Driving Change: How Norway's EV Experience Can Guide Global Transitions

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Driving Change: How Norway's EV Experience Can Guide Global Transitions

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Glossary of Key Acronyms

LNC
Lawrence National Centre for Policy & Management

ZEV
Zero-Emission Vehicles

BEV
Battery Electric Vehicle

ICEV
Internal Combustion Engine Vehicle

PHEV
Plug-in Hybrid Electric Vehicle

GHG
Greenhouse Gas

OECD
Organisation for Economic Co-operation and Development

Key Highlights

While electric vehicle (EV) adoption has been slow in advanced economies, Norway stands out, with EVs accounting for about 90% of new cars sold.

Norway's EV experience exemplifies the S-curve diffusion pattern commonly seen in other new technology products, suggesting that its adoption process is not unique and can be potentially replicable.

Norway's success in EV adoption stems from early and sustained policy interventions, including tax exemptions, toll waivers, and investments in charging infrastructure, overcoming challenges like affordability and range anxiety.

Countries lagging Norway must prioritize overcoming early-stage market challenges, using rapid infrastructure expansion to meet compressed timelines and reducing the cost disparity between internal combustion engine vehicles and EVs.

Key drivers of Norway's progress include a willingness to experiment with different policies, strong political will, and long-term financial commitment to incentives and infrastructure.

While Norway offers a valuable blueprint, countries must adapt policies to their unique circumstances, embracing flexibility in policy solutions to address specific challenges and scale solutions effectively.

Introduction

Most countries have pledged to achieve net zero greenhouse gas emissions (GHG) by 2050. Attaining this goal requires significant reduction in transportation-related emissions, which accounted for 23% of global CO2 emissions in 2022.[1] Yet, despite its critical importance, the global transition to greener transportation has been slow, with 25% of new cars sold globally classified as electric vehicles (EVs) in 2024.[2,3,4]

Canada has set targets for sales on zero-emission vehicles (ZEV): by 2026, 20% of passenger cars and light trucks sold must be ZEVs, rising to 100% by 2035.[5] However, as of Q3 2024, only 16.5% of new cars sold in Canada were EVs (12.2% BEVs and 4.3% PHEVs), and concerns have been raised around Canada's ability to meet this target.[6]

Industry observers have noted several impediments to EV adoption. These include 1) the relatively higher prices of EVs compared to those with internal combustion engines (ICE),[7] 2) insufficient complimentary infrastructure, such as public EV charging stations and home or office chargers,[8] 3) insufficient consumer incentives,[9] 4) supply chain bottlenecks, especially around sourcing critical minerals for battery production,[10] and 5) anti-EV sentiments emanating from concerns around an economy dependent on oil and gas industries.[11,12]

Interestingly, Norway, an OECD country and a major oil and gas exporter, is the leading adopter of EVs worldwide. By September 2024, about 96.4% of new passenger cars registered were BEVs or PHEVs[13] as its total stock of EVs reached over 968,000.[14] Norway's success is particularly notable given its economic reliance on oil exports, which shares some parallels with Canada's economic profile. This raises critical questions: How did Norway achieve such high rates of EV adoption? What policies were instrumental in promoting EVs? And how can Norway's experience inform policies for advancing EV adoption in Canada and elsewhere?

This policy brief explores Norway's EV policy and its remarkable adoption journey, noting that its success exemplifies the power of early, strategic interventions to overcome challenges such as affordability, range anxiety, and infrastructure deficits. Key measures—including tax exemptions, toll waivers, and significant investments in charging infrastructure highlight the transformative potential of sustained policy efforts. Norway also managed to balance its role as a leading oil exporter with its pioneering efforts in vehicle electrification, setting a global benchmark for sustainable transportation initiatives.

This report identifies three critical factors that underpinned Norway's success: 1) a **willingness to experiment** with policy when there was no proven blueprint; 2) a **strong political will** to advance a green transportation agenda early on, despite technological and market uncertainties; and 3) a **long-term financial commitment** to fund incentives and infrastructure programs that supported the transition.

While the adoption experience in EVs in many countries so far has been accompanied by mixed signals around policies, affordability and infrastructure, creating uncertainty among consumers and automakers, our report offers a more positive perspective on this transition.

It highlights Norway's EV experience as a prime example of the S-curve diffusion pattern commonly observed in the adoption of many new technologies around the world, suggesting that the EV adoption process may not be unique to Norway, and is likely to be replicable in other parts of the world. A critical milestone in this pattern is overcoming the initial hurdle from early to mass market adoption. Once this tipping point is reached, adoption follows a predictable trajectory, accelerating significantly.

Key to crossing this early adoption threshold is reducing the cost disparity between ICEVs and EVs and investing in robust charging and grid infrastructure. Thanks to advancements in EV technology, countries, including Canada, now face a smaller challenge in narrowing cost gaps than Norway did when its market tipped—meaning the point at which EV sales surpassed those of ICE vehicles. The availability of EVs with better range and lower price points has reduced the burden, though targeted incentives are still likely to be important, given market conditions in these countries. Importantly, once markets reach the tipping point, such incentives can be phased out over time, reducing the fiscal strain on governments.

Today, with a broader range of EV options and rapidly improving technology, countries, however, face a compressed timeline for infrastructure expansion. This makes prioritizing charging infrastructure a critical task, both to support the transition and to meet the growing demand as EV adoption accelerates. Even after the tipping point, Norway's experience demonstrates the need for ongoing infrastructure investment to sustain the market's growth.

While Norway provides a useful blueprint, it is important for each country to design policies tailored to their own geographical and economic context. This involves embracing a flexible and, to some extent, experimental approach to policy design to address idiosyncratic challenges effectively and implement strategies that can be scaled more broadly. In Canada, this means prioritizing regional charging infrastructure expansion, reducing cost disparities between EVs and ICEVs, and ensuring long-term grid preparedness.

Yet, Canada now finds itself in an increasingly volatile geopolitical landscape. At the time of publishing this report, newly imposed U.S. tariffs on autos and certain auto parts have injected fresh uncertainty into the development of a cohesive North American EV manufacturing hub. The U.S. has also scaled back federal support for EVs under the current administration, including cuts to funding for public charging infrastructure.[15] These developments risk disrupting cross-border supply chains, inflating production costs, and dampening the momentum of EV adoption.

North America stands at a pivotal moment, as global players, particularly in Europe and China, continue to advance their EV ecosystems. If current U.S. policy shifts persist, they risk hindering regional EV manufacturing and adoption, underscoring the need for Canada to pursue a more globally oriented strategy and reduce its over-dependence on the integrated North American market. In doing so, Canada can leverage its innate strength, including rich reserves of critical minerals essential for battery production, a strong manufacturing base, and a highly skilled workforce.

At the same time, it must be recognized that the integrated Canada-U.S. auto market has historically made manufacturing hubs on both sides of the border more dynamic and competitive, enabling them to fend off intense global competition. Preserving the core provisions of the Canada -United States -Mexico Agreement (CUSMA) must therefore remain a fundamental priority.

Norway has demonstrated that the transition to EVs is not only possible but follows familiar patterns of technological diffusion. The question countries now face may no longer be whether the EV transition will happen, but when and how. Canada must navigate the current wave of disrupted U.S. policies to avoid becoming trapped at the lower end of the S-curve of adoption.

At this critical juncture, crafting a winning EV strategy that secures manufacturing investment and drives adoption in Canada is more important then ever. This will not be easy, but a challenge we must embrace. Other countries will draw confidence from Norway's success, knowing they too can achieve similar outcomes and continue advancing in the global shift to EVs.

Norway and Canada:

Economic Parallels, Institutional Divergences, and the Role of Oil and Gas

Norway, with a population of 5.5 million, boasts one of the highest GDP per capita globally, reaching US$107,964 in 2022.[16] It benefits from an efficient legal framework, openness to global commerce, and preferential access to the EU market.[16] Its economy is heavily export-driven, with oil, gas, energy-intensive goods, and seafood being primary contributors.[17] The country is also home to one of the few complete maritime clusters worldwide, equipped to build and service shipping needs.[18] Beyond its industrial sector, Norway features a robust services sector, including finance, insurance, telecommunications, information technology, and healthcare. Its power grid is among the cleanest globally, with 88% of electricity generated from hydropower and nearly 10% from wind farms.[19]

Canada and Norway share similarities in geography and resource-based economic characteristics but differ significantly in scale and governance. Both countries have low population densities and concentrated populations in their southern regions, with extensive road networks playing a critical role in transportation. Further, both are situated in the northern hemisphere with remote communities in parts of the country within subpolar and polar climate zones. However, Canada's land area is twenty-five times larger, its population seven times greater, and its GDP four times higher than Norway's.

Both economies are rich in oil and gas and rely on resource exports, with Norway focusing on renewables for domestic energy production. Canada's clean power supply is primarily hydro and nuclear based, particularly in Ontario and Quebec.

Unlike Norway's centralized policymaking, Canada's federal system results in varied policy outcomes among provinces, influencing the adoption rates. Norway's largely unitary government structure enables a streamlined approach to policy development and implementation, ensuring consistent and reliable application nationwide. In contrast, Canada's federal government system, where provinces wield significant policymaking power, results in regional differences.[22] For example, EV adoption in Canada is driven by both federal incentives and other provincial initiatives, such as those in Quebec and British Columbia. Meanwhile, Norway has achieved high EV adoption through largely uniform national policies, although local authorities have recently been granted flexibility to adjust certain measures based on community needs and conditions.

The oil and gas sector plays a more significant role in Norway's economy than in Canada's, with the petroleum sector accounting for an estimated 24% of Norway's GDP in 2023,[20] compared to over 10.3% in Canada.[21]

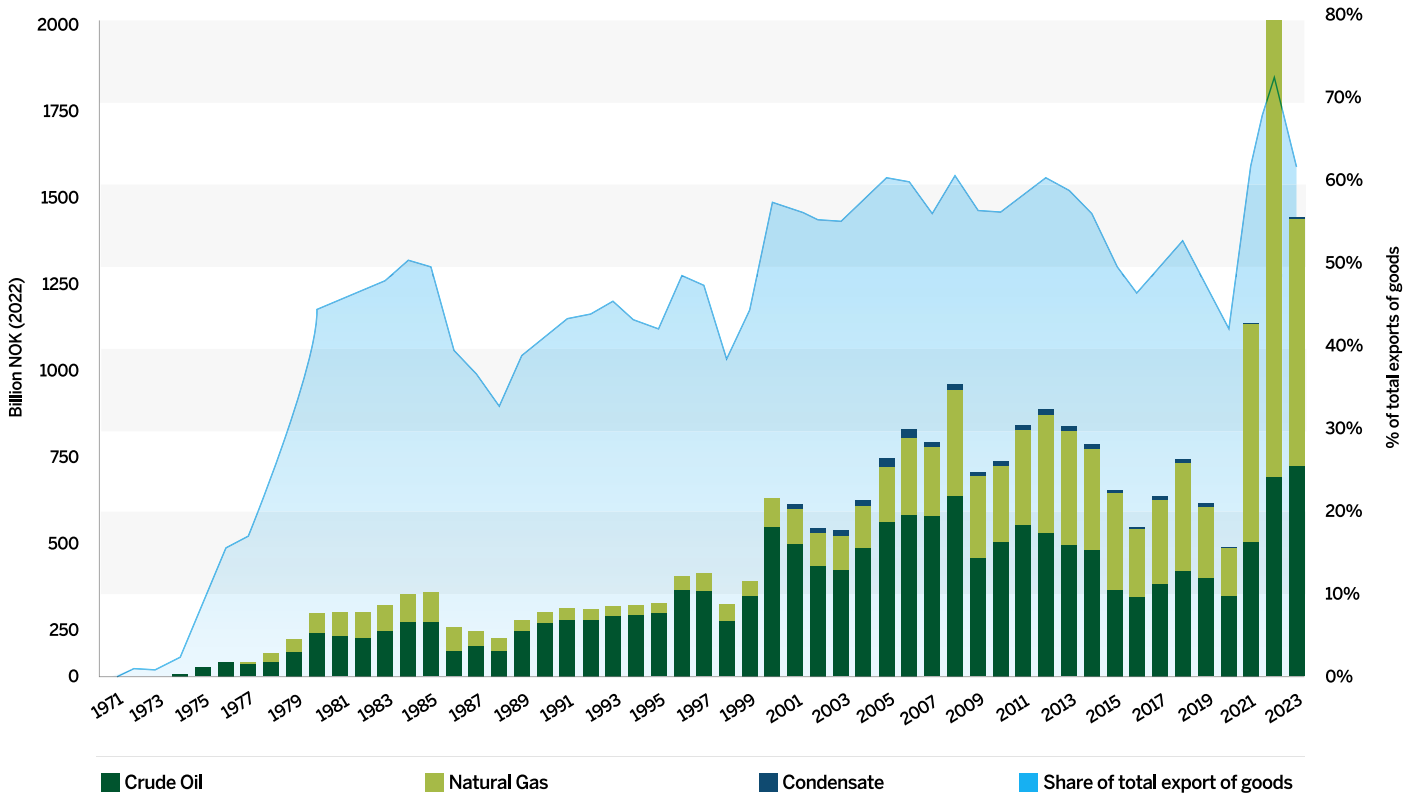
The manufacturing landscape further distinguishes the two countries. Canada has a large automotive manufacturing sector employing 500,000 workers, with significant investment commitments in EV production.[23] Norway, lacking a comparable manufacturing base, has instead prioritized incentives and infrastructure to accelerate EV adoption, leveraging its renewable energy dominance.

Oil and gas remain pivotal to Norway's economy, with the country being Europe's largest producer and a net exporter of electricity.[24] In 2022, oil and gas accounted for 73% of Norway's total exports, bolstered by increased European demand following Russia's invasion of Ukraine.[25] This sector has been a major contributor to foreign exchange earnings since the late 1970s (see Figure 1).[26] Despite higher production costs compared to countries like Saudi Arabia and Russia, Norway's oil and gas sector remains competitive, supported by its critical role in European energy security.[27,28]

Most of Norway's oil and gas is exported, as domestic consumption is minimal due to widespread renewable electricity and the rapid adoption of EVs. Local consumers face high taxes on carbon emissions and fuels, ranging from NOK 2.53 to NOK 6.91 (USD 0.24 and 0.65) per litre in 2023, further discouraging domestic use.[30] Exports remain more attractive to firms, and contribute significantly to national revenues.

In 2023, oil and gas companies in Norway invested NOK 220.5 billion (US$ 20.9 billion) with projections for 2024 reaching NOK 240 billion (US$ 21.8 billion).[31] As part of its long-term strategy, the government approved the development of 19 new oil and gas fields in 2023, aiming to sustain production for decades. Despite its commitment to decarbonizing the economy, Norway has supported the oil and gas industry during downturns, such as through temporary tax incentives introduced during the pandemic in 2020.[32]

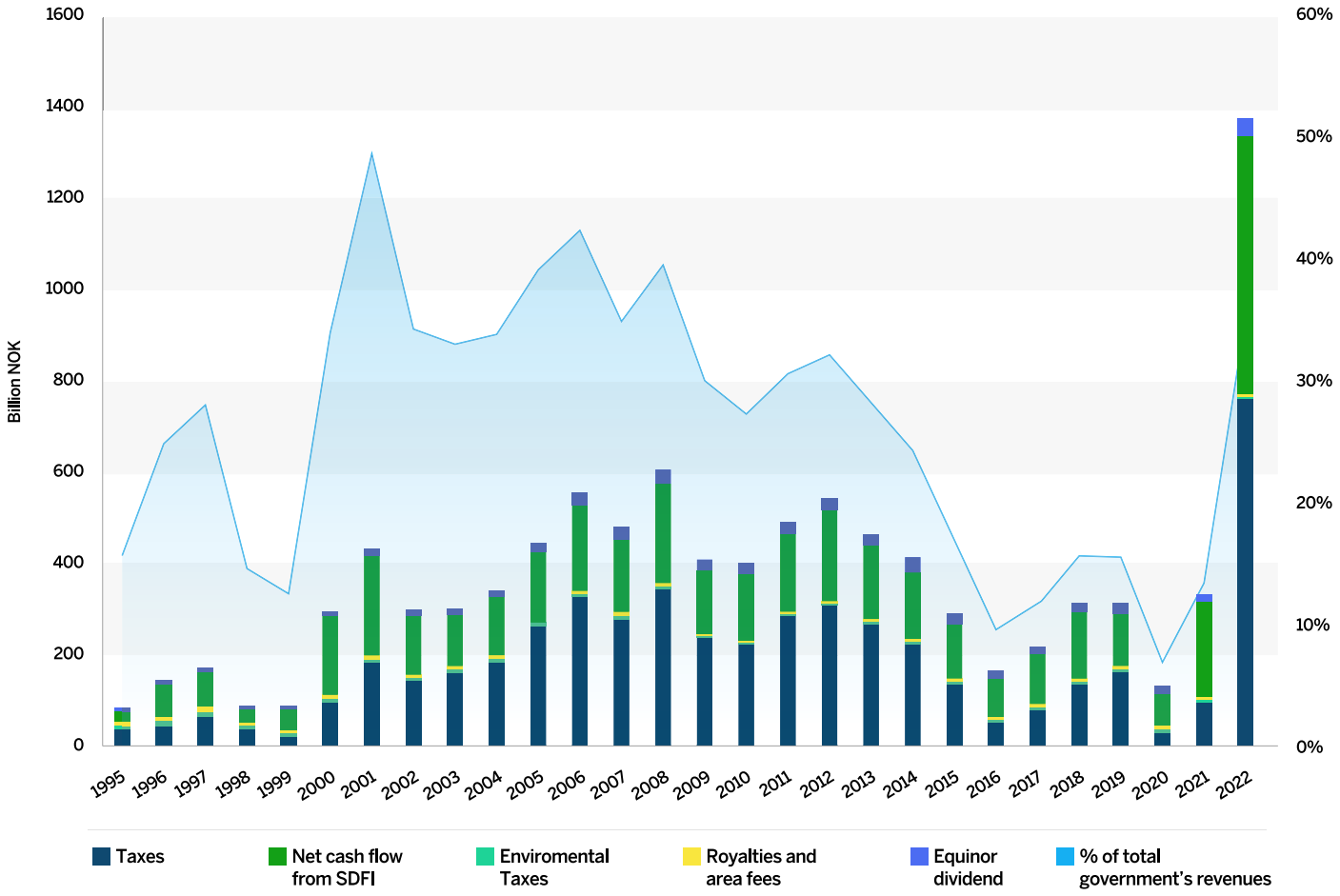
Figure 1
Norwegian oil and gas exports in 1971-2023[29]



Source: Norwegian Petroleum based on data from Statistics Norway, table 08800.

Figure 2

Norwegian government revenues from oil and gas sector (1995-2022)



Source: Norwegian Petroleum based on the date from Ministry of Finance, Statistics Norway[33] and Statistics Norway (National accounts), Ministry of Finance (National Budget 2025.[34]

Norway's public finances are supported by the world's largest sovereign wealth fund, the Government Pension Fund Global (GPG), which is primarily funded by petroleum revenues.[35] Between 1995 and 2022, these revenues on average contributed 26.3% of total government revenues annually (see Figure 2).[36,37] This revenue stream supports key public spending areas, including healthcare, social welfare, education, and public services.[38]

Norway defies the perception that oil-rich economies struggle to invest in clean energy. Its oil and gas revenues have funded programs that enabled early EV adoption and renewable energy investments. However, environmental activists have criticized the country for what they view as a double standard: exporting oil and gas while pursuing a green transportation agenda domestically. The Norwegian government defends its policy stance, emphasizing that oil and gas are essential to European energy security and that their absence would lead to increased reliance on coal-fired power plants, which have a more harmful environmental impact.[39,40]

EV Adoption Policy in Norway

Surprising as it may seem to the rest of the world, Norway instated its first EV incentive in 1990, after Gro Harlem Brundtland, from the Labour party was elected to serve her third term as the Prime Minister. Under Brundtland, who had championed the concept of sustainable development in the influential Brundtland Report in 1987, Norway began to introduce policies to reduce greenhouse gas emissions.

Two additional factors may have also contributed to the focus on EVs as part of the broader goal of reducing GHG emissions.

In 1989, two members of the popular band, A-Ha, Morten Harket and Magne Furuholmen, were inspired by the demonstration of a Fiat Panda that was converted to run on electricity at an exhibition in Switzerland. They imported an electric Fiat Panda and embarked a series of trips across Norway, refusing to pay road tolls and parking illegally to incur fines. Their aim was to gain publicity for EVs and push the government to provide incentives for their adoption.[41] The media coverage of their efforts and public attention are said to have sparked a cultural shift towards EVs.

Additionally, the motivation for developing policies for EV adoption is likely to have been driven in part by a desire to grow an infant EV industry. In the 90s a few EV start-ups were founded in Norway, including the Kewet-Buddy[42] and TH!NK City.[43] However, only 1,500 and 2,500 units of Buddy and TH!NK City models were sold. These EVs had little space, unconventional design, limited range (50-150 km) and long charging times (6-8 hours). Both companies turned out to be commercially unsuccessful.[44]

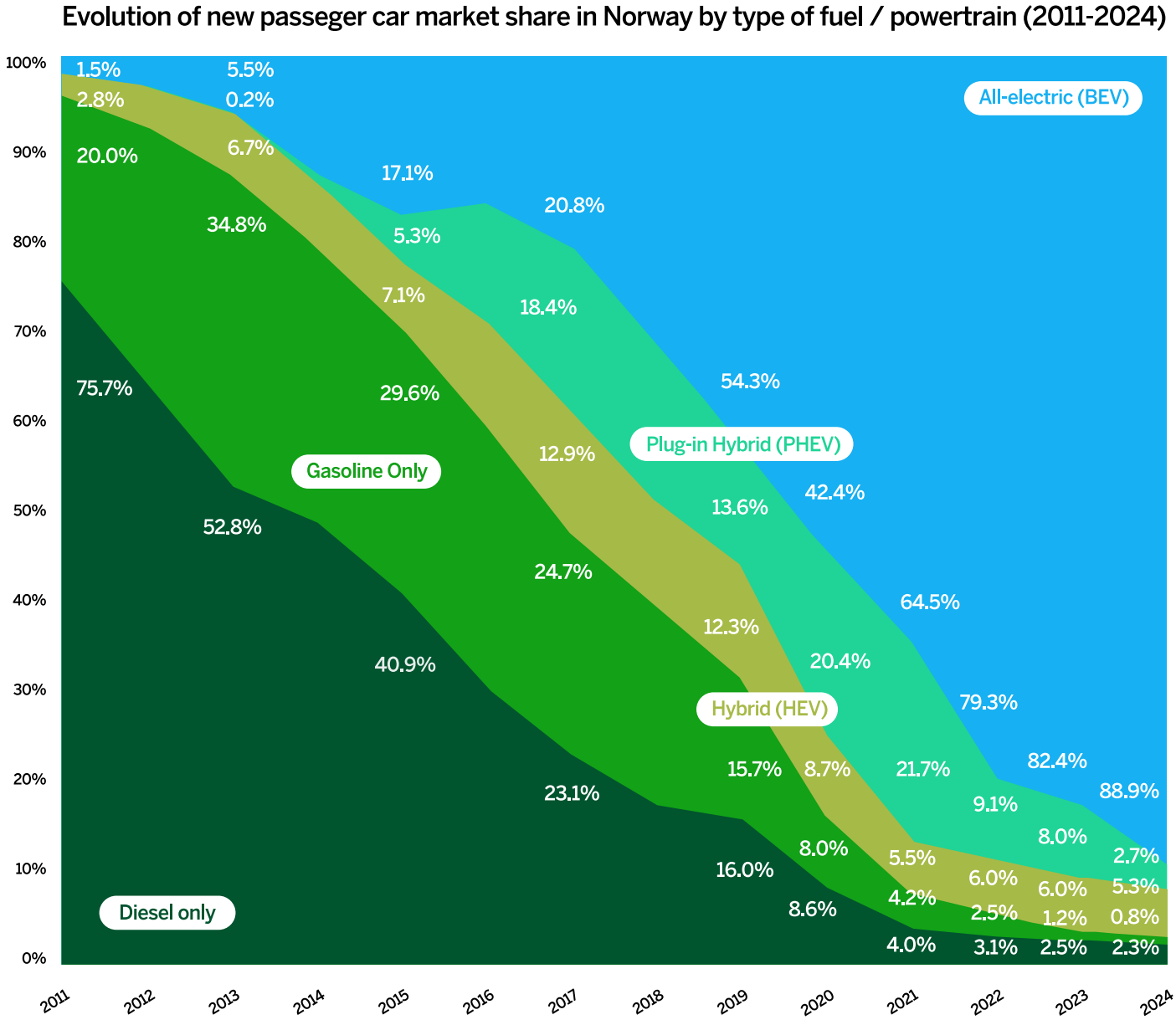
Successive governments in Norway consistently advanced EV policies over the years. By mid 2010s, the country had already established a comprehensive EV incentives program and developed extensive charging infrastructure. Norway remains the global leader in the number of fast chargers per capita. In 2011, Norway had approximately 3,000 public charging stations, including around 150 fast chargers. By 2020, the number of fast chargers had grown to nearly 1,600, and by 2022, the total number of public charging stations had reached just under 23,800.[45] This groundwork allowed EV adoption to rise significantly when manufacturers began introducing mass-market models like the Tesla Model 3, Nissan Leaf (second generation) and Chevy Bolt. Figure 3 illustrates the market dynamics from 2011 to 2024.

In 2016, BEVs accounted for less than 20% of all new car sold; By 2024, BEVs represented close to 88.9% of new cars sold, bringing Norway closer to its national goal of ensuring that, by 2025, all new cars sold will be zero-emission, whether electric or hydrogen-powered.[46]

Since 2020, Chinese EV brands have entered the Norwegian market and now account for approximately 10% of new car sales in just five years. Unlike Canada and the EU, which impose import tariffs of 100% and 45.3% respectively, Norway does not apply any import

Figure 3

Dynamic of automobile market in Norway[49]



Source: Mario R. Durán Ortiz, Wikimedia Commons, with registrations figures and market share figures from Opplysningsrådet for Veitrafikken AS (OFV) - Norwegian Information Council for Road Traffic.[50]

Key Policy

Consumer Incentives

Table 1 lists important policy initiatives undertaken by the Norwegian government to promote EVs since 1990. The incentives are categorized broadly under consumer (Panel A) and charging infrastructure (Panel B).

Table 1

Key ZEV consumer incentives and charging infrastructure policies in Norway[51]

Panel A: Key Consumer Incentives

Year of Introduction	Policy	Description	Status
1990	Purchase and import tax exemption	The one-off tax due upon vehicle purchase	In force, with modifications
1991	Carbon tax	Tax on all carbon emissions	In force
1996	Annual road tax exemption	Annual one-time	Eliminated in 2022
1997	Toll road privileges	ZEVs were exempted from paying tolls nationwide.	100% exemption until 2017; up to 50% fee in 2018-2022; up to 70% fee from 2023
1999	Parking privileges	Municipal parking for ZEVs became free nationwide.[52]	In force till 2017, then up to 50% of the fee
2000	Company car tax incentive	Private use of company cars	In force, with modifications
2001	VAT exemption	Value added tax exemption	In force, with modifications for luxury cars
2005	Bus lane access	Permission to use restricted lanes	In force
2009	Ferry privileges	Reduced fees	In force, from 2018 up to 50% of the ICEV fee
2018	Change of ownership tax exemption	A one-time change of ownership tax for used cars	In force

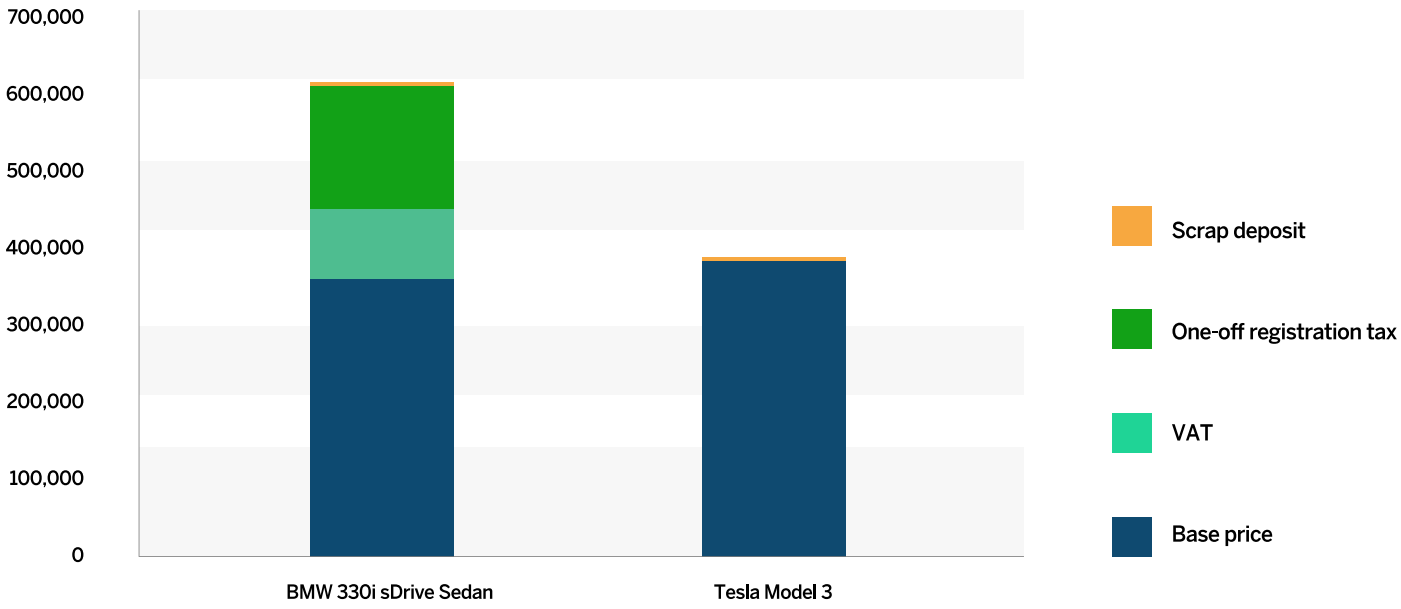
Panel B: Key Charging Infrastructure

Year of Introduction	Policy	Description	Status
2009-2011	Subsidies for public charging infrastructure	Financial support for installation	In force, program based, with modifications
2016	Charging port requirements for new developments	Requirements to install chargers	In force
2020	Right of charge law	Requirements to install chargers in existing housing cooperatives	In force
2022	Subsidy for smart chargers at home	Rebate for installing smart equipment in private homes	In force

Norway introduced two important policies for EV adoption in the early 1990s. Firstly, while ICE vehicles were subjected to high purchase and import taxes based on a set of key parameters, including emission, weight and cylinder capacity, EVs enjoyed full exemption from 1990 to 2022. Figure 4 shows the comparison of final prices of BMW 330xi and Tesla Model 3, after accounting for VAT and registration tax, which includes import taxes (note, tax deposit is same for both models). From 2023, when adoption had gained substantial momentum, EVs were subjected to tax, based on weight and price.

Figure 4

Comparison of total purchase prices of BMW 330i xDrive sedan and Tesla Model 3, NOK, 2022



Models	BMW 330i sDrive Sedan	Description
Final Price Breakdown	Price 357,980 VAT 89,495 One-off registration tax 157,225 Scrap deposit 2,400	Price 381,600 VAT 0 One-off registration tax 0 Scrap deposit 2,400
Total Price (in 2022, NOK)	607,100[54]	384,000[55]

Secondly, a carbon tax instated on all CO2 emissions was passed on to consumers in the form of fuel tax on petroleum and diesel,[55] making ICEVs more expensive to operate. As of 2023, this tax ranged between NOK 2.50 and 6.91 (US$0.24 and 0.65) per liter. For a Norwegian driving 15,000 km/year that would translate into additional US$360 – US$1000 of fuel costs annually.

In 1996, EV drivers were exempted from paying annual road tax which further reduced the relative cost of owning EVs over ICEVs by an additional US$300 per year. In 1997, EVs were exempted from paying tolls nationwide. As most toll roads were situated in and around cities, this policy promoted adoption of EVs in urban areas. Through this exemption, residents in Oslo typically saved from US$400 to $650 a year. Later, with the rise in EV adoption, municipalities were granted discretion to set road tolls, which were increased to 50% in 2018 and to 70% from 2023.

In Norway, employees using company cars for private purposes must declare taxable benefits based on the price and personal usage of the vehicles.[56] To entice corporate EV adoption and employees' personal use of corporate EVs, the government reduced the percentage of the taxable benefit for EVs from 30% to 22.5% in 2000, then to 15% in 2009. As EV adoption increased, this taxable benefit was raised to 18% in 2018 and to 24% in 2022 wstill below 30% for ICE powered cars.[57] For an employee in a marginal tax bracket of 35% and driving 30% of the distance for personal purposes saves about $252 with an EV over an ICEV (when both EV and ICEv vehicles are valued at US$40,000).

From 2001 to 2022, EVs were also exempted from the 25% value added tax (VAT) that ICEVs were subject to. This exemption was expanded to include leasing of EVs and purchasing batteries in 2015. However, by 2020 ZEVs comprised majority of new vehicle registrations, and VAT was reintroduced on purchase of luxury EVs vehicles price exceeding NOK 500,000 (US$47,350) in 2023.

Finally, as a secondary market for EVs developed, the government suspended fees on ownership change in used electric cars in 2018. This saved new owners between US$450 and US$650 per transaction, which increased residual values of used EVs. This, in turn, encouraged new EV sales.

Key Policy

Charging Infrastructure

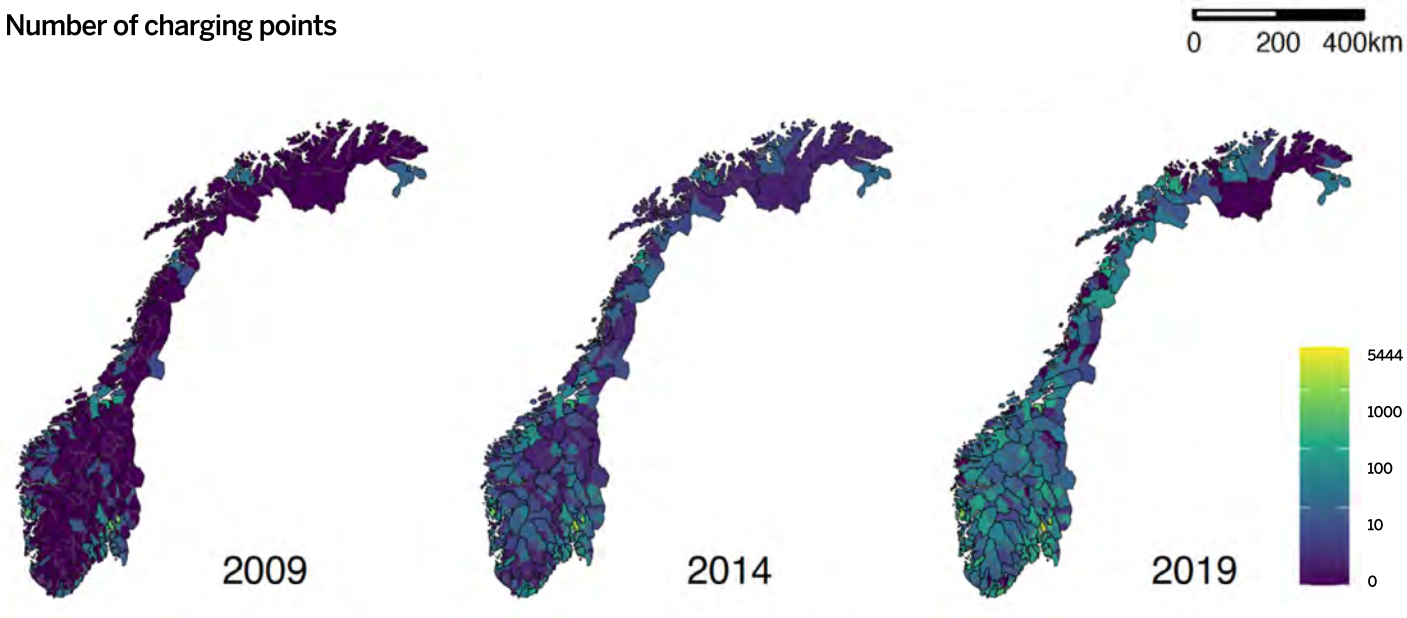
Starting from 2009, the Norwegian government started a scheme to subsidize EV charging infrastructure development aiming to increase the number of public charging points in the country. Subsidies for installation of public chargers of Type 1 began in 2009, and of fast chargers – in 2011.[58,59]

In 2015, Norway initiated a nationwide campaign to ensure that all major public roads had fast chargers spaced no more than 50 km apart. The initiative, led by the government environmental agency Transnova (now ENOVA),[60] was executed in three phases: first in rural southern Norway (2015), then across countryside nationwide (2017), and finally in remote northern regions (2019). By 2022, the country has installed 5,041 public rapid charging stations, with approximately 700 funded through public subsidies. By the end of 2023, this number reached 9000.[61] Figure 5 notes the sharp increase in charging points across the country, demonstrating how Norway successfully met its goal of establishing fast-charging infrastructure along all major roads.[62]

Canada had much larger public road system than Norway. Total length of public roads in Canada is 1,042,718 km, of which 167,843 km are highways.63 Norway has 94,700 km of public roads, of which 10,500 km are national roads. That translates into 4.2 km of highways per 1000 people in Canada vs 1.9 km of national roads per 1000 residents in Norway. Because of this, building out a system of chargers every 50 km across the country would cost an average Canadian more than it did an average Norwegian.

Figure 5

Distribution of public chargers in Norway in 2009-2019



Source: Schulz, Felix and Rode, Johannes, Public Charging Infrastructure and Electric Vehicles in Norway (September 27, 2021). Energy Policy, 2022, pp. 112660, DOI:10.1016/j.enpol.2021.112660, Available at SSRN: https://ssrn.com/abstract=3931394 or http://dx.doi.org/10.2139/ssrn.3931394[65]

The Norwegian government has mostly encouraged a market-driven development of the charging infrastructure and intervened where there appeared to have a market failure, through its policy supports to cover the development costs; there were no subsidies on operations of charging stations. As of 2021, only 23% of charging points were owned and operated by public authorities.[66] The system of charging stations is highly fragmented[67] and the largest operators include Recharge, Mer, Eviny, Ionity, Ishavsveien, Tesla and Circle K,[68] which has been supplementing its core gas retail business with EV charging.

Local governments introduced grants covering 20-50% of charger installation costs in apartment buildings and condominiums,[69] supporting both existing housing associations and developers of new residential projects while accelerating EV infrastructure expansion. In 2017, an amendment to the Housing Cooperatives Act (2003), **granted tenants the right to set up charging points for electric cars and rechargeable hybrid cars,** enabling the full electrification of all parking spaces, provided they submit a detailed plan outlining cost distribution, pricing transparency, safety measures, and an implementation timeline.

The scope and implementation of incentives vary across regions and municipalities, with notable programs in Oslo, Bergen, and Bærum.[70,71] By distributing charging infrastructure costs among all tenants, these policies effectively lowered financial barriers for EV adoption, providing indirect subsidies to EV drivers while creating an incentive for ICEV owners to switch to EVs.

In 2022, the Norwegian government-owned energy agency Enova launched a program for private residences, covering 35% installation costs – up to 10,000 NOK – for smart charging management systems designed to enable charging during off-peak load times.[72,73]

This initiative was taken to relieve the load on the grid during the peak demand times. As Norway increases the share of wind and solar power generation, the power supply fluctuations increase due to intermittent nature of these energy sources.[74] Smart energy management systems pick low-demand and high-supply times to charge cars, heat water tanks and homes. In Norway, almost every EV has a dedicated home charger, and many Norwegians charge their EVs at home.[75]

The government also issued guidelines for land use for the deployment of charging infrastructure in private and public land allocated for parking spaces.[76] When private developer files a plan for a new construction, the municipalities have a right to amend the plan by allocating sufficient parking and charging facilities to support EVs. Local authorities are responsible for installing and operating EV supply infrastructure for public parking and charging facilities.

Aided by its policy on developing charging infrastructure, Norway currently holds the record for the highest number of fast chargers per capita (See Table 2).

Because of the recent rapid adoption of EVs, it also has one of the highest numbers of vehicles per charger (utilization) in the world.[77,78] There have been also few reports on issues related to charging ports compatibility. Mannekes Type 2 charger has been the European standard since 2003,[79] and many manufacturers, including Tesla, provide adaptors to enable drivers to charge their car at most charging stations.

Table 2

Number of publicly available electric vehicle charger in 2022, by major country and type[80,81]

Country	# of Slow Charger	# of Fast Charger	Population	# of Chargers All Types (per 1000 citizens)	# of Chargers Fast Chargers (per 1000 citizens)
China	1,000,000	760,000	1, 425, 887, 337	1.23	0.53
South Korea	180,000	21,000	51,815,810	3.88	0.41
United States	100,000	28,000	338,289,857	0.38	0.08
Netherlands	120,000	4,300	17,564,014	7.08	0.24
France	74,000	9,700	64,626,628	1.30	0.15
Germany	64,000	13,000	83,369,843	0.92	0.16
United Kingdom	42,000	8,600	67,508,936	0.75	0.13
Italy	31,000	6,500	59,037,474	0.64	0.11
Japan	21,000	8,400	123,951,692	0.24	0.07
Norway	15,000	9,100	5,434,319	4.43	1.67
Canada	17,000	3,900	38,454,327	0.54	0.10
Sweden	15,000	2,600	10,549,347	1.67	0.25
Spain	10,000	2,200	47,558,630	0.26	0.05

EV Policy
Challenges and Successes

Evaluating the impact of each policy is challenging as many of them were in force simultaneously, and supply of EVs changed over time. But the policies overall supported the goal of transitioning to EVs. The incentive policy instruments (both incentives and taxes) essentially made the total cost of ownership **lower** for EVs relative to ICEVs. The build-out of the public and residential charging infrastructure was instrumental for fast adoption since it addressed one of the main obstacles for consumers – range and charging anxiety.

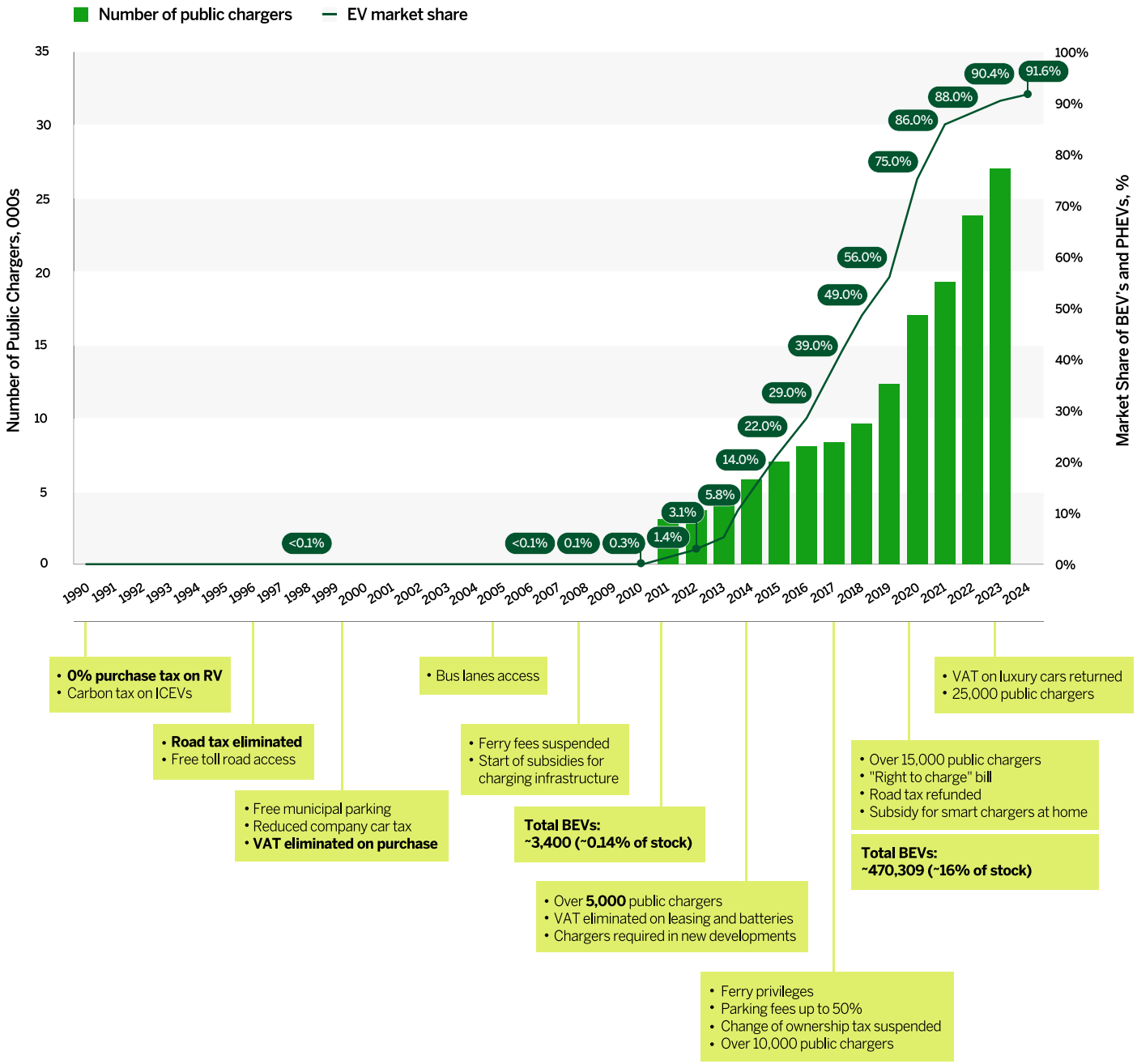
Figure 6 demonstrates that Norway has had generous incentive and investment programs for EVs for a while, but the adoption, measured in terms of percentage of EVs among new cars sold, started to rise a decade after that, when mass-market (and longer-range) EVs became available[82] and the network of over 5000 chargers was deployed. By 2011, Norway's cumulative BEV stock reached approximately 3,300–3,400 vehicles, accounting for 0.14% of the 2.4 million total passenger cars, and by 2021, this number had grown to 470,309 BEVs, making up around 16% of the 2.8 million total passenger vehicles.[83] This pattern follows the typical S-curve adoption seen in many new technology-driven products.

With the shift from early adoption phase to mass adoption phase, Norway is facing its share of challenges. The rapid growth of EV adoption has outpaced the commensurate increase in public charging station deployment. By 2030, Norway needs between 5000 and 9000 additional rapid chargers for passenger cars. As EV charging stations require significant area, a key challenge Norway faces is finding space, especially in urban areas to keep up with the need of developing charging infrastructure.

Another challenge is that total electricity demand in Norway is expected to increase from 145 TWh in 2022 to 373 TWh in 2050.[85] Transport is one of the four sectors that will spur this growth. Historically, Norway relied on inexpensive hydropower, but the opportunities to expand hydro power plants are limited. The government plans to create new generation capacity by mainly harnessing onshore and offshore wind energy.

Figure 6

Timeline of ZEV adoption: Charging infrastructure and incentive policies in Norway[86,87,88]



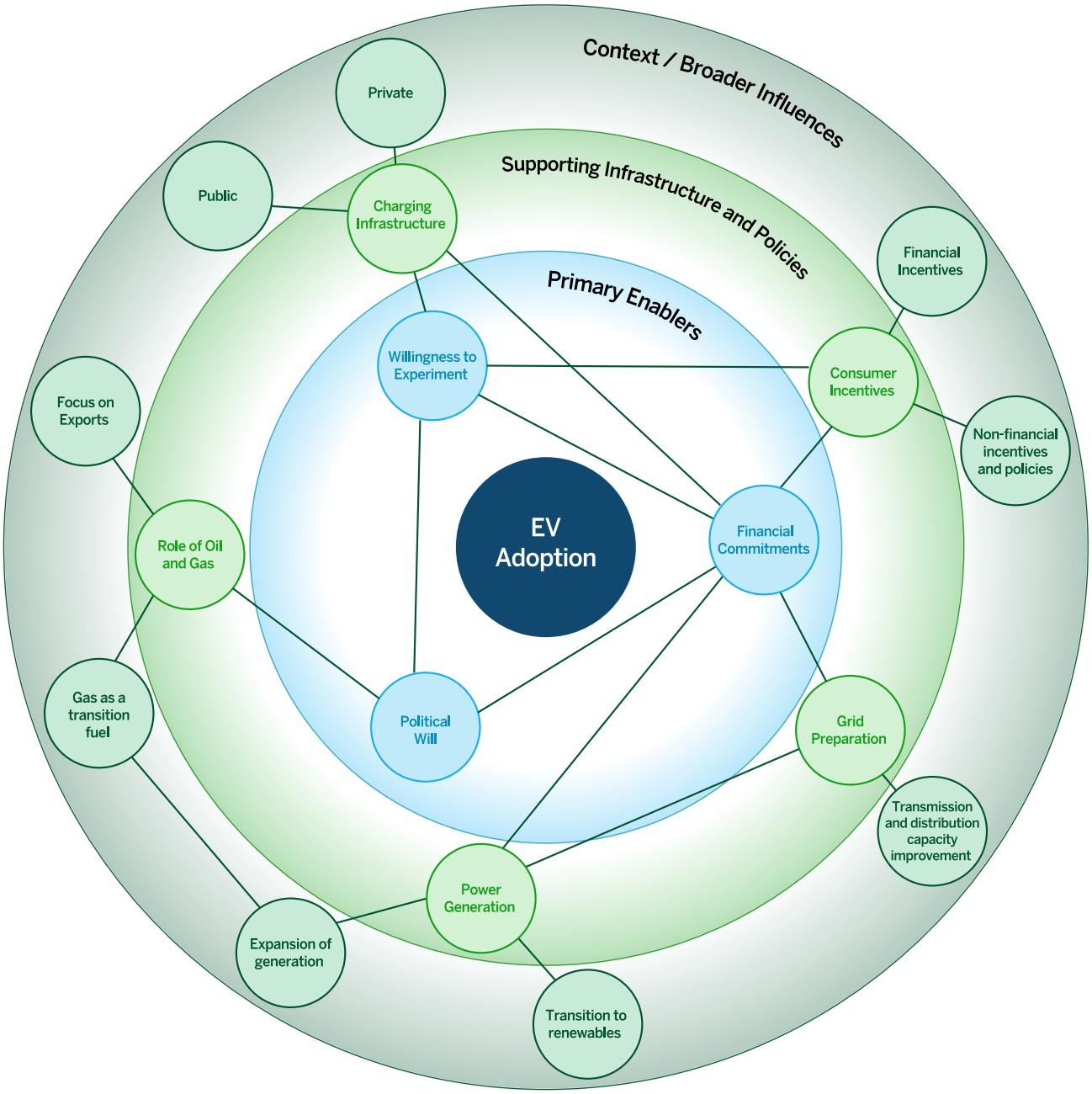
Lessons From Norway's EV Experience

Our analysis of Norway's EV experience highlights three key factors that were central to its successful EV transformation: **1) Willingness to Experiment** – in the absence of a proven policy blueprint and amid technological and market uncertainties, Norway embraced risk and remained flexible in its policy design for EV adoption; **2) Strong Political Will** – the government committed early on to a green transportation agenda, despite an uncertain path forward; and **3) Commitment to Financial Support** – this political resolve was backed by sustained funding and investment that enabled the transition to scale.

These foundational enablers catalyzed progress in five critical areas: the development of charging infrastructure, provision of consumer incentives, preparation of the power grid, expansion of electricity generation, as well as redefining the role of the oil and gas industry in the national economy and society (See Figure 7).

Through a combination of these factors, Norway addressed key barriers such as affordability, range anxiety, and infrastructure gaps. Its pioneering experience offers insights for designing actionable EV policies that can encourage scalable adoption, an area of importance for Canada and many other economies.

Figure 7
Norway's EV adoption strategy map



Willingness to Experiment with Policy

Today, Norway's achievements in EV adoption are well-known, but not many people recognize the experimental nature of the policies that drove this success. As an early pioneer in EV policy design, Norway began implementing various measures in the 1990s—a time when there was no certainty that EV technology would advance sufficiently to have practical use or that EVs would ever be affordable enough to compete with conventional cars.

Despite these challenges, Norway committed to ambitious initiatives, including significant investments in public charging infrastructure as early as 2009—years before mass-market EVs became widely available.

These investments, made without foreseeable returns, exemplified Norway's risk-taking approach to creating conditions for future EV adoption.

This willingness to experiment allowed Norway to refine its policies over time, retaining those that drove adoption and adjusting those that posed challenges. For example, EV access to bus lanes was restricted to vehicles with multiple passengers when congestion became an issue, and free parking for EVs was replaced with partial fees in some cities to address space shortages and revenue losses.

Political Will & Financial Commitments

Norway's decision to invest public funds in EV adoption early on reflects its strong political commitment to a successful EV transition, even as political power shifted over time. A social democratic government initiated the transportation electrification strategy, which was later expanded by a conservative administration in 2013, reflecting bipartisan support for environmental priorities.[89]

For many Norwegian voters, environmental protection was a key national priority.[90] However, when Norway began promoting EVs, there was resistance from various sectors, including the auto retail and oil and gas industries. Policymakers also faced backlash from other stakeholders and activists, sparking complex political debates.[90,91] One early concern was that wealthier individuals, who were more likely to afford EVs, disproportionately benefited from government incentives, while lower-income groups were left behind. Similarly, the "right to charge" bill required residents of apartment buildings to share the costs of charging infrastructure, which benefited wealthier EV owners, but placed a financial burden on lower-income residents who were less likely to own EVs.

Advocates for public transportation and car-free lifestyles also clashed with those supporting EV adoption, as issues like congestion, tire particle pollution, and parking shortages could not be solved by simply electrifying vehicles. Additionally, EV policies highlighted differences between urban and rural residents: those in remote areas faced challenges in using EVs due to longer travel distances and fewer charging stations.

Norway showed how perseverance in building consensus among stakeholders could drive significant progress in EV adoption. National leadership effectively implemented policies and awareness campaigns to educate citizens,[93] and engaged with Norwegian EV Association to address its concerns.[94] The government tax incentives supported manufacturers by creating favourable market for EVs as early as 1990s.[95] The Ministry of Transportation worked with energy companies to develop supportive policies, while the Norwegian EV Association helped members by sharing information on EVs, locating charging stations, and organizing test drives for interested drivers and, hosting international summits.[96] Regional governments aligned with national directives to support the overall strategy.

As EV adoption grew, the government introduced a progressive VAT to improve policy equity. Local municipalities now have more authority to adapt policies for local infrastructure needs related to EVs. The gradual phasing out of incentives, along with the introduction of new taxes on EVs, aims to balance government spending with the goal of continued EV adoption. In 2022, EV incentives were estimated to cost the government around US$4 billion, or 2% of its revenues.[97] With 174,329 new EVs registered that year, this translates to an average incentive of approximately $22,945 per vehicle.

Balancing EV Adoption with Oil and Gas Exports

Norway has managed to balance its position as a major oil and gas producer with its ambitious push for EV adoption by strategically separating domestic environmental policies from its export-oriented energy economy. While oil and gas exports remain central to Norway's economy, the government has used revenues from this sector to finance its transition toward a greener and more sustainable future.

A key component of this strategy is the sovereign wealth fund, which is funded mainly from oil and gas revenues and is invested in a diversified global portfolio, which includes sustainable assets and renewable energy projects. This fund has provided financial cushion, enabling Norway to support green initiatives and implement EV policies without constraining other government programs. Simultaneously, the long-term prospects of the oil and gas sector have been regarded as finite, further motivating the push for a more sustainable future.

Domestically, Norway has committed to reducing GHG emissions by imposing a carbon tax on oil companies, encouraging cleaner extraction practices, and investing in carbon capture and storage (CCS) technologies. Facilities such as Sleipner and Snøhvit are leading examples of CCS projects that mitigate emissions by storing carbon underground. These initiatives align with Norway's commitments to international environmental agreements, including the Paris Agreement, while supporting global climate resilience projects, such as deforestation reduction and renewable energy investments in developing countries.

To address criticism of its reliance on oil and gas exports, Norway has actively pursued economic diversification. Investments in technology, sustainable fishing, and tourism aim to reduce the country's dependence on fossil fuel revenues over time. Norway's multi-faceted approach—leveraging oil wealth to fund green policies, promoting EVs domestically, and gradually diversifying its economy—has enabled the country to create a striking balance between being a leading oil exporter and a pioneer in environmental and EV policy.

EV Adoption follows an S-Curve Pattern

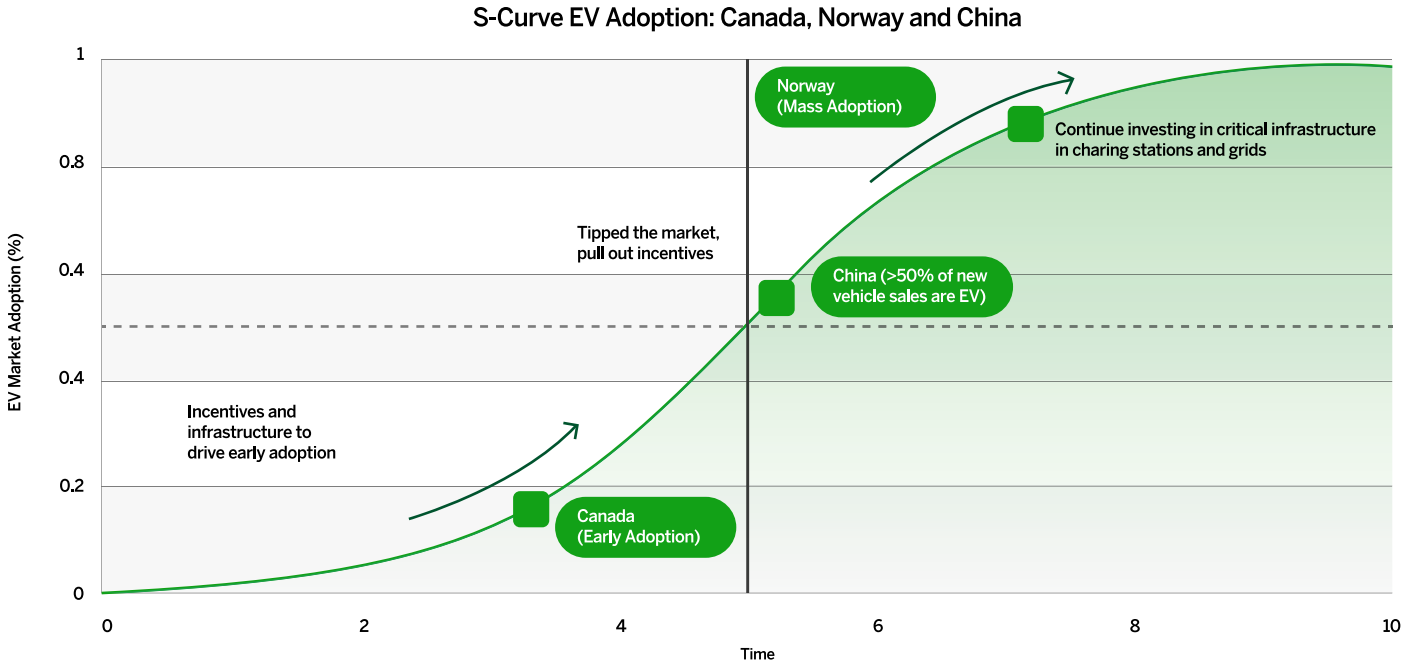
As shown in Figure 6, Norway's EV adoption rate over time follows the S-curve pattern, which comprises three distinct phases (see Figure 8). In the first phase, adoption begins slowly, driven primarily by a small group of early adopters. These individuals are primarily motivated by the technology itself and are less sensitive to factors such as price and the availability of complementary infrastructure (e.g., charging stations).

The second phase, marked by rapid growth, begins when the market reaches a tipping point. This mass adoption phase is triggered by overcoming critical barriers, such as reducing the cost of EVs to competitive levels and expanding complementary infrastructure. Adoption accelerates due to network effects – for example, higher EV usage encourages further development of charging infrastructure, which in turn reduces range anxiety and fosters more adoption, creating a reinforcing "virtuous cycle." During this phase, peer influence also plays a critical role, persuading hesitant consumers to adopt.
Eventually, the market enters a maturity phase where adoption plateaus, growth slows, and the technology becomes ubiquitous as the market nears saturation. However, if early barriers—such as infrastructure gaps and high price differentials—are not addressed, the transition to mass adoption can be significantly delayed. In such cases, the early adoption phase can stretch out significantly, delaying the tipping point and prolonging the transition to mass adoption.

Canada and many other advanced economies are still in the early adoption phase, grappling with the initial barriers to widespread EV uptake. In contrast, Norway reached the mass adoption phase earlier, though it continues to face challenges in scaling infrastructure and integrating EVs into its energy systems. Meanwhile, China's EV market has already tipped, with electric vehicles making up more than 50% of new car sales in 2024, driven by strong government policies, domestic manufacturing, affordability, and widespread charging infrastructure.[98]

Norway's experience demonstrates that EV adoption reliably follows the S-curve pattern, offering hope to other countries in their efforts to electrify vehicles. The S-curve adoption model is not unique to EVs; it has been observed in many other technologies and follows a predictable trajectory. For other economies that are in the first phase, the critical challenge is to overcome the initial hump, and Norway's experiences provide additional valuable insights for navigating this process effectively.

Figure 8
EV market adoption S-Curve for Canada, Norway, and China



Incentives to Grow EV Adoption

As EV adoption progresses, policies should transition from targeting early adopters to focusing on the broader population, where cost and convenience are primary considerations. In Norway, the tax exemption policies on EVs essentially increased the cost of ICEV relative to EVs. Additionally, non-financial benefits like preferred parking and toll exemptions amplified the appeal of EVs. Norway's experience underscores how non-monetary benefits can also amplify the impact of direct financial measures.

While Norway initially relied on substantial incentives to support early adoption due to the higher costs and limited practicality of early EV models, today Canada and other economies trailing in EV adoption have the advantage of greater availability of EV models with improved performance and pricing. This allows those countries to focus on bridging the remaining cost gap between EVs and ICEVs while investing in infrastructure and renewable energy to build consumer confidence and address concerns like range anxiety and grid readiness.

Clearly incentives have to be designed while keeping fiscal budgetary constraints. Interestingly, once the initial hump is overcome, and mass adoption picks up momentum, incentives can be phased out gradually to avoid revenue losses. Additionally, policymakers may consider spreading policy-induced benefits of owning EVs over the lifetime of a vehicle, rather than offering one-time, large payments (e.g. rebate), to alleviate immediate pressure on public budgets.

However, the experience of Sweden highlights the risks associated with premature incentive withdrawals. In 2022, Sweden ended its EV incentives program, which disrupted the momentum of EV adoption. Consequently, by 2023, the BEV market share fell to 42%, with hybrids accounting for 26.5%—a slowdown compared to the strong growth seen in the previous year, under the previous incentive regime.[100] Sweden's case emphasizes the importance of a gradual policy transition to ensure that consumer demand, market maturity, and infrastructure readiness are sufficient to sustain growth without subsidies.

Charging Infrastructure to Support EV Adoption

Investments in charging networks and grid capacity are critical to sustaining growth of EV adoption.[101] Studies show that a dense network of fast chargers significantly reduces this concern, making EV ownership more appealing.[102] However, infrastructure investments carry inherent risks, as they are fixed costs that may not yield immediate returns. At the early adoption stage, countries face a "chicken-and-egg" dilemma: insufficient infrastructure discourages EV purchases, while low EV adoption reduces private incentives to invest in infrastructure. Breaking this cycle is crucial to accelerating adoption and achieving countries' EV targets.

Norway took proactive steps by subsidizing the installation of chargers along highways and in remote areas where commercial viability was limited. Additionally, Norway supported housing associations and developers with installation costs and regulations to encourage shared investments in charging equipment. However, Norway's government offered minimal support for private home chargers, as these were not seen as significant barriers to EV ownership. Most EV owners relied on affordable Type 1 or Type 2 chargers, with minimal installation challenges. Type 1 charger often comes with the car at no cost and only requires a regular to North America 120V outlet, and Type 2 chargers cost around $500-$700 and require a 240V typical for Norway outlet.[103]

In contrast, Canada faces a compressed timeline for developing the necessary infrastructure. The availability of affordable and practical EV models may reduce entry barriers for consumers, but it places greater pressure on Canada to rapidly expand its charging networks to sustain momentum. Unlike other leading EV markets, Canada faces unique geographic and infrastructural barriers, as one of the highest per capita road mileages, vast rural areas, and limited charging infrastructure.

To maximize impact, initial effort should focus on densely populated regions such as the Quebec City-Windsor Corridor, Canada's most industrialized and populated region, spanning approximately 1150 km and home to nearly half of the country's population. In this corridor, charging infrastructure development is more viable due to concentrated demand. However, rural and remote regions require targeted strategies, as range anxiety remains a major barrier for prospective buyers, underscoring that for the foreseeable future PHEVs need to be a key component of EV policies for these areas. Canada's EV strategy must account for regional variations, balancing full electrification in high-density areas with hybrid solutions where infrastructure limitations may persist.[104]

Integrating Renewable Energy and Grid Modernization

Infrastructure development and grid modernization are interconnected priorities for EV adoption. Norway's strategy integrated EV growth with renewable energy expansion, aligning with the country's long-term sustainability goals.

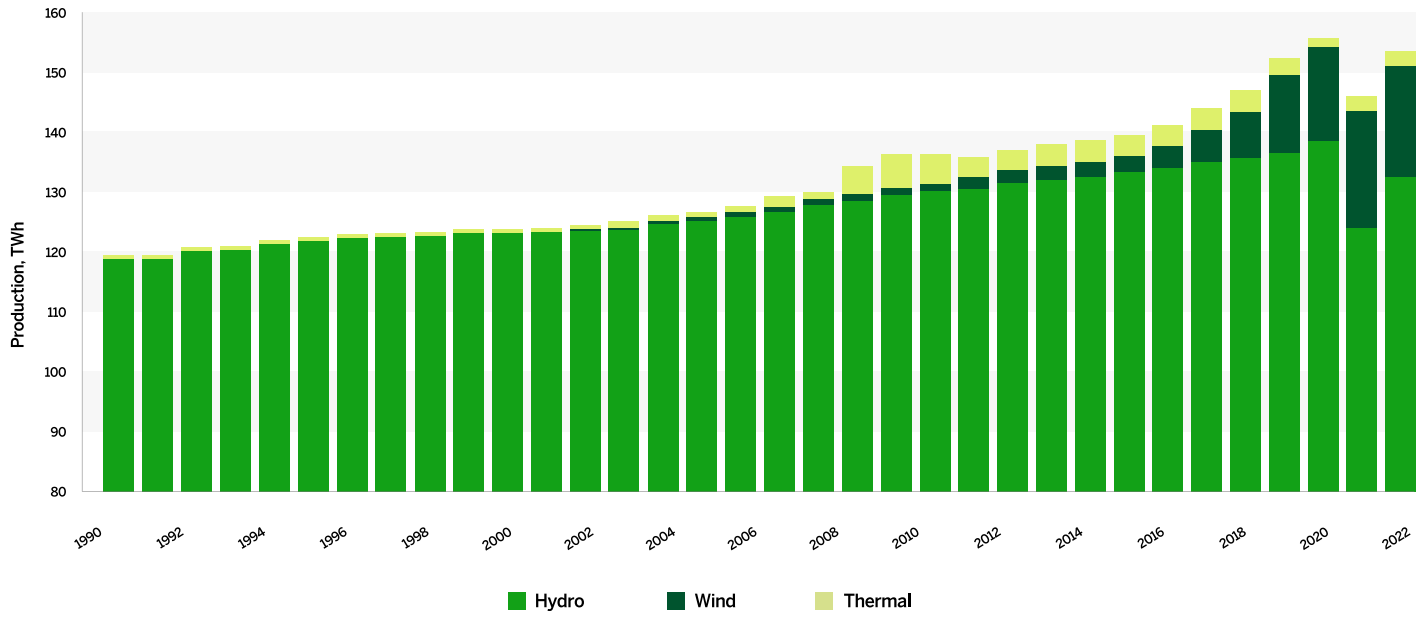
Canada faces a similar challenge but on a much larger scale. With electricity demand projected to triple by 2050, some studies suggest that Canada will require significant investments (about CAD 1.1 trillion) in grid capacity, renewable energy generation, and energy storage.[105] In provinces like Ontario and Quebec, where low-carbon grids are already established, electrifying road transportation offers significant potential for reducing GHG emissions.

Figure 9 shows power generation in Norway from 1990 to 2022. The country accelerated expansion of wind generation capacity after 2010 to satisfy growing demand from households and industrial consumers. Further, both government owned and private companies are investing significant capital in generation projects. For example, just in 2024, Statkraft committed $6.6 billion on upgrades of hydroelectric plants and wind farms,[106] while Equinor is investing $34.2 billion in renewable energy farms.[107]

Despite the efforts, Norway's variability in weather patterns has occasionally disrupted energy output. For instance, reduced rainfall in 2022 lowered inflows into hydro reservoirs. Canada, and other nations, must similarly anticipate and mitigate the challenges posed by renewable energy variability, particularly as EV adoption places additional demand on the grid.

Norway's experience underscores that the demands of a growing EV fleet extend beyond initial adoption phases, suggesting that infrastructure development, including charging and grid modernization, must remain an ongoing process, even as EV adoption reaches mass-market levels.

Figure 9
Production of electricity (GWh) in Norway, by contents and year



Conclusion

Norway's remarkable success in EV adoption provides a powerful narrative of what is possible when ambitious goals are matched with strategic, long-term policy interventions.

Norway's remarkable success in EV adoption provides a powerful narrative of what is possible when ambitious goals are matched with strategic, long-term policy interventions.

Central to this success were three factors: a willingness to pioneer and refine policies without a pre-existing blueprint, a strong political will to champion green transportation despite uncertainties, and a sustained financial commitment to fund critical incentives and infrastructure. Norway's experience underscores the importance of bold, early action in enabling the transition to sustainable transportation.

By addressing barriers such as affordability, range anxiety, and infrastructure deficits early, Norway set the stage for widespread EV adoption. Key measures—like tax exemptions, toll waivers, and substantial investments in charging infrastructure—were instrumental in overcoming these challenges.

As this report demonstrates, the transition to EVs follows a predictable diffusion pattern once the tipping point of mass adoption is reached. Countries on the cusp of this threshold, like Canada, have a unique opportunity to accelerate their progress by learning from Norway's key successes and challenges.

However, the Norwegian example is not a one-size-fits-all solution. For countries, including Canada, the path to widespread EV adoption requires a nuanced approach adapted to its economic, political, and geographical realities. Canada can pursue a regionally adaptive strategy—scaling up charging infrastructure in urban centers and high traffic corridors, while creating targeted solutions for rural and remote communities.

The global race toward transportation decarbonization is accelerating, and it is reshaping the future of mobility and industrial competitiveness. While shifting policies in North America have introduced new uncertainties and made the prospects for EV manufacturing and adoption more challenging, Canada retains significant enduring advantages: world-leading reserves of critical minerals, a resilient manufacturing sector, and a highly skilled workforce poised to drive the next industrial transformation.

Although an analysis of how Canada can best navigate these headwinds lies beyond the scope of this report, it is clear that success will depend on aligning domestic ambitions with global momentum, investing boldly in innovation and infrastructure, and charting a course that secures long-term competitiveness within and—critically important beyond—the traditional North American framework.

The road to net-zero transportation emissions is challenging, but Norway's journey shows it is achievable. With focused efforts and a willingness to adapt, countries can overcome their specific obstacles and join Norway in paving the way toward an electrified future.

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