Super Smart Charging Hubs | Interreg North Sea | Co-funded by the European Union

SSCH Policy Barriers

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Summary sheet

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Project partners

Organisation	Abbreviation	Country
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City of Vlissingen (subpartner)	VLI	Netherlands
Gate 21	Gate 21	Denmark
ASTER cv	Aster	Belgium
GreenFlux Assets B.V.	GFX	Netherlands
VUB-MOBI Electromobility Research Centre	VUB-MOBI	Belgium
Flux50	Flux50	Belgium
Agrisnellaad	ASL	Netherlands
Autodelen.net – carshare Belgium	Autodelen	Belgium
Hub Park AB	HUB	Sweden
Free Hanseatic City of Bremen	BRE	Germany
l'Association Européenne de la Mobilité Électrique (inactive)	*AVERE*	*Belgium*
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0.1	17/09/2025	Flux50	Swedish input	
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1. Summary

This document explores whether upgrading traditional charging hubs into 'super smart charging hubs' encounters significant regulatory barriers. Super Smart Charging Hubs (SSCHs) are defined as advanced EV infrastructure nodes integrating bidirectional charging, energy communities, and smart grid interaction. An SSCH includes ≥10 bidirectional 11–22 kW smart chargers supporting V2X-enabled EVs (shared/private/light). These hubs act as decentralized energy assets within urban grids.

SSCHs are vital to decarbonized, decentralized energy systems and represent a next-generation integration of energy flexibility, digital infrastructure, and mobility services. Their deployment is influenced by a complex regulatory landscape spanning European, national, and local levels.

To evaluate the potential influence of regulatory frameworks on the deployment of Smart and Sustainable Connected Homes (SSCHs), this document conducts a detailed analysis of how current policies and institutional structures shape critical operational domains. These domains—grid capacity, data governance, urban planning, and financial mechanisms—are examined through the lens of thematic categories that reflect areas where regulatory evolution is most likely to exert significant impact. By mapping these domains against emerging legislative trends and policy shifts, the assessment aims to identify both barriers and enablers to SSCH implementation. Key domains include:

1. Flexibility and energy sharing
2. Grid connection and grid capacity
3. Data and digitalisation
4. Technical integration
5. Charging infrastructure and land use
6. Financial structures and incentives
7. Mobility and owner models

As part of the living lab deployment, the consortium will continue to explore regulations and boundaries to identify practical constraints and opportunities. The classification serves as a foundation for understanding where regulatory alignment is needed and how SSCH initiatives can be shaped to comply with—and benefit from—ongoing policy developments. The document will benefit municipalities, energy communities, and infrastructure providers by clarifying legal frameworks, streamlining permitting processes, and enabling flexible energy and mobility solutions. It also supports manufacturers, grid operators, and consumers through harmonized standards and market reforms that foster interoperability, innovation, and user-friendly services.

2. Introduction

In the project a SSCH has been defined as:

A charging hub with multiple (at least 10) bi-directional 11 kW or 22 kW smart1 charging stations.

- A SSCH provides charging infrastructure for V2X enabled electric vehicles (these could be shared cars, private cars and vans and possibly also light electric vehicles).
- The SSCH is connected to the electricity grid and makes use of locally produced renewable energy sources. It consists of an energy management system for load balancing and optionally also energy storage capabilities (next to the V2X EV's).
- The SSCH includes a 'virtual power plant' (VPP) that solves the business case as it aggregates energy within a portfolio.
- The SSCH interacts directly with the grid operator, using a smart energy management system to optimize electricity use. This will reduce strain and have a positive impact on the grid, often allowing for a smaller connection to that grid.
- The SSCH may also provide energy for other energy users than for charging the EVs. For instance office buildings or houses.

This means they go beyond more established smart charging hubs (like for example Fastned charging hubs along highways) which are hubs with multiple charging stations, with integration of local renewable energy provision and/or batteries, located where there are mobility needs for charging.

This means that organisations that want to set up SSCHs come from different fields and encounter different barriers.

Figure: some of the barriers for setting up SSCHs identified by stakeholders during kick-off meeting.

These barriers are in the field of organisation, human behaviour, technology, legislation and financing.

Some successful smart charging hubs have been identified. Succes factors identified by project partners include in the first place strong needs: user needs (need for smart charging, convenience of smart charging, good location, combination of smart charging with shared mobility) and other urgent needs (grid limitations and associated financial benefits). Other identified success factors include different opportunities: technical optimisation (for example large batteries have been identified as success factors), a clear vision (for example an inspiring lead for the project) and an attractive business case and new opportunities (for example energy behaviour driven by energy/flexibility needs).

The drivers differ between countries in the North Sea Region. Some examples:

- The wide use of EVs in Norway drives the development of charging stations. In countries like France there are much less EVs, and therefore not many charging hubs have been developed.
- Grid issues can be a driver and a barrier. A stable grid allows for charging stations and hubs to be developed (as in Norway). Grid congestion however (as in the Netherlands) increases the need for smart charging, and therefore super smart charging hubs.
- Successful projects (for example charging hubs with carsharing and V2G in the Netherlands) attract new companies and new projects.

Although regulation has not been identified as the main barrier for the development of SSCH, some regulatory changes are needed for the full development and upscaling of SSCHs.

Project partners have identified that most benefits will come from changes in the regulation in following fields:

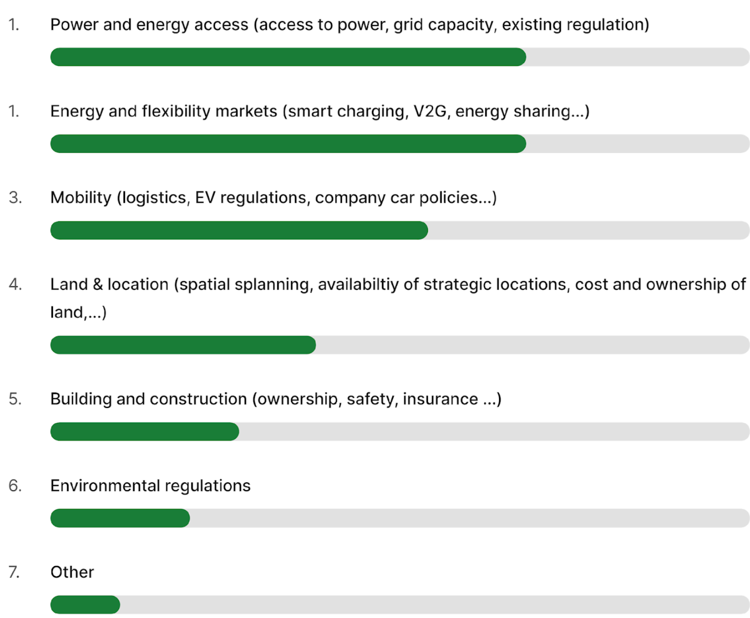


Figure: fields where regulatory changes will bring most benefit for the deployment of SSCHs (identified by project stakeholders).

Next chapters explore whether upgrading charging hubs into so-called 'super smart charging hubs' (SSCHs) faces significant regulatory barriers. SSCHs represent an advanced integration of energy flexibility, digital infrastructure, and mobility services, and their deployment may be influenced by multiple layers of regulation. The successful deployment of Super Smart Charging Hubs (SSCHs) across Europe depends hinges on a supportive regulatory environment that fosters innovation, integration, and local empowerment. Several regulatory advancements offer direct benefits to a wide range of stakeholders involved in smart mobility and energy transition.

First, the harmonization of EU standards such as ISO 15118-20 and IEC 63110 will benefit EV manufacturers, charge point operators, and municipalities by ensuring interoperability, reducing integration costs, and enabling seamless Plug & Charge experiences. These standards also support advanced functionalities like bidirectional charging and vehicle-to-grid services, which are essential for grid flexibility. Second, the reform of tariffs and market rules to support flexibility will empower energy communities, aggregators, and smart hub operators to participate in local energy markets and monetize demand response. Municipalities can use these reforms to incentivize adaptive consumption and local balancing, aligning with broader sustainability goals. Third, empowering municipalities with governance tools in living labs will allow local governments to pilot innovative SSCH models under controlled conditions. This is particularly relevant for the SSCHliving lab environments in the Interreg project, where experimentation and stakeholder engagement are key.

The consortium will actively explore these EU, national and local frameworks during the rollout of its living labs to identify practical constraints and opportunities. Permitting and integration of SSCHs into mobility plans will benefit urban planners, infrastructure providers, and project developers by reducing administrative barriers and aligning SSCH deployment with transport strategies. Clarifying legal frameworks for energy communities will support citizen-led initiatives, reduce investment risks, and enable municipalities to facilitate shared ownership models for energy assets. Together, these regulatory shifts create a fertile ground for SSCH innovation, enabling scalable, inclusive, and resilient urban energy systems.

Key domains:

The following key domains provide a thematic classification of relevant EU regulatory frameworks, serving as a foundation for understanding where regulatory alignment is needed and how SSCH initiatives can be shaped to comply with—and benefit from—ongoing policy developments.

1. FLEXIBILITY AND ENERGY SHARING

SSCH should be able to function as a virtual power plant (VPP) by balancing the grid, selling support services and sharing energy locally.

2. GRID CONNECTION AND GRID CAPACITY

Access to the electricity grid (capacity, connection time, costs) is crucial for SSCH. What are the requirements for connection and how can bottlenecks in the grid affect establishment. Questions rise about capacity shortages in local grids, waiting times for connection, connection costs, high network fees, the need for flexible connection agreements and management of tariff regulation (DSOs or regulators).

3. DATA AND DIGITALISATION

Effective governance of SSCH relies on digital systems (EMS) that control charging, storage and sharing and real-time data. This area includes interoperability between chargers, vehicles and grids, standards (such as ISO 15118 and OCPP – see further), as well as cybersecurity and data protection (GDPR, Cybersecurity Act).

4. TECHNICAL INTEGRATION

SSCH combines many technologies and technical components: chargers, solar cells, batteries, V2X cars and a grid connection. The challenges relate to standardization of protocols and components, safety requirements (fire, electrical safety), certification and approval of equipment. A uniform technical framework is required to ensure operational reliability, scalability and cost-effectiveness. Included is the topic of bidirectional Charging where regulatory support is weak. Several critical technical and regulatory gaps remain unresolved, including the lack of standardized approaches to AC/DC interfacing, smart metering integration, and harmonized taxation frameworks for energy flows. Additionally, the absence of clear grid code recognition for bidirectional charging and distributed energy resources continues to hinder seamless SSCH deployment across jurisdictions..

5. CHARGING INFRASTRUCTURE AND URBAN PLANNING

Physical establishment issues (building permits, environmental permits, parking and mobility plans and access to land) affect where and how SSCH can be built. Since SSCH are larger facilities with many charging points, they need to be integrated into urban planning, traffic solutions and local/regional development strategies. Conflicts with parking policies and car-free zones also have an impact.

6. FINANCIAL AND LEGAL STRUCTURES

Economic conditions, subsidies and EU Taxonomy affect the profitability of SSCH. The profitability of SSCH depends on clear and long-term economic conditions. What subsidies and support are available; What are the tax rules? (double taxation for V2G)

7. MOBILITY AND CAR OWNERSHIP

SSCH is strongly influenced by how electric cars are used – private ownership, leasing or car pools. Policies around company cars, car-sharing and fleet management shape the demand for charging and V2X. Parking regulations, social justice and incentives for shared mobility are central to how SSCH can be integrated into broader transport solutions. Creating business models that attract investment and distribute revenues fairly between actors is crucial.

	European level	National level	Local level
Flexibility and energy sharing	x	x	
Grid connection and grid capacity	x	x	
Data and digitalisation	x	x	
Technical integration	x	x	
Charging infra. and urban planning	x		x
Financial and legal structures	x	x	x
Mobility and car owner models	x	x	x

3. Overview European legislation

To support strategic planning and policy alignment in smart cities and energy systems, it is essential to understand how European regulatory frameworks intersect with key thematic domains. The following table offers a structured classification of eleven major EU regulations across seven critical topics: (1) **Flexibility and energy sharing**, (2) **Grid connection and grid capacity**, (3) **Data and digitalisation**, (4) **Technical integration**, (5) **Charging infrastructure and urban planning**, (6) **Financial and legal structures**, and (7) **Mobility and car owner models**.

This classification helps stakeholders—including urban planners, energy coordinators, mobility experts, and legal advisors—navigate the complex regulatory landscape and identify which frameworks are most relevant to their operational focus. Different pieces of European legislation can be relevant for SSCH:

- The Energy Performance of Buildings Directive (EPBD)
- The Alternative Fuels Infrastructure Regulation (AFIR)
- The Renewable Electricity Directive (RED)
- The Electricity Market Design Directive and Regulation (EMD)
- Including Demand Response Network Code
- The EU Taxonomy Regulation for sustainable activities
- The EU Cybersecurity Act
- Trans-European transport network Regulation (TEN-T)
- The Energy Efficiency Directive (EED)
- The regulation on CO2 emission performance standards for new passenger cars and for new light commercial vehicles
- Regulation on CO2 emission standards for HDVs

For instance, regulations like the **Electricity Market Design Directive and Regulation (EMD)** and the **Renewable Electricity Directive (RED)** are central to enabling flexibility and energy sharing, as they promote demand response, aggregation, and energy communities. Meanwhile, the **Alternative Fuels Infrastructure Regulation (AFIR)** and the **Trans-European Transport Network Regulation (TEN-T)** are pivotal for planning and deploying charging infrastructure and aligning urban mobility with EU transport corridors.

The **EU Cybersecurity Act** and the **Energy Performance of Buildings Directive (EPBD)** contribute to the digitalisation of energy systems, ensuring secure and smart data flows across buildings and networks. Technical integration is addressed through multiple regulations, including those on CO_2 emission standards for vehicles, which drive innovation in fleet electrification and infrastructure adaptation. Financial and legal structures are shaped by the **EU Taxonomy Regulation**, which defines sustainable investment criteria, and the **Energy Efficiency Directive (EED)**, which links efficiency targets to funding mechanisms.

Finally, mobility and car ownership models are influenced by vehicle emission standards and infrastructure regulations that support new usage patterns, such as shared mobility and electrified fleets. By mapping these regulations to thematic areas, the table provides a practical tool for identifying synergies, gaps, and opportunities for integrated policy development and project design.

	Flexibility and energy sharing	Grid connection and grid capacity	Data and digitalisation	Technical integration	Charging infra. and urban planning	Financial and legal structures	Mobility and car owner models
Energy Performance of Buildings Directive (EPBD)	X	-	X	-	X	-	-
Alternative Fuels Infrastructure Regulation (AFIR)	-	X	-	-	X	-	X
Renewable Electricity Directive (RED)	X	-	-	X	-	X	-
Electricity Market Design Directive and Regulation (EMD)	X	X	X	X	-	-	-
Demand Response Network Code	X	-	-	-	-	-	-
EU Taxonomy Regulation for sustainable activities	-	-	-	-	-	X	-
EU Cybersecurity Act	-	-	X	-	-	-	-
Trans-European transport network Regulation (TEN-T)	-	X	-	-	X	-	X
Energy Efficiency Directive (EED)	X	-	-	-	-	X	-
Regulation on CO2 emission performance standards for new passenger cars and for new light commercial vehicles	-	-	-	X	-	-	X
Regulation on CO2 emission standards for HDVs	-	X	-	X	-	-	X

Several overlaps emerge across the classified EU regulation frameworks, reflecting the interconnected nature of energy, mobility, and digital infrastructure in the European policy landscape. For instance, the **Electricity Market Design Directive (EMD)** and the **Renewable Electricity Directive (RED)** both support flexibility and energy sharing, but also touch on technical integration and, in the case of EMD, data and digitalisation. Similarly, the **Alternative Fuels Infrastructure Regulation (AFIR)** and the **TEN-T Regulation** both address charging infrastructure and urban planning, while also contributing to mobility and grid capacity. The **Energy Performance of Buildings Directive (EPBD)** spans three domains—flexibility, digitalisation, and charging—highlighting the role of buildings as active nodes in the energy system. These overlaps suggest that implementing one regulation often supports compliance with others, offering synergies for integrated planning. However, they also imply the need for coordination across policy domains and stakeholders to avoid duplication and ensure coherent deployment strategies. This reinforces the importance of cross-sectoral governance in smart city and energy transition projects.

Following are some of the most relevant aspects:

The **Energy Performance of Buildings Directive (EPBD)** covers principles for private charging.

While focused on the energy efficiency of buildings, this directive also impacts the installation of electric vehicle charging infrastructure in residential and commercial properties. The EPBD determines how many charging stations must be installed in new, renovated and selected existing buildings.

The Energy Performance of Buildings Directive (EPBD), adopted as part of the EU's broader climate goals, includes (since the amendment in 2018) provisions to support the deployment of charging infrastructure for electric vehicles (EVs). By 2020, Member States had to transpose the directive into national law and implement the provisions within their building codes and construction standards.

Obligations for EV Charging infrastructure include:

1. Residential Buildings, New Buildings and Major Renovations, for residential buildings with more than 10 parking spaces:
    - Pre-cabling Requirement: All parking spaces must include pre-wiring to allow for the installation of charging points in the future.
2. Non-Residential Buildings, New Buildings and Major Renovations, for non-residential buildings with more than 10 parking spaces:
    - At least one charging point must be installed.
    - Pre-cabling is required for at least 20% of parking spaces to enable future installation of charging points.
3. Existing Non-Residential Buildings:
    - By 2025, all non-residential buildings with more than 20 parking spaces must have at least one charging point installed.

The revised Energy Performance of Buildings Directive (EU/2024/1275) entered into force in all EU countries on 28 May 2024 and will have to be transposed within 24 months in all Member States. It has a broader scope, lowering the thresholds in number of parking spaces and setting earlier deadlines. This requirement mandates that new parking facilities must be prepared for future electric vehicle (EV) charging points. For at least 50% of parking spaces, this involves installing pre-cabling to allow for a direct and simple connection of a charging point later. For the remaining spaces, it requires installing two separate ducts for electrical cables to facilitate future charging infrastructure, as stated in this European directive summary.

- New and Renovated Non-Residential Buildings with more than 5 car parking spaces

- At least 1 recharging point for every 15 parking spaces, and
- Pre-cabling for 50% of spaces: This means running electrical cables from the main electrical infrastructure to the specific parking spots. This makes the installation of a charging point in those spots significantly easier and less costly in the future, as the main cabling is already in place.
- Two ducting for the remaining 50%: This involves installing two separate, empty conduits for the future. This allows for electrical cables to be pulled through the ducts when charging points are needed later. Installing two separate ducts can provide redundancy or separate channels for different types of cables, as required by the directive.
- Member States shall ensure the installation of at least 1 charging point for every 2 parking spaces in the new office buildings and office buildings undergoing major renovation, with more than 5 parking spaces.

2. Existing Non-Residential Buildings with more than 20 parking spaces - by 1 January 2027
   - At least 1 charging point for every 10 parking spaces, or
   - Ducting for at least 50% of the parking spaces to enable the installation at a later stage of 2 charging points for electric vehicles
   - In case of buildings owned or occupied by public bodies, Member States shall ensure pre-cabling for at least 1 in 2 parking spaces 3 by 1 January 2033.
3. New and Renovated Residential Buildings with more than 3 parking spaces
   - At least 1 charging point and
   - Dimensional pre-cabling for at least 50% of car parking spaces and dimensional ducting of 2 charging points for electric vehicles.

Pre-cabling refers to all measures that enable the installation of recharging points later; this includes cable routes and space for transformers and electricity meters. Ducting means putting the conducts in place without the cables. It includes provisions for the 'right to plug', so that Member States should streamline installation procedures and remove regulatory barriers such as the consent of the landlord or co-owners. It also makes smart charging a standard for all new and upgraded charging points, and, where appropriate, bidirectional charging. These points should be operated based on non-proprietary and non-discriminatory communication protocols and standards, in an interoperable manner, and in compliance with AFIR.

Since there are no requirements for the current stock of residential buildings, Member States could include this in their own legislation.

The **Alternative Fuels Infrastructure Regulation (AFIR)** guids regulation for publicly accessible charging infrastructure.

The Clean Power for Transport Package was initiated in 2013 and included a number of documents, including the Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. The CPT Directive provides a comprehensive framework to address infrastructure barriers to EV adoption, foster interoperability and user convenience across Member States and to create a supportive ecosystem for EV growth by harmonizing technical standards and ensuring transparency.

The AFIR is the successor to the CPT Directive and is part of the EU's Green Deal and Fit for 55 initiatives, which focus on achieving carbon neutrality by 2050. AFIR updates the provisions of the CPT Directive with more specific, ambitious targets for infrastructure development, focusing particularly on electric vehicle charging. The AFIR Regulation is applicable since 13 April 2024 and Member States should fully comply with the regulation by 2030. The change from directive to regulation means that it will become a binding legislative act, instead of requiring a lengthier process of transposition into national legislation. It introduces stricter and binding targets for charging infrastructure deployment, and focuses on interoperability, accessibility, and coverage to ensure the seamless operation of electric cars across the EU.

Relevant for SSCH are :

- Binding charging infrastructure targets and coverage goals for urban charging infrastructure (Member States must ensure the availability of public charging infrastructure in urban and densely populated areas and infrastructure should also cater to EV owners without private parking facilities)
- A number of technical and operational standards, relevant for CPOs, such as mandatory power levels (minimum power requirements) and interoperability requirements (standardized connectors), standardization of charging protocols (e.g., communication standards like OCPP), ….
- Obligations on smart charging and 'smart recharging'. AFIR requires the deployment of charging infrastructure that is capable of providing flexibility to the electricity grid, meaning that charging stations must be capable of responding to signals from grid operators (such as during peak demand or supply shortages). Smart charging enables this by adjusting charging times and speeds based on grid conditions. This contributes to grid stability and helps prevent overloads, especially as the number of EVs on the road increases. There is an obligation for all new infrastructure to be equipped with smart charging capabilities. It promotes infrastructure that supports bidirectional charging.
- 'Smart recharging' means a recharging operation in which the intensity of electricity delivered to the battery is adjusted in real-time, based on information received through electronic communication (art 2 AFIR). This definition emphasizes the dynamic and responsive nature of smart charging, where charging sessions can be optimized based on grid conditions, electricity prices, or user preferences. It is a key enabler for integrating electric vehicles into the energy system.
- Several user-focused services, such as transparent pricing (CPOs must provide clear and consistent pricing information to users), accessible payment systems (no special subscriptions required, ad hoc payment methods…) and real-time information (operators must provide up-to-date details on station availability, power output, and prices via digital platforms).
- The regulation encourages public-private partnerships in the deployment of charging infrastructure. By facilitating cooperation between governments, energy providers, and

private operators, AFIR fosters the development of more advanced and robust smart charging networks. This collaboration ensures that infrastructure development is aligned with broader energy system goals, enabling the efficient and sustainable integration of electric vehicles.

- AFIR emphasizes the importance of cybersecurity and data protection for charging stations, which is vital for smart charging infrastructure that is connected to digital grids and energy management systems. By ensuring that the infrastructure is secure and that user data is protected, AFIR supports the growth of smart charging networks, which rely on secure communication protocols between vehicles, charging stations, and grid operators.

The revised **Alternative Fuels Infrastructure Regulation (AFIR)**, adopted in 2023, introduces binding targets for the deployment of public EV charging infrastructure across EU member states. For SSCHs—defined in this project as hubs with ≥10 bidirectional 11 kW or 22 kW smart charging stations—AFIR provides a critical regulatory foundation that supports both scalability and cross-border operability:

- **Smart Charging Mandate**: AFIR promotes smart charging as a default mode, enabling dynamic load management and integration with local energy systems. This aligns directly with SSCHs' role in grid flexibility and decentralized energy provision.
- **Interoperability Requirements**: The regulation mandates open access and standardized communication protocols, ensuring that SSCHs can serve a wide range of EVs and energy management systems. This is essential for V2X functionality and seamless user experience.
- **Cross-border Functionality**: AFIR encourages harmonization of payment systems, data exchange formats, and roaming capabilities. SSCHs benefit from this by being able to operate across regions without technical or administrative barriers.

Implementation Challenges

Despite AFIR's supportive framework, several implementation gaps remain:

- **National Variability**: Member states differ in how they transpose AFIR into local law, affecting SSCH deployment timelines and technical compliance.
- **Certification Bottlenecks**: The lack of streamlined certification processes for smart charging components delays interoperability testing and rollout.
- **Data Governance**: While AFIR promotes open data, clarity is needed on ownership, access rights, and cybersecurity—especially for SSCHs acting as virtual power plants.

Recommendations

To fully leverage AFIR for SSCH deployment:

- **Standardize Protocols**: Promote adoption of ISO 15118-20 and IEC 63110 across all SSCH components to meet AFIR's interoperability goals.

- **Support Municipal Integration**: Provide technical guidance and funding to local governments for integrating AFIR-compliant SSCHs into urban mobility plans.
- **Accelerate Certification**: Establish EU-wide fast-track certification schemes for smart charging hardware and software.

The **Renewable Energy Directive III (RED III)** is a key part of the European Union's Fit for 55 package, which aims to make the EU's energy system more sustainable and achieve its target of net-zero emissions by 2050. RED III updates the previous Renewable Energy Directive (RED II) and introduces stricter measures to increase the use of renewable energy across different sectors, including transport. The amendments under RED III introduce stricter requirements and deadlines compared to RED II, emphasizing faster deployment, mandatory bidirectional smart charging, and stronger links to renewable energy sources.

- Member States must ensure that electricity supplied to EV charging points increasingly comes from renewable energy sources. Charging hubs are encouraged to use renewable energy sources. Charging points can be linked to guarantees of origin to ensure that the electricity used is renewable.
- For public charging, Member States must ensure the deployment of sufficient public charging points, especially in urban and densely populated areas. According to RED III, smart charging functionalities are to be integrated into public charging networks, ensuring that these systems are widely available and accessible.
- For private charging, support mechanisms should be in place to promote the installation of private charging points, particularly in residential and workplace settings.
- Charging infrastructure must support smart charging technologies. Consumers must have access to dynamic electricity pricing to benefit from lower tariffs during periods of high renewable energy availability or low grid demand and smart charging systems should be designed to automatically adjust to these price signals. Member States are encouraged to create financial or regulatory incentives for the adoption of smart charging technologies, such as subsidies, tax benefits, or reduced electricity costs for EV owners using smart chargers.
- RED III also emphasizes the need for charging points to support vehicle-to-grid (V2G) capabilities: Member States are required to establish strategies for the deployment of smart and bidirectional charging infrastructure, aligned with their renewable energy and decarbonization goals.

The **Electricity Market Directive (EMD5)** (EU/2019/944), that needed to be transposed into national legislation by the end of 2020, is relevant for the electricity market framework, and the role of smart charging and charging hubs in demand response and flexibility provision. The electricity market design was redrawn with new rules in the amending Directive EU/2024/1711 and the amending Regulation EU/2024/1747. They were adopted on 21 May

2024 and entered into force on 16 July 2024. In these, demand-side response and flexibility services are further facilitated.

The EMD promotes the decentralization of the energy system, including the use of local, smaller-scale energy resources such as solar panels, local storage, and distributed generation. This decentralization requires more sophisticated management systems to balance local supply and demand.

The Energy Market Design (EMD) and smart charging are deeply interconnected because both aim to enhance the flexibility, sustainability, and efficiency of the electricity system. The EMD promotes policies that encourage the integration of renewable energy, flexible grid management, market participation, and decentralized energy systems.

Smart charging systems enable these objectives by:

- Providing demand response and real-time adjustments to charging schedules based on grid conditions and energy prices.
- Integrating renewable energy into EV charging and supporting vehicle-to-grid (V2G) technologies to help balance supply and demand.
- Allowing EVs to participate in the electricity market, responding to price signals, and supporting grid stability.

EV owners or smart charging hubs are encouraged to participate in demand response programs, to support V2G and to adjust charging patterns based on dynamic pricing. They can do this directly or through aggregators. Smart charging hubs can also operate as energy aggregators. The Directive also encourages the creation of local energy communities where EVs, solar panels, and other distributed energy resources can share energy locally.

The **EU taxonomy** is a cornerstone of the EU's sustainable finance framework and an important market transparency tool. It helps direct investments to the economic activities most needed for the transition, in line with the European Green Deal objectives. The taxonomy is a classification system that defines criteria for economic activities that are aligned with a net zero trajectory by 2050 and the broader environmental goals other than climate. The EU taxonomy allows financial and non-financial companies to share a common definition of economic activities that can be considered environmentally sustainable.

In this way, it plays an important role in helping the EU scale up sustainable investment, by creating security for investors, protecting private investors from greenwashing, helping companies become more climate-friendly and mitigating market fragmentation.

The Taxonomy Regulation entered into force on 12 July 2020. It establishes the basis for the EU taxonomy by setting out the 4 overarching conditions that an economic activity has to meet in order to qualify as environmentally sustainable. The taxonomy compass declares installation, maintenance and repair of charging stations for electric vehicles in buildings and parking spaces attached to buildings to be in line with the net zero goals.

Smart charging infrastructure can comply with the EU Taxonomy if it meets the following conditions:

1. Contributes to climate change mitigation by supporting the transition to electric mobility and reducing greenhouse gas emissions in the transport sector.
2. Meets the DNSH criteria, ensuring that it does not cause significant harm to other environmental objectives (e.g., pollution, biodiversity).
3. Supports renewable energy integration and energy efficiency, optimizing the charging process to prioritize renewable electricity and contributing to flexible, decarbonized energy systems.
4. Helps electrify the transport sector and aligns with the EU's long-term sustainability goals.

The Do No Significant Harm (DNSH) criteria are part of the EU Taxonomy Regulation and are designed to ensure that economic activities contributing to one environmental objective do not significantly harm any of the others. These criteria are essential for classifying sustainable investments and guiding public and private funding toward environmentally responsible projects.

To meet the DNSH requirements, an activity must avoid causing significant harm to any of the following six environmental objectives:

- **Climate Change Mitigation**
- **Climate Change Adaptation**
- **Sustainable Use and Protection of Water and Marine Resources**
- **Transition to a Circular Economy**
- **Pollution Prevention and Control**
- **Protection and Restoration of Biodiversity and Ecosystems**

Thus, smart charging infrastructure that is energy-efficient, supports renewable energy and facilitates the decarbonization of transport can be classified as a sustainable investment under the EU Taxonomy, provided it meets the relevant criteria.

EU Cybersecurity Act (EU) aims to increase cybersecurity in critical infrastructure, including smart charging systems for EVs. It ensures that as smart charging systems become more connected and integrated with the grid, they meet high standards for data protection and cybersecurity, which is essential for building consumer trust and avoiding security breaches in connected infrastructures.

One of the key components of the Cybersecurity Act is the establishment of an EU-wide framework for cybersecurity certification of digital products and services. Products that meet specific cybersecurity criteria can receive certification, providing assurance that they have been tested against cyber threats. The Cybersecurity Act also addresses the need to protect critical infrastructure, including the energy sector, from cybersecurity risks. This includes electric vehicle charging infrastructure, which is becoming increasingly integrated into the smart grid.

4. Overview of National and Local regulatory boundaries

This chapter explores whether upgrading charging points into 'super smart charging hubs' (SSCHs) encounters significant regulatory changes at national and local levels. To assess this, the chapter examines how existing frameworks impact the 7 key thematic areas where regulatory evolution is likely to affect the rollout of SSCHs. As part of the living lab deployment, the consortium will actively explore national and local regulations and boundaries to identify practical constraints and opportunities. This classification serves as a foundation for understanding where regulatory alignment is needed and how SSCH initiatives can be shaped to comply with—and benefit from—ongoing policy developments.

	Flexibility and energy sharing	Grid connection and grid capacity	Data and digitalisation	Technical integration	Charging infra. and urban planning	Financial and legal structures	Mobility and car owner models
National level	x	x	x	x	-	x	x
Local level	-	-	-	-	x	x	x

1. Flexibility and energy sharing

European legislation such as EMD5 states that EVs and other assets should be able to participate in demand response programs, participate in the electricity market, respond to price signals and support grid stability. RED II and EMD5 legislations encourage the creation of energy communities and energy sharing, where EV's, solar panels and other distributed energy sources can share energy locally. However, the implementation of regulations on energy sharing and energy communities is a specific barrier for SSCH in different countries.

SSCHs should maximally be able to use their flexibility for market-based procurement, directly or through aggregators. In many member states however, these markets and these applications are not optimally integrated yet.

BE Flemish Region: Taking away barriers for flexibility from smart and bidirectional charging is included in the Flemish Energy regulations and the Flemish flexibility plan 2025.

- Flemish Flexibility Plan 2025: Targets removal of barriers to flexibility from smart and bidirectional charging.
- Dynamic Price Contracts & Supply Split: Proposed mechanisms to enable smart charging and energy sharing.
- Double Tariffs for Batteries: Identified as a barrier to flexibility and energy exchange.

Netherlands

- National Charging Infrastructure Agenda (NAL): Promotes smart charging as the default, enabling flexibility.
- ElaadNL Guidelines: Support bidirectional charging and energy sharing through standardized technical protocols.

France

- LOM Law: Encourages infrastructure readiness for smart charging, indirectly supporting flexibility.
- Barriers to Bidirectional Charging: Ongoing work to resolve grid code and taxation issues that limit energy sharing.

Denmark

- Flexibility Focus: National efforts to unlock bidirectional charging and energy sharing through regulatory alignment.
- Grid Integration Challenges

When a charging hub integrates production assets and flexible demand from different owners, before different metering points, some form of energy sharing is needed. In a common charging hub, energy is being shared between a few large assets. In more complex super smart charging hubs, many different assets are being integrated, and energy is shared with additional parties such as houses or local SMEs.

In Flanders this regulation is transposed and energy sharing is allowed. Energy sharing or selling is possible between two entities, as is energy sharing within an energy community. In all cases, no geographical boundaries exist within Flanders. This also means that there is no advantage (e.g. no differentiated grid tariffs) when sharing locally (e.g. within a local hub). If energy is shared before the meter, this means that all grid and administrative costs and other taxes have to be paid, even if the energy is for free. The business case is only positive if large amounts of energy are shared with complementary profiles. A large charging hub connected to a large asset could have a profitable business case, but sharing within an energy community or sharing between many smaller prosumers is difficult to realise financially.

2. Grid connection and congestion

A super smart charging hub is connected to the grid and interacts with the grid.

Not getting a grid connection due to congestion is an important barrier. Super smart charging hubs have the potential to lower grid congestion, and could therefore benefit from easier grid access, with a lower connection capacity, or lower tariffs.

In the Netherlands, due to grid congestion it's only possible to get a connection of max. 3x80A. Bigger (industrial) connections are not possible until aprox. 2030, having big impact on the roll out of charging hubs with multiple chargers and fast charging (DC) locations. Solution: Add smart charging/load balancing. Sometimes in combination with a battery and/or own energy production.
As of 1 October 2024, the social prioritisation framework, developed by the ACM (Authority Consumers and Market, the regulator in the Netherlands), was introduced. This gives network operators the possibility to give priority to grid users that serve a major public interest or have positive impact on the net congestion, as soon as transport capacity becomes available somewhere.

The ACM is still considering a code amendment proposal submitted by the grid operators that would allow group transmission agreements. This would allow a group of wholesale customers to sign a contract with a jointly contracted transmission capacity whereby, through mutual coordination on moments of use, the existing space is optimally used. It is expected the ACM will take a final decision on the proposal soon. In addition, the existing elaboration of cable pooling (sharing of a cable for multiple connections to put less load on the grid) expanded, allowing other technologies and customers on the power grid to cooperate via this form, in addition to generation from solar and wind.

In Flanders, since June 2021, it is mandatory to register a private charging station connected to the low-voltage network with a capacity of 5 kVA or more with Fluvius, the DSO. Large installations need a permission and a net study. For smart charging hubs, it could be possible to have a lower connection capacity (reducing the cost). It would be even more interesting to share a grid connection with several CPO's in one location. The current capacity tariff doesn't give enough reason for CPO's to reduce the use during peaks or net congestion. Extra stimuli are needed to delay charging.

3. Data sharing for smart charging

European legislation (Energy Market Directive EMD5) states that smart charging systems should provide real-time adjustments based on grid conditions and energy prices. However, such complex systems are not commonly available yet, and **standardisation** is still lacking. Especially for super smart charging hubs, market participants should be able to participate in different markets and optimise the benefit through value stacking.

In a charging hub, an energy management system (EMS) can be used for example to optimise charging in function of local production. In more complex charging hubs, more **complex EMS systems** are needed, that manage diverse assets (interoperability is important), that react dynamically to different signals (price signals, flexibility markets…) and interact with the grid. The optimisation strategy will have to be chosen carefully (what is best for the hub or the system might not be the best for one asset owner).

Specific barrier for SSCH regarding is data sharing are:.

- Metering data on the grid and voltage levels and better data exchange (e.g. grid operator being aware of curtailment of converters) could improve the implementation of SSCH. Now DSOs have no real-time insight into V2G operations, which is a barrier for the compensation for grid services.
- data protection: For integrating EV charging into the smart grid, the EU cybersecurity act lays out provisions to protect critical infrastructure. Also for data exchange between the different users and the grid, regulations are relevant. In the European AFIR regulation, user data should be protected and there should be secure communication protocols.
- Data sharing for payments could be a problem. Currently there is a lack of uniform standards for payment systems at charging hubs, but AFIR will solve this.

BE Flemish Region: In Flanders, various charging networks such as BlueCorner, Allego, Fastned, and Ionity allow EV drivers to easily locate, access, and pay for charging services through apps or RFID cards.

Netherlands: In the Netherlands, TNO (Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek, in English Dutch Organisation for Applied Scientific Research) concludes that an open and future-proof communication protocol is needed for communication between smart devices and energy management systems. In the market there is no consensus on what the best solution is. Therefore, the Cabinet has asked the Royal Netherlands Standardisation Institute (NEN) to work with the market to lay down agreements in standards, obviously taking into account the development of standards in neighbouring countries. NEN shared its findings, with recommendations for policy to arrive at a suitable communication protocol. (link: file). The Dutch NDW stands for Nationaal Dataportaal Wegverkeer (National Road Traffic Data Portal). It is a collaborative initiative among Dutch government entities—including national, provincial, and municipal authorities—to collect, combine, store, and distribute mobility and traffic data across the Netherlands. NDW will provide standards to implement the the AFIR regulation. This includes real-time charging station usage, cost prices, locations and availability. This gives NDW a clear picture of the types of data that CPOs (Charge Point Operators) are required to share with the government.

4. Technical integration

Charging hubs consist of a large number of assets and components, all of which have **technical specifications, standard**s and regulation. SSCHs have even more specific barriers, because a combination of assets (EV charging stations, renewable energy supply, storage and flexible demand) has to be operated in the most optimal, sustainable and energy efficient way. The **integration** of all these different assets is challenging for the safety, stability and reliability of the grid. Integration of all these components requires international technical standards (such as OCPP, ISO 15118) and network codes (such as RFG network ([1])code), but the requirements and network codes have not been specified for all elements, or they are not harmonised across countries. Moreover, DSOs might prefer regional requirements.

There are also a number of specific techo-regulatory barriers related to V2G. Different European legislations support V2G. REDIII supports the need for charging points to support V2G capabilities. EMD5 states that EV owners or smart charging hubs are encouraged to support V2G.

But there are some uncertainties regarding roles and responsibilities. DSOs are unsure whether they should directly manage V2G energy flows, delegate control to aggregators or CPOs, or rely on price signals from wholesale markets to influence V2G behaviour indirectly.

A main barrier is the lack of standards, especially since standards for charging may differ for AC versus DC.

Since the conversion from AC to DC (for bidirectional charging) takes place in the charging station (and not in the car), it requires a new type of homologation, and it is the charging

[1] The RfG Network Code refers to the **Network Code on Requirements for Grid Connection of Generators (NC RfG)**, formally established by **Commission Regulation (EU) 2016/631**. It's one of the key European electricity network codes developed under the Third Energy Package to harmonize technical requirements across EU member states

stations themselves that have to meet the requirements of the grid operator. For example in Flanders it is the manufacturer of the bidirectional charging stations that must homologate them with Synergrid, and so far, there are only a few that have done so. For the vehicles, there is a lack of protocols, and the OCPP doesn't allow V2G. Car producers are currently not forced to allow for V2G capabilities.

In the Netherlands for example, Dutch government investigates dropping double energy tax on bi-directional charging ([2]) . Key is that nowadays you pay taxes twice with bi-directional charging: once when you charge your vehicle, twice when returning energy from your battery into the grid. Owning a vehicle that is able to bi-directionally charge will be more attractive for shared mobility fleet owners and private EV owners.

In the Netherlands, not all cars meet the requirements (tested by an independent institute supported by the grid operator in the Netherlands (https://elaad.nl/). Even though V2G-capability is claimed by several manufacturers, the test results show otherwise. Moreover, the grid operator itself does not yet know what requirements this charging stations must meet (parameters), just like the inverters in 2008 => these requirements have been tightened and tightened every year. These charging stations only operate with compatible vehicles that can charge in two directions with DC. So far, many car manufacturers don't allow this.

If AC becomes the charging standard, the non-stationary nature of EVs becomes problematic for network code compliance. If the network codes specific to V2G differ for each region, the EV needs to adapt when crossing borders. This becomes very problematic if the network codes diverge significantly and require different hardware specifications. Amendments to the EU RfG network code will be relevant for SSCHs.

5. Charging infrastructure and urban planning / land use

As mentioned above, the European EPBD directive puts **obligations on the amount of private charging points** for new and renovated buildings. This directive has been transposed in national or regional regulation.

Sometimes additional **tax incentives or subsidies** are being given. In Flanders, subsidies for property owners or tenants to install charging points outside the public domain are no longer valid. An advantage is still given to employees who charge their company car at home and the electricity costs are reimbursed by the employer.

There are also other regulatory barriers. In Flanders, in existing apartment buildings, installing charging infrastructure and especially collective charging infrastructure can be difficult to the co-ownership of all the apartment owners, who have to give permission. Another issue is energy sharing on private property, even behind one meter, when crossing a public road. In business parks, a potential solution could be to connect different parking spots through a 'direct line'.

[2] Bidirectional charging: "let's avoid double taxation for EV owners" – Platform for Electromobility (Sept 2022)

There are no major **environmental** regulatory barriers. In Flanders, the installation of charging stations is exempt from a permit requirement, although exceptions apply for any associated environmental development (e.g. additional paving, installation of structures such as canopies, etc.).

Countries and regions are also trying to achieve the European target of 1 **public charging station** per 10 electric cars. For example, Flanders has set the target of providing 35,000 charging equivalents (CPE) for passenger cars by 2025 and 100,000 charging equivalents (CPE) by 2030. With more than 46.000 CPEs in 2024, Flanders has achieved this ambition but still needs to speed up towards 2030. For AC charging in the public domain, this is done via a three-pronged approach: demand-driven (Pole follows Car), data-driven (Pole follows Pole) or at the proposal of local authorities (strategic placement).

With a Pole-follows-Car approach, Flemish citizens can request a public charging point within a radius of 250m around their home. This is already up to debate, since the advantages of clustered charging hubs can justify a greater walking distance than 250m. This will be important for the implementation of SSCHs.

In July 2022, the Flemish Government awarded the **concession** for the roll-out of public charging points in the public domain to private companies Engie and TotalEnergies (with DSO Fluvius as a facilitator), through a competitive bidding process. Through concessions, it is easier for local governments (who sometimes lack capacity or knowledge) to roll out charging infrastructure. However, it is up to debate how the expansion of charging infrastructure will be organised in the future (the concessions last till 2025). Future concession could also for example include specific provisions for smart charging hubs. In general in Flanders, it is indicated that the current lack of local policies is a barrier for public charging hubs (compared to the amount of charging hubs on private land). There is a consensus that for future charging hubs, private and semi-public domain will be important. It is recommended to include this in urban development regulations for new project developments or to provide subsidies. [3]

Also in the Netherlands, individual agreements e.g. with concessions determine how charging hubs are exploited.

<u>A specific barrier for SSCHs relates to the planning and location</u> of charging infrastructure and hubs. Regular charging hubs are being planned according to mobility needs and financial revenue, for example along highways. Super smart charging hubs integrate different RES, combined with batteries and/or flexible demand from the hub and other users (homes, SMEs…), often with many different owners.

Therefore, the optimal location for mobility and parking needs doesn't always allow for the optimal location for a SSCH.

Cities indicate that public charging points must always be seen in relation to parking policy, where a balance needs to be found between regular parking spaces and parking spaces reserved for electric vehicles (problems of social inequality and potential gentrification as electric vehicles are often owned by the (upper) middle class and residents with company cars).

[3] The New Drive en APPM for Bond Beter Leefmilieu en Fluvius, Potentieel voor slimme laadhubs in Vlaanderen, 2024.

In the Netherlands, this is being countered by not making all charging points at charging hubs exclusively for EVs. In Flanders, some cities are therefore focusing more on off-street and semi-public parking for EVs for the future, or are trying to make the link with shared mobility.[4]

In Flanders, policies regarding car-free cities and concessions for charging hubs determine the potential location for charging hubs. These are not always good locations for super smart charging (due to private ownership of parking towers, unavailability of RES…). Sometimes the 'smartest' solution is in a business park, but this is not always the best location for mobility needs. There are also difficulties with different CPO's operating on the same hub.

6. Financial and legal structures - Ownership models

Specific regulatory opportunities or constraints can be related to ownership models.

For example, car sharing and car sharing models can have specific regulatory barriers.

Also company cars can have specific regulations.

In Flanders, people with company cars get a reimbursement for the electricity they use at home to charge their car. This is a not taxable income, since it is considered a reimbursement of work-related expense. If the electricity used is generated by your own PV and valued at a market rate or pre-agreed amount, this gives you even more benefits. With V2G, the electricity could even be used elsewhere, while still not paying taxes. This is up to debate. Another possibility, being debated for company cars, would be to split the supply in the charging part (being paid directly by the company) and the rest of the electricity bill.

7. Mobility

The **roll-out of electric vehicles** is supported in many countries, with tax exemptions or support schemes, leading to increased market shares. In some countries, e.g. Belgium, mainly company cars get tax benefits, where battery Electric Vehicles are 100% deductive from Company Taxes since 2020 until 2026; this also happens for the energy used to charge them (federal legislation). As a result, company cars in particular are driving the growth of the electric fleet (in the first half of 2024, 24.5% of new registrations in Belgium were battery-electric, and as of 1 September 2024, 5.5% of the total passenger car fleet in Flanders is fully electric). Fluvius (the Flemish DSO) expects, based on a 'middle' scenario, that there will be a growth from 600.000 EVs in 2025 to 1.5 million by 2030 (or 1/3 of the Flemish vehicle fleet) and views the integration of these vehicles as a major challenge.

This could be a risk since prices for public charging can become very high (no incentive to lower the prices, since it is being paid by companies). In Flanders, tax exemptions for private EVs exist (no vehicle registration taxes, no annual circulation taxes, VAT benefits), but purchase subsidies, which led to an increase market share of private EVs by 157% in 2024 compared to 2023, were ended in 2024 .

[4] The New Drive en APPM for Bond Beter Leefmilieu en Fluvius, Potentieel voor slimme laadhubs in Vlaanderen, 2024.

Subsidies support the uptake of EVs and charging infrastructure. But subsidies for company cars could also be a risk, since prices for public charging can become very high (no incentive to lower the prices, since it is being paid by companies).

Moreover, also the amount of electric light trucks and heavy trucks will increase rapidly by 2030. These will also have a public charging need, in which charging hubs with fast charging infrastructure will play an important role.

The **modal shift**, for example through the promotion of car-free city centres, could present a challenge for deploying charging infrastructure within these areas, depending on the local or regional incentives to reduce the number of cars in these areas. For example, in Flanders, zero-emission zones (ZEZs) that have been implemented in Ghent and Antwerp (decision by city councils) are under pressure, and tightening of the regulations has been postponed under electoral pressure (they were set to get stricter from 1 January 2025).

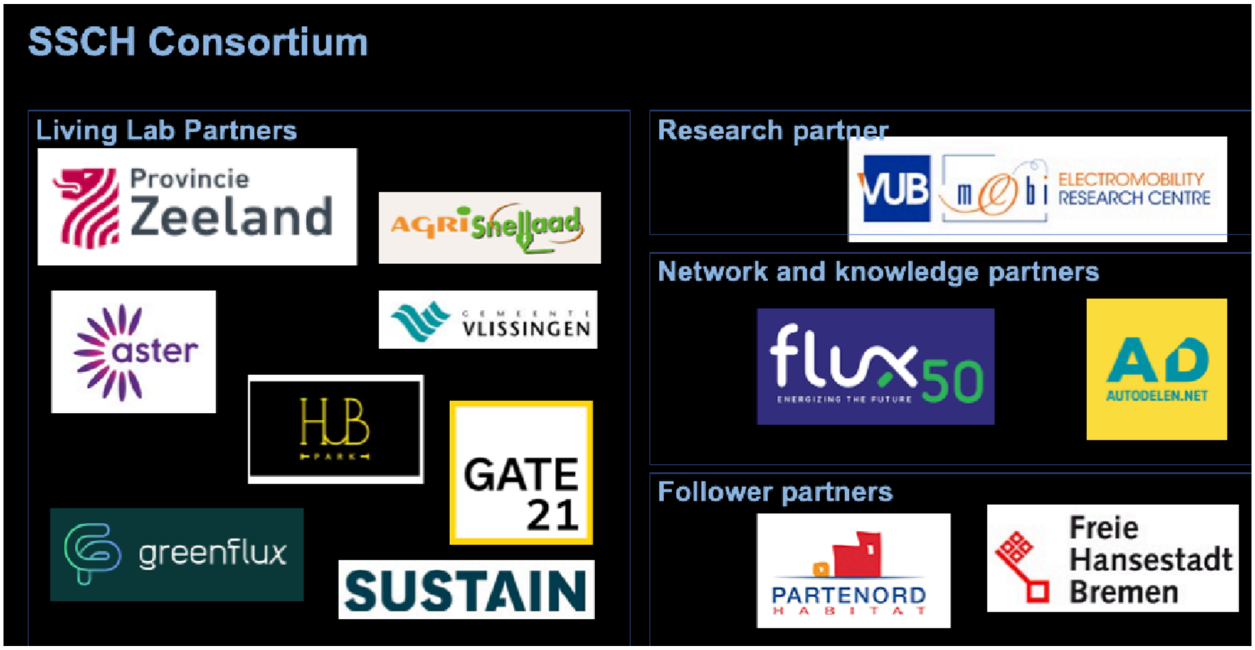
Also for **logistics**, zero-emission zones for urban logistics are being implemented in some city centres. For example, the Flemish government sets ambitions to make light and heavy trucks stepwise emission-free in the city centres. From 2025, the Flemish government will take major steps towards emission-free urban logistics via zero-emission zones for urban logistics (ZES) in the city centres. It sets ambitions to make light and heavy trucks stepwise emission-free in the city centres, starting with 100% emission free new light trucks from 2027. Fluvius (the DSO) expects that the Flemish fleet will consist of approximately 100,000 electric light trucks (N1) and 7,000 heavy trucks (N2 & N3) by 2030. These will also have a public charging need, in which charging hubs with fast charging infrastructure will play an important role.

To prepare for these steps, regulations will be developed. This could be an opportunity for smart charging hubs.

Al these regulatory opportunities and barriers are relevant for all charging stations or hubs.

A specific barrier for SSCHs is the integration of EVs into **car sharing** fleets, especially when regional governments implement concessions (exclusivity arrangements) for charging infrastructure. Integration of EVs into car sharing could increase acceptance of and familiarity with EVs. However, when some regions (like Flanders) use concessions for charging infrastructure, it is not always possible for local governments or car-sharing providers to provide charging infrastructure themselves in the public realm. A charging point for shared cars can be requested via the concession, but it is noted that the principle of pole-follows-car is no longer sustainable for electric shared cars. For station-based car sharing a one-on-one solution is still needed, meaning that every shared car has a dedicated charging point. However, with the current growth of the market, this is not a sustainable solution for the future. Pilot projects with multiple shared cars (from the same company) per charger are taking place. There are more possibilities for semi-public parking because they are not part of the concession.

Combining V2G with car sharing would be interesting (since driving times are more predictable for car sharing vehicles that register parking times).



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