



Electric Mobility: Driving to Zero

NATHAN

Trusted for Excellence

Electric mobility – also known as e-mobility or transportation electrification – means replacing fossil fuel in vehicles with low-carbon or zero-carbon electricity and is one of the most promising solutions to climate change.

Climate change is one of the most important and challenging issues facing the globe. Serious impacts extend widely and deeply across both natural ecosystems and human societies. The transportation sector is one of the key contributors to climate change, accounting for roughly one-quarter of global greenhouse gas (GHG) emissions.

Without immediate and concerted action, both the absolute amount and relative share of these emissions are projected to increase dramatically over the next few decades. It is no exaggeration to say that we cannot solve the climate problem without solving the transportation emissions problem. We must be “driving to zero.”

Electric mobility is one of the most promising solutions to this problem. As the name implies, electric mobility – also known as e-mobility or transportation electrification – means replacing fossil fuel in vehicles with low-carbon or zero-carbon electricity. It includes both standard passenger cars, but also a wide range of electric vehicles (EVs) of different types including motorcycles, scooters, buses, vans and trucks, and even forklifts, ships, and airplanes.

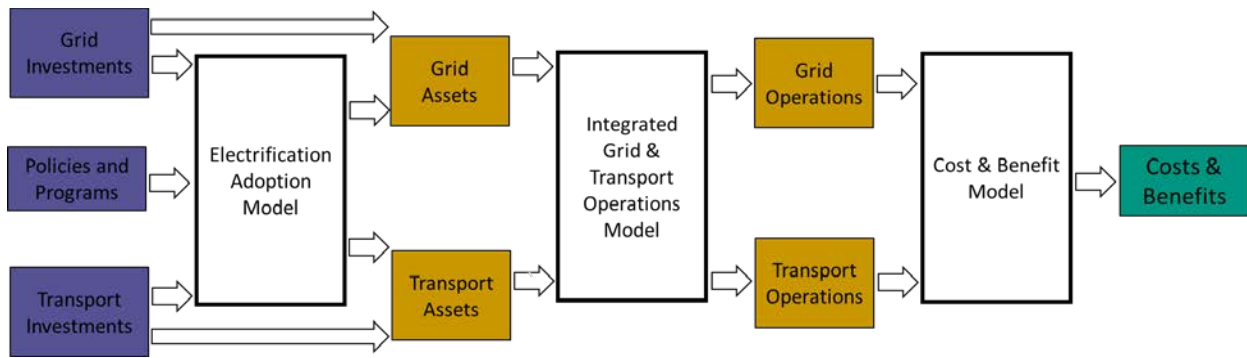
Climate necessity is the mother of transportation invention, and electric mobility is now emerging as a massive technological and economic force. Lithium-ion battery packs, the technology at the core of EVs, cost perhaps a fourth of what they did ten years ago, and are projected to cost a fourth of what they do now within ten years. Vehicle manufacturers have announced plan to dramatically reduce or even eliminate their production of fossil fuel vehicles over the next 10-20 years. With appropriate public and private sector

encouragement, EV sales could be a trillion dollar a year business within ten years, and the electricity sales for these vehicles could itself be a separate \$100 billion dollar a year business.

ELECTRIC MOBILITY & NATHAN ASSOCIATES

Nathan Associates, Inc. (Nathan) is a management consulting firm focused on economic development, broadly defined. We help public and private institutions domestically and internationally make decisions that maximize financial, social, and environmental benefits across all elements of society. Electric mobility sits at the nexus of two of Nathan’s key focus areas – energy and transport. Given our emphasis on economic development, we have a particular focus on assessing electric mobility costs and benefits, understanding the role that technological, market, financial and regulatory factors play in shifting the benefit-cost balance, and in facilitating changes in those factors to improve economic conditions.

The figure below illustrates the analytic framework that Nathan has developed to guide this work. This framework provides a comprehensive, rigorous foundation for our work and enables us to communicate a compelling case for our observations and recommendations.



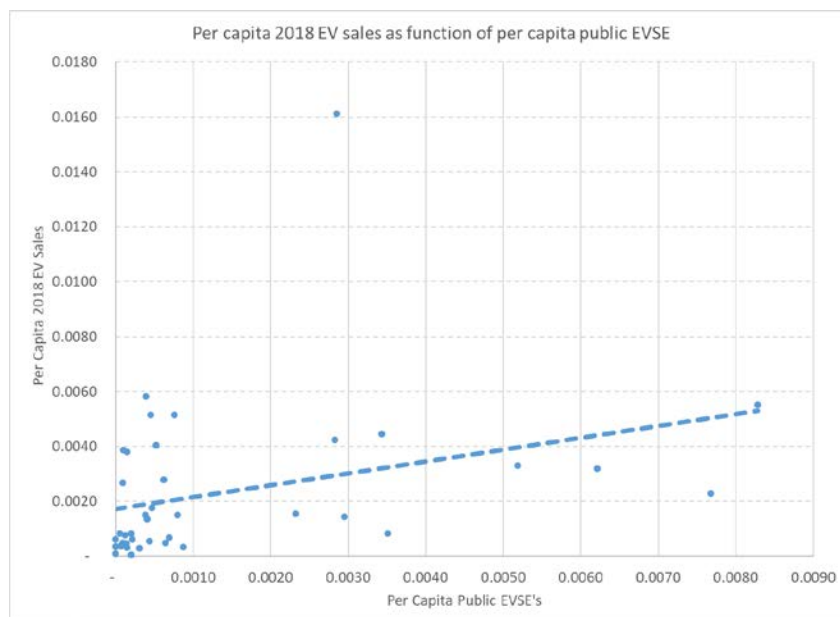
At the left, the framework begins with possible private and public sector interventions. These are the investments, policies, and programs that “set the stage” of the electric mobility market. To the right, the framework ends with costs and benefits. These include financial, environmental, and social impacts across the spectrum of societal stakeholders. In the middle are the elements necessary for estimating the costs and benefits of various interventions. Customers of various types choose to adopt EVs (or not) given the interventions, the operation of both the electric and transport networks is transformed, and ultimately individual stakeholders feel the costs and benefits of that operation.

ELECTRIC MOBILITY SERVICES

Based on this framework, Nathan offers a range of electric mobility services targeted at the needs of different clients in different contexts.

EV PROGRAMS

Government agencies, regulated utilities and other organizations offer a variety of programs intended to encourage EV adoption and use. These programs include direct investments in infrastructure such as public electric vehicle supply equipment (EVSE or chargers), financial incentives such as rebates for purchasing an EV or EVSE, and EV charging tariffs such as special subscription rates. Nathan helps these organizations design, monitor and evaluate these programs, thereby enabling them to devote their time and money on the most effective programs. For example, in a recent analysis of EV programs in California, we determined that investment in public EVSE appears to be one of the most effective tools for encouraging EV adoption. The figure below shows the relationship between per capita public EVSE and per capita EV sales.

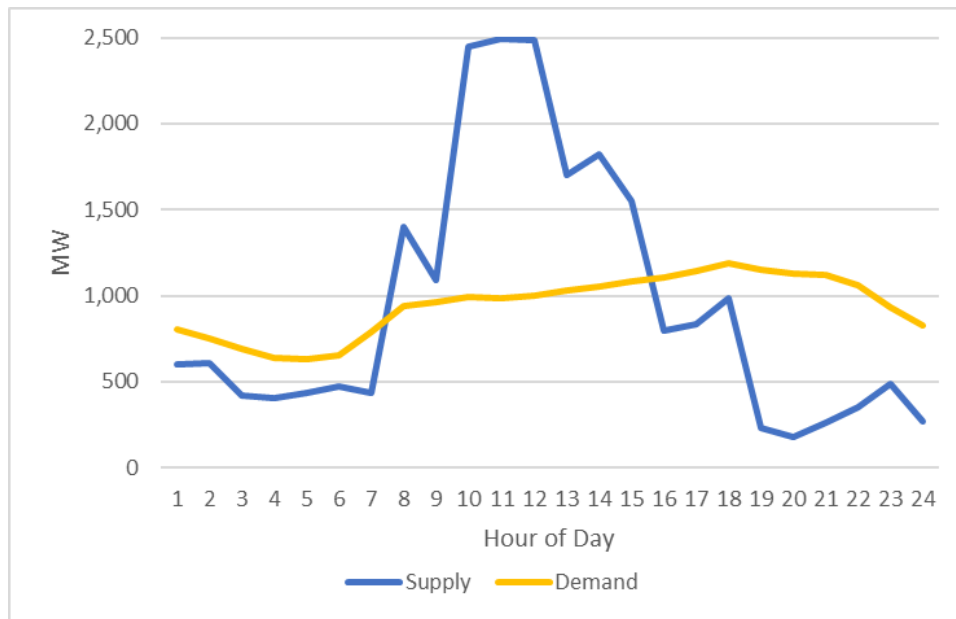


As the figure indicates, EV sales and EVSE installations appear to be mutually reinforcing. While there are other factors at work, more EVSE installations encourage customers to buy more EVs and more EV sales encourage organizations to install more public EVSEs.

MARKET FORECASTING AND ASSESSMENT

For both public and private organizations, an important first step in deciding how to approach electric mobility is to understand what the future may hold and what impact that future may have on

the organization itself and society more generally. Nathan helps organizations forecast the uncertain and changing future and assess the implications of that future. One of the most important examples is forecasting potential scenarios of EV adoption and use, and then assessing what these scenarios mean for the electricity infrastructure. This impact can be dramatic and without a working electricity infrastructure, of course, there will be no electric mobility. The figure below illustrates one key challenge – the difficulty of matching supply with demand in a high renewable and high EV penetration future.

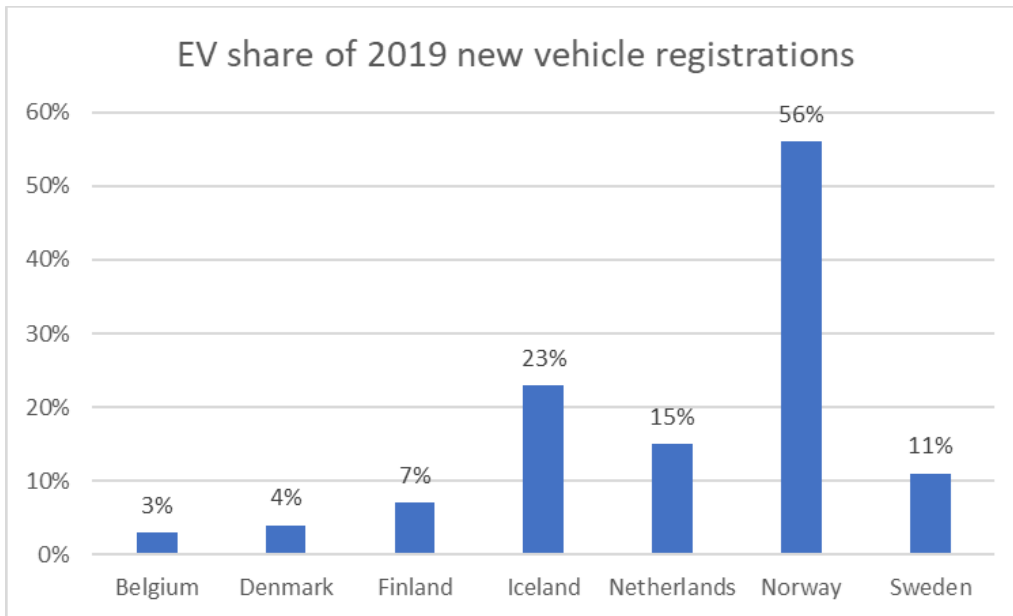


This high penetration future is still years off in most locations. Nevertheless, with long investment lead times, steps must be taken now to prepare.

BUSINESS MODEL

The electric mobility ecosystem is large, diverse, and rapidly evolving. Market players include EV manufacturers, EV dealers, electricity suppliers, EVSE installers, EV charging companies, EV fleet managers and more. Many organizations face the daunting task of determining their appropriate

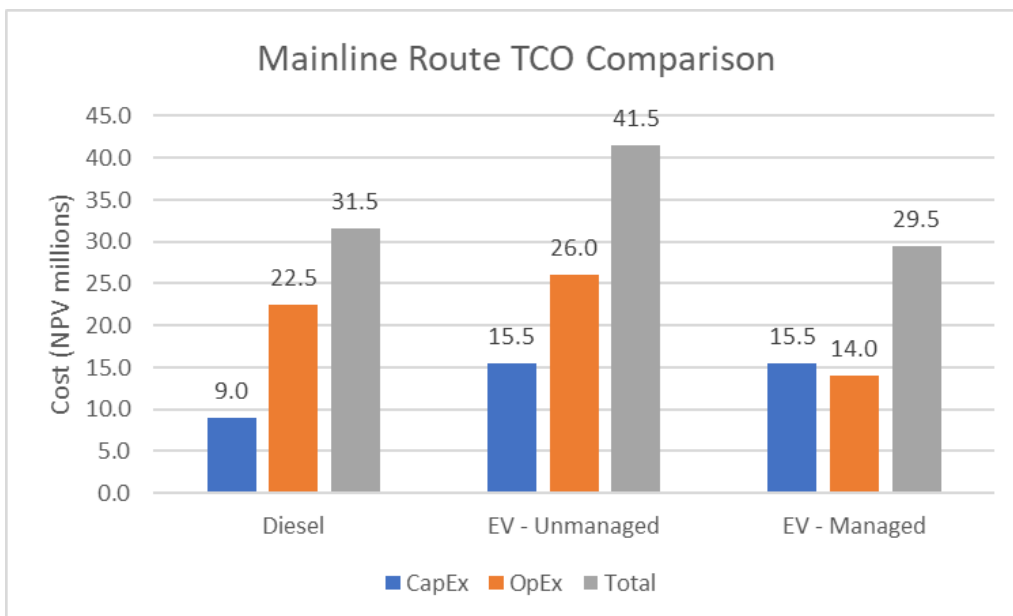
current and future role in this ecosystem, if any. Nathan helps these firms identify and evaluate alternative business models and select the best ones. The choice of business model can have a dramatic effect both on the organization and on society. The figure below shows EV penetration in several arguably similar European countries. Norway and Iceland have achieved high penetration in part because of the range of organizations, ranging from electric utilities to transit agencies to vehicle suppliers, that are active and committed market participants.



FLEET ELECTRIFICATION

Much of the electric mobility “buzz” involves personal cars. However, electrification of commercial fleets such as buses, trucks and vans is equally if not more important – especially in the near term. Fleet owners typically have considerable control over their EV and EVSE infrastructure, and electrification decisions are driven heavily by pure economics or the “total cost of operation” (TCO). Consequently, fleet electrification can be encouraged simply with a compelling TCO business

case. Nathan helps fleet owners, and other stakeholders like governments and utilities, with TCO analysis, thereby enabling them to make the right investment decisions. The graphic below shows the result of such a TCO analysis for a representative bus fleet. As the graphic indicates, the TCO of an appropriately managed electric fleet is lower than the equivalent diesel fleet. This is a pure economic comparison and does not include the beneficial reduction in GHG emissions of thousands of tons.



MULTI-UNIT DWELLING (MUD) AND WORKPLACE CHARGING

Roughly 40% of United States households rent rather than own their home, typically in a multi-unit dwelling. For these households, electric mobility is a challenge. They cannot rely on a dedicated “personal” EVSE or take advantage of homeowner EVSE incentives. Instead, they must rely on “public” MUD or workplace charging. The barriers for this form of charging are considerable. There are multiple stakeholders – property owners, property managers, employers, workers, residents and more – so costs and benefits must be carefully calculated and allocated. There are complex technical

considerations – building electricity loads, parking spaces, parking structures, service panels and the like – that require special expertise to address. MUD and workplace charging is essential to ensure that the benefits of electric mobility are not just limited to wealthy homeowners but are widely shared, including among lower-income renters. Nathan works with MUD and workplace stakeholders to assess the costs and benefits of EV charging, to develop mechanisms for appropriately allocating those costs and benefits and facilitate the best investment decisions. The table below provides a high-level qualitative comparison of the costs of EVSE installation at homes vs. apartments at scale.

Element	Rental Apartment	Owned Home	Advantage
Feeder	Upgrade of a single large transformer	Upgrade of multiple smaller transformers over a large area	Apartment
Line to EVSE	Upgrade may be required of line to garage or multiple lines to scattered parking	Rarely will require a line upgrade	Home
Panel	Requires a single large panel or a few smaller panels in a single location	Sizable fraction of homes over a large area will require a panel upgrade	Apartment
EVSE	Single sophisticated control system and single installation site for high-power charger.	Many installation sites with individual low-power hardware and software	Apartment
Meter	Metering combined with control systems to lower cost	Sizable fraction of homes over a large area will require metering upgrade	Apartment

While the direct cost of installing a single apartment EVSE is higher than installing a single home EVSE, the total cost of installing multiple EVSE in an apartment may actually be lower than installing multiple EVSE in a neighborhood of single-family homes.

About Nathan

Nathan Associates Inc. (“Nathan”) is a leading economic development consulting firm headquartered outside of Washington, DC with additional corporate offices in Los Angeles, Delhi, and London and field offices in more than 20 locations across the globe. Nathan has approximately two hundred staff in its corporate offices, and several hundred staff in field offices. Since its founding in 1946, Nathan has worked in more than 140 countries on six continents.

Nathan works for an array of public and private sector clients including multilateral donors such as the World Bank, national government agencies such as USAID and FCDO (UK), local governments, electric utilities, investment firms, industrial companies, and utilities. Nathan works across a broad range of topics with a particular focus on energy, transport, financial management, governance and compliance, employment, environmental impact, and social and gender inclusion.

CONTACT

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