Electrification:
Options for Consumers and the Environment

March 5, 2019

Materials will be available at: www.eesi.org/030519beneficial

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EESI

Environmental and Energy Study Institute

- Founded in **1984** by a **bipartisan** Congressional caucus.
- Now an **independent**, bipartisan **nonprofit** with no Congressional funding.
- We provide **fact-based information** on **energy** and **environmental** policy for Congress and other policymakers.
- We focus on **win-win solutions** to make our energy, buildings, and transportation sectors **sustainable** and **resilient**.

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Efficient Electrification

Barbara Tyran
Executive Director, Government & External Relations

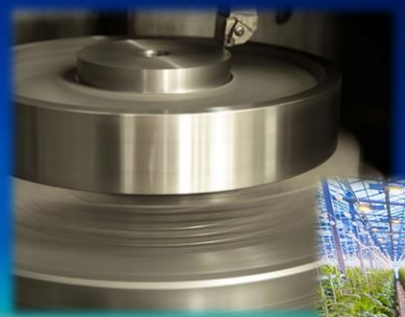
EESI Briefing
March 2019

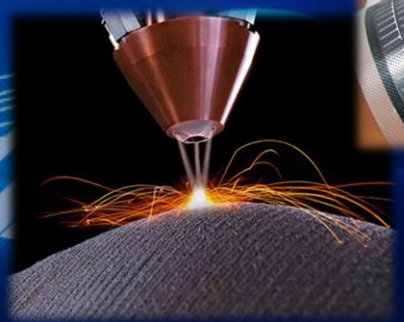
Efficient Electrification

Mobility

Heating and Cooling

New Applications





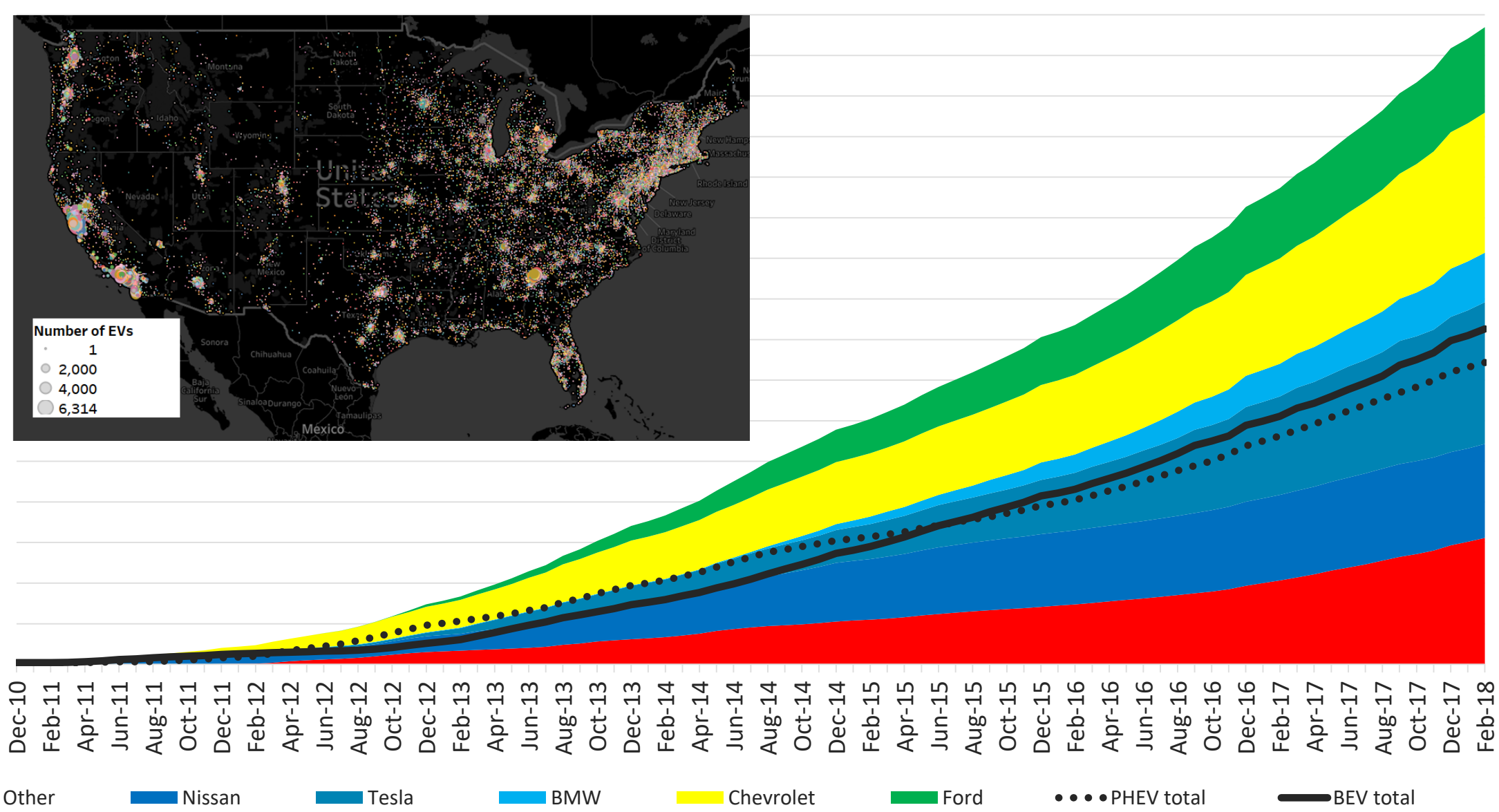
EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Meeting Future Customer Energy Expectation

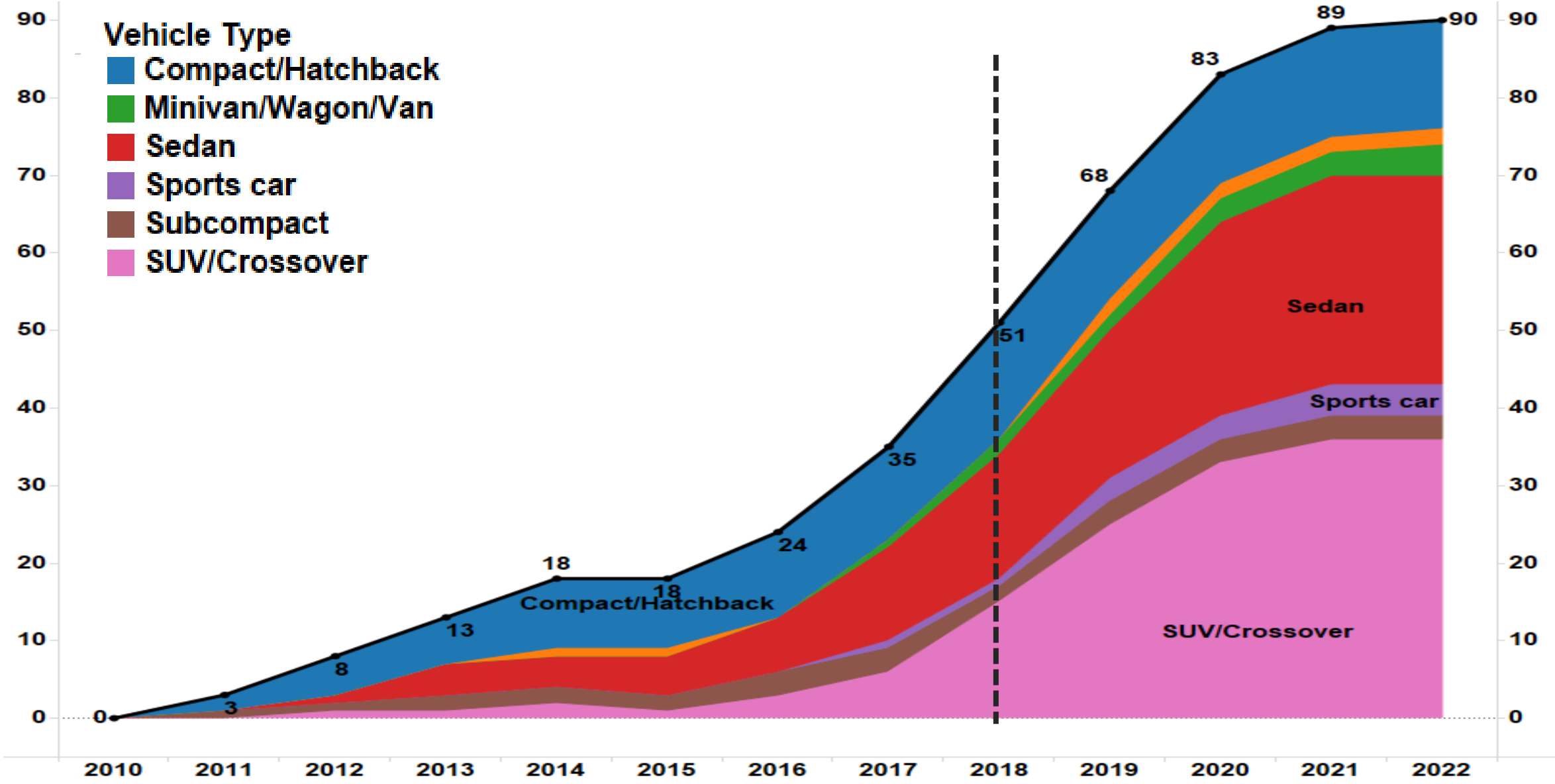
Integration can Improve Reliability, Increase Efficiency, Create New Opportunities, and Expand Customer Choice

IEN leads to an increasing societal reliance on electrification and resiliency will be key – **cyber and physical resiliency** against man-made and natural disaster

US EV sales exceed 782k through end of February 2018

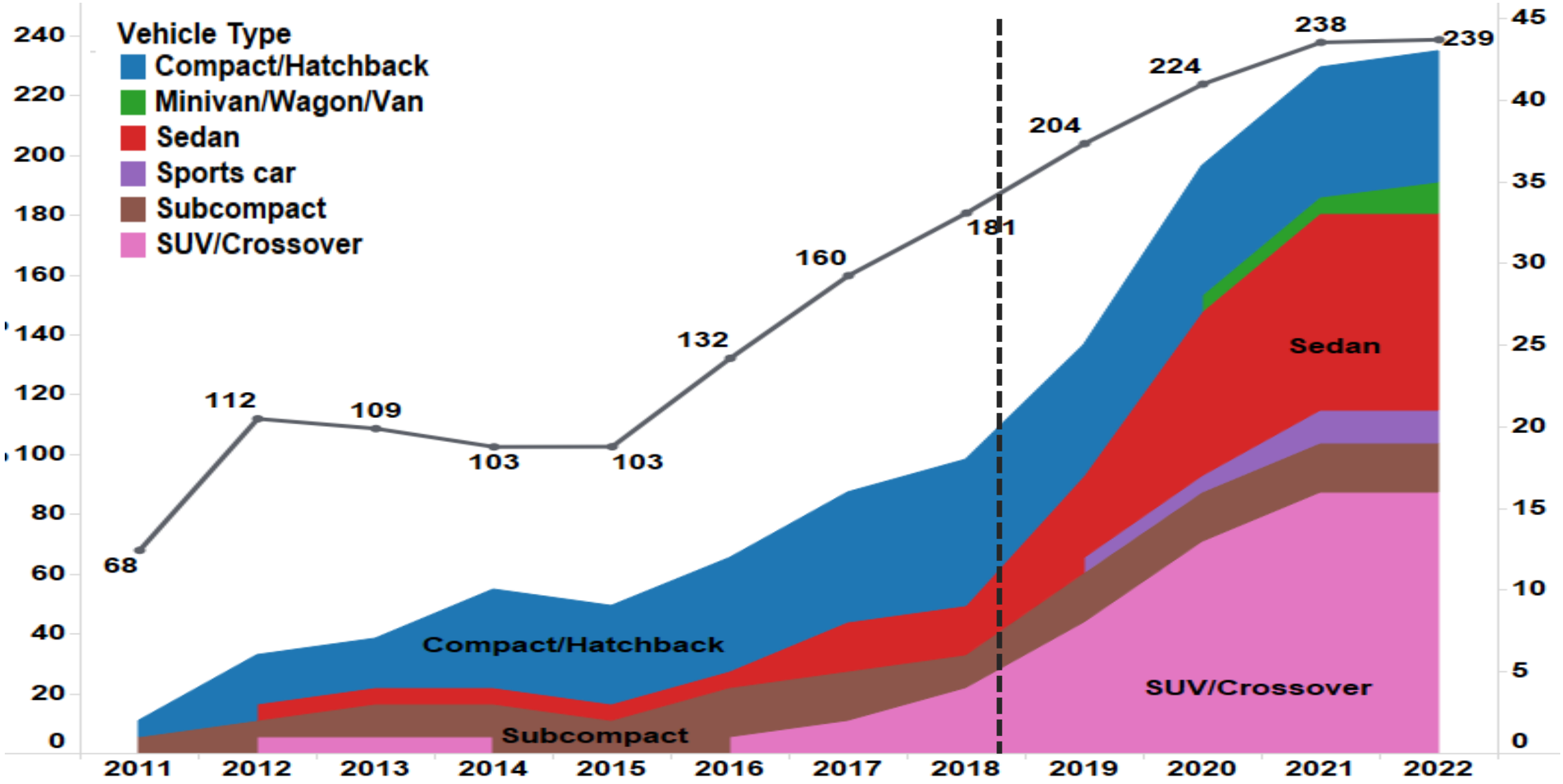


Customer choice increasing with ~90 EVs by 2022



Updated 1/15/2018

Range of battery electric vehicles (BEVs) is also increasing

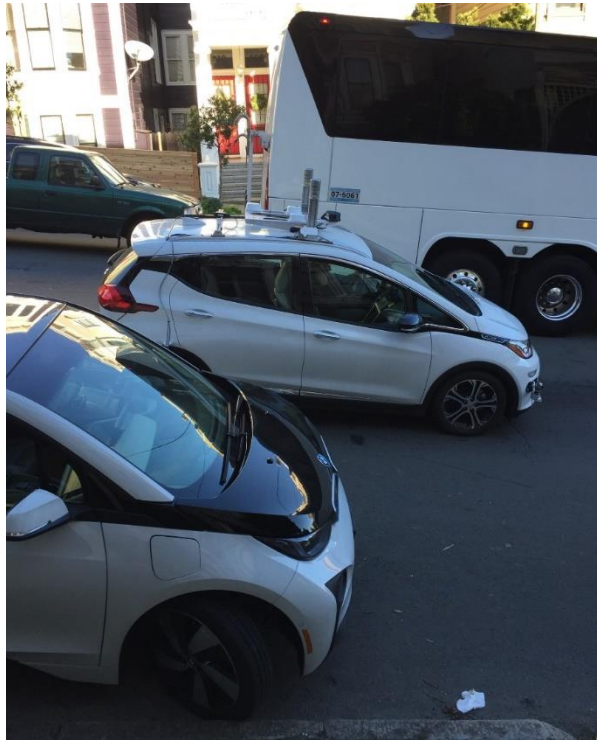


Updated 1/15/2018

Looking Ahead – Today and Tomorrow

Time

- New transportation models
- 200+ mile mass-market battery electric vehicles
- High power charging
- Autonomous driving



Indoor Agriculture

Clean Air… Less Water…
Less Land… Less Pesticide…
More Yield… Clear Choice

Emerging and Enabling Technologies

Sharing Economy

Cryptocurrencies

Augmented Reality

Blockchain Transactions

"Wattcoin is Bringing Blockchain Technology to the Energy Industry"

What is the objective of EPRI's assessment?

Customer Choices for End-Use Energy:

- **Economy-wide assessment - Residential, commercial, industrial and transport**
- **Customers have broad technology choices and control**
- **Customer decisions integrated with detailed electricity supply model**

Source: EPRI 3002009917 February 2017

Critical Trends: "Shared" Integrated Grid

Customer Engagement

Connected Devices = Shared Economy

Community Resiliency

Together…Shaping the Future of Electricity

Beneficial Electrification: The Future Is Electric!

Beneficial Electrification League (BEL)

NRECA
A Touchstone Energy® Cooperative

NRDC
NATURAL RESOURCES DEFENSE COUNCIL

Beneficial Electrification League (BEL)

Introduction!

Electrification Futures Study (EFS) Overview

www.nrel.gov/efs

Goal: explore potential & impact of electrification of U.S. economy; power sector focus

NREL NATIONAL RENEWABLE ENERGY LABORATORY

OAK RIDGE National Laboratory

BERKELEY LAB Lawrence Berkeley National Laboratory

EVOLVED ENERGY RESEARCH

EPRI

NORTHERN ARIZONA UNIVERSITY

Multi-year research effort with development of a series of publications, tools, and data, to be released and finalized as the project continues.

EFS Scenario Descriptions

Reference

- **No dramatic technological, societal, or policy changes**
- **Electro-technology adoption follow current trends**
- **(EIA AEO Reference Case)**

Medium Electrification

- **Plausible but not transformational changes**
- **“Low-hanging fruit” end-uses see accelerated adoption**
- **Limited, niche market adoption elsewhere**
- **Technical, economic, and consumer preference barriers remain**

High Electrification

- **More favorable set of conditions for electrification**
- **Aggressive adoption where many barriers are overcome**
- **Not a “technical potential”**

Beneficial Electrification League (BEL)

Beneficial Electrification (BE)

The application of electricity to end-uses that would otherwise use fossil fuels and where doing so satisfies at least one of the following conditions, without adversely affecting the others:

- *Saves consumers money over time*
- *Benefits the environment and reduces green house gas emissions*
- *Improves product quality or consumer quality of life*
- *Fosters a more robust and resilient grid*

Beneficial Electrification League (BEL)

Beneficial Electrification!

- Environmentally Beneficial Electrification – Nov. 2015, July 2016
- 'Beneficial Electrification' RAP Whitepapers & Webinars
- PLMA 'Beneficial Electrification' Webinars & Workshops
- EPRI 'Electrification 2018' Conference
- 2018 Beneficial Electrification Leadership Forum
- Website & Resources – www.beneficialelectrification.com
- Beneficial Electrification League – BEL
- Beneficial Electrification Ambassador (BE-A) Program

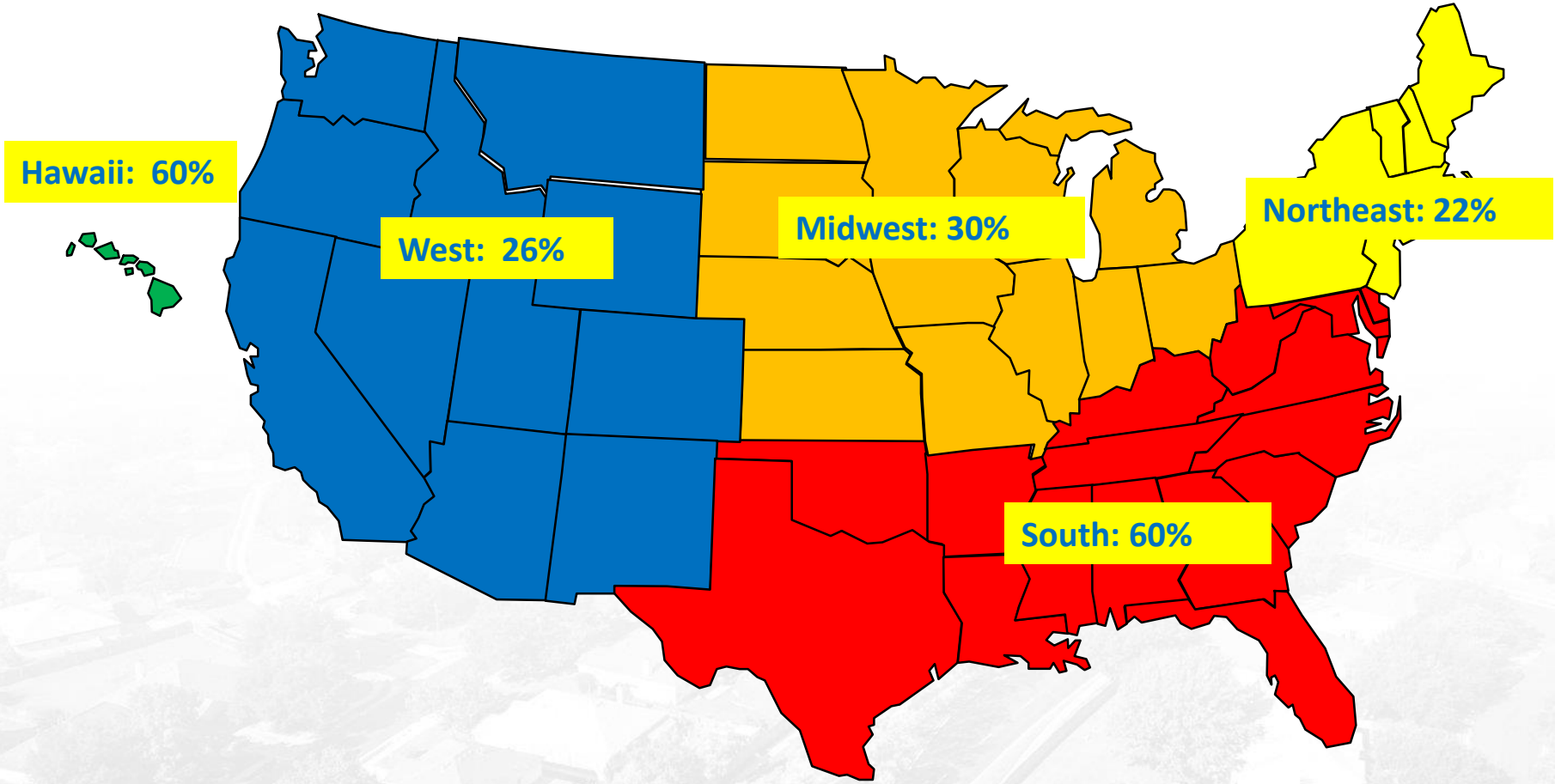
Beneficial Electrification League (BEL)

It Started With …….

Electric Water Heating!

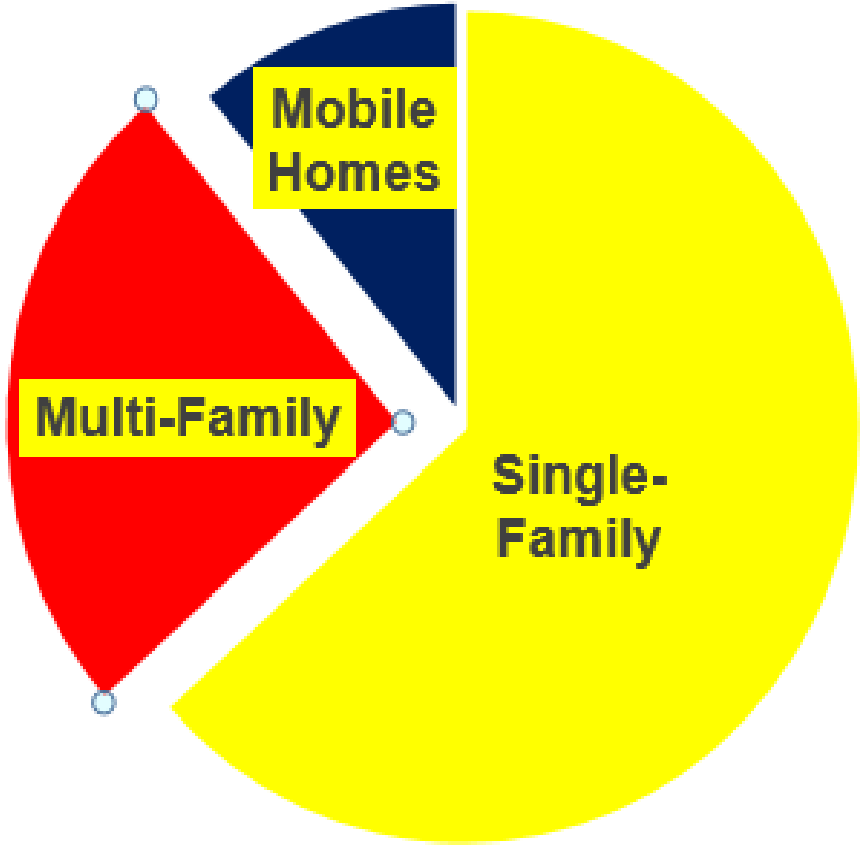
Beneficial Electrification League (BEL)

Electric Water Heating Market Share



Beneficial Electrification League (BEL)

45 Million Water Heaters		Total
Capacity	4.5kW/ea.	202.5 gW
Energy Storage Capacity	12kWh	540 gWh
Annual Energy	3800kWh/ea.	171 tWh

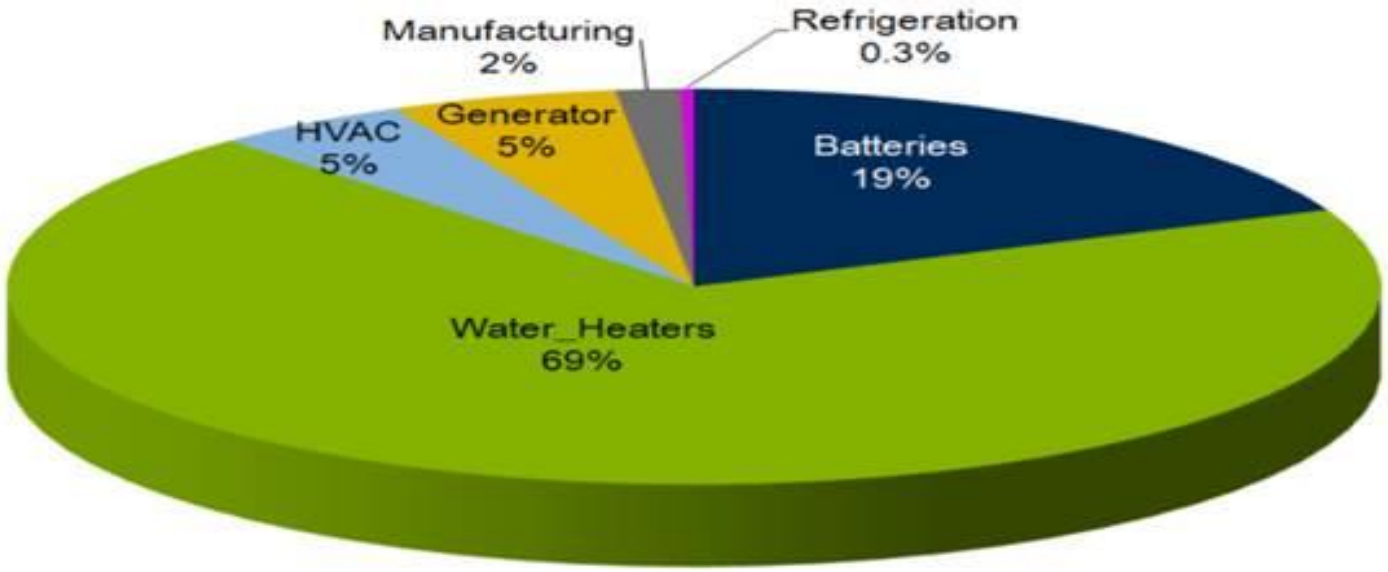


Beneficial Electrification League (BEL)

Regulation	Zone	Jan	Feb
Locations	RTO	414	428
Average Number of Unique Participating Locations per Month:		**421**	
MWs	RTO	64	65
Average MWs per Month:		**65**	

Capability represents total amount that may be offered. Actual offered and cleared volume may be significantly lower and is represented in subsequent figures/tables in report

Figure 10: 2017 PJM Demand Response Confirmed Regulation Registrations Load Reduction Methods



Beneficial Electrification League (BEL)

Recognizes:

- Electricity is getting cleaner, less carbon intensive
- Electricity production is becoming more intermittent and variable
- The electric grid is more sophisticated, more efficient, and more resilient
- Consumers are more sophisticated and expect more
- End-use technologies are more advanced, more efficient, and more wide-spread
- Climate change goals are not going away

Beneficial Electrification League (BEL)

Background:

- BE is the most effective and inclusive GHG reduction strategy
- To be successful, BE requires a collaborative effort
  - Utilities
  - Environmental and consumer advocates
  - Manufacturers and technology providers
  - Policymakers
- Immediate opportunities include:
  - Electric vehicles
  - Electric space and water heating
  - Commercial/industrial, and agricultural applications

Beneficial Electrification League (BEL)

Key Objectives:

- Create a broad stakeholder coalition
- Establish definitions and goals for stakeholders
- Build strategic partnerships
- Provide stakeholder engagement opportunities
- Identify policies that support / hinder BE
- Support BE market development
- Seek additional sponsorship and grant opportunities

Beneficial Electrification League

Current Activities:

- Hosting state/regional “Intro to BE” meetings
- Engaging in speaking opportunities
- Creating state/regional BE Leagues
- Promoting the BE Ambassador Program
- Providing input on policy requests
- Establishing a national BEL presence

Public Awareness & Market Development!

Beneficial Electrification League (BEL)

“In this age, in this country, public sentiment is everything. With it, nothing can fail; against it, nothing can succeed.

Beneficial Electrification League (BEL)

The Times They Are A-Changin'

Bob Dylan

Come gather 'round people wherever you roam,
And admit that the waters around you have grown,
And accept it that soon you'll be drenched to the bone
If your time to you is worth savin'
Then you better start swimmin'
Or you'll sink like a stone
For the times they are a-changin'!

Beneficial Electrification League - BEL!

Thank You!

The Win-Win-Win of Beneficial Electrification!

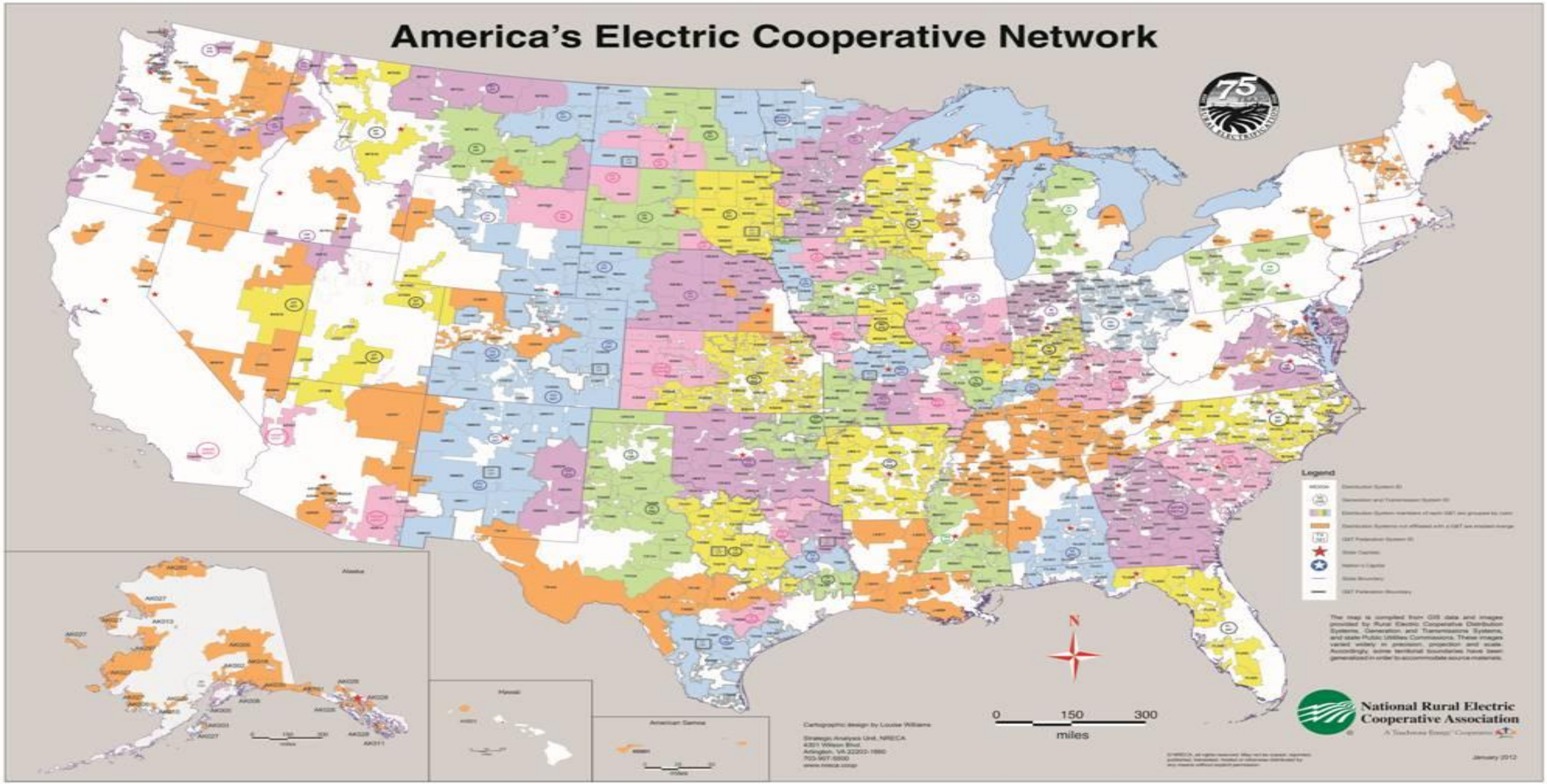
Beneficial Electrification: Changing the Way We Think About Electricity

Keith Dennis
Senior Director
National Rural Electric Cooperatives Association (NRECA)

NRECA
America's Electric Cooperatives

Keith Dennis
March 5, 2019

America's Electric Cooperative Network



Beneficial Electrification Opportunity / Takeaways

- Many stakeholders believe that Beneficial Electrification (BE) is key to meeting US and global GHG reduction goals – and it's compatible with a **pro-growth strategy!**
  - Emissions of generation are declining
  - Efficiency of devices is increasing
  - More flexible loads are desirable
- BE may lead to scenarios where more electricity is used, but fewer overall GHG emissions are produced.
- An opportunity for electric utilities and environmental groups to identify solutions that work well for the consumer, local communities and the environment

NRECA
America's Electric Cooperatives

Introduction: What is “Beneficial Electrification?”

The Beneficial Electrification League asserts that BE includes:

The application of electricity to end-uses that would otherwise consume fossil fuels (e.g., fuel oil, diesel, natural gas, propane, gasoline) where doing so satisfies at least one of following conditions, without adversely affecting the others:

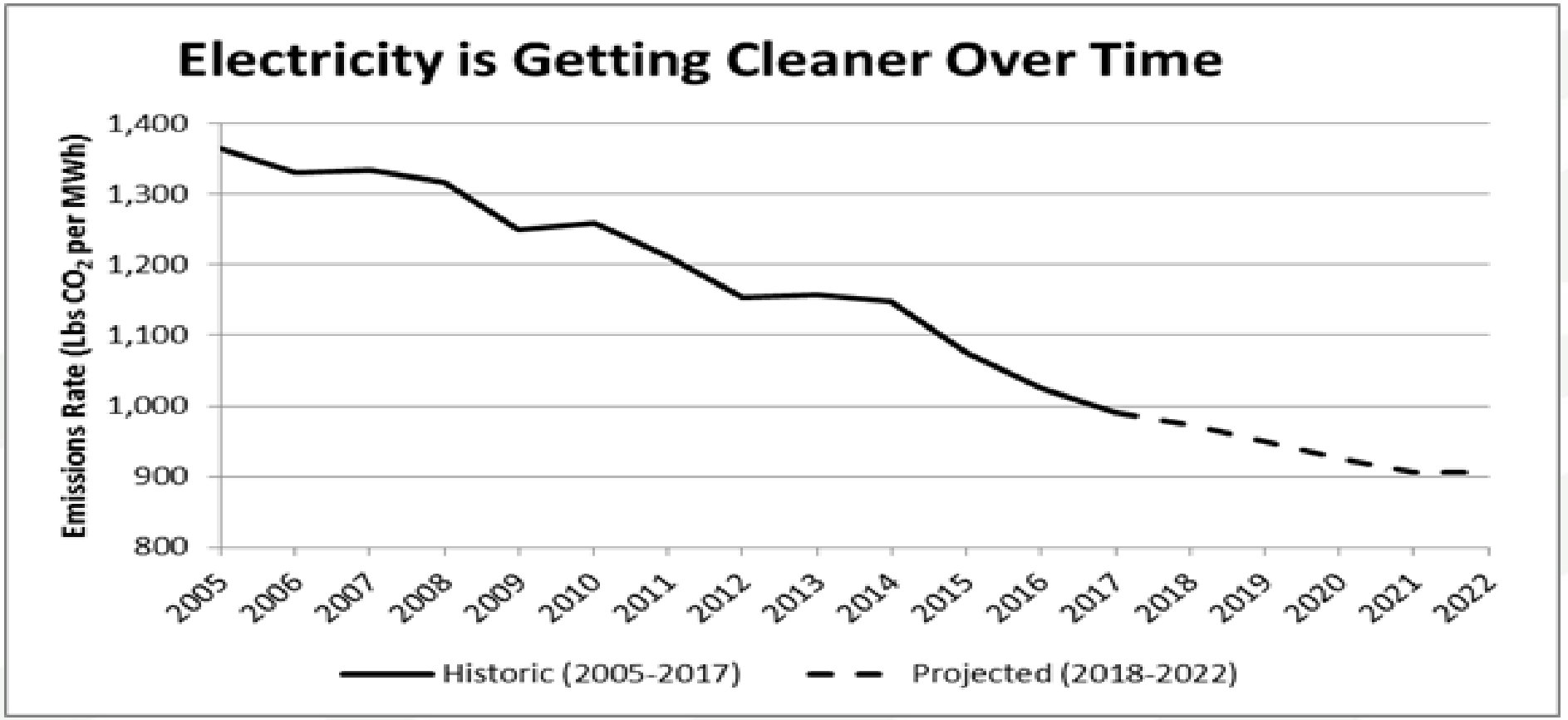
- save consumers money over time;
- benefit the environment and reduce greenhouse gas emissions;
- improve product quality or consumer quality of life; or
- foster a more robust and resilient grid.

Beneficial Electrification programs are a valuable opportunity to engage both electric utilities and environmental groups in the effort to identify solutions that work well for the end-use consumer, local communities and the environment

NRECA
America's Electric Cooperatives

NRECA
America's Electric Cooperatives

Opportunity for "BE" to Improve "Emissions Efficiency"



By virtue of being plugged into the grid, the environmental performance of electric devices improves over time.

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Electric Technology Has Changed -
Electric Agricultural Pumps and Heat Pumps

Great opportunity to incentivize electric agricultural pumps and heat pumps for space heating in rural areas!

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America's Electric Cooperatives

Beneficial Electrification – Improves Product Quality

Image: Electric rock crushing using electricity in Illinois (Coles-Moultrie) increases co-op load, improves operation, and reduces air pollution

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Down The Road – More Electric Tractors and Broadband/Technology Enabled Water Management

John Deere unveils latest all-electric tractor prototype for zero-emission agriculture

Fred Lambert - Dec. 5th 2016 5:30 am ET @FredericLambert

ELECTRIC TRACTOR JOHN DEERE

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Example: Steele-Waseca Water Heaters and Solar

THE SUNNA PROJECT

Buy a 410 watt panel in the SUNNA project and get a free electric thermal storage water heater

- $170 panel cost to consumer
- No sighting issues
- No maintenance issues
- Hedge against future energy hikes

GREAT RIVER ENERGY

Example – Dakota Electric School Bus

America's schools spend roughly $2 billion on fuel each year for transportation.

Transitioning to electric-powered school buses could cut these costs *in half*, down to $1 billion.

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America's Electric Cooperatives

What is the Future of Smart Homes?

Image source: Tesla Motors

Who will survive?

wemo

SAMSUNG SmartThings

hue PERSONAL WIRELESS LIGHTING

INSTEON

IRIS by LOWE'S

HomeKit

tp-link

works with nest

ecobee

NRECA America's Electric Cooperatives

wink

amazon echo

What is Next?

America's Electric Cooperatives

Welcome the “Beneficial Electrification League”!

- A new non-profit dedicated to promoting the benefits of beneficial electrification
- www.beneficialelectrification.com
- Supporters include: Natural Resources Defense Council (NRDC), National Rural Cooperative Association (NRECA), Environment and Energy Institute (EESI), WECC, Great River Energy, Oglethorpe Power, Jackson EMC, and more.

NRECA
America's Electric Cooperatives

Further Contact Information

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Board Member

Beneficial Electrification League

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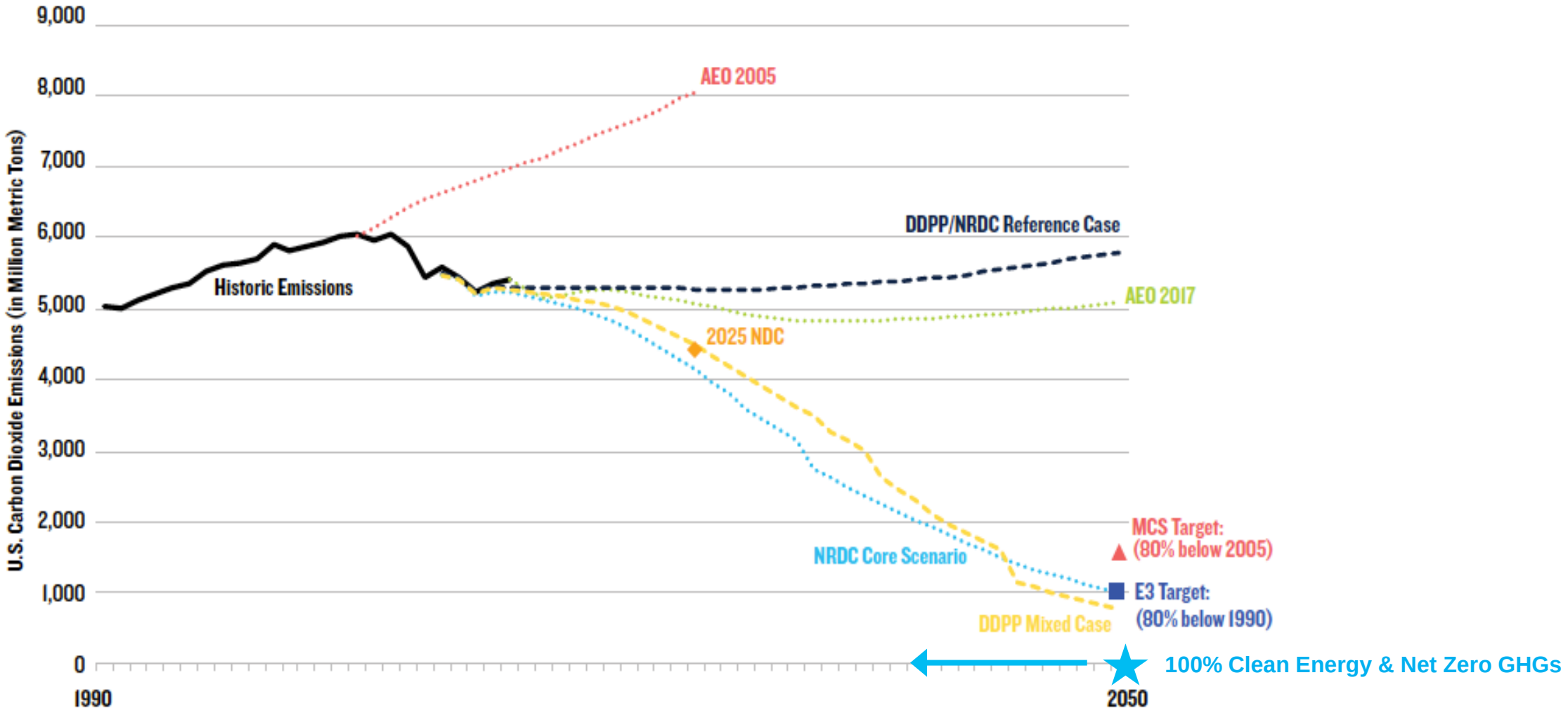
America's Electric Cooperatives

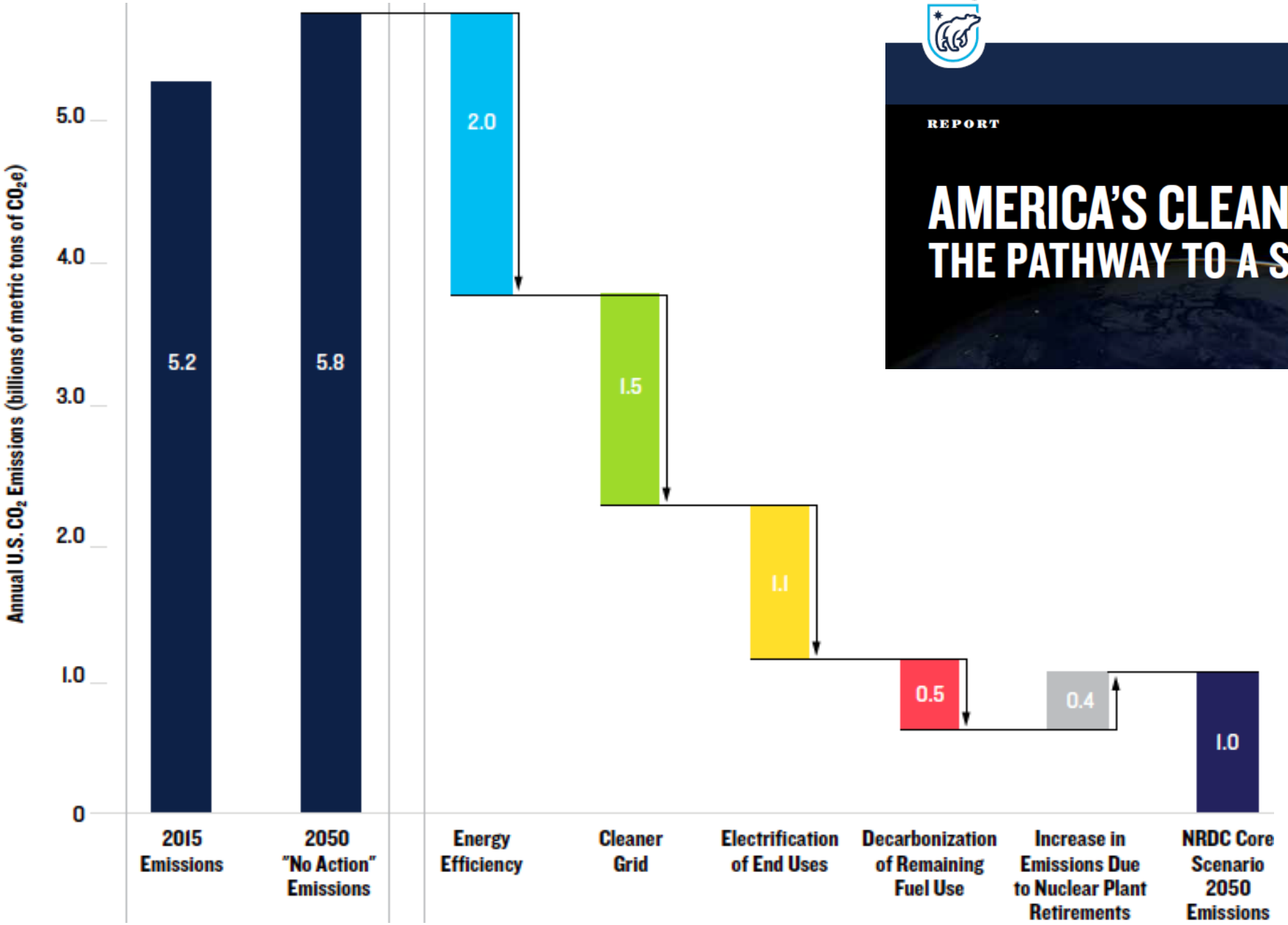
Beneficial Electrification:
A Key to Carbon Reduction

EESI Hill Briefing
March 2019

U.S. Carbon Dioxide Emissions Scenarios

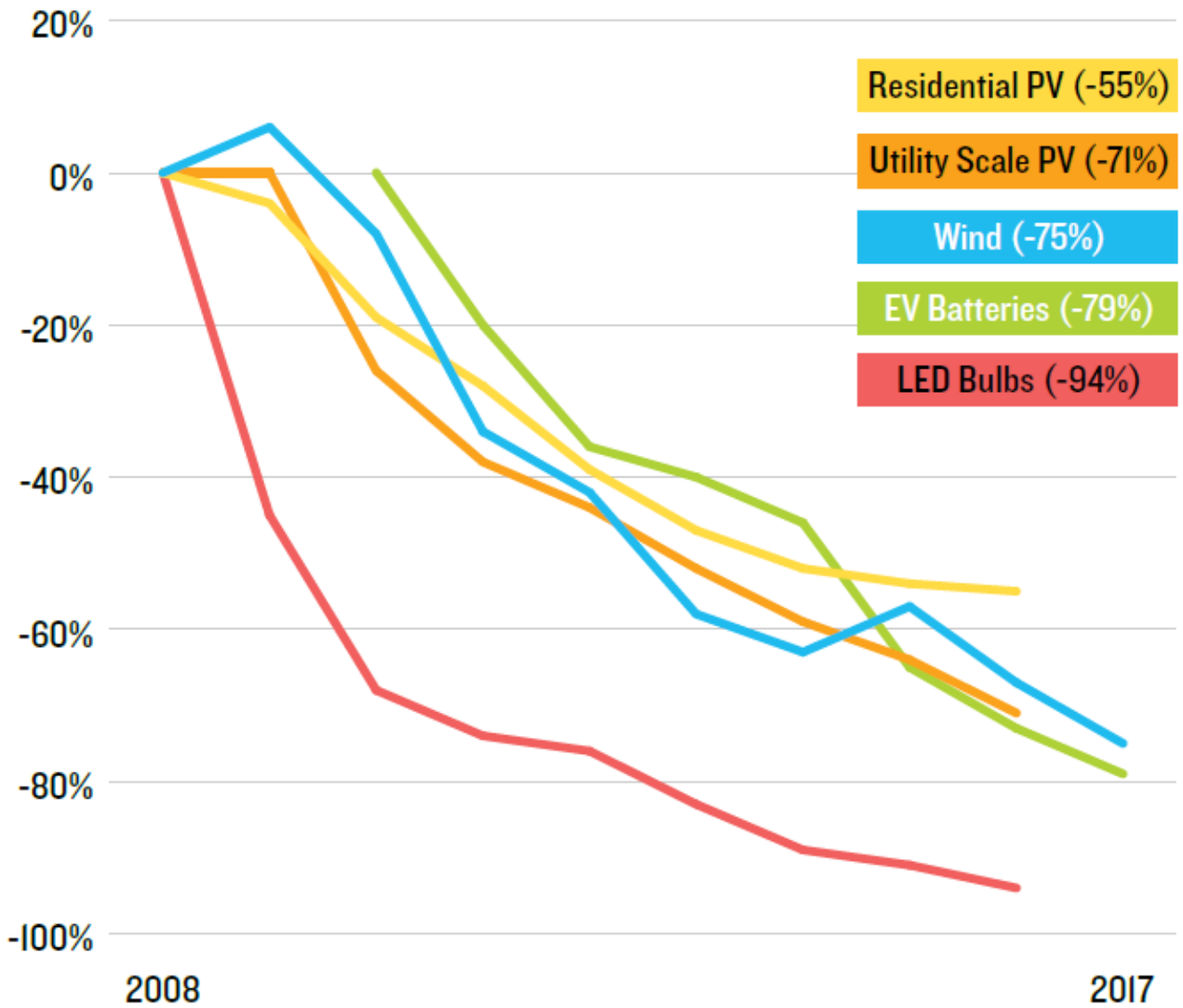


The DDPP/NRDC Reference Case is based on AEO 2013. E3 used a reduction goal of 80 percent by 2050 based on 1990 levels. MCS stands for Mid-Century Strategy, which was decarbonization modeling completed by the Obama administration following the Paris accord; MCS used a goal of 80 percent by 2050 based on 2005 levels.



Currently assessing how to close the gap to net-zero

COST REDUCTION IN MAJOR CLEAN ENERGY TECHNOLOGIES



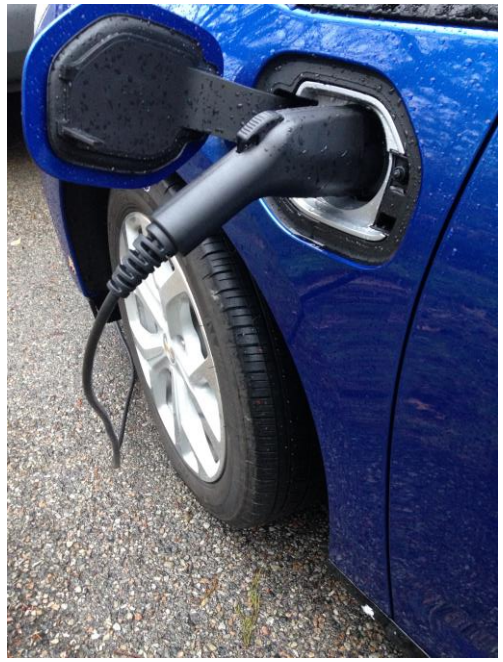
NRDC

FACT SHEET

REVOLUTION NOW

THE FUTURE IS HERE FOR CLEAN ENERGY

Transportation Electrification



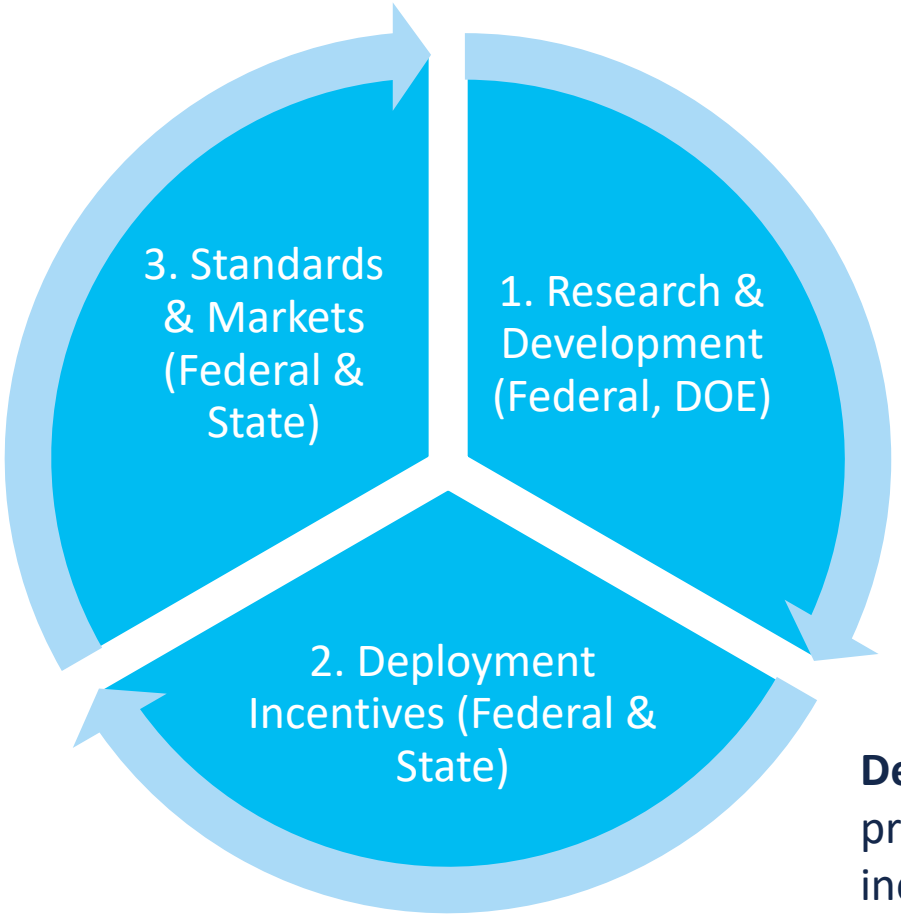
Building Decarbonization

Energy Efficiency	Electrification	Demand Flexibility
Use least energy	From cleanest fuel	At the right time

Climate & Clean Energy Policy Cycle

Standards & Markets: State & federal clean energy, efficiency, vehicle and carbon standards lock-in wide-spread adoption and deployment.

(The cycle keeps going to allow for continuous improvement and the next set of stronger standards).



Innovation: DOE funds basic science and early stage product development.

Deployment: Federal & state programs provide tax incentives, grants and financing to get products out into the market and drive down costs.

Contact Information

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Electrification:
Options for Consumers and the Environment

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