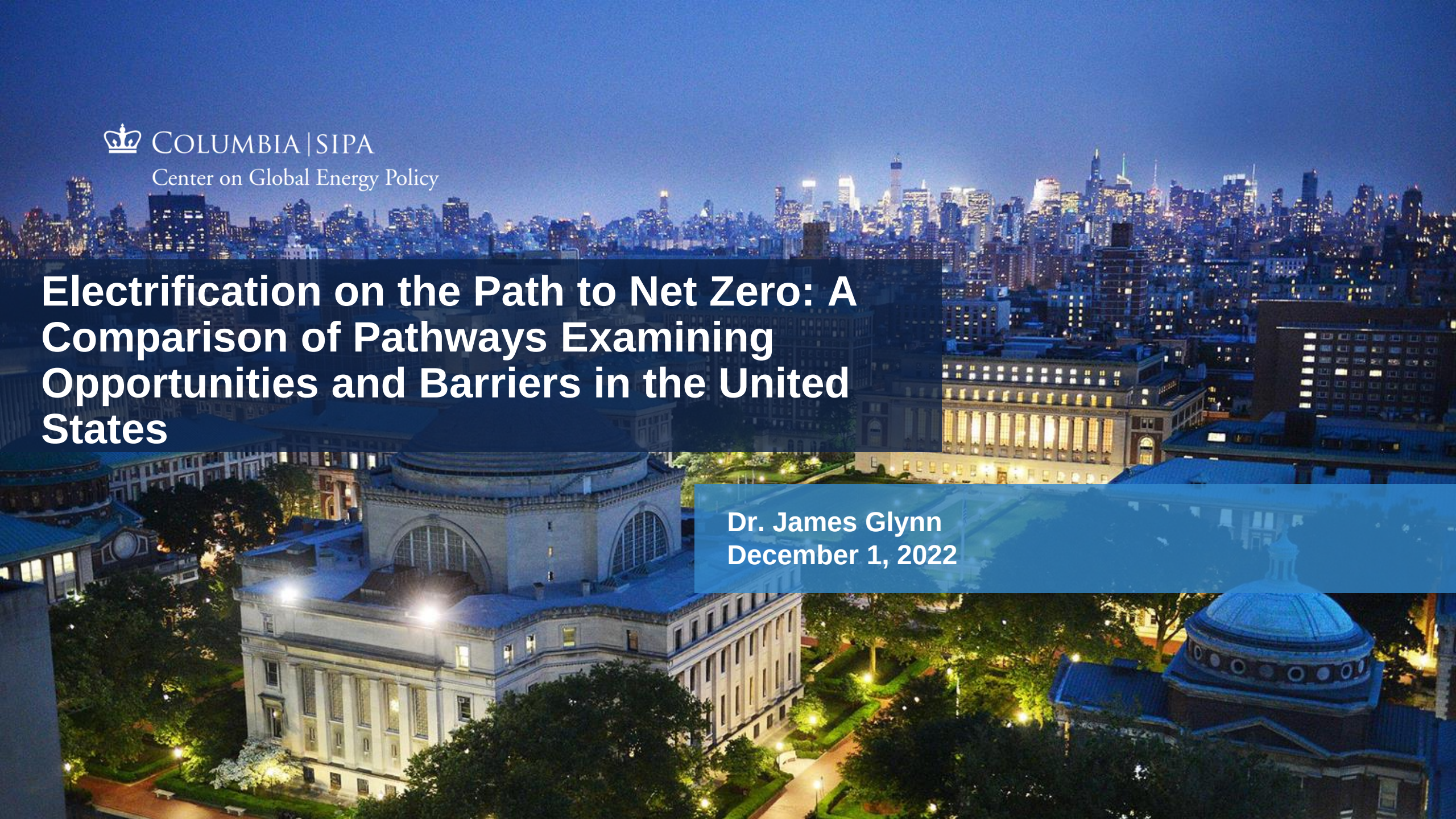

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# Electrification on the Path to Net Zero: A Comparison of Pathways Examining Opportunities and Barriers in the United States

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# Acknowledgements

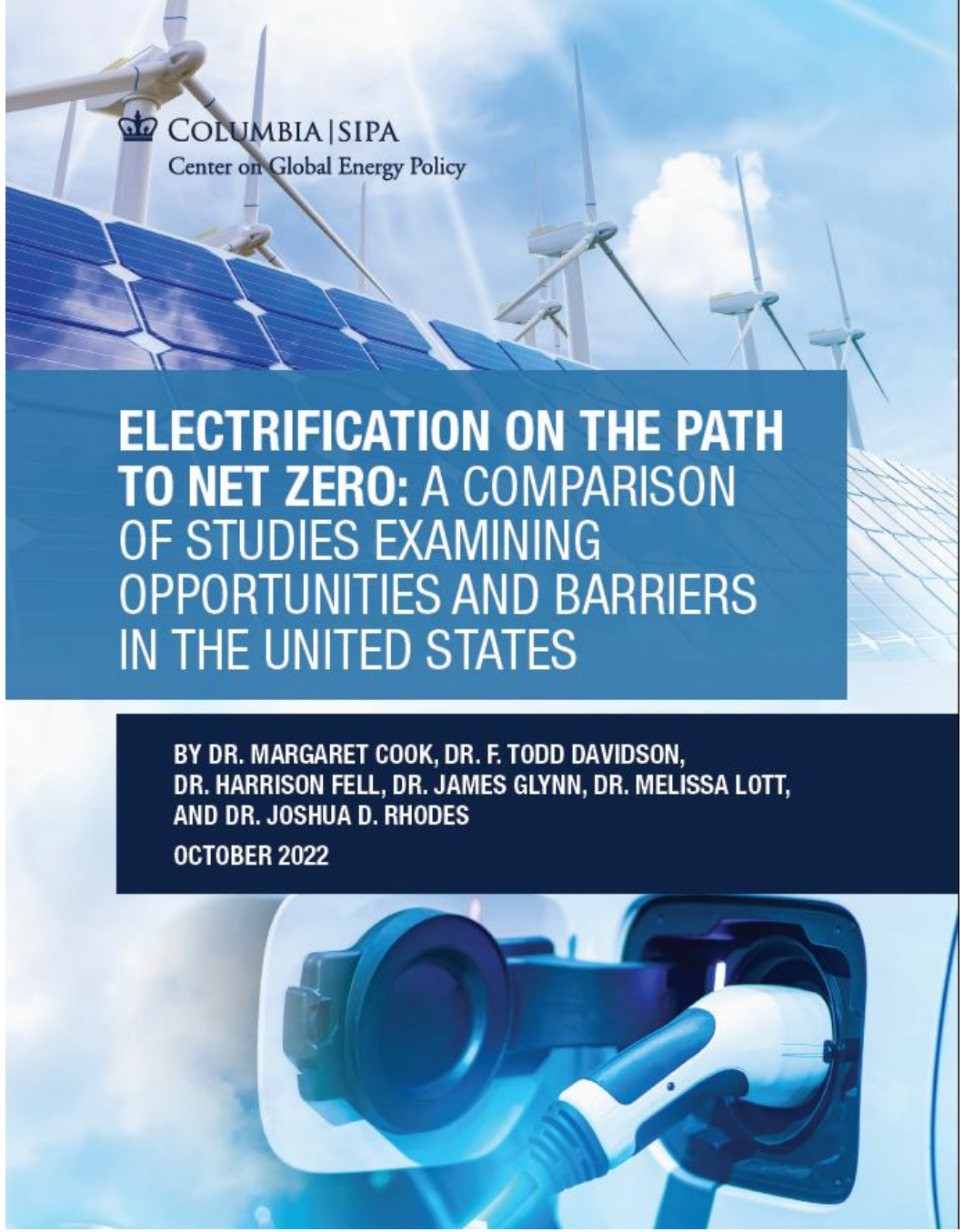
**New CGEP report addressing the calls to "electrify everything"**

**1. Explore degrees of electrification in the United States that might be needed to achieve net-zero pathways under model assumptions.**

**2. Relative roles of variable generation resources, energy storage, and firm low-carbon power in the energy transition to meet increasing levels of clean electricity demand.**

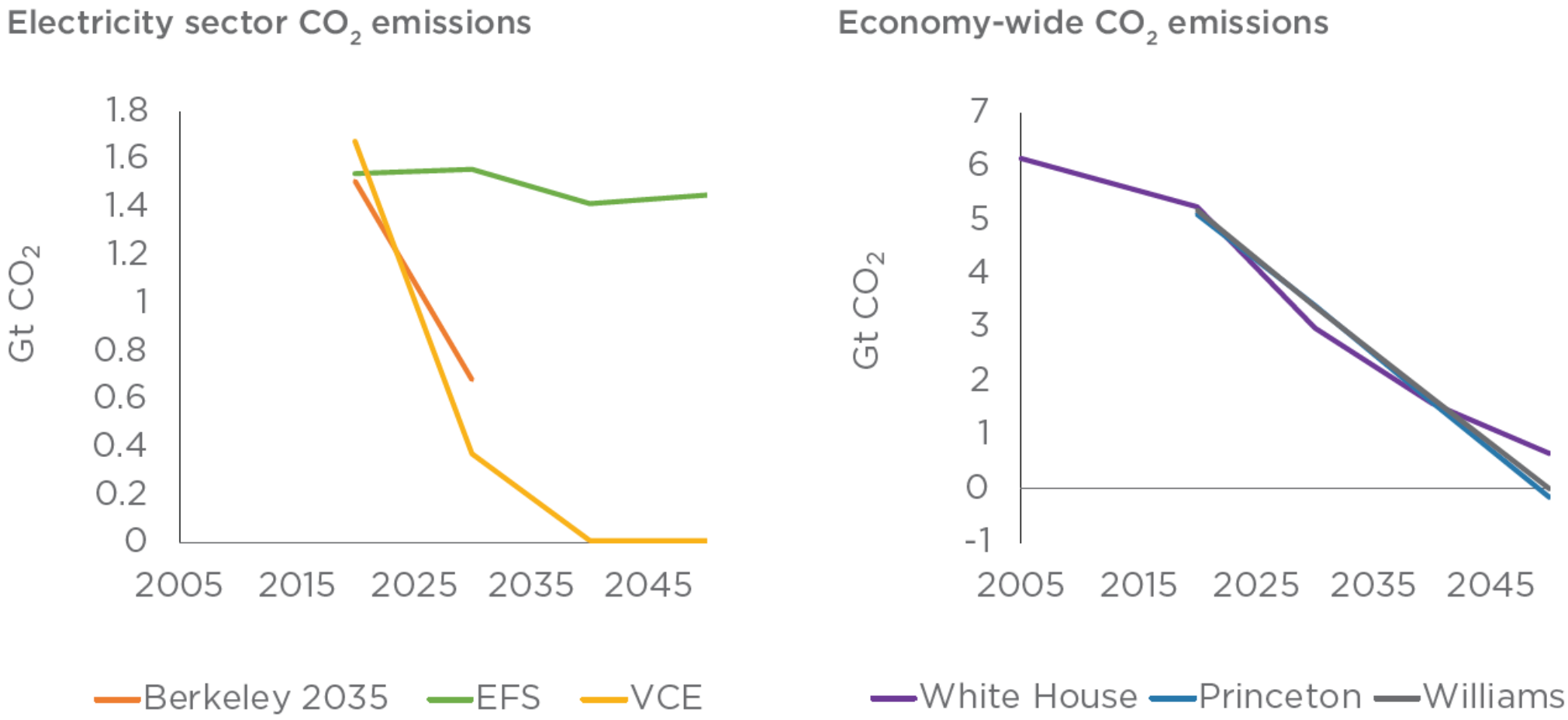
**3. Barriers that could hinder both increased electrification and decarbonization of the pivotal power sector.**

**Source: https://www.energypolicy.columbia.edu/research/report/electrification-path-net-zero-comparison-studies-examining-opportunities-and-barriers-united-states**



# Overview of Studies and scenarios climate mitigation targets

**Figure 1:** Carbon reduction timelines across studies



# Overview of Major Themes

## Despite great variance between decarbonization scenarios and their assumptions, common threads undeniably exist:

### Future Energy Needs

Electricity consumption ⬆ with electrification.

Fuel switching and increased efficiency ⬇ primary and final energy needs.

### System Costs

Decarbonized electrification requires capital-intensive strategies.

Renewables to lower variable cost of production.

### Future Electricity Infrastructure Needs

Consensus for rapid expansion, spearheaded by wind and solar.

Need large investments in increasing transmission.

### Technical & Market Constraints

Grid stability issues require modernized ancillary services and intra-day and intra-seasonal storage.

# Supply Side

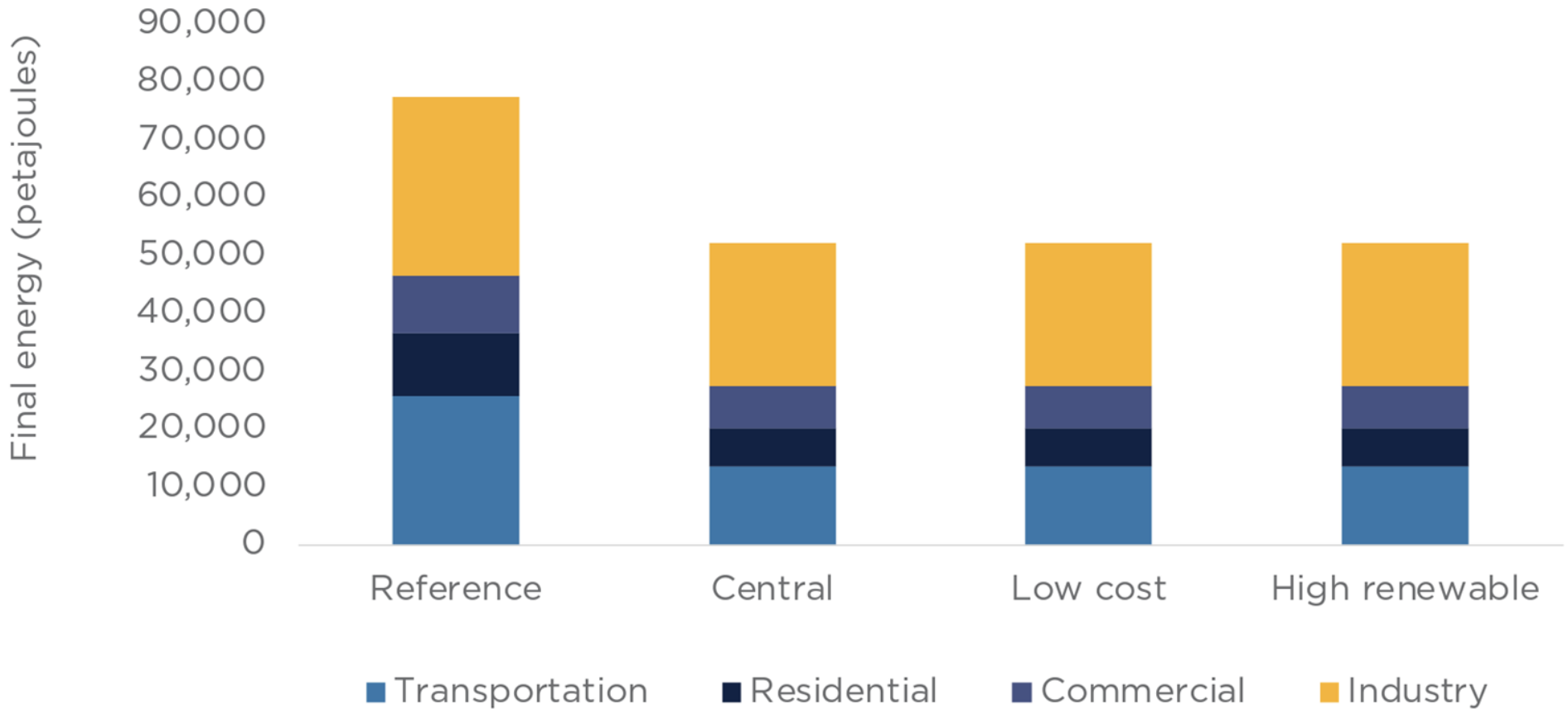
**All scenarios phase out the use of coal for electricity generation by 2035 and rely on a large increase of firm and variable renewable energy (VRE) sources.**

| Scenarios | 2020 | | | 2050 | | |
|---|---|---|---|---|---|---|
| | Generation (TWh) | Fraction that is variable renewable | Fraction that is nonfossil | Generation (TWh) | Fraction that is variable renewable | Fraction that is nonfossil |
| Reference | 3,900–4,300 | 11–12% | 35–40% | 5,000–8,000 | 30–62% | 50–75% |
| Electrification | 3,900–4,300 | 11–13% | 37–41% | 5,600–12,000 | 47–91% | 73–100% |
| High renewables | 3,900–4,300 | 11–13% | 37–41% | 6,600–16,000 | 76–98% | 99–100% |
| Lowest cost | 3,900–4,300 | 11–13% | 37–40% | 5,600–9,600 | 44–90% | 73–100% |

# Demand Side

## Most scenarios show similar timing and magnitude of net zero transitions across technologies and sectors.

**Figure 9:** Final energy demand by sector in 2050, estimated by Princeton



# Recommendations

## General Recommendations

1. Decarbonizing electricity
2. Electrifying end-uses
3. Lowering energy demand
4. Increasing transmission, distribution and energy storage infrastructure

## Acknowledge the Diversity of Actors

Supply side issues require less public involvement, while certain technology adoption have to effectively engage individuals, requiring adequate incentives

## Timing is Essential

Large capital considerations in public transportation, transmission and distribution capacity = necessary and interdependent

## Beyond Electrification

Lowering of demand, enhanced land sinks and STEM training for job reskilling

Broader public awareness and involvement

# Thank You