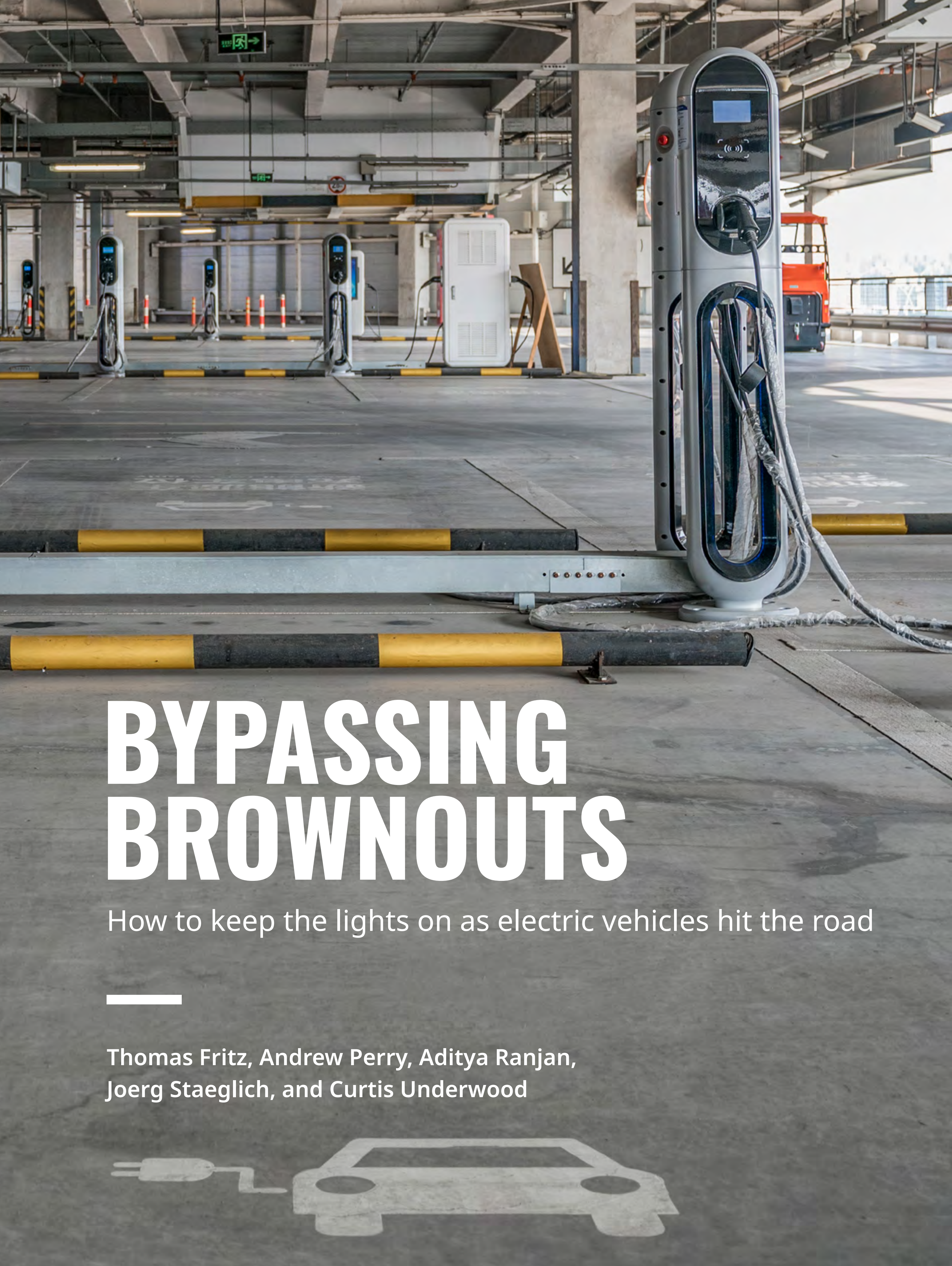

BYPASSING BROWNOUTS

How to keep the lights on as electric vehicles hit the road

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The number of electric vehicles (EVs) on the road worldwide is expected to grow to 125 million by 2030, up from four million at the end of 2018. While it took 60 months to reach the one million mark in annual sales in 2015, going from three million to four million took just six months last year. With several large countries proposing bans on sales of fossil fuel-powered vehicles, Chinese low-cost EVs headed to the West in the near future, and several established automakers switching their focus to all-electric cars and hybrids, it’s clear the trend toward EV ownership will accelerate even more in the coming years.

That means more and more EVs in urban and suburban neighborhoods worldwide could be plugging in daily to recharge. Most electrical distribution networks are simply not ready to provide the additional load — especially during peak evening hours when many EV owners are likely to first plug in to recharge their cars.

Currently, drivers in the United States log some three trillion miles annually in their automobiles. While currently less than two percent of the vehicles are electric, what happens when that number increases? One study estimated that if all the cars in Texas today were EVs, the state might need as much as 30 percent more power; California would need 50 percent more. Nationwide, we calculate that the conversion of all internal combustion engines to electric vehicles could add as much as 45 percent to electricity demand.

GRID PRESSURE

Admittedly, the US Energy Information Administration estimates seven out of 10 cars will still have internal combustion engines by 2050. Even so, the grid will no doubt feel increasing pressures if sales of electric vehicles accelerate as predicted.

Europe is likely to face more of a problem, given recent edicts that start banning sales of internal combustion vehicles over the next decade and beyond. In Germany, by 2035, 37 percent of cars on the road will run on electricity. Given the current German power grid and assuming no grid upgrades, our analysis shows a significant risk for widespread blackouts as early as 2032.

These estimates are based on the “average” community. For many years, the new demand generated by EVs will be uneven, with high- and medium-density residential parts of the distribution grid seeing the first pickup. For communities where there is a heavy preponderance of EVs, challenges to the distribution grid may arise much sooner.

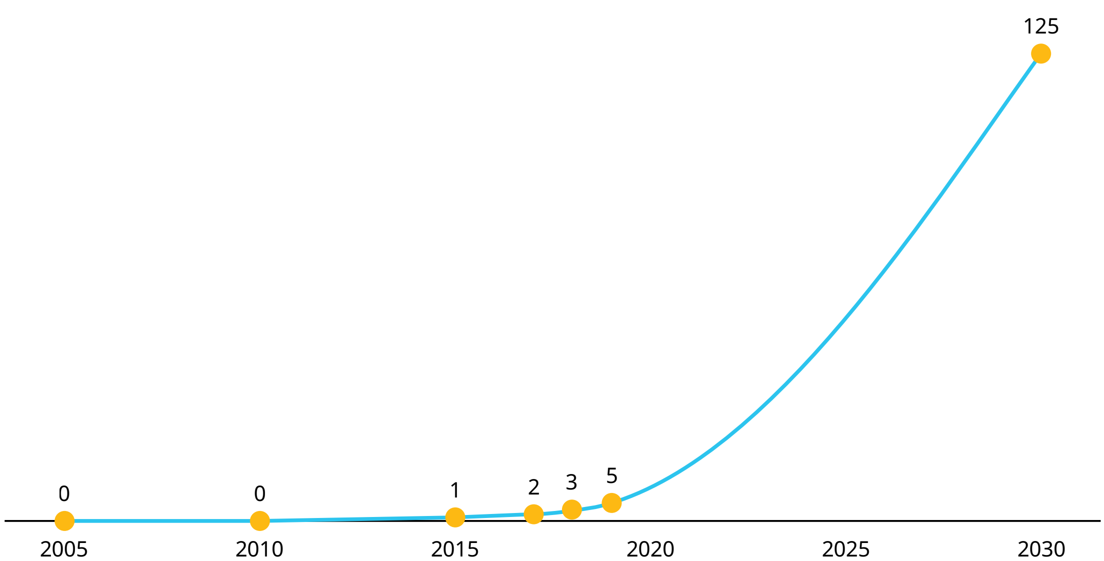
IF NOTHING IS DONE

In the United Kingdom, brownouts from electric vehicles could begin by the time they represent 25 percent to 30 percent of cars on the road if no significant action is taken, according to our calculations. That's expected by the early 2030s. Still, projections for EV adoption are notoriously hard to calculate and have generally underestimated the pace, because of the wide range of variables, including decarbonization policies, gasoline prices, the accessibility of charging stations, and the cost of EVs themselves. Today, in the UK, forecasts are wide-ranging, anticipating anywhere from 2.5 million to 10.5 million electric vehicles in the UK by 2030 and as many as 35 million by 2040.

The traditional response of distribution network operators, the businesses that manage electricity networks at the local level, would be to spend billions to reinforce residential networks. With this approach, by the time electric vehicles represent 50 percent of the cars and trucks on the road, German network operators would have had to spend an estimated 11 billion euros to prevent service interruptions, based on our data.

With the risk of outages and the danger that inadequate electricity networks may become a barrier to EV uptake, regulators and policymakers could be tempted to push for investment in residential networks to accommodate additional demand. This would be both expensive and disruptive because of the major roadwork required.

The Accelerating Adoption In Electric Vehicles (In Millions)



Source: International Energy Agency

Networks last for up to 50 years, during which much can change to turn these investments into stranded assets unless carefully thought through. Given that costs are usually passed along, consumers will be the ones paying for any mistakes made.

CHARGING ALTERNATIVES

But there are incremental options to consider that don't require substantial commitments of funds. Encouraging car park EV charging and en route rapid charging may mean that people would not need to charge at home. Alternatively, more ride-hailing might also mean fewer cars charging in the city if vehicles serving city residents are based elsewhere.

As autonomous vehicles develop and gain regulatory acceptance over the next 10 to 15 years, the result could be fleets of cars that charge in centralized depots rather than on the street, a much simpler and more efficient proposition from a charging perspective. On the other hand, if ridesharing and autonomous vehicles don't take off as predicted, the potential for power shortages in a world of individually owned electric cars becomes a more pressing and immediate problem.

Besides the sheer magnitude of investments potentially required, regulators are also confronted by two equally suboptimal possibilities: the disastrous impact of funding projects too late and the risk of stranded assets if made too early. Together, these scenarios leave networks and regulators in a quandary. Still, it is important that decisions not be rushed, so that the market can be allowed to develop as much as possible before commitments are made to large-scale infrastructure investments.

Adding to the confusion, the EV charging market is still nascent, with numerous business models competing for supremacy. Already automotive manufacturers, energy suppliers, technology players, and international oil companies are involved, adding another layer of complexity as individual players steer the market in different directions. Any major oil company with service stations has the capital to deploy a network of rapid-charging stations and influence customer behavior. At the same time, partnerships involving carmakers, supermarkets, and charging-point suppliers could lead to greater charging at "location" car parks.

INTERIM SOLUTIONS

Pursuing a smart charging option may offer one way to delay decision-making long enough to allow various mobility scenarios to play out. The most economically attractive solution to better managing the electrical power supply involves incentivizing EV owners to charge their cars at off-peak hours and coordinating charging on a staggered basis with other local owners.

This approach requires charge-points, and their associated electricity meters, to be capable of sophisticated two-way communication, so they can be controlled and managed remotely by grid operators. Monetary incentives for EV owners may be needed to encourage participation, as well as penalty pricing to ensure compliance.

The faster smart charging becomes standardized, the better networks can manage EV adoption.

Another approach entails encouraging use of photovoltaics – solar cells – and the use of decentralized, local energy storage at the point of charging, including use of the car battery itself. These can act as a buffer to avoid overloading the grid at times of peak energy demand. In some markets such as Germany where there is a longer winter and fewer hours of sun, solar solutions would likely offer limited relief.

The faster smart charging becomes standardized and mandated for all EV charge-points, the better networks will be able to manage the crunch of significant EV adoption. Whether such solutions will ultimately solve the problem is unclear, but at the very least these approaches will ease the pressure on grids and provide the industry with the opportunity to make better decisions on infrastructure needs.

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