GREENPEACE

Wind vs Nuclear 2003

A report commissioned by Greenpeace France
summary
Dec. 4th 2003

About the Report

Greenpeace France has commissioned a report with the French research institute DETENTE to help inform the discussion on the European Pressurized Reactor. The main authors are Antoine Bonduelle and Mathias Lefère. The full version of the report is only available in French at http://www.greenpeace.fr

Introduction

Plans being promoted by the French Industry Minister, Fontaine, are currently being considered by the French government. The so-called European Pressurized Reactor (EPR) - a ten-year old Framatome/Siemens design - would officially cost some 3.5 billion € and begin producing electricity as early as 2010. In the Minister's view, the 59th French reactor would not be needed to match a growing electricity demand at a competitive price, but to « *to have at our disposition a maximum of energy options which will enable us to decide whether or not to replace the nuclear park entirely or partly at the time horizon of 2020 - 2025* [1].»

The Government was widely believed to planning to support the Minister's proposal but may delay a decision until after the 'Energy Debate' in the French Assemblée next March, as concerns have been raised about the EPR's economics.

To help inform this discussion, Greenpeace France has commissioned a report from the French research institute DETENTE comparing the EPR option with wind energy. If instead of investing in an EPR, the French utility EdF would instead invest as much money in wind generation, how much electricity will then be produced and how many jobs will be created?

In recent years wind power has gone through an industrial and technological revolution. In Germany, some 13,500 MW are now operational, of which 3,200MW have been installed last year alone, the equivalent of the consumption of more than 2 million households. France is lagging far behind with only 220MW installed today. At a European level, the European Wind Energy Association (EWEA) is cautiously estimating that the installed wind capacity by 2010 will be 75,000MW[2], tripling the current installed capacity and adding the equivalent electricity production of some 14 large nuclear reactors or more than 2 reactors every year. In reality, wind has already taken the lead and left nuclear far behind.

1 Quote from the 'Livre Blanc' or white paper on energy as presented by the French Industry Minister Fontaine on Nov. 7Th 2003 : www.industrie.gouv.fr
2 See http://www.ewea.org

Meanwhile, nuclear power has been at a standstill or even in decline retreat in the European Union. No single reactor has been connected to the grid in the last 4 years. In reality, it will take at least another 10 years before a new reactor could come on line, while a growing number of old reactors will be permanently shut down.

The aim of the report is not to present a comprehensive energy scenario, but to clarify the economic and social impacts of a key energy choice about to be made by the French government: either to add a 59th nuclear reactor to the nuclear overcapacity or to launch a renewable energy sector. The latter would be supported by 85% the French clients of EdF[3].

Methodology

The report compares the job creation and electricity production of 2 energy options: a new EPR or wind power:

1. The report first calculates the cost of a new EPR, based on figures from the French nuclear industry and French official references. It then estimates the amount of electricity (TWh) that would be produced over its lifetime.
2. Calculates at an equal investment base as 1 EPR, how many wind turbines could be installed, and how much electricity would be produced. Interest rates are assumed to be identical.
3. Compares the electricity production of the EPR and wind options
4. Estimates and compares the job creation for both options

A sensitivity study, comparing nuclear and wind option under 4 scenario's:

1. **DETENTE** scenario, or central scenario: based on the construction of 1 EPR 'demonstration' reactor'
2. **EoP-H** scenario: lower costs nuclear – higher costs wind
3. **EoP-B** scenario: higher costs nuclear – lower costs wind
4. **1+4 EPR** scenario: where 5 EPRs are constructed instead of 1, based on the central scenario

The 4 scenario's are described in more detail in the annex. It should be noted that the capital base in the 4 scenario's is different, as based on the investment in the nuclear capacity.

A conservative estimation of costs, in favor of nuclear

DETENTE has preferred to use figures from the French nuclear industry and French official references (government, parliament) in order to give the report more relevance to the forthcoming French Energy Debate. However, DETENTE questions the credibility and correctness of these figures, which in general favor the nuclear option by under-estimating nuclear costs and over-estimating costs related to wind power.

3 The most recent opinion polls have been summarized in the annex of the full report (only available in French)

Main Results

The DETENTE scenario or central scenario, is based on the most 'balanced' figures from the French nuclear industry and official references. Comparing the construction of 1 EPR with a wind project of an identical investment, gives a much higher job creation and electricity production in the wind option. This is shown in graph 1 and graph 2

Electricity production

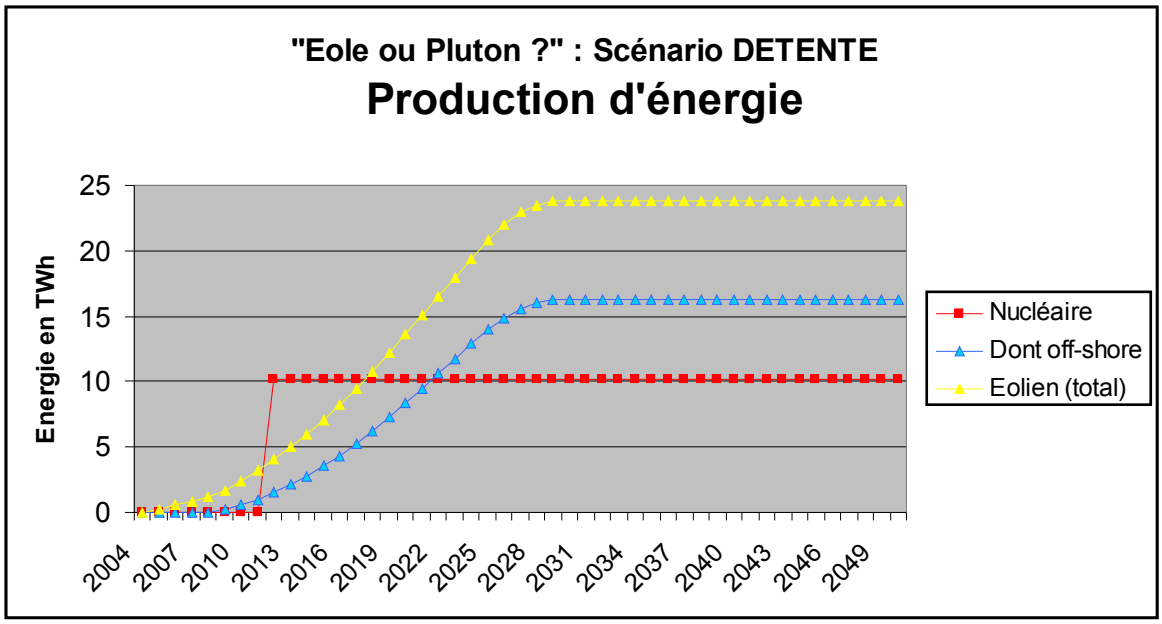


Figure 1: annual electricity generation – DETENTE scenario: (nuclear:red ; total wind: yellow ; offshore wind: blue)

A wind programme generates 2.3 times more electricity at its full deployment than an EPR. In electricity terms: 24 TWh / year for wind instead of 10 TWh / year for EPR.

This annual production is not identical to the actualized production which is used in the economic calculations of this study. Production early in the studied timeframe are favored by the actualization. The actualized wind production is thus 'only' 52% higher (111 TWh wind – compared to 73 TWh nuclear over their lifetime), whereas the annual wind production – once fully deployed – is 2.3 times higher than the nuclear production.

In the wind programme, the increase in capacity is more smooth than in the nuclear option, which would be an advantage in the French context of large generation overcapacity. The need for new capacity will indeed be large from 2030 onwards. The startup of an EPR as early as 2012 will thus be more of a commercial handicap to EdF.

Generated Employment

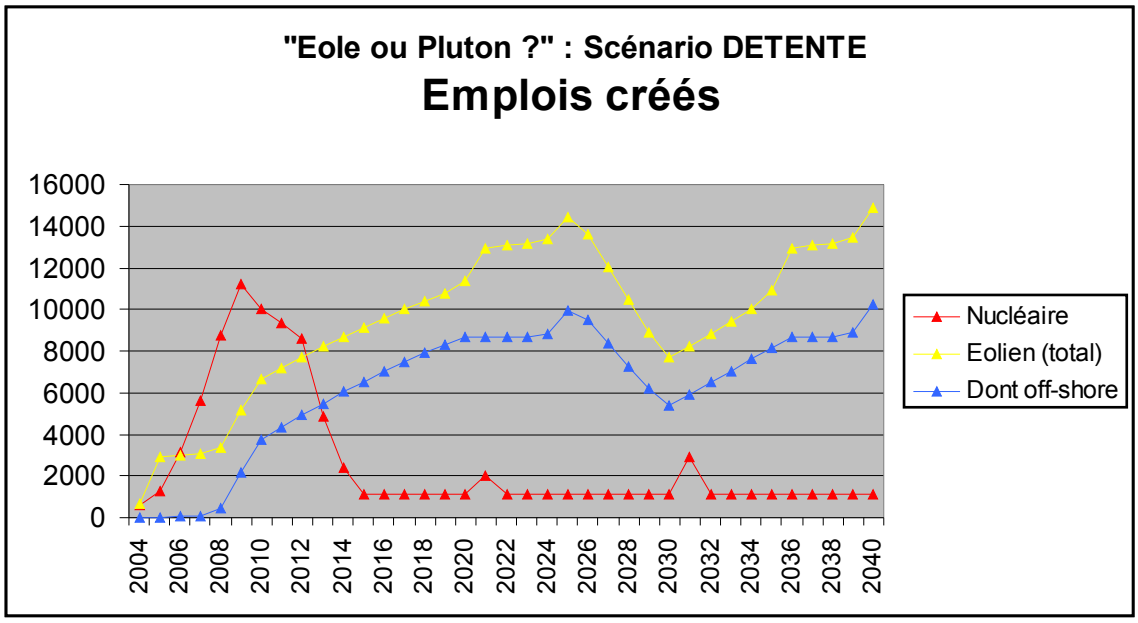


Figure 2: job creation in man-years – DETENTE scenario: (nuclear:red ; total wind: yellow ; offshore wind: blue)

The results in terms of employment are spectacular. In the EPR option, the construction generates up to 8000 temporary jobs[4] with a peak shortly in advance of the entry into operation of the reactor in 2012. But after startup, employment takes a steep dive. In the wind option, construction is more evenly spread over time and employment takes the lead over nuclear.
But above all, the permanent employment in the nuclear sector – either in the maintenance and the operation of the reactor – remains very limited, even if ratios favorable to nuclear are applied[5].

In the EPR case, refurbishment creates temporarily increases in employment. In the wind case, the decrease in employment after 2030 corresponds to the choice of this scenario not to construct new turbines after this date.

The distribution of the creation of employment in time is different in the 2 cases. A comparison of man-years of employment is however possible. It corresponds more or less to the surface under the graphs presented above.

Job creation could be valued more by decision-makers if it arises earlier in time. This is presented by actualizing the job creation, using a rate of 8% as used by the French public services[6].

4 This figure is higher than the 5000 used by the industry. Quoted from 'Le Point' July 27th 2003
5 The ratios of permanent employment in the nuclear sector are taken from SFEN (Société Française d'Energie Nucléaire), and are clearly favoring the nuclear option
6 As part of the sensitivity study, a rate of 3% has been applied, which gives an even more favorable result for wind power.

Jobs created in the DETENTE scenario « Wind vs Nuclear 2003 »						
	Man-years			Man-years actualised		
	EPR	Wind	Ratio	EPR	Wind	Ratio
DETENTE	133 477	630 339	4,7	50 051	98 502	2,0

Over a timeframe of 60 years – the official lifetime of the EPR – the number of man-years generated by the wind option is nearly 5 times higher. If employment is actualized, reflecting the political preference for early job creation, the ratio is still a factor 2 higher for wind. The wind option thus shows major social benefits.

Sensitivity study

Starting from the 'central' DETENTE scenario, 3 other scenario's are developed, which are presented in more detail in the annex.

It is remarkable that in every scenario, the annual production by wind energy is by far larger at its full deployment. Even in the case where 5 EPRs are constructed – a case considered as unrealistic given the large nuclear overcapacity in France – wind still generates 30% more electricity (65 TWh/y instead of 50 TWh/y for the EPR) at an equal capital base.

The wind option has large social advantages with a job creation which surpasses the nuclear option in every scenario. Even in the 1+4 scenario, nearly 3 times as much jobs are created by wind (if actualized, the ratio remains 1.6 times higher).

Conclusions

Based on figures from the nuclear industry and French official references which in general favor nuclear energy, the report «Wind vs Nuclear 2003» demonstrates that a clear choice for wind power instead of a new EPR would offer France major social and economic benefits. At an equal investment, wind power generates 5 times more jobs and 2.3 times more electricity than nuclear. Even in an extreme scenario with low costs for nuclear and high costs for wind, wind remains the best option.

In the context of the French 'Energy Debate', the French Parliament should carefully and critically evaluate the socio-economic consequences of the proposal of the French Industry Minister to construct the EPR.

Annexe 1 :

Overview of cost and productivity values in the different scenario's

Overview of the scenario's

scenario's	Characteristics
DETENTE « Wind vs Nuclear »	1 EPR, medium estimation of costs
EoP-H	1 EPR, costs favorable for nuclear and unfavorable for wind
EoP-B	1 EPR, costs unfavorable for nuclear and favorable for wind
1+4 EPR	5 EPR with 4 more added, medium estimation of costs

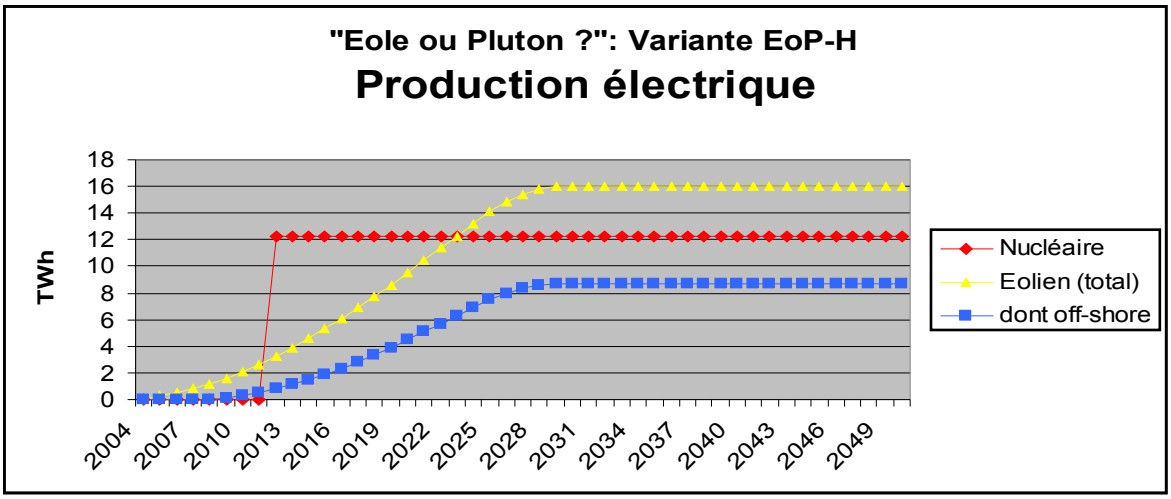
Summary of hypothesis of EPR

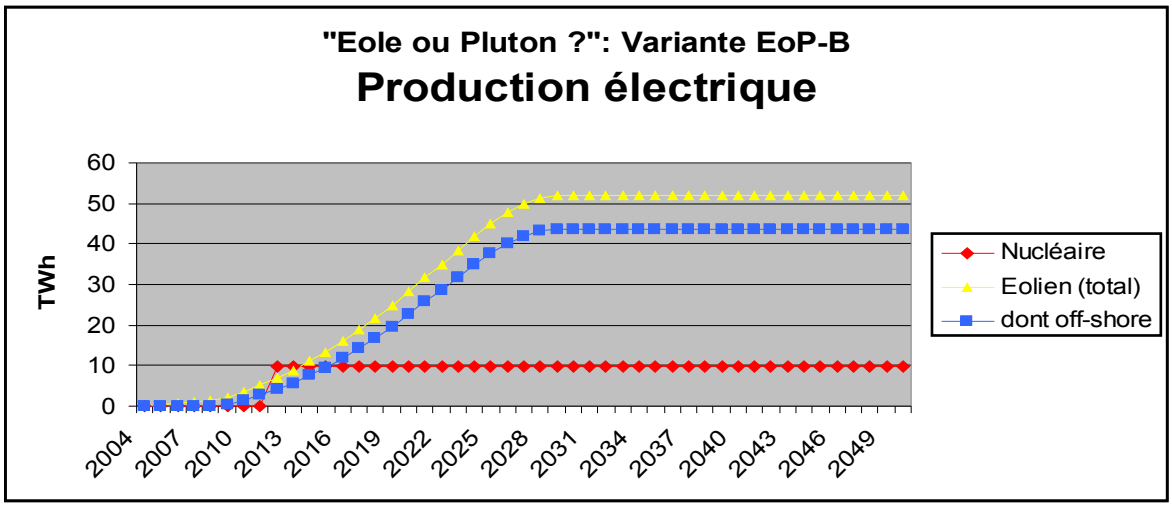
Summary of hypothesis on EPR				
	Units	Scenario DETENTE	scen EoP-H	scen EoP-B
Economic lifetime	years	60 ans	60 ans	50 ans
Construction time	years	8	6	12
load factor	%	75	90	71
gross investment*	€/kWe	1550	1472	1705
Lead time costs	€/kWe	527	380	728
Operation and maintenance	€/MWh	10,46	4,8	12,55
dismantling	€/kWe	15% of cost DIGEC	15% of cost DIGEC	50% of cost DIGEC
Additional provisions	€/MWh	0,61	0	3
fuel	€/MWh	8,4	6,9	8,4
Reprocessing and/or storage	€/MWh	4,12	2,74	16
Liability / assurance	€/MWh	0,22	0,22	13,72
research	€/MWh	1,14	0,76	2,29
External costs	€/MWh	4,95	2,5	7,4
* without lead time costs and dismantling costs - DETENTE 2003				

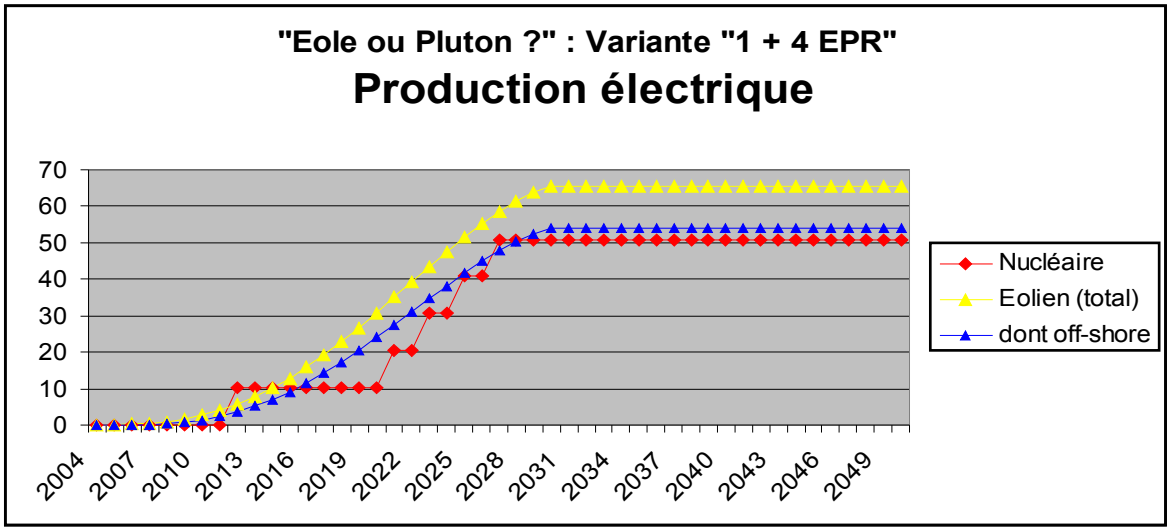
Summary of hypothesis on Wind

Summary of hypothesis on Wind				
	Units	Scenario DETENTE	scen EoP-H	scen EoP-B
Economic lifetime	years	15 ans	15 ans	15 ans
Construction time	years	4	4	4
Load factor (land)	Hours/y	2800	2500	3020
Load factor (offshore)	Hours/y	3300	3100	3500
Investment (land)	€/kWe base 2001	Base 962 €/kWe decreasing afterwards	Idem	Idem
Investment (offshore)	€/kWe base 2001	Base 1995 €/kWh decreasing afterwards	Idem	Idem
Lead time costs (8% actualisation)	%	3,8% of investment		
Lead time costs (3%)	%	2,3% of investment		
Operation and maintenance	€/MWh	See table		
dismantling	€/kWe	20% of initial investment	Idem	Idem
fuel	€/MWh	n.a.	n.a.	n.a.
Reprocessing and storage	€/MWh	n.a.	n.a.	n.a.
Liability / nuclear assurance	€/MWh	n.a.	n.a.	n.a.
External costs	€/MWh	2,24	3,65	0,84
* without lead time costs and dismantling costs - DETENTE 2003				

Annex 2 : Results of the different scenario's: Electricity production







Results of the different scenario's: job creation