EV-REDI: Ready to Launch

October 18, 2018

Panelists

Pat Knight

Moderator: Bruce Biewald, Founder and CEO

@SynapseEnergy

Webinar Logistics

- The webinar is being recorded and will be circulated to all attendees, along with the slides
- All attendees have been muted on entry and will remain muted throughout the webinar
- Please send any questions on the content of the webinar to webinar@synapse-energy.com
- During the Q&A session, the panelists will answer written questions that have been sent to webinar@synapse-energy.com
- Please use the chat feature only to notify the host if you are having a technical issue with the WebEx software or audio

Who we are

Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald
- Research and consulting firm specializing in energy, economic, and environmental topics
- Services include economic and technical analyses, regulatory support, research and report writing, policy analysis and development, representation in stakeholder committees, facilitation, trainings, and expert witness services for public interest and government clients
- All non-confidential publications and open-source tools available for free at www.synapse-energy.com

Agenda

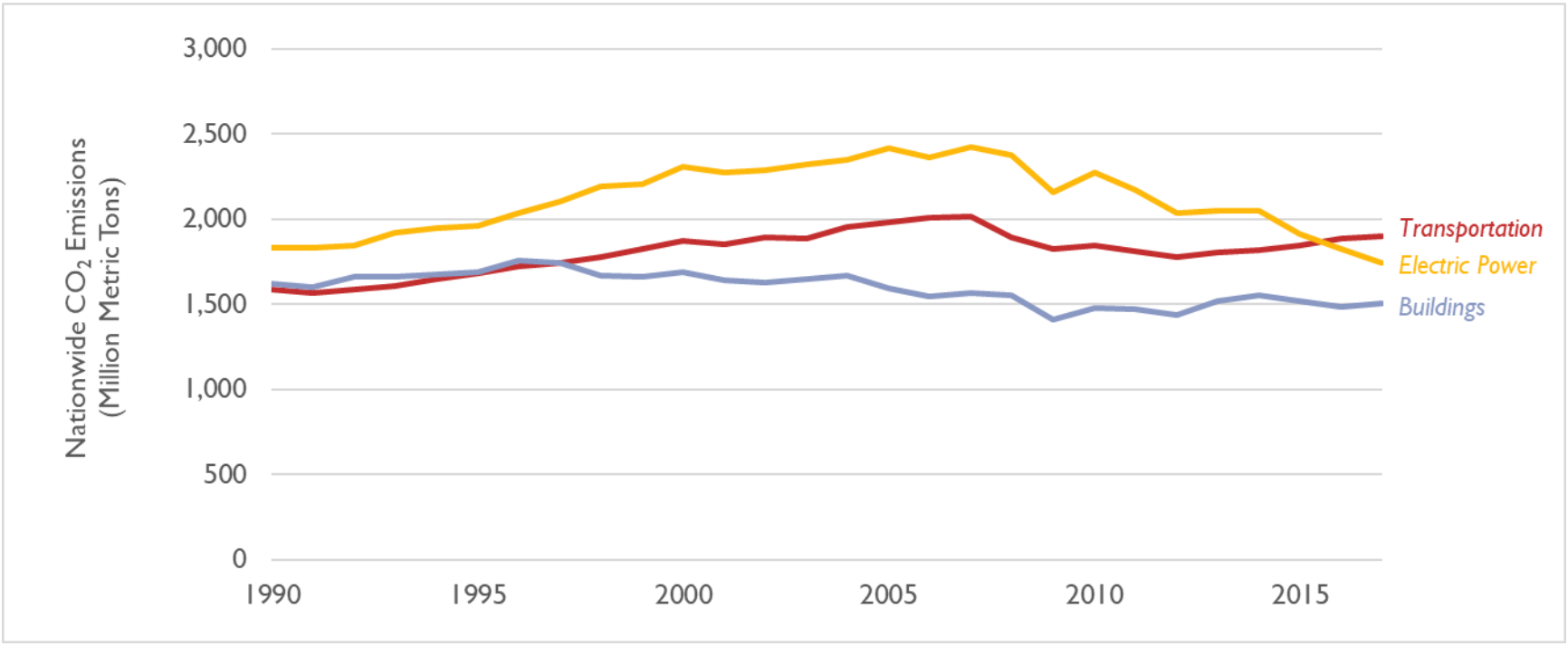
1. What is EV-REDI?
2. Why did we make EV-REDI?
3. How does EV-REDI work?
4. Example application of EV-REDI
5. Where to next?
6. Questions

What is EV-REDI?

- Our new EV-REDI (Electric Vehicle Regional Emissions and Demand Impacts) tool models multiple impacts of transportation electrification for specific states.
- With EVs on the rise, enormous opportunities for making transportation more sustainable and modernizing the electric grid will emerge. But to realize this potential, it will be necessary to plan ahead.
- EV-REDI can quantify the impacts of increased EV penetration on electricity sales, greenhouse gas emissions, and avoided gasoline consumption.

Why did we make EV-REDI?

1. **More nationwide CO_2 emissions come from the transportation sector than any other source.**

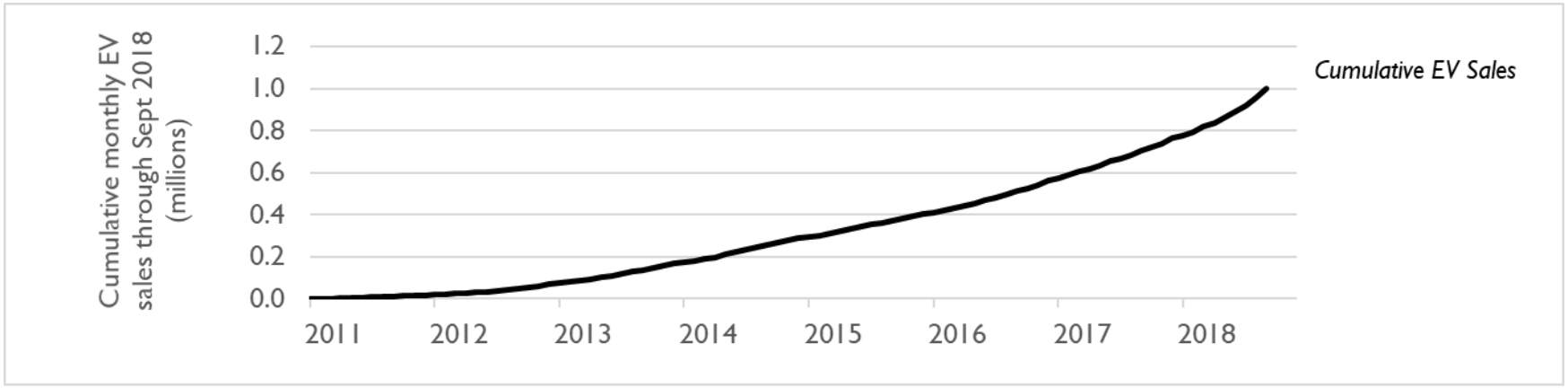


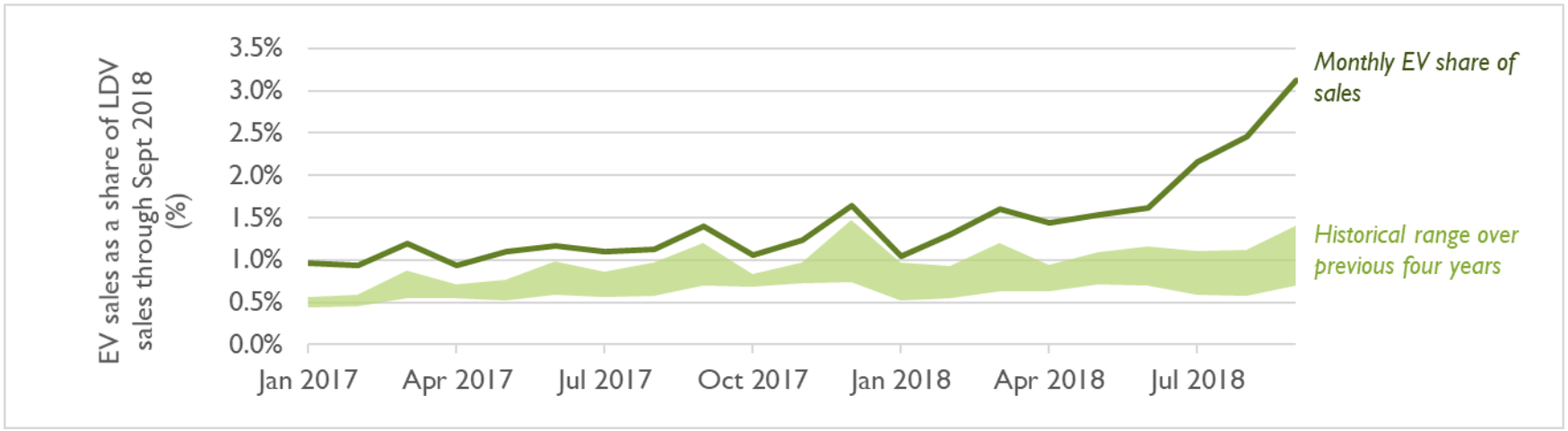
Source: EIA. U.S. Carbon dioxide emissions from energy consumption (from 1973). Released September 2018

In 2016 and 2017, cars and trucks produced more of the United States' CO_2 than any other source.

Why did we make EV-REDI (cont.)?

2. Sales of electric vehicles are accelerating.





Sources: InsideEVs.com; U.S. Federal Reserve Economic Data

Why did we make EV-REDI (cont.)?

3. Investment in electric vehicle infrastructure is increasing.

Cycle 2 invests $200M in California between July 1, 2019 and Dec. 31, 2021 to increase ZEV adoption

Source: https://www.electrifyamerica.com/news

National Grid's $24 million program will utilize a "make ready" approach, where it essentially helps prepare a host location for an EV charging

Source: https://www.utilitydive.com/news/in-massachusetts-utilities-take-a-collaborative-approach-to-ev-infrastruct/442047/

Through EVolve NY, NYPA has committed up to $250 million through 2025 - and will partner with the private sector and other key stakeholders on initiatives that address key infrastructure and market gaps to accelerate the adoption of electric vehicles (EV's) throughout the state.

Source: https://www.nypa.gov/innovation/programs/evolveny

Many investments in EV charging infrastructure are partly due to $2 billion settlement with Volkswagen (i.e., “Electrify America”).

Why did we make EV-REDI (cont.)?

As stakeholders plan for the deployment of electric vehicles, they need to take into account:

What impacts could EVs have on the electric system?

- How will greater levels of electricity demand impact generating and T&D infrastructure?
- Will EVs have dramatic impacts on hourly demand?
- What are ratepayer impacts of EV deployment?

What impacts could EVs have on the transportation system?

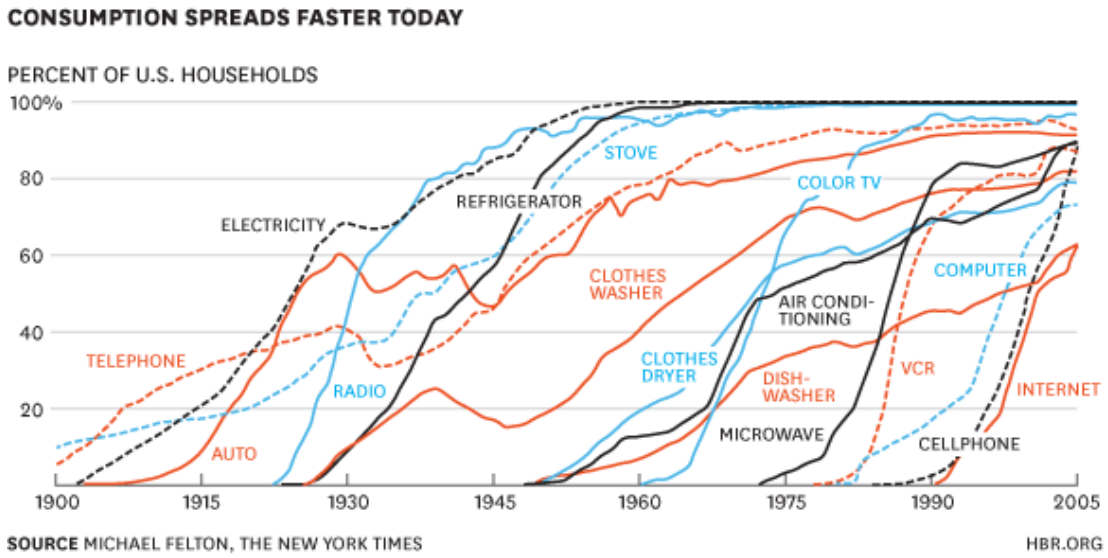
- What does a certain level of future EV sales imply for vehicle stock?
- What types of cars are EVs displacing?
- What are the driving patterns of EVs?
- What is the impact on gasoline consumption?

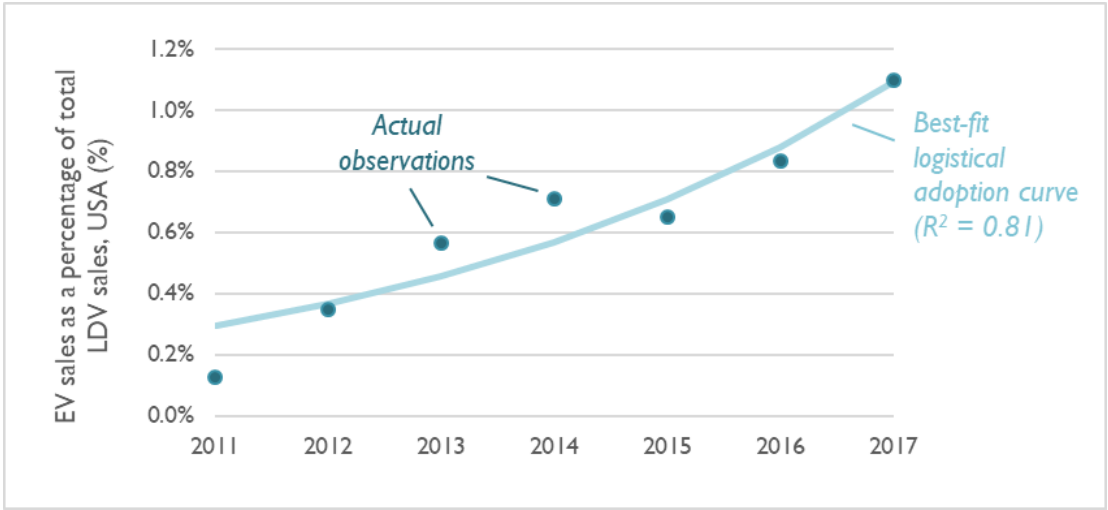
What impacts could EVs have on emissions?

- How does wide-scale deployment of EVs impact CO_2 emissions in the electric power sector?
- How do potential CO_2 emission increases in the electric sector compare to CO_2 emission reductions in the transportation sector?
- What are the impacts of EVs on criteria pollutants?

How does EV-REDI work?

- Within EV-REDI, users first specify a projection for EV deployment.
- Projections can be framed in terms of EV sales (# sold or % of sales) or EV stock (# on the road or % of stock) or based on extension of historical trends.
- All trends utilize a logistical adoption curve to model trends of innovators, early adopters, laggards, and other consumers.





How does EV-REDI work (cont.)?

- EV-REDI incorporates state-specific data for many other key input parameters, including:
  - Vehicle ownership lifetime
  - Vehicle miles traveled
  - Efficiency over time (both for EVs and ICEs)
  - Trends in vehicle preferences
  - Differentiation between passenger cars and light trucks (SUVs, pickups, minivans, crossovers)
  - Differentiation between PHEVs and BEVs
- EV-REDI comes prepped with default values for all input parameters but is also customizable
- All data is state-specific, wherever possible. EV-REDI is adaptable and can also be modeled at the county- or municipality-level, where data exists.
- Currently most of the data in EV-REDI focuses on light-duty vehicles, although future versions may expand to medium- and heavy-duty vehicles (dump trucks, buses, etc.)

How does EV-REDI work (cont.)?

- State-specific outputs on:
  - LDV-wide sales and stock
  - EV sales and stock
  - VMT
  - Retail and wholesale electricity sales
  - Avoided gasoline
  - Avoided transportation energy
  - Avoided CO_2 emissions
- All outputs are provided for any and each state at the annual level
- Annual data can be allocated to monthly or daily data using other information on load curves and driving patterns.

Outputs can be passed to a wide range of other models, including:

COBRA
Co-Benefits Risk Assessment
Health Impacts Screening and Mapping Tool

AVERT
AVoided Emissions and geneRation Tool
www.epa.gov/avert

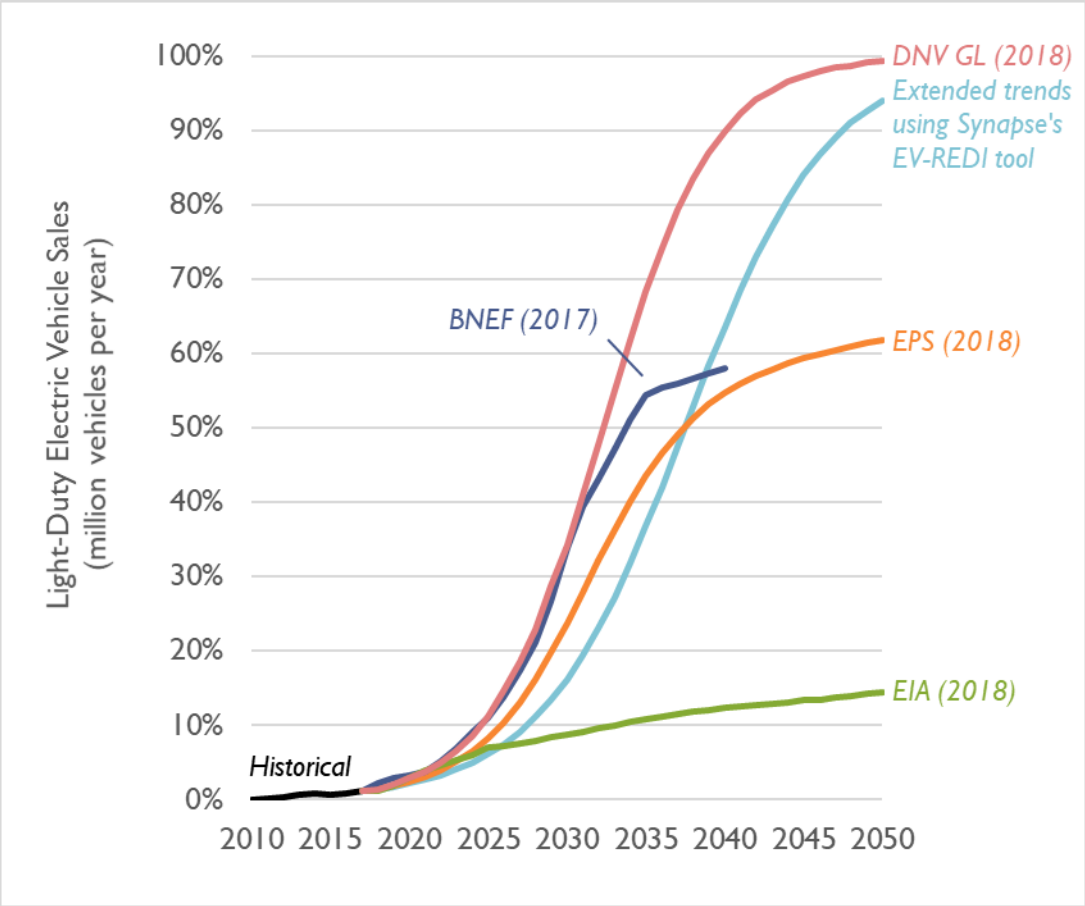
ENCOMPASS
POWER PLANNING SOFTWARE

M-SEM
Industrial | Building | Electric | Transport

IMPLAN

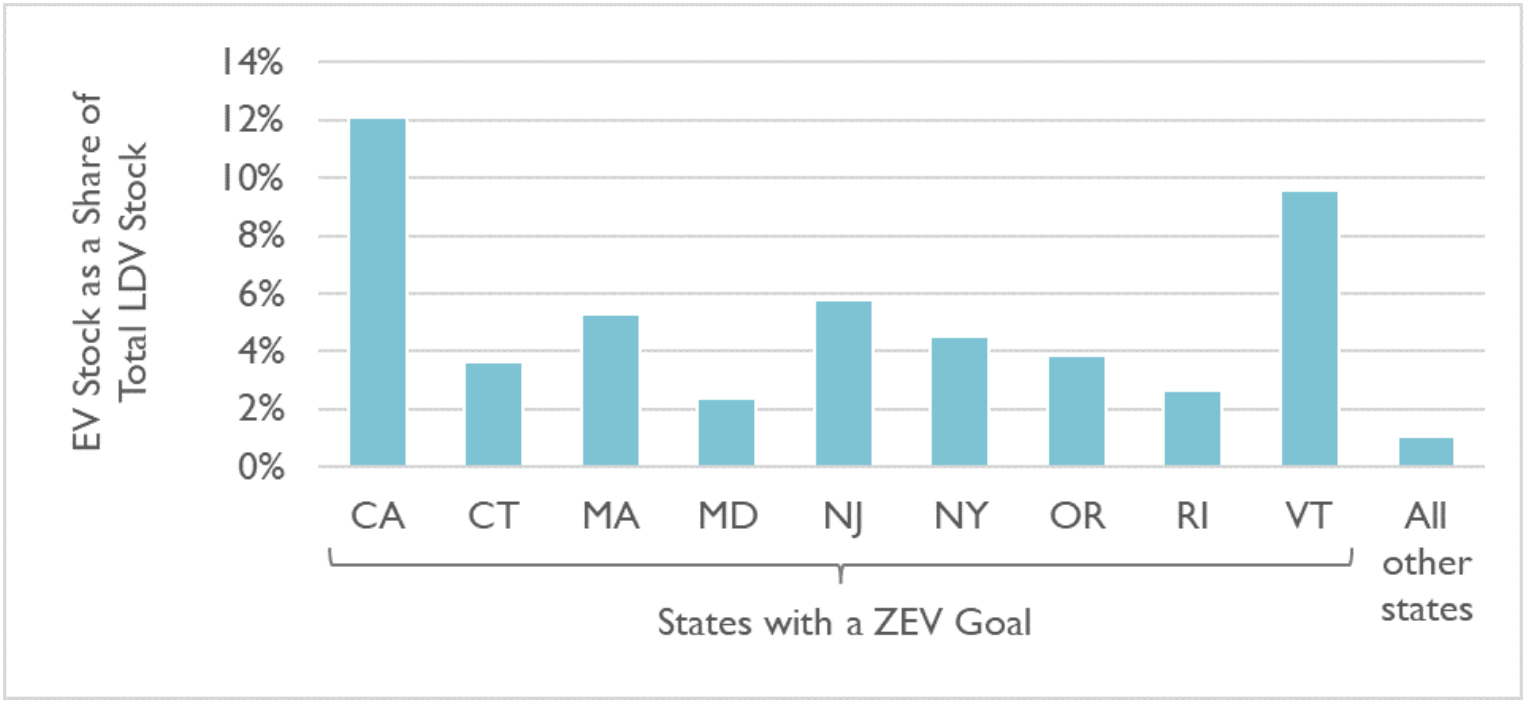
Example application of EV-REDI

- Synapse developed an "Extended Trends" trajectory.
- This trajectory fits a logistical adoption curve to historical trends observed from 2011-2017 for each state.
- Total nationwide results for "Extended Trends" trajectory is in line with projections modeled by other organizations.



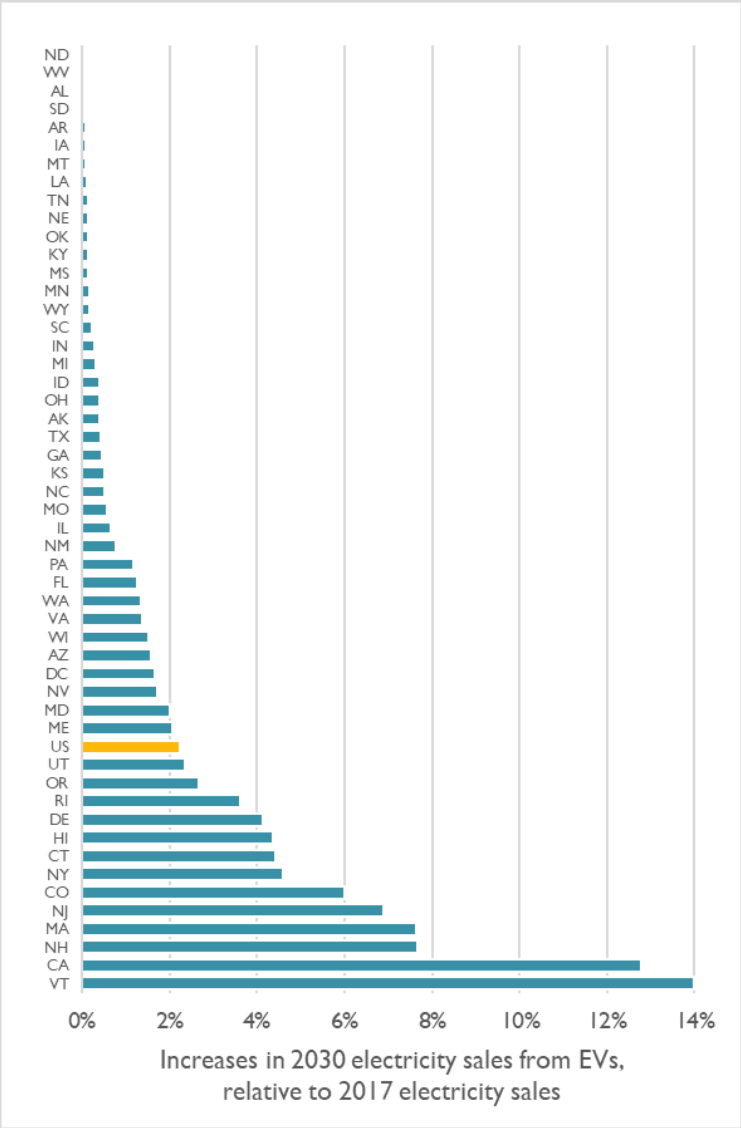
Sources: https://about.bnef.com/electric-vehicle-outlook/, https://www.eia.gov/outlooks/aeo/, https://eto.dnvgl.com/2018/download, and https://us.energypolicy.solutions/scenarios/home

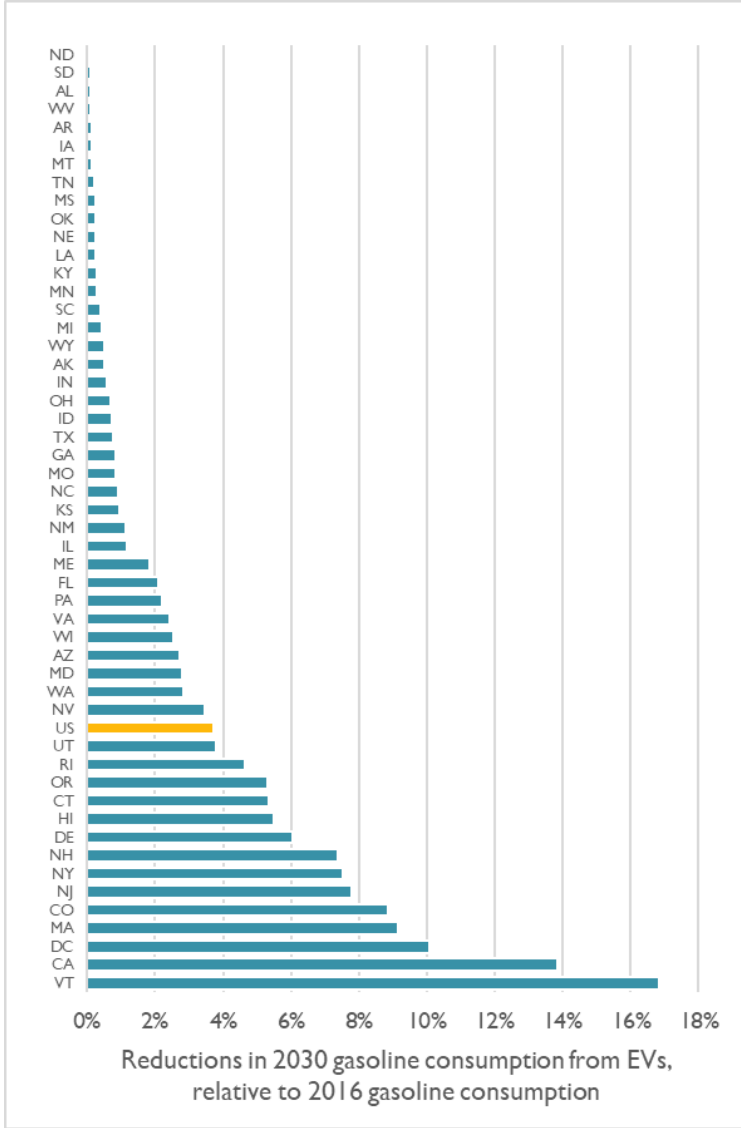
Example application of EV-REDI (cont.)



- In this "Extended Trends" case, deployment of EVs through the next 5-10 years is concentrated in "ZEV MOU" states.
- An extension of current trends implies that by 2025, 5.3 million EVs will be on the road in these nine states, versus a stated goal of 3.3 million.

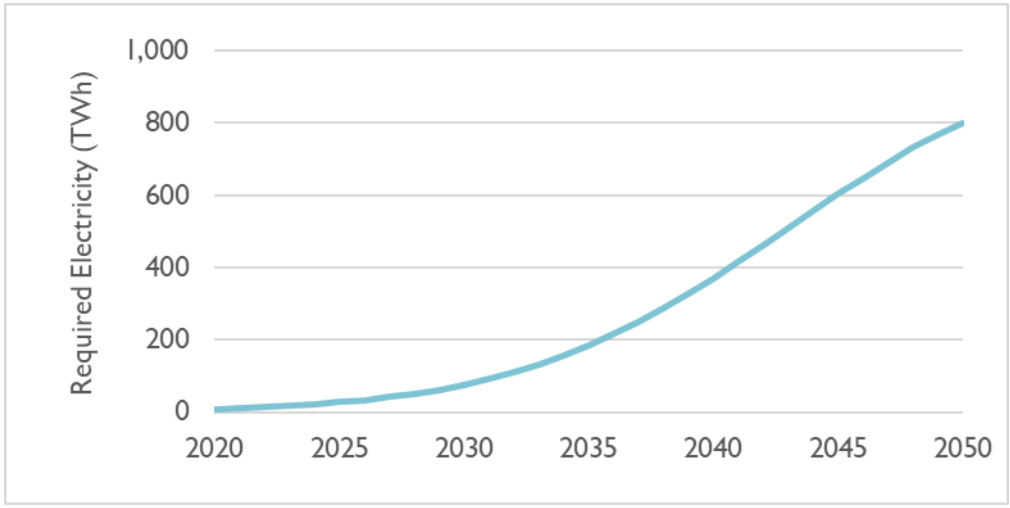
Example application of EV-REDI (cont.)

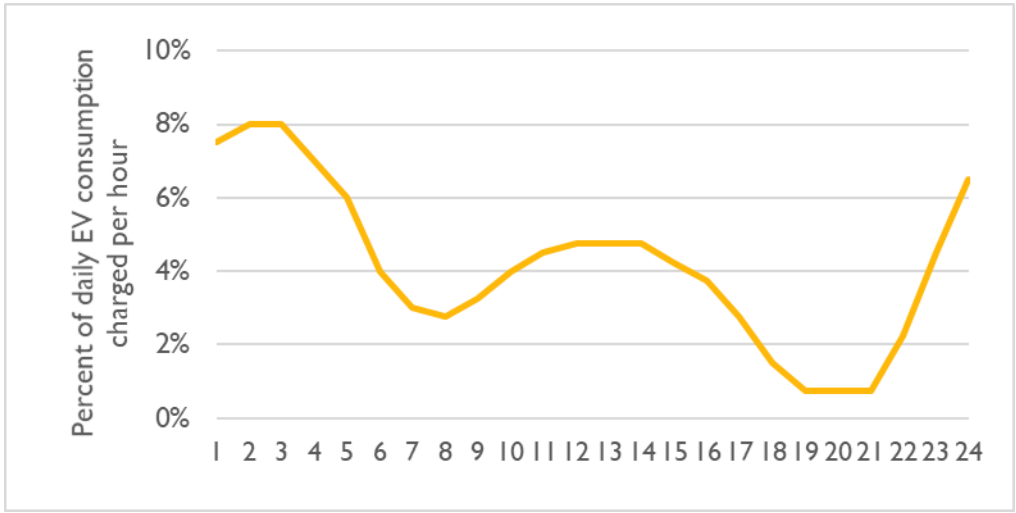




Example application of EV-REDI (cont.)

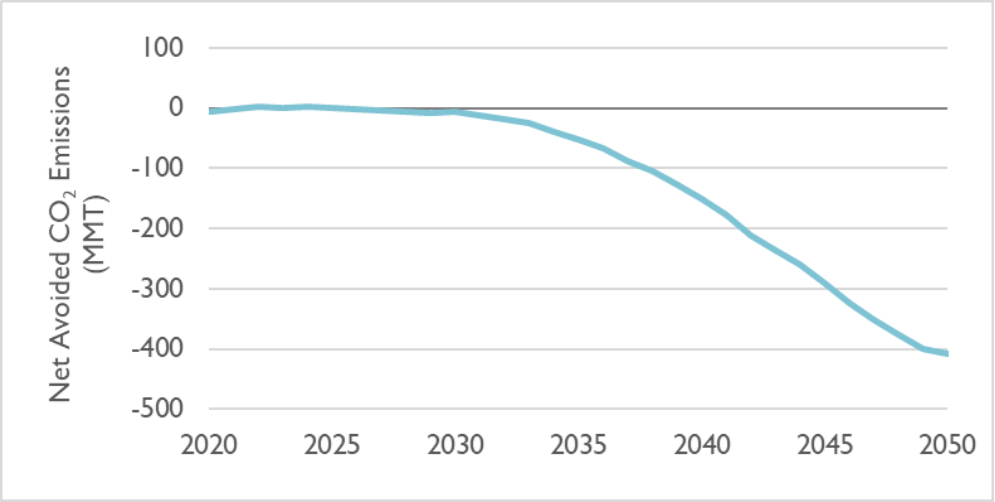
- To get a better handle on the electric sector impact of EVs, we modeled the electricity sales projected by EV-REDI in the EnCompass model.
- EnCompass is an electric sector power dispatch model, capable of modeling all or part of the nationwide electric system at an annual level (i.e., through 2050) or at a very granular level (i.e., hourly).





Example application of EV-REDI (cont.)

- As a quick first-pass, we modeled a future in which most of the incremental demand for electricity is met with increased generation from gas and coal plants.
- This "worst-case" future models a lower bound for possible avoided CO_2 emissions
- By 2050, 550 $MMTCO_2$ avoided from the transportation sector more than offsets a 150 $MMTCO_2$ increase in the electric sector



- Other important considerations include:
  - What is the effect of renewable portfolio standard (RPS) policies on this incremental level of electricity sales?
  - To what level are EVs already being considered in a "base case"?
  - What vehicles are EVs replacing? Ones with high or low MPG?
  - Do increase loads slow or defer plant retirements?

Where to next?

A wide range of research questions on EV deployment exist.
EV-REDI and other tools can help answer them.

- How do consumer preferences for vehicle type match with the types of EVs sold today? How will changing trends in available EV models impact EV sales, electricity sales, and avoided emissions?
- How will EV deployment impact the electric sector? Will it require an expanded buildout of renewables to ensure a decrease in overall CO_2 emissions? What are the implications for peak demand and the T&D system?
- How many charging stations will be required? How much will this infrastructure cost? Who will or should pay it?
- How might electricity use or avoided emissions change throughout the day? Can different incentives for off-peak charging or rate structures impact this?
- What kind of impacts will EVs have on jobs or GDP? What kind of impacts will EVs have on criteria pollutants (NO_X, SO_2, PM)? What kind of impacts will EVs have on public health?

Questions?

webinar@synapse-energy.com

Link to more information about EV-REDI:
http://synapse-energy.com/tools/electric-vehicle-regional-emissions-and-demand-impacts-tool-ev-redi

Want to team up with us?

Synapse provides:

- Economic and power system modeling
- Research and report writing
- Policy analysis and development
- Representation in voting and stakeholder committees
- Economic and technical analysis
- Expert witness services
- Regulatory support
- Facilitation and trainings
- Development of analytical tools

Contact Information

Pat Knight, pknight@synapse-energy.com
Bruce Biewald, bbiewald@synapse-energy.com