C.I.R.E.D.
CENTRE INTERNATIONAL DE RECHERCHE SUR L'ENVIRONNEMENT ET LE DÉVELOPPEMENT

Contractual and financing arrangements for new nuclear build in liberalised markets

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  - The cooperative of consumers
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  - Nuclear Investment by oligopoly of middle-size firms

1. Introduction

- **Remember: With cost of service regulation, risks is widely transferred on consumers.**
- **With liberalised model investors bear all the risks**

- **1. Financing community interested in economic prospects of nuclear (CO_2 advantage, fuel cost, etc.)**
  - Announcements of nuclear merchant plants combined with project finance in the USA (NRG Energy, Constellation, etc.)

  =>Is this business model with project finance adapted to new nuclear financing?

- **2. Deterrence on lenders and producers to invest in nuclear technology in the decentralised market model**
  - Risks specific to nuclear technology
  - But also market risks magnified by high fix cost/variable cost ratio

- **3. Some legitimate solutions for risk tranfer onto government for risks specific to nuclear technology and "re-learning" process**

- **4. Variety of reforms suggests variety of solutions for transfer of market risks: Different combinations of financing and contractual arrangements possible**

1. Reference to decentralised electricity market model
2. The reference business model in generation: the merchant plant
3. The initial refereence of financing model: project finance

Definitions:

"*Merchant Plants*" are Independent Power Producers having not contracted for their output.

« Project finance » : non recourse debt with project out of balance sheet, Guarantee on the the future cash flow and the asset value

- Control of risks by the financial investor
- Low WACC and high return on equity (20% equity, 80% debt at 5%)

2. Risks specific to nuclear investment:

Which risks can legitimately be transferred to governments?

Risks specific to nuclear projects

- **Usual risks of electricity generation investment**
  - **Construction risks**
  - **Operating risks**
  - **Market risks in liberalised electricity markets**
    - Price risks
    - Volume risks

Specific risks of nuclear investment

Difficulty of sitting and planning

Regulatory and political risks during construction

Risk of re-learning process

Risk with scarcity of manufacturing and E&C

Amplification of construction risks and **operating risks** (size, lead time, capital indivisibility)

Amplification of market risks:

- No correlation between market prices and contruction costs
- CO2 risk

About market risks

I. Market risks are amplified by the characters of nuclear technology

- Capital intensiveness and indivisibility
  - (€ 3 to 5 billion instead of € 200 million CCGT of 500 MW))
- Long lead time in construction:
  - Difficulties to anticipate net cash flow when commissioning
  - Greater difficulties to anticipate period of price spikes for pure producers
- **Low marginal cost, high fixed costs:**
  - **For a " merchant plant"** , **constraints of debt repayment schedules**
  - **High operating leverage**:
    - **small changes in revenue lead to large changes in profits**
    - greater risk of bankruptcy if low price
- Greater need for **risk management** than non-nuclear generation

II. Design of environmental policies amplifies market risks

- quantity instrument (quotas) and not price instrument (tax) = uncertainty on CO2 price
- ETS not sufficiently long term foreseeable

Nuclear investment risk mitigation by government (I)

For nuclear investors, political commitment and credibility is needed

Government's risk bearing

Need of guarantees

Exception:
If governments keep large size companies, companies are able to bear this risk (France)

Specific risks of nuclear investment

- **Difficulty of siting and planning**
- **Regulatory and political risks during construction**
- **Prelicensing and standardisation**

Nuclear investment risk mitigation by government

Relearning risks to be borne with vendors(II)

Government's Risks bearing

Different types of support:

- **Loan guarantees**
- **US Production tax credit : c$1.8 / kWh**

Ex. US federal loans guarantees of up to 80% of a project

- ***Loan guarantees allow access to guaranteed debt,***

much lower interest rate

- ***Increase the leverage of a project, up to 80% of debt***
- ***Effect on cost: c$ 1.1/ kWh***

- **Specific risks of nuclear investment**

Cost & Risk of re-learning process

Turnkey contract with the **reactor vendor** for a FoAK**:**

ex.: AREVA in OL3 (Finland), GE Hitachi in STP

But vendors reluctance to do it after FoAK

Nuclear investment risk mitigation by government (III)

Government's risks bearing

Nuclear obligation

- **Purchase at cost price**

Public commitment on CO2

- **option contrat**

- **Specific risks of nuclear investment**

Amplification of construction risks and operating risks (size, lead time, capital indivisibility)

Amplification of market risks:

- **No correlation between market prices and contruction costs**
- **Uncertainty on CO2 advantage**

3. Financing arrangements of nuclear investment in different institutional and organisational models

Other solutions for market risks…

To go round the pure "decentralised market model" …

Other existing liberalised models :

- **because imperfect liberalisation**
- **Or because adaptation of the model (vertical integration and some concentration)**

Whatever the model, need to secure vertical arrangements for any generation investment

- The model of pure merchant plants/project finance is not viable, even for CCGT:
  - bankruptcy of merchant plants in project finance with CCGT: **130 GW**

- **So how to transfer market risks on suppliers and consumers**

  - **Long term contracts with large consumers at fixed price**
    - Large on-site and common projects
    - Consortium with power purchase agreement

  - **Long term contracts with large suppliers at fixed price**
    - Historic suppliers with core consumers
    - Problem for suppliers without a large segment of 'sticky' consumers

  - **Vertical integration production-supply**

=>Peculiarities of nuclear technology reinforce the need for vertical arrangements (LTC and integration)

Three models of industrial organisation

1. **De-centralised market model**: Some American regional markets, Nordic markets, Some Australian markets
    - **Nuclear IPPs with long term contracts**
    - **Cooperative of industrial consumers and suppliers**

2. **Oligopolistic model of re-integrated firms** (UK case)
    - Re-integration after a first stage of structural shake-out in UK
    - Middle-size firms
        - **Consortium on nuclear project**

3. **Imperfect market reform : preservation of former vertical and horizontal structures:**
    - **Nuclear project of a large-size and vertical firm**

It could be France , Germany , Central European markets, (Italy, Spain)

3.1. The model of "nuclear merchant" with long term contracts

A ‘nuclear merchant’ backed by long term contracts and state guarantees

- The South Texas project of NRG Energy
- The context : Texas, a liberalised de-integrated market but with monopolies ‘islands’ (large municipalities)
  - **interest to be non-regulated producer (higher opportunity of higher price than the regulated price)**
- The promoter of the project: NRG Energy ((23 GW):
  - an IPP company with a diversified portfolio in technologies and on different markets
- **Capital structure:**
  - The merchant company NRG : 44% i.e. equivalent of 1200 MW
  - Partnership with large and monopolist municipalities :
    - Austin Energy : 16%
    - CPS energy of San Antonio : 40%
- **Securing longer term contracts:**
  - 1. offtake by municipalities: 56%
  - 2. NRG energy’s share : offtake by long term contracts on 75%
  - NB. **Only Short term sales on 10% of the production** in order to extract value from future CO2 restriction policies

The model of 'nuclear merchant' with long term contracts

Market model		**Imperfect "decentralised market model"** **Variety of firms: IPPs, integrated suppliers, municipalities**
Reference case		**NRG projects in Texas** **(South Texas Project of two ABWR)**
Characteristics of the project		**IPP** with long term contracts with historic LSEs and municipalities
Structure of financing		**Project financing** Helped by **production tax credit during 8 years** **loan guarantees**
Leverage ratio equity/debt		Intrinsically moderate degree of leverage because of risks (40/60) But **possibly 20/80 because credible state support**
Risk management		**Portfolio approach** (NRG has 23 GW of capacity in CCGT and coal Risk Allocation on consumers: Specific contracts with distributors
Viability		**Only because PPAs and government guarantees**

Question: Reproducibility of this model?

- **Other IPP candidates to develop merchant nuclear generators**
  - Constellation Energy, Exelon , TXU
- High probability of project finance for the six first supported projects in the USA (EPact 2005)
- **As the butterflies, this model is ephemera**
    - Banks agree to lend in project finance for plants installed in liberalized markers
      - because of the federal support and loan guarantee
      - because the possibility of shifting risks by long term contracts on the consumers
- There is not any project finance for conventional electricity project in the US
  - PPAs with regulated LSE or historic LSE is a crucial condition
  - Only corporate financing with large IPPs
- *Next Nuclear Investments mainly in the non-liberalised markets (1/2 of the juridictions)*

3.2. The model of the cooperative of consumers in decentralised markets

The Finnish EPR project

TVO : Cooperative of large consumers (pulp and paper) (and municipal utility companies

TVO owns thermal plants and two nuclear power plants

Securitization by long term PPA at flat price (cost-price)

- Sales electricity “at cost” during the life of the plant (40 years) to its investors

- This structure of investment ensures very stable prices as well as exemption from carbon issues

Vendor bears the risks above €3 billions

- Turnkey contract with AREVA
- Operating risks on AREVA ,
  - penalty on the manufacturer when performance below to 90% on 40y (Important risks for the FOAK)
- Effectiveness: a provision of around € 1.5 billion by AREVA

Finance : Consequently an hybrid of corporate finance/project finance

- A leverage identical to a project finance (25/75):

- Refinancing:
  - Stand-by credit contract with very low interest rate (2.6%) by the Bayern bank for €2.2 billion and the French export credit bank COFACE for 800 millions

The key elements: the **PPAs at cost-price on 40 years and the turnkey contracts**

=> Consequence: a low WACC of 5-6%

The model of the cooperative of consumers

Market model	**Decentralised market model**
Reference case	TVO Finnish plant OL III
Characteristics of the project	Cooperative of large consumers (and suppliers) TVO
Structure of financing	Hybrid of corporate/Project financing
Leverage ratio equity/debt	high degree of leverage (25/75)
Risk management	1. PPA with the participants 2. Turnkey contract
Viability	To be proved without turnkey contract

Which reproducibility of this model?

- **1. Which reproducibility without the construction risk borne by the reactor vendor**
  - For instance what else with the new announcement of a Finnish project in consortium ?
    - New Consortium Fenmovia of industrial and energy companies for a 1500MW (2016-2018)

- **2. Consortium of industrial consumers with common interest :**
  - Compatibility of horizon of the industrial firms : timing of investment cycle
    - (risk of delocalisation, of closure in case of mergers, etc.)

  NB in the Finnish case, location of resource (forestry) and long investment cycle

  - **Difference of preferred time-span of the contract with nuclear lifetime**
    - Experience of the present consortium Exeltium in France (with up-front payment, 15 TWh/y around)
    - 15 years instead of 40 years for TVO

3.3. The model of dominant vertical firm

The case of EDF's EPR Flamanville 3

- No turnkey contract
  - Electricity Company bears the construction risk
  - Capacity to control E&C costs
- N.B. need to restore it in the future

- Normal corporate finance
  - Not so low WACC because high ROE: High WACC (9.7%)

  - Association of ENEL (12.5%) , but not Electrabel-Suez, a competitor

- Discussion: Difference of official cost with Finnish project : € 46-48 versus €25-30€/MWh

  - WACC in real terms of 5% in Finland
  - Finnish Investment cost: € 15 /MWh instead of € 32/MWh
  - Finnish evaluation does not include cost increase borne by vendor

  - EDF logic : reference to sale on power exchange, with normal risk

Some advantages of dominant oligopolisitic firms

The advantage of vertical integration :

- to shift the market risks on the supply and the consumers (as every historic supplier)

The advantage of horizontal concentration large size:

A. Scale economies in risk management

- 1. Portfolio of different types of assets
  - Possibility of cross subsidization between equipment on short term market
- 2. Ability to operate in different markets (compensation of market risks)

Better financing conditions than mid-size firms' project or merchant plant

- Corporate financing instead of project financing
- Good Financial rating

B. Scale economies in control of construction cost

- Skills to control costs (n E&C intermediary)
- Bargaining power with constructors

Market model	**Large and vertically integrated companies in oligopolistic**
Reference case	French EPR Flamanville 3 Japanese projects ABWR
Characteristics of the project	Eventual minority shareholder
Structure of financing	**Corporate financing**
Leverage ratio equity/debt	50/50
Risk management	1. Porfolio 2. Risks allocation to consumers :High/medium if large base of sticky consumers 3.***Possibility to increase price-cost margin by market power when investment is needed*** ***(in Germany for instance)***
Viability	Yes Advantage of scale economies

Reproductibility of the model ?

- Suez-Electrabel's EPR projects (Tricastin 5 in France, Belgium?)
- The case of Central European projects
  - because of weak competition and incumbent's dominant position
  - Presence of large scale European producers (ENEL)
  - 2 VVER ordered to Rosatom in Bulgaria
  - Slovakia
  - Czech after Temelin

Type of reforms	Decentralised market industries with IPP companies	Decentralised market industries	Liberalised industries with large vertical companies	Liberalised industries with medium-size vertical companies
Reference case	**South Texas Project**	**Finnish plant Olkiluoto III**	**French EPR Flamanville 3**	**UK projects US project Eastern Europe projects**
Allocation of construction risks	On Government *Standby insurance Governmental loan guarantee on 80%*	On Vendor *Turnkey contracts*	On producer	On producer consortium
Allocation of market risks on consumers	PPA with municipalities / historic suppliers	PPA with large industrial users / historic suppliers	Large base of sticky consumers	Large base of sticky consumers
Structure of financing	Project finance	Hybrid finance	Corporate finance	Corporate finance
Capital structure ratio debt/equity	**70/30**	**75/25**	**50/50**	**50/50**
WACC In nominal	9.2%*	5%	9.3 %	NA

5. Some conclusions

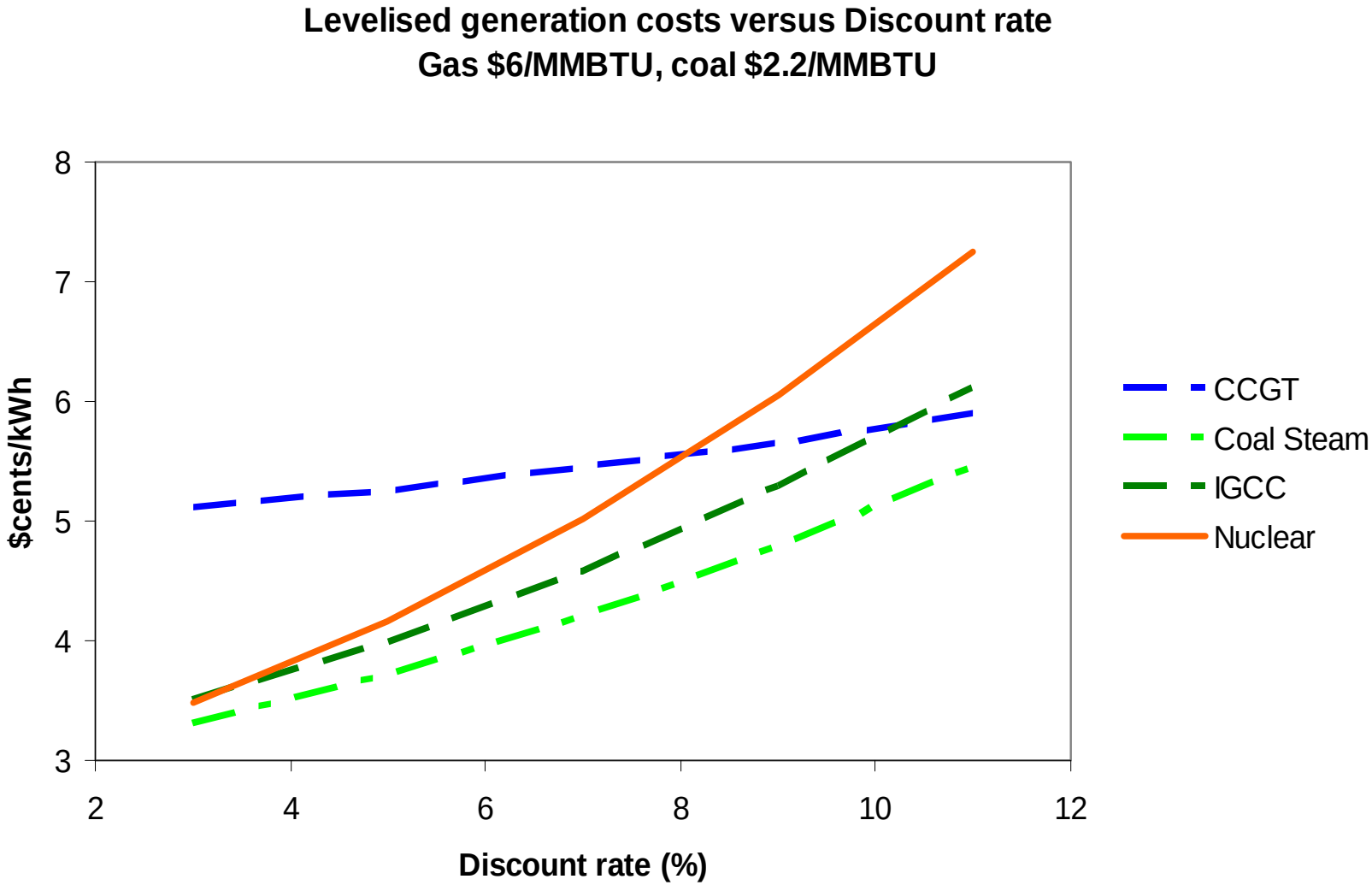
- To create a level playing field for capital intensive technologies in liberalized markets,

  allocation of risks through contracts, industrial structure and politico-institutional arrangements is critical

- **Necessity to transfer some risks away from producers**
  - Need of clear delineation of role of state / other stakeholders

- **The optimal mode of risk transfer (contracts, vertical integration, portfolio, …) depends upon the industrial model**
  - Many markets are far from the decentralised market model…
  - **In countries without large companies**, institutional and contractual arrangements are crucial,
    - **governments can help by bearing some specific risks for the first new units**

- **Financing arrangements will depend on to these specific institutional and contractual risks isolations and/or transfer**
  - Corporate financing most likely with large and vertically integrated companies…
  - **Project financing only for 'niche' markets / projects**
  - Impact on the cost of capital is important and affects the relative competitiveness of nuclear vs. other technologies


Levelised generation costs versus Discount rate
Gas $6/MMBTU, coal $2.2/MMBTU
$cents/kWh
8
7
6
5
4
3
2
4
6
8
10
12
Discount rate (%)
CCGT
Coal Steam
IGCC
Nuclear

Annex 1

Case 4. Nuclear Investment by oligopoly of middle size firms: The Case of British nuclear projects

- Vertical oligopoly of middle-size companies
- Solutions:
  - Consortium with owner of nuclear sites (British Energy)
  - Consortium of two major competitors (?)
  - Consortium of producers and consumers (?)
- Corporate financing
- Transfer of Market risks on consumers and government
  - Vertical integration with sticky customers
  - PPAs with obligated suppliers (nuclear obligation)
  - CO2 price guarantee: (Carbon option contracts ?)
- Problem with competition policy:
  - Consortium of producers on a capital intensive equipment means:
    - Generation margins would not collapse
    - ***Annual average price must stay at the level of "nuclear entry" cost***

Reference case	UK projects
Characteristics of projects	Single company **or** Consortium of Producers with British Energy
Structure of financing	**Corporate financing**
Leverage ratio equity/debt	50/50
Risk management	1.Portfolio 2.Risk allocation to consumers by vertical integration ***3. Possibility to increase price-cost margin by market power when investment is needed and then installed(?)***
Viability	**Yes** **if regulatory and political risks assumed by government.** **Much better in UK** **· if turnkey contract for the FoAK** **· if CO2 price guarantee**

Annex 2

Economic non risk relatively to other generation technologies

- **For new nuclear build the following factors are relatively minor:**
  - **Decommissioning costs** (50-60 years in the future)
  - **Fuel costs** (raw U308 is only a few % of total costs)
  - **Geopolitical risks** (fuel is easily stored and is regarded as “domestic” for energy security)