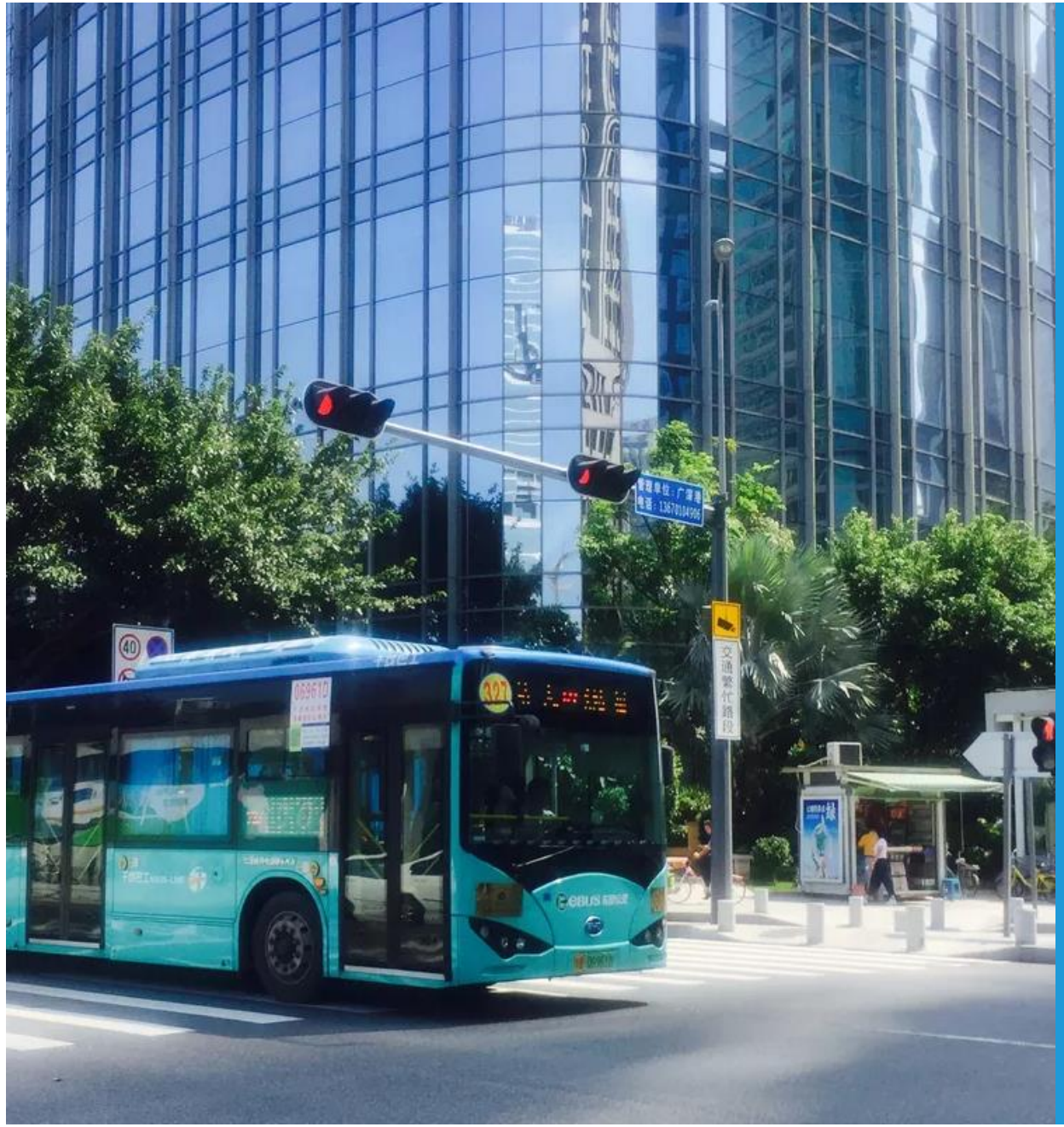


International comparison sustainable transport approach

Insight in similarities and differences between three frontrunners on zero emission (electric) transport

28 May 2020

Table of contents

I. Introduction and approach

In order to reach climate targets and combat congestion and local air pollution, a shift is needed towards smart and sustainable mobility. Although numerous countries, regions and cities are actively engaged in this topic, they all have their own characteristics and challenges when it comes to sustainable transport. Therefore, every strategy and policy aimed at achieving zero emission transport is different.

It is interesting to see how different countries, regions and cities approach zero emission transport and how they can improve and learn from each other's policies and incentives. This report provides an insight in three global frontrunners in the transition on three different levels: The Netherlands (national), California (regional) and Shenzhen (local). The report identifies their best practices, what they share and where they differ in their approach to achieve sustainable transport.

Figure 1 gives an illustrative overview of the approach. We have identified three types of policy measures that have to be met in order for a sustainable mobility approach to succeed. First of all, there should be government leadership, which makes sure that there is a clear vision, there are set targets, ambitions are formulated and measures are enforced to stimulate sustainable transport. Secondly, policy measures should be taken in order for the fleet of vehicles to grow. Finally, there should be an adequate infrastructure to charge these vehicles.

In order to narrow the scope of sustainable transport, the comparison focuses on three different groups: (i) passenger cars, (ii) freight and logistics, and (iii) ports. These different groups also represent three stages of the transition. The uptake of passenger cars is slowly moving from infancy to expansion, whereas sustainable freight and logistics have only recently become a focus area. Ports might be the next area where electrification could have a big impact and therefore this subject is included in the analysis as well.

This report starts out with an introduction of the three frontrunners, providing some context on their current government leadership, fleets and infrastructure. This is followed by an overview of the policy measures that are taken regarding passenger cars, freight and logistics, and ports. Next, the main analysis is presented which consists of a comparison between the policies of the frontrunners and an insight in the major similarities and differences. The report is concluded with more in-depth information on the analysis.

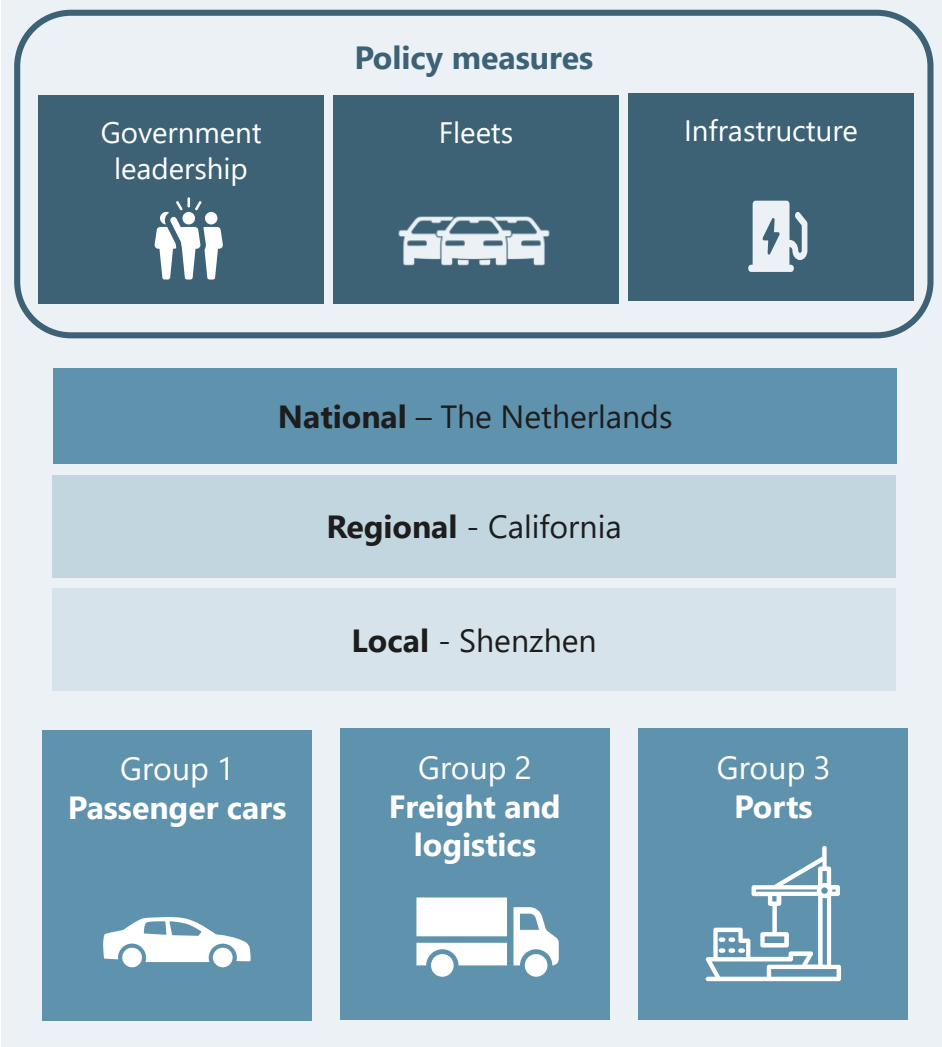
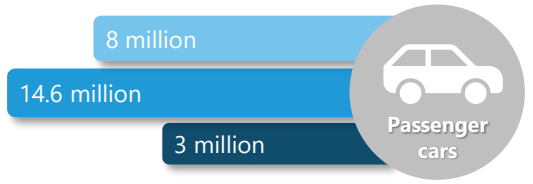


Figure 1: Illustrative overview of components of international comparison

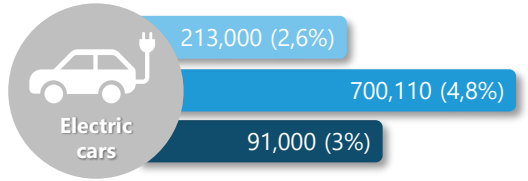
II. Context (1)

This chapter provides insight in the three frontrunners and the current situation regarding government leadership, fleets and infrastructure. Whereas this page focuses on the fleets and infrastructure, the next page goes into detail on the government leadership.



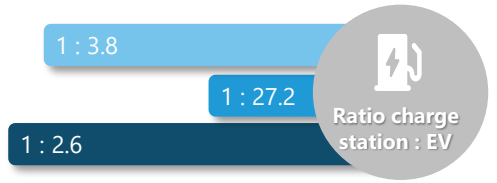
The Netherlands

The Netherlands, a country with 17 million inhabitants, has been working hard since 2010 to roll out electric transport. Today, they have a fleet of over 116,000 battery electric vehicles (BEV) and almost 98,000 plug-in hybrid electric vehicles (PHEV). The country has one of world's densest charging infrastructure networks, with one charging point for every 3.8 electric vehicles (both BEV and PHEV). Private and public parties have created an open and competitive market model for charging infrastructure. Furthermore, there are national agreements on interoperability. This makes it possible to charge at any public charge point in the Netherlands with a single charging pass. The Netherlands is advocating the implementation of this interoperability elsewhere in Europe as well so the 'borders' for electric driving will disappear.



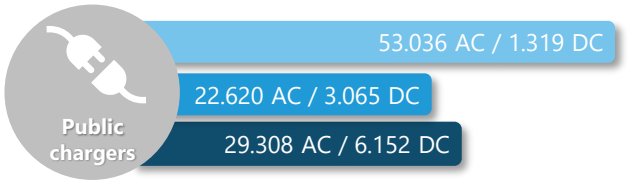
California

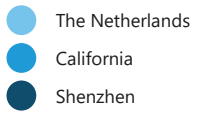
California, a state with 39.5 million people, implemented a unique combination of laws, incentives, regulations and funding opportunities for sustainable mobility. Examples include the state's Zero Emission Vehicle regulation, consumer rebates, access to carpool lanes on congested highways, extensive electric vehicle charging infrastructure, progressive electric utility policies, greater model availability and marketing, and continued growth of local electric vehicle promotions. Currently there are over 700,000 EVs on the road (4.8% of total) and over 24,000 charging points. This is the largest network of publicly accessible charging stations in the United States and is strongly supported by the state. Next to electric vehicles for consumers there is a strong focus on freight, with a combination of supporting measures and mandates. This had led to a much faster uptake of electric vehicles than elsewhere in the United States and most other places around the world.



Shenzhen

In 2010, Shenzhen (12.5 million people) was appointed as one of the eight low-carbon pilot cities by the Chinese government. The carbon-trading scheme, already implemented in 2013, shows that Shenzhen is a frontrunner. When it comes to sustainable transport, Shenzhen is one of the most aggressive cities in government efforts promoting electric cars with a broad scope of policy actions. An example of this is the targeted approach to achieve electric cars in the public transport sector, which has resulted in 16,359 electric transit buses and almost all 21,000 commercial taxis being battery-electric. Shenzhen's policy has led to 91,000 so-called New Energy Vehicles (NEV), which is a collective name for both BEVs and PHEVs. Especially its DC-charging network has seen a large increase, partly due to subsidies that stimulate the roll-out of "concentrated" charging locations with high cumulative charging power.





II. Context (2)

The timeline below aims to provide insight in the government leadership of the three frontrunners. It shows their ambitions and targets up to 2050.

2020

California
- 250,000 electric vehicle charging stations

The Netherlands
- Zero-emission zones for city distribution in 30-40 large municipalities
- Zero-emission city logistics
- All new public transport buses zero emission
- School buses/target group transport is zero emission in 32 municipalities

Shenzhen
- 25% of vehicles sold should be New Energy Vehicles (BEV, PHEV)
- 'Made in China 2025' aims for domestic carmakers to sell 3 million EVs a year

Shenzhen
- Aim to cut all CO_2 emissions in the public transport sector
- All ride-hailing services must use a fleet of electric vehicles
- Action Plan to Control Air Pollution from Ships and Ports (2015-2020) aims to reduce shipping air pollution in three coastal port clusters by up to 65% by 2020

California
- ZEV Requirement for car production
- All California state agencies must support the commercialization of ZEVs
- CARB develops fleet emissions requirements

2030

California
- All airport shuttle fleets must be 100% ZEV
- Advanced Clean Trucks standard (draft): 300,000 electric trucks on California's roads

California
- Goal of 5 million ZEVs on the roads
- Deploy over 100,000 zero-emission freight vehicles and associated equipment

The Netherlands
- All new cars sold are zero-emission
- Reduction of 7.3 megatons of CO_2 in the mobility sector compared to 1990
- There is adequate charging infrastructure for ±1.9 million electric vehicles
- All public buses and cleaning vehicles are zero-emission

2040

California
- All public transit agencies have 100% zero-emission buses

The Netherlands
- All port journeys by car or truck over short distances are zero-emission in the Port of Rotterdam

California
- Reduce port-related GHG emissions by 80% in the Port of Los Angeles

The Netherlands
- 95% reduction of CO_2 in the mobility sector compared to 1990

2050

III. Overview of sustainable transport policies

III. Overview of sustainable transport policies (1)

			Policy instrument		
	Policy measure	**Subcategory**	*The Netherlands*	*California*	*Shenzhen*
Passenger cars 	**Government leadership**	Ambition	• All new cars are emission-free by 2030 and there are 1.7 million charging points • Aim to emit 49% less greenhouse gases in 2030 than in 1990. The mobility sector must reduce 7.3 megatons of CO_2 with electrification of transport playing an important role	• California has a goal of 5 million ZEVs on the roads by 2030 and 250,000 electric vehicle charging stations by 2025 • All California state agencies must support the commercialization of ZEVs • ZEV Requirement for car production	• China has set the target that by 2025, 25% of the vehicles sold should be New Energy Vehicles (BEV, PHEV, FCEV) • The 'Made in China 2025' plan aims for domestic carmakers to sell 3 million EVs a year • Shenzhen aims to cut all CO_2 emissions in the public transport sector by 2020 • All ride-hailing services must use a fleet of electric vehicles
	Fleets	Monetary measures	• Lease car drivers can take advantage of tax breaks, tax deduction and subsidies • Purchase subsidy for all consumers for new and used electric vehicles (only BEV)	• Vehicle Rebates • Voluntary Vehicle Retirement and Replacement Incentives • Sales and use tax exclusion to manufacturers that promote alternative energy and advanced transportation • Major utilities have their own support program	• Subsidy to manufacturer and supplier • National and local subsidy for private and commercial buyer • Subsidy for public transport companies (bus and taxi) • Tax incentives • Toll road privilege • Privileges for accident insurance
		Complementary measures	• By 2025, there are zero-emission zones for city distribution in 30-40 municipalities	• High Occupancy Vehicle (HOV) and High Occupancy Toll (HOT) Lane Exemption for electric vehicles • Mandatory Volkswagen ZEV Investment Plan • Special parking rules for ZEV • Public information campaigns with Veloz	• Free (curbside) parking in the city • Car number plate lottery
	Infrastructure	Charging infrastructure	• EV-drivers can request a public charging point for free in the majority of the municipalities • A reduction in the energy tax for public charging stations until 2021 • Obligation from 2025 to install charging infrastructure in buildings with more than 20 parking places	• Finance for charging infrastructure • "Right to charge" laws provide residents at multi-unit dwellings with the right to install a charging station for the individual's use • Regional rebates are often available for the purchase of charging points	• Newly built commercial buildings and parking places reserve at least 30% of these places for EV charging

III. Overview of sustainable transport policies (2)

			Policy instrument		
	Policy measure	**Subcategory**	*The Netherlands*	*California*	*Shenzhen*
Freight and logistics 	**Government leadership**	Ambition	• EU CO_2 reduction target of 30% by 2030 (revision in 2022) • Public bus transport is zero-emission at the exhaust in 2030 • By 2025 city distribution is zero-emission • By 2030 all cleaning vehicles are zero-emission	• CARB proposed to mandate 100,000 zero emission freight vehicles and associated equipment by 2030 and 300,000 electric trucks on California's roads in 2035 • By 2035, all airport shuttle fleets must transition to 100% ZEVs • By 2040, all public transit agencies have 100% ZE-buses	• China has set the target that by 2025, 25% of the vehicles sold should be New Energy Vehicles (BEV, PHEV, FCEV) • Since 2018, all newly-registered vehicles must be electric
	Fleets	Monetary incentives	• Co-financing subsidy scheme for investments in ZE vehicles (DKTI) • Subsidy scheme for delivery vans	• Low Emission Truck and Bus Purchase Vouchers, fleet rebates and tax exemptions • Heavy-Duty Vehicle Emissions Reduction Grants	• Local purchase subsidy that matches national subsidy • Fleet operation subsidy
		Complementary measures	• Favorable delivery windows for ZE logistics for city distribution • Use of public bus and taxi lane • By 2025, there are zero-emission zones for city distribution in 30-40 municipalities	• Heavy-Duty Truck and school buses Idle Reduction Requirement • Funding for research, development, demonstration, pre-commercial pilot, and early commercial implementation projects	• Operation 24/7 and access to green logistics zones • Free (curbside) parking in the city
	Infrastructure	Charging infrastructure	• Co-financing subsidy scheme for investments in charging infrastructure (DKTI)	• EV equipment loan financing and rebate program • A tariff specific to heavy-duty PEV fleets that encourages PEV charging when there is excess grid capacity	• Infrastructure installation subsidies and preferential electricity prices
Ports 	**Government leadership**	Ambition	• By 2040 all port journeys over short distances are zero-emission in the Port of Rotterdam • The Port of Rotterdam is looking at setting up the largest green hydrogen plant of Europe	• The Port of Los Angeles (POLA) has the goal to Reduce port-related GHG emissions by 80% by 2050	• Action Plan to Control Air Pollution from Ships and Ports (2015-2020) aims to reduce shipping air pollution in three coastal port clusters by up to 65% by 2020
		Incentives	• Environmental zones for freight traffic	• CARB has policies for diesel emission control strategies and vehicle replacements in ports • CARB has awarded $41 million dollars to the POLA for 10 heavy-duty hydrogen fuel-cell-electric trucks and 2 hydrogen stations • Environmental zones for freight traffic	• Incentive scheme to encourage vessels to switch to low sulphur fuels or to connect to shore power whilst berthed at the region's ports

IV. Main findings analysis

IV. Passenger cars

Similarities

Start with electrifying public fleet

In Shenzhen there is a focus on electrifying the public fleet first (e.g. bus and taxi) and in parallel encouraging passenger EV uptake. In the Netherlands the initial focus was on lease car drivers, but also ambitions have been put in place to electrify the bus and taxi sector. Electrifying the public fleet can be seen as 'free marketing' as the technology is showcased, and people get a glimpse of what zero emission transport is like.

Combination of different policy instruments

All three frontrunners work with a combination of subsidies, rebates, quotas for vehicle manufacturers and tax exemptions to decrease the price of electric vehicles and stimulate the sales of electric vehicles. These are either implemented by themselves or by an overarching governmental organization (e.g. EU).

Car manufacturers are forced to change

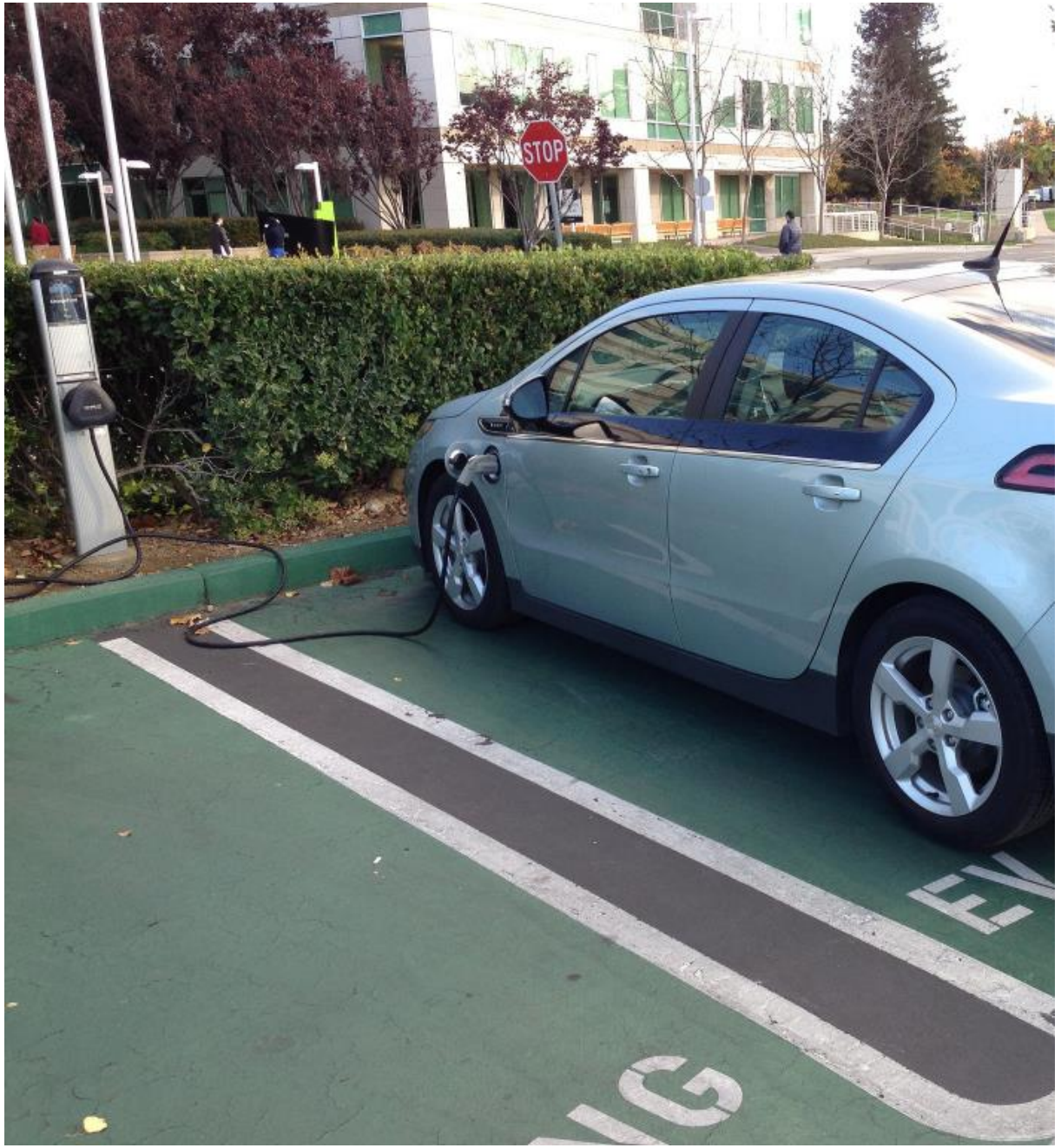
By setting sales targets, policy makers in all three regions force car manufacturers to change their production and transform their company. This mandatory shift is one of the reasons almost all major car makers now have their own electric car lines.

Uniform paying solutions

China and the Netherlands focus on high interoperability by mandating certain protocols for charging infrastructure. This in turn has led to better uniform payment methods and data sharing between different charge point operators. CARB in California is also considering to adopt new regulation that would ensure that all drivers of EVs are able to access public charging stations regardless of a membership or subscription.

Together with sustainable mobility comes an EV industry

All three regions are economically successful in the field of electric mobility. Local companies, such as BYD, EVBox and Tesla, flourish because of the transition to sustainable mobility. These companies employ an increasing number of people, making the sector increasingly economically relevant.



IV. Passenger cars

Differences

Eligibility requirements for subsidies

Chinese subsidies require a minimum battery energy density and battery range, whereas subsidies in The Netherlands are available to all battery-electric vehicles and only capped by the purchase price of a vehicle.

Sustainable transport available to all

California is focusing on public support to achieve the transition to sustainable mobility. They have developed subsidies for low income households and are very active with public information campaigns.

Spatial planning of charging infrastructure

In Shenzhen, “concentrated” charging stations receive a preferential electricity rate. Due to certain subsidy requirements, this puts fast-charging stations at an advantage. The Netherlands focuses on obtaining a nation-wide charging network which is scattered rather than clustered and has a balance between slow and fast charging. Smart procurement, where municipalities cooperate in their procurement process, has led to a large regional roll out of charging infrastructure at low costs.

Withdrawing movement from the US federal government

Due to a dip in the number of sales, China has decided to extend national subsidies beyond 2020. In the Netherlands, there is a supporting structure up and until 2024. Although the US federal government supported EV car manufacturers with a tax credit, they have decided that the measure is not extended in 2020. Currently there are no plans for new supporting measures. States like California are trying to fill the gaps created by the retreating movement of the federal government.

Electrify America

Electrify America is one of the largest open charging networks in the United States. It is a subsidiary of Volkswagen and established as part of its efforts to offset emissions in the wake of the Volkswagen emissions scandal.

IV. Freight and logistics

Similarities

Stimulating sustainable freight with zero-emission zones

In Shenzhen zero-emission trucks are able to operate at all hours and days of the week and have access to so-called 'green logistics zones' and delivery and shipping routes specifically destined for zero-emission vehicles. The Netherlands has a similar policy, where delivery windows of cities are expanded for sustainable distribution vehicles. Currently this also includes fossil-fueled vehicles (Euro VI and higher). From 2025 onwards, 30 to 40 municipalities will introduce zero-emission zones for city distribution with more stringent conditions.

Reduction of higher upfront costs

In both Shenzhen and California, purchase incentives are offered. In Shenzhen, transit operators are given the opportunity to lease a vehicle rather than pay for the full upfront cost. California's HVIP program provides cost reductions through a voucher system. The Netherlands is developing a subsidy scheme for delivery vans.

Funding available for research

For some sectors, the current technology is still far from sufficient for a complete transition to electric. That is why governments are committed to innovation and development. Large budgets are available for this in all three regions.

Stick and the carrot for public transit companies

Public transit companies in California, the Netherlands and Shenzhen are obligated to electrify their fleet. There is a strong pressure from the government for public transit companies to change their fleet. In Shenzhen there are financial measures to support these companies and in the Netherlands transit companies are required to electrify their fleet through transit tenders.

Differences

Operational subsidy standards

Shenzhen is the first Chinese city to carry out operational subsidy standards. Fleets that own 300 or more trucks and at least 100 electric light vehicles (ELVs) can earn the subsidy if each truck has a mileage of more than 15,000 kilometers.

Price parity between slow and fast charging

In Shenzhen, the price at public fast and residential slow chargers is almost equal. This has resulted in a strong preference for fast charging to charge ELVs, which, while convenient for drivers, requires significant investments in the grid. In the Netherlands, residential charging is the cheapest, followed by public (slow) charging and then fast charging.

Reliability of charging infrastructure

At the start of charging network deployment in Shenzhen, there was no planning process to select sites for chargers. Operators 'claimed' spots by placing chargers without connecting them to the grid. Furthermore, the charging market is highly fragmented with many small players that are financially unstable which results in a high share of nonfunctional chargers. In the Netherlands, agreements are laid down that charging infrastructure should have a specific uptime. If an operator does not meet these requirements, he is penalized.

Vehicles manufacturers are forced to change

Manufacturers of freight vehicles are forced to develop electric vehicles in China and California. There are set quota that manufacturers should meet. The EU does not obligate its vehicle manufacturers to meet a certain quota.

IV. Ports

Similarities

Innovation is essential to reach targets

While more and more machines at ports are becoming electric, currently the biggest challenge is to make large vessels and ships more environmentally friendly. At this moment electric container trucks are not yet a viable option. To change this there are investments available for research and pilots in the Netherlands, California and Shenzhen.

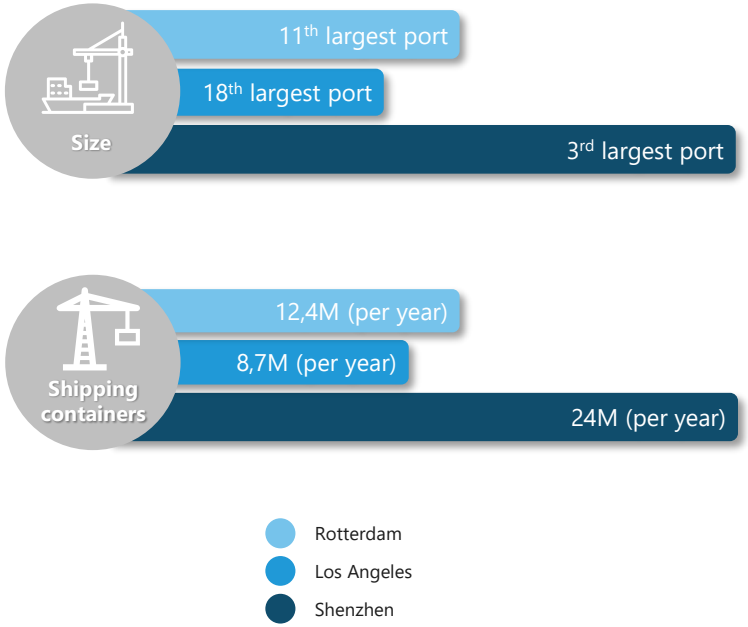
Global emission reduction as driver

Targets to improve the sustainability of the ports are mostly based on general government policies on carbon reduction. If targets are formulated already, they seem to focus on the far future (2040 or 2050). They are not as concretely formulated as for passenger cars and freight and logistics. The role of the central government seems larger, as economic impact plays an important role.

Differences

Role of hydrogen

While both the ports of Rotterdam and Los Angeles are interested in the combination of hydrogen and mobility, their focus is different. Rotterdam currently sees hydrogen as an important way to make industry at the port more sustainable. Los Angeles is currently experimenting with hydrogen trucks.



V. In-depth information

V. The Netherlands

Ambitions and goals

In 2019, the national Climate Agreement was presented in order to combat climate change. The goal is to emit 49% less greenhouse gases in 2030 compared to 1990. The government aims for all new sold passenger cars to be zero-emission by 2030.

There are large local and regional differences as to how the Climate Agreement is implemented. In the City of Amsterdam, for example, cars and motorbikes that run on fossil fuels will be banned from the city from 2030 onwards. This is one of the policy measures in order to combat local air pollution.

The Netherlands can be seen as one of the frontrunners in the field of sustainable and electric mobility, illustrated by the following examples:

- Dutch trains, subways, and trams are 100% electric and entirely powered by wind energy.
- The country has one of the largest zero-emission bus fleets in the world. It aims for all *new* buses to be zero-emission by 2025 and *all* buses to be zero-emission by 2030.
- The first electric taxi service worldwide was initiated at Schiphol Airport.

Charging network

The Netherlands is internationally regarded as a major player in the field of electric mobility. In 2018, the Netherlands, together with Norway, Iceland, Sweden and China, was among the five countries in the world where electric passenger cars accounted for more than 1% of the total fleet.

The Netherlands has invested heavily to build an infrastructure for electric vehicles. Currently there are over 50,000 public charging points. The Climate Agreement aims for a sufficient charging infrastructure in 2030 to accommodate the approximately 1.9 million electric vehicles. Thanks to an early developed market, Dutch companies have laid a solid foundation for offering products and services in the sector.

The Netherlands advocates open standards and protocols. Ten years ago, the argument for a universal charging plug was the Netherlands' first achievement when it comes to open standards. The Netherlands has since shown itself to be a true champion of standardization also outside of the Netherlands. Through the efforts of the eViolin partnership, for instance, it is possible to charge at any public charge point in the Netherlands with a single charging pass. As this initiative is gaining ground internationally through e-clearing.net, the Netherlands is advocating the implementation of this interoperability elsewhere in Europe as well so the 'borders' for electric vehicles will disappear.

Smart procurement

The Netherlands is an urban patchwork: from large cites to the countryside and small rural villages. Not every municipality has the opportunity to arrange charging infrastructure themselves, because of their local capacity and costs. Therefore in multiple occasions, a cooperation with market parties and charge point operators (CPOs) has been initiated for the public procurement of charging infrastructure. Because of the scale of these tenders, market parties have been increasingly willing to invest. This has led to low prices for charging with no public investment needed.

Business opportunities

Within Europe, Dutch companies are at the forefront when it comes to developments in the EV sector. Between 2017 and 2018 the turnover in the Dutch EV market has increased by 44% to EUR 1.3 billion. This has resulted in a significant growth in the number of jobs in this sector. At the end of 2019 there were about 4290 jobs.

Dutch companies are at the forefront of the development of charging infrastructure. For example, the OCPP protocol has also been developed in the Netherlands, EVBox is an innovative producer of charging stations and the Dutch company Fastned is realizing a European network of fast chargers.

V. California

ZEV Mandate

The Zero-Emission Vehicle (ZEV) program is part of the California Air Resources Board's (CARB) Advanced Clean Cars package of coordinated standards that controls smog-causing pollutants and greenhouse gas emissions of passenger vehicles in California. The ZEV regulation is designed to achieve the state's emission reduction goals by requiring car manufacturers to sell specific numbers of zero emission vehicles.

Because the ZEV regulation is a credit requirement, it is difficult to exactly predict the number of vehicles that will result from the regulation. Updated estimates using publicly available information show about 8% of California's new vehicle sales in 2025 will be ZEVs and PEVs. Because of the economic importance of the region, this measure has had an impact across the state borders. Currently twelve states have adopted California's ZEV regulations, as well as low-emission vehicle regulations, and multiple other states are expected to join in the near future. Together with California, these states represent around 30% of new car sales in the United States.

Role federal government

In 2011, President Obama predicted that there would be 1 million electric vehicles on U.S. roads by 2015. His forecast was supported with a program where electric vehicles were eligible for a federal tax credit of up to $7,500. These credits were available for the first 200,000 customers of each car company producing eligible vehicles. Both GM and Tesla have already hit 200,000 EV sales and the U.S. Congress has declined to extend or broaden this support and no new policies are being developed at the moment.

Freight

CARB in a partnership with CALSTART, launched the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) to accelerate the adoption of cleaner, more efficient trucks and buses in California. From its inception in 2009, more than $589 million has been allocated to HVIP.

Furthermore CARB proposed the Advanced Clean Trucks standard. The proposal will put roughly 100,000 and 300,000 electric trucks on California's roads in 2030 and 2035, respectively, out of approximately 1.8 million and 1.9 million total trucks expected in those years.

Promoting EV

Electrify America is one of the largest open DC fast charging networks in the United States. It is a subsidiary of Volkswagen Group of America, established by the car manufacturer as part of its efforts to offset emissions in the wake of the Volkswagen emissions scandal. Electrify America is also tasked to increase education and awareness of zero-emission vehicles through brand-neutral outreach, discover-and-drive events, and other marketing approaches.

Another important organization that is promoting EV in California is Veloz. This is a diverse group of action-leaders from key sectors, Fortune 500 companies, public agencies and nonprofits, focused on accelerating the shift to electric cars. They try to do this through public-private collaboration, public engagement and policy education innovation.

The California Energy Commission has the goal of 100 percent clean energy. As the state's primary energy policy and planning agency, the Energy Commission plays an important role in the energy transition and has a strong focus on clean mobility.

Tesla

Tesla is an American electric vehicle and clean energy company based in Palo Alto, California. The company specializes in electric vehicle manufacturing. After 11 years in the market, Tesla ranked as the world's best-selling plug-in as well as best-selling battery electric passenger car manufacturer by cars sold in 2019, both as a brand and automotive group, with a market share of 17% of the plug-in segment and 23% of the battery electric segment. Tesla's global vehicle sales increased 50% from 245,240 units in 2018 to 367,849 units in 2019. On March 9, 2020, the company produced its 1 millionth electric car.

V. Shenzhen

Technical eligibility requirements subsidies

The city of Shenzhen has set technical eligibility requirements to be granted a purchase subsidy. Electric cars and trucks should have a minimum battery energy density of 115 Wh/kg and a minimum battery range requirement of 150 km. Additionally, Shenzhen is the first to carry out operational subsidy standards for electric logistic vehicles. In order to avoid wasting subsidies on vehicles that are never used, it is required that a truck travels a minimum of 15,000 kilometers a year.

Zero emission zones

Shenzhen has initiated zero-emission zones. Zero-emission trucks are able to operate at all hours and days of the week and have access to "green logistics zones" and specific delivery and shipping routes. This priority access represents a significant advantage for electric logistics vehicles in terms of operational efficiency and improved customer service.

Purchase incentives buses

In order to replace its public fleet with zero-emission buses, Shenzhen has introduced an innovative business model. This model enabled transit operators to lease, rather than buy, the vehicles and therefore avoiding the high upfront costs. Furthermore, manufacturers provide free life-time maintenance and battery change support for the vehicle operators, which greatly relieves the operator's concern and reduces the cost during vehicle usage. This consequently improves the cost competitiveness of electric buses. Electric cars and trucks also have longer warranties than internal combustion engine vehicles (ICEV).

Subsidy charging infrastructure

In order to be granted subsidy for charging infrastructure, the cumulative charging power installed should be 8,000 kW or more. This means that only large-scale players are able to meet this requirement. Furthermore, "concentrated" charging stations receive a preferential electricity rate. A charging station qualifies as concentrated if it has at least three chargers with a total capacity of at least 350 kW and a minimum of a three-year contract with the parking lot where they are located. This requirement puts fast-charging stations at an advantage, because fewer fast chargers are required to meet the capacity threshold. Instead of a well-balanced city-wide charging network, this results in fast charging hubs that form a mismatch with charging demand.

Price parity slow and fast charging

The price of electricity increases with total load at residential places. Especially when charging a logistic vehicle, this could lead to high prices. These prices are almost equal to off-peak rates from fast chargers. Although this has a large impact on the grid, it is therefore more attractive to use fast-charging during off-peak hours than charge at home.

Planning of charging infrastructure

At the advent of electric mobility, there was no planning process to select locations for charging infrastructure. Charge operators were allowed to put chargers on any land they were able to secure rights to and "save" spots. However, a large number of charging stations was never connected to the electricity grid. Furthermore, the market of charging infrastructure in Shenzhen is highly fragmented and knows many small players that do not always have a profitable business. These two things lead to a high share of nonfunctional chargers.

Given that land availability is one of the most significant challenges for an efficient layout of the charging infrastructure, especially in Shenzhen's urban area, it is recommended to start with early and smart planning to avoid waste and improve the usage of charging stations.

License plate quota system

In order to combat air pollution and relieve severe congestion, Shenzhen imposes a limit on total new vehicle registrations. New vehicle owners must enter a lottery or auction system to be able to obtain a license plate. Electric cars are either exempted or treated preferentially in this quota system.

Colophon
This report with an international comparison of sustainable transport policies has been drawn up on behalf of the Zero Emission Vehicles Policy Lab.

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Sources

Allison Crow et al., *A New EV Horizon: Insights from Shenzhen's Path to Global Leadership in Electric Logistics Vehicles*, Rocky Mountain Institute, 2019, www.rmi.org/insight/a-new-ev-horizon

Lauer, Johannes & Dickhaut, Wolfgang. *(2016). Shenzhen's New Energy Vehicles and charging infrastructure - policies, instruments and development*, https://www.researchgate.net/publication/299340726_Shenzhen's_New_Energy_Vehicles_and_charging_infrastructure_-_policies_instruments_and_development

Netherlands Enterprise Agency, Mission Zero Powered by Holland (May 2019), https://www.rvo.nl/sites/default/files/2019/06/Misson%20Zero%20Powered%20by%20Holland.pdf

Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland), *Elektrisch rijden* https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/elektrisch-rijden

Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland), Verzilvering verdienpotentieel elektrisch vervoer 2017-2018 https://www.rvo.nl/sites/default/files/2019/10/Rapport%20Verzilvering%20Verdienpotentieel%20elektrisch%20vervoer%202017-2019.pdf

Study EV Consult, *E-trucks vanuit de Rotterdamse haven* https://www.portofrotterdam.com/sites/default/files/e-trucks-elektrisch-containervervoer-vanuit-de-rotterdamse-haven.pdf

The California Air Resources Boar, *The Zero Emission Vehicle (ZEV) Regulation* https://ww2.arb.ca.gov/sites/default/files/2019-06/zev_regulation_factsheet_082418_0.pdf

US Department of Energy, *California Laws and Incentives,* https://afdc.energy.gov/laws/all?state=CA