# Spent Nuclear Fuel Management: LCOE In Different Production Scenarios

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## 1. Introduction

The large consumption of resources necessitates the world to create efficient energy generation systems. Implemented with specific back-end strategies, renewable nuclear energy has been proven to be economically, environmentally and socially sustainable. There are currently three available options: open cycle, close cycle, and advanced cycle. The most significant cost of nuclear reprocessing is DGR, which is decreasing for the closed cycle and increasing for open cycle. Therefore, many other factors, such as waste management, the intangible asset, and the energy regulations of each country, should be taken into account when choosing the best strategy using the LCOE method. Many other countries have adopted a strategy meeting their national needs. Spain, however, is yet to make a decision. Based on the research carried out in this paper, it's suggested that costs are not a relevant criterion in order to select an energy policy for spent nuclear fuel management.

## 2. Results and Discussion

Using the data given by OECD-NEA, the LCOE can be obtained for all the three back-end strategies: Once-through Fuel Cycle, Partial Recycling and Advanced Fuel Cycle. Under a few assumptions, the results are shown in the tables and figures below:

| Electricity Production | 0% Discount Rate | | | 3% Discount Rate | | |
|---|---|---|---|---|---|---|
| | OFC | Partial Recycling | AFC | OFC | Partial | AFC |
| 25 TWh/year | 10.65 | 10.23 | 7.58 | 6.70 | 6.71 | 5.80 |
| 75 TWh/year | 6.86 | 6.21 | 4.93 | 5.25 | 5.41 | 5.02 |
| 400 TWh/year | 5.33 | 5.55 | 4.95 | 4.66 | 5.16 | 5.03 |
| 800 TWh/year | 5.15 | 4.77 | 4.21 | 4.59 | 4.52 | 4.42 |

**Figure 1:** Comparison between different production scenarios and strategies

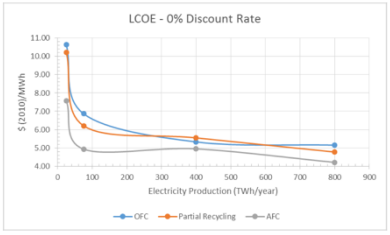


**Figure 10.** LCOE for different backend strategies: 0% discount rate.

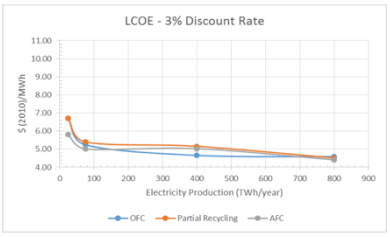


**Figure 11.** LCOE for different back-end strategies: 3% discount rate.

Also it can be observed that the capital recovery factor is higher from 40 to 60 years old than from 60 to 80 years old.
The figures show that the most profitable strategy is AFC because that the savings in the front-end cost achieved by the reduction in natural uranium requirement thoroughly compensate the FRS and integral processing plant costs. This is result is strongly supported by Figure 10 with the exception at discount rate of 3% and electricity production of 400,TWh/year, where the OFC is the optimal strategy in this case.

## 3. Conclusions

According to the LCOE results for the strategies analyzed, a greater decrease in costs is experienced in countries with a small nuclear energy production. Nowadays, spain has a production of 57 TWh nuclear energy per year, which implies that an increase in the nuclear energy production should lead to considerable cost savings.

It is also worth noting that decrease in the LCOE extending the NPP operational lifetime from 40 to 60 years is more significant than that from 60 to 80 years.

Furthermore, the differences between the open cycle and the closed cycle costs are lessthan an 8%, which is not relevant enough to make a decision based only on the economic aspects. This is why the fuel cycle cost only represent a small fraction of the nuclear electricity generation cost.