5.1 Sweden (SE)

5.1.1 *Main messages from the Commission assessment of the NPF*

In its original assessment of the Swedish NPF the Commission concluded:

The Swedish NPF addresses only very few of the requirements of Article 3. According to the Swedish NPF, climate change is 'one of the top priority issues for the government'. The expression 'fossil-free' is emphasised throughout the NPF. Sweden clusters national policy objectives of interest to the Directive into 6 groups: climate, energy, transport, regional, industry and consumer. Numerical targets are shown only for the first two. The Swedish NPF contains neither future estimates for alternative fuels vehicles nor any targets for alternative fuels recharging or refuelling infrastructure. This violates a basic requirement of the Directive. It can pose a serious risk to cross-border continuity and a functioning internal market for alternative fuels vehicles.

Concerning future estimates of electric vehicle stock, the Swedish NPF is rather vague. The lack of clear targets for future electric vehicle market deployment jeopardises the assessment and may represent an obstacle to policy efforts towards electro-mobility. It will be important to establish appropriate infrastructure targets in line with the market developments.

The Swedish NPF indicates regional discrepancies with regards to the share of natural gas use. No natural gas refuelling points can be found in large inland areas in Northern Sweden (see Figures 7-8 of the NPF). CNG refuelling infrastructure halfway the Skellefteå - Härnösand route (around southern Umeå) as well as halfway the Sundsvall - Gävle route (around Hudiksvall) would appear sufficient to meet the requirement of one refuelling point at least every 150 km.

The use of alternative fuels for public transport activity is concisely addressed. Rail is briefly mentioned. Additional details would be desirable.

The Swedish NPF highlights the role of biofuels in the country's transport sector and the fact that Sweden has already met the sectoral 2020 target set by the Renewable Energy Directive. The Swedish NPF stresses that no special infrastructure is required for biofuels and regards this as a cost-effective solution for road vehicles. At the same time, the NPF indicates that new flex-fuel car registrations have decreased dramatically in recent years (0.4% share in 2015).

The Swedish NPF contains a relatively comprehensive portfolio of measures. Overall, Sweden appears to be implementing a solid policy package, beneficial to the deployment of alternative fuels vehicles, also visible in the current high shares of newly registered EV; but, as the Swedish NPF does not contain future quantitative targets for AFI, it is difficult to judge how the support measures can support reaching the objectives.

Further elaboration on the possibility of Member State cooperation to establish a harmonised fairway and port recharging system in the Baltic Sea Area would be advantageous.

Information on AFI targets related to inland waterways, airports and private electro-mobility is inadequate. Information on these is essential in view of the requirements stipulated in the Directive.

5.1.2 *Overview of requirements' fulfilment from Annex I of the Directive*

Table 5.1.2-1 Checklist Table

Part of the Directive 2014/94/EU	Requirement	Mode of transport / Alternative Fuel (provided in the NIR)		Yes / No
ANNEX I: 1. Legal measures	Information on legal measures, which may consist of legislative, regulatory or administrative measures to support the build-up of alternative fuels infrastructure, such as building permits, parking lot permits, certification of the environmental performance of businesses and fuel stations concessions.	Road, Water / All		Yes
ANNEX I: 2. Policy measures supporting the implementation of the national policy framework	Information on those measures shall include the following elements: • direct incentives for the purchase of means of transport using alternative fuels or for building the infrastructure, • availability of tax incentives to promote means of transport using alternative fuels and the relevant infrastructure, • use of public procurement in support of alternative fuels, including joint procurement, • demand-side non-financial incentives, for example preferential access to restricted areas, parking policy and dedicated lanes, • technical and administrative procedures and legislation with regard to the authorisation of alternative fuels supply, in order to facilitate the authorisation process.	Road, Water / All		Yes
	• consideration of the need for renewable jet fuel refuelling points in airports within the TEN-T Core Network	Air	Biofuels	Yes
ANNEX I: 3. Deployment and manufacturing support	• Annual public budget allocated for alternative fuels infrastructure deployment, broken down by alternative fuel and by transport mode (road, rail, water and air).	Road, Combination / Electricity, Combination		Yes
	• Annual public budget allocated to support manufacturing plants for alternative fuels technologies, broken down by alternative fuel and by transport mode.	Combination / CNG		Yes
	• Consideration of any particular needs during the initial phase of the deployment of alternative fuels infrastructures.			No
ANNEX I: 4. Research, technological development and demonstration	• Annual public budget allocated to support alternative fuels RTD&D, broken down by fuel and by transport mode.	Road, Water, Air / All		Yes
ANNEX I: 5. Targets and objectives	• Estimation of the number of alternative fuel vehicles expected by 2020, 2025 and 2030	Road / Electricity, CNG, Hydrogen		Yes
	• Level of achievement of the national objectives for the deployment of alternative fuels in the different transport modes (road, rail, water and air)	Road / Electricity, CNG, Hydrogen		Yes
	• Level of achievement of the national targets, year by year, for the deployment of alternative fuels infrastructure in the different transport modes	Road, Water / Electricity, CNG, LNG, Hydrogen, E85, HVO		Yes
	• Information on the methodology applied to take account of the charging efficiency of high power recharging points	Road	Electricity	Yes
ANNEX I:6 Alternative fuels infrastructure developments	Changes in supply (additional infrastructure capacity) and demand (capacity actually used)	Road, Rail / Electricity, CNG, Hydrogen, E85, HVO		Yes

The checklist shows that almost all the requirements of Annex I from the Directive are covered in the Swedish NIR.

Regarding the combination of AF/AFV/AFI with transport mode, electricity is partially covered for all modes; CNG, hydrogen and HVO are partially covered for road transport; LNG for road and maritime transport; biofuels are partially covered for road and air transport; all the other combinations are either absent or not applicable.

The Swedish NIR reports 67 measures. Under the Policy and Deployment & Manufacturing sections it was possible to identify six AF/transport mode clusters of measures, all assessable.

5.1.3 *Quantitative assessment: Vehicles and infrastructure*

It is important to note, when interpreting the values shown in

Table *5.1.3-1*, that the original Swedish NPF notified to the Commission did not specify relevant AFI targets and AFV estimates. The government of Sweden later provided this information officially to the Commission (document 'Information supplementing the Swedish policy framework for alternative fuels infrastructure in accordance with Directive 2014/94/EU' (Annex to minutes II 20 of government meeting of 30 August 2018, N2018/04594/MRT)). This fact is acknowledged in the Swedish NIR, which also indicates that those AFI targets and AFV estimates differ from the ones provided in the NIR. For the purpose of this assessment, the relevant AFI targets and AFV estimates communicated by the Swedish government in its NIR and in the document supplementary to its NPF will be considered and the latter will be referred to as "NPF".

Table 5.1.3-1 National AFV estimates and AFI targets established in the NIR at the horizon 2020, 2025 and 2030 and their comparison with the NPF situation

Alternative fuel / Transport mode		2018		2020		2025		2030	
		AFV	AFI public	AFV	AFI public	AFV	AFI public	AFV	AFI public
Electricity / road*	NIR	68,728	6,700	142,211	9,000	370,617	NA	644,148	NA
	Change NIR vs NPF [%]			-10.95%	0.00%				
	Attainment [%]			48.33%	74.44%	18.54%		10.67%	
CNG / road	NIR	42,463	185	42,351	230	54,268	≥ 230	76,898	NA
	Change NIR vs NPF [%]			-10.16%	0.00%	15.12%	0.00%		
	Attainment [%]			100.26%	80.43%	78.25%		55.22%	
LNG / road	NIR	NA	6	NA	22	NA	≥ 22	NA	NA
	Change NIR vs NPF [%]				0.00%		0.00%		
	Attainment [%]				27.27%				
LNG / water (maritime)	NIR	NA	11	NA	NA	NA	17	NA	17
	Change NIR vs NPF [%]						0.00%		0.00%
	Attainment [%]						64.71%		64.71%
LNG / water (inland)	NIR	NA	0	NA	NA	NA	0	NA	0
	Change NIR vs NPF [%]								
	Attainment [%]								
H2 / road	NIR	42	6	≥ 36	13	≥ 36	≥ 13	≥ 36	NA
	Change NIR vs NPF [%]			0.00%	0.00%	0.00%	0.00%		
	Attainment [%]				46.15%				

Legend:

	not applicable
	the value could not be computed
NA	no value/information provided/available in the NIR

*The Swedish NIR indicates that its AFV estimates are based on the 'Reference EU' scenario reported by Swedish Energy Agency, which takes into account instruments introduced by 1 July 2018. For electric LCVs and buses and coaches, the Swedish NIR reports the estimates only as percentage values, presumably of the total stock of respectively LCVs and buses and coaches. The same occurs with HDVs powered by CNG. Without information on the absolute numbers of these, it is not possible to apply our methodology to these vehicle types. As a result, the 2020 percentage change NIR vs NPF reflects electric passenger cars (NIR) relative to the sum of electric passenger cars and electric LCVs (NPF).

5.1.3.1 Road transport

5.1.3.1.1 Electricity

Vehicles

Sweden recorded 68,728 battery-electric and plug-in hybrid electric vehicles in use in 2018[1] (

[1] The 2017 EV values reported in the Swedish NIR match those reported in the document supplementary to the Swedish NPF.

Table *5.1.3-1*). Of these, 66,058 were passenger cars (one-fourth were battery-electric) and 2,670 were LCVs (of which 2,661 battery-electric). The Swedish NIR provides information on neither past electric buses and coaches (it only provides percent estimates for 2020, 2025 and 2030) nor, as in the NPF, past and future electric HCVs (the NIR considers that the use of electricity to power lorries is still relatively uncommon). Compared to the NPF, the Swedish NIR reflects a lower policy ambition – the 2020 estimate is almost 10.95% lower (with caveats concerning the heavy-duty sector, as noted) than the original estimate in the NPF. Sweden did not provide 2025 and 2030 EV estimates in the NPF, but the NIR presents estimates: by 2030, the Swedish NIR expects a stock of 644,148 electric cars (of which battery-electric account for only 17%). In addition, the Swedish NIR expects that, by 2030, the share of electric LCVs reaches 1.4% of, presumably, the future total stock of LCVs (up from 0.6% in 2020) and that the share of electric buses and coaches reaches 14% of, presumably, the future total stock of buses and coaches (up from 4% in 2020). Information is not available on electric PTW. Finally, the possibility of converting mining trucks to electric operation is being explored in an RTD&D project (see Section 5.27.4).

The 2018 ***attainment*** of future EV estimates is 48.33% for 2020 and 10.67% for 2030. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to an ***adequate progress*** towards reaching the envisaged EV estimates. The calculated ***average annual growth rate*** corresponding to the period 2016-2030 for EV fleet evolution planned by Sweden is equal to 24%.

Infrastructure

Sweden recorded 6,700 publicly accessible recharging points in 2018 (

Table *5.1.3-1*). The NIR target for the public AFI (electricity /road) for 2020 is 9,000, with no information provided on the share of normal (≤22kW) versus high power (>22kW) recharging points. In addition, Sweden reports a value of 20,000 private recharging points for 2020. In both cases, the NIR values for 2020 are the same as in the NPF. Sweden did not provide targets for publicly accessible electric recharging points for 2025 and 2030 in its NPF. In the NIR, these are not provided either.

The 2018 ***attainment*** of future publicly accessible recharging infrastructure targets is 74.44% for 2020. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to a ***fast progress*** towards reaching these envisaged targets. The calculated ***average annual growth rate*** corresponding to the period 2016-2020 for publicly accessible recharging infrastructure evolution planned by Sweden is equal to 36%.

Ratio

Based on the SE NIR, the following table shows the ratio between vehicles and publicly accessible recharging points (i.e. sufficiency index) for the pair electricity/road. The foreseen sufficiency index deviates from the value of 10 in 2018 to almost 16 in 2020. Considering the lack of information regarding the share of normal power and high power recharging points, this can be regarded as potentially inadequate.

Sufficiency Index	2016	2017	2018	2020	2025	2030
Electricity	10.74	9.63	10.26	15.80		

Information on charging efficiency

Although the Swedish NIR devotes a section to this aspect, the information provided refers to an assumption on the usage of publicly accessible high power (>22kW) recharging infrastructure, rather than on the methodology applied to take account of the charging efficiency of high power recharging points or observed data on usage (which was the minimum requirement set by the Commission (Frequently-Asked Questions document notified to the Member States on 16 September 2019)).

5.1.3.1.2 CNG

Vehicles

The Swedish NIR indicates that natural gas is the most common alternative fuel to power LCVs, HCVs and buses (where it accounted for 18% of the bus fleet in 2018) but acknowledges that data disaggregated by type of fuel (either CNG or LNG) are not available in the road traffic register. As a result, the NIR provides values only for passenger cars: Sweden recorded 42,463 CNG passenger cars in use in 2018 (

Table *5.1.3-1*). This represents a slight decline relative to 2016. Compared to the NPF, the Swedish NIR reflects a lower policy ambition in the near-term but higher in the mid-term, in fact the 2020 and 2025 estimates are 10.16% lower and 15.12% higher respectively than the original estimates in the NPF. Sweden did not provide 2030 CNG estimates in the NPF, but the NIR presents estimates: the CNG stock is planned to increase to 76,898 CNG passenger cars. In addition, the Swedish NIR expects that, by 2030, the share of CNG HCVs reaches 1.9% of, presumably, the future total stock of HCVs (up from 1.2% in 2020) and that the share of CNG buses and coaches reaches 15.4% of, presumably, the future total stock of buses and coaches (down from 16.6% in 2020).

The 2018 ***attainment*** of future CNG vehicles estimates is superior to 100% for 2020 and 55.22% for 2030. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to a ***slow progress*** towards reaching the envisaged CNG vehicles estimates. The calculated ***average annual growth rate*** corresponding to the period 2016-2030 for the CNG vehicle fleet evolution planned by Sweden is equal to 4%.

Infrastructure

The Swedish NIR indicates that 185 publicly accessible CNG refuelling points were available in 2018 (

Table *5.1.3-1*)[2]. The NIR does not modify the 2020 and 2025 targets of respectively 230 points and at least 230 points indicated in the NPF. Both the NPF and NIR lacked 2030 targets for publicly accessible CNG refuelling points. Concerning non-publicly accessible infrastructure, the Swedish NIR indicates that there were 60 private and municipal CNG refuelling points in 2018. The NIR also indicates that the share of biogas in natural gas use in road transport grew significantly from 55% in 2013 to 93% in 2018.

The 2018 ***attainment*** of future publicly accessible CNG refuelling infrastructure targets is constant and equal to 80.43% for 2020 and 2025. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to a ***fast progress*** towards reaching these envisaged targets. The calculated ***average annual growth rate*** corresponding to the period 2016-2025 for publicly accessible CNG refuelling infrastructure evolution planned by Sweden is equal to 3%.

Ratio

Based on the SE NIR, the following table shows the ratio between vehicles and publicly accessible refuelling points (i.e. sufficiency index) for the pair CNG/road. The sufficiency index is well below the indicative value of 600 (see Section 2.1.5) for the whole 2016-2025 period.

Sufficiency Index	2016	2017	2018	2020	2025	2030
CNG	257.02	249.75	229.53	184.13	235.95	

5.1.3.1.3 LNG

Vehicles

The Swedish NIR indicates that natural gas is the most common alternative fuel to power LCVs and HCVs but provides no information on the number of heavy-duty vehicles powered by LNG, indicating that the figures for the period 2016-2018 are not available in the road traffic register. It is also unclear whether a fraction of the buses powered by natural gas (Section 5.27.3.1.2) is LNG-fuelled. The NIR acknowledges that interest in LNG-fuelled heavy-duty vehicles is increasing among manufacturers. It also mentions, in the context of an innovation cluster for liquefied biogas, the demonstration of 159 bio-LNG lorries, 10 bio-LNG coaches and one port tow vehicle in 2019.

Because there were no future LNG vehicle estimates in the Swedish NIR, the 2018 ***attainment*** and ***progress*** could not be computed.

Infrastructure

The Swedish NIR indicates that six publicly accessible LNG refuelling points were available in 2018 (

[2] The Swedish NIR updates the 2017 value provided in the supplement document to the NPF from 170 to 175 points. Note also that the NIR refers to natural gas vehicles and infrastructure as CNG/CBG (compressed biogas) or LNG/LBG (liquefied biogas).

Table *5.1.3-1*). The NIR does not modify the 2020 and 2025 targets of respectively 22 points and at least 22 points indicated in the NPF. Both the NPF and NIR lacked 2030 targets for publicly accessible LNG refuelling points. The NIR also mentions, in the context of the aforementioned innovation cluster for liquefied biogas, the demonstration of five (bio-)LNG refuelling points and two bunkering depots in 2019.

The 2018 ***attainment*** of future LNG road refuelling infrastructure targets is constant and equal to 27.27% for 2020 and 2025, while the ***progress*** could not be computed.

Ratio

Since there are no vehicle estimates in the SE NIR, it is not possible to calculate the sufficiency index.

5.1.3.1.4 Hydrogen

Vehicles

The Swedish NIR indicates that 42 hydrogen-powered vehicles were in use in 2018 (

Table *5.1.3-1*), without providing information on the type of vehicle[3]. The Swedish NIR expects a future stock of at least 36 hydrogen-powered vehicles.

Because the Swedish government expects a decrease of the hydrogen-powered vehicles fleet in the future, no ***attainment*** and ***progress*** values have been computed.

Infrastructure

The Swedish NIR indicates that six publicly accessible hydrogen refuelling points were available in 2018 (

[3] The Swedish NIR updates the 2017 value provided in the supplement document to the NPF from 36 to 37 vehicles.

Table *5.1.3-1*) and that additional ones were under construction in 2019. By 2020, both the Swedish NPF and NIR indicated a target of 13 points. The Swedish NPF had also provided a 2025 target of at least 13 points.

The 2018 ***attainment*** of future hydrogen refuelling infrastructure targets is constant and equal to 46.15% for 2020 and 2025, while the ***progress*** could not be computed.

Ratio

Based on the SE NIR, the following table shows the ratio between vehicles and infrastructure (i.e. sufficiency index) for the pair hydrogen/road (see Section 2.1.5) for the 2016-2025 period.

Sufficiency Index	2016	2017	2018	2020	2025	2030
Hydrogen	4.60	7.40	7.00	2.77	2.77	

5.1.3.1.5 Biofuels

Vehicles

The Swedish NIR recorded about 215,600 ethanol-powered passenger cars in use in 2018, making E85 still the most common alternative fuel for passenger cars. However, it also reports a declining stock of passenger cars powered by E85 in the past three years (following the trend highlighted in the NPF) and indicates that new sales in 2019 were limited by model availability (five models from one manufacturer). The NIR considers that the use of ethanol to power lorries is still relatively uncommon and indicates that 9% of the bus fleet in 2018 was powered by biodiesel. The Swedish NIR acknowledges the difficulty of indicating the number of diesel vehicles running on FAME (including B100) because those vehicles are not registered as such. Finally, the NIR mentions an innovation cluster for ethanol, particularly to power HCVs (see Section 5.27.4).

Because there were no future biofuels vehicle estimates provided in the Swedish NIR, the 2018 ***attainment*** and ***progress*** could not be computed.

Infrastructure

The Swedish NIR reports information on infrastructure for E85 and FAME (mainly RME). The number of E85 and RME sales points decreased between 2016 and 2018: from 1,828 to 1,723 and from 38 to 9, respectively. Further information on energy use can be found in Section 5.27.5.

Because there were no future biofuels refuelling infrastructure targets provided in the Swedish NIR, the 2018 ***attainment*** and ***progress*** could not be computed.

Ratio

The sufficiency index for E85 was 125.13 in 2018, the only year for which it could be computed with the information provided in the SE NIR.

5.1.3.1.6 LPG

Apart from mentioning that this alternative fuel is part of the Directive, the Swedish NIR does not cover LPG.

Vehicles

Information is not available in the Swedish NIR. According to EAFO, Sweden recorded 465 LPG vehicles in 2016.

Infrastructure

Information is not available in the Swedish NIR. According to EAFO, Sweden recorded 30 LPG refuelling points in 2016 and 25 in 2018.

Ratio

The following table shows the ratio between vehicles and publicly accessible LPG refuelling points (i.e. sufficiency index) for the pair LPG/road. The sufficiency index could only be computed for 2016 by using data from EAFO.

Sufficiency Index	2016	2017	2018	2020	2025	2030
LPG	15.5*					

* Values taken from EAFO

5.1.3.1.7 Synthetic and paraffinic fuels

Vehicles

As in the case of FAME (Section 5.27.3.1.5), the Swedish NIR acknowledges the difficulty of indicating the number of vehicles powered by HVO100, which can be used in approved diesel engines of buses and lorries. The NIR confirms that just a few manufacturers have approved their car models to run on pure HVO, which currently limits its use.

Infrastructure

The Swedish NIR reports that the number of HVO100 sales points grew from zero in 2016 to 162 points in 2018.

5.1.3.2 Rail transport

5.1.3.2.1 Electricity

Vehicles

The Swedish NIR indicates that the stock of railway vehicles was 2,699 at the end of 2017, of which 641 were locomotives and shunters and the rest railcars. Between 2016 and 2017, the number of railway vehicles went up by 141 units (mainly electric).

Infrastructure

The length of the Swedish railway lines was 10,874 km in 2017, of which 75% was electrified. Further information on energy use can be found in Section 5.27.5.

5.1.3.3 Waterborne transport (maritime)

5.1.3.3.1 Electricity

Vessels

The Swedish NIR mentions that several ferries powered by electricity are in operation (see also Section 5.27.3.3.3). In addition, the NIR indicates that interest in alternative fuels by shipping companies is growing and claims to be providing government support to R&D and innovation in the field of electrified vessels (see Section 5.27.4).

Infrastructure

The Swedish NIR indicates that the number of ports with access to shore-side electricity supply (defined in the NIR as 'quay-side electric connection') went up from nine in 2015 to 20 in 2017[4]. According to the NIR, there were at least 20 ports with such connections also in 2018. Unfortunately, neither the NPF nor the NIR distinguished between maritime and inland port electricity supply.

In terms of future targets, the Swedish NIR indicates that values were provided in the supplement document to the NPF. That document indicates a target of 23 ports with access to shore-side electricity in 2025 and at least 23 in 2030. Furthermore, the NIR acknowledges that no official data exists on vessel access to shore-side electricity supply and that information on shore-side electrical connections use is not available.

5.1.3.3.2 LNG

Vessels

The Swedish NIR mentions that several vessels powered by LNG are in operation and on order but provides no LNG vessel estimates. Therefore, the 2018 ***attainment*** and ***progress*** could not be computed.

Infrastructure

The Swedish NPF indicated that the number of (maritime) ports in the TEN-T Core Network with access to LNG was two in 2017 and expected to be five in 2025 and 2030. In addition, the NPF indicated that the number of other (maritime) ports with access to LNG was five in 2017 and expected to be 12 in 2025 and 2030. The Swedish NIR indicates that the number of ports with access to LNG was 11 in 2018 (of which three in ports that are part of the TEN-T Core Network). It also states that seven ports gained access to LNG in early 2019. Information is not available for 2020.

The 2018 ***attainment*** of future LNG refuelling infrastructure targets in maritime ports is constant and equal to 64.71% in 2025 and 2030. According to the assessment methodology described in Section 2.1, the ***progress*** obtained by Sweden from 2016 until 2018 for LNG refuelling infrastructure deployment in maritime ports is 60.00% of the overall planned deployment during the period 2016-2030.

5.1.3.3.3 Synthetic and paraffinic

Vessels

The Swedish NIR reports that a hybrid electric vessel capable of running also on synthetic diesel was commissioned by the Swedish Transport Administration's shipping company in March

[4] The Swedish NIR updates the 2017 value provided in the supplement document to the NPF from 16 to 20 ports.

2019. In addition, it can be understood from the NIR that the Stena Germanica ferry powered by methanol continues to be in operation.

Infrastructure

Information is not available in the Swedish NIR.

5.1.3.4 Waterborne transport (inland)

5.1.3.4.1 Electricity

Vessels

Information on battery-powered inland vessels in unavailable in the Swedish NIR.

Infrastructure

For shore-side electricity supply, see Section 5.27.3.3.1.

5.1.3.4.2 LNG

Vessels

Information on inland waterborne vessels powered by LNG in unavailable in the Swedish NIR.

Infrastructure

The Swedish NPF had indicated that the number of inland ports with access to LNG was zero in 2017 and was expected to be zero also in 2025 and 2030. The Swedish NIR confirms that the number of inland ports with access to LNG was zero in 2018 and provides no information for 2020.

5.1.3.5 Air transport

5.1.3.5.1 *Electricity*

Airplanes

The only information found on this in the Swedish NIR relates to government support to R&D and innovation in the field of electrified airplanes (see Section 5.27.4).

Infrastructure (for stationary airplanes)

As in the NPF, the Swedish NIR provides information on the ten airports owned by Swedavia AB and confirms that GPUs are available at all aprons in seven of them. In two others, 20% of the moorings have electrical connections. According to the NIR, the number of moorings providing electricity supply for stationary aircraft has risen and demand from airlines for such connections is high.

5.1.3.5.2 *Biofuels*

Airplanes

The only piece of information found in the Swedish NIR relates to a programme by an airline targeting greater use of bio-jet fuel.

Infrastructure

The Swedish NIR reports that one of the world's first initiatives to showcase bio-jet fuel use in existing refuelling infrastructure took place in Karlstad airport in 2014. The NIR also mentions a central refuelling point in Arlanda airport. However, it also indicates that the amount of bio-jet fuel supplied in Sweden is very low and remains unreported in the official statistics.

5.1.4 ***Measures assessment***

As in the NPF, the Swedish NIR contains a rather comprehensive portfolio of measures. They tend to target either a combination of alternative fuels, or of transport modes or both.

5.1.4.1 Legal measures

The Swedish NIR contains 16 legal measures. This represents a significant increase compared to the seven legal measures identified in the NPF. All presented measures are in place, with the exception of one related to the Energy Performance of Buildings Directive (2018/844/EU). While three legal measures target specifically electricity, 63% of the legal measures target a combination of alternative fuels and transport modes.

Considering all the legal measures, they appear, if fully implemented, to be fit to support the realisation of the AFV/AFI objectives as described in the NPF and revised in the NIR. The level of ambition of the legal measures has increased in the NIR, compared to the NPF.

5.1.4.1.1 Legislative & Regulatory

Of all the legal measures described in the Swedish NIR, six can be categorised as legislative and regulatory measures (most of them targeting road transport) and include the following ones:

- Norms & requirements: Act (2016:915) and Ordinance (2016:917) on requirements for installations for alternative fuels.
- National targets: Pumps Act (2005:1248) entailing the obligation for refuelling stations and sales outlets to supply renewable fuels.

5.1.4.1.2 Administrative

Of all the legal measures described in the Swedish NIR, ten can be categorised as administrative measures. The following new ones can be highlighted:

- AFV classification on environmental performance: fairway and port charges disaggregated by environmental class. The Swedish NPF had indicated the intention to introduce in 2018 a more environmentally ambitious charging model. The Swedish NIR confirms that the new system was introduced on 1 January 2018. The fairway charge is differentiated into four environmental classes. Environmentally differentiated port levy charges are also in use in around 20 ports. According to the NIR, the system incentivises vessel performance and the use of electricity, LNG and methanol.
- Another measure targeting waterborne transport concerns national guidelines for liquid methane bunkering at ports, which have since 2018 clarified the requirements for (bio)LNG.

Other measures concern CEF applications, a national freight strategy and coordination assignments at regional level. Finally, the number of actors involved in the 'Fossil-Free Sweden' initiative grew from more than 170 reported in the NPF to over 400 in the NIR. In this

context, industry roadmaps on automotive, aviation, haulage and shipping have been or will be presented.

5.1.4.2 Policy measures

The Swedish NIR contains 18 policy measures, compared to 14 policy measures identified in the NPF. Of all the policy measures, 67% can be characterised as targeting a combination of alternative fuels (most of them are road-related measures), 17% a combination of transport modes and 11% as targeting a combination of both. The majority of these measures have a financial nature.

5.1.4.2.1 Measures to ensure national targets and objectives

Of all the policy measures described in the Swedish NIR, twelve can be categorised as measures to ensure national targets and objectives. With one exception, these measures featured in the NPF. However, for some of them the level of ambition has increased. This is prominently the case of the bonus-malus/feebate system, which covers new passenger cars, LCVs and light buses. The budget allocation has increased from 1.24 billion SEK in 2019 to 1.63 billion SEK in 2020. As a consequence of implementing the bonus-malus system, two measures (vehicle tax exemption for green cars and super green car premium) were abolished.

Other policy measures to ensure national targets and objectives include CO_2 and energy tax exemptions for high-blend sustainable biofuels and aid for the procurement of vehicles (including heavy lorries) that can run on alternative fuels. For the latter, 63.8 million SEK were granted over 2016-2018 for 495 vehicles (with around 400 of them powered by bio-LNG). It is, however, unclear what proportion of this budget was for heavy commercial vehicles.

5.1.4.2.2 Measures that can promote AFI in public transport services

Of all the policy measures described in the Swedish NIR, four can be categorised as measures that can promote AFI in public transport services (of which three were mentioned in the NPF). They deal with public procurement and lower vehicle taxation for AFVs, aid for municipalities and country councils for measures that promote public transport solutions via the so-called ‘urban environment agreements’ as well as an electric bus premium (applicable also to fuel cell and trolley buses) endowed with 750 million SEK for the period 2016-2023.

5.1.4.2.3 Measures that can promote the deployment of private electro-mobility infrastructure

While no measures promoting the deployment of private electro-mobility infrastructure were identified in the NPF, two were found in the NIR. Both of them focus on electricity for road: the so-called ‘BeBo’ and ‘Belok’ networks to promote recharging infrastructure deployment in apartment and commercial buildings as well as aid for home recharging for private individuals. The latter entails aid to cover 50% of the acquisition and installation cost of a charging box, with a limit to SEK 10,000 per property. A status report released in April 2019 indicates that 3,300 people have received aid.

5.1.4.3 Deployment and manufacturing support

5.1.4.3.1 AFI deployment

The Swedish NIR reports three AFI deployment measures, of which two are related to the Climate Leap initiative and one is new: investment aid for recharging stations used by companies and other organisations, which is provided through a grant that covers up to 50% of the costs, with a maximum of SEK 15,000 per recharging point. Concerning the Climate Leap and according to the NIR, aid amounted to 276.1 million SEK for the period 2016-2018 and had been granted for over 30,000 recharging points by the end of 2018. It is unclear how this figure relates to the AFI targets provided in the NIR. In addition, 533.9 million SEK of Climate Leap aid was given for biofuels/liquefied biogas (mainly publicly accessible) refuelling points between 2016 and 2018.

5.1.4.3.2 Support of manufacturing plants for AF technologies

The Swedish NIR lists four measures to support manufacturing plants for AF technologies, all of them targeting mainly biogas production. In total, 1,209 million SEK have been earmarked for manufacturing support for the period 2014-2023, of which over 250 million SEK for two projects focusing on production of biofuels from waste products from forestry.

5.1.4.3.3 Consideration of any particular needs during the initial phase of the deployment of alternative fuels infrastructures

Information is not available in the Swedish NIR.

5.1.4.4 Quantitative assessment of Policy and Deployment & Manufacturing measures

Table 5.1.4-1 presents an analysis of all the Policy and Deployment & Manufacturing measures, carried out according to the assessment methodology described in Section 2.2. As it can be seen, clusters of measures on electricity, CNG, hydrogen and biofuels for road transport as well as LNG for road and waterborne transport could be identified in the Swedish NIR. The electricity/road cluster is the only having a high score; the other clusters receive a medium score. Half of the clusters (on electricity, CNG and biofuels) can be considered comprehensive. In terms of expected impact of these measures to support the realisation of the AFV/AFI objectives as presented in the NPF and revised in the NIR, the measures for the pair electricity/road result to have a high impact, those for the pairs CNG/road and biofuels/road have a medium impact while all the other measures have a low impact. Compared to the NPF, the level of ambition of the Policy and Deployment & Manufacturing support measures has increased for all the identified clusters.

Table 5.1.4-1 Quantitative assessment of Policy and Deployment & Manufacturing support measures

AF	Transport mode	Score	Comprehensiveness		Impact		Ambition (NIR vs NPF)
Electricity	Road	H	C		**H**		+
CNG	Road	M	C		**M**		+
LNG	Road	M	N		**L**		+
	Water (Maritime & Inland)*	M	N		**L**		+
H2	Road	M	N		**L**		+
Biofuels	Road	M	C		**M**		+

Legend: Score and Impact: H = high; M = medium; L = low; X = not assessable. Comprehensiveness: C = comprehensive; N = Not comprehensive. Ambition level: '+' means 'higher'; '=' means 'comparable'; '-' means 'lower'.

*It is unclear which measures correspond to maritime transport, which to inland and which cover both.

5.1.4.5 Research, Technological Development & Demonstration

The Swedish NIR lists 26 RTD&D projects. Because the number and a detailed description of them were not available in the NPF, it is not possible to make a proper comparison of the amount and nature of the projects reported in the NPF and NIR. Nonetheless and based on the corresponding start and stop years reported in the NIR, it can be deduced that a substantial proportion of the projects can be considered new. The majority of the funding is national, with instances of co-funding with industry.

As the Swedish NIR indicates, many of the RTD&D projects cannot be attributed to a single alternative fuel or transport mode, and are thus reported as a combination thereof. Specifically, 38% of the RTD&D projects can be characterised as targeting a combination of alternative fuels and 62% target a single alternative fuel; 65% focus on a combination of transport modes and 35% on a specific one; overall, 27% of the RTD&D projects target a combination of both alternative fuels and transport modes. Regarding transport modes, road, water and air transport are individually represented. For those projects that focus on a single fuel, electricity and biofuels can be highlighted. Two RTD&D projects worth mentioning are the Northvolt Pilot Production Line for lithium-ion battery cell manufacturing (up to 146 million SEK of aid) and the 'Electrified roads'. Following the tests initiated in 2016 and an evaluation in 2018, the Swedish authorities decided to support with 175 million SEK the construction of two stretches of electrified roads with the expectation that they will become operational during 2019-2022: one demonstrating conductive ground rail and one inductive technologies. Concerning biofuels, two innovation clusters (one demonstrating ED95 for road freight and one for sustainable biofuels for aviation) were being established and biofuels production from lignocellulosic or residual products funded with 180 million SEK for the period 2017-2021. A project on lignin, which can be refined into HVO, is also listed. Hydrogen or fuel cell technology is not explicitly mentioned in the section of the NIR that covers RTD&D.

The NIR acknowledges that, in some cases, annual budget values (shown in the corresponding tables of the NIR only for the period 2016-2019) could not be reported, so total budget figures are provided in their place (this is the case of e.g. SamspEL and TripleF projects). For some projects, the total budget does not match the sum of the corresponding annual budgets, so that it can be presumed that the difference is due to the budget being used before 2016 or after 2019. Overall, for the period 2016-2030[5], it is calculated that the total estimated budget for RTD&D projects reported in the NIR amounts to around 4.4 billion SEK (ca. 425 million €).

5.1.5 *Additional information on alternative fuels infrastructure developments*

Based on input from the Swedish Energy Agency, the Swedish NIR provides information on past (1990-2016) energy use, by type of fuel, for domestic transport and four scenarios for the period 2017-2050[6].

The Swedish NIR indicates that no official statistics on electricity use in road transport are available. Based on the information provided in the NIR, HVO100 and E85 accounted for

[5] Budget information pre-dating 2016 is also available in the NIR for some projects.
[6] With the information provided in the NIR, it is not possible to compile the corresponding table of the Excel template provided to Member States. Further details can be found in sections 8.2.1 and 8.3 of the Swedish NIR.

respectively 4.6% and ca. 1% of road transport fuel consumption in 2018. In the same year, 1.65 TWh of road fuel gas were used.

For rail transport, the NIR provides the split between diesel and electricity use, disaggregated into tram, underground and rail (passenger, freight) operations. Overall, the share of electricity use in the Swedish railways remained stable at 94% over the period 2016-2018.

5.1.6 *Summary of the assessment*

Tabular overview

Table 5.1.6-1 Overview of the NIR assessment

		Indicators	Alternative fuel / transport mode						
			Electricity / road	CNG / road	LNG / road	LNG / water (maritime)	LNG / water (inland)	Hydrogen / road	E85 / Road
AF Vehicles / Vessels		Past situation (2016)	27,935	43,693	NA	NA	NA	23	235,000*
		Situation (2018)	68,728	42,463	NA	NA	NA	42	215,600
		Estimate (2030)	644,148	76,898	NA	NA	NA	≥ 36	NA
		Future share (2030) [%]	9.96%	1.19%				> 0%	
		Estimate attainment (2018 vs 2030) [%]	10.67%	55.22%					
		Progress (2018)	adequate	slow					
Publicly accessible AF Infrastructure		Past situation (2016)	2,600	170	6	2	0	5	1,828
		Situation (2018)	6,700	185	6	11	0	6	1,723
		Target (2030)	NA	NA	NA	17	0	NA	NA
		Target attainment (2018 vs 2030) [%]				64.71%			
		Progress (2018)	fast	fast		60.00%			
Sufficiency Index		2016	10.74	257.02				4.60	
		2018	10.26	229.53				7.00	125.13
		2020	15.80	184.13				2.77	
		2025		235.95				2.77	
		2030							
Measures**	Legal measures	Ambition (IR vs NPF)	+	+	+	+		=	+
	Policy measures + Deployment & manufacturing support	Score	H	M	M	M		M	M
		Comprehensiveness	C	C	N	N		N	C
		Impact	H	M	L	L		L	M
		Ambition (IR vs NPF)	+	+	+	+		+	+
	RTD&D	Ambition (IR vs NPF)	+	+	+	+		=	+

Legend:

	not applicable
	the value could not be computed
NA	no value/information provided/available in the NIR

* Value taken or calculated from SE NPF; **It is not possible to disentangle the inland from the maritime-related measures.

The Swedish NIR reiterates its ambition "to become one of the first fossil-free developed nations in the world" and seeks to achieve zero net GHG emissions by 2045 and negative emissions thereafter. At the same time, the NIR acknowledges that, despite the increasing renewable energy use in transport, "Sweden's emissions are falling too slowly to be in line with climate policy targets". Concerning the passenger car fleet, the Swedish NIR highlights that a switch from conventional to alternative technologies powered by alternative fuels is taking place.

The Swedish NIR does not cover the whole AFID period (2016-2030). Compared to the Swedish NPF that had addressed only very few of the requirements of Article 3 of the Directive, the NIR almost fully addresses the requirements of Annex I of the Directive, with the exception of information on any particular needs during the initial phase of AFI deployment. Moreover, Sweden should provide data (rather than assumed values) on the usage of high power recharging infrastructure, as per the Commission's Frequently-Asked Questions document notified to the Member States on 16 September 2019.

The main outcomes of the technical assessment of the Swedish NIR on vehicles/vessels estimates and infrastructure targets can be summarised as follows:

Road transport

- **Electricity** – In 2018, Sweden recorded 68,728 light-duty EVs and 6,700 publicly accessible recharging points. No details were provided on heavy-duty vehicles. With reference to the objectives of the SE NPF as updated by the NIR, Sweden's progress is fast in terms of infrastructure and adequate in terms of EV deployment. The NIR lowers the level of ambition on the number of EVs for 2020 compared to the NPF. The calculated Swedish sufficiency index is becoming potentially inadequate in 2020. The NIR does not provide recharging points targets for 2025 and 2030.
- **CNG** – The SE NIR provides values only for passenger cars: Sweden recorded 42,463 CNG passenger cars in use in 2018. The NIR also shows a substantial growth in the share of biogas use relative to natural gas use in road transport over the period 2013-2018, but records a declining stock of CNG passenger cars and conveys a future declining share of buses powered by natural gas. With regards to CNG road vehicle deployment, Sweden is progressing slowly and the level of ambition is lower for 2020 but higher for 2025, compared to the NPF. Around 75% of the CNG refuelling points in use in Sweden in 2018 was publicly accessible. It is worth mentioning that 93% of road fuel gas used in Sweden in 2018 was biogas. The progress of infrastructure deployment is fast.
- **LNG** – The NIR provides insufficient information on LNG vehicles. One of the limitations faced when analysing the stock of CNG versus LNG vehicles is the impossibility of a clear disaggregation in Sweden's road traffic register. The NIR states that this hurdle is to be removed in December 2019. So, this should no longer be a limitation in future NIR assessments.
- **Hydrogen** – In 2018, 42 hydrogen-powered vehicles were circulating on Swedish roads, supported by six publicly accessible hydrogen refuelling points. Further deployment of refuelling infrastructure can be expected in the future.
- **Biofuels** – FAME100 remains one of the most common alternative fuels used for Sweden's road transport. However, the number of RME sales points significantly decreased between 2016 and 2018.
- **LPG** – No assessment on LPG can be made using the information provided in the Swedish NIR. According to EAFO, there were 25 LPG refuelling points in 2018.
- **Synthetic and paraffinic** – The NIR indicates that HVO100 refuelling infrastructure for road transport became available in recent years.

Rail transport

- **Electricity** – The length of the Swedish railway lines was 10,874 km in 2017, of which 75% was electrified, with an average share of electricity use above 90%. Further rail electrification does not seem to play an important role in the NIR.

Waterborne transport (maritime)

- **Electricity** – It is expected that electricity supply will be available in 23 Swedish ports by 2025, compared to 20 in recent years. Future NIR assessments would benefit from a clear distinction between maritime and inland port electricity supply.
- **LNG** – The NIR restates the target of having all maritime ports in the TEN-T Core Network with LNG supply by 2025.
- **Synthetic and paraffinic** – The NIR indicates that a few vessels powered by synthetic diesel and methanol are in use.

Waterborne transport (inland)

- **Electricity** – A proper understanding on the use of electricity for inland waterborne transport cannot be derived from the information provided in the NIR. Future NIR assessments would benefit from a clear distinction between maritime and inland port electricity supply.
- **LNG** – Based on the figures provided by Sweden, it seems that LNG availability in inland ports will remain inexistent until 2030, which jeopardises uptake of inland vessels powered by LNG.

Air transport

- **Biofuels** – Bio-jet fuel for aviation is available in Sweden but currently supplied in small quantities. The NIR mentions a study, presented on 4 March 2019, containing a series of proposals to promote sustainable biofuels in aviation. It also indicates that investments in this area have been made.

With regards to the **measures**, similarly to the NPF, the Swedish NIR reports a rather solid package, consisting in 67 measures. A significant number of them targets a combination of alternative fuels and/or transport modes. There were two potentially effective measures in road and waterborne transport that were envisaged in the NPF and have become a reality in the NIR: the bonus-malus system for light-duty road vehicles and an upgraded version of differentiated port and fairway charges for vessels.

With regards to the Policy and Deployment & Manufacturing measures, six clusters on electricity, CNG, hydrogen and biofuels for road transport as well as LNG for road and waterborne transport could be identified in the Swedish NIR. In terms of expected impact of these measures to support the realisation of the AFV/AFI objectives as presented in the NPF and revised in the NIR, the measures for the pair electricity/road result to have a high impact, those for the pairs CNG/road and biofuels/road have a medium impact while all the other measures have a low impact. Compared to the NPF, the level of ambition has increased for all the identified clusters.

The Swedish NIR lists 26 RTD&D projects where all transport modes and alternative fuels are represented.

5.1.7 *Final remarks*

The Swedish NIR provides a comprehensive report on the efforts made to implement the Directive, which is largely in line with the provisions of Annex I to the Directive. However, no information is provided on targets for recharging points by 2025 and 2030 and for CNG and LNG refuelling points for vehicles in 2030. Nor are estimates provided for LNG vehicles and vessels by 2020, 2025 and 2030. The Swedish NIR contains a rather comprehensive portfolio of measures. They tend to target either a combination of alternative fuels, or of transport modes or both. In general, the Swedish NIR states the ambition to promote the large-scale electrification of road and rail transport, airports and ports.

As regards electricity, the NIR estimates that about 645,000 electric vehicles could be on the roads by 2030, representing about 10% of the future fleet by that time. Taking into account the current situation, fleet and existing trends, this level of ambition does not appear to be fully compatible with the pace of deployment of electric vehicles considered necessary for a full transition to carbon neutrality by 2050. The current infrastructure deployment is lower than the

current vehicle uptake. Sweden should provide information on targets for 2025 and 2030 with a view to the expected vehicle uptake. Limited information on charging efficiency is provided. In 2017, shore-side electricity supply was available in 20 ports. This number should increase to 23 ports by 2025. However, no differentiation is made for maritime and inland ports. In addition, several electrically powered ferries are already in operation. Electricity supply to stationary airplanes is largely installed at Sweden's airports and 75% of Sweden's railways lines are already electrified.

Concerning hydrogen for road transport, the target is to have at least 13 hydrogen refuelling points available from 2025 onwards, which is an ambitious target that will need to be matched by adequate vehicle uptake.

According to Sweden's estimates, CNG vehicles will represent about 2% the vehicle fleet by 2030. The NIR presents a target to have at least 22 LNG refuelling points available from 2020. This seems sufficient considering the length of the Swedish TEN-T Core Network, provided that the refuelling points are equally distributed along the network. The NIR does not provide any information on the current number of LNG vehicles or any future estimates. Eleven maritime ports, three of which are part of the TEN-T Core Network, supplied LNG to vessels already in 2018. However, there is no estimate on LNG infrastructure in inland ports. Sweden should also provide estimates of the number of LNG vessels in its fleet by 2020, 2025 and 2030.

The Swedish NIR does not cover LPG.

Regarding biomethane, the number of vehicles running with biomethane represent a large share of the natural gas fleet. Concerning the use of E85 in vehicles, the NIR shows that by 2018 there was already a large fleet of 215,600 E85 vehicles and a significant number of refuelling points in Sweden. However, the use of E85 in flex-fuel vehicles seems to decrease due to the lack of vehicle models. ED95 use in heavy-duty vehicles is today an emerging market. As for the use of renewable fuels in aviation, very limited quantities of bio-jet are currently supplied to airplane fleets. Sweden should provide more information in future reporting on efforts to promote the use of renewable fuels in transport, and particularly in aviation.

5.1.8 *ANNEX - Description of the Member State*

On a surface area of 450,300 km², Sweden has a population of 10.120 million people in 2018, which makes up for a population density of 22 inhabitants/km².

Number of main urban agglomerations

- 13 urban agglomerations > 50,000 inhabitants

In 2018, Sweden achieves a per capita gross domestic product at market prices of €46,310, which represents a per capita gross domestic product in purchasing power standards of 121 if expressed in relation to the EU-28 average set to equal 100.

Length of the road networks

The length of the road TEN-T Core Network in Sweden is 3,034 km. The total road network length is 172,891 km, of which 2,132 km are motorways.

The following lengths of the TEN-T Road Corridors are present in Sweden: 16% (1,039 km) of the Scandinavian - Mediterranean Corridor.

Through the TEN-T Road Corridors, Sweden is connected with the following Member States:
- Denmark (through the Scandinavian – Mediterranean Corridor),
- Finland (through the Scandinavian – Mediterranean Corridor)

Number of registered road vehicles

At the end of 2018, Sweden accounts for 6,145,560 registered road vehicles of which 4,869,979 are categorized as passenger cars, 570,252 as light goods vehicles, 79,652 as heavy goods vehicles and 14,377 as buses and coaches. The motorisation rate is 481 passenger cars per 1,000 inhabitants.

Number of ports in the TEN-T Core Network

- 5 maritime ports in the TEN-T Core Network (Göteborg, Luleå, Malmö, Stockholm, Trelleborg)
- 20 maritime ports in the TEN-T Comprehensive Network
- 2 inland ports in the TEN-T Core Network (Göteborg, Stockholm)
- 2 inland ports in the TEN-T Comprehensive Network

The inland waterways TEN-T Core Network in Sweden is 667 km long.

Number of airports in the TEN-T Core Network

- 3 airports in the TEN-T Core Network (Göteborg-Landvetter, Malmö-Sturup, Stockholm-Arlanda)
- 23 airports in the TEN-T Comprehensive Network