MISSISSIPPI STATE UNIVERSITY

INDUSTRIAL ASSESSMENT CENTER

Decarbonization & Electrification

MSU-IAC Training
2/4/22

Outline

- Basics of decarbonization
  - What?
  - How?
- Calculating emissions savings
- Basics of electrification
  - What?
  - How?

Decarbonization

How can we decarbonize industry?

What is Decarbonization?

- Decarbonization is the process of reducing carbon dioxide emissions by using low carbon power sources to generate electricity
  - Using renewables (solar, hydro, etc.) over fossil fuels (coal, petroleum, etc.)
- Reducing carbon emissions in industrial processes
- Reducing output of greenhouse gasses into the atmosphere

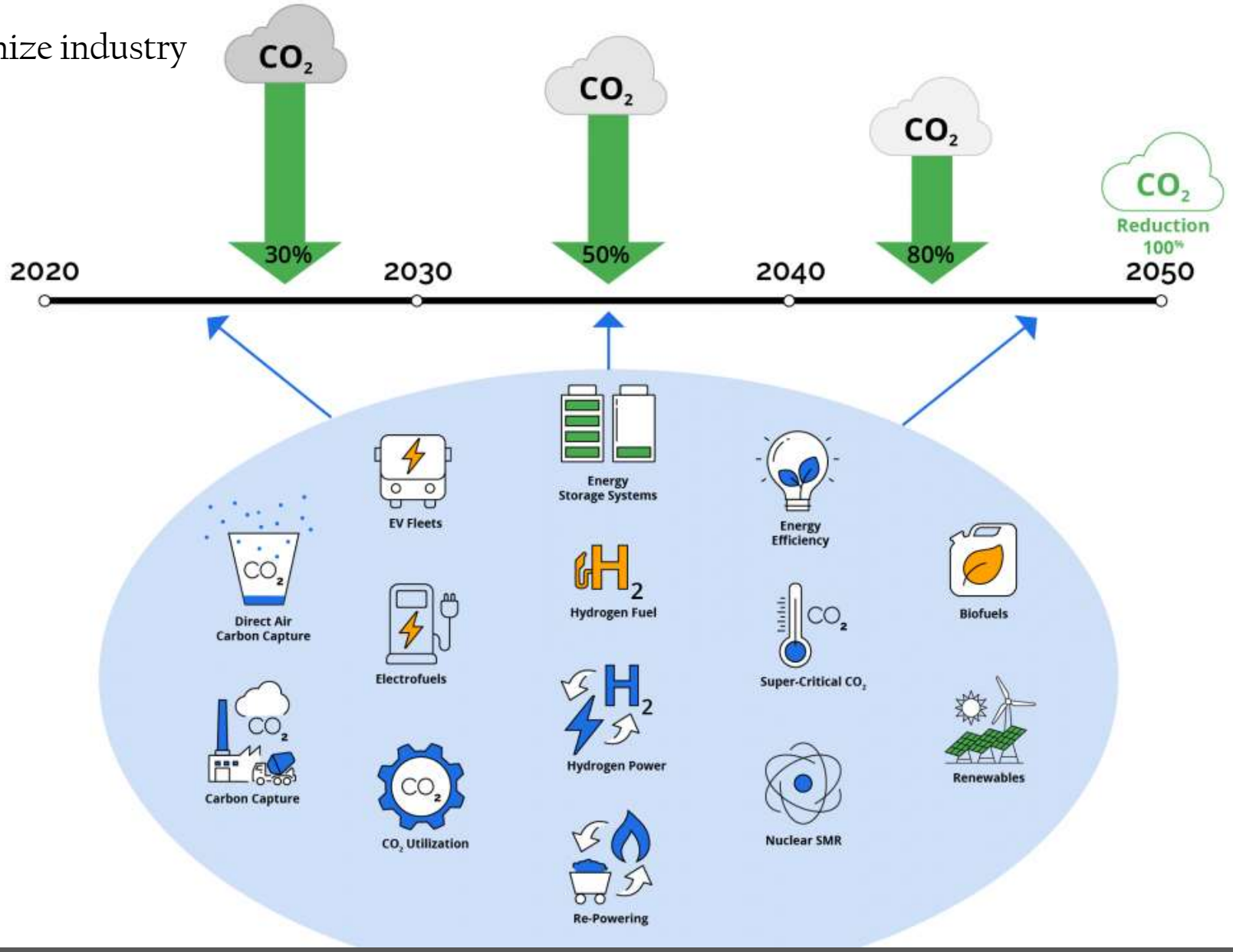
Challenges to decarbonizing industry

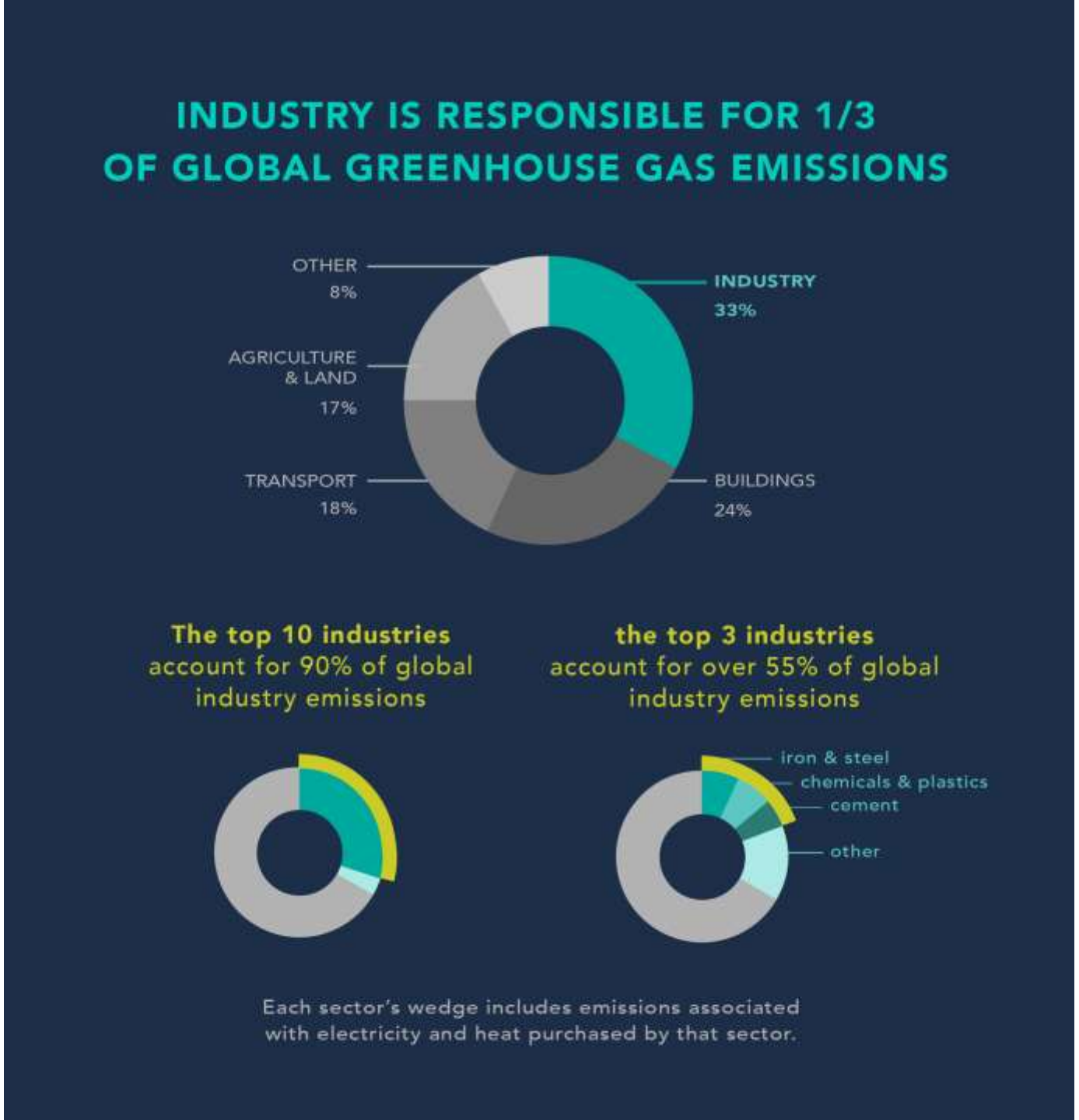
1. Industrial processes need high process heat, which is difficult to generate by renewables or other alternative methods.
2. Industrial processes are highly integrated, making changes very complicated.
3. Industrial CO_2 emissions from fuel require process level changes, cannot simply be eliminated by fuel change.
4. Industrial existing facilities can require costly rebuilds or retrofits.

How can we decarbonize industry?

- Energy efficiency – lower the energy used per product produced
  - In motors and heating equipment, especially!
- Fuel switching
  - Fossil fuels to electricity for certain applications
- Electrification of heat – Replace fossil fuel for heating with electricity
- Replace feedstock or fuel with carbon neutral hydrogen or biomass
- Capture the CO_2 emitted and store
- Process improvements

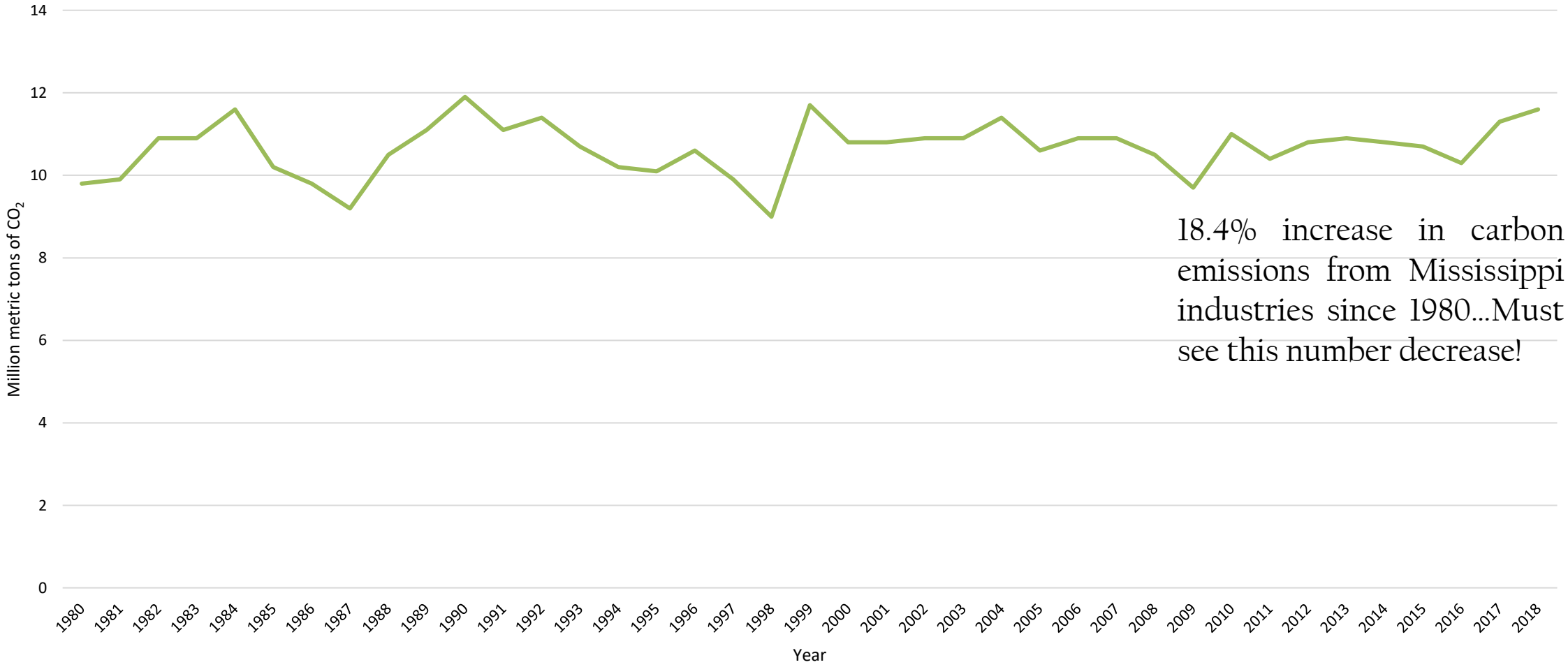
Ways to decarbonize industry by 2050[1]





From Energy Innovation[2]

Mississippi Industrial Carbon Emissions 1980-2018[3]



18.4% increase in carbon emissions from Mississippi industries since 1980...Must see this number decrease!

Calculating emissions reduced from electricity savings

- It is simple to calculate the CO_2 savings associated with electricity savings!

$$\text{Emissions Reduced } (tCO_2e) = \text{Electricity Savings (MWh)} \times \text{Emission Factor } \left(\frac{tCO_2e}{MWh}\right)$$

- If you have the total electricity savings (in MWh) for a certain project or recommendation, multiply by the emission factor (in units of tons or lbs. of CO_2/unit energy) to achieve the total emissions reduced (in units of tons or lbs. of CO_2)
- Note, the emissions factors are regional – use the Southeast emission factors for our analysis.

Example problem

- For one facility, we estimate from our site assessment we estimate that they can save 800 MWh(or 800,000 kWh) annually by implementing our recommendations – that's great ☺
- Using the regional emissions factor for the Southeast (1,507 lb./MWh), how many lbs. of CO_2 can the facility avoid if they implement our recommendations? … How many tons?

Solution:

Pounds of CO_2: 800 * 1,507 = 1.206 million lbs.

Tons of CO_2: 1.206 million lbs. * 1 ton/2000 lbs. = 602.8 tons

Regional Emission Factors

Avoided CO_2 Rate (lb/MWh)				
	Wind	*Utility PV*	*Portfolio EE*	*Uniform EE*
Northeast	1,077	1,105	1,199	1,163
Great Lakes / Mid-Atlantic	1,558	1,560	1,671	1,668
Southeast	1,412	1,399	1,505	1,507
Lower Midwest	1,604	1,605	[illegible]	1,721
Upper Midwest	1,822	[illegible]	1,914	1,942
Rocky Mountains	[illegible]	1,576	1,723	1,758
[illegible]exas	1,275	1,264	1,326	1,336
Southwest	1,248	1,250	1,377	1,375
Northwest	1,531	1,534	1,634	1,665
California	999	1,008	1,107	1,097

Electrification

How can we electrify industry?

What is electrification?

- Electrification is the process of: Replacing technologies that use fossil fuels (coal, oil, and natural gas) with technologies that use electricity as a source of energy!
- Electrification can potentially reduce carbon dioxide (CO_2) emissions.

How can we electrify industry?

- Electrification of fuels used for heat
  - Replacement of a piece of equipment, such as a boiler or furnace, running on conventional fuel with electric equipment
- Electrification of industrial fleet (i.e., heavy duty electric vehicles for industrial use)
- Electrification of equipment and processes
  - Using electric motors
  - Using electric heat pumps

Of all the fuel that industrial companies use for energy, we estimate that almost 50 percent could be replaced with electricity using available technology.

References

- 1. https://www.bv.com/perspectives/navigating-decarbonization-mining
- 2. https://energyinnovation.org/policy-programs/industrial-sector-decarbonization/.
- 3. Table: Industrial energy-related carbon dioxide emissions by state: Mississippi https://www.eia.gov/environment/emissions/state/
- 4. https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/plugging-in-what-electrification-can-do-for-industry