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Roadmap to Clean Energy: The role of Efficiency, Solar, Building Electrification, and EVs in the Clean Energy Transition

Utah APA Conference

February 28, 2020

Kate Bowman and Kevin Emerson

SOLAR ENERGY INNOVATION NETWORK
U.S. DEPARTMENT OF ENERGY

UTAH CLEAN ENERGY

UCAIR UTAH CLEAN AIR PARTNERSHIP | PARTNER

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UTAH CLEAN ENERGY

- Non-profit organization, est. 2001
- Policy and regulatory expertise
- Public education & outreach
- Solutions-oriented approach

www.utahcleanenergy.org

STOP
ENERGY WASTE

CREATE
CLEAN ENERGY

BUILD
A SMART ENERGY FUTURE

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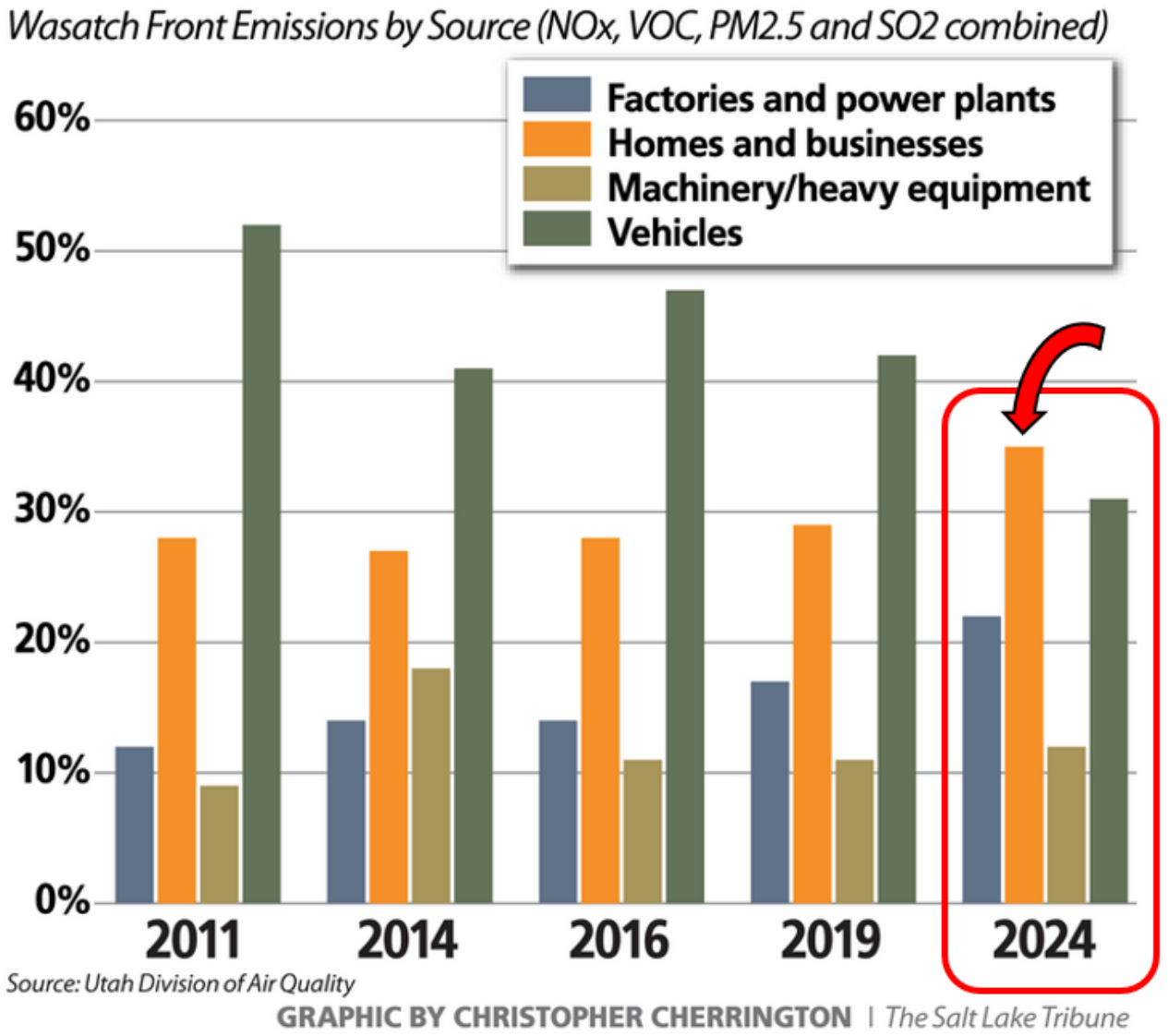
Question 1:

What is your role/position?

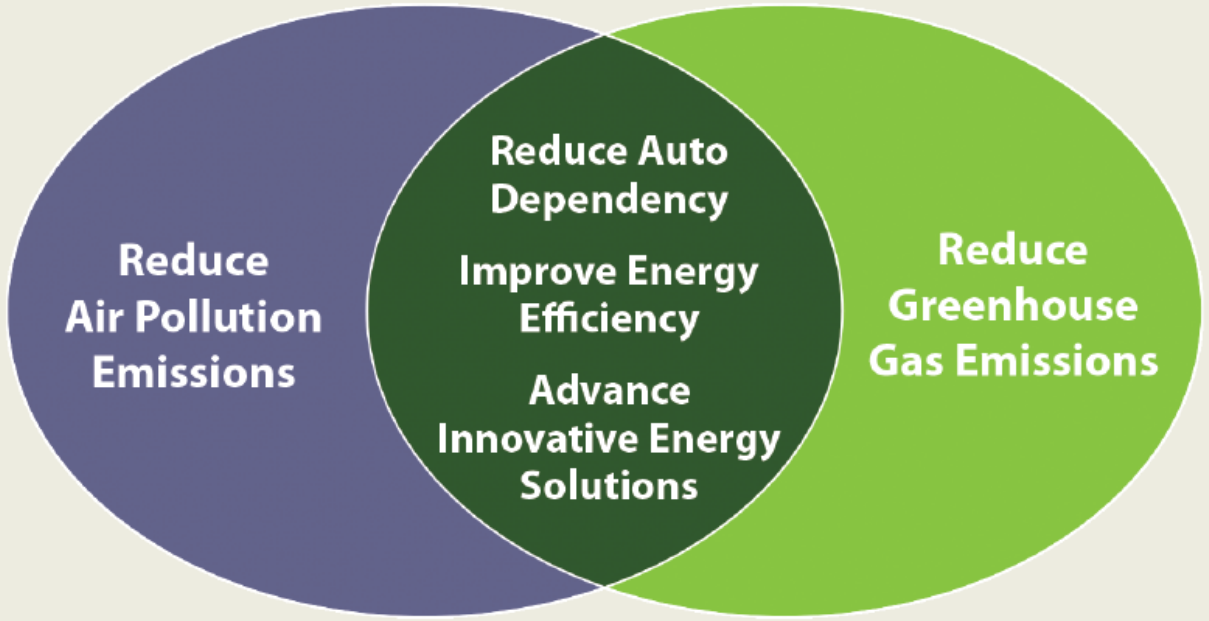
AIR QUALITY & BUILDINGS

By 2024, homes and businesses will become the largest contributors of Utah air pollution.



CLIMATE CHANGE AND AIR QUALITY

Reducing air emissions throughout Utah benefits both air quality and changing climate issues. Some emissions-reduction strategies, such as those in the center of the diagram, directly address this connection, improving air quality and the climate.



Courtesey: Kem C. Gardner Policy Institute, University of Utah, The Utah Roadmap, Positive Solutions on Climate and Air Quality (2020)
https://gardner.utah.edu/utahroadmap/

Charting a Path for Reliable, Resilient and Affordable Clean Energy

A Roadmap for
Three Communities in Utah

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Question 2:

What % of greenhouse gas emissions in Utah come from electricity generation?

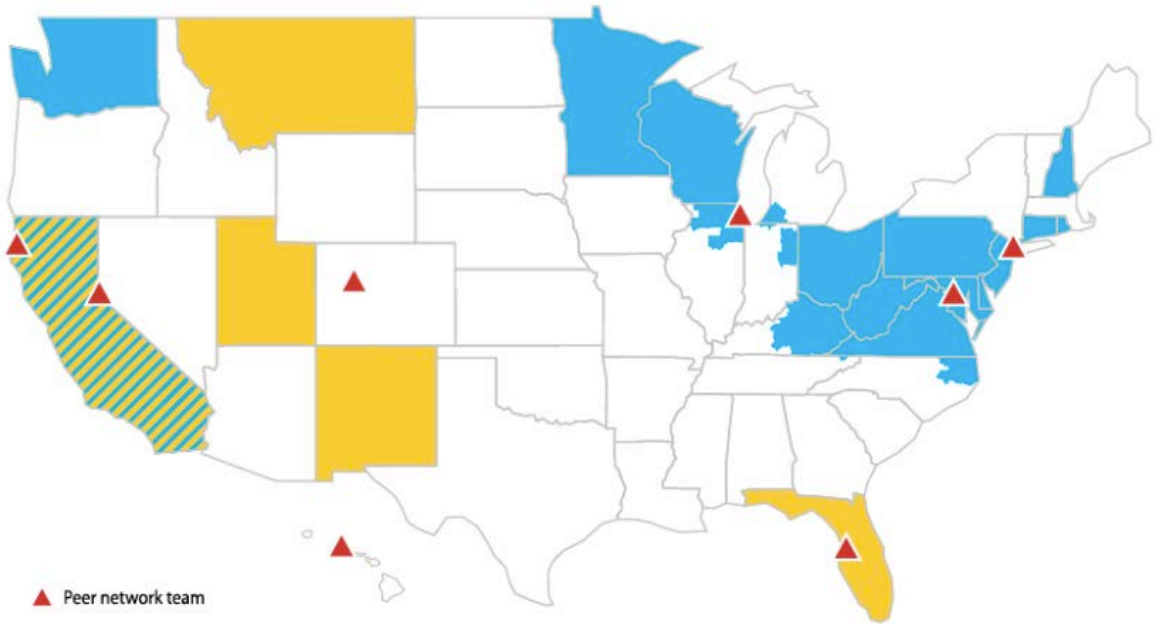
a. 15%

b. 25%

c. 40% ✓

d. 50%

SOLAR ENERGY INNOVATION NETWORK



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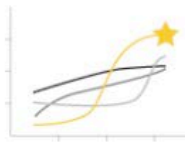
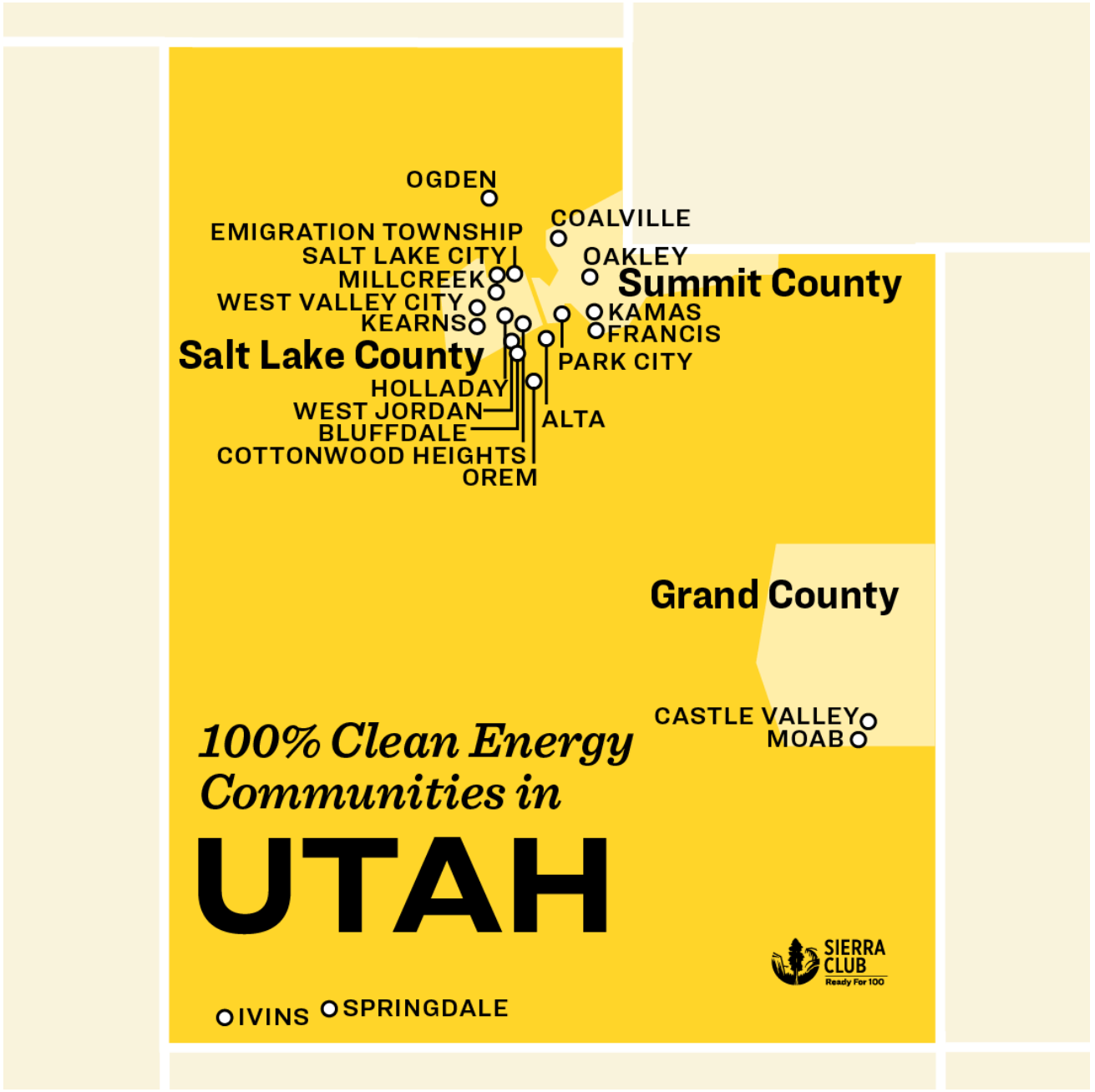
NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Options Analysis
Improving reliability and affordability of solar energy through options analysis and systems design

Grid Flex
Improving grid flexibility and resiliency through advanced siting and operations of solar + DER

Disclaimer: This work is funded in part or whole by the U.S. Department of Energy Solar Energy Technologies Office, under Contract No. DE-AC36-08GO28308 led by the National Renewable Energy Laboratory as part of the Solar Energy Innovation Network. The Solar Energy Innovation Network assembles diverse teams of stakeholders to research solutions to real-world challenges associated with solar energy adoption. This report was prepared as an account of work sponsored by an agency of the U.S. Government. Neither the U.S. Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof.
The strategies outlined in this Roadmap have been developed through collaborative discussions with project partners, but may not represent the opinions of or positions of all partner organizations and parties involved in the "Renewable Energy Impacts and Solutions in Utah" project. Rather, the strategies outlined in this Roadmap represent a suite of tools and actions that Salt Lake City, Park City, and the City of Moab can consider as each city works towards their community renewable electricity goals.



COMMUNITY RENEWABLE ENERGY ACT

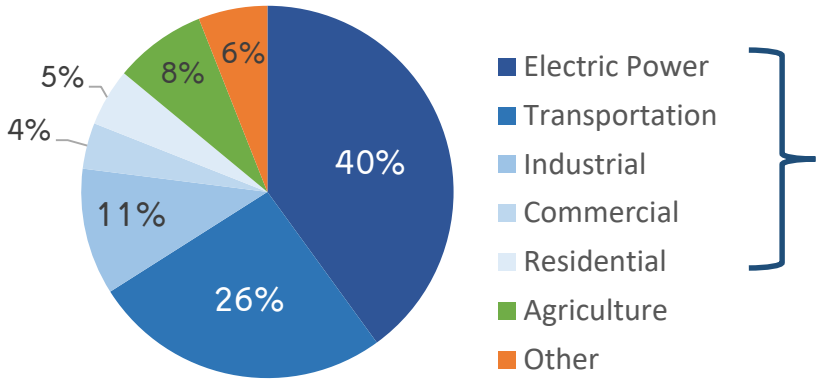
- 23 communities
- 850,000+ Utahns
- ~25-30% of RMP's electricity load in Utah
- Next steps in 2020:
  - 23 communities enter into an interlocal agreement
  - Negotiate and enter into an agreement with RMP
  - Submit a filing with UT PSC to approve the program in 2021

UTAH CLEAN AIR PARTNERSHIP

Advancing Urban Efficiency to Improve Utah's Air Quality

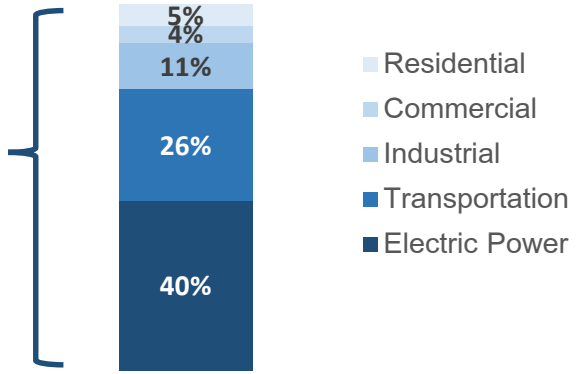
GREENHOUSE GAS EMISSIONS IN UTAH

Utah Greenhouse Gas Emissions By Sector



Energy
(electricity, gasoline, natural gas)

Utah Greenhouse Gas Emissions from Electricity, Natural Gas, and Gasoline MMBtu



Electricity:	40%
Transportation:	26%
Buildings:	20%

Utah's Electricity

= 9th most affordable

= 6th most carbon intensive

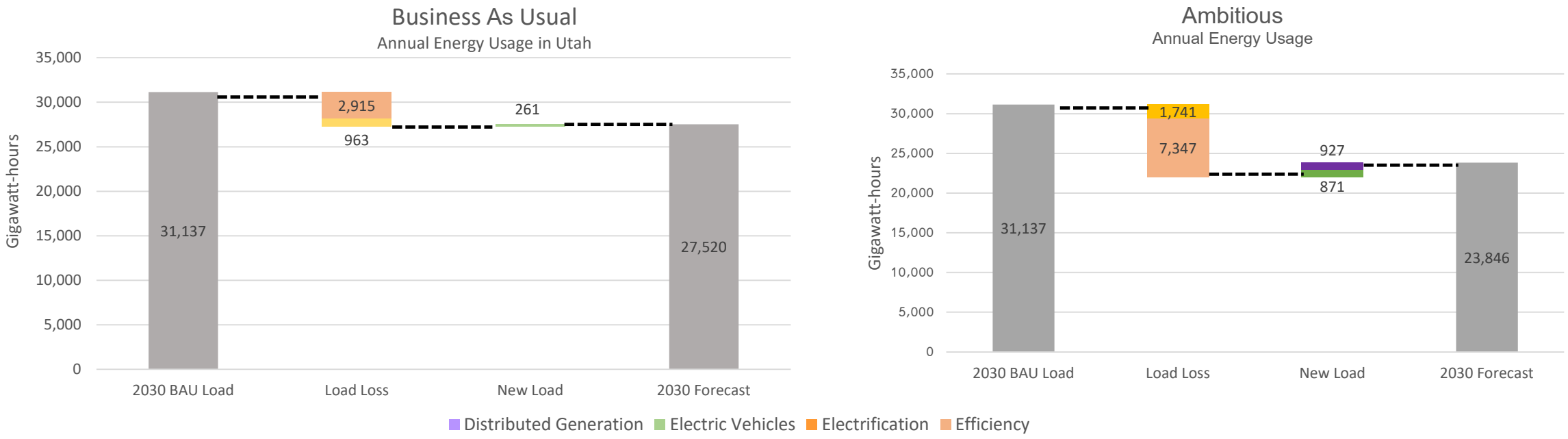
"Other" includes industrial, Mineral and Chemical Processes, Waste, Petroleum Extraction and Refining

Data includes all emissions from power generation within Utah, including emissions from power generated locally that is then exported for use in another state.
Emissions due to non-combustion sources are derived from the EPA Facility-Level Information on Greenhouse Gases Tool (2017) and USDA (2013) reports on non-combustion sources.
Emissions due to combustion sources are derived from U.S. Energy Information Administration (2016) reports on combustion sources.

ELECTRICITY SECTOR ANALYSIS RESULTS

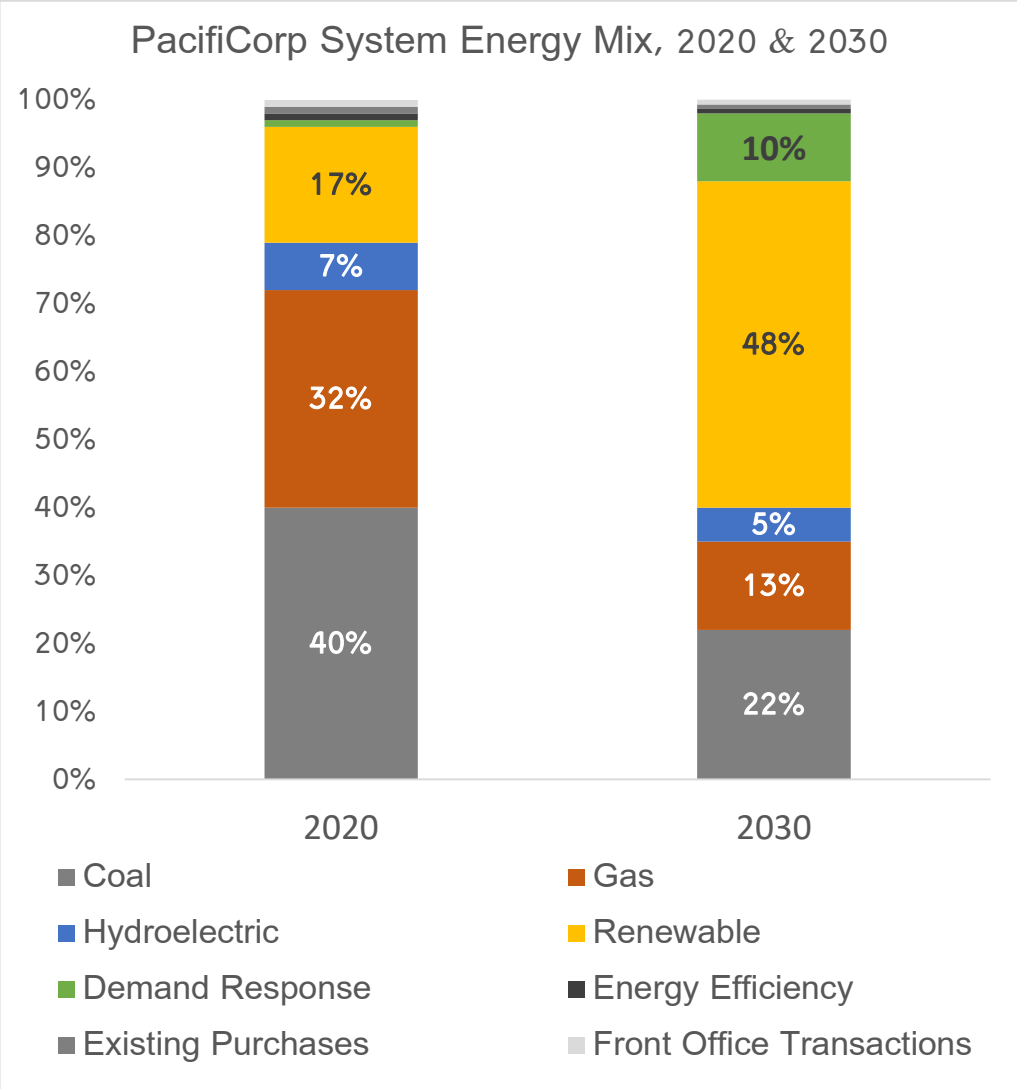
Energy efficiency and distributed solar have the potential to provide **3,877 – 9,084** gigawatt-hours of clean energy annually in Utah by 2030.

At the same time, the growth of electric vehicles and residential beneficial electrification has the potential to add **451 – 1,798** gigawatt-hours of energy usage annually in Utah by 2030.



Note: Business as usual load forecast is based on pre-DSM forecasted annual load growth and includes generation from the base case rooftop solar forecast, as described in slide 38.

UTILITY-SCALE RENEWABLE ENERGY



PacifiCorp projected system renewable energy additions through 2030:

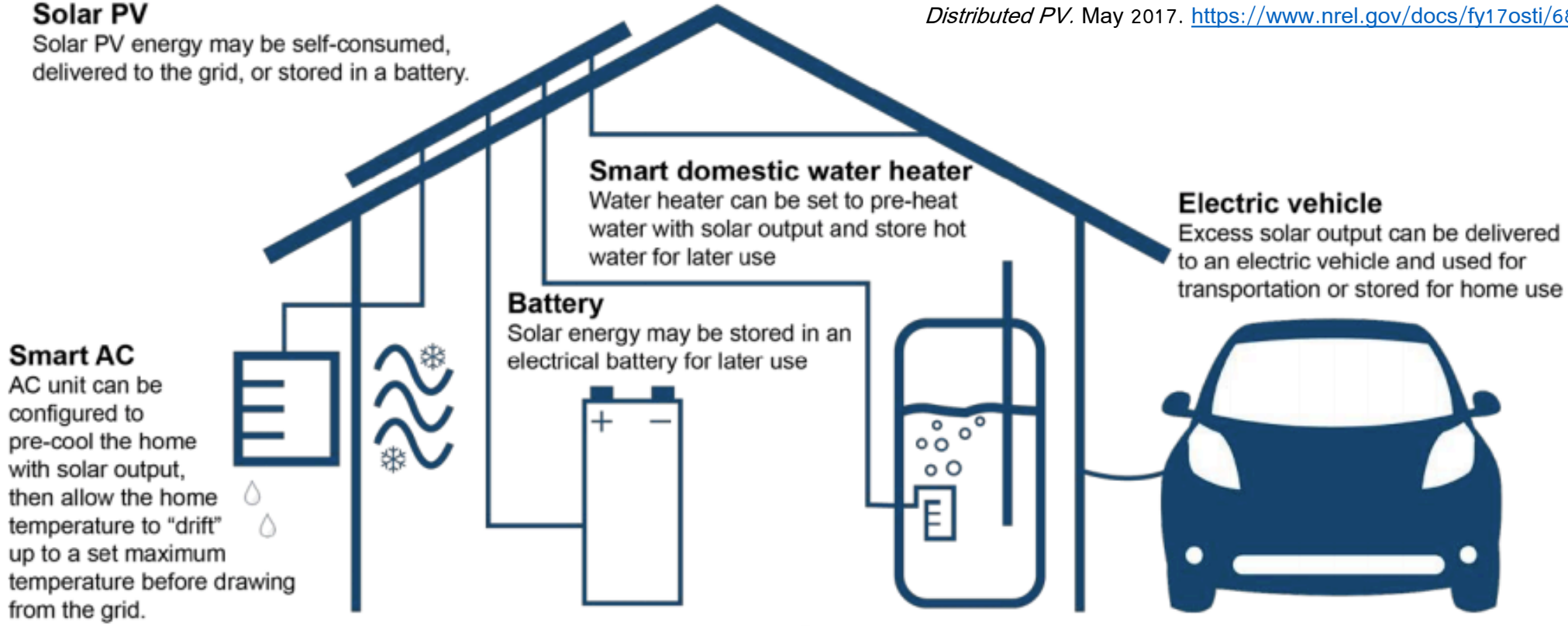
Wind + 3,040 MW

Solar + 3,200 MW

2019 Integrated Resource Plan. PacifiCorp. Oct 18, 2019. Figure 8.18, page 258. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2019_IRP_Volume_I.pdf

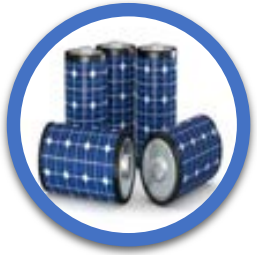
ENERGY OPTIMIZATION

Source: National Renewable Energy Laboratory. *Solar Plus: A Holistic Approach to Distributed PV.* May 2017. https://www.nrel.gov/docs/fy17osti/68495.pdf




Energy Efficiency


Distributed Generation


Storage


Electric Vehicles

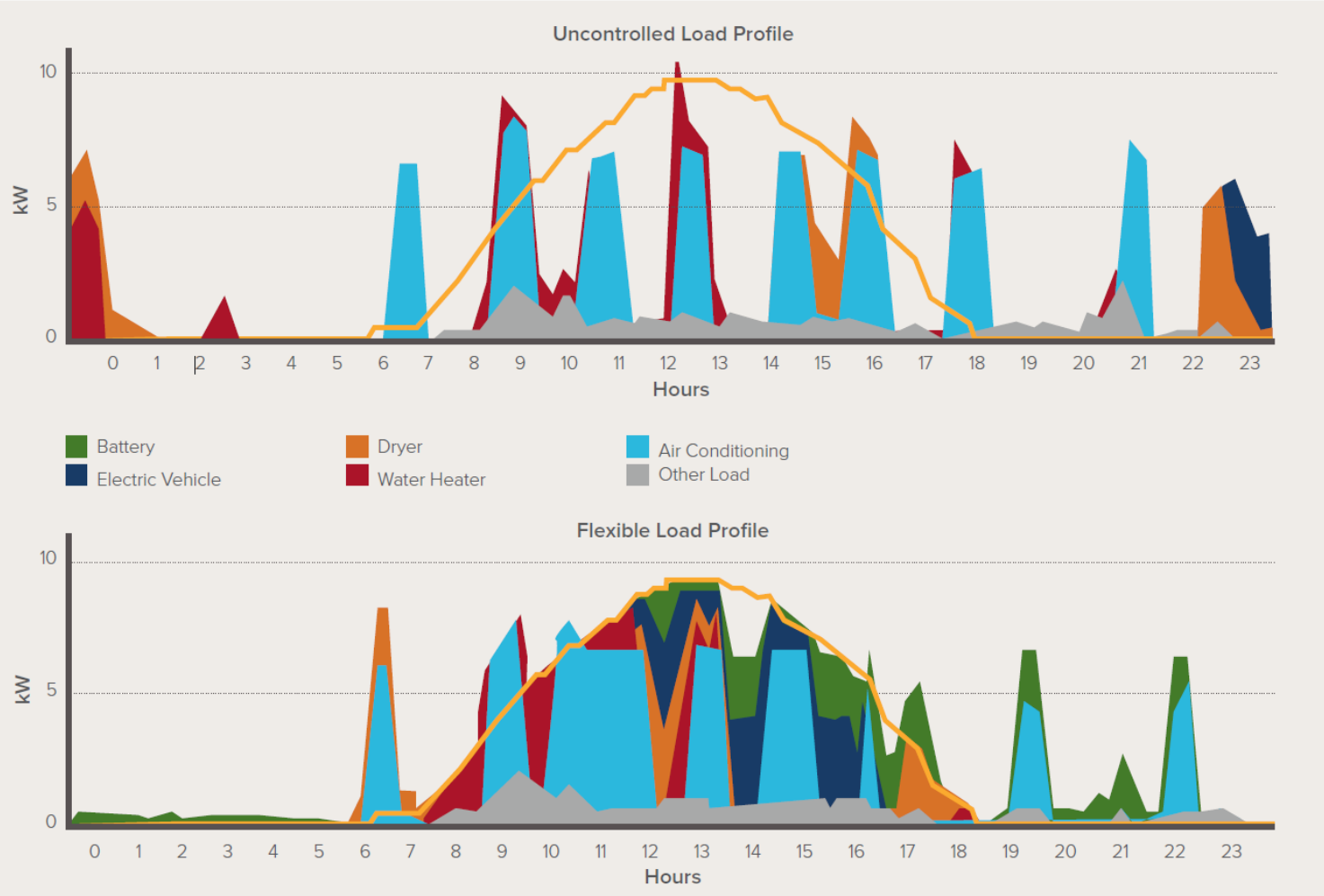

Beneficial Electrification


Demand Response


Utility Scale

Distributed energy resources can be deployed to shift energy usage to times when low-cost renewable energy resources are available

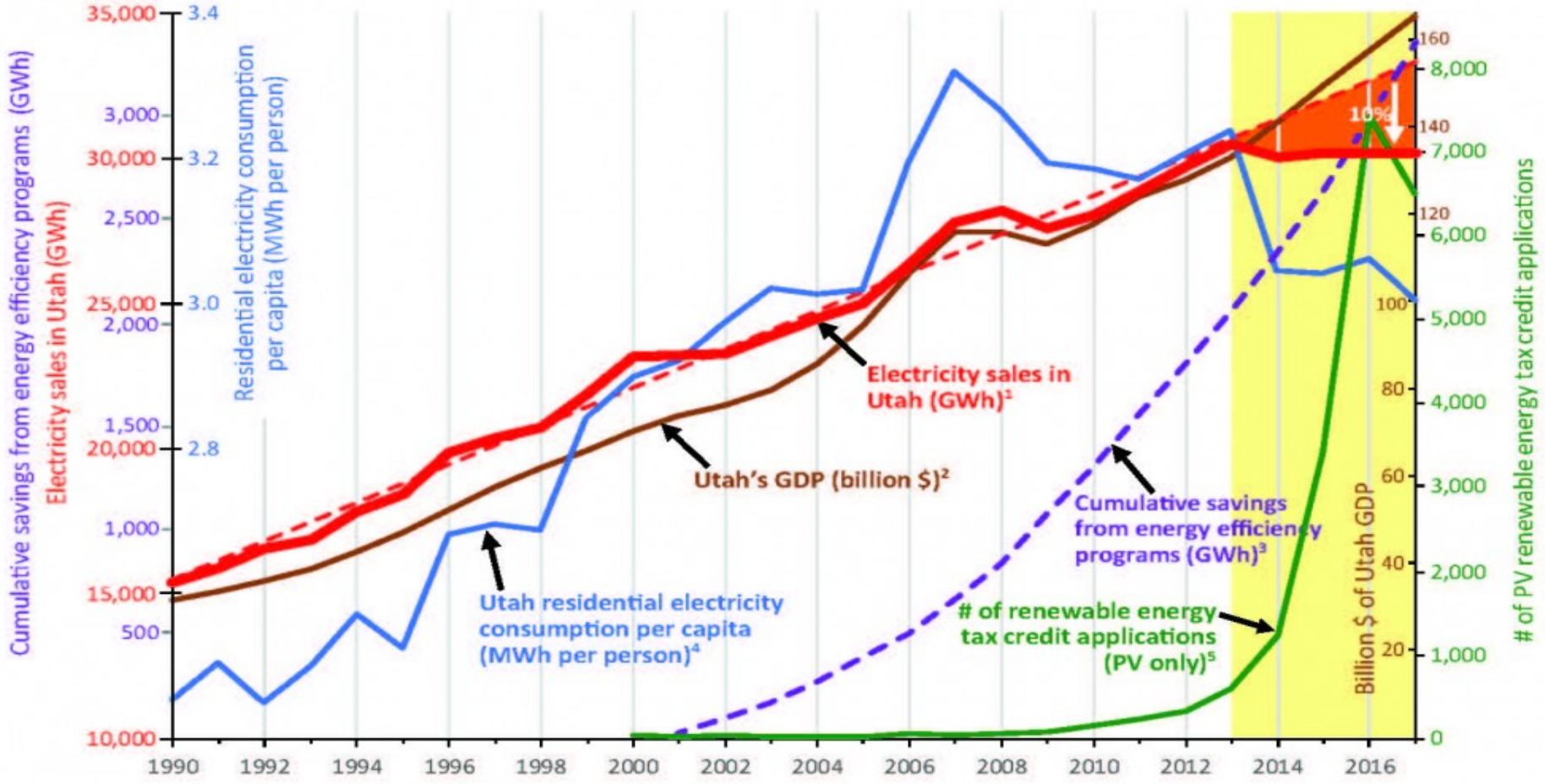
Figure 1: Impact of demand flexibility on residential load profile



Demand Flexibility: the Key to Enabling a Low-Cost, Low-Carbon Grid. Rocky Mountain Institute. http://rmi.org/wp-content/uploads/2018/02/Insight_Brief_Demand_Flexibility_2018.pdf

ENERGY EFFICIENCY

Energy Efficiency Works!



[1]Data from U.S. Energy Information Administration
[2]Data from U.S. Bureau of Economic Analysis
[3]Utah Public Service Commission, Rocky Mountain Power, Utah Clean Energy
[4]Utah population data from Kem C. Gardner Policy Institute, University of Utah
[5]Data from Utah Office of Energy Development; 2017 data estimated

Source: Utah Geological Survey, 2018: https://geology.utah.gov/map-pub/survey-notes/energy-news/heroconservation/

ENERGY EFFICIENCY

Utah Top 10 Improvements

* Pays back in less than 5 years for most households

HVAC * High-efficiency heat pump (replace electric furnace at wear out)

Enclosure Drill-and-fill wall cavity insulation

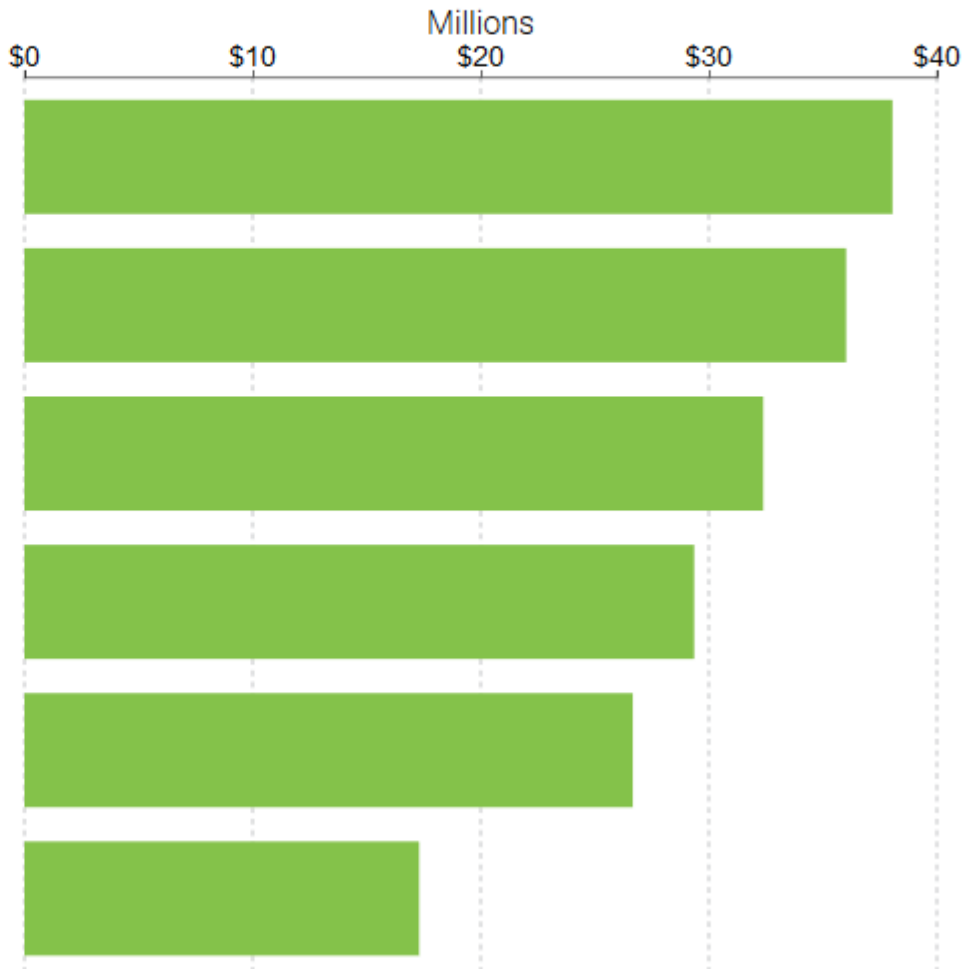
Enclosure R-10 basement wall insulation

Lighting * LED lighting

HVAC * Smart thermostat

HVAC Ductless heat pump (displaces electric baseboard)

Utah Utility Bill Savings (electricity, gas, propane, and fuel oil)



NREL ResStock State Fact Sheet: Utah. National Renewable Energy Laboratory. https://resstock.nrel.gov/factsheets/UT

Net Zero Energy Building

"An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy."

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

ZERO ENERGY CERTIFICATION

U.S. DEPARTMENT OF ENERGY

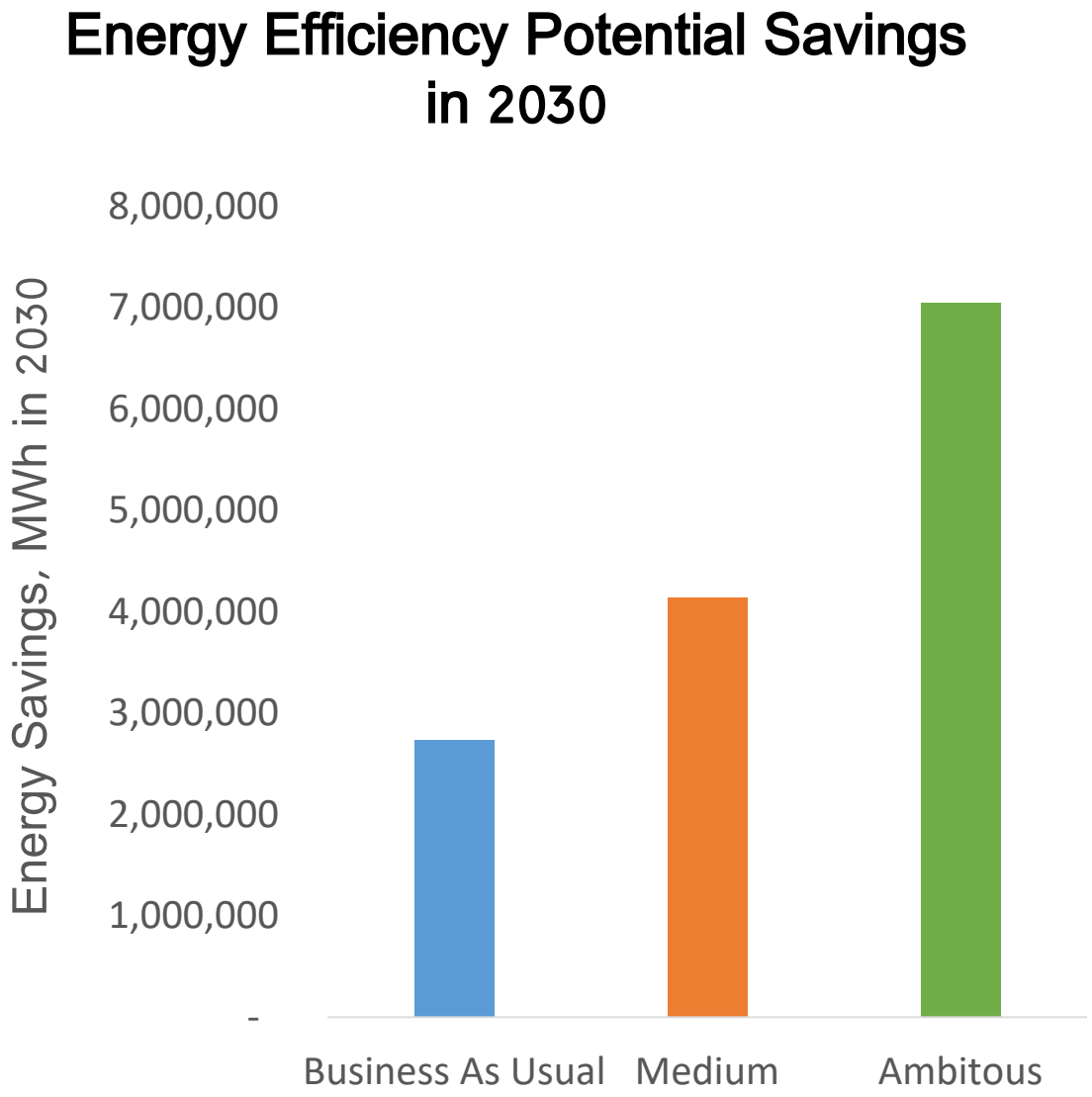
ZERO CARBON CERTIFICATION

Sources: U.S. Department of Energy: http://bit.ly/33NMo0Q; World Green Building Council: https://www.worldgbc.org/;

ENERGY EFFICIENCY

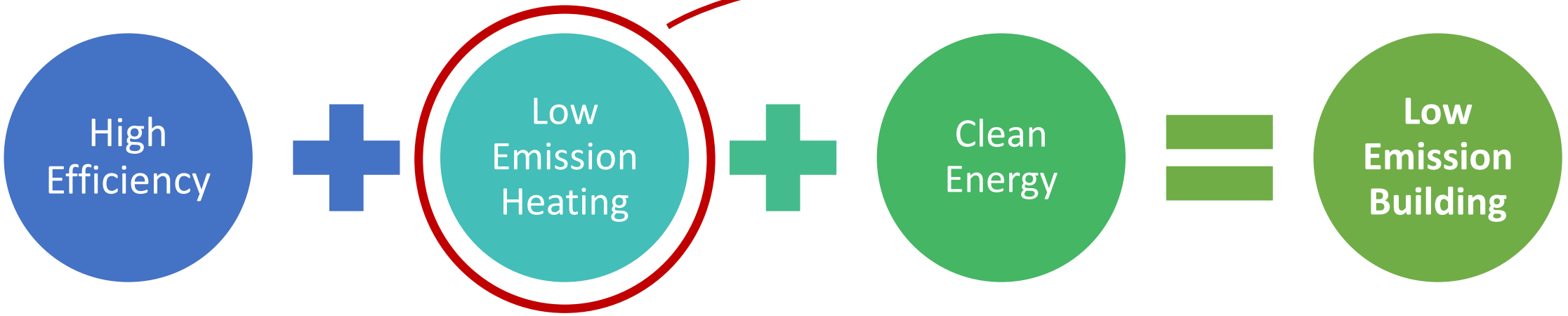
Potential for energy efficiency to reduce electricity demand

1. **Business As Usual** : Level of energy efficiency in Rocky Mountain Power's 2017 20-year plan.
2. **Medium** : All homes and businesses adopt the most energy efficient and cost-effective commercially available measures.
3. **Ambitious** : The technical potential of energy efficiency if all homes and businesses adopted the most energy efficient commercially available technologies and measure, regardless of cost.



Low Emission Buildings

Low Emission Buildings



Zero Emission Buildings

BENEFICIAL ELECTRIFICATION

Air source heat pumps: an energy-efficient alternative to both furnaces and air conditioners, resulting in fewer greenhouse gas emissions when powered by renewable energy.

Controllable electric water heaters: shift energy use to times when low-cost renewable energy resources are available without impacting customer comfort.

Geothermal heat pumps: transfer energy to or from the ground to heat or cool a home.

Controllable EV charging: align EV charging with times of day when energy costs are low.

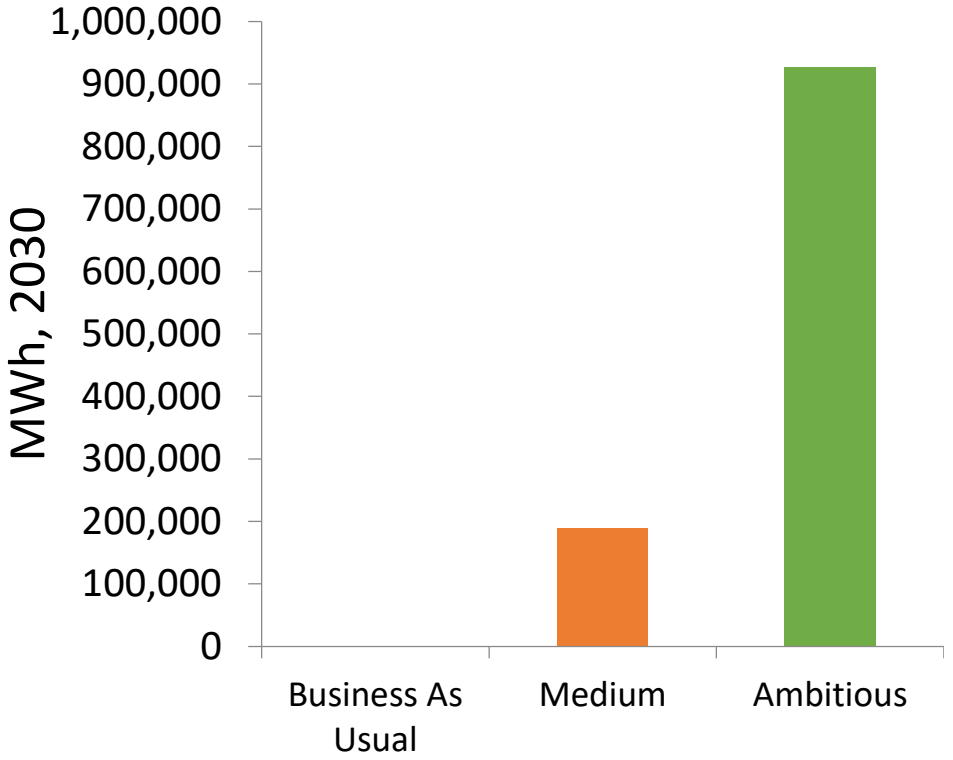
BENEFICIAL ELECTRIFICATION

Has the potential to **use** **190 – 927 more** gigawatt-hours of energy annually in Utah by 2030 and reduce greenhouse gas emissions by **65,583 –215,138** metric tons.

Scenarios were considered:

1. **Business As Usual:** Negligible adoption of beneficial electrification technologies for residential space and water heating.
2. **Medium:** The economic potential of beneficial electrification of existing single-family homes, including all available technology options that meet cost-effectiveness criteria.
3. **Ambitious:** The technical potential of beneficial electrification of existing single-family homes using available technology regardless of cost.

Residential Single-Family Potential Electricity Usage From Beneficial Electrification, 2030



Efficiency Potential in U.S. Single-Family Housing Stock. Eric Wilson, Craig Christensen, Scott Horowitz, Joseph Robertson, and Jeff Maguire. Technical Report NREL/TP-5500-68670. December 2017.

BENEFICIAL ELECTRIFICATION

Priority Strategies

- **Lead by example**: All city-owned and city-funded facilities built to zero emission standards – 3rd party verified
- **Master Plans:** acknowledge role of zero emission buildings in protecting general welfare and conserving resources – 3rd party verified
- **Affordable housing:** include low- and moderate-income action plan for zero emissions buildings in master plan
  - **Energy retrofits:** work with utilities and other partners to provide "deep energy retrofits" in low- to moderate-income housing
- **Adopt Zero Emission Building Zoning District** to encourage zero emission standards
  - **Waive permit fees** to incentivize zero emission buildings
  - **Allow variances** for density, height, etc.
- **Educate developers** about energy efficient & zero emission building standards heat pump electric heating
- Target **homes with electric resistance heat** for beneficial electrification retrofits

Questions and feedback?

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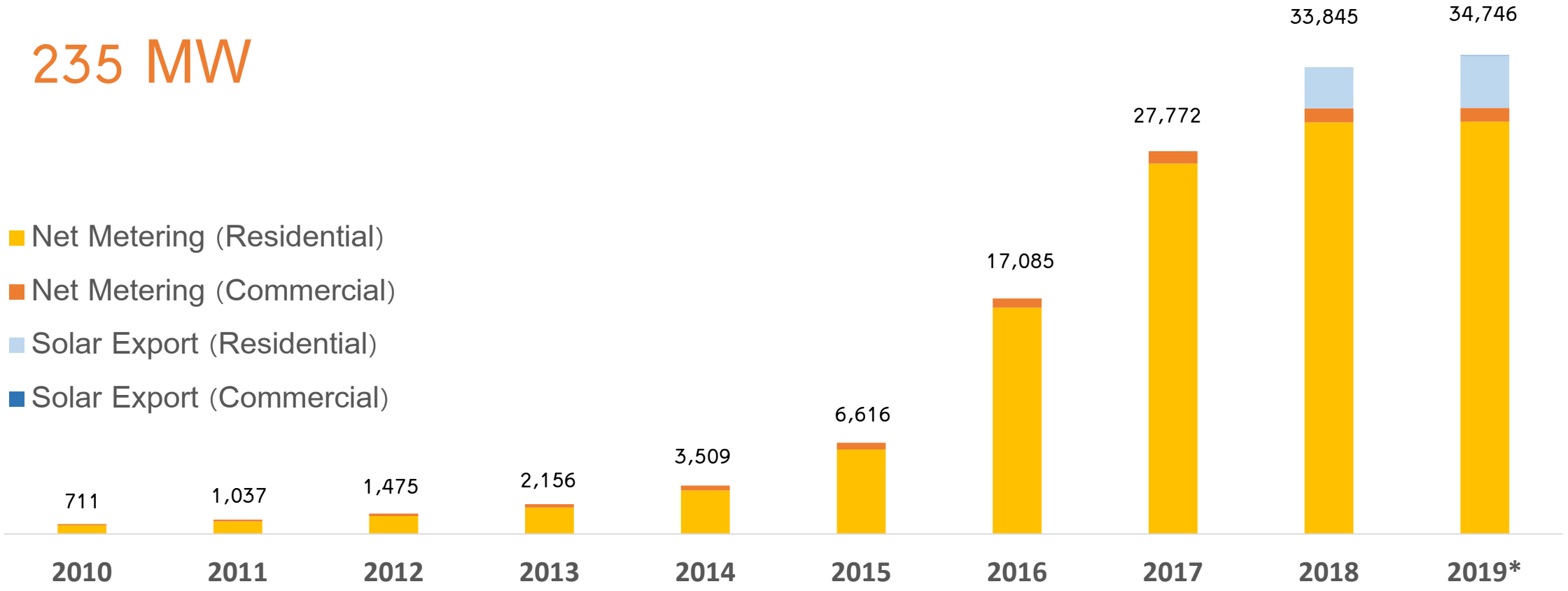
Question: What other key actions come to mind that planners can take to support **zero emission buildings**?

DISTRIBUTED GENERATION

Utah Homes & Businesses with Rooftop Solar:

235 MW



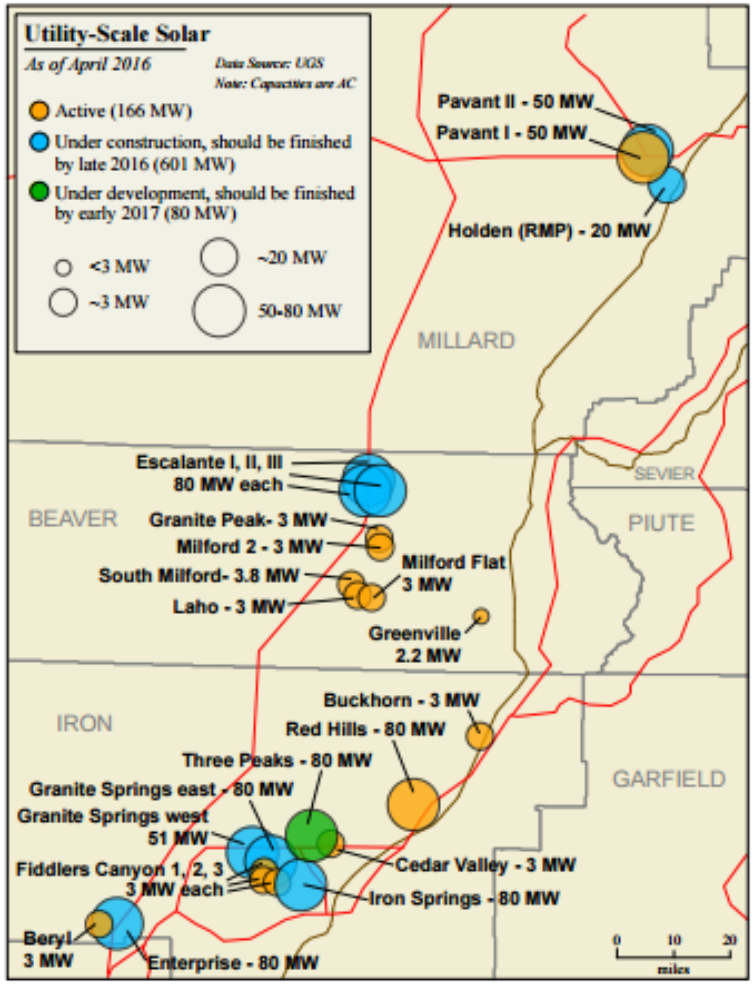
* Through March 2019

2018 Customer Owned Generation and Net Metering Report. Rocky Mountain Power. July 2019. https://psc.utah.gov/2019/07/01/docket-no-19-035-29/

DISTRIBUTED GENERATION

Utility-Scale Solar:

1,700 MWdc



Source: *Utah's Energy Landscape, 4th Edition,* Utah Dept of Natural Resources

DISTRIBUTED GENERATION

Distributed solar has the potential to provide **963 – 1,741** gigawatt-hours of clean energy annually in Utah by 2030.

Three distributed solar scenarios were considered:

1. **Business As Usual**

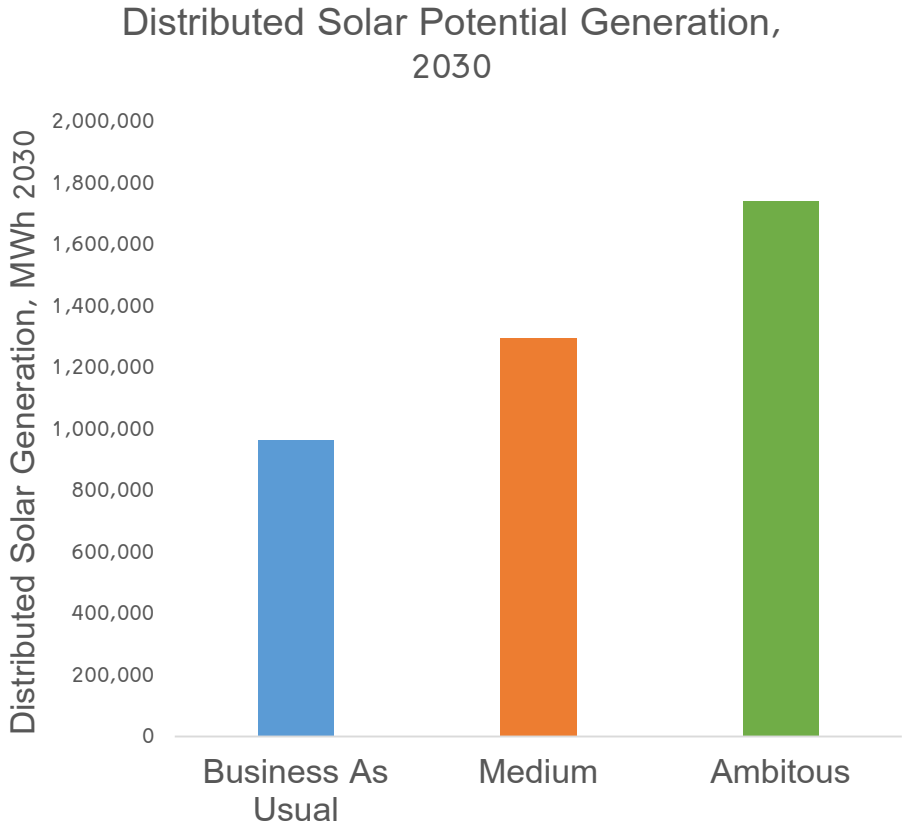
   The base case for distributed generation as forecasted for use in Rocky Mountain Power's 2017 Integrated Resource Plan

2. **Medium**

   The high case for distributed generation as forecasted for Rocky Mountain Power's 2017 Integrated Resource Plan.

3. **Ambitious**

   A forecast for the growth of distributed solar based on the reference case scenario from the National Renewable Energy Laboratory's 2018 Standard Scenarios Report.



Private Generation Long-Term Resource Assessment (2017-2036). Karin Corfee, Shalom Goffri, Andrea Roman. Navigant Consulting, Inc. July 2016.
2018 Standard Scenarios Report: A U.S. Electricity Sector Outlook. Cole, Wesley, Will Frazier, Paul Donohoo-Vallett, Trieu Mai, and Paritosh Das. National Renewable Energy Laboratory. NREL/TP-6A20-71913. https://www.nrel.gov/docs/fy19osti/71913.pdf.

DISTRIBUTED GENERATION

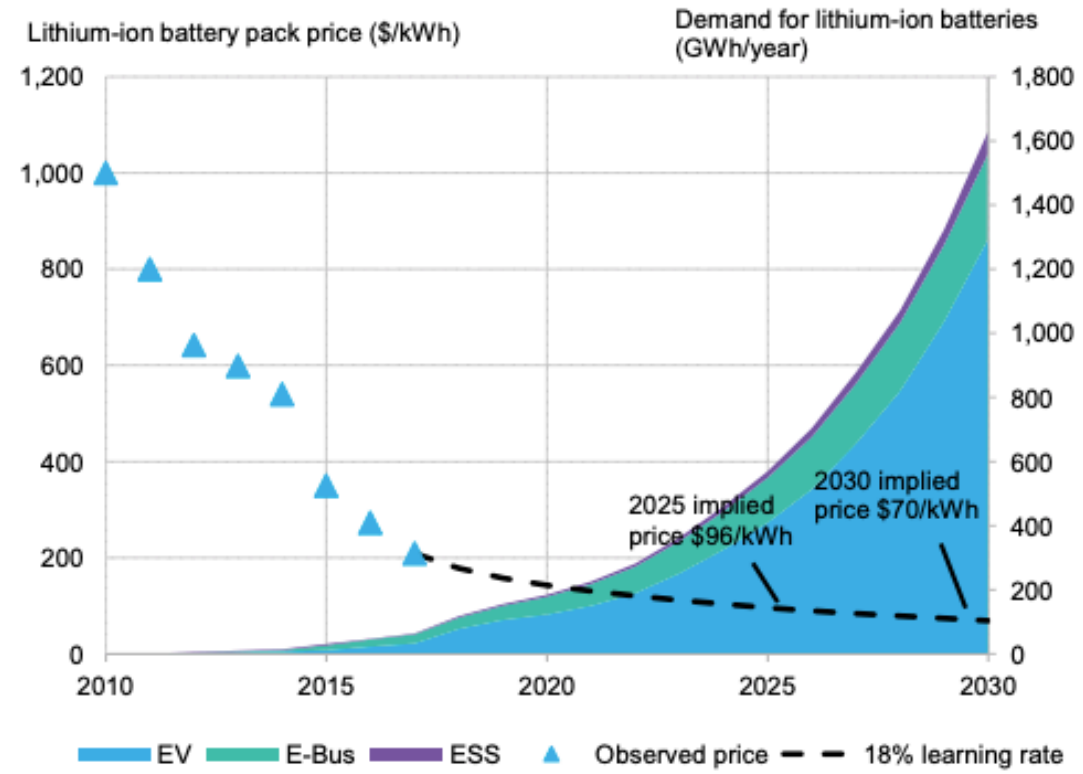
Priority Strategies:

- **Lead by example:** install rooftop solar at municipally-owned or city-funded facilities.
- **Resiliency**: Explore the use of solar + battery storage to improve resiliency and provide emergency backup power at critical facilities.
- **Financing:** Opt-in to Utah's Commercial Property Assessed Energy (C-PACE) financing district.
- **Zoning & ordinances:** Support solar- and storage-ready construction through zoning, ordinances, or voluntary codes.
- **Permitting & interconnection:** Streamline permitting requirements for rooftop solar.
- **Battery storage:** Monitor codes & interconnection rules for customer-sited battery storage.

ENERGY STORAGE

Energy storage will play a critical role to facilitate the transition to renewable energy, including utility-scale energy storage and customer-sited batteries.

Lithium-ion Battery Pack Price Forecast



Source: Bloomberg New Energy Finance. Note: ESS is stationary energy storage applications.

USES:

- Discharge energy to meet peak load
- Provide ramping to integrate renewable energy resources
- Emergency backup power

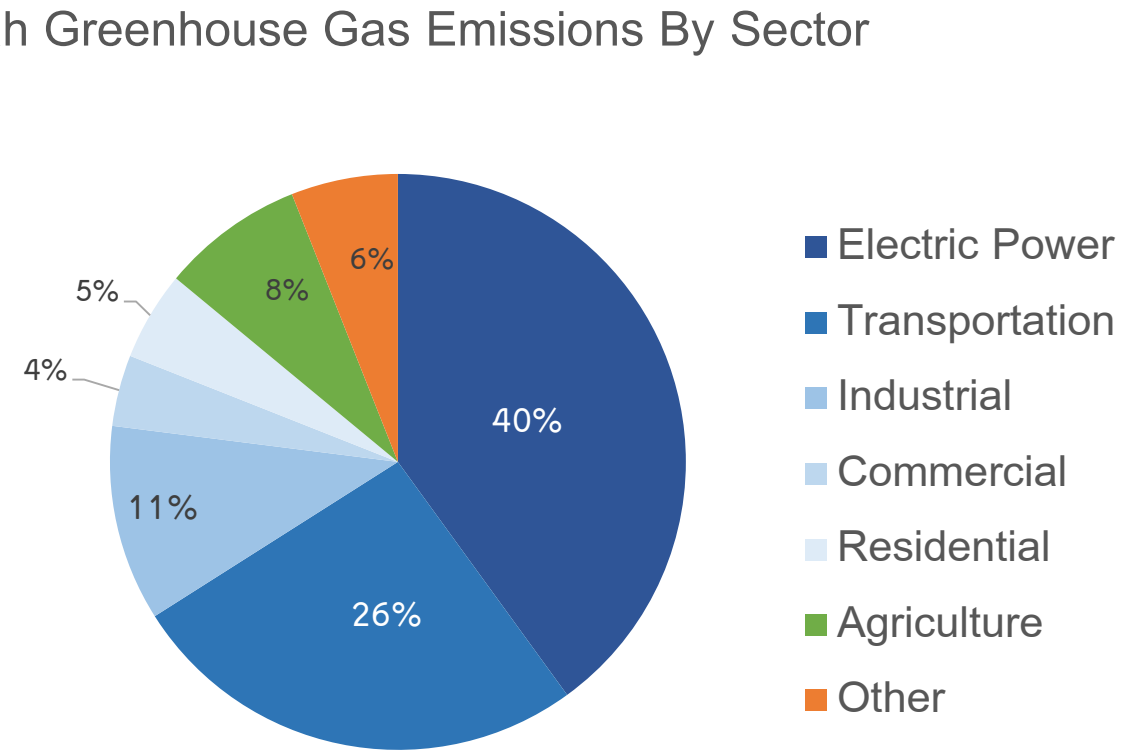
ENERGY STORAGE

Soleil Lofts, a 600 unit apartment building complex in Herriman, Utah is equipped with solar and battery storage that can be operated by the utility, allowing the apartments to serve as a “virtual power plant.”

Photo: Soleil Lofts

ELECTRIC VEHICLES

Electric vehicles and plug-in hybrid electric vehicles have **reduced** or **zero tailpipe emissions**, and result in overall reductions in greenhouse gas emissions **when powered with renewable energy**.

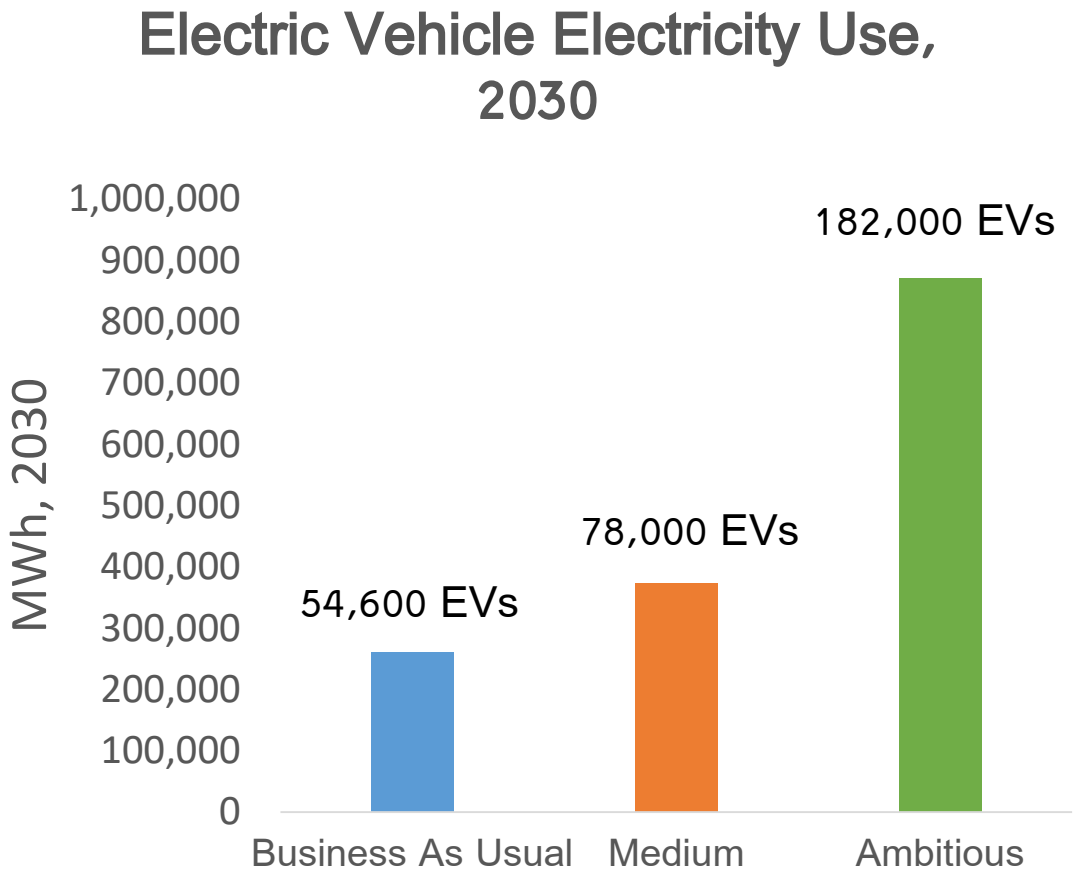


Energy Information Administration 2016.

ELECTRIC VEHICLES

The growth of light-duty electric vehicles will provide significant air quality benefits and reduce greenhouse gas emissions, but will increase overall electricity usage and could impact peak energy usage.

1. **Business As Usual** : This scenario assumes electric vehicles reach 7% of all light-duty vehicles on the road in Utah 2030.[1]
2. **Medium** : This scenario assumes electric vehicles reach 10% of all light-duty vehicles on the road in Utah in 2030.[2]
3. **Ambitious** : This scenario assumes electric vehicles reach 20% of all light-duty vehicles on the road in Utah in 2030.[2]



1 **Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030**. Edison Electric Institute. November 2018. https://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20EV%20Forecast%20Report_Nov2018.pdf

2 **National PEV Infrastructure Analysis.** Eric Wood, Clément Rames, Matteo Muratori, Sesha Raghavan, and Marc Melaina. DOE/GO-102017-5040. September 2017.

Electric transit buses on the road in Park City and Salt Lake City pave the way

Photo: Visit Park City

Photos: uncrate.com, nikolamotor.com

Priority Strategies:

- **Lead by example**: convert city fleets to electric vehicles. FuelEconomy.gov can help compare costs and pollution totals for different vehicle types, and Utah Clean Cities can help make smart decisions for a cleaner fleet.
- **Transportation Plans:** Evaluate EV infrastructure needs through comprehensive transportation plans.
- **Utility Engagement:** Work with electric utility to optimize EV electricity load and save money on utility costs.
- **Charging infrastructure:** Identify priority locations with access to electricity and install charging stations in convenient and strategic locations, including underrepresented neighborhoods.
- **Parking and transportation incentives:** Local governments can encourage EV ownership by offering priority parking spaces, free metered parking and other incentives for cleaner vehicles.
- **Codes**: Utilize codes, ordinances, or voluntary codes to support EV charging or EV-ready construction and EV charging, especially for multi-family housing.
- **Charging incentives:** RMP and DEQ offer incentives for EV charging equipment costs, plus grants for custom projects. Use incentives to support building out your public charging network and encourage organizations in your community to apply as well.
- **Public transit:** Prioritize electric transit buses for use in city and state transit services.
- **Implement the strategies** outlined in Salt Lake City's Electrified Transportation Roadmap.

DISTRIBUTED GENERATION

VEHICLE ELECTRIFICATION

ENERGY STORAGE

Questions and feedback!

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Question: What other key actions come to mind that planners can take to support **distributed energy resources** & **vehicle electrification**?

Thank you!

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