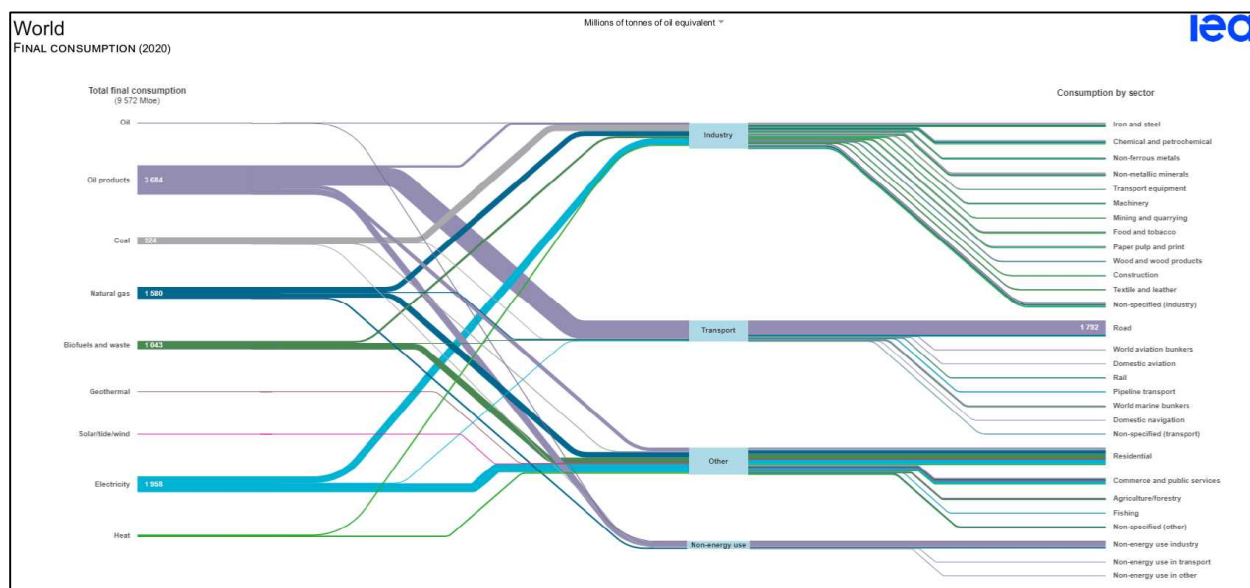


# ELECTRIFICATION OF ECONOMIES



Source: <https://www.iea.org/sankey/#?c=World&s=Final%20consumption>

Electricity's ubiquity and its many irreplaceable uses (just think of possible pre-electricity alternatives to computers: complex assemblies of metal gears run by steam?) makes it appear more important than it is when its contribution is measured as the share of final energy consumption. Calculations are easy: download the latest version of BP's *Statistical Review of World Energy*, find data on electricity generation and on primary energy consumption, divide the two and you will see that in 2021 electricity made just 17.2% of the world's energy supply, with the shares of 17% for the US, 16.6% for Germany and 19.5% for China. Surprising but unassailable: electricity provides less than a fifth of all final energy uses, that is of all fuels (clean and sorted coal, refined liquids,

processed gases) and all modes of electricity generation (thermal, hydro, wind, solar, geothermal).

And the shares are even lower when using net electricity consumption (rather than gross generation) and final energy use (rather than total supply). I calculated such ratios with pre-1950 data from Sam Schurr's and Bruce Netschert's 1960 volume on *Energy in the American Economy 1850-1975* and with all subsequent figures published by the US Energy Information Agency. Obviously, until the beginning of commercial electricity generation in 1882 that share was zero and for decades it remained very low: it reached one percent only in 1920, it was still just 3% by 1950, got to 10% by 1980 and by 2020 it was about 15.5%. For comparison, Lawrence Livermore National Laboratory diagrams of US energy flows indicate electrification share of 17.9% in 2020 and 17.6% in 2021, and slightly higher shares are implied by the International Energy Agency's *World Energy Balances* (mostly between 20-25% in affluent countries). All one has to do to avoid arguments is to state clearly how the calculations were done, and compare numbers of identical provenance.

But these small differences do not change the fundamental conclusion: electricity supplies much smaller shares of final energy consumption than most people would think, direct combustion of fossil fuels still dominates. Even the IEA's global share is below 20% numbers, and the highest shares are in smaller economies that derive the largest proportions of their primary energy from hydroelectricity (Norway, Sweden) or, in Iceland's unique case, from exploiting geothermal flows. That China has a higher share than the US does not mean

that country is more electrified. Its per capita electricity consumption is still less than half of the US average, but America's share of electricity is lowered by the extraordinarily large demand for liquid fuels in transportation and for natural gas for industries and heating (this is even more true for Canada, the world's second largest hydroelectricity producer). In contrast, China's share is boosted by the country's enormous hydrogeneration (by far the world's largest) and by its large electricity consumption in export-oriented manufacturing (as is the case in South Korea).

No less important is the fact that the electricity's share of the final energy uses has been rising only slowly, in the US by less than one percent a year since the year 2000, and that its trajectory shows clear signs of saturation. Globally, the share has been growing by only about 1.5% a year, and in many countries, including Brazil and Canada, it has stagnated. Going all the way is bound to take time. Even for affluent nations, there is a long road from, at best, 20–25% to 100% -- and far greater challenges are ahead for the world's poorest countries where electricity now supplies just around 10% of their final energy consumption. Given the past pace of this fundamental energy transition, and the fact that its future progress will be tempered by its enormous scale and that it will require extensive, expensive and commonly resented infrastructural expansion, fully electric world remains a distant aspiration. Proponents of rapid decarbonization of global energy supply now talk about electrifying everything in a matter of a few decades: they should reconsider.

*(Disclaimer: The views and impressions in the columns are personal opinions of Prof. Smil and do not represent the opinions of ICEF.)*