

# Embodied Carbon Emissions and Implications for Infrastructure Projects

**Bu Wang, Ph.D.**

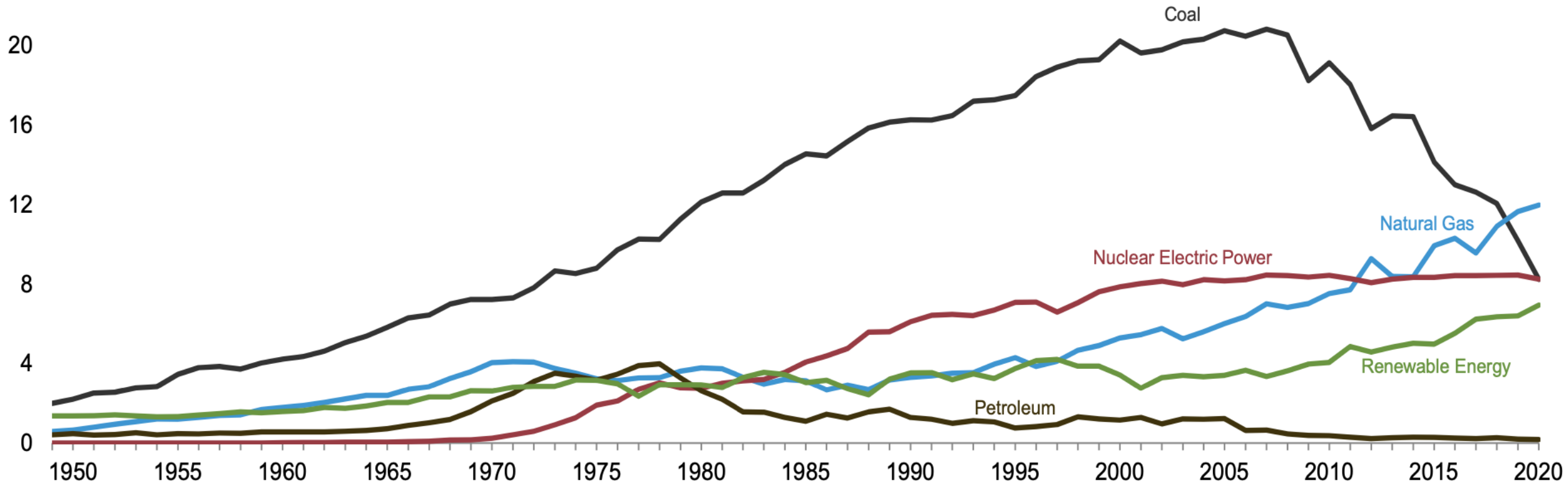
**Assistant Professor**  
**Civil and Environmental Engineering**  
**[bu.wang@wisc.edu](mailto:bu.wang@wisc.edu)**



nrg<sup>❖</sup> | cosia  
CARBON XPRIZE<sup>®</sup>

# U.S. electric power consumption by source

24 Quadrillion Btu



[MER, EIA, 2021]

# This town powered America for decades. What do we owe them?

NATIONAL

## Bust Times In A Former Wyoming Coal Boomtown

January 28, 2020 · 4:55 PM ET  
 Heard on [All Things Considered](#)

COOPER MCKIM

**3-Minute Listen**

Gillette, Wyo. once produced 40% of all U.S. coal, but is now losing half its jobs as coal demand plummets. A nearby town survived a bust in the 1950s and offers lessons.

TOP STORY

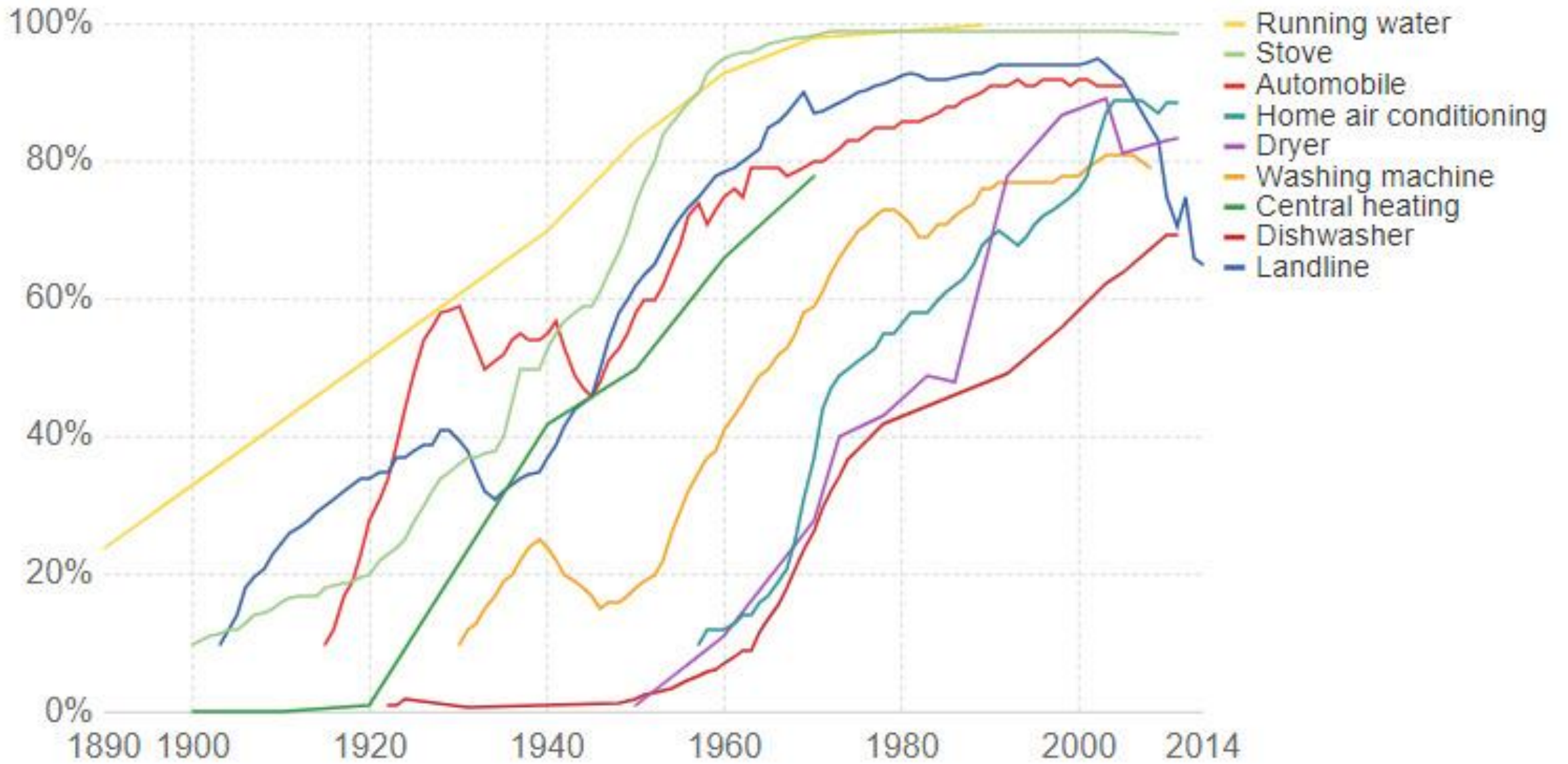
## As government spending is cut to the bone, Wyoming is spending millions to promote coal. Will it pay off?

Camille Erickson , Nick Reynolds Dec 5, 2020 Updated Jan 25, 2021 0

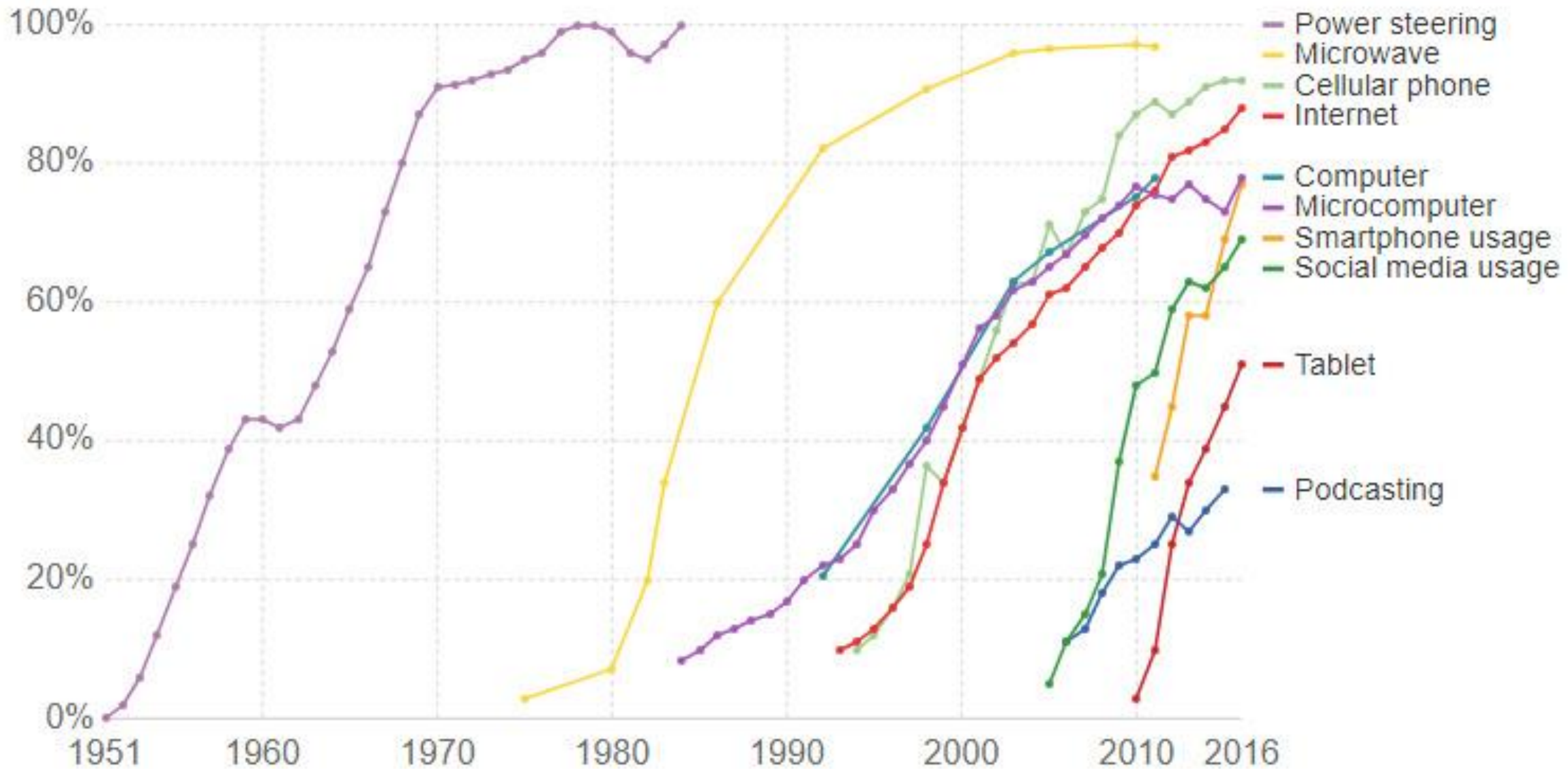
ECONOMY

## Wyo unprepared to grab federal coal community lifeline, experts say

by Dustin Bleizeffer August 4, 2021

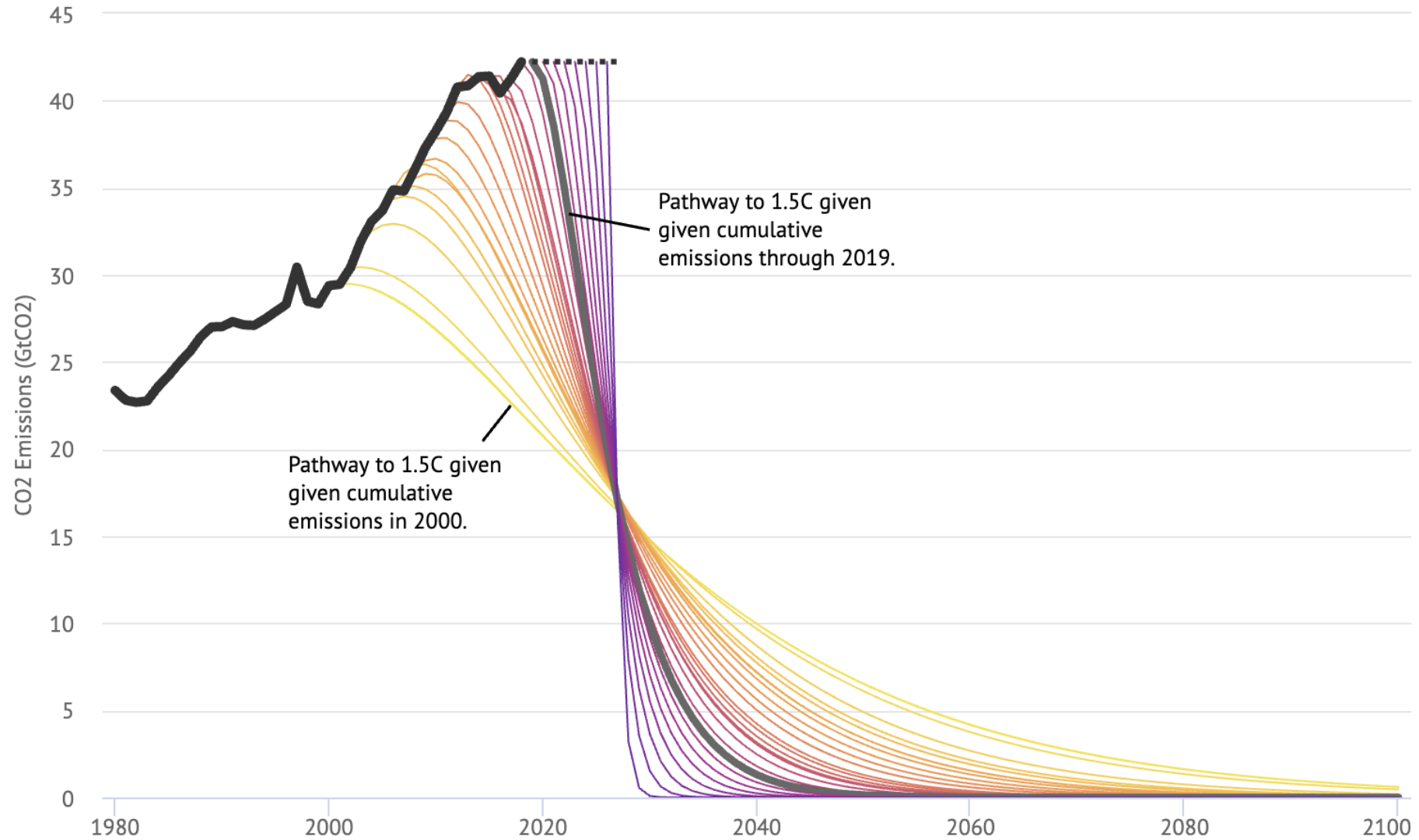


[OurWorldInData.org]



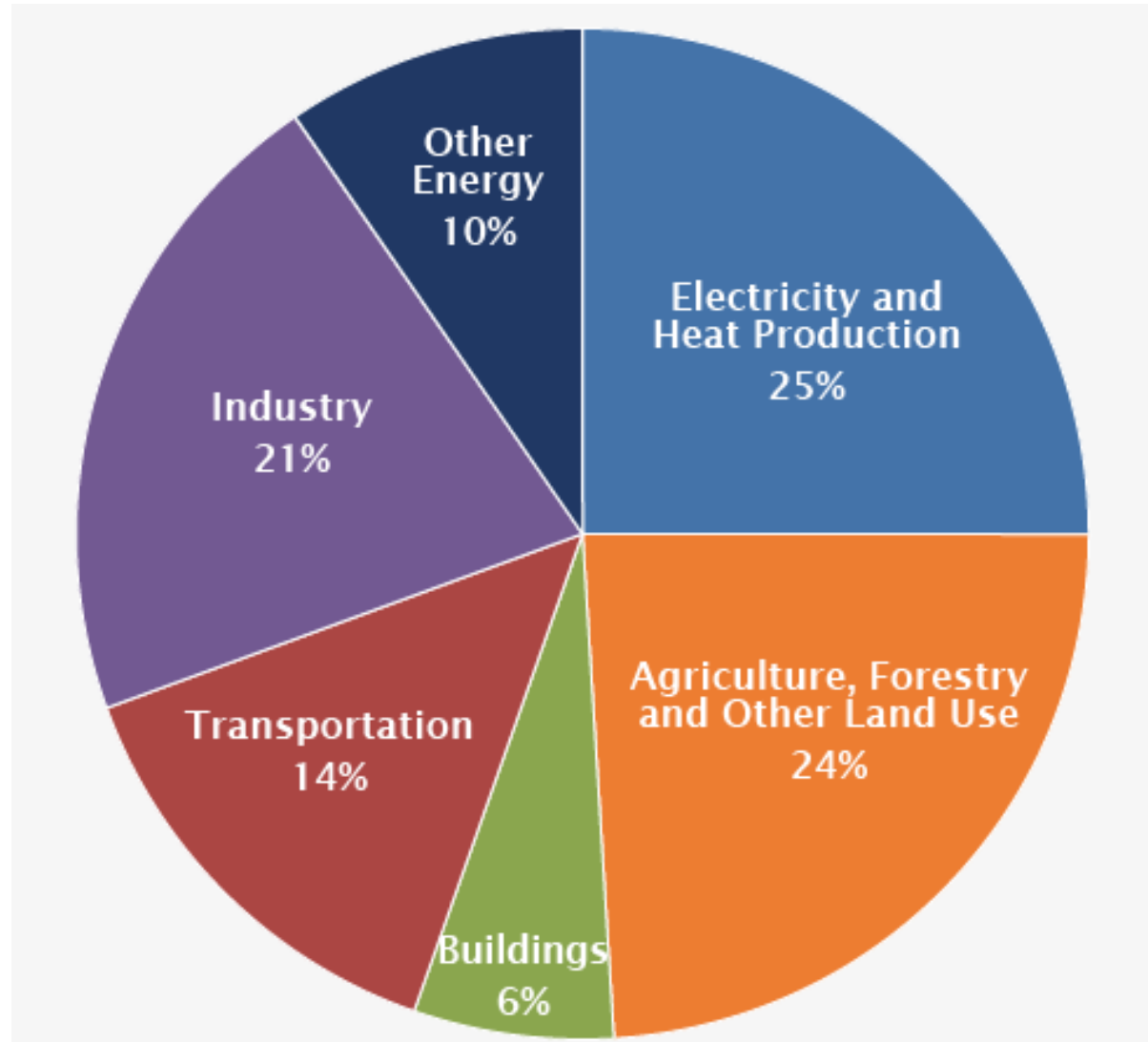
[OurWorldInData.org]

# Our carbon budget



[Carbon Brief]

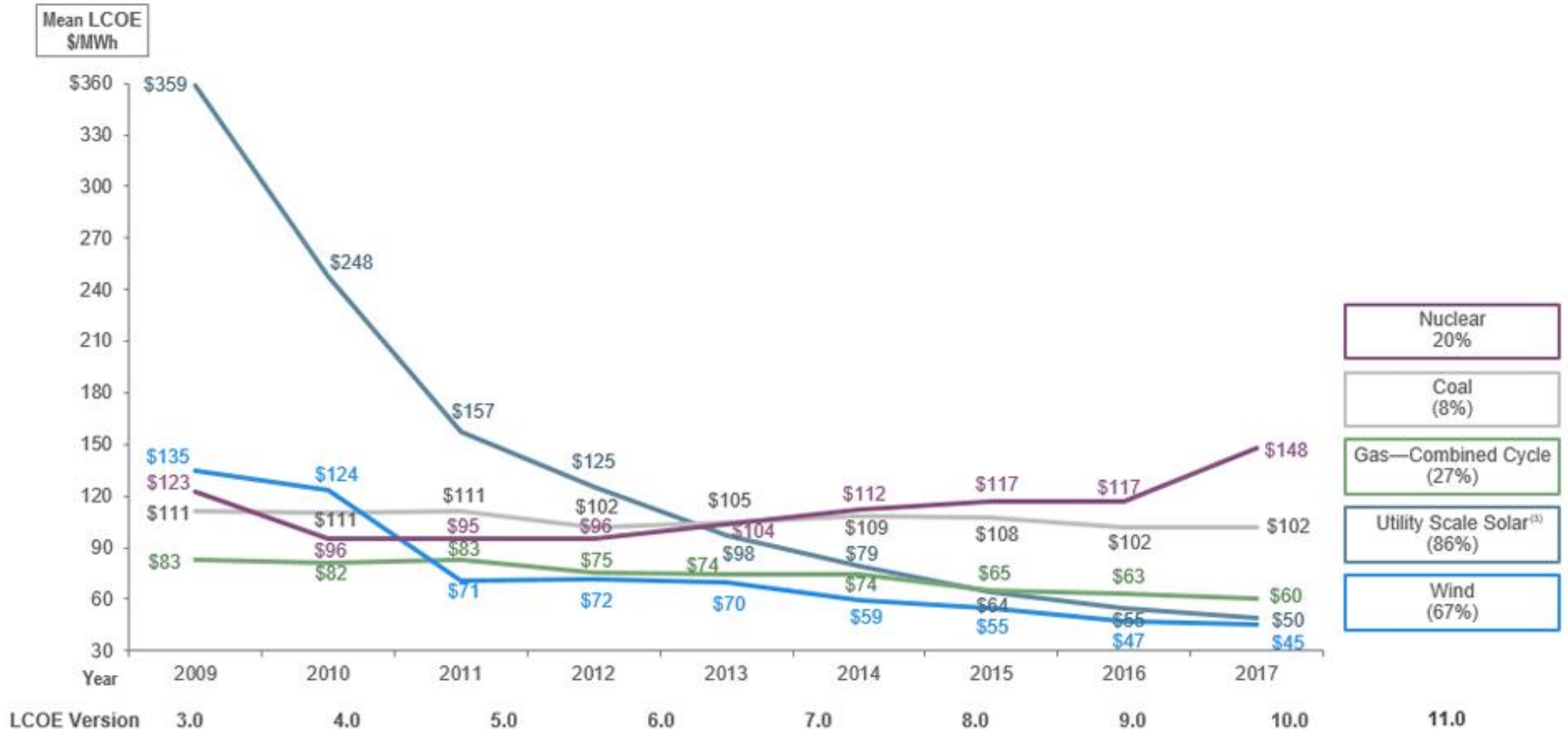
# Global GHG emissions by sector



[EPA]



# Electric power sector

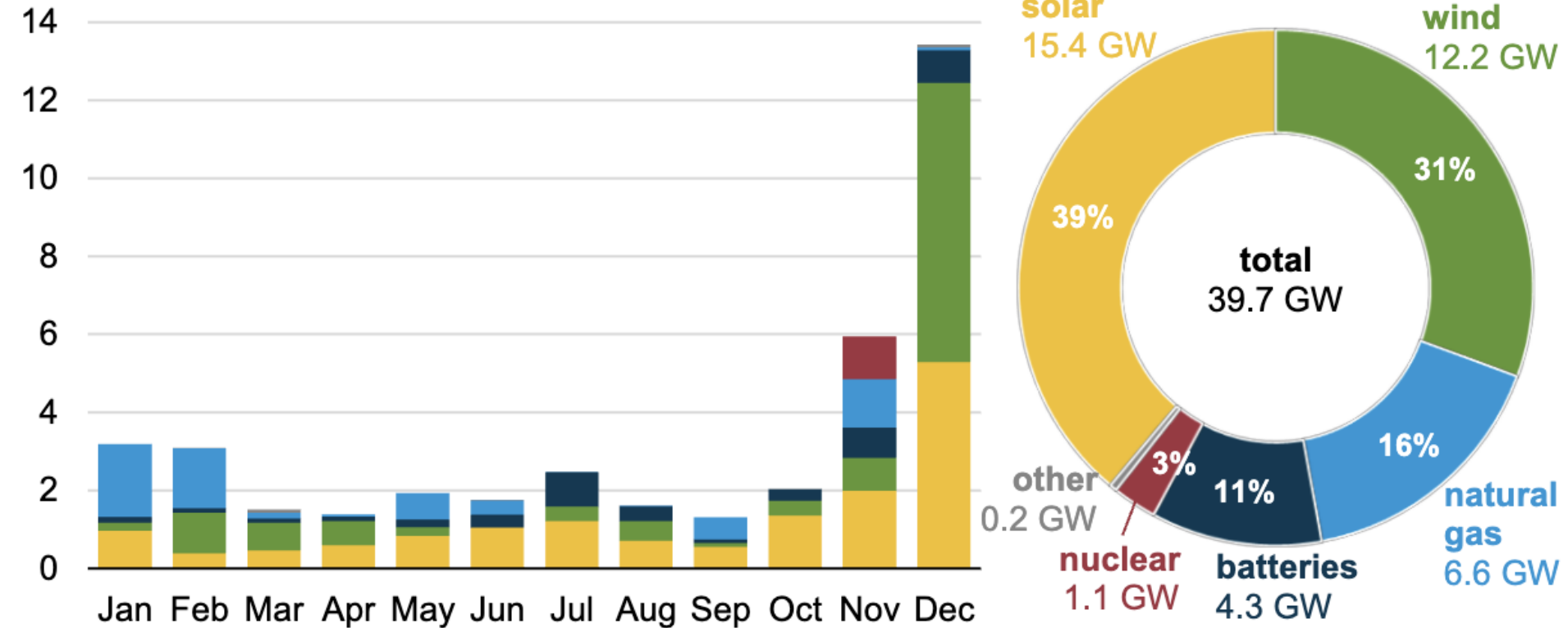


[Lazard]

# Electric power sector

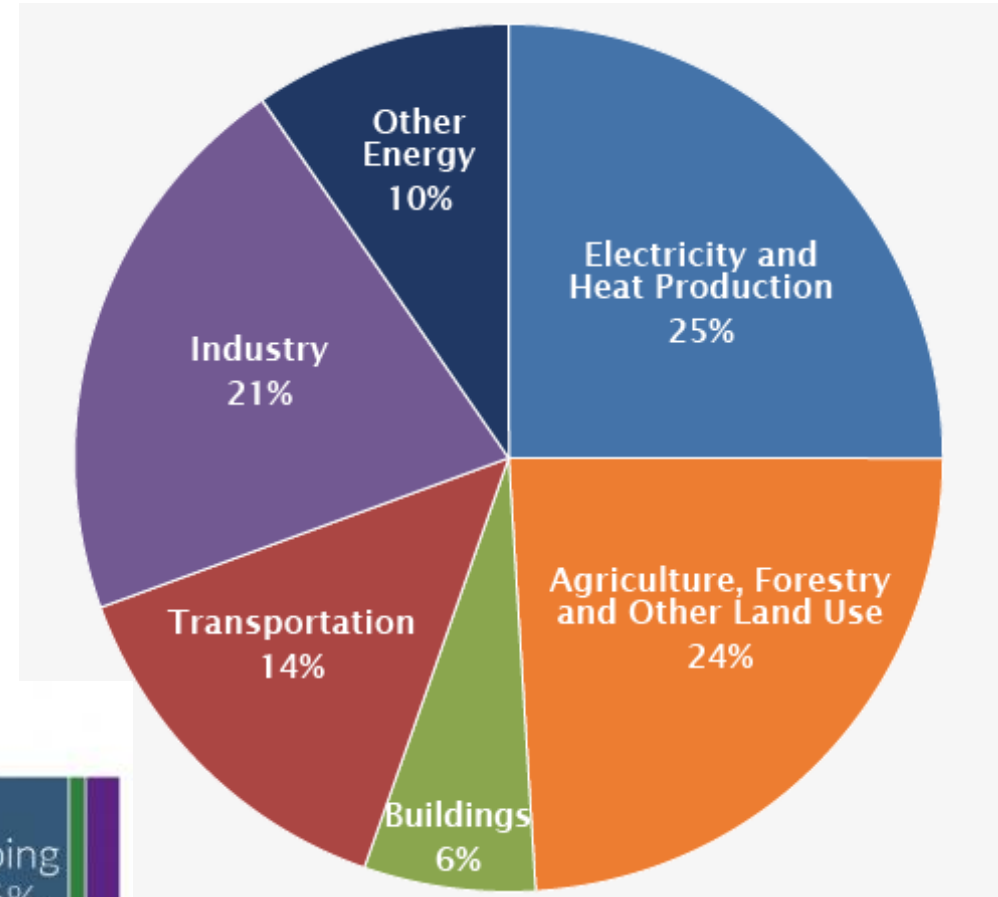
## Renewables account for most new U.S. electricity generating capacity in 2021

**Planned U.S. utility-scale electricity generating capacity additions (2021)**  
gigawatts (GW)



[EIA]

# Transportation sector



74.5% of transport emissions come from road vehicles



Of passenger emissions:  
60% from international;  
40% from domestic flights

(mainly transport of oil, gas, water, steam and other materials via pipelines)

# Transportation sector

**Forbes**

**Global EV Sales Rose 160%  
In First Half, Overcoming  
Component Shortages And  
Covid – Canalys**

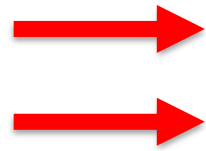
EV share of new car sales:

- Europe: 15%
- China: 12%
- U.S.: 3%
- California: 11%

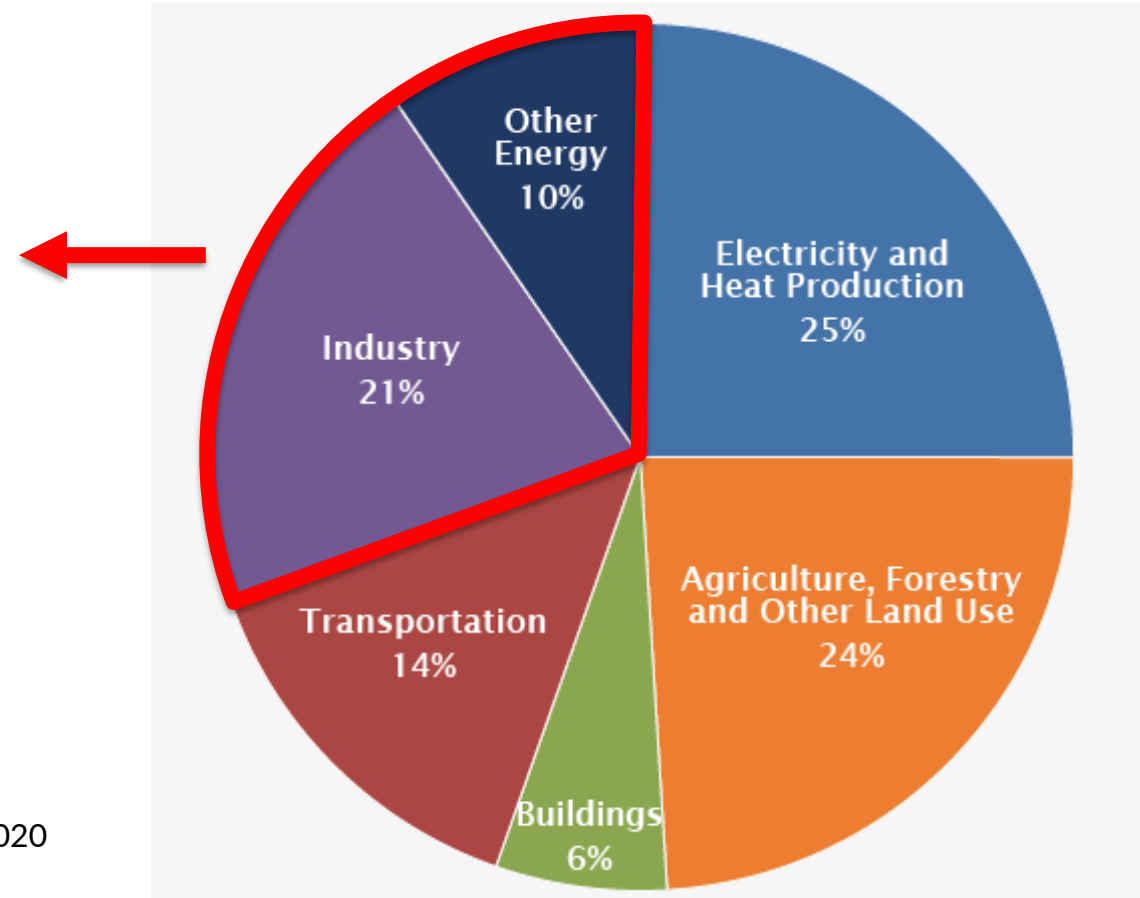
# Industry sector

Annual production:

- **Concrete – 30 B t<sup>1</sup>**
- **Cement – 4.1 B t<sup>2</sup>**
- **Steel – 1.6 B t<sup>3</sup>**
- **Plastic – 0.3 B t<sup>4</sup>**

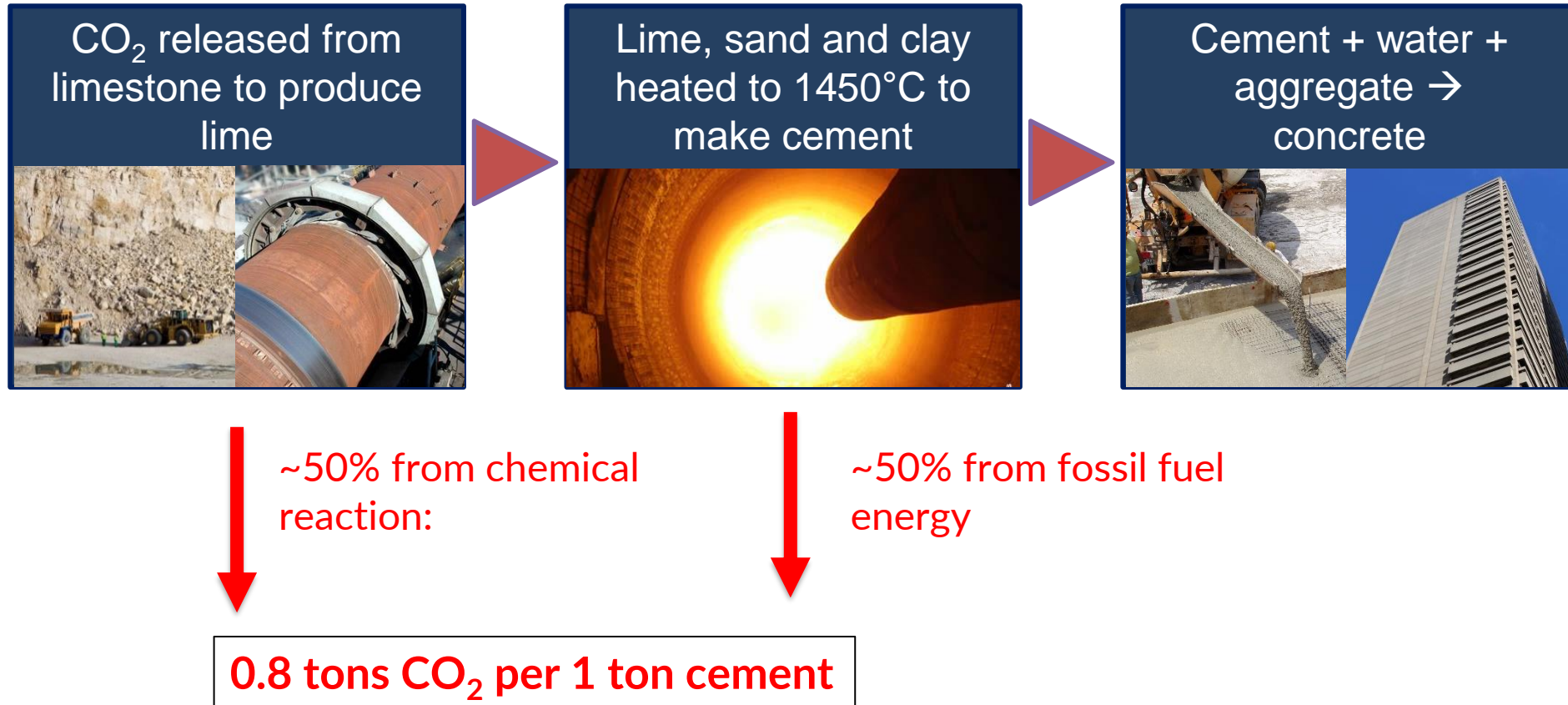


**7%<sup>5</sup>**  
**8%<sup>6</sup>**



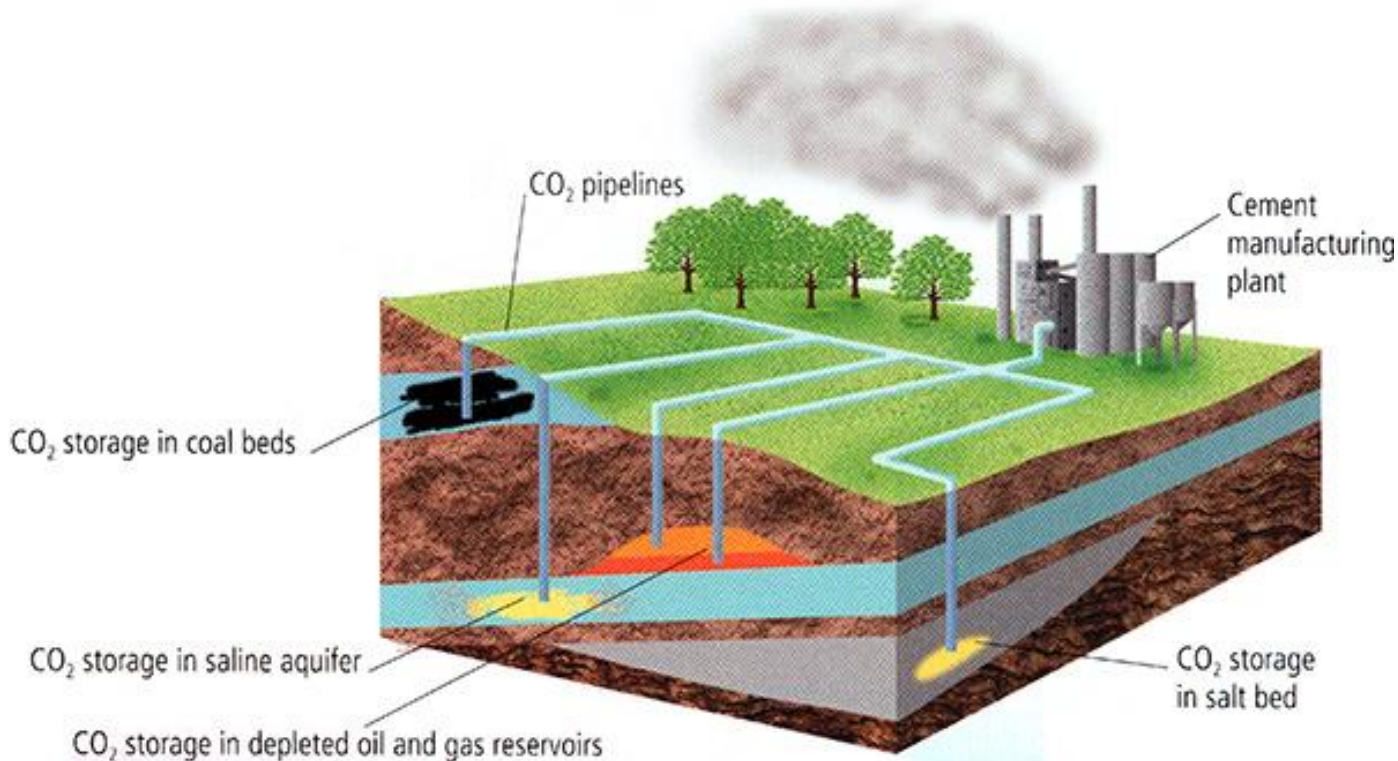
<sup>1</sup> WBCSD, 2009  
<sup>2</sup> USGS, 2017  
<sup>3</sup> Worldsteel, 2017  
<sup>4</sup> PlasticsEurope, 2016  
<sup>5</sup> IEA, 2020  
<sup>6</sup> World Steel Association, 2020

# Cement production



# Carbon capture

## CARBON CAPTURE AND STORAGE (CCS)



[Mann & Kump, 2015]

**\$40~\$120 per ton CO<sub>2</sub>**

[IEA, 2021]

THE WALL STREET JOURNAL

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BUSINESS

### Exxon, Once a Skeptic, Sees Profit in Capturing Carbon Emissions

Oil giant had been pessimistic about economic prospects of the technology but now wants to commercialize carbon capture

HOME | ENERGY

### Q&A: Occidental Wants to Be Tesla of Carbon Capture

The world's largest effort to do that on a commercial scale is coming from an oil and gas company.

Mar 22nd, 2021 | By [Cathy Bussewitz](#)

# Carbon market and price

## Present carbon markets (price as of May 2021)

- California Low Carbon Fuel Standard (LCFS): ~\$190/ton CO<sub>2</sub>
- California and Québec cap-and-trade market: ~\$20/t (Dec. 2021 future)
- EU Emissions Trading System (ETS): ~\$50/t (Dec. 2021 future)
- China National ETS: Coming online in June 2021

Market Summary > KraneShares Global Carbon ETF

33.65 USD

+0.050 (0.15%) ↑

Closed: Jun 4, 4:58 PM EDT · Disclaimer

After hours 33.80 +0.15 (0.45%)

NYSEARCA: KRBN

+ Follow

1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max





# Disclosing embodied carbon emission

## ISO 14025: Environmental Product Declaration (EPD)

EPD “Nutrition” Label

**Your Building Product**

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Amount per Unit

| LCA IMACT MEASURES                                      | TOTAL    |
|---|----------|
| Primary Energy (MJ)                                     | 12.4     |
| Global Warming Potential (kg CO <sup>2</sup> eq)        | 0.96     |
| Ozone Depletion (kg CFC-11 eq)                          | 1.80E-08 |
| Acidification Potential (mol H <sup>+</sup> eq)         | 0.93     |
| Eutrophication Potential (kg N <sup>-</sup> eq)         | 6.43E-04 |
| Photo-Oxidant Creation Potential (kg O <sub>3</sub> eq) | 0.121    |

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Your Product's Ingredients: Listed Here

EPD “nutrition label” for concrete mixes

### Issues for project owners:

- Industry-average vs. facility specific
- Lack of consistency
- Does NOT disclose emissions over the entire life-cycle

# Recommendations

## For project owners:

- Start collecting EPD from suppliers
- Conduct trial carbon accounting

## For the sector as a whole:

Build standard carbon accounting method specific to the sector and the region that:

- Encourages local economy
- Helps small business prepare for the upcoming changes related to carbon emissions

# Thank you!

## **For more information:**

Check the Wisconsin Initiative on Climate Change Impacts (WICCI)'s Infrastructure Working Group website or contact [bu.wang@wisc.edu](mailto:bu.wang@wisc.edu).