

Electricity Scenarios and the Need for Infrastructure

Tom Wilson

Principal Technical Executive
Energy and Environmental Analysis, EPRI



iiESI International Conference on Systems Integration

Golden, CO
6 December 2017

EPRI – Born in a Blackout

Founded in 1972 as an independent, nonprofit center for public interest energy and environmental research



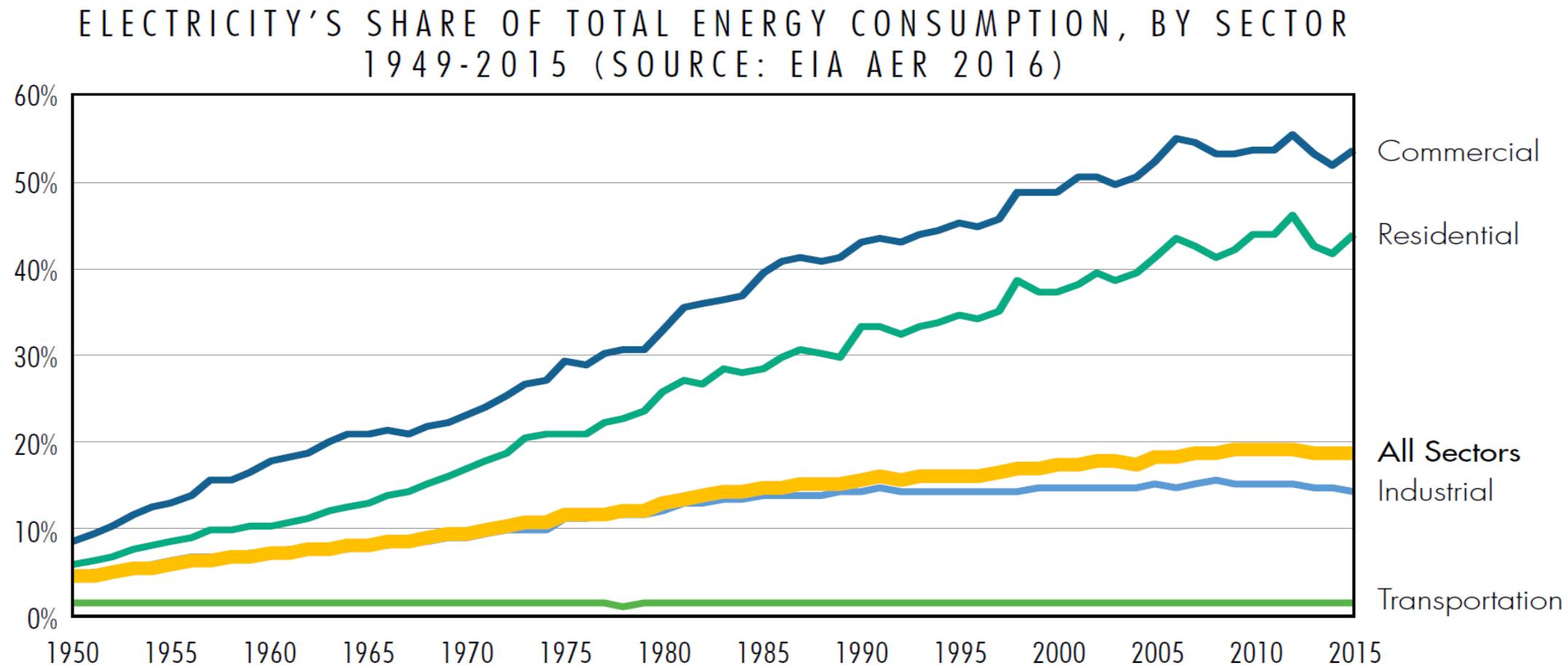
New York City, The Great Northeast Blackout, 1965

Our Members...

- 450+ participants in more than 30 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding – nearly 25% of EPRI's research, development, and demonstrations



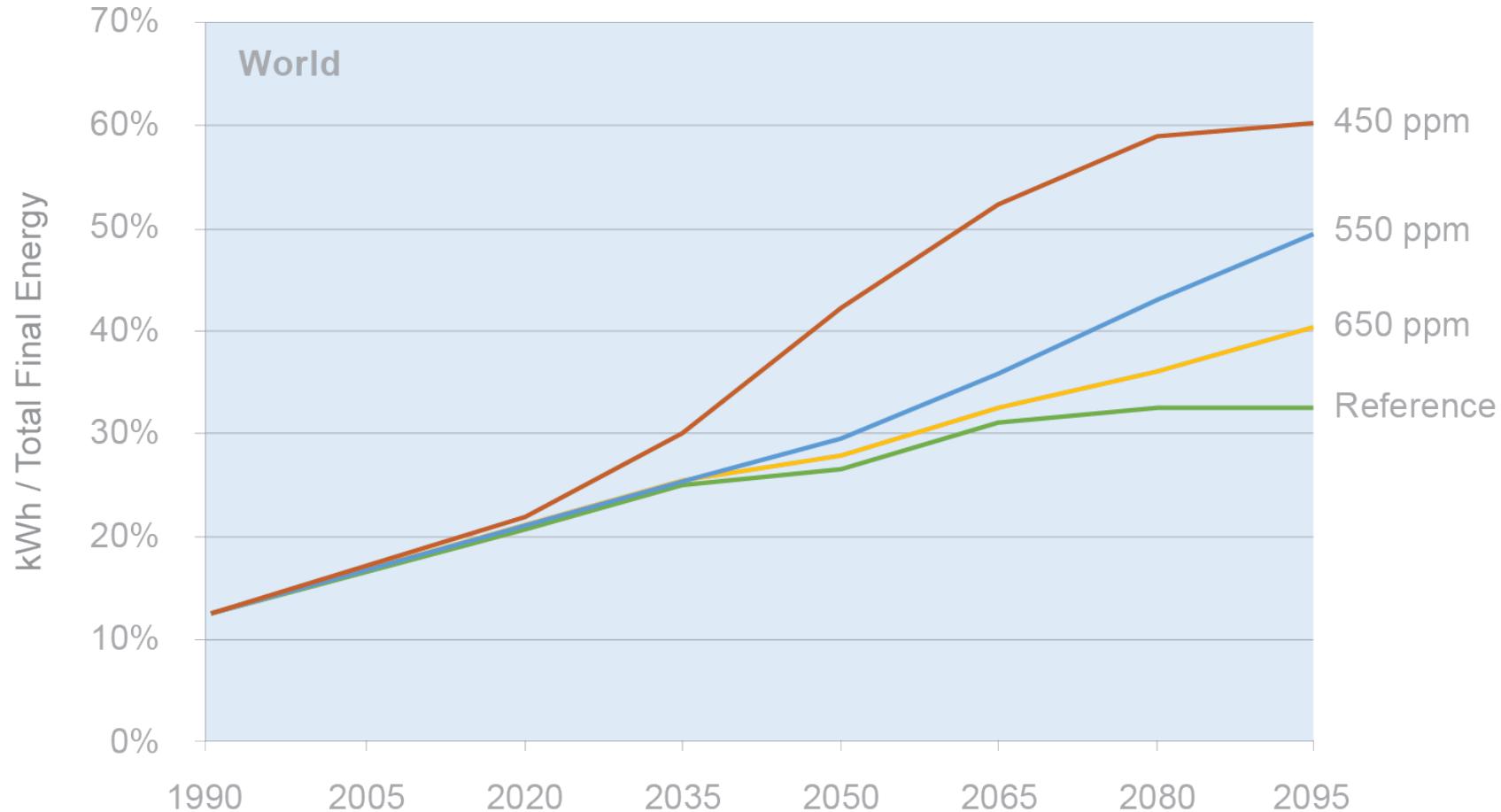
Electricity Use Has Grown Faster than Total Energy for More than A Century... What Will or Could Happen Next?



Growth Driven By Efficiency, Convenience, Safety, and Low Cost

One Driver Could be Electricity's Role in Decarbonization

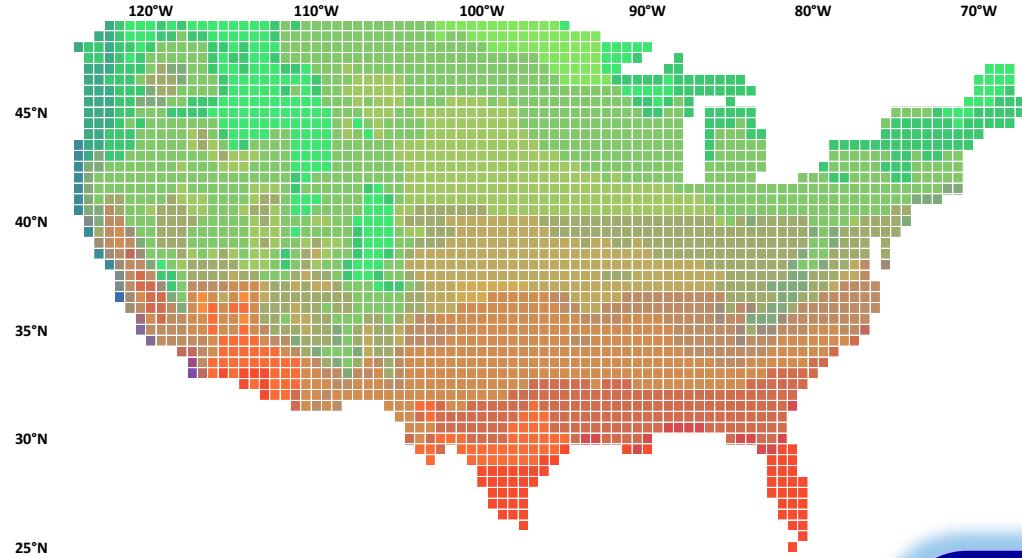
The Tighter the CO₂ Cap,
The Greater the Role Electricity Plays



Edmonds, Wilson, Wise, Weyant, 2006 *Environmental Economics and Policy*.

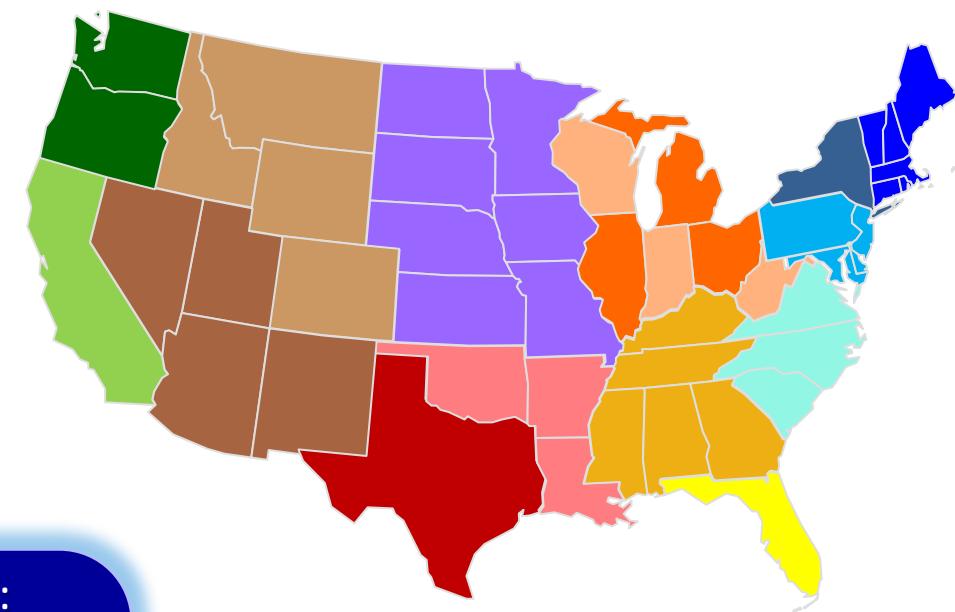
Preview of US National Electrification Assessment – Forthcoming Q1 2018

Energy Use



Synchronized
↔
Hourly Load,
Renewables,
and Prices

Electric Generation



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

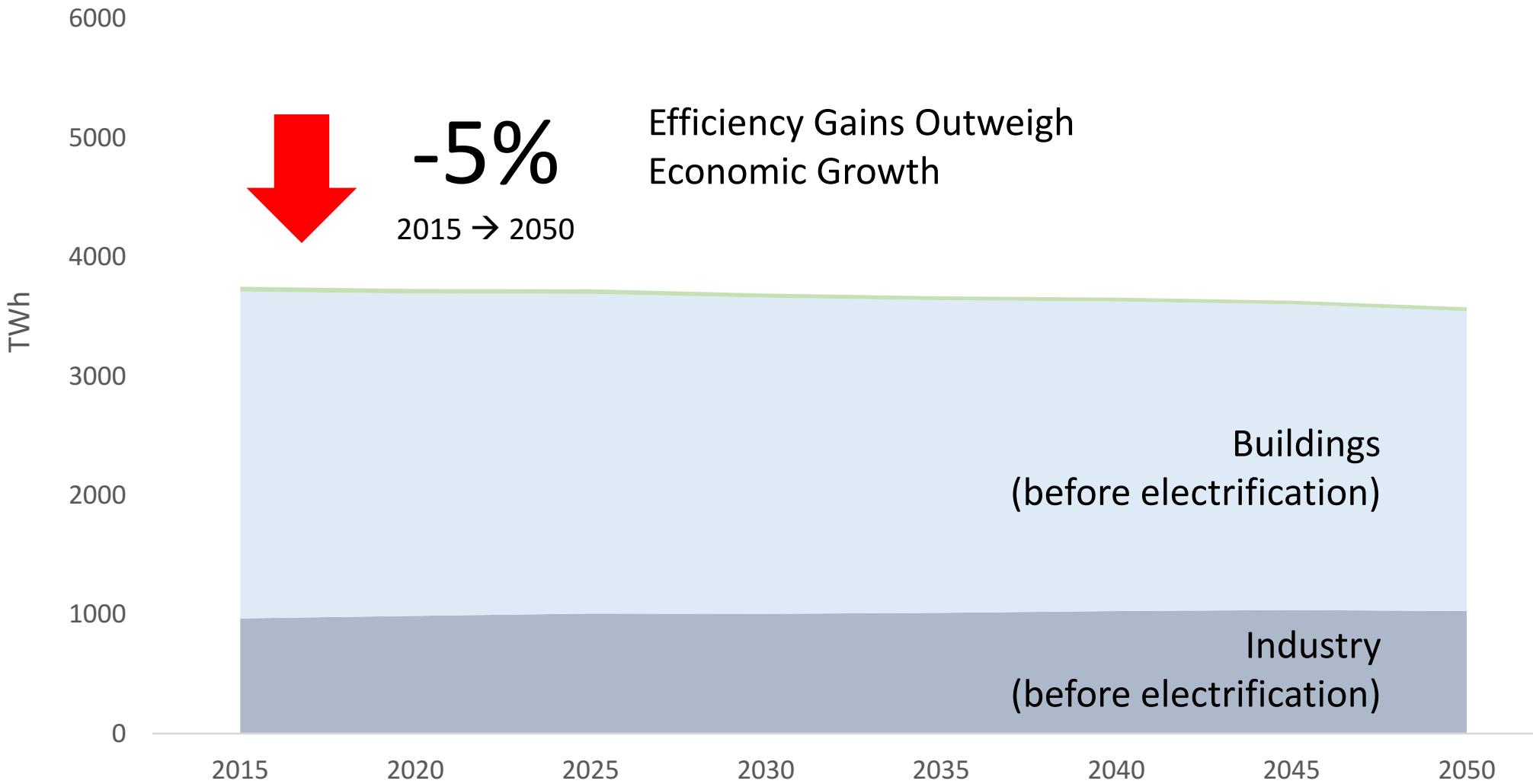
Model Outputs:

Economic equilibrium
for generation, capacity,
and end-use mix

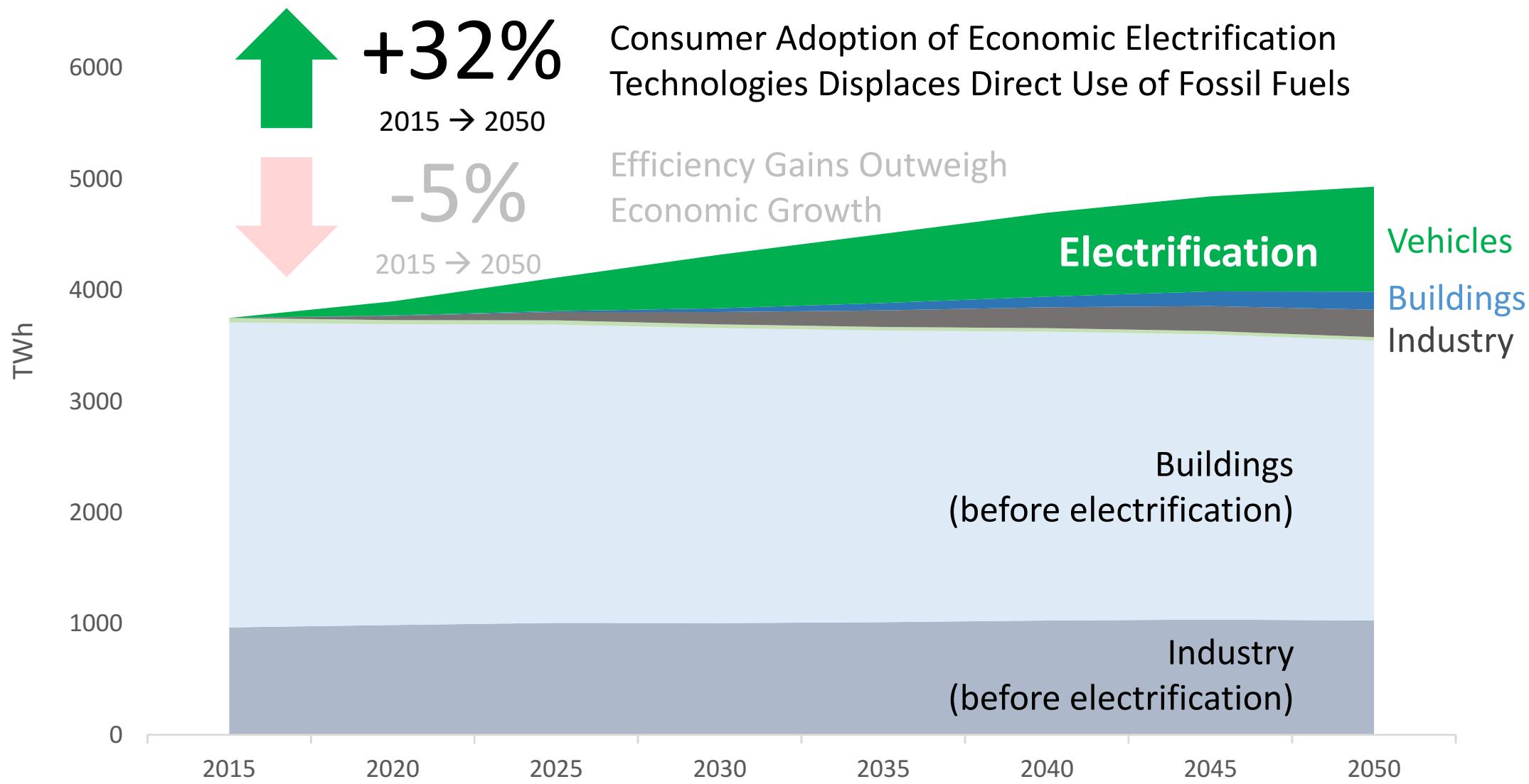
Emissions, air quality,
and water

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

For Traditional Electric Loads, Efficiency Gains Likely to Exceed Population and Economic Growth



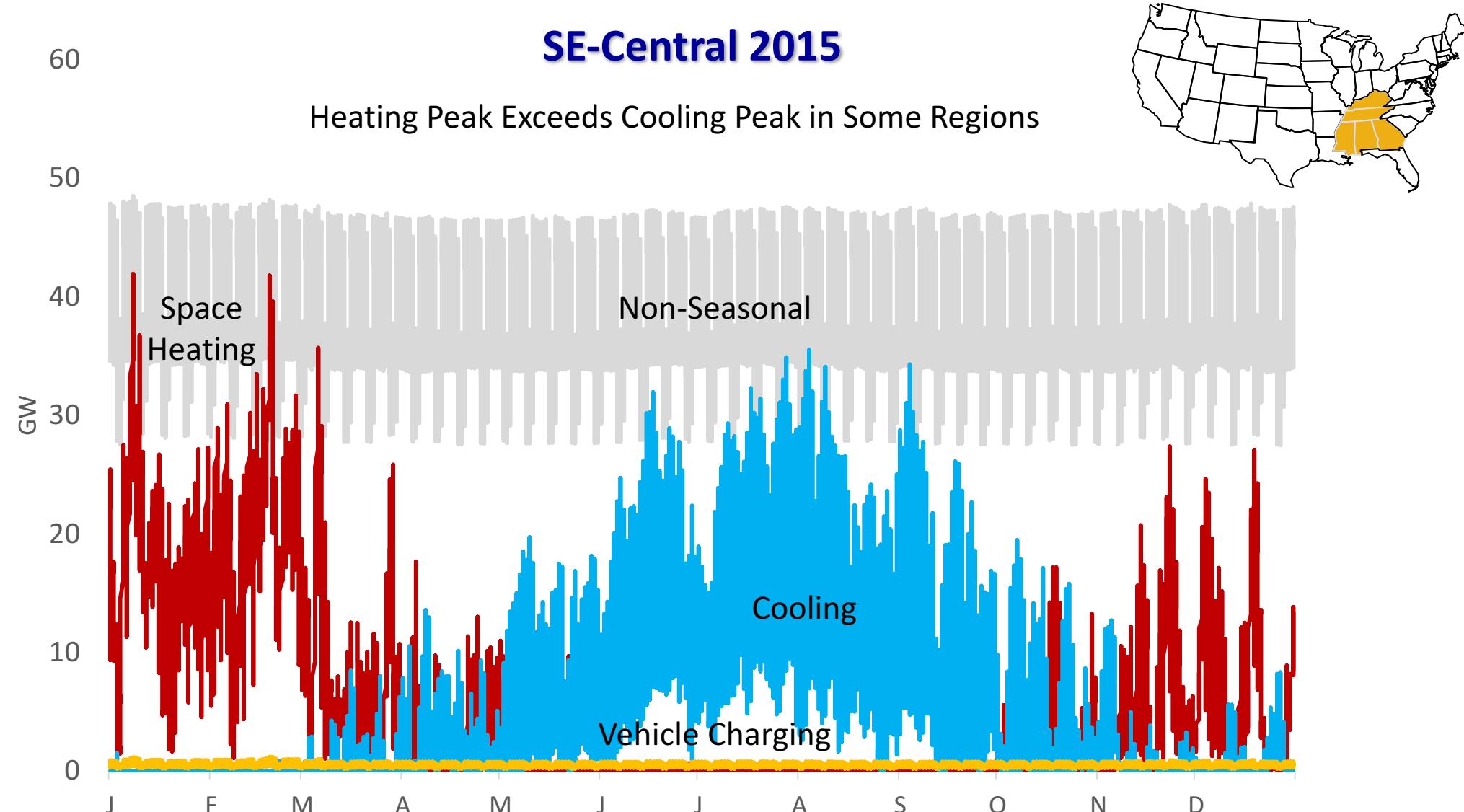
Load Growth Driven by Electrification



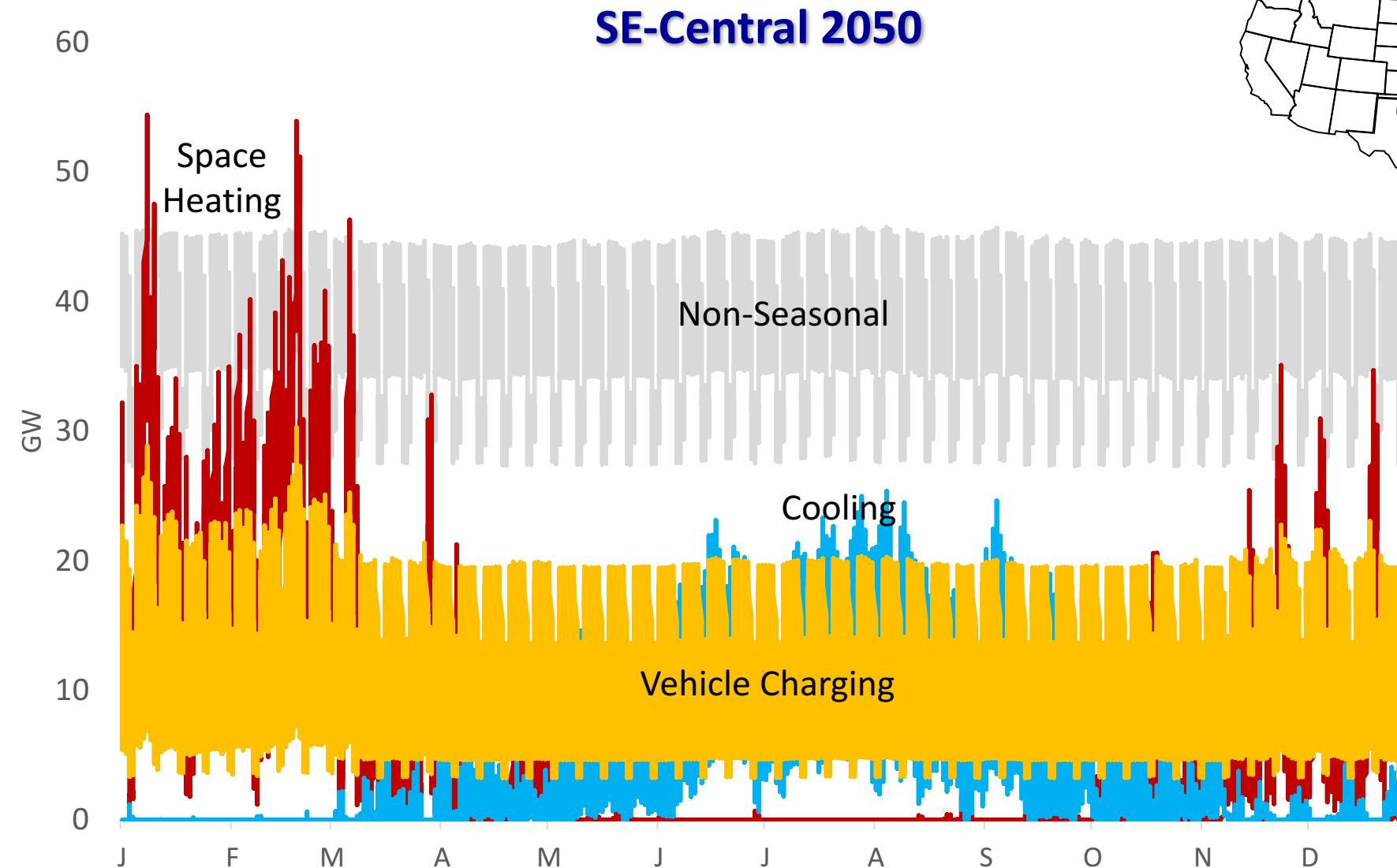
8 Assumes technology-driven adoption only

© 2017 Electric Power Research Institute, Inc. All rights reserved.

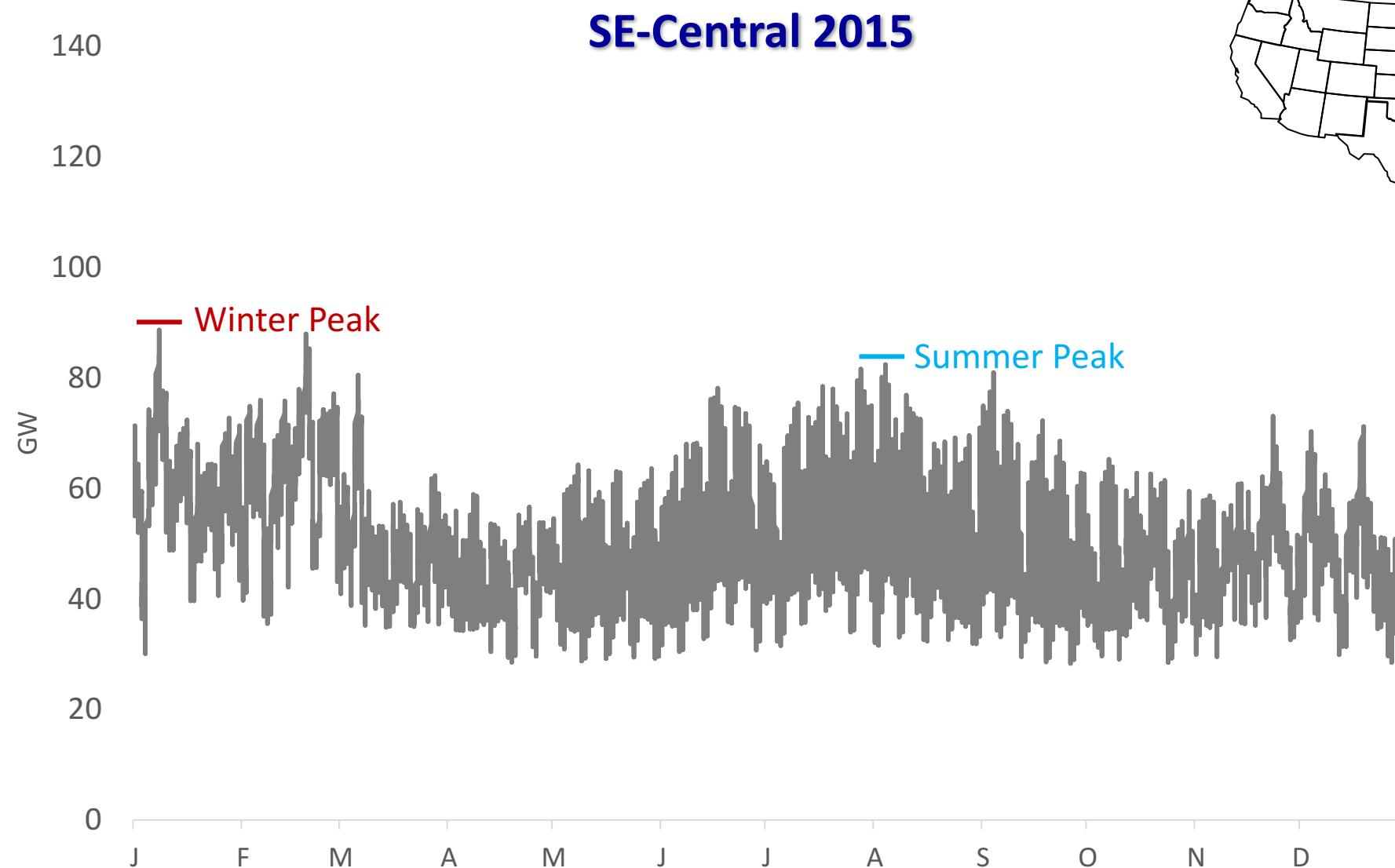
Load Shape Changes...Electrification and Efficiency Impact



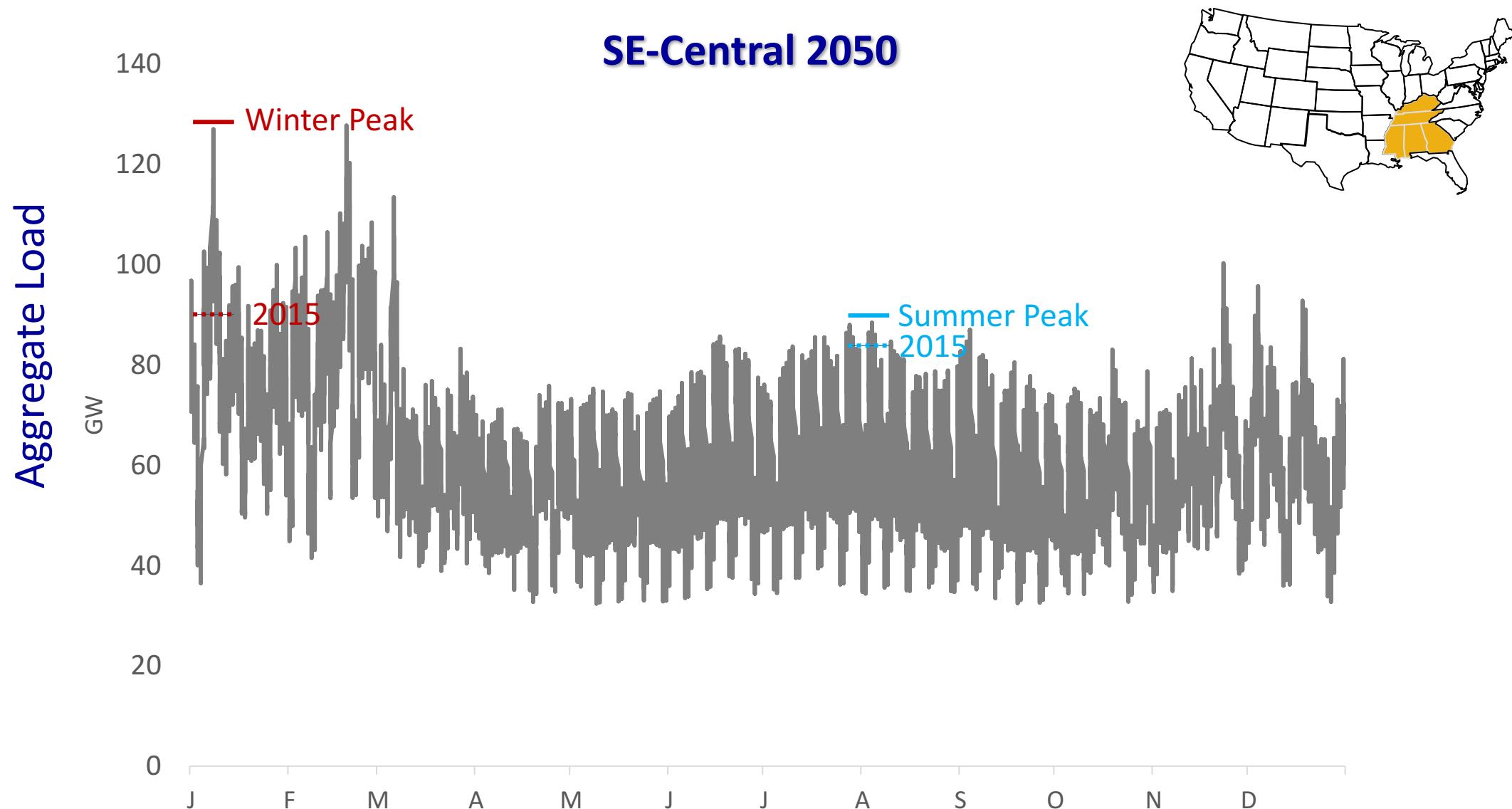
Load Shape Changes...How Will This Impact Supply Mix/Grid Assets?



Hourly Load Shape Aggregated Across Uses



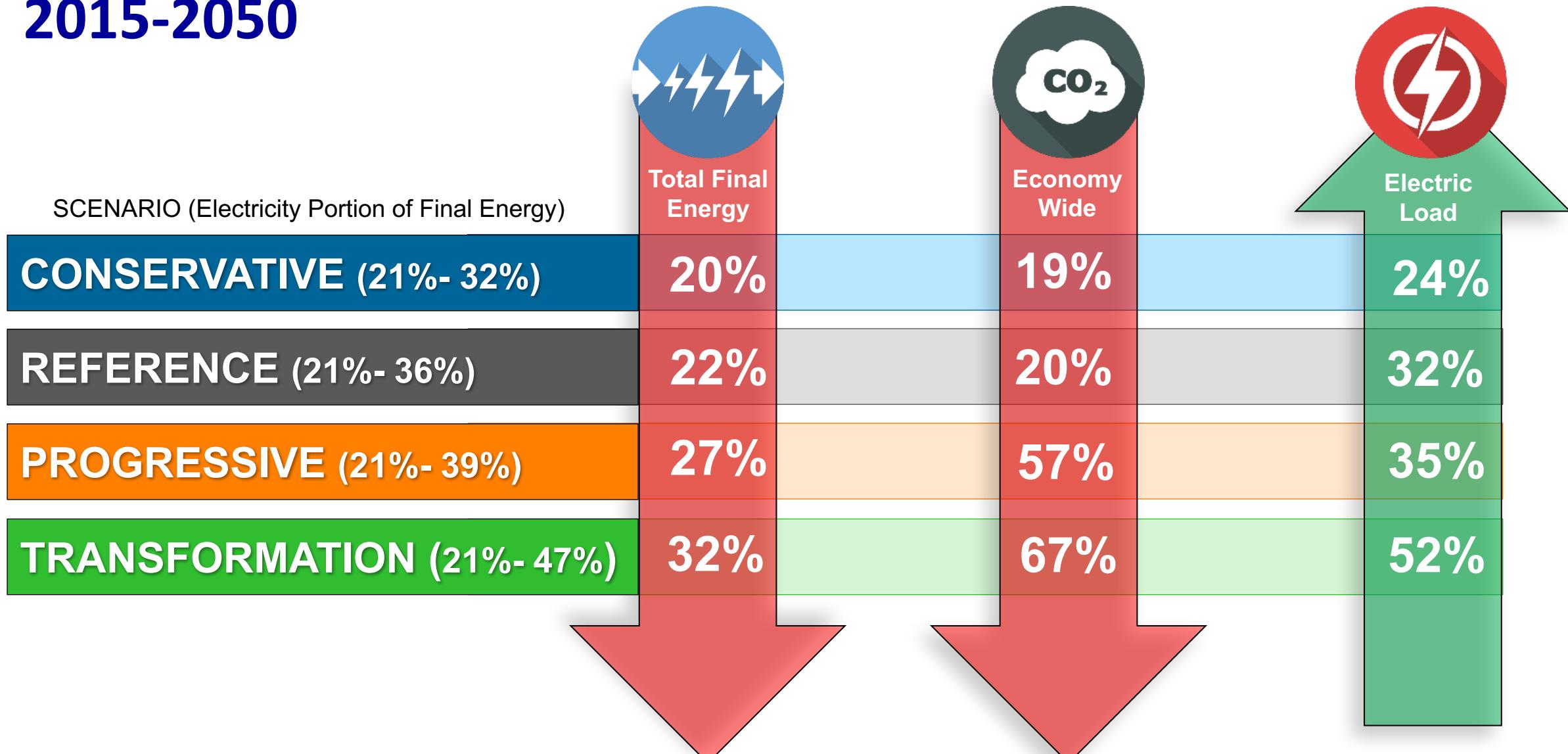
Load Shape Changes...How Will This Impact Supply Mix/Grid Assets?



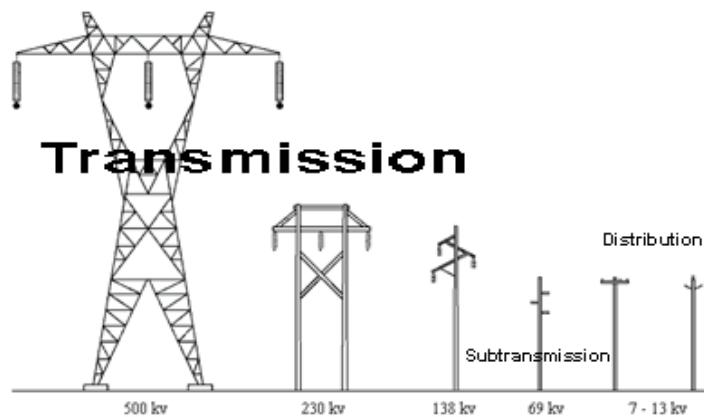
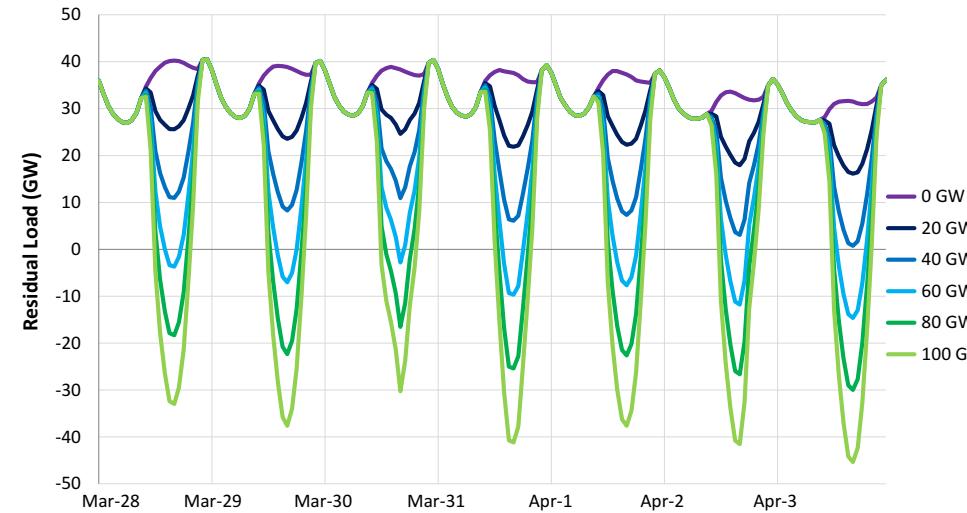
Key Assumptions for NEA Scenarios

	CONSERVATIVE	REFERENCE	PROGRESSIVE	TRANSFORMATION
Light-duty vehicle costs	Slower decline in battery costs	EPRI/ANL estimates	EPRI/ANL estimates	EPRI/ANL estimates
Other technology costs	EPRI estimates	EPRI estimates	EPRI estimates	EPRI estimates
Efficiency Improvements	EPRI estimates	EPRI estimates	EPRI estimates	EPRI estimates
Economic growth / service demands	AEO 2017	AEO 2017	AEO 2017	AEO 2017
Primary fuel prices (NG, oil)	AEO 2017 Low Price Case	AEO 2017 Low Price Case	AEO 2017 Low Price Case	AEO 2017 Low Price Case
Electric sector policies	State RPS only	State RPS only	State RPS + \$15/tCO₂ in 2020, rising at 7%	State RPS + \$50/tCO₂ in 2020, rising at 7%
End-use sector policies	None	None	\$15/tCO₂ in 2020, rising at 7%	\$50/tCO₂ in 2020, rising at 7%

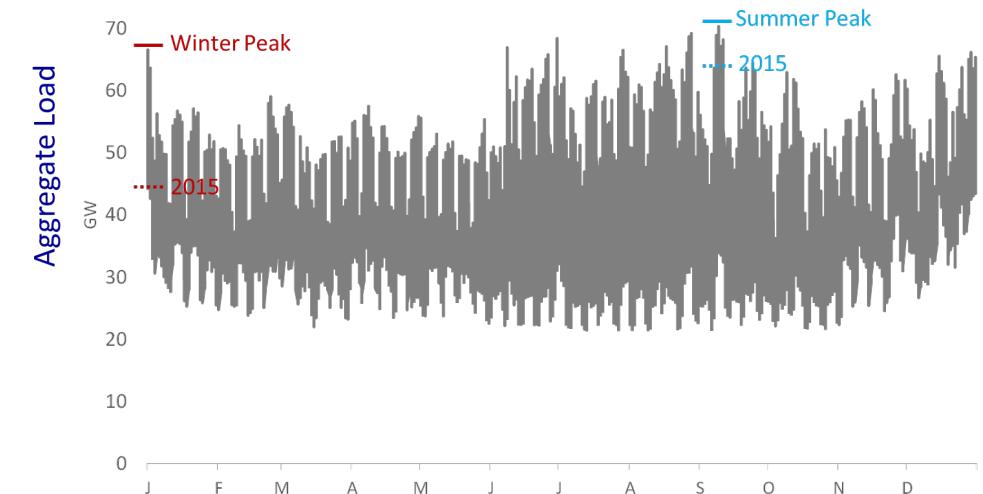
Scenario Impacts on Final Energy, CO₂, and Electric Load; 2015-2050



Supply and Demand Changes Require Grid Changes

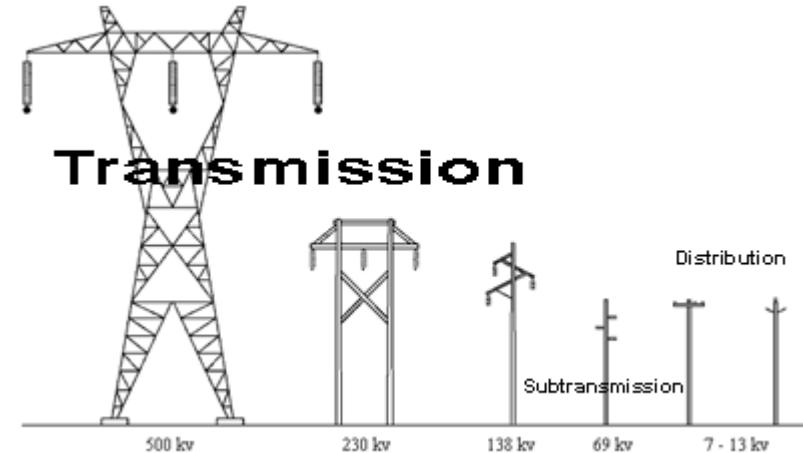


California 2050



Implications for Infrastructure

- New challenges/business models
 - For homes, system upgrades
 - For transport, EV charging infrastructure
 - California – daytime; Minnesota – nighttime
 - Matching supply resources with changing seasonal loads
- New opportunities
 - Potential for flexible electric loads – industrial, buildings, transport
- Increased risks/opportunities from integration
 - Expanded threat surface – physical/cyber security



EPRI Initiative on Efficient Electrification – Much More to Come



National Assessment
Q1 2018

Regional Assessments
2018-2019



Efficient Electrification
Newsletter

National Conference
August 20-23, 2018
Long Beach, CA
www.electrification2018.com

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

Together...Shaping the Future of Electricity



Industrial Centers
of Excellence



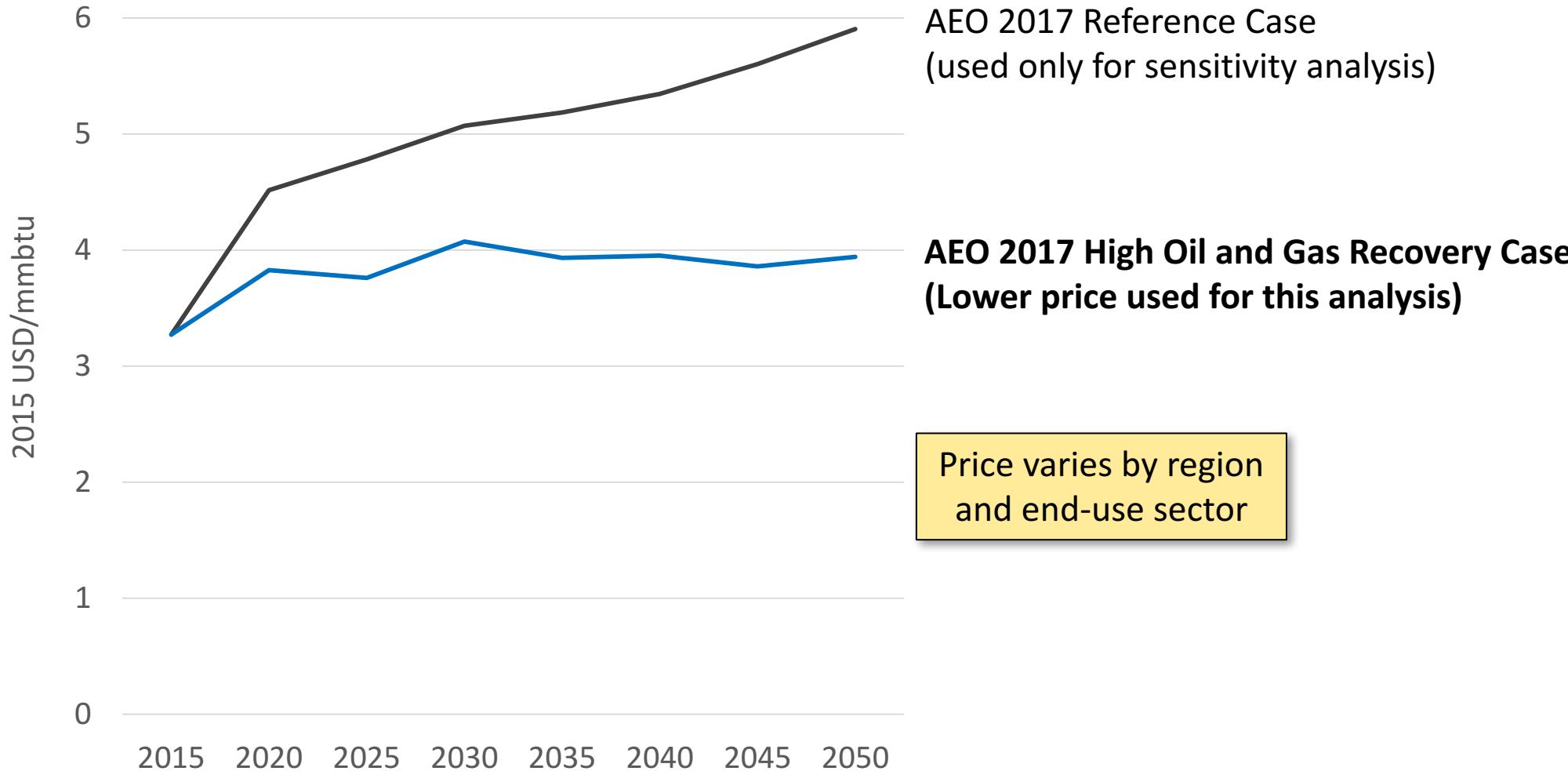
Efficient
Electrification
Research Project
Portfolio



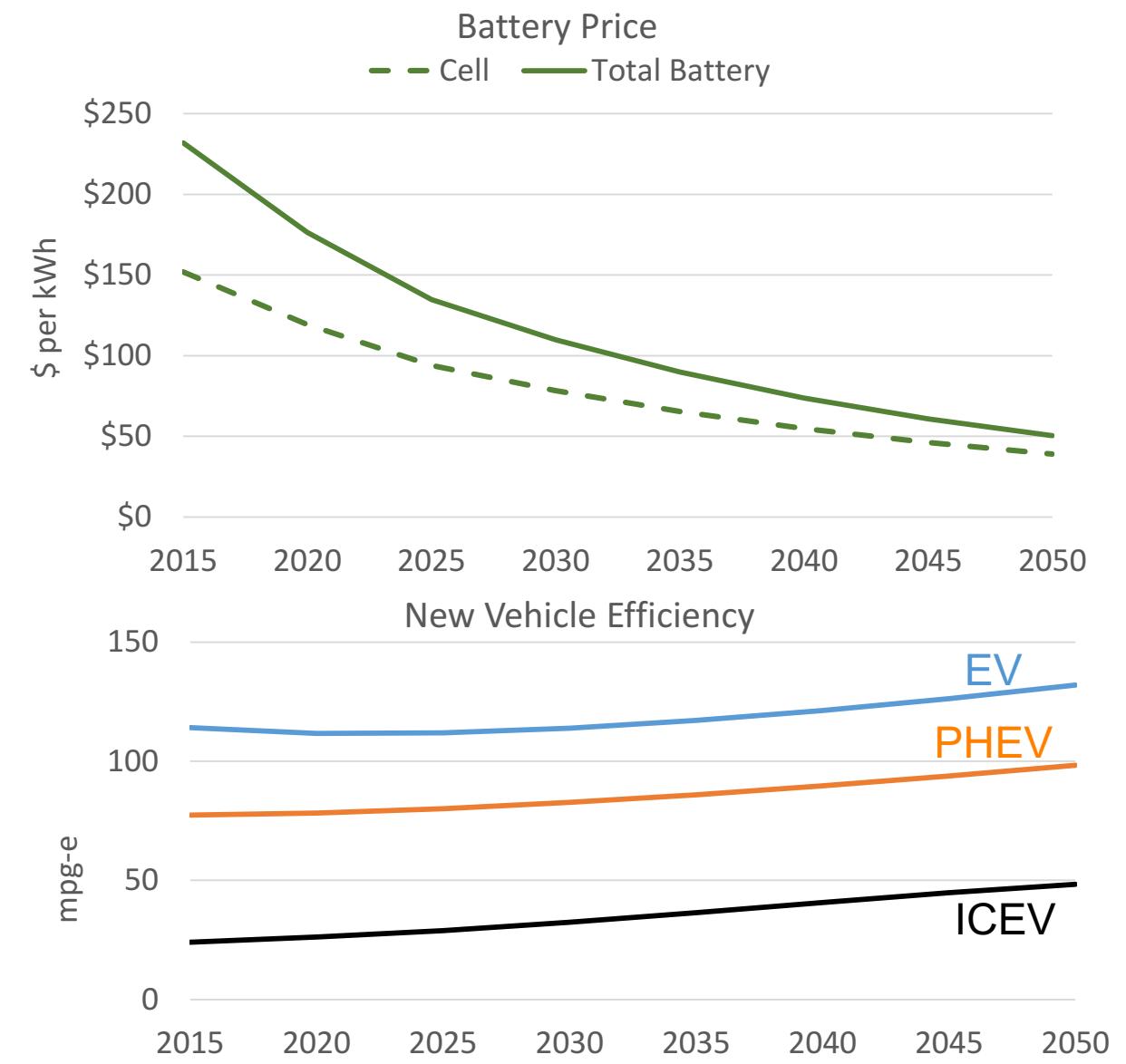
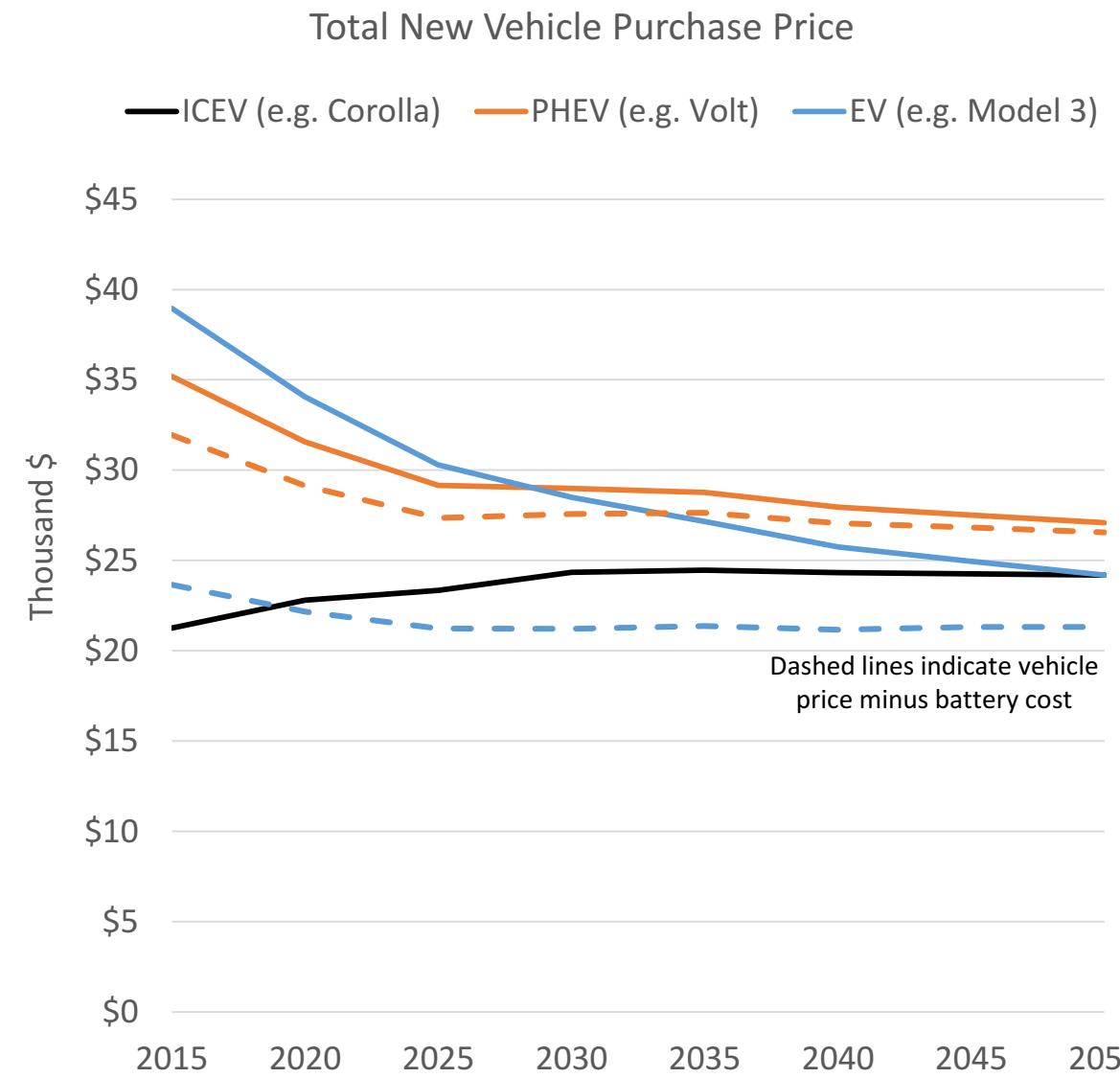
Together...Shaping the Future of Electricity

Backup Slides on Some Key Assumptions

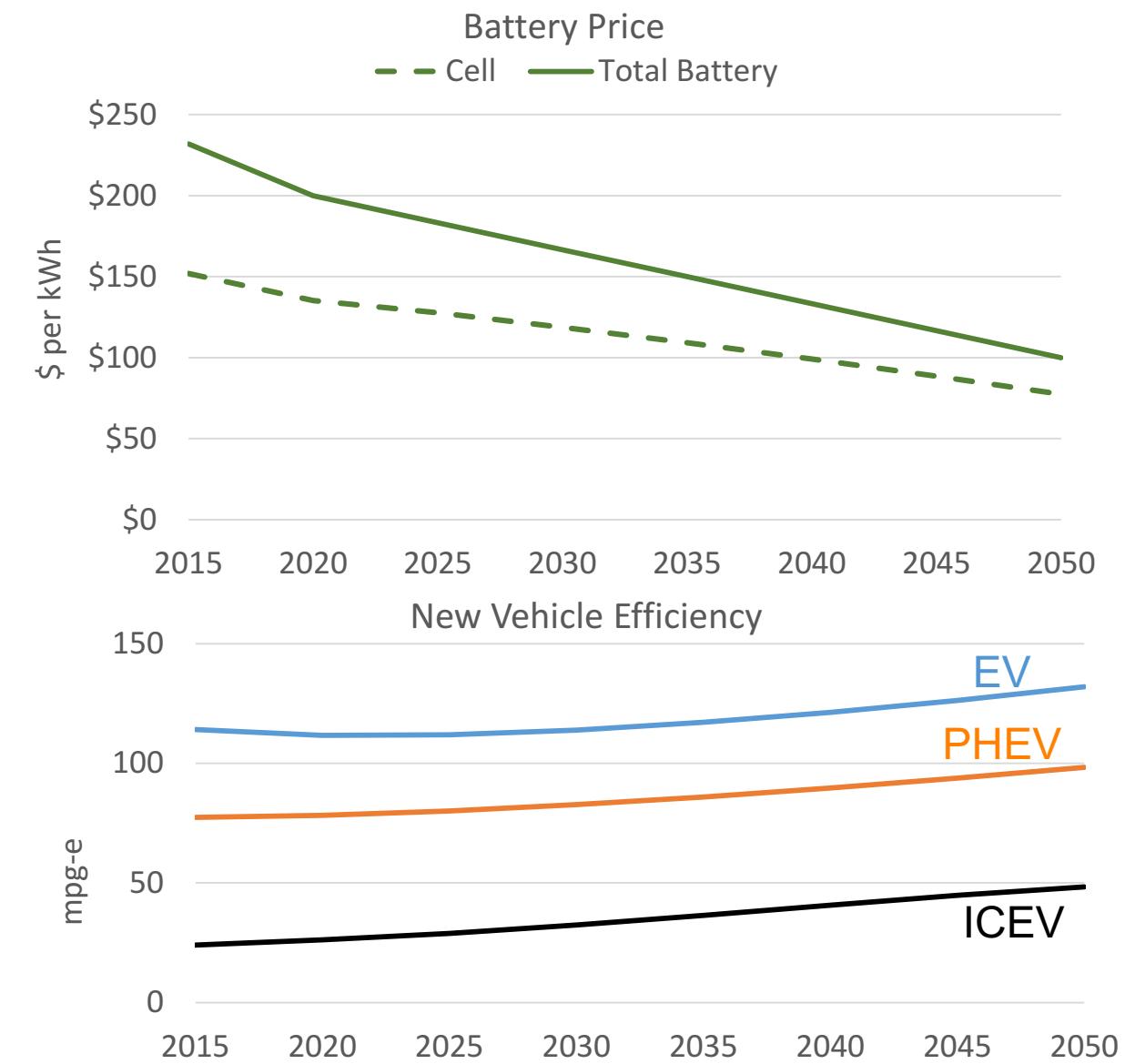
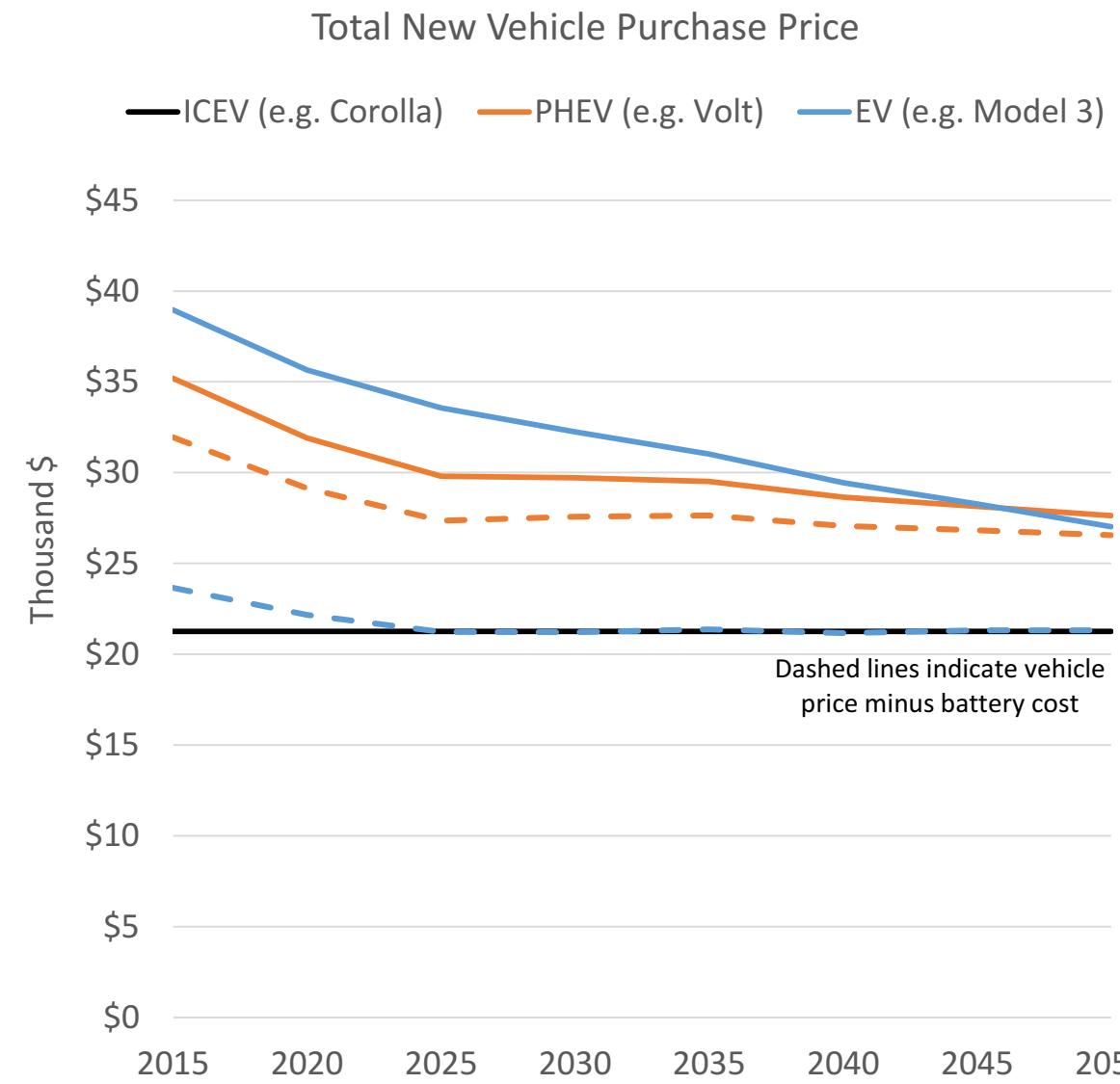
National Average Wholesale NG Price Paths



Reference Scenario; Vehicle Cost and Performance



Conservative Scenario; Vehicle Cost and Performance



US-REGEN Capital Costs for Electric Generation

