

Tech-to-market introduction

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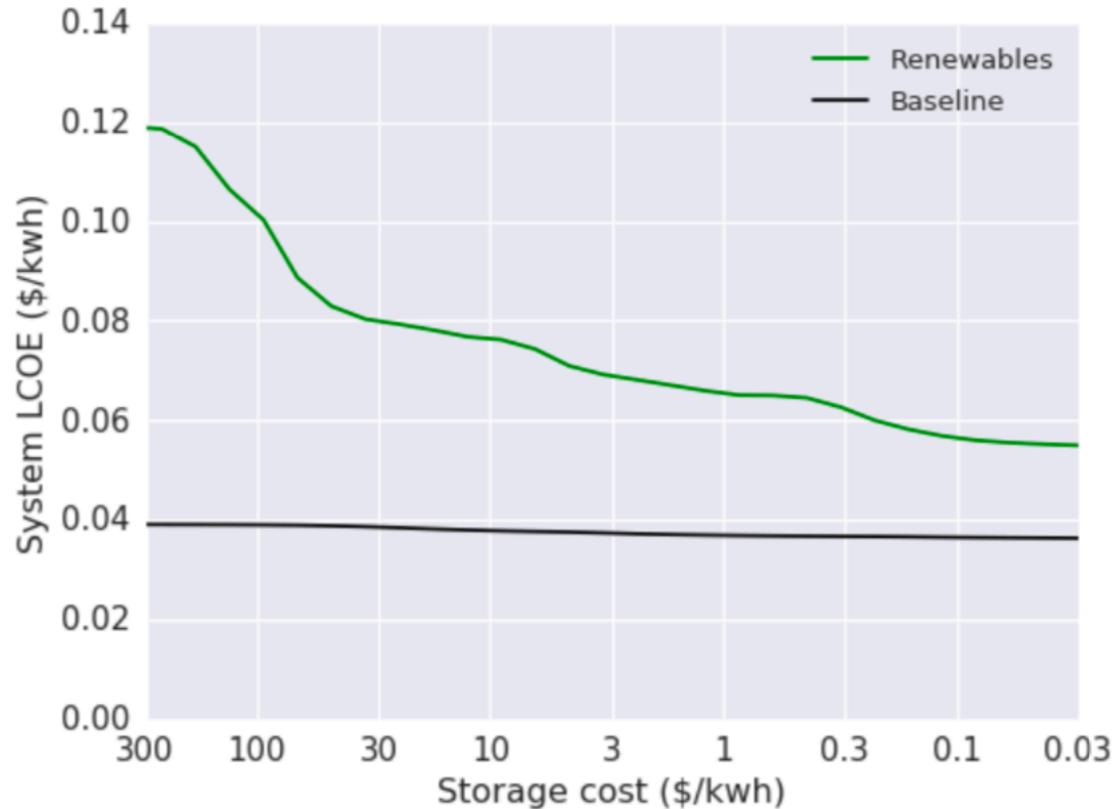
Outline

- ▶ Fusion's value proposition
- ▶ From gain to the grid
- ▶ Fusion's market
- ▶ Financing

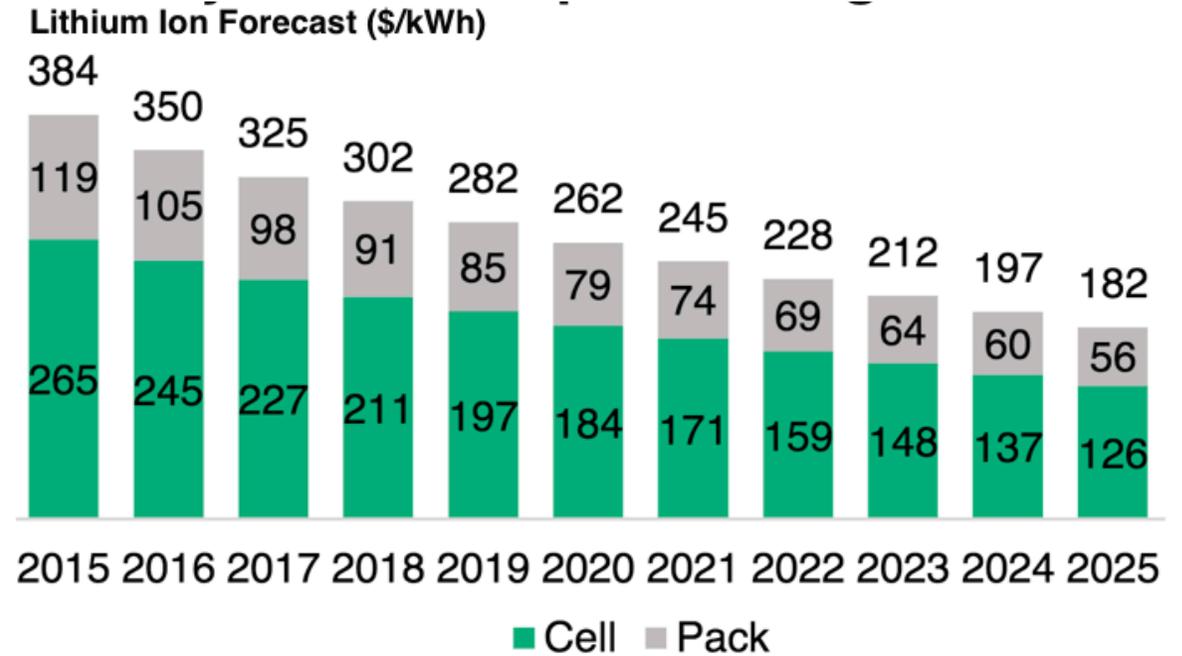
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Renewables + storage is too expensive



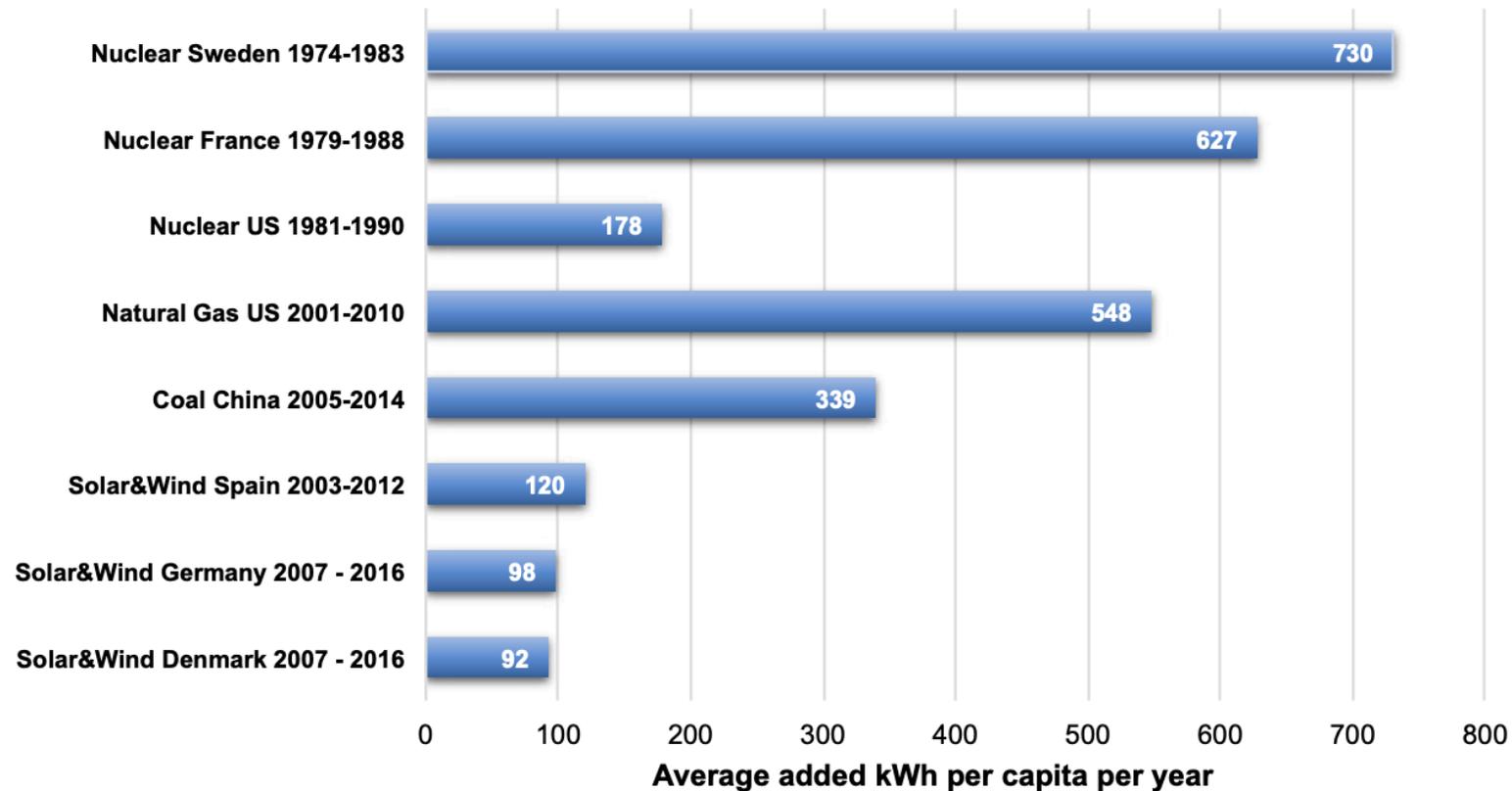
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Renewables are slow to deploy

Figure 1.3: Electricity growth (kWh per year per capita) based on actual data for added power capacity in various countries



Fusion is a promising alternative to fission

	Fission	Fusion
Method	Splitting atoms	Combining atoms
Waste	Long- and short-lived	Short-lived
Meltdown	Possible	Impossible
Proliferation	High	Low
Cost	Low-high	Lower
Demonstrated	Yes	No

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From gain to the grid

Optimistic post-gain roadmap:

- ▶ Demo: \$2B, 10 years
- ▶ Bankability: \$5B, several plants

Still have:

- ▶ Market risk
- ▶ Financing risk

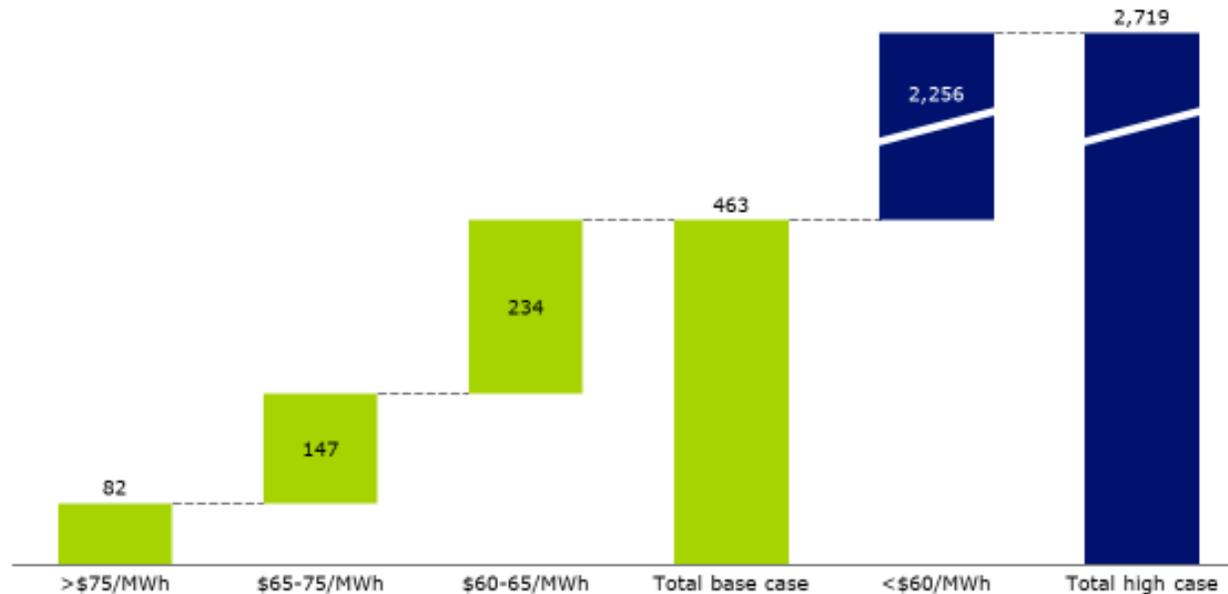
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Market exists for expensive fusion, grows as price drops

The likely addressable market for fusion in the 2030s amounts to ~465 GW globally, with a much bigger potential of ~2,720 GW if fusion can compete with fossil fuels below \$60/MWh

Total estimated addressable market for fusion (GW) at different price levels in a high electrification scenario



Wholesale electricity prices vary widely:

- ▶ Singapore: [13¢/kWh](#)
- ▶ Germany: [6¢/kWh](#)
- ▶ Texas: [3¢/kWh](#)

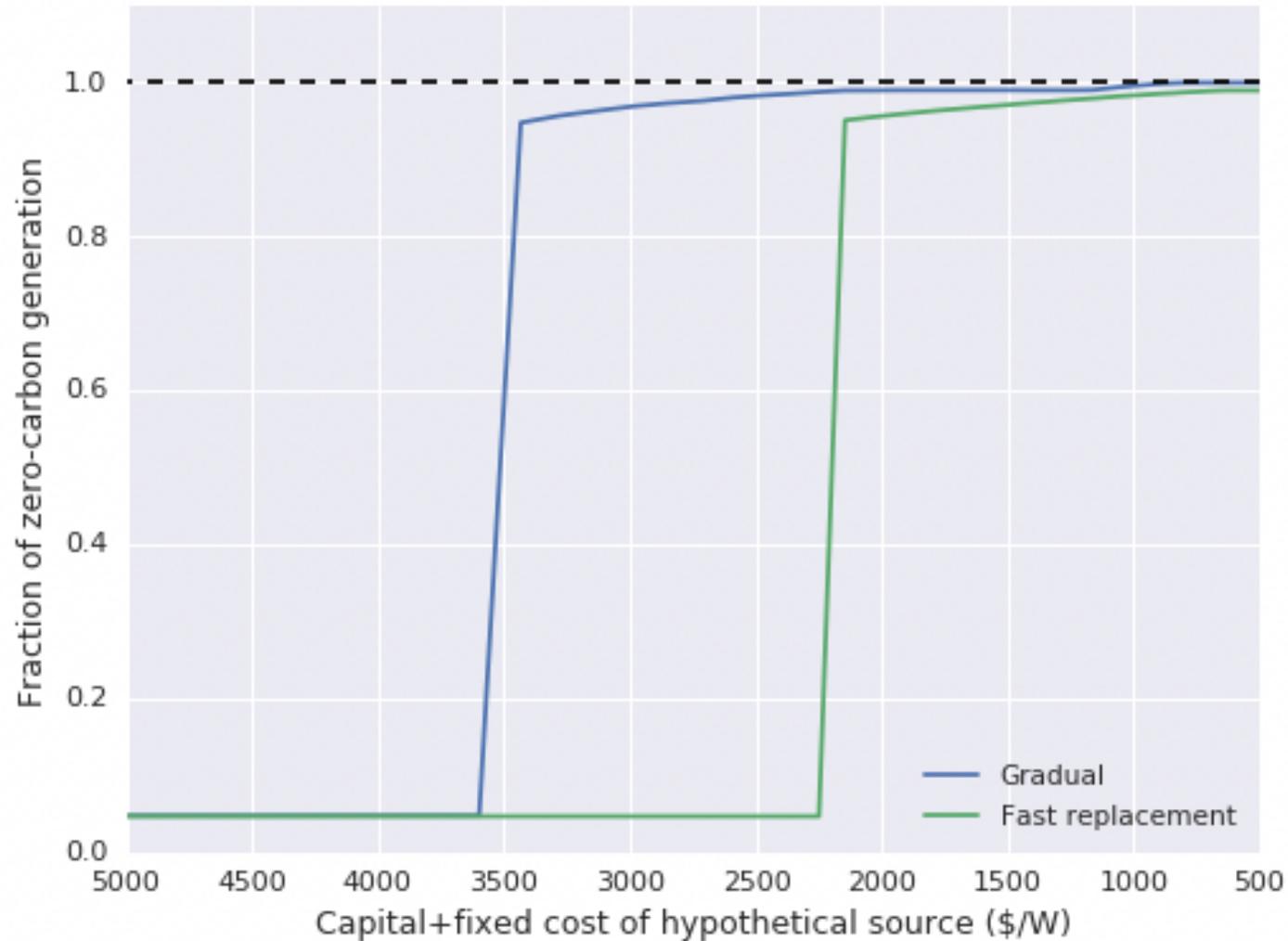
Source: SYSTEMIQ analysis. Note: Based on high power demand scenario (Shell Sky Scenario). Country analysis for 7 countries: Brazil, China, France, India, Japan, UK, USA. Proxy analysis by archetype for Bahrain, Colombia, Germany, Italy, Indonesia, Israel, Malaysia, Philippines, Singapore, Spain, South Korea, Taiwan, Thailand, Vietnam.



SYSTEMIQ 12

[Electrification and decarbonization: the role of fusion in achieving a zero-carbon power grid](#)

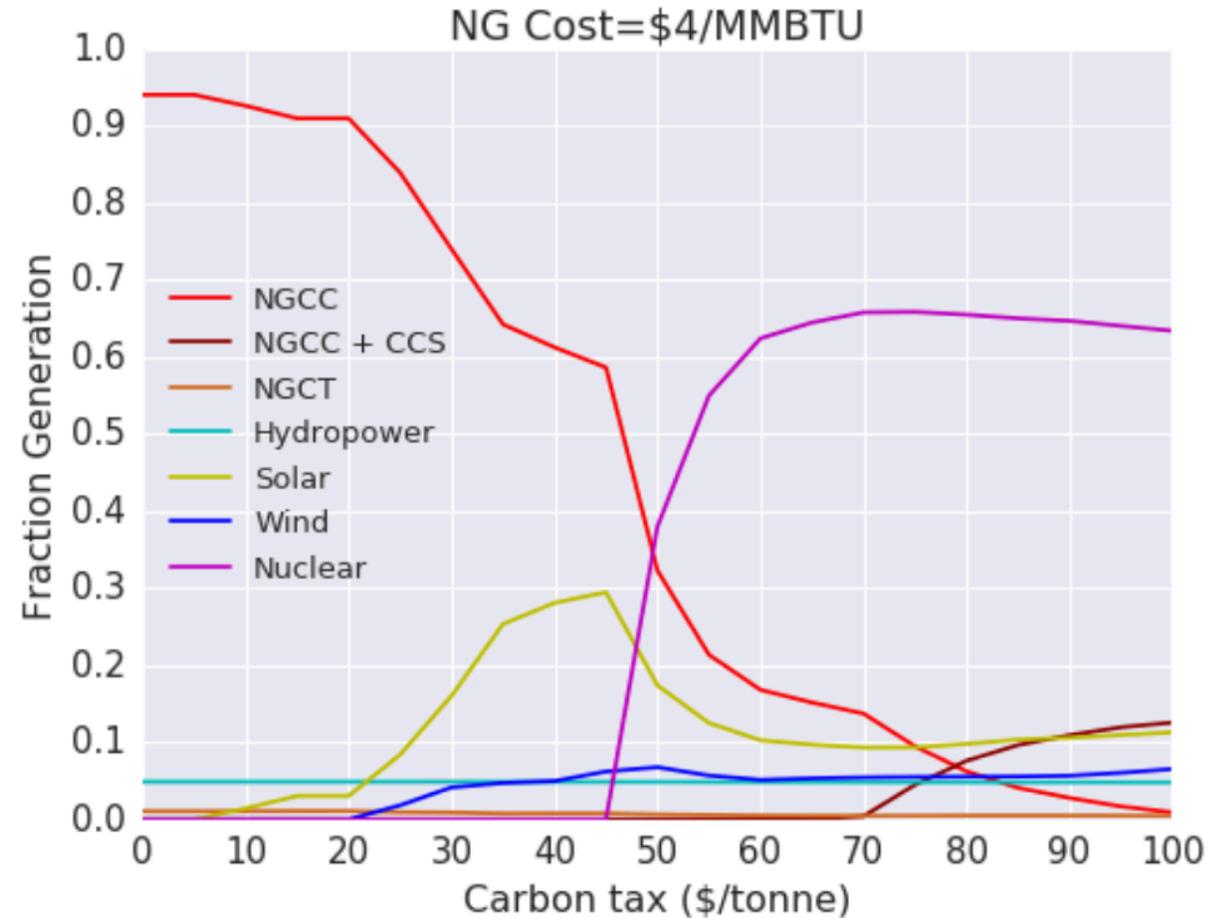
Lower-cost fusion might dominate the market



A carbon price further expands the market for fusion

Some current prices

- ▶ EU: [floats, currently around €25/ton](#)
- ▶ California: [\\$15/ton](#)
- ▶ British Columbia: [\\$30/ton](#)



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Estimated prices fit these markets

- ▶ Benchmarking on fission, Bechtel conservatively estimates \$4-13/W, plant possible for <\$1B
- ▶ Companies' estimates are much lower: \$2-5/W
- ▶ Rough modeling suggests LCOEs of 3-6¢/kWh

Process heat could be a large market for fusion

- ▶ Process heat is about 20% of energy usage
- ▶ Renewables produce electricity, which is inefficient to turn into heat
- ▶ Fission can address ~20% of this market (150MWth in US, 640MWth globally) but siting restrictions make this hard to address
- ▶ Small, safe, high-temp fusion could win here
- ▶ But competing with gas requires cheap fusion or a price on carbon (gas is ~3¢/kWth)

Design the right reactor

- ▶ Firm, but flexible, power
- ▶ Produce high temps, not direct generation of electricity
 - Provide process heat
 - Integrate thermal storage instead of ramping for market timing
- ▶ Competitive in some markets initially (\$, not just \$/W and \$/MWh)
- ▶ Evolve to be cheaper with quantity or learning in preference to size
- ▶ Flexible siting

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Milestones can facilitate investment

- ▶ COTS milestones and awards supported SpaceX, but also Sierra Nevada
- ▶ FDA approval milestones are critical for biotech fundraising
- ▶ Can ARPA-E set similar milestones for fusion companies?

None of this matters without insurance and financing

- ▶ Without project finance, plants don't get built
- ▶ Without insurance, project finance isn't available
- ▶ Early investors take this into account
- ▶ NetPower struggled to raise \$150M to build a 50MW plant

What else?

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