Embodied Carbon Emissions and Implications for Infrastructure Projects

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U.S. electric power consumption by source

Quadrillion Btu

[MER, EIA, 2021]
This town powered America for decades. What do we owe them?

Bust Times In A Former Wyoming Coal Boomtown

January 28, 2020 · 4:55 PM ET
Heard on All Things Considered

COOPER MCKIM

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

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.

Wyo unprepared to grab federal coal community lifeline, experts say
[OurWorldInData.org]
Our carbon budget

Pathway to 1.5C given cumulative emissions through 2019.

Pathway to 1.5C given cumulative emissions in 2000.

2021 SE WI Transportation Symposium
Global GHG emissions by sector

- Electricity and Heat Production: 25%
- Agriculture, Forestry and Other Land Use: 24%
- Industry: 21%
- Transportation: 14%
- Buildings: 6%
- Other Energy: 10%

[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)

- Solar: 15.4 GW (39%)
- Wind: 12.2 GW (31%)
- Natural gas: 6.6 GW (16%)
- Batteries: 4.3 GW (11%)
- Nuclear: 1.1 GW (3%)
- Other: 0.2 GW (3%)

Total: 39.7 GW

[EIA]
Transportation sector

- Agriculture, Forestry and Other Land Use: 24%
- Buildings: 6%
- Transportation: 14%
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- Electricity and Heat Production: 25%
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74.5% of transport emissions come from road vehicles.
Transportation sector

EV share of new car sales:
- Europe: 15%
- China: 12%
- U.S.: 3%
- California: 11%
Industry sector

Annual production:
- **Concrete** – 30 B t\(^1\)
- **Cement** – 4.1 B t\(^2\)
- **Steel** – 1.6 B t\(^3\)
- **Plastic** – 0.3 B t\(^4\)

\(^1\) WBCSD, 2009  
\(^2\) USGS, 2017  
\(^3\) Worldsteel, 2017  
\(^4\) PlasticsEurope, 2016  
\(^5\) IEA, 2020  
\(^6\) World Steel Association, 2020
Cement production

CO₂ released from limestone to produce lime

Lime, sand and clay heated to 1450°C to make cement

Cement + water + aggregate → concrete

~50% from chemical reaction:

~50% from fossil fuel energy

0.8 tons CO₂ per 1 ton cement
Carbon capture

$40~$120 per ton CO$_2$

[IEA, 2021]

[Mann & Kump, 2015]

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.

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 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 CO₂
- California and Québec cap-and-trade market: ~$20/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%)
ISO 14025: Environmental Product Declaration (EPD)

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.