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Cofrentes Nuclear Plant (1064 MW) / Cofrentes, Valancia, Spain.

The Climate and Economic Rationale for Investment in Life Extension of Spanish Nuclear Plants

Anthony Fratto*, John Parsons

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Working Paper:

http://ceepr.mit.edu/publications/working-papers/692

Questions we sought to answer

- What will Spain's energy mix look like in 2030 to meet emission targets?
- Each of Spain's 7 operating nuclear reactors is **approaching the end of its original 40 year design life.**
- Extending the life beyond 40 years will require an investment.
- **Should Spain make the investment to extend the life beyond 40 years ?**
  - Are the they a cost-efficient source of low carbon electricity?
- **What would the costs be if NPP were replaced by renewables or NGCC?**

Nuclear in Spain

Installed Capacity

7,117 MW

⇓

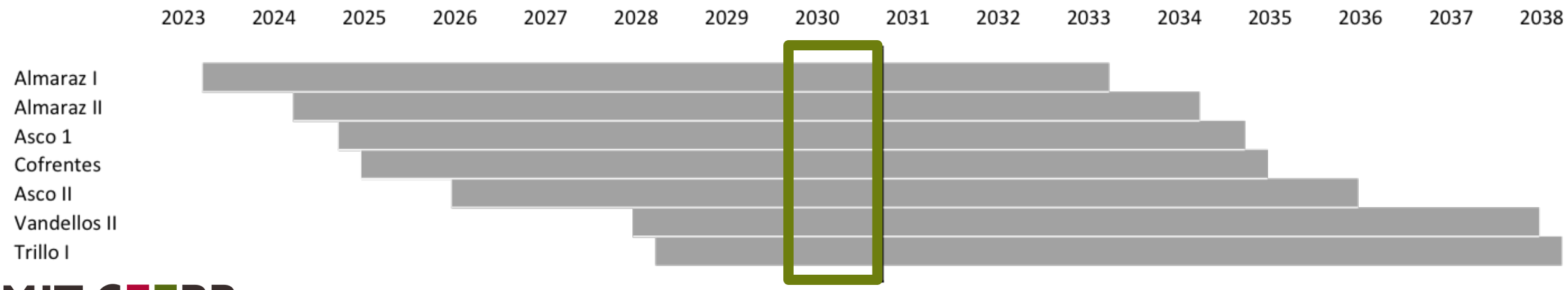
7 %

2018 Generation

53.2 GWh

⇓

21 %



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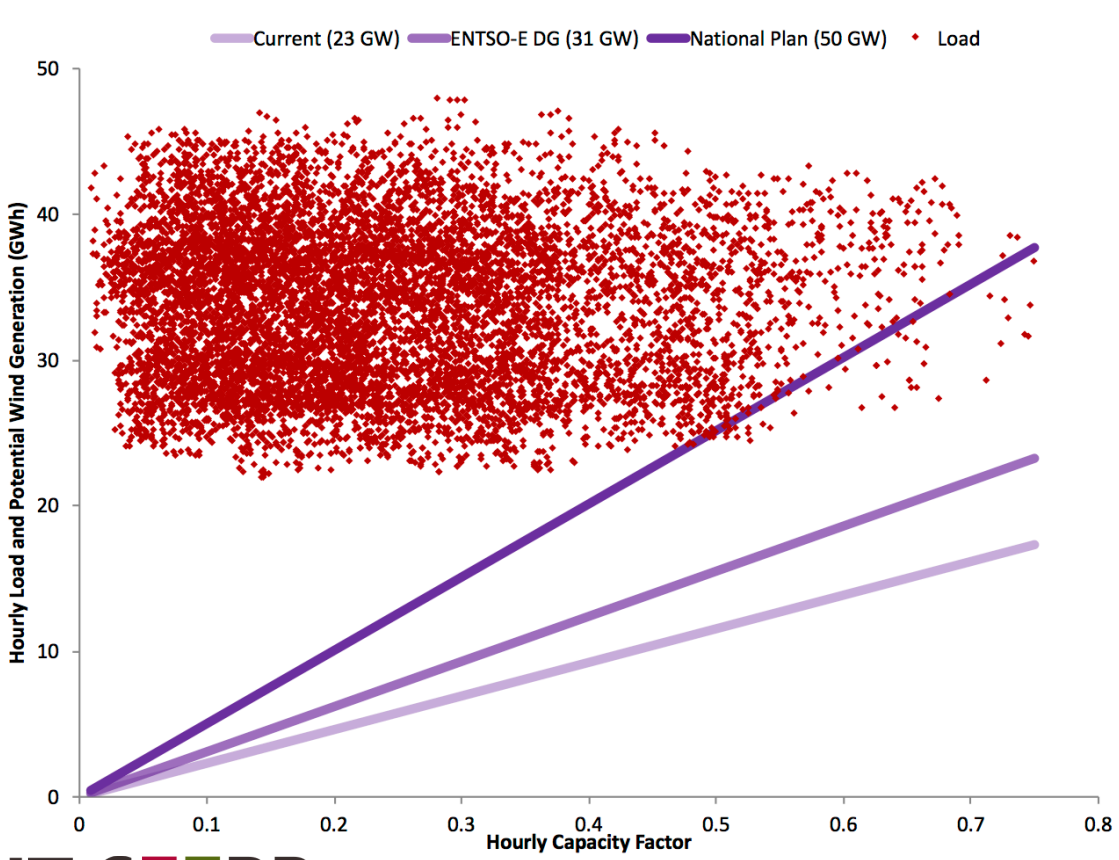
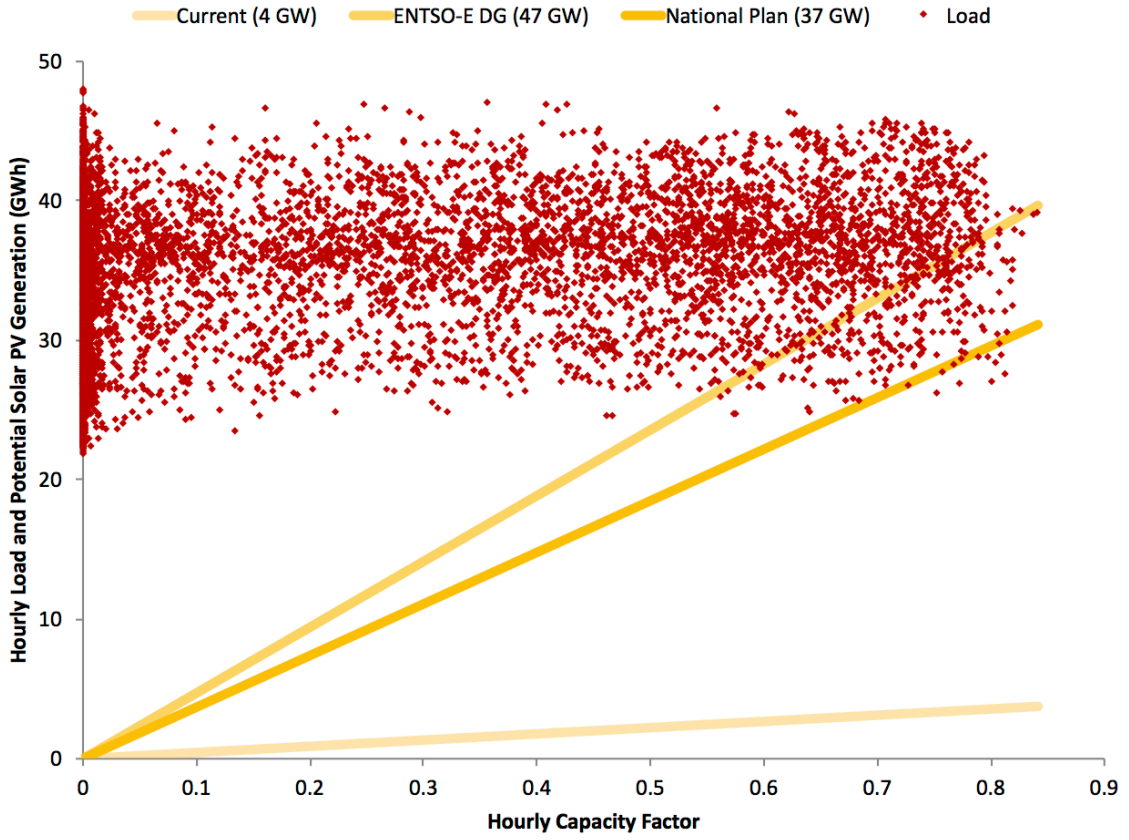
Our Approach

Highlight the time profile of **renewable resources** and relation to load; Expanded capacity of renewables produces increasing levels of curtailment.





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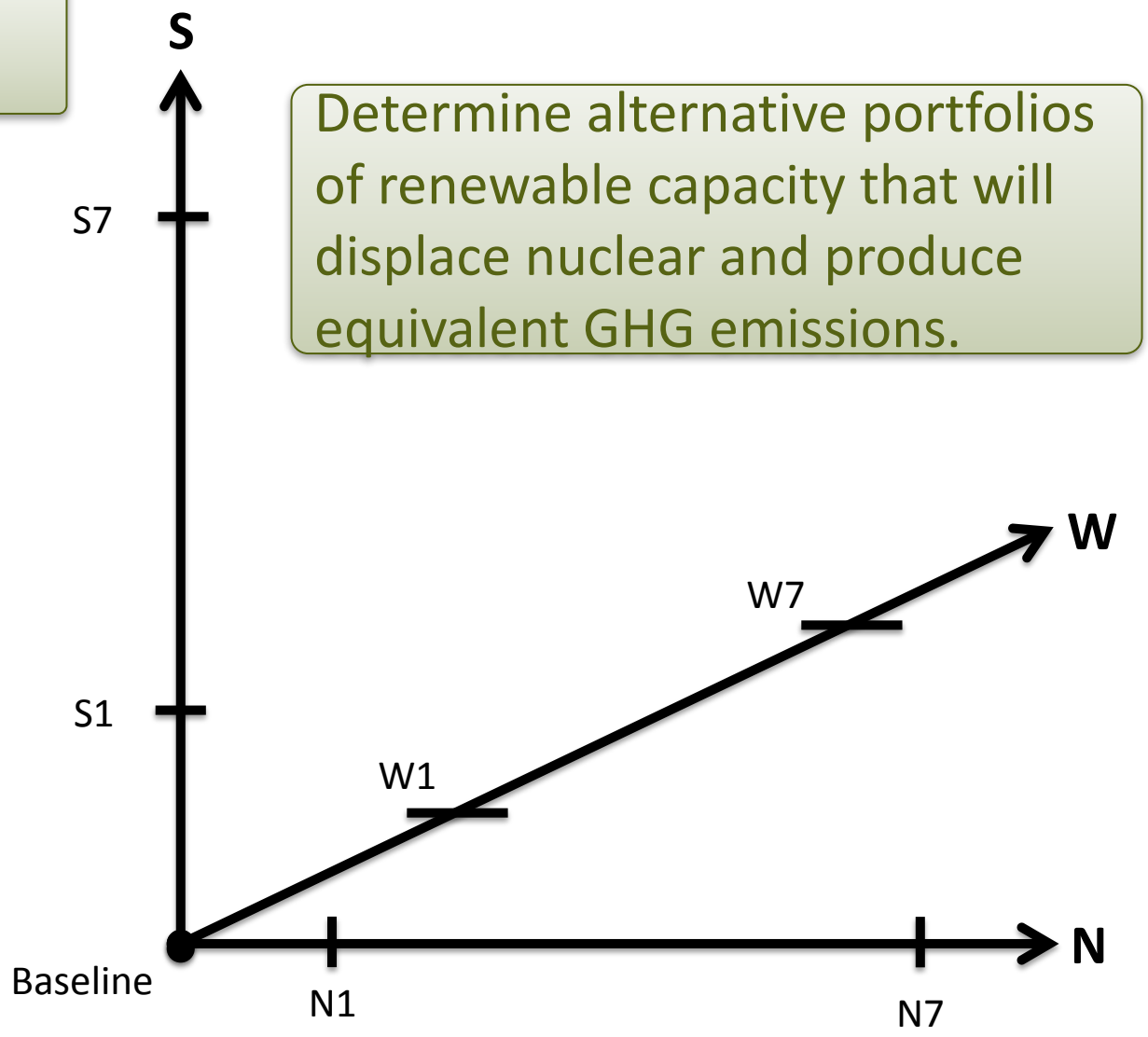
Our Approach

Create a baseline portfolio of installed electricity resource mix for 2030

Baseline		Installed Capacity (MW) [A]	Share [B]	Generation & Demand (GWh) [C]	Share [D]	Capacity Factors [F]
	Spanish Generation (Peninsula)					
[1]	Nuclear	-	0%	-	0%	
[2]	Hydro	23,050	16%	39,190	13%	19%
[3]	Wind	31,000	22%	64,021	22%	24%
[4]	Solar PV	47,157	33%	88,338	30%	21%
[5]	Solar Thermal	2,419	2%	4,022	1%	19%
[6]	Bio	2,550	2%	11,871	4%	53%
[7]	Coal	847	1%	-	0%	0%
[8]	Combined Cycle	23,746	17%	80,995	27%	39%
[9]	Cogeneration	8,500	6%	38,901	13%	52%
[10]	Batteries	2,358	2%		0%	0%
[11]	**Total**	141,627		327,339		
[12]	PHS Generation			5,669		
[13]	Battery Generation			2,944		
[14]	PHS Consumption			(8,098)		
[15]	Battery consumption			(3,634)		
[16]	Baleric HVDC Link			(1,377)		
[17]	Interconnection Balance			(27,819)		
[18]	**Spanish Demand (Peninsula)**			295,023		
	Ancillary Calculations					
[19]	Storage losses			3,120		
[20]	Subtotal, N+W+S-losses			149,239		
[21]	Total, N+W+S+CC-losses			230,234		
[22]	GHG Emissions (MtCO2eq)			29.75		



Determine alternative portfolios of renewable capacity that will displace nuclear and produce equivalent GHG emissions.

Our Approach

Least-cost hourly dispatch model complemented with algorithm to optimize storage

*With & without Unit Commitment constraints

Input projected 2030 capacity factors for each portfolio into LCOE to compare nuclear extensions with equivalent renewables investment

			[A] N7	[B] S7	[C] W7	[D] SW7	[E] WS7
[1]	Incremental Capacity	(MW)	7,117	456,543	33,096	61,043	35,820
[2]	Incremental Low Carbon Generation	(GWh)	51,421	51,446	51,419	51,438	51,433
[3]	Incremental Capacity Factor		82%	1%	18%	10%	16%
[4]	Incremental Unit Cost	(€/MWh)	32.12	583.91	60.14	86.28	60.26
[5]	Incremental System Cost, gross annual	(€ millions)	1,652	30,040	3,092	4,438	3,099
[6]	Incremental System Cost, gross 10 years	(€ millions)	11,602	210,988	21,719	31,173	21,769
[7]	Difference to Nuclear	(€ millions)		199,386	10,117	19,571	10,167
				1719%	87%	169%	88%

Portfolios **N1 and N7 have the lowest system cost** among their respective sets. **Social cost savings are at least €1 and €10 billion** relative to the other options in their respective sets.

Takeaways

1. **Nuclear life extensions** are **an element of the least-cost path to decarbonization**. Closure raises cost or adds carbon.
2. Government should help to **preserve the existing fleet** to avoid emission increases

Recent News

- **Spanish Government** released a **draft proposal** of new legislation calling for **100% renewables by 2050** (11/18)
- Spanish government + Iberdrola/Endesa/EDP agreed that the **NPPs would close as early as 2025 but no later than 2035** (02/19)

The Spanish Climate Change and Energy Transition Law

(A supporting document for journalists)

1. THE AIM OF THE PROPOSED LAW

This law aims to ensure compliance with the Paris Agreement, accelerate the full decarbonisation of the economy, and implement a model of sustainable development that generates stable and quality employment, and provides economic and regulatory signals that give stability and security to investors and other economic actors.

It is a law fit for the purpose of establishing a transition to a fully decarbonized economy by 2050. It provides a framework that anticipates the risks that arise from the impact of climate change, and delivers security and regulatory stability to mobilize the necessary investments, thus making the most of the socioeconomic opportunities that the process of change will generate.

Thank you for your attention!

Working Paper: http://ceepr.mit.edu/publications/working-papers/692

Questions? *Please ask, or contact me at:*

@ afratto@mit.edu
☎ **801-664-3508**

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Center for Energy and Environmental Policy Research

Massachusetts Institute of Technology (MIT)
MIT Building E19-411
400 Main Street, 4th Floor
Cambridge, MA 02142-1017

http://ceepr.mit.edu
ceepr@mit.edu
617-253-3551 617-253-9845