2021 Renewable Energy Summit

Building the Clean Energy Mosaic

Emerging Technologies 101:
Reshaping the Energy Landscape

January 14, 2021

slipstream

About Slipstream

We create, test, deliver and scale the next generation of solutions that move us farther, faster toward a clean energy economy.

Who is in the Virtual Room?

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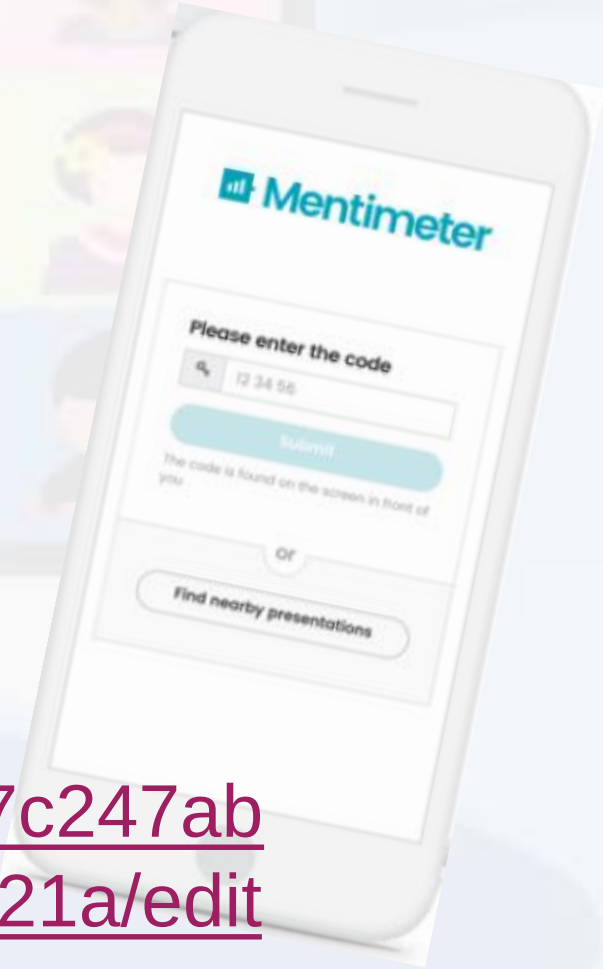

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Global Carbon Dioxide Emissions, 1850–2040

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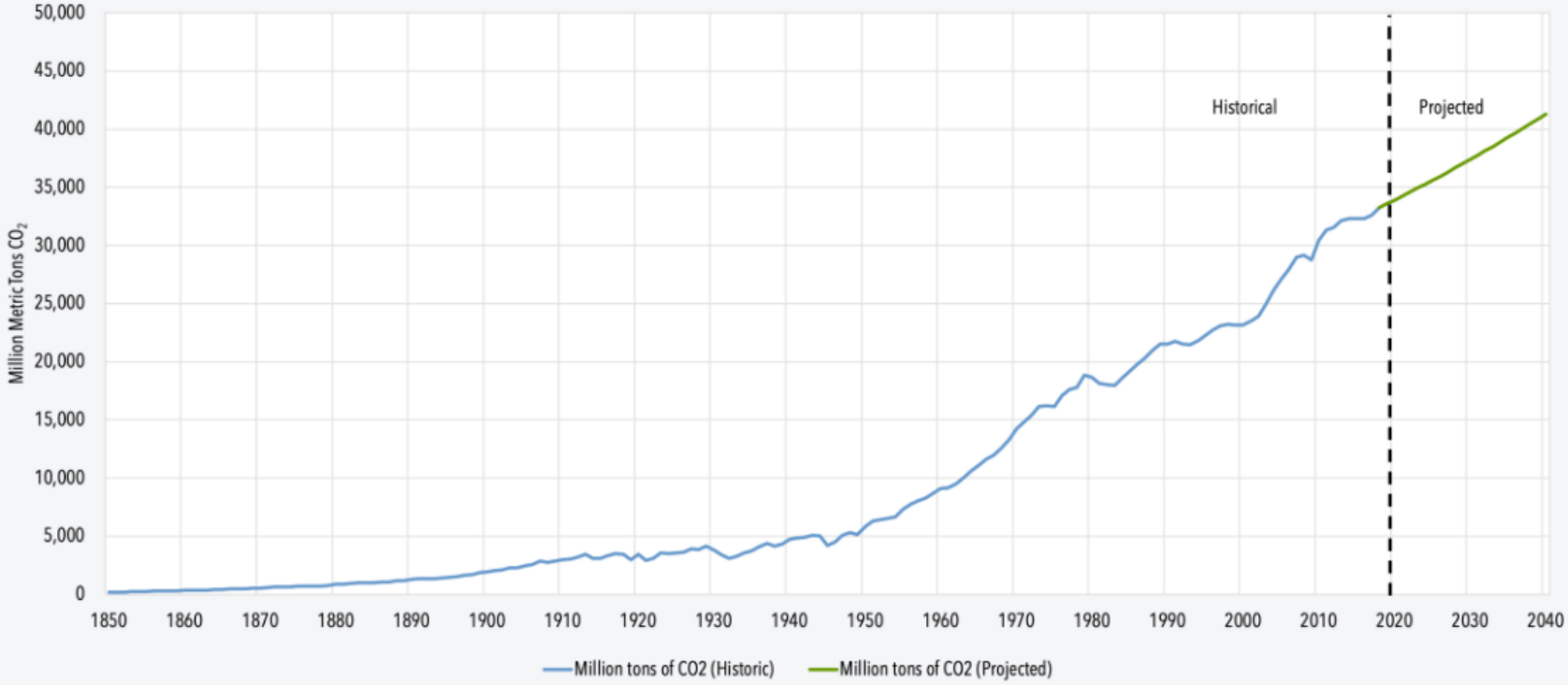

SOURCE

Carbon Dioxide Information Analysis Center (Oak Ridge National Laboratory, 2017)

World Energy Outlook (International Energy Agency, 2019).

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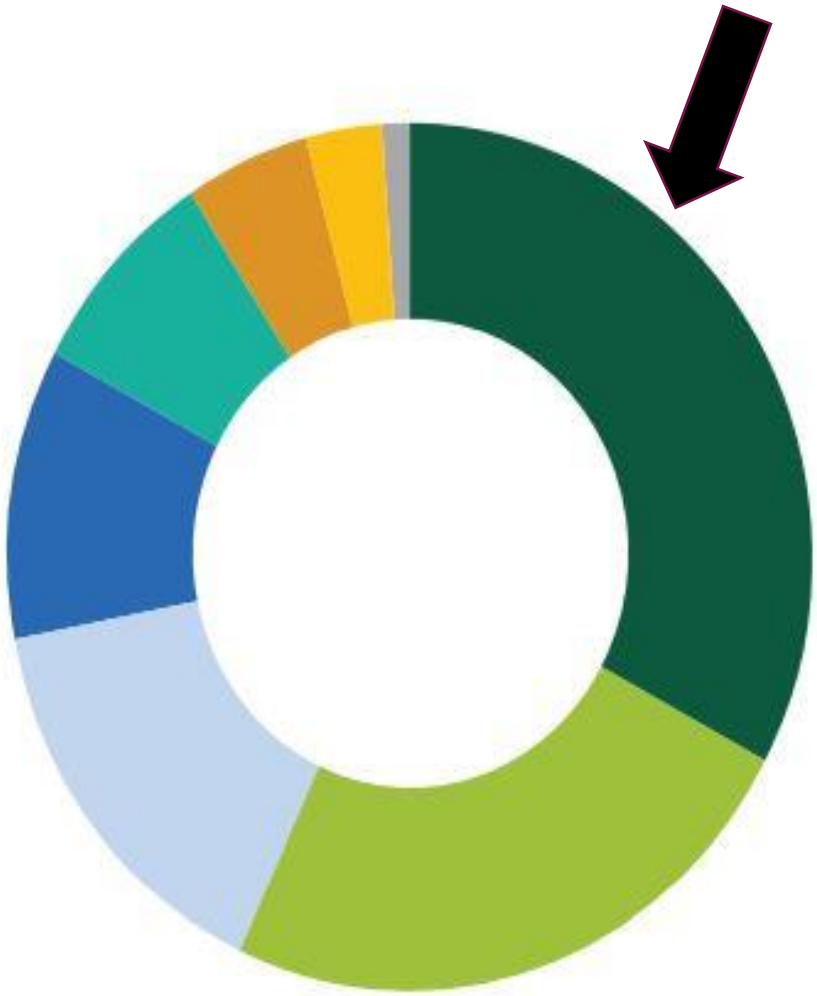
2017 WISCONSIN EMISSIONS BY SECTOR



Source: Wisconsin Climate Task Force Report

Poll: What Portion of Wisconsin Electricity Generation is Renewable?

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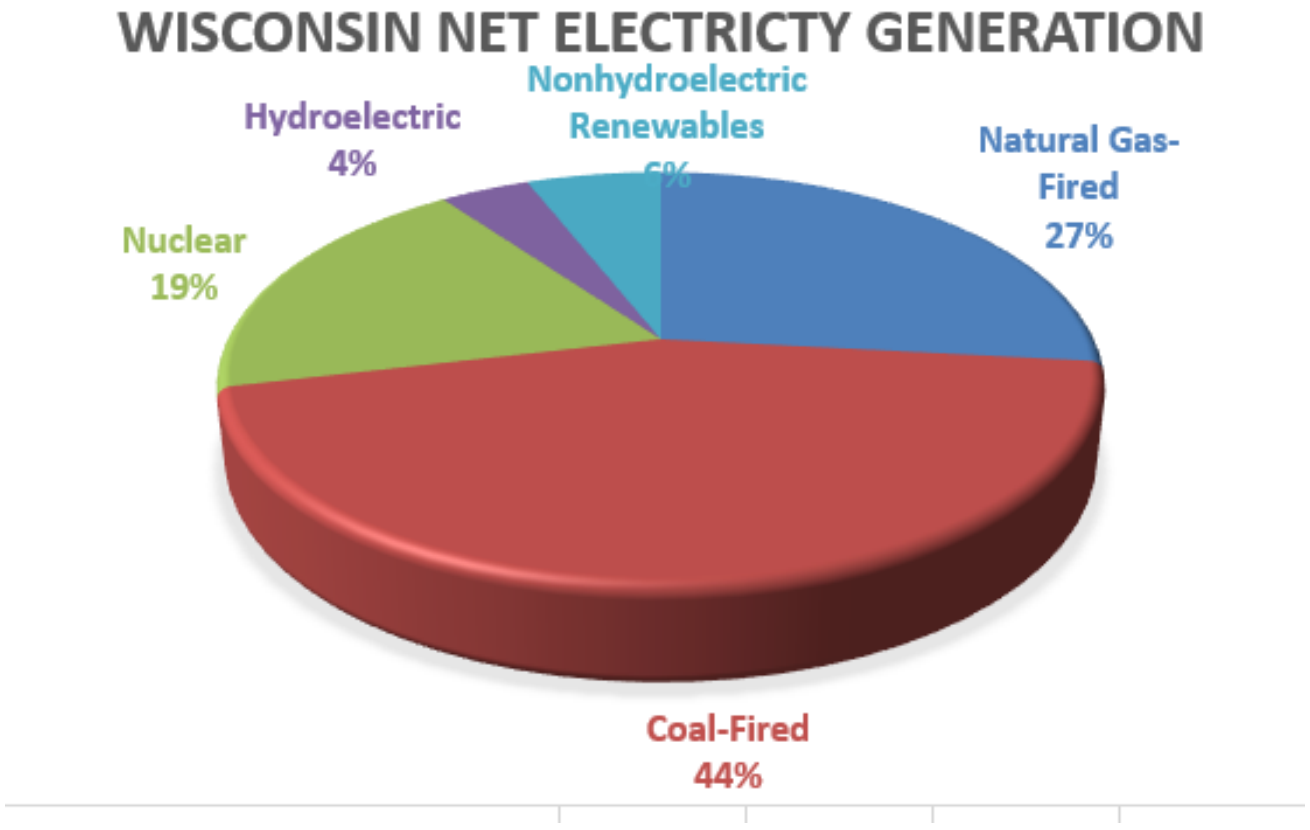
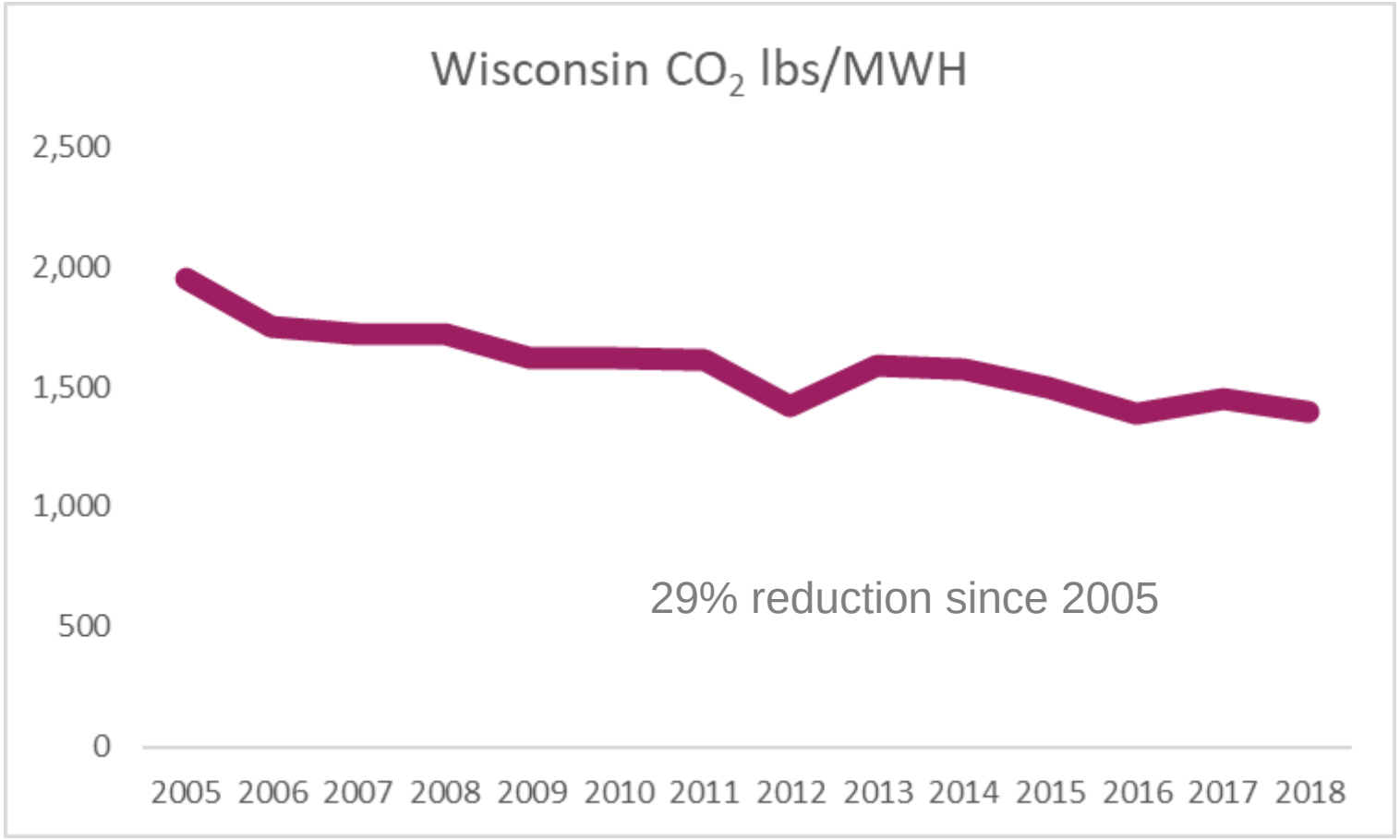
Wisconsin Electricity Generation



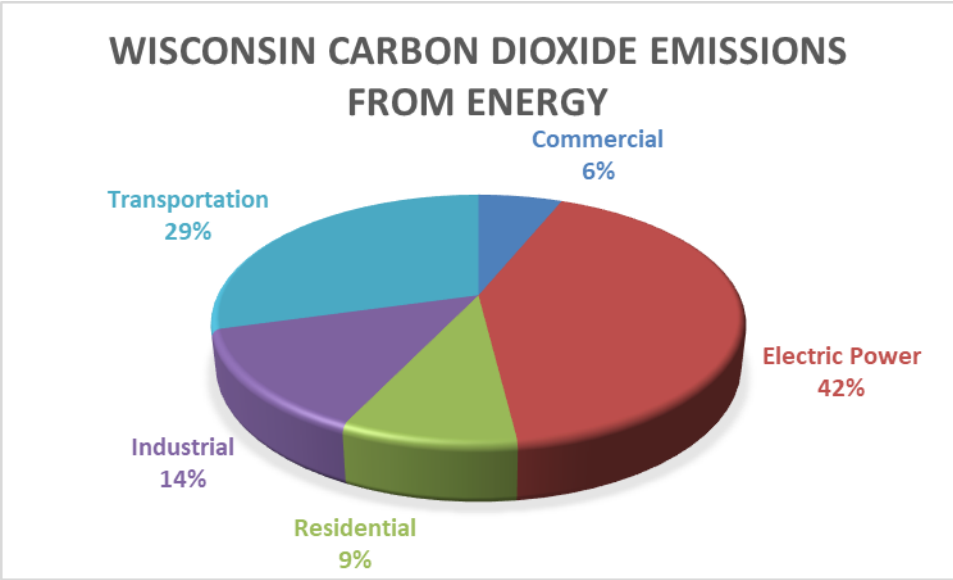
Data source: EIA, 2019

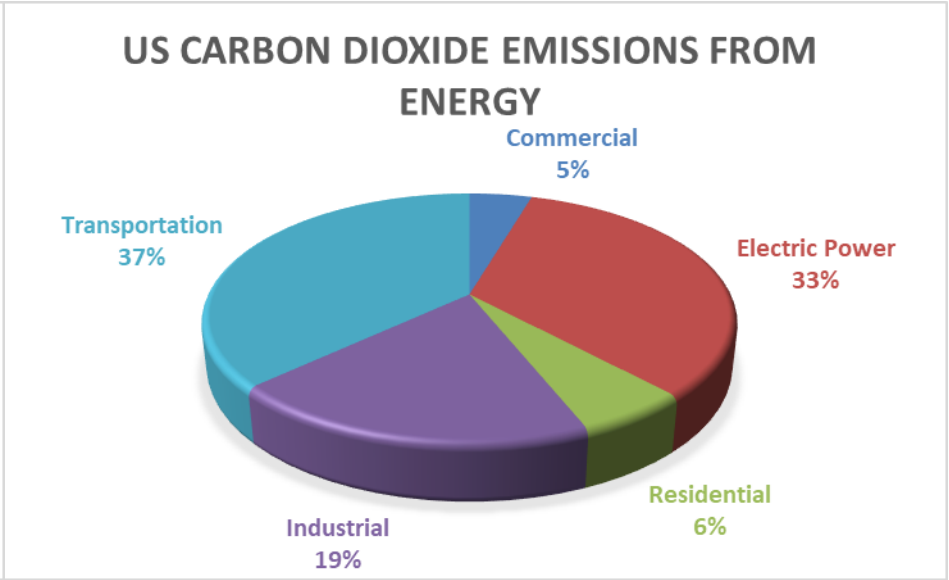
Carbon Intensity of Electricity



Data source: EIA

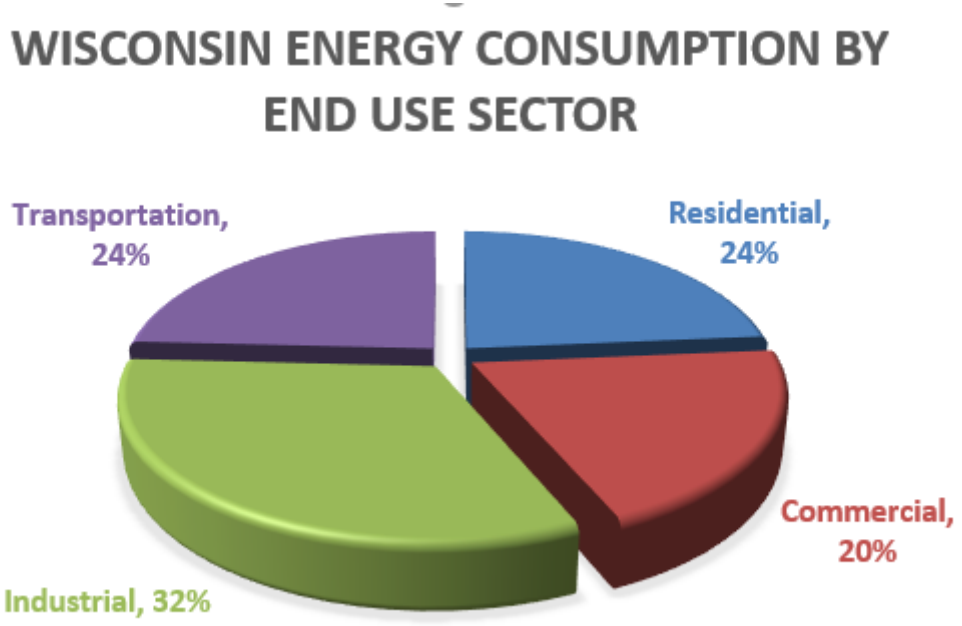
Emissions from Energy





Data source: EIA

Wisconsin Energy Consumption by End Use Sector



Data source: EIA

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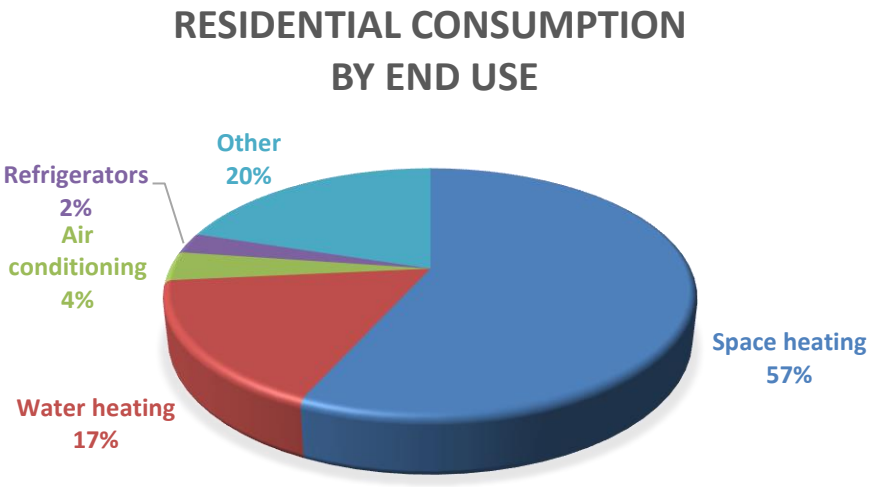
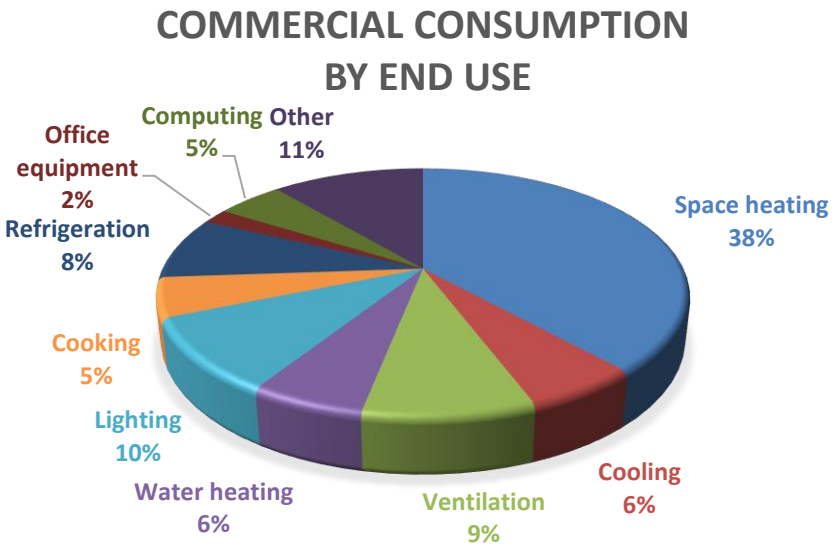




Data source: EIA, Midwest ENC representing Wisconsin

Energy-Related Emissions by End Use (US)

#	Sector	End Use	MMmt CO_2 2019
1	Transportation	Light-Duty Vehicles	1012.82
2	Transportation	Freight Trucks	396.37
3	Residential	Space Heating	329.61
4	Industrial	Bulk Chemicals	291.80
5	Commercial	Other Uses	286.27
6	Industrial	Refining	258.62
7	Residential	Other Uses	238.28
8	Biogenic Energy Combustion	Biomass	209.98
9	Biogenic Energy Combustion	Other Sectors	187.91
10	Transportation	Air	182.97
11	Residential	Water Heating	138.48
12	Commercial	Space Heating	129.23
13	Industrial	Mining	115.78
14	Industrial	Iron and Steel	114.30
15	Industrial	Balance of Manufacturing	107.84
16	Commercial	Refrigeration	86.03
17	Biogenic Energy Combustion	Ethanol	81.65
18	Industrial	Food Products	81.27
19	Residential	Space Cooling	80.23
20	Industrial	Agriculture	79.39

Beneficial Electrification

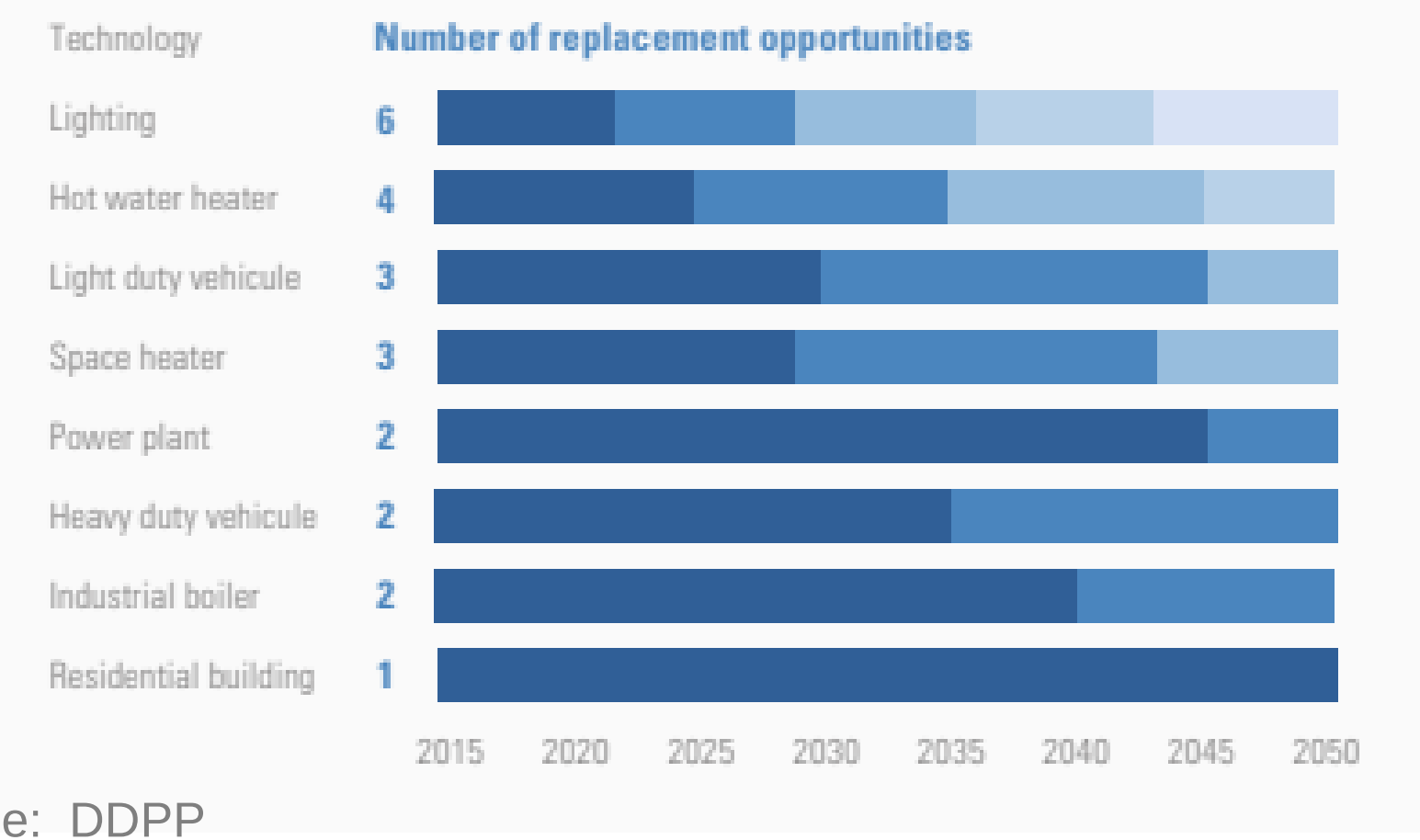
Beneficial electrification is the practice of electrifying end uses traditionally powered by fossil fuels to reduce greenhouse gas emissions

What Does Beneficial Mean?

Residential Electrification Focus Areas

- Vehicles
- Space heating
- Water heating
- Cooking

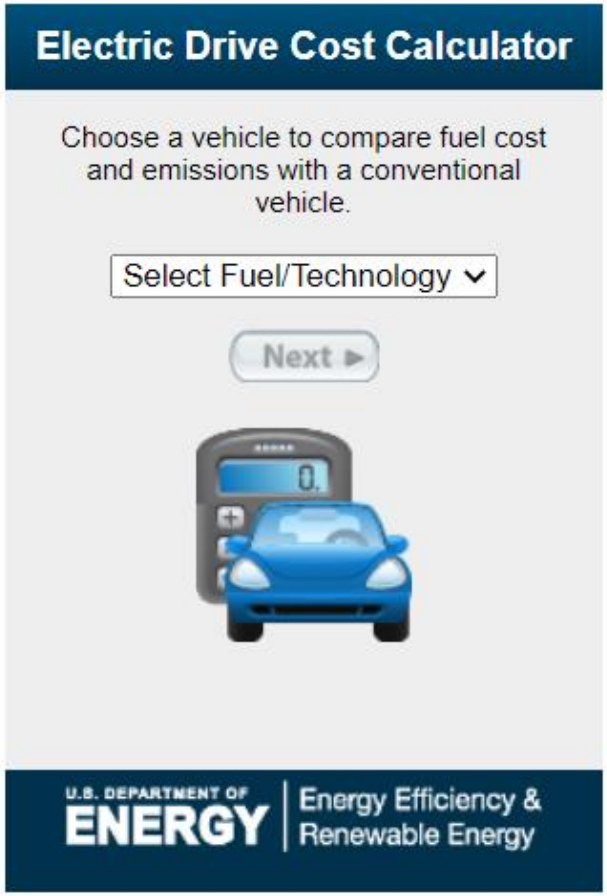
Few Replacement Opportunities



Source: DDPP

Electric Vehicles

- Use electric motor powered by electricity from battery of fuel cell
- Benefits
  - Environmental
  - Cost savings
  - Quiet
  - Fun to drive
  - Convenience



https://afdc.energy.gov/widgets/

WI EV Status 2019

EV Stat	Count	%
Wisconsin Sales	789	44% of total EV sales
Out-of-State Sales	1,018	56% of total EV sales
Total Sales	1,807	.79% market share
New Sales	1,236	68% of total EV sales
Used Sales	571	32% of total EV sales
Total Registrations	5,971	30% of EV registrations are from 2019 EV sales

Space Heating Electrification

- Residential space heating is the 3rd largest end use source of CO_2 emissions in the US.
- Air source heat pumps (ASHPs) are a key building electrification technology.
- Highly-efficient. Makes 2-4 times more heat than electricity it consumes (2.0 - 4.0 COP).
- Moves heat. Extracts exterior heat to warm a home when it's cold. Reverses direction like a typical air conditioner by transferring indoor heat outdoors.
- Technology innovation in recent years that makes heat delivery possible even in cold temperatures of the Upper Midwest.
- Inverter-driven technology can keep home comfortable to -15º F (ductless systems) and 5º F (ducted systems).

Space Heating Electrification (continued)

- Several benefits to consumers
  - Reduced exposure to fuel price variability
  - Comfort, health, and safety
  - Adds cooling
- Can reduce emissions
- Many cost-effective applications –incumbent fuel matters
- $300 federal tax credit thru 12/31/20
- Focus on Energy currently offers ASHP incentives
  - 36 ASHP projects in 2019
  - ASHP projects supported by Focus TRM
- Must level up ASHP adoption

WI Heating Fuels

Utility gas: 65.1%

Propane: 11.2%

Electricity: 15.7%

Fuel oil: 2.3%

Wood: 4.1%

Other fuel: 1.0%

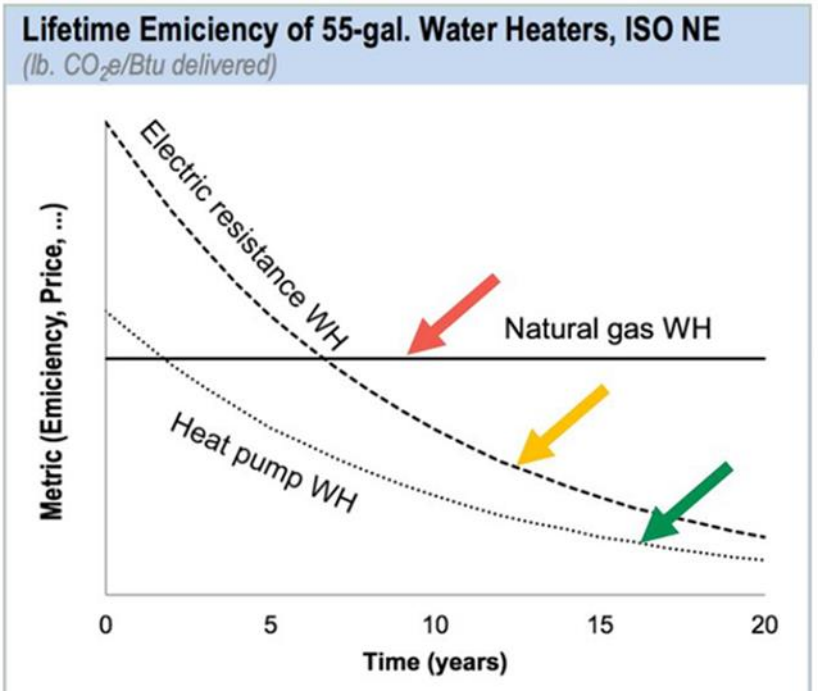
No fuel: .5%

Water Heating Electrification

- Water heating accounts for almost 20% of residential energy consumption in Wisconsin
- Second largest end use opportunity for home electrification
- Heat pump water heaters are a key electrification technology

Water Heating Electrification

- Multiple benefits
  - More efficient than gas and ER
  - Enhances safety
  - Controllable
- Can reduce emissions
- Cost effective applications – incumbent fuel matters
- $300 tax credit through 12/31/20
- Focus on Energy currently offers HPWH incentives
  - Few projects in 2019
  - HPWH projects supported by Focus TRM
- Must level up adoption and overcome barriers particularly in replacement market



Cooking Electrification/Induction

- Cooking as an end use is an important consideration in electrification—can be the last fossil fuel appliance
- Multiple benefits
  - Speed to boil
  - IAQ
  - Minimal wasted heat
  - Lifetime emission reduction
- Challenges remain
  - Incremental cost
  - Uncertain efficiency gains
  - More study needed
- No Focus incentives & no tax credits available
- Incentivized where there are clear electrification imperatives

Poll: Which End Use Will You Electrify Next?

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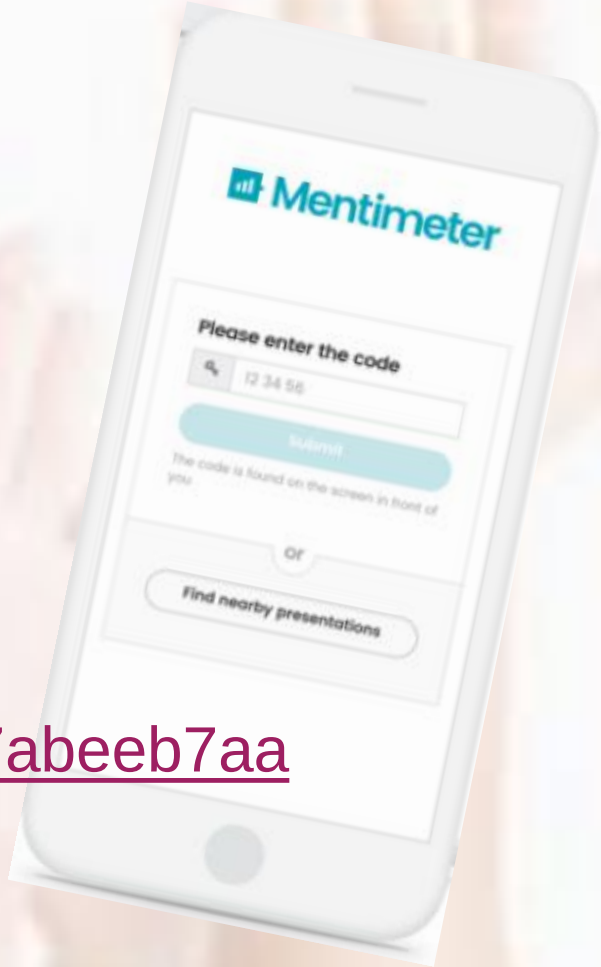

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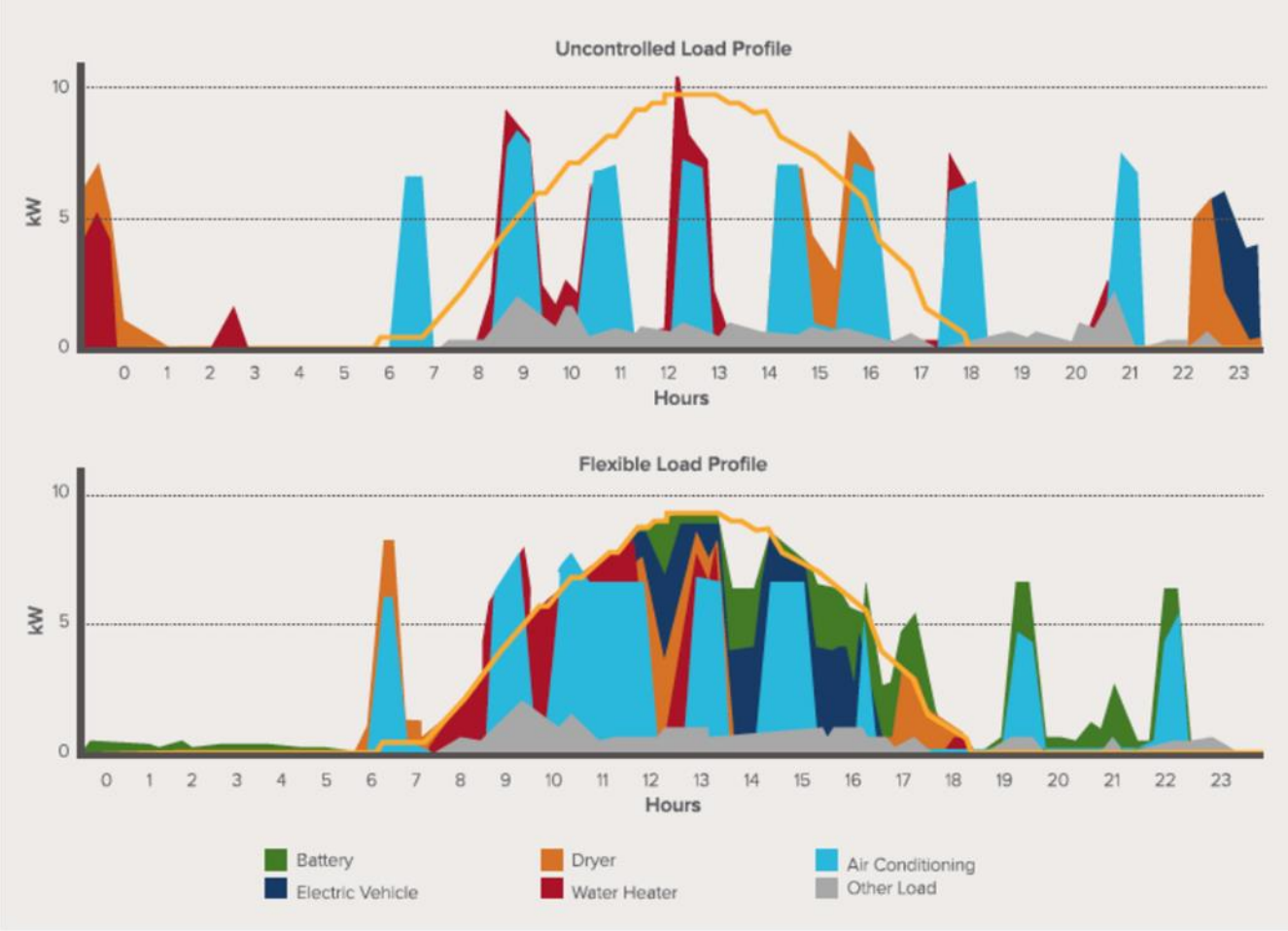
Demand Response/ Responsive Demand

- A way to balance supply and demand
- Consumers reduce or shift electricity usage during peak periods
- Time-based rates or financial incentives
- Load control
- Enables/is part of grid modernization and beneficial electrification

Load Flexibility



Storage

- Capture energy produced at one time for use at another time
- Energy can be stored various ways
  - Pumped hydro
  - Compressed air
  - Flywheels
  - Batteries
  - Thermal energy storage
- Benefits
  - Economic
  - Reliability
  - Environment

Microgrids

- Local energy grid that disconnect from main grid and operate autonomously
- Can be powered by batteries, solar/other renewable sources, distributed generators
- Benefits
  - Resiliency/backup
  - Economic
  - Environmental

Poll: How Likely Are You to Enroll in a DR Program?

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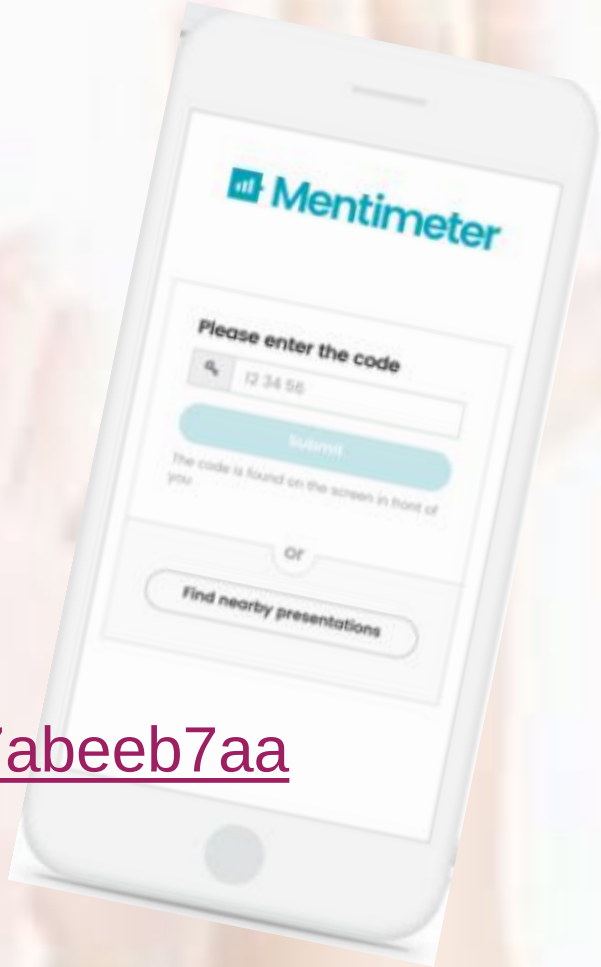

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Summary

Electrification of end uses, such as vehicles, residential space heating, residential water heating, and residential cooking benefits from and promotes renewable generation on the electric grid; and, demand response, storage, and microgrids are complementary interventions, that when married with end use electrification, can help amplify progress toward clean energy and climate goals.

What Questions Do You Have?

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