The role of regulations in driving sustainability in supply chain and logistics

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1. Introduction

In today's world, supply chains and logistics are the lifelines of the global economy, ensuring that goods and services move seamlessly from one part of the world to another. Almost everything that we use daily relies on the complex web of supply chain networks. These networks have been becoming increasingly global, interconnected and also more regulated. Laws and standards now touch every stage of the supply chain from production and transportation to distribution and retail.

Sustainability has become a critical component of global supply chain and logistics operations. Regulatory frameworks play a critical role in driving environmentally responsible practices, ensuring the reduction of greenhouse gas (GHG) emissions and supporting renewable energy adoption.

This report represents the second part of Work Package 2 of the Green Supply Chains (GSC) project. It focuses on identifying synergies between green energy transition models in (inland) ports and the regulatory framework for freight transport within regional logistics, with the aim of advancing toward zero-emission solutions.

The objective of the report is to provide an overview of the initiatives taken by project participant organizations to enhance sustainability and examines how regulations influence and impact these initiatives. The focus is on identifying synergies between green energy transition efforts and the existing local, national or regional regulations in logistics. At the same time, it highlights the complexities, challenges associated with adapting to these regulations, particularly in the context of operational constraints, financial implications and varying regional requirements. This dual perspective highlights the intersection between external regulatory pressures and internal sustainability goals, offering a clear understanding of how these factors interact in practice.

The findings presented in this report are derived from multiple sources, including regulatory frameworks obtained from the European Commission and the International Maritime Organization's (IMO) official websites and documents. Furthermore, key data was collected through online interviews and a survey conducted with project stakeholders. The stakeholders engaged in this process include representatives from Brest Port, Hamburg Port Authority, Kristinehamns

Municipality, Municipality of Waalwijk, and North Sea Port. Their inputs significantly enriched the report by shedding light on critical aspects such as local, national, and international regulations, key challenges in regulatory compliance, major sustainability initiatives, and the pivotal role of regulations in driving sustainability efforts.

The report is structured to define the critical role and influence of sustainability related regulations on project partner organizations' initiatives followed by an analysis of the challenges and opportunities as well as the impact areas of these regulations. The analysis dives into identifying similarities and differences in application across regions and examine influence of existing regulations on local initiatives and green agendas, financial implications, preparation for future regulatory developments and the collective experiences of participants. The report concludes with key findings and actionable recommendations for next steps aiming to support organizations in adaptation to evolving logistics regulations while advancing their sustainability objectives and accelerating the transition journey.

2. Overview regulations

2.1. Background

The global logistics and transportation industry is going through a significant transformation driven by the increasing urgency to address climate change and reduce the environmental impacts of key industries. This transformation is not only a response to environmental pressures but also a reflection of growing public demand for businesses to adopt more sustainable practices.

The logistics and transportation sectors have traditionally been significant contributors to GHG emissions, accounting for a huge portion of global carbon outputs. Consequently, these sectors are now under intense review and inspection by governments, industries and international organizations/authorities which are committed to achieving ambitious climate goals. The focus has shifted from incremental improvements to transformative change, emphasizing the reduction of emissions, integration of renewable energy and the development of sustainable supply chain practices.

At various levels, global, regional or national governments and regulatory authorities have rolled out a range of policies and regulations aimed at decarbonizing the industry, upgrading infrastructure and accelerating the adoption of green technologies. These regulations aim to align logistics operations with broader environmental objectives while encouraging businesses to invest in sustainable technologies. Through these mechanisms, governments not only aim to reduce carbon emissions but also to stimulate innovation, enhance operational efficiency and build resilience in the face of climate-related challenges.

Regulations provide the framework that keeps the global supply chain functioning in a safe, fair and efficient way. Without clear rules, the system would descend into chaos with unsafe goods, unfair labor practices and environmental damage. For instance, transportation laws ensure that hazardous materials are handled safely while customs regulations streamline cross-border trade and protect national interests.

There's also a bigger picture to consider. Regulations reflect the values and priorities of the society. As consumers demand more sustainable and ethical practices, governments are responding with laws to match. Environmental regulations, for instance push companies to reduce emissions and manage waste more responsibly, while labor laws ensure workers in warehouses, factories and transport are treated fairly. Ignoring these rules doesn't just lead to fines or shutdowns but it can result in damaged reputations, lost customers and even protests or boycotts.

The consequences of non-compliance can be severe. Beyond the immediate costs, fines, lawsuits or production halts there could be a long-term damage to a company's reputation. On the other side, studying regulations can uncover opportunities. Many of the most successful companies use regulatory requirements as a starting point for innovation. Stricter emissions standards, for example, have led to breakthroughs in electric vehicles and renewable energy in logistics. Food safety regulations have driven the development of advanced tracking systems that improve efficiency across the board. By staying ahead of the curve, businesses can use regulations as a catalyst for growth rather than a roadblock.

But regulations aren't just about following rules to avoid penalties hence they also play a big role in how efficient and competitive a supply chain can be. Compliance with regulations often means extra work, added costs and sometimes

longer lead times. For example, stricter environmental laws may require companies to upgrade their fleets or find greener ways to operate. While this can be challenging, it also presents an opportunity such as quick businesses adaptation where companies can set themselves apart from competitors, turning compliance into an advantage rather than a burden.

At the end of the day, regulations are much more than a set of hurdles to clear. They're tools that shape the way supply chains operate. They ensure that goods are safe, workers are treated fairly and businesses operate responsibly. Studying their impact helps us understand the balance between compliance and efficiency, preparing companies to adapt to a fast-changing world. As supply chains continue to evolve, understanding the role of regulations is key to building systems that are not only effective but also ethical, sustainable and future-proof.
The Paris Agreement has set the tone for international efforts to fight climate change. By committing nations to ambitious GHG reduction targets, it has provided a roadmap for aligning logistics and transportation practices with broader environmental objectives. Similarly, regional initiatives such as the European Union's Green Deal are offering structured plans for achieving carbon neutrality. National governments are complementing these efforts by tailoring global and regional directives to address specific local challenges, ensuring that progress is both inclusive and effective.

As climate change mitigation efforts intensify, the transportation and logistics sectors are witnessing a surge in regulatory actions. These actions are designed to establish a clear path toward a greener future and ensure that industry practices are aligned with global climate targets such as those outlined in the Paris Agreement.

In order to accelerate this transition, governments are deploying a range of incentives, including subsidies, tax breaks, and funding programs which are designed to encourage investment in sustainable technologies and practices. These incentives not only lower the barriers to adoption for businesses but also speed up innovation ensuring that decarbonization efforts remain economically viable and technologically forward-looking. The push for decarbonization within logistics and transportation is no longer a future goal but an urgent priority, actively shaped by national, regional and global policies aimed at driving sustainability and long-term industry transformation.

2.2. Key regulation types

Regulatory initiatives targeting the logistics and transportation sectors are being introduced at multiple levels:

- **Global Efforts:** Policies like the Paris Agreement set broad targets for GHG reduction and the promotion of renewable energy.
- **European Initiatives:** The EU's Green Deal provides a structured roadmap for achieving carbon neutrality by 2050, influencing policies like the "Fuel EU Maritime" a part of "FIT for 55".
- **National Adaptations:** Countries implement EU directives tailored to local challenges, promoting economic and regional development while focusing on environmental sustainability.

2.3. Role of regulations in sustainability

Sustainability has become a critical component of global supply chain and logistics operations, shaped by a range of international, national and local regulations designed to encourage environmentally responsible practices.

Regulations play a crucial role in promoting and increasing sustainability within supply chains & logistics by creating a balance between economic growth, environmental protection and social responsibility.
These regulations are designed to create a balance between economic growth and environmental protection. The aim is to ensure businesses contribute to sustainability without compromised profitability. Regulations also set clear standards and establish compliance requirements such as emissions limits or waste reduction targets. Failure to comply often results in penalties, restricted market access or bad reputation. Some of the regulations offer incentives to encourage businesses to adopt sustainable practices. For instance, subsidies for renewable energy adoption can lower costs while enhancing sustainability.

By providing frameworks for accountability and transparency regulatory authorities help drive positive transformations in supply chains, benefiting not only businesses but also consumers and the environment.

Basically, regulations in supply chain extends far beyond compliance. They provide a clear guide for organizations to operate in an environmentally friendly way, with set standards, rewards and clear process to track progress. This makes sustainability a key part of supply chain operations, supporting both long-term success and global well being.

Key purposes of regulations in supply chain:

Regulations play a crucial role in shaping sustainable and efficient supply chain practices. They address a broad spectrum of goals, from reducing environmental impacts to fostering transparency and resilience, ensuring that supply chains align with global sustainability objectives. Below are the some of the key purposes of regulations:

- **Reducing Carbon Emissions:** Governments and international authorities impose regulations that require companies to limit their carbon emissions.
- **Sustainable Sourcing and Waste Management:** Regulations may require companies to manage waste and minimize environmental harm.
- **Ecosystem Protection:** Regulations can also require businesses to ensure that their supply chains do not harm ecosystems or contribute to deforestation.
- **Incentivizing Green Practices:** Governments often offer subsidies, tax incentives, or financial grants to encourage businesses to adopt more sustainable practices in logistics
- **Mandatory Reporting and Disclosure:** Many countries now require companies to disclose their sustainability practices and performance. This can include mandatory carbon footprint reporting, energy usage, waste management, and water consumption.
- **Compliance with International Standards:** Regulations often require businesses to comply with international sustainability standards and certifications, such as ISO 14001 (Environmental Management) or the UN Sustainable Development Goals (SDGs).
- **Green Logistics Standards:** Regulatory frameworks often set standards for sustainable logistics practices, such as energy-efficient freight transport, sustainable packaging, and efficient warehouse operations.
- **Building Resilient Supply Chains:** Sustainability regulations can encourage companies to develop resilient and diversified supply chains. Authorities may require companies to conduct risk assessments regarding environmental and social factors that could disrupt the supply chain, such as climate change or social unrest.
- **Climate Risk Reporting:** Many regulations are focused on the physical and transitional risks associated with climate change.
- **International Trade:** Authorities may negotiate and implement trade agreements that covers sustainability standards within supply chains across borders. For example, the European Union's trade agreements with developing countries may require partners to comply with environmental standards before goods can be exported to the EU.

3. Analysis

The project group discussions and collected input from the project group discussions highlights the regulatory influences across four categories Ports, Landside Terminals, Shipping and Road Transportation. Each category plays an important role in driving the transition to sustainable and low-emission logistics systems.

- **Ports**
  Regulations such as "Fuel EU Maritime" and "RED II 2020" drive emissions reduction and adoption of alternative fuels. Port authorities are expected to upgrade infrastructure for green energy such as onshore power supply and renewable energy integration.

- **Landside Terminals**
  Regulations target emissions reduction, green energy adoption (e.g., solar and wind) and improved connectivity. Challenges include high costs for infrastructure upgrades and limited incentives for smaller operators. Unified policies and funding support are needed to progress.

- **Shipping**
  Key regulations like "Fuel EU Maritime" enforce cleaner fuels and lower emissions, while CO_2 trade policies incentivize efficiency. Challenges include technology gaps in alternative fuels. Global standardization and investments in scalable green technologies are needed.

- **Road Transportation**
  Policies such as “FIT for 55” and subsidy programs promote zero-emission trucks and cleaner road transportation however, the high cost of electric vehicles and lack of charging infrastructure remain barriers in almost all countries in Europe. Expanding financial incentives and accelerating infrastructure development are critical to overcoming these obstacles.

3.1. Findings based on the input shared by the project members

EU regulations are rated as the most important regulation types by the project members replying to the survey. They indicate a strong impact on moving towards sustainable port operations followed by roads, terminals, shipping as well as industrial areas. The main focus on green initiatives are based on reducing emissions and increasing energy efficiency. As per below table the European category dominates contributions with entities like North Sea Port. This highlights a strategic emphasis on international collaboration. Local contributions are minimal, suggesting a lack of focus on localized efforts, especially for entities like BrestPort and Kristinehamns municipality. Municipality of Waalwijk and Kristinehamns municipality prioritize national contributions, indicating a stronger local operational focus. Hamburg Port Authority stands out for its balanced approach across all categories, reflecting diverse strategic objectives.

Impact of regulations towards sustainable ports:

- European regulations: 52%
- National regulations: 38%.
- Local regulations: 10%

Table 1. Comparison of project partners’ regulation compliance area

Project partners	European	Local	National	Total
BrestPort	6		1	7
Hamburg Port Authority	3	3	2	8
Kristinehamns municipality	1		5	6
Municipality of Waalwijk	1	2	8	11
North Sea Port	9			9
Total	**20**	**5**	**16**	**41**

3.2. Overview of regulations impacting partners’ initiatives

The partners in the project provided input in terms of which regulations were important and relevant for their initiatives. In the survey, they all responded on the question: “Which regulations impact your work towards a green/sustainable port?”. We categorized their input into European, National and Local regulations as per below presented figures.

- **European Regulations:**

In general, the European regulations primarily focus on creating a unified framework to reduce GHG emissions, promoting renewable energy, and modernizing port and transportation infrastructure. The project partners particularly mentioned eight regulatory areas shown in Figure 1.

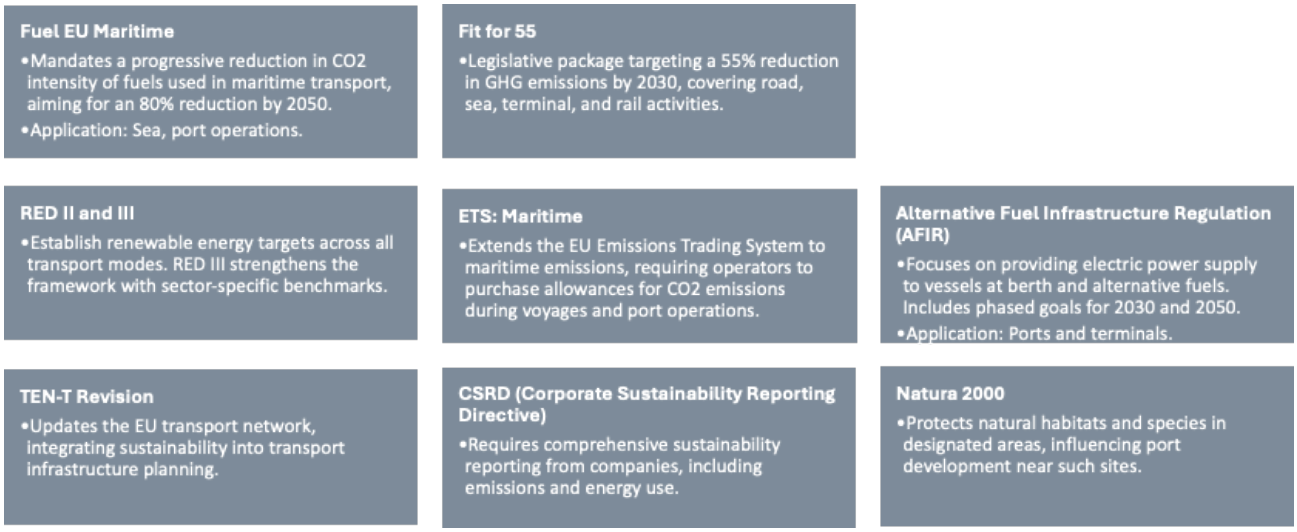

Figure 1. EU regulations for stakeholders in the port ecosystem (Source: Survey-project stakeholders)

- **National Regulations:**

Below regulations address local or country-specific challenges, often implementing European directives while catering to national interests. They fall under four primary categories: environmental, energy/zero-emission, transportation/infrastructure and economic/regional development.

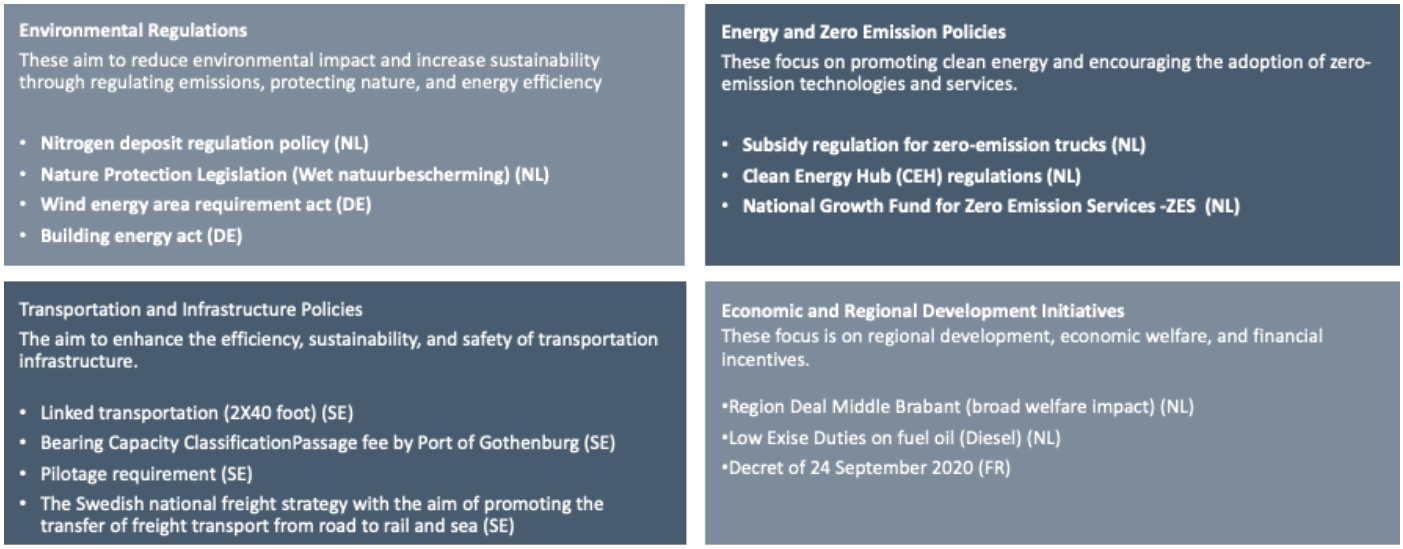

Figure 2. National regulations for stakeholders in the port ecosystem (Source: Survey-project stakeholders)

- **Local Regulations:**

Local regulations focus on municipal and provincial efforts and goals to promote renewable energy, local air pollution and emissions reductions. The partners in Netherlands (NL) and Germany (DE) mentioned local regulations.

Figure 3. Local regulations for stakeholders in the port ecosystem (Source: Survey-project stakeholders)

3.3. Mapping Identified regulations to sustainability objective

Regulations promoting sustainability are transforming shipping and logistics by focusing on reducing emissions, using renewable energy, adopting alternative fuels and improving transport efficiency. The identified regulations (impacting the partners' initiatives) have been grouped into regulatory objective areas to get an overview of their coverage towards different green ambitions, see Table 2. It's basically a way of organizing the regulations based on their main goal or focus.

Table 2. Regulatory Areas and Related Regulations from Partners

Regulatory objective area	Regulations identified from partners
Green Fuel Transition	Fuel EU Maritime RED II & RED III
Carbon Reduction & CO2 Market	Fit for 55 & ETS (Emissions Trading System) Integration of Maritime Sector into CO2 Market
Infrastructure and Renewable Energy Development	AFIR (Alternative Fuel Infrastructure Regulation):Wind & Solar Energy Policies:Clean Energy Hub and National Growth Fund for Zero Emission Services.
Regulatory Complexity in Green Energy Transition	SEVESO III & Related Regulations & Impact on Ship Repair and Maintenance.
Nature Protection and Environmental Impact	Nature Protection Legislation & Natura 2000 & Nitrogen Deposit Regulation Policy
Sustainable Transport and Modal Shift	Swedish National Freight Strategy & Linked Transportation (e.g., 2x40 Foot Containers
Waste and Circular Economy Regulations	Subsidy Regulations for Electrification & Funding Programs
Investment and Funding Opportunities	Subsidy Regulations for Electrification & Funding Programs
Port-Specific Challenges	Port of Gothenburg Passage Fee & Pilotage Requirements

Examples of regulations impact on ports

Regulations related to fuel infrastructure, emissions reductions and energy efficiency are influencing port operations. Below table highlights some examples of regulations and a short description of the impact on the project participant ports and how these regulations shape their work towards more sustainable operations. By focusing on key regulations and their impacts, we can better understand the path for ports in adopting green practices and achieving their sustainability goals.

Below categories play a critical role in terms of implementing green logistics. They are closely connected to following regulations as well as meeting the port's own sustainability goals.

Table 3 Impact of Key Regulations on Port Sustainability Efforts

Port	**Key Regulation**	**Impact on Sustainability**
Brest Port	Fuel EU Maritime	Requires refueling infrastructure shift to greener fuels (e.g., bio-LNG).
Brest Port	Fit for 55	Drives emissions reduction and aligns activities with EU sustainability goals.
Brest Port	AFIR (Alternative Fuel Infrastructure Regulation)	OPS for vessels at berth, supporting green energy use for ship repairs and sustainable fuels.
Brest Port	CO2 Market Integration	Incentivizes carbon footprint reduction across all activities.
Municipality of Waalwijk	Nitrogen Deposit Regulation	Delays construction of port infrastructure.
Municipality of Waalwijk	Nature Protection Legislation	Requires nature compensation for port construction, complicating environmental compliance.
Kristinehamns Municipality	Swedish National Freight Strategy	Promotes increased shipping, generating funds for port sustainability initiatives.
Kristinehamns Municipality	Linked Transportation (2X40 foot)	More efficient transport with fewer trips reduces emissions but risks modal shift from sustainable transport.
Hamburg Port Authority	Fuel EU Maritime	Mandates electric supply for vessels and alternative fuels. Focus decarbonization.
Hamburg Port Authority	Hamburg Climate Act	Targets emissions reduction and drive the port towards green energy solutions.
North Sea Port	Fit for 55	Facilitates innovation
North Sea Port	AFIR (Alternative Fuel Infrastructure Regulation)	Mandates OPS for vessels, impacting port infrastructure especially inlandways.
North Sea Port	ETS (Emissions Trading Scheme)	Incentivizes shipping lines to reduce emissions and helps fund green initiatives (e.g., OPS).

Key Observations

- BrestPort focuses on green fuel transition with regulations like Fuel EU Maritime and Fit for 55, while also incorporating Onshore Power Supply (OPS) systems to support vessels at berth. The port is actively exploring fossil free fuel solutions as part of their decarbonization goals.
- Municipality of Waalwijk faces construction delays due to nature protection regulations but the port benefits from subsidies for zero-emission trucks and charging stations, aligning with their commitment to electrification.
- Kristinehamns Municipality supports sustainable shipping through the Swedish national freight strategy, which promotes shipping over road transport, although increased fees (e.g., pilotage and passage fees).
- Hamburg Port Authority is highly impacted by EU regulations, focusing on alternative fuels, electric power supply and emissions reduction goals with additional focus on renewable energy sources like wind and solar power.
- North Sea Port is actively engaging in green fuel transitions through AFIR and EU funding programs such as TEN-T and CSRD. The port is also implementing Onshore Power Supply (OPS) systems and aiming to increase hydrogen projects.

3.4. Similarities across various regulations

When we create an overview of the shared regulations and their impacts on port operations then we are able to capture many similarities for how these regulations influence the ports' sustainability efforts, providing a broader understanding of its effects. Input from ports column is the actual input received from the participants, see Table 4.

Table 4 captures the core similarities in how regulations influence ports

Regulation	Shared impact description	Input from ports
Fuel EU Maritime	Supports transitioning to greener fuels, adapting ship refueling infrastructure.	- "The port must adapt ship refueling from oil & gas to greener fuels." - "Obligation for onshore power and demand for alternative fuels." - "Compliance falls mainly on shipping lines; the port adjusts bunkering infrastructure."
AFIR (Alternative Fuel Infrastructure Regulation)	OPS for vessels, investment in alternative fuels and renewable energy infrastructure.	- "Public authorities expect vessels to use OPS, especially for ship repairs." - "Obligation for electric supply." - "OPS mandates applicable; scope expansion could impact more quays."
Fit for 55	Aligns ports with EU climate goals to reduce emissions and increased sustainability.	- "Incentivizes ports to reduce carbon footprint." - "Unified direction for sustainability initiatives across borders." - "Helps align port developments with EU decarbonization targets."
ETS: Maritime (CO2 Market Integration)	Provides incentives for carbon emission reduction, supports OPS investments and funds projects.	- "Incentives to reduce carbon footprint." - "ETS revenues should fund port decarbonization."
RED II/RED III	Encourages the adoption of renewable energy sources and alternative fuels	- "The port is directly impacted for its bio-LNG site." - "Challenges arise for hydrogen

		targets; opportunities emerge for sustainable aviation fuels."
Nature Protection (Natura 2000, Local Policies)	Enforces nature compensation and ecological preservation.	- "Nature compensation required for port construction." - "Impact on port construction and barge operations."
SEVESO III Directive	Regulates the storage and handling of hazardous materials and complication the transition to green fuels.	- "Applies to green fuels, ship maintenance; complicates the switch to less-known energies."
Waste Framework Directive (WFD)	Circular economy practices, focusing on reducing waste and managing waste product logistics.	- "Framework for waste vs. product logistics."
National Freight Strategies	Promotes modal shift to rail and sea and sustainable logistics.	- "Supports transfer of freight from road to sea, promoting sustainable shipping."
Pilotage Requirements	Regulates inland transportation costs and its competitiveness compared to other transport modes.	- "Cost regulation weakens competitiveness of inland shipping."
Wind and Solar Energy Policies	Encourages local renewable energy generation	- "Regulations support local renewable energy generation (e.g., wind, solar)."
TEN-T Revision	Recognizes ports' importance as logistics and energy hubs and also links to funding programs for sustainability.	- "Being a core TEN-T port ties the port to EU funding for sustainability."
Building Energy Act	Drives transition away from oil and gas heating in port buildings and operations.	- "Focus on removal of oil and gas heating."
Passage Fees	Introduces additional costs for inland shipping.	- "Increased fees discourage maritime transport, contradicting sustainability goals."
Subsidy Regulations for Zero Emission Vehicles	Encourages investment in zero-emission technologies like electric trucks and barges.	- "Subsidy programs support electric trucks and charging station feasibility studies."

Key Observations for similarities

- Focus on Alternative Fuels and Renewable Energy. Fuel EU Maritime and AFIR are universally driving the transition to greener fuels and infrastructure
- Alignment with EU Climate Goals. Regulations such as Fit for 55 and ETS align all ports.
- Circular Economy. Waste Framework Directive encourages innovative waste management solutions, supporting the ports' transition to sustainable operations.
- Challenges in balancing costs and investments in initiatives

3.5. Regulatory impacts across supply chain

The regulatory landscape plays a critical role in shaping the sustainability initiatives of stakeholders across the shipping and logistics sectors. We have categorized the key regulations identified by project partners and their impacts on following areas sea, road, ports, terminals, and industrial sites. These regulations are categorized by their main objectives such as emissions reduction, fuel transition, energy infrastructure and environmental sustainability goals. Each category reflects unique challenges and opportunities faced by stakeholders in achieving compliance. A detailed breakdown is provided in Appendix A.

- **Sea**
  Ocean transportation has the highest number of regulations primarily driven by maritime-specific regulations like Fuel EU Maritime and REPowerEU.
- **Road**

a. **Fuel & Emissions**: Regulations like Fit for 55, Low Excise Duties on Diesel, and EED promote cleaner fuels and emission reductions.
b. **Electrification**: Subsidy Regulations for Zero-Emission Trucks and CEH Regulations support the shift to electric road transport and charging infrastructure.
c. **Infrastructure**: Bearing Capacity Classification and Linked Transportation (2x40 Foot) improve road infrastructure, reducing emissions and congestion.

- **Ports**
  Fuel Transition & Energy Supply: Fuel EU Maritime and AFIR require ports to develop green fuel infrastructure and onshore power for vessels.
  Environmental Considerations: SEVESO III and Natura 2000 affect port construction & operations enforcing stricter environmental standards.
  Sustainability Support: Regulations like the Hamburg Climate Act and ZES fund and encourage green energy adoption and port emissions reduction.
- **Terminals**
  Mainly focus on infrastructure and energy requirements like Alternative Fuel Infrastructure Directive and Wind and Solar Energy Policy Regulation.
- **Industrial Sites** have fewer regulations, mainly related to energy production, handling dangerous goods and specific regional policies.

3.6. Impacts of complying with sustainability and energy efficiency regulations

Part of the discussions with the participants was to understand the impacts of complying with sustainability and energy efficiency regulations. The insights presented are based on project group discussions and contributions from participants who provided different perspectives on the challenges and opportunities associated with regulatory compliance. This list shows an overview of the environmental, economic, operational, reputational, workforce and general supply chain impacts observed and mentioned by stakeholders.

Environmental Benefits

- Reduction of GHG emissions through adoption to regulations.
- Encouragement of fuel transitions to biofuels, hydrogen and electrification.

Economic Impacts

- High capital requirements for upgrading infrastructure or technology which leads to financial strain for smaller operators without subsidies.
- Energy-efficient solutions reduce operating costs over time.
- Access to funding opportunities and incentives, like the EU's National Growth Fund for Zero Emission Services.

Operational Efficiency

- Improved Logistics Performance. Green logistics practices (e.g., electric trucks) often lead to higher operational efficiency, faster delivery times and lower operational costs.
- Enhanced Fleet Management. The use of alternative fuels or electric vehicles on road transportation can reduce the dependency on fossil fuels.

Reputation and Competitiveness

- Compliance with sustainability regulations and environmental certifications enhances a company's reputation and attract eco-conscious consumers and investors.
- Shipping companies and logistics providers that meet sustainability criteria can gain a competitive edge, especially with growing pressure from stakeholders and consumers for greener practices.

Workforce and Labor Impacts

- The shift toward green logistics and energy-efficient solutions requires additional training and upskilling for employees, especially in areas like renewable energy systems, electric vehicle maintenance and energy management.
- As companies adopt sustainable practices, new roles and opportunities are created in areas such as sustainability management, environmental compliance and green technology operations.

Supply Chain Impacts

- Many clients, especially in retail, require their logistics partners to meet sustainability goals. Companies that comply to regulations are better positioned to meet these expectations.
- Sustainable Sourcing, companies implement green procurement policies, ensuring that their supply chains are sustainable from end to end.

3.7. Challenges in compliance

Compliance with sustainability regulations creates a range of challenges for stakeholders. We have identified some of these through discussions and inputs from participants reflecting their perspectives. We have put these challenges under following 4 high level categories: regulatory complexity, technological and infrastructure, financial constraints and coordination issues across jurisdictions.

Regulatory Complexity

- Risk with evolving regulations creating administrative burdens for international operators.
- Variability in local, national and regional governments. Different regulations across areas might create complexities for companies operating internationally and even on local.

Technological and Infrastructure Gaps

- Limited availability of scalable technologies for alternative fuels and energy storage.
- Insufficient infrastructure for hydrogen refueling and EV charging in developed and isolated areas.

Financial Barriers

- High costs discourage adoption of sustainable technologies, particularly for smaller enterprises.
- Lack of uniformed subsidy schemes across the EU creates gaps.

Coordination Across Jurisdictions

Complexity of alignment among local, national and European standards which could lead to duplication of efforts and create inefficiencies.

4. Conclusions and next steps

In this report, we study the critical role and influence of sustainability related regulations on project partner organizations initiatives in the Green Supply Chains project. Based on project partners' view of regulations relevance for their green initiatives we discuss the influence of sustainability regulations across various aspects of the shipping and logistics sectors. Similarities among initiatives and regulations reveal a clear focus on fuel transition, carbon reduction, infrastructure development and the promotion of sustainable transports. These shared goals demonstrate a collective commitment and efforts to driving green logistics, despite the shared challenges related to regulatory complexity and variability across regions.

Discussions with project partners highlighted both the benefits and challenges of complying with regulations. On the positive side, regulations might lead to environmental benefits, better operational efficiency and a better company image. It also helps organizations to meet growing customer demands for sustainability, giving them a competitive edge.

High costs, limited technology and non-standardized subsidies are some of the challenges, especially for smaller companies. To meet the regulations and benefit from them, we need to have more consistent policies, financial support and investment in technology and infrastructure. All organizations and authorities in supply chain must work together to overcome these issues and build a more sustainable and energy-efficient logistics and transportation

Sustainability regulations are influencing the initiatives taken by organizations and they reshape the supply chain and logistics landscape. Even though we see environmental and economic benefits, the challenges still persist. Regulatory complexities, high infrastructure costs and technological gaps hinder easy adoption of green practices. To overcome these barriers a collaborative and unified approach which involves governments, industry stakeholders and technology developers is crucial. Increased financial incentives and infrastructure investments are also extremely important in terms of achieving sustainable development goals. To address the challenges and leverage the benefits of sustainability regulations, the following are important:

Strengthening the financial support

Develop a unified EU-wide subsidy framework to equalize financial support for sustainable initiatives.
Increase funding for R&D of emerging green technologies to expand further.

Continues Development of the infrastructure

- Construction of hydrogen refueling stations and EV charging networks and prioritizing underdeveloped regions.
- Upgrade port facilities to include onshore power supplies and alternative fuel storage.

Creating policy simplification

- Work towards global harmonization of sustainability regulations to facilitate cross-border operations.
- Provide clear guidelines and timelines to reduce regulatory uncertainty for businesses.

Promoting workforce development

- Implement training programs to equip the workforce with skills for managing renewable energy systems and electric vehicle maintenance.
- Support job creation in green logistics technologies and compliance monitoring.

Improving stakeholder collaboration

- Encourage partnerships between governments, private companies, and academia to share best practices and scale successful initiatives.
- Organize industry forums to address shared challenges and innovate solutions.

By focusing on these strategic priorities, the logistics and supply chain industry can achieve greater sustainability and efficiency, ultimately leading to a more sustainable future.

5. Appendices
APPENDIX A

Regulations raised by partners by application area (Source: Survey-Project partners)

Regulations by Application Area						
Regulation	**Type**	**Sea**	**Road**	**Port**	**Terminal**	**Industrial Sites**
	European					
Fuel EU Maritime	European	✓		✓		
Fit for 55	European	✓	✓	✓	✓	
Alternative Fuel Infrastructure Regulation (AFIR)	European	✓		✓	✓	
SEVESO III	European			✓		✓
Transport/Handling of Dangerous Goods Regulation (EU)	European	✓	✓	✓	✓	
Subsidy Regulation for Zero-Emission Trucks	European		✓			
Subsidy Regulation for Electrification of Barges	European	✓				
Wind and Solar Energy Policy Regulation	European	✓	✓	✓	✓	
Sustainable Transition of Business Parks (Grote Oogst)	European		✓		✓	
Swedish National Freight Strategy	European	✓	✓	✓	✓	
Bearing Capacity Classification	European		✓	✓	✓	
Alternative Fuel Infrastructure Directive	European	✓	✓	✓	✓	

Fuel EU Maritime Directive	European	✓		✓		
REPowerEU	European	✓	✓	✓	✓	
Building Energy Act	European				✓	
FIT for 55 (Innovation Call for Hydrogen Projects)	European	✓	✓	✓	✓	
Waste Framework Directive (WFD)	European	✓	✓	✓	✓	
Waste Shipment Regulation	European	✓	✓	✓	✓	
	Local					
Integration of Maritime Sector in CO2 Market	Local	✓	✓	✓	✓	
RED II 2020	Local	✓	✓	✓	✓	
Nitrogen Deposit Regulation Policy	Local			✓		
Nature Protection Legislation	Local			✓		
Natura 2000 Protected Areas	Local			✓	✓	
Low Excise Duties on Diesel	Local		✓			
National Growth Fund for Zero-Emission Services (ZES)	Local	✓				
Linked Transportation (2x40 Foot)	Local		✓	✓	✓	
Passage Fee by Port of Gothenburg	Local	✓	✓	✓	✓	
Pilotage Requirement	Local	✓	✓	✓	✓	
Hamburg Climate Act	Local	✓	✓	✓	✓	
Hamburg Port Development Plan	Local	✓		✓		
	National					
Decree of 24 September 2020	National			✓		✓
Clean Energy Hub (CEH) Regulations	National		✓			
Wind Energy Area Requirement Act	National	✓	✓	✓	✓	
Climate Protection Strengthening Ordinance	National				✓	
Energy Efficiency Directive (EED)	National	✓	✓	✓	✓	

APPENDIX B

Examples of international regulations/policies for stakehodlers in a port eco-system (Source: European Commission and IMO)

Stakeholder segment	Description	Regulator/Policy maker
Ports		
LNG-bunkring TENT ports	EU standards on the deployment of alternative fuels infrastructure require all ports in the core part of the TEN-T network to be equipped with LNG refuelling stations by 2025.	International (EU)
Shore-side electricity supply at maritime and inland waterway ports	Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure -Containerships and passenger ships will be obliged to use on-shore power supply (unless they used another zero-emission technology) for all electricity needs while moored for more than two hours at the quayside in TEN-T ports as of 2030. - The rules apply to ships of more than 5 000 gross tonnes(GT), regardless of their flag and set requirements for OPS for inland waterway vessels at berth.	International (EU)

Stakeholder segment	Description	Regulator/Policy maker
Shipping		
IMO greenhouse gas strategy	2023 IMO greenhouse gas strategy . The revised 2023 strategy sets a goal of net zero emissions from ships “by or around, i.e. close to, 2050”. - A trajectory has also been agreed with indicative checkpoints set at reducing GHG emissions from ships by at least 20% - striving for 30% - in 2030 and at least 70% - striving for 80% - in 2040, both in comparison to 2008 levels. - The strategy also sets an important target of at least 5% - striving for 10% - uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources by 2030.	International (IMO)
Inclusion of maritime emissions in the EU Emissions Trading System (ETS)	Inclusion of maritime emissions in the EU Emissions Trading System Emissions from shipping are to be in incorporated into the EU’s Emissions Trading System (ETS) from 2024. The phase-in of requirements for the shipping industry is scheduled as follows: 40 % of emissions reported in 2024 to be paid for in 2025 70 % of emissions reported in 2025 to be paid for in 2026 100 % of emissions reported in 2026 to be paid for in 2027	International (EU)
FuelEU Maritime	Regulation (EU) 2023/1805 on the use of renewable and low-carbon fuels in maritime transport To stimulate the uptake of sustainable maritime fuels and zero-emission technologies the Fuel EU Maritime proposal sets a maximum limit on the greenhouse gas intensity of energy used on-board by a ship arriving at, staying within or departing from ports within the European Economic Area (EEA). Shipping companies will have to improve the GHG intensity of the fuels they use by • 2% from January 1, 2025, • 6% from 2030, • 14,5% from 2035, • 31% from 2040, • 62% from 2045, and	International (EU)

	• 80% from 2050	
Use of onshore power supply	Regulation (EU) 2023/1804 on the deployment of alternative fuels infrastructure Container and passenger vessels at EU ports must use onshore power supply (OPS) (or an equivalent zero-emission technology) for their energy needs when at berth instead of using fossil fuels or alternative fuels. This rule comes into effect on 1 January 2030.	International (EU)
The energy taxation directive (ETD)	Revision of the energy taxation directive (ETD) Heavy oil used in the maritime industry will no longer be fully exempt from energy taxation for voyages in the EU. The revised Energy Taxation Directive proposes a minimum tax on heavy fuel oil starting at 0.9 EUR per gigajoule in 2023.	International (EU)

Stakeholder segment	Description	Regulator/Policy maker
Road		
Regulation on CO_2 emission standards for HDVs.	According to the Regulation on CO_2 emission standards for HDVs, manufacturers will have to comply with targets for fleet-wide average CO_2 emissions starting from 2025. These targets will apply to new HDVs registered in the reporting period of a given year, namely from 1 July of that year to 30 June of the following year. CO_2 emission reductions: 45% by 2030 65% by 2035 90% by 2040	International (EU)
Recharging stations for trucks	New law for more recharging and refuelling stations across Europe Alternative Fuel Infrastructure Regulation (AFIR)_ secondary motorways, and in major cities. The AFIR requires that public chargers for electric trucks be provided at regular intervals along Europe's primary and secondary motorways, and in major cities. According to the regulation, recharging stations for HDVs (above 3.5 tonnes) with a minimum output of 350kW must be deployed: -At every 60 km along the Trans-European Transport Network (TEN-T) core network (main roads). -At every 100 km on the larger TEN-T network from 2025 onwards, with complete network coverage by 2030. -The regulation also states that at least two recharging points must be deployed in each safe and secure parking area by the end of 2027 and four by the end of 2030.	International (EU)

Stakeholder segment	Description	Regulator/Policy maker
Rail		
EU policy to shift freight from road to rail	EU policy on freight shift rail and sea. Among other things, the new rules oblige member states to "make all possible efforts" to enable freight trains with a length of 740 meters to use all routes of the "core" TEN-T network by 2030.	International (EU)
EU policy to shift freight from road to rail	The Transport 2050 roadmap to a Single European Transport Area - The Transport 2050 roadmap sets different goals for different types of journey - within cities, between cities, and long distance.	International (EU)

	1. For intercity travel: 50% of all medium-distance passenger and freight transport should shift off the roads and onto rail and waterborne transport. - By 2050, the majority of medium-distance passenger transport, about 300km and beyond, should go by rail. - By 2030, 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport, and more than 50% by 2050.	