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Embracing Electromobility in Europe: Analysis of good practices and their Transferability in nine European Regions

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Abstract

Emissions production and energy consumption are continuously and exponentially increased worldwide. European Union annual reports concerning mobility and transport reveal that transportation sector has the highest share in energy consumption while road transportation constitutes the second contributing factor in CO₂ emissions. The shift towards a more sustainable mobility seems to be an urgent need and alternative fuels and electromobility are considered the key solutions for more environmental-friendly transportation systems. The scope of this paper is to identify the good practices related to electromobility and alternative fuels already implemented or planned to be implemented in nine European regions. The good practices are classified and evaluated for their effectiveness and their transferability potential constituting a useful guide for policy makers and stakeholders. Results showed that the transferability of a practice highly depends on regional characteristics and indicators and that similar region profiles present higher transferability potential.

Keywords: electromobility; good practices; European regions; energy saving

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1. Introduction

Environment protection should be a priority for all countries, their policy makers and their citizens and a basic pillar for the strategic plans in national and regional level. However, the already high energy consumption and emission production are continuously and exponentially increased worldwide revealing that the environment is still suffering from human activities, actions and decisions. Annual reports of the European Union (www.europa.eu) reveal that the transportation sector has the highest share in energy consumption (33.1% in 2015) and constitutes the second contributing factor in CO₂ emissions (28.5% in 2015). Specifically, the road transportation field is responsible for most CO₂ emissions (72.9% in 2015). The significant contribution of the transportation sector reveals that decisions and actions should be taken and be implemented towards a more sustainable mobility in order to achieve energy consumption reduction and emissions savings. Electromobility and alternative fuels are considered to be the key-solutions for designing a more environmentally friendly transportation system and simultaneously attractive and efficient for the users.

Electric vehicles and other alternative fuel vehicles are promising alternatives to reduce CO₂ emissions providing better air quality for the city residents and the road users as well as increase energy efficiency. Additionally, electric vehicles are more quiet than conventional cars and even silent in low speeds improving life quality and reducing noise levels. This advantage of electric vehicles has also psychological benefits for the drivers, passengers and other road users as the noise reduction or absence brings about less anxiety, less frustration and better and potentially less aggressive driving behaviour. Production, sale and use of electric cars has already started in the European Region and their penetration rate is being slowly increased during the last years (Europe Environment Agency). More specifically, the biggest increase since 2008 occurred in 2017, when the sales of the battery electric vehicles (BEV) increased by almost 50% compared to 2016 while for plug in hybrid electric vehicles the corresponding increase was 35% for the same time period (Europe Environment Agency). Concerning registrations of these two types of electric vehicles in the European region, they consist 0.7% of the total number cars.

One of the major targets of the European Union is environment protection and less energy production and therefore EU aims at increasing the share of electric vehicles. Forecasts made by the International Energy Agency support that the share of EVs in the European region can be up to 23% in 2030 concerning all road transport vehicles except of two and three wheelers. Achieving this target means promotion of the electromobility concept and continuously increase of user acceptance and willingness to abandon their conventional diesel cars and shift to the electric ones. Various policy instruments promoting e-mobility can be applied on different policy levels: federal, regional and local and can be divided in four main groups: financial incentives, laws and regulation, improving infrastructure and communication campaigns (Vanhaverbeke & Van Sloten, 2018). Financial incentives include tax exemptions free parking, exemption or price reduction on toll roads, free charging, etc. (Vanhaverbeke & Van Sloten, 2018). Law and regulation measures, often referred to as 'non-financial incentives', include licence plate policies, transparency in pricing of charging, interoperability of payment cards and standardisation of charging infrastructure, high occupancy lanes, low emission zones, free parking, etc. (Coffman, et al., 2017). Finally, communication campaigns aims at increasing public awareness through informing potential users about technological specifications, governmental policies and pricing of vehicles, affecting purchase intention (Coffman et al., 2017), environmental benefits, performance, maintenance cost or charging intervals (Zhang, et al., 2011).

The scope of this paper is the collection of Good Practices, planned, ongoing or finished in 9 different European Regions for the promotion and diffusion of electromobility. These Good Practices are further evaluated based on their results and the levels of emissions savings while transferability potential among different regions is also investigated and further discussed.

2. Good Practices in European Regions

“In the context of the Interreg Europe program, a Good Practice is defined as an initiative (e.g. methodologies, projects, processes, techniques, technologies, etc.) undertaken in one of the program's thematic priorities which has already proved successful and which has the potential to be transferred to a different geographic area. Proved successful is where the Good Practice has already provided tangible and measurable results in achieving a specific objective.” (“Glossary | Interreg Europe,” n.d.). Good Practices are collected within the framework of the project eMOPOLI (Electro MOBility as driver to support POLicy Instruments for sustainable mobility) funded by the European Union within the framework of the Interreg Mediterranean (MED) Program.

Totally, 54 good practices were collected from 9 European Regions of 8 European Countries: Italy, Slovenia, Greece, Norway, Belgium, Finland, Romania and Latvia. The GPs are further classified based on the project's selected themes of Good Practices: charging and tolling policies, development of charging infrastructure, integration of charging infrastructure in spatial planning, support to the deployment and purchase of alternative fuel vehicles in public transport, promotion of electromobility in niche markets fleets, measures favouring public-private partnership, promotion and awareness campaigns and research, training and education policies. Figure 1(a) illustrates the number of good practices collected by each European Region while their distribution per project theme is presented in Figure 1(b). The collected good practices were also classified based on their policy level: federal, regional (with exclusive e – mobility authority), regional (with local e – mobility authority) and local (Figure 1(c)). Excluding the “Other” category, most of the collected good practices refer to charging infrastructure development and charging and tolling policies. More specifically, practices involving while almost 65% of the practices are situated on regional level.

The evaluation of each good practice is done in terms of its general impact and ease of implementation from scale -3 to 3 (very low/very high impact and very hard/very easy implementation respectively). In tables 1-9 an overview of the good practices and their evaluation is given.

Table 1: Charging and tolling policies favouring e-vehicles

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
01_Mobility in the urban area: regional incentives to purchase commercial vehicles	Brescia	15	Regional	+2	+2	X
02_Mobility in urban areas: taxis	Brescia	12	Regional	+1	+1	X
03_Move in Green	Brescia	n/a	Regional	+1	+1	X
04_PRICE LIST of Chamber of Commerce implemented with costs for charging post installation	Brescia	12	Federal	+2	+2	X
05_Regional Law for reducing emobility costs (Law n.13, July 2003)	Brescia	n/a	Regional	+3	+3	X
06_Vehicle to grid in the energy communities	Calabria	30	Local	+2	+2	X
07_Urban environment projects financed through toll collection	Rogaland	180	Regional	-2	+2	X
08_Charging and tolling policies favouring vehicles	Bucharest-Ilfov	36	Federal	+3	+3	X

Table 2:Development of charging infrastructure

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
09_”Ricarica Valli Bresciane” Project	Brescia	60	Regional	0	+1	X
10_Public tender for the development of charging infrastructure networks for e-vehicles	Calabria	3	Regional	+1	+2	X
11_Development, construction and operation of the first standalone Solar Electric-Vehicle (EV)	Attica	10	Local	+1	+2	X

<i>Charging Station in the country, "CARPORT"</i>						
<i>12_Installation of 4 Vehicle-2-Grid electric vehicles charging stations in Meltemi, Greece (SHAR-Q project)</i>	Attica	36	Regional	0	+3	X
<i>13_Deployment of public charging infrastructure in Flanders Region</i>	Flanders	45	Regional	+1	+3	X
<i>14_Development of charging infrastructure</i>	Bucharest-Ilfov	48	Local	+2	+3	X
<i>15_Development of charging infrastructure</i>	Bucharest-Ilfov	13	Local	+2	+3	X

Table 3: Integration of charging infrastructure and charging hubs in spatial planning

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
<i>16_Lombardy Region - Regional Strategy And Guidelines For Electric Mobility</i>	Brescia	n/a	Regional	+2	+2	X
<i>17_Participation to ministerial project "CReAMO PA"</i>	Brescia	n/a	Federal	+2	+3	X
<i>18_Regional and provincial guidelines for electric charging infrastructure</i>	Brescia	n/a	Regional	+2	+2	X
<i>19_Working group for electric mobility in Lombardy (mel)</i>	Brescia	36	Regional	+1	+1	X
<i>20_Cycle Path Implementation Program - Plan of Regional Transport of Calabria</i>	Calabria	62	Federal	+1	+3	X

Table 4: Supporting to the deployment, purchase of alternative fuel vehicles in public transport by financial incentives and setting up regional financial support schemes

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
<i>21_PISL- Better moving</i>	Calabria	96	Regional	+2	+2	X
<i>22_Eco Fund subventions of the Slovenian national government</i>	Gorenjska	n/a	Federal	+3	+3	X
<i>23_Outsourcement of Group purchase electric cars</i>	Flanders	5	Regional	+3	+2	X
<i>24_Demo project of three battery buses</i>	Rogaland	60	Regional	-1	+2	X

Table 5: Promotion of electromobility in niche market fleets

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
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25_City Logistics	Calabria	72	Federal	+3	+3	X
26_Shared electric city bikes	Rogaland	n/a	Regional	+2	+3	X
27_Electric cars for municipal services	Zemgale	9	Local	-1	+1	+2

Table 6: Promotion of new measures favouring public-private partnership in e-mobility sector

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
28_EVAI PROJECT	Brescia	n/a	Regional	+2	+2	X
29_EDISON - Eco Driving Innovative SOLUTIONS and Networking	Gorenjska	58	Federal	+2	+2	X
30_Promotion of the use of electric scooters in urban areas through the development of sustainable market model	Attica	30	Regional	+2	+2	X
31_Green Deal instrument (governance)	Flanders	21	Regional	0	+1	X
32_Zero-emission transition through project funding	Flanders	24	Regional	+1	+2	X

Table 7: Promotion & awareness

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
33_Metropolitan chart of electric mobility and EMOB event - Lombardy Region	Brescia	n/a	Regional	+3	+1	X
34_Website about environment friendly vehicles	Flanders	n/a	Regional	+3	+3	X

Table 8: Research, training & education

	Regio	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
35_e-HUB - virtual and physical help-desk for e-mobility and charging infrastructures	Brescia	n/a	Regional	+2	+2	X
36_Training courses for mechanics of e-vehicles	Brescia	n/a	Regional	+2	+2	X
37_Electrical Retrofit of a Minicar	Calabria	n/a	Regional	+1	+3	X
38_Metron	Gorenjska	n/a	Federal	+2	+2	X
39_Strategic Research Innovation Partnership "SRIP MOBILITY" SRIP ACS+	Gorenjska	58	Federal	+3	+3	X

Table 9: Other

	Region	Duration	Policy Level	Ease of Implementation	Impact	Benefit-cost ratio
40_Monitoring solutions for biogas production	Kainuu	29	Local	+2	+1	

3. Good Practice transferability

The collection of good practices aims at knowledge transferability and exchange among regions, policy makers and stakeholders as well as policy making process improvement in regions where there is not advanced progress and success in electromobility promotion and increase in electric vehicles use. The success of this interregional leaning process depends on the transferability of good practices from one region to another. According to Dolowitz and Marsch (2000) transferability is the process where knowledge, ideas, policies, actions implemented in one region or political setting can be used in other regions or political settings. The core point when testing transferability is the analysis of the regional situation of the targeted region before policy measures addressing the identified problems can be selected (Coffman et al, 2017, Davies et al., 2016). Macário and Marques (2008) propose a logical framework of 10 steps for the transferability process depicted in Fig.1.

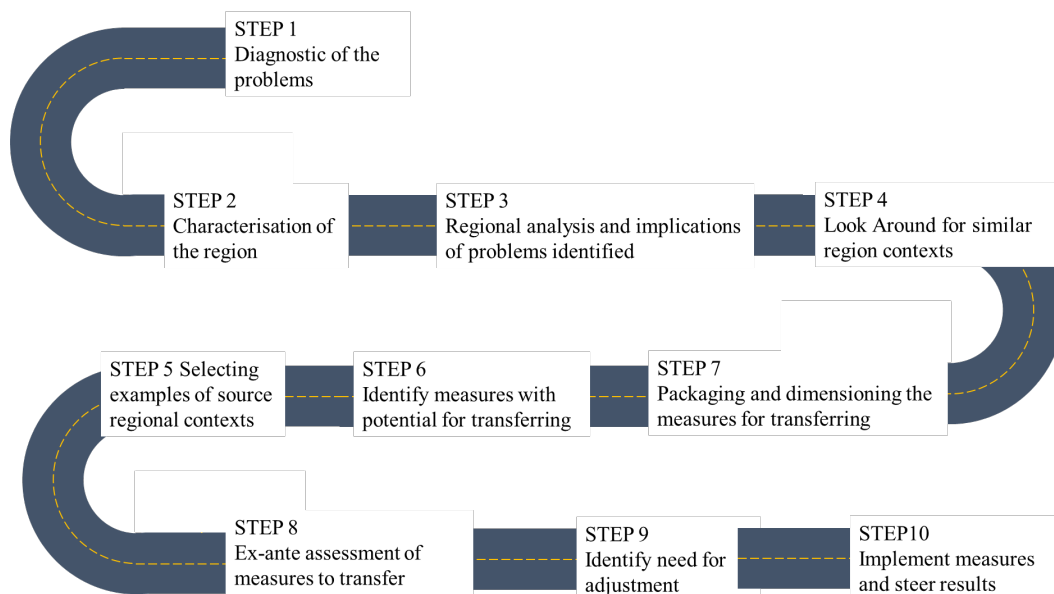


Fig. 1: Framework for transferring good practices for electromobility.

The first two steps include an analysis of objectives and regional characteristics in the region of origin. Based on the information gathered in the first two steps, a profile of the different regions is formed in step 3, enabling different regions that share similarities to be clustered in step 4. Next, in step 5 and 6, measures proven to be successful are identified and selected when they appear to be transferable. To be transferable, measures should be operational viable in terms of cost-effectiveness and regional acceptance. Step 7 highlights the relationship between policy instruments and stresses the importance of strategically combining measures, so that impact is enhanced. In step 8, the expected goals of the transferred measure in the receiving region are identified. Finally, in step 9 adjustments to the policy instruments are made to make the instrument more compatible and in step 10 the measure is implemented (Macário & Marques, 2008). To provide an indication for transferability of the selected Good Practices to other regions, the regional context of project partners was tested against the different themes of Good Practices. Various regional indicators such as region size, total population, GRP per capita, average income were selected and their theoretical influence on the specified themes of Good Practices was qualitatively estimated. Joint with the regional information from the associated Regional Context Analysis, a sensitivity analysis for suitability of types of policy measure will be conducted per region.

4. Regional context analysis

The regional context analysis demonstrates vast differences between regions and allows to categorize the regions into 4 groups. Group 1 (Rogaland) indicates the most outstanding numbers in terms of market uptake. Unique characteristics of the region are its favourable economic indicators and low population density. Group 2 (Brescia and Flanders) demonstrates promising market uptake prospects. The regions differentiate themselves through its developed charging infrastructure network, favourable economic indicators and size. Market uptake in group 3 (Attica and Bucharest) seems to be starting, though infrastructure is still lacking behind. The regions differentiate themselves from group 4 in terms of population density and slightly better economic indicators. Market uptake in group 4 (Calabria, Gorenjska, Kainuu, Zemgale) still needs to start. The regions seem to demonstrate lower values for demographic, economic and mobility indicators.

Table 10
Overview regional context analysis per region

	Rogaland	Brescia	Flanders	Attica	Bucharest	Calabria	Gorenjska	Kainuu	Zemgale
Region Size	9.363	23.864	13.599	3.817	1.804	15.222	2.137	22.688	10.732
Population	473.525	10.019.166	6.526.061	3.773.559	2.287.347	1.965.128	203.800	73.085	232.759
Population density	53,5	434,5	484,8	992,5	1.304,40	129,6	95,4	4	22
Gross Regional Product	28.294,52	366.541	241.094	84.374	44.512	32.440	3.769	2.441	n/a
GRP per capita	60.233,00	36.583,90	37.137,10	22.313,60	19.449,90	16.462,60	18.493,20	28.596,30	n/a
Average income	43.300	25.200	26.100	12.200	12.700	11.200	11.493	19.771	10.200
Total vehicles	264.038	4.194.000	3.538.693	3.920.083	1.382.122	1.280.935	143.555	62.469	74.199
Cars per household	1,3	1,45	1,26	0,99	1,54	2,31	1,31	0,71	0,7
Total battery electric vehicles	20.155	2.805	7.934	283	308	55	30	28	12
Available charging infrastructure	630	646	2.733	24	26	104	28	13	15

5. Results

Analysis of regional suitability for certain types of policy measures unveil potential for charging and tolling policies in regions where geographical or infrastructure characteristics provide opportunities, combined with an adequate number of provided users. Brescia, Flanders, Kainuu and Rogaland were identified as favourable receptors for these kind of policy measures.

The availability of charging infrastructure is one of the greatest predictors for market uptake, allowing long distance travel and operability in regions with a high population density. This is identified as a relevant policy measure in every region. The effectiveness of charging infrastructure can be magnified when spatial planning is considered.

Financial and technological operability of alternative fuel vehicles in public transport and niche markets is difficult in larger regions and regions with a low population density. Additionally, a minimum of available charging infrastructure can be useful to enhance operability. Suitable regions that were identified are Attica, Brescia, Bucaresti and Flanders.

Promotion and awareness campaigns are considered beneficial in every region except Rogaland, where the high

level of market penetration for electric vehicles indicates already a high level of awareness already and, additionally, acts as a promotion campaign itself. The high level of market penetration in this region might indicate the need for adequate and properly trained technicians.

An overview of these summarizing findings can be found in table 21.

Table 10: Overview suitability of themes of policy measures

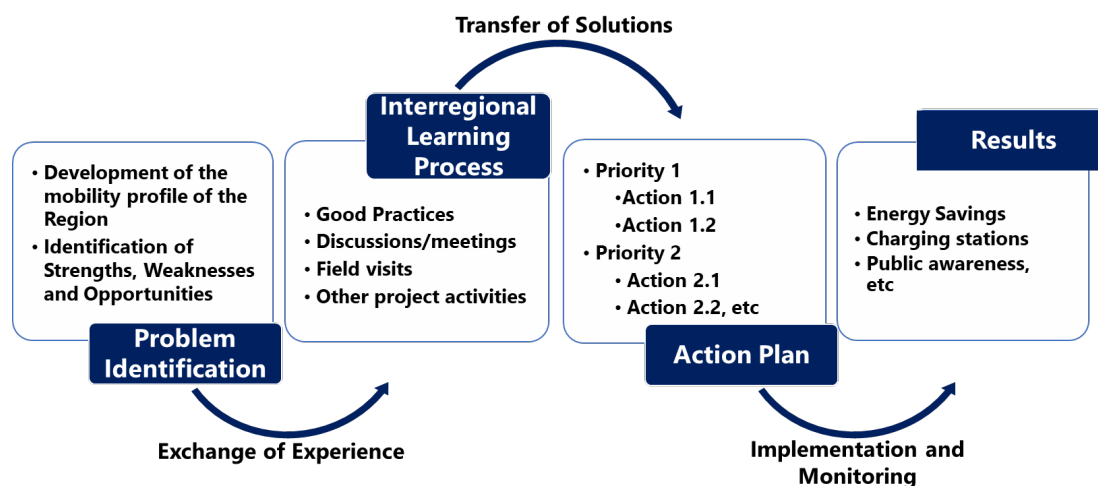
	Charging & tolling	Charging infrastructure	Spatial planning	Alternative fuel vehicles in public transport	Niche markets & urban logistic	Public-private partnership	Other:	Promotion & awareness	Research, training & education
Rogaland	✓	✓	✓						✓
Brescia	✓	✓	✓	✓				✓	
Flanders	✓	✓	✓	✓	✓	✓		✓	
Attica		✓	✓	✓	✓			✓	
Bucaresti		✓	✓	✓	✓			✓	
Calabria		✓	✓					✓	
Gorenjska		✓	✓					✓	
Kainuu	✓	✓	✓					✓	
Zemgale		✓	✓					✓	

6. Next step

The collection and evaluation of Good Practices constitutes a useful sourcebook and guide for stakeholders, policy makers and every responsible authority for promoting electromobility towards more sustainable transportation systems. Beside this, it will be served as the basis for one of the key outputs of the e-MOPOLI project which is the development of action plans which will contribute in promoting electromobility and alternative fuels in the region of each project partner. The exchange of Good Practices as well as their transferability analysis consist an inspiration for the formulation of actions adopted not only from the project partner regions but from any other local, regional or national authority interested in electromobility and alternative fuels.

The overall methodological process that will be adopted for the Action Plan formulation is illustrated in Figure 1 and briefly explained below.

Figure 1: Flow diagram



The first step refers to the **problem identification** and each Region will assess its SWOT mobility profile in terms of electromobility and alternative fuel, in order to identify main strengths, weakness, opportunities and threats in the examined mobility aspects. The next step, the **Interregional Learning Process**, consists a core factor for the formulation of the action plan. The exchange of good practices among the project partners, the discussions and meetings, the field visits and the various project activities are the components for the development of actions suitable and necessary for each region based on the current situation and according to its needs and visions. After the identification of good practices and experience sharing among the project partners as well as the consultation with the regional stakeholders' group, each region will formulate, in the third step, an **action plan** which will contain the necessary actions that should be implemented in order to promote electromobility and use of alternative fuels. During this step, each action will be thoroughly described in terms of objectives, stakeholders involved, timeframe etc. Among these factors, also the transferability of each action will be estimated, i.e. the level of transferability of the action in other regions/territories. It is important to highlight that besides the good practices' exchange, the Regional Context Analysis conducted in order to group the different project regions, highly contributes in revealing similarities and differences among them, and therefore increasing or decreasing the transferability potential of an action from one region to another. Additionally, the suitability of different types of policy measures in regional context that has been conducted and presented in this paper will assist region in formulating appropriate actions based on their regional indicators (e.g. campaigns for raising awareness will have a higher positive impact in promoting electromobility in one region and lower impact in another). Finally, the fourth step refers to the **implementation and monitoring** (in phase 2 of the project) of the actions that are established and presented in the action plan.

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