Implementing Solutions for SECAP Transport Sector Towards Climate Neutrality

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Abstract. Transport sector is one of the pillars pursuits by the European Green Deal strategy in achieving the climate neutrality by 2050. One of the main aims is re-thinking transportation, as contributor to climate change, adopting a holistic approach towards the reduction of greenhouse gases (GHG) reduction. The authors define a methodological approach based on open-access data, for effective evaluation of CO_2 stock emitted by the private vehicle fleet for the Italian Municipalities. This approach is based on data describing the structure of the private vehicle fleet, distinguishing them according to vehicle class, age of construction or EURO classification. Hence, this framework supports the local administrators and local stakeholders in implementing place-based solutions for the reduction of the GHG emissions such as electric mobility, renovation of private vehicle fleet and support to sustainable mobility. The methodological approach was applied to three Municipalities in Southern Italy, highlighting common issues such as the relevant percentage of old vehicles and the lack of infrastructure serving sustainable mobility (bike lanes, electric recharge infrastructure, strengthening of public transport…). Results obtained represent an operative, support for local administrations in developing Sustainable Energy Action Plans in the framework of the Global Covenant of Mayors.

Keywords: Sustainable mobility · Covenant of mayors · SECAP · Voluntary-based planning · European policies

1 Introduction

European Union (EU) on December 2019 adopted the European Green Deal [1] as an ambitious package of measures to cut GHG gas emissions, in order to be the first climate-neutral continent. The European Council in March 2020 submitted its long-term strategy [2] to the UNFCCC presenting the European Climate Law and it has recognized that to meet the challenge of "net zero" GHG emission by 2050, actions should by undertaken by everyone in every aspect of society and the economy. The Green Deal Strategy (and its Acton Plan) re-thinks all the ways we contribute to climate change (manufacturing, transportation, heating) through a holistic approach, providing actions oriented to improve the well-being and the health of the European citizens. Transport sector is one of these

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pillars, contributing around 5% to EU GDP and employing more than 10 million people in Europe but at the same time, it is responsible of greenhouse gas and pollutant emissions, noise, road crashes and congestion. The Sustainable and Smart Mobility Strategy [3] facing these issues, chooses greening mobility as the new license for the transport sector to grow and support the transition to an efficient and interconnected multimodal transport system in Europe. In Sect. 2 is suggested a methodological approach based on open-access data, for effective evaluation of CO_2 stock emitted by the private vehicle fleet for the Italian Municipalities. In Sect. 3, the methodological approach was applied to three Municipalities in Southern Italy, highlighting common issues such as the relevant percentage of old vehicles and the lack of infrastructure serving sustainable mobility. In Sect. 4, results obtained represent a support for local administrations in providing and implementing solutions for Sustainable Energy Action Plans in the framework the Global Covenant of Mayors. Section 5 explains the conclusions and future perspectives of this research.

2 The Methodological Approach Applied to the Private Vehicle Fleet

The methodological approach proposed in this paper for the evaluation of CO_2 emission from the transport sector, is based on open-access data related to the fuel consumption using specific databases available in Italy. The database examined are:

- sales related to the annual oil consumption and the major oil products of the internal market, provided by the Italian Ministry of Ecological Transition. These data are divided for each Italian Province, specifying also the monthly sales;
- Vehicle fleet (cars, buses, two-wheelers, heavy and light-duty vehicles) in the territory of the Municipality and its Province searching on the Italian National Automotive Club (ACI) database;
- Vehicle fleet classification per year of registration and EURO classification provided by the Italian National Automotive Club (ACI) database;
- Data provided by UnipolSai and ACEA databases. The first was developed in 2018 by the Italian insurance company UnipolSai, the second was developed in 2019 by European Automobile Manufacturers' Association (ACEA)

The methodological approach is structured in two phases. The first is related to the computation of the fuel consumption (and related CO_2 emissions) for each Municipality classified per vehicles per type of power supply. The second phase is a validation of the first one, comparing results obtained by the methodological approach with UnipolSai and ACEA databases as meaningful check-step to the proposed methodology. The comparison of two phases highlights the level of accuracy and reliability of the methodological proposal.

The first phase is structured as follows:

1. The annual oil consumption per Province is divided for the number of vehicles per Province. The result is the fuel consumption expressed as the number of the fuel tons per Province vehicle.

2. ACI provides the vehicle fleet for each Italian Municipality but it does not classify the vehicles by type of power supply. In order to know this classification at Municipal level, it has computed the percentage of the vehicles divided per class (cars, buses, two-wheelers, heavy and light-duty vehicles) and type of power supply (gasoline, gasoline & lpg, gasoline and natural gas, diesel, lpg, electric) from the province classification of the vehicle fleet. This percentage has been considered constant for each Municipality inside the Province.
3. The percentages of the vehicles divided per class and type of power supply have been multiplied by the number of vehicles of the Municipality. The result is an estimation of the number of the vehicles classified for each class and type of power supply.
4. The fuel consumption per Province vehicle is multiplied by the number of the vehicles classified for each class and type of power supply. The result is the fuel consumption for each Municipality classified per vehicles per type of power supply.
5. The fuel consumption is transformed in CO_2 emission applying the standard factors proposed by Institute for Environmental Protection and Research (ISPRA) [4] in order to achieve the tons of CO_2 emitted for each type of power supply and for each class of vehicles.

The second phase of validation is based on the computation of CO_2 emissions by the following equation:

$$\begin{aligned} &CO_2 \text{ emissions [ton]} = CO_2 \text{ average emission factor} \left[\frac{\text{ton}CO_2}{\text{Km}}\right] * \\ &\text{Km driven (UnipolSai)*no. of total cars(methodological proposal)} \end{aligned} \tag{1}$$

where the comparison is operated by the computation of Eq. 1 adopting the two CO_2 average emission factors suggested by UnipolSai and ACEA databases.

3 A Comparison of Three Small Municipalities

The methodological approach has been applied to three small Municipalities with specific features in Southern Italy (Basilicata Region): Castelsaraceno, Ginestra and Pietragalla. These three Municipalities are working on the development of their Sustainable Energy and Climate Action Plans (SECAPs), and the classification of the private vehicle fleet with related consumptions is part of the Baseline Emission Inventory (BEI) development. In detail the three Municipalities are:

- Castelsaraceno Municipality, (1274 inhabitants) is located in an inland area of Basilicata Region and the only transport infrastructure of the municipal territory is the road network, thus the CO_2 emissions has to be related only to the vehicle transport. Furthermore, the Municipality recently realized a tourism attraction according to the tourism development and since in August 2021 "The world's longest Tibetan bridge" operates in Castelsaraceno;
- Ginestra Municipality, (721 inhabitants) was selected because the 96% of its Municipal territory are forests or agricultural areas and as Castelsaraceno Municipality the only transport infrastructure is the road network. A particular feature is that Ginestra is one of *arbëreshe* Italian communities, a minority of ancient Albanian settlement;

- Pietragalla Municipality (3930 inhabitants) is one of industrial areas of Basilicata Region related to the production of building materials and food industries (olive oil and pasta). The Municipal territory is characterized by a main urban area with main public services and historical centre of Pietragalla, and three urban settlements dispersed in Municipal territory, where there are located other public services like schools. It was selected for the relevant contribution to transport emissions related to the mix of industrial activities and private transportation.

The methodological approach has been applied to the three Municipalities, classifying the private vehicle fleet according to the ACI year of registration compared to the relative percentage on overall private vehicle fleet and total cumulative count of private vehicles (see Fig. 1).

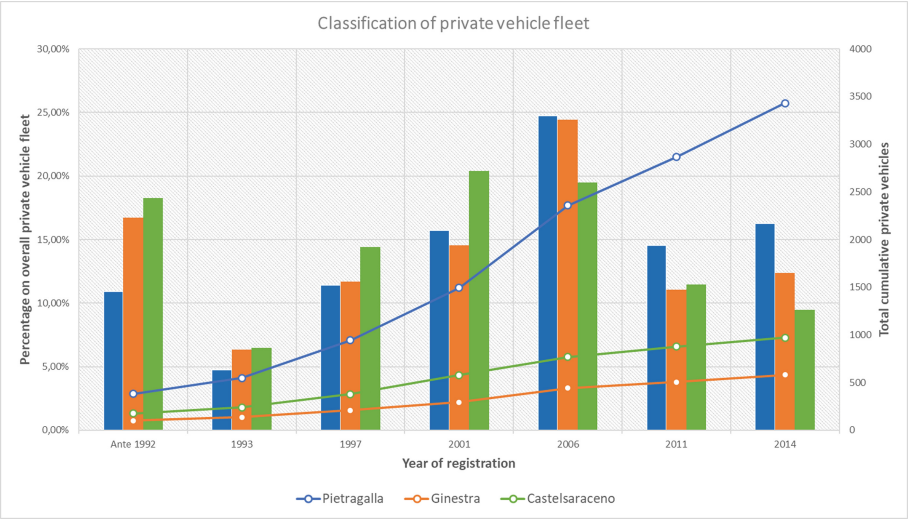

Fig. 1. Classification of vehicle fleet per year of registration to ACI compared to percentage on overall and total cumulative count of private vehicle fleet

Another classification of private vehicle fleet is the EURO classification, in order to understand which class of vehicle fleet needs intervention to produce less pollutant (see Fig. 2). An interesting remark coming from Figs. 1 and 2 is that EURO 5 and 6 vehicles represent for each of the three Municipalities a percentage under the 20% compared to the overall fleet.

In Fig. 3 are presented the total CO_2 emissions from the private vehicle fleet divided per classes and type of power supply as final step of the suggested methodology. Looking to the total CO_2 emissions, for each of the three Municipalities, diesel is the first power supply while other power supplies (i.e. Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG) or Hybrid) are in percentage under the 10% of the total.

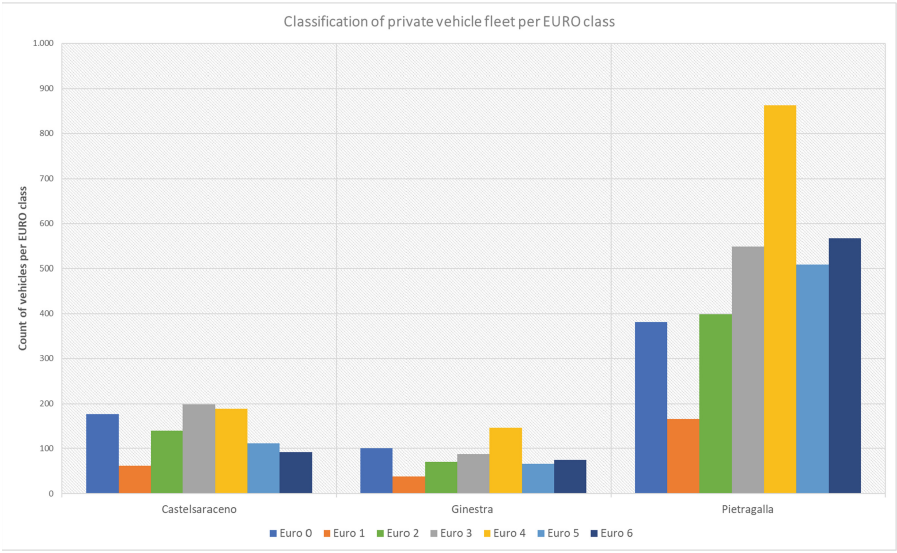

Fig. 2. EURO classification of private vehicle fleet

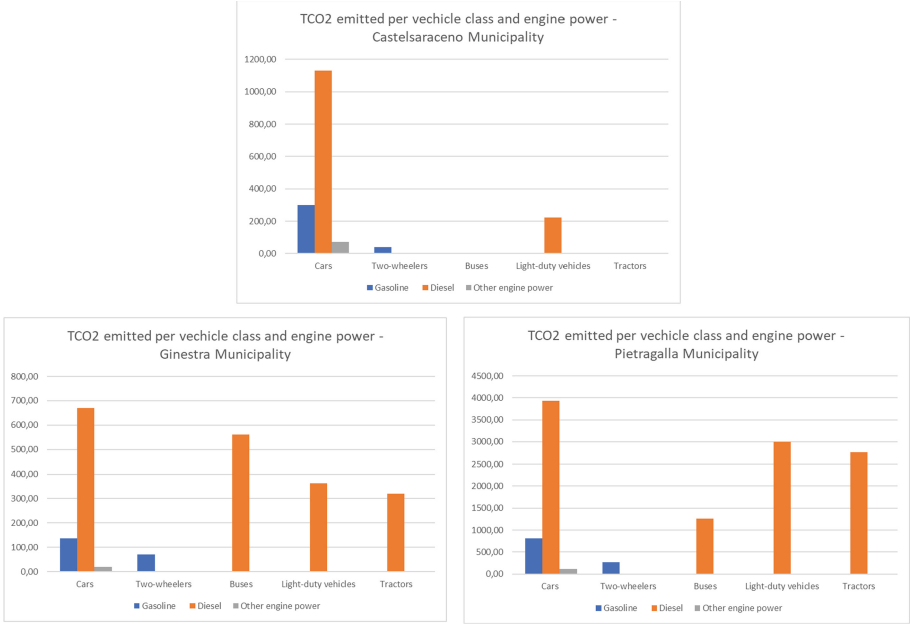

Fig. 3. Total CO_2 emissions from private vehicles of the three Municipalities divided per vehicle class and engine power

Considering the structure of vehicle fleet (see Table 1), cars are the majority class of it per number of vehicles, while other classes such as buses are characterized by percentages very low (under the 5% of the total amount of vehicles per class). This highlights a mode of transport mainly based on the private vehicle fleet, rather than public transport, also if it is remarkable that in all of three Municipalities for each inhabitant there is less than one vehicle. Furthermore, vehicle fleet structure highlights the economic structure of the Municipalities, through the light-duty vehicles (including essentially commercial vehicles) and tractors classes. Indeed, Castelsaraceno and Ginestra have light-duty vehicle class equal to 10% of the total class and it is characterized by an economy on craft and agriculture; contra Pietragalla has the industrial area and an economy based on production of building materials and food industries, and it is remarked by a percentage near to 20% of light-duty and tractor related to the total vehicle fleet.

Table 1. Vehicle fleet features of the three municipalities

Vehicle fleet features	**Castelsaraceno**	**Ginestra**	**Pietragalla**
Cars	831	459	2701
Two-wheelers	47	56	212
Buses	1	4	9
Light-duty vehicles	94	63	498
Tractors	0	3	26
Vehicle per inhabitants	0,770801	0,829404	0,887277

4 Improving Mobility in Sustainable Energy and Climate Action Plans

Sustainable Energy and Climate Action Plans (SECAPs) are voluntary plans developed by the Covenant of Mayors Signatories, in order to achieve and exceed the energy and climate targets submitted, towards the EU2050 objectives. The classification of the private vehicle fleet represents and related consumptions is an opportunity to investigate and promote interventions related to the transport sector. However, the planning of interventions is not the same for all Municipalities but it is related to specific features of each one Municipality, such as the geographical location, the transport infrastructure, the socio-economic structure or also the presence of tourist attractors that increase the traffic flows [5]. Thus, from the analysis of the vehicle fleet structure they have been suggested some possible interventions designed for the three Municipalities:

- For Castelsaraceno are suggested interventions on the renovation of private vehicle fleet (less of 10% of the cars are EURO 6) and promotion of transport by bus in order to reduce the touristic flows related to the operative period of Tibetan Bridge,

that increases the number of visitors (about 50′000 tourists for the period August-December 2021) and produces a variable emissions stock of 113 tCO_2 (see also [5]);

- For Ginestra are suggested interventions on the renovation of diesel vehicles (first producers of CO_2 emissions) with electric vehicles or supplied by LPG, CNG or hybrid and implementation of the transport infrastructure with green infrastructure based on bike lines and sustainable mobility oriented to the "net zero emissions";
- For Pietragalla is suggested the renovation of the vehicle fleet supporting the purchase of EURO 6 vehicles (supplied by LPG, CNG or hybrid) and electric vehicles. This renovation can be supported by Municipal financial support as the free recharge of electric vehicles or the reduction of ownership tax for LPG, CNG and hybrid vehicles. Furthermore, considering the urban settlements located in Municipal territory where there are public services as schools, these can be linked to the Pietragalla urban area, by a network of carpooling or car sharing

5 Conclusions

The adoption of the methodological approach to evaluate the structure of the private vehicle fleet and the total CO_2 emissions has allowed to establish a first assessment of the possible interventions oriented to reduce CO_2 emissions and greening the mobility demand. The analysis of the Municipal vehicle fleet highlighted a different interventions design, based on the specific features of each one Municipality. However, considering the private vehicle fleet of the three Municipalities, some common issues can be highlighted:

- A relevant number of vehicles powered by diesel motors and not in line with more recent normative (EURO 6) that need a restoration in order to achieve the foreword EU2030 objectives;
- The interventions provided should have as main target cars, considering that they are the first class for total CO_2 emissions of private vehicle fleet in all of the three Municipalities

In order to develop interventions related to the reduction of CO_2 emissions (not only referred to the transport sector), SECAPs represent an opportunity in supporting local actions related to energy and climate targets [6–8], and also a boost for the small Municipalities (as the three one considered in this research) in the domain of the planning. Also if previous researches remark the fruitful aspect of the sectorial approach [9–12], cities and territories should be evaluated as set of systems (such as green spaces, green infrastructures waterproofed soils, energy system [13], active mobility [14–17] etc.) achieving an "urban vision" [18]. Future perspectives of this research are related to the improvement of the methodological approach for the private vehicle fleet, the evaluation of touristic flows as the case of the Castelsaraceno, where the realization of a tourist attraction produced a surplus in terms of CO_2 transport emissions. Furthermore, interventions are related in designing interventions related to green infrastructure as the implementation of mitigation actions to reduce the CO_2 emissions.

References

1. European Commission: Communication from the Commission: The European Green Deal. Bruxelles (2019)
2. European Commission: Long-term low greenhouse gas emission development strategy of the European Union and its Member States. Bruxelles (2020)
3. European Commission: Putting European transport on track for the future. Brussels (2021)
4. Romano, D., et al.: Italian Greenhouse Gas Inventory 1990–2016. Institute for Environmental Protection and Research - Communications Area, Rome (2018)
5. Santopietro, L., Scorza, F., Murgante, B.: Multiple components in GHG stock of transport sector: technical improvements for SECAP baseline emissions inventory assessment. TeMA - J. L. Use, Mobil. Environ. **15**, 5–24 (2022). https://doi.org/10.6092/1970-9870/8391
6. Santopietro, L., Scorza, F., Rossi, A.: Small Municipalities Engaged in Sustainable and Climate Responsive Planning: Evidences from UE-CoM. In: Gervasi, O., et al. (eds.) ICCSA 2021. LNCS, vol. 12957, pp. 615–620. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-87013-3_47
7. Bertoldi, P., Economidou, M., Palermo, V., Boza-Kiss, B., Todeschi, V.: How to finance energy renovation of residential buildings: review of current and emerging financing instruments in the EU. Wiley Interdiscip. Rev. Energy Environ. **10**, e384 (2021). https://doi.org/10.1002/WENE.384
8. Pietrapertosa, F., et al.: Urban climate change mitigation and adaptation planning: are Italian cities ready? Cities **91**, 93–105 (2019). https://doi.org/10.1016/j.cities.2018.11.009
9. Corrado, S., Giannini, B., Santopietro, L., Oliveto, G., Scorza, F.: Water Management and Municipal Climate Adaptation Plans: A Preliminary Assessment for Flood Risks Management at Urban Scale. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 184–192. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_14
10. Santopietro, L., et al.: Geovisualization for Energy Planning. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12252, pp. 479–487. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58811-3_35
11. Santopietro, L., Scorza, F.: A Place-Based Approach for the SECAP of Potenza Municipality: The Case of Green Spaces System. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 226–234. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_18
12. Scorza, F., Santopietro, L., Giuzio, B., Amato, F., Murgante, B., Casas, G.L.: Conflicts Between Environmental Protection and Energy Regeneration of the Historic Heritage in the Case of the City of Matera: Tools for Assessing and Dimensioning of Sustainable Energy Action Plans (SEAP). In: Gervasi, O., et al. (eds.) ICCSA 2017. LNCS, vol. 10409, pp. 527–539. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-62407-5_37
13. Scorza, F.: Towards self energy-management and sustainable citizens' engagement in local energy efficiency agenda. Int. J. Agric. Environ. Inf. Syst. **7**, 44–53 (2016). https://doi.org/10.4018/IJAEIS.2016010103
14. Scorza, F., Fortunato, G.: Cyclable cities: building feasible scenario through urban space morphology assessment. J. Urban Plan. Dev. **147**, 05021039 (2021). https://doi.org/10.1061/(asce)up.1943-5444.0000713
15. Scorza, F., Fortunato, G., Carbone, R., Murgante, B., Pontrandolfi, P.: Increasing urban walkability through citizens' participation processes. Sustain. **13**, 5835 (2021). https://doi.org/10.3390/su13115835
16. Fortunato, G., Scorza, F., Murgante, B.: Hybrid Oriented Sustainable Urban Development: A Pattern of Low-Carbon Access to Schools in the City of Potenza. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 193–205. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_15

17. Scorza, F., Fortunato, G.: Active mobility oriented urban development: a morpho-syntactic scenario for mid-sized town. Eur. Plan. Stud. (2022). https://doi.org/10.1080/09654313.2022.2077094
18. Scorza, F., Santopietro, L.: A systemic perspective for the sustainable energy and climate action plan (SECAP). Eur. Plan. Stud. 1–21 (2021). https://doi.org/10.1080/09654313.2021.1954603