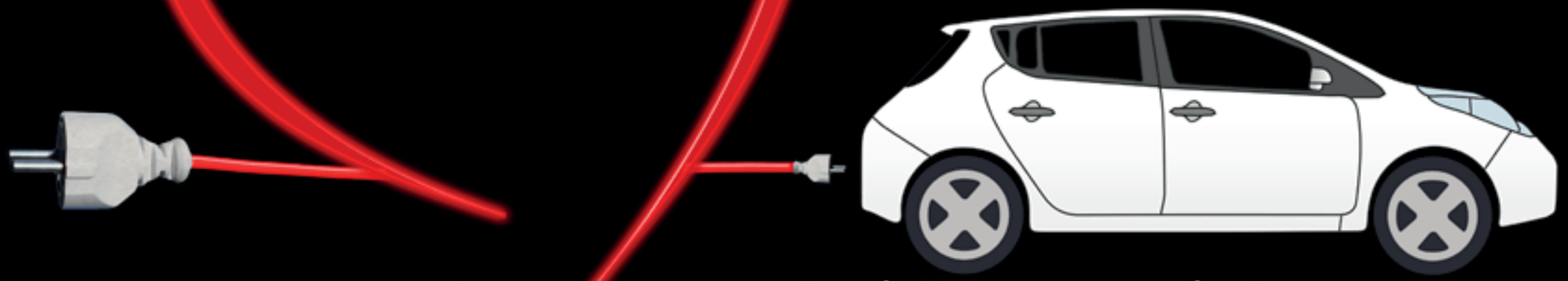
The coming EVolution of road transport



Aaron Cosbey examines the full impacts of a low-carbon future on the transport sector, where governments and carmakers are hastening the end of the internal combustion engine

The global transition to a low-carbon future is going to be fundamental, wide-reaching, and anything but smooth. One of the best illustrations is the transport sector, where governments and carmakers are hastening the end of the internal combustion engine (ICE) age.

Electric vehicles (EVs) will account for more than half of global vehicle sales by 2040, according to estimates that are probably too conservative. The transition will be a wave of creative destruction, crippling long-entrenched markets and fostering new ones in their place. The full impacts will challenge economic and social systems to adapt at uncomfortable speeds, and result in significant shifts in geopolitical power and relations. While the switch to electric vehicles is being driven primarily by environmental concerns, it could set back the achievement of broader sustainable development goals if the transition is not well managed.

The transition to electric vehicles (EVs) shifted into high gear in 2017 with a series of major announcements. Norway will ban conventional automobiles by 2025, with other countries following close on: India in 2030; Scotland in 2032; Netherlands in 2035; France and the UK in 2040. The private sector, sensing an opportunity for first-mover advantage, is not far behind; Volvo and Jaguar/Land Rover will sell no conventional automobiles by 2019 and 2020, respectively, and in 2017 Daimler, Volkswagen and BMW all announced accelerated plans for new EV models. Two influential jurisdictions are widely expected to announce phase-out targets soon: California, valued as a regulatory leader in the US; and China, the world's biggest consumer of new cars, with a 30% share.

Those announcements will hasten a trend that already has momentum. The global EV stock grew by 62% in 2016, albeit from a small base[1]. Bloomberg New Energy Finance predicts EVs will be at cost parity with conventional automobiles in the mid- to late-2020s, and that globally by 2040 54% of new car sales and 34% of cars on the road will be electric[2]. ING Bank predicts that by 2035 all new cars sold in Europe will be electric[3].

The question is not whether EVs will replace internal combustion engines, but rather when. And the answer is: sooner than everybody thinks. All the analysts focusing on that question have been scrambling to revise their predictions, as costs of production for batteries– currently around one third of the cost of an EV –dropped more quickly than expected, plunging from $1,000 per kWh in 2010 to $273 in 2016[4]. In 2017, The International Energy Agency more than doubled its previous year forecasts for EV fleet size by 2030, to 58 million; Exxon boosted its 2040 estimate from 65 million to 100 million; and BP increased its 2035 estimate by 40%. OPEC's 2040 estimate jumped 578%, from 46 million to 266 million[5]. This dynamic recalls the International Energy Agency's forecasts of renewable energy uptake over the last decade, which have consistently had to be revised upward, and have just as consistently still been far too conservative[6].

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Underlying the accelerated pace of change is a mix of drivers all working in the same direction. Governments are enacting new policies to fulfill their climate change commitments under the Paris Agreement, and to pursue green industrial policy goals that promise both environmental improvement and domestic economic prosperity in the new green transport sectors. There has been a slow but accelerating consolidation of the relevant industry standards, such as those used for charging systems, leading to cost reductions and efficiency. Growing investment in high-speed public charging infrastructure has meant progress on the chicken-and-egg problem: nobody will buy electric cars if there aren't charging stations, but nobody will build charging stations unless there are users. Cost of production for EVs is falling as scale of production increases and learning-by-doing effects kick in.

The new EVs are also beating conventional engines in ways that are important to consumers, including acceleration and power. As well, consumer acceptance of EVs has begun to increase exponentially as they become less novel and more commonplace. Many of these trends are non-linear, subject to quick take-off once tipping points are reached. The biggest game changer may be China's weighing in with the kind of full-on industrial policy support that has made it an overnight world leader in solar and wind power technologies[7].

The EV transition is about more than what kind of cars are on the road; the impacts will be felt across a range of areas, many obvious but some perhaps surprising. Environmental impacts are to be expected, since most government policies in this area are climate- and pollution-related. If we take the Bloomberg prediction that 34% of cars on the road in 2040 will be EVs, this means 8 million barrels of oil per day displaced[8], or roughly 1,256 Mt of CO_2 per annum[9] - just under the total GHG emissions of Japan in 2015[10].

But the transition will also have important non-environmental impacts. The most obvious is loss of markets for oil exporters. Road transport consumes 43% of all oil produced[11], so loss of over half of that market in the next 20 years would not be a trifling matter, especially for the many states over-dependent on oil exports. At least 16 countries

relied on fuel for over 60% of their merchandise exports in 2015, including countries like Iraq, Angola, Algeria, Brunei Darussalam and Venezuela, where the figure exceeds 90%[12]. This is not just an economic challenge; it's a geopolitical and social challenge as well, with influential states such as Russia and Saudi Arabia facing significant loss of markets for a major export revenue earner. The social and political chaos in Venezuela over the last few years are in some part a function of persistent low global prices for oil.

The shift to electric vehicles also implies a shift in categories of government revenue and spending. In many non-oil producing countries, transport fuel levies are a significant portion of revenues. The EU collected an estimated €167 billion in revenues from transport fuel excise taxes in 2013[13]. These countries will need to shift tax rates and models to accommodate the loss of revenues as fuel sales drop. In many oil producing countries, the impacts will be mixed: loss of royalties from oil production, balanced off against a lower fiscal burden, given that many such countries heavily subsidize domestic consumption of fossil fuels. Lower demand, leading to world oil prices, will decrease the need for such subsidies (though in many cases the subsidy is not an actual outlay, but is rather losses of income from selling domestically at lower prices than could be had on the world market).

Industries that supply the automobile manufacturing sector will also be shaken up. Miners and smelters of lead, for example, will suffer from a major drop in the demand for lead-acid batteries, to which almost three quarters of their product goes[14]. Markets for new products will boom. To satisfy the Bloomberg predictions for EV fleet by 2030, production of lithium and cobalt will need to increase by 300% and 127% respectively (assuming current battery technologies). This again points to geopolitical shifts and risks, depending on the distribution of resource endowments. Around half of the world's current cobalt production, for example, is in the Democratic Republic of Congo.

While EVs demand more material inputs, primarily because of their batteries, they are not as labour-intensive as conventional automobiles because their engines are much simpler are more easily amenable to automation[15]. This

will reduce employment in a sector that has traditionally employed large numbers of middle class workers. In the United States, just under a million workers were involved in vehicle and parts manufacturing in 2017[16].

The transition will also affect the electricity sector. A primary impact will be an increase in demand for electricity, but the challenge may be more about when demand occurs than overall level of demand. One scenario for the UK foresees an increase in peak demand of 30% by 2050 due to EV demand[17]. Building new capacity to meet those peak levels would be prohibitively costly; they will have to be met by smart grids and systems of demand-side management that go well beyond what now exists. One upside of that kind of systemic reform would be the possibility of using a fleet of electric vehicles as a huge distributed battery to smooth out electricity demand peaks.

Another would be the ability to better handle intermittent sources of power such as solar and wind. There is also an issue with the so-called last mile of distribution, given that many local transformers will not be able to handle the spikes in demand created by EVs returning from their daily commute and plugging in to charge at the same time. This problem is serious enough that, even at today's low rates of penetration, California and Texas are considering requiring that utilities be notified when customers in their service areas purchase EVs[18].

The ongoing EV transition will be disruptive, no matter what anyone does. It will destroy long-entrenched markets, create new ones, will challenge economic and social systems to adapt at uncomfortable speeds, and will be accompanied by significant shifts in geopolitical power and relations. While it is being driven primarily by environmental concerns, if not managed well it will set back the achievement of broader sustainable development goals such as poverty reduction, decent work and economic growth, and reduced inequalities.

All that said, it is a more or less predictable transition, and timely action by governments and their agencies will make a huge difference to the extent of the coming disruption. Grid operators need to plan now for the needed

investments, schools and education ministries need to plan now for the new skill sets needed as automobile manufacturing fundamentally changes, planning ministries need to redouble their efforts to diversify national economies over-dependent on the status quo.

All of these processes are already ongoing in most countries, of course; economic diversification in commodity-dependent economies, for example, has been preoccupying economists for decades (with decidedly mixed success – many of the countries most in need are those with the least capacity to plan and execute the needed changes). But the coming changes make all those efforts more urgent.

Beyond crisis management, governments should be striving to exploit the opportunities that the transition presents. The market for EVs, and associated materials and technologies such as batteries, represents a huge new territory, with commensurate payoffs for those firms and economies able to anticipate, innovate and invest appropriately.

China's strategic drive to develop national excellent in renewable energy offers a vivid illustration of the possibilities[19]. From a global market share in solar PV production of around 1% in 2001, China has grown to become the world's single biggest producer, with 40% of global polysilicon manufacturing capacity – twice the next largest country's share[20]. Of course, few countries can match China's potential for state support, but the point is that support matters; there are national payoffs to judicious support for finance, research, demonstration, commercialization, and market creation for new technologies.

This is the stuff of green industrial policy – the drive by the state to help push national economies in the direction of the coming green markets[21]. While industrial policy has a history with more failures than successes, the modern discourse in this area focuses less on whether it should be done and more on how to do it right, in light of the lessons

of the past. Among other things, it requires an executing bureaucracy that is close enough to the business community and capable enough to understand its needs, but independent enough to be insulated from the influence of rent-seekers.

The EV transition is just one of several that will change the global economic and social fabric in the coming decades, as countries, firms and citizens seek to orient toward more sustainable pathways. The lesson to be drawn from the assessment in this article is that some of those changes will be fundamentally disruptive, with potential to set back sustainable development more broadly, but that they will be less so if they are anticipated, managed, and even exploited for their positive potential. This is a difficult path for governments, and a risky one for firms, but it's a path down which we will go like it or not, so it were best to go intentionally and strategically. ■

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