if a better justification was available on costs, benefits, and the Federal role?

#4. Greatly accelerate energy conservation R&D programs in all major areas.

Analysis

Budget Authority/Outlays ($ Millions)	1975		1976		July 1 - Sept. 30, 1976		1977		1978		1979		1980		1981	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Alt. #1	31	17	72	55	18	14	72	65	72	72	72	72	72	72	72	72
Alt. #2 (OMB rec.)	31	17	72	55	18	14	99	78	120	90	130	110	140	130	140	140
Alt. #3	31	17	72	55	18	14	124	90	160	130	180	160	190	175	200	190
Alt. #4 (Agency req.)	31	17	72	55	18	14	224	150	345	257	392	305	400	324	395	336

. Alternative #1, which is level in dollars, would result in a decrease in program level due to inflation. It would signal a very limited Federal role. It would be interpreted as totally unrealistic by supporters in Congress and elsewhere who believe there are substantial benefits available from conservation R&D, particularly as compared to benefits from other energy R&D programs. While the level of benefits is open to discussion, there is sufficient information about benefits to warrant modest increases on programmatic grounds in all key areas. In the areas of transportation and energy storage, significant opportunities may be missed.

- Concerning the agency request (Alternative #4) information is not sufficient either from ERDA or other sources to justify a tripling of BA. The Federal role relative to industry would be significantly increased in all areas, particularly with demonstrations. ERDA would infringe on many other agency responsibilities. Finally, ERDA's ability to effectively manage a tripling in BA is doubtful.

- Alternative #2 best satisfies the criteria for R&D by providing for increases in transportation and energy storage.

  - Benefits from advanced autos include a 25-40% improvement in fuel economy, even after the 40% improvement being promised by Detroit. Advanced engines would also meet the most stringent emission standards and run on fuels other than gasoline, such as methanol and synthetic gas from oil shale or coal. Battery advances whether applied to transportation, industry, homes, and even utilities can smooth the fluctuations in energy demand during the day and week and as mentioned before in the case of autos reduce petroleum demands. Energy saved in transportation and energy storage is potentially more cost-effective in terms of oil and gas savings relative to energy savings in buildings and industry, since the latter areas depend more heavily for energy from fuels other than oil and gas.

  - The Federal role associated with Alternative #2 is more clear in an absolute sense and relative to other conservation programs. While industry does R&D in energy storage and advanced automobiles, its level of effort is below what is probably socially desirable. In advanced autos alone it is estimated that the nation, including Government and industry, should be spending from three to five times what it is currently spending. Industry would probably spend more on R&D in advanced autos but does not because Federal requirements on auto emissions and safety divert R&D funds in the industry to these purposes. For example, in the 1974 NSF survey private R&D spending by the auto industry was reported as $139 million for environment and $54 million for conservation.

  - The ERDA role is also clear relative to other Federal agencies for Alternative #2. The increase in transportation R&D would go almost exclusively to advanced autos. NASA would retain the predominate role in aviation conservation as evidenced by their 1977 budget mark of $29 million, up from $11 million in 1976. In energy storage no other agency is performing significant R&D.

  - Finally there is little doubt ERDA could manage the increase associated with Alternative #2.

- Alternative #3, provides further increases in buildings and conservation, because ERDA feels so strongly about them. Yet these programs are not as well justified in terms of costs, benefits, risks, Federal role, etc. But as a fallback position to appeals from the agency on Alternatives #1 and #2, this alternative still does not provide for the most questionable projects in the agency request, such as in garbage recycling (about which they also feel quite strongly) and demonstration projects, like the steel mill.

FY 1977 ERDA Budget - Overview

General

- This Overview paper discusses:
  - OMB's initial planning assumptions for ERDA (7/75).
  - ERDA's original FY 1977 budget request (9/75).
  - ERDA's response to the revised FY 1977 ceiling (10/75).
- The primary differences between the OMB staff recommendations and the ERDA approach to reaching the revised FY 1977 ceiling are highlighted and major issues are identified.
- Following this Overview paper is a separate section on energy R&D strategy.
- In addition, possible further reductions are listed in priority order at the end of this paper.

OMB Initial Planning Assumptions

- In July 1975, ERDA was provided an FY 1977 Planning Ceiling of $5.1B (BO) which was essentially a runout of the ongoing program levels with no provision for major new initiatives. The $1B allowed over the FY 1976 spending total of $4.1B was required to cover three roughly equal amounts of increase to carry out the approved program: (a) runout costs of approved energy R&D facilities or demonstration projects; (b) additional uranium enrichment production and capacity expansion; and (c) cost-of-living increases for other programs.

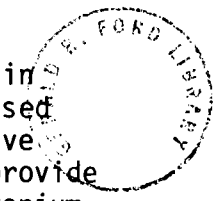
ERDA Original FY 1977 Budget Request

- On September 30 ERDA submitted its FY 1977 budget request of $6.2B ($1.1B over ceiling). ERDA was unwilling to provide its recommended approach to reach the Planning Ceiling. ERDA took the position that the Planning Ceiling level was inadequate to provide for needed growth in high priority energy R&D and defense programs (see attached letter of September 30 from Mr. Fri).
- The original FY 1977 ERDA budget submission of $6.2B (outlays) assumes a very ambitious growth rate for all program categories:
  - Energy R&D - ERDA desires to press forward with an accelerated program for all technologies (pursuant to their June 30 Plan).
  - Uranium enrichment - The cost growth is the result of the planned increase in production from existing Government plants (including increased costs of electricity) and the ongoing capacity expansion program for these three plants. These increases are required to assure enriched fuel for civilian power plants and to provide inventories to backstop private uranium enrichment.

- Defense-related programs - The increases primarily relate to the desire of ERDA and DOD for ERDA's weapons design laboratories to devote more effort to advanced R&D, including related underground testing (this objective was recently supported by the President in a FY 1976 budget amendment). In addition, ERDA projects substantial increases for weapons production and for storage of radioactive wastes from plutonium production.

- Other programs - The increases cover a request for more than 1,000 additional Civil Servants (over a base of 8,052) and a plan to initate a major construction program to rehabilitate and modernize ERDA's laboratories.

ERDA Response to Revised (Cutback) FY 1977 Ceiling



- Although the Division identified a number of potential cutbacks in response to the President's $28B tax reduction program, the revised ERDA ceiling had to be raised from $5.1B to $5.3B in order to give some recognition to the fact that the original ceiling did not provide funds for major initiatives in the nuclear fuel cycle (e.g. plutonium recycle and radioactive waste management).

- In response to the revised ceiling, ERDA (after an intensive review) reduced its FY 1977 request by $.4B to $5.8B. ERDA also identified actions which could be taken to reach the $5.3B revised ceiling. However, ERDA strongly recommended against going below the revised request of $5.8B (see attached ERDA letter of October 29). Thus, the gap between OMB and ERDA has been reduced from $1.1B (initial request) to $.5B (revised request).

OMB Staff Assessment of Revised ERDA Request and Ceiling Case

- The reductions made by ERDA to reach the $5.8B level have removed much of the excessive funding contained in the original request. All programs have been reduced and in a generally reasonable way.

- In addition, despite ERDA's objections, we believe that many of the specific reductions identified by ERDA to get to the revised ceiling of $5.3B are acceptable. These include:

  - A slight slowdown in energy R&D programs (particularly conservation and fusion) which would still be 42% above FY 1976 spending levels.

  - A reduction in the request for nuclear weapons R&D, testing, and production (still almost 10% over FY 1976 spending levels).

  - An 8% increase in the charge for uranium enrichment services, based upon cost increases experienced.

  - Across-the-board decreases in procurement of equipment, computers, and facility improvements.

- However, in some cases ERDA has suggested unacceptable reductions to reach the $5.3B revised ceiling:

  - We would recommend against the large reduction in the production of enriched uranium which was identified by ERDA to reach the revised ceiling. This would result in large penalty charges for cancelling electric power already ordered for the production plants. Most importantly, this would reduce the amount of enriched uranium available to backstop private enrichment ventures and handle contingenices.

  - In addition, we would not recommend accepting ERDA's revised ceiling action of deferring the initiation of new efforts to resolve critical nuclear fuel cycle issues (See Issues #6-#7).

  - We would also recommend against the shutdown in FY 1976 of the N-Reactor, Richland, Washington, which we do not believe is a realistic option (See Issue #11).

  - Furthermore, we would also recommend against a non-programmatic reduction suggested by ERDA which would only consist of deferring the payment of $40M of bills to FY 1978.

OMB Staff Approach

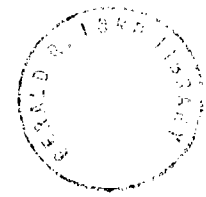
- Although OMB staff has not bought all of the reductions identified by ERDA to reach the revised ceiling of $5.3B, we have been able to come even lower ($5.2B) by:

  - Decreasing non-nuclear energy R&D.

  - Reducing supporting energy R&D.

  - Decreasing weapons R&D, testing, and production.

  - Applying other, relatively smaller, reductions throughout ERDA's program.



- The principal difference between the OMB staff approach and the ERDA revised ceiling solution concerns the relative priority of certain non-nuclear energy R&D programs (mainly solar and conservation) versus uranium enrichment production.

  - ERDA would protect a very large (65%) growth in non-nuclear energy R&D by greatly reducing the production of enriched uranium.

  - OMB staff believes that the rate of spending growth in non-nuclear energy R&D can and should be constrained. In particular, we believe that solar, geothermal, and conservation R&D could not effectively use the full amounts contained in ERDA's revised ceiling case and that, in many areas, there should be greater reliance on the private sector. Under the OMB staff approach, non-nuclear energy R&D would still receive a 31% increase over FY 1976 (see separate section following on Energy R&D strategy).

- In addition, for the reasons discussed previously, OMB staff would protect the production of enriched uranium.

- The OMB staff approach also provides for the initiation of major R&D efforts on nuclear reprocessing and commercial radioactive waste management. The ERDA revised ceiling solution assumes that these important initatives could not be covered within the revised ceiling.

- The OMB staff approach would substantially reduce the size of a new initiative on improving the reliability of commercial nuclear power plants which we believe should primarily be the responsibility of the private sector.

Summary Table

- The following table summaries ERDA's budget trends by major program category (outlays $M):

			FY 1977			
	FY 1975	FY 1976	ERDA Req.	Rev. ERDA	ERDA Ceiling	OMB
Direct energy R&D	(1012)	(1417)	(2514)	(2308)	(2100)	(1931)
Non-nuclear.....	207	514	1043	872	847	671
Nuclear.....	805	903	1471	1436	1253	1260
Supporting energy R&D	(317)	(363)	(498)	(425)	(424)	(392)
Environmental.....	149	178	241	210	210	190
Basic sciences.....	168	185	257	215	214	202
Production of enriched uranium (including offsetting revenues).....	- 27	300	651	623	498	601
Defense-related programs	(1501)	(1647)	(1984)	(1924)	(1793)	(1796)
Nuclear weapons.....	1010	1067	1293	1238	1168	1141
Weapons materials production.....	276	341	466	460	399	429
Naval propulsion reactor R&D.....	215	239	226	226	226	226
All Other	(344)	(382)	(570)	(511)	(479)	(488)
High energy physics.....	172	178	215	201	195	191
Program support (e.g. personnel).....	206	245	328	295	284	266
Misc. revenues.....	- 85	-101	- 81	- 81	- 53	- 76
Other/fin. adjustment...	51	60	109	96	53	71
Subtotal.....	3146	4085	6216	5791	5291	5208
Other funds.....	--	5	6	6	6	11
Total Outlays.....	3146	4090	6222	5797	5297	5219
(BA)	(3588)	(5194)	(7570)	(6948)	(6343)	(5971)

Major Issues

- At this time, the major issues between OMB and ERDA appear to be the following:
  - The rate of growth for non-nuclear energy R&D programs (Issues #1-#5).
  - The scope and pace of initiatives in the nuclear fuel cycle (reprocessing and radioactive waste management)(Issues #6-#7).
  - The initiation of a program to improve the reliability of commercial nuclear power plants (Issue #8).
  - The additional 1,040 personnel requested by ERDA (Issue #9).
  - The level of weapons R&D and underground testing (Issue #10).
  - Future plans for the N-Reactor, Richland, Washington, (Issue #11).
- In addition, there are numerous other issues which involve less significant differences between OMB and ERDA. These issues are covered in the "Other Issues" section of this book.

Possible Further Reductions

- If it were necessary to reduce ERDA spending below the $5,219M recommended by OMB staff, the following actions could be taken (arranged in priority order with the most attractive potential action listed first and the least desirable action last).

	(Outlays - $M)
1. Further increase the price charged for uranium enrichment to the level likely to be charged by a new commercial plant.....	- 72
2. Terminate the Molten Salt Breeder Reactor (MSBR) civilian power backup concept.....	- 4
3. Further slow the pace of development of the controlled thermonuclear fusion program.....	- 14
4. Terminate all R&D on gas-cooled civilian power reactors.....	- 45

(Outlays - $M)

5. Shutdown the N-Reactor, Richland, Washington, in FY 1976.....	- 9
6. Greatly reduce the production of enriched uranium, as identified in ERDA's Planning Ceiling solution.....	- 92
7. Cancel construction of the $2B Clinch River Breeder Reactor (CRBR) Liquid Metal Fast Breeder Reactor demonstration plant.....	-100
TOTAL	-322

- The pros and cons of these potential actions are discussed in the last section of this book.

The Treatment of Inflation

- Although ERDA has not formally requested an exception to the section of Circular No. A-11 concerning price levels, ERDA has been frank to state that future increases in cost-of-living have been assumed. ERDA has projected an average cost-of-living increase of 9.8% over the price levels assumed in the FY 1976 budget and the transition quarter (which ERDA calculates is equivalent to an annual rate of 7.8% over the 15 month period).

- It would be hard to argue that inflation has not had a severe impact upon ERDA's budget and programs. Over 96% of ERDA's budget is spent with contractors and suppliers. As a result, relative to other agencies, ERDA does not benefit much from the semi-automatic inflation adjustment made possible by periodic Civil Service pay raises.

- ERDA must pay competitive market rates for highly skilled technical staff, complex equipment and components, construction of facilities, and electric power for uranium enrichment and high energy physics accelerators.

- In recent years, much of the funding increase allowed by OMB for ERDA programs has in fact been consumed by inflation. Expressed another way, if level funding had been provided there would have been about a 10% per year reduction in real program levels.

- In level-of-effort programs (e.g. weapons R&D, basic research), OMB has not allowed sufficient funding growth to cover actual inflation. As a result, there has been a gradual reduction in program activity and in-house contractor employment levels.

- We believe that it would be unrealistic to assume no inflation for FY 1977. We have, therefore, generally assumed an inflation rate of 7.5%, which is about the amount of the GNP deflator for 15 months.

Conclusions

1. We believe that the $5,219M case recommended by OMB staff would provide for a balanced and forward-moving program which covers all of ERDA's high priority requirements.

2. ERDA will strongly resist a $5.2B allowance and will fight hard for its $5.8M "Minimum Budget" (including amendments). ERDA will rely upon the fact that its two main programs (energy and defense) have been given high priority by the Administration. OMB and ERDA have the most disagreements on the non-nuclear energy R&D programs other than fossil (primarily solar and conservation) and the weapons programs.

3. At the $5,219M case, OMB can reply that all of ERDA's energy programs are receiving significant increases--the only question is the rate of increase. Moreover, we have not recommended wholesale program terminations or drastic program stretchouts.

4. Depending upon the severity of the overall fiscal situation, some of the possible further reductions may be attractive. However, these reductions would require substantial changes in ERDA's ongoing program which would be difficult to achieve.

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

September 30, 1975

Honorable James T. Lynn, Director
Office of Management and Budget

Dear Mr. Lynn:

Enclosed is a summary presentation of our 1977 Budget Estimates which has been reviewed informally with your staff. Detailed justification material prepared in accordance with OMB Circular No. A-11 is being provided separately.

Our request for budget authority amounts to $7,520 million, of which $5,487 million is for the Operating Expenses appropriation and $2,033 million is for the Plant and Capital Equipment appropriation. Estimated net outlays amount to $6,219 million, of which $4,922 million is for Operating Expenses and $1,297 million is for Plant and Capital Equipment.

In terms of outlays, our estimates are $1,149 million over the 1977 budget planning target of $5,070 million provided in your letter of July 25, 1975. The OMB target leaves no room for growth in key energy conservation and research, development and demonstration programs, many of which are in their initial stages and require substantial increases to develop into effective programs. In fact, the combined effect of the inflation being experienced in the economy and current "mortgages" in the ongoing energy R,D&D programs and uranium enriching activities essentially absorb the entire increase reflected in the OMB target. The target is also inadequate to provide needed additional funding in 1977 in support of our national defense obligations and to alleviate present unsatisfactory conditions in our facilities through upgraded nuclear safeguards, improved fire and safety protection, compliance with the Occupational Health and Safety Act and replacement of general purpose facilities.

Nearly all ERDA programs involve high priority Presidential commitments and objectives. This is particularly true of those programs directed toward the reduction of energy demand through conservation and the development of additional sources of clean energy, the production of nuclear materials for civilian power plants, and national defense activities. The timely accomplishment of these program objectives is fundamental to the Nation's energy independence, economic well-being, and national security. Thus, we feel a strong obligation to present our best judgment of the resources required to carry out these programs most effectively.

We are, of course, keenly aware of and firmly dedicated to the President's objectives of minimizing Federal spending to help curb inflation. Our request reflects an intensive and painstaking review by the Assistant Administrators and Senior staff to minimize 1977 funding while meeting the program objectives established in the June 30, 1975 National Plan for Energy Research, Development and Demonstration. While we recognize that any increase in OMB's short-term budgetary planning may be difficult to accomodate, we strongly believe that our programs will contribute significantly to stablizing the economy in the future and to providing new sources of energy essential for the Nation's continued development.

We also recognize that there are a large number of policy issues to be considered in the 1977 budget cycle. Among these are the support of the civilian nuclear fuel cycle including R&D to improve the current generation of light water civilian reactors, the Presidential initiative for commercial enriching, funding for national security, peaceful uses of nuclear explosives, and initiatives required by the Federal Nonnuclear Energy Research and Development Act of 1974. In the next few weeks we will be submitting the results of several internal studies and analytical efforts dealing with these issues.

As you are aware, we are conducting a review of our laboratory and field office utilization which may necessitate some modification to our request. We also plan to provide OMB with a revised estimate for the Weapons Production program following decisions on the DOD budget, about December 1, 1975.

Finally, we are in the process of reviewing our Management by Objectives (MBO) program to insure that current goals and objectives are compatible with those outlined in the National Plan for Energy R,D&D as well as other policy decisions made since the establishment of ERDA. We are now in the process of establishing a Program Approval Document (PAD) system. The PAD's will establish the baseline for program evaluation and will include the definition and examination of critical milestones and objectives necessary to program success. It is anticipated that PAD's documenting all significant energy programs will be completed by late January, 1976. We believe that this system will provide the necessary framework for selection of the key milestones and objectives essential to the effective measurement of agency performance and progress.

We look forward to working closely with you and your staff in the next few months in developing an optimum Administration program for ERDA in the President's 1977 budget.

Sincerely,

Robert W. Fri
Deputy Administrator

Enclosure:
As Stated

October 29, 1975

Honorable James T. Lynn
Director
Office of Management and Budget

Dear Mr. Lynn:

As requested by your staff, we have made a further review of the 1977 budget request for ERDA to determine the programmatic impacts of an outlay constraint at $5,290 million instead of the $6,219 million we requested. Our review indicates that a reduction to the $5,290 million level would require a drastic curtailment of high national priority efforts and initiatives essential to the nation's further energy independence, economic well-being, and national security; would be inconsistent with announced Presidential goals and objectives; and is, we believe, an unacceptable level in the context of an overall budget for the Federal Government. Specifically it would require, among other things, that we:

- o Defer for one year the initiation of new Federal initiatives to close the nuclear fuel cycle, to resolve acceptable methods of long-term storage of commercial nuclear wastes, and to improve the availability of current light water reactors. Such action could jeopardize the growth of nuclear power as a national energy source and make us even more dependent upon foreign oil.

- o Defer energy research and development programs to increase the efficiency of electrical energy transmission and storage, and delay the development of nuclear fusion and fission as inexhaustible energy resources, thus prolonging our dependence on others.

- o Drastically curtail our national defense activities by:

  - — Reducing production and stockpile maintenance below levels considered acceptable by the Secretary of Defense and the Joint Chiefs of Staff.

  - — Reducing laboratory R&D and advanced weapons development programs which the President recently approved for increased funding in 1976 based on recommendations from ERDA, the Secretary of Defense, and the National Security Council.

— Reducing testing below that necessary to support the R&D program agreed upon by ERDA and the Secretary of Defense.

- Deferral of construction and reduced production from our uranium enriching operations, resulting in the permanent loss of 2,500,000 units of separative work valued at about $190 million. This loss could jeopardize our ability to support the introduction of private enrichment.

- Across-the-board reductions resulting in elimination and stretchout of new construction projects and equipment purchases which will impact programs to upgrade our facilities for fire and safety protection and compliance with environmental standards and OSHA requirements.

We recognize, however, the severe problem in fashioning a budget which holds overall Federal outlays to the level recently announced by the President. We want to be fully supportive of this effort. Accordingly, we have developed an alternate request for 1977 which would hold our outlays to $5,734 million, which is about $500 million or 8 percent less than our already "trimmed down" request of September 30th. This alternate level still requires substantial cutbacks and deferrals, which adversely affect our programs, and we believe it to be the minimum level needed to meet our objectives in energy R&D, production of nuclear materials for civilian nuclear power, and support of national security programs. In the event OMB considers that this minimum level cannot be accommodated, I would appreciate the opportunity to meet personally with you and the President in order to resolve an acceptable budget level for the programs we are to carry out.

We have provided to your staff detailed statements of the programmatic impacts at these levels. A separate classified impact statement is being forwarded for our national security programs.

Sincerely,

Robert C. Seamans, Jr.
Administrator

R&D STRATEGY

Overview Paper

1977 Budget for Energy R&D

I. Introduction

A. Role of R&D in Overall Energy Policy

- Although the specifics of a national energy policy have not yet been agreed upon, it is generally accepted that, for reasons of national security as well as economic stability, the U.S. must move to become less dependent on foreign energy supplies.

- R&D, although by no means the only potential contributor to achieving U.S. energy independence, can provide important new energy supply and utilization options for the future as well as improving or assuring the viability of current technologies.

- Thus, the overall goal of an energy R&D program is to assure development of a range of commercially viable and environmentally acceptable technological options to provide the capability to use extensive U.S. domestic energy resources more fully. This will, in many cases, require Federal support to bring technologies to the commercial demonstration stage.

- Due to long development lead times, major payoffs from new technology will come after 1985. However, because domestic oil and gas supplies currently in widespread use are declining and because of an expected increase of 50% in total U.S. energy demand by 1985, it is important to have new energy technologies available for possible commercialization in this time frame.

B. Energy Resource Considerations

Table 1
Domestic Energy Consumption and Supplies
(in 10^{15} Btu or Quads)

Fuel Source	Consumption 1974	Reserves*	Recoverable Resources*
Coal	13.8	5,200-10,400	33,000-
Oil	33.8	250- 410	590-1,920
Gas	22.3	230- 430	1,040-1,700
Shale	0.0	460- 1,160	1,050
Hydro	2.9	N/A	N/A
Nuclear	1.2	29,200- ?	88,200- ?
Solar	0.0	0.0	N/A
Geothermal	0.0	Negligible	900-2,000
TOTAL	73.2**	35,000+	120,000+

- Although oil and gas, including imports, account for about 80% of domestic energy consumption, they represent less than 2% of U.S. domestic proved recoverable energy reserves and about 1% of recoverable resources.

  - At $11/barrel (in 1974 dollars), domestic production of oil and gas is expected to peak in the middle to late 1980's and decline thereafter, even with extensive use of advanced recovery technologies and aggressive exploration of OCS and Alaska.

- By contrast, coal and nuclear fuel supplies--which currently provide for only 18% of domestic consumption--account for almost all of the remaining 98% of energy reserves and 99% of recoverable resources.

*Entries correspond to full energy content of resource and do not take account of efficiencies of utilization.
**1985 demand is estimated to be between 103 and 118 Quads, depending on the prevailing world price of oil.

- Although domestic coal supplies are extensive and accessible, their use is severely limited by environmental constraints. Widespread use of coal without relaxing environmental standards will require new clean conversion technologies (e.g., gasification, liquefaction) or those permitting direct use of coal (e.g., flue gas desulphurization).

- Current projections of nuclear plant capacity indicate that in 20 to 30 years, all economically recoverable supplies of uranium ($_U235$) to fuel current generation of reactors would be fully committed. Tapping the remaining 98% of known U.S. nuclear resources, represented by $_U238$ and thorium, will require development of breeder reactors.

- Recovery of potentially significant solar and geothermal resources is currently limited by technological and economic uncertainties. Their economical use will require development of new or improved technologies.

C. Criteria for Federal Involvement

. Rationale for Federal involvement in energy R&D is to compensate for inability of market system to meet adequately, or in a timely fashion, certain important U.S. goals related to national security, environmental protection, and economic growth and stability. More specifically, Federal R&D efforts are needed:

- To increase the probability of success of the Nation's energy R&D effort by assuring adequate National investment despite short-term fluctuations in market incentives;

- To accelerate significantly the achievement of U.S. capability to make use of the full range of its domestic energy resources;

- To ensure that the U.S. energy R&D effort is balanced and gives appropriate emphasis to all relevant national goals, particularly those which cannot be readily internalized into market incentives by other forms of Federal intervention (e.g., environmental protection);

- To supplement private sector investment at stages of R&D where appropriable benefits are not commensurate with the costs and risks (e.g., basic research, first demonstration plants);

- To compensate for structural imperfections in the market such as excessive fragmentation and undercapitalization, and including those which may result from Federal intervention justified on other public policy grounds (e.g., antitrust laws, utility price regulations, etc.); and

- To support Federal regulatory activities of certain Federal agencies, e.g., NRC, EPA.

. Though the need for Federal support in energy R&D is indicated, the Federal effort should encourage private investment and to avoid unnecessary government expenditures which merely replace private efforts.

  - Private sector participation in planning, financing, and executing the R&D program will reduce requirements for Federal support and will increase the likelihood that technologies will be commercially viable and rapidly introduced.

II. Status of U.S. Energy R&D Effort

A. Status and Potential Payoff of Major Energy Technologies

. Table 2 summarizes the status and potential energy contribution of the major new energy technologies under development.

Table 2

STATUS AND POTENTIAL PAYOFF OF MAJOR NEW ENERGY TECHNOLOGIES

Technology Area	Current Stage[1] of Development	Date of First[2] Comm. Demonst.	Potential Energy Contribution 1985	Potential Energy Contribution 2000
			Quads[3]	
Nuclear				
Light Water Reactors	Commercial	in service	5.5	20.0
Gas Cooled	Demonstration	1976	neg.	1.5
Liquid Metal Breeder	Pilot Devel.	1983	neg.	2.5
Other Breeders	Applied Res.	unknown	0	neg.
Fusion (CTR + Laser)	Basic Res.	post-2000	0	neg.
			5.5	25.0
Coal				
Low Btu Gasification	Pilot Devel.	1975	.3	5.0
High Btu Gasification	Pilot Devel.	1980	.5	6.0
Liquefaction	Pilot Devel.	1980	.2	5.0
Clean Combustion	Applied Res.	mid-1980	neg.	5.0
Limestone SGC	Demonstration	1974	5.0	15.0
Advanced SGC	Pilot Devel.	late 1970's	neg.	5.0
			6.0	41.0
Geothermal				
Dry Steam	Commercial	in service	neg.	neg.
Wet Steam & Liquids	Applied Res.	1983	.4	1.1
Hot Dry Rock & Geopressured	Basic Res.	1987	.2	1.1
			.6	2.2
Solar				
Heating of Buildings	Demonstration	1974	.1	.75
Cooling of Buildings	Pilot Devel.	late 1970's	.1	.75
Solar Electric Applications	Applied Res.	early 1980's	neg.	1.5
Fuels from Biomass	Applied Res.	early 1980's	.5	0.9
			.7	3.9
Oil, Gas and Shale				
Advanced Oil Recovery	Pilot Devel.	late 1970's	3.0	6.0
Surface Shale Retort	Demonstration	late 1970's	.3	5.0
In-Situ Shale Retort	Pilot Devel.	mid-1980's	neg.	2.0
			3.3	13.0
New Conservation Technologies				
Industrial Processes	Pilot Devel.	1980	.5	2.0
Commercial & Residential Buildings	Demonstration	1977	.3	1.5
Transportation	Pilot Devel.	1980	.3	4.0
			1.1	7.5

1/ Definitions:

- -- Basic Research: Fundamental scientfic problems have not been overcome.
- -- Applied Research: Laboratory experiments have verified that no fundamental scientific problems remain to be solved.
- -- Pilot Development: Pilot plant (approximately 1/100 scale) operations or prototype assembly have verified that major engineering problems associated with integrated systems have been solved.
- -- Demonstration: First near-commercial scale demonstration has successfully operated, although perhaps not in an economically competitive way because of first-of-a-kind costs.
- -- Commercial: Technology is commercially available and presently competitive with existing alternatives

2/ Rapid commercial introduction could follow by 5-10 years, depending on relative economics.

3/ Units in Quads or 10^{15} B.t.u. U.S. consumption in 1974 in 75 Quads.

B. Recent Trends in Federal and Private Energy R&D Expenditures

. On June 29, 1973, a major acceleration of the Federal energy R&D program was announced. Supplemental funds were appropriated for FY 1974 and further major increases were approved for FY 1975 and are also expected for FY 1976.

Area	Obligations ($ Billion) 1974 Actual	1975 Estimate	1976 Estimate
Direct Energy R&D			
Nuclear	0.8	0.9	1.1
Fossil	0.1	0.4	0.5
Other Non-Nuclear	0.1	0.3	0.3
Total	1.0	1.6	1.9
Support Program			
Environmental Effects	0.1	0.3	0.3
Basic Research	0.2	0.2	0.2
Total	0.3	0.5	0.5
Total Energy R&D	1.3	2.1	2.4
(ERDA)	1.1	1.7	2.1
(Other agencies)	.2	.4	.3

. Though difficult to estimate accurately, private sector funding for energy R&D currently appears to be over $1 billion annually and increasing.

- A survey of 1,400 firms indicates annual increases in private spending on energy R&D of over 20% in both 1973 and 1974.

III. Energy R&D Program Strategy

A. Criteria for Determining Federal Energy R&D Priorities

. Priorities among specific energy R&D programs (e.g., nuclear, coal, solar, etc.) should be determined by:

- Potential contribution of new technology to increasing usable energy supplies.
- Probability R&D will be technically successful.
- Likelihood that technology will be economically competitive when environmental costs are considered.
- Timing of potential contribution considering any non-technical constraints to commercialization.
- Cost of R&D.
- Extent of private sector investment.

B. General Elements of Pre-ERDA Federal Energy R&D Strategy

. Minimum Federal involvement in R&D projects with good potential for early commercial application and where substantial private sector resources and capability exist (e.g., oil and gas recovery, conservation, automotive, etc.).

- Strong Federal support, on a cost-shared basis, for longer-term (10 years +) R&D programs aimed at making use of vast U.S. coal and nuclear resources (e.g., breeder nuclear reactor, coal liquefaction and gasification, etc.).

  - This includes partial Federal support of expensive, high-risk, first-of-a-kind demonstration plants, e.g., synthetic fuels, nuclear fuel reprocessing, etc.

- Continuing Federal support, even without substantial industry cost-sharing, of very long-range, high-risk R&D programs which have potential for great payoff (e.g., fusion, central station solar electric).

- Continuing Federal support of programs in basic research, environmental and health effects research, and safety where there is no strong incentive for private sector investment.

C. ERDA's Recently Proposed Energy R&D Strategy

- As required by statute, ERDA has prepared its first version of a comprehensive National Energy Research, Development and Demonstration Plan. This plan must be updated annually in January, and thus it coincides with the submission of the President's Budget.

- The major conclusions of ERDA's Energy R, D and D Plan (ERDA Report No. 48) are:

  - To achieve our National energy policy goals including reducing our reliance on imports, the U.S. "must have the flexibility of a broad range of energy choices."

  - "To generate the necessary options," the Nation's energy R&D program must "facilitate the changeover from dependence on a narrow base of diminishing domestic resources to reliance on a broader range of less limited or unlimited alternatives."

- And finally, "all the national energy technology goals must be pursued together. Concentration on only one or a few technological avenues is not likely to solve the energy problem."

. ERDA's priorities among major energy R&D program areas have been generally established through a National Ranking of Energy R,D and D Technologies, shown in Table 4. As will be discussed further, ERDA's priority ranking does not correspond totally with its budget requests that greatly accelerate smaller pay-off programs.

. As a result of its analyses, ERDA concluded that "five major changes are needed in the nature and scope of the Nation's energy R&D program" (although the first and to some extent the second were already reflected in the President's 1976 Budget Request to Congress and his State of the Union Message).

1. "Acceleration of commercial capability to extract liquid and gaseous fuels from coal and shale."

2. "Emphasis on overcoming the technical problems inhibiting expansion of high leverage existing systems - notably coal and light water reactors."

3. "An immediate focus on conservation efforts."

4. "Inclusion of the solar electric approach among the inexhaustible resource technologies be given high priority."

5. "Increased attention to under-used new technologies that can be rapidly developed." (e.g., geothermal, solar, heating and cooling)

. As a result of ERDA's view of energy R&D strategy and its recommendations to alter the President's 1976 Budget, some further increases were requested from the Congress in:

- conservation R&D;
- solar R&D;
- advanced oil and gas recovery R&D;
- coal R&D;
- oil shale R&D; and
- nuclear fusion.

Table 3

ERDA'S NATIONAL RANKING OF R,D,&D TECHNOLOGIES

Highest Priority Supply	
Near-Term Major Energy Systems	Coal-Direct Utilization in Utility/Industry Nuclear-Converter Reactors Oil & Gas-Enhanced Recovery
New Sources of Liquids and Gases for the Mid-Term	Gaseous & Liquid Fuels from Coal Oil Shale
"Inexhaustible" Sources for the Long-Term	Breeder Reactors Fusion Solar Electric
Highest Priority Demand	
Near-Term Efficiency (Conservation) Technologies	Conservation in Buildings & Consumer Products Industrial Energy Efficiency Transportation Efficiency Waste Materials to Energy
Other Important Technologies	
Under Used Mid-Term Technologies	Geothermal Solar Heating and Cooling Waste Heat Utilization
Technologies Supporting Intensive Electrification	Electric Conversion Efficiency Electric Power Transmission and Distribution Electric Transport Energy Storage
Technologies Being Explored for the Long-Term	Fuels from Biomass Hydrogen in Energy Systems

D. Critique of Major Aspects of ERDA's Energy R&D Strategy

. The most fundamental conclusion of ERDA's analysis, and the major premise underlying its National Energy R&D Plan is in error - that is, that "all the national energy technology goals must be pursued together, and that... concentration on only one or a few technological avenues is not likely to solve the problem."

- As can be seen from considering Tables 1 and 2, all technological approaches do not have to be pursued. If Light Water Nuclear Reactors continue to provide an increasing fraction of electric generation capacity, if breeder reactors are developed for future electric power generation and if synthetic gaseous and liquid fuels are produced from coal and oil shale, then the U.S. can achieve and maintain substantial energy independence by the year 2000 from a relatively few technologies.

- Solar and geothermal utilization technologies are expected to provide only a small contribution to domestic energy supplies before the year 2000.

- Improved conservation technologies, as opposed to wide application of existing technologies, while providing some reductions in demand, are not likely to result in large savings.

. Another major change in ERDA's proposed energy R&D strategy, and also reflected in its budget request for FY 1977, is the inclusion of fusion power and solar electric technology in the same priority category as the Liquid Metal Fast Breeder Reactor (LMFBR). This does not appear warranted on the basis of the current status of the technologies and the likely timing of their payoff.

- The LMFBR is a proven technological concept. Although substantial engineering developments remain and there are concerns about environmental and safety problems, there is little doubt it will work and can be made safe. (The French have been operating a 250 MWe. plant for one year). Furthermore, its economics are likely to be favorable.

- Although fusion offers the potential of virtually unlimited energy supplies with fewer and less severe environmental and safety problems, fusion has not even reached the point of proven scientific feasibility, and years remain before the engineering feasibility is established, much less a workable reactor system.

- Generation of electricity from the sun, although technically feasible now, is far from being economically competitive. Major technological advances will be needed to reduce the high capital costs of this option.

. Finally, the last major element of ERDA's proposed revised Energy R&D strategy is to emphasize shorter-term and potentially high payoff technologies to ensure substantial energy production from conventional nuclear power and conventional oil and gas. The major issue here is the need for and extent of Federal involvement.

E. OMB Staff's Recommended Strategy

. Continued strong emphasis on R&D programs that will assure the U.S. a capability to use its vast coal and nuclear energy resources. Specifically:

- R&D and demonstration of technologies for fuel reprocessing and waste management so that the growth in the generating capacity from the current generation of Light Water Nuclear Reactors can be assured. The OMB staff recommendation for FY 1977 provides for a major acceleration in ERDA's research and development programs for nuclear fuel reprocessing and commercial radioactive waste management.

- R&D and demonstration of the Liquid Metal Fast Breeder Reactor to provide a technology to tap the 98% of uranium resources which cannot now be used. The FY 1977 OMB staff recommendation provides for the continuation of the design and construction of the $1.95B Clinch River Breeder Reactor LMFBR demonstration plant, with initial operations scheduled for 1983 (the same schedule and funding level as requested by ERDA).

- R&D and demonstration of advanced coal gasification and liquefaction and other technologies that can greatly increase usable coal supplies. The OMB staff recommendation for FY 1977 would continue an aggressive R&D program related to coal including gasification, liquefaction and direct combustion and would also include funds for demonstration plant design in gasification and for construction of a clean boiler fuels demonstration plant.

- A Synthetic Fuels Commercialization Program to gain early information on economic, environmental, regulatory and other uncertainties inhibiting early commercialization. The FY 1977 budget would provide mainly for administrative costs.

. A more orderly pace for development of very long-term options of solar electric and nuclear fusion, which are not likely to be determined to be commercially feasible for 10-20 years. The OMB staff recommendation for FY 1977 provides for a 50% growth in fusion over 1976 (as opposed to ERDA's requested 100% increase) which would slip the next large fusion experimental reactor by perhaps 3 months and the overall schedule for commercial demonstration by 2-3 years in the mid-1990's. The FY 1977 solar electric program would grow substantially in the potentially high payoff area of solar thermal and photovoltaics, but would be sharply reduced in the lower payoff area of wind energy and ocean thermal energy conversion.

. Low priority on highly popular (with the Congress and the public) but lower payoff programs in solar heating and cooling and geothermal energy. The OMB staff recommendation for FY 1977 would be to hold these programs at their FY 1976 level pending completion of cost/benefit analyses justifying a larger effort.

- Low Federal priority on nearer-term, higher payoff program, such as advanced oil and gas recovery, nuclear plant reliability, and certain conservation R&D programs, where industry has both the resources and the incentives due to higher energy costs to fund such R&D. The OMB staff recommendation for FY 1977 would essentially hold these programs to their current low levels.

- A limited and highly selective approach to Federal funding in other end-use conservation R&D areas in order to ensure maximum private sector response to market forces. The OMB staff recommendation for FY 1977 would provide some increase in potentially high payoff areas of energy storage and transportation.

- Continued Federal support of basic and environmental effects research where industry has little or no incentive for investing. The OMB staff recommendation for FY 1977 would provide increases sufficient to cover inflation of the past year.

- Table 4 summarizes the impact of the OMB staff strategy on the trend of direct energy R&D funding, and its relation to estimates of private sector R&D investments.

  - The OMB recommended level of Federal funding for FY 1977 continues the recent trend of $500 million (BA) per year increases. The Federal non-nuclear R&D remains in FY 1977 about 40% of the total direct energy R&D budget.

  - The total national energy R&D effort, federal plus private, is estimated to be about 60% non-nuclear R&D activity over the 1974-1981 time period, but with most of the nuclear R&D being undertaken with Federal funds. Table 4 also indicates the major amount ($8.6 billion) of private funds that will be spent on commercial-scale demonstrations due to federal financial incentives programs, as well as the almost $3 billion to be expended in joint private-federal R&D.

TABLE 4
Private and Federal Energy R&D Funding
($Millions, Budget Authority)

Program Area	Federal Funding 1/ 1974	1975	1976	1977 2/	TOTAL 1974-1981	Private Funding 3/ 1974	TOTAL 1974-1981 Participation in Federal R&D	TOTAL 1974-1981 In-house R&D
Direct Energy R&D:								
Non-nuclear R&D:	(253)	(619)	(795)	(910)	(7248)	(877)	(2040)	(10440)
Fossil 4/	111	393	413	538	4261	506	1400	6000
Solar	24	51	94	126	840	2	140	20
Geothermal	13	34	34	49	355	2	--	20
Conservation	39	48	78	99	852	150	400	1800
Environmental Control	66	93	84	98	940	217	100	2600
Nuclear R&D:	(756)	(938)	(1147)	1617	(11353)	(128)	(800)	(1540)
Fission	644	749	880	1223	8670	125	800	1500
Fusion	112	189	267	384	2683	3	--	40
TOTAL, DIRECT ENERGY R&D	1009	1557	1942	2527	18601	1005	2840	11980
Synthetic Fuels Commercial Demonstration Program			600	--	600	--	8000	
Geothermal Development Fund			4	4	24	--	600	

1/ Includes R&D in ERDA and other agencies such as EPA, NSF, DOI, NASA, and NRC.
2/ OMB recommended level of funding.
3/ 1974 is the most recent available data. Statistics are based on two NSF surveys, and because of inevitable non-respondents figures are presumed to represent a lower limit. The 1974-1981 in-house R&D figures are extrapolated from 1974 data.
4/ The Federal funding is only about 8% for oil and gas, whereas, the private funds are 95% for oil and gas.

POSSIBLE REDUCTIONS

FY 1977 ERDA Budget

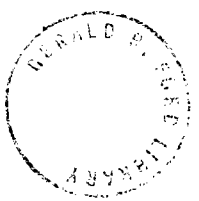
Possible Further Reductions

	Savings (Outlays-$M) FY 1977	FY 1978	PRO	CON
1. Further increase uranium enrichment charge (to $100 per unit).....	72	70	• Economically justifiable (new enrichment plants will probably charge this amount).	• May jeopardize the Administration's current legislative proposal to allow ERDA to recover more than just the Government's costs (ERDA has estimated to GAO and Congress that the new "commercial charge" proposed in the FY 1976 budget would be about $76 per unit). The increase to $81 per unit included in ERDA's Planning Ceiling Case may be all that is politically feasible now.
2. Terminate the Molten Salt Breeder Reactor (MSBR)...	5	5	• The MSBR concept is not now a viable backup effort in case the Liquid Metal Fast Breeder Reactor (LMFBR) is unsuccessful (a much higher funding level would be required).	• The MSBR has some potential attractiveness from the standpoint of resource utilization (uses thorium) and reprocessing (continuous on-line).
			• The LMFBR program is likely to be successful and not need the MSBR as a backup.	• Has strong support from Tennessee delegation (R&D done at Oak Ridge).
			• The MSBR has difficult technical problems.	
3. Slow the pace of controlled thermonuclear fusion program.....	14	22	• Although potentially very attractive in the long-term (beyond year 2000) fusion has not yet been proven to be scientifically feasible. The program is now entering a phase which requires high cost large scale experimental devices and large investments to solve the engineering problems. An alternative would be to conduct a basic technology program which will emphasize the use of smaller experimental devices while deferring major test reactors until more results are available from experiments.	• ERDA has prepared and is following a detailed plan for development of fusion which, if successful, could lead to the realization of the benefits of fusion in the shortest reasonable time. • The fusion program is very popular in Congress because of its potential environmental and safety advantages over fission reactors.

FY 1977 ERDA Budget

Possible Further Reductions (cont'd.)

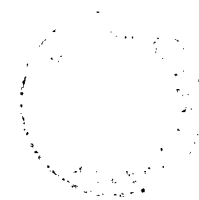
	Savings (Outlays-$M) FY 1977	FY 1978	PRO	CON
4. Terminate R&D on gas-cooled civilian power reactors.....	45	50	• The commercial support for the High Temperature Gas Reactor (HTGR) has virtually collapsed as a result of utility contract terminations. The parent firms of Gulf Atomic Corporation appear to be cutting losses and offloading the company. • Even if commercial support can be reconstituted, it would probably require at least $1B of Government funds to make the HTGR an economically attractive venture (primarily requires solving difficult reprocessing and waste management problems). • If the HTGR is terminated, gas-cooled fast breeder R&D could also be terminated because of lack of commercial support and the likely succes of the LMFBR. The GCFBR also has a serious safety problem.	• The HTGR has potential advantages over light water reactors (in addition to uranium, uses thorium which is a relatively abundant resources; higher thermal efficiency means less thermal pollution; possible utilization for process heat applications). • The Government should not take the initiative to cancel ongoing research on the HTGR until it becomes clear that the concept is unable to attract new commercial support. • The gas-cooled fast breeder reactor (GCFBR) appears to have a higher breeding ratio than the LMFBR (which means that it could produce plutonium fuel at a faster rate than the LMFBR).
HTGR.....	(36)	(41)		
GCFBR.....	(9)	(9)		
5. Shutdown the N-Reactor, Richland, Washington in FY 1976 (net).....	9	30	Discussed in Issue #11.	



FY 1977 Budget

Possible Further Reductions (cont'd.)

	Savings (Outlays-$M) FY 1977	FY 1978	PRO	CON
6. Reduce the production of enriched uranium.....	92	--	• Due to the slippage in the construction schedules of many power reactors, near-term requirements for enriched uranium fuel have been deferred and ERDA's pre-produced inventory will thereby be increased. • The 10% reduction in future inventory from this action may not be critically required.	• The effects of the reactor schedule slippage are offset by other factors: - plutonium recycle will at least be delayed, increasing requirements for uranium fuel. - utilities are experiencing difficulties obtaining uranium feed needed for the enrichment process, which means that more of ERDA's inventory may have to be used. • Since the inventory covers many contingencies (e.g., backstop private enrichment ventures, meet emergency requirements), the prudent course would be to maintain a stockpile adequate to ensure a reliable fuel supply for nuclear power plants. • The lost inventory would have a value of $200M.



FY 1977 Budget

Possible Further Reductions (cont'd.)

	Savings (Outlays-$M) FY 1977	FY 1978	PRO	CON
7. Cancel construction of the Clinch River Breeder Reactor (CRBR) LMFBR demonstration plant.....	100	220	• The $2B CRBR has experienced a huge cost overrun (original estimate was $.7B) which raises questions as to whether the benefits of the project are worth the cost. • The CRBR will be based upon a relatively conservative design, which, together with its small size (350 MWe), ensures that the CRBR will not demonstrate potentially favorable economics. • An alternative would be to cancel the CRBR and initiate design of a larger plant with full-scale components which would be much closer to a commercial power plant.	• The CRBR will demonstrate licensability, maintainability, and operability of LMFBRs. • ERDA maintains that going directly to a full-scale plant would be technically risky. • The CRBR project has momentum with a Government-industry team in place and components being ordered. • The CRBR has become symbolic of the entire LMFBR program which the Administration strongly supports. Any move to cancel the CRBR (even with the intent of going to a larger project later) would be interpreted as a major blow by Administration against the LMFBR program and nuclear power in general.