

# Greening Industry: The Forgotten Climate Wedge

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Join the Conversation: Submit your questions in the Q&A

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# About ITIF

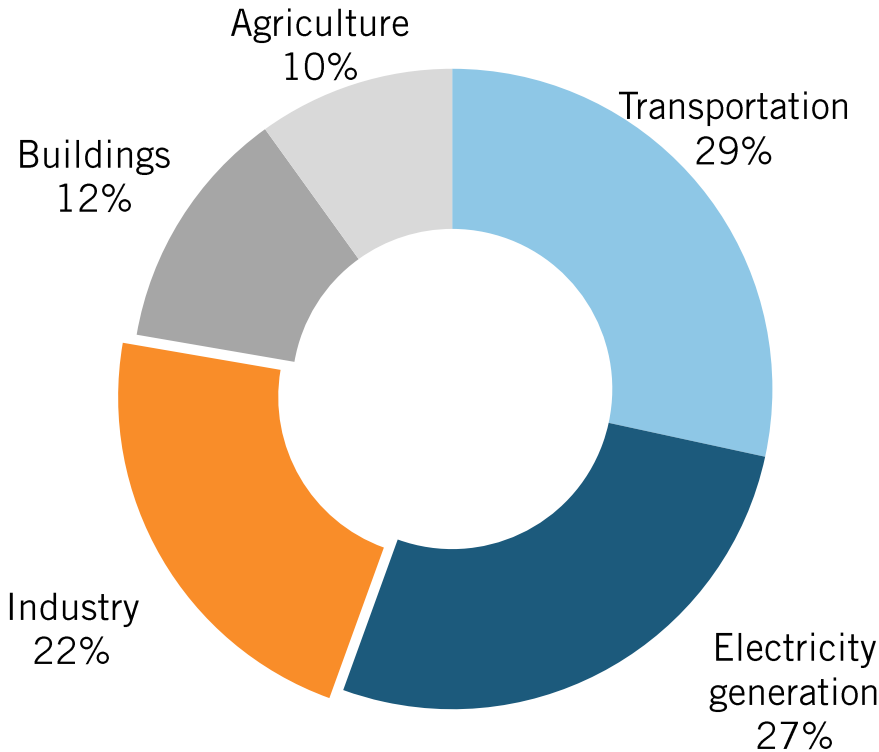
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- Independent, nonpartisan research and education institute focusing on intersection of technological innovation and public policy, including:
  - Innovation and competitiveness
  - IT and data
  - Telecommunications
  - Trade and globalization
  - Life sciences & agricultural biotech
  - Clean energy innovation
- Formulates and promotes policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress
- World's top think tank for science and technology policy, according to the University of Pennsylvania's authoritative *Global Go To Think Tank* Index

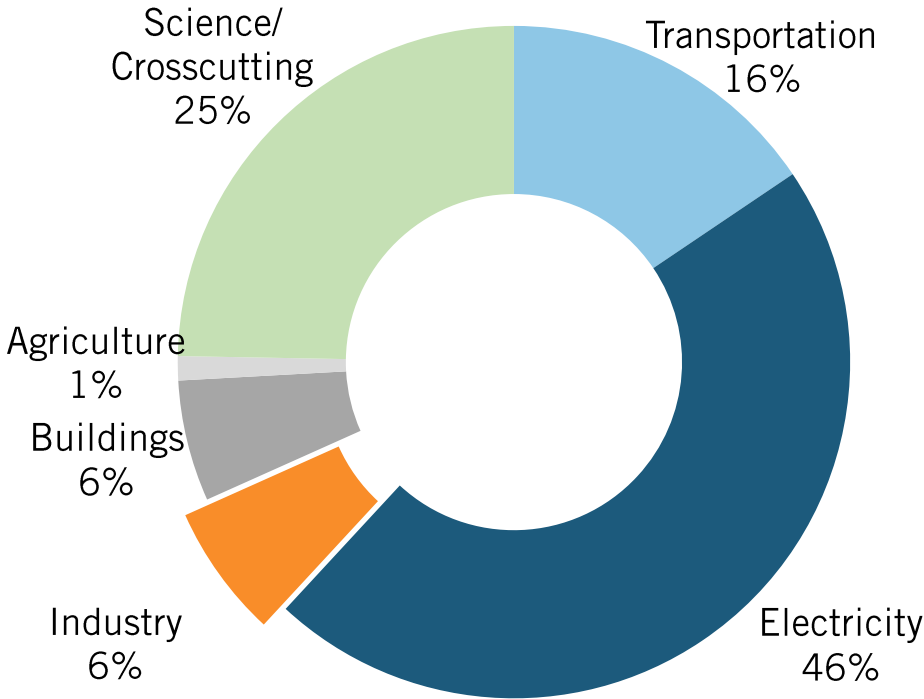
# Industrial emissions: the forgotten climate wedge

## 2018 U.S. GHG emissions vs. FY20 DOE clean energy RD&D funding

U.S. Greenhouse Gas Emissions (2018)

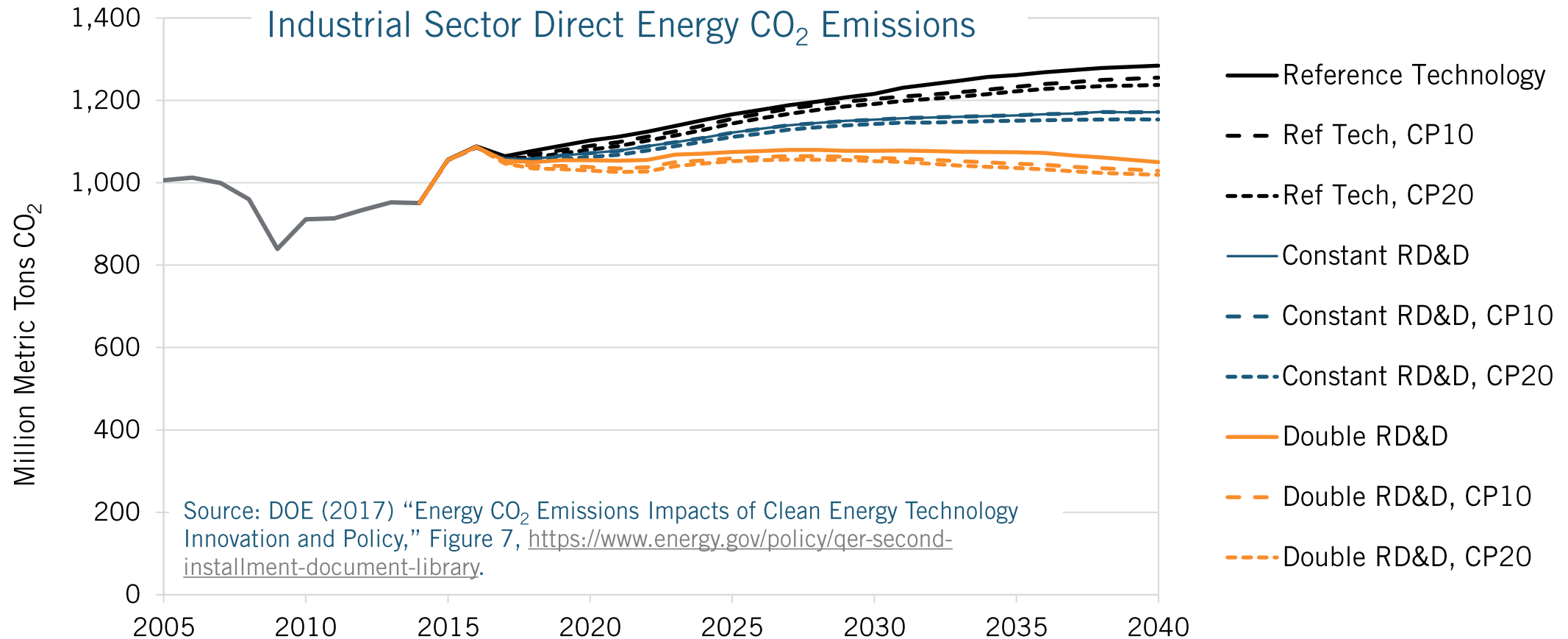


DOE Portfolio, by Sector, FY 2020



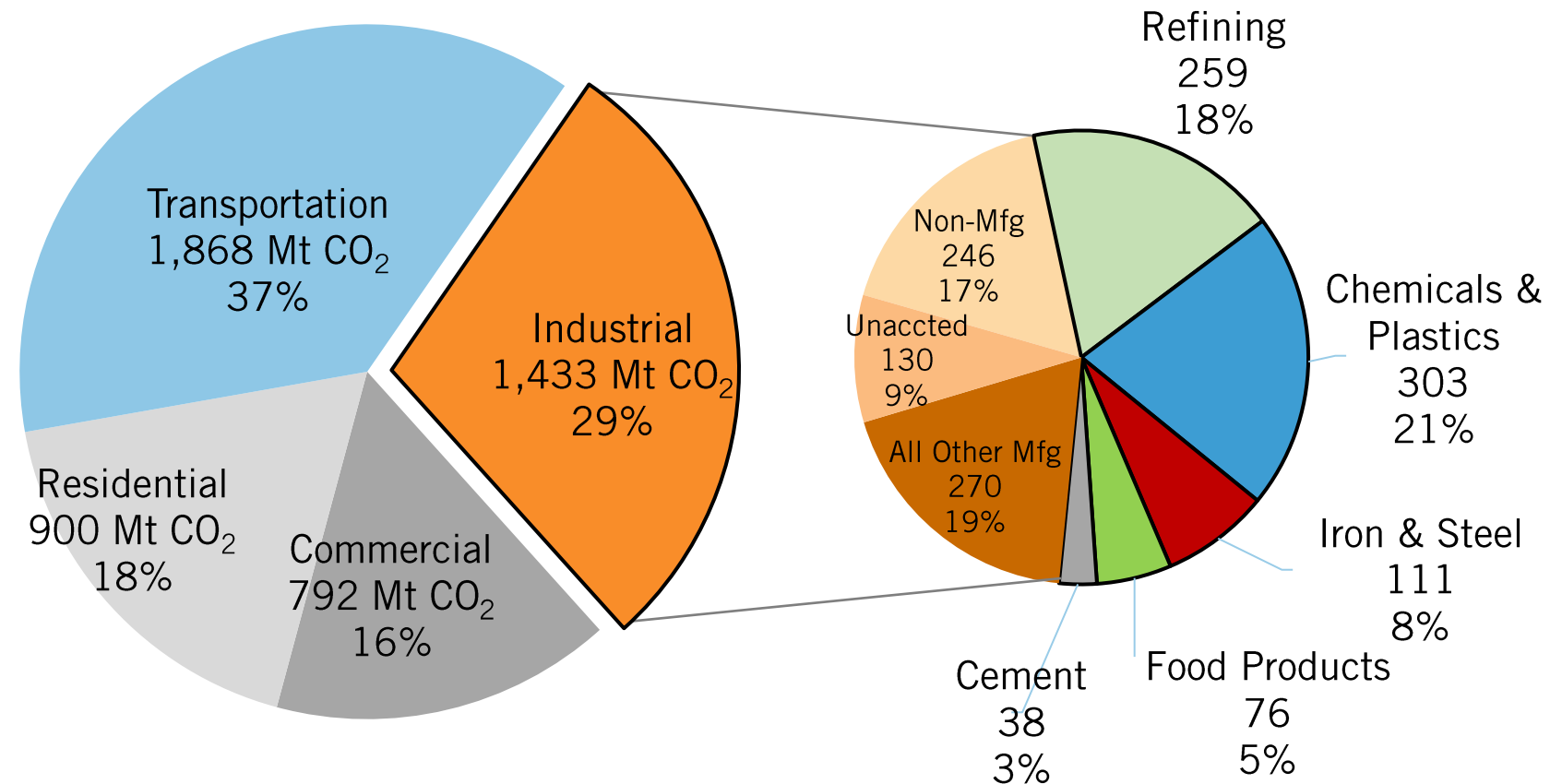
Source: Sivaram, Cunliff, Hart, Friedmann, and Sandalow (2020)

# Industrial emissions are remarkably inelastic to climate policy



# U.S. energy-related CO<sub>2</sub> emissions in 2020

- Five energy-intensive sectors account for 70% of manufacturing energy CO<sub>2</sub> emissions
- These sectors will be the focus of forthcoming AMO industrial decarbonization roadmaps



Source: AEO (2020)

# Why are emissions from heavy industry hard to abate?

**Challenge #1: High-temperature heat** for industrial processes cannot be easily electrified

**Challenge #2: “Process”** emissions from chemical transformations cannot be eliminated by switching to zero-carbon energy

Calcination:  $\text{CaCO}_3 + \text{heat} \rightarrow \text{CaO} + \text{CO}_2$

**Challenge #3: Long lifetimes** of industrial plants, ~30-40 years, which leads to slow stock turnover and long investment horizons

**Cement**



**Iron and Steel**

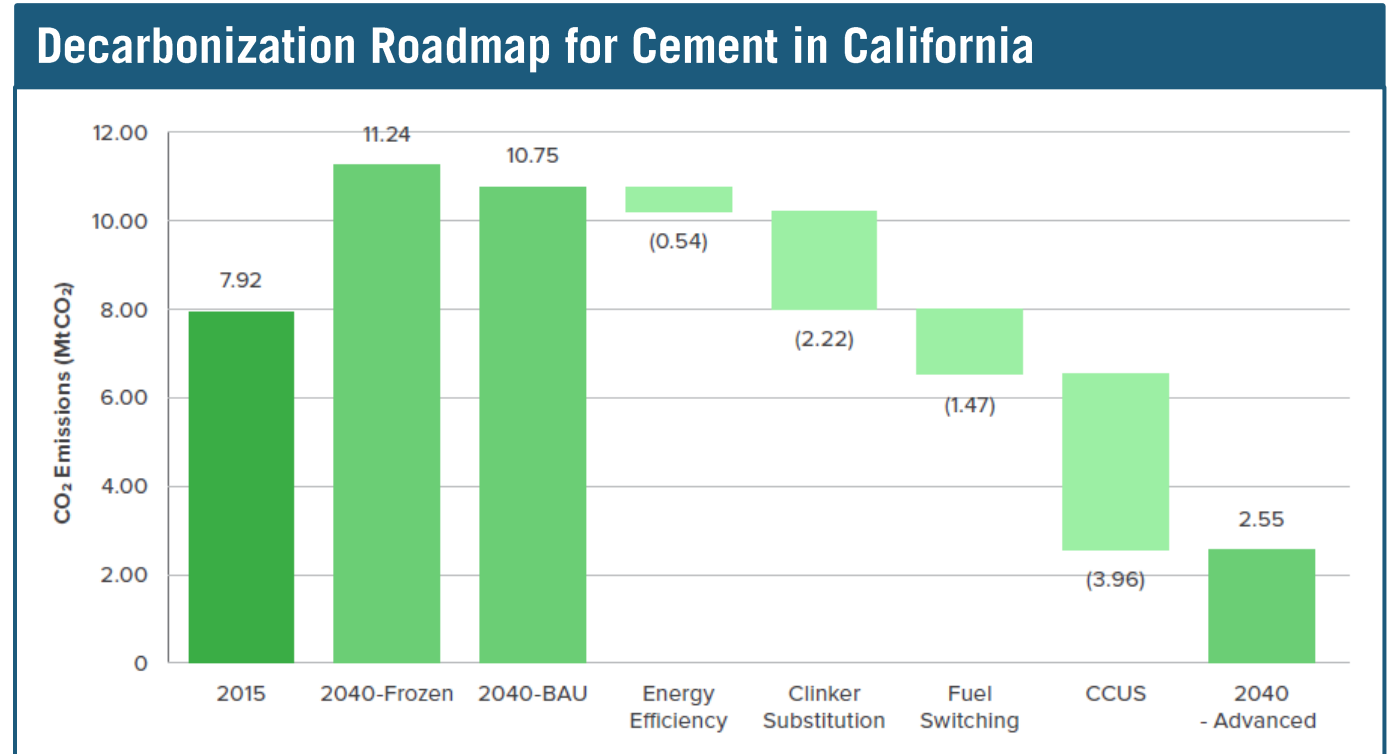


**Chemicals**



# Decarbonization levers for heavy industry

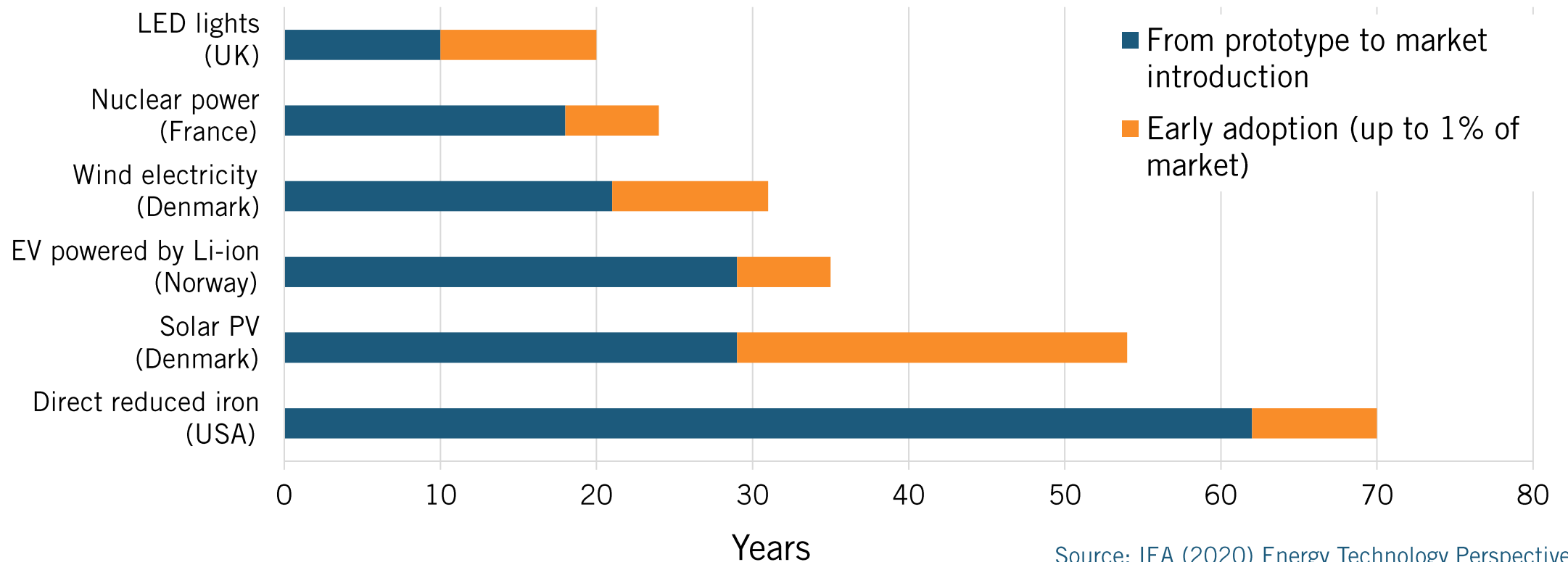
Near-term	Demand management
	Energy Efficiency
	Materials Substitution
Deep Decarbonization	Hydrogen
	Electrification
	CCUS
	Transformational processes



Source: Hasanbeigi and Springer (2019)

# Bringing new technologies to market on a large scale can take 20-70 years

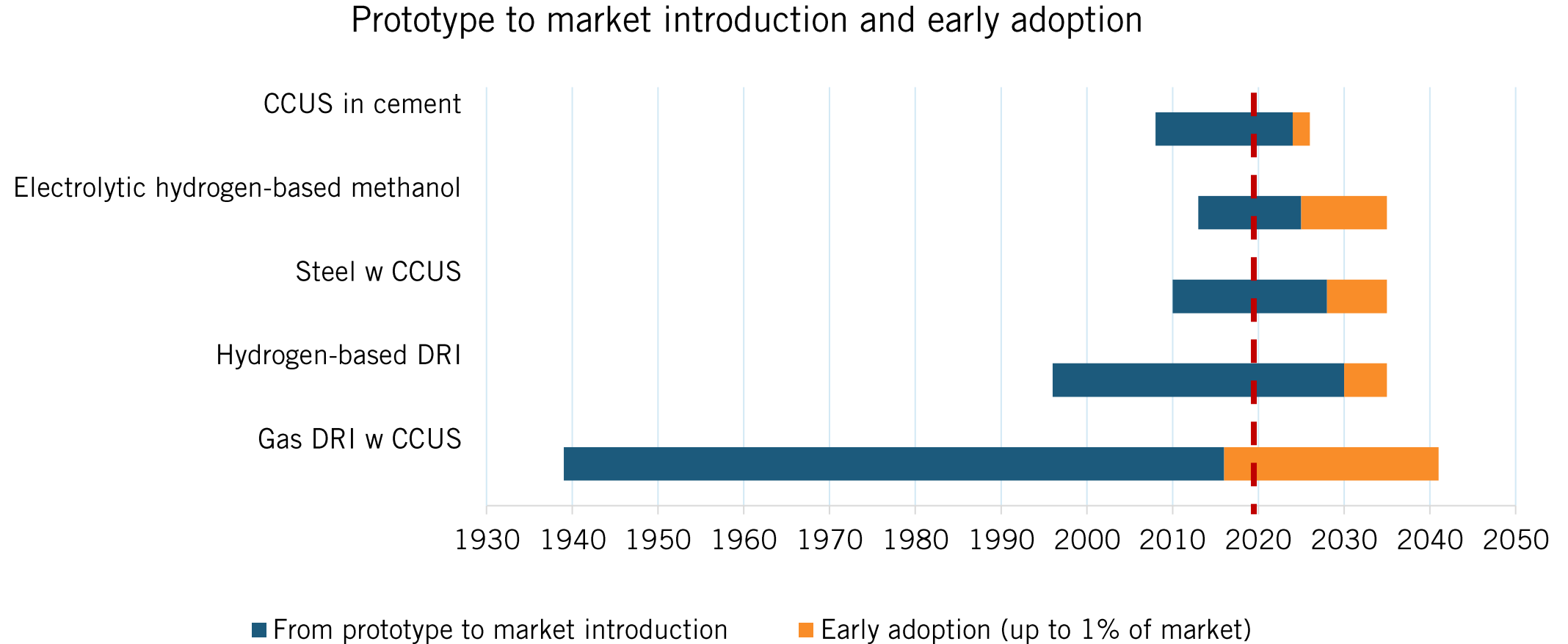
## Prototype to market introduction and early adoption



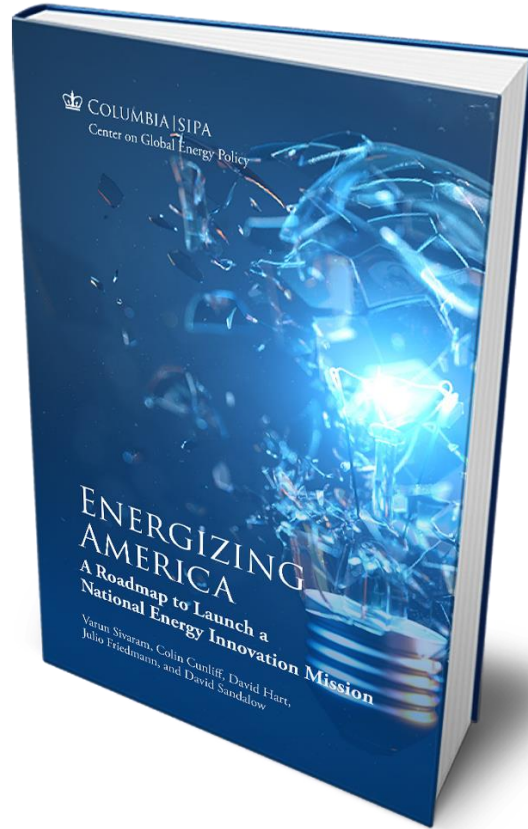
Source: IEA (2020) Energy Technology Perspectives



# Times to early adoption for select technologies in IEA's Sustainable Development Scenario



# Toward a clean manufacturing RD&D strategy



<http://bit.ly/energizingamerica>



More funding for industrial decarbonization (AMO appropriations and CITA)



Refocus AMO on decarbonization (not just efficiency). Industrial decarbonization roadmaps are a good start.



Explore H2 applications in industrial sectors (not just transportation)



Explore CCUS applications in industrial sectors (not just coal power generation)

# Thank You!

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