

Why and How You Should Pursue Beneficial Electrification

Highlights from the E Source white paper

Kevin Andrews, Luke Currin,
Bill LeBlanc, and Ryan Odell

E Source

Web Conference



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What has happened in 3 years

- Renewable-energy and emissions-reduction goals have skyrocketed.
- Utilities are committing to 100% carbon-neutral, carbon-free, net-zero emissions, and/or renewable energy by 2050 or sooner.
- Electrification is one of the ways we are going to achieve these goals.
 - Transportation electrification
 - Building electrification



The Electrification Framework That Benefits Customers, the Grid, and the Planet

An E Source White Paper

Kevin Andrews, Gabe Cuadra, Luke Currin, Steven Day, Bryan Jungers, Bill LeBlanc, Ryan Odell, Jay Stein, Tim Stout, Courtney Welch

NOVEMBER 11, 2019



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Contents

What is beneficial electrification?

What are the goals of beneficial electrification?

The beneficial-electrification framework

Cost-effectiveness tests for electrification

Regulatory incentives for beneficial electrification

Beneficial-electrification technologies

Electrification through the customer's eyes

Next steps for utilities

RELATED CONTENT

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Ethnographic Insights on Low Income, Connected Homes, and Electric Vehicles: E Design 2020 Residential Market Research

E Source electrification white paper

- Defining beneficial electrification
- What are we trying to achieve?
- The beneficial electrification framework
- Regulatory incentives
- Setting up the economics and environmental equations
- Beneficial electrification technologies
- Electrification through the lens of the customer
- Utility action plan

Today's agenda

- Defining beneficial electrification
- What are we trying to achieve?
- The beneficial electrification framework
- Electrification through the lens of the customer
- Putting electrification into play



Defining beneficial electrification

The past 100 years of electrification



Source: US Department of Agriculture

1930s

1950s

1990s

The past 100 years of electrification



Source: US Department of Agriculture



Source: iStock

1930s

1950s

1990s

The past 100 years of electrification



Source: US Department of Agriculture



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1930s

1950s

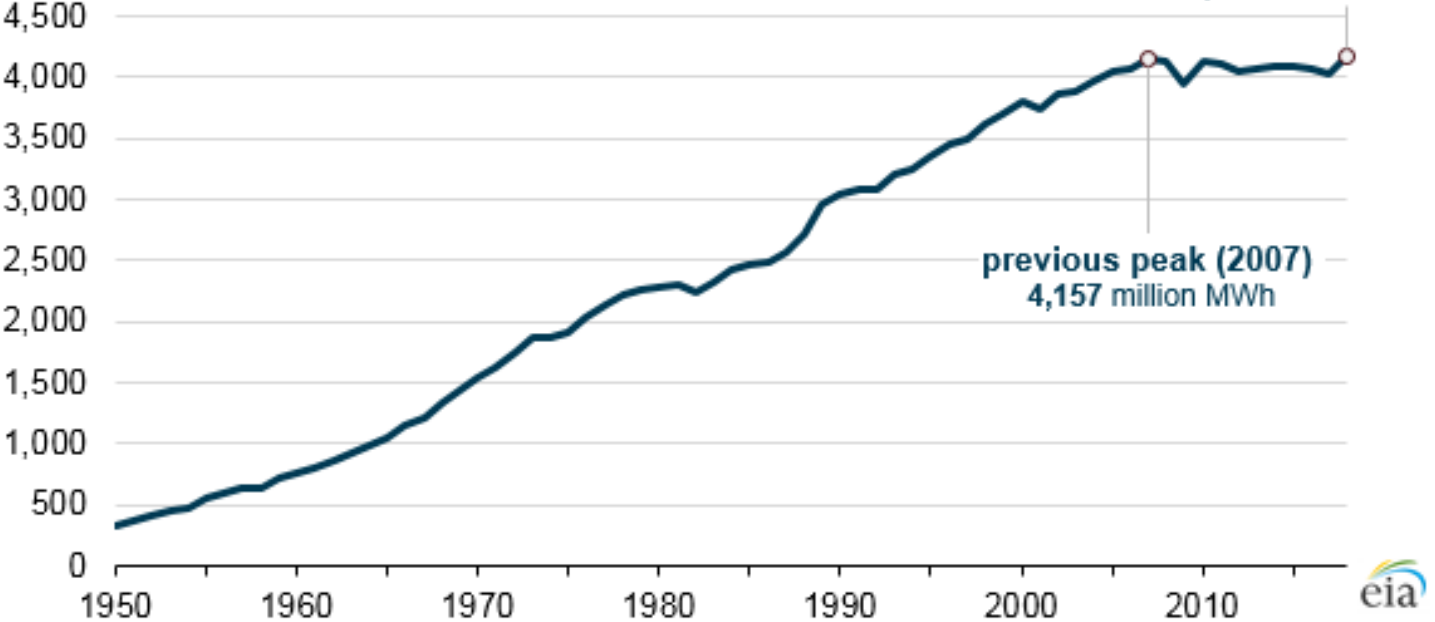
1990s

Beneficial electrification is the fourth wave



Electric load growth in the US

U.S. annual net generation, all fuels (1950-2018)
million megawatthours (MWh)

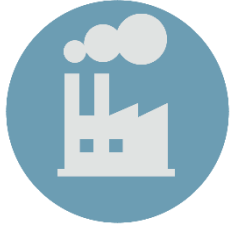


Source: US Energy Information Administration

The image features a green-tinted landscape with several wind turbines scattered across rolling hills. In the foreground, there are large, rounded rocks and some low-lying vegetation. A white rectangular box is centered in the image, containing the text "What are we trying to achieve?".

**What are we trying
to achieve?**

What are we trying to achieve?



Decarbonizing and improving environments



Optimizing the electric grid and reducing electric rates



Reducing overall energy costs

A commitment to equity

Widespread transportation electrification requires increased access for disadvantaged communities, low- and moderate-income communities, and other consumers of zero-emissions and near-zero-emissions vehicles ...

California Public Utilities Code §740.12
(a)(1)(C)

Important applications and sectors



Buildings

- Heat pumps
- Water heaters
- Induction cooking
- Battery storage
- Smart thermostats



Transportation

- Electric vehicles
- Public transit
- Commercial fleets
- Shipping and freight
- School buses



Industrial processes and material handling

- Forklifts
- Airport ground support
- Port equipment
- Mining equipment

Relationship with demand-side management



Decarbonization, grid optimization, lower energy costs, equity

Integrated resource planning

Program design, implementation, and evaluation

Technology deployment

Ethnographic and quantitative market research

Energy utilities are key stakeholders

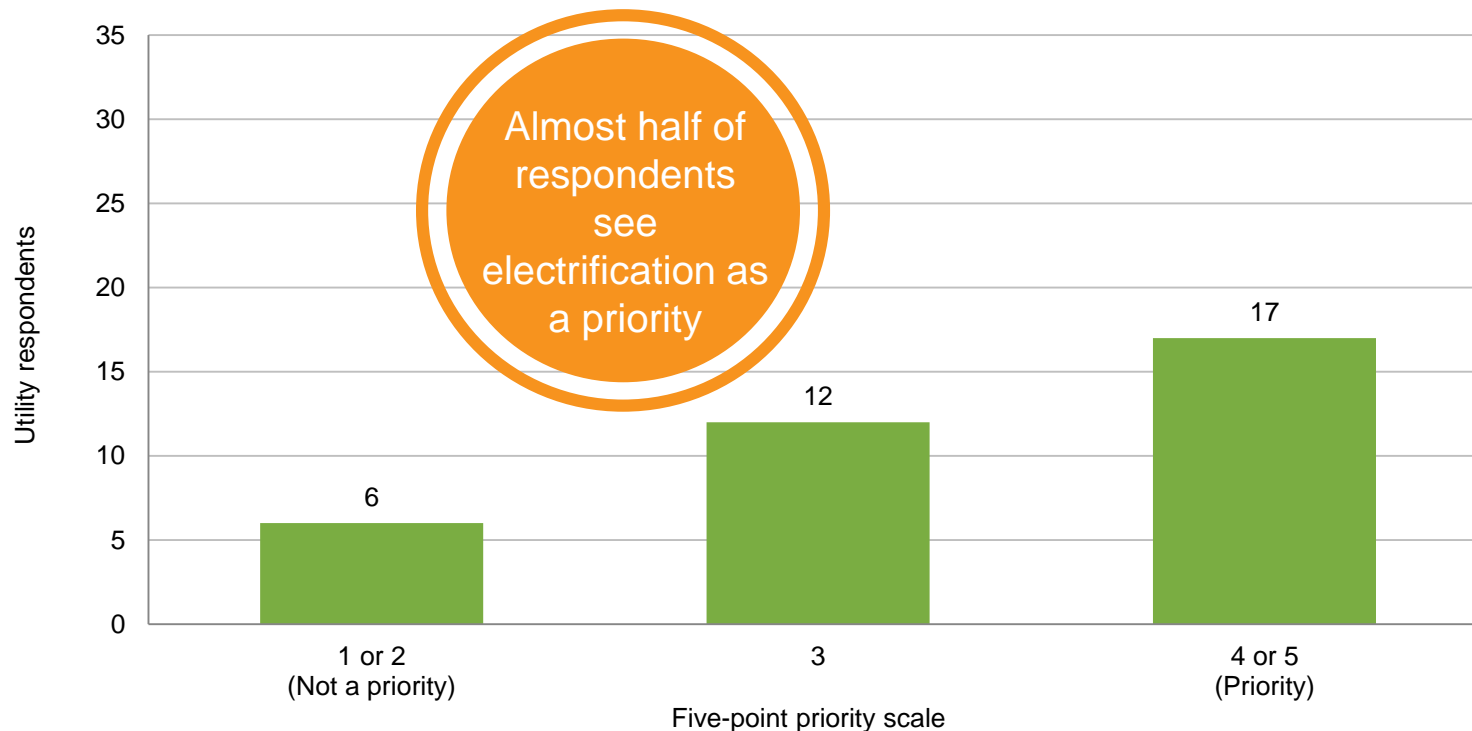
- ✓ Customer relationships
- ✓ Access to capital
- ✓ Infrastructure development
- ✓ Energy-supply choices





The beneficial electrification framework

Electrification is a priority



Base: n = 35 utilities **Question S4_14:** How much of a priority do you anticipate electrification (of transportation, natural gas appliances, etc.) will be for your utility in the next 7 years?

© E Source (2018 Utility DER Strategy Benchmark)

What are 2 to 3 key drivers behind your utility's interest in electrification?



© E Source (2018 Forum, electrification polling question)

Building electrification business cases

While we don't call it electrification, the programs that offer related incentives focus on the financial savings of going from fuel oil to electricity, in addition to comfort of the home.

We are in the business of reducing greenhouse gas emissions. Any cost-effective approach to doing so, including fuel switching (gas-to-electricity or electricity-to-gas) over the lifetime of technologies, will be considered.

We don't currently promote building electrification although that may come in the next three years.

As a utility, we see building electrification as one, if not the most, important focus area for us as a utility of the future. One of two first main objects of our recently hired CEO is the promotion/preparation for electrification.

© E Source (2018 Utility
DER Strategy Benchmark)

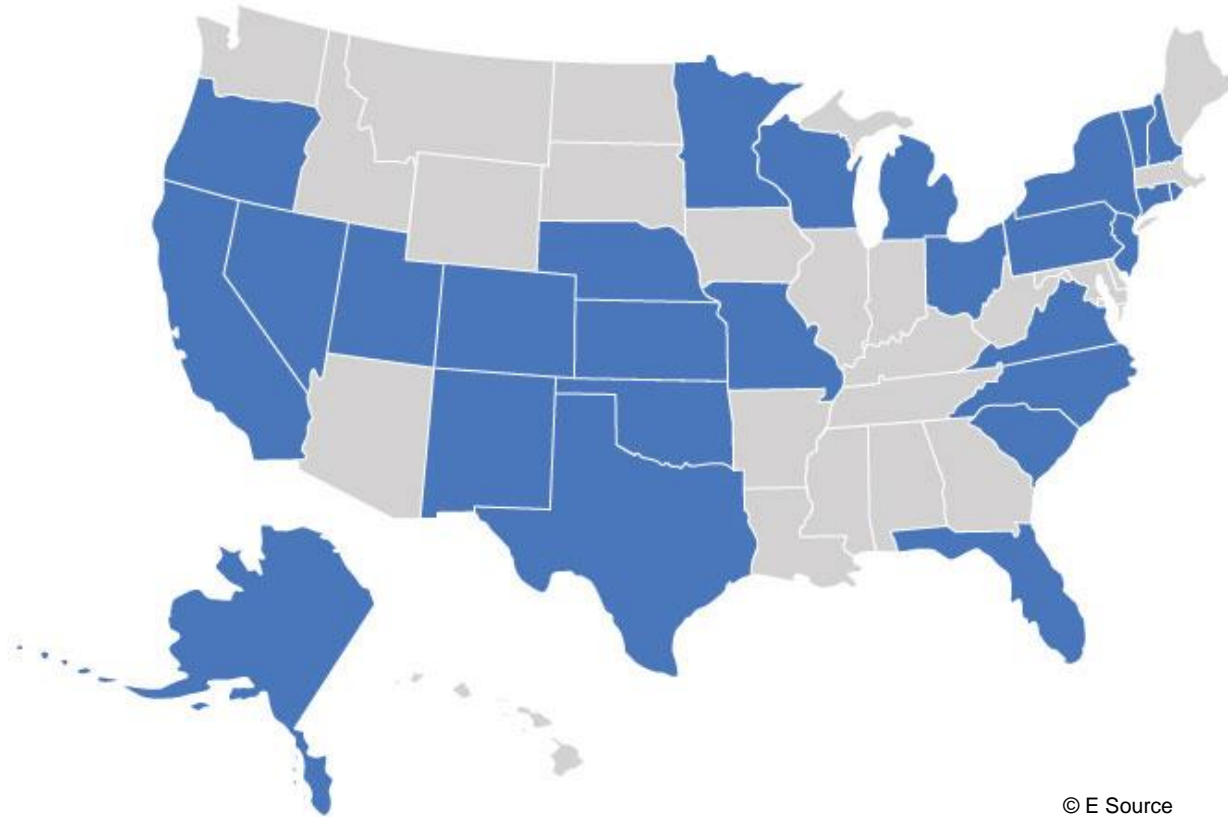
Utilities plan to implement EV TOU rates and/or Solar-specific rate changes over next 3 years

Anticipated utility program changes	Number of utilities	Percentage of utilities
EV TOU rates	22	63
Solar-specific rate change	20	57
Universal increased fixed charges	14	40
Universal TOU rates	11	31
Universal demand charges	8	23
Universal critical peak pricing	4	11

Base: n = 35 utilities. **Question: S5_2.** Which changes do you anticipate proposing, piloting, or implementing in the next 3 years for residential customers? This includes any changes that are underway and will continue into the next 3 years. Select all that apply. **Notes:** EV = electric vehicle; TOU = time of use. "Other" and "None of the above" responses are excluded from the slide.

© E Source (2018 Utility DER Strategy Benchmark)

Cities and communities are taking action*

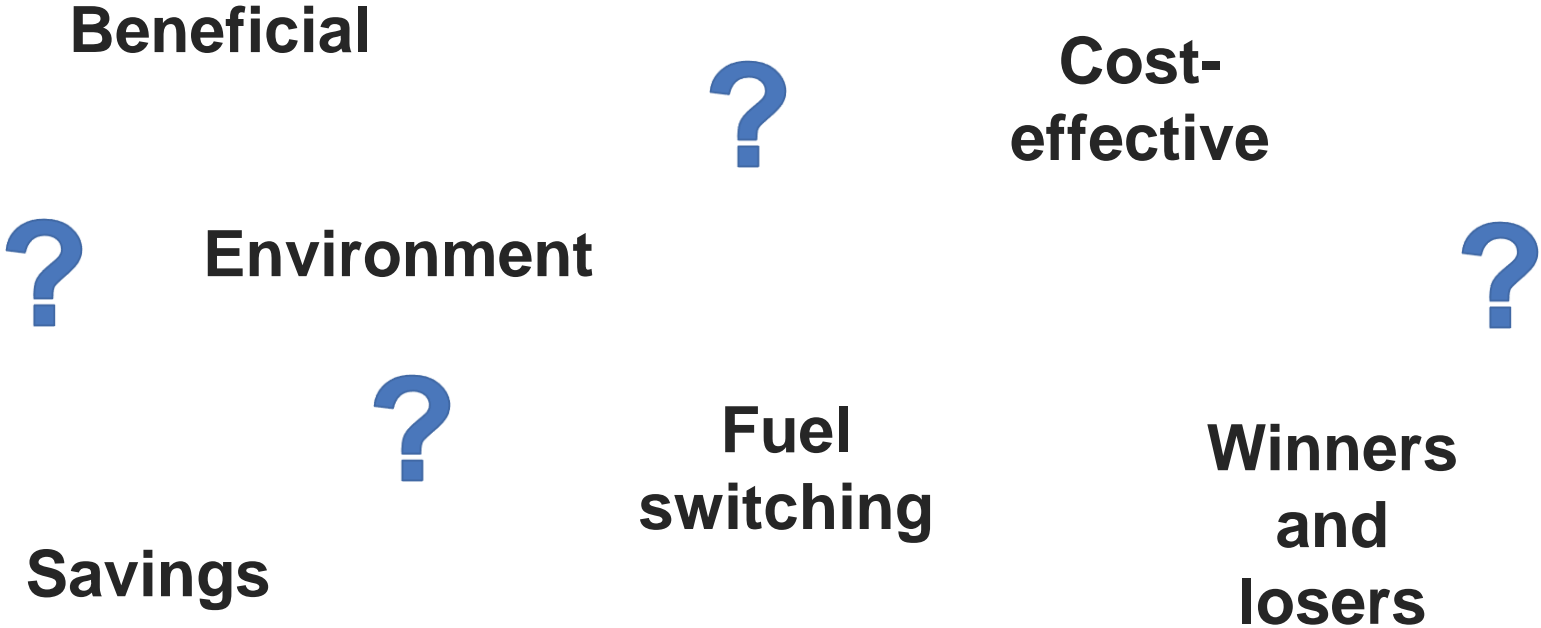


100 US cities have committed to 100% renewable power

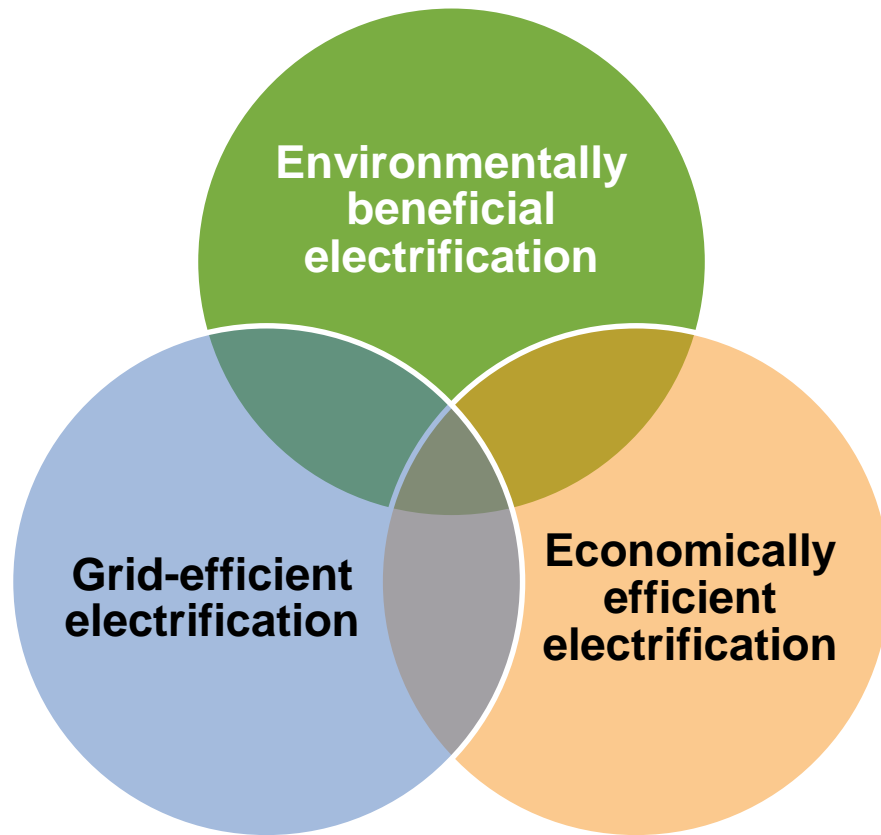
© E Source

*as of 10/15/18

Getting to yes ... use the same terminology



Defining beneficial electrification



Environmentally beneficial electrification

When the new, electrified end use has less of a negative environmental effect than the prior use. It's implied that cost isn't a defining element of this equation.

Environmentally beneficial electrification

When the new, electrified end use has less of a negative environmental effect than the prior use. It's implied that cost isn't a defining element of this equation.

Note: Each jurisdiction defines what environmental effects to address.

Economically efficient electrification

When the new, electrified end use costs less to produce with the same or better outcome for the end user.

Economically efficient electrification

When the new, electrified end use costs less to produce with the same or better outcome for the end user.

Example: Life cycle costs of keeping a home comfortable in the heating season have a lower cost with the electrified option compared to the prior option.

Grid-efficient electrification

When the new, electrified end use creates electric production which delivers overall MWhs for less money than if that option had not been taken.

This also provides downward pressure on rates, on a relative basis.

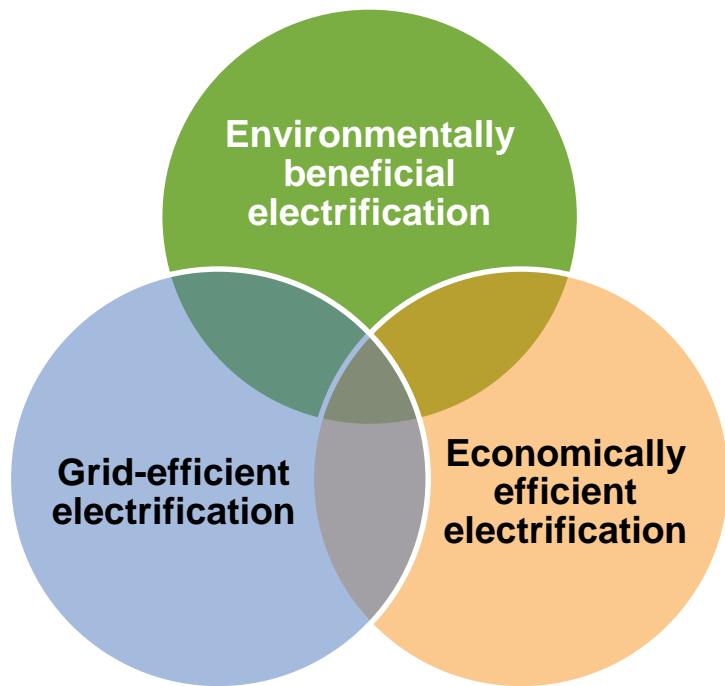
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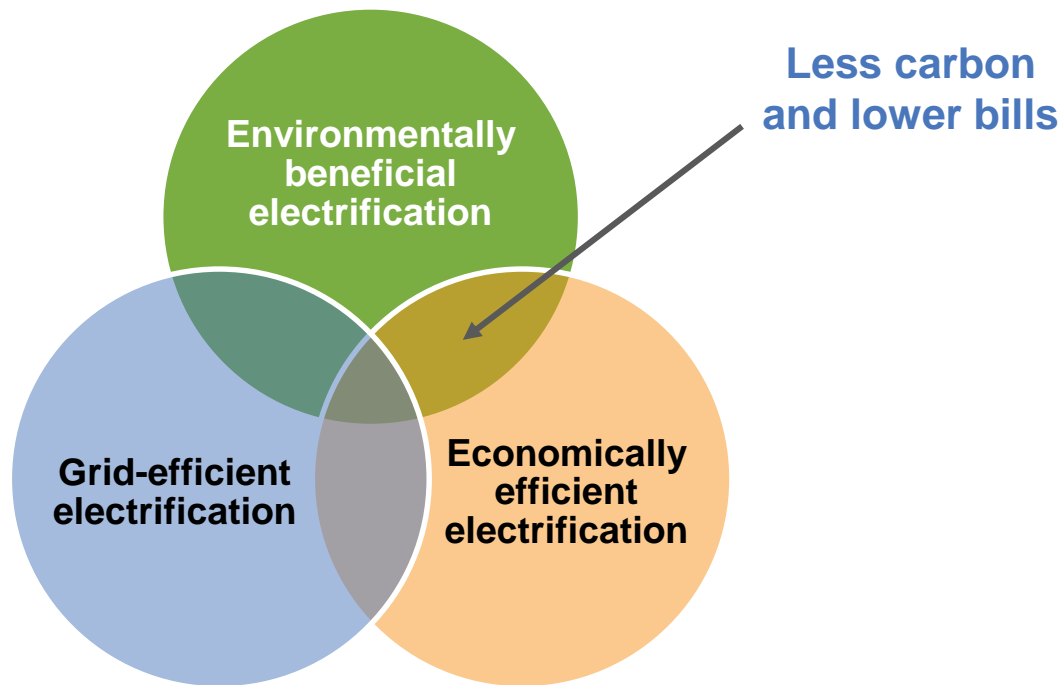
This also provides downward pressure on rates, on a relative basis.

Example: An electric vehicle charges in a manner that does not cause additional infrastructure costs, and improves system load factors.

Defining beneficial electrification



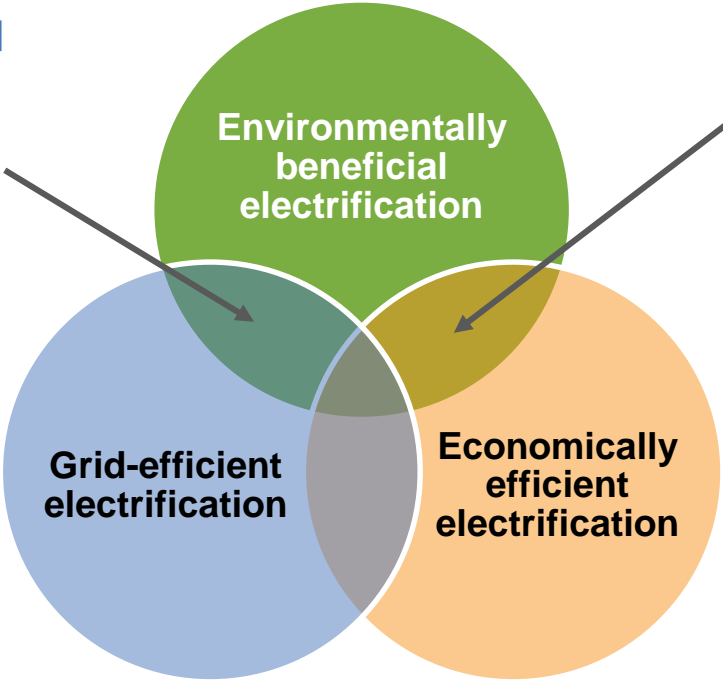
Defining beneficial electrification



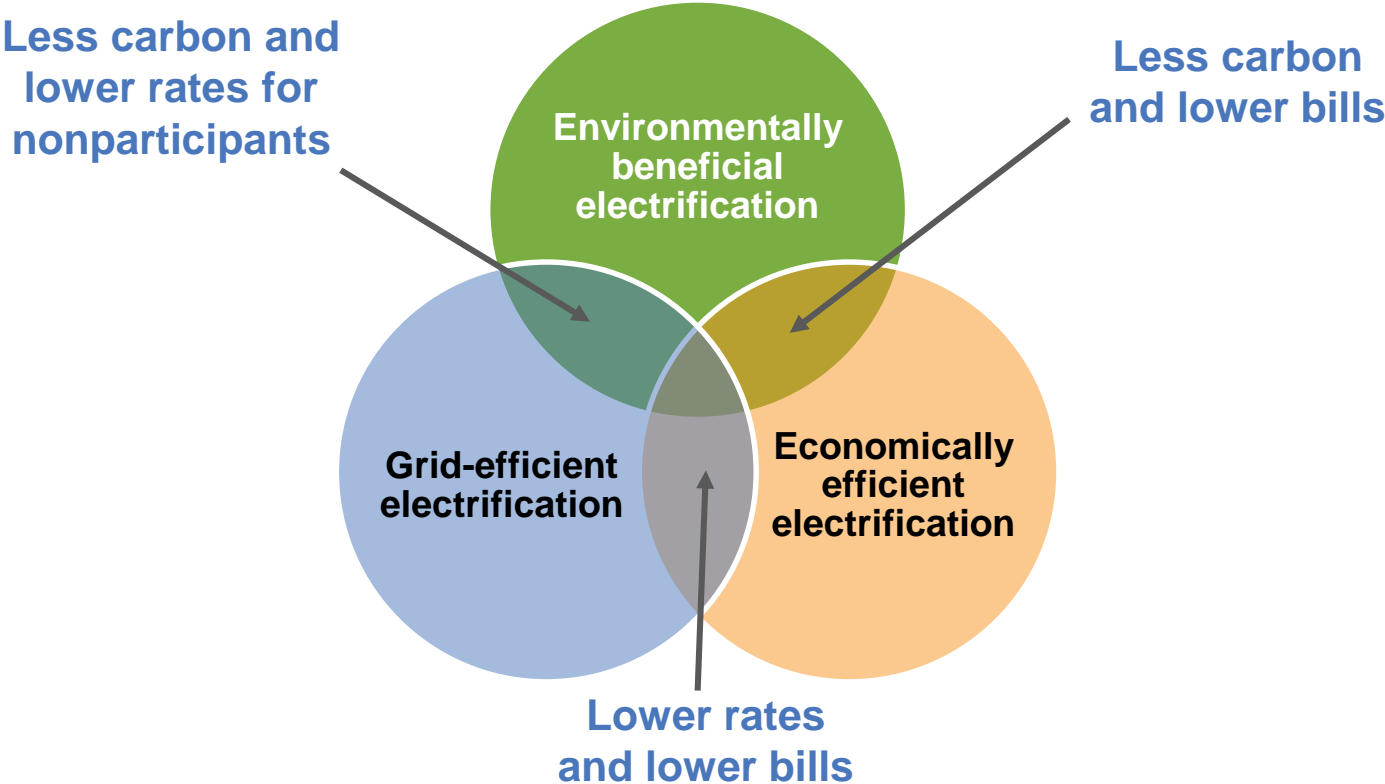
Defining beneficial electrification

Less carbon and lower rates for nonparticipants

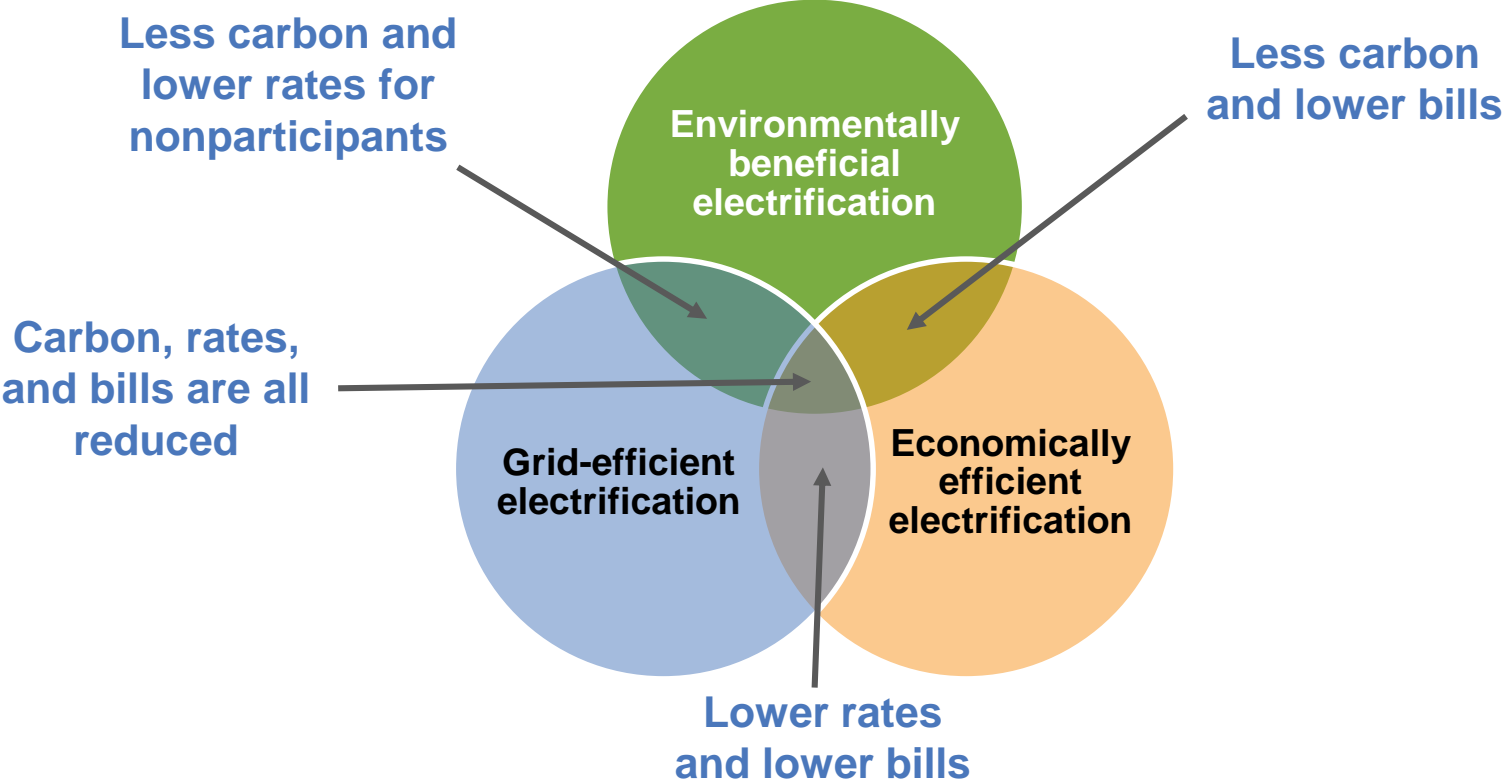
Less carbon and lower bills



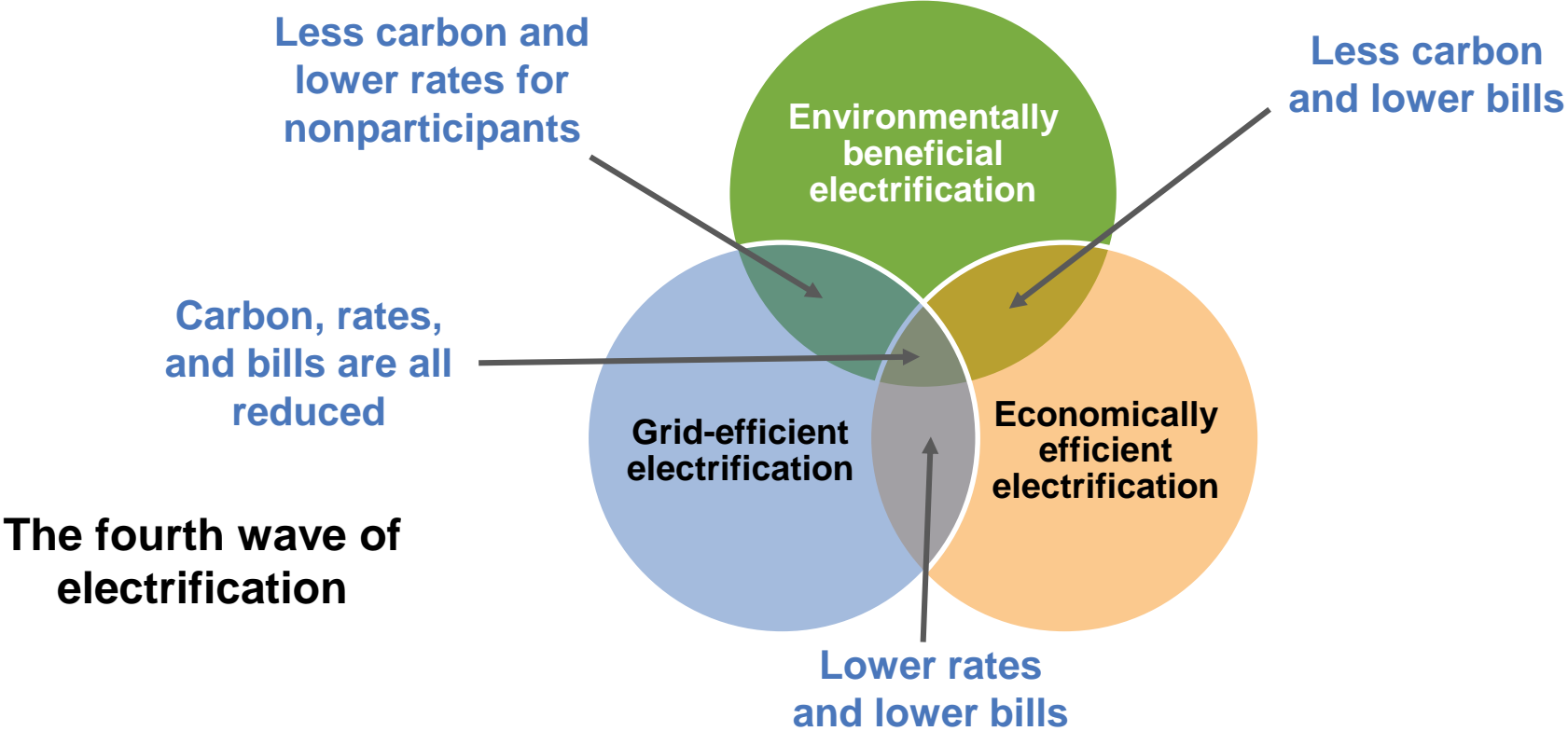
Defining beneficial electrification



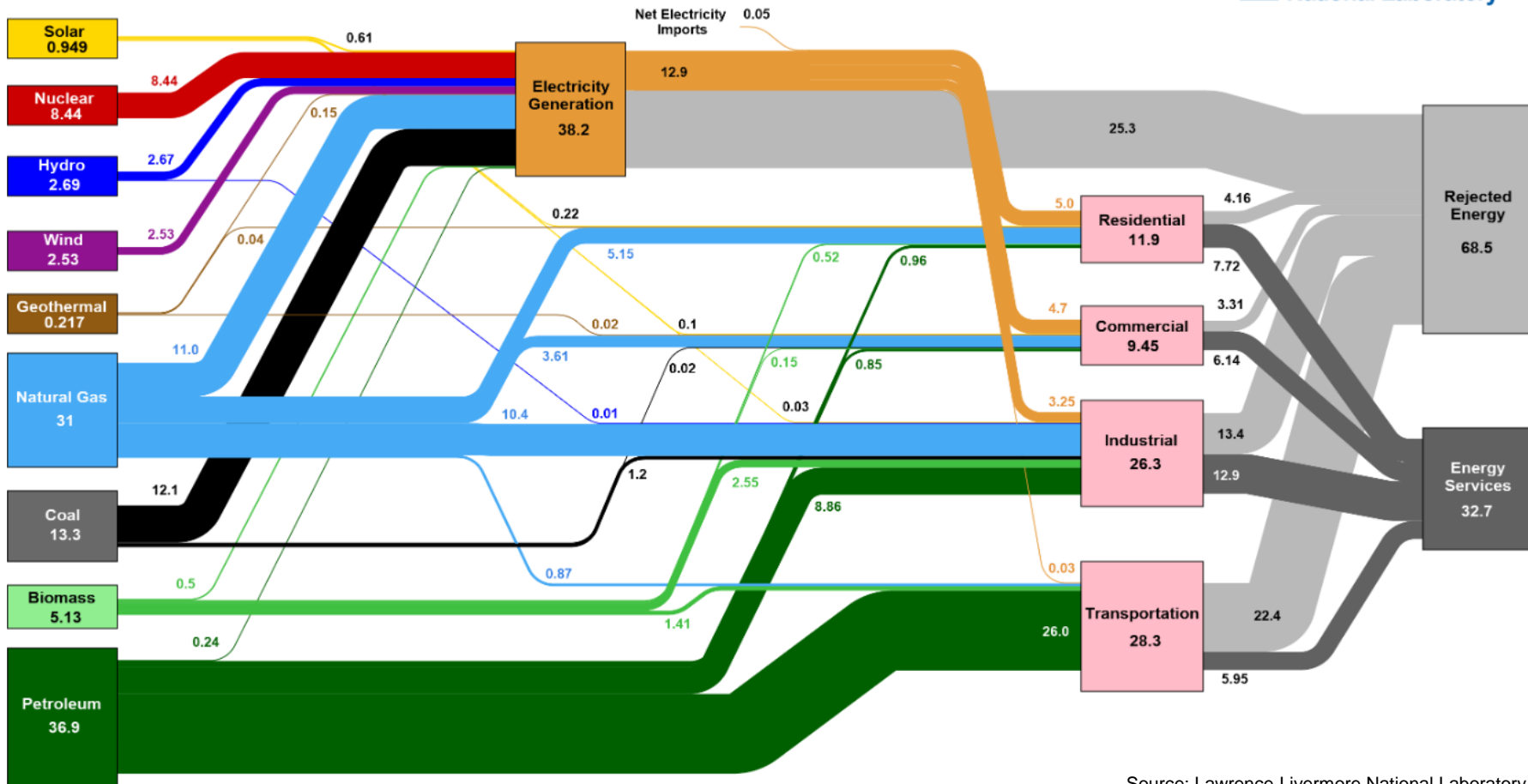
Defining beneficial electrification



Defining beneficial electrification

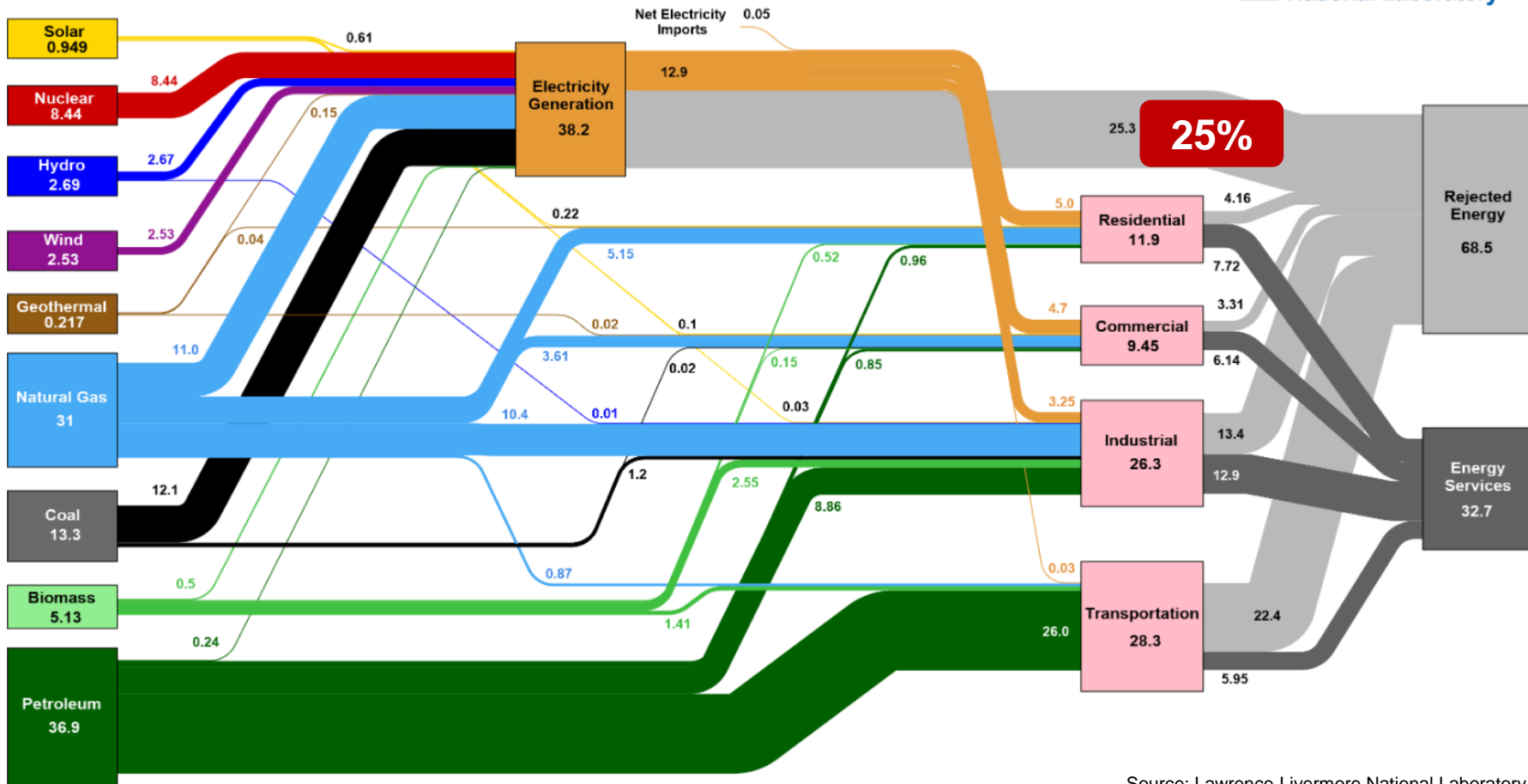


Estimated U.S. Energy Consumption in 2018: 101.2 Quads



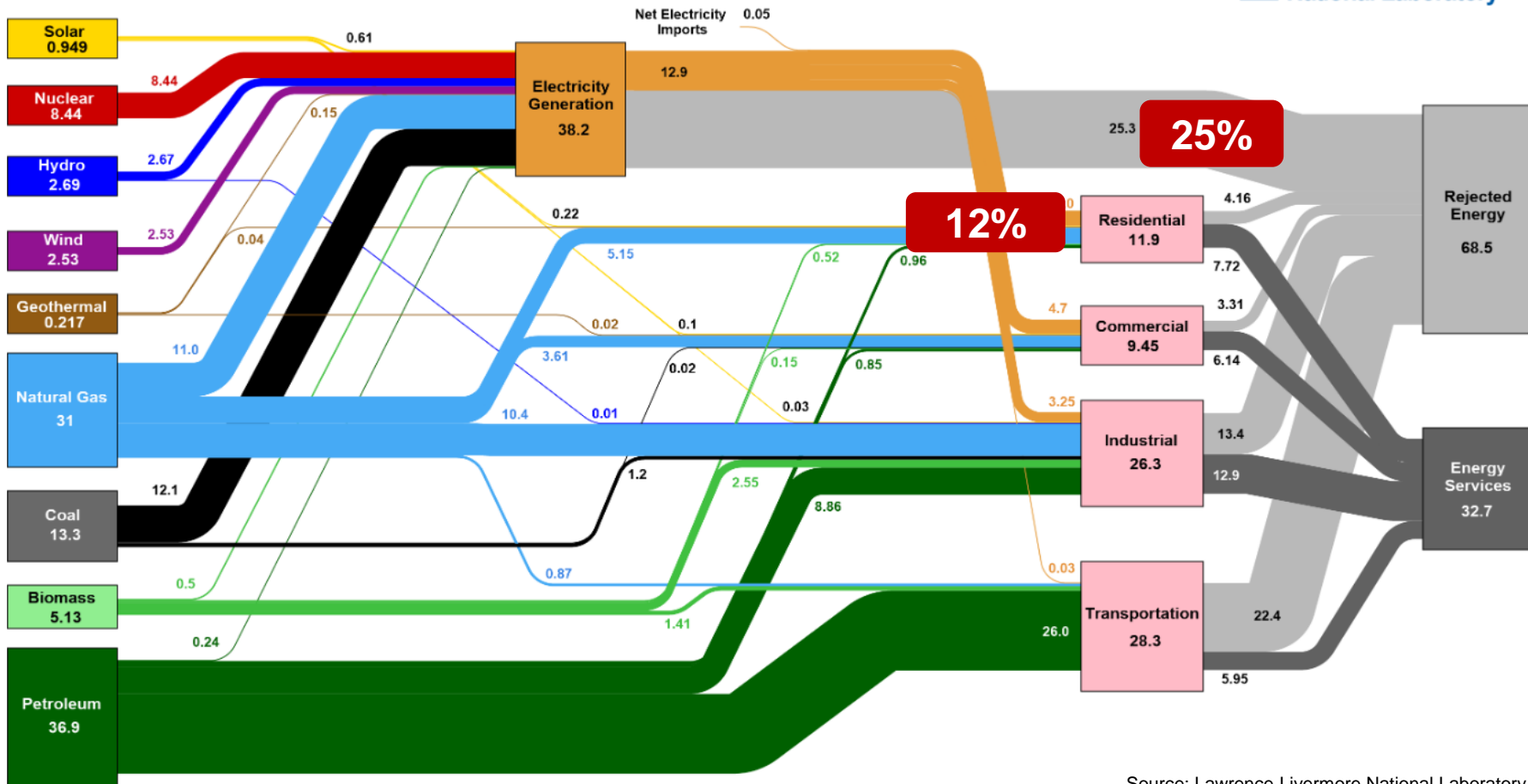
Source: Lawrence Livermore National Laboratory

Estimated U.S. Energy Consumption in 2018: 101.2 Quads



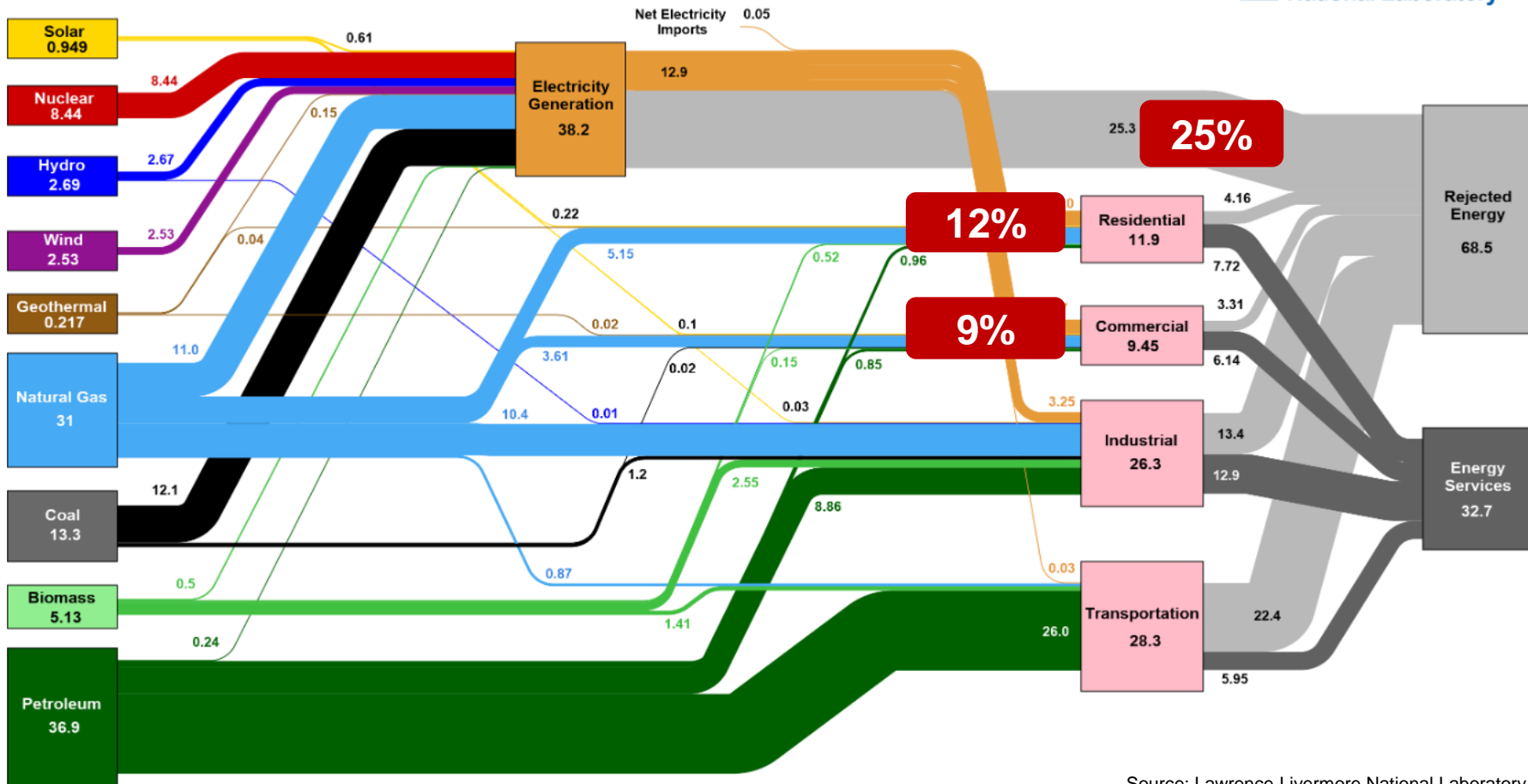
Source: Lawrence Livermore National Laboratory

Estimated U.S. Energy Consumption in 2018: 101.2 Quads



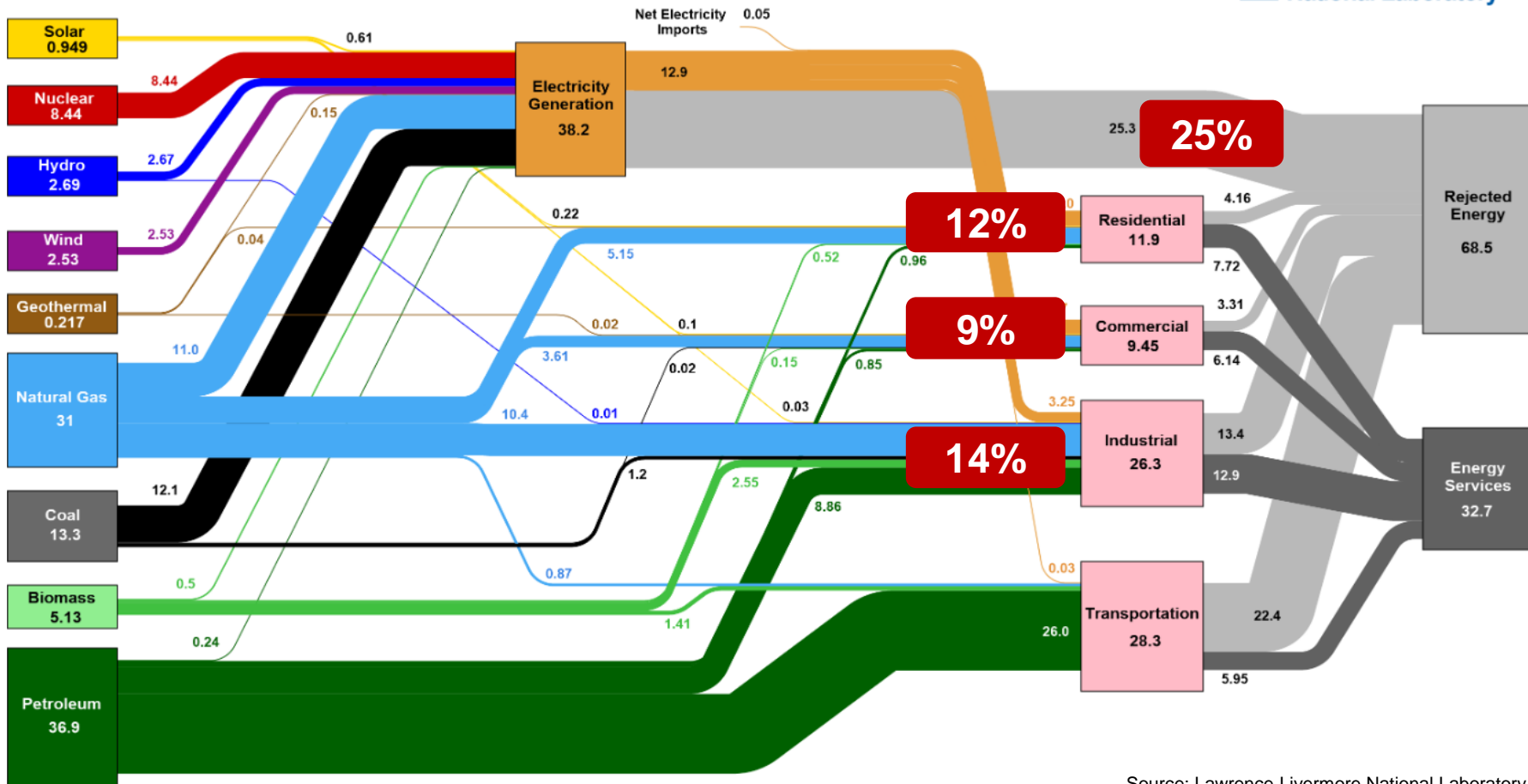
Source: Lawrence Livermore National Laboratory

Estimated U.S. Energy Consumption in 2018: 101.2 Quads



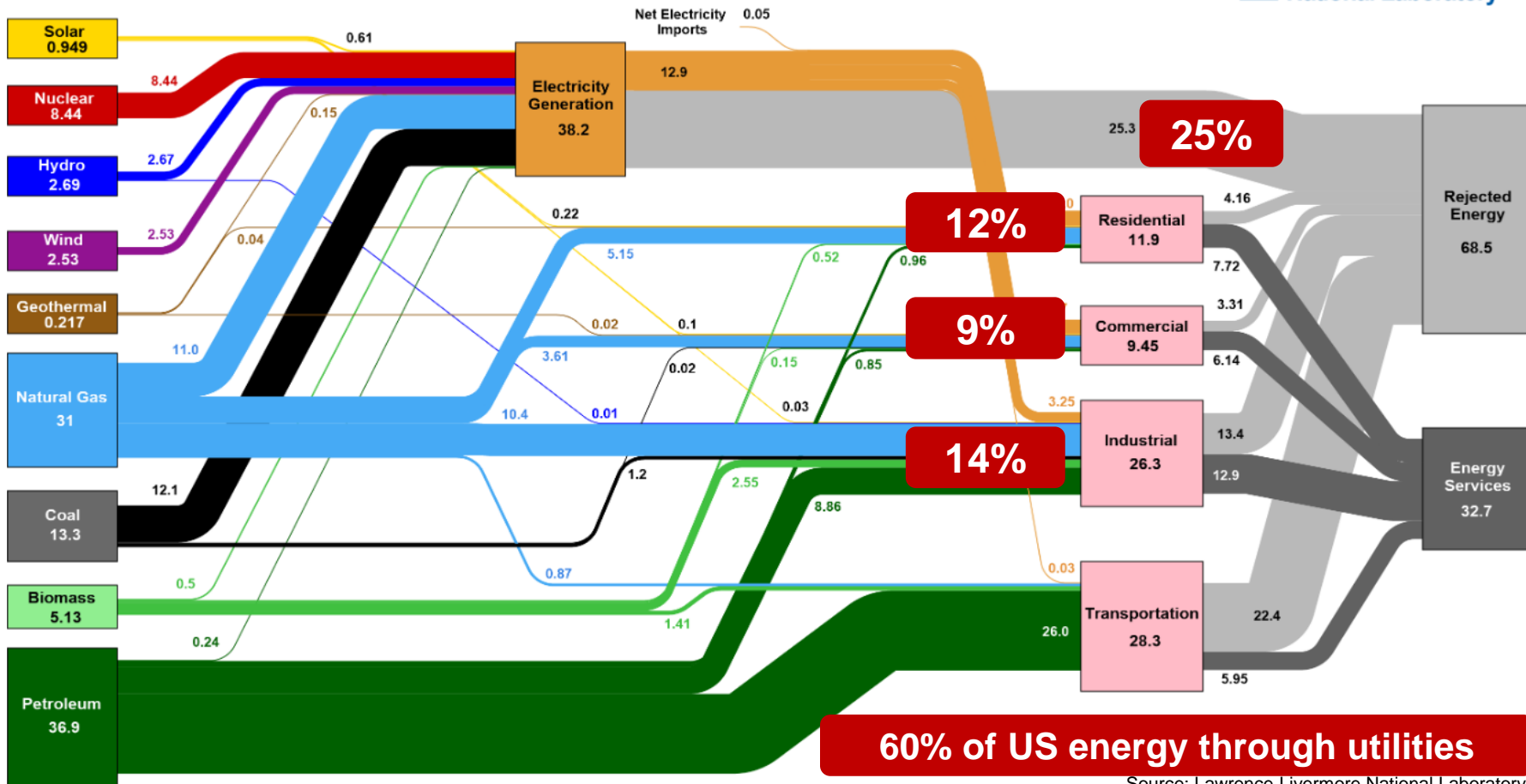
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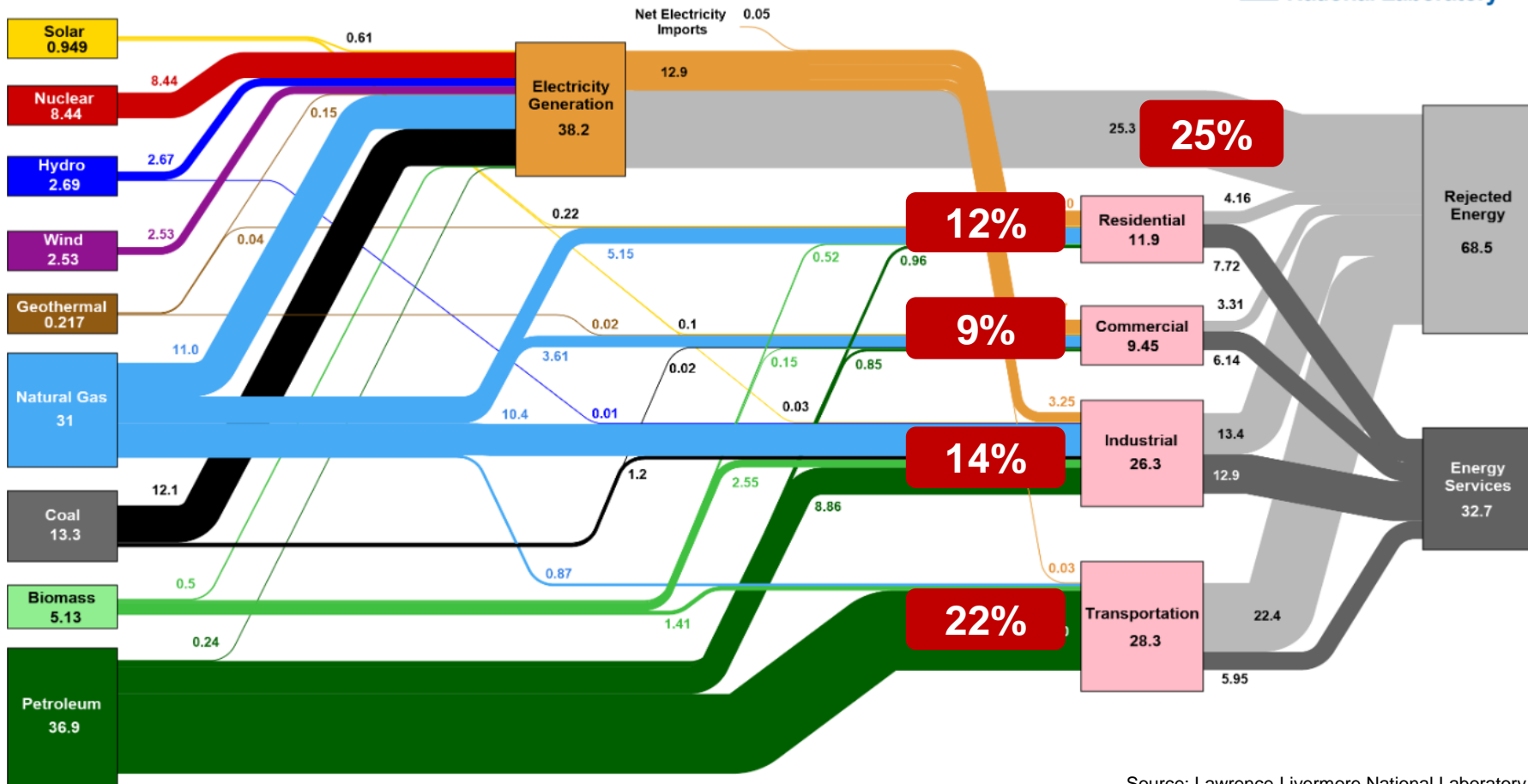
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Estimated U.S. Energy Consumption in 2018: 101.2 Quads



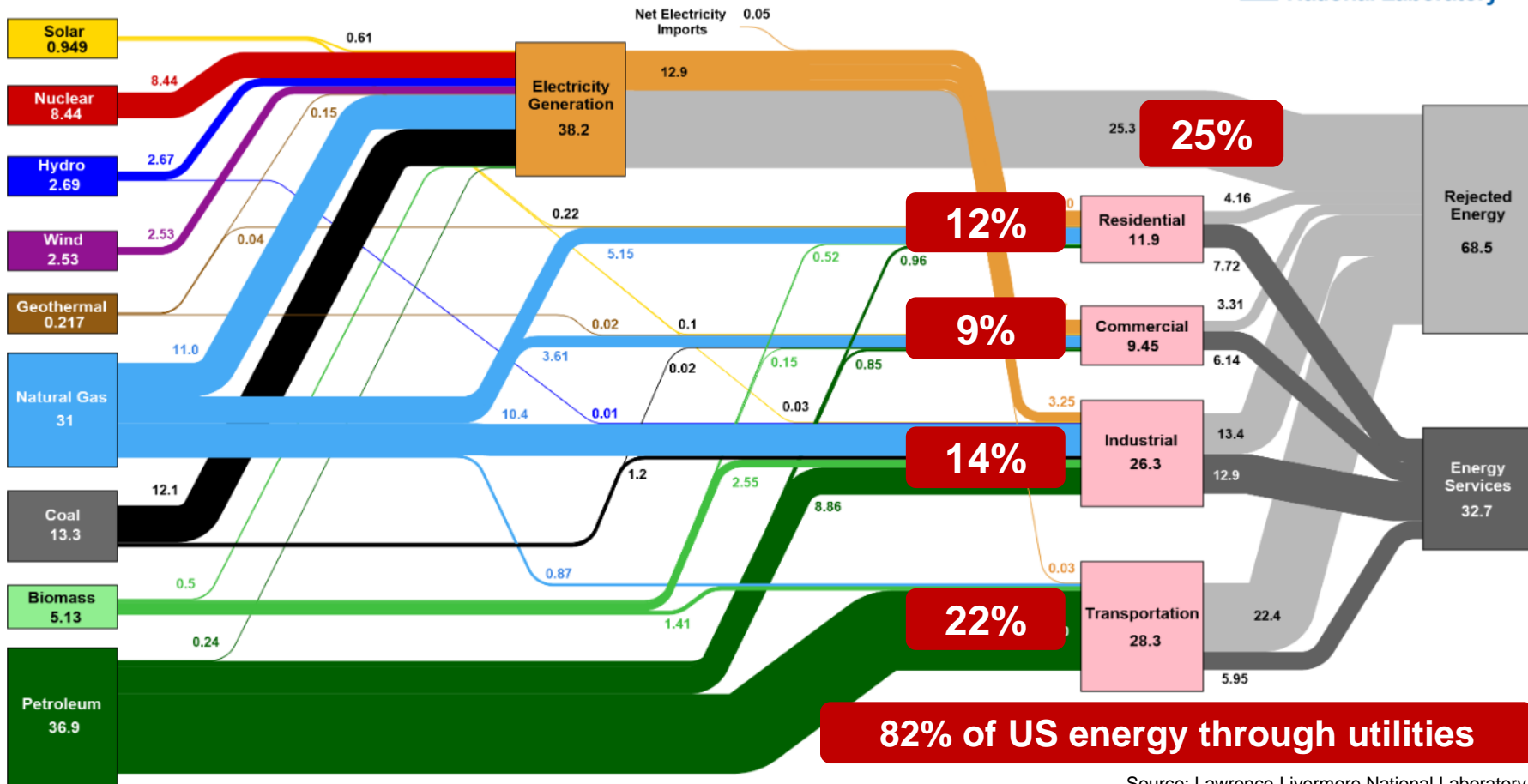
Source: Lawrence Livermore National Laboratory

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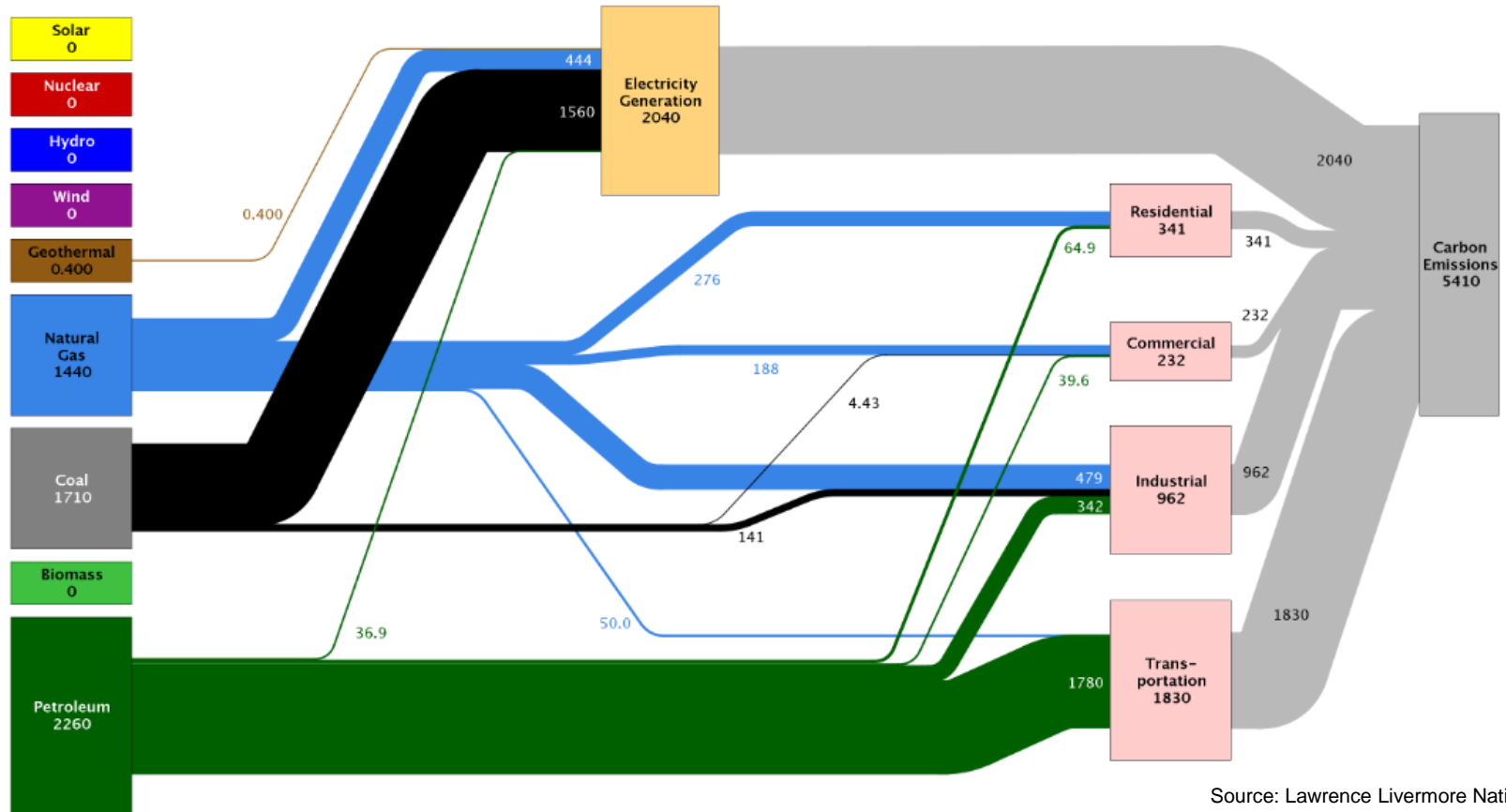
Source: Lawrence Livermore National Laboratory

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Source: Lawrence Livermore National Laboratory

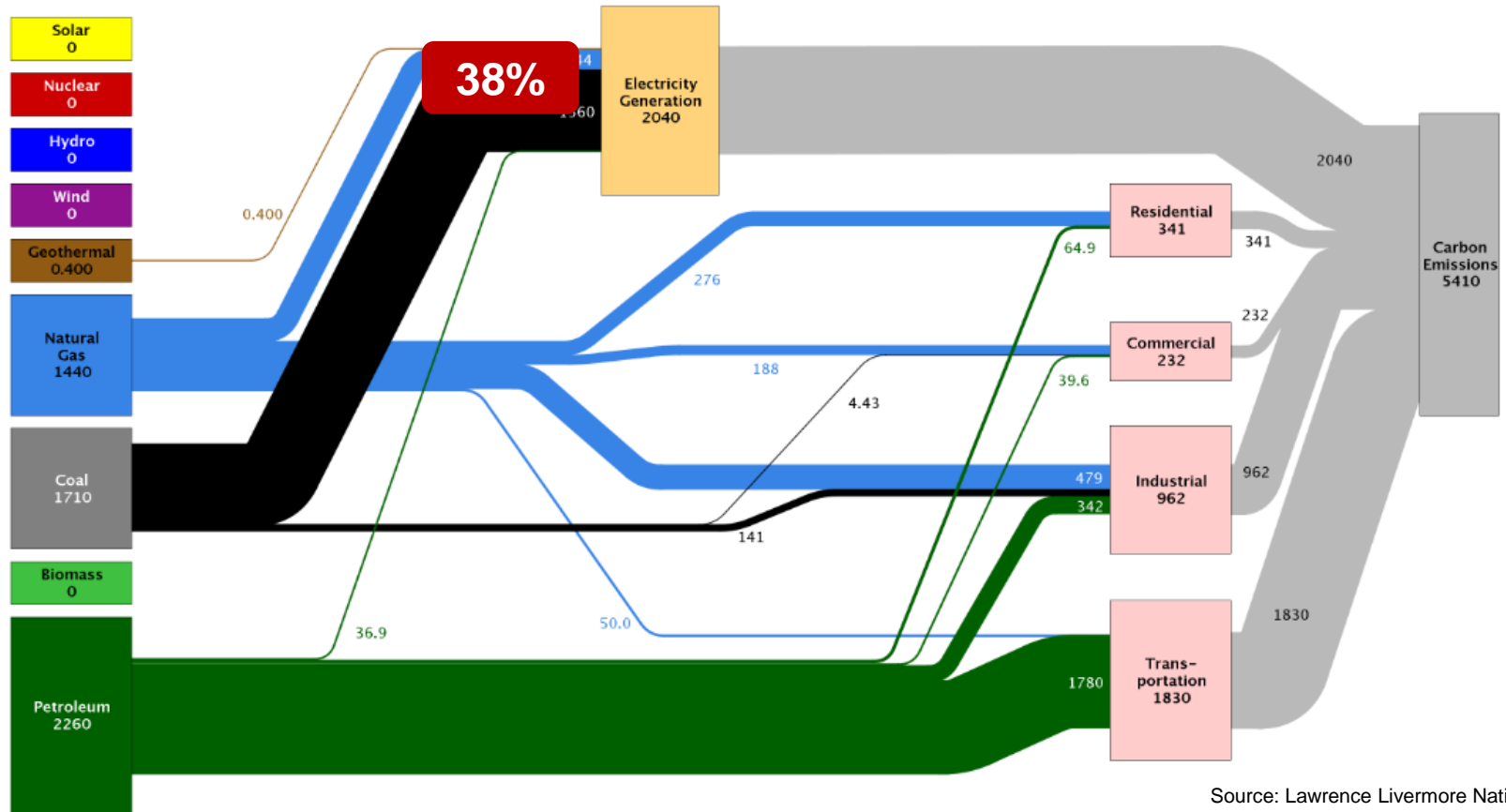
Estimated U.S. Carbon Emissions in 2014: ~5,410 Million Metric Tons



Source: Lawrence Livermore National Laboratory



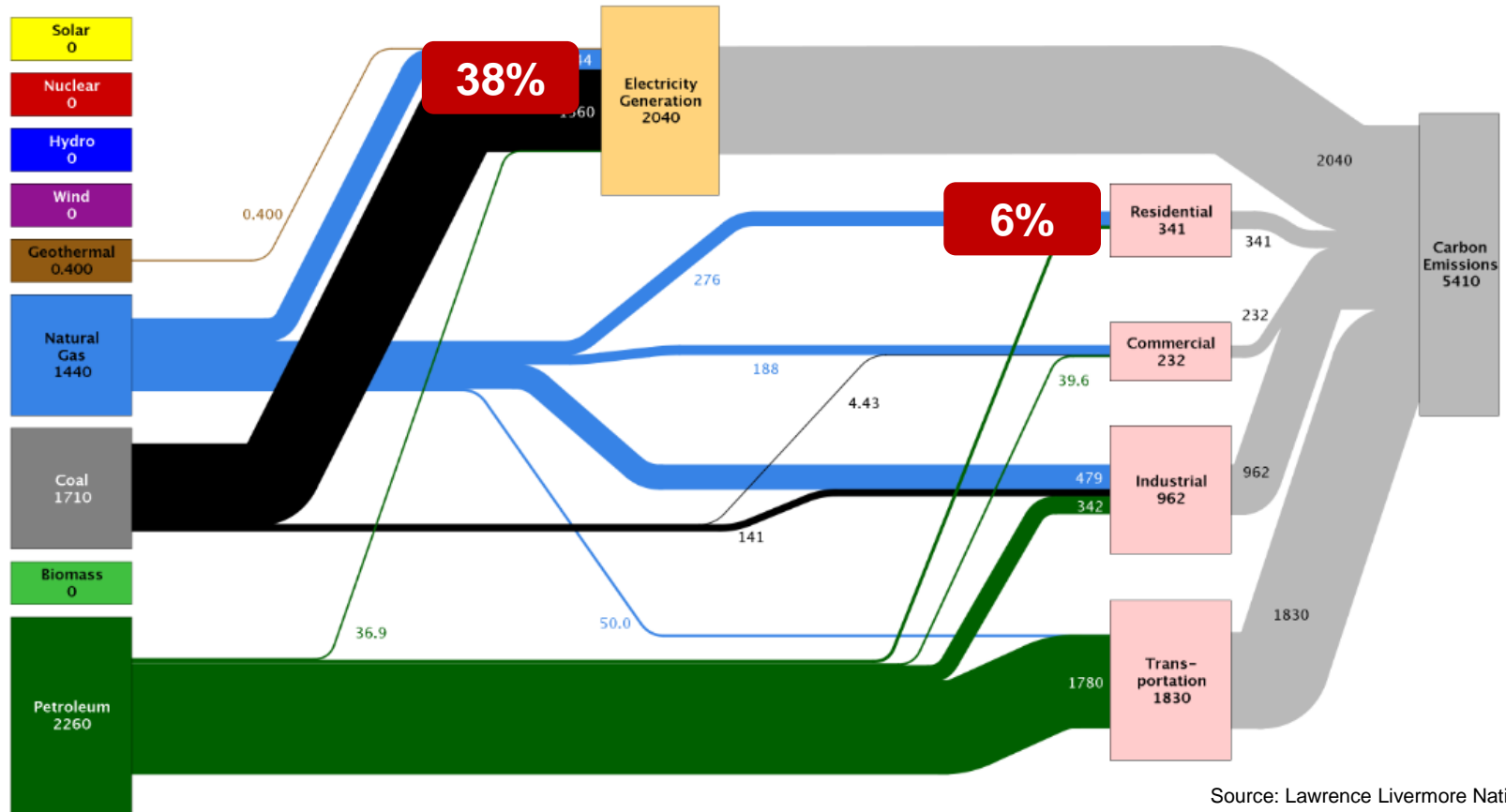
Estimated U.S. Carbon Emissions in 2014: ~5,410 Million Metric Tons



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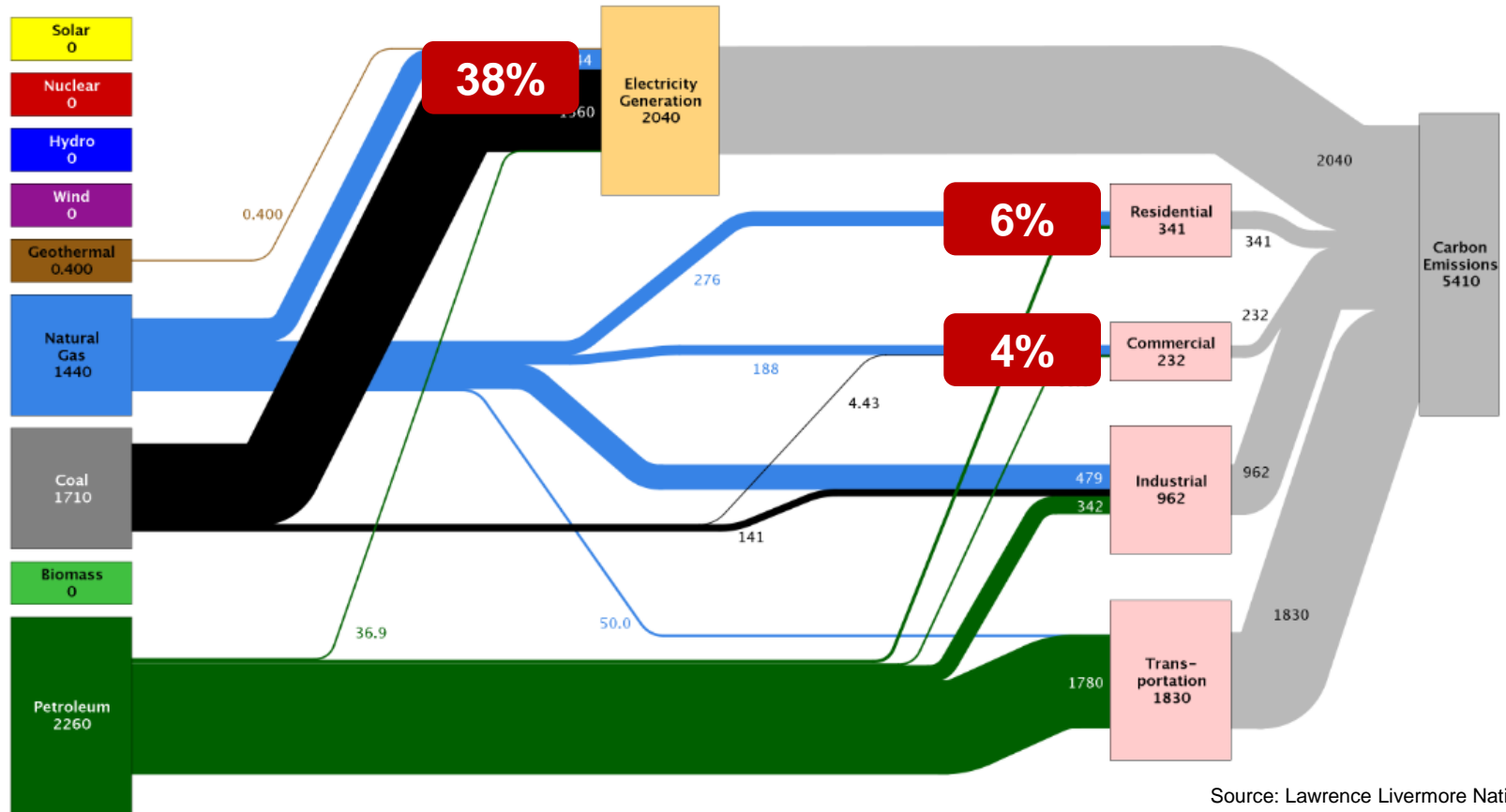


Estimated U.S. Carbon Emissions in 2014: ~5,410 Million Metric Tons



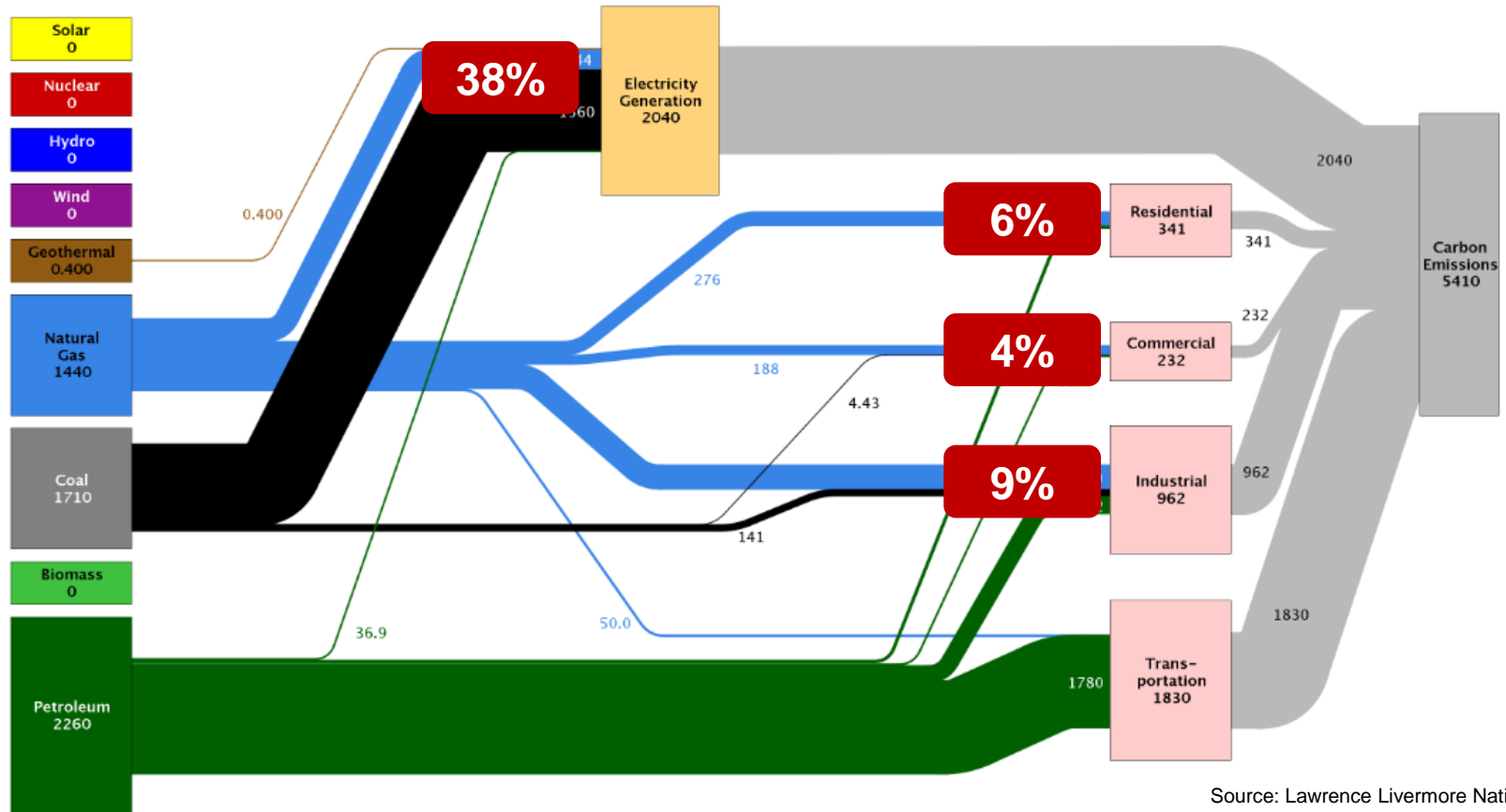
Source: Lawrence Livermore National Laboratory

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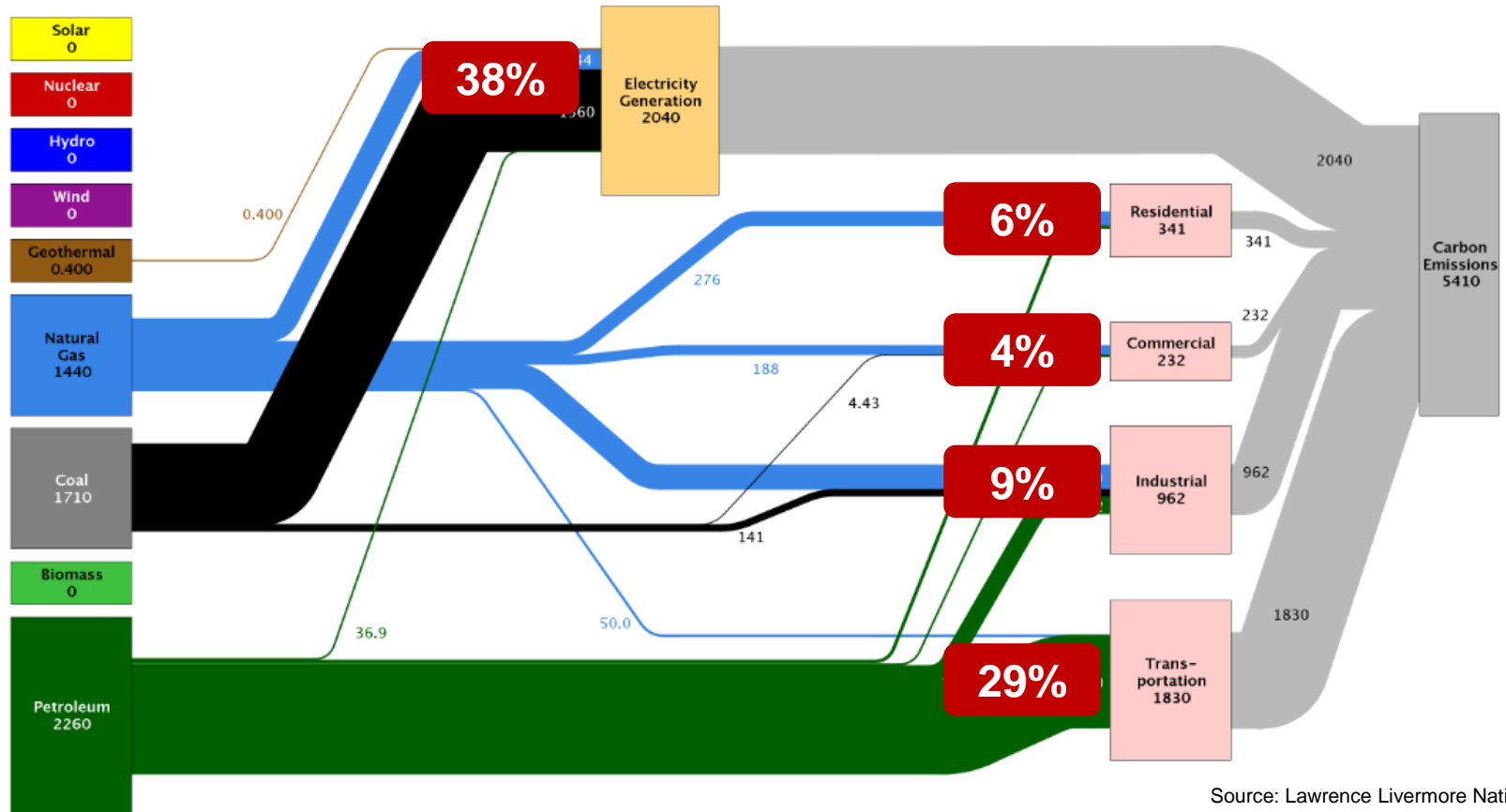
Source: Lawrence Livermore National Laboratory

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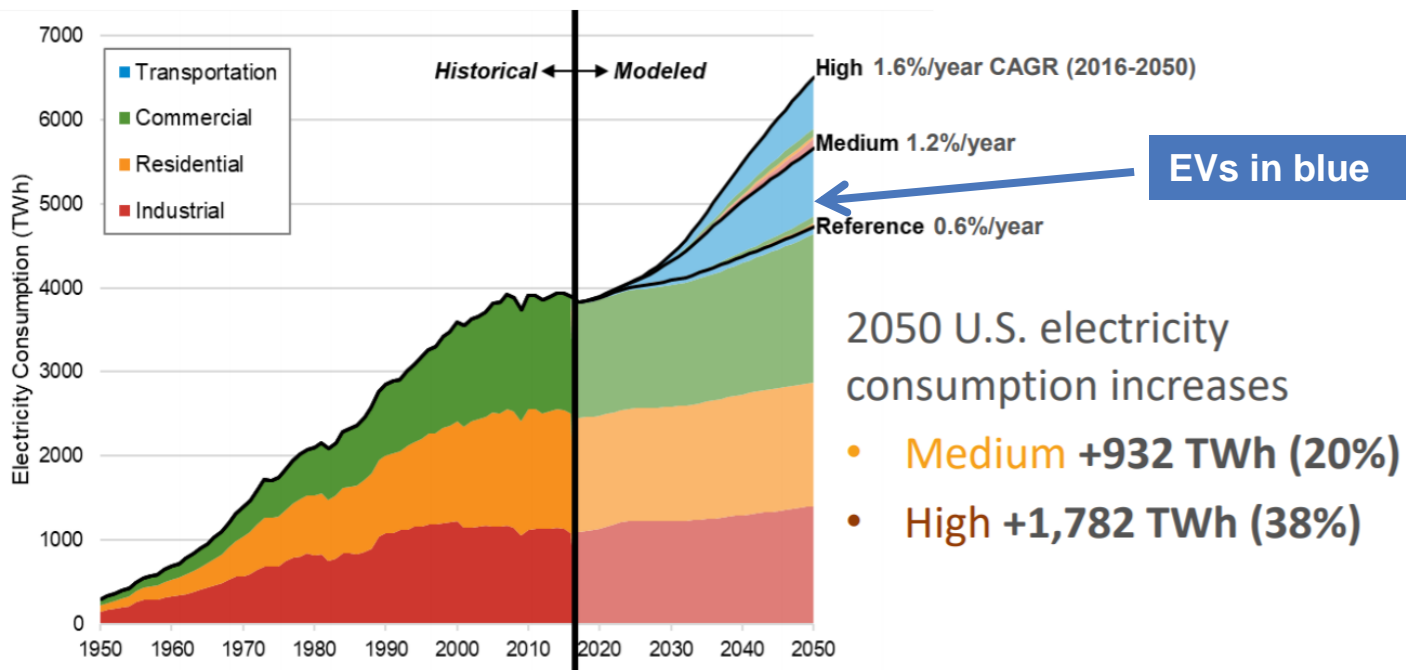


Source: Lawrence Livermore National Laboratory



NREL electrification model: EVs dominate

Vehicle electrification dominates incremental growth in annual consumption



Source: National Renewable Energy Laboratory



**"Oh, You Needn't Hurry Home
I Use An Electric Range - - -"**

—You see I just put the dinner roast in the oven, set the automatic clock, and forget all about it. And my vegetables too, they are disposed of just the same way. It's simply wonderful to have the dinner worries off my mind and be free for hours and hours at a time.

My electric bill is astonishingly low too! Think of it—dinner always ready and piping hot just when I want it and yet I'm no longer tied down to my kitchen."

This modern housewife might have told you also that electricity is the only cooking device that does not require oxygen to produce heat—no air vents are necessary on an electric range. Their mode of the juices of the meat escape through steam. You will find that a four pound roast cooked by electricity is equal to a six pound roast cooked by gas.

ORLANDO UTILITIES COMMISSION

"COOK BY WIRE"

Postcard - Stop 11/2/25

**The Biggest
NICKEL
IN ORLANDO**



5
CENTS



**WE GIVE YOU THE BIGGEST
NICKEL'S WORTH OF SERVICE
THROUGH OUR - - -**

"TRIAL PLAN"
ON RANGES AND WATER HEATERS

We Install a Range or Water Heater in Your Home "Without Cost to You" for **ONLY 5c PER DAY** Payable With Your Monthly Bill.

ORLANDO UTILITIES COMMISSION
and ASSOCIATED DEALERS

NO. 1 EAST JACKSON
PHONE 6168

Source: OUC

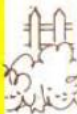
A GOLD MEDALLION HOME OFFERS MORE...



safety

It's easier to prevent accidents in a Gold Medallion Home. Plenty of properly-located electrical outlets eliminate the need for hazardous tangles of extension cords. Wall switches at strategic spots let you "light your way ahead," on stairways . . . down hallways . . . to and from the garage. Proper lighting in kitchen and bathrooms helps to prevent nicks and cuts, while outdoor lights discourage prowlers . . . prevent falls-in-the-dark.

Full Housepower Wiring has ample capacity for all your electrical appliances and equipment. Use them indoors or out without any danger of overloading circuits.

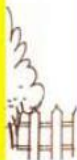


comfort



In Gold Medallion Homes, electric heating and cooling provide the ultimate in family comfort. Precise temperature control is assured. Many types of electric heat even permit individual room-by-room temperature selection. For summer comfort, electric air conditioning offers a choice of individual room units or whole-house cooling . . . often including air-cleaning and filtering.

And, better-than-average insulation keeps Gold Medallion homes warmer in winter . . . cooler in summer.



cleanliness



Everything stays clean longer in a Gold Medallion Home. Electricity is pure energy. There are no products of combustion to settle on walls and furnishings. No soot . . . no smoke. So, it's easy to keep a Gold Medallion Home fresh and sparkling. You can postpone redecorating 'til you want a change in color scheme. Drapes and upholstery need cleaning far less often. Air-borne dust and dirt can be shut out, thanks to electric climate control. Inside air stays fresh and pleasant, even with windows closed!



quiet

There's almost no noise in a Gold Medallion Home, except for the happy sounds created by your own family.

Electric heating equipment contains virtually no moving parts. No clanking or hissing, or noisy furnace to disturb your sleep. Closed windows shut out street noises, too, while electrically-conditioned air circulates gently throughout the house.

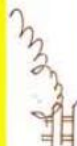
And, the extra insulation in a Gold Medallion Home doubles as a sound barrier, too.

convenience



Every Gold Medallion Home contains several work-saving major electric appliances. They're yours to command at the turn of a dial or the flick of a switch. The electric range offers precise heat settings on the surface and in the oven—frees you from "pot watching" and "oven peeking"!

Choose the most convenient time for you to do the laundry, or bathe the baby! Hot water is always on tap from your electric water heater. And, of course, with electric house heating, you just "set it and forget it."



economy

Electricity is today's biggest bargain in any home. But, it's the "best buy" of all in a Gold Medallion Home, thanks to special low total-electric rates. What's more, you get full measure from every penny's worth of electricity used for heating and cooking. Electric heat is 100% efficient. None goes "up the chimney." An electric range puts *all* its heat into the food—not into the kitchen.

You save on maintenance costs, too, in a house equipped with carefree electric heating equipment. It has virtually no moving parts.



good investment

A Gold Medallion Home is an excellent long-range investment—a better buy now and a better value in years to come. It's a complete "package" of good living, fully equipped with major electric appliances and good lighting. Whatever its size or price-range, Full Housepower wiring assures that the home will not soon "grow old" electrically.

In a Gold Medallion Home, you enjoy all the advantages of Total-electric Living, secure in the knowledge that yours is the kind of home most families will want, should you wish to sell some time in the future.

Source: OUC

go all electric

the medallion for  modern living

A Medallion home is planned to provide the wonderful comfort and convenience of modern electrical living. It has Full Housewired. That means plenty of outlets and switches in convenient locations, with provisions for future needs.



It has Light Fixtures! Planned to combine beauty and decorativeness as well as set the desired mood for family life.



It has Electrical Appliances! A modern electric range, plus at least three additional major appliances. They go with the plan of the house and are conveniently placed to give your back and save you time.

Ask your builder or electrical contractor how you can qualify your present home as the one you plan to build or buy. For this Medallion of Modern Electrical Living.

1054 of Handy 7-30 TV Range & Dry Water Meter 6-00 191



WIRING ALLOWANCE:

\$50 allowed when replacing other fuel with Electric Range; \$15 allowed when replacing other fuel with Electric Water Heater.

your Orlando Utilities

COMMISSION



*Orlando Sentinel 4/12/59
3/26/59*

...cook ELECTRICALLY

FOR BETTER MEALS

\$45.00 Allowance. See Your Electrical Dealer for \$25.00 Allowance on Wiring for Your Electrical Range and Hot Water Heater, When replacing other fuel.

Better meals build better families!

Now modern electrical appliances take the work out of cooking, help you prepare better meals. An electric range will help keep your kitchen cooler too!

ORLANDO Utilities COMMISSION

Owned and Operated by the people of Orlando

A BOOK OF NEW IDEAS FOR HOMEOWNERS! To add to your book. Includes with information, inspiration.

- How to plan "flexible living systems"
- Beautiful principles of room after room in an exciting Total Electric Home.
- The facts about electric heating. (Can't be added just to your cozy tidy -the apple in the pie!)

You can live better ELECTRICALLY!

"GOOD LIGHTING is GOOD BUSINESS."

says Harry Hanson, president of the Downtown Orlando Council Inc.

The downtown merchants have long realized the importance of adequate lighting ... lighting for store identification, lighting for window displays, and interior lighting to enhance the beauty of today's varied merchandise.

Lighting keyed to today's buying habits is one of the important aspects of any store. The mood of an interior or of its occupants is varied by the way lighting affects one's perception. A majority of today's buying is impulsive buying. Attractively lighted displays and interiors create the desire to observe and handle the products.

If you are planning to remodel your present store or build in the future, make sure your lighting and lighting techniques are an integral part of your plan.

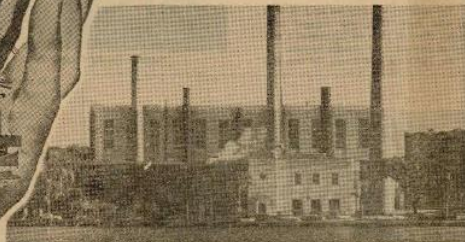
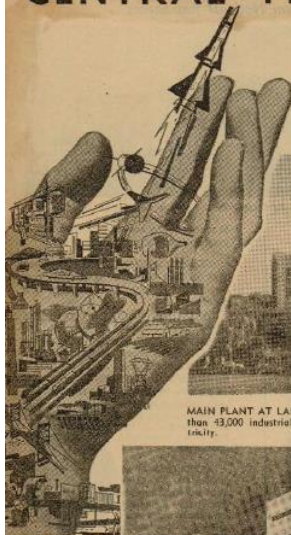
For further information regarding adequate lighting, call George Yucius, Sales Engineering, Orlando Utilities, Cherry 1-4411.



CENTRAL FLORIDA

*Moves forward rapidly into
a future unlimited!*

We too, are planning and building to take care of the future needs of Florida's largest and fastest growing inland city. 100,000 population today, 250,000 in 10 years.



MAIN PLANT AT LAKE IVANHOE with a total capacity of 138,000 kilowatts serving more than 43,000 industrial plants, commercial establishments and homes with efficient electricity.



NEW BREVARD COUNTY, INDIAN RIVER PLANT with a total capacity of 90,000 kilowatts scheduled for completion late this year.

We invite inquiries from industries and businesses interested in this fantastically growing area in the heart of beautiful Central Florida, where an abundant source of electric power and pure fresh water combined with ideal living conditions make Orlando a truly great city to live, work and play. Write Public Relations Dept., Orlando Utilities Commission, P. O. Box 3193, Orlando, Florida.



BUSINESS OFFICE:
City Hall, Orlando

FRIDAY, JUNE 14, 1950

23

Source: OUC



Electrification through the lens of the customer

What does electrification mean to customers?



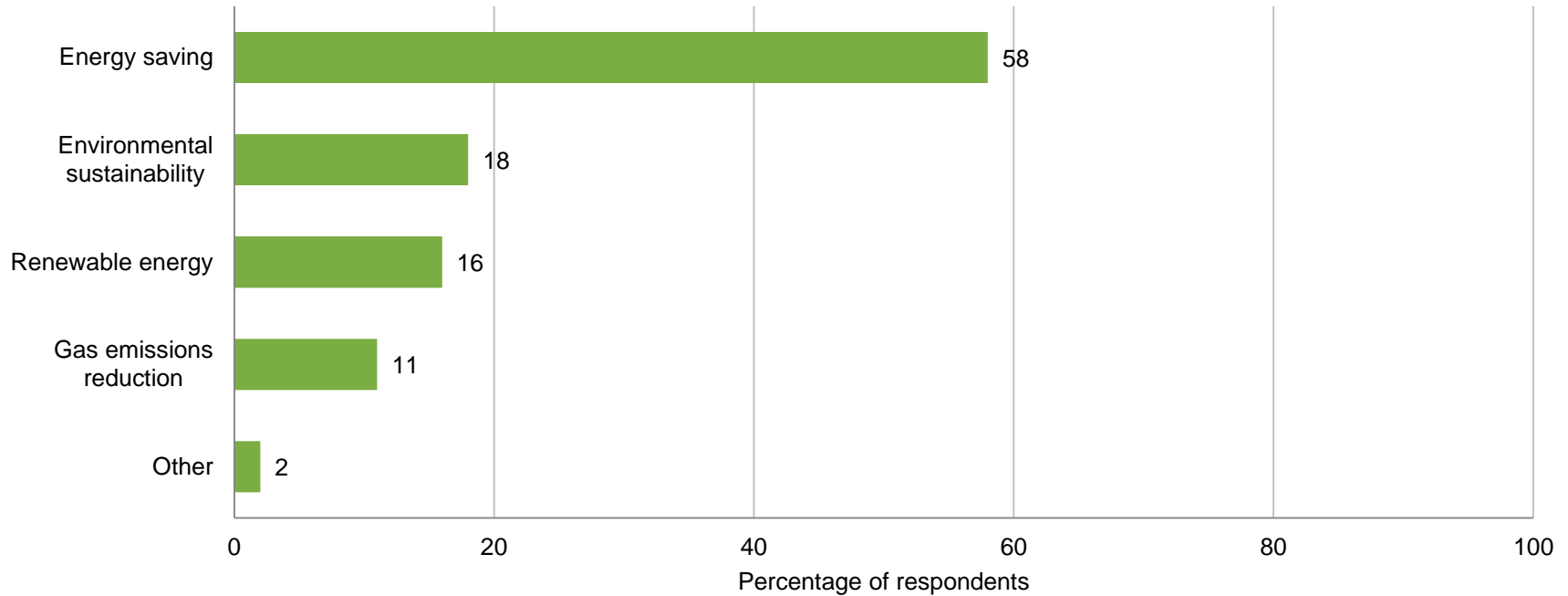
Source: iStock

Speak to residential customers' priorities

According to the E Source Solar Strategy Service 2016 Market Research Study, customers' priorities are:

1. Me and my family
2. The environment
3. Future generations
4. My community

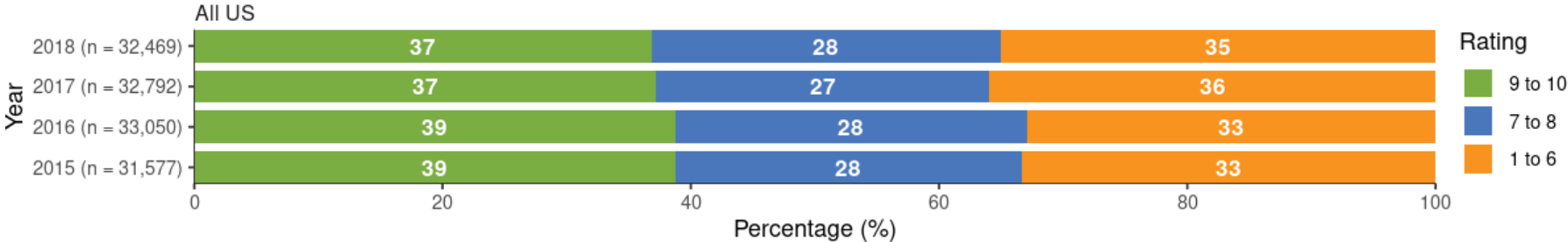
Speak to business customers' priorities



Base: All respondents (6,658). **Question S4_9 (S5_7):** Which of the following energy-related goals, if any, does your business currently have in place? Select all that apply.

© E Source (2018 Gap and Priority Benchmark Survey)

65% of people believe their utility should source more renewables



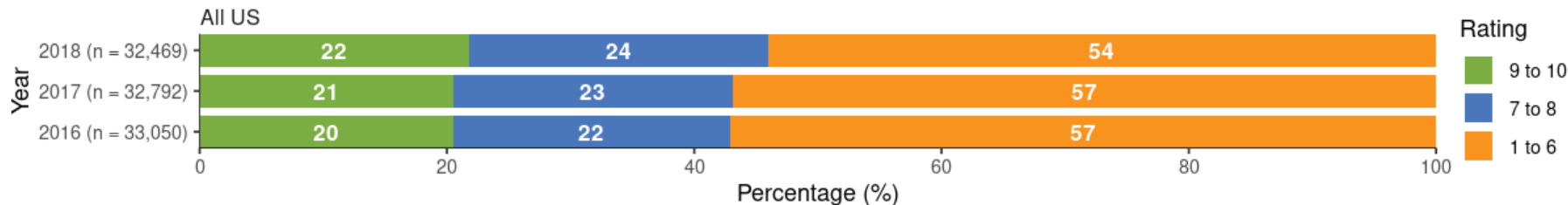
Base: All respondents.

Question C1_3: Please indicate the extent to which you agree or disagree with the following statements: More of my electric utility's electricity supply should come from renewable energy resources. (Grouped)

Note: Respondents used a scale of 1 to 10, where 1 means strongly disagree and 10 means strongly agree. Data may not add to 100% due to rounding. Percentages shown in the charts reflect weighted data; sample sizes (n) are based on unweighted data.

© E Source (Residential Customer Insights Center)

46% believe their utility supports its customers' use of solar energy



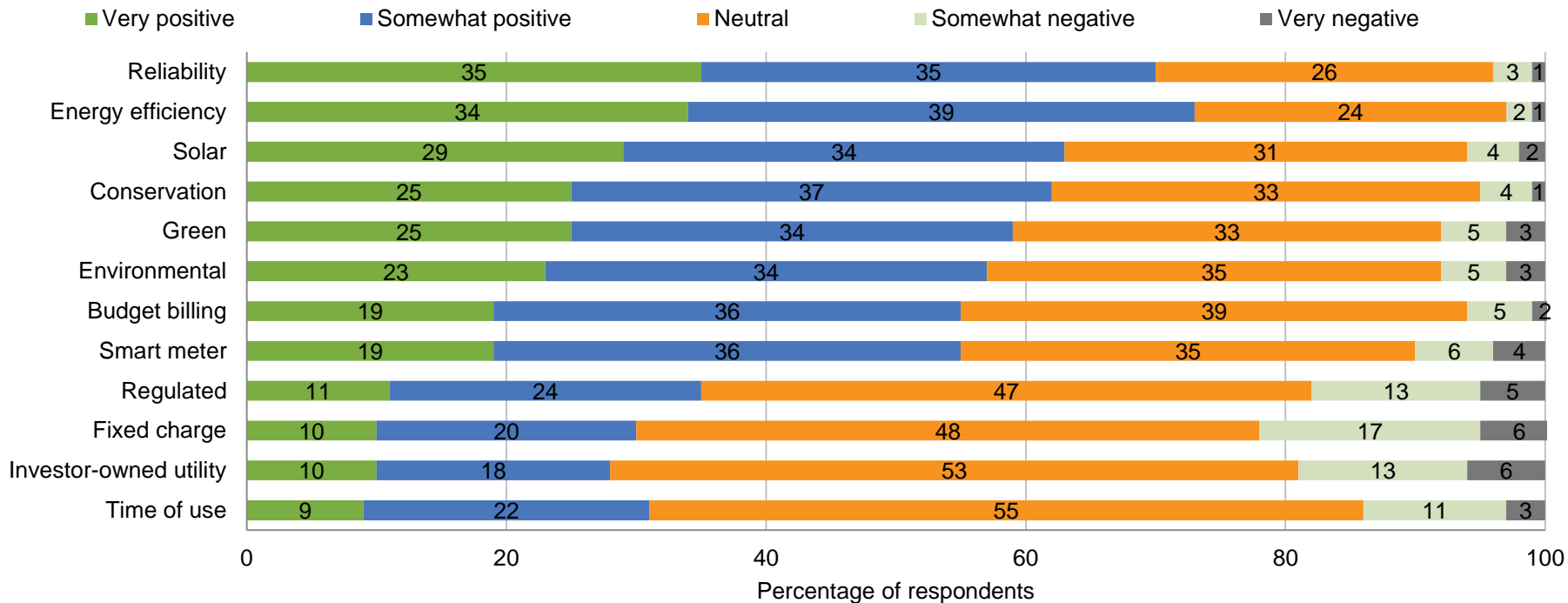
Base: All respondents.

Question C1_7: Please indicate the extent to which you agree or disagree with the following statements: My energy provider supports the use of solar energy by its customers. (Grouped)

Note: This question was first asked in 2016. Respondents used a scale of 1 to 10, where 1 means strongly disagree and 10 means strongly agree. Data may not add to 100% due to rounding. Percentages shown in the charts reflect weighted data; sample sizes (n) are based on unweighted data.

© E Source (Residential Customer Insights Center)

Perception of terms energy companies use

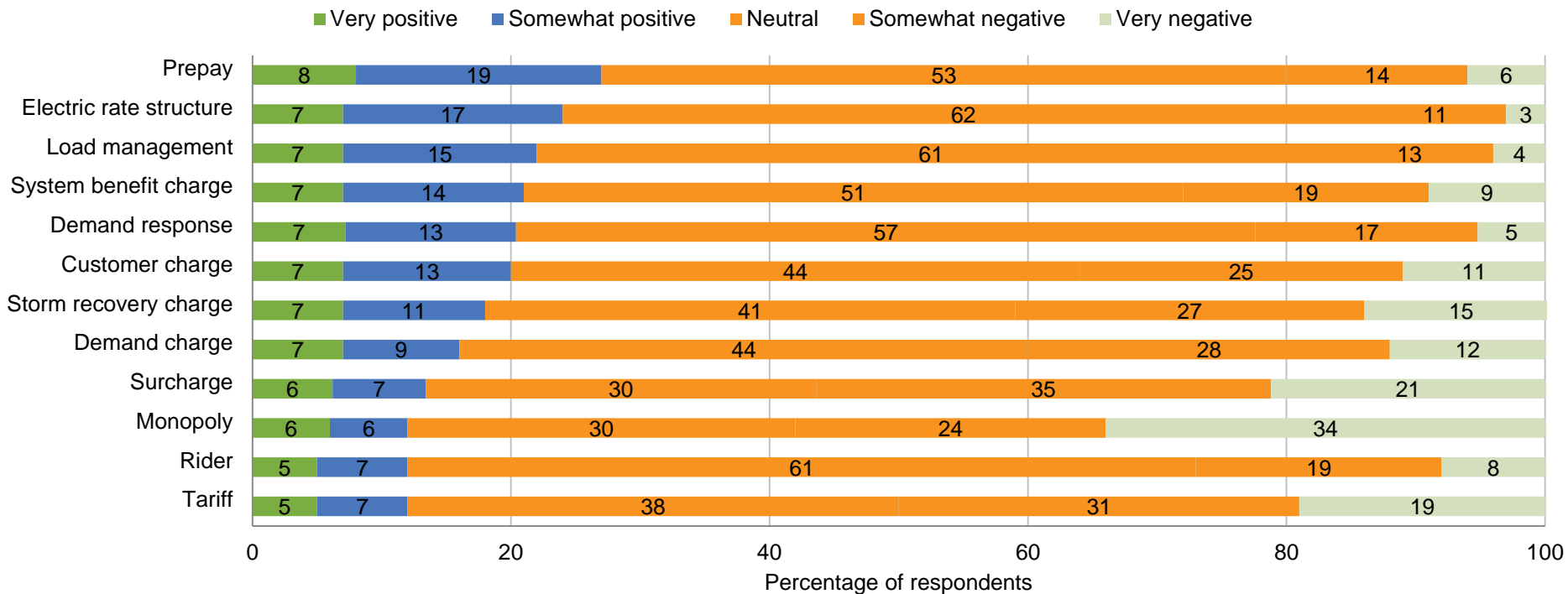


Base: All respondents (n = 3,000). **Question S4_5:** Below are terms that energy companies use to communicate with customers. We want to know whether these specific terms evoke positive or negative feelings or impressions for you, not whether you like or support the underlying concept. Please answer based on your emotional response to the term.

Note: Percentages may not add to 100 percent due to rounding.

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Perception of terms energy companies use



Base: All respondents (n = 3,000). **Question S4_5:** Below are terms that energy companies use to communicate with customers. We want to know whether these specific terms evoke positive or negative feelings or impressions for you, not whether you like or support the underlying concept. Please answer based on your emotional response to the term.

Note: Percentages may not add to 100 percent due to rounding.

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A historic story about change and the vital role everyday people can play





Putting electrification into play

Next steps

- Creating the cost-effectiveness framework
- Assessing the value of environmental benefits
- Forging a utility incentive/reward approach for delivering truly beneficial electrification

Upcoming events

- [Results of the 2019 E Source Voice-of-Utility DER and Electrification Benchmark](#) (web conference)
 - November 20, 2019, 2:00 to 3:30 p.m. ET
- Part 2 of this series: [Designing Incentives and Technology Roadmaps for Beneficial Electrification](#) (web conference)
 - December 3, 2019, 2:00 to 3:00 p.m. ET
- [E Design Week](#) (in-person event)
 - Boulder, CO, Tuesday, December 10, 2019–Thursday, December 12, 2019

How we cover DERs, decarb, and electrification



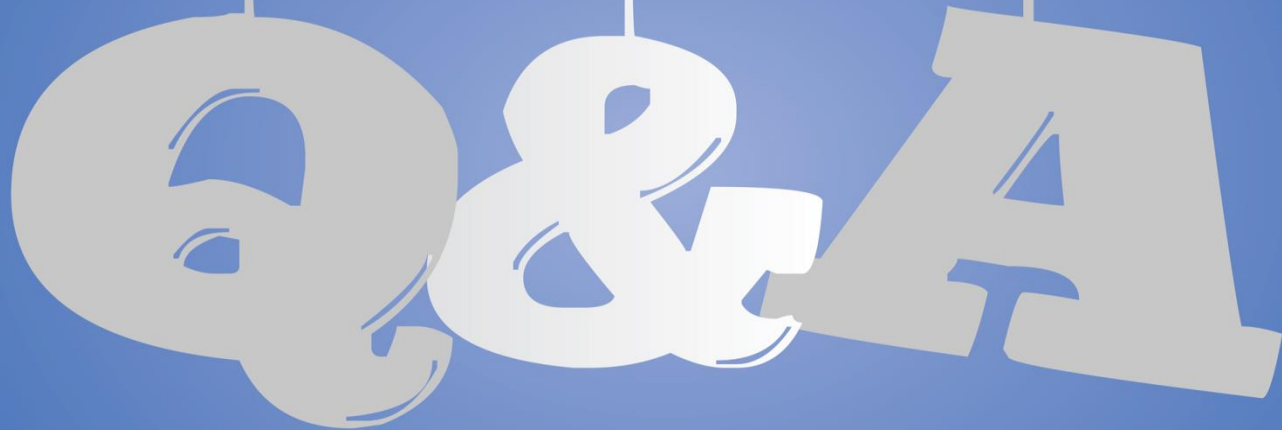
E Source consulting solutions

- Building an electrification strategy



- Technology road mapping





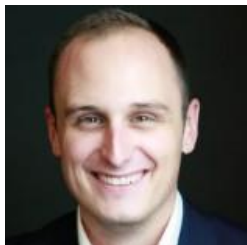
Thank You! Questions?



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