



*The Abdus Salam  
International Centre for Theoretical Physics*



**2257-13**

**Joint ICTP-IAEA School of Nuclear Energy Management**

*8 - 26 August 2011*

**Financing Nuclear Projects**

N. Barkatullah  
*IAEA, Vienna  
Austria*

# Financing of Nuclear Power Projects

IAEA/ICTP School of Nuclear Energy Management  
Trieste, Italy  
August 9, 2011

*Nadira Barkatullah*

*Department of Nuclear Energy, Planning and Economic Studies Section*



**IAEA**

International Atomic Energy Agency

# Overview

- **Define Financing**
- **Nuclear Power Plants (NPPs) Financing: Some Challenges**
- **Sources and Types of Financing**
- **Existing and Emerging Financing Models and Trends**
- **Contractual and Ownership Arrangements**
- **Financial Risk Management**
- **Concluding Comments**

# Financing

- So what is Financing? Providing necessary capital through issuance and sale of debt and/or equity

## Debt Financing



Local banks  
international financial institutions

export credit agencies  
Suppliers

international development  
organizations

Capital markets



Cost of debt:  
Interest paid

## Equity Financing



Local and foreign investors

Shareholder

Capital markets: like IPO



Cost of capital:  
return on  
capital

# Financing: Cost of finance

- In simple case weighted average cost of capital (WACC) is:\*

$$\text{WACC} = \frac{\text{Debt}}{\text{Debt} + \text{Equity}} R_d + \frac{\text{Equity}}{\text{Debt} + \text{Equity}} R_e$$

*Where:*

- *R<sub>d</sub> is the cost of debt*
- *R<sub>e</sub> is the cost of equity*

*\* Without any tax adjustment*

# Financing: Cost of finance

## Why is WACC important in managing financial risk for nuclear?

$$\text{WACC}_{\text{Other}} + \text{Risk premium for nuclear} = \text{WACC}_{\text{Nuclear}}$$

Generally, for nuclear the cost of finance is higher – with risk premium of x% above other power generation assets added to the interest rate...why?

# The Economics of Nuclear

## Key Advantages of the Nuclear Power

- Relatively low fuel cost: economic competitiveness
- Price stability
- Current fleet performance of nuclear reactors
- Long life time
- Guarantee for energy supply
- Clean source of energy
- Economic development: job creation and contribution to national high technologies sector

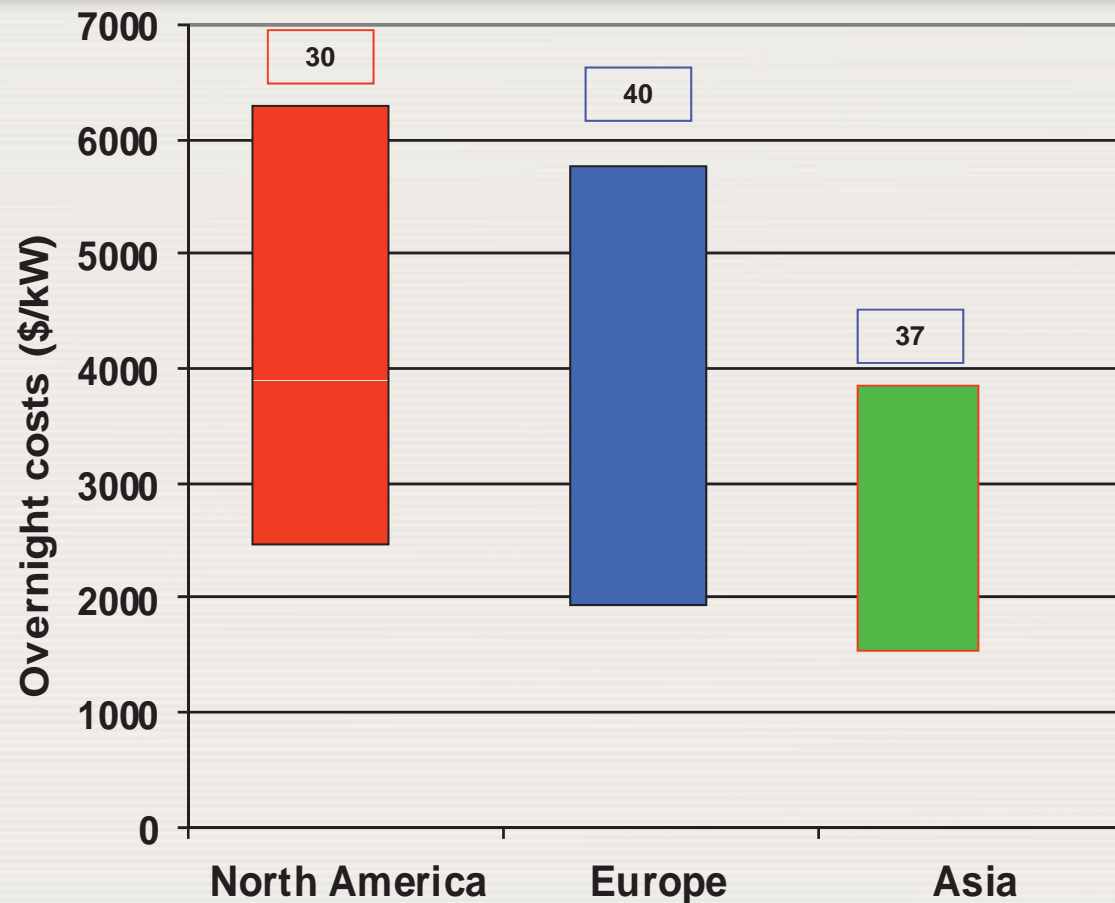


## Key Challenges to the Nuclear Power

- Complex and highly capital intensive: high upfront capital costs, which are difficult to finance
- Sensitive to interest rates
- Long lead times (planning, construction, etc)
- Long payback periods
- Construction cost uncertainty
- Regulatory/policy risks (revised safety measures)
- New financing structures required to attract private investors

# Challenge: NPPs overnight capital cost uncertainty -

## Overnight capital cost range by region



*Overnight capital cost quoted for a typical 1000MW NPP ranging from: \$2 - \$6 billion – Why?*

All data in 2008 USD



IAEA: Data collected from various publications and studies to keep track of nuclear power plants investment costs, since 2008 (updated April 2011)



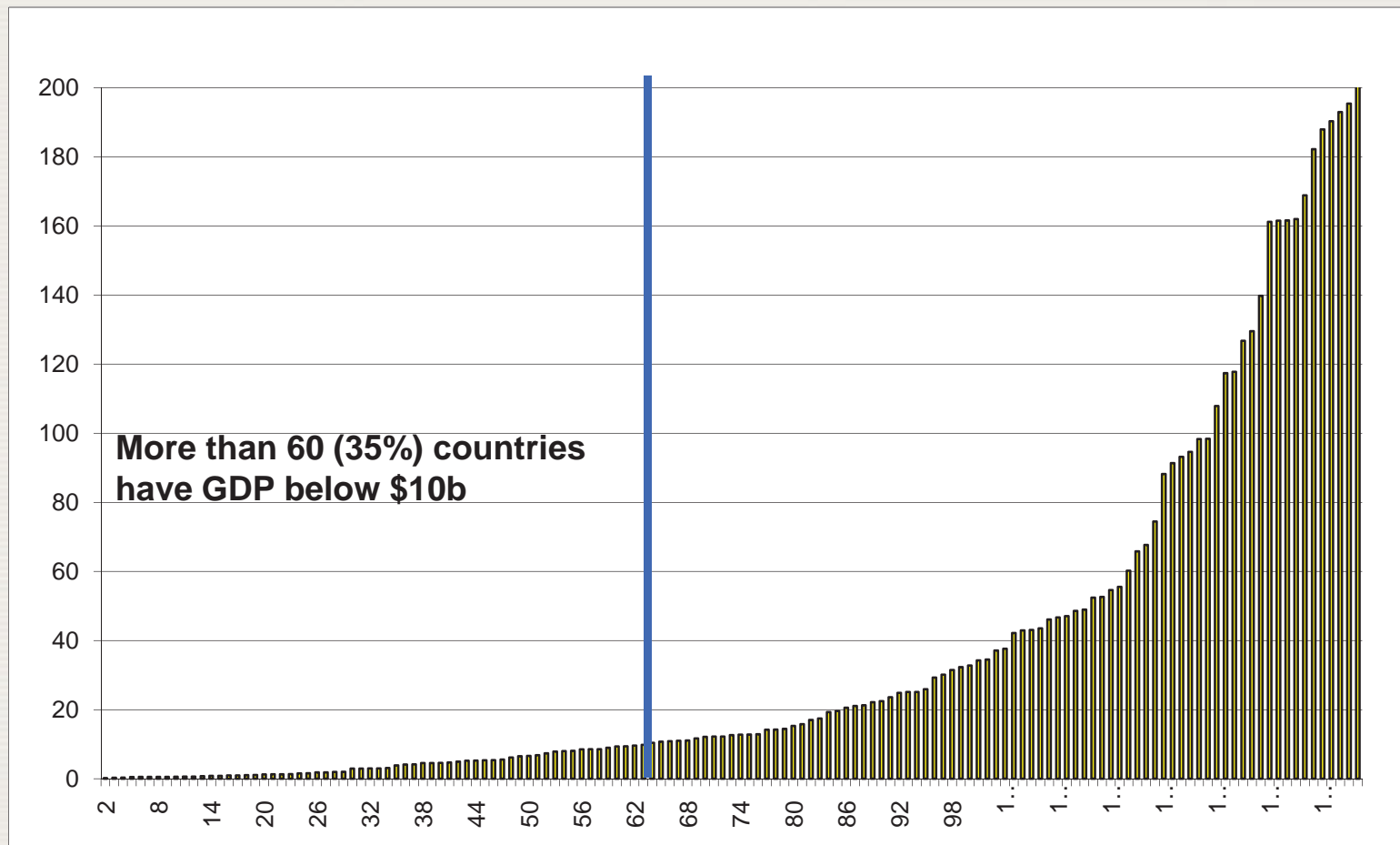


# Challenge: Investment cost uncertainty

- Possible explanations?
  - Different definitions: what are the true costs? EPC costs, owners cost and contingency costs
  - Regional input cost differences
  - Localisation rate
  - First-of-a-kind (FOAK)
  - Existing site or greenfield site
  - Technology and reactor type
  - Accounting, regulatory, ...

# Challenge: Highly capital intensive

## Gross Domestic Product (GDP) in \$2010 billions

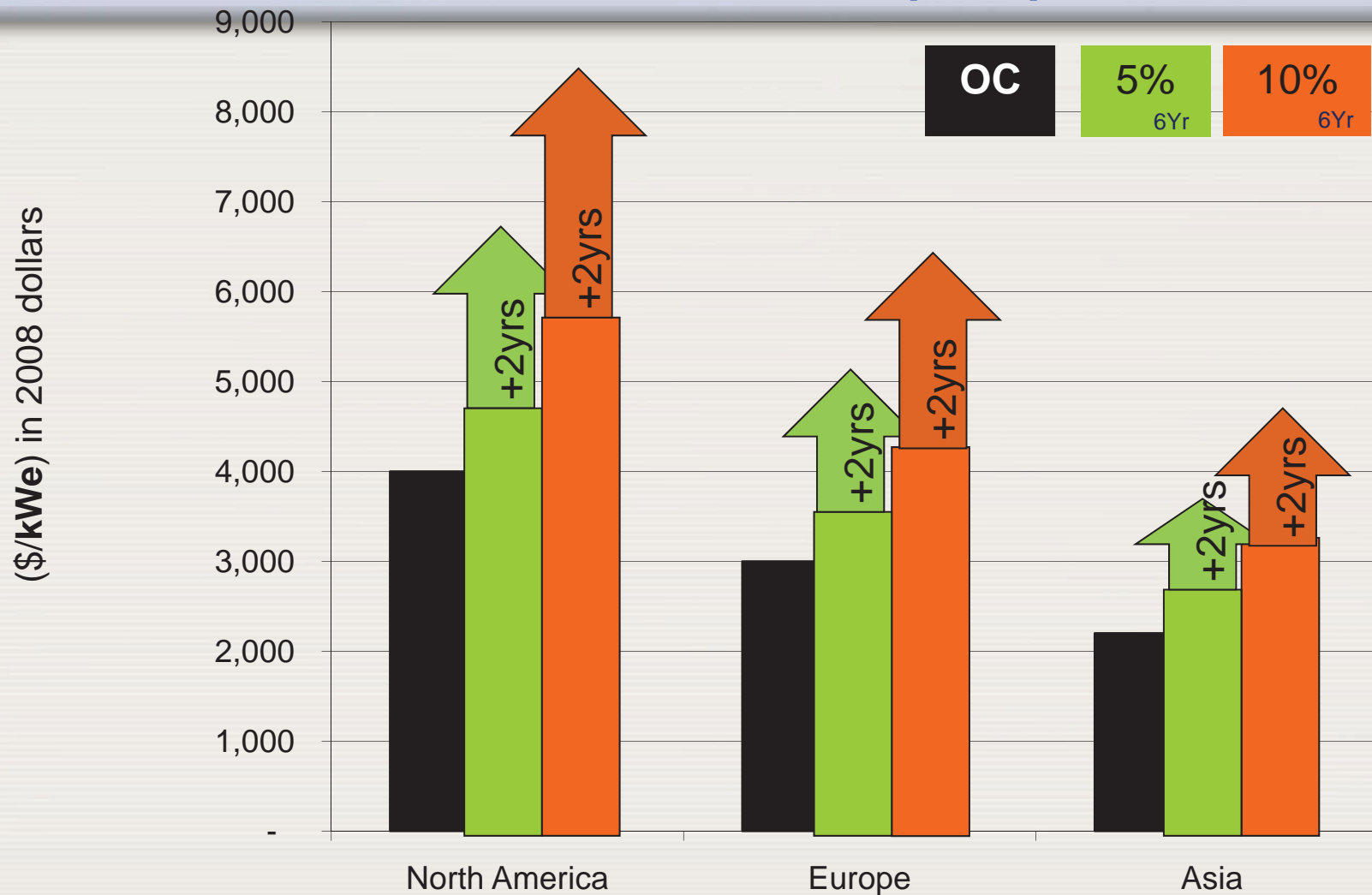


## Challenge: Highly capital intensive

➤ Approximate market capitalisation of the leading EU and US utility companies, with nuclear assets (Updated July 2011)

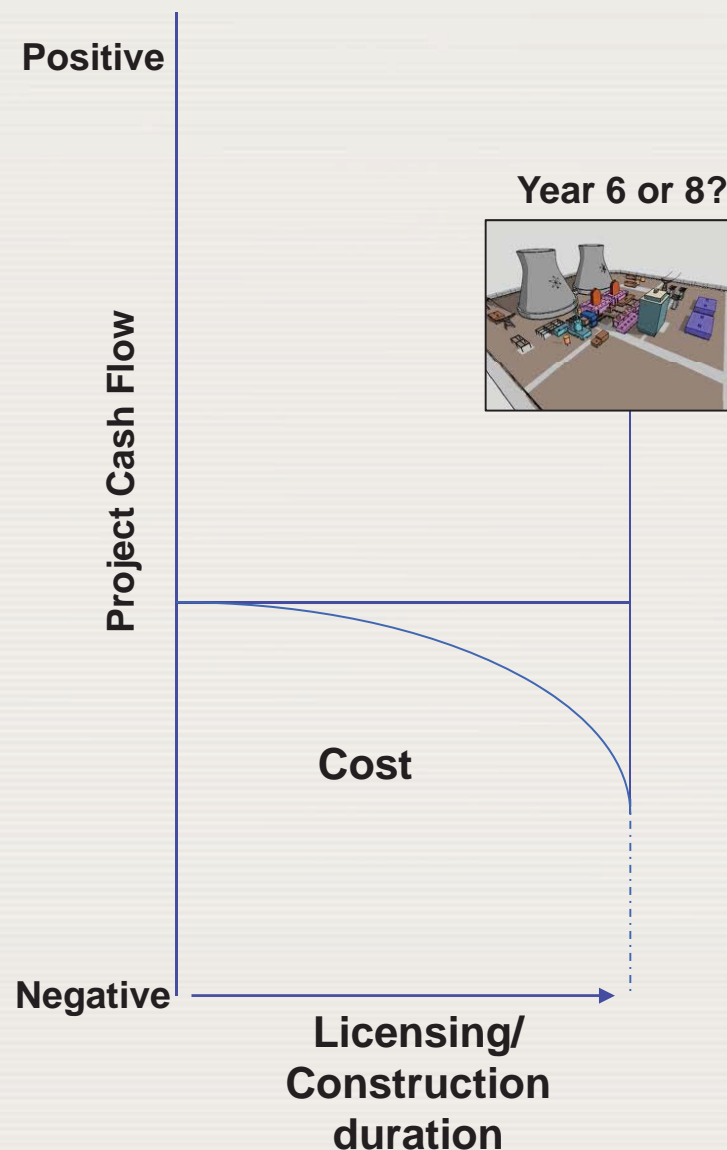
Country	Utility	Market capitalisation (USD billions)
EU	GDF SUEZ	72
EU	EDF	67
EU	Enel	53
EU	RWE	27
US	Southern Company	34
US	Exelon Corporation	29
US	Dominion Resources	28
US	Duke Energy	25
US	Public Service Enterprise Group	16
US	Progress Energy	14

# Challenge: Investment cost and Interest During Construction (IDC)



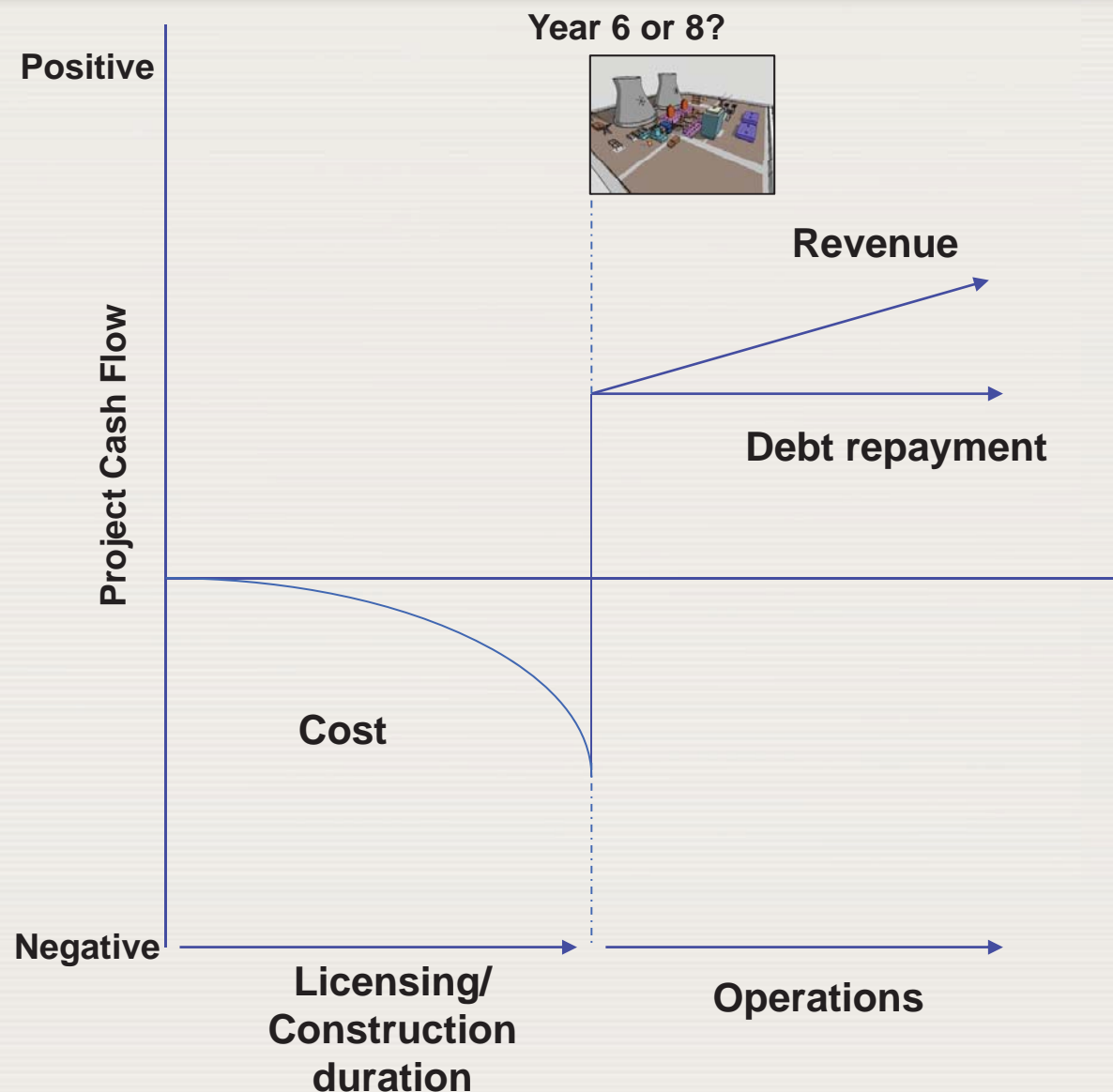
# Challenge: Longer NPP Payback Period

- Commercial banks usually look towards a payback period of 5 – 7 years!
- That is generally the construction duration of NPPs and payback period starts after 6- 8 years



# Challenge: Longer NPP Payback Period

- Commercial banks usually look towards a payback period of 5 – 7 years!
- That is generally the construction duration of NPPs and payback period starts after 6- 8 years



# Challenge: Long lead times

## USA

*A long history of construction delays and cost overruns still haunt the industry with average cost overruns for 75 nuclear plants built in the US between 1966-1977 was on average 200% (CBO 2008).....*

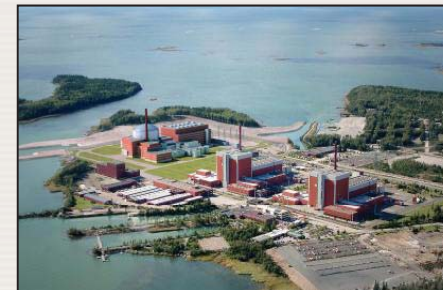
## Asia



- Some projects in Asia are constructed in 5 or less years
- Example: the success story Qinshan III CANDU Unit 1 reactor built in China in 51.5 months, 117 days ahead of schedule, total project cost of \$2.5b



## Finland



- Olkiluoto-3 project in Finland, by Areva (EPR 1600MW)
- Original cost Dec 2003 Fixed Contract (Areva-Siemens) €3.2 billion
- Operational: 2012?
- Considerable cost overruns?

FUTURE? Financiers want to see more success stories

# Challenge: Credit rating pressure

Credit ratings



- Below investment grade rating can add to the cost of finance: Credit rating is applicable to both corporations and countries (called sovereign rating)
- Below investment grade rating (BBB+) increases the cost of finance and makes financing very difficult
- So what do the credit rating agencies seek?
  - Partnerships - balance sheet strengthening of the utilities
  - increasing liquidity to help utilities maintain their credit rating



# Challenge: Credit rating pressure

## Strengthening Balance Sheet

➤ Approximate market capitalisation of the leading EU and US utility companies  
(Updated July 2011)

Country	Utility	Rating (S&P)	Market capitalisation (USD billions)
EU	EDF	A	67
EU	GDF SUEZ	A	72
EU	Enel	A-	53
EU	RWE	A	27
US	Southern Company	A	34
US	Exelon Corporation	BBB	29
US	Dominion Resources	A-	28
US	Duke Energy	A-	25
US	Public Service Enterprise Group	BBB	16
US	Progress Energy	BBB+	14

**\$45b**



Duke Energy and Progress Energy have announced a merger agreement to combine the two companies. Subject to shareholder and regulatory approval (April 2011)

# Challenge: Credit rating pressure

## Sovereign credit

➤ If countries cannot manage their debt it has an impact on their sovereign credit rating?



# Challenge: Credit rating pressure

## Sovereign credit

➤ If countries cannot manage their debt it has an impact on their sovereign credit rating?

**US: AAA rating under review possible downgrade?**

**Europe credit crisis persists**

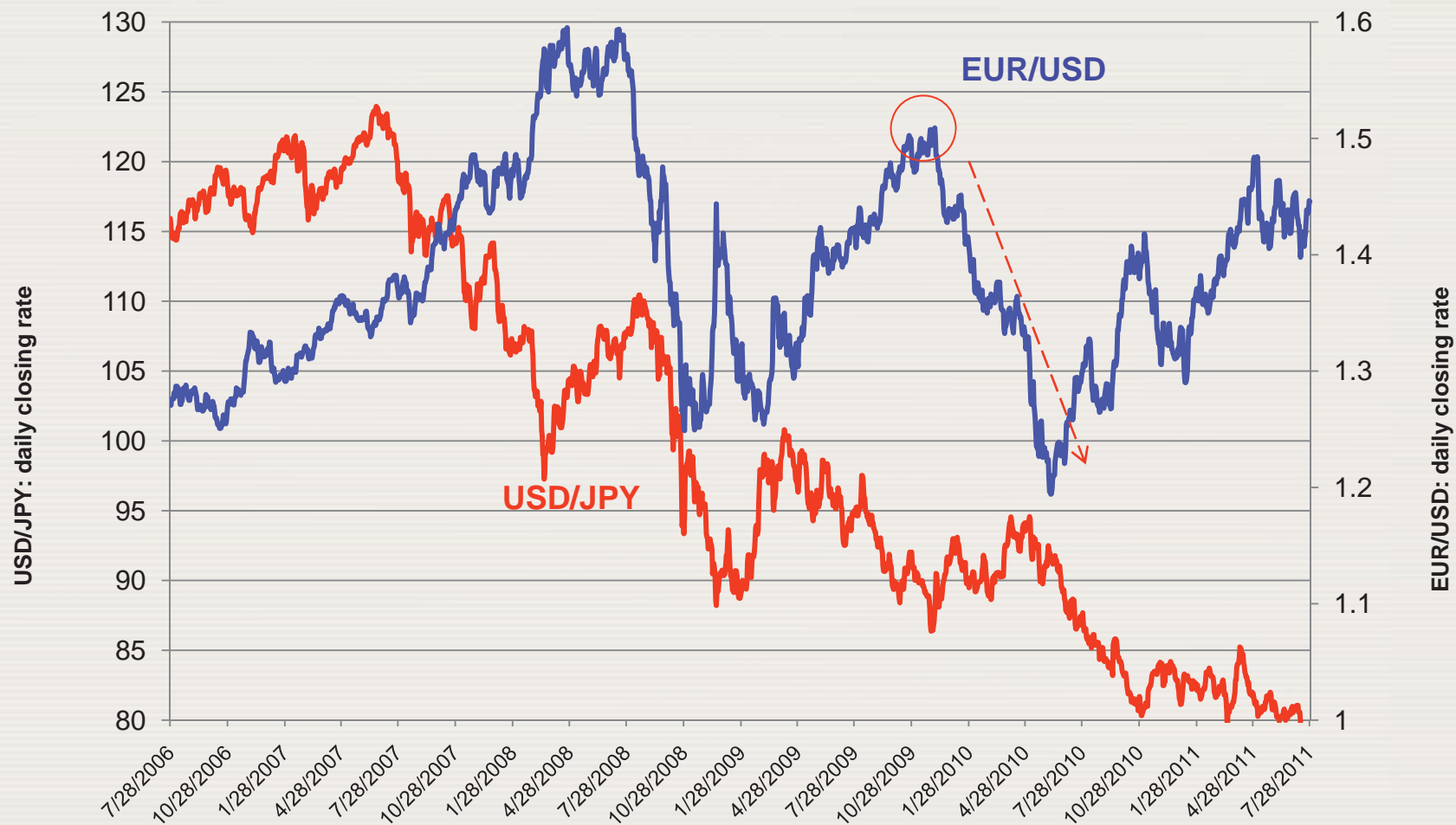
**Greece: S&P cut Greece credit rating to CCC (junk status) from B – fears of default (18Jul 2011)**

**Ireland: Republic of Ireland €85b bailout, Mar 2011 credit rating AAA and now to junk status ba1 (Moody's) – 12 Jun 2011**

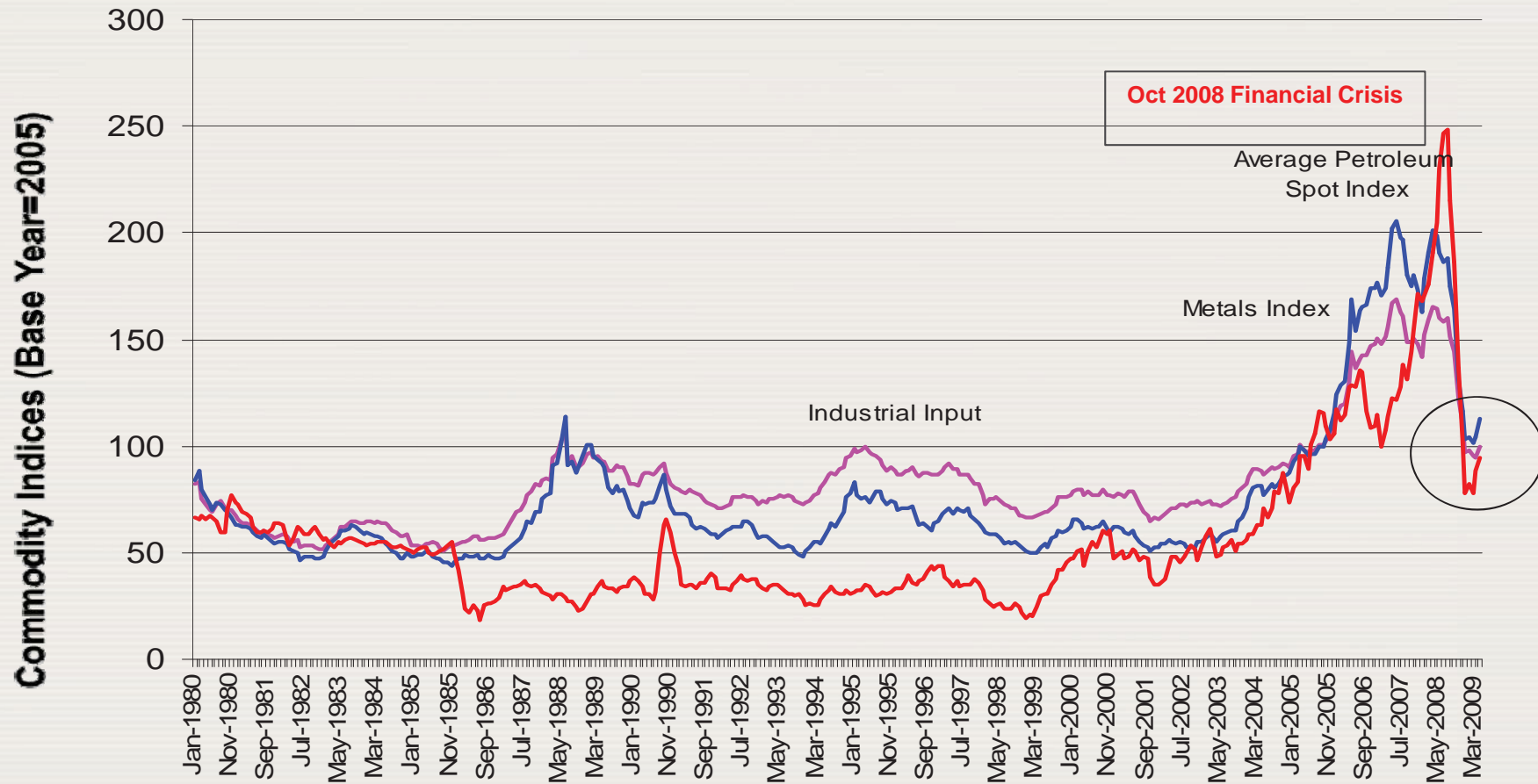
**Portugal: credit rating also cut to ba2 (Moody's) – 12 Jun 2011**

**Spain: Moody's cut Spain credit rating to Aa2 from AAA (10 Mar 2011)**

# Challenge: Foreign exchange risk

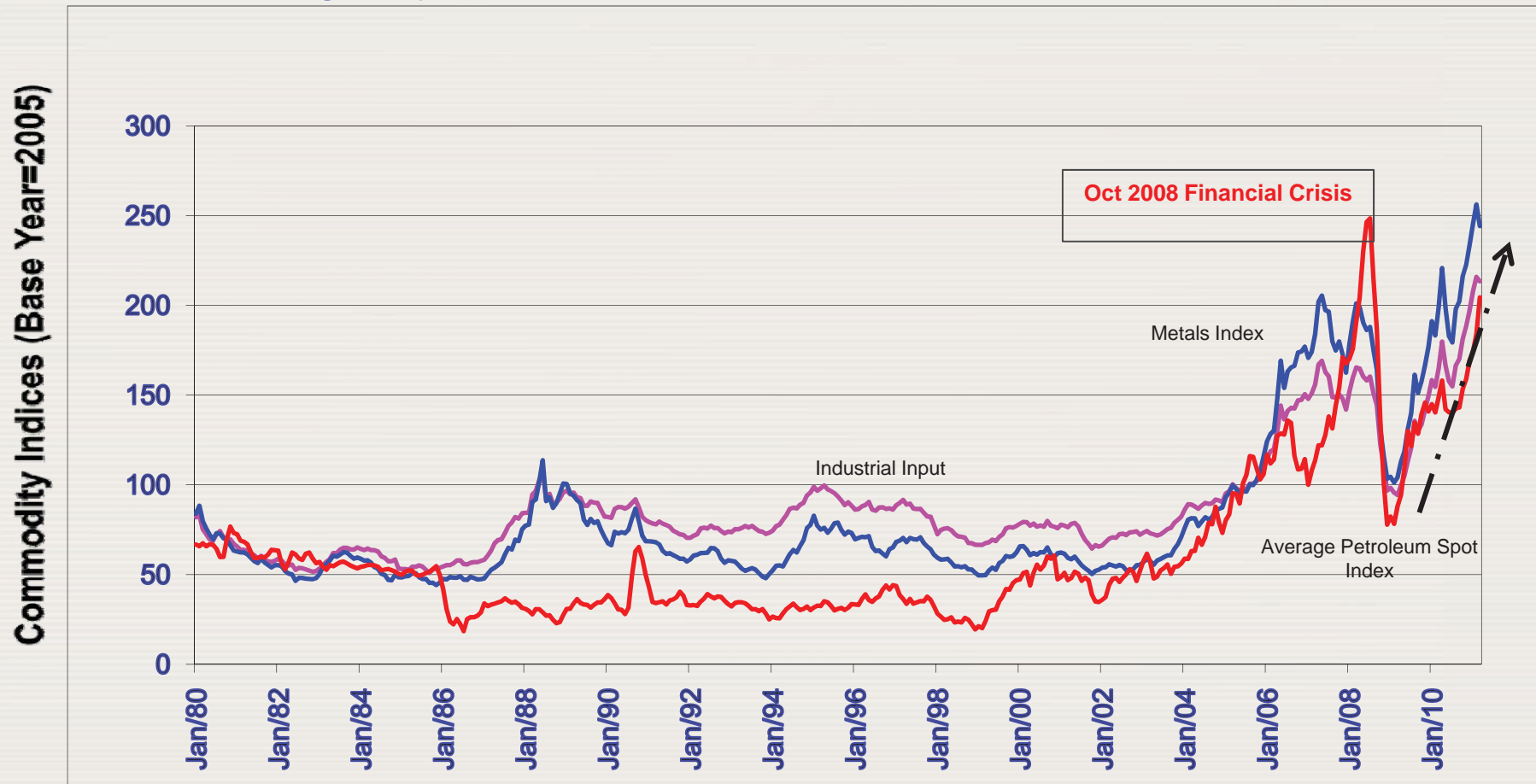


# Challenge: Commodity prices risk – impact on input cost



# Challenge: Escalation cost - Commodity prices

Latest Power Plant Construction Cost Index (PCCI) Power plant construction cost pressure returning (July 2011)



# Challenges: Yield Seeking Investors

## ➤ Nuclear vs non nuclear market index





# Major Challenges to Financing NPP

## ➤ Other Challenges

- **Enhancement of safety and impact on investment cost**
- **Increased regulatory risk and Uncertainty in the Regulatory process**
- **Negative Public Perception of nuclear**
- Multinational Banks policy on credit availability
- Construction Supply Chain risks
- Deregulated electricity market rules and regulation
- Operational performance risk
- **Nuclear liability and insurance on how to cap and allocate the “extraordinary nuclear occurrences”**
- Management of spent fuel and waste, and decommissioning



# So what next?

Challenges! Challenges!  
Challenges!!!



How to finance?



# How to attain finance?

- What are the different financing models employed in the nuclear industry?
  - Government
  - Industry



# Types of Financing

## ➤ **Government**

- State Budget (like, tax revenue)
- Equity ownership
- Government incentives (like, loan guarantee, construction delay insurance, guaranteed long term power purchases agreements)
- Export credit
- Long-term Infrastructure bonds issuance

# Government Financing: Traditional Nuclear Financing Model

## ➤ Government financing: take all risks and costs

### UAE



JV between State and  
Kepco and other Korean  
equity partners to build  
nuclear power

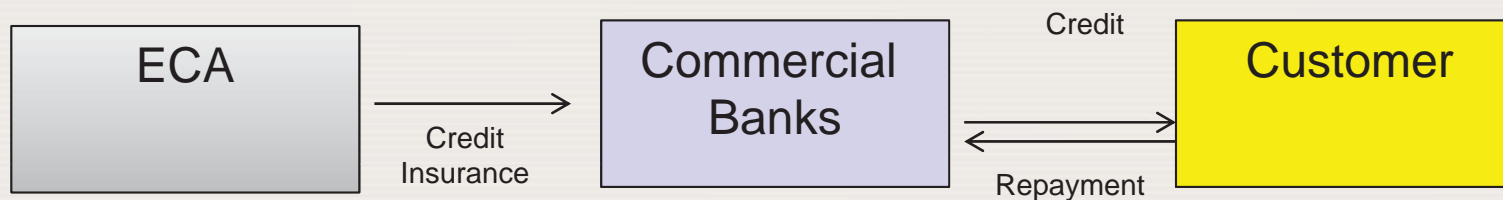
### China



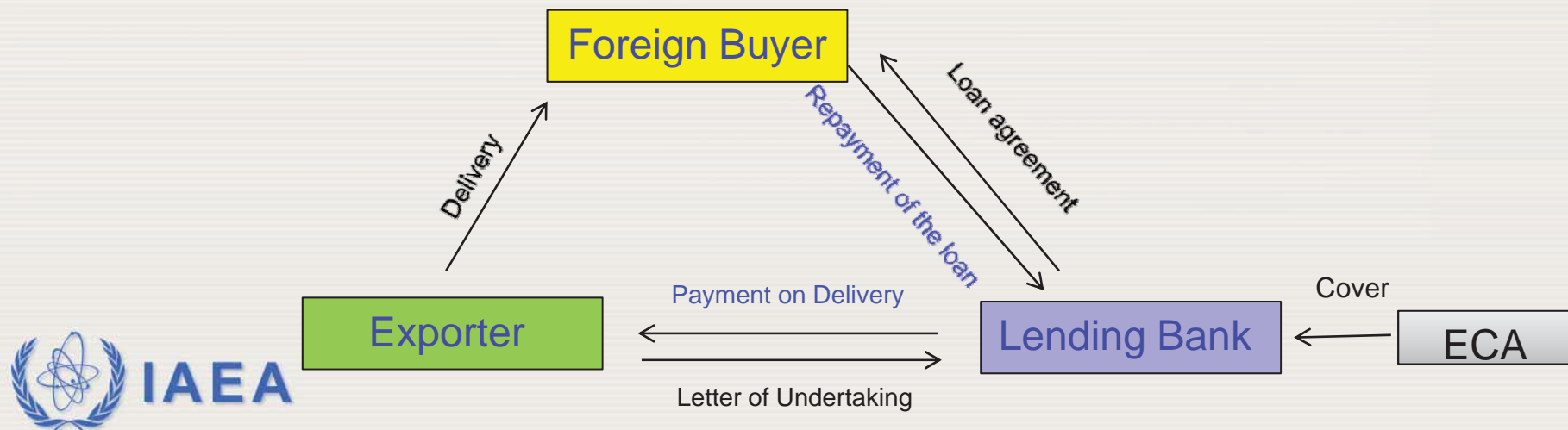
JV between China  
Guangdong Nuclear Power  
Company and EDF to co-  
own and operate two nuclear  
reactors at Taishan

# Government Financing: Traditional Nuclear Financing Model

- **Export Credit Agency (trade finance):** Provides financing services such as guarantees, loans and insurance to domestic companies for their activities in order to promote exports in the domestic country:



- **How does it works?**



# Types of Financing

## ➤ Industry

- Corporate finance or balance sheet finance
- Project Finance (non or limited recourse): Long term finance based on the projected cash flow of the project
- Co-operative finance or hybrid financing
- Innovative financing methods

# Industry Financing

- **Corporate finance or balance sheet finance:** borrowing or raising equity against the assets of the company as a whole. A bank or bond holder which provides funds to the company has a claim against the company's whole cashflows, unless the loan is secured against a particular asset, as is common for mortgages. Risk of that investment is borne by all providers of capital to that company – Example EDF

France



- Flamanville 3 project in France, by EDF (Areva PWR 1650MW)
- Construction cost €6b (Jul 2010)
- Operational: 2016?
- 4 yrs behind schedule
- More than € 2 billion over budget (2005 estimate €3.3 billion)

Others: Enel, RWE, E.On GDF SUEZ..

# Industry Financing

- **Project Finance or non recourse financing** has been increasingly used to finance large scale non nuclear energy power projects – how does it work?

*Mechanism:*

- *Special purpose company (SPV) Is formed to build the power plant*
- *Lending entity has no or limited recourse to sponsors*



Project company  
(SPV)

*Long term finance is based on the projected cash flow of the project*



- *Benefit: access to a large pool of debt financing, from banks and bond holders*
- *Risk to financiers: If the project is unsuccessful or bankrupt the parent's liability is limited to its equity investment stake in the project company*
- *In Nuclear pure project finance is still not applied*



# Industry Financing: New trends emerging

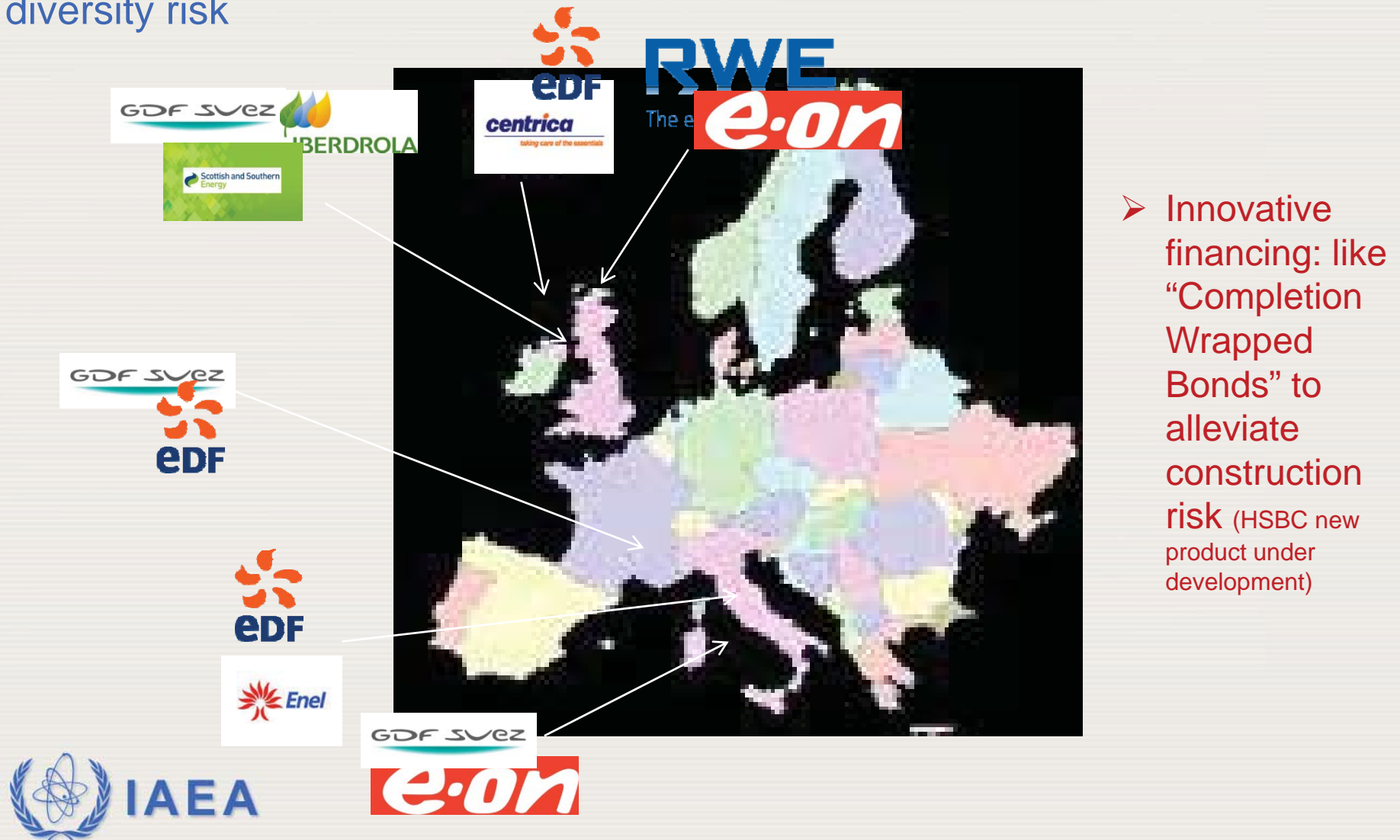
- **Co-operative model** :Olkiluoto 3 or Finnish Model....Expanding equity partners to diversity risk
  - Characteristics of hybrid financing (corporate/project finance) :
    - The project financed on the balance sheet of TVO (Finland Private Power Company)
    - Leverage characteristics similar to project finance  
75% Debt financing and 25% equity financing
    - Part of equity and loan is provided by the large customers
    - A long-term PPA with large customers ensuring future stable revenue stream from the project
    - Export credit guarantee by the French and Swedish Government

**Finland**

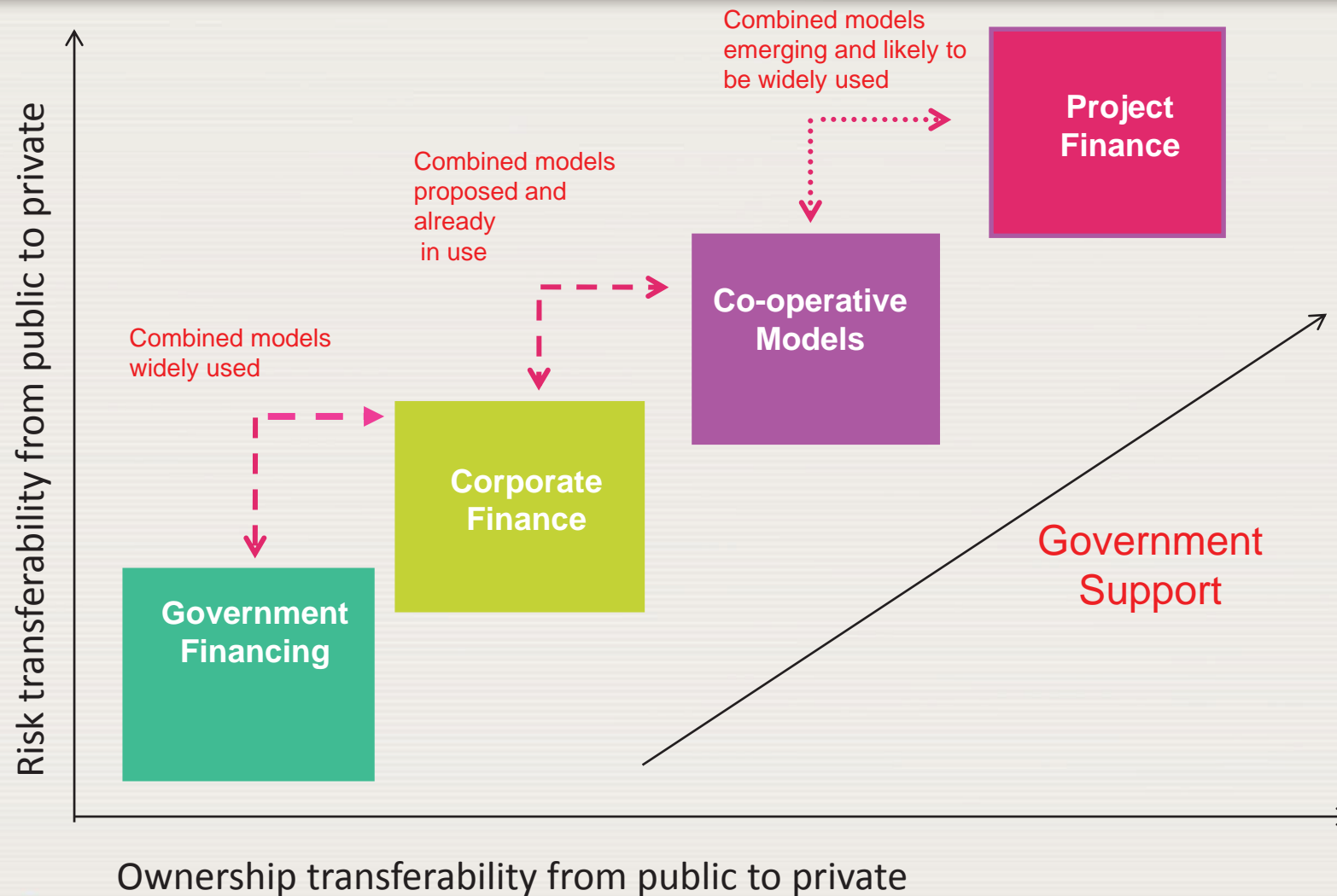


# Industry Financing: New trends emerging

Project Finance: Some trend emerging as new partnerships are formed to diversity risk



# Financing Models Trend



# Existing Contractual Arrangements

- Basically there are the following main types of contractual approach that have been applied for NPP projects:
  - **Turnkey contract:** a single contractor or a consortium of contractors takes the technical responsibility for the whole NPP project.
  - **Split-package:** the overall responsibility is divided between a relatively small number of contractors, each building a large section of the work.
  - **Multi-contract:** the owner or its architect-engineer assumes overall responsibility for engineering and managing the NPP project, issuing a large number of contracts.

# New Contractual Arrangements

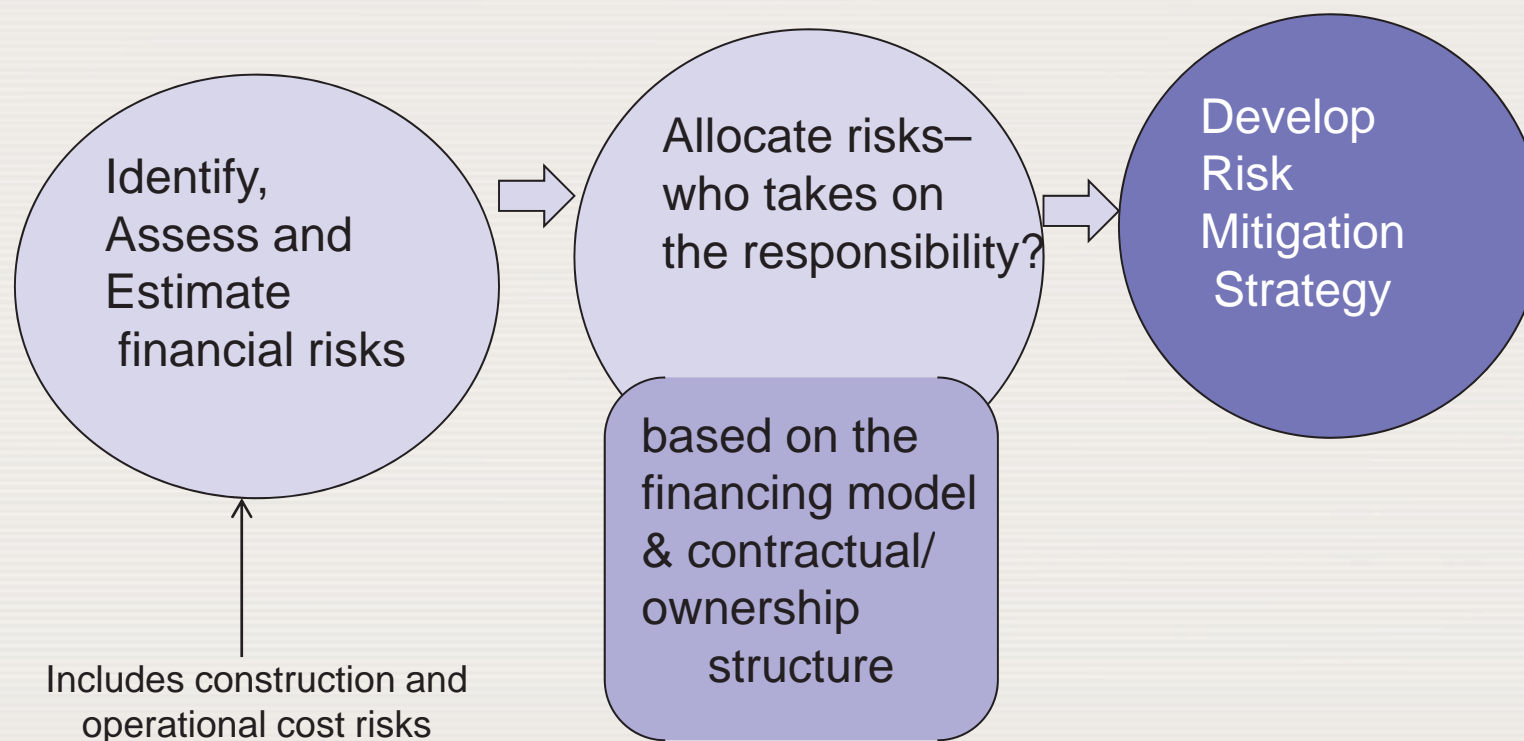
- Built Own Operate scheme: A contractual arrangement whereby a project company is authorized to finance, construct, own, operate and maintain an infrastructure.
- The project company is allowed to recover its total investment, operating and maintenance costs plus a reasonable return thereon by collecting tolls, fees, rentals or other charges from facility users.



- Akkuyu project in Turkey by a Russian consortium

# Financial Risk Management

- To attain finance requires development of “Financial Risk Management Strategy Framework”



# Financial risk mitigation strategy framework

## An Example

### ➤ Construction Phase

Name of risk	Nature of risk	Risk assessment	Allocation	Mitigation
Construction delay	Pure	High	Owner/Contractor	Terms of contract
Technology	Speculative	Low	Owner	Proven design/EPC contract TOA
Foreign Exchange/Currency	Financial	Medium	Owner/Contractor/ third party	Fixed contract price/FX Hedging/
Interest	Financial	Medium	Owner	Fixed rate/ECA



# Concluding Comments

- Firm government commitment and support - imminent
- Pure project finance is still challenging for nuclear: more difficult due to Fukushima accident, foreseeable risk is unnecessary safety measures might increase the cost of NPPs – adding to higher premium
- October 2008 global financial crisis and strict financial industry regulation will impact liquidity and make financing tough for investors, like Basel III, that will force banks to increase the capital reserve and to be vigilant regarding risky projects, like NPPs
- Governments also urging multilateral financial institutions like World Bank, EBRD, to assist with the financing of NPPs
- Private financing will be in the form of JV among utilities with robust balance sheets and financial risk management strategy
- *Construction risk is rated no 1 – so to gain confidence of investors the industry needs more projects on Schedule and within Budget*



# Thank you for your attention!



***IAEA...atoms for peace.***

