Better alternatives for city authorities:

EUROCITIES policy paper on the revision of the alternative fuels infrastructure directive

Key messages

- Establish multilevel governance frameworks to coordinate the deployment of alternative fuels infrastructure and address potential gaps
- Develop charging infrastructure deployment methodologies that reflect actual investment needs and demand
- Recognise urban space as a limited resource and promote infrastructure that supports sustainable modal shift
- Drive the deployment of charge points in residential and non-residential buildings
- Increase the information and accessibility of charge points to increase their potential use and support local planning processes
- Define a minimum, flexible set of criteria for smart charge points and require publicly accessible charge points and charging infrastructure developed with public funds to meet this definition
- Ensure coherence with relevant EU climate and energy legislation

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Executive Summary

Alternative fuels infrastructure is essential to decarbonise the transport sector. Without adequate recharging and refuelling infrastructure, the transition towards clean vehicles will fail.

The revision of the Directive 2014/94/EU on the deployment of alternative fuels infrastructure (AFID) is an opportunity to support this transition. City authorities have led the deployment of recharging and refuelling infrastructure to achieve our shared climate and air quality goals. Urban areas will be at the centre of this transition and it is crucial to shape the legislative framework to accelerate progress in city authorities at all stages of development. This policy paper offers our views on how to achieve this.

Multilevel governance frameworks should be the primary mechanism to deliver a coherent approach to alternative fuels infrastructure. This is necessary to address local and regional infrastructure gaps and align policy measures between authorities to leverage impact.

Legislation on alternative fuels infrastructure should be developed in coherence with relevant EU instruments, such as the Clean Vehicles Directive[1] and the Governance Regulation[2], to mutually reinforce efforts and ensure alignment with EU climate and energy goals. This is also an opportunity to embed sustainability within the Trans-European Transport Network (TEN-T) and recognise the role of hydrogen in the decarbonisation of transport modes that are challenging to achieve zero emissions, such as long-distance heavy duty vehicles.

The legislative framework should recognise that cities are at different stages in the deployment of alternative fuels infrastructure. While some city authorities are initiating development, others have shifted from demand-led deployment to a strategic approach in response to urban space and grid capacity constraints. New methodologies required to accurately reflect investment and demand, incentivise infrastructure that supports sustainable modal shift and drives the deployment of charge points in residential and non-residential buildings. To accelerate the deployment of charging infrastructure, provisions should incentivise and facilitate private investment.

Publicly accessible infrastructure will serve as a backbone of charging but will not be able to meet demand alone. The greatest proportion of infrastructure is needed in privately and semi-publicly accessible areas, such as garages, carparks, and residential and commercial buildings. New methodologies for deployment should recognise that urban space is a limited resource and support broader public policy goals in our sustainable urban mobility plans. These methodologies and targets should be enhanced with provisions that strengthen information and accessibility of charge points to increase their potential use. This should include greater information for consumers, access to data for city authorities to support planning processes, and measures to access charging infrastructure in a fair and non-discriminatory manner.

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[1] Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles

[2] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action

We need to develop legal definitions for smart charge points and vehicle-to-grid charging to better integrate electric vehicles in our energy systems. An open and interoperable charging network should be pursued with a performance-based approach to standardisation requirements until a higher level of market maturity is achieved.

Finally, we need to expand financial support and capacity building among local and regional authorities. This will ensure that best practices are implemented in a transition where outcomes remain unclear.

1. Introduction

Transport is responsible for a quarter of Europe's greenhouse gas emissions and is the main cause of air pollution-related deaths in our cities[3]. A transition to clean vehicles is essential and the deployment of adequate alternative fuels infrastructure is a fundamental aspect of this.

City authorities deploy alternative fuels infrastructure to achieve climate and air quality goals, as part of sustainable urban mobility strategies. This includes the establishment of recharging and refuelling points alongside supporting measures, such as reduced tolls and parking fees for clean vehicles, procurement of low and zero-emission vehicles, zero and low emission zones (ZEZ/LEZs), reduced local taxes and free recharging services.

The revision of the Alternative Fuels Infrastructure Directive 2014/94/EU (AFID) is crucial to ensure that we achieve our shared climate and energy goals. Technology has evolved and pathways towards a decarbonised transport sector are clearer now than they have ever been. In the following sections, we outline our recommendations for a legislative framework that ensures ambition for the deployment of alternative fuels infrastructure and meet the needs of all city authorities.

2. Alternative fuels in scope

The inclusion of fossil fuels in Art.2 of the AFID is inconsistent with EU climate and energy goals and should therefore be removed from the scope, where feasible. We are committed to a future without fossil fuels and recommend a reduced scope to fuels with a renewable potential or feedstock, such as electricity, hydrogen, biomethane and sustainable advanced biofuels in road transport. This should apply from 2031, to ensure coherence with the recent adoption of the Clean Vehicles Directive[4], which includes clean vehicle public procurement targets for 2025 and 2030. The definition of these clean vehicles is aligned with alternative fuels under Art. 2 of AFID.

The removal of fossil fuels from the scope of the AFID requires a division of fuels per transport mode to account for the specificities of the maritime and aviation sectors.

Recommendations:

- Reduce the scope of alternative fuels in road transport to fuels with a renewable potential from 2031 onwards
- Define alternative fuels by transport mode

3.Sustainable urban mobility

3.1 Public transport

[3] https://www.eea.europa.eu/publications/air-quality-in-europe-2019

[4] Directive (EU) 2019/1161 on the promotion of clean and energy-efficient road transport vehicles

High upfront capital costs for infrastructure is a barrier for alternatively fuelled public transport. [5] The AFID requires Member States to detail measures that promote the deployment of alternative fuels infrastructure in public transport services, but this is not mandatory or consistent across the EU.

National policy frameworks (NPFs) show deep differences in the ambition of measures to support alternative fuels infrastructure in public transport. While there are several best-practice examples[6], many Member States detail only limited or no supporting measures. City authorities that are transitioning to alternatively fuelled buses are often required to make significant investments in infrastructure: for example, retrofitting bus depots with substations to cope with additional power demands of multiple electric buses.

Following the adoption of Clean Vehicles Directive, Member States must ensure a fixed proportion of publicly procured vehicles are low- or zero-emission in a first reference period (2021-2025) and an increased proportion in a second (2026-2030). Approximately 75% of these vehicles will be procured by local authorities and allocations of Member State procurement mandates must be agreed together. The Clean Vehicles Directive defines 'clean' vehicles by their respective alternative fuels in Art. 2 of the AFID. However, no other formal link exists in EU legislation on the coherence of alternative fuels infrastructure national policy frameworks and the public procurement of alternative fuelled vehicles.

The availability of EU and national funds and financing has played a significant role in supporting city authorities to establish alternative fuels infrastructure. EUROCITIES members have been the recipient of approximately 200 EIB urban mobility lending operations over the last ten years, covering tramways, metros, urban railways, and buses, to support public fleets and their sustainable transition.

Where a procurement mandate has been agreed under the Clean Vehicles Directive with local (or regional) authorities, support for alternative fuels infrastructure should be available and reported. The COVID-19 crisis has placed city authority and public transport operator budgets under severe strain. Coupled with high upfront costs of clean vehicles and infrastructure, the sustainable transition of public fleets is significantly challenged without appropriate support.

Recommendations:

- Ensure that Member States report on public transport infrastructure support measures for the first (2021-2025) and second (2026-2030) reference periods of the Clean Vehicles Directive
- Ensure technical support for local and regional authorities in the establishment of alternatively fuelled public transport is available under the European Investment Bank urban investment advisory platform (URBIS)

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[5] https://civitas.eu/sites/default/files/civitas_policy_note_clean_buses_for_your_city.pdf

[6] https://ec.europa.eu/transport/sites/transport/files/legislation/swd20190029.pdf (Netherlands, France, and the United Kingdom)

3.2 Electric bicycles and cargo bikes

Transport modes covered by the AFID are not explicit, but Annex II details technical specifications for motor vehicles, buses, inland waterway vessels and seagoing ships. In the development of their NPFs, several Member States took a broader view and highlighted measures to support alternative fuels in other modes, such as electric bicycles and cargo bikes.[7] Ambition here is a powerful opportunity for sustainable modal shift among women, who are more willing to use environmentally friendly transport modes and reduce their use of passenger cars.[8]

The availability of infrastructure for electric cargo bikes to support city authorities' ambitions for sustainable urban logistics is crucial. Many cities offer a broad range of subsidies to promote eBikes as an alternative, by publicly procuring fleets of electric bicycles, offering purchase subsidies to consumers and small businesses for electric bikes and cargo bikes, and funding temporary rental schemes. For instance, Barcelona provides subsidies of 250 EUR per annum for eBike purchases, supported small logistics company purchases of cargo bikes by 50% and distributed 500 eBikes to municipality employees. These actions can often be competitive: in Berlin a 200,000 EUR funding programme for cargo bikes was exhausted within a single day and was relaunched with double the budget. Such measures can be complemented by comprehensive action at EU and national level, especially with funding for pilots, infrastructure for parking and micro-hubs to support business models. Let us note that the COVID-19 crisis could boost this trend.

Recommendation:

- Establish targets for the deployment of infrastructure for electric bicycles and cargo bikes and require reporting on related measures

4. Governance of Alternative Fuels Infrastructure Deployment

The deployment of alternative fuels infrastructure by Member States is governed by NPFs. NPFs comprise national targets, objectives and supporting measures for the market development of alternative fuels and respective infrastructure. It was foreseen that the interests of local authorities shall be considered (Art 3.3), although this has often not been the case.

There is a debate on whether a revised AFID should retain the NPF approach, strengthen existing provisions or replace the NPFs with mandatory targets, defined by a common European methodology. The objective is to better address a lack of cross-border connectivity and ensure equivalent ambition to infrastructure deployment across the EU, which was lacking in certain Member State NPFs.

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[7] https://ec.europa.eu/transport/sites/transport/files/legislation/swd20190029.pdf (Austria, Croatia, Lithuania, Luxembourg, and Malta)

[8] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/women-european-transport-focus-research-and-innovation

EUROCITIES recommends retaining the NPF approach in combination with the establishment of multilevel governance frameworks, an improved methodology for the deployment of charging infrastructure and strengthened coherence with EU climate and energy policy instruments. Multilevel governance frameworks should be used to address potential local and regional infrastructure gaps and align policy measures between authorities. A revised methodology for the deployment of charging infrastructure should better reflect actual public investment needs and incentivise charge points that meet urban area requirements.

Recommendations:

- Retain the National Policy Framework approach and introduce multilevel governance frameworks
- Improve the methodology for the deployment of charging infrastructure
- Strengthen coherence with EU climate and energy policy instruments

4.1 Multilevel governance frameworks

European cities are among the global leaders in the deployment of alternative fuels infrastructure. The approaches of EU city authorities to alternative fuels are often determined by their Covenant of Mayors local energy and climate action plans[9] (SECAPs) and urban mobility plans[10], with goals for sustainable modal shift and reduction of climate impact.

Coherence should be sought with national and European authorities to ensure that measures implemented by different governance levels reinforce and leverage impact. Oslo and the Norwegian government are a successful example of this: measures across split competencies have been aligned to drive the fastest uptake of electric vehicles in Europe, while advancing sustainable modal shift.

Our members in the Netherlands have reported the benefits of their consultation on alternative fuels infrastructure, as part of the Nationale Agenda Laadinfrastructuur (NAL). [11] Overseen by the Ministerie van Infrastructuur en Waterstaat (Ministry of Infrastructure and Water), the goal of the NAL is to ensure that infrastructure is not a barrier to the electrification of transport by engaging with local and regional authorities, network operators, national ministries and independent technical expertise. Public and private stakeholders in the NAL collaborate to determine goals, actions and agreements for the deployment of infrastructure. This leads to improved coordination in the deployment of infrastructure, while ensuring broad multi-stakeholder buy in. Best practices can also be found under the Governance Regulation[12], which requires Member States to undertake public consultations (Art. 10) and establish multilevel climate and energy dialogues (Art. 11), with the involvement of local authorities to develop National

[9] https://www.covenantofmayors.eu/en/

[10] https://sumps-up.eu/sump-registry/

[11] https://www.rvo.nl/sites/default/files/2019/11/Governance%20Nationale%20Agenda%20Laadinfrastructuur_0.pdf

[12] Regulation on the governance of energy union (EU) 2018/1999

Energy and Climate Plans (NECPs). Analysis undertaken by the LIFE PlanUp project of local authority involvement in NECPs [13] notes the following success factors: entrust local authorities with key roles in governance frameworks, establish dedicated frameworks with clear mandates, engage stakeholders in formats that represent a balance of interest, ensure adaptability and provide sufficient resources.

In Member States where multilevel dialogue has not occurred, city authorities report challenges and uncertainty. This can be due to a delegation of responsibility for implementing national targets without guidance or a coherent discussion on the achievement of shared goals.

Recommendations:

- Establish national governance frameworks to ensure multilevel dialogue and coordinate the deployment of infrastructure with local and regional authorities
- Consult local authorities in the development of NPFs or strategies to deliver targets

4.2 Charging infrastructure deployment methodologies

The AFID requires Member States to deploy an 'appropriate' number of public EV charge points, which 'should be equivalent to at least one recharging point per 10 cars'. As electromobility further develops, there is a need to enhance the granularity of the metric to avoid distorting public investment needs for charging infrastructure and drive a greater deployment of semi-public and private charge points. We recommend an improved methodology that incorporates the following elements:

- Relationship between the demand for charge points and their supply
- Availability of semi-public and private charge points
- Member State targets that reflect local authority deployment strategies
- Availability and utility of fast and ultra-fast charge points
- TEN-T Core and Comprehensive Networks

4.2.1 Demand and supply

EUROCITIES recommends that requirements to establish a minimum number of charge points should remain aligned with actual, not projected, battery electric vehicle (BEV) and plug-in hybrid vehicle (PHEV) sales. This demand-supply approach should be coupled with the governance structure detailed in Sect. 4.1 to address potential geographic infrastructure gaps, ensuring the optimal deployment and allocation of resources. The potential to oversize charging infrastructure deployment ahead of uncertain EV sales may lead to the inefficient allocation of financial resources, particularly in a period of economic instability.

The Inception Impact Assessment for the revision of the AFID notes that 'there are not enough recharging and refuelling points across Member States and modes', which follows

[13] NECP case studies included: France, Netherlands, Sweden, Luxembourg, Ireland, Germany and Estonia

the European Commission's Assessment of National Policy Frameworks that reported insufficiency of infrastructure deployment across Member States in relation to 2020 projections for EVs and public charge points.

The AFID requires Member States to deploy an 'appropriate' number of public EV charge points, which 'should be equivalent to at least one recharging point per 10 cars'. However, data provided by the European Alternative Fuels Observatory (EAFO) shows that there is currently an average of one public recharging point per seven cars across EU Member States; a figure more ambitious than is suggested by the Directive. Projections for 2020 recharging points targets and EV estimates appear to have been miscalculated and thereby distorted sufficiency assessments. For instance, France had projected nearly 1 million EVs and 35,000 recharging points by 2020. Actual figures for 2019 are 166,000 BEVs, 61,000 PHEVs and 29,000 public charge points: a ratio of one recharging point for eight plug-in vehicles.

The most effective EU instrument to advance the sale of EVs are CO_2 emission performance standards and targets should be as ambitious as possible. In a study undertaken by Thiel and Harrison (2017)[14], the strongest driver for the deployment of public charge points and EVs were found to be CO_2 emission performance standards, rather than public subsidies for charge point deployment. In contrast, public infrastructure subsidies, which would be required in the case of an oversized charging network, were shown to have a weak impact on EV sales.

We need to carefully consider the role of potentially flawed projections in mandating infrastructure deployment and the risk in decoupling supply of charge points from demand by EVs. Minimum targets for charging infrastructure should be driven by actual sales of EVs to avoid risks of prematurely oversizing networks, to the detriment of private investments. Investment uncertainty in infrastructure is not solved by oversizing charge point supply and we should avoid scenarios in which legislative requirements stress delicate business models. This limits the possibilities for city authorities that wish to deploy charge points through market-based approaches.

Recommendations:

- Ensure any future electricity charge point deployment metric maintains a demand and supply approach

4.2.2 City authority deployment approaches

EUROCITIES considers that the 'appropriate' number of charge points established by the AFID, of one public charge point per ten EVs, lacks the granularity to capture mobility policy goals for city authorities. We recommend that city authorities establish charging infrastructure strategies at local level in collaboration with national authorities, supported by planning tools.

Urban space is an often-marginalised aspect in European transport policy discussions. The availability of public space in urban areas is limited and, in the context of charge point

[14] https://www.sciencedirect.com/science/article/pii/S0040162516302104

deployment, is further constrained by the need to consider availability of uncongested network substations and the impact of urban furniture on pedestrian traffic, disability access etc. City authorities have objectives for charge point coverage as well as measures to maximise utilisation rates.

Among other variables, the optimum relation of public charge points to ZEVs is a function of building typologies and the ratio of on-street and off-street parking, which can vary significantly between urban areas. Modelling undertaken by Oslo has estimated that 90% of inhabitants that reside in apartment blocks without private parking will depend on public charging, 30% of those in residential areas with parking and, 1% of those in detached housing. Similarly, London found that approximately 30% of owners will require on-street charge points in the outer boroughs.

In the original Commission proposal for the AFID, the optimum number of public charge points was determined as a function of total number of cars, estimated sales of EVs and the degree of urbanisation. However, this is a limited approximation for planning the deployment of public charge points in urban areas. Access to off-street parking (which varies by respective typologies of cities) has a stronger relationship in the determination of public charge point needs.

City authorities will develop charging infrastructure deployment strategies (and alternative fuels infrastructure more broadly) within the context of existing urban mobility plans and parking policies. There are an estimated 1000 Sustainable Urban Mobility Plans (SUMPs) in the EU[15], which primarily target sustainable modal shift: reducing the use of private passenger cars and increasing walking, cycling and public transport. Similarly, a broad range of parking policy strategies are in place to ensure an equitable and social use of public space, encourage sustainable modal shift, ensure economic performance and balanced public finances.

National targets for charging infrastructure deployment were frequently translated into targets for local authorities, often without consultation or guidance. Additional targets for urban areas, which mandate a specific deployment approach, has been raised as a policy option. The result of such an approach would likely lead to two sets of targets for city authorities to follow, restrict flexibility in deployment approaches and have no regard for local urban mobility strategies and parking policies.

The development of tools to support city authorities in their decision-making is crucial. As an example, the Horizon 2020 USER-CHI project foresees the development of a 'Charging Infrastructure LocatIon and HolistiC Planning Kit' (CLICK) that will analyse inputs on vehicle fleets, local mobility strategies, potential electricity grid impact and territory aspects to provide guidance on optimal deployment frameworks. The tool will be developed with the involvement of Barcelona, Berlin, Budapest, Murcia, Rome and Turku; engagement of city authorities is a critical precondition to shape tools according to cities' needs.

Recommendations:

[15] https://sumps-up.eu/fileadmin/user_upload/Tools_and_Resources/Publications_and_reports/Boosting_SUMP_Take-Up/CIVITAS_SUMPs-Up_-_Status_of_SUMP_Take-up.pdf

- Define charging infrastructures strategies at local level and incorporate into respective Member States' strategies through national governance frameworks
- To not require additional targets for urban areas and restrict local deployment approaches
- Recognise urban space as a constraining factor in the deployment of charging infrastructure in urban areas
- Develop and disseminate charging infrastructure deployment decision-making tools together with city authorities in research and innovation programmes

4.2.3 Residential and commercial buildings

One of the most significant gaps for charge point deployment under the AFID is the limited consideration for charge points that are not publicly accessible. The lack of measures to increase the uptake of semi-public and private charge points slows the transition to BEVs and the lack of data on their deployment distorts information on overall infrastructure needs, especially in urban areas. We therefore support the legal definition and further provisions for semi-public charging infrastructure (i.e. accessible to the public on private grounds) and private charging infrastructure (i.e. residential and non-residential properties).

The Energy Performance of Buildings Directive[16] made progress towards the deployment of recharging infrastructure in semi-public and private grounds, with provisions to require charge points and ducting infrastructure in new constructions and major renovations of residential and non-residential buildings. However, with the current rate of renovations in the EU this is unlikely to scale sufficiently in line with charging demands for the home and the workplace (approximately 90% of demand); even with the increased ambition that would arise from the Commission's 'Renovation Wave' proposal.

Complementary provisions are needed in a revised AFID to ensure coherence with the EPBD and incentivise the deployment of infrastructure in semi-public and private charging infrastructure in residential and non-residential buildings that are not newly constructed or undergoing major renovations. Analysis of the NPFs revealed ambition from several Member States to address semi-public and private charging infrastructure through subsidies. However, this has been inconsistent across the EU and requirements to subsidise their establishment should be made mandatory.

The inclusion of residential and workplace charge point deployment can have an impact in determining optimum public charge point coverage. The Danish Technical University (DTU) reported that, with an average workplace parking time (6h:51m), one session at a 22kW charge point would satisfy 157% of an average weekly driving need. If sufficient residential and highway charging is achieved in Denmark, the total need for public and destination charge points approximates 27 EVs per charge point.[17]

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[16] Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

[17] https://www.ncl.ac.uk/media/wwwnclacuk/cesi/files/Webinar_PeterBA_2019-12-10-compressed.pdf

To support planning approaches to deploy charging infrastructure at the local level, all semi-public charging infrastructure, and all private charging infrastructure that receives public subsidies, should be required to have a Type-2 plug and provide a minimum set of static data (i.e. location and physical characteristics of the charge point) to provide greater information and accessibility for consumers and businesses (see Section 6).

Beyond fiscal measures and data requirements, the lack of a 'right to plug' is an obstacle to the further development of charging infrastructure in off-street parking. This is an issue that has received broad cross societal and industry support.[18] The Energy Performance of Buildings Directive encourages Member States to 'provide measures to simplify the deployment of recharging infrastructure' in residential and non-residential buildings. However, this does not go far enough. Consumer organisations have reported challenges in permit procedures, such as long waiting times and complexity in application processes.

Recommendations:

- Develop charging deployment methodologies that balance public charge point deployment with semi-public and private availability
- Introduce mandatory deployment targets for privately accessible charge points on residential and commercial properties
- Introduce mandatory deployment targets for semi-accessible charge points
- Require all semi-public charging infrastructure to be equipped with Type-2 or CCS plugs and provide a minimum set of static data types
- Require all semi-public and private charging infrastructure that receives public subsidies to have smart charge point capabilities (discussed in Sect. 5.1)
- Ensure a 'right-to-plug' in residential buildings

4.2.4 Charging infrastructure that supports sustainable urban mobility goals

Sustainable modal shift and reduction of emissions are key objectives for city authorities. This is evident in the growth and ambition of Sustainable Urban Mobility Plans (SUMPs) across Europe that guide the implementation of goals, such as increases in walking, cycling, use of public transport and shared, zero-emission mobility to reduce passenger car use and ownership. Within the context of charging infrastructure deployment, it is important to promote charge points that support shared mobility, electrified logistics and taxis, and do not obstruct active mobility.

Rapid charging hubs enable the simultaneous high-power charge of multiple vehicles and can increase consumer and commercial confidence, through availability and reliability of high-power and quality infrastructure.[19] Rapid charging hubs can take different forms: 'virtual' rapid hubs, dedicated rapid hubs, commercial rapid hubs and shared access

[18] https://www.acea.be/uploads/press_releases_files/Joint_call_to_action-ACEA_Eurelectric_TE.pdf

[19] https://theicct.org/sites/default/files/publications/EV_charging_guide_02262020.pdf

depots[20]. All forms of rapid charging hubs should be promoted in a revised AFID to incentivise shared fleets and heavy-duty vehicles (HDVs), which operate from depots.

Analysis undertaken by London to understand charging needs of different user categories noted that shared vehicles, taxis, commercial fleets of light goods vehicles (LGVs) and private LGVs would depend the most on the availability of high-power charging.[21] Moreover, a study undertaken by the Netherlands showed that for the establishment of each high-power charger, 44 fewer normal charge points are required.[22]

The AFID has no mechanisms to promote rapid charging hubs or high-power charge points. High power charging points are defined, but there is no meaningful differentiation for their deployment ahead of normal power charge points. This is problematic, as high-power charge points face the greatest financial barriers, with challenges in high upfront costs, revenue stacking and uncertainty in the return on investment.[23]

Urban space is limited and competition for space is constant. Given the size of electric vehicle supply equipment (EVSE) and expected increases in deployment, it is important to limit the disruption caused by infrastructure to movement, especially for disabled pedestrians. Demonstration trials in cities on innovative charge point designs have shown it is possible to offer charging services, with lower impact on urban streetscapes[24][25]. Charging infrastructure with a limited streetscape impact would be challenging to adequately define and incentivise through legislation. However, soft measures, such as research and innovation, or conditionality on EU funding for charging infrastructure in urban areas, should be established.

Recommendations:

- Promote rapid charging hubs and high-power charging infrastructure with targets, counting bonuses or other regulatory incentives that reflects their utility
- Define ‘rapid charging hubs’ and require reporting on their establishment
- Fund research and innovation for charging infrastructure with a reduced streetscape impact, or inclusive for disabled persons, and support best-practice exchange among local authorities

4.2.5 TEN-T Core and Comprehensive network

The AFID required a charge point for every 60km on the TEN-T Core Network. As shown in the analysis of NPFs, progress towards reaching this target has progressed well, with limited exceptions. Targets should now be required for the TEN-T Comprehensive Network, to further drive the expansion of charging infrastructure.

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20 http://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf

21 http://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf

22 https://www.rvo.nl/sites/default/files/2019/11/Geactualiseerde%20prognose%20laadinfrastructuur_20190329.pdf

23 https://www.pwc.co.uk/power-utilities/assets/powering-ahead-ev-charging-infrastructure.pdf

24 https://www.london.gov.uk/press-releases/mayoral/4-million-boost-for-more-than-1000-new-ev-points

25 https://www.oxford.gov.uk/news/article/1246/oxford_trials_world_s_first_residential_pop-up_on-street_electric_vehicle_charging_points

Support should also be strengthened for Hydrogen refuelling stations, which were an optional target for the TEN-T Core Network. Hydrogen offers the possibility to decarbonise some transport use cases that are challenging for other alternative technologies, particularly long-distance transport of heavy-duty vehicles.

Recommendations:

- Extend charging point deployment metrics to include the TEN-T Comprehensive Network
- Introduce mandatory deployment targets for hydrogen refuelling stations on the TEN-T Core Network

4.3 Coherence with EU Climate and Energy policy

Alternative fuels infrastructure is fundamental in the achievement of EU climate and energy goals, yet the AFID does not require Member States to develop NPFs with long-term strategies on the transition from fossil fuels. Reporting obligations extend only to objectives for the number of alternatively fuelled vehicles and achievements on alternative fuels infrastructure until 2030.

Several Member States showed foresight on long-term alternative fuels infrastructure planning, as part of their NPFs. For instance, Sweden established the 'Fossil Free Sweden' initiative and created a formal taskforce to coordinate the transition to a fossil-free transport sector with an accompanying strategic plan. Similarly, Malta established a working group to decide on when to implement a ban on the importation of all internal combustion engine vehicles. Momentum has since grown among Member States for a coherent strategy on the transition from fossil-fuels in transport. The October 2019 Environment Council AOB item on the 'transition to a fleet of zero-emission passenger cars', initiated by Denmark, received widespread support among Member States.[26]

There is an opportunity for a revised AFID to ensure greater coherence with long-term EU climate and energy policy through reporting under the Governance Regulation. The Governance Regulation requires Member States to develop integrated National Energy and Climate Plans (NECPs) and 'long-term strategies', to track climate progress on sectors under the Effort Sharing Regulation. NECPs cover the Energy Union and require Member States to plan their climate and energy objectives, targets, policies and measures: Annex I, Sect. 3.1.3 requires Member States to describe 'policies and measures to achieve low emission mobility (including electrification of transport)'. Long-term strategies extend the outlook of NECPs, with a perspective of at least 30 years, to contribute to commitments under the UNFCCC and the Paris Agreement; Annex IV, Sect. 2.4.3 requires Member States to detail decarbonisation options for transport.

Recommendation:

[26] https://www.consilium.europa.eu/en/meetings/env/2019/10/04/

- Develop a template for Member States to integrate alternative fuels infrastructure plans in the National Energy and Climate Plans and long-term strategies under the Governance Regulation, ensuring a meaningful involvement of city authorities.

5. Integration of electric vehicles in power systems

5.1 Smart charging

Smart charging is the ability to influence the charging of an EV through external input, such as user requirements and power system characteristics. The advantages of establishing smart charging can include the avoidance of expensive grid reinforcement, reducing renewable energy curtailment and improving operating expenses for consumers[27]; when combined with a grid access contact, costs can be significantly reduced.

While the electrification of transport is not forecast to be constrained by energy limitations (kWh), the expected load (capacity, kW) in urban area distribution networks can be a concern. Smart charging capable infrastructure can be a powerful means to address this and defer required investments. However, the ability to smart charge depends on several complementary elements, such as network tariff design and sufficiently advanced infrastructure.

Tariff design is a critical enabler of smart charging. Research has highlighted the role that time-differentiated network tariffs can have on managing the impact of EV charging on the grid and ensuring a lower total cost of ownership (TCO) for consumers[28]. Art. 18 of the Internal Market for Electricity Regulation[29] established a principle for cost-reflectivity and encourages national regulatory authorities (NRAs) to introduce time-differentiated network tariffs where appropriate. We therefore recommend that Member States implement such tariffs wherever feasible to ensure that city authorities can manage capacity constraints.

A legal definition of a 'smart charge point' is needed to advance smart charging infrastructure in the EU. A reasonable baseline has been established by the UK, which defines 'smart charge points' as charging infrastructure that can receive and process information, react to information (i.e. by adjusting the rate of charging or discharging), transmit information, monitor and record energy consumption, comply with security requirements, achieve energy efficiency and be accessible remotely[30]. Charge points that are established with public funds are required to meet this definition.

Legislative criteria should be the minimum possible to fulfil the needs of all relevant stakeholders. Satisfying the broad range of smart charging use cases implies disproportionately high costs relative to benefits, or even obstruct innovative business

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27 https://www.raponline.org/wp-content/uploads/2019/03/rap-start-with-smart-ev-integration-policies-2019-april-final.pdf

28 https://www.raponline.org/wp-content/uploads/2019/03/rap-start-with-smart-ev-integration-policies-2019-april-final.pdf

29 Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity

30 http://www.legislation.gov.uk/ukpga/2018/18/section/15/enacted

cases[31]. We therefore recommend establishing criteria for smart charge points with an effective minimum baseline that permits flexibility in charge point design.

However, criteria for smart charge points should be required only when it is useful. The utility of smart charging functionalities increases in line with the amount of time that a vehicle is parked at a charge point, as well as the probability of the charging event occurring during a demand peak. While there are demands for all public charge points to be smart charge points, derogations should be considered for some specific circumstances. Instances in which a user requires charging for a limited amount of time, such as short-stay parking, will not necessarily require a broad range of advanced smart charging functionalities. Systems that determine capacity per active charger within the operational limits of the connection point and distributed network, without communication to external parties, can be sufficient based on the decision of the charge point operator (CPO).

Recommendations:

- Legally define 'smart charge points' with minimum criteria that permits flexibility in design
- Require publicly accessible charging infrastructure to meet the criteria for smart charge points
- Require semi-publicly accessible and privately accessible infrastructure that have received public subsidies to meet the criteria for smart charge points
- Include the possibility for derogations from smart charge point requirements, based on an agreed set of criteria

5.1.1 Vehicle-to-Grid charging

Vehicle-to-grid (V2G) allows bidirectional power flows between EVs and grids, opening the possibility for a broader range of network ancillary services. However, the ability to offer these network services can depend on the specific national regulatory context and the aggregation of sufficient supply. The technology is still in an early phase of market development, with uncertain business cases. Revenues from the participation in network services will need to outweigh higher EVSE hardware costs and any additional impact on battery degradation, which is not yet well understood. Given the additional hardware costs, V2G charge points should be legally defined separately.

Several city authorities have explored the feasibility of V2G charging to achieve environmental goals, such as integration of renewables. In Copenhagen, a partnership with Enel and Nissan launched the world's first commercial V2G hub with a capacity of 100kW, which was possible with access to the Danish frequency containment reserve service. In Amsterdam, the Johan Cruijiff Arena offers 3MW of flexibility with electric passenger cars and second life batteries. In London, trials will begin soon on the 'E-Flex' project that will aggregate the flexibility of commercial fleets.

[31] https://www.beama.org.uk/asset/2945FEB3-9DAD-450F-BAECC95F51BDDFB9/

Public transportation fleets are another area where the potential of V2G should be explored, given the significant power capacities that could potentially be offered as network services. We recommend that EU research and innovation funding pursues this as a future area to be addressed.

Recommendations:

- Legally define 'vehicle-to-grid charging', separately to 'smart charge point' criteria
- Expand research and innovation projects on vehicle-to-grid projects, including for public transport

5.2 Interoperability

The economic viability and network integration of electric vehicle charging infrastructure depends in part on systems interoperability. This is important for city authorities to minimise capital and operational expenditure in the deployment of charge points, support charging service business models and maximise consumer accessibility. In addition, open standards can promote competition, avoid vendor lock-in and ensure the transfer of charge points to new operators at the end of concessions. However, the standardisation of high-level communication for the electromobility ecosystem remains fragmented and at an early stage of development.

Experience has demonstrated the risks inherent in mandating standards through European legislation. IEC/EN 62916-X 'Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles'[32], required by the AFID, did not define material compatibility requirements for plug and sockets. When coupled with high contact pressure, often resulted in overheating at high power due to premature abrasion of contact sleeves and contact pins.

Given the current stage of development in standards that will govern interoperability in the electromobility ecosystem, we recommend a principle-based approach to legislative provisions until a higher level of maturity is achieved.

Recommendations:

- Apply a principle-based approach to legislative provisions for interoperability of the electromobility ecosystem

5.2.1 Electric Vehicle and Electric Vehicle Supply Equipment

Communication between the EV and the EVSE in normal power AC charging infrastructure deployed by city authorities is primarily undertaken via IEC 61851 'Electric vehicle conductive charging system', which provides safety requirements and low-level analogue communication. While IEC 61851 has a high degree of market maturity, limitations in functionality restrict possibilities to achieve a broad range of smart charging use cases.

ISO/IEC 15118 'Road vehicles – vehicle to grid communication interface' aims to ensure high-level communication between the EV and EVSE, which includes the 'Plug & Charge'

functionality to reduce authentication obstacles. While Edition 1 of ISO/IEC 15118 had suffered implementation challenges because of complexity and security weaknesses, it is expected that Edition 2 of ISO/IEC 15118 will be increasingly required by city authorities in tenders. Expected functionalities include automated authentication, authorisation, and billing, wireless (WPT) and bidirectional power transfer (BPT), support for automated connection devices (ACD) and optimised load management for AC and DC charging. These will be valuable for the development of the electromobility services market for destination charging, streamlining authentication for consumers, minimising grid investments and create possibilities for public transport to generate revenue from ancillary services. However, while ISO/IEC 15118 Ed. 2 will be published in 2020, the development of testing specifications, and compliant vehicles and infrastructure is only expected by 2023 at the earliest. It will be important to understand the performance of compliant devices first, before considering their applicability in legislation.

For high power normal charging infrastructure deployed by city authorities, charge points are generally required to offer both Combined Charging System (CCS) and CHAdeMO plugs, which respectively use the ISO/IEC 15118 Ed. 1 and the CHAdeMO standard. Although the implementation of both implies higher cost per EVSE, we support consumer choice between CCS and CHAdeMO.

Recommendation:

- To not legislate on the application of communication protocol standards between the electric vehicle and electric vehicle supply equipment

5.2.2 Electric Vehicle Supply Equipment and Charge Point Operators

City authorities tend to require the latest version of the Open Charge Point Protocol (OCPP) for communication between the EVSE and the charge point operator (CPO). However, as OCPP 2.0 is offered by few manufacturers, in practice OCPP 1.6 is the version most often implemented at present.

It is expected that the international standard IEC 63110 ‘Protocol for Management of Electric Vehicles charging and discharging infrastructure’ will incorporate OCPP 2.0 and align with ISO/IEC 15118 Ed. 2, to complete the communication ecosystem immediately surrounding the EVSE. IEC 63110 is due to be published in mid-2021 and compliant products will require several more years to reach the market.

Recommendation:

- To not legislate on the application of communication protocols between electric vehicle supply equipment and the charge point operator

6. Information and accessibility

A strengthening of provisions on information and accessibility is vital to address urban space constraints in cities, while supporting consumers and commercial operators. This should include:

- Greater information for consumers to better understand the location, availability, and suitability of charge points
- Access to information for public authorities that can inform their local planning approaches to charging infrastructure and better determine the allocation of public investments
- Fair and non-discriminatory measures for access charging infrastructure and payment for charging services, ensuring that consumers and commercial operators can charge their vehicle wherever and whenever possible

6.1 Provision of static and dynamic data

An important element in maximising the availability of charging infrastructure is to provide comprehensive information to consumers and businesses on publicly and semi-publicly accessible charge points. To find an appropriate charge point, consumers should be able to receive the location, characteristics, and occupancy of charging infrastructure in real-time. In addition, specific in-vehicle data should be made available to support the emergence of smart charging services.

Art. 7 of the AFID states that 'Member States should make information on the geographic location of recharging points accessible to the public where available. Information on real-time accessibility as well as historical and real-time charging information may be included were available.' Unfortunately, implementation of this provision has been largely inconsistent. We therefore recommend that, as a minimum, the following static and dynamic data types are required and made available free of charge on National Access Points (NAPs): location, plug types, power, opening users, user identification options, available payment methods, prices, CPO contact information, eMobility Service Provider (eMSP) options and roaming provider options. These requirements should be detailed in both the AFID and in the revision of the Delegated Regulation EU-wide real-time traffic information services 2015/962.

The 'Berlin Model' is one example of achieving this at the local level. Berlin requires all private CPOs that would like to establish charging infrastructure on public land to follow strict rules on their installation and operation, guaranteeing consumers the same conditions on information and accessibility at every publicly accessible charge point.

To further support the development of smart charging services, non-discriminatory access to a limited number of relevant in-vehicle data types, such as the state-of-charge (SoC) and charging profile characteristics, should be established.

There should however be a division in requirements for publicly and semi-publicly accessible charge points, which could be owned by CPOs with only a limited, or indirect, interest in the financial viability of their infrastructure. While it is important for semi-publicly accessible charge points to provide static data on location and physical characteristics, we recommend that only semi-public charge points that have received public subsidies be required to provide dynamic data.

Recommendations:

- Require publicly accessible charge points to provide static and dynamic data
- Require semi-publicly accessible charge points to provide static data
- Require semi-public accessible charge points that have received subsidies to provide static and dynamic data
- Require privately accessible charge points that receive public subsidies to be registered
- Revise the Intelligent Transport Systems Directive Delegated Act on Real-Time Traffic Information Services to ensure the availability of the data from publicly accessible and semi-publicly chargers on Member States National Access Points (NAPs)

6.1.1 Business to Government (B2G) data

The availability of data to city authorities for long-term planning is limited and undermines the effectiveness of alternative fuels infrastructure deployment. A comprehensive approach should be established that ensures city authorities have access to the datasets necessary for enhanced decision-making and planning.

Two notable examples of valuable datasets for planning deployment are access to information on substation capacity and utilisation rates of public charge points. For instance, in the siting of EVSE in the urban area, knowledge on available power capacity is essential to ensure that undue demands are not placed on the electricity network and that grid reinforcement upgrades can be undertaken sufficiently in advance if power demands are forecast to exceed limits. In London, collaboration with the local distributed network operator (DNO) was established to develop capacity maps of substations that could be easily accessed by local boroughs for their own infrastructure deployment planning.

In charging infrastructure deployed by tender in Utrecht, data on utilisation rates is provided by the CPO to the city authority. If the average utilisation of a public charge point rises above 70% in a residential area during peak hours, the city authority will deploy an additional charge point in a nearby location. This is an evolution of a previous 'demand-driven by request' approach, in which a charge point would be deployed within a 250m radius of a request for a public charge point. The new approach serves two functions: supporting the planning and decision-making of the city authority in the expansion of charging infrastructure, and providing evidence that can be used to justify the establishment of infrastructure to residents that are otherwise reluctant to agree to additional uses of limited public space.

While the above examples highlight the utility and feasibility of such arrangements, a comprehensive approach at EU-level is required to ensure this occurs on a systematic basis, particularly for privately operated charge points. We recommend building on the aims of the 'European strategy for data' Communication and recommendations of the High-Level

Expert Group on Business-to-Government Data Sharing to ensure that data valuable for planning and management purposes is available for public authorities.[33][34]

Recommendations:

- Require data on average utilisation to be made available to public authorities from publicly available charge points
- Encourage distribution system operators and distribution network operators to provide data on local substation capacity on request
- Ensure the upcoming Data Act includes an ambitious Business-to-Government data sharing dimension

6.2 Price transparency and comparability

Art. 4 of the AFID requires operators of charge points to ensure that prices are 'reasonable, easily and clearly comparable, transparent and non-discriminatory'. However, we have observed that tariffs among charging networks can differ significantly and that costs are not always sufficiently transparent. This can create confusion for users, particularly when combined with a variety of payment models that can further obstruct the most economic choice. This is particularly problematic for ad-hoc charging, where cost components are frequently not made clear to the end-user. This opacity in price transparency has been found to have an impact for commercial fleet operators and small businesses, which rely on certainty in running costs.

We recommend that prices are expressed as a minimum in the comparable unit price per kilowatt-hour (price-kWh) to ensure that the provisions of Art. 4 are realised. This provides a common basis for comparison across offers, provides transparency on total cost of ownership (TCO) and better provides for the possibility of time-differentiated tariffs. To improve the transparency of payment models, the division of price components for ad-hoc charging should be harmonised to support consumers and businesses and this must include an option for a time-based component.

A time-based component parking fee is often required by city authorities to ensure fairness in the availability and access of charge points, and to manage finite urban space. The JRC has estimated that, on average, an electric vehicle connected to charge points is idle 61% of the time, using data from 1.8 million charge events over 6 years.[35] This places additional pressure on existing charge points and options to incentivise their more efficient use should be encouraged to avoid unnecessarily oversizing charging networks.

Recommendations:

- Express the price for a charging service in price per kilowatt-hour (price-kWh)
- Harmonise price components for ad-hoc charging, with an option for a time-based component

[33] http://eurocities.eu/eurocities/documents/Smart-cities-in-the-age-of-the-digital-revolution-WSPO-BGYS3W

[34] http://www.eurocities.eu/eurocities/documents/EUROCITIES-principles-on-citizen-data-10-data-principles-for-the-common-good-WSPO-BAXFRH

[35] https://ec.europa.eu/jrc/en/news/electric-vehicles-new-model-reduce-time-wasted-charging-points

6.3 Roaming

Roaming enables an EV user to access charging infrastructure that would otherwise be inaccessible by virtue of their eMSP membership. We view roaming as an important element to maximise the availability of charging infrastructure, particularly for cross-border or intercity travel.

The use of a roaming network typically implies an additional cost component for consumers and businesses that are not members of that network. The European consumer organisation BEUC has highlighted potential risks of cost-reflectivity in roaming surcharges[36], which raises issues of discriminatory pricing and can undermine the TCO of EVs relative to conventional mobility. In the short to medium term, we recommend that the Commission monitors the level and evolution of roaming cost components in the EU and assesses the possibility for harmonising regulations for the taxation of transnational transactions.

Recommendations:

- Harmonise regulation for the taxation of transnational transactions
- Ensure roaming charges are cost-reflective and non-discriminatory

6.4 Payment solutions

The access and overall availability of charging infrastructure depends on 'ad-hoc' charging, which enables any user to charge at any charge point. Art. 4 of the AFID requires that 'recharging points accessible to the public also provide for the possibility for electric vehicle users to recharge on an ad-hoc basis without entering into a contract with the electricity supplier or operator concerned.

Unfortunately, we have noted numerous examples within our cities whereby private networks have not implemented ad-hoc payment possibilities and charging is permitted only on a contractual basis. In part this is a failure of enforcement, but also a lack of specificity in the definition of 'ad-hoc' under Art. 4. We therefore recommend that the Commission requires that payment by bank or credit cards should be a mandatory option at new publicly accessible charging infrastructure, alongside payment by a third-party service provider. This should apply to new deployments of charge points only, as the proportionality of retrofit costs is high relative to the increase in benefit.

The applicability of these provisions to semi-public charge points is however questionable, as these may apply to CPOs that have a limited business interest.

Recommendation:

- Require all new publicly accessible charge points to permit payment by bank or credit card and third-party service provider

7. On-shore Power Sources

[36] https://www.beuc.eu/publications/beuc-x-2019-032_making_electric_cars_convenient.pdf

Air quality and noise emissions are significant issues for port cities in our network. Estimates have shown that if all EU maritime ports were electrified, the projected health benefits would reach close to 3bn EUR per year.[37]

The AFID requires Member States to assess the 'need for shore-side electricity supply … in maritime and inland ports', as part of their NPFs. On-shore Power Sources (OPS) shall be established unless 'there is no demand and the costs are disproportionate to the benefits'. The Commission has noted options available for supporting the uptake of OSP[38]: priority under the TEN-T Guidelines, funding from the Connecting Europe Facility, eligibility under the General Block Exemption Regulation and derogations under the Energy Taxation Directive. These have not been effective in the promotion of OPS in European ports.

An internal survey of EUROCITIES members with a maritime port noted persistent financial, technical and regulatory challenges to the establishment of OPS. Business case viability is often dependent on a combination of tax exemptions and subsidies. Installations can be complex, available grid capacity can be limited and standardisation is unresolved. Finally, upfront capital-intensive investments often may not be justified due to insufficient use. Therefore, funding from the inclusion of the maritime sector in the scope of the Directive (EU) 2018/410 to enhance the cost-effective emissions reductions and low-carbon investments (EU Emissions Trading System) would be beneficial for port investments that would otherwise not be economically viable.

Sustainable technology pathways for zero-emission vessels are at different stages of maturity and therefore feasibility. We encourage the consideration of a phased approach to zero-emission vessels at berth, with an initial focus on inland navigation, roll-on/roll-off (RoRo), ferries and offshore vessels, and then cruise liners, cargo vessels, bulk vessels and other types of vessels. We also encourage a greater focus on ports that include traffic from vessel types that are easier to electrify.

However, while OPS is an important measure to achieve zero emissions at berth, alternative solutions could achieve the same objectives and should be supported.

Recommendations:

- Finance the establishment of onshore power and alternative solutions to vessel emissions in ports from the inclusion of the maritime sector in the EU Emissions Trading System
- Address remaining equipment and vessel OPS standardisation issues
- Expand the scope of priority ports from TEN-T Core to those that include high inland navigation, roll-on/roll-off and ferry traffic

8. Financial support, capacity building and procurement

[37] https://www.sciencedirect.com/science/article/abs/pii/S0301421515300240?via%3Dihub

[38] https://www.europarl.europa.eu/doceo/document/E-9-2019-002668-ASW_EN.html

The transition to alternative fuels and electrification of transport requires knowledge and capacity to ensure that best practices are implemented in a transition where outcomes remain unclear. However, provisions that support financing, capacity building and joint public procurement for local and regional authorities were absent in the AFID. Research undertaken for the European Parliament's Transport and Tourism Committee has highlighted the obstacle that the lack of information and support can have on the progress of alternative fuels infrastructure[39].

Reinforcement of the European Investment Bank (EIB) European Local ENergy Assistance (ELENA) agency and the urban investment advisory platform (URBIS) under the European Investment Advisory Hub (EIAH) would be valuable, ensuring that support offered meets the needs of city authority alternative fuel infrastructure deployment of all scales. In addition, we recommend strengthening the Connecting Europe Facility (CEF) Transport Blending Facility, which has driven deployment alternative fuels infrastructure in urban areas through combinations of grants and financing.

Support for joint public procurement between city authorities, particularly within national cross-border contexts, could accelerate the cost-effective deployment of infrastructure through advantages created by higher purchasing power, collaborating on market consultations and sharing information on availability, specifications and prices.

Recommendations:

- Reinforce the European Local ENergy Assistance (ELENA) agency and urban investment advisory platform (URBIS) to ensure technical and financial support is available for all types of deployment
- Strengthen the Connecting Europe Facility (CEF) Transport Blending Facility
- Support joint public procurement among city authorities

[39] https://www.europarl.europa.eu/RegData/etudes/STUD/2018/617470/IPOL_STU(2018)617470_EN.pdf