ANALYSIS OF THE EMISSION IMPACT OF THE PROGRAMME 2014-2020 FOR THE REGION OF SARDINIA OVER TIME

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ABSTRACT

The assessment of the emission impacts of public interventions has assumed an increasing role in the debate on EU Cohesion Policies. The need to estimate, analyse and monitor the carbon impact of funding has prompted the search for suitable tools.

In response to this need, in 2011, the European commission – DG Regio published a call for tender to help European regions to populate the Common Indicator 34, an indicator introduced to measure GHG emissions related to the Cohesion Policy. ENEA was part of the consortium that developed the model CO_2MPARE to face this challenge and to this day continues to update it both in data and in its architecture to make it operational in the programming cycles that have followed since then.

The CO_2MPARE model is an important piece of the support toolkit in the programming, monitoring and evaluation of EU funds, as it enables the estimation of the impact in terms of additional/avoided/reduced CO_2 emissions of national and regional Ops financed with EU funds.

In the framework of the ES-PA - Energy and Sustainability for Public Administration project, financed by the national OP "Governance e Capacità Istituzionale" 2014-2020, dedicated to the improvement of multi-level governance and the administrative and technical capacity of public administrations in public investment programmes, ENEA together with the Sardinia Region, supported by Poliedra-PoliMI, have explored the possibility of elaborating annual emission estimates linked to the eligible costs financed.

The flexibility provided by the CO_2MPARE model made it possible to build a model architecture capable of reproducing the architecture used in the Sardinia Region's own ERDF ROP, based on seven axes and related investment priorities.

Normally the application of the CO_2MPARE model is made with reference to the entire operational programme analysed, because the purpose of the model is to estimate the GHG emissions related to the investments made through the OP.

In the present work, on the other hand, an attempt was made to historicise the data to consider the different timing of the start-up and implementation of the works, thanks to the monitoring data uploaded into the Regional Monitoring and Control Information System (SMEC) broken down by year, according to the implementation reports approved by the monitoring committee.

The exercise aims to give an estimate of the emissions over time linked to the costs admitted year by year, thus monitoring the performance of the ROP, which required a historical reconstruction of the results.

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1. Introduction

The aim of Cohesion Policy is to ensure the economic development of all EU regions in order to reduce economic disparities between the various European regions by supporting economic growth, employment, business competitiveness, sustainable development and environmental protection. Cohesion Policy is, therefore, the EU's main investment policy and is implemented through special funding sources, including the ERDF - European Regional Development Fund, which aims to help even out existing disparities between the different levels of development of European regions and to improve living standards in the least favoured regions.

With the changed meaning of economic development, in which the role of sustainability and environmental protection has become increasingly important, as demonstrated by the commitments undertaken by the EU, both individually (Climate - Energy Packages, Fit to Fifty five, European Climate Law), and within the Framework Convention on Climate Change (Paris Agreement 2015), also projects financed through the ERDF must for consistency contribute to ensure the fight against climate change and support environmental protection (Del Ciello, Camporeale, 2018; Del Ciello et al., 2014).

Reinforcing this pathway, Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment aims "to ensure a high level of protection for the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment " (Art.1).

The assessment of the impacts of public interventions has thus assumed a central role within Cohesion Policies (Del Ciello, Camporeale, 2018), pushing towards the measurability of the obtained results of Operational Programmes.

The orientation towards measurable results is one of the elements that - from one programming cycle to the next - has become increasingly important: if in the 2007-2013 programming cycle the orientation towards measurable outputs and results was strengthened, in the 2014-2020 programming cycle a set of indicators linked to each expected result was defined, as provided for in Annex I to EU Regulation 1301/2013.

The European Commission has developed a list of indicators, the so-called *Common Indicators*, i.e. of the expected welfare change in the programme area (Gramillano et al., 2018), among which there is the specific indicator for the reduction of greenhouse gases (*Common Indicator 34*), also pointing out a lack of appropriate methodologies and instrumentation to populate the indicator (Del Ciello et al., 2014).

In order to respond to the lack of methodologies and instrumentation to estimate the carbon footprint of the OPs (Del Ciello et al., 2014; Amerighi et al., 2013), the European Commission has supported, through DG Regio - Directorate General for Regional Policy, the realisation of a specific model - the CO_2MPARE model - that allows to estimate the emissions related to the financial allocations established at the level of the Managing Authorities.

In fact, the model was created to offer a tool for returning results with reference to the Programme in the entirety of its seven-year period, regardless of the year in which the projects are accepted for funding. In this sense, it is assumed that all the projects financed are implemented at the same time and produce their effects taking into account the lifespan of the individual project.

The Region of Sardinia, a pilot region for a specific line of activity within the ES-PA (Energy and Sustainability for PA), project financed by the NOP Governance and Institutional Capacity 2014-2020, expressed an interest in evaluating the historicization of data to take into account the different timeframes of project start-up and implementation.

The paper reports the main results of this historicization exercise carried out through the simulation for each year of the total eligible cost for the period 2016-2022.

2. Methodology and approach

The CO_2MPARE model - CO_2 Model for Operational Programme Assessment in EU Regions was developed in 2012 to be an operational tool to support national and regional authorities and thus help them to make informed decisions on investments made within the Operational Programmes, orienting the planning of funded programmes towards sustainable growth that ensures a low CO_2 impact of the interventions implemented.

The realisation of the model was made possible thanks to a European partnership involving 6 technical-scientific organisations[5] in response to DG Regio's call for tender launched in 2011. Since then, ENEA has continued in this field of research, through model maintenance activities, updating the architecture to make the model functional for its use also in the 2014-2020 programming period, modifying the nomenclature of the expenditure categories in line with what was introduced by the EU regulation.

The architecture of the model is based on the reproduction of the OP constructed with reference to the expenditure categories univocally established at European level by the Commission Implementing Regulation (EU) No. 215/2014 of 7 March 2014.

The CO_2MPARE model starts from the financial distribution resulting from the programming choices and through a series of transformation coefficients arrives at estimating, for each of the individual expenditure categories activated during the programming period, the CO_2 emissions.

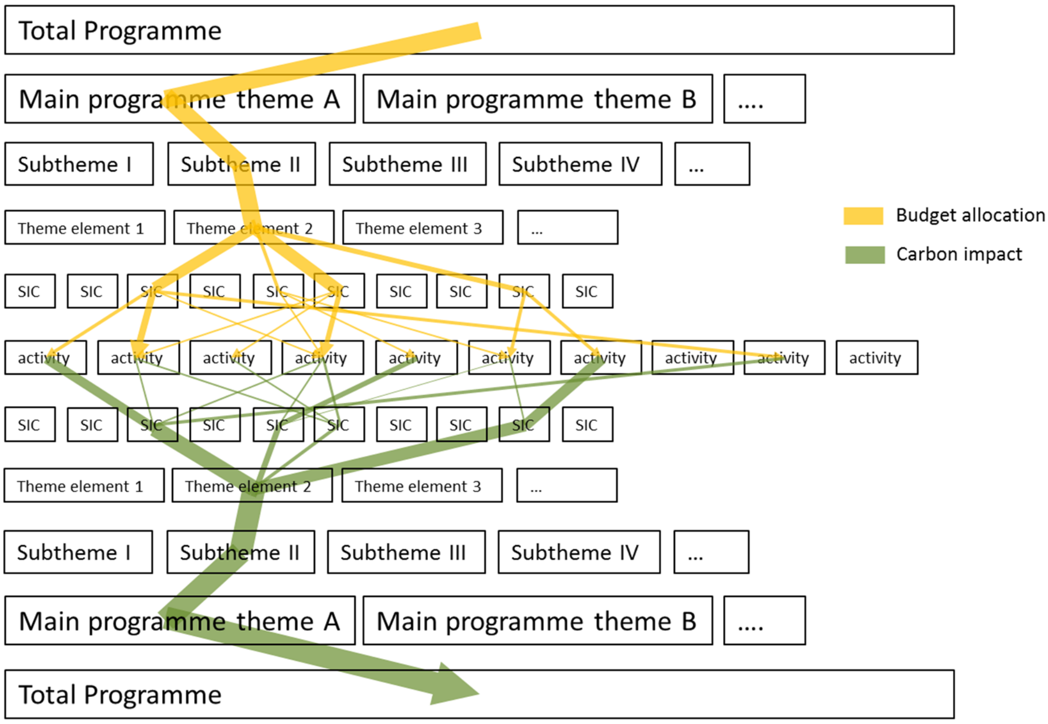
The approach of the model is essentially based on two information flows: on the one hand the economic flows and on the other hand the carbon footprint: the model reproduces the financial allocations by translating them into specific types of intervention, called SIC - Standardized Investment Components, to which actions are associated that can be measured in physical or intangible quantities realised/consumed and which allow the quantification of CO_2 emissions per unit according to an LCA approach.

The model was developed as a generic model to be used at different territorial levels in line with the single geographical distribution scheme used for the territorial redistribution of EU structural funds. In addition, the model relies on a large database with specific economic and physical indicators, which can be updated by the operator, to calculate the CO_2 impact of spending a given amount on a standardised type of intervention.

The CO_2MPARE model can be used in the different programming phases and thus estimate the impact of emissions in the *ex-ante*, *in itinere* and *ex-post* phases.

[5] In addition to ENEA for Italy, the Consortium was composed of: Energy Research Centre of the Netherlands ECN (coordinator) for the Netherlands, Ènergies Demain for France, University College London (UCL) for the United Kingdom, ENVIROS for the Czech Republic and The Centre for Renewable Energy Sources and Saving (CRES) for Greece

Figure 1 – Scheme of the CO2MPARE model architecture: from financial input to carbon impact



Source: Hekkenberg M., Schram J., Amerighi O., Keppo I., Papagianni S., ten Donkelaar M. (2012), CO_2 Model for *operational Programme Assessment in EU Regions – A tool for regional policy markers.* Final Report

2.1 The operational steps for setting up a programme architecture in the model

The CO_2MPARE model reproduces by default the architecture according to the 104 expenditure categories of the 2014-2020 programming period as provided by the Commission Implementing Regulation (EU) No. 215/2014 of 7 March 2014.

Thanks to the extreme flexibility of the model and its functionalities that allow it to be adapted to different nomenclatures of expenditure categories, it is possible to build a new architecture reproducing the Axes structure of the operational programme under analysis.

Through the use of the Programme management function, in fact, the CO_2MPARE model allows the user to build the desired architecture and to proceed to the identification of the SIC - Standardized Investment Component associated to each expenditure category among the 26 present in the model.

The construction of a programme architecture is a fundamental step in estimating emissions according to an allocation of financial resources, articulated at most on 3 levels where the second is optional, while the first and third are mandatory. The third level, which corresponds to the minimum unit on which the expenditure items are allocated, corresponds to the expenditure categories of the programming cycle.

The evaluation of the Operational Programme, through the CO_2MPARE model, requires the following operational steps:

- setting of the programme within the model: for each expenditure category, the SIC that can be activated and the distribution among them of the related funds are indicated, as well as the indication of the leverage that the ERDF funds activate (leverage is the ratio between all other contributions and the ERDF contribution);
- construction of the scenario with the related financial distribution: in this phase each expenditure category is attributed the amount programmed/implemented by the Operational Programme;
- attribution of the financial allocations among the activated SIC: in this phase, once the amount attributed to the single expenditure category has been established, the allocation of it within the various SIC, and - within these - within the various targets is carried out;
- estimation of CO_2 emissions, i.e. the achievement of results.

2.2 The annualization of eligible costs

As mentioned, the CO_2MPARE model was created to provide an estimate of the emissions of the entire Programme and can be used in the different phases of the programming cycle.

In order to historicize the results, it is necessary to have the funding data broken down by year, which in this work are provided by the Regional Information System for Monitoring and Control Sardinia (SMEC), in accordance with the financial data annually transmitted by the ROP Managing Authority to European commission, as reported in the annual implementation reports. Therefore, the financial data provided by the Region of Sardinia were used to set the total eligible cost of the operations selected for support - broken down by category of intervention - applying the architecture the same for each year: from 2016 to 2022.

Through the merge of the simulations carried out for each year by the CO_2MPARE model, it is possible to obtain a historical reconstruction of the emissions of the ROP.

However, it should be borne in mind that the sum of the annualizations is higher than the total investment allocated for the ROP Sardinia, due mainly to the following factors:

- overbooking of operations selected by the Region, in order to ensure full utilisation of EU and national funds. It will only be possible to identify the amount of the overbooking that will be covered by the regional budget once the programme is closed;
- operational changes in the programme, with eligible operations being selected and moved to other programmes or funding sources over time.

Operating on annual data, therefore, discounts these factors without allowing for immediate identification, which can only be correctly recorded and entered into the information systems at the end of the programme.

3. The 2014-2020 ROP ERDF of Sardinia

Although the CO_2MPARE model has by default an architecture that traces the structure of expenditure categories specifically identified by Regulation (EU) No. 215/2014, thanks to the flexibility provided by the CO_2MPARE model it has been possible to create a specific programme, based on the breakdown into *priority axis* (first level), that follows exactly what the Region itself envisages, and the third level shows the expenditure categories as provided by the EU Regulation.

The eligible costs updated to 2022 provide a picture of what has actually been financed over time under the operational programme.

In the seven years considered, 2018 was the year with the highest funding for the Sardinia Region (about 30% of the entire programme), mostly related to *Axis IV - Sustainable energy and quality of life* and *Axis VI - Efficient use of resources and enhancement of natural, cultural and tourist attractions*, while the negative value of the year 2021 is consequent to the reallocation of a large number of operations on other financial sources, necessary to allow reporting on the emergency expenditure programme arranged to deal with the crisis generated by the Covid-19 pandemic.

Table 1 – Evolution of eligible costs for Axis – ROP Sardinia (thousand €)

Programme architecture - level 1	2016	2017	2018	2019	2020	2021	2022
Axis I - Scientific research, technological development and innovation	6.533,4	40.168,3	52.247,0	8.739,6	-746,2	7.520,8	4.746,2
Axis II - Digital Agenda	32.861,5	14.618,7	41.214,4	33.901,7	12.889,8	-25.051,0	20.232,9
Axis III - Competitiveness of the productive system	61.828,5	31.283,7	29.681,2	13.465,6	69.855,9	49.656,0	7.450,9
Axis IV - Sustainable energy and quality of life	30.650,0	21.348,5	103.808,0	17.587,0	5.166,8	4.140,5	-3.878,2
Axis V - Environmental protection and risk prevention	21.539,2	8.000,0	17.429,1	9.026,6	3.190,0	-10.187,4	0
Axis VI - Efficient use of resources and enhancement of natural, cultural and tourist attractions	0	45.670,0	97.655,5	45.111,7	33.410,8	-59.122,3	7.123,0
Axis VII - Promotion of social inclusion, combating poverty and all forms of discrimination	9.050,0	2.267,6	28.371,4	6.247,5	59.993,5	-32.832,9	-1.449,6
Axis VIII - Technical assistance for the efficient and effective implementation of the OP	11.422,0	18.785,4	856,2	1.835,6	959,1	4.463,2	2.212,5
Total eligible cost	**173.884,7**	**182.142,1**	**371.262,7**	**135.915,4**	**184.719,9**	**-61.413,1**	**36.437,7**

Figure 2 – Sardinia: trend of total eligible costs per year

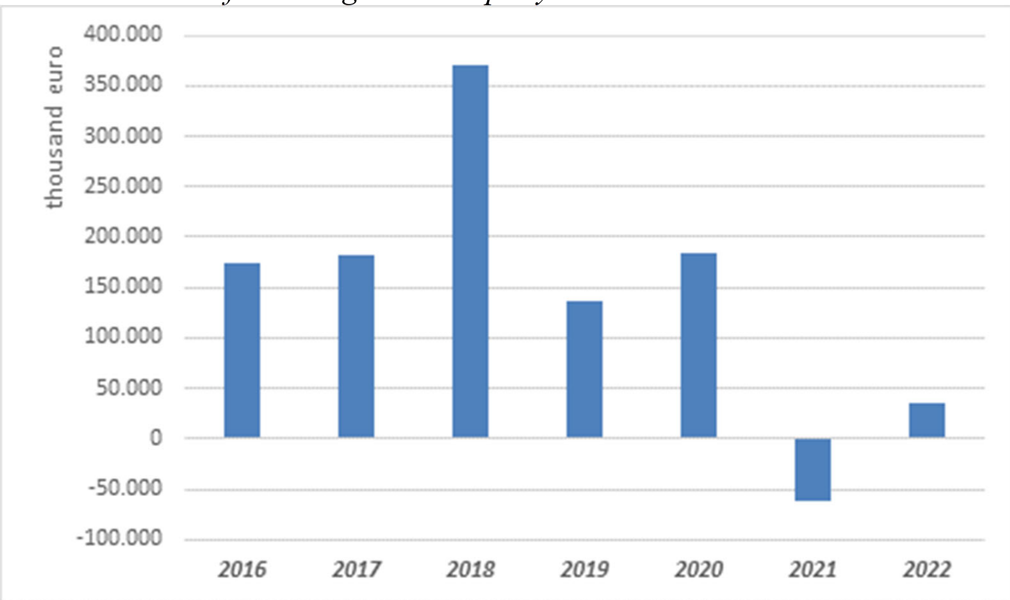
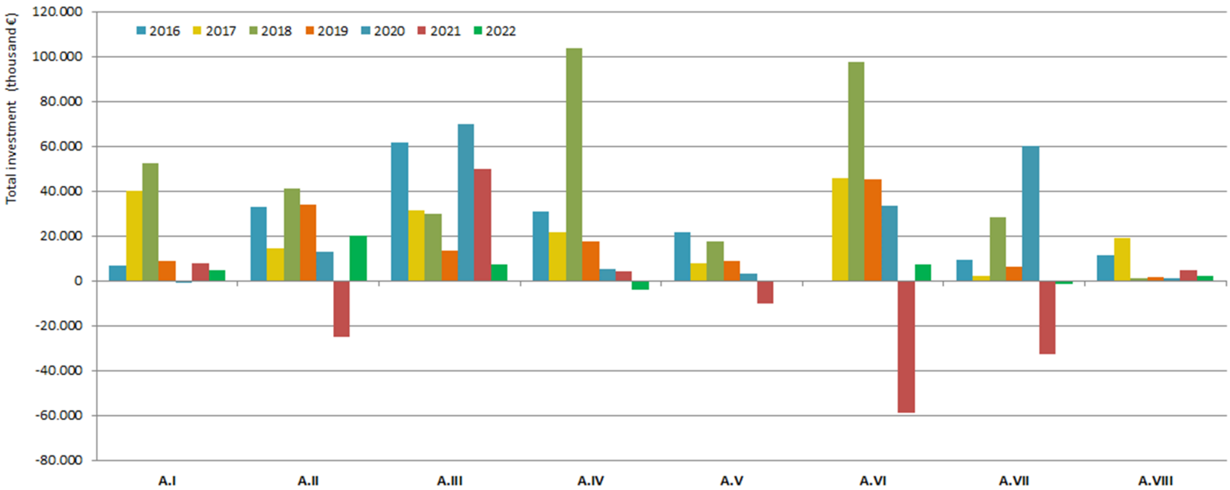


Figure 3 – Sardinia: trend of eligible costs by Axis per year



3.1 The main results

Taking into account the progression of eligible costs over time, emissions show reduction in the seven-year period.

In particular, looking at Table 2, it is possible to see the different contribution to CO_2 reduction/addition from each axis.

For example, with an investment of around 12% of the annual amount in Axis V, the emissions can be estimated at -556 ktCO_2; while the Axis with the highest percentage weight in terms of investment (Axis 3 with 36%) shows a decrease in emissions of -391 ktCO_2.

In 2017, it is above all Axis IV that has the greatest reduction in emissions (-462 ktCO_2) despite the investment weight being 12%; the greatest investment is in Axis VI (25%) where, however, emissions decrease by -248 ktCO_2), and so on. Moreover, in 2021, following reprogramming to support the post-pandemic economy and competitiveness, the Axis with the largest budget was Axis III (EUR 49,656.0 thousand), which led to a reduction of -424 ktCO_2.

The trend in emissions clearly depends on the type of interventions that are financed within the Axis.

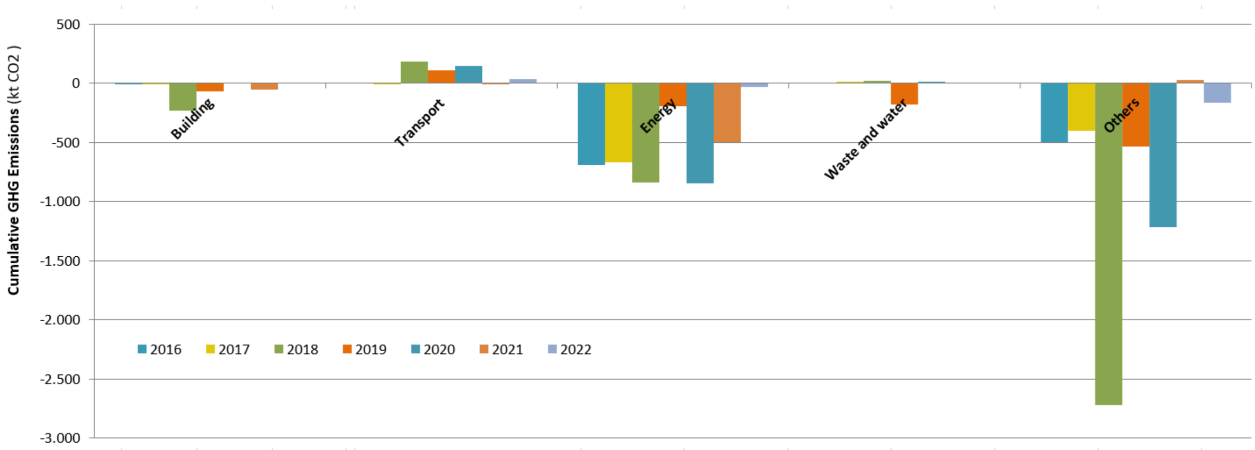
Table 2 – Sardinia: cumulative emissions by year and Axis (kt CO_2)

Programme architecture - level 1	2016	2017	2018	2019	2020	2021	2022
Axis I	3	24	49	7	1	7	5
Axis II	13	6	17	13	5	0	8
Axis III	-391	-166	-253	-57	-472	-424	-21
Axis IV	-229	-462	-763	-189	-83	-105	0
Axis V	-556	-206	-450	-233	-82	0	0
Axis VI	0	-248	-2209	-411	-1015	-1	-142
Axis VII	-38	-9	14	-3	-243	0	-6
Axis VIII	0	0	0	0	0	0	0
Total	**-1197**	**-1061**	**-3595**	**-872**	**-1889**	**-524**	**-156**

Looking at the five macro-themes (Figure 4) into which the standardised projects reconstructed in the model can be grouped, it emerges that the most relevant interventions were recorded in the *Energy* sector, thanks to the construction of renewable energy plants and investments in energy efficiency. Also relevant is the contribution to the containment of emissions linked to the *Reforestation*, which more than compensates for the emissions of the interventions in *Civil engineering* and in *Equipment*, interventions falling under the '*Others*' theme. Additional emissions are instead found in the transport sector, related to the construction of new infrastructure.

Figure 4 –Sardinia: trend of total emissions by macrothemes: by themes (a) and by year (b) of funding of interventions

a) *by themes*



b) *by year*

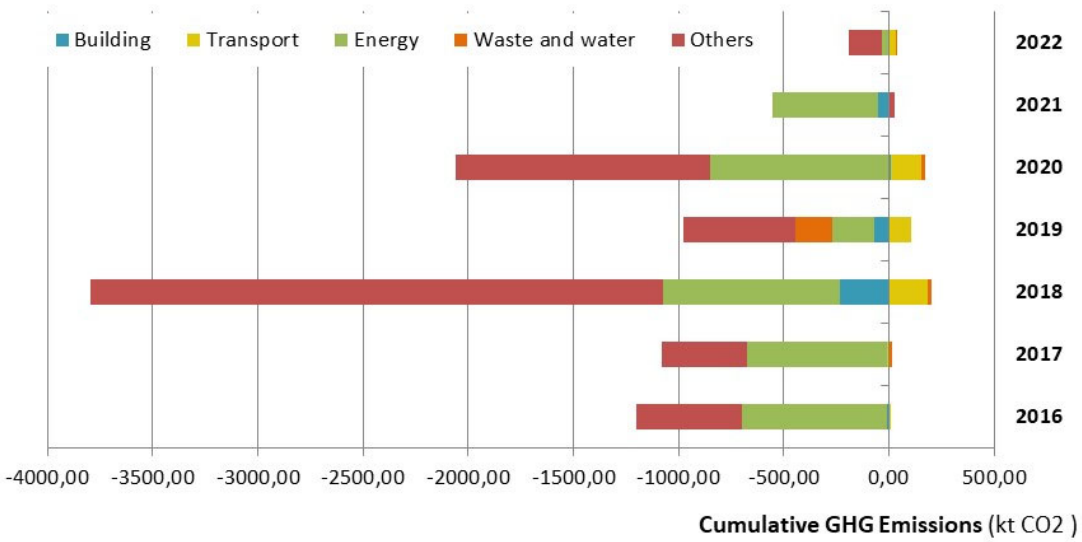


Figure 5 shows the trend in cumulative emissions over time, taking into account the lifetime of each project and its start-up in each year analysed. In all years, the start-up phase of each project leads to additional emissions for the first year, which then tend to decrease during the operation phase of the project.

As can be seen from Figure 5, the construction phase shifts in time following the evolution of the admission costs, while the black line shows the cumulative value of emissions related to the entire programme.

The black line represents the performance of the Sardinia programme as a whole and is constructed by summing the emissions of each year and shifting them in time. The peak emission curve is, therefore, concentrated in the first seven years coinciding with the period of the programme, albeit with a softening.

In this sense, our estimates show that between the sixth and seventh year, the offsetting of emissions from the construction phase takes place, and then a gradual reduction in emissions occurs due to the operational phase of the completed projects.

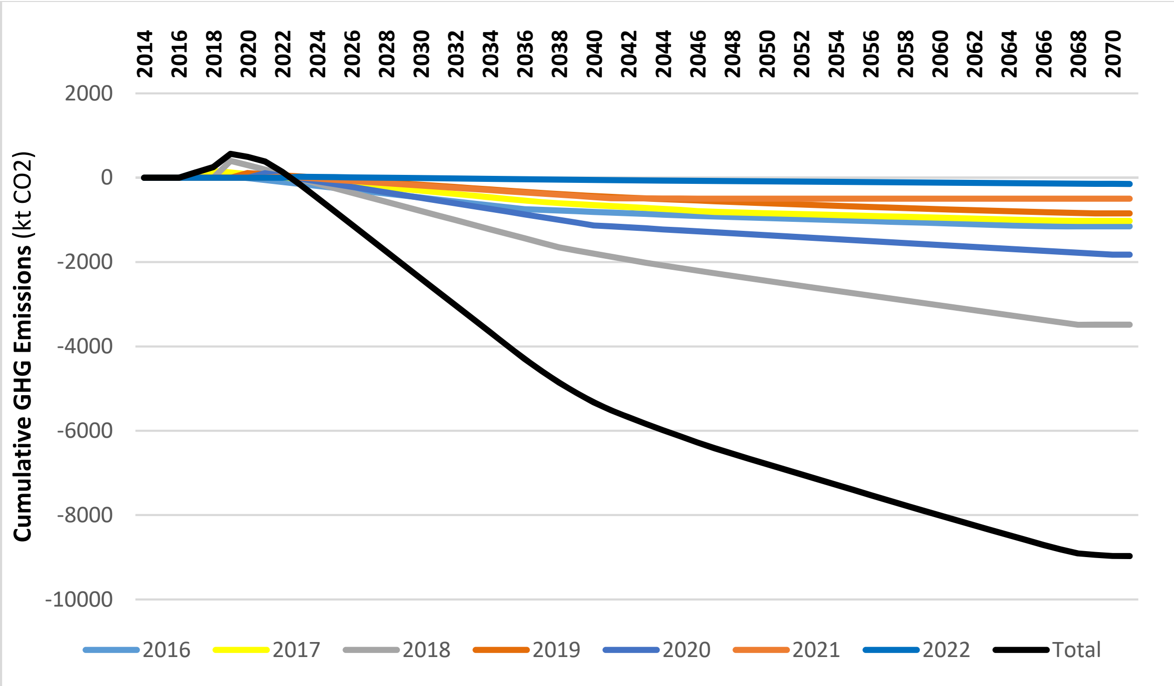


Figure 5 – Sardinia: comparison over time of cumulative emissions

The cumulative emissions can be distinguished in the two phases: construction and operational over the entire lifetime of the different projects, as shown in figure 6.

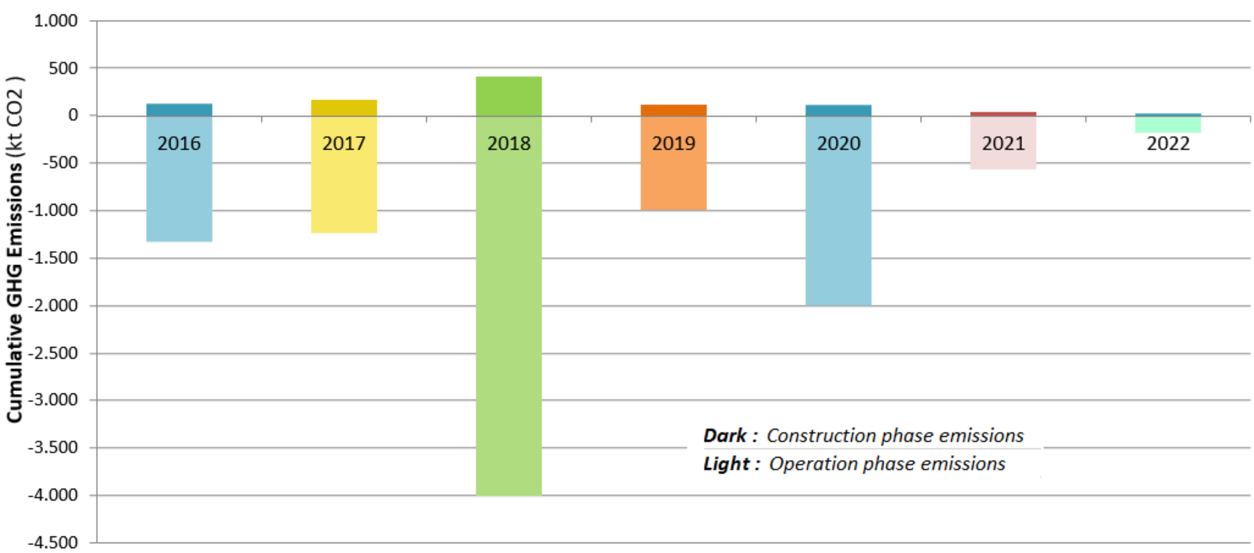


Figure 6 – Sardinia: comparison of cumulative emissions

4. Conclusion

The exercise proposed here has made it possible to historicize over the seven-year period covered by the 2014-2020 programming period the issues related to the eligible costs of ERDF Sardinia.

The historicization offers the possibility to have a chronological picture of the evolution of the Operational Programme, both from the economic point of view, with the indication of the eligible cost for each year, and from the environmental point of view, with the estimation of the emissions (additional or avoided) that the various eligible projects have caused.

Moreover, the possibility of being able to have a temporal indication of the emissions but above all to be able to estimate the realisations makes it possible to have a greater detail of information including the quantification of what has been realised.

The CO_2MPARE model, therefore, confirms itself as an excellent support tool for planning, monitoring and evaluation, whose estimation is all the more reliable the more specific information is available (e.g. targeting).

The exercise, in fact, illustrates how the possibility of relying on specific data and information allows the model to improve the evaluation of the Operational Programme's performance. It is an estimate, that of the present work, which is more adherent to reality since it not only considers the different timeframes for the start-up and implementation of the works as they result from the Regional Monitoring and Control Information System (SMEC), but also allows for the monitoring of the ROP's performance in the area of greenhouse gas reduction.

5. References

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