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Alternatives for Financing New Nuclear Reactors in Mexico

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Nuclear Power In Mexico

- Two identical units BWR/5 reactors (1931 MWt Nominal Power)
- Built under an Administration Contract (multiple construction delays)
- Commercial operation
  - Unit 1, July 29,1990,
  - Unit 2, April 10, 1995

- September 1999, Stretch Power Uprate in both units (105% nominal Power 2027 MWt)
- For the last 10 years provided ~10% of the Total Electricity Generation in Mexico
- They represent only 2.7% of the installed capacity in 2008
- Currently, an Extended Power Uprate is under revision by the Mexican Regulatory Body (120% nominal Power 2317 MWt)

Plans for New Nuclear Power

- Since 2003 several viability nuclear power studies have been done in Mexico
- The electricity state company (CFE) has considered it as an alternative option
- The decision is highly political
- According to Mexican Law the generation of nuclear power is exclusively operated by CFE
- An International solicitation is mandatory
- Any new nuclear project is forecast to be from own resources or under a turn key project.

Why Nuclear is Considered Today

- High volatility of gas prices
- Concern for CO_2 emissions
- National Security
- Better Performance
- Economical generation costs

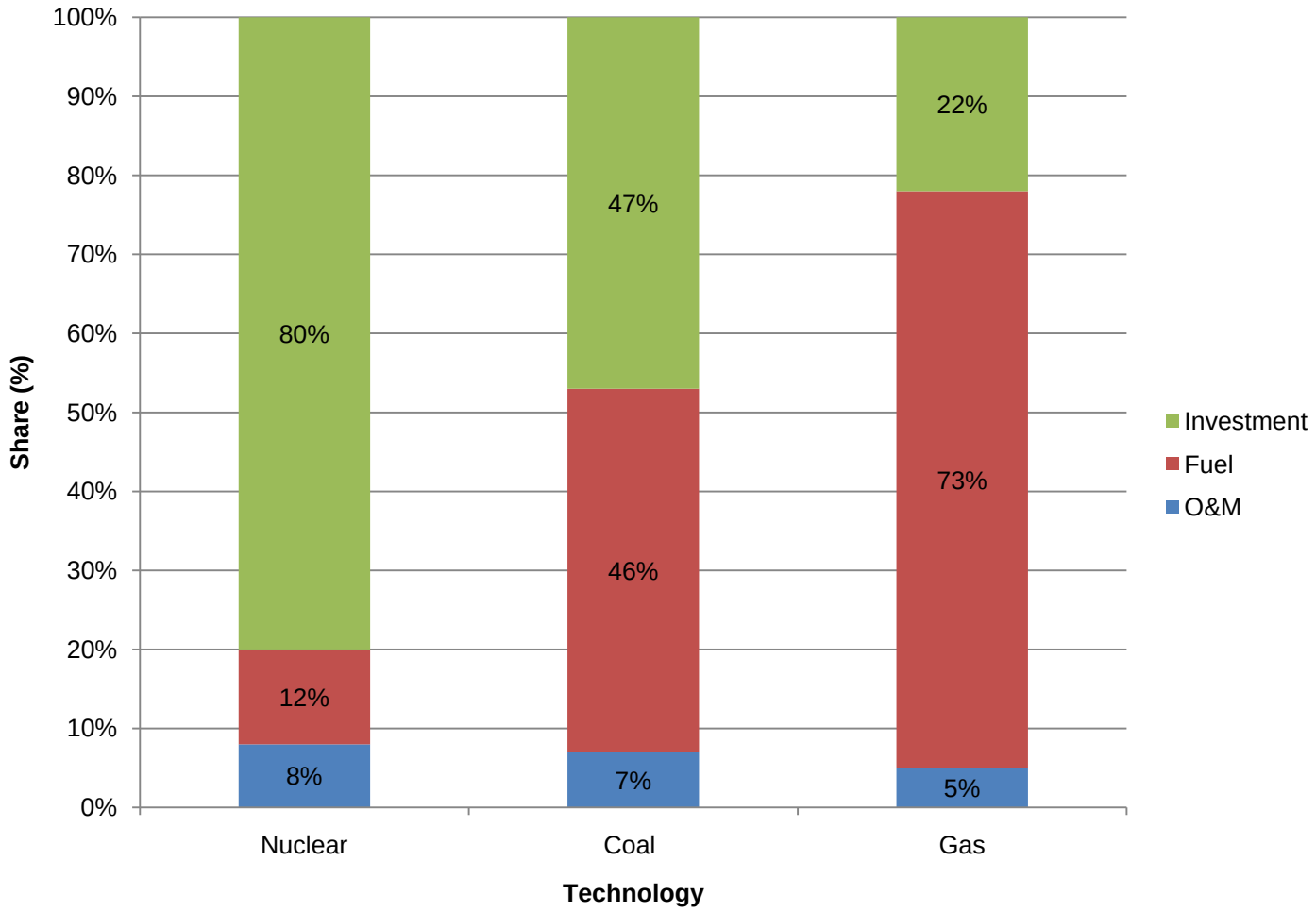
Reactor Alternatives

General Characteristics of a Nuclear Power Plant

Lifetime (years)	Capacity Factor (%)	Power Output (MW)	Construction Time (years)	Overnight Cost (US$/kW)	Fuel Cost US$/MWh	O&M Cost US$/MWh
40	90	1350	5	2500-3500	6.80	7.83

ABWR	1350 MW
EPR	1600 MW
AP1000	1100 MW
ACR 1000	1100 MW

Technologies Cost Share



Overnight Costs

- EdF Flamanville, France, EPR: EUR 3.3 billion/US$4.8 billion, so EUR 2000/kWe or US$2900/kWe
- Bruce Power Alberta, Canada, 2x1100 MWe ACR, US$6.2 billion, so US$2800/kWe
- CGNPC Hongyanhe, China, 4x1080 CPR-1000 US$6.6 billion, so US$1530/kWe
- AEO Novovronezh, Rusia, 6&7 2136 MWe net for US$5 billion, so US$2340/kWe
- KHNP Shin Kori, Korea 3&4 1350 MWe APR-1400 for US$5 billion, so US$1850/kWe
- FPL Turkey Point , USA, 2 x 1100 MWe AP1000 US$2444 to US$3582/kWe
- Progress Energy Levy County, USA, 2 x 1105 MWe AP1000 US$3462/kWe
- NEK Belene, Holand 2x1000 MWe AES-92 EUR 3.9 billion (no first core), so EUR 1950 or US$3050/kWe
- UK composite projection US$2400/kWe

Overnight Costs

- NRG South Texas, USA, 2 x 1350 MWe ABWR US$8 billion, so US$2900/kWe
- CPI Haiyang, China, 2 x 1100 MWe AP1000 US$3.25 billion, so US$1477/kWe
- CGNPC Ningde, China, 4 x 1000 MWe CPR-1000 US$7.145 billion, so US$1786/kWe
- CNNC Fuqing, China, 2 x 1000 MWe CPR-1000 (?) US$2.8 billion, so US$1400/kWe
- CGNPC Bailong/Fangchengang, China, 2 x 1000 MWe CPR-1000 US$3.1 bilion, so US$1550/kWe
- CNNC Tianwan, China, 3&4, 2 x 1060 MWe AES-91 US$3.8 billion, so US$1790/kWe

The World Nuclear Association 3000 US$/kWe

The Update of the MIT 4000 US$/kWe assuming a penalty for delays from previous US experiences, if these are not taken into account then 3000 US$/kWe

Source: The Economics of Nuclear Power, www.world-nuclear.org/info/inf02.html
Update of the MIT 2003. Future of the Nuclear Power. 2009 Massachusetts Institute of Technology.

Levelized Electricity Cost

	Levelized Cost US$/MWh (Generation)			Investment Cost US$ Millions			Investment no interest US$ Millions
Discount Rate	5%	8%	10%	5%	8%	10%	Overnight Cost US$/kW X Reactor Power
Overnight Cost US$/kW							
2500	36.63	47.98	55.95	4028.57	4334.59	4547.82	3375
3000	40.97	54.57	64.14	4834.28	5201.51	5457.39	4050
3500	45.31	61.17	72.34	5639.99	6068.43	6366.95	4725

Investment

- Nuclear power deployment requires an extensive capital investment that in many cases prevents its expansion.

- The deployment of a single unit of 1000 MWe with current costs requires around 5 billion US dollars assuming no delays or unforeseen problems.

Legal Considerations

- According to the Mexican Constitution the construction of new Nuclear Power Plants is an exclusive government activity.

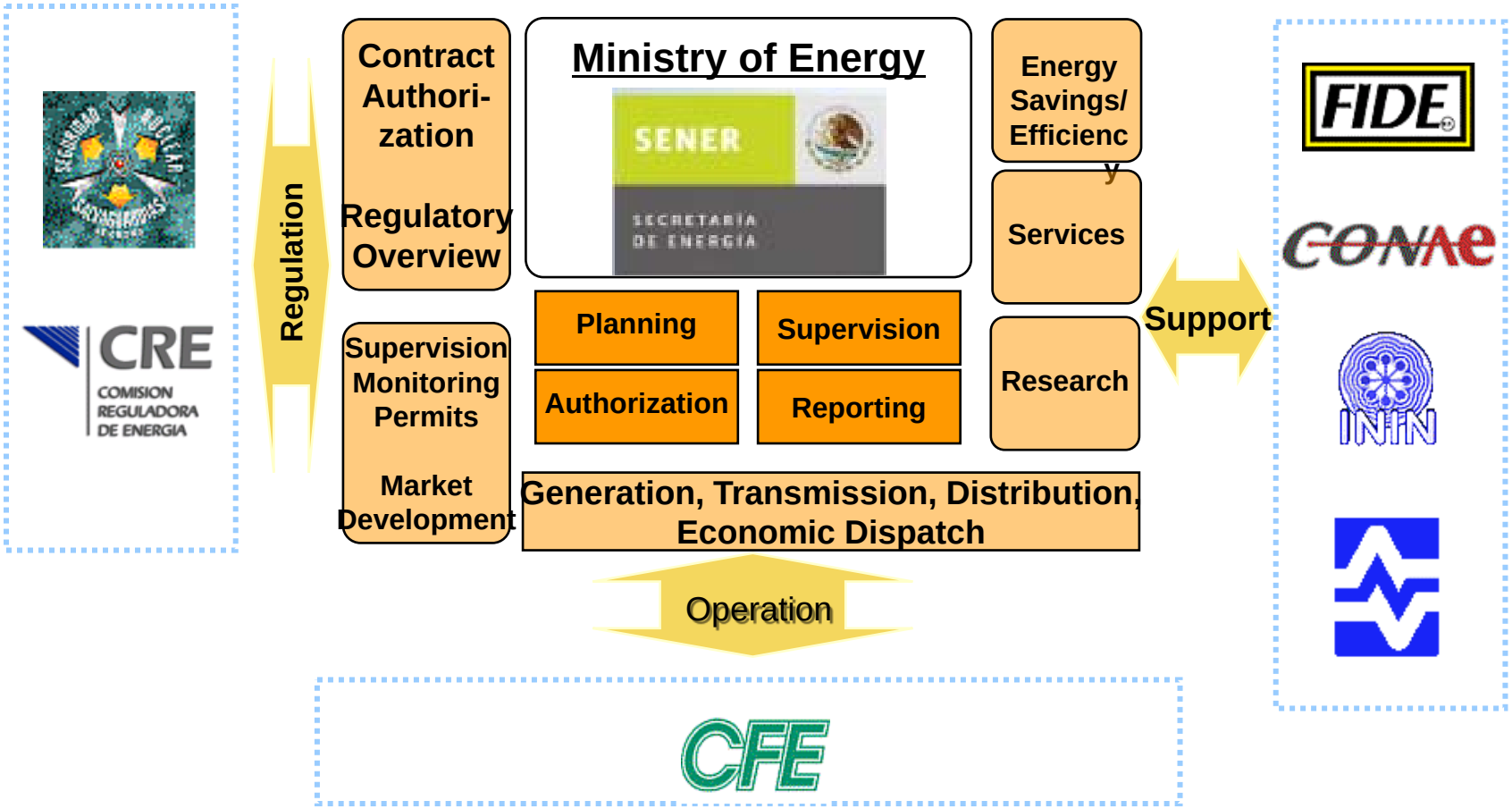
- The electricity company (CFE) prepares a forecast for the following ten years requirements for electricity expansion.

- The President proposes to congress the nuclear program.

Financing Considerations

- The Congress review the proposal to determine the fiscal budget for the following year.
- This budget contains the necessary investments for the construction of new electricity power plants
- The most viable option for the investment for nuclear power is that the financing comes from the federal budget.
- Another option is if the financing could be considered as a Financed Public Work, where funds can come from a third party.

Mexican Electrical Sector



Financing Alternatives

- Two financing alternatives can be used to support such a project:
  - Financing comes from federal budget for a long term investment.
  - International and national credits to support the nuclear project.

Mexico Credit Qualifications

- To be a loan candidate the viability of the nuclear project must be demonstrated. It assumes among other things to have a qualified national infrastructure.

- Also, the utility (CFE) must have a good international credit status as determined by international companies. This status is already achieved by CFE.

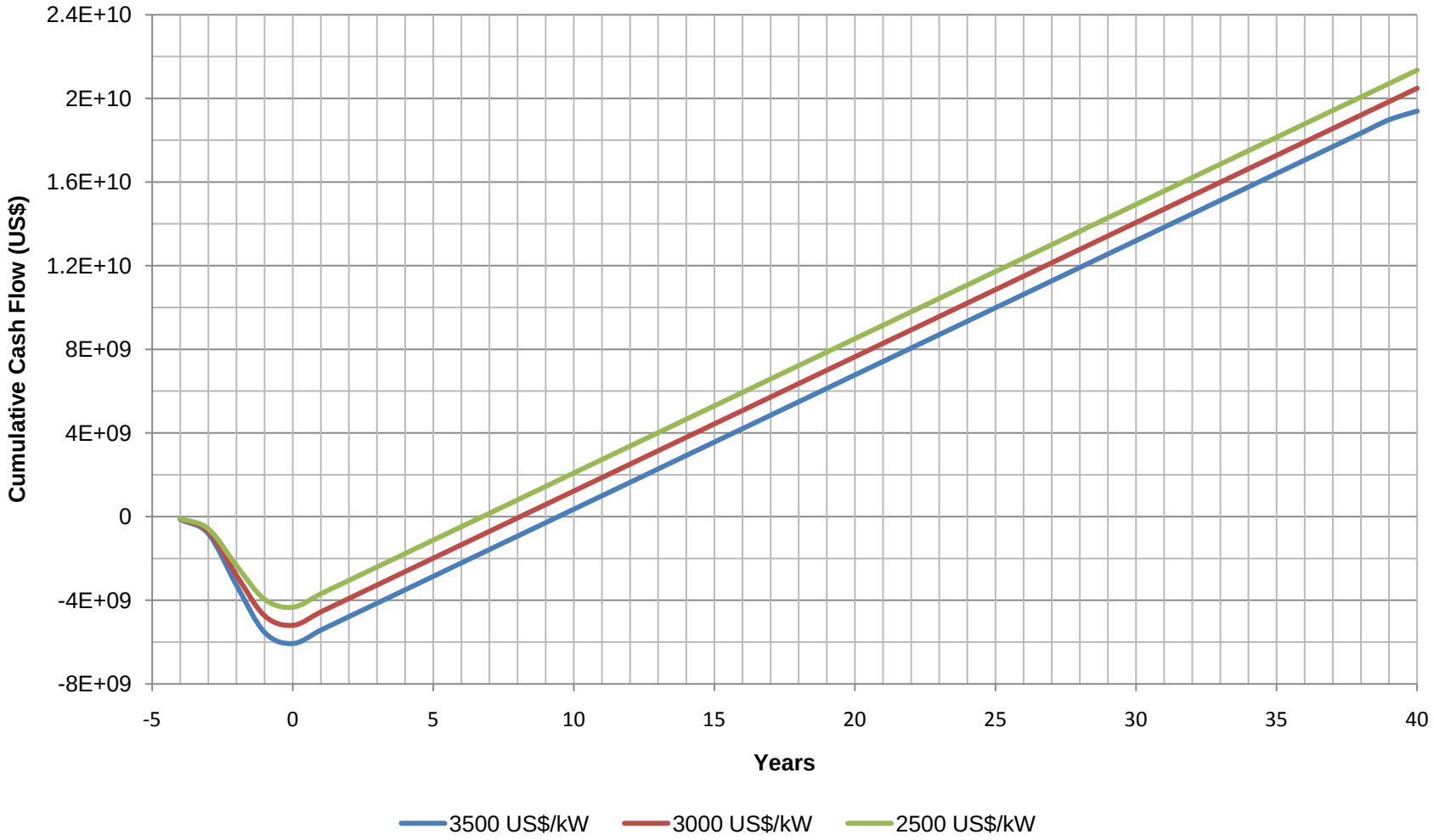
Own Resources Investment

Electrical Power (MWe)	Opportunity Cost	Overnight Cost (US$/kW)	Investment without Interest (millions of US$)	Investment with Opportunity Cost (millions of US$)
1350	8%	2500	3375	4335
		3000	4050	5202
		3500	4725	6068

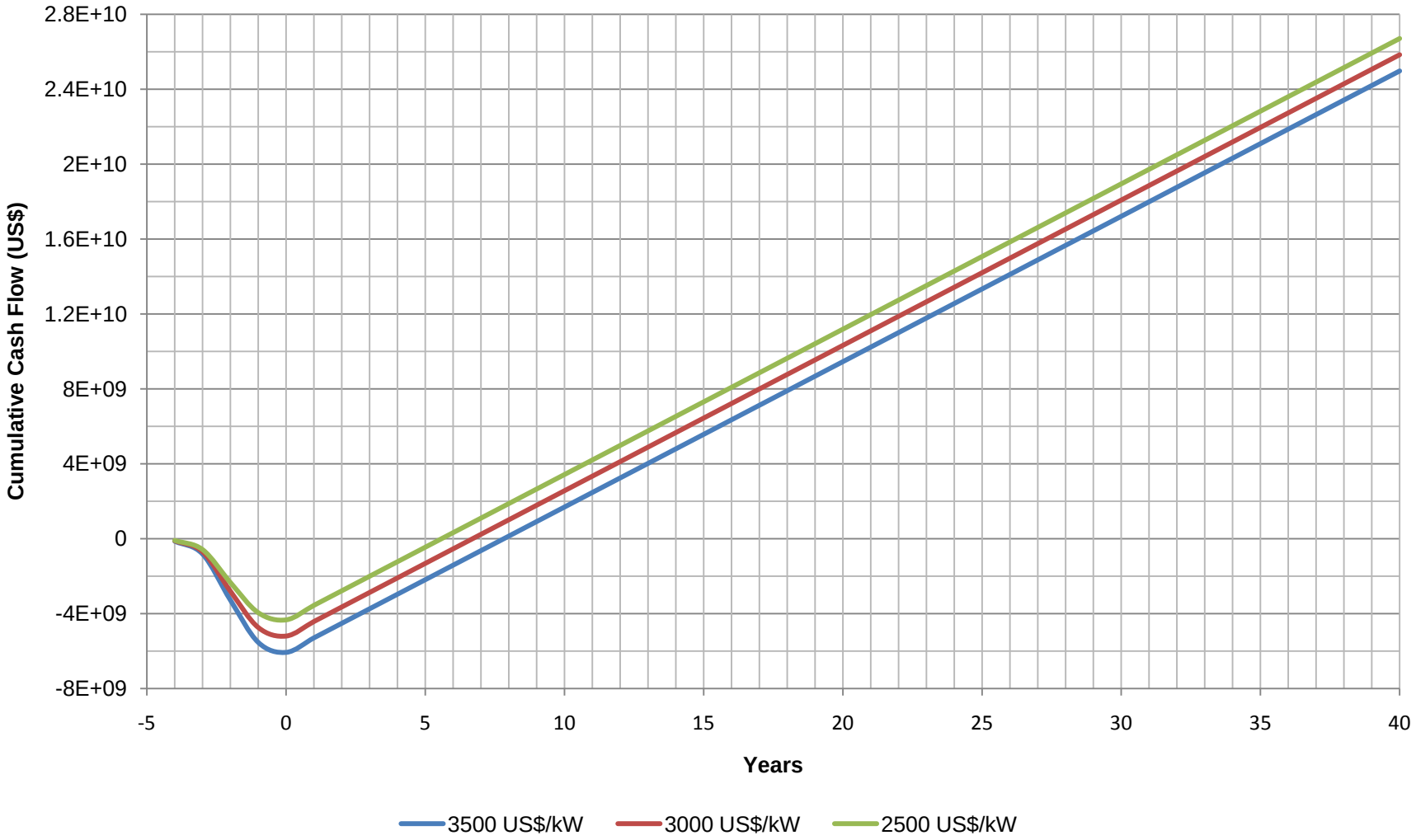
Annual

Power Output GWh	Fuel Cost US$	O&M Cost US$	Backend & Dismantling Fund US$	Electricity Selling Price US$/MWh	Selling Income US$
10,359.92	96,192,154	48,512,045	48,512,045	87.07	902,038,234
				100.00	1,035,992,000

Cumulative Cash Flow
87.07 US$/MWh



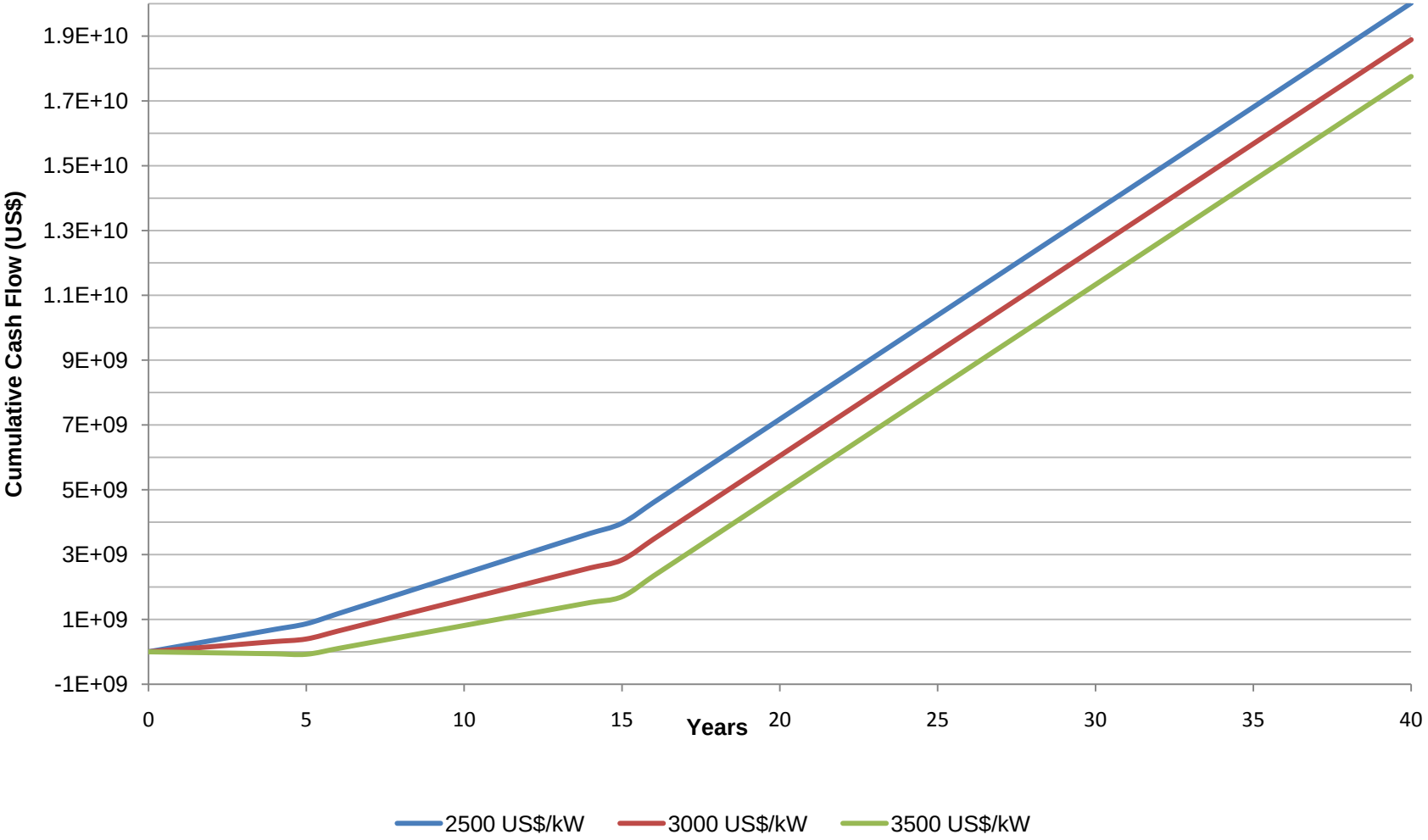
Cumulative Cash Flow
100 US$/MWh



Credit Resources

- The main international credit assumptions are:
  - Payment credit period: 15 years.
  - 30 payments, each one every 6 months
  - Grace period: 6 months after commercial operation.
  - Annual discount rate in dollars: 8%.
- The main national credit assumptions are:
  - Payment credit period: 5 years.
  - 10 payments, each one every 6 months
  - First payment: at start up of commercial operation.
  - Discount rate in dollars: 12%.

Cumulative Cash Flow
87.07 US$/MWh



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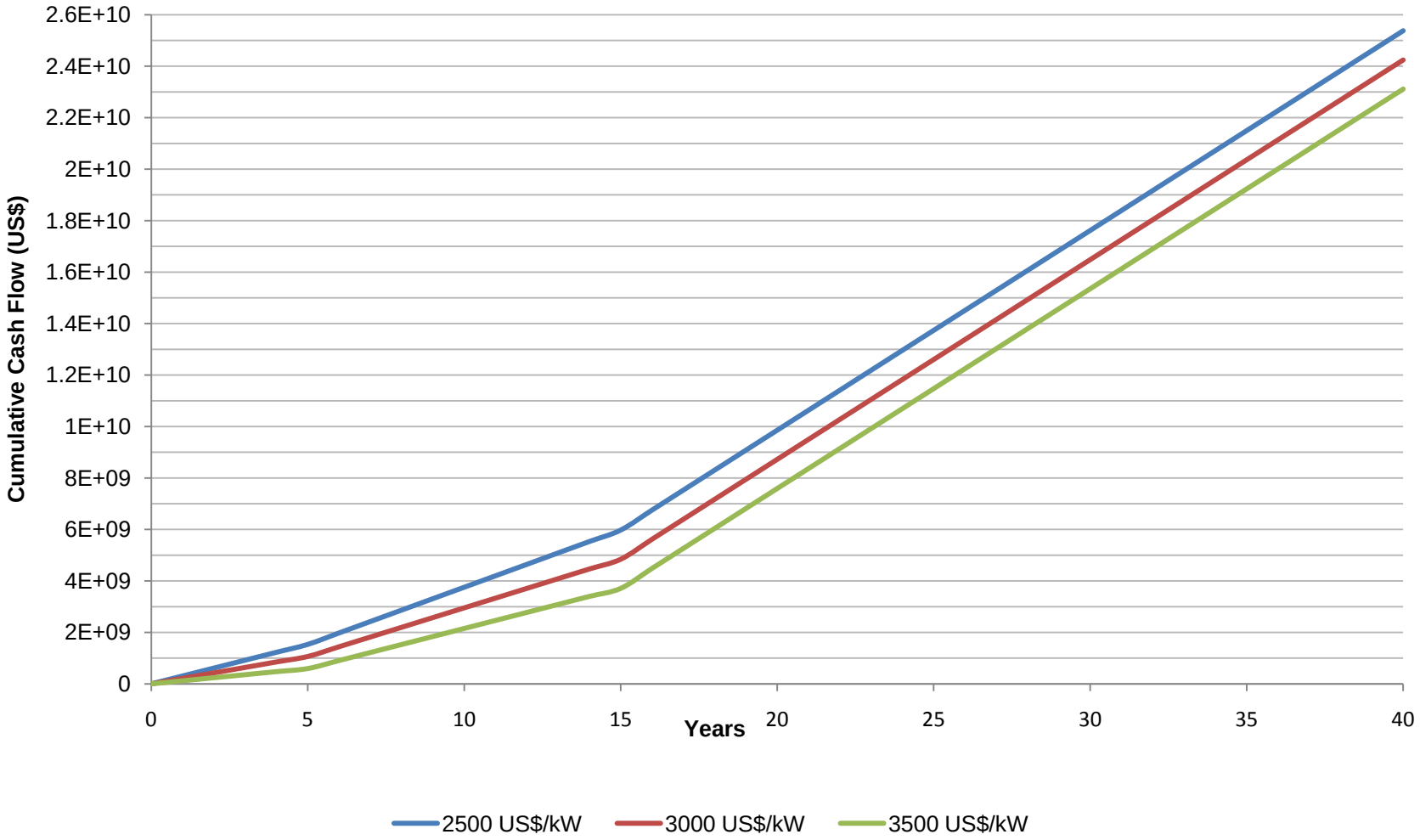

Conclusion

- Financing for the deployment of New Nuclear Plants seems to be a feasible option.
- Investment by using own resources can recover the investment in less than ten years depending on the overnight cost considered and the selling price of the electricity
- For a medium average price 100 US$/MWh it can be recovered between 6 to 8 years, therefore there is a great dependence of the electricity selling price.
- This alternative reduces the cash flow of the company

Conclusion

- Credit Resources is an available option. In the cases analizedthe combination of a high overnight cost and a low electricity selling price can result in a negative cash flow which is not admissible for this alternative.
- An increase in the sell price of electricity, can result in a positive cash flow at all times.
- This alternative produces a lower cumulative cash flow in comparison to using own resources
- In this alternative there is no reduction on the company´s cash flow.

Discussion

- In the last 10 years The Laguna Verde Power Plant has provided 5% per year of the total annual electricity generation with a very good operational record.
- A diversification strategy can give greater protection against primary fuels volatility prices.
- Greater energy security eliminates external energy dependence.
- Reduction in carbon emissions

Discussion

- Economic competitive option.
- In Mexico several studies have already considered the expansion of nuclear power
- In Mexico the use of nuclear power is a Presidential decision that involves many political constraints and also requires the approval of the Congress.
- Public opinion remains a big obstacle.