Net zero: Strategy and tactics

The Climate Econometrics group on how to achieve net zero in the UK and beyond

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The autumn saw catastrophic floods in Spain and Hurricanes Helene and Milton in the US, and the importance of moving to net-zero greenhouse gas (GHG) emissions is stark. Past and current emissions are increasing temperatures, raising sea levels, leading to more droughts and floods, and affecting nature, biodiversity, and economies.

Despite public scepticism and considerable uncertainty around effective climate actions, recent economic research has highlighted success stories of decarbonisation, providing a clearer picture of how to achieve emission targets (Castle and Hendry 2024a, b; Stechemesser et al. 2024).

The UK's first strategic framework – the 2008 Climate Change Act, with almost unanimous agreement – had legally binding legislation, monitored by the independent statutory Climate Change Committee. Its current target of net-zero GHG emissions by 2050 requires a viable strategy to facilitate major energy transitions from coal, oil and gas to electricity, as well as eliminating all other sources of GHG emissions. The figure shows where we are: in panel (a) the UK's falling energy use in millions of tons of oil equivalent (Mtoe); (b) its domestic carbon dioxide (CO_2) emissions per capita; (c) UK sources of GHGs in Mt CO_2 equivalents; and (d) its policy-induced emissions reductions estimated by counterfactual analysis.

Decarbonizing an economy requires an integrated sequential approach. First, electricity generation from wind, solar, hydro, thermal, waves and tides must be expanded with non-GHG nuclear, including small modular reactors. This requires a far larger, more resilient, intelligent electricity grid with backup storage systems and interconnectors facing intermittency of renewables supply.

Electric-powered vehicles replacing petrol and diesel would eliminate oil, and connected to a grid with sufficient two-way charging stations provide short-term electricity backup from their batteries when not in use, paid at peak prices and replaced at trough, another incentive to switch. Renewable electricity can also face excess supply, allowing low-cost hydrogen production with liquid hydrogen as medium-run storage and a high-heat source for industry.

Next, eliminate natural gas and oil-fired domestic boilers, retrofit housing with improved insulation, and install heat pumps and solar photovoltaics (cost reductions having far outpaced forecasts – Way et al. 2022). Decarbonise agriculture by replacing artificial fertilisers with ground basalt (improving soil and removing CO_2); selective breeding and dietary changes

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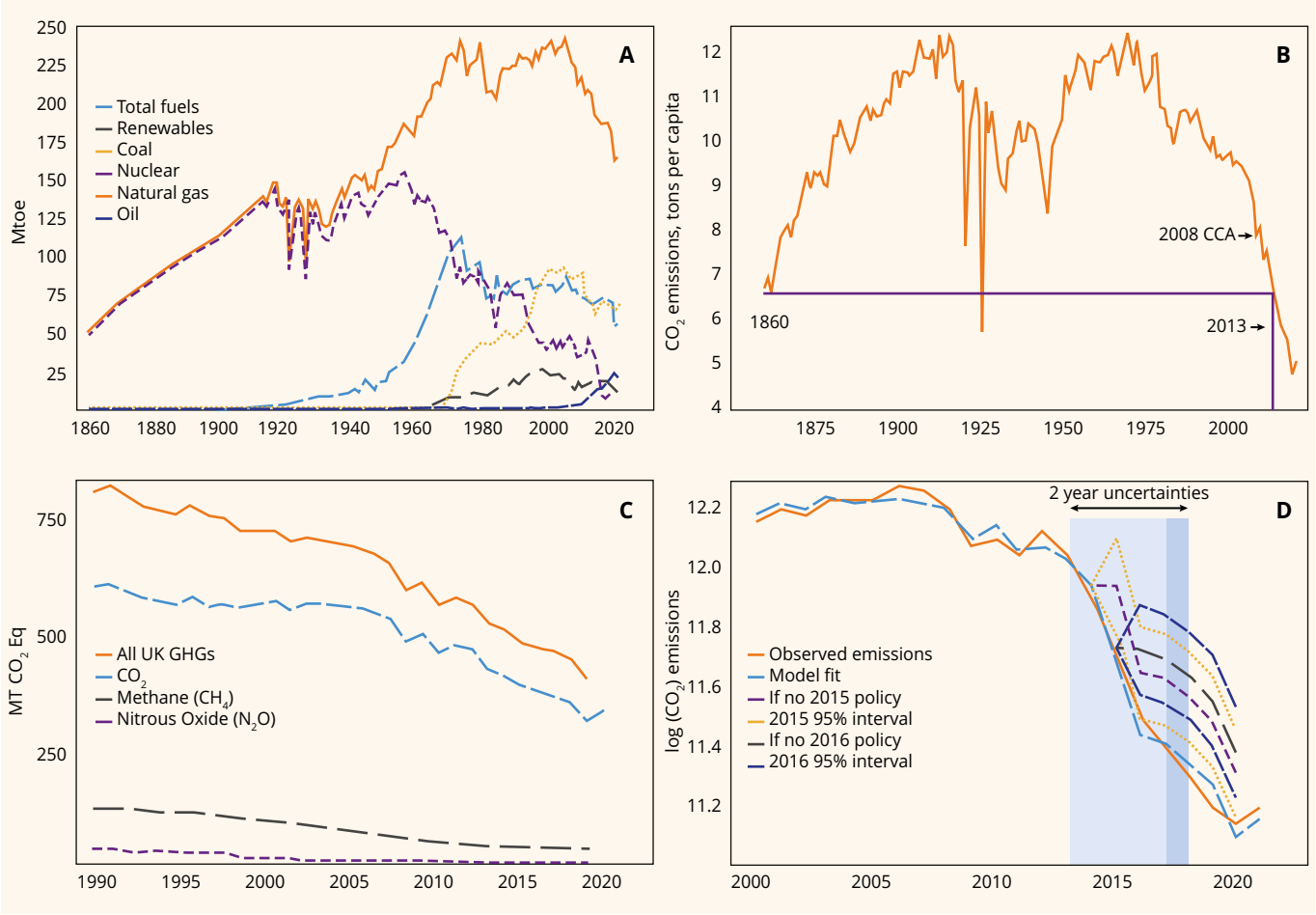

for ruminants; and vertical and underground 'farms'.

Implementing such changes requires well-designed tactics mobilising complementary policies. Stechemesser et al. (2024) combine (1) the break detection methodology of indicator saturation estimation with (2) the Climate Actions and Policies Measurement Framework (CAPMF) database, developed by the OECD, to evaluate systematically the effectiveness of different climate mitigation policies to date. Across four sectors (electricity, industry, transport, and buildings), 41 countries, and two decades, the authors identified 63 climate policy interventions (out of approximately 1,500 analysed) that were successful in inducing major (>4.5%) sectoral emission reductions.

Combined, these lowered emissions between 0.6 and 1.8 billion metric tonnes of CO_2. While far from sufficient, they show a road to climate success. The results indicate that the majority of policy types, whether pricing, subsidy, regulation, or information based, are most effective when combined with complementary policy instruments. Pricing mechanisms are especially effective, either alone or combined with other instruments.

The study finds that the UK has made exemplary progress in reducing the emissions of its electricity sector in the last decade. The combination of a mid-2013 introduction of a carbon price floor with a minimum price for UK power producers in the EU Emissions Trading System, command-and-control measures (renewable portfolio standards, expansion planning, stricter air pollution standards, and the phase-out of coal power plants) with other market-based incentives (renewable feed-in tariff and auctions) ushered in this change. The authors estimate that UK electricity sector emissions would have been around 43.6% percent higher in the absence of those policy interventions in the early 2010s, as shown in Panel (d).

The UK's success in electricity is not matched in transport, buildings, or industry, where insights can be drawn from other countries. There is no one-size-fits-all climate policy facing political realities. Despite renewable energy being cheaper than fossil fuels, it is essential to maintain employment and real per-capita growth, and reduce inequality. Public support for a green economy may wane if economic costs are seen as too high or unfair. Fortunately, recent successes in climate policy, with rapidly advancing technologies in renewable energy with emissions reductions, represent a pathway to an increasingly resilient, cost-effective, and sustainable future.