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Situation Analysis of Policies for Electric Mobility Development: Experience from Five European Regions

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Received: 28 February 2020; Accepted: 3 April 2020; Published: 7 April 2020



Abstract: The decarbonization of the mobility and energy sector is one of the major necessary trends for achieving targets set for the European Union (EU) in the 2020 and 2030 climate and energy frameworks. Two key technologies which offer great potential for climate change mitigation are electric vehicles (EVs) and renewable energies (REs). Thus, there is the need for innovative and stable policies in order to favor these technologies. The purpose of the study is to identify and compare features of policies for the integration of EVs, REs, and information and communication technology (ICT). This study uses an integrated Strengths, Weaknesses, Opportunities and Threats (SWOT), and Political, Economic, Social, Technological, Environmental and Legal (PESTEL) qualitative methodology in order to show different policies and initiatives, related to e-mobility, RE and ICT, collected from five European regions. This research provides discernments to the EVs and RE challenges, such as the lack of capacity to deal with high energy demands or limited EV-charging infrastructure. On the contrary, a high percentage of REs share, raising climate change awareness, and decreasing EV prices which are great opportunities for the whole EU. Such insights encourage policymakers and other groups of interest to improve their RE and mobility policies, which could lead to effective sustainable mobility systems in urban areas.

Keywords: electric vehicle; renewable energy; transport policy; sustainable mobility

1. Introduction

Europe faces challenges in achieving targets set for the 2020 and 2030 climate and energy frameworks, as well as, the 2050 long-term strategy [1]. The transportation sector in the EU has a significant impact on the environment, and is responsible for 33.1% of total energy consumption. Road transport is one of the most energy expending modes of transport, where consumption rose by 23.3% since 1990 [2]. In addition, the transportation sector has the largest oil demand in the EU, where 77% of total consumption of oil-derived fuels in 2016 accounts for road transport [3].

Electrification of road transport has become a principal tendency for sustainable mobility, and two of the most significant trends which are gaining momentum in European cities are EVs electric

vehicles (EVs) and renewable energies (REs). Therefore, it is important to co-develop a framework of experiences and policies where energy and mobility will work together and not act as different entities. For this reason, the INTERREG EUROPE EV ENERGY (Electric Vehicles for City Renewable Energy Supply) project consortium was created. The partners from five European regions (Italy, Lithuania, Spain, Sweden and the Netherlands) have identified a need for a common framework and repository of interrelated and analyzed policies and initiatives to lay the basis for systematic interregional dissemination. The majority of the partners have gained experience in analyzing opportunities and developing actions and policies. This research provides insight into the EV and RE challenges and opportunities within the European Region project partners.

Registrations of new electric cars in 2017 reached over 1 million sales worldwide; as a result, the global stock exceeded 3 million electric cars in 2017 [4]. That notwithstanding, EVs will be even more advantageous if electricity is generated by RE sources [5,6]. The implementation growth of support schemes for RE technology and decreasing costs of RE systems made a positive impact in the consumption of RE [7]. The share of RE in gross final energy consumption reached 18.9% in 2018 (from 8.5% in 2004). Moreover, the transport sector increased the share of RE to 8.3% in 2018, compared to 3.1% in 2007 [8]. Smart charging applications could also boost the share of RE used to charge the EVs; in particular, wind and solar energy is becoming an important research topic. Ultimately, the vehicle-to-grid (V2G) strategies have shown a promising solution to the energy market [9].

Chen et al. (2020) revealed that the V2G capability and EV-charging time attribute was the most significant factor of e-mobility in determining prospective EV integration. In addition, financial savings, the fuel economy, and environmental value were also one of the strongest predictors [10]. Furthermore, Noel et al. (2018) revealed an extensive range of benefits for both EVs and V2G, such as emissions, economic savings, and RE integration, as well as noise reduction and better performance. Moreover, authors revealed that V2G benefits covered topics like vehicle-to-home and solar integration, as well as, vehicle-to-telescope and emergency power backup [11].

Both the growth of the EV fleets and the increase of RE production can contribute significantly to climate change mitigation, but their intelligent integration is of a high priority. Different, fragmented policies are observed, favoring EVs through incentives at local, regional and national level. In order to boost e-mobility technologies and sustainable transportation, innovative and stable policies are required.

There are research studies that have been performed on EV legislation, policies, good practices, drivers and barriers, challenges and opportunities. Bekiaris et al. (2017) conducted research on legislation, in order to underline the importance of e-mobility [12]. Biresselioglu et al. (2018) undertook a detailed review of literature analysis covering motivators and barriers for integration of EVs in the EU, covering environmental, economic, technical and other aspects [13]. Rietmann and Lieven (2019) explored the influence of policy measures supporting EVs in 20 countries worldwide, showing various policy incentives, which promote the implementation of EVs. In addition, the study highlighted the need for collaboration between the public and private sectors in order to promote EVs [14]. Global EV adoption and the impact of policy measures have also been analyzed by Haddadian et al. (2015), who concluded: "In order for EVs to achieve a large-scale market presence, the corresponding regulatory framework should be designed to incorporate both push and pull factors within its incentive schemes." The authors also emphasized that countries should learn from each other's experiences and set up forceful policies based on their national priorities and technical resources in order to promote sustainable transportation [15]. Another international viewpoint was stated by Wang et al. (2019), who analyzed the adoption of EVs across 30 countries for the year 2015. The authors summarized that fuel price, chargers' density and road priority are significantly effective factors correlated with a country's EVs market share [16]. Furthermore, another study was carried out by Cansino et al. (2018), where authors focused on measures to promote e-mobility within the EU28. The authors summed up that the most important policy instruments to promote EVs are tax and infrastructure measures together with financial incentives for purchasing and supporting R&D projects [17].

There are research studies that have been carried out regarding potential trends, policies, good practices, drivers and barriers in the e-mobility sector in various individual countries: Austria [18], Brazil [19,20], China [21], Denmark [22], Ireland [23], Germany [24], Latvia [25], Lithuania [26], Norway [27,28], Portugal [29], Spain [30–32], Sweden [33], the USA [34], Nordic countries [35], etc. For instance, case studies in Norway revealed a positive EV integration when various incentives were implemented: permanent exemption for vehicle registration tax, exemption for yearly fee and road toll, exemption for value-added tax, reduced tax for company cars, free parking on municipal parking spots, permanent access bus lanes, exemption congestion charge, and fast charging infrastructure availability [27,28]. Besides, users of BEV drivers also described their EVs as more comfortable than their (previous) cars with internal combustion engine, both by means of driving experiences and technical equipment [28]. Next, a Spanish case introduced its national legal framework and policy measures to promote the use of EVs in Spain: financial support and incentives for residents and public authorities for the purchase of EVs, and financing for R&D projects. In addition, there are also two relevant taxes for vehicles: tax on vehicle's ownership and a tax regarding CO₂ emissions (g/km). Consequently, EVs have exemptions for these taxes [30]. Moreover, another Spanish case showed a good example of moving towards a sustainable sharing economy business model. Ampudia-Renuncio et al. (2018) performed a research showing a holistic evaluation of the impacts generated by electric free-floating car-sharing (FFCS) on user behavior of university students in Madrid. Authors also revealed the positive effects of FFCS to the environment and a possibility to complement public transportation [31]. Furthermore, Luna et al. (2020), analyzed the incentive policy of the first e-car-sharing scheme in Brazil, which showed a significant reduction (29%) in carbon emissions and increase (36%) of awareness and adoption of EVs [19]. According to the U.S. Department of Transportation, Federal Highway Administration (2016), a number of social, environmental and economic benefits have been identified from the use of shared mobility modes. Several studies have documented reduced vehicle use, ownership, and vehicle distance travelled. Additionally, cost savings and convenience are often cited as popular reasons for shifting to a car-sharing mode [36].

However, no study has yet been performed related to features of policies and incentives for the integration of e-mobility, RE, and information and communication technology (ICT) in different regions of Europe. Therefore, the main objective of the study was to identify and compare features of policies for the integration of EVs, RE, and ICT in five European regions: Italy (Lazio), Lithuania, Spain (Barcelona), Sweden (Stockholm) and the Netherlands (Amsterdam and Flevoland). In order to highlight drivers and barriers, possibilities and risks of the mobility conditions in these countries, the integrated Strengths, Weaknesses, Opportunities and Threats (SWOT), and Political, Economic, Social, Technological, Environmental and Legal (PESTEL) analysis based on local mobility policies and initiatives was carried out.

Such comprehensive situation analysis would inform urban transport planners, experts and policymakers about the transition from internal combustion to renewable energy-fueled vehicles, as well as show mobility policies, good practices, and circumstances that are the most appropriate for the integration of sustainable urban mobility. Moreover, it is important for countries to learn from each other's good practices in order to determine significant local policies and apply initiatives that could promote a healthy, environmentally friendly city transport system.

2. Methodology

In order to develop a framework of innovative policymaking, a comprehensive situation analysis of mobility policies and initiatives (MPI) needs to be performed. The study area of the current research consists of five European regions: Italy (Lazio), Lithuania, Spain (Barcelona), Sweden (Stockholm) and the Netherlands (Amsterdam and Flevoland). The consortium of regions was formed by dedicated cities at the forefront of the integration between RE and e-mobility, and committed to evaluating and disseminating the results of their insights. Situation analyses of policies and initiatives were carried

out in each EV ENERGY project partner regions by using an integrated SWOT and PESTEL qualitative methodology [37–40]. The situation analyses were based on the three pillars approach:

(1) Policies and initiatives related to EVs

Every region worked on the identification of specific local MPI related to EVs. This included incentives and measures stimulating EVs, such as purchasing, their traffic participation, parking and charging circumstances.

(2) Policies and initiatives related to Renewable Energy Supplies (RES)

In parallel, policies and initiatives of RE were identified and analyzed. This included incentives and measures stimulating local RE, namely financial support constructions, permitting procedures, energy pricing, and net metering arrangements, etc.

(3) Policies and initiatives related to ICT Tools for Energy and Mobility

This analysis took into particular account the appropriate rollout of policies of the three combined disciplines, optimization of RE and increased deployment of EVs and their intelligent integration using ICT.

In the context of the current research, an overall methodological approach was developed in order to identify and compare features of policies for the integration of EVs/RES/ICT in different regions of Europe. The implemented methodological approach consists of the following two steps (Figure 1):

- (1) Inventory of Mobility Policies and Initiatives (IMPI);
- (2) Conduction of SWOT and PESTEL analysis (based on IMPI);

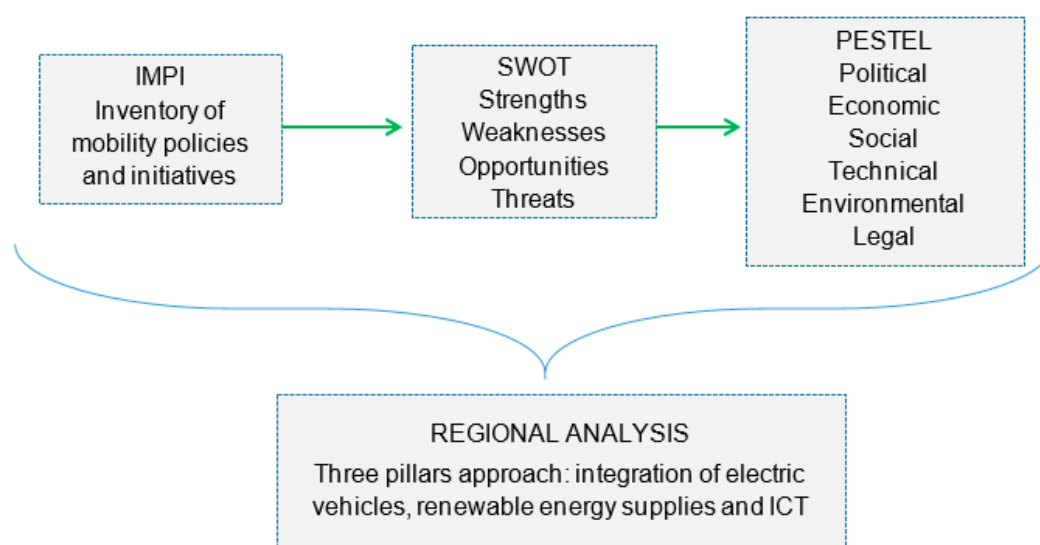


Figure 1. Illustrated methodology approach adopted for the current research process.

All partners were actively involved in the data collection process for IMPI. To ensure the harmonization of information and data collection, templates for the IMPI (Table 1) were prepared and spread among partners. IMPI was obtained by analyzing secondary resources: bibliography, laws/regulations, relevant sites, public reports, national and international standards, and other related initiatives.

2.1. Inventory of Mobility Policies and Initiatives

The IMPI was the starting point for collecting and understanding what governs, regulates, and perhaps, controls the growth of clean and energy efficient mobility. The most relevant policy aspects for EVs/RES/ICT in five analyzed regions were investigated.

Mobility policies were grouped and analyzed on city/regional, national and EU (international) scale. Additionally, IMPI were grouped into four different types, covering different aspects of mobility:

e-mobility, urban and spatial planning, ICT tools for energy systems, awareness and adoption (Table 1). E-mobility is more extensive than others.

Table 1. Template for the IMPI

Region Name:			
Inventory of Mobility Policies and Initiatives	City/Regional	National	EU
Policy Type			
E-mobility			
– may include issues such as: taxation/value-added tax; energy pricing/regulations; incentives such as parking, access, and other; charging			
Urban planning			
– may include: land-use regulations, parking, energy efficiency levels, employee transport plans			
ICT-energy system (incl. REs and production and consumption)			
– may include issues such as: feed-in tariffs; net metering; funding by purchase; grid energy exchange measures			
Awareness and adoption (jobs, growth and investment)			
– include investment in REs/Sustainable environment; transport and ICT; new jobs in low carbon economy etc.			

The initiatives are interpreted as stories of successful projects implemented in the five countries of EV ENERGY project partners. Each project partner had to present several successful initiatives, which they are proud of and which would have the potential to be transferred to other countries.

In this study, the presentation of initiatives was not too detailed and was mentioned in line with the policies. Therefore, all selected initiatives (in EV ENERGY project called Good Practices) will be reported and submitted to the INTERREG Europe Program website.

2.2. Conduction of Integrated SWOT and PESTEL Analysis

The second step of the implemented methodological approach consists of the conduction of integrated SWOT and PESTEL analysis based on local MPI in order to highlight strengths, weaknesses, opportunities and threats of mobility conditions in analyzed European regions. The SWOT analysis was presented individually for three main pillars of the project: EVs/REs/ICT. Therefore, SWOT analysis was performed in line with PESTEL, with the assessment of the six factors: political, economic, social, technological, environmental and legal.

The methodology could be successfully used in different fields: for the development of industry [41], for studying government challenges [42], and for integrated Strategy Framework development [43]. The result of the PESTEL analysis is often used to identify threats and weaknesses as input for a SWOT analysis. These tools are often used together as they complement each other [40].

Information basis for the SWOT and PESTEL analysis was data, collected using top-down approach—study of existing local MPI, planning documents, analysis of statistical and scientific data and using bottom-up approach—participatory approach, reports and outputs from regional stakeholder events. Four events were held in each of the five regions, where representatives from government, municipalities, experts, and professionals from business companies and research institutions shared and overviewed preconditions, potentials and challenges of the particular region in form of many different thoughts and aspects related to EVs and related smart solutions.

3. Data Analysis Results and Discussions

One of the project's objectives was to collect MPIs, which are the starting point for understanding what regulates, governs and controls the growth of EVs, REs and ICT in regions of the project partners.

3.1. Mobility Policies and Initiatives

The MPIs, as well as other policies, can be grouped into city/regional, national and international scale. Additionally, MPIs were grouped into different types covering different aspects of mobility: e-mobility, urban and spatial planning, ICT energy systems, awareness and adoption.

On the international scale, the Kyoto Protocol is a well-known treaty. This treaty extends the 1992 United Nations Framework Convention on Climate Change. This framework requires states to reduce greenhouse gas emissions, while in the EU alone, about 12% CO₂ is emitted by passenger cars [44].

Other well-known international policies are focused on EU level. For instance, the Clean Vehicles Directive (2009/33/EC) encourages clean and energy-efficient road transport vehicles, the Alternate Fuels for Sustainable Mobility in Europe Directive (2014/94/EC) focuses on the deployment of an alternative fuel's infrastructure. Additionally, a number of various European regulations cover various aspects of e-mobility: setting emission performance standards for new passenger cars as a part of the community's integrated approach to reduce CO₂ emissions from light-duty vehicles (443/2009); approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information (715/2007); sound level of motor vehicles and of replacement silencing systems (540/5014); and setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO₂ emissions from light-duty vehicles (510/2011). In 2011, the European Commission adopted a roadmap (Roadmap to a Single European Transport Area—Towards a competitive and resource efficient transport system) of 40 concrete initiatives to build a competitive transport system, which would increase mobility, reduce Europe's dependence on imported oil and reduce carbon emissions in transport by 60% by 2050 [45].

Despite EU regulations and directives, a list of communications between the European Commission, the European Parliament, the European Council and various EU committees' documents concerning e-mobility have been released: Towards Europe-wide Safer, Cleaner and Efficient Mobility: The First Intelligent Car Report (COM/2007/0541); Greening Transport (COM/2008/433); Action Plan on Urban Mobility (COM/2009/0490); A European strategy on clean and energy efficient vehicles (COM/2010/0186); Clean Power for Transport: A European alternative fuels strategy (COM/2013/17). The urban and spatial planning addressing mobility policies in Europe are highlighted in the previously mentioned white paper—the Roadmap to a Single European Transport Area (COM/2011/0144) for the EU, which aims to increase cooperation between the EU Member States, Cities, and the European Commission by utilizing sustainable growth of European cities. The ICT domain is addressed by the Renewable Energy Directive (2009/28/EC), which enacts a general policy for production and promotion of energy from renewable sources.

Additionally, ICT is covered by EU communication documents identifying A Stronger European Industry for Growth and Economic Recovery (COM/2012/582); A Strategy for Smart, Sustainable and Inclusive Growth (COM/2010/2020) and A Roadmap for Moving to a Competitive Low Carbon Economy in 2050 (COM/2011/112). The awareness and adoption are addressed by the Horizon 2020 program, which is an EU research and innovation initiative covering energy, ICT, transport, environmental and climate actions, and by an EU funding instrument, called Connecting Europe Facility (CEF), which promotes the growth of jobs and competitiveness through infrastructure investment within the sectors of energy, transport and telecommunications. All these international level policies present a good basis for national policies, which intend to tackle EV, ICT, and energy-related issues on a national level. However, in order to transfer policies from one region to another, the results (Table 2) of inventoried city/regional and national policies were segregated by the countries of project partners.

Table 2. National and local/regional policies and initiatives addressing EVs, RE, ICT spatial planning and social awareness in EV ENERGY project countries.

	Italy	Lithuania	Spain	Sweden	The Netherlands
National policies and initiatives	National Energy Efficiency Fund	National Energy Independence Strategy	Mobility Impulse Plan	Pump Act ensuring access to renewable fuels at fuel stations	National Charging Infrastructure Knowledge Platform
	Retrofit	National Transport Development Program	Vehicle impulse strategy with alternative energy (2014–2020)—Industry, Energy and Tourism Ministry	Climate Step giving grants, e.g., for charging infrastructure	ElaadNL knowledge center
	National Strategic Framework	Lithuanian Long-Term Strategy for Development of the Transport System	Spanish strategy for sustainable mobility—Ministry of Development	Electric bus purchase subsidy	Formule E-Team
	Incentives for the purchase of new cars with reduced CO ₂ emissions.	Feasibility study on Electric Transport Development	White Paper on Sustainability in Spanish Urban Planning—Ministry of Development	Public transport and cycling support by national climate goal to reduce greenhouse emissions from the transport sector by 70% compared to 2010	Administrative Agreement on Zero-Emission Buses
	Deduction in 10 years of 50% of the expenses incurred for the purchase and installation of a private charging station	Detailed EV Development Strategy report	Infrastructure, Transport and Housing Plan—2012–2024—Ministry of Development	State grant for purchasing environmentally friendly cars	Green Deal
	Ecotax for polluting vehicles with emissions over 160 CO ₂ g/km	National Strategy for the Development of Renewable Energy Sources	Aid program for modal shift actions and more efficient use of modes of transport—Industry, Energy and Tourism Ministry	Solar panel investment support for private households	Association of Netherlands Municipalities
		Energy Efficiency Action Plan	National Energy Efficiency Fund—Industry, Energy and Tourism Ministry	Regulation on Feed-in-tariff for private producers of solar energy/electricity	Energieakkoord (Energy Agreement)
		Forecast of the Use of Renewable Energy Sources		City environmental agreement supporting local transition projects	SDE+ (Stimulating Renewable Energy)
		Lithuanian Innovation Strategy for 2010–2020		Grants for purchasing electric bikes (25% of prize)	Energy Top Sector—Urban Energy TKI
		Operational Program for Promotion of Cohesion for 2014–2020		Political climate framework for Sweden—goal of net zero emissions 2045	Energy Investment Allowance
	Guidelines for e-cars charging infrastructure		Power agreement for Sweden—fossil-free electricity production latest 2040	Regeling Groenprojecten (Settlement Green Projects)	

Table 2. Cont.

	Italy	Lithuania	Spain	Sweden	The Netherlands
Local/Regional policies and initiatives	Lazio Region Taxation Law	EV-charging schemes	PIRVEC Plan 2016–2019—Strategic Plan for the Deployment of Charging Infrastructure for Electric Vehicles	Grants for increasing EV-charging infrastructure in the Stockholm region (based on State grants)	Clean Air policy in Amsterdam
	Retrofit	Public transport modernization	Strategy for the impulse of electric vehicles in Catalonia	Regional development plan for the Stockholm region	Metropole Region Amsterdam
	SUMP policies regarding e-mobility	Park and Ride, Bike and Ride	Urban Mobility Plan—2013–2018. City of Barcelona	List of policy instruments for cities and municipalities	Mobility vision 2030
	Implementation of local fiscal policies	Master Plans for majority of cities	Urban Mobility Metropolitan Plan—Barcelona Metropolitan Area	Solar maps for entire region and City of Stockholm	Solar Energy Amsterdam
	The Strategy for the Energy Plan of the Lazio Region		Mobility Masterplan—2013–2018		Program mobility and space
	National Strategic Framework for e-infrastructures		National Agreement on Energy Transition in Catalonia—2016–2050		Lelystadt sustainability framework
			Plan to improve air quality in Barcelona 2015–2018		Mobility plan of Almeire
			Program of Anti-air Pollution Measures		

In Italy the main EV and its infrastructure outlying policy is the National Strategic Framework for e-infrastructures aiming to install a network of EV-charging points, with the ambition to spread adequate e-infrastructures in the Italian territory for over 130,000 electric vehicles, adding to the current 9,000 EV-charging points, up to 19,000 charging points including up to 6,000 “high power” charging points. This policy constitutes the electricity section of the national strategic framework for the development of the alternative fuels market in the transport sector and the construction of the related infrastructure. Among the most important financial instruments to support the implementation of interventions aimed at ensuring the achievement of the National Strategic Framework for e-infrastructures and the Italian energy efficiency targets, in line with the provisions of the Kyoto Protocol, the measure of the “National Fund for Energy Efficiency” aimed at supporting the implementation of energy efficiency interventions carried out by Companies, ESCO and Public Administration on buildings, plants and production processes and integrates incentive tools dedicated to achieving national energy efficiency objectives. This fund introduces infrastructure for charging EVs and provides grants to implement charging infrastructure in order to replace and/or transform public transport and waste collection with EVs. Another regulation is called Retrofit, which addresses installation procedures of energy regeneration systems for EVs. On a regional level, the region of Lazio EV users is exempt from motor vehicle taxes for five years after first registration. The urban planning as well as ICT and energy system in Lazio is not centralized, but rather regulated by individual municipalities, which develop their own policies, mobility and parking management facilities and infrastructure development.

In the context of Lithuania, the taxation policies are not as generous for EV users as they are in Sweden or the Netherlands, as Lithuania does not have any tax benefits. The future of the Lithuanian energy sector until the year 2050 is drawn by the National Energy Independence Strategy, which defines the vision of the Lithuanian energy sector and its implementation principles, strategic directions, goals and objectives. Furthermore, it emphasizes the results to be achieved regarding REs in transport sector by 2050. The other initiative, the National Transport Development Program, is defined for a shorter period, until 2020. This program is intended to support policies by developing a sustainable transportation system, effectively managing resources and EU funding, increasing the sector’s competitiveness. The other policy, known as the Lithuanian Long-Term Strategy for Development of the Transport System is valid until 2025. It covers land-use regulations, governmental policies, sharing mobility and possible measures required to improve mobility. Concerning EVs and REs, the Ministry of Transport and Communication have developed guidelines for EV-charging infrastructure and allocated funds for installing charging points along main highways. Furthermore, the Ministries of Transport, Economy and Energy shared a commissioned feasibility study on Electric Transport Development. The urban planning, ICT, and REs are addressed by the Law on Renewable Energy Resources, National Strategy for the Development of Renewable Energy Sources, Energy Efficiency Action Plan, Forecast of the Use of Renewable Energy Sources and Lithuanian Innovation Strategy for 2010–2020. On the city level, EV-charging schemes and public transport modernization (alternative fuel or electric busses) exist for 25 cities. The cities of Vilnius, Kaunas, Klaipeda and Druskininkai installed “Park and Ride” and “Bike and Ride” stations used for combined mobility. Moreover, each city in Lithuania has its own Master Plan, which is the core policy document defining land-use regulations, infrastructure plans and feasibility studies.

On a national level, the Ministry of Economy, Industry and Competitiveness in Spain issued the Mobility Impulse Plan. It promotes EVs and the implementation of charging infrastructure. While on a regional level, the Catalan Government initiated PIRVEC Plan 2016–2019, which is a strategic plan for the deployment of charging infrastructure in the region. The other plans, such as Urban Mobility Plan (2013–2018) and Urban Mobility Metropolitan (Barcelona) Plan and Mobility Master Plan regulate urban planning and mobility policies. The ICT and RE sectors are affected by the National Agreement on Energy Transition in Catalonia 2016–2050, by the Barcelona City Plan to improve air quality in 2015–2018, and by the Program of Anti-Air Pollution Measures, applied in 40 municipalities around Catalonia.

In Sweden, the tax policy ensures that EV users do not have to pay annual circulation tax, companies' EVs can be used for commercial and private purposes, there are more parking spaces for EVs, and generous purchase subsidies. Moreover, the Pump Act (2005:1248) obligates operators to provide renewable fuels at filling stations. Meanwhile, the National Swedish Energy Agency issued a policy called Climate Step, which supports investment for carbon reduction measures, for instance, charging infrastructure. Concerning the public transport in Sweden, the Ministry of Environment and Energy subsidizes regional and public transport, and promotes bicycles. The RE is a high priority in Sweden as well—county administrative boards provide investment support for households willing to install solar and wind power plants and energy storages. Furthermore, such households obtain tax reductions by producing and selling RE to the state. On a higher level, counties and municipalities are supported by a state-issued policy called the City Environmental Agreement, which supports developing a sustainable urban environment. On a city level, Stockholm promotes EVs and e-mobility by changing its own fleet to EVs and by installing 1,000 public charging points by 2020 (this goal was achieved already in 2019 with 1,500 public charging points) and 15,000–25,000 until 2030. Stockholm, as well as other Swedish cities, has comprehensive policies defining regional goals, initiatives and planning on a local level, detailed development plans representing functions, forms and use of public spaces, transportation plans, and regulations and local ordinances for parking, public streets and spaces. Concerning RE, many municipalities have solar maps showing the potential for installing solar panels.

The Province of Flevoland and Green IT Amsterdam created an inventory of the policies related to e-mobility, urban/spatial planning, ICT tools for energy systems, awareness and adoption. The high inclusion of citizens in the development of the policies are materialized through a demand-driven positioning of charging points where private and semi-public charging points are growing faster than public charging points. In the Netherlands, the Green Deal initiative achieved very positive results, which emerged as a governmental, municipal and private contribution to initiate a joint deployment of publicly accessible EVs. Namely, the goal is to improve and expand the charging infrastructure for EVs and to employ the EVs' storage capacity, which could be used by RE and for the stability of the grid.

Moreover, the country is pushing forward the City Deals, concrete cooperation agreements laid down between cities, the central government, local and regional authorities, and companies and social organizations. This involvement and cooperation are a great example of bottom-up approach strategies. On a local level, the city of Amsterdam has a clear strategy for the roll-out of EVs such as implementing EV-charging points directly available in the public space or subsidizing the purchase of electric commercial vehicles. The municipalities in the Amsterdam Metropolitan Area co-operate to stimulate e-mobility and enhance the realization of a good network of charging stations in the whole area. Cross-over policies foster the development of the region itself while lowering the barriers between the various sectors involved such as mobility, RE, new transport mode, stimulating ICT measures, etc.

3.2. *Integrated SWOT and PESTEL Analysis*

This part of the paper presents features of EV, RE and ICT sectors from political, economic, social, technological, environmental and legal (PESTEL) perspectives in five countries of the EV ENERGY project partners. Features are presented as strengths, weaknesses, opportunities and threats, which were identified through integrated SWOT and PESTEL analyses. Features are grouped according to the regions, the same way as MPI, in order to identify drivers and barriers, risks and possibilities in each region.

3.2.1. Italy

Italy has a high number of initiatives supporting the introduction of EVs. These initiatives support not only in form of legislation, regulations, and standards, but also in promotions and project demonstrations. On a municipality level, a number of municipalities in Italy have committed to implementing a Sustainable Energy and Climate Action Plan. From an economic perspective, Italy has a

National Energy Efficiency Fund, which grants about 310 million euros to support sustainable mobility. Additionally, Italy implemented a taxation policy, which liberates EV users from motor vehicle tax for five years, and new buildings' regulations require that new buildings should have an EV-charging infrastructure. Moreover, the Ministry of Infrastructure and Transport provides substantial funding for local and regional initiatives. Additionally, Italy increases its RE production—in 2016, 44% of all produced energy came from renewable sources and that contributed to lower emissions. As a result, from 2015, Lazio is ranked 12th with 6.4 tCO₂ below the national average.

Despite these advantages, the public sector in Italy has low awareness of EVs and e-mobility. Mainly, this is due to duplication and overlap of competences. The public sector, enterprises, research, and public bodies have weak relationships, especially in managing innovative projects. The Italian government lacks a clear legislative basis and national/regional financial instruments, which would subsidize EV purchase. Available funding is limited not only by the government, but also by private initiatives. For instance, small and medium companies spending in R&D only make up for 0.53% of Gross Domestic Product (2011 data), which limits the companies' competitiveness. Another issue is the limited EV popularity combined with a high motorization rate in Rome—9 vehicles per 10 inhabitants. This causes high pollution, noise and congestion.

Most of the opportunities of e-mobility have been identified on a political level. For instance, one of the targets is the Paris Climate Agreement, which could contribute to implementing e-mobility related projects and reduce greenhouse emissions. On a municipal level, according to the new building regulations, new housing must have EV-charging infrastructure. In addition, the government initiated the National Strategic Framework for e-infrastructures to develop a recharging system in Italy, and a Single National Platform to collect information on charging infrastructure accessible to citizens and operators. The other opportunities are growing EV popularity and increasing EV numbers in Europe and Italy.

While there were more opportunities for policies, more economic and technology-related threats have been identified. First of all, the high purchase price of EVs and their batteries are the main economic risk, which could limit EVs. Other economic issues are the low degree of company internalization rate and a strong dependence on traditional energy sources. A structured integrated SWOT and PESTEL analysis of Italy is presented in Table 3.

Table 3. Integrated SWOT and PESTEL analysis for EV, RE and ICT sectors in Italy.

Strengths	Weaknesses
<ul style="list-style-type: none"> • National Energy Efficiency Fund supports sustainable mobility <ul style="list-style-type: none"> • Taxation policy • Increasing production of RE • New buildings with EV-charging infrastructure • Local and regional initiatives funded by the Ministry of Infrastructure and Transport <ul style="list-style-type: none"> • Expansion of electric car-sharing • Innovation is driven by great innovative companies 	<ul style="list-style-type: none"> • The weak relationship between enterprises, research, and public <ul style="list-style-type: none"> • Low awareness in the public sector • Lack of a clear National Legislative address strongly geared towards e-mobility • Lack of National and Regional financial instruments for new policies <ul style="list-style-type: none"> • Limited competitiveness • High car ownership and congestion • Lack of needed funds to implement new infrastructures and technologies <ul style="list-style-type: none"> • Lack of true electrical corridors and recharge station infrastructure
Opportunities	Threats
<ul style="list-style-type: none"> • Contribution to the Paris Climate Change Agreement <ul style="list-style-type: none"> • Support of EU Directives • New building regulations help to develop EV-charging networks <ul style="list-style-type: none"> • National Strategic Framework for e-infrastructures <ul style="list-style-type: none"> • Three Year Plan for National Electricity Research • An increasing number of EV models on the market <ul style="list-style-type: none"> • Growing EV popularity 	<ul style="list-style-type: none"> • High costs of EVs as a barrier of broad market penetration <ul style="list-style-type: none"> • Limited EV-charging infrastructure • Still very low degree of internationalization of enterprises • Strong dependence on traditional energy sources (oil products)

3.2.2. Lithuania

EVs and e-mobility is a relatively new topic in Lithuania; therefore, the political strength is that the government and municipalities are aware of these topics and provide their support. The businesses and IT-related sciences are willing to take part in the whole process. Businesses have good connections with major EV developers. Additionally, Lithuanian authorities promote the use of EVs by allowing them to use the bus and taxi lanes as well as providing free parking within any of the cities' paid parking zones. From an economic perspective, although EVs are not so favorable in Lithuania, active business actors exist. On a national level, the Ministry of Transport and Communications allocated a specific budget for EVs and their infrastructure. On a household level, the ownership of cars is high and people are aware of the maintenance costs—EVs have lower maintenance costs compared to gas/diesel-powered vehicles (gas price, oil change, engine repair, etc.). Another motivation is the growing use of smartphones. Successful integration of ICT, EVs and smartphones, growing car-sharing schemes and similar initiatives motivate people to use sustainable transport. Furthermore, an EV-supporting website, for example, <https://elv.lt>, has recently been developed in order to increase a public awareness of EVs, maintenance services, charging stations, etc.

Unfortunately, Lithuania experiences a series of weaknesses in all domains. The most important political issues are the absence of a common EV policy and strategy at a national level, which limits initiatives at local and regional levels, and creates a lack of political will and knowledge at a local level. Limited coordination and cooperation between ministries, a lack of responsibility for EV-charging infrastructure, and the absence of permanent legislation and politics are further problems. In general, the high purchase price of EVs and their batteries are probably the most significant problem in Lithuania, limiting EV popularity. A lack of vehicle taxation mechanisms motivates people to use second-hand vehicles, which have a strong demand in Lithuania.

Additionally, there are very few sustainability-promoting procurement options, which would help reduce high costs of EV-charging infrastructure and limit companies and staff capable of providing full EV services. Considering the social weaknesses, most Lithuanians have a limited income and prefer large, sophisticated, diesel vehicles. Probably the most important technology-related issue in Lithuania is limited EV-charging infrastructure, especially for intercity travel. The growth of EVs is a great opportunity for Lithuania and a registration tax for high pollution-emitting vehicles powered with diesel/petrol/gas has already been initiated. According to the law on motor vehicle registration tax (published in December 2019), the vehicle registration fee will come into force in July 2020. The fee will range from 13.50 to 540 euros, depending on the type of vehicle and CO₂ emissions, if they exceed 130 g CO₂ per kilometer.

An increase of EVs in Lithuania would also dramatically rejuvenate the national car pool, and would help reduce dependence on oil products. Additionally, EVs give new opportunities for business and science in the development of new markets, and increase car-sharing competitiveness, additional subsidies, and support mechanisms. From an economic/environmental perspective, the EV market would enable the trade of surplus in allowances, pollution permits, and use emission trading schemes, while Sustainable Urban Mobility Plans (SUMP) guidelines and development funds give new opportunities for smaller municipalities to obtain additional funding. An increase of EVs would require EV-charging stations, which could be installed around communal blocks and flats— this would improve space management concerning apartment structures. By 2022, the Lithuanian Road Administration and local municipalities will install a network of public access EV chargers. A great opportunity for Lithuania is that the development of EV-charging networks would not only connect major traffic arteries in the biggest cities, but would also imply a renovation of the power grid.

From an environmental perspective, e-mobility would help reduce air pollution and noise in the cities caused by internal combustion engine vehicles powered by petrol or diesel. EVs could be promoted by establishing low emission zones around city centers and limit the access for high pollution and freight vehicles.

The market of EVs, REs, and ICT in Lithuania has a list of foreseen threats. First of all, EVs and their infrastructure in Lithuania do not have much political support; such political decisions are lagging behind other EU states. The national legislation distorts EU recommendations and formulates a negative opinion about the EU. At the same time, EU subsidiary rule prevents a common standard among all EU Member States. There is no single body responsible for EV-charging infrastructure development; therefore, missing coordination leads to fragmented and delayed growth. The legislation and documentation should also be improved, as there are no EV-charging operator rules, and installation requirements are unclear. The number of potential economic threats in Lithuania increases the risk of successful e-mobility integration. Lithuania alone has very limited possibilities to fund EV and e-mobility development. Most of the initiatives are funded by the EU; consequently, funding could be provided due to the fact that Lithuania is among the five EU countries which do not have subsidies for EVs. Regarding the average household, people prefer to have a cheap second-hand vehicle than an expensive EV. Moreover, although the second-hand vehicle market is strong in Lithuania, there is a risk that second-hand EVs will be more expensive than fuel-powered cars. A structured integrated SWOT and PESTEL analysis of Lithuania is presented in Table 4.

Table 4. Integrated SWOT and PESTEL analysis for EV, RE and ICT sectors in Lithuania.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Bus and taxi lanes for EVs <ul style="list-style-type: none"> • Ministry support • Good business connections with major EV development companies <ul style="list-style-type: none"> • Strong positions of businesses and science in IT <ul style="list-style-type: none"> • Community activity in transport issues • Competent vehicle restoration and repair businesses <ul style="list-style-type: none"> • Allocated budget for e-mobility • Low maintenance costs of EVs <ul style="list-style-type: none"> • Growing smartphone use • Cost-competitive EVs in car share schemes <ul style="list-style-type: none"> • High car ownership • Developed EVs' prototypes by universities • Universities working on e-mobility technologies and applications <ul style="list-style-type: none"> • Planned EV-charging network • High awareness of traffic-related environmental impact • The share of passengers' cars powered by alternative fuels is 17% <ul style="list-style-type: none"> • Supporting EV websites 	<ul style="list-style-type: none"> • Systematic approach to power demonstration <ul style="list-style-type: none"> • The old age of the vehicle fleet • The absence of common EV policy and strategy <ul style="list-style-type: none"> • Lack of cross-ministry coordination and cooperation • Low quality and unclear documentation regulating EVs • Lack of body responsible for infrastructure development <ul style="list-style-type: none"> • Lack of permanent legislation and politics • High purchase prices of EVs and batteries • Unknown approaches of traditional vehicle conversion to EV • Strong secondary market of old gas/diesel-powered vehicles <ul style="list-style-type: none"> • Minimum taxation of vehicles • Lack of sustainable/green procurement <ul style="list-style-type: none"> • Low public awareness of EVs • Low resident purchasing power • Prevailing attitude on large, sophisticated, diesel vehicles <ul style="list-style-type: none"> • Undeveloped EV-charging infrastructure • Limited cooperation between municipalities and universities
Opportunities	Threats
<ul style="list-style-type: none"> • Unified and universal rules for EV-charging stations <ul style="list-style-type: none"> • Support mechanisms and subsidies <ul style="list-style-type: none"> • Collective municipal actions • Rejuvenation of national car pool • Independence from fast depleting petroleum • Businesses and science engagement in the development of new markets <ul style="list-style-type: none"> • Registration tax for gas/diesel/petrol-powered vehicles <ul style="list-style-type: none"> • Car share competitiveness • Trade in surplus allowances of EVs • Sale of surplus pollution permits • Opportunities to obtain SUMP development funding <ul style="list-style-type: none"> • Understanding of sustainable transport benefits <ul style="list-style-type: none"> • Available support mechanisms and subsidies <ul style="list-style-type: none"> • Low emission zones and their accessibility • The planned network of public EV-charging stations • Better control and management of communal space around residential blocks 	<ul style="list-style-type: none"> • Lack of political support <ul style="list-style-type: none"> • Disagreement between national and EU legislation <ul style="list-style-type: none"> • Fragmented EV growth • Maintenance of free public EV-charging financed by all taxpayers <ul style="list-style-type: none"> • Lack of EV-charging operator rules • EV-charging station installation requirements unclear <ul style="list-style-type: none"> • The disadvantage of EU subsidiary rule • No single body for infrastructure development <ul style="list-style-type: none"> • Lagging political decisions <ul style="list-style-type: none"> • No direct income from EV promotions • Reduced fuel consumption reduces excise tax income <ul style="list-style-type: none"> • The strong second-hand vehicle market • Limited EU funding for public transport modernization <ul style="list-style-type: none"> • Limited national funding for EVs and e-mobility • Lithuania, one of five countries without subsidies for EVs <ul style="list-style-type: none"> • The uncertainty of retrofitting of used EVs

3.2.3. Spain

Spain is an advanced country regarding RE, and Barcelona is a leading city in e-mobility. It has a high number of plans, incentives, and projects, which helped to gain valuable experience in the sectors of EVs, RE and ICT. Another strong aspect in Spain is a comprehensive political and financial support for the development of EV-charging infrastructure. Regarding the average household, Spain has a list of financial initiatives, which lower EV purchase and maintenance costs, where most of the EV customers

are concentrated around Barcelona. It can be seen as a positive aspect because developed infrastructure gives better access to recharge EVs. From another point of view, the concentration around Barcelona shows great territorial imbalances and limitations of EV use, ICT and RE developments. Moreover, Spain experiences a high solar radiation, compared with the rest of Europe, this represents a great potential for solar photovoltaic (PV) electricity generation. Despite a number of strengths, EV, RE and ICT sectors experience many weaknesses. In political terms, the general problem is that decisions are quite fragmented. Another problem is that only one actor in Spain is qualified to charge for reselling energy. This can limit fair competitiveness in all energy-related sectors. Furthermore, in Spain, the R&D of the RE in private companies is the lowest among European countries. Although the EV-charging and RE infrastructure are well developed, limited finances slow down the development of new infrastructure and technologies. For the average household, most people purchase gas/diesel-powered vehicles. EVs and hybrids only have 0.4% of the market share. Additionally, people miss public information about the advantages of EVs and e-mobility.

Besides the identified strengths and weaknesses, the sectors of EVs, RE and ICT offer many opportunities. At international and city levels, the use of such advanced technologies is a very positive advertisement for the city and country itself. Barcelona, for instance, is a city which hosts a high number of congresses and expositions, e.g., Expoelectric, the most important event in southern Europe bringing together enthusiasts and companies from the entire world. Among the economic opportunities are the growing investments and positive market developments, such as price decrease of solar energy (by 80% in the last six years) and an increase of EV owners. From a social point of view, technologies improve the quality of life—decreasing air pollution in Barcelona reduces deaths and illnesses caused by bad air quality, and positively changing mobility patterns increases people’s health.

Among the main political threats are the missing facilitating regulations, standards, training and framework for implementation as well as various barriers for public access to EV-charging stations. The technical side would have even more threats. Firstly, although much of EV-charging infrastructure is newly developed, it could be obsolete soon because of the rapid technological advancement. Secondly, the local power distribution is weak (already mentioned in the list of weaknesses). Thirdly, the energy sector does not have many control mechanisms to store surplus energy, and to generate additional energy during high demand. A structured integrated SWOT and PESTEL analysis of Spain is presented in Table 5.

Table 5. Integrated SWOT and PESTEL analysis for EV, RE and ICT sectors in Spain.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Strong political and financial support for EV-charging infrastructure’s development • Number of initiatives for EVs’ purchase and cost- saving • The high potential of solar PV integration in electricity production compared with the rest of Europe 	<ul style="list-style-type: none"> • Irregular investment cycles • Private company spending of R&D of RE is lowest in Europe • Low share of purchases and ownership of EVs and hybrids compared to gas/diesel-powered vehicles • Mobility and congestion in Barcelona Metropolitan area has increased <ul style="list-style-type: none"> • Missing public information on the advantages of e-mobility <ul style="list-style-type: none"> • Limited experience with smart grid projects • Limited infrastructure and EV service capacities • High dependence on natural gas due to high accessibility in the cities
Opportunities	Threats
<ul style="list-style-type: none"> • Keep the positioning of Barcelona related to e-mobility and smart grids • Contribution to the reduction of greenhouse gasses in Europe <ul style="list-style-type: none"> • Growing investments • Positive market developments • Improved life quality • A higher share of locally-generated energy in Barcelona • PRIVEC initiative to develop EV-charging infrastructure • Acceleration and motivation of R&D in the energy sector • Easier introduction of new RE producers due to power grid regulations 	<ul style="list-style-type: none"> • Political issues regarding public accessibility and facilitation <ul style="list-style-type: none"> • Smart grid integrity is not territorially-balanced • Price of electricity highly dependent on the price of natural gas • Resistance from car owners to use the car battery for temporary energy storage <ul style="list-style-type: none"> • Misinformation among citizens regarding EVs • The negative impact of Catalonia’s investments in hydrogen fuel cell vehicles • Current EV-charging infrastructure can be outdated due to technological advancement • RE dependency on changing the weather and seasonal patterns <ul style="list-style-type: none"> • Higher purchase costs of ICT tools <ul style="list-style-type: none"> • Weak local power distribution • Limited control of peaks and shifts in power demand <ul style="list-style-type: none"> • Emissions of EVs depends on electric mix

3.2.4. Sweden

The strengths of political aspects in Sweden are solid agreements between political parties on the importance of energy and climate transition towards fossil-independent systems. There is a high number of ambitious goals, programs and plans. For instance, the city of Stockholm supports EV-charging station installations by giving public street space to companies building them. From an economic perspective, Sweden has implemented a number of subsidy and tax reduction mechanisms for EVs; meanwhile, the EV fleets and power procurement options are already in place. Although the higher concentration of EV customers around Stockholm has a positive effect (concentrated services and infrastructure give better accessibility), another part of the Stockholm region might have weaker preconditions for a massive introduction of EVs due to lower household incomes and less charging infrastructure. A high advantage that Sweden has regarding e-mobility is that the power grid used for the EV-charging network is powered mostly by RE, which helps the city of Stockholm to move towards a zero-emission society.

The main political weakness in Sweden is due to different goals and ambitions between state, local municipalities and businesses. For instance, mitigation goals of the transport sector disagree with political budgets on all levels—from state to regional and municipal level. Another problem is a lack of political steering on a national level to promote rural areas more actively. Therefore, although an EV-charging infrastructure network is developed, most of the infrastructure is concentrated on city centers, leaving rural areas offside. Addressing economic-related issues, the highest economic concern in Sweden is that with the higher EV popularity, a need of investments increases as well. Another challenge is that companies expect a high return of investments, while at the same time, the second-hand value of EVs still is rather uncertain. This increases the risk of a lack of profitability, not only when it comes to EVs, but also in ICT and the RE sector, where technological advancement is fast. In addition, people miss information about advantages of e-mobility and payment possibilities. Additionally, they are concerned about privacy, which might be violated through open data used in e-mobility and ICT.

A political opportunity in Sweden related to EVs is that the costs can be shared between stakeholders, which could lead to a faster EV introduction. While a number of potential incentives and smart city or grid initiatives give great possibilities for a successful EV, RE and ICT integration. People in Sweden are eager to produce their own energy and use it on their own mobility. This also encourages the creation of small local power production facilities, which in turn create jobs and increase the sustainability of local communities. If such communities have car-sharing or carpool systems, it is even better. Technical-related opportunities in Sweden address new ways of street and city design, electricity-supplied rapid transport systems, quick technology development and easier access to the RE market for new players.

Although Sweden has a high number of initiatives, there is still the need for public incentives and more user-friendly rules, e.g., parking facilities and local energy production taxation. Another possible threat is that affordable EVs might increase mobility and traffic congestion and reduce the use of public or other types of transport (e.g., walking, cycling). Therefore, a modal shift is essential in order to encourage more sustainable modes of travel. Furthermore, another problem is that the local power supply in parts of the Stockholm region is too weak for a massive introduction of EVs. Parts of the local power supply might experience a lack of enough power effect and thereby a certain instability of the system. A structured integrated SWOT and PESTEL analysis of Sweden is presented in Table 6.

Table 6. Integrated SWOT and PESTEL analysis for EV, RE and ICT sectors in Sweden.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Clear targets of the agreements between government and agencies • EV stimulation has been politically accepted by regions and municipalities in the form of plans, targets, and incentives • Good financial support for the development of EV-charging network <ul style="list-style-type: none"> • Stockholm’s initiative to install e-chargers and allocate parking places for no costs • National organizations and agencies promote ICT and EVs <ul style="list-style-type: none"> • Subsidies and tax reduction for EVs • EV fleets and power procurement options are already operational <ul style="list-style-type: none"> • E-mobility contributes to silent and healthy cities <ul style="list-style-type: none"> • Positive attitude and lifestyle change • Higher environmental awareness and consciousness <ul style="list-style-type: none"> • Higher customer concentration around Stockholm <ul style="list-style-type: none"> • People’s willingness to support the environment • Electric and autonomous vehicles can increase public transport service coverage • The power grid required by EV-charging network is already developed <ul style="list-style-type: none"> • Most of the power in Sweden is renewable 	<ul style="list-style-type: none"> • Many ambitious political decisions experience difficulties • Transport policy does not match with the economic and political decisions <ul style="list-style-type: none"> • High technology advancements increase risks of profitability • High investments, purchase price and operational costs limit use of EVs • EVs have a high exception on the return of investments but the low expected second-hand value
Opportunities	Threats
<ul style="list-style-type: none"> • Costs of the EVs can be shared between partners • Synergies between political levels can reduce risks and costs <ul style="list-style-type: none"> • Tourism – a possibility to show EV advantages • Development of national supercharger network • Cheaper public and freight transport due to sharing economy <ul style="list-style-type: none"> • The good economic potential with light EVs • Possibility to produce “own” fuel (electricity) <ul style="list-style-type: none"> • Local electricity production creates jobs • Easy entry of new RE producers due to good power grid regulations 	<ul style="list-style-type: none"> • Conflicts between business economy and environmental needs • Procurement model for municipalities is an obstacle for EVs <ul style="list-style-type: none"> • Budget limitations for high EV costs • Subventions for fossil-based economy • Affordable private mobility solutions are a threat to public transport, walking and cycling <ul style="list-style-type: none"> • Habits and attitudes are difficult to change <ul style="list-style-type: none"> • Weak power distribution locally • Lower power supply security when uses from local sources only • Rapid technology advancement has a risk to be outdated

3.2.5. The Netherlands

In a recent report of International Energy Agency, the Netherlands is the second EV market—after Norway—with up to 6.4% EV market share [46]. This was the result of a favorable environment policy in recent years, ranging from incentives, tax reduction, CO₂-based taxation, and citizen involvement.

The Metropolitan Region of Amsterdam is considered to be one of the most dynamic regions in relation to the development of new cross-sector policies and the subsequent implementation of initiatives that aim to transfer knowledge and experiences between European cities.

When looking at the development of integrated policies for sustainable energy and e-mobility, the Province of Flevoland has a lot of opportunities to influence existing policies and develop new ones. From a political aspect, various existing policies are supporting Flevoland’s ambition in increasing the share of RE.

From an economic point of view, an ongoing trend enables the price of solar PV technology, EVs, and EV-charging equipment to drop, compared to the previous year. This opportunity will benefit the roll-out of such strategies and hence, meeting the objective more rapidly.

When it comes to the social aspect of sustainability performance, the province of Flevoland is involved in various projects with different purposes. However, the integration of energy in Flevoland is limited. Hence, EV ENERGY integrates scopes that define Flevoland’s energy and mobility ambition. Another level of social cooperation is the stakeholders. They represent the key towards the successful implementation of an initiative or projects. For the Province of Flevoland, it is materialized through multi-stakeholder cooperation, where every expertise will improve the overall end goal. For example,

with the initiative of PowerParking, business, knowledge partners and public administration are gathered to exchange and cooperate for a common result.

The region is expressing more and more awareness for the need of an integrated energy system, with further opportunities to balance the grid. Technological innovation lies in the renovation of a more modern energy network, which is of crucial importance for the implementation of energy and ICT innovations. There is a growing interest for (temporary) energy storage from energy companies, as well as a new business model for second-life batteries. For instance, Amsterdam ArenA has partnered up with Nissan for a 10-year deal to provide back-up power from used Nissan LEAF batteries. Amsterdam ArenA stated that using Nissan LEAF batteries, the system designed for the Amsterdam ArenA project, will be the largest energy storage system powered by second-life batteries used by a commercial business in Europe and will have four megawatts of power and four megawatts of storage capacity. This incredible public and private partnership is providing financial, energy and new business model opportunities for a lot of stakeholders throughout Europe and the world. From an environmental perspective, a Dutch carpark is responsible for 12% of the total CO₂ emissions in the Netherlands, while one goal is to reduce this emission by 17% in 2030 and by 60% in 2050 compared to 1990. A structured integrated SWOT and PESTEL analysis of the Netherlands is presented in Table 7.

Table 7. Integrated SWOT and PESTEL analysis for EV, RE and ICT sectors in the Netherlands.

Strengths	Weaknesses
<ul style="list-style-type: none"> • Strong sustainability goals of Flevoland (in 2030—energy neutral, transport included) • Active policy framework for solar PV promotion goals (goal is to create space for 1000 ha PV) • Part of the MRA Elektrisch programs to develop the charging infrastructure in the provinces Noord-Holland, Utrecht, and Flevoland • Running projects of PowerParking and energy storage <ul style="list-style-type: none"> • Culture of close public-private cooperation • Regional inventory on the possibilities to combine wind parks and road infrastructure with PV 	<ul style="list-style-type: none"> • The complexity of integrated energy projects shows to be slow process <ul style="list-style-type: none"> • Limited stakeholder cooperation • Limited experience with integrated energy projects
Opportunities	Threats
<ul style="list-style-type: none"> • Spacious cities: large surfaces in the cities available for PV and for solar carparks <ul style="list-style-type: none"> • Decrease of PV, EV and charging equipment prices • Interest for (temporary) energy storage is raised by energy companies • The market for second-life batteries is developing <ul style="list-style-type: none"> • Funding opportunities • Presence of a large number of lease companies in the province (Athlon, LeasePlan) <ul style="list-style-type: none"> • Relatively modern energy network 	<ul style="list-style-type: none"> • Unstable/short-term national policies regarding EV support (no favorable conditions for hybrid cars anymore) <ul style="list-style-type: none"> • A large part of PV installation in rural areas → Connection with EV not so obvious • Concerning EV promotion: lack of awareness among citizens, charging infrastructure is still limited

4. Conclusions and Discussions

This paper has presented SWOT and PESTEL analyses of EV, RE and ICT-related policies and initiatives in five European regions. Various policies were overviewed and collected not only at the national and local levels of the analyzed countries, but also at EU and international levels. Meanwhile, only selected policies were inventoried and investigated in this paper. Based on policies and initiatives, the integrated SWOT and PESTEL analyses have been done.

Besides EU directives, regulations and documents, EVs, e-mobility, RE, spatial planning and social awareness in the analyzed countries are affected by national and local policies. Most of these national policies in the Netherlands and Sweden are related to a high number of privately-supported initiatives and incentives; meanwhile, there are only a few such initiatives in Lithuania, Spain and Italy. Lithuania

has very limited private support, therefore, the sector mostly relies on national strategies and programs. On a local level, cities in all analyzed countries have relevant innovative plans and motivation.

Good initiatives such as successfully-applied projects from different regions are intended to be shared with other EU countries. For instance, the Netherlands and Italy emphasize EV stimulation projects; meanwhile, Lithuania and Spain have experience in increasing cooperation between the public and private sector or society. Self-efficiency is highly appreciated in the Netherlands and Spain. Other good examples are the funding programs (Sweden and Italy), public transport (Lithuania and the Netherlands), and the development of charging infrastructure (Spain and Italy). Additionally, countries have successful projects in EVs and solar PV integration and flexible energy systems (the Netherlands), websites for EV users (Sweden, Lithuania), changes of vehicle fleets to EVs and family/location-oriented smart projects (Sweden), increasing company efficiency and competitiveness, improvement of public policies (Spain), and developing EV-promoting legislation (Italy).

Considering the main drivers and barriers, possibilities and risks related to e-mobility policies and initiatives, each country has different features, which have been identified in this paper. Sweden, for instance, has many plans and incentives, good financial support for EV-charging infrastructure and tax reduction measures for EV users. The EV-charging infrastructure and RE sector are already well-developed, and many people use EVs daily. The main barriers in Sweden are typical for other countries—expensive EVs for households, limited possibilities to deal with high energy demands and risks towards profitability. Lithuania has to brace up in order to compete with other countries. Due to the low purchasing power, limited EV-charging infrastructure and a strong second-hand vehicle market, EVs are not so popular. Private initiatives are very limited, as well as national funding and EV-friendly legislations. Although the RE sector is well-developed, compared to other regions, EV-charging infrastructure in Lithuania is limited. Therefore, to most of its strengths, Lithuania responds with measures on a planning level—high governmental awareness and activity by municipalities, interest from business and science, good business connections with developers, and planned infrastructure. EVs are new in the market of Lithuania, so it might open new opportunities, such as implementation of registration tax for gas/diesel/petrol-powered vehicles, rejuvenation of car fleets and municipalities as test pilot areas for electric and autonomous vehicles. Spain and Italy have similar features. Both countries have a high number of initiatives, favorable legislation, good financial support, experienced stakeholders, a well-developed RE sector and appropriate taxation measures. The main problems both countries identified are fragmented political decisions, weak relations between the public and private sector, and limited private investment into R&D. Comparing all five European regions, the Netherlands has the greatest experience in EV-related projects and highest technology advancement. It is followed by Sweden, where government and households are more and more interested in the adoption of EVs. Spain and Italy have a number of initiatives, but they experience some difficulties which might slow down their ambitious plans. Finally, Lithuania, with the lowest purchasing power and a high market of used vehicles has a lot to learn from others, but might have a great potential if national-level incentives will continue. However, local authorities of EU countries still seem to be unprepared to optimize strategies for effectively interconnecting RE resources with the electric grid. This does not bode well for the EU that drives car production in the world. Despite the aforementioned limitations, the five analyzed EU countries are going towards positive changes in EVs, RE, ICT policy and practices in order to promote environmentally benign mobility in a city's transport system.

Author Contributions: Conceptualization, K.P., J.D., G.K. and D.K.; Data curation, G.K., J.C., L.H., C.B., G.S. and M.E.; Formal analysis, J.C., L.H., G.S. and M.E.; Investigation, G.K., J.C., B.P., A.V. and M.E.; Methodology, D.K.; Project administration, J.D.; Supervision, J.D.; Validation, D.K.; Visualization, K.P. and D.K.; Writing—original draft, K.P., J.D., G.K. and D.K.; Writing—review and editing, K.P. All authors have read and agreed to the final version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: This research was funded by INTERREG EUROPE Program in the framework of the Regional Initiative Project “Electric Vehicles for City Renewable Energy Supply” led by the Green IT Amsterdam (The Netherlands) (Project No: PGI02049 EV ENERGY). Additionally, we would like to thank Berta Fauró Canadell,

consultant at the Institut Idelfons Cerdà (Barcelona, Spain) for providing input to the different sorts of analyses on the Catalanian context of EVs and REs carried out within the framework of EV ENERGY project. Furthermore, we would like to thank James McGeever (former project expert) for providing significant input to analyses in the context of Lithuania.

Conflicts of Interest: The authors declare no conflict of interest.

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