The scale of the decarbonization challenge

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ritain's rate of energy consumption is about 5000 watts per person, and its population density is about 250 people per square kilometre. If we multiply the per-capita energy consumption by the population density, we obtain the average primary energy consumption per unit area, which for Britain is 1.25 watts per square metre. This areal power density is uncomfortably similar to the average power density that could be supplied by many renewables: the gravitational potential energy of all rainfall in Scottish highlands has a raw power per unit area of roughly 0.24 watts per square metre; energy crops in Europe deliver about 0.5 watts per square metre; wind farms deliver 2.5 watts per square metre; solar photovoltaic farms in Bavaria deliver 5 watts per square metre; concentrating solar power stations in deserts might deliver 20 watts per square metre. In a decarbonized world that is renewable-powered, the land area required to maintain today's British energy consumption would have to be similar to the area of Britain. Several other high-density, high-consuming countries are in the same boat as Britain, and many other countries are rushing to join us. Decarbonizing such countries will only be possible through some combination of the following options: the embracing of country-sized renewable power generation facilities; large-scale energy imports from country-sized renewable facilities in other countries; population reduction; radical efficiency measures and lifestyle changes; and the growth of non-renewable low-carbon sources, namely "clean coal" and nuclear power.

primary energy consumption today is about 300 GW, most of it fossil fuel. Roughly one third of energy consumption relates to transport and one third to heating. **We build almost *every* zero-carbon technology we possibly can, as fast as we possibly can, starting right away.**

Renewables (domestic and imported) are increased roughly 20-fold, and nuclear power is increased 7-fold over 2008 levels.

Keywords: B

1. Power per unit area

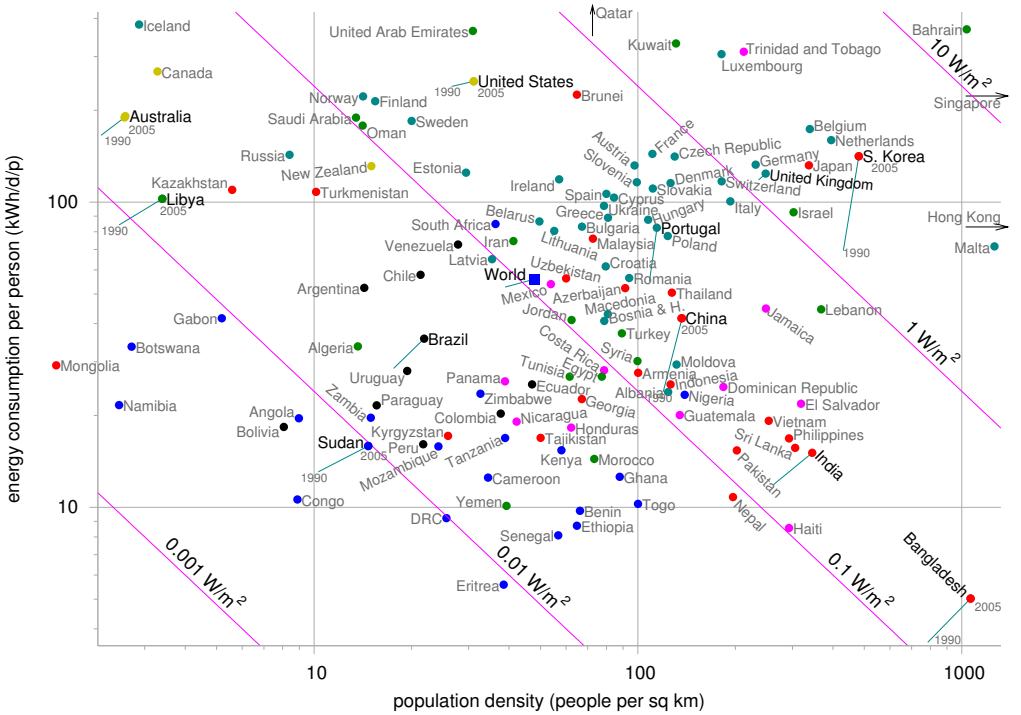

Figure 1. Power consumption per person versus population density

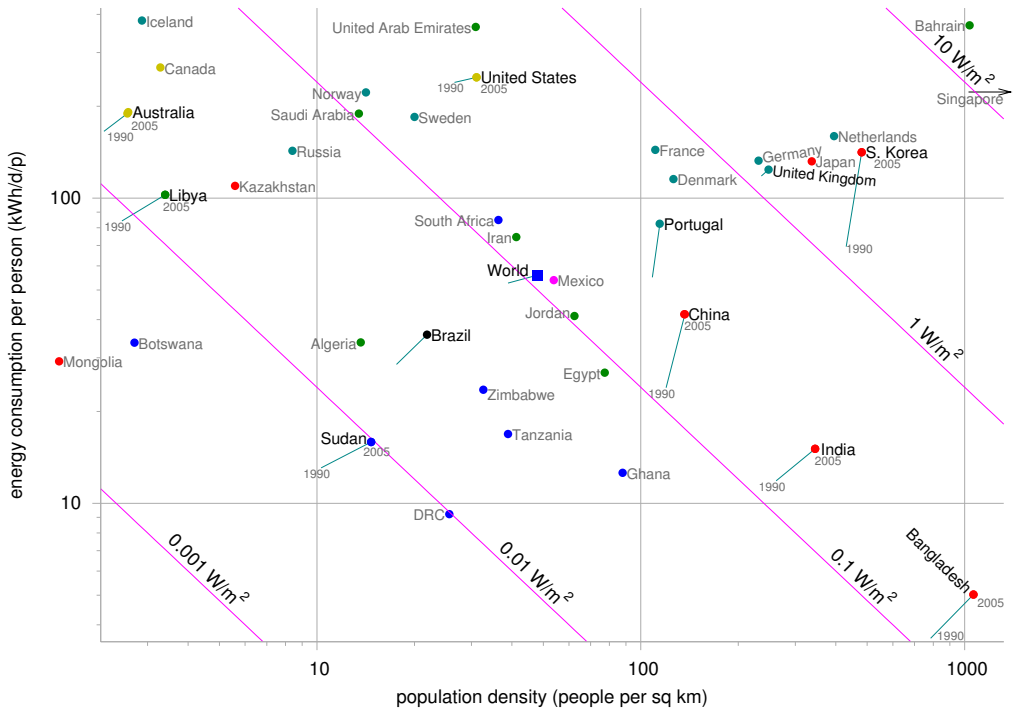

Figure 2. Power consumption per person versus population density

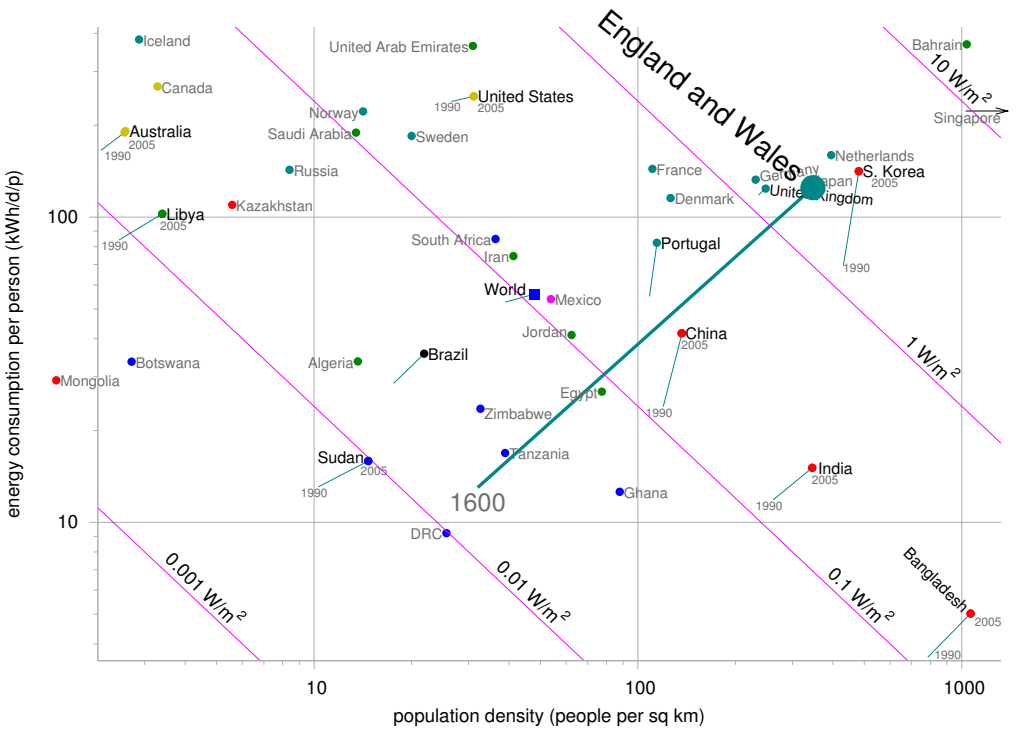

Figure 3. Power consumption per person versus population density

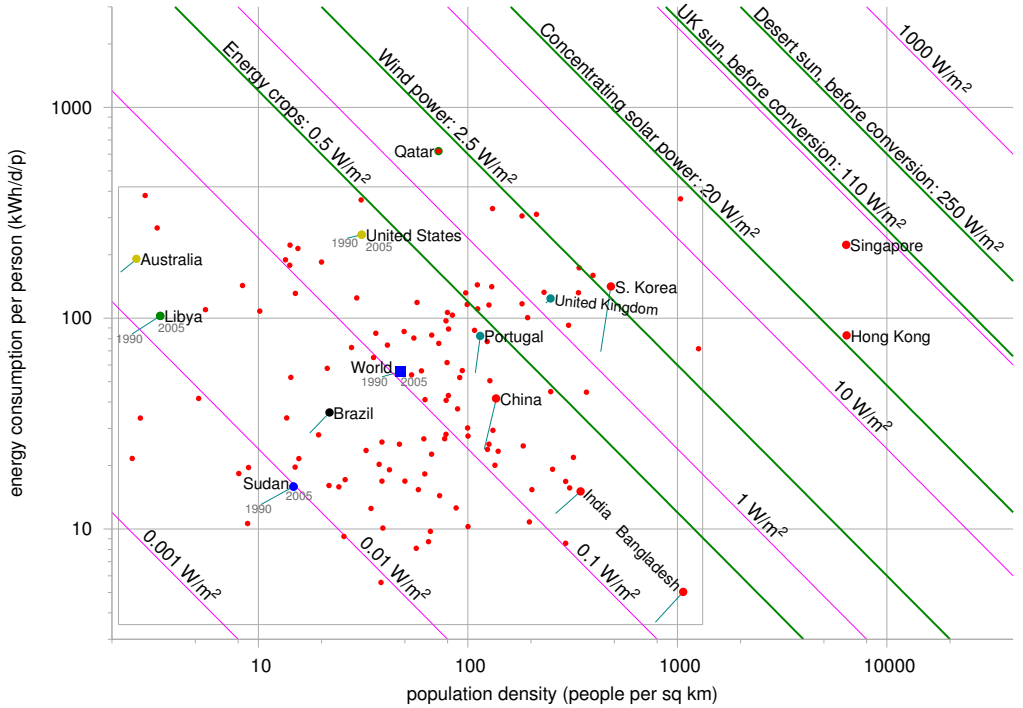

Figure 4. Power consumption per person versus population density

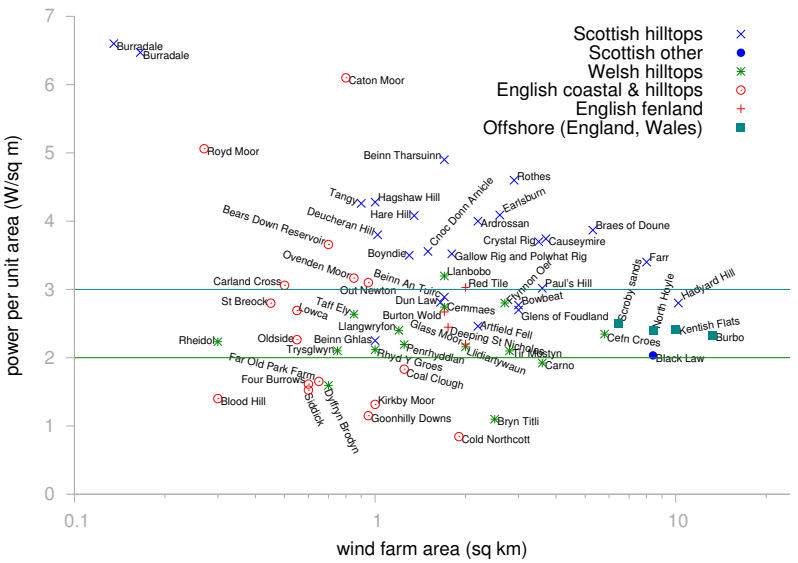

Figure 5. Power per unit area of UK windfarms versus their size