Our Global Challenge

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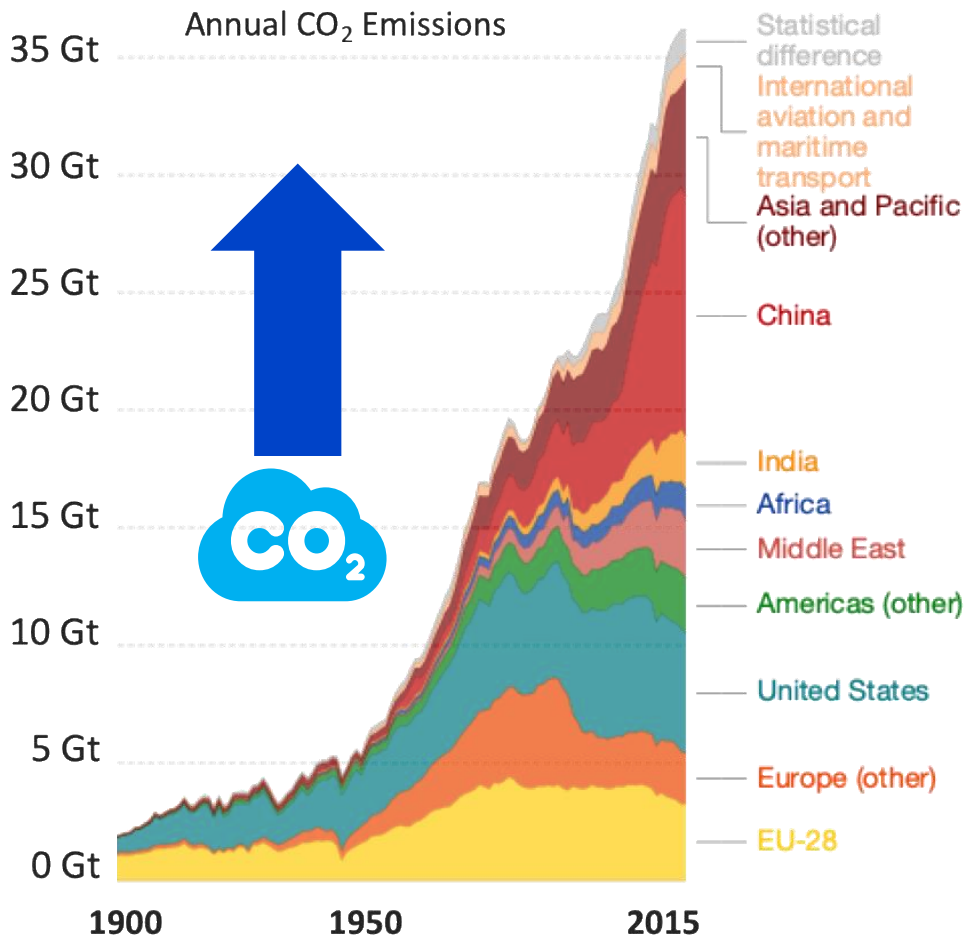
Our Global Challenge: More Energy Services, Less Carbon

With Global Access To

- Clean
- Affordable
- Reliable, and
- Safe Energy

. . . While Improving Quality of Life with Sustainable Energy Production and Consumption

Global Carbon Emissions and Energy Growth



Source: Carbon Dioxide Information Analysis Center

Carbon in Atmosphere Today: 3,200 $GtCO_{2eq}$

+ 3,500 – 4,100 $GtCO_{2eq}$ Through 2070

Business As Usual

CO_2

1,170 $GtCO_{2eq}$ to limit warming to < 2C (3.6°F)

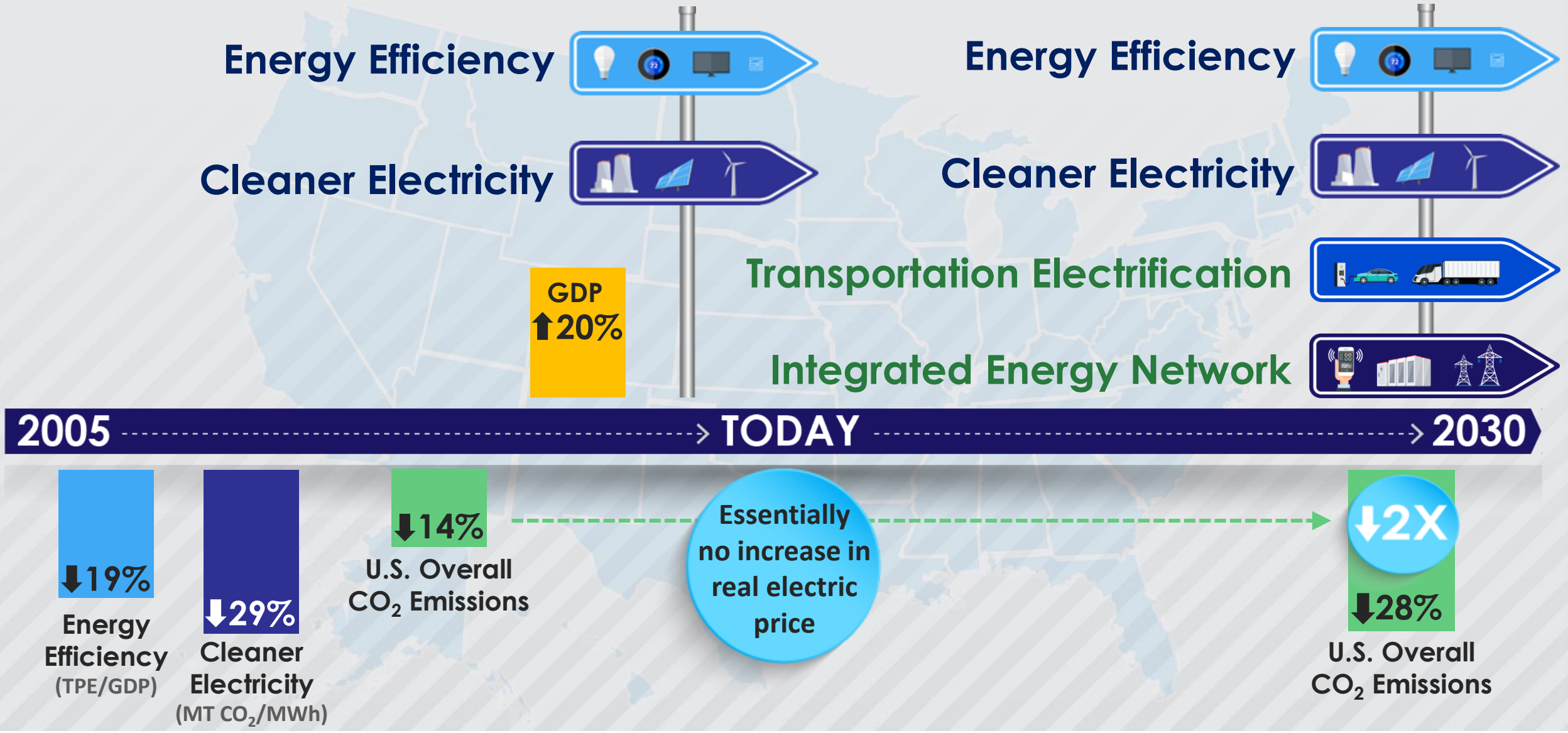
Source: IPCC (2015, 2018). BAU range from CD-Links scenario database.

40% Global Energy, 65% Global Electricity Demand Increase by 2050

Our Global Challenge: More Energy Services, Less Carbon

What are the Pathways to Meet Our Global Challenge?

Near-term: Reducing U.S. Economy-wide Carbon Emissions

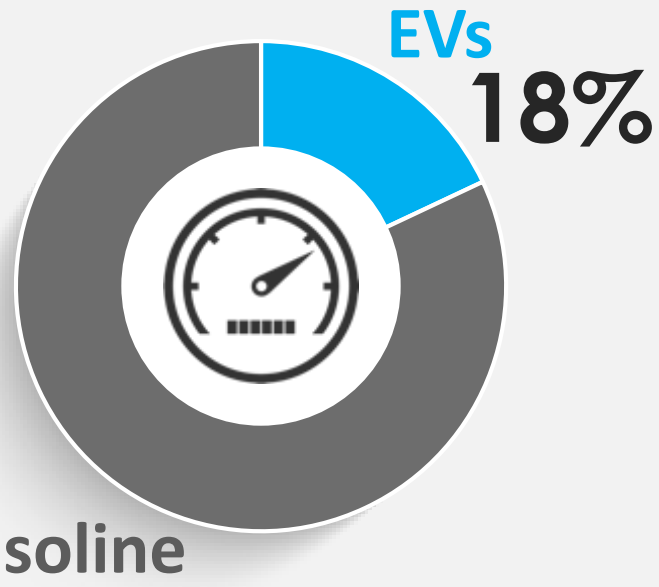


Transportation Electrification

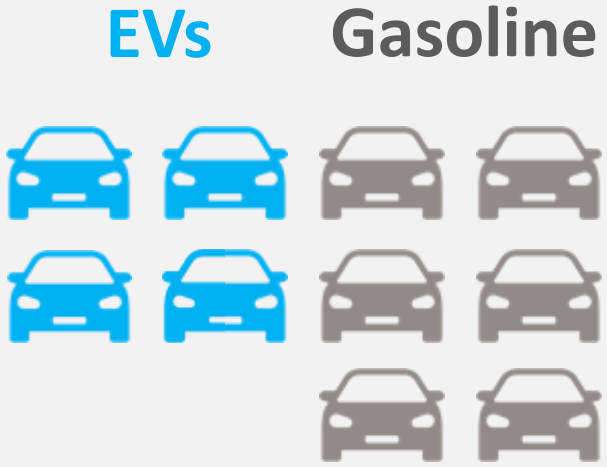
Today, EVs Emit Less CO_2 Than the Average Car in Every State
In 2030, Electricity ½ as Carbon Intensive

2030:

Vehicle Miles Traveled



New Vehicle Sales



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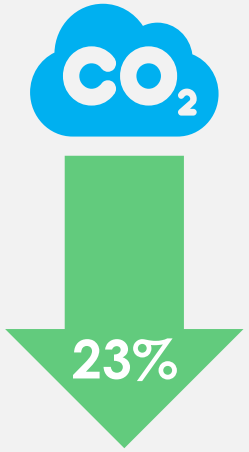


From 2005 levels

Cleaner Transport
(MT CO_2)

[1] Historic data from EIA *Monthly Energy Review*, February 2019. Projections from *USREGEN reference case.*

Integrated Energy Network

Integrated Grid

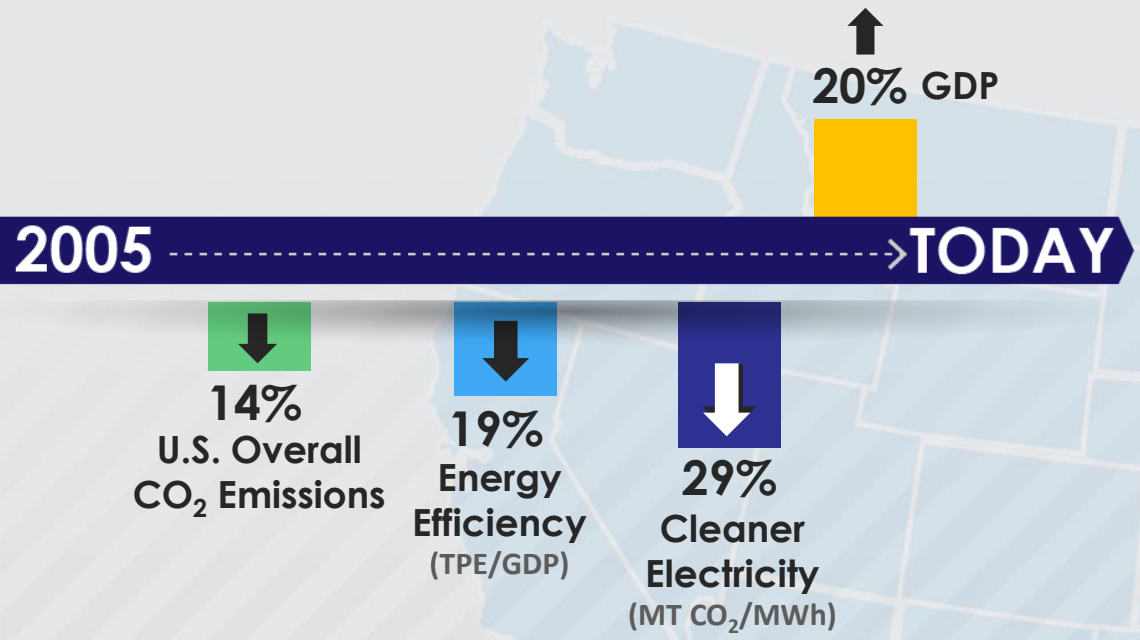
Connecting Central Generation and DER with Customers that's More Adaptive, Predictive, Dynamic and Flexible

Integrated Energy Network

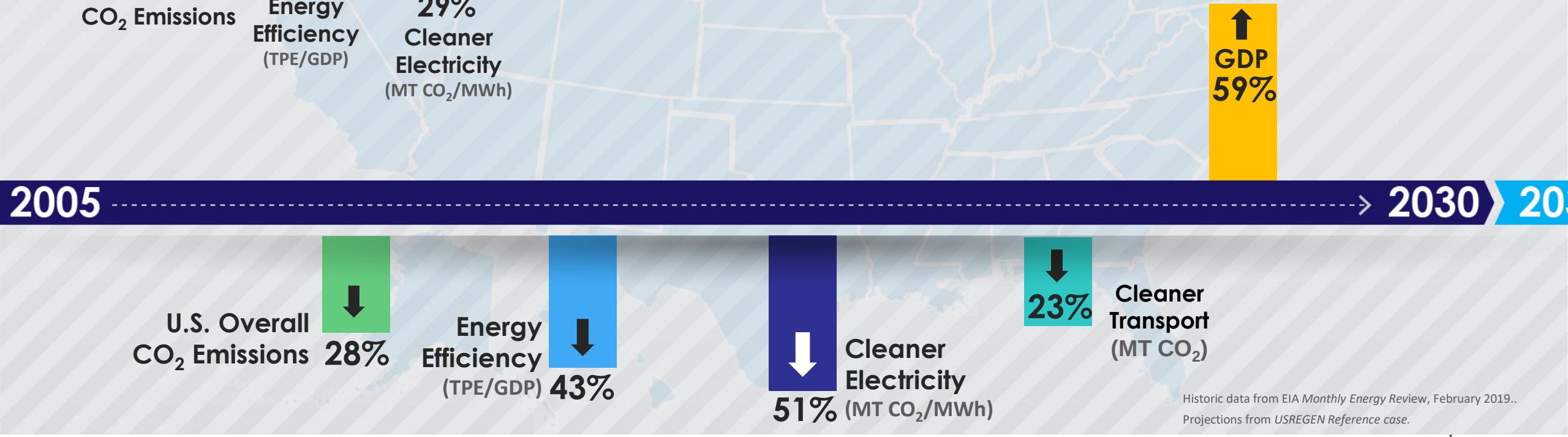
A Digitally Connected Grid

Sensors, Information, Communication, Analytics + Artificial Intelligence

Near-term: Reducing U.S. Economy-wide Carbon Emissions

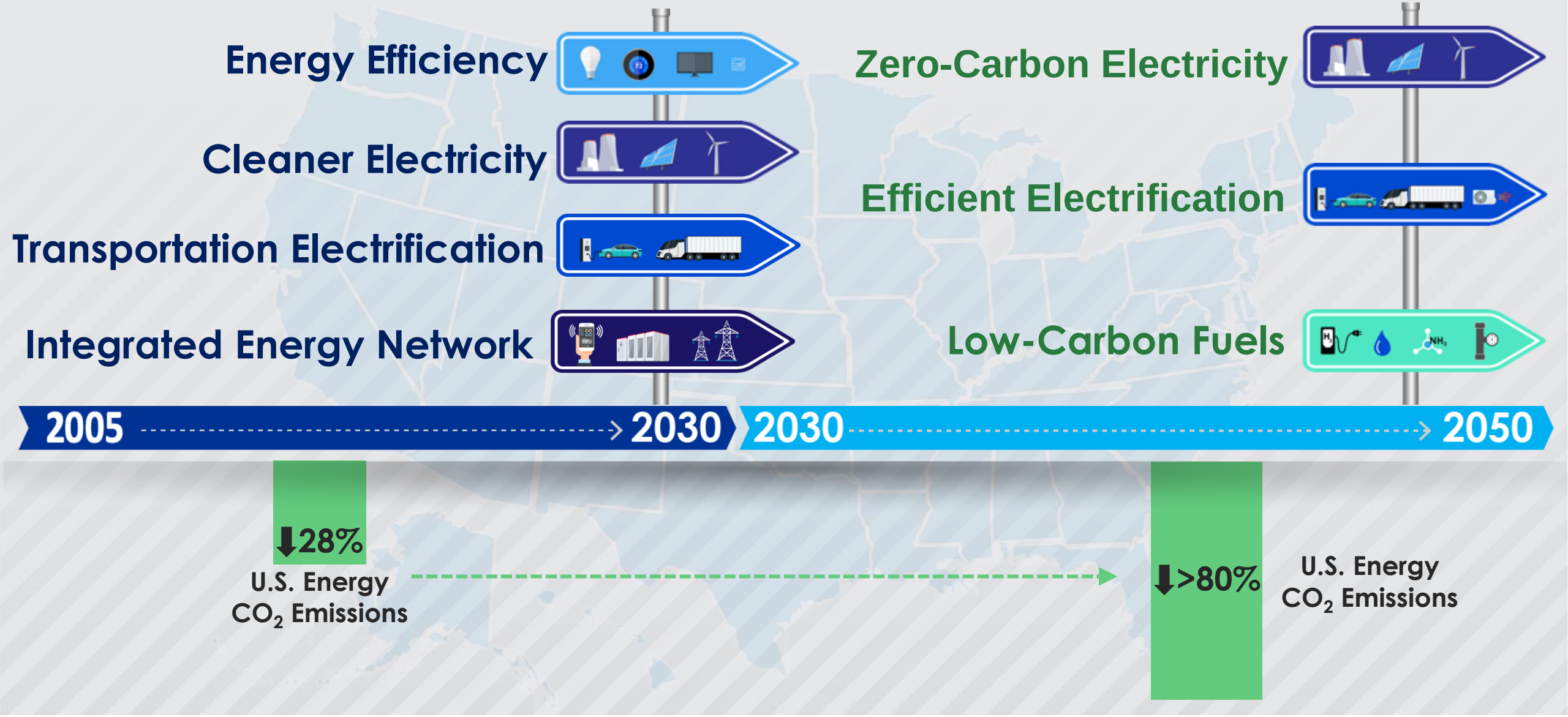


- Energy Efficiency
- Cleaner Electricity
- Transportation Electrification
- Integrated Energy Network



Historic data from EIA *Monthly Energy Review*, February 2019..
Projections from *USREGEN Reference case.*

2030 – 2050: *Continue Progress, Develop Technical Options*

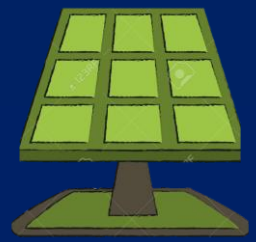


Zero-Carbon Electricity

- Carbon Capture, Utilization & Storage

- Advanced Nuclear Power

- Renewable Energy and Storage

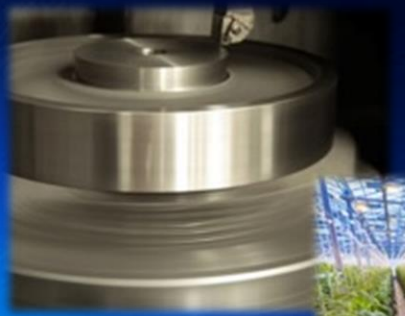


Efficient Electrification

Mobility

Heating and Cooling

New Applications



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

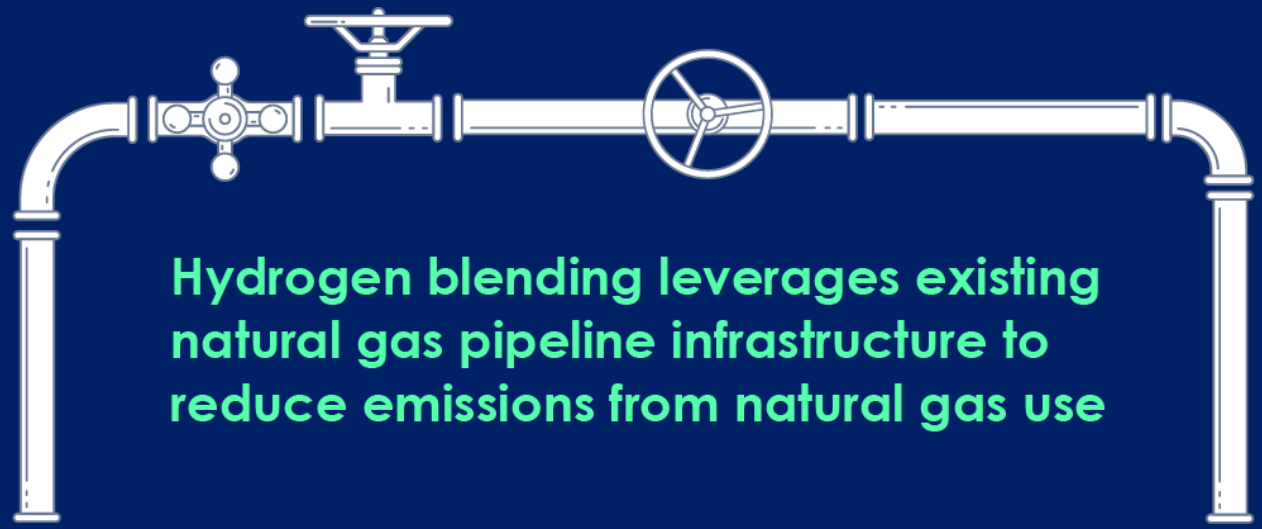
Develop Very Low-Carbon Fuels

Very Low-Carbon Fuels

cleaner electricity

cleaner energy carriers (H_2, NH_3)

heavy duty transportation, heating, & industry



Hydrogen blending leverages existing natural gas pipeline infrastructure to reduce emissions from natural gas use

Key Takeaway: *Our Global Challenge*

More Energy Services, Less Carbon

Technically Feasible But Requires . . .

1. Dedicated and Global Collaborative RD&D Commitment
2. Mitigation, plus Adaption and Geoengineering Solutions
3. Decisive Policies & Regulations, with Significant Financial Commitments

Decisions Today . . . Will Shape 2050