

## Carbon Neutrality by 2050



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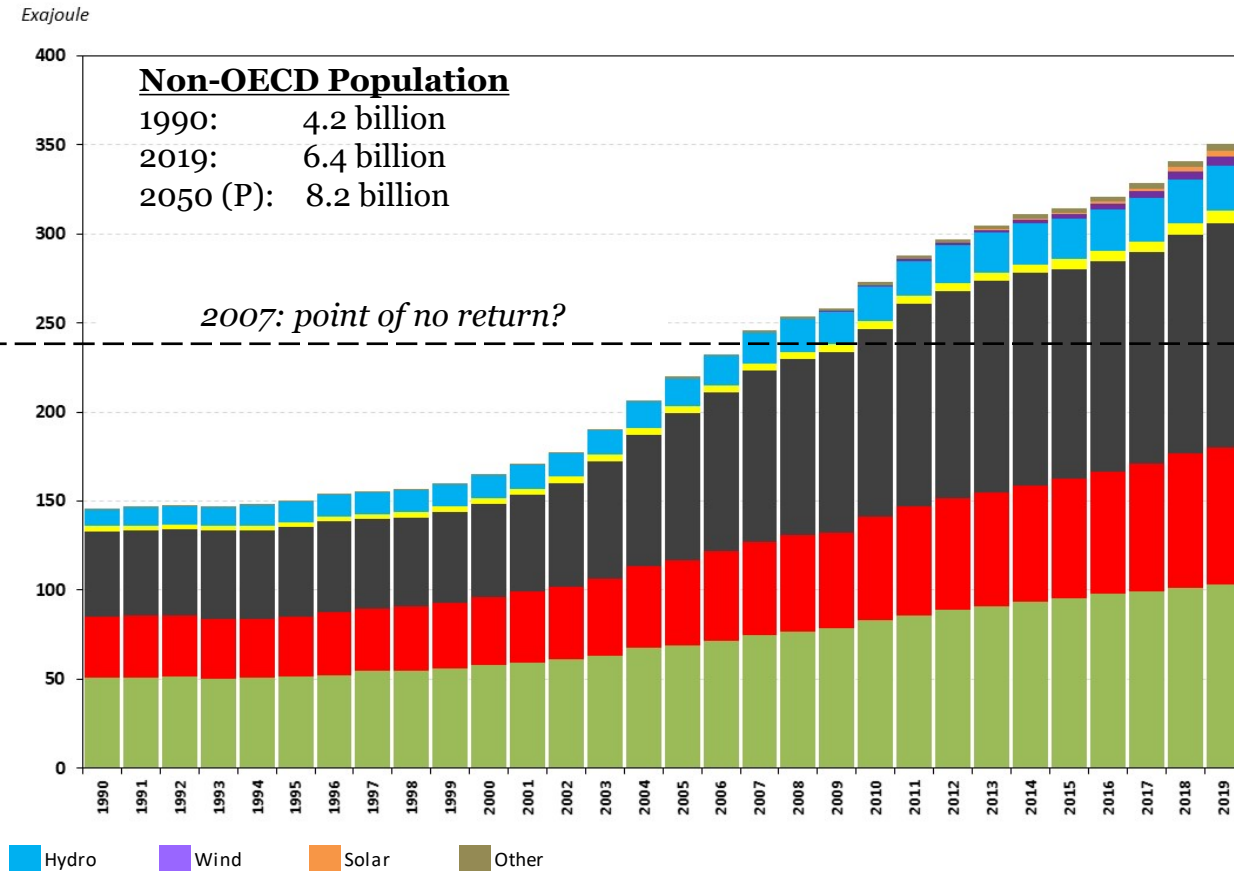
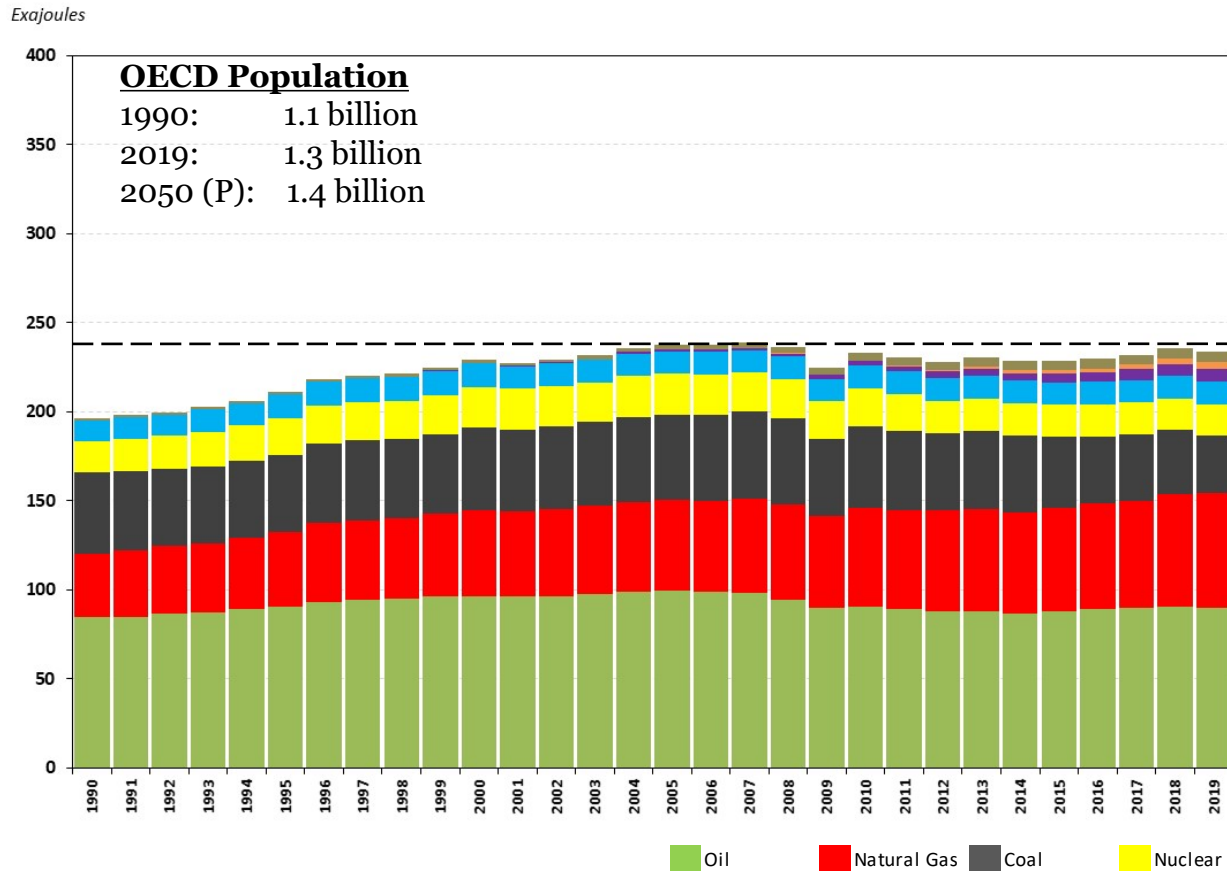


## Legacy, Scale, Technology, Comparative Advantage and Policy



## The evolving energy landscape is a developing nation story

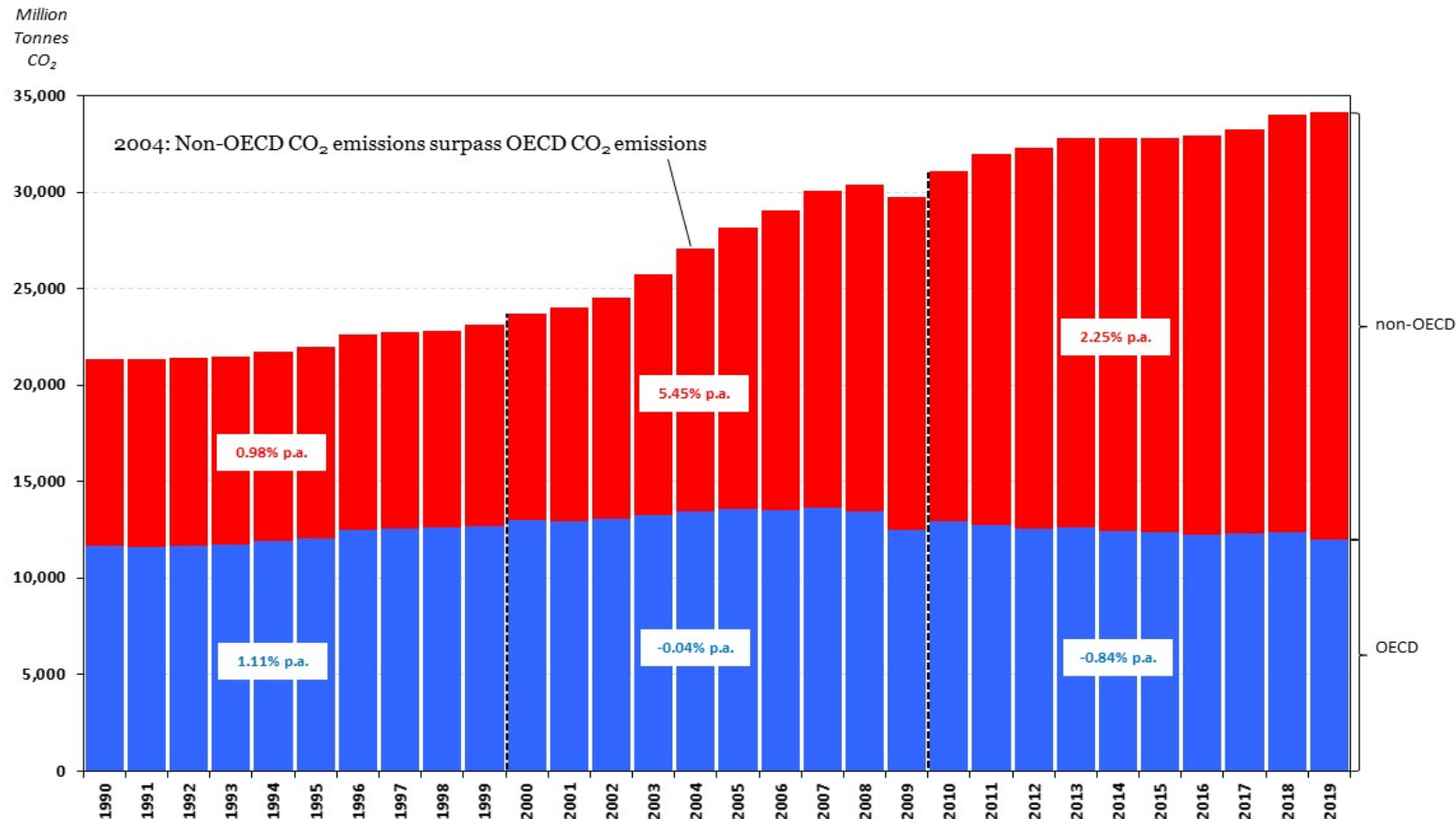
- Energy demand is rising fastest in the developing world, largely driven by hydrocarbon fuels.
  - EU is 11.8% of global demand; N. America is 20.0% of global demand; developing Asia is 36.9% of global demand.
- Projections for population and economic growth indicate this trend will likely continue.





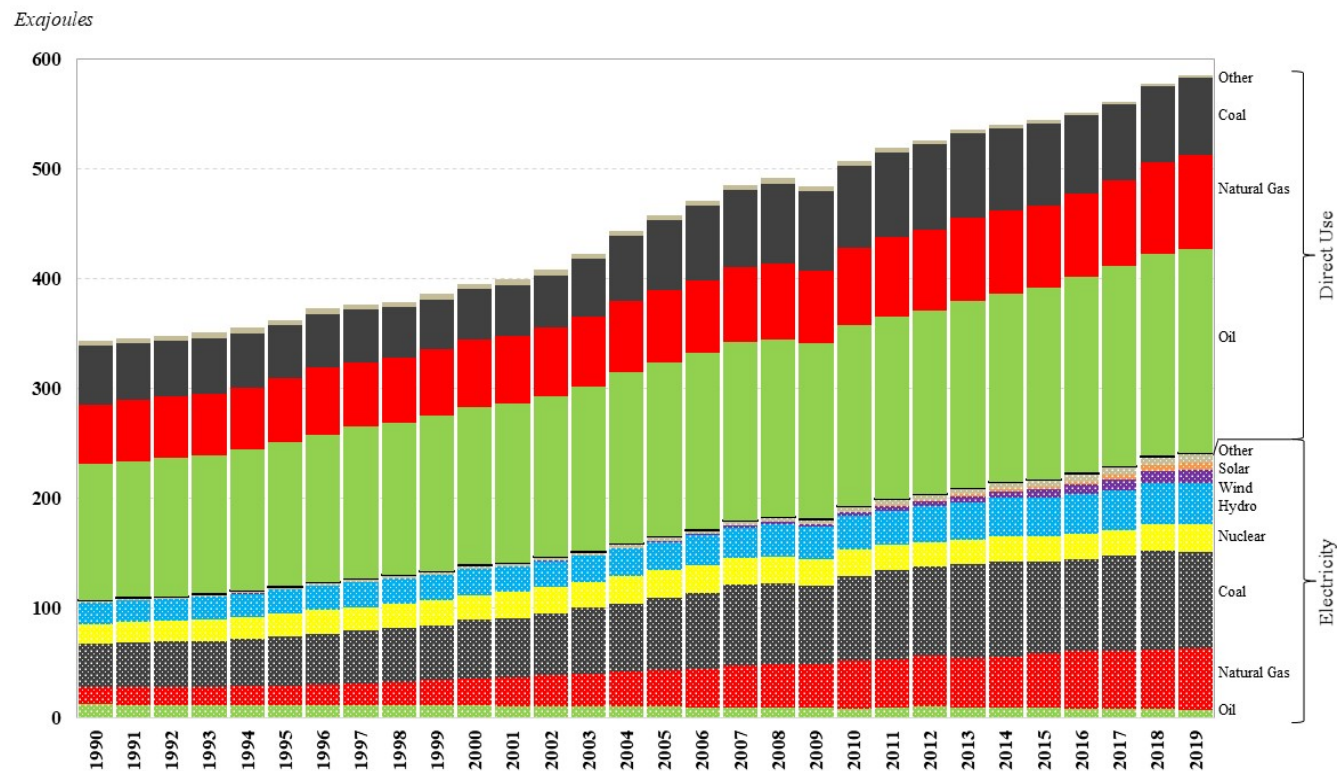
## It all has implications for CO<sub>2</sub> emissions

- Non-OECD emissions have grown substantially over the last 20 years, while OECD emissions have declined.
- Even if OECD emissions dropped to zero now, global emissions would still exceed 1995 levels.
- Deep decarbonization requires action everywhere, which presents challenges related to legacy, scale and technology!



## The global energy landscape, the reality of “scale”...

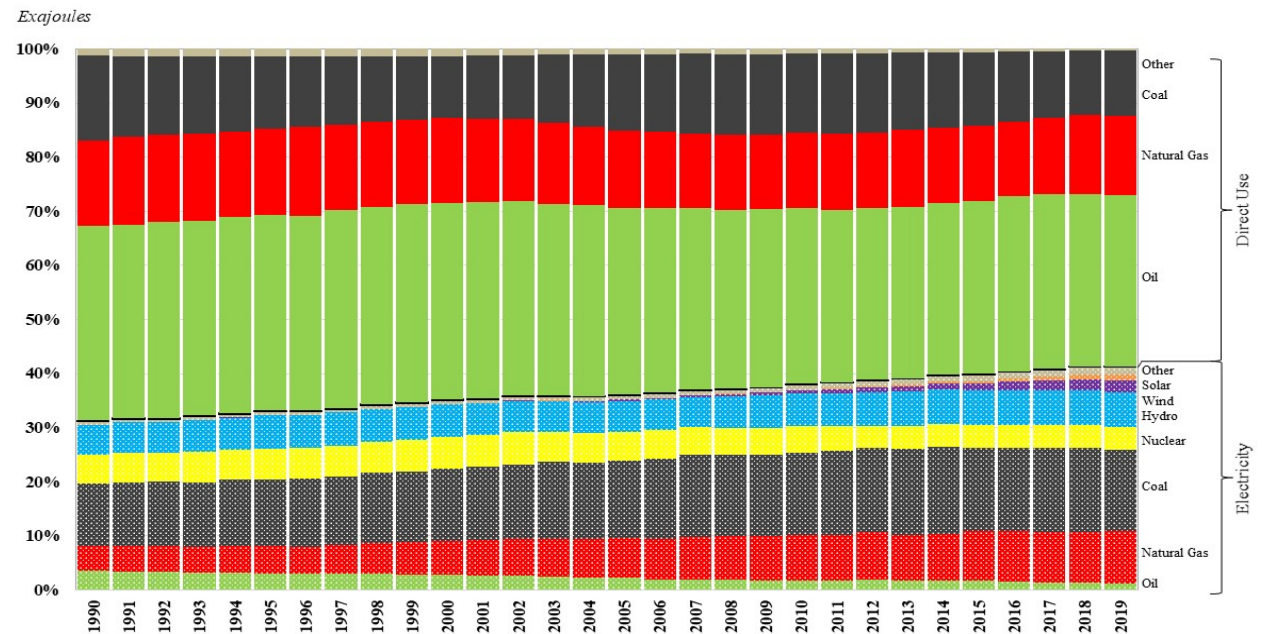
- In 2019, wind and solar represented 8.9% of global electric generation and 3.3% of total energy, which is up from 1.1% and 0.3%, respectively, just a decade prior, but even with astounding double-digit average annual percentage increases for the last 20 years, wind and solar are still a relatively small part of the total energy mix.
- Even with continued growth, the prospect for replacing hydrocarbons is challenging.
  - Total energy demand continues to grow. So, incumbent fuels must be displaced, and new demand met, simultaneously.
  - Greater electrification is a challenge. Electricity is 41% of total energy in 2019, which is up from about 31% in 1990. But continuation of trend requires massive movement into transport and heavy industry.
  - Direct combustion of hydrocarbons is prominent, accounting for 99% of non-electric energy.



Data Source: BP Statistical Review, 2020

## ... and the implications for market shares of TPE

- Market shares are slow to change, especially relative to overall demand growth.
  - Coal: 27.2%<sub>1990</sub> → 27.0%<sub>2019</sub>; Oil: 39.6%<sub>1990</sub> → 33.1%<sub>2019</sub>; Natural Gas: 20.5%<sub>1990</sub> → 24.2%<sub>2019</sub>
  - Hydrocarbons: 87.4%<sub>1990</sub> → 84.3%<sub>2019</sub>
  - Total Primary Energy Demand: 342.2 EJ<sub>1990</sub> → 583.9 EJ<sub>2019</sub>, which is a 70.6% increase.
  - For hydrocarbon demand to have remained flat given the energy demand increase, market share would have had to decline to 51.2%<sub>2019</sub>, which is a massive shift... and not complete decarbonization, thus highlighting scale!
- Carbon neutrality demands the world do more than this over the next 30 years... or does it?
- Decarbonization cannot be only about renewable energy technologies... changing the way we combust fossil fuels, carbon capture, nuclear energy, and expanding carbon sinks must all play a role!
- Comparative advantage will dictate outcomes, and solutions will vary by region.



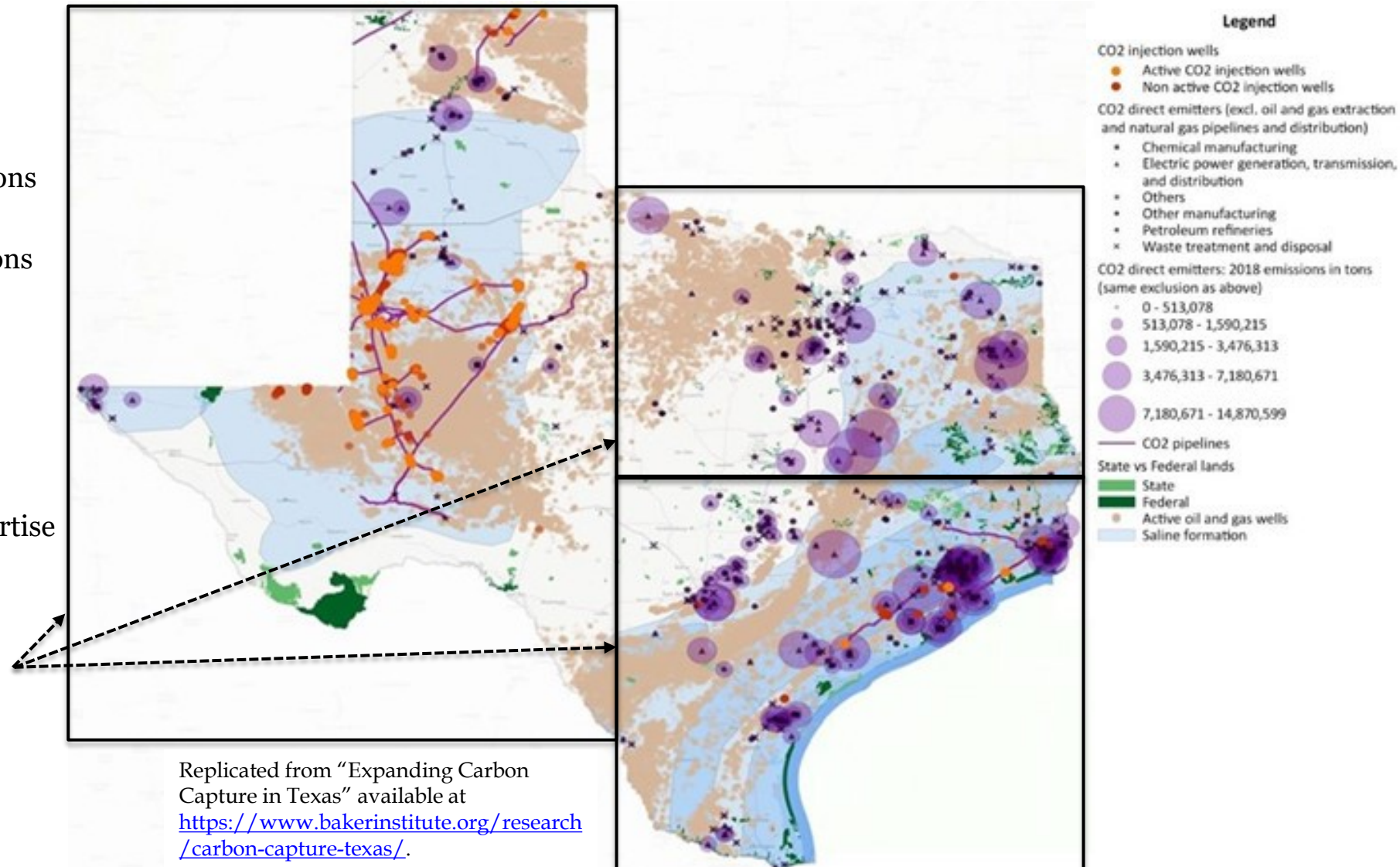
Data Source: BP Statistical Review, 2020

**Every Region is Different!**  
**The Role of Comparative Advantage:**  
**Texas as a Microcosm**



## Texas and the Gulf Coast Region: Carbon Capture

- 24% of US energy-related emissions from industry
- 12% of US energy-related emissions from power generation
- Large CO<sub>2</sub> footprint
- Supply chain logistics and management expertise
- Engineering and subsurface expertise
- Geologic endowment
- Business-friendly



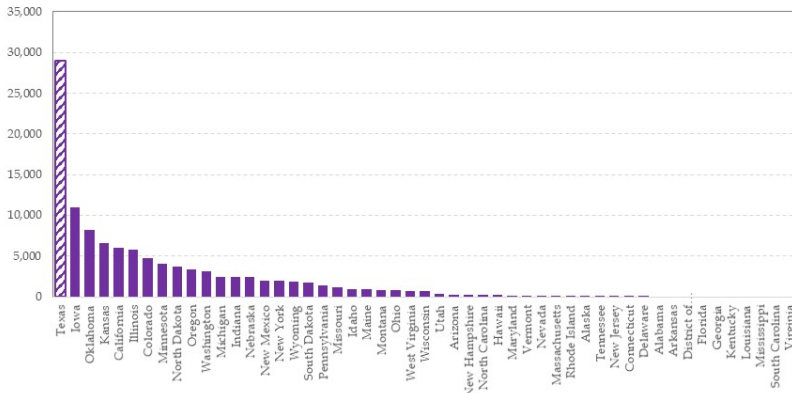
Replicated from "Expanding Carbon Capture in Texas" available at <https://www.bakerinstitute.org/research/carbon-capture-texas/>.



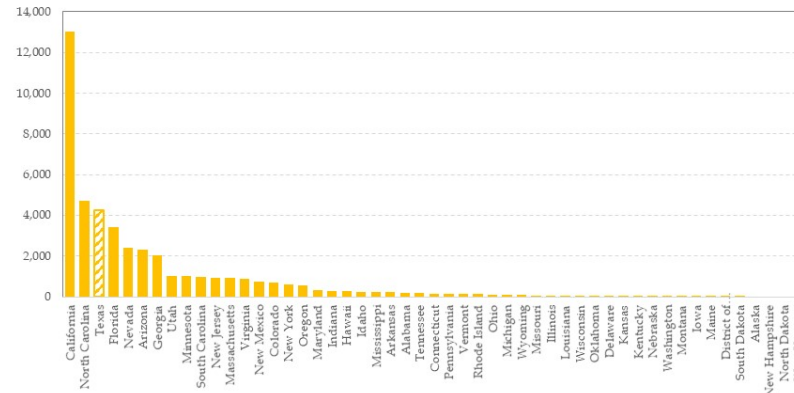
# Texas and the Gulf Coast Region: Green Energy

## Operating Capacity

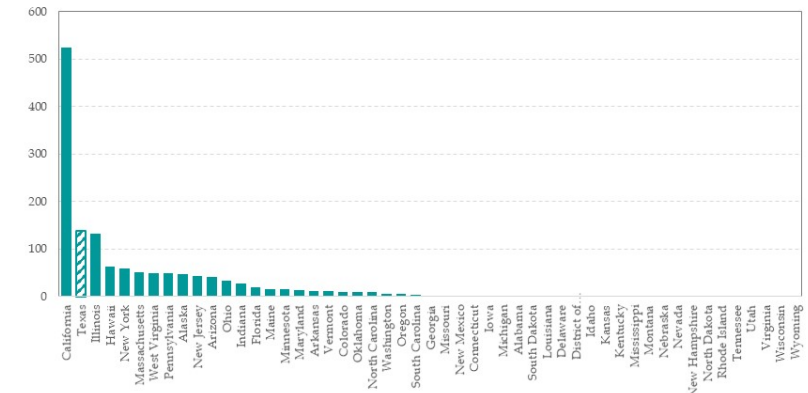
Wind Capacity, MW



Solar Capacity, MW

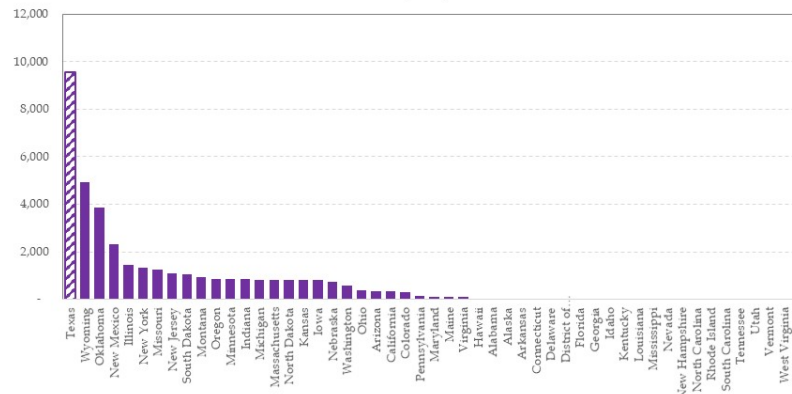


Battery Capacity, MW

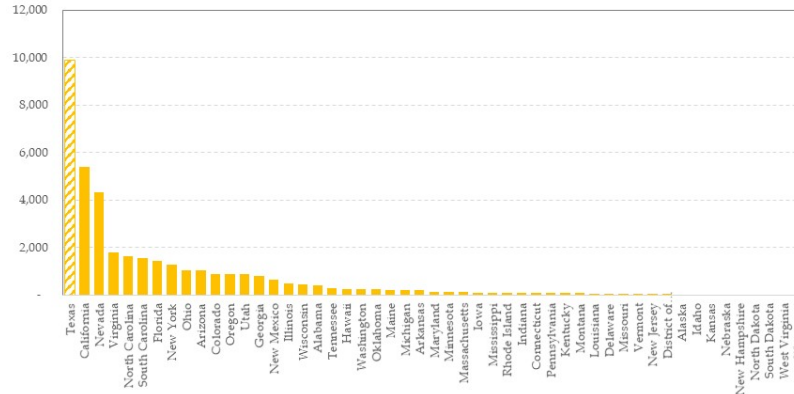


## Planned Capacity

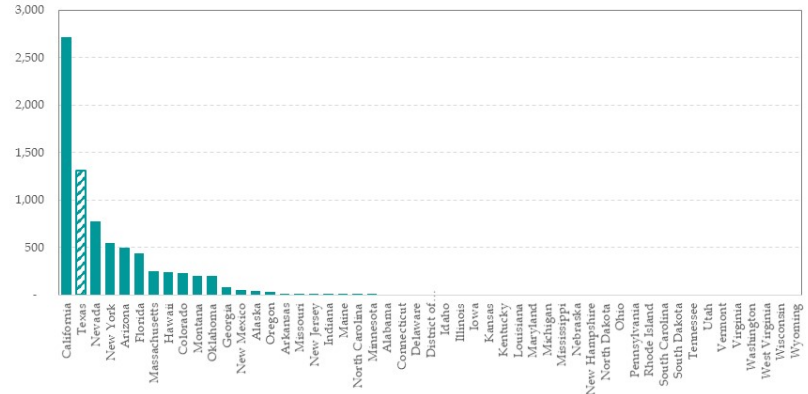
Wind Capacity, MW



Solar Capacity, MW



Battery Capacity, MW



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