Transport: from Disruption to Decarbonization

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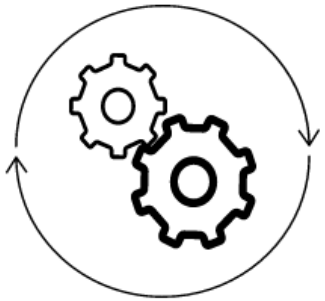
3 Revolutions. What are they?

Electrification

Hybrid electric and all-electric vehicles



Automation

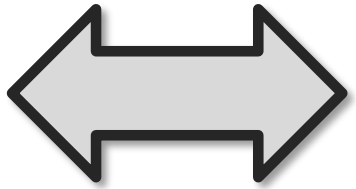
Automated vehicles, eliminating the need for a driver

Shared Mobility

Shared vehicle trips and public transport

Image source: UC-Davis (https://3rev.ucdavis.edu/what-are-the-3-revs/)

Electrification



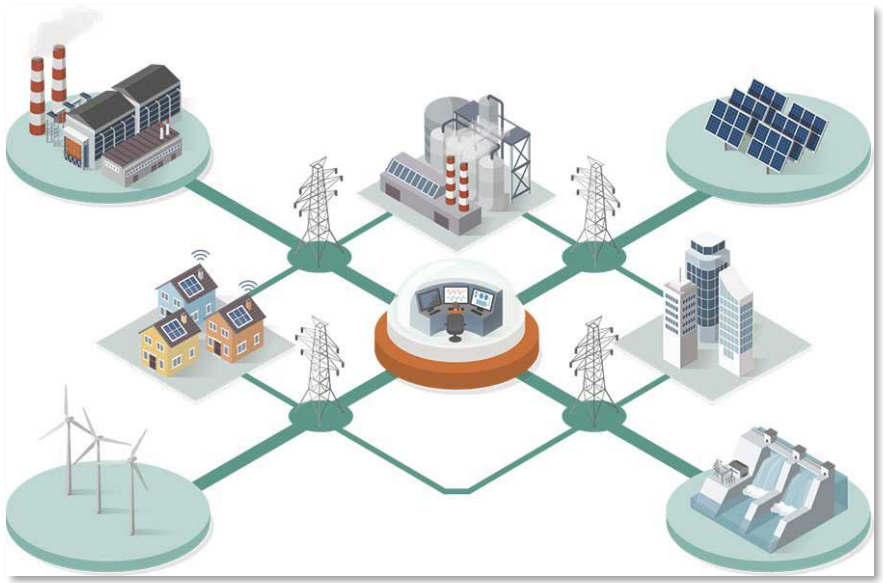


Image sources: UC-Davis (https://3rev.ucdavis.edu/what-are-the-3-revs/); https://www.freepik.com/free-vector/transport-elements-collection_1170138.htm; https://www.grupoase.net/contratar-energia-verde-renovable-luz/

Electrification represents the continuation of a long-term, historical trend – But how much further, and how quickly?

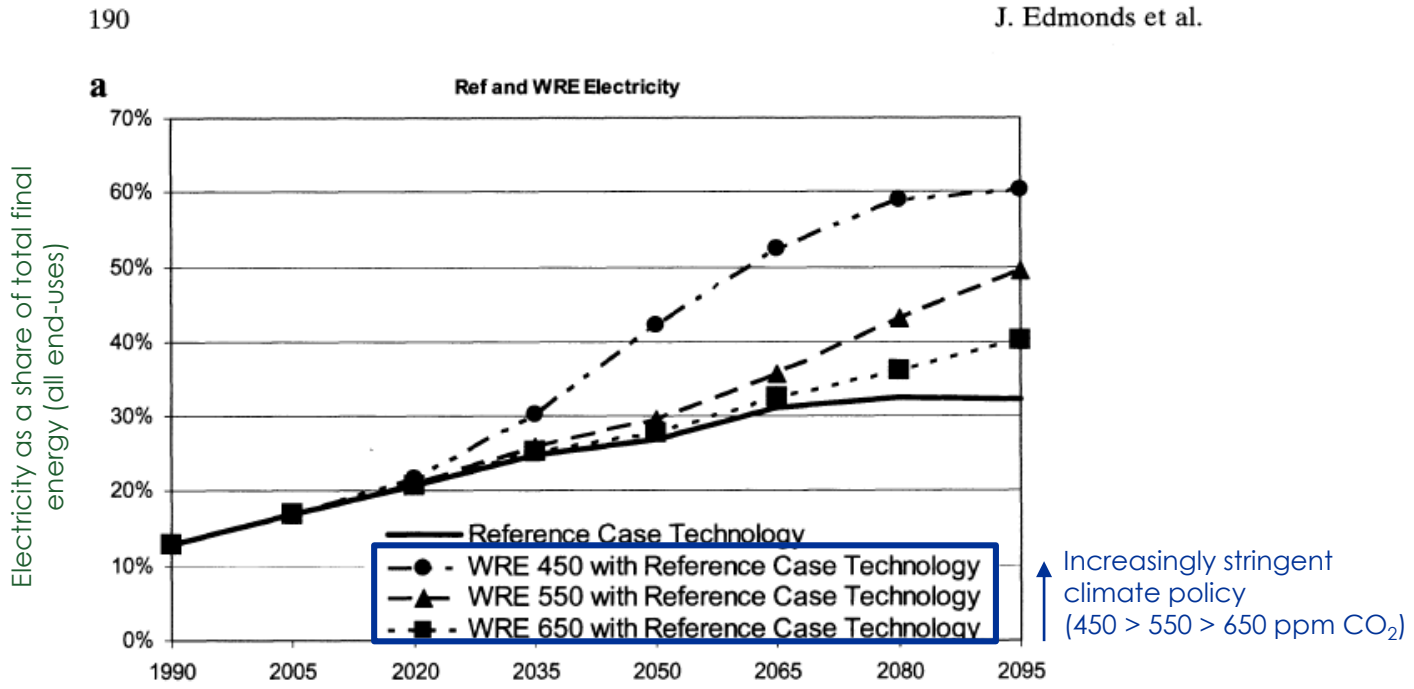


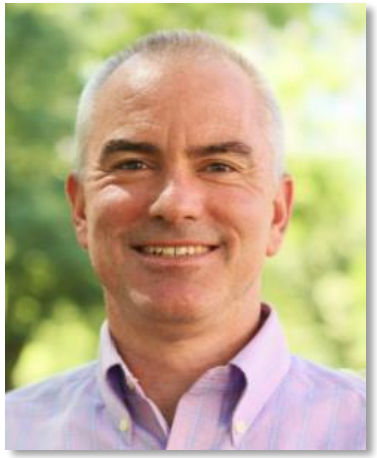
Fig. 10a, b. Ratio of electricity production to total final energy use in the four scenarios of the reference case and stabilization of CO_2 concentrations at 450 ppm, 550 ppm, and 650 ppm. **a** Ratio of global electricity production to total final global energy use, **b** ratio of US electricity production to total final US energy use

Edmonds, Wilson et al. (2006). "Electrification of the economy and CO2 emissions mitigation".

Where are we headed in transport?

Image sources: https://www.freepik.com/free-vector/transport-elements-collection_1170138.htm

Panelists



Drew Kodjak

- *International Council on Clean Transportation (ICCT), Executive Director*
- *Previously U.S. EPA and several non-profits*

David Greene

- *University of Tennessee, Research Professor*
- *Retired from Oak Ridge National Laboratory, Corporate Fellow*

Andreas Schäfer

- *University College London, Professor*
- *Previously IIASA, MIT, Cambridge, Stanford*

Panel Discussion

- Andreas
  - Battery technology: Do we need one or two step-changes in battery chemistries to achieve the required energy and power densities?
  - Recharging requirements at airports (modular batteries make sense, how long to charge?, MW total power draw at a given airport)
  - Lifetimes of batteries vs. gas turbines
  - Is there similar propulsor redundancy with electric aircraft as for gas turbines (i.e., if one engine/motor goes out, can aircraft still fly safely?)
  - Slides 12 and 14 => Carbon tax calculation is in terms of CO2-only, not CO2eq. But electric aircraft save a lot on contrails/cirrus formation. So doesn't this increase the allowed price of electricity by ~2x (up to $0.15-0.20/kWh)? For this to happen, climate policies would need to take into account the full suite of radiative forcing agents, not just the six Kyoto GHGs.
  - What is ICAO's position on electric aircraft? And how do Boeing, Airbus, GE, Rolls Royce, etc. see things developing, and how are they adapting, e.g. through joint ventures or buying start-ups?
- Drew
  - What seemingly effective EV-supporting policies have been tried elsewhere but not yet in North America?
  - China's EV market is already considerably larger than the US and growing. And mostly served by Chinese-built auto OEM technologies (right?), like BYD. Are we poised to see Chinese OEMs selling EVs in US anytime soon, irrespective of the current trade war?
  - Trend again toward bigger cars in US => impact on EV prospects?
  - How much does the average person know about EVs? (I'm thinking of Kurani and Turrentine work.) And how does this compare to other countries? Is lack of knowledge imposing a significant market imperfection? How to mitigate this?
  - Is electrified micro-mobility an even bigger mega-trend than car electrification in the world's big urban centers, and can this lead to substantial GHG reductions?
- David G.
  - Of all the EV-supporting policies that have been experimented with up to now (globally and in US), which ones seem to be the most powerful in terms of spurring early adopter and/or mass market deployment?
  - Can CAFÉ (or tailpipe emissions standards) become the main driver for electrification? At what point (X MPG) would it become a binding constraint for automakers within the complicated CAFÉ crediting system?
  - What do we know about the internal discount rates (or payback periods) that EV buyers are exhibiting? Still 3 years as for increased fuel efficiency? Or is something different about the technology? Or is it too early to tell because we are still largely in the early adopter phase?
  - The electric utility industry has much to gain from transport electrification. Are they out in front on the issue, trying to accelerate EV diffusion as much as they can? If not, why is that? What incentive is missing? Is there a policy instrument that can push them? For example, in the CA LCFS there is a scheme in place for utilities to sell credits to oil companies, but then the utilities must use the money they bring in to give rebates/subsidies back to EV owners. Is the situation any different in other countries? (also a question for Drew)
  - Are oil majors (Shell, etc.) getting into the power generation game so as not to become obsolete? (Yes, see here https://www.greentechmedia.com/articles/read/shell-new-energies-director-on-investing-in-clean-energy#gs.c4sfbz).