7. COMPARISON BETWEEN THE RESULTS OF THE PRESENT STUDY AND THE 1985 STUDY

The main purpose of the present study is to revise the 1985 NEA study on *The Economics of the Nuclear Fuel Cycle*[7]. The principal revisions concern the unit prices for the fuel cycle and the reactor core performance. The uranium purchase price which shared approximately 40 per cent of the total fuel cycle costs in the 1985 NEA study for both spent fuel disposal options is now much lower and stable for reasons of over-supply. Furthermore, the N4 reference French reactor is expected to have an improved core performance and a higher burn-up (42 500 MWd/t).

The results of the 1985 study cannot be compared directly with the results of the present study because of the differences in money values and core performances adopted. Therefore, two approaches are used to compare the results of these studies. Firstly, the January 1984 money value is converted to the January 1991 money value by using the GDP deflator to the US dollar and by recalculating the fuel cycle costs of the 1985 study utilising the converted unit prices. Secondly, the fuel cycle costs are calculated by using the 1985 study adopted reactor burn-up (33 000 MWd/t) and the unit prices of the present study.

The importance of the changes in unit prices can be estimated by comparing the results of the above mentioned approaches. This comparison is not, strictly speaking, accurate because of the adoption of the slightly different core performances assumed in the two studies, but is quite helpful in indicating the total cost changes. The effects of the reactor core performances can be seen by comparing the results of the present study to those of the above mentioned second approach.

Tables 7.1, 5.6 and 7.2 show the plant performance and fuel cycle data for the two studies while the various unit prices are displayed in Table 7.3. From these data it can be seen that the uranium purchase price which was used in the present study is drastically lower than that used in the 1985 study.

Figure 7.1 displays the comparison of the results of the two studies for the reprocessing option. It can be seen that the total fuel cycle costs are reduced from 10.86 to 6.23 mills/kWh. Nearly 80 per cent of this reduction is due to the differences in unit prices and, in particular, the much lower uranium purchase cost component (approximately 60 per cent). The rest of the reduction is due to the improved reactor performance.

Figure 7.2 shows the comparison of the results of the two studies for the direct disposal option. Total fuel cycle costs are reduced from 9.85 to 5.46 mills/kWh. Nearly 85 per cent of this reduction is due to the reduction in unit prices and the rest is due to the improved reactor and fuel performance.

Table 7.1. **Basic assumptions used in PWR cycle cost calculations**

Item	Basic assumptions (reference case)	
	This study	**Last study (1985)**
1. Reactor and fuel data		
Reactor type	PWR (French N4 type)	PWR
Thermal output	4 020 MWt	3 800 MWt
Electric output	1 390 MWe	1 285 MWt
Load factor [a]	75%	70%
Commissioning year	2000	1995
Life of plant	30 years	25 years
Fuel burn-up[b]	42 500 MWd/t	33 000 MWd/t
Fuel mass balance	see Table 5.6	see Table 7.2
2. Cost data		
Base date of monetary unit	Early 1991	1.1.1984
Monetary unit	Front-end: US dollar Back-end: ECU	US dollar
Unit cost for each component	see Table 7.3	see Table 7.3
Escalation factor	see Table 7.3	see Table 7.3
3. Fuel cycle data		
Tails assay for enrichment	0.25%	0.25%
Lead/lag time for:		
- uranium purchase	24 months[c]	21 months[c]
- conversion	18 months[c]	18 months[c]
- enrichment	12 months[c]	12 months[c]
- fabrication	6 months[c]	6 months[c]
Reprocessing option[d]:		
- Reprocessing	6 years	5 years
- VHLW disposal	56 years	40 years
Direct disposal option[d]**:**		
- S.F. transport/interim storage	5 years	
- S.F. encapsulation/disposal	40 years	40 years
Loss factor for:		
- conversion	0.5%	0.5%
- fabrication	1.0%	1.0%
- reprocessing	2.0%	2.0%
- others	0%	0%
4. Other data		
Discount rate	5.0%	5.0%
U credit	70% of the cost of new uranium at the same enrichment	80% of the cost of new uranium at the same enrichment
Pu credit	$5/g Puf	$15/g Puf

Notes:
a. Discounted average.
b. At equilibrium.
c. For initial fuel 6 months are added.
d. Including storage time at reactor.

Table 7.2. **Material balance (PWR, 33 000 MWd/t)**

Time (EFPY)	Interval between reload (EFPY)	Total uranium (tonne)	U-235 (%)	Fissile Pu (kg)	Total Pu (kg)	Burn-up (MWd/t)
1. Non-equilibrium cycle charge data						
0		35.00	1.50			
0		34.50	2.40			
0		34.50	2.95			
0.919		34.70	3.10			
1.687		34.70	3.10			
2. Equilibrium cycle charge data						
2.467	0.325	34.70	3.10			
3. Non-equilibrium cycle discharge data						
0.919		34.30	0.64	159.00	217.00	12 035
1.687		33.50	0.76	201.00	274.00	23 860
2.476		33.10	0.80	224.00	305.00	31 750
3.292		33.30	0.85	232.00	318.00	32 000
4.117		33.30	0.85	229.00	314.00	33 000
4. Equilibrium cycle discharge data						
4.942	0.825	33.30	0.85	229.00	314.00	33 000
5. Final core discharge data						
		33.30	0.85	229.00	314.00	33 000
		33.30	1.60	200.00	272.00	21 000
		33.40	2.35	171.00	214.00	11 000

Note: EFPY = effective full-power year

Table 7.3. **PWR fuel cycle unit prices**

Component	Basic assumptions for PWR (reference case)		
	This study (early 1991 US$)	**Last study (US$ at 1.1.84)**	**Last study[a] (early 1991 US$)**
Uranium purchase	$50/kg U (in 1990) ($19.2/lb U_3O_8) Escalation 1.2% p.a.	$83.2/kg U (in 1984) ($32/lb U_3O_8) Escalation 2.0% p.a.	$105/kg U (in 1991) ($41/lb U_3O_8) Escalation 2.0% p.a.
Conversion	$8/kg U	$6/kg U	$8/kg U
Enrichment	$110/SWU	$130/SWU	$165/SWU
Fabrication	$275/kg U	$190/kg U	$241/kg U
Reprocessing option:			
- spent fuel transport[b]	ECU 50/kg U	$40/kg HM	$51/kg HM
- spent fuel storage	—	$(40+4/year)/kg HM	$(51+5/year)/kg HM
- reprocessing (incl. buffer st.):	ECU 720/kg U	$550/kg HM	$696/kg HM
- vitrification		$200/kg HM	$253/kg HM
- waste disposal	ECU 90/kg U	$150/kg HM	$190/kg HM
Direct disposal option:			
- spent fuel transport[b]		$40/kg HM	$51/kg HM
- spent fuel storage	ECU 230/kg U	$(40+4/year)/kg HM	$(51+5/year)/kg HM
- encapsulation		$200/kg HM	$253/kg HM
- disposal	ECU 610/kg U	$150/kg HM	$190/kg HM

a. Prices have been revised by using a GDP deflator of 1.266.

b. Transportation within the European area.

Figure 7.1 **Comparison of levelised PWR fuel cost**
(reprocessing option)

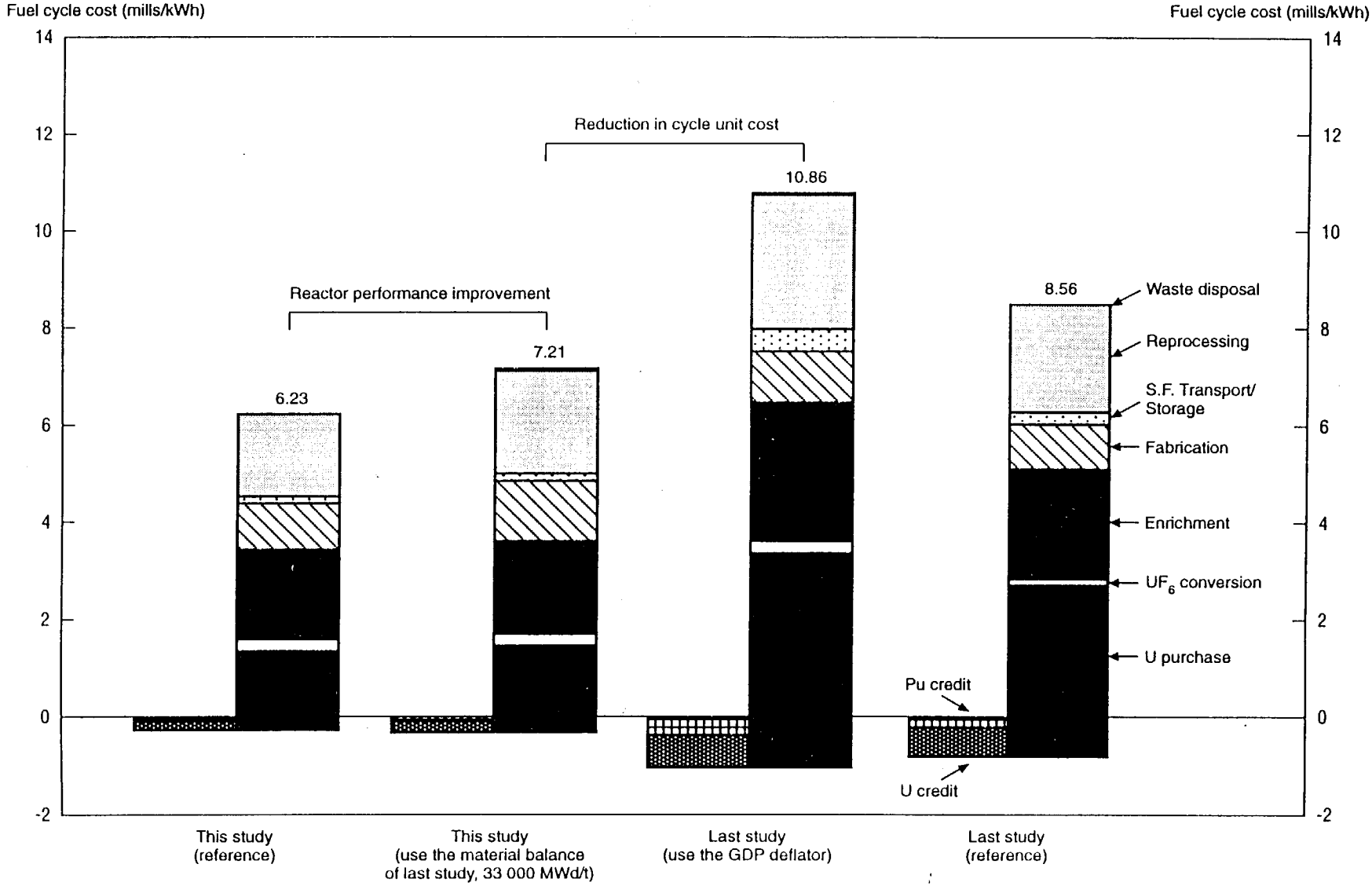

Figure 7.2 **Comparison of levelised PWR fuel cost**
(direct disposal option)