Electrification of the U.S. Economy and its Impacts on the Electricity System

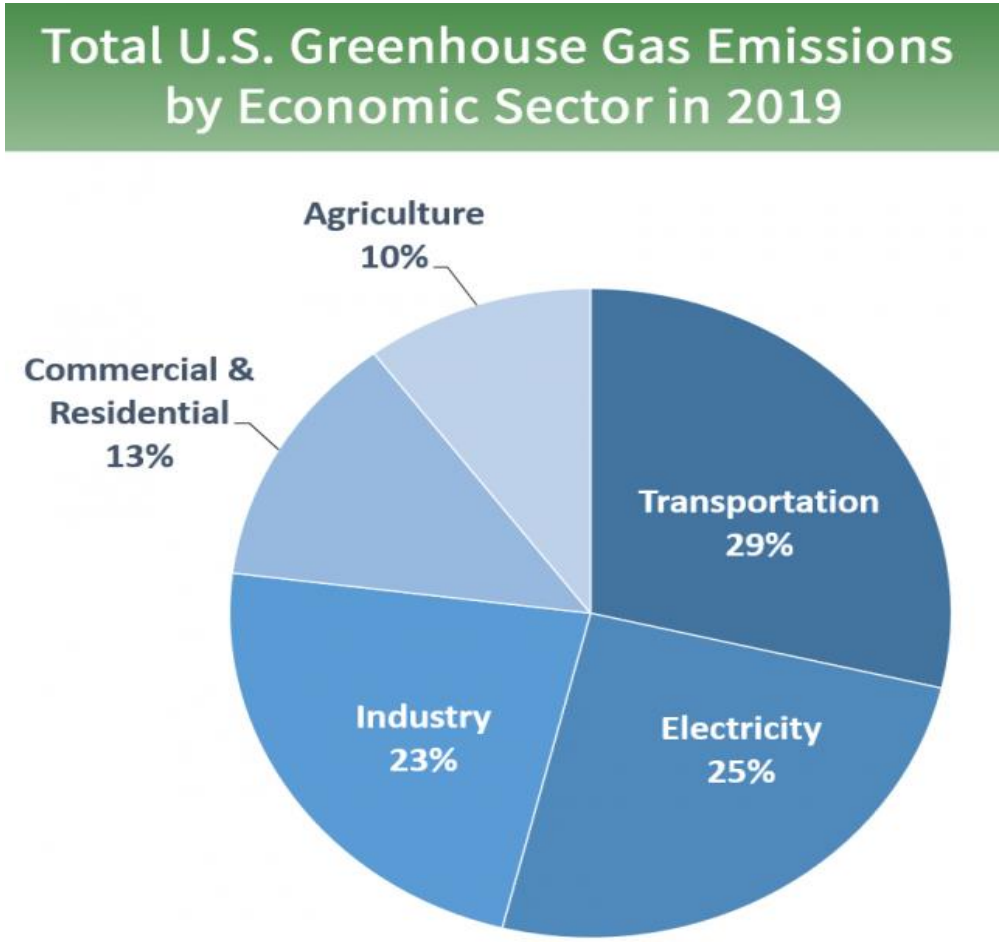
Jeff Dennis
General Counsel and Managing Director
Advanced Energy Economy

About Advanced Energy Economy (AEE)

- National association of businesses that are making the energy we use secure, clean, and affordable.
- AEE is the only industry association in the United States that represents the full range of advanced energy technologies and services, both grid-scale and distributed. Advanced energy includes energy efficiency, demand response, energy storage, wind, solar, hydro, nuclear, electric vehicles, and more.
- AEE also supports the work of the Advanced Energy Buyers Group (”AEBG”), a coalition of large buyers of advanced energy technologies to meet sustainability goals.
- AEE pursues policy transformation in the states and in wholesale power markets that expand market opportunities for advanced energy technologies and lay the foundation for a 100 percent clean advanced energy future.

U.S. greenhouse gas emissions sources

- While not the leading source of GHG emissions in the U.S., the electricity sector is the foundation for decarbonizing the broader economy
- As a result, federal, state, and local policies aimed at reducing GHG emissions focus on decarbonizing electricity supply first



Source: U.S. Environmental Protection Agency

Drivers of electrification in the United States

State policies	• Clean electricity standards/renewable portfolio standards • Economy-wide decarbonization goals in some states • Laws and agreements phasing out sales of ICE vehicles, increasing fuel economy standards, expanding EV charging, etc.
Local policies	• City and county 100% clean energy commitments • Electrification of municipal fleets (e.g., transit and school buses) • Local codes banning natural gas hookups in new building construction
Emerging federal policies	• Federal procurement of clean energy and electric vehicles for its own use • Pending investments in bipartisan infrastructure bill and Build Back Better Act • Strengthening fuel economy and emissions standards

These policies are driving additional demand, cost declines, and innovation in key technologies

ELECTRIC VEHICLES AND CHARGING

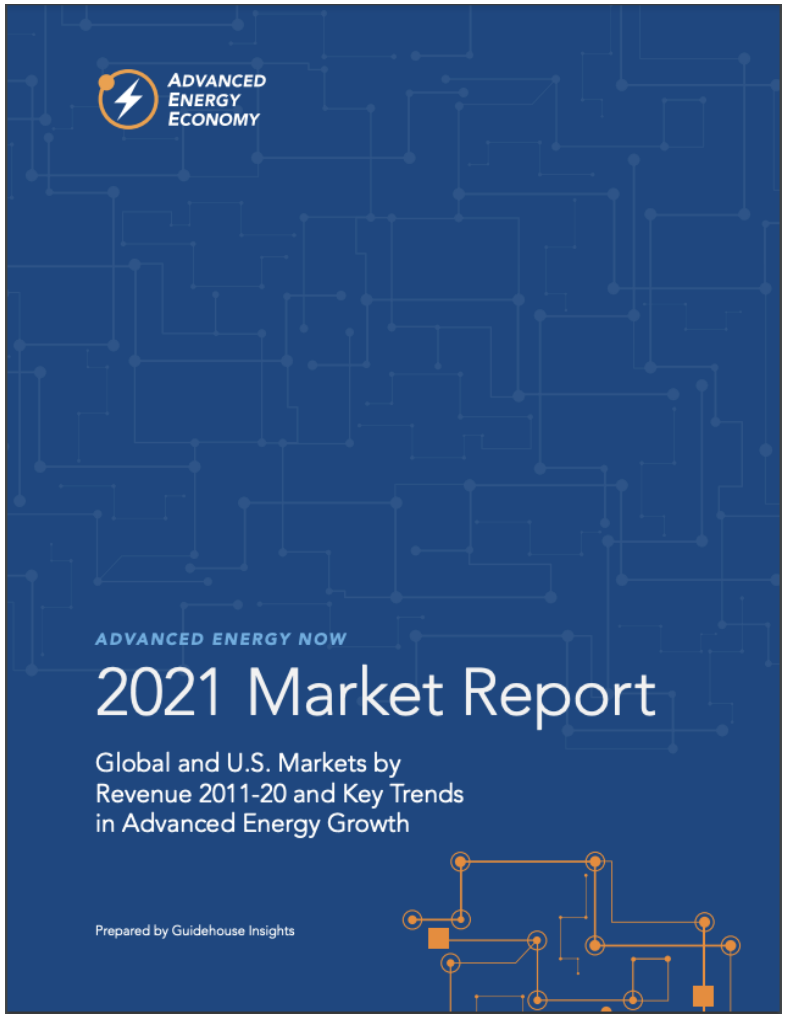
- EV cost expected to reach equivalence with ICE counterparts by 2022

- Battery ranges rapidly improving

BUILDING HEAT PUMPS

- Steep increase in adoption over the last 5 years

- U.S. now a leading growth market



Available at https://info.aee.net/aen-2021-market-report

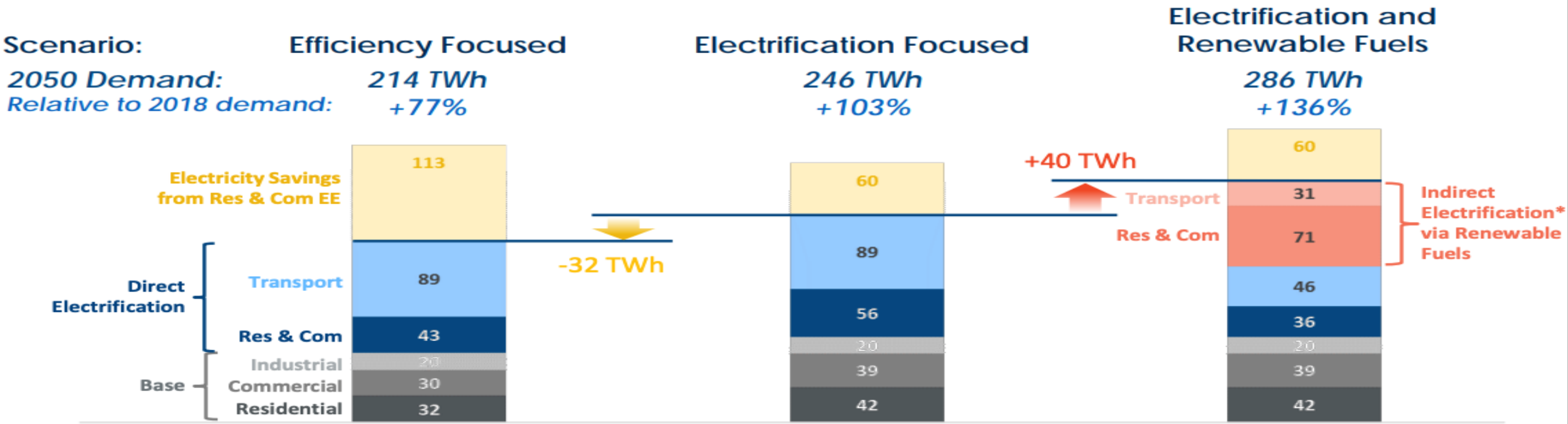
Impacts on electricity demand and infrastructure

- Significant increases in overall demand for electricity and clean generation capacity
  - *Brattle Group: 77-103% increase in electricity demand in New England region*
  - *Brattle Group: New York's Climate Leadership and Community Protection Act creates need for 43 GW of new clean generation by 2040*
- New patterns of demand and new peaking requirements
  - *New winter peaking needs in systems traditionally planned to meet summer peak*
  - *Increased daily and hourly demand fluctuations (primary from EV charging)*
- Increased need for delivery infrastructure (e.g., high-voltage regional and interregional transmission)
  - *National Renewable Energy Laboratory, "Electrification Futures Study: Scenarios of Power System Evolution" at 14 (January 2021)*

2050 Electricity Demand

Electricity demand will likely double by 2050 across plausible scenarios

2050 New England Annual Electricity Demand (TWh)



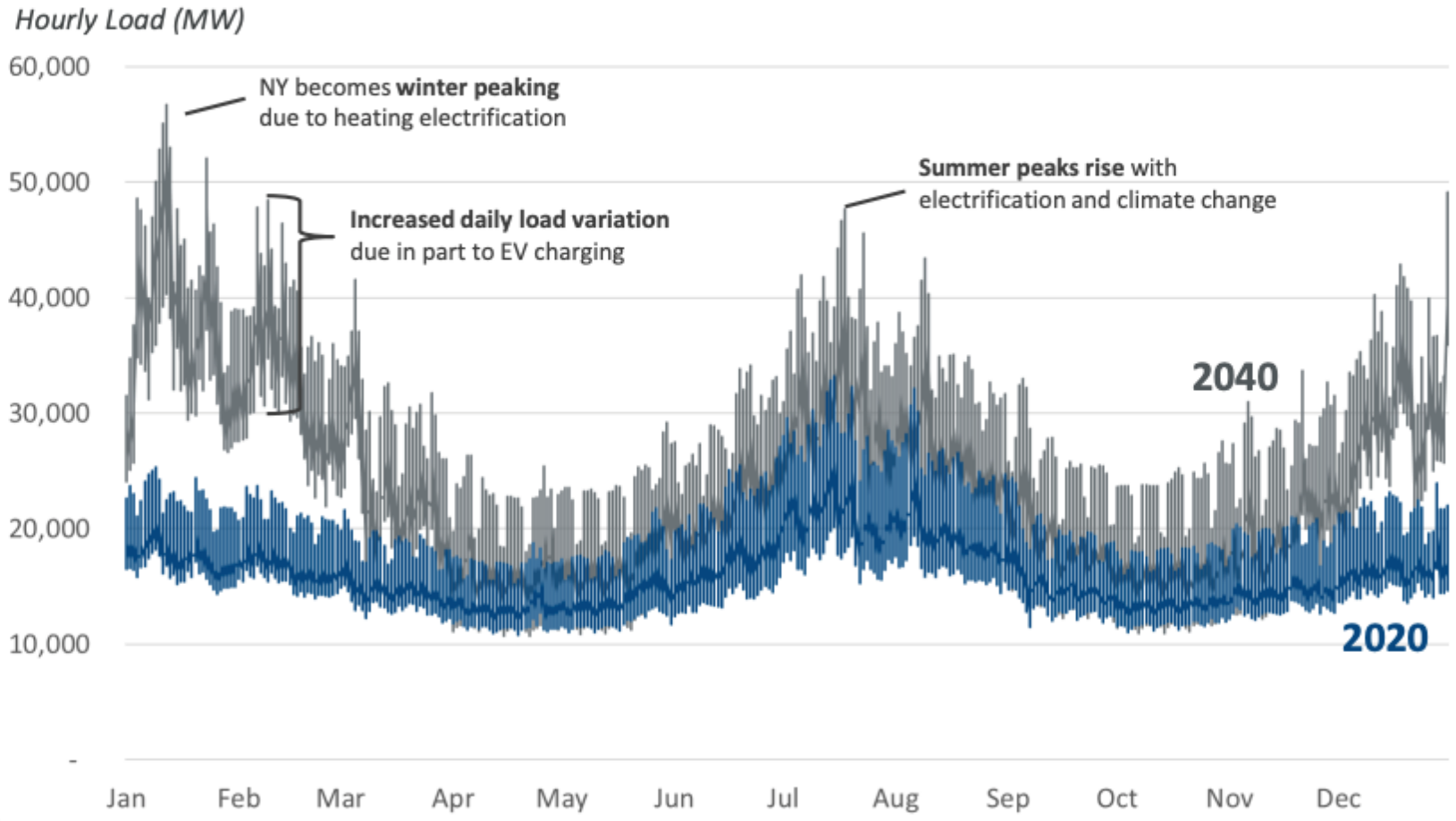
Building Energy Efficiency	**1.5%/year**	0.7%/year	0.7%/year
Building Electrification	All fuels: **80% Direct**	All fuels: 95% Direct	Natural Gas: **50% Direct, 50% Indirect** Other Fuels: 95% Direct
LDV/MDV Electrification	90%/80%	90%/80%	90%/80%
HDV Electrification	80%	80%	**100% Indirect**
Clean Electricity Generation	95%	95%	**100%**

Brattle

*Source and notes: 2050 demand based on projections in EIA 2019 AEO for New England and Brattle analysis of electrification and energy efficiency adoption rates and assumed efficiencies summarized on prior slide. *Indirect electrification refers to the production of renewable gas (hydrogen, methane) from electricity that is then burned as the end-use fuel.*

Loads will grow with economy-wide electrification

- Electrification and climate change will alter long-standing NY load patterns
  - Loads will rise in all periods
  - Shift to winter peaking
  - Load will become more variable hour-to-hour
- The basis of this study is NYISO's **high electrification load forecast**
- Results also provided for **reference case** with less electrification



See Slide 2 Disclaimer

Sources and Notes: "CLCPA Load Case" forecasts from Climate Change and Resilience Study - Phase I, ICAP WG December 17, 2019.

Challenges to holistic planning for electrification in the U.S.

- Lack of a single forum for planning
  - *Federal government (FERC) regulates wholesale markets and transmission*
  - *States (public utility commissions) regulate distribution systems and retail service*
  - *Transportation policy (electrification of vehicles) resides with other agencies and authorities*
  - *Creates significant need for inter-agency, inter-governmental, and multi-sector cooperation*

- Limits in the current transmission planning processes
  - *Current processes are reactive and focused on silos of transmission needs (reliability, economic efficiency, "public policy"-driven)*
  - *Solution: explicitly include electrification scenarios in planning, both in terms of demand and geographic sources of clean supply needed to meet that demand*

- Need to better integrate electrification-driven demands into markets
  - *Distributed electrification-related technologies (EVSE, grid-interactive buildings, residential solar+storage, etc.) create new dynamic demands but also offer new demand-side flexibility that is lacking today*
  - *Solution: Unlock flexibility and tools to manage dynamic demands and steep peaks by integrating these technologies into bulk power system operations and dispatch*

Thank you!

Jeff Dennis, Managing Director & General Counsel
jdennis@aee.net
571.338.7547

Twitter: @EnergyLawJeff