Electrification Outlook for Transportation

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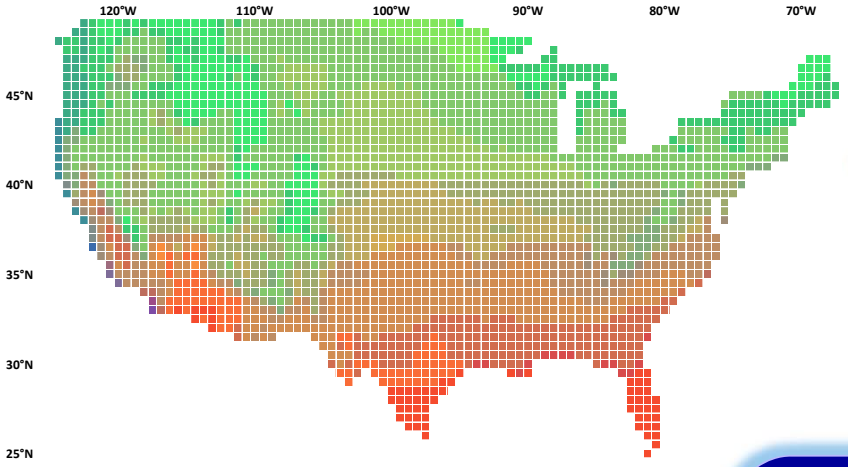
US National Electrification Assessment (USNEA)

- New study released April 2018
- Modeling and analysis of electrification opportunities, challenges, and actions across the US economy
- Available for download at www.epri.com

USNEA Modeling Approach: US-REGEN

Energy Use



- Climate zones
- Building types
- Household characteristics
- Industrial mix
- End-use technology detail

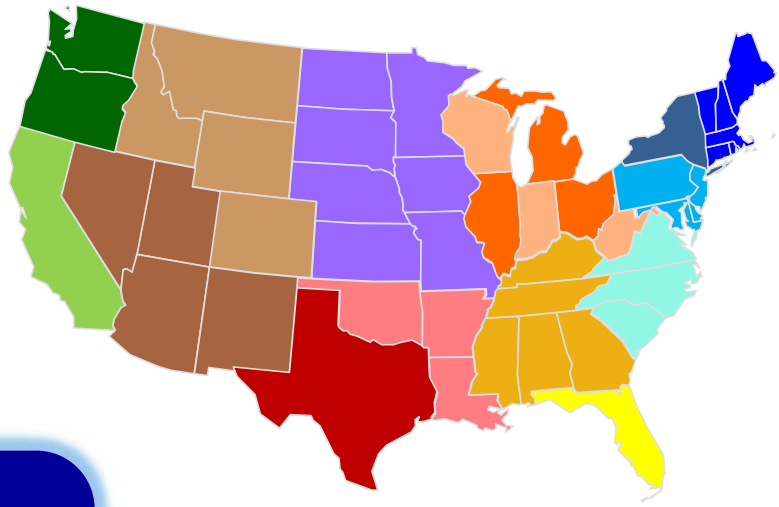
Synchronized Hourly Load, Renewables, and Prices

Model Outputs:

Generation, capacity, prices, and end-use mix

Emissions, air quality, and water

Electric Generation



- Investment and dispatch
- Transmission
- Intermittent renewables
- Energy and capacity requirements
- State-level policies and constraints

Model Projections of EV Economic Potential in Reference Case

Battery costs continue to fall rapidly

Car manufacturers develop wide range of EV models with ~300 mile range

Home or work charging is available for most drivers

EV maintenance costs are lower

NG prices remain low, moderate increase in oil price

ICEV fuel economy continues to improve

Economic Potential

EV / PHEV are most economical choice for **75%** of potential new vehicle decisions by **2030**

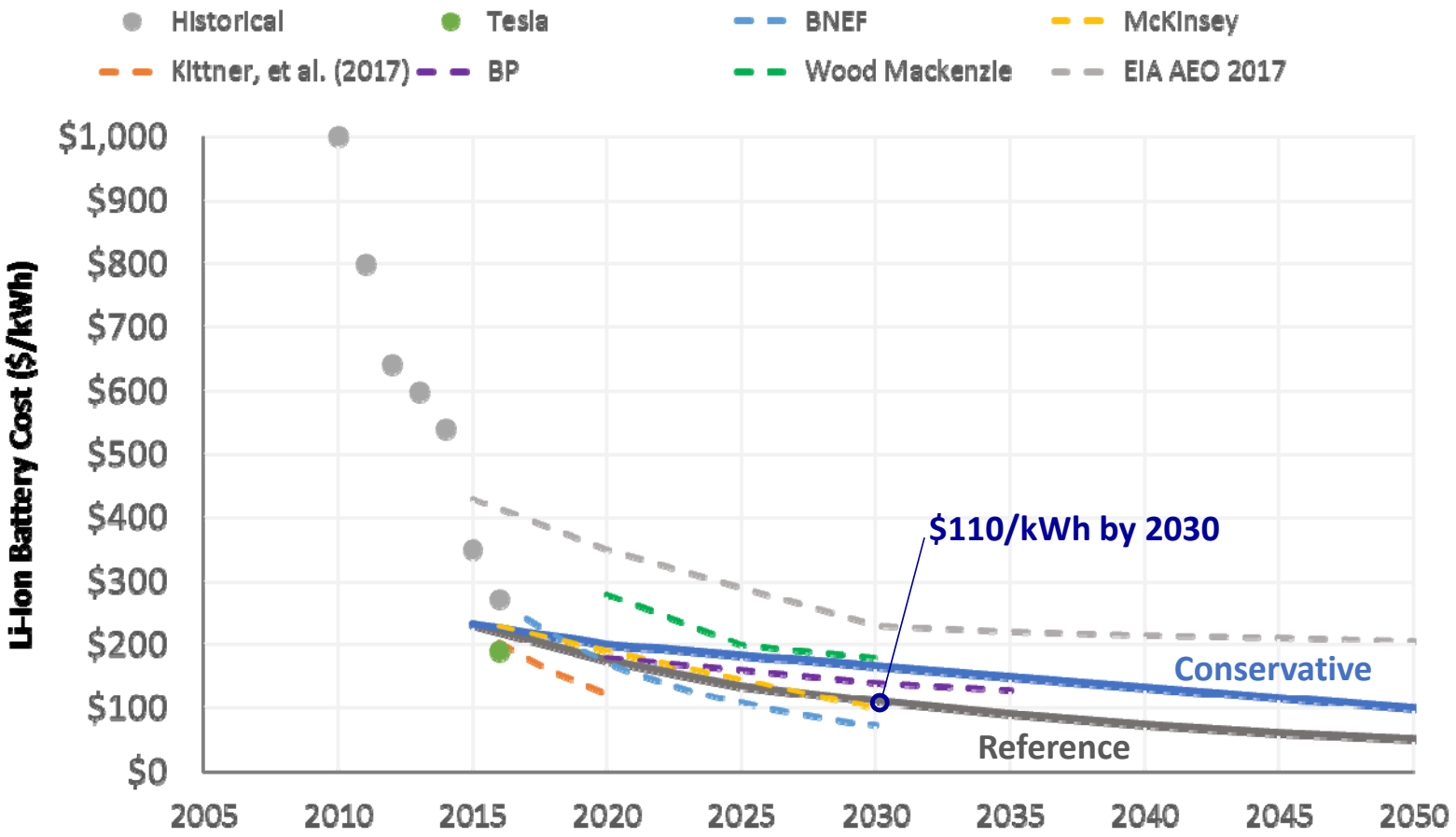
(90% by 2050)

Adoption

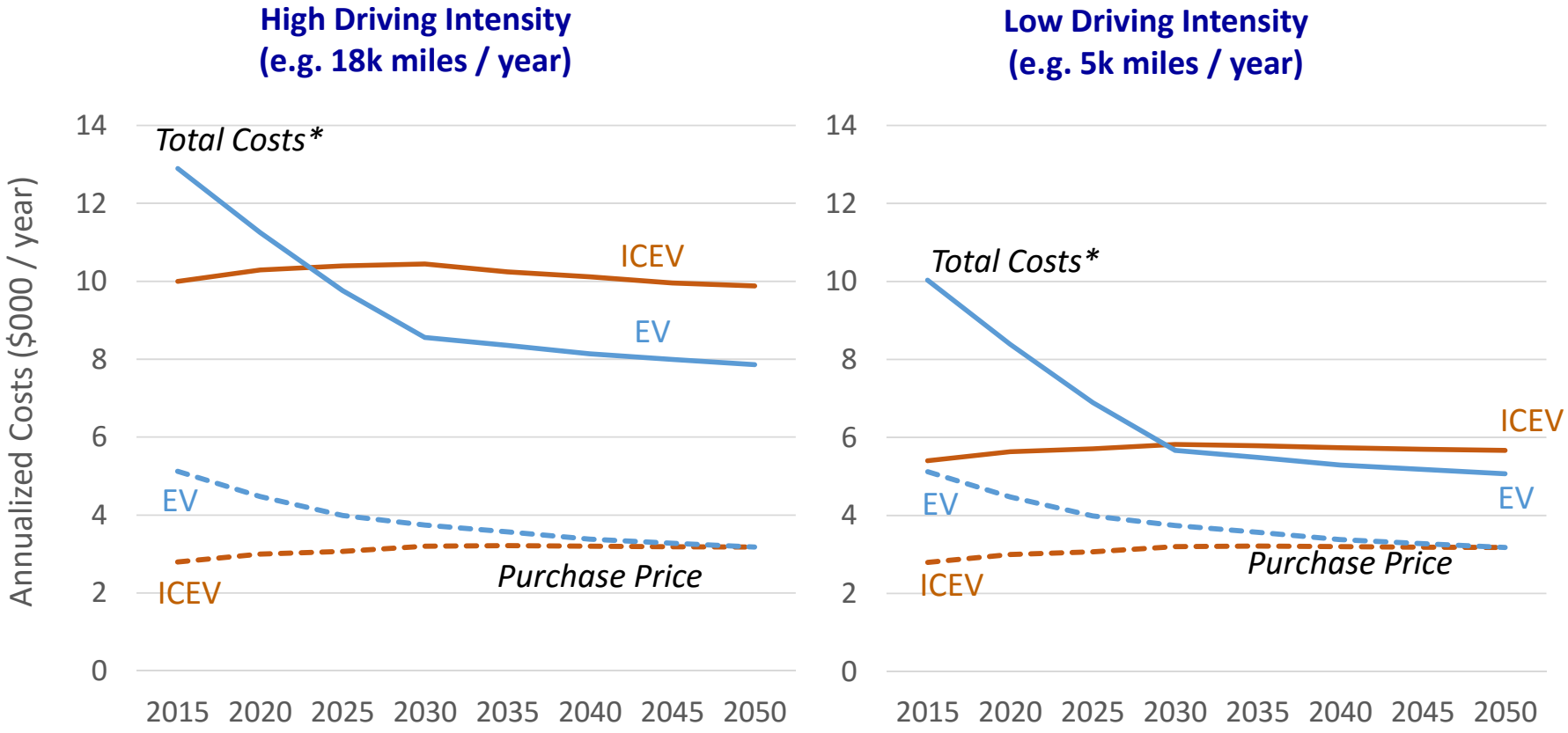
EV / PHEV represent **40%** of new vehicle market by **2030**

(75% by 2050)

Battery Cost Projections



Passenger Vehicle Cost Trade-offs for Representative Household

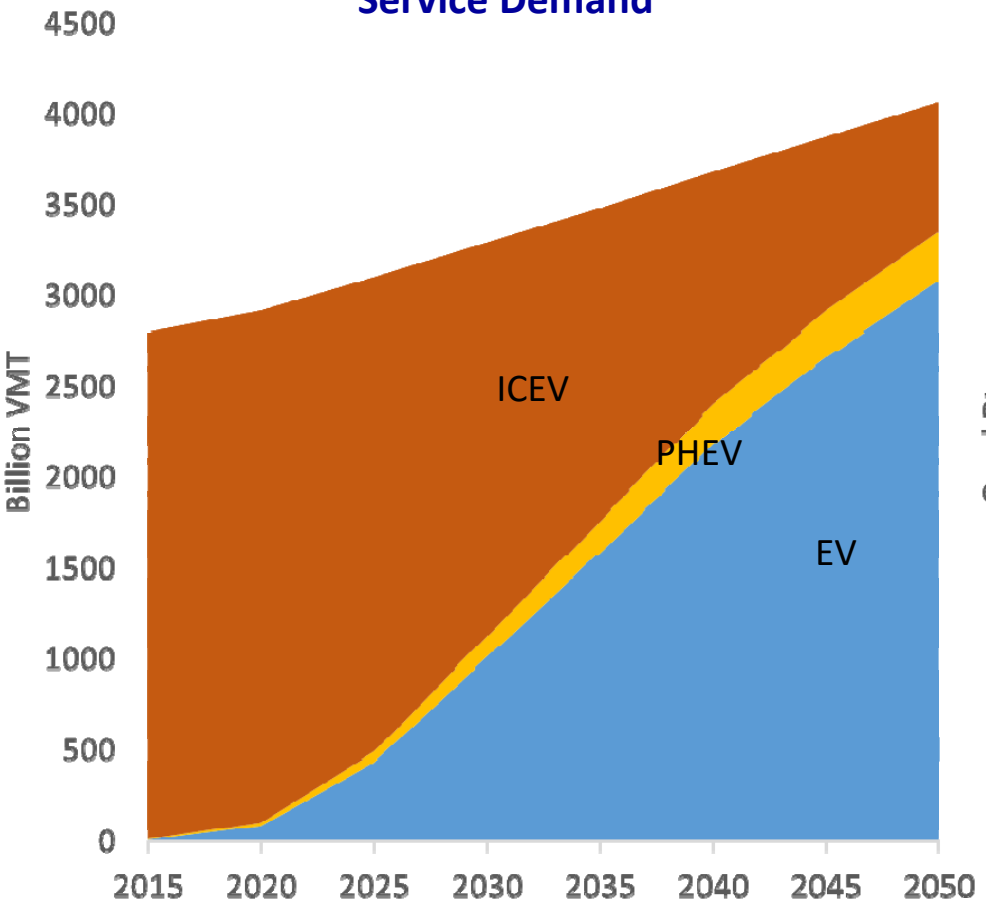


* ***Total Costs*** include fuel, maintenance, charging equipment, and estimated "disutility" associated with range limitations, model availability, etc.

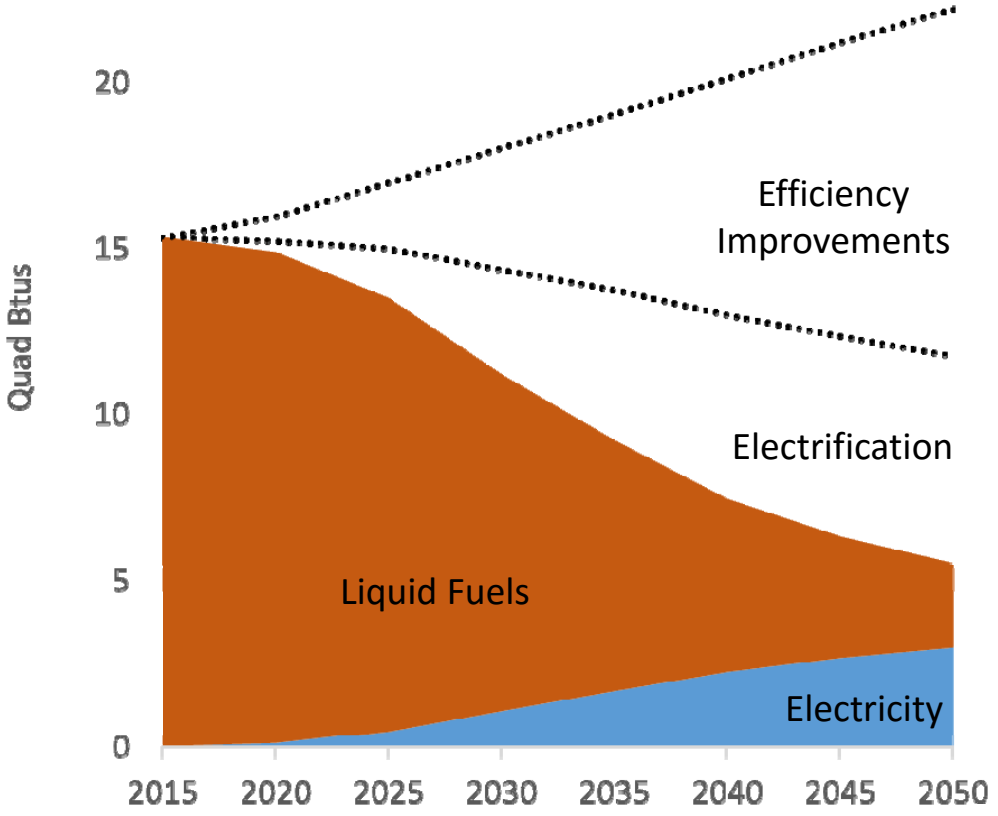
Based on suburban household in NE-Central model region

Reference Projections for US Light-Duty Vehicles

Service Demand



Final Energy



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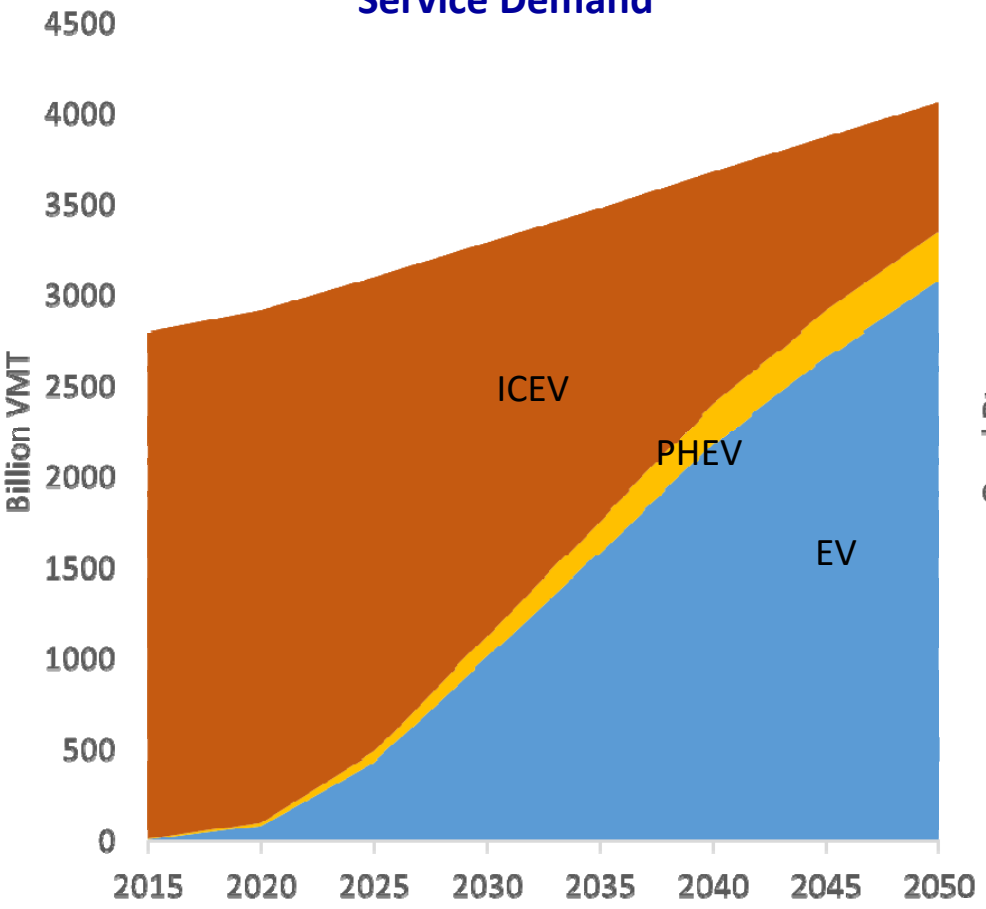
Reference Projections for US Light-Duty Vehicles

Service Demand



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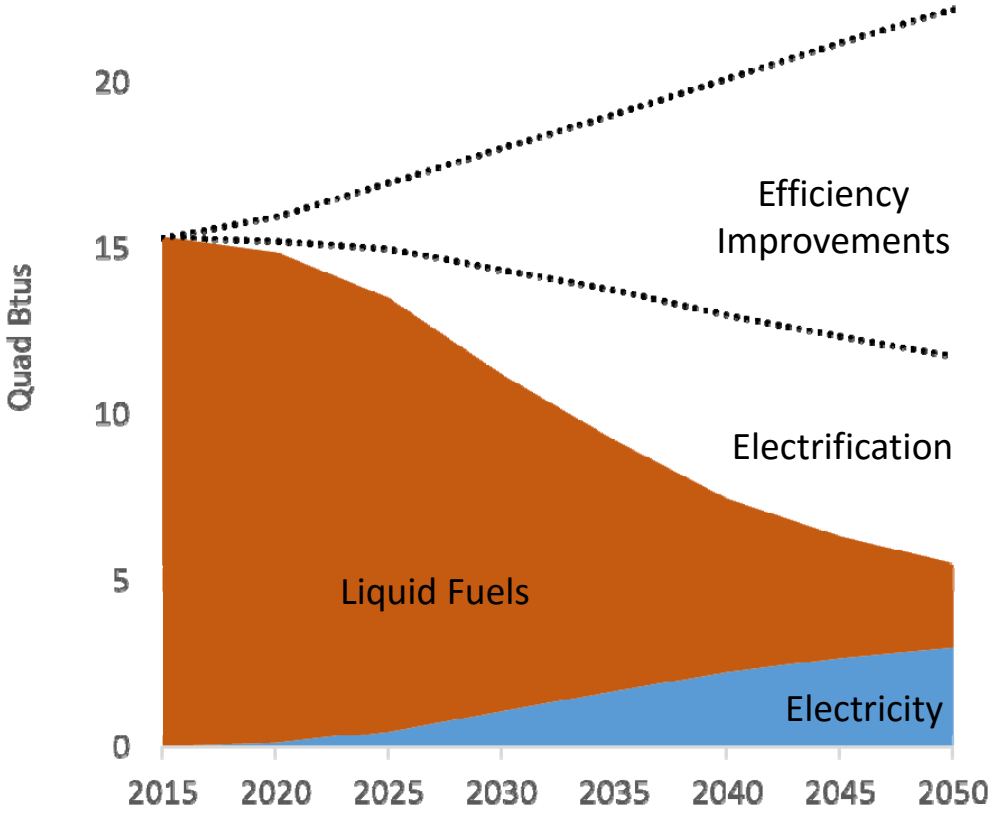

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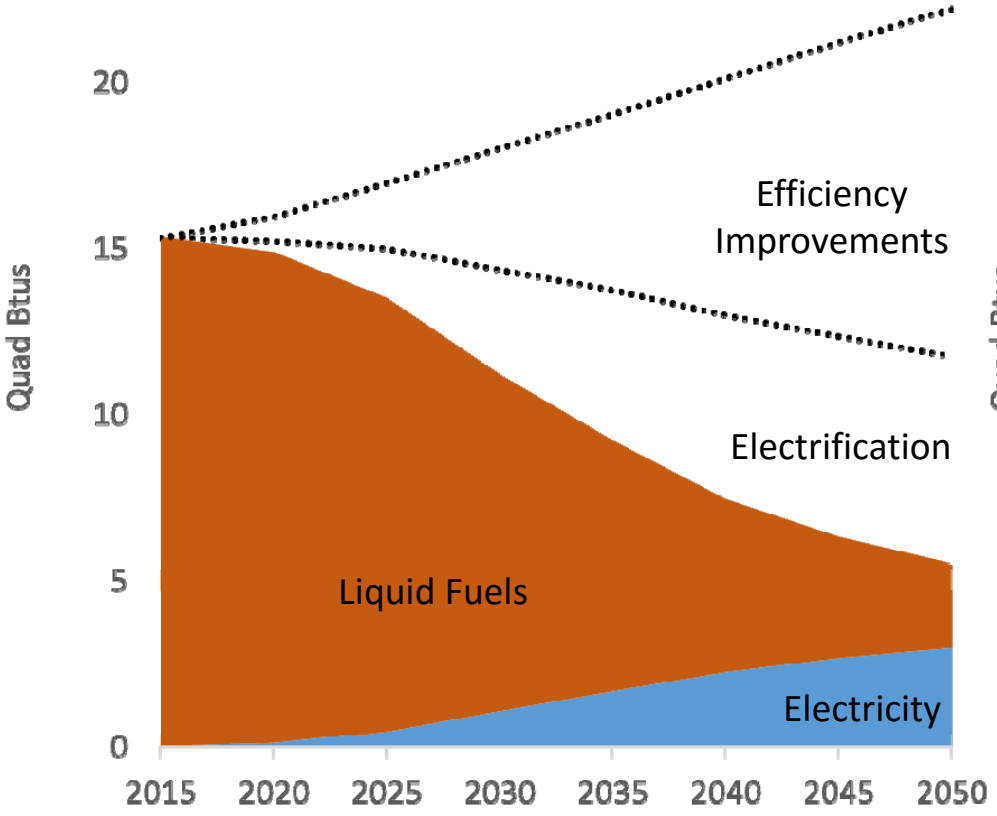
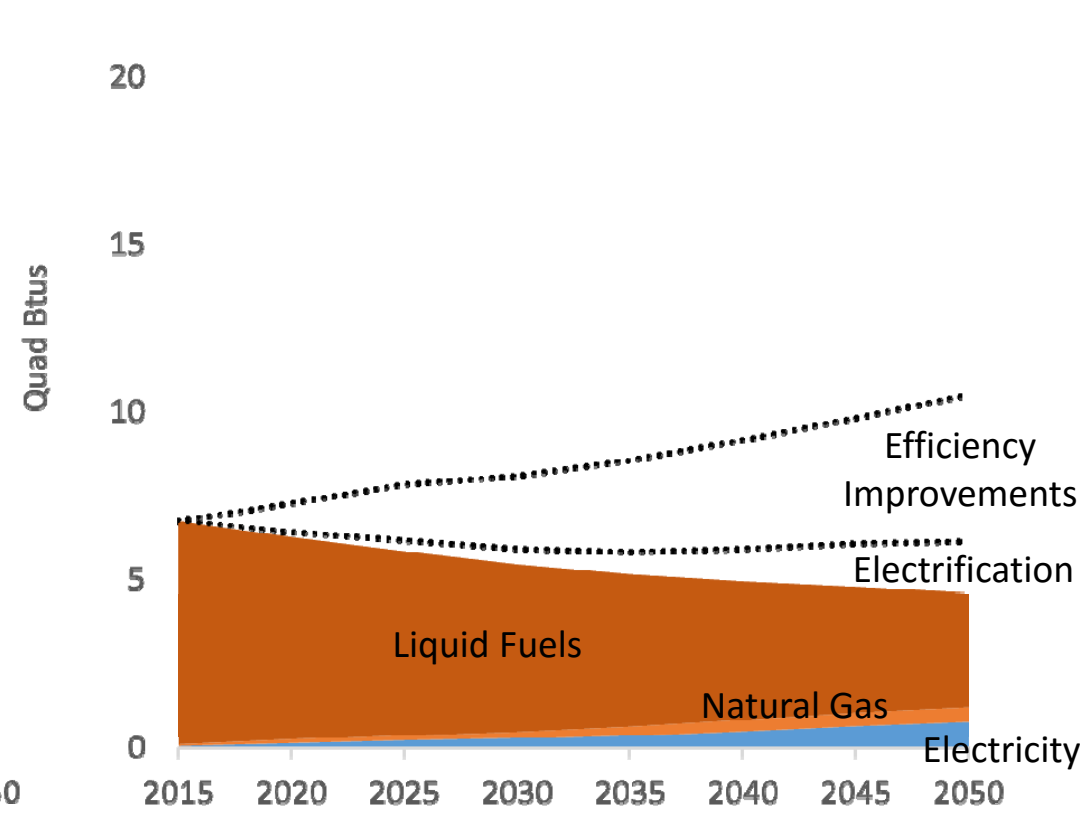
Reference Projections for All Highway Vehicles Final Energy

Light-Duty Vehicles



Trucks and Buses



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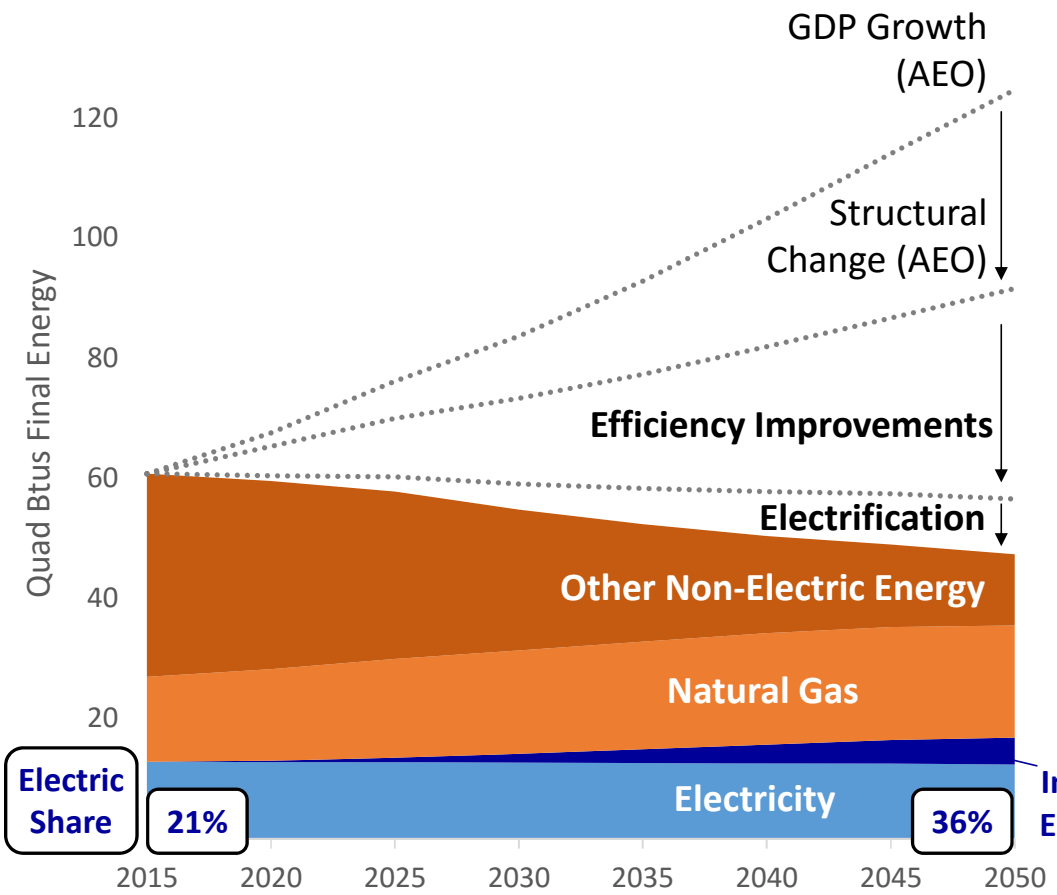
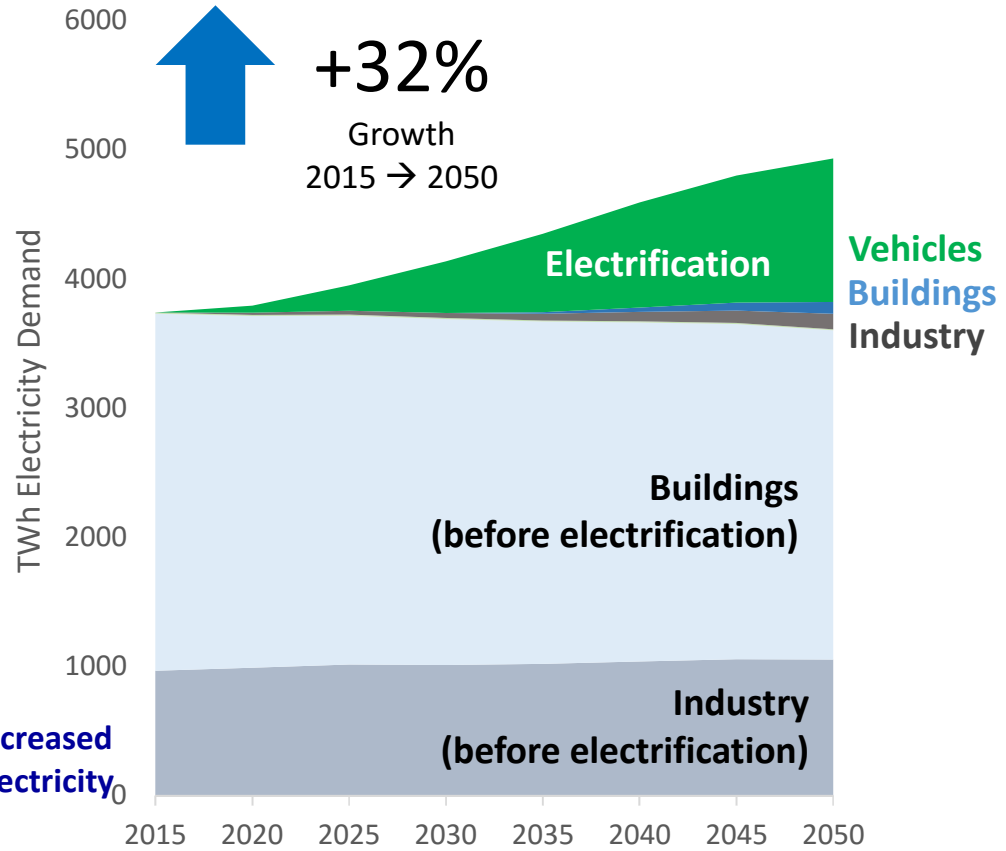
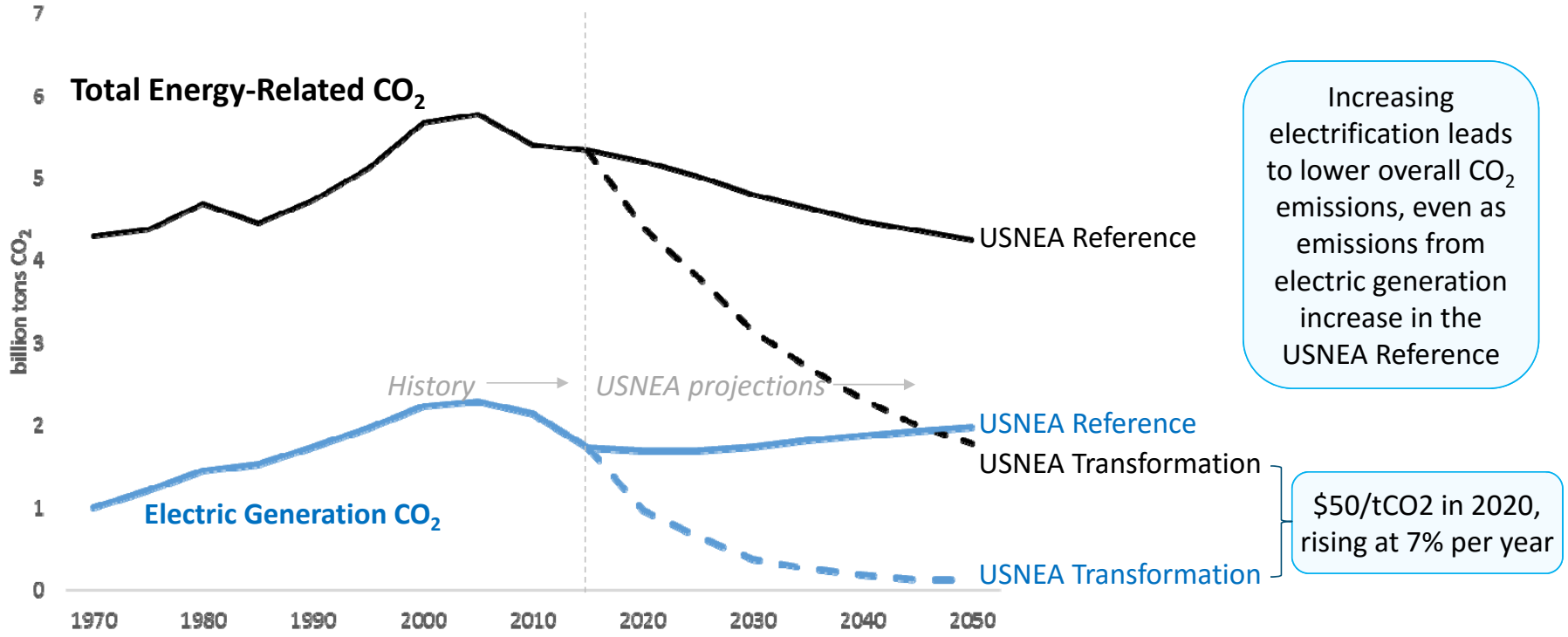
Efficient Electrification: Reference Scenario



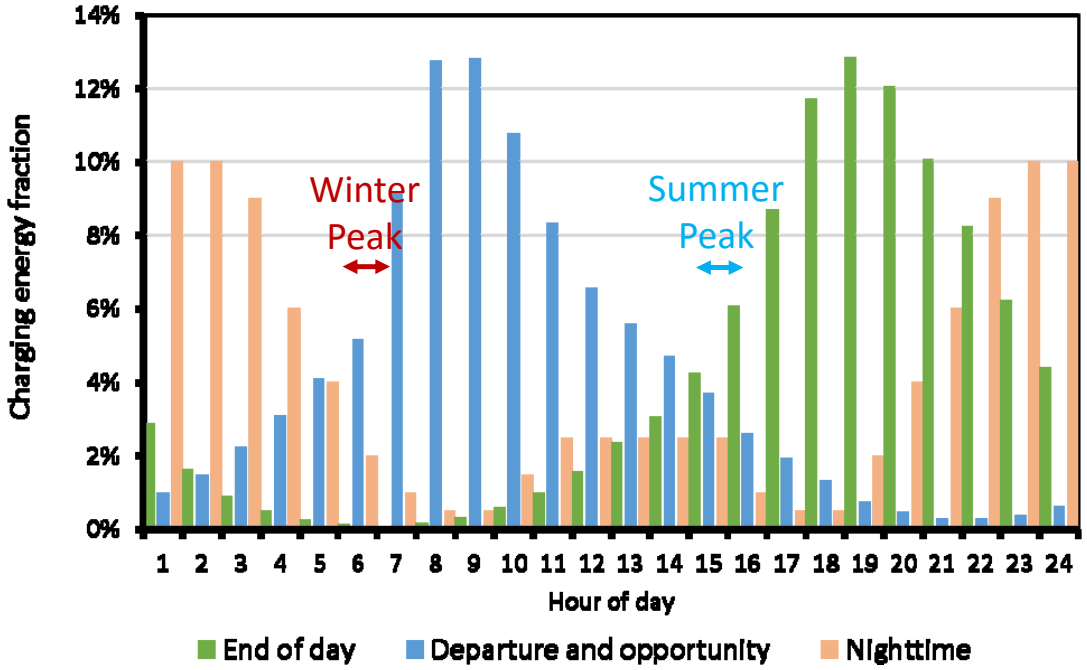


Total and Electric Generation CO_2 Emissions



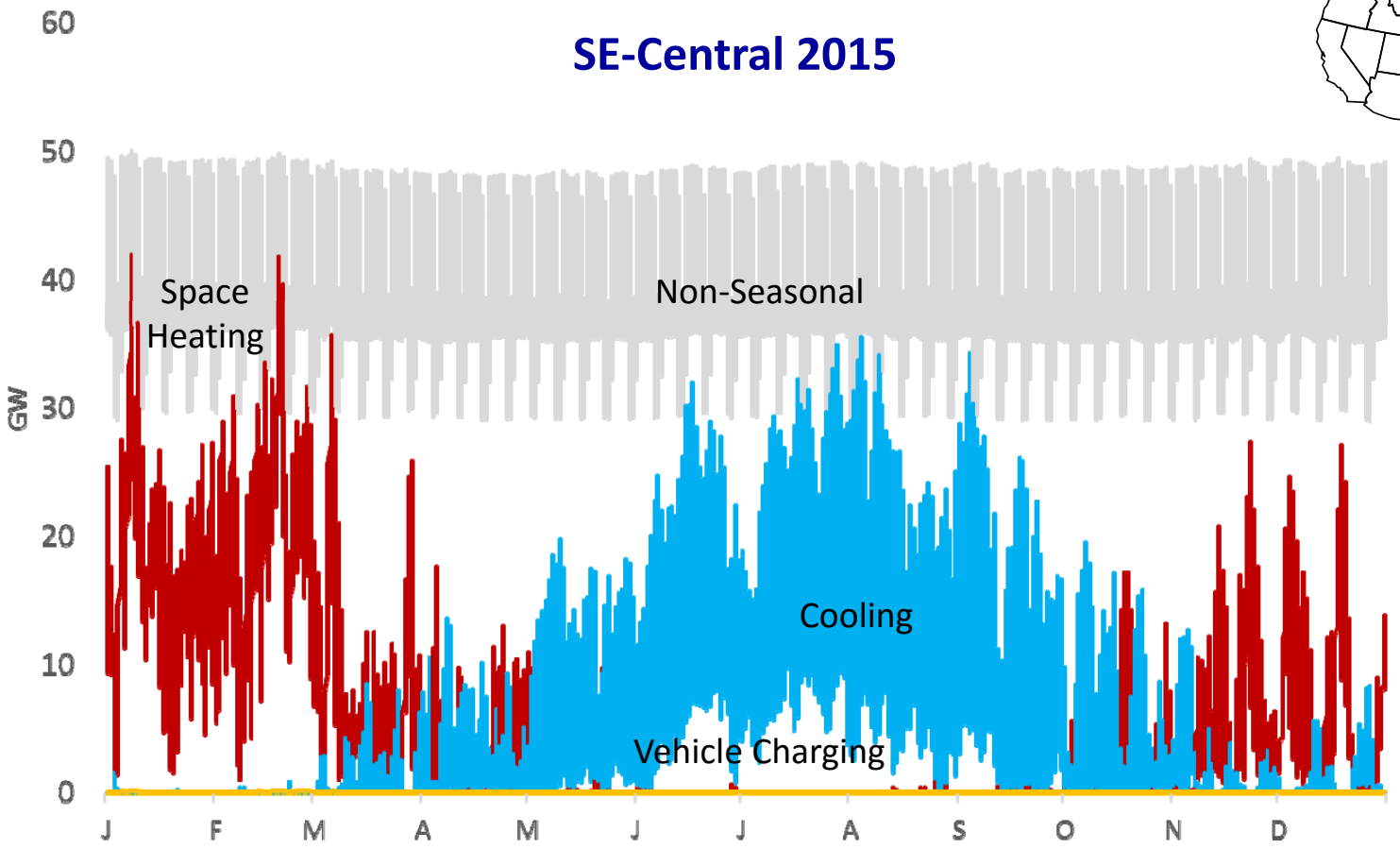
When are vehicles charged?

- EPRI-NRDC (2015) developed three different charging profiles:

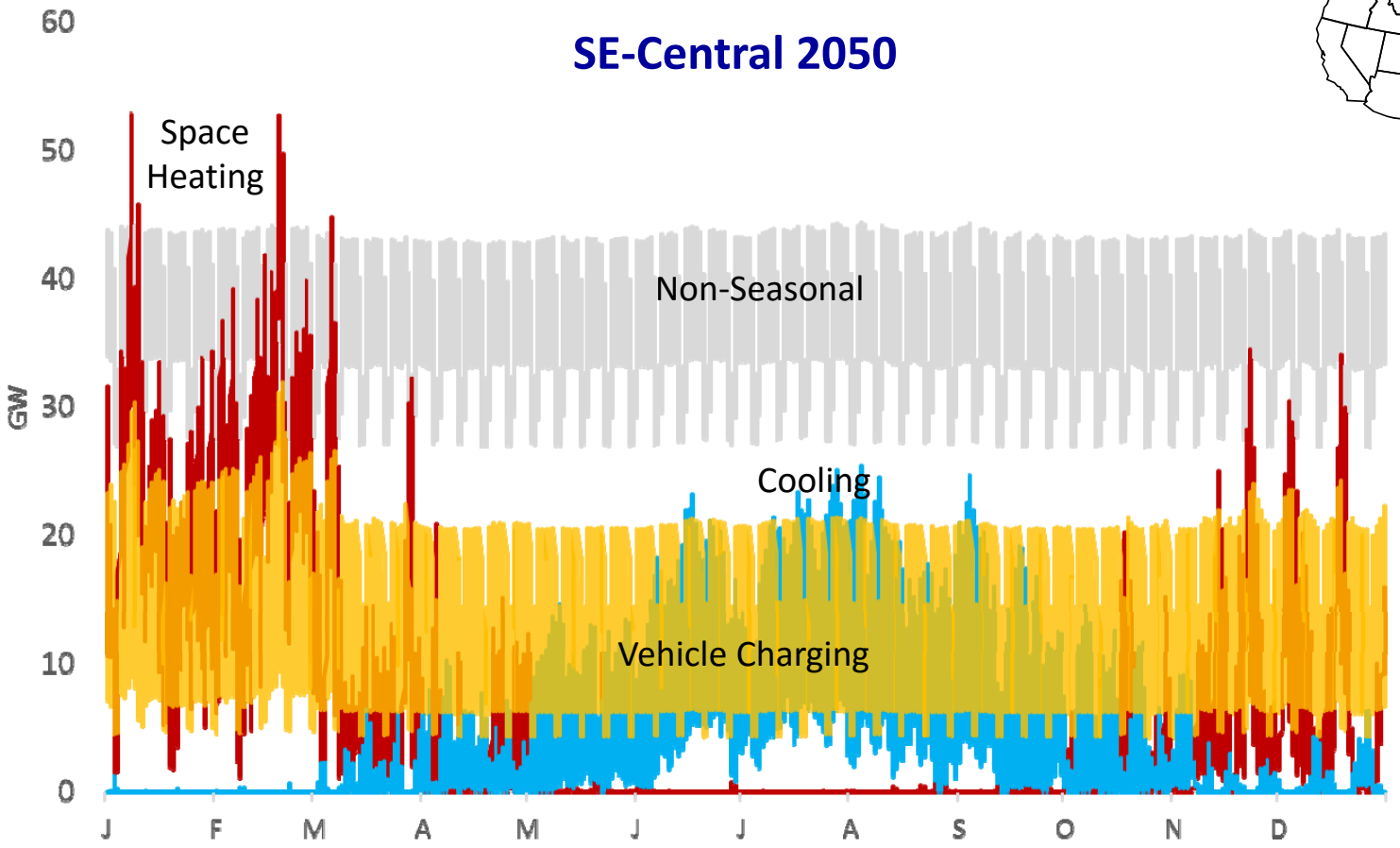


- USNEA assumed a mix over these three profiles (starting point)

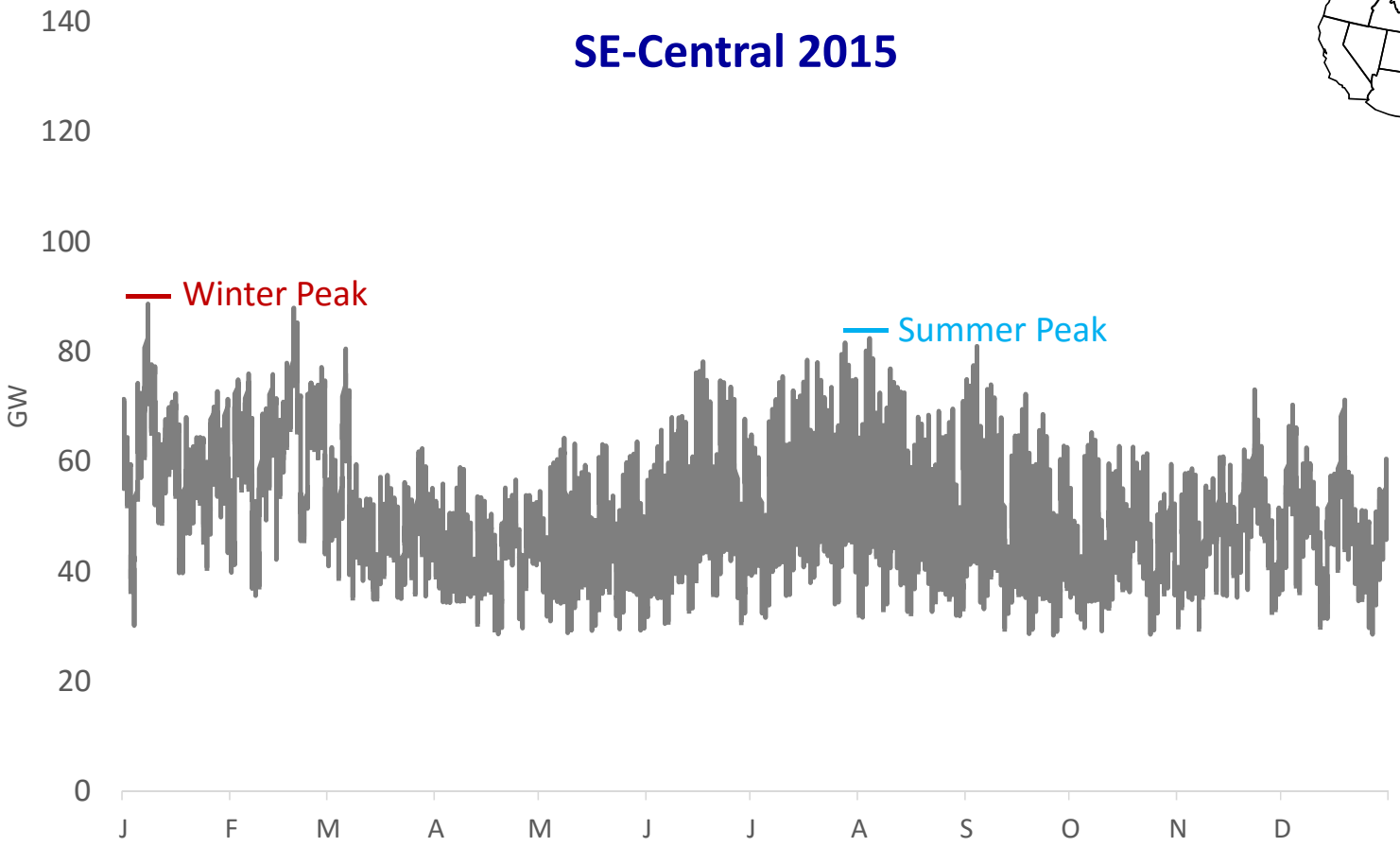
Base Year Load Shape Reflects Current Technology Stock



Reference Projections Reflect Electrification / Efficiency



Aggregate Load Shape Already Has Winter Peak in Some Regions



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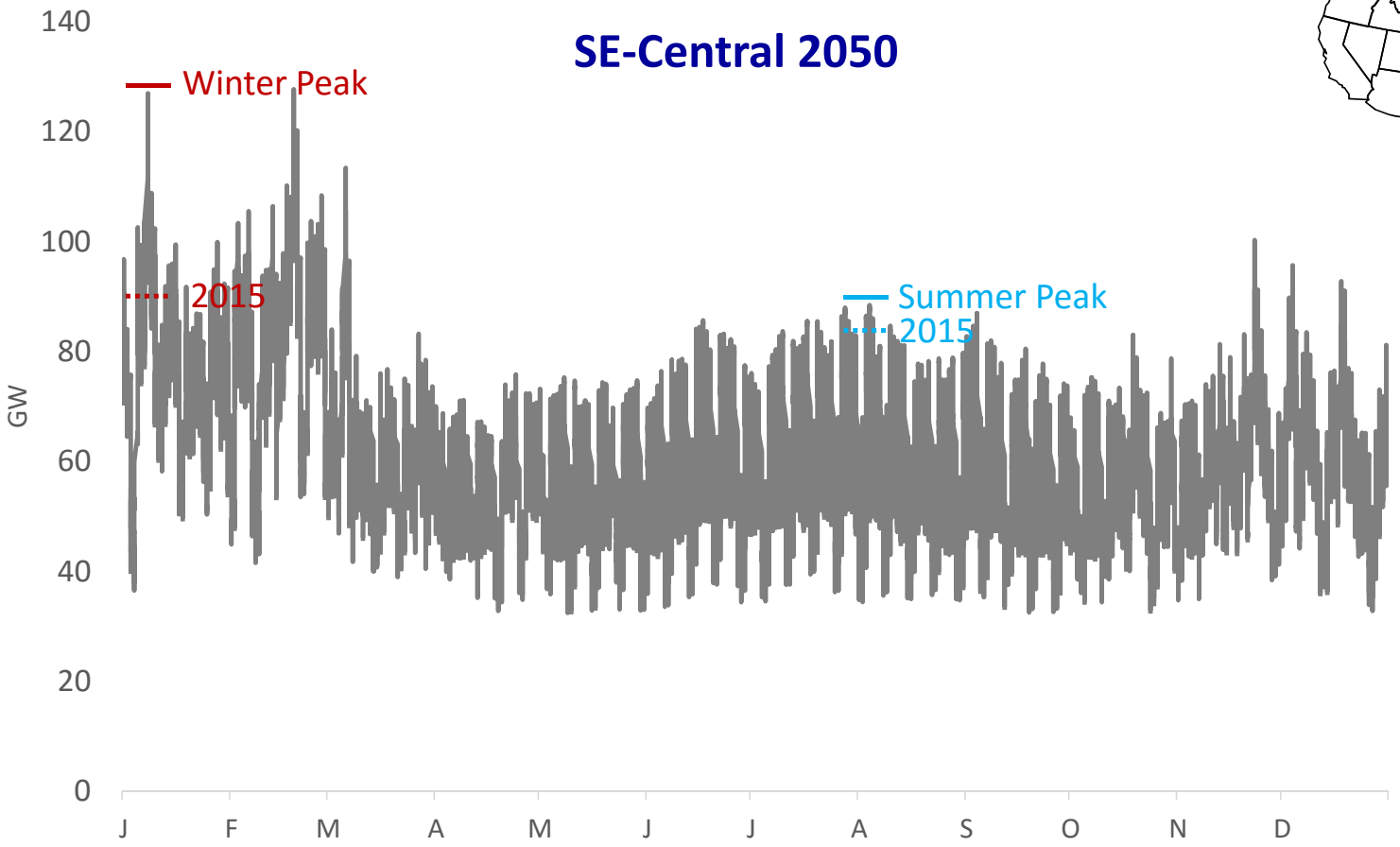
Aggregate Load Shape Changes from Electrification and Efficiency



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Key Messages

- Electrification technologies for transportation are developing rapidly and could soon offer strong economic advantages
- Emissions advantages are clear for CO_2 even without explicit CO_2 policy for generation
  - Air quality requires more detailed modeling → forthcoming
  - Previous studies (e.g. EPRI-NRDC, 2015) have shown benefits
- Vehicle charging will be an important new load shape with seasonal winter peak and opportunities for diurnal flexibility
- Autonomous vehicles / mobility-as-service could transform passenger vehicle sector and accelerate electrification

Together…Shaping the Future of Electricity