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Sources of Electricity

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Sustainability Series

How clean are your electricity sources?

With the building industry on the cusp of an electrification and decarbonization trend, electricity and its sources matter more than ever. The need of the hour is to simultaneously convert buildings to electricity-only and to convert the sources of the electricity to no-carbon and low-carbon alternatives.

Here are some big picture international trends in electricity sources.

The current state of things

About 38% of US national electricity currently comes from low- and no-carbon sources like renewables, hydro and nuclear, with the balance generated primarily from coal and natural gas.

The US EPA's Emission & Generation Resource Integrated Database (eGRID) provides a comprehensive resource for the environmental characteristics of electrical power generation, including carbon intensity, which varies widely by region and state. For instance, the latest eGRID report lists carbon intensity for Vermont at less than 50 pounds of CO_2 per MWh, whereas Wyoming is over 2,000.

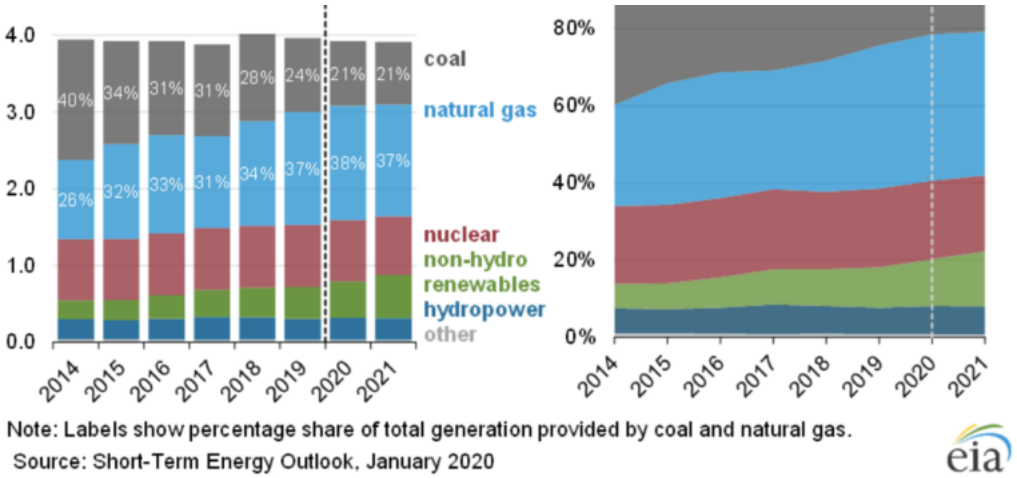


Figure 1. Image source: https://www.eia.gov/outlooks/steo/report/electricity.php

Germany gets around 40% of its electricity from renewables, with the rest coming from coal, nuclear, etc.

In China, now the largest global CO2 emitter, renewable sources make up 26% of electrical generation. Nuclear is at 4%, and fossil fuels, primarily coal, provide 70% of electrical generation.

What are some short-term trends?

Despite commitments to overarching initiatives like the Paris accord, the short-term trends for several countries leave great room for improvement.

In the U.S., and generally, in the world, renewables and related infrastructure need to scale up at a faster rate. Rural electrification and the interstate highway system are historic precedents of rapid public infrastructure investment that give reason for optimism.

Germany seems to be headed towards phasing out nuclear plants by 2022 and coal-fired plants by 2038. Renewables as a share of electricity sources, currently at 40%, are facing limits to further expansion.

China's electrical consumption and generation have been growing rapidly. Solar PV reached 175 GW in 2018, which is now equivalent to Germany's installed solar PV. However, thermal

Why does all this matter?

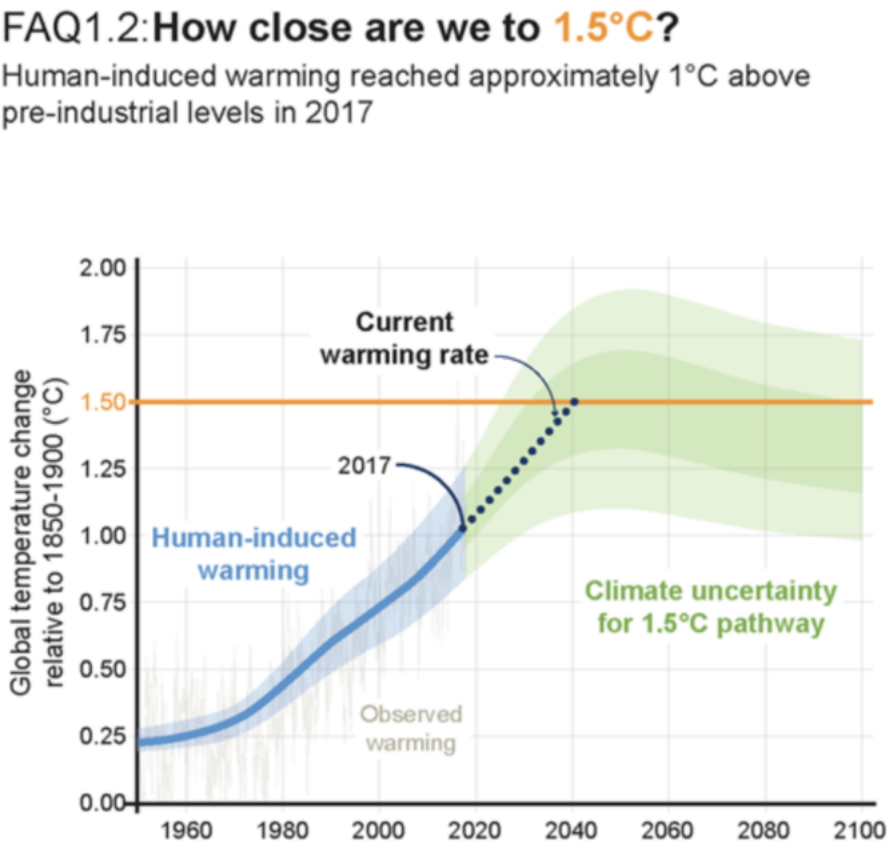


Figure 2. Image source: https://www.ipcc.ch/sr15/graphics/#cid_455

We are currently at 1 °C warming globally and we have until the year 2030 to stave off warming beyond 1.5 °C and resulting consequences that would be hard to address.

Natural gas emits 50-60% lower CO2 when subjected to combustion, compared to coal. However, leakage of methane, a primary component of natural gas, is 34 times more potent than CO2 in trapping heat. Leakage represents 2.3% of US natural gas production.

For this reason, there is a push in several jurisdictions across the U.S. to phase out natural gas as a heating fuel and make buildings all-electric.

What does this mean for Katerra?

Katerra has recognized this electrification and decarbonization trend in buildings and has become an early innovator and adaptor in responsive technologies.

We have begun specifying heat pump water heaters in lieu of natural gas heaters for domestic hot water on our multifamily projects. Service water heating energy use dropped to a third compared to a minimal energy code compliant natural gas baseline. Although fuel costs negated some of this benefit in the past, this is expected to change. (Energy code changes are now beginning to provide compliance paths to ~~s~~specifying heat pump based all electric water heaters.)

Katerra's official building products brand, KOVA, is developing KOVA Comfort Intelligent HVAC, which sets a new bar for HVAC efficiency and utilizes electricity for heating, cooling, and ventilation.

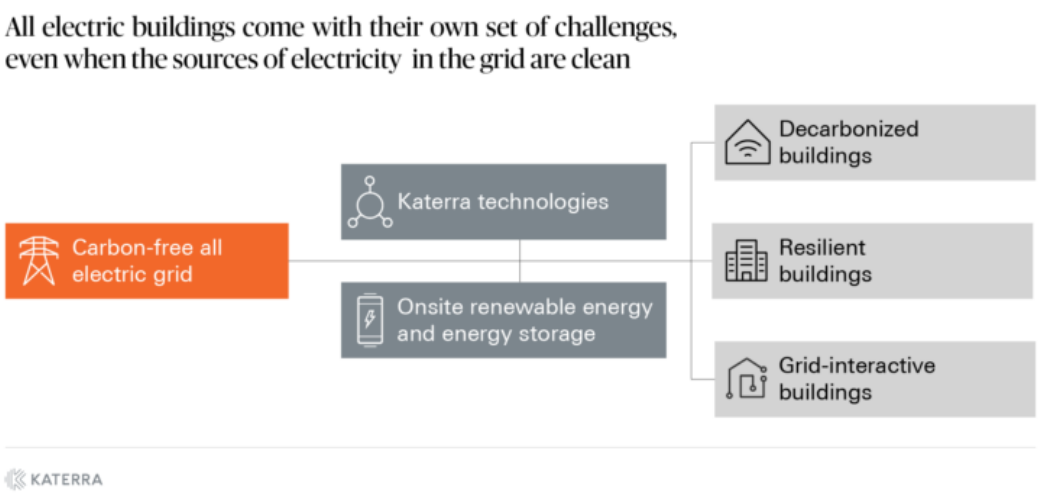
We are also leveraging our vertically integrated model to better understand and reduce environmental impacts across the end-to-end building process.

What follows for electrification and decarbonization?

Carbon-free electricity comes from renewable energy sources such as solar and wind. Renewable energy production ebbs and flows depending on availability of sunlight and wind whereas electricity end-users have come to rely on a supply that consistently meets demand. Maturing and increasingly affordable flexible generation technologies, i.e., battery or energy storage, will fill this gap.

California wildfires in 2019 affected power supply including instances of planned power cuts by utility providers to prevent new wildfires from occurring. In an all-electric scenario, planned or unplanned power loss leads to loss of comfort, and in some instances, life-supporting conditions indoors. This places a greater burden on buildings to be more resilient in two ways: maintain comfort and life-supporting conditions indoors passively (sometimes referred to as passive

One of the ongoing research areas for Katerra is to make buildings switch seamlessly between the grid, onsite renewable energy generation, and onsite energy storage. This approach requires an element of smartness to the technology that rations the energy source based on what makes the most economic and environmental sense to a given situation.



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