U.S. DEPARTMENT OF ENERGY

Office of Electricity Delivery & Energy Reliability

Developments in Electrification and Implications for the United States Electric Industry

U.S. Department of Energy Perspective

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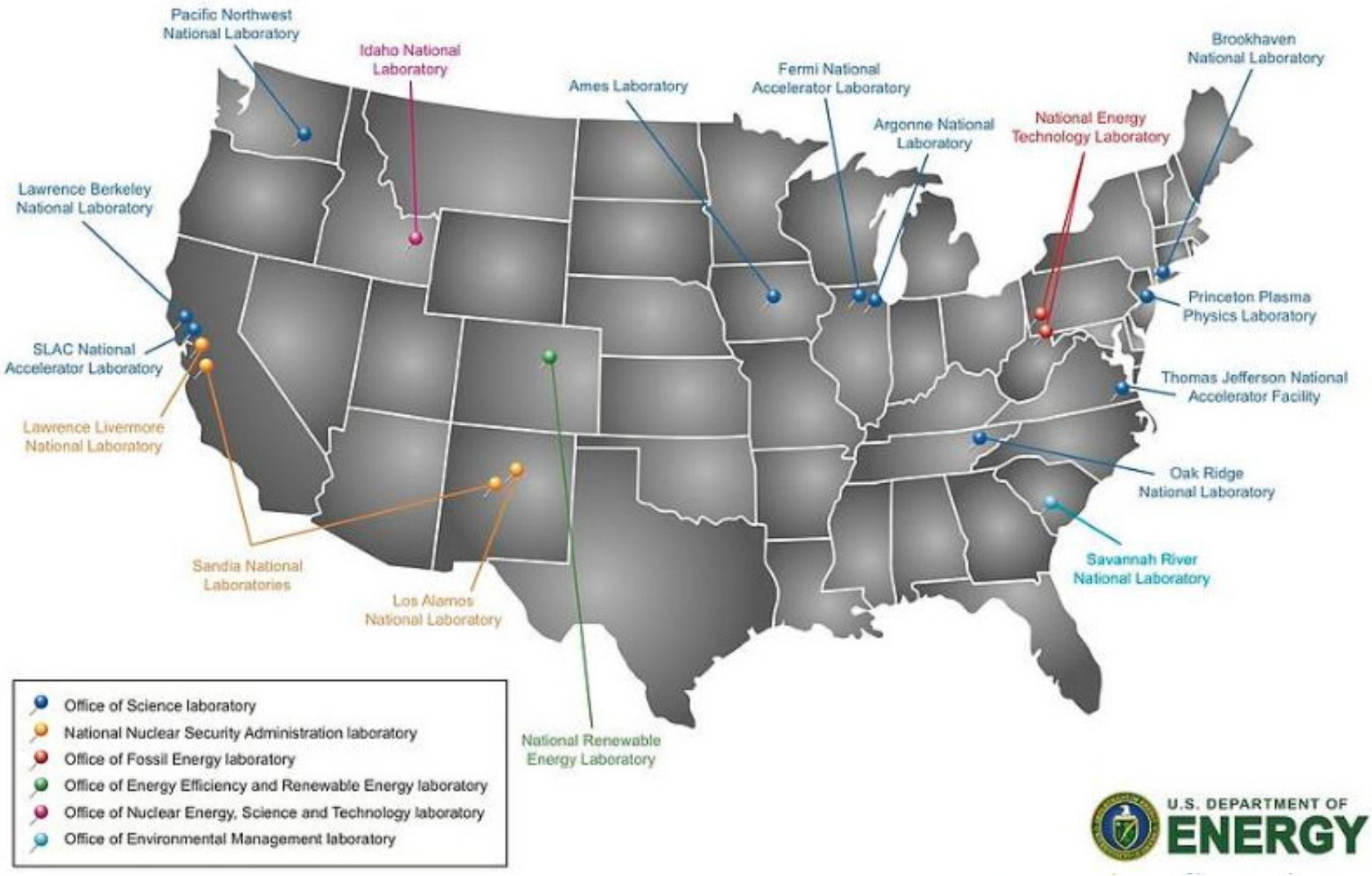
U.S. Department of Energy

The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

Visualization Lab, ESIF

U.S. Department of Energy National Laboratories



Electrification definitions

New energy services

- New technologies
- Smartphones, datacenters

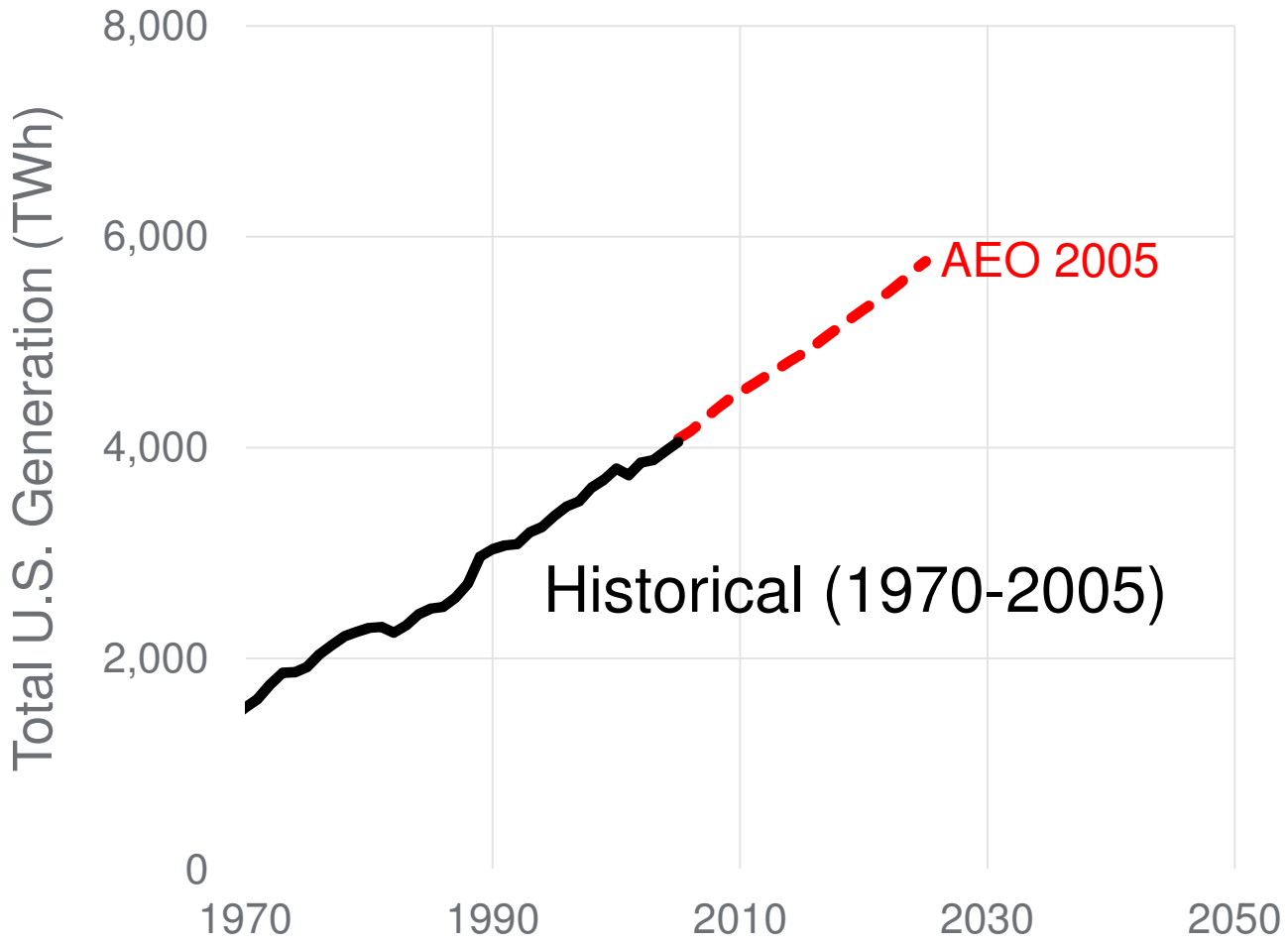
Same energy service

- “Fuel switching”
- Heat pumps instead of fuel oil

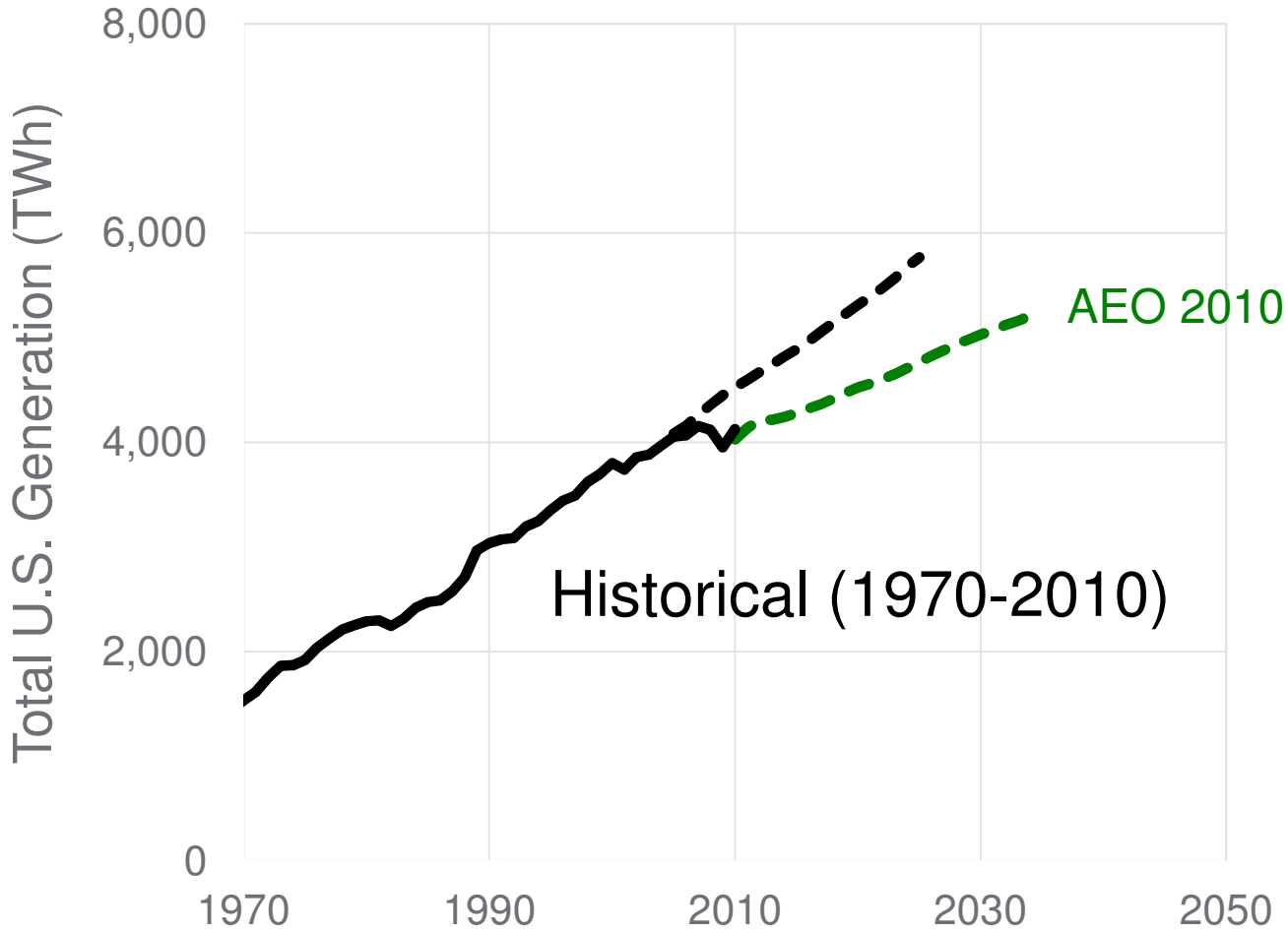
Economic growth

- More demand for the same service

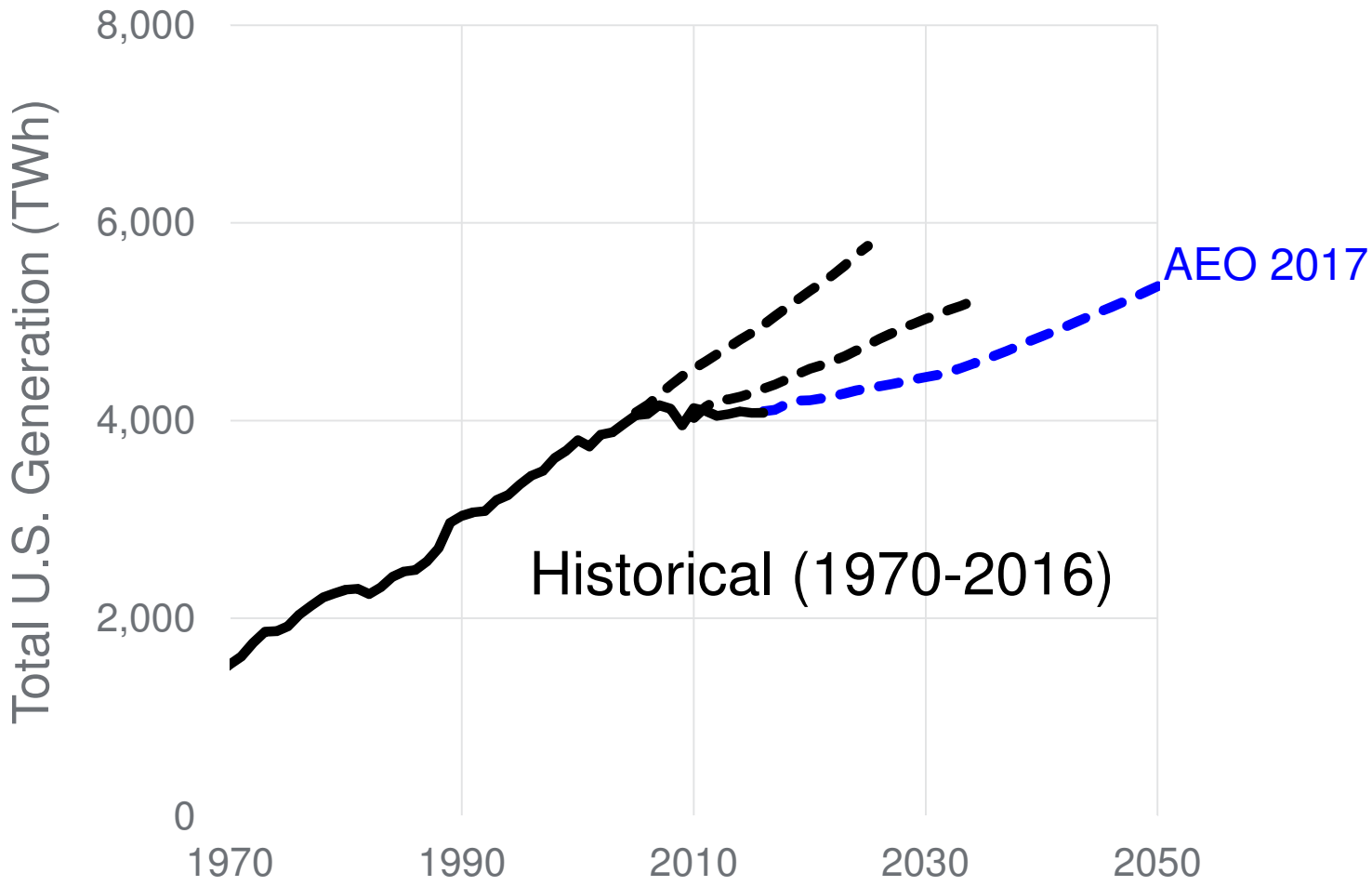
Predicting electricity trends used to be easy…



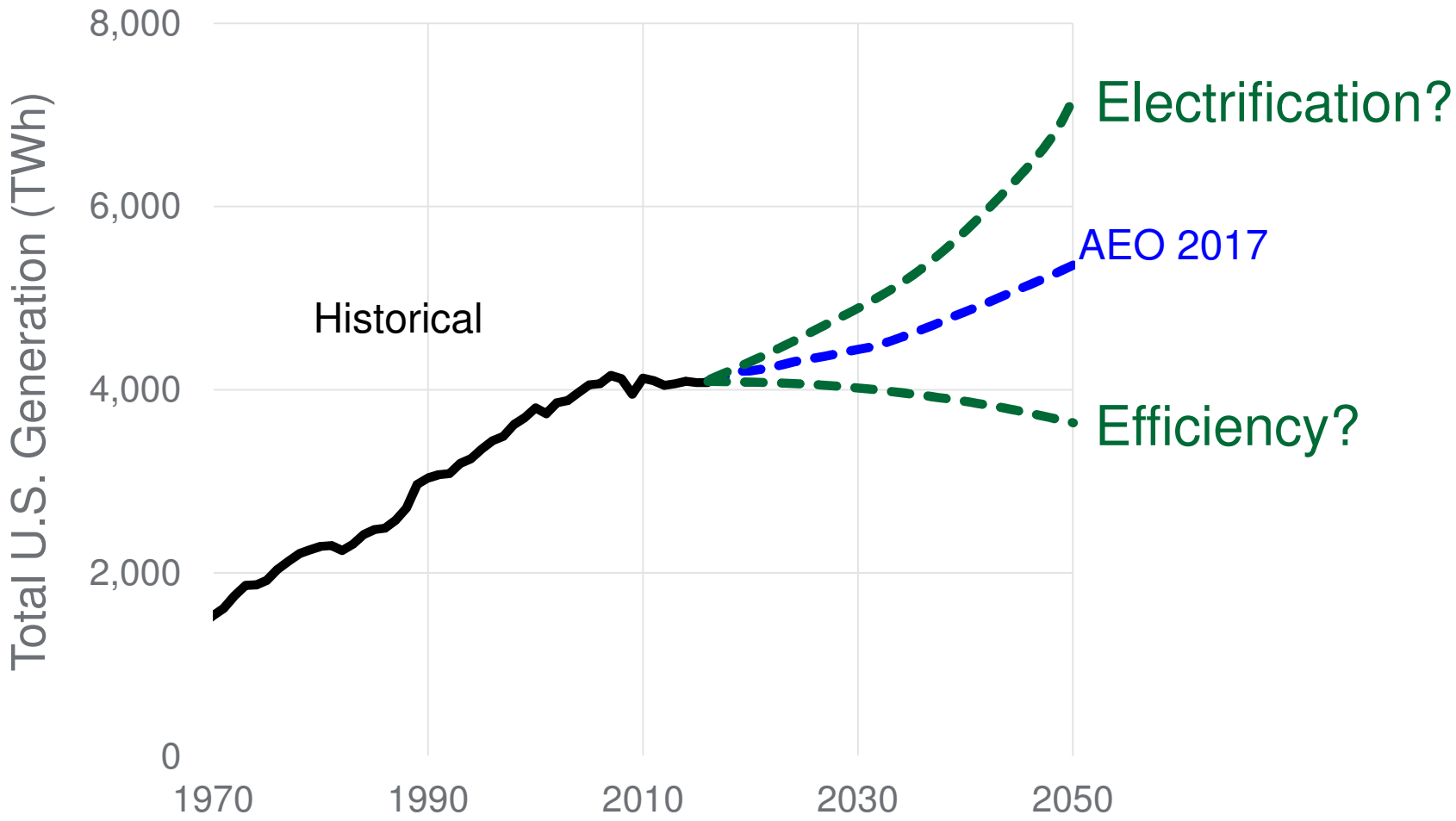
… but increasing technology performance…



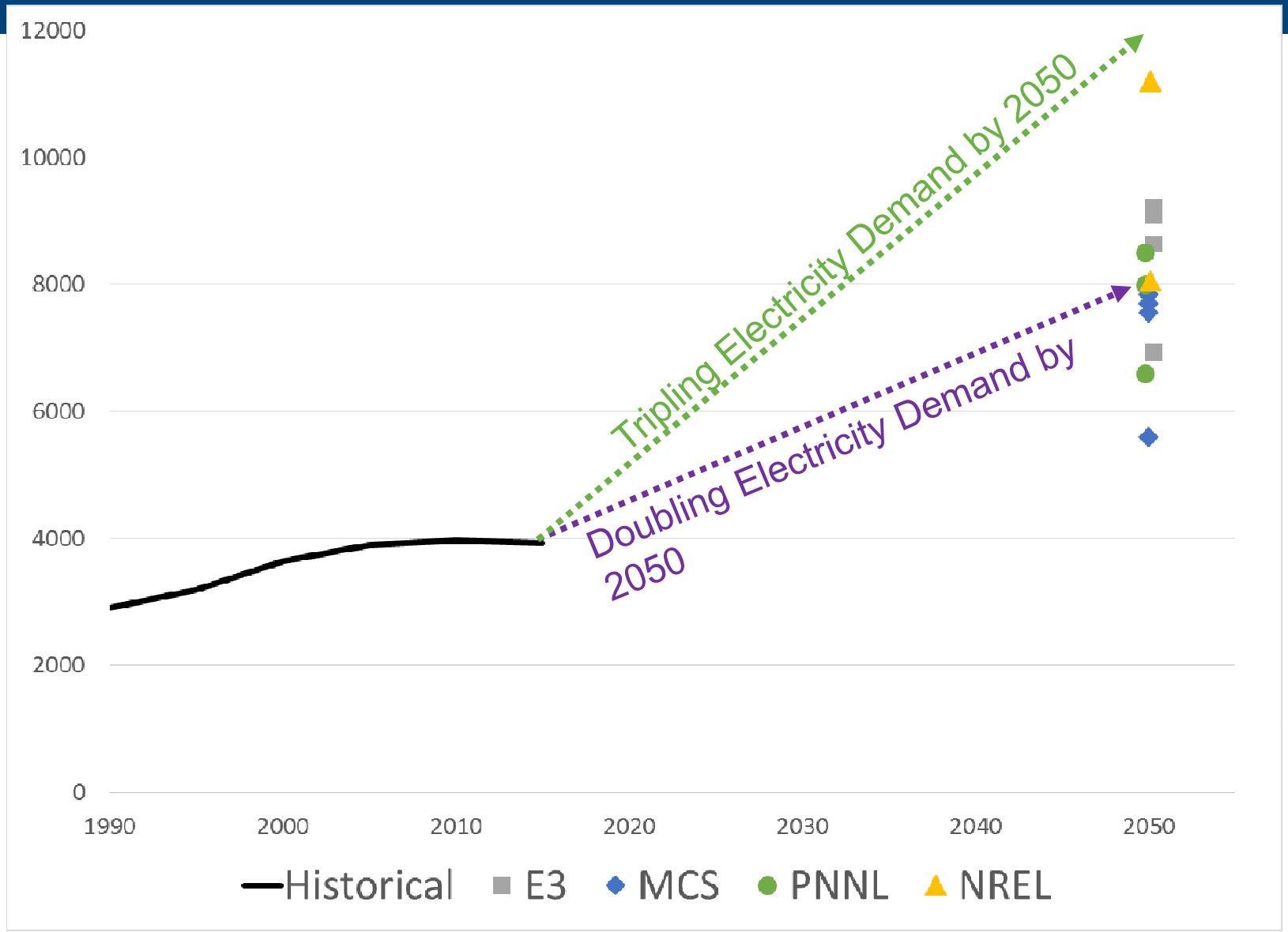
… and efficiency are making it difficult



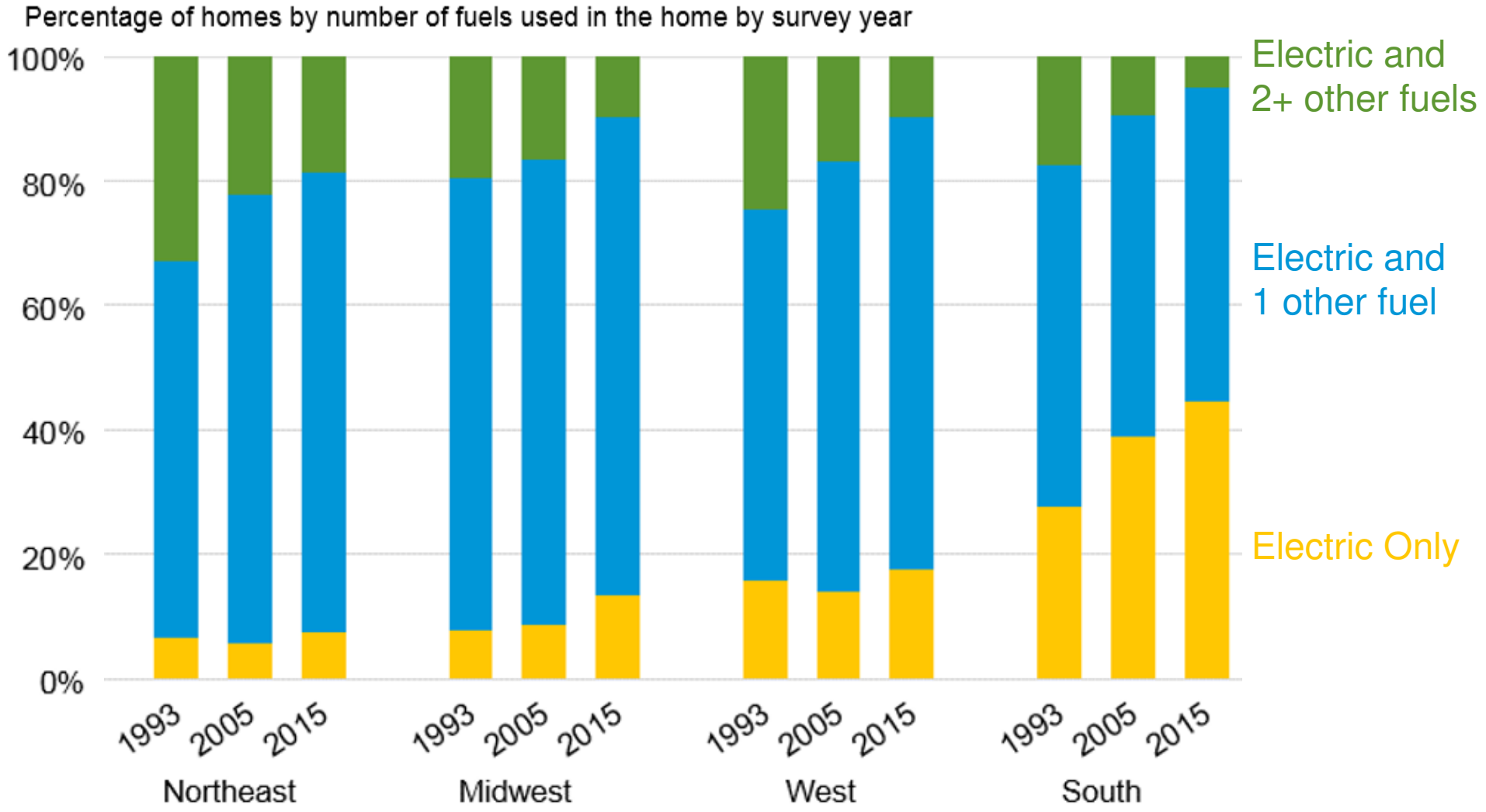
What does the future look like?



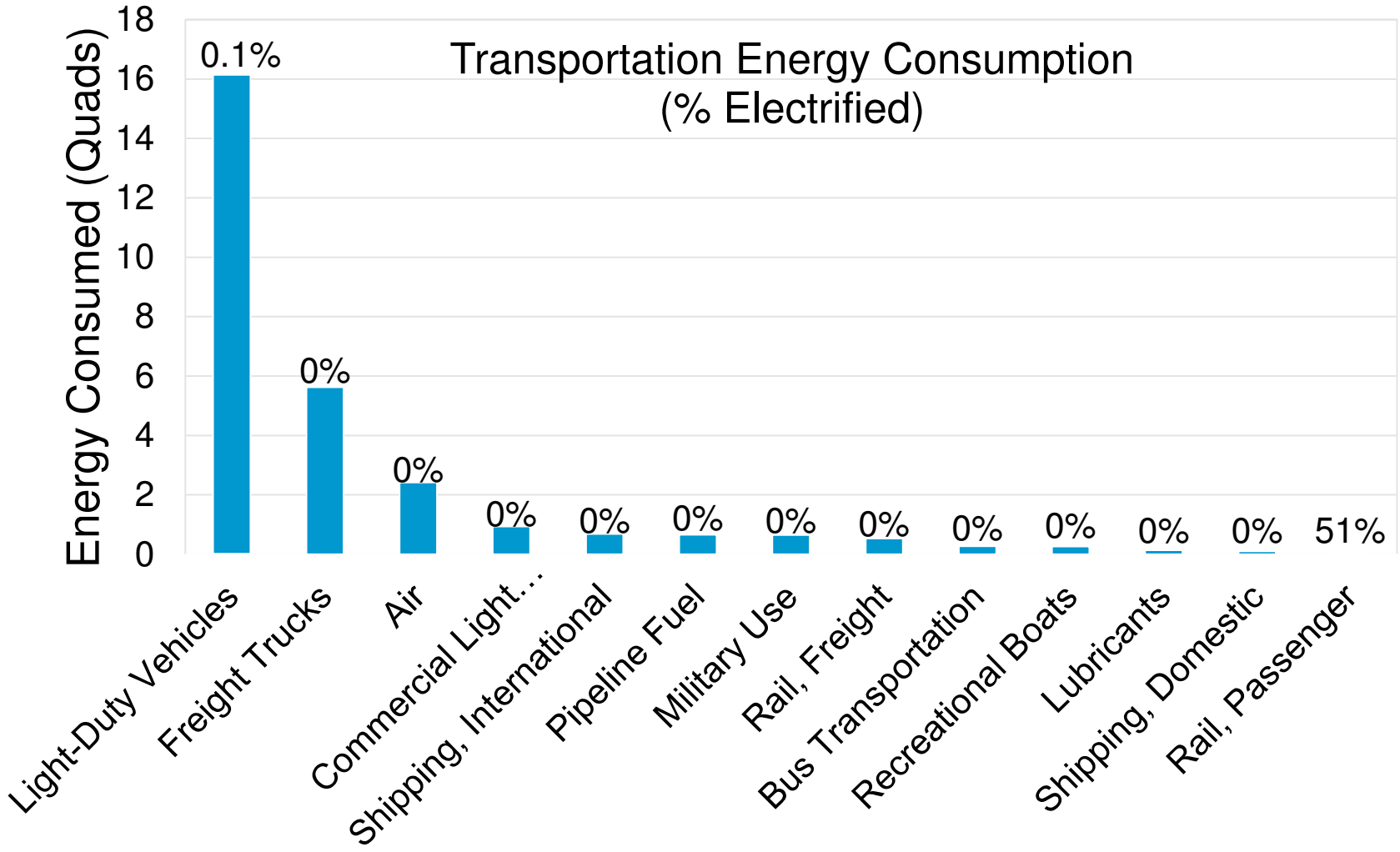
Many studies forecast a significant increase in electricity demand due to end-use electrification. Growth in demand could support electric utilities



Newer homes in milder climates are increasingly fully electrified

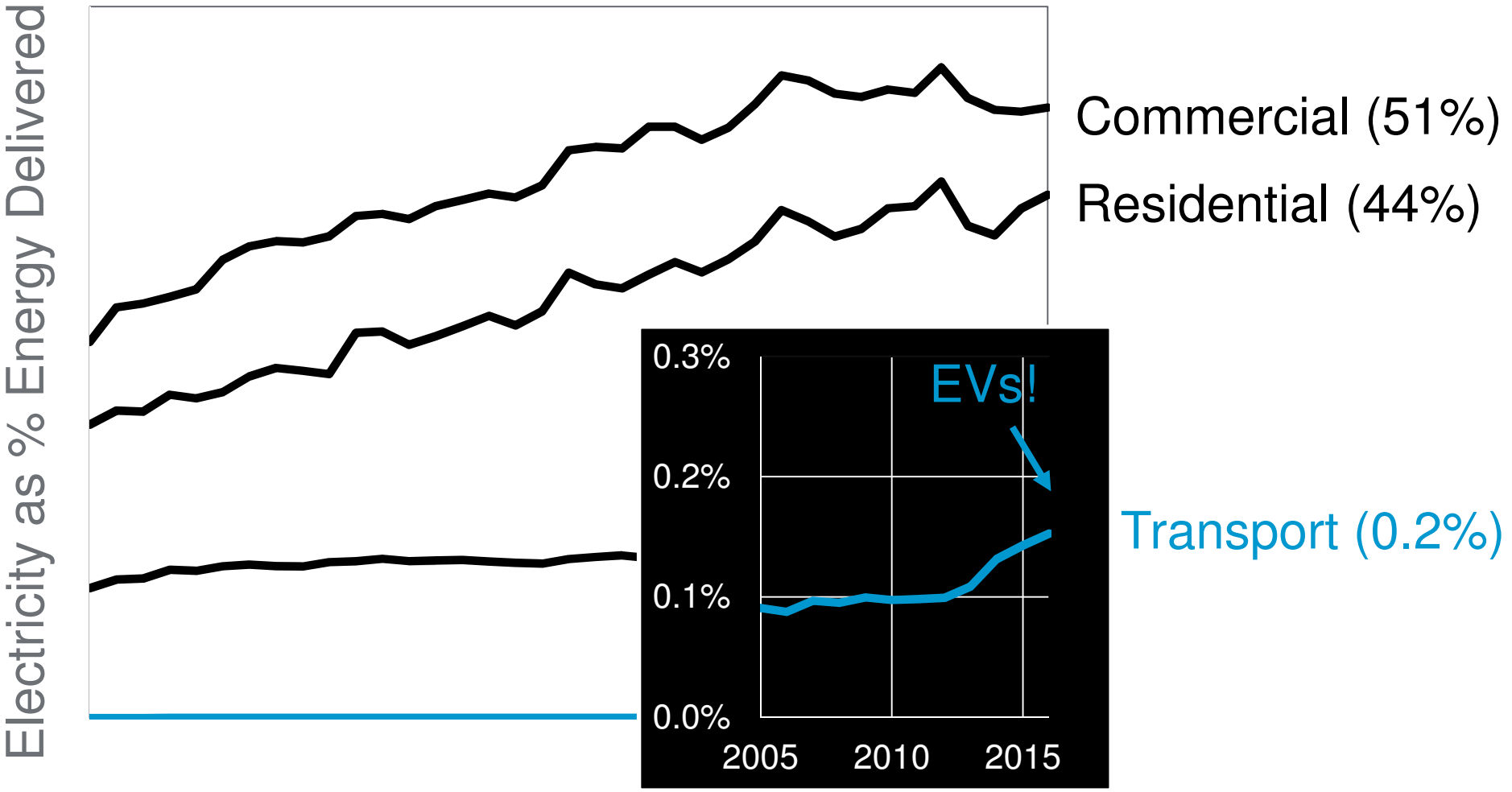


Transportation today is almost completely non-electric…

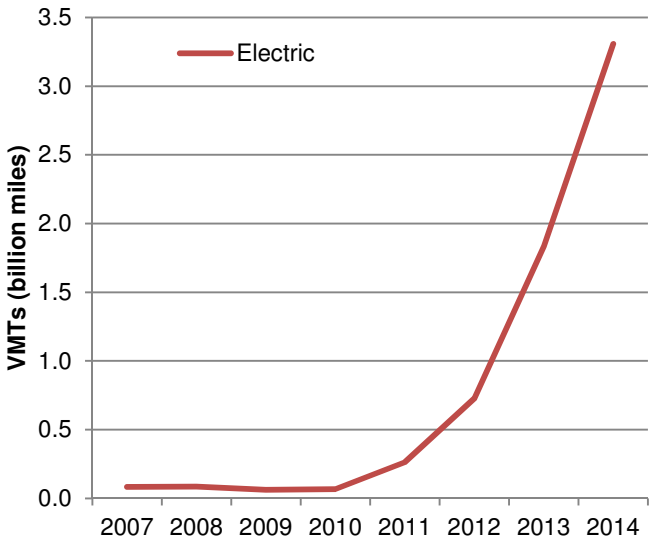


Source: EIA, *Annual Energy Outlook 2017*

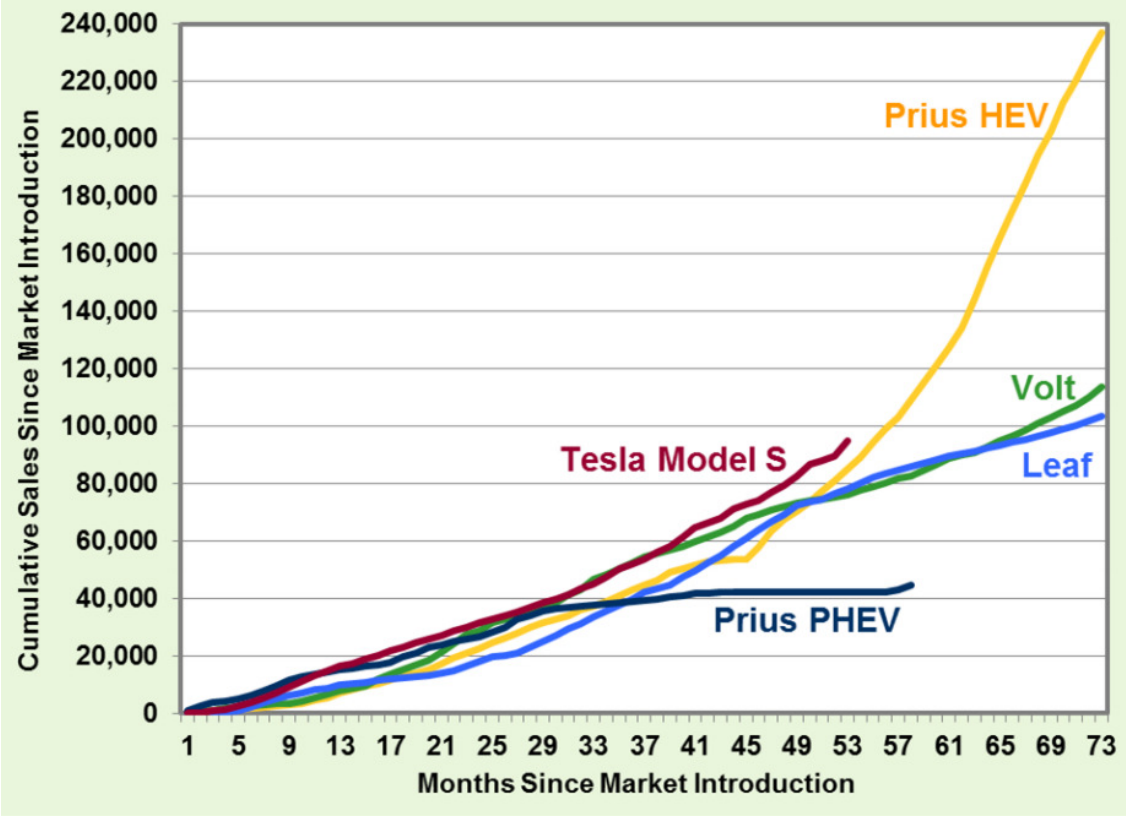
…and vehicle electrification is in infancy…



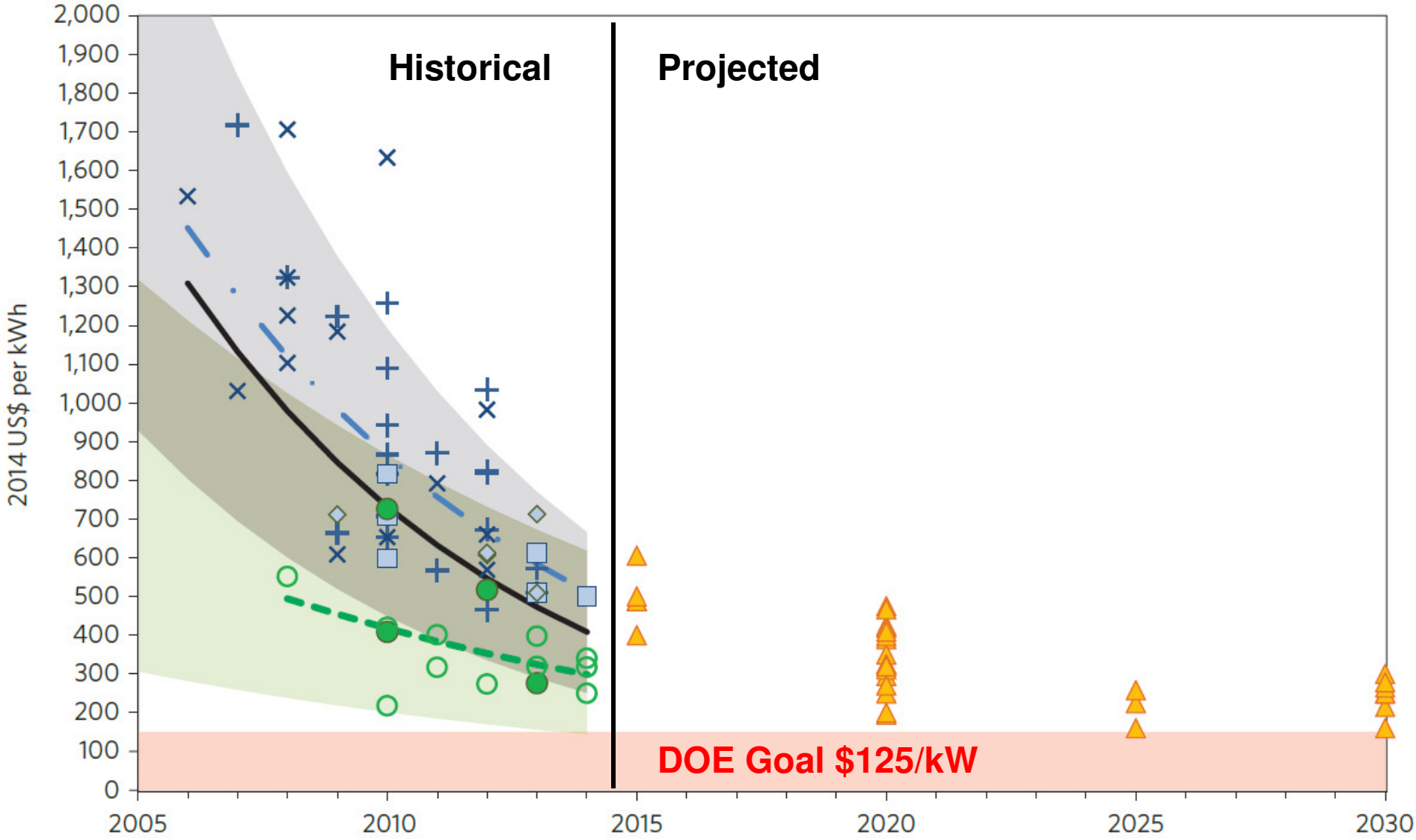
…but electricity demand in the transportation sector is growing, …



Electric vehicle miles traveled (eVMTs) show significant growth over the past 3 years. eVMTs in 2014 totaled 3.3 billion miles or 0.1% of total VMTs.



…battery costs are dropping…



Source: *Nykvist et al. (**2015**)*

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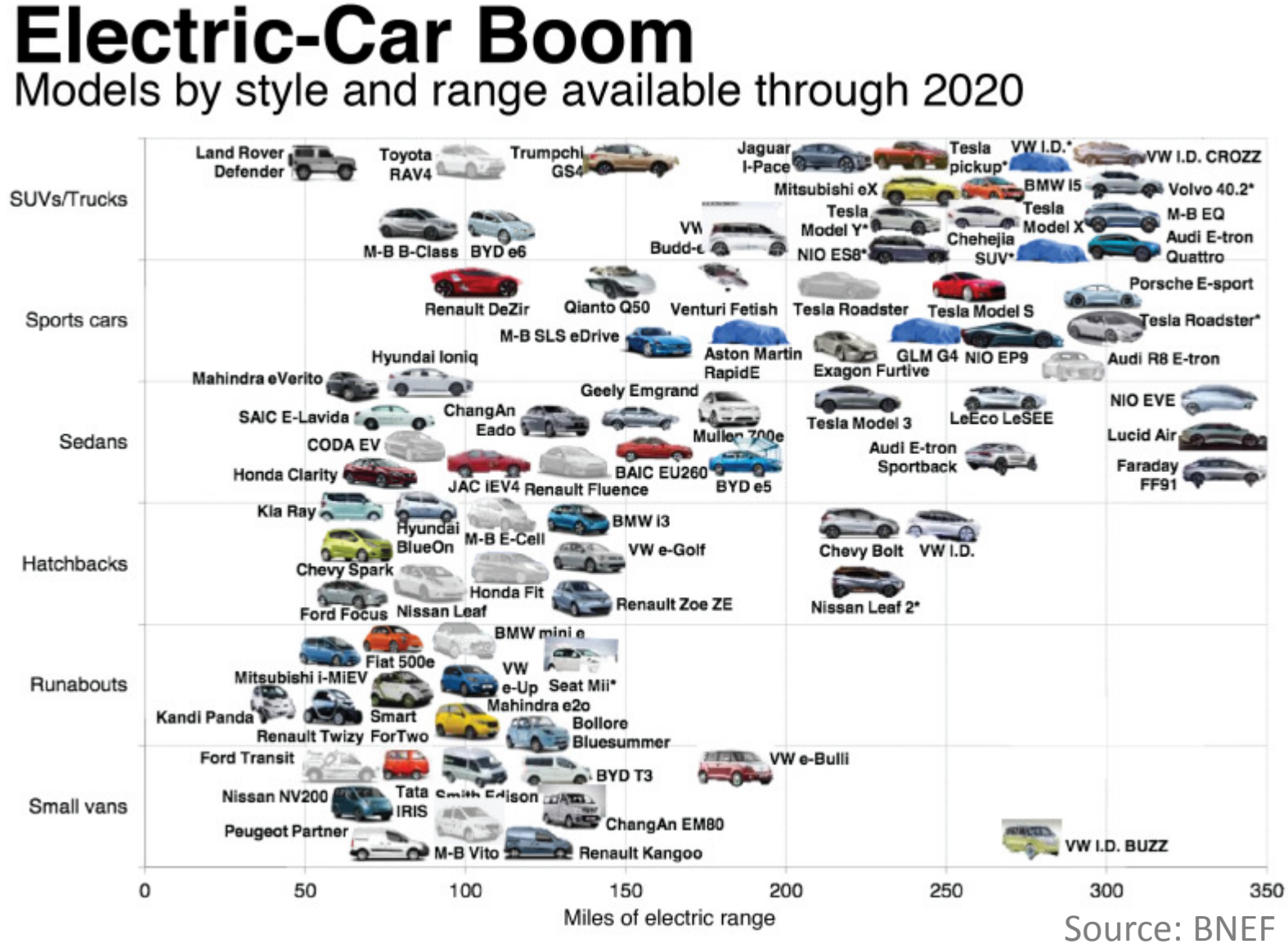
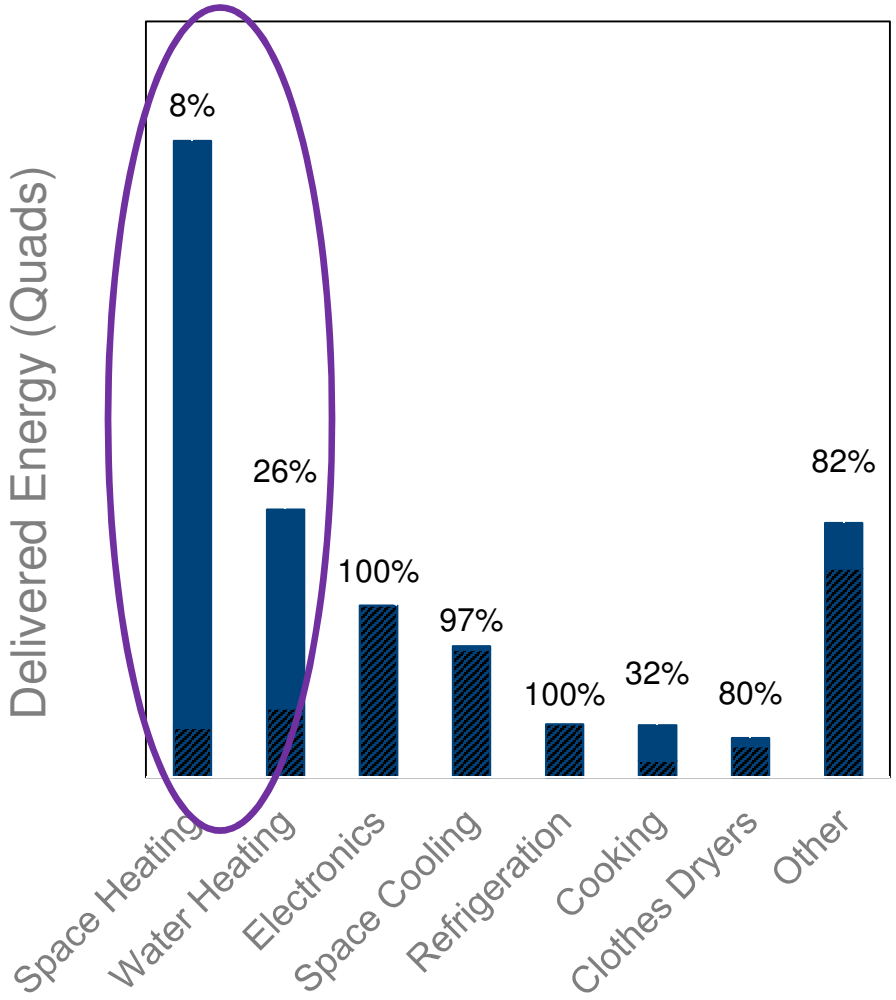
…and electric car options are expanding rapidly



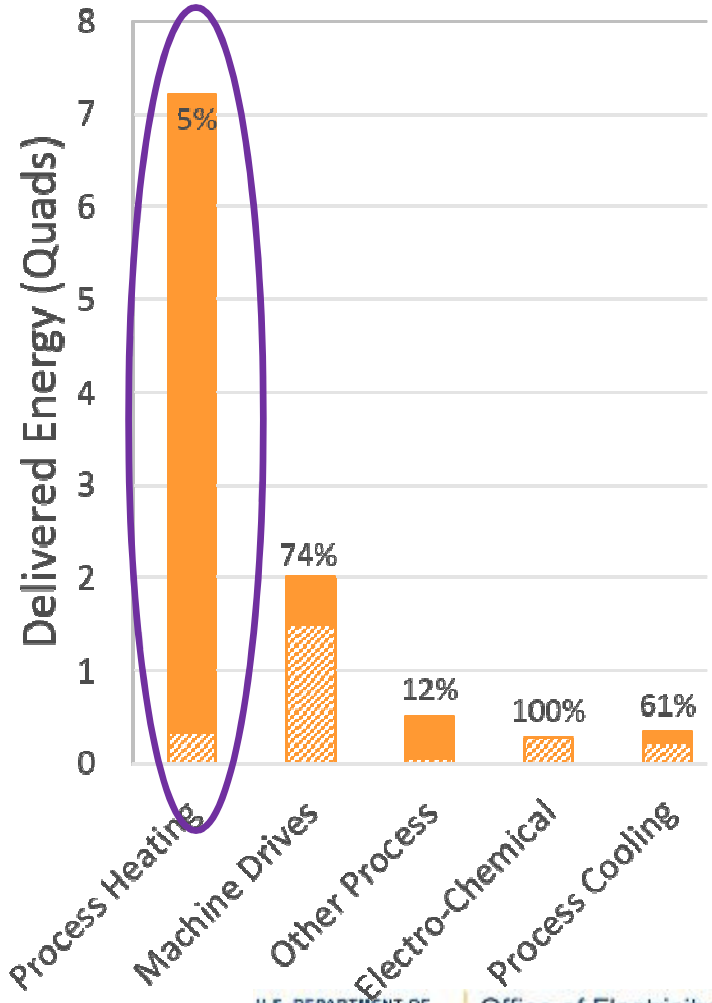
Source: BNEF

Significant opportunities exist for electrification through fuel switching

Residential Energy Consumption by End-Use and Fuel-Type (with % Electrified)



Industrial Process Energy Consumption by End-Use and Fuel-Type (with % Electrified)



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EFS - Project Overview

Goal: explore potential & impact of electrification of U.S. economy

Project Lead: NREL led collaboration with ORNL, LBNL, EPRI, Evolved Energy Research

Timeline: FY17 through FY19, budget depending

Outcomes:

- Integrated demand-side model
- Power sector evolution
- Electrification enabled flexibility
- Energy, pollution, water impacts
- Costs: households, system, electricity

EFS – Products & Publications

End-Use (FY18 Q2)

- Technology costs & performance
- Highly resolved demand model (dsgrid)
- Energy consumption under electrification scenarios

Power Sector Impacts

- Electric system evolution
- Electricity consumption patterns
- Operational impact of demand flexibility

Impacts Assessment

- Costs
- Infrastructure
- Pollution and water

EFS – Research Questions

End-Use Services & Technologies

- What end-use services could be electrified?
- To what extent might they plausibly be electrified?
- What are the cost and performance projections for electro-technologies?

Power Sector

- How would national & regional consumption change?
- How would generation evolve to meet electrification?
- How would the grid operate with varying levels of demand flexibility?
- Impacts on existing generators & markets?

Impacts (full scope tdb)

- What are system costs?
- What are environmental impacts – air quality, ghg emissions, water?

THANK YOU