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Deliverable D5.6

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1 SCOPE

The scope of this report is to present the long- term energy vision for each of the participating regions that was formulated by the regional agencies/authority, participating in the EMPOWERING project along with the regional representatives involved in the capacity building process (task 3.4 and 4.3. . Within the activities of the task 5.4 the regional representatives managed to point out the direction in which their region wants to head, with a view to become low carbon communities, taking into account the national energy policy as well as the EU energy policy objectives.

2 EU ENERGY FRAMEWORK

2.1 ENERGY 2020- A STRATEGY FOR COMPETITIVE, SUSTAINABLE AND SECURE ENERGY[1]

The energy challenge is one of the greatest issues that Europe has to face. The well-being of our society depends on safe, secure, sustainable and affordable energy, while, energy related emissions account for almost 80% of the EU's total greenhouse gas emissions[2].

The EU Energy 2020 for is also known as 20-20-20 strategy. The package was a set of binding legislation for EU in order to meet its energy and climate targets for the year 2020.

The three key targets:

- **20% cut in greenhouse gas emissions (from 1990 levels)**
- **20% of EU energy from renewables**
- **20% improvement in energy efficiency**

"The targets were set by EU leaders in 2007 and enacted in legislation in 2009. They are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth." EU energy and climate goals have been incorporated into the Europe 2020 Strategy for smart, sustainable and inclusive growth, adopted by the European Council in June 2010
"By 2020, the EU aims to reduce its greenhouse gas emissions by at least 20%, increase the share of renewable energy to at least 20% of consumption, and achieve energy savings of 20% or more. All EU countries must also achieve a 10% share of renewable energy in their transport sector.
Through the attainment of these targets, the EU can help combat climate change and air pollution, decrease its dependence on foreign fossil fuels, and keep energy affordable for consumers and businesses.
Meeting the targets-Priorities

[1] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2020-energy-strategy

[2] EEA EN01 Energy related greenhouse gas emission

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj9_YWbpNLjAhUGwMQBHXCVAwYQFjAAegQIARAC&url=https%3A%2F%2Fwww.eea.europa.eu%2Fdata-and-maps%2Findicators%2Fen01-energy-related-greenhouse-gas-emissions%2Fen01&usg=AOvVaw2yE_2mKI9Ja9f04NAIuqYc

In order to meet the targets, the 2020 Energy Strategy sets out five priorities:

- *Making Europe more energy efficient by accelerating investment into efficient buildings, products, and transport. This includes measures such as energy labelling schemes, renovation of public buildings, mandatory energy efficiency certificates accompanying the sale and rental of buildings and ecodesign requirements for energy intensive products,*
- *Building a pan-European energy market by constructing the necessary transmission lines, pipelines, LNG terminals, and other infrastructure. Financial schemes may be provided to projects which have trouble obtaining public funding. By 2015, no EU country should be isolated from the internal market*
- *Protecting consumer rights and achieving high safety standards in the energy sector. This includes allowing consumers to easily switch energy suppliers, monitor energy usage, and speedily resolve complaints*
- *Implementing the Strategic Energy Technology Plan – the EU's strategy to accelerate the development and deployment of low carbon technologies such as solar power, smart grids, and carbon capture and storage*
- *Pursuing good relations with the EU's external suppliers of energy and energy transit countries. Through the Energy Community, the EU also works to integrate neighbouring countries into its internal energy market."*

2.2 2030 CLIMATE & ENERGY FRAMEWORK[3]

"In October 2014 The European Council agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2021 and 2030. The targets for renewables and energy efficiency were revised upwards in 2018."
The key targets for 2030 are summarised as follows:

- *At least 40% cuts in **greenhouse gas emissions** compared to 1990 levels*
- *At least 32% share for **renewable energy (the original target of at least 27% was revised upwards in 2018)***
- *At least 32.5% improvement in **energy efficiency** (**the original target of at least 27% was revised upwards in 2018)".***

The package "Clean energy for all Europeans" - new energy rulebook

The clean energy package consists of a comprehensive update of EU's energy policy framework and concerns eight policy priorities. The legislation process (political agreements and adoption documents) was finalized in May 2019.

[3] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy
https://ec.europa.eu/clima/policies/strategies/2030_en

Table 1: Legislation process of EU clean enrgy package [source: European Commission[4]]

	European Commission Proposal	EU Inter-institutional Negotiations	European Parliament Adoption	Council Adoption	Official Journal Publication
Energy Performance in Buildings	30/11/2016	Political Agreement	17/04/2018	14/05/2018	19/06/2018 - Directive (EU) 2018/844
Renewable Energy	30/11/2016	Political Agreement	13/11/2018	04/12/2008	21/12/2018 - Directive (EU) 2018/2001
Energy Efficiency	30/11/2016	Political Agreement	13/11/2018	04/12/2018	21/12/2018 - Directive (EU) 2018/2002
Governance of the Energy Union	30/11/2016	Political Agreement	13/11/2018	04/12/2018	21/12/2018 - Regulation (EU) 2018/1999
Electricity Regulation	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 - Regulation (EU) 2019/943
Electricity Directive	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 - Directive (EU) 2019/944
Risk Preparedness	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 - Regulation (EU) 2019/941
ACER	30/11/2016	Political Agreement	26/03/2019	22/05/2019	14/06/2019 - Regulation (EU) 2019/942

Meeting the targets-Priorities

In order to meet the targets, the European Commission has proposed:

- *A reformed EU emissions trading scheme (ETS)*

[4] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

- *New indicators for the competitiveness and security of the energy system, such as price differences with major trading partners, diversification of supply, and interconnection capacity between EU countries*
- *First ideas on a new governance system based on national plans for competitive, secure, and sustainable energy. These plans will follow a common EU approach. They will ensure stronger investor certainty, greater transparency, enhanced policy coherence and improved coordination across the EU.*

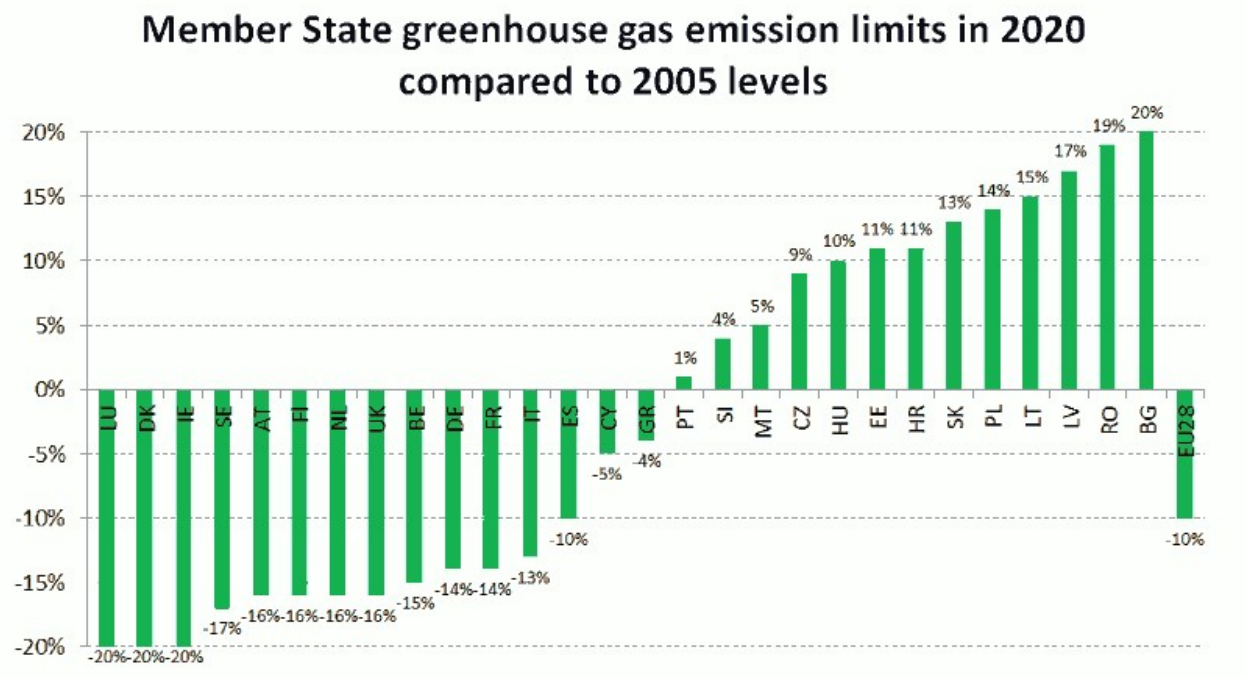
2.2.1 GREENHOUSE GAS EMISSIONS – A CUT OF AT LEAST 40%

A binding target to cut emissions in the EU by at least 40% below 1990 levels by 2030,will enable the EU to move towards a low-carbon economy and implement its commitments under the Paris Agreement.

To achieve the target:

- *EU emissions trading system (ETS) sectors will have to cut emissions by 43% (compared to 2005) – to this end, the ETS has been revised for the period after 2020*
- *non-ETS sectors will need to cut emissions by 30% (compared to 2005) – this has been translated into individual binding targets for Member States.*

Emission reductions by 2020: 10%

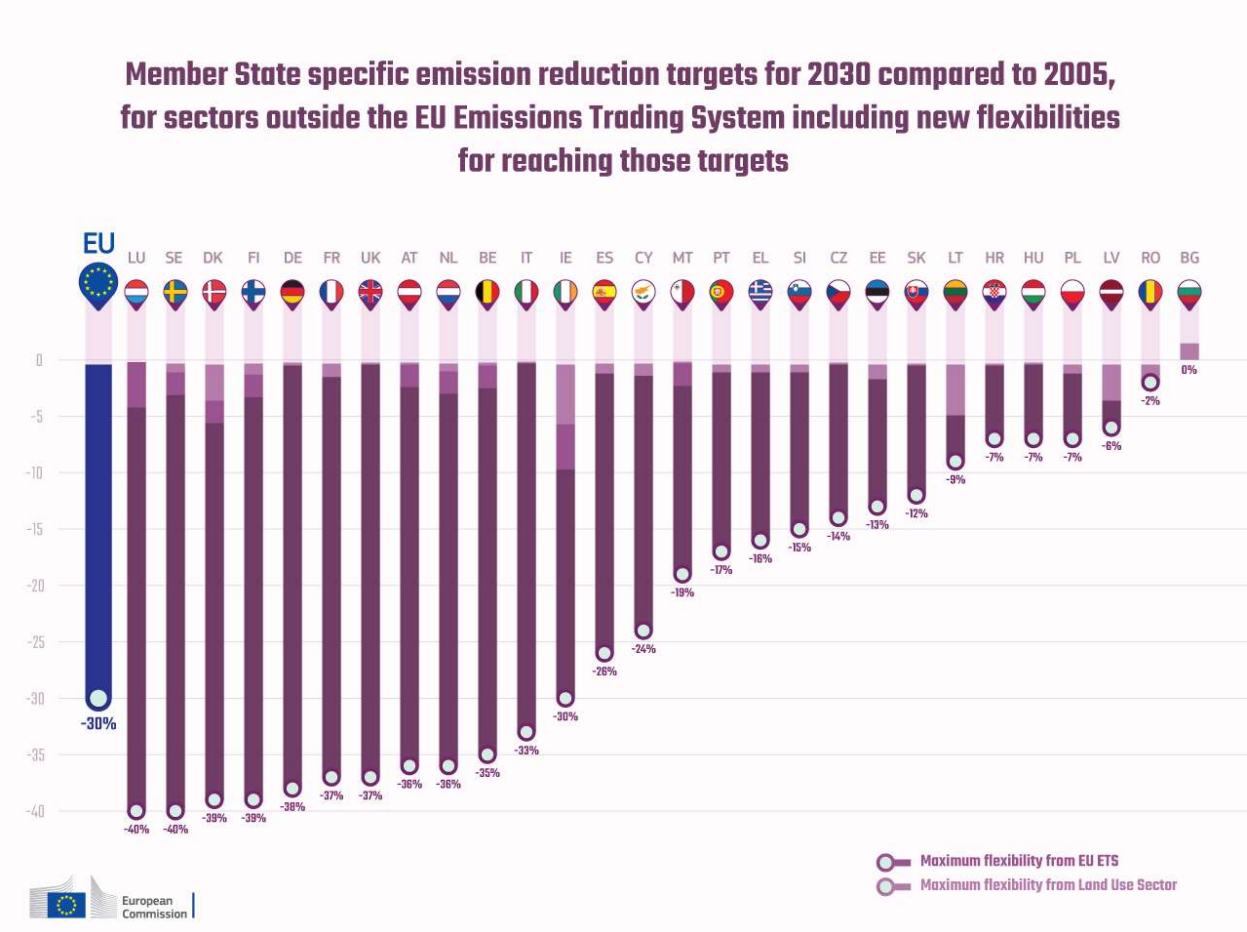


Source: European Commission (https://ec.europa.eu/clima/policies/effort_en)

The Effort Sharing Decision forms part of the EU's climate and energy policy framework for 2020.

It sets national emission targets for 2020, expressed as percentage changes from 2005 levels. It also lays down how the annual emission allocations (AEAs) in tonnes for each year from 2013 to 2020 are to be calculated and defines flexibilities.

Emission reductions by 2030: -30%



Source: European Commission (https://ec.europa.eu/clima/policies/effort_en)

The Regulation on binding annual emission reductions by Member States from 2021 to 2030 (Effort Sharing Regulation) adopted in 2018 is part of the Energy Union strategy and the EU's implementation of the Paris Agreement.

It sets national emission reduction targets for 2030 for all Member States, ranging from 0% to -40% from 2005 levels.

2.2.2 RENEWABLES – INCREASING TO AT LEAST 32% SHARE

The second target concerns a binding renewable energy target for the EU for 2030 of at least 32% share of final energy consumption, including a review clause by 2023 for an upward revision of the EU level target [December 2018, the new revised Renewables energy directive (2018/2001)].

The third headline target refers to at least 32.5% increase for energy efficiency to be achieved collectively by the EU in 2030, with an upward revision clause by 2023. Member States were required to draft by the end of 2018 their 10-year integrated National Energy & Climate Plans (NECPs) for 2021-2030, outlining

how they will meet the new 2030 targets for renewable energy and for energy efficiency (to be finalised by the end of 2019).

Member States were required to draft by the end of 2018 National Energy & Climate Plans (NECPs) for 2021-2030, outlining how Member States will meet the 2030 targets for energy efficiency and for renewable energy (finalised by the end of 2019).

2.2.3 MONITORING

The EU has adopted integrated monitoring and reporting rules to ensure progress towards the 2030 climate and energy targets in an efficient and coherent manner and its international commitments under the Paris Agreement.

Based on the better regulation principles, the governance process involves consultations with citizens and stakeholders.

Under the governance system, Member States countries are also required to develop national long-term strategies by the 1st January 2020, and ensure consistency between their long-term-strategies and NECPs.

2.3 2050 LONG-TERM STRATEGY

On the 28th November 2018, the European Commission adopted a strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by **2050 – A Clean Planet for all**[5].

This strategy does not set targets, but aims to create a vision and sense of direction, plan for it, and inspire as well as enable all stakeholders and citizens to develop new and innovative industries, businesses and associated jobs.

All sectors of the economy will contribute to in the transition towards climate neutrality.

Power sector: "Power generation should be fully decarbonised by 2050. More than 80% of the EU's electricity would be produced by renewable energy sources".

Industry: "Significant innovation efforts are needed in the next ten years to deploy the economically competitive technologies needed to contribute to a low-carbon and circular industrial transformation."

Mobility: "There is no single fuel solution for the future of low-carbon mobility – all main alternative fuel options will be needed, but different options are more suitable for different transport modes. Changes in behaviour and consumer choice to shift from private transportation to low-carbon public transport, shared mobility and zero-carbon mobility (biking, walking) are also key. Rethinking mobility will deliver

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

tangible benefits, including clean air, reduced noise, and more liveable urban spaces, generating major benefits for citizens' health and quality of life and the European economy."

Agriculture: "Emissions from agriculture can be reduced through a range of practices and technologies such as improved livestock, fertiliser and manure management. Agricultural practice also influences the carbon stored in soil. Furthermore, it has an important role to play in producing sustainable biomass for use in the bio-economy and the energy sector."

Buildings: "An integrated approach and consistency across all relevant policies will be necessary for the modernisation of the built environment and mobilisation of all actors. This is a condition sine qua non to engage citizens and businesses in the necessary renovation activities."

3 EXISTING ENERGY POLICY AND ACTION PLANS ON NATIONAL & REGIONAL LEVEL

3.1 ITALY

3.1.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

The National Energy policy priorities & targets, as indicated in the SEN 2017, are to:

- Promote the growth of renewable energy technologies thanks to lower costs. For this reason it is essential to reduce technological costs; optimize energy transport networks and simplify bureaucratic procedures.
- Increase distributed generation ensuring system security, consumer protection and fair sharing of network and system charges.
- Increase energy efficiency in the civil and transport sectors: continue to encourage innovation in the productive sectors, also as a lever for competitiveness.
- Guaranteeing security in a market undergoing profound transformation: in recent years, the increase in renewable sources has accentuated the need for adequacy and flexibility in the electricity sector, with recourse to new technologies and new structures; on the other hand, gas is still an essential source for domestic and industrial uses and this requires greater attention to the diversification of supply sources.
- Reduce consumption in the oil sector more and more. At the same time protect the industrial fabric to have an adequate availability of derivative products and to reconvert infrastructure towards biofuels.

3.1.2 MARCHE REGION

The Marche Region is a territory where national energy ***policies*** are implemented and optimized. The main ***policies*** are:

- Reduction of greenhouse gas emissions

- Development and promotion of renewable energies
- Energy efficiency
- Exploitation of EU, National and local innovative financial funds
- Burden Sharing

The Burden Sharing is the process of regionalization of the energy consumption / production target from renewable sources attributed by the European Union to Italy, when approving Directive 2009/28/EC. It is defined as the ratio between the production of energy from renewable sources (electric and thermal) divided by the total energy consumption. In the case of Marche Region, the ***target*** to be reached by 2020 is the value of 15.4%.

The Marche Region has drawn up the ***action plan*** "PEAR 2020" to reach this goal. Among the ***priorities*** defined in this document the most relevant is energy efficiency with the goal of reducing total consumption by 20% up to 2020.

The PEAR was drawn up on the basis of data provided annually by the Energy Services Manager (GSE). The latest data from the GSE (2016) show that the Marche Region has already reached 16.7% of the Burden Sharing report.

Furthermore,monitoring the main towns in the Marche shows that the reduction of GHG emissions between 2005 and 2016 was 18%.

3.2 SPAIN

3.2.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

Spain has just presented the **DRAFT of the Energy and Climate Integrated National Plan 2021-2030**, which lays the foundations for the modernization of the Spanish economy, the creation of employment, leadership positioning in clean energy and technologies, development of the rural environment and improving the health of citizen.

The main results that will be achieved with this Plan are:

- 21% reduction in greenhouse gas emissions compared to 1990
- 42% of renewables on total final energy consumption, for the entire EU
- 39,6% improvement in energy efficiency
- 74% of renewable energy generation in 2030

By 2030, a total installed power in the renewable energy sector of 157 GW is expected, of which 50 GW will be wind energy, 37 GW solar photovoltaic, 27 GW combined natural gas, 16 GW hydraulic and 7 GW of thermoelectric solar, as well as minor amounts of other technologies.

The penetration of renewables in the mobility sector will reach 22% in 2030 through the incorporation of 5M of electric vehicles and the use of biofuels.

In relation to energy efficiency, priority is given to the rehabilitation of existing buildings, with an expected average annual rate of energy rehabilitation of 120.000 homes in the next decade. The renovation of national, regional and local public buildings will also be promoted, at an annual rate of 3%.

In 2050, the objective is to achieve climate neutrality with a reduction of at least 90% of GHG emissions and achieve a 100% renewable electric system. In this regard, the ***2050 Long Term Low Emissions Strategy*** is being prepared, to be sent to the European Commission at the end of 2019.

All this data and the full the **DRAFT of the Energy and Climate Integrated National Plan 2021-2030 (PNIEC 2021-2030)** is available here:

- https://www.idae.es/informacion-y-publicaciones/plan-nacional-integrado-de-energia-y-clima-pniec-2021-2030
- https://elperiodicodelaenergia.com/wp-content/uploads/2019/02/PNIEC-2021-2030-2.pdf

Targets, objectives and measures proposed on the scenarios 2020-2030-2050 have been taken from this document.

3.2.2 REGION OF ANDALUSIA

Energy planning has a huge impact on the regional economy and takes on special relevance in the current context. After the end of the **Andalusian Energy Sustainability Plan 2007-2013**, the Regional Council approved in October 2015 the **Andalusian Energy Strategy 2020**, a strategic document that includes the main lines of the Andalusian energy policy in the 2020 horizon.

The full Strategy can be consulted here:

https://juntadeandalucia.es/organismos/haciendaindustriayenergia/areas/energia/planificacion-ordenacion.html

The **Andalusian Energy Strategy 2020** includes five Action Programs, specify on the following table:

	Action Program	Principle
	Intelligent Energy	Contribute to an efficient use of energy, prioritizing the use of regional sustainable resources, and self-consumption systems
	Improvement of Competitiveness	To place sectors such as renewable energies and energy efficiency as engines of the Andalusian economy
	Improvement of Infrastructures and Quality of Energy Services	To guarantee the quality of energy supply, promoting the transition towards an intelligent and decentralized model, integrated in the territory

	Energy Culture	To make the citizenship protagonist of the energy system
	Energy Management in Public Administrations of Andalusia	To optimize the energy consumption of regional government buildings and equipments

Its execution is being carried out through Action Plans throughout the validity period, and involves all sectors of Andalusian society.

This new planning framework continues the road towards a low-carbon, sufficient, intelligent and quality energy model, in line with European guidelines. It incorporates concepts that allow citizens to be placed at the centre of the energy system, such as self-consumption, training and energy information or the collective management of energy, so that they can adequately manage their demand and choose the source of the energy they consume.

The **Andalusian Energy Strategy 2020** proposes five objectives by 2020:

- Reduce the trend consumption of primary energy by 25%
- Contribute 25% of the final gross energy consumption with renewable energies
- Decarbonise energy consumption by 30% with respect to the value of 2007
- Self-consume 5% of the electric power generated with renewable sources
- Improve the quality of the energy supply by 15%

Actions are evaluated by action Plans:

Action Plan 2016-2017 https://juntadeandalucia.es/export/drupaljda/Plan_de_Accion_2016_2017_vDEFINITIVA.pdf

Action Plan 2018-2020 https://juntadeandalucia.es/export/drupaljda/20181217%20Plan%20de%20Acci%C3%B3n%202018-2020.pdf

For 2050, one of the Andalusian goal is decarbonisation in the Andalusian energy sector. It is expected that the most efficient technologies will have reached maturity, being available to the public and being introduced into society gradually throughout this time. Therefore, the use of innovative efficient technologies will be a continuous action throughout this period.

In the horizon of 2050 very efficient technologies will appear and coexist, but a continuous development is necessary., Citizens, companies and research centres are central pieces.

3.3 ROMANIA

3.3.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

The energy sector has an essential contribution to Romania's development, with strong influence on economic competitiveness, life quality and the environment. To meet consumers' expectations in the long run, the Romanian energy sector must become cleaner, more economically robust and technologically advanced.

The focus of the Energy Strategy is the year 2030, for which detailed analysis and strategic planning are provided. The Strategy advances a vision and a proposal for energy sector development by 2030, and relies on a set of main principles and key strategic goals. The vision is presented in figure 1. To achieve the key strategic goals, prioritised actions and measures must be defined following a thorough analysis of the Romanian energy sector, against the background of international economic, geopolitical and technological trends.

For proper delineation of the strategic options, an extensive macroeconomic modelling study was conducted, with simulation and benchmarking of multiple scenarios, presented in the appendix on methodology. Forecasts for 2030 rely on high resolution quantitative modelling. The outlook for 2050 places Romania in a context of long-term technological, economic and energy policy trends. Inevitably, forecasts for 2050 have a higher level of uncertainty and are reliable only in terms of general tendencies, providing a long-term perspective for the 2030 strategic options.

According to EU obligations Romania has set a national indicative target of 19% for reducing energy consumption by 2020. The National Action Plan for Energy Efficiency-III for 2014-2020 was approved by GD122/2015. It provides measures similar to those included in the previous plans.

Romania's indicative energy efficiency target is to achieve primary energy savings of 10 Mtoe by 2020. The envisioned 19% reduction corresponds approximately to a target of 42.99 Mtoe primary energy consumption and 30.32 Mtoe of final energy consumption.

The Law on Energy Efficiency no. 121/2014 transposes EU Directive 27/2012 on Energy Efficiency into national legislation. The main purpose of the law is to establish a coherent legislative framework for the development and implementation of national energy efficiency policy in order to achieve the national target. The Romanian Energy Regulatory Authority (ANRE) is responsible for transposing the provisions of this law into secondary legislation. Accordingly to that, ANRE established the Department for Energy Efficiency within ANRE (order no. 95/2014).

Primary energy in 2012 was 34.8 Mtoe 20% lower than the 2020 target, the final energy consumption was 25% lower than the target. This indicates that the measures of the NEEAPs contributed to reductions of primary and final energy consumption.

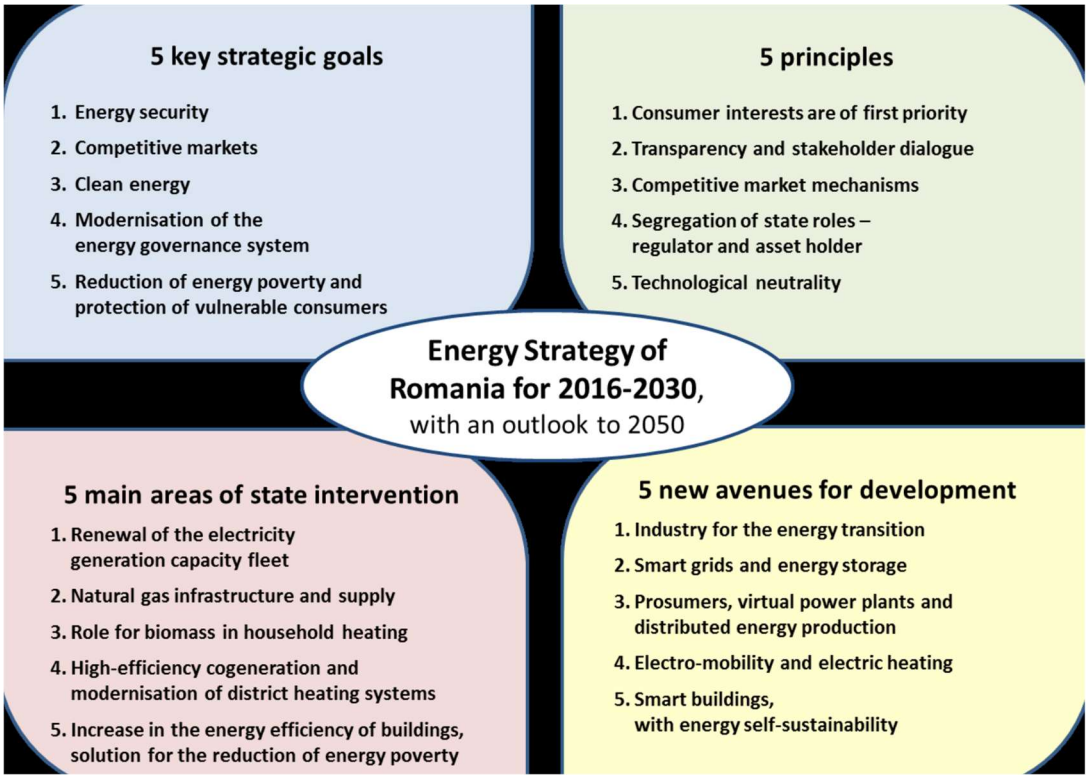


Figure 1 **Elements defining the Energy Strategy of Romania for 2016-2030, with an outlook to 2050**

The targets set at EU level for 2020, the contribution of energy policies to reducing impact of climate change, have been reached in advance by Romania. The commitment 20% reduction in emissions of GHG compared to the reference year 1990, Romania recorded in 2012 a reduction by 47.96%, compared to the EU level of 82.14%. Romania record in 2016 an increase by 25.03% in the balance of energy from renewable sources in consumption and a reduction in energy consumption of 41.6%, compared to 20% assumed.

The premise of developing the energy sector by the year 2050 is useful for two main reasons: (1) The energy sector has a high capital intensity, and many projects have a long investment cycle, so that a good part of the decisions Investments to take place in the near future will continue to produce its effects in 2050; and (2) the EU's energy and environmental policies, including targets for the year 2030, are built around the long-term objective of reducing GHG emissions by at least 80% by 2050.

The development trends outlined below refer to: Increasing the sustainable role of biomass in the energy mix; The future of electromobility; Increasing the share of RES in the mix of electricity and the use of CCS technologies; Forms of energy storage; Energy efficiency, in particular buildings; Heat pump based electric heating.

All these developments, although they are expected to reduce GHG emissions, could have a strong impact on the environment, the opportunity to develop new large-scale technologies should be thoroughly analyzed. Most likely, new generations of these technologies, more efficient and environmentally friendly, will be adopted on a large scale.

To benefit from the global energy transition, Romania should take advantage of the opportunities that build on its strengths, and pursue new avenues for energy sector development. Investment in these areas is encouraged by the Romanian state.

One such opportunity is the development of the manufacturing industry for equipment, tools, parts and materials for the energy transition. By strengthening its attractiveness for investment in these industries, Romania can create new jobs and increase its competitiveness.

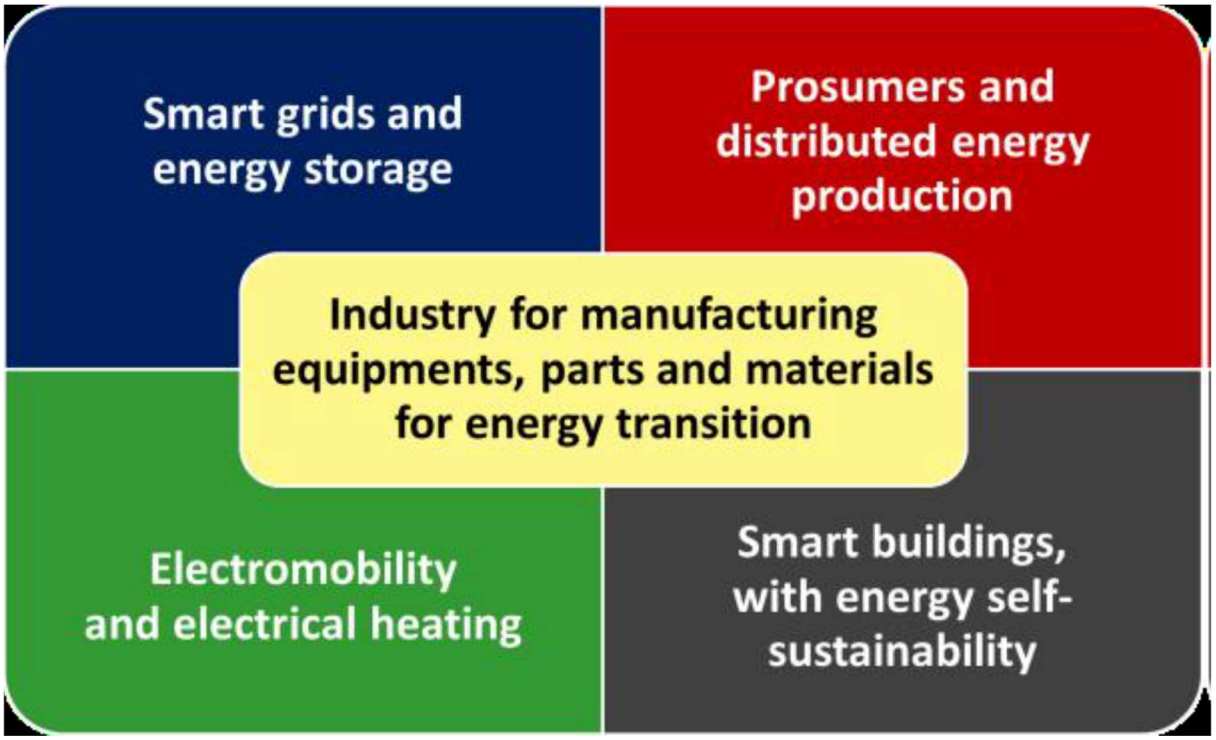


Figure 2 New avenues for development

(I) Turning Romania into a manufacturing centre for the energy transition; e.g., electric vehicle and household-size batteries, heat pumps, materials for increasing energy efficiency in buildings, smart grid technologies etc. Research and innovation in Romania can reinforce this path of technological evolution. There is a fierce competition between countries to attract investments in manufacturing equipment, parts and materials for the energy transition. To become an attractive destination for investment and to create jobs in this field, Romania should progressively become a regionally important user of such technologies, in line with its strategic priorities. (II) Smart grid development. Smart grids enable real-time communication with consumers, with better control and instant optimization of energy generation and consumption. The interaction between electricity grids, the Internet and communication networks will be enhanced, leading to efficiency and flexibility gains. New technologies should be adopted gradually, at minimum cost, while protecting the privacy of personal data and a high level of security against cyber-attacks. (III) Smart grids facilitate the transition from consumers to prosumers, who deliver to the grid their own electricity production. Distributed electricity generation (i.e. power generated in different types of low-capacity systems) and virtual power plants can reduce grid losses, and increase flexibility and

security of supply. In the long run, prosumers will influence grid architecture, especially when equipped with an electricity storage capacity, to limit interactions with the grid. There will be fewer households without access to power in Romania, not least following the adoption of off-grid solutions, which are increasingly affordable. (IV) Promotion of electric and hybrid vehicles, including cars, buses and light duty vehicles (LDVs), especially those mainly used in urban areas. By 2030, hybrid and electric vehicles will be a common occurrence, contributing to a reduction in pollution from exhaust gases. The main role of the state in this transition is to support the development of charging infrastructure and to kick-start the market in its early stages of development. Romania is well placed to manufacture electric vehicles, including batteries and other parts; an active policy for attracting such type of investment will be put in place. (V) Smart buildings, in terms of construction, architecture, operation, inter-changeability and storage of all forms of energy, with prosumer features. The construction of such buildings will be promoted at national level on the long term, including by setting ambitious standards for energy efficiency for new buildings. Achieving the decarbonisation targets for 2050 will require large investments in reducing energy demand in buildings. The countries which succeed to attract investments in the energy efficiency industry will stand to gain, compared to the mere importers of such technologies. Romania may be among the winners in this field: sustainable construction materials and equipment may be manufactured in Romania, both for the domestic and for international markets.

(Source: National Energy Efficiency Action Plan IV for Romania; ROMANIAN ENERGY STRATEGY 2016 2030, WITH AN OUTLOOK TO 2050; Integrated National Energy and Climate Change Plan for 2021 - 2030)

3.3.2 NORTH-EAST REGION

Due to the fact that in Romania the regions are statistical NUTS2 and not administrative regions (no regional government) North-East region of Romania has adopted the same policies, targets and priorities.

3.4 CROATIA

3.4.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

As a member of the European Union, granted by the 2012 **Treaty concerning accession of the Republic of Croatia to the European Union[6],** Croatia participates in the adoption and implementation of common EU policies, including the umbrella of EU energy policy.

Even before accessing the EU, Croatia signed two important international energy agreements:

- The Republic of Croatia signed[7] the **Energy Charter Treaty[8]** in Lisbon on December 1994, together with the protocol for energy efficiency of the energy system and taking into account the effect on the environment. As a result of this treaty, an "energy package" was drafted and Croatia is taking into account all EU legislation and guidance (such as the Clean Energy For All Europeans[9]) when drafting its documents.
- The **Energy Community Treaty** was signed on October 25th, 2005. in Athens[10]. The main goal of this treaty is to create a stable and unique regulatory frame and a competitive market which ensures secure energy supply. Currently, 20 out of 28 EU MS have the status Participants (instead of observers) in the Energy Community pursuant to Article 95 of this Treaty, meaning they can be permitted to participate in the discussions of the Ministerial Council, the Permanent High-Level Group, the Regulatory Board and the Fora.

On April 22nd, 2016 the Paris agreement on Climate change was signed[11], with a long-term goal to commonly keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change.

Concerning national energy legislation, Croatia has passed:

- ENERGY ACT[12]
- ACT ON THE REGULATION OF ENERGY ACTIVITIES[13]

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6 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A12012J%2FTXT

7 https://narodne-novine.nn.hr/clanci/medunarodni/1997_10_15_98.html

8 https://energycharter.org/process/energy-charter-treaty-1994/energy-charter-treaty/

9 https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

10 https://eur-lex.europa.eu/legal-content/HR/ALL/?uri=CELEX%3A22006A0720%2801%29

11 https://narodne-novine.nn.hr/clanci/medunarodni/2017_04_3_16.html

12 https://narodne-novine.nn.hr/clanci/sluzbeni/2018_07_68_1397.html

13 https://narodne-novine.nn.hr/clanci/sluzbeni/2018_07_68_1397.html

- ELECTRICITY MARKET ACT[14]
- ACT ON THE GAS MARKET[15]
- ACT ON TERMINAL FOR LIQUIFIED PETROLEUM GAS[16]
- ACT ON THE MARKET OF OIL AND OIL DERIVATIVES[17]
- THE HEALTH ENERGY MARKET ACT
- ACT ON TRANSPORT BIOFUELS[18]
- ACT ON THE ESTABLISHMENT OF INFRASTRUCTURE FOR ALTERNATIVE FUELS
- ACT ON RENEWABLE ENERGY SOURCES AND HIGH-EFFICIECY COGENERATION[19]
- ENERGY EFFICIENCY ACT[20]
- ACT ON HYDROCARBON EXPLORATION AND EXPLOITATION[21]

Energy Act is the main Act which transposes into the legislation of the Republic of Croatia the acquis communautaire in the field of energy, in particular Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC (SL. L 211, 14 Aug 2009) and Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC (SL. L 211, 14 Aug 2009).

Since many acts, including the Renewable Energy and the Energy Efficiency Act, have set targets, a **National Energy and Climate Plan**[22] was delivered in 2019. It integrates all targets set and covers the period from 2021. until 2030. Croatian energy and climate goals are the following:

Table 2: Table 2-1 from Croatian NECP: Targets for reducing greenhouse gases for Croatia in 2030.

In regards to year	Scope	Realized in 2015.	Target for 2030.

[14] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_07_68_1396.html

[15] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_02_18_372.html

[16] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_06_57_1156.html

[17] https://narodne-novine.nn.hr/clanci/sluzbeni/2017_07_73_1768.html

[18] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_10_94_1820.html

[19] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_12_111_2151.html

[20] https://narodne-novine.nn.hr/clanci/sluzbeni/2018_12_116_2291.html

[21] https://narodne-novine.nn.hr/clanci/sluzbeni/2013_07_94_2122.html

[22] https://ec.europa.eu/energy/sites/ener/files/documents/croatia_draftnecp_hr.pdf

2005	ETS sector	-21,1%	-43%*
	Non-ETS	-18,2%	-7%

*The stated target is indicative, and it is binding on the level of ETS EE system

The same document states that the share of RE in gross final energy consumption in 2030 should be 36,4% and energy efficiency measures should contribute with 367,76 PJ of savings in primary consumption (286,91 PJ of savings in final consumption).

The document also gives an overview of 85 measures per different areas (decarbonisation, renewable energy, energy efficiency, R&D, national energy market, energy security).

3.4.2 ISTRIA

Energy efficiency balance and targets

In order to accomplish set national goals for the reduction of energy through energy efficient measures, the Energy Efficiency Act has prescribed that all Counties and large cities (with more than 35.000 inhabitants) have to make three-year energy efficiency Action Plans and Yearly Plans. This means that in Istria only the largest City of Pula- and the Istrian County are obliged to make such plans.

Istrian County made its three-year plan in 2016[23], which gives the energy balance of the Istrian County, as well as sets energy efficiency targets. The Istrian energy balance states that in Istria around 13,63 PJ are being spent annually, which is approximately 5,51% of final energy consumption in Croatia. Spending per sector is shown in the following table.

Table 3: Final energy consumption of Istrian county, data from 2016

Final energy consumption	PJ	GWh	Share
Industry	2,00	556	14,67%
Transport	5,90	1 639	43,27%
Buildings	5,73	1 539	42,06%
Total:	**13,63**	**3 787**	**100%**

[23] https://www.istra-istria.hr/fileadmin/dokumenti/novosti/sjednice_skupstine_2013/38/38-25-En_ucinkovitost_IZ_2017_2019.pdf

The plan sets out 27 measures to be realized until 2019. For those measures that can be monitored and verified through the National monitoring tool SMIV, it was calculated that they will save $1{,}155*10^{-3}$ PJ.

Energy Efficiency Action Plan of the City of Pula-Pola 2017-2019[24] sets the target and energy balance of Pula-Pola. Energy balance states that in Pula around 3,537 PJ are being spent annually, with transport contributing to 41% of this balance and households contributing with 33%. Spending per sector is shown in the following table.

Table 4: Final energy consumption of the City of Pula-Pola, data from 2016

Final energy consumption	PJ
Household sector	1,162
Service sector	0,914
Transport	1,162
Total:	**3,537**

The plan sets out 27 measures to be realized until 2019. For those measures that can be monitored and verified through the National monitoring tool SMIV, it was calculated that they will save $1.11584*10^{-2}$ PJ in the period 2017.-2019., through nine planned measures set out in the Plan.

All ten municipalities in Istria are signatories of the Covenant of Mayors, including Vodnjan – Dignano, Novigrad – Cittanova, Poreč – Parenzo, Pazin, Buje, Umag, Pula – Pola, Labin, Buzet, Rovinj – Rovigno, meaning they have obliged to at least a 40% greenhouse gas-reduction by 2030.

[24] https://www.istra-istria.hr/uploads/media/Akcijski_plan_energetske_ucinkovitosti_Grada_Pule_2017.-2019..pdf

3.5 GREECE[25]

3.5.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

Greece has elaborated the National Energy & Climate Action Plan towards 2030 and submitted it to the European Commission in January 2019.

The increased penetration of renewable energy sources (RES) and the improvement of energy efficiency through a broader policy approach for reducing greenhouse gas emissions, also taking into account such key parameters as energy security and achieving lower costs across the energy sector, are a key objective for Greece.

The following figure presents the Individual quantitative targets in the context of attaining the national energy and environmental objectives for 2030 in Greece.

[25] Information based on the NECP for Greece (January 2019)

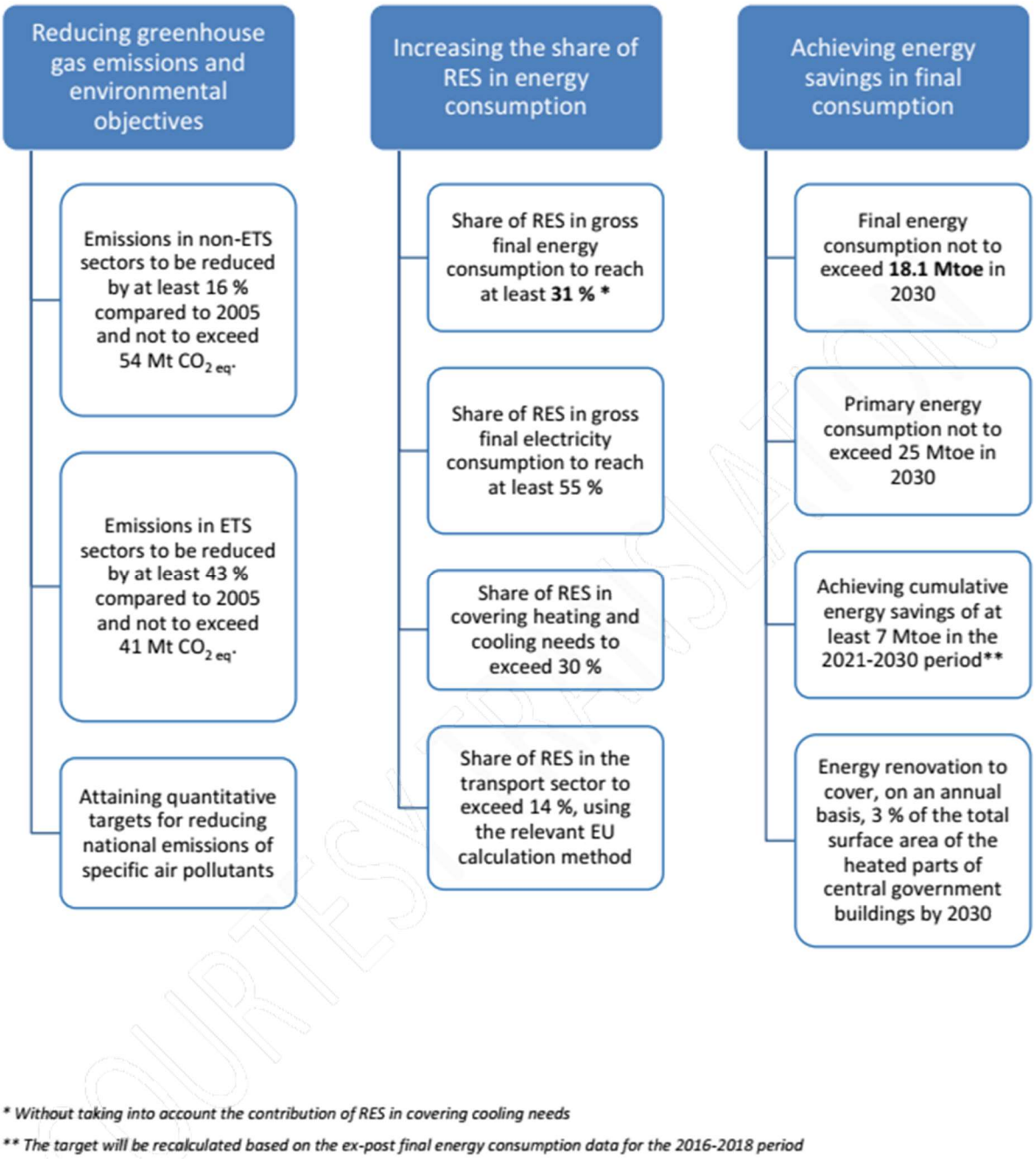


Figure 3: National energy and environmental objectives for the 2021-2030 period in the context of EU policies [Source: National Energy and Climate Plan, Greece 01/2019[26]]

[26] https://ec.europa.eu/energy/sites/ener/files/documents/ec_courtesy_translation_el_necp.pdf

In the following table the key policy priorities for each dimension (of Energy Union) of the Greek national climate and energy plan, which are deemed necessary for attaining these objectives are presented. These policy priorities are the axes for planning and applying/implementing specific measures under each dimension.

Table 5: Key policy planning priorities

GHG emissions and removals
PP1: Reduction of emissions from conventional power plants and from the interconnection of autonomous island systems
PP2: Promotion of natural gas as an intermediate fuel for the decarbonisation of the energy system
PP3: Promotion of RES
PP4: Improvement in energy performance of buildings, industry and infrastructures
PP5: Reduction of emissions in the transport sector
PP6: Reduction of fluorinated gas emissions
PP7: Reduction of emissions in the agricultural sector
PP8: Emission reduction measures in the tourism sector
Renewable energy sources
PP1: Promoting RES power generation technologies - Achieving zero operating support for financially competitive ones
PP2: Smooth functioning of the authorisation and physical planning framework
PP3: Promoting dispersed RES systems and strengthening the participation of local communities / consumers
PP4: Inclusion of RES in energy networks
PP5: Statutory obligation for a minimum share of RES in covering the energy needs of buildings
PP6: Strengthening the use of RES systems for covering thermal and cooling needs
PP7: Coupling energy sectors to promote optimal penetration of RES
PP8: Promoting the use of biofuels in transport
PP9: Promoting the use of electricity and other RES fuels in transport
Energy efficiency
PP1: Improvement in energy efficiency of public buildings
PP2: Improvement in energy efficiency of private buildings
PP3: Promoting market mechanisms and energy audits
PP4: Horizontal measures to improve energy efficiency
PP5: Improvement in energy efficiency of industrial sector
PP6: Improvement in energy efficiency of transport sector
PP7: Improvement in energy efficiency of electricity and gas infrastructures
PP8: Promoting measures for modernising water/sewage and irrigation infrastructures
Security of supply
PP1: Increasing the diversification of energy sources and supply from third countries, storage and demand response
PP2: Reducing energy import dependency from third countries
PP3: Readiness of Greece to cope with constrained or interrupted supply of an energy source
PP4: Deployment of domestic energy sources
Energy market

PP1: Strengthening interconnectivity with neighbouring countries for power transmission purposes
PP3: Strengthening competition in the markets of electricity and natural gas
PP4: Protecting consumers and addressing energy poverty
PP2: Promoting gas transmission, distribution and storage infrastructure projects
Research, innovation and competitiveness
PP1: Promoting innovative energy saving technologies
PP2: Promoting innovative decarbonisation technologies
PP3: Digitisation of energy networks - smart networks
PP4: Promoting innovative transport technologies
PP5: Promoting innovative energy storage applications
PP6: Implementing horizontal measures to improve the conditions for research
PP7: Promoting entrepreneurship through research and innovation actions which are part of market functions
PP8: Optimising/adjusting the support framework and schemes for implementing investments intended to strengthen competitiveness
PP9: Strengthening competitiveness by setting up and operating special funds
PP10: Promoting circular economy

3.5.2 REGION OF CENTRAL MACEDONIA

The most important programming and financial instrument for supporting development policy in the Region of Central Macedonia during the programming period 2014-2020 is the Operational Program (OP) of the Region of Central Macedonia approved on 18/12/2014 and revised on 6/12/2017 by the European Commission.

The ROP of Central Macedonia includes resources totalling 1.009 million euros, aiming at addressing the needs and problems as well as exploiting the potential and advantages of the Region to become a dynamic competitive international pole. It is co-funded by the European Regional Development Fund (ERDF) and the European Social Fund (ESF). "

Based on the architecture of the new NSRF (Development Partnership Pact) 2014-2020, the promotion of the Region's development strategy, also depends significantly on additional significant resources from the Sectoral Operational Programs, for projects and actions in the Region of Central Macedonia such as the Thessaloniki Metro, for Solid Waste Treatment Units, ca).

In the context of the new programming period, **three thematic objectives** specific to energy and the environment were set:

Q1: Energy redeployment for a low-carbon economy
Q2: Adaptation to climate change
Q3: Environmental protection and resource efficiency

Taking into account that during the EMPOWERING project duration, there was not available any official Regional Energy Plan for Region of Central Macedonia, the same policies, targets and priorities have been adopted for elaborating the intermediate tasks towards drafting region's energy vision for 2050.

3.6 HUNGARY

3.6.1 NATIONAL ENERGY POLICY PRIORITIES & TARGETS

The Government's energy strategy objectives include guaranteeing the safe energy supply of Hungary, taking into account the country's economic competitiveness, environmental sustainability and the load-bearing capacity of consumers (Figure 4), while enabling a shift toward structural change in terms of energy.

Over the time-frame of the National Energy Strategy 2030 ('Energy Strategy'), Hungary will probably continue to need to rely on energy imports, which would not present a major risk if appropriately diversified supply routes and supply sources were available. However, Hungary is in a vulnerable situation in terms of the supply of traditional energy sources (particularly natural gas) due to the sources and transit routes available in the medium term. The most efficient and effective way, also viable in the short term, of increasing the security of supply is to lower consumption and to treat energy conservation and energy efficiency as priorities.

As an open, export-oriented economy with low stocks of economically exploitable fossil fuels, Hungary obviously cannot be entirely independent in terms of energy supply. The cornerstones of reducing Hungarian energy imports are reducing energy consumption, improving energy efficiency, the greatest possible utilisation of domestic energy sources and the long-term maintenance of our nuclear energy capacities.

The energy policy of the future should be developed on the basis of the answers to the most important domestic and global challenges and the energy policy efforts of the EU, also taking into consideration our specific geopolitical features. It should focus on achieving both a rationalised energy demand and an energy supply (infrastructure and supply) encouraging the growth of the Hungarian economy, ensuring the accessibility of the services and prices affordable to a large group of consumers. At the same time, through its positive impacts to economic growth, the development of the green economy gives a major economic stimulus.

The path to the future is to ensure the lowering of energy consumption as a result of energy efficiency measures and the application of innovative technologies and to increase the carbon consciousness of stakeholders through targeted awareness-raising campaigns.

The **change of the energy structure** should include:

- energy efficiency measures spanning the entire supply and consumption chain;
- increasing the share of low CO2-intensive electricity generation based primarily on renewable sources of energy;
- promoting renewable and alternative methods of heat generation;
- increasing the share of low CO2-emission modes of transport.

By achieving the above four objectives Hungary could take a significant step toward the establishment of sustainable and safe energy systems, paying special attention to increasing the competitiveness of the economy.

Article 24(2) of the EED provides that by 30 April 2014, and every three years thereafter, Member States shall submit National Energy Efficiency Action Plans. Based on Article 3 of the EED, the indicative target notified in April 2013 for 2020 under the joint effort scenario was 1 113 PJ (expected value of primary energy use). That energy use forecast was notified on the basis of the Energy Strategy, based on 2008 data.

During the period since the drawing up of the National Energy Strategy, economic growth has been significantly lower than originally expected, which resulted in lower energy use. According to information by the KSH and the Hungarian Energy and Public Utility Regulatory Authority, factual data for 2012 show a value of 992 PJ for primary energy use, which represents 12 % decline in the primary energy demand compared to the 2008 initial data of the Energy Strategy.

On the basis of values in 2012, taking into account current trends, GDP forecasts and proposed energy efficiency measures and based on Government Resolution No 1160/2015 of 20 March 2015 on updating the energy consumption forecasts of the National Energy Strategy, **the target value of primary energy consumption in 2020 is 1 009 PJ** (under the 'joint effort' scenario). The target value for final energy consumption is 693 PJ.

Accordingly, the expected value of **gross final energy consumption** (the difference between primary energy consumption, conversion, calculation and grid losses and non-energy uses) in 2020 is 603 PJ/year.

The European Commission published the so-called Energy Winter Package at the end of November 2016, which, in addition to setting out several new regulatory proposals concerning climate and energy policy, called on Member States to draw up **National Energy and Climate Plans** (NECP) based on a single methodology, with uniform content.

In the course of drawing up the NECP, Hungary conducted wide-ranging professional, CSO and social consultations to ensure that the plan is implemented with public support. Integrated planning spans the dimension of decarbonisation, energy efficiency, energy security, the internal energy market, research, innovation and competitiveness.

The table below summarises Hungary's key, quantified objectives and the main measures supporting these.

Objectives of Hungary and main measures supporting these

Hungary's objectives compared to EU objectives	2020		2030		Main measures supporting national objectives
Share of renewable energy	**20 %**	**14.65 %**	**32 %**	**20 %**	Photovoltaic panel (PV), Greening of transport (E-mobility) Modernisation of

						heat market (district heating)
Energy efficiency – Reduction of energy consumption		**20 % indicative(1)**	**1 009 PJ(2)**	**32.5 % indicative(3)**	**8–10 %(4)**	Reduction of end-use (energy management in buildings) Promotion of industrial energy efficiency investments
Change in GHG emissions	Gross total vs 1990	**-20 %**	**-**	**-40 %**	**-40 %**	Climate-friendly modification of electricity mix
	ESD/ESR vs 2005	**-10 %**	**+10 %**	**-30 %**	**-7 %**	

(1) Reduction of primary energy consumption compared to the 'business as usual' scenario (measures aimed at reducing energy consumption are not implemented)
(2) Primary energy consumption of Hungary
(3) Reduction of energy consumption compared to 'business as usual' scenario
(4) Reduction of energy consumption compared to 'business as usual' scenario

Dimension of decarbonisation

GHG emissions and removals

The EU climate and energy framework approved by the European Council in October 2014 provides for a 40 % GHG emissions reduction on an EU level by 2030, compared to the figure for 1990. In the long term, Hungary plans a minimum 52 % reduction of gross emissions by 2050 based on the second National Climate Change Strategy approved by Parliament in October 2018, noting that the preferred rate of reduction is 85 % compared to 1990, if enabled by the country's economic potential, i.e. a gross GHG emission reduction of 52–85 % should be achieved by 2050 compared to 1990.

As an intermediate goal, GHG emissions should be reduced by at least 40 % by 2030 compared to 1990, which requires the reduction of 64.44 million tCO2e in 2017 by an additional 8.2 million tCO2e.

Renewable energy

Hungary set the target of reaching a 20 % share of renewable energy sources within primary energy consumption by 2030.

Dimension of energy efficiency

Based on the national objective of Hungary, energy consumption in 2030 should not exceed the value for 2005 (gross final energy consumption of 27.6 Mtoe). The energy efficiency measures will reduce the value of expected energy consumption – without the measures – in 2030 by approximately 8–10 %.

With the existing policy measures, final energy consumption may increase by 14 % between 2015 and 2030 based on the forecast. The increase is attributable to the rise in industrial production and higher fuel consumption resulting from increasing income, while household energy consumption is expected to decrease. The weight of electricity and petroleum products is expected to increase within the end consumer energy mix, while the share of other energy sources will decline

Dimension of energy security

T establish a climate-friendly electricity sector, the supply of electricity should rely on a secure availability of an electricity mix based on energy sources at the lowest possible price, including a decarbonisation programme that takes into account fiscal sustainability.

Dimension of the internal energy market

The appropriate operation of the internal energy market primarily depends on three components: level of interconnection, or necessity of its increase, the level of market coupling, and its reduction of prices and price volatility, and the liquidity of the Budapest electricity and gas exchange.

Hungary is already significantly surpassing the EU target relating to electricity interconnection. It follows that the Government of Hungary does not consider it necessary to define a new quantified target. The increase of cross-border capacities, however, is justified, as an interconnected energy network operated with neighbouring countries improves the national security of supply.

Dimension of research, innovation and competitiveness

Hungary aims to maximise the ability of the Hungarian energy and RDI sectors to fulfil the energy and climate policy objectives of Hungary and the European Union. To this end Hungary assigns a priority to the objective of improving innovation, maximising the economic development opportunities underlying energy innovation and climate change. Related key sub-tasks of this process: development of the system integration of electricity generation capacities based on renewable sources, development of household and industrial scale energy storage technologies, support of the development of energy efficient technologies, digitisation and promotion of smart metering.

Key planned measures serving the above objectives:

- Climate-friendly transformation of the energy sector by reducing electricity generation methods with high GHG emissions and promoting solar energy
- Development of household-scale small power plants combined with smart metering and electricity storage
- Promotion of network electricity storage facilities with a larger capacity
- Ensuring of systemic demand for reserves in conformity with requirements arising from increasing PV panel capacities
- Greening of transport by supporting electromobility and developing rail and other public transportation vehicle fleets
- Promotion of the modernisation of household heating equipment and of the use of modern biomass based heating fuels to ensure the sustainable use of fuel wood

- Increasing the budget of energy efficiency programmes for energy management in buildings and improving the effectiveness of their distribution of funds
- Support of housing construction
- Development of the efficient generation of district heating based on renewable energy sources
- Promotion of industrial energy efficiency investments

3.6.2 REGION OF NORTH-HUNGARY

Northern Hungary is one of the seven Hungarian statistical regions located in the north-eastern part of the country. The region includes Borsod-Abaúj-Zemplén, Heves and Nógrád counties. In 2013, the Territorial Development Concept of Borsod-Abaúj Zemplén County was completed. The main purpose of the long-term county development plan for the period up to 2030 is to define the vision of Borsod-Abaúj-Zemplén County by 2030, as well as the overall objectives of regional development /regional policy and the system of strategic goals to achieve them.

In the concept, two strategic objectives - in line with the vision of the county - include proposals that impact energy supply: promoting the production and local use of energy from renewable sources, and promoting energy efficiency, and the sustainable use of unique natural and cultural resources. These goals are to maximize the use of renewable energy sources and increase energy efficiency.

In the case of renewable energy sources, the concept is based on the "local" natural features of the county: including biomass (based on agricultural by-products or afforestation), geothermal energy (based on thermal waters), hydropower (existing power plants) and wind power. Changes in the structure of energy supply systems and the use of energy from renewable sources on the ground can result from 1 village - 1 MW program. In fact, this can lead to a shift from 'centralized' power generation to a decentralized energy system, which, in addition to making energy cheaper, also enables communities to engage in energy trading.

At the same time, the concept suggests strengthening traditional energy production based on local carbon assets. The use of clean coal technology is based on greater efficiency in energy production and a significant reduction in carbon dioxide emissions. All this requires (re) opening coal mines, as the concept emphasizes.

From an economic point of view, it is primarily the increase of energy efficiency in the concept and the minimization of energy loss, since the costs and expenses can be significantly reduced.
The Environmental Protection Program of BAZ County can also be mentioned as a strategic document. Objective 3 of the Program: promoting resource-efficient circular green economy development in Borsod-Abaúj-Zemplén County. The related topic is the sustainable energy management, with the following specific goals:
- Contribute to the improvement of the energy efficiency of public and residential buildings (modernization of heating, cooling and lighting systems, building insulation), in national or settlement programs for the integration of existing and new buildings into district heating, with particular regard to awareness-raising activities,
- Promote decentralized use of renewable energy sources (mainly solar cells, solar panels, heat pumps).

4 SHAPING OF THE REGIONAL ENERGY VISION TO 2050

"The vision serves as the uniting component that all stakeholders can refer to, meaning everyone from leading politicians to citizens and interest groups. This vision should be developed along with the local communities through citizen participation and discussion groups (Hernandez et al., 2018)."

The shaping of a long-term vision towards sustainability was the core topic of the task 5.4, in which the regional representatives participating in the EMPOWERING project's activities were called to work on.

4.1 METHODOLOGICAL APPROACH

The **vision** is the guiding principle for a local or a regional authority to work towards sustainability and low carbon economy transition.

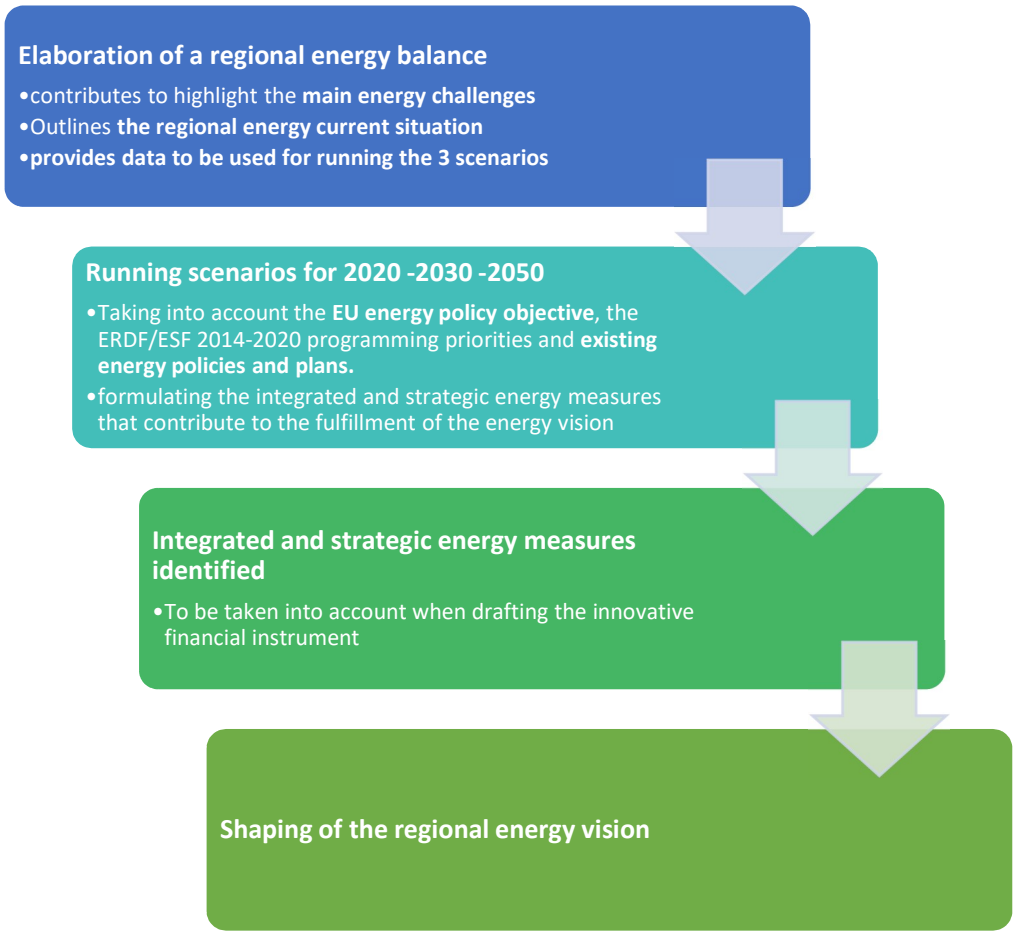
In order to translate the vision into actions is necessary to have knowledge on the regional current situation in terms of energy. The comparison of the current situation and the vision will be the basis for identifying which are the main energy challenges that the regional territory will face and the possible strategic actions to be implemented in order to reach the desired objectives.

The EMPOWERING Project Partners worked along with the regional representatives by providing them with the methodological approach and guidance throughout the all procedure.

By adapting the CoM methodological approach for the SECAP development, the energy balance for each region was elaborated (considering energy consumption and production on regional level -per sector using territorial/regional data and an estimation of the respective CO2 emissions).

After assessing the current situation, the regional representatives with the support of project partners elaborated three scenarios (2020, 2030 and 2050). For this action, the forecasting feature of the SF_5.2b "Empowering data collection template, BEI calculation and forecasting tool" was used.

Figure 4: Methodological approach for shaping



Scenarios definition & Integrated and strategic energy measures identified

The analysis carried out was either on NUTS 2 or NUTS 3 level depending on the administration level and the data availability.

Various data sources were used for the energy balance elaboration and regional energy analysis. Based on the regional energy balances (common format with CoM) drafted, CRES supported regional project partners on how to analyse and formulate the scenarios for 2020, 2030, 2050 using the EMPOWERING TOOL. Furthermore, CRES provided support on the identification of indicative measures per sector and the level of their impact based on the potential of final energy consumption mitigation.

Figure 5: Regional Energy Balance example (case of B-A-Z county)

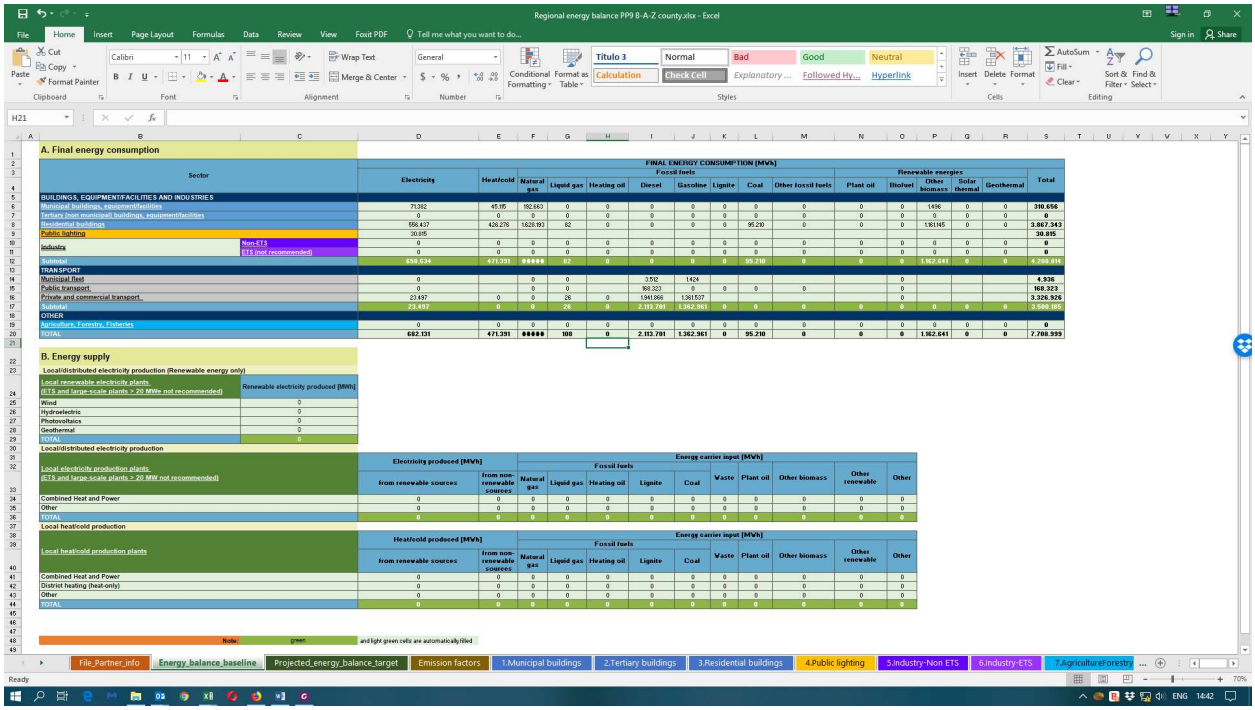
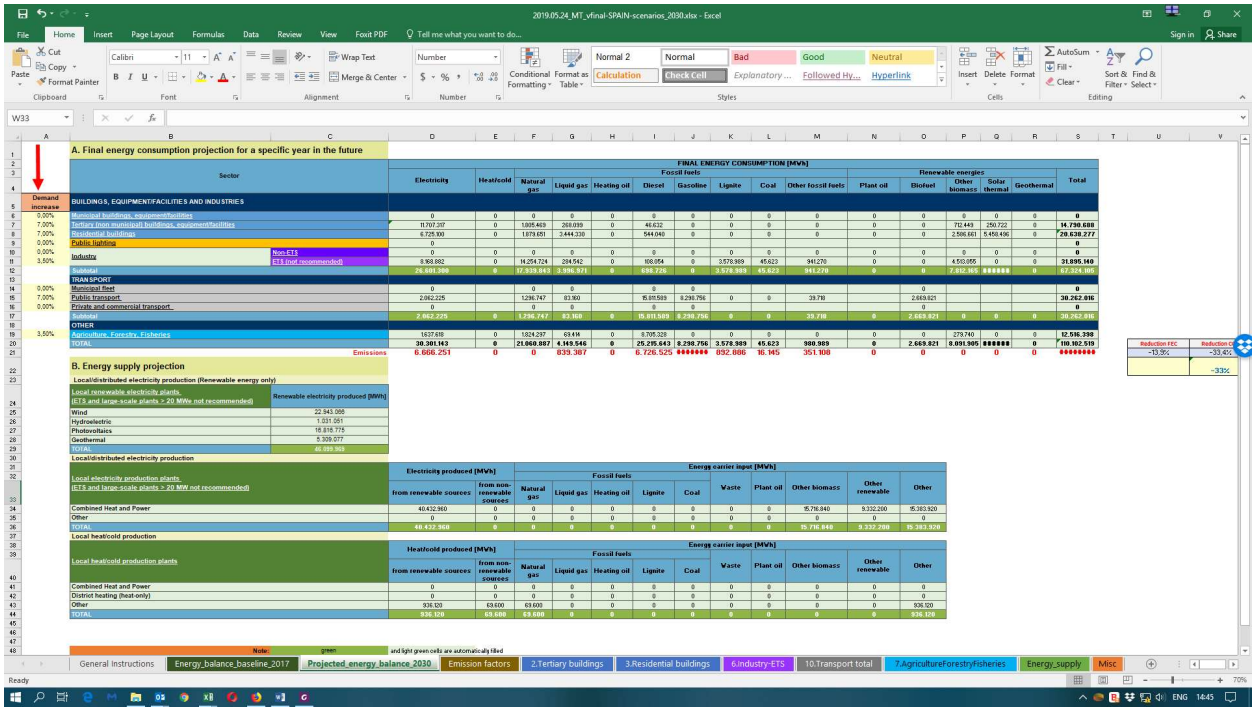


Figure 6: Screenshot of the scenarios result for target year 2030 (Example of the energy balance for 2030, Andalusia Region)



5 MARCHE REGION ENERGY VISION TO 2050 (ITALY)

Energy Vision:

The Marche Region strengthens its commitment to a policy aimed at protecting the environment and safeguarding the health and quality of the population's life. The local administration strongly believes that environmental sustainability and economic growth can go together promoting investments and job creations. The strategy for climate change mitigation foresees a progressive reduction of CO_2 emissions with the goal, of the 40% GHG-reduction target by 2030. The 2050's long term vision includes new targets for the decarbonisation, improvements in the capacity to adapt to unavoidable climate change impacts, and strategies to guarantee secure, sustainable and affordable energy.

Main Energy Challenges Identified:

a. Energy efficiency
b. Promote the use of the electricity source
c. Increase the use of renewable sources, in particular the solar and wind source
d. Energy self-sufficiency facilitated by self-consumption
e. Reduction of fossil fuel consumption
f. Reduction the GHG emission in the transport
g. Technological development and circular economy

Possible integrated and strategic energy measures Identified:

a. Increase the use of RES for electricity production due to the electricity consumption in the buildings and in the industrial sector
b. Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop
c. Reduce the consumption of diesel and gasoline in private and commercial transport with the implementation of energy efficiency interventions or the promotion of a more environmental friendly fuels such as LPG or natural gas
d. Reduce the energy consumption of the industrial sector mainly with the implementation of energy efficiency interventions
e. Increase the use of Heat Pumps for heating and cooling in the buildings

Background information & Conclusions:

The data shown below are calculated starting from the Regional BEI 2016 so the results achieved before this year are not considered. The following scenarios are elaborated with the Empowering tool made by CRES with the implementation of the strategic energy measures listed in the previous section. For each scenario, different implementation and saving coefficients are considered.

Estimation for each strategic energy measure and scenario:

RENEWABLE ENERGY PRODUCTION [MWh]									
	2020			2030			2050		
	Wind	Hydroelectric	Photovoltaics	Wind	Hydroelectric	Photovoltaics	Wind	Hydroelectric	Photovoltaics
Measure a	10.950	14.016	183.960	78.840	35.040	508.080	350.400	70.080	1.226.400

ENERGY EFFICIENCY						
MEASURES	2020		2030		2050	
	Implementations	Savings	Implementations	Savings	Implementations	Savings
Measure b	25%	20%	55%	20%	90%	40%
Measure c	25%	35%	75%	35%	90%	80%
Measure d	30%	30%	65%	45%	90%	70%
Measure e	50%	10%	70%	10%	100%	40%

- Scenario 2020:
  - *energy savings: 8%*
  - *RES: +12%*
  - *GHG emissions avoided: 11%*
- Scenario 2030:
  - *energy savings: 20%*
  - *RES: +35%*
  - *GHG emissions avoided: 27%*
- Scenario 2050:
  - *energy savings: 53%*
  - *RES: +93%*
  - *GHG emissions avoided: 67%*

6 ANDALUSIA REGION ENERGY VISION TO 2050 (SPAIN)

Energy Vision:

Andalusia 2050 Horizon establishes an ambitious goal of decarbonisation in the Andalusian energy sector, based on energy savings and efficiency and a notable increase in the use of regional renewable energy resources. It is a reference guide in the long term, always visible and coherent with the Andalusian priorities throughout the first half of the 21st century.

This objective must take into account the intermediate milestone to 2030, binding for the member states according to the conclusions of the European Council on the action framework on climate and energy, which includes a reduction of GHG of 40% with respect to the values of 1990 and a share of renewable energies within the total energy consumption of the EU in 2030, at least 27%.

Andalusia 2050 Horizon guides the future energy policies for the region in line with the reality of Spanish and European context, to have access to the culmination of an energy transition already initiated towards an energy model that respects the environment. A model that is safer, economic and wealth generator for the region.

The cornerstone of the objective and its success guarantees are to achieve a society that makes a very efficient use of the energy it consumes. In short, it is about achieving a very economically dynamic society and at the same time having a very small energy intensity. Achieving this objective requires the active participation of citizens It can not be a political-legislative objective that does not stand in the population. Citizens are the only actors that can guide a radical change towards an optimal use of energy. People with their behaviour are the engine of energy saving, for this reason the improvement of energy communication and training is the first axis of **Andalusia 2050 Horizon**.

In the horizon of the year 2050 will appear and coexist with very efficient technologies, but it is necessary to bet, as has been done in Andalusia, for a continuous development, where companies and research centres are the protagonists. In parallel, the most efficient technologies that have reached maturity must be available to the public and be introduced into society gradually throughout this time. Therefore, the use of innovative efficient technologies will be a continuous action throughout this period, becoming the second axis of **Andalusia 2050 Horizon**.

The transition towards a decarbonised energy system in the 2050 horizon needs to adopt different decisions (regulations, research activities, implementation of innovative projects, etc.) that approach the framework objective. The impulse of concrete actions throughout this period of time will be the third axis of **Andalusia 2050 Horizon**.

Main Energy Challenges Identified:

- Decarbonisation of economy
- 90% of primary energy covered with renewable energy
- Energy self-consumption

Possible integrated and strategic energy measures identified:

a) Residential sector

1. Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop.
   i. Energy efficiency interventions in the building envelop
   ii. Promotion of NG
2. Increase the use of RES for electricity production due to the considerably high electricity consumption in the buildings.
   i. Promotion of solar thermal
   ii. Promotion of photovoltaic solar energy
3. Increase the use of RES for heating and cooling in the buildings.
   i. Promotion of solar thermal

b) Transport sector

1. Reduce the consumption of diesel and gasoline in transport sector with the implementation of energy efficiency interventions or the promotion of a more environmental friendly fuels such as LPG or natural gas.
   i. Measures for more efficient use of means of transport
   ii. Measures for renewal of existing fleet of cars: Promotion of NG vehicles
   iii. Measures for renewal of existing fleet of cars: Promotion of electricity cars
   iv. Measures for renewal of existing fleet of cars: Reduce n. diesel cars
2. Increase penetration of biofuels in transport sector.

c) Tertiary sector

1. Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop.
   i. Energy efficiency interventions in the building envelop
   ii. Promotion of NG
   iii. Promotion of heat pumps

d) Agricultural and fisheries

1. Reduce the consumption of diesel in agriculture, forestry and fisheries with the implementation of energy efficiency interventions or the promotion of a more environmental friendly fuels such as LPG or natural gas.
   i. Promotion of a more environmental friendly fuels: NG
   ii. Promotion of a more environmental friendly fuels: LGP

Background information & Conclusions:

The main results in terms of energy savings, RES, GHG emissions avoided for the three scenarios

The methodological tool created for EMPOWERING has been used to calculate the scenarios for 2020-2030-2050 with the key actions identified.

Table 6. Hypothesis and data sources

	2020	2030	2050
Objectives	20% reduction respect 1990	33% reduction respect 2017 *In this scenario was possible to refer to the last year with available data.*	90% reductions respect 1990
Emission factors	Hypothetical National electric MIX: the same as 2017 emissions inventory (conservative assumption)	Hypothetical National electric MIX: 0,22 tCO2/MWh	Hypothetical National electric MIX: 0,15 tCO2/MWh Decarbonization objective with a residual consumption of NG for periods when demand overcome renewable generation
	Fossil fuels: Annex 7 of National Emissions Inventory 1990-2017		
Demand increase	Demand increase estimated: 0,6% growth 2017-2018 (0,6 x 3 years): 1,8%. A reduction due to awareness measures is considered: 1%	Demand increase estimated: 0,6% growth 2017-2018 (0,6 x 13 years): 7,8%. A reduction due to awareness measures is considered: 7%	Demand increase estimated until 2030: 0,6% annual From 2031 to 2050: 0,4% annual
	Reduced increase in Industry and Agriculture sectors		

The main results of % implementation of key actions, energy savings, reduction FEC and CO2 reduction for the 3 scenarios are shown below.

Scenario 2020

% implementation of key actions:

Tertiary buildings

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation						15%									
	Savings						20%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						15%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of heat pumps	Implementation						17%									
	Savings															
Substitution	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Residential buildings (include administrative buildings)

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation	27%		12%			15%									
	Savings	20%		20%			20%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						12%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of solar thermal	Implementation	10%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO
Promotion of photovoltaic solar energy	Implementation	7%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO

Transport (total: municipal fleet, public, private and commercial transport)

Key actions		Energy savings								
		Electricity	Fossil fuels							RES
			Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Measures for more efficient use of means of transport	Implementation				15%	15%				
	Savings				10%	10%				
	Substitution	NO								
Measures for renewal of existing fleet of cars -> Promotion of NG vehicles	Implementation				12%					
	Savings									
	Substitution	YES								
Measures for renewal of existing fleet of cars -> Promotion of electricity cars	Implementation				20%	10%				
	Savings									
	Substitution	YES								
Measures for renewal of existing fleet of cars -> Reduce n. diesel cars	Implementation				15%					
	Savings									
	Substitution	YES								
Increase penetration of biofuels in transport sector	Implementation				20%	20%				
	Savings				15%	15%				
	Substitution	NO								

Agriculture, Forestry, Fisheries

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Promotion of a more environmental friendly fuels -> NG	Implementation			5%												
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of a more environmental friendly fuels -> LGP	Implementation				5%											
	Savings															

Energy savings:

Tertiary buildings

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	-22.461	0	-20.862	0	0	54.404	0	0	0	0	0	0	0	0	0

Residential buildings (include administrative buildings)

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	3.012.845	0	-41.241	0	0	116.580	0	0	0	0	0	0	0	-2.286.534	0

Transport (total: municipal fleet, public, private and commercial transport)

Calculations net energy savings (MWh)	Electricity	Fossil fuels						RES
		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Total	-1.400.039	-734.109	0	19.388.020	630.193	0	0	0	0

Agriculture, Forestry, Fisheries

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	0	0	97.556	3.712	0	-112.745	0	0	0	0	0	0	0	0	0

Reduction FEC: -13,7%

CO2 reduction: -21%

Scenario 2030

% implementation of key actions:

Tertiary buildings

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation						30%									
	Savings						40%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						30%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of heat pumps	Implementation						35%									
	Savings															
Substitution	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Residential buildings (include administrative buildings)

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation	55%		25%			30%									
	Savings	40%		40%			40%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						25%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of solar thermal	Implementation	20%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO
Promotion of photovoltaic solar energy	Implementation	15%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO

Transport (total: municipal fleet, public, private and commercial transport)

Key actions		Energy savings									Energy supply								
		Electricity	Fossil fuels							RES	Electricity	Fossil fuels							RES
			Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Measures for more efficient use of means of transport	Implementation				20%	20%													
	Savings				10%	10%					0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO																	
Measures for renewal of existing fleet of cars -> Promotion of NG vehicles	Implementation				20%														
	Savings										0%	15%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES																	
Measures for renewal of existing fleet of cars -> Promotion of electricity cars	Implementation				30%	20%													
	Savings										10%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES																	
Measures for renewal of existing fleet of cars -> Reduce n. diesel cars	Implementation				20%														
	Savings										10%	5%	0%	0%	15%	0%	0%	0%	0%
	Substitution	YES																	
Increase penetration of biofuels in transport sector	Implementation				30%	30%													
	Savings				15%	15%					0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO																	

Agriculture, Forestry, Fisheries

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Promotion of a more environmental friendly fuels -> NG	Implementation			10%												
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of a more environmental friendly fuels -> LGP	Implementation				10%											
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO

Energy savings:

Tertiary buildings

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	-46.243	0	-41.723	0	0	119.689	0	0	0	0	0	0	0	0	0

Residential buildings (include administrative buildings)

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	7.666.614	0	2.009	0	0	287.564	0	0	0	0	0	0	0	-4.707.570	0

Transport (total: municipal fleet, public, private and commercial transport)

Calculations net energy savings (MWh)	Electricity	Fossil fuels						RES
		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Total	-2.047.145	-1.505.866	0	28.799.680	1.054.370	0	0	0	0

Agriculture, Forestry, Fisheries

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	0	0	195.112	7.424	0	-225.490	0	0	0	0	0	0	0	0	0

Reduction FEC: -17,3%

CO2 reduction: -38,1%

Scenario 2050

% implementation of key actions:

Tertiary buildings

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation						75%									
	Savings						40%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						75%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of heat pumps	Implementation						75%									
	Savings															
Substitution	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Residential buildings (include administrative buildings)

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Energy efficiency interventions in the building envelop	Implementation	75%		75%			80%									
	Savings	40%		40%			40%									
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of NG	Implementation						80%									
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of solar thermal	Implementation	75%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO
Promotion of photovoltaic solar energy	Implementation	75%														
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO

Transport (total: municipal fleet, public, private and commercial transport)

Key actions		Energy savings									Energy supply								
		Electricity	Fossil fuels							RES	Electricity	Fossil fuels							RES
			Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Measures for more efficient use of means of transport	Implementation				80%	80%													
	Savings				20%	20%					0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO																	
Measures for renewal of existing fleet of cars -> Promotion of NG vehicles	Implementation				80%														
	Savings										0%	15%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES																	
Measures for renewal of existing fleet of cars -> Promotion of electricity cars	Implementation				80%	80%													
	Savings										10%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES																	
Measures for renewal of existing fleet of cars -> Reduce n. diesel cars	Implementation				80%														
	Savings										30%	5%	0%	0%	15%	0%	0%	0%	0%
	Substitution	YES																	
Increase penetration of biofuels in transport sector	Implementation				80%	80%													
	Savings				15%	15%					0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO																	

Agriculture, Forestry, Fisheries

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Promotion of a more environmental friendly fuels -> NG	Implementation			80%												
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of a more environmental friendly fuels -> LGP	Implementation				80%											
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO

Energy savings:

Tertiary buildings

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	-99.093	0	-104.308	0	0	279.792	0	0	0	0	0	0	0	0	0

Residential buildings (include administrative buildings)

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	24.210.360	0	-28.744	0	0	870.464	0	0	0	0	0	0	0	-20.175.300	0

Transport (total: municipal fleet, public, private and commercial transport)

Calculations net energy savings (MWh)	Electricity	Fossil fuels							RES
		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Total	-12.706.176	-6.023.462	0	100.892.995	4.382.294	0	0	0	0

Agriculture, Forestry, Fisheries

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels								Renewable energies				
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Total	0	0	1.560.896	59.392	0	-1.803.923	0	0	0	0	0	0	0	0	0

Reduction FEC: -58,2%

CO2 reduction: -117,9%

7 NORTH-EAST REGION ENERGY VISION TO 2050 (ROMANIA)

The targets set at EU level for 2020, the contribution of energy policies to reducing impact of climate change, have been reached in advance by Romania. The commitment 20% reduction in emissions of GHG compared to the reference year 1990, Romania recorded in 2012 a reduction by 47.96%, compared to the EU level of 82.14%. Romania record in 2016 an increase by 25.03% in the balance of energy from renewable sources in consumption and a reduction in energy consumption of 41.6%, compared to 20% assumed.(Romanian Sustainable Development Strategy (SDG):Implementation of the 2030 Agenda in Romania)

The strategy takes into account a reduction in the Emissions by 75% in 2050, exceeding this level being conditional on reduced costs technologies more than anticipated in current projections.

Table 7 Renewable Energy Production in North-East, Romania

Indicators	Result/value	Description/remarks/data source
Use of renewable energy		
Share of renewable energy in gross final energy production[27] - *Share of total regional installed energy production capacity/potential*	***88.24%***	Information available at the level of North-East Region of Romania (Sources: www.transelectrica.ro and http://www.hidroelectrica.ro/Details.aspx?page=33). Data and information collected, compiled and processed at reference date of July 12, 2017 http://www.transelectrica.ro/widget/web/tel/sen-grafic/-/SENGrafic_WAR_SENGraficportlet
Electricity generated from renewable sources	*748.56 MWh (0.75 GWh)*	
Production of renewable energy by type	***Hydro-power**: 576.74 MWh; 67.94% of total regional electricity production* ***Wind-power**: 83.79 MWh; 9.87% of total regional electricity production* ***Photovoltaic power**: 27.19 MWh; 3.20% of total regional electricity production* ***Biomass power**: 57.37 MWh; 6.76% of total regional electricity production*	

[27] Given the fact that in Romania: 1. the regions are statistical NUTS2 and not administrative regions (no regional government); 2. there are no regional energy agencies, the energy-related issues & strategies are regulated and coordinated from national level; 3. regional energy suppliers and/or distributors does not provide any information concerning public/household/industry supplying/consumption data as the latter are considered subject to be confidential data that may negatively influence free-market competition – it was impossible to collect information concerning total energy /renewable energy consumption. This is the reason why all information was referred to/provided in relation to total existing potential/production capacity.

	***Biogas power**: 3.47 MWh; 0.46% of total regional electricity production*	
Climate change contribution		
CO2 Emissions	*4.16 metric tons/capita (2015)*	Source: World Data Atlas (Romania) https://knoema.com/atlas/Romania/CO2-emissions-per-capita https://knoema.com/atlas/Romania/CO2-emissions-intensity
CO2 Intensity	*205.6 kg per 1000 dollar GDP (2015)*	
Greenhouse reduction target of your region	*40% by 2030*	Country level (Romania); (Source: The Energy Strategy of Romania 2016-2030); http://www.mmediu.ro/app/webroot/uploads/files/2017-03-02_Strategia-Energetica-a-Romaniei-2016-2030.pdf

As far as targets are concerned, priorities and action plans the North-East region of Romania has adopted the similar goals with the national level.

Scenario for 2020

In the implementation of Regional Operational Program from the North-East Region a large amount of projects that regards energy efficiency are founded in sectors like: Transport, Municipal buildings, Residential buildings.

Demand increase	Sector	FINAL ENERGY CONSUMPTION [MWh]															
				Fossil fuels								Renewable energies					
		Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
-5%	Municipal buildings, equipment/facilities	19,583	70,360	164,882	0	40,485	0	0	98,320	0	0	0	0	0	7,844	0	401,474
5%	Tertiary (non municipal) buildings, equipment/facilities	142,489	8,336	242,663	0	0	0	0	0	0	0	0	0	0	18,731	0	412,220
-5%	Residential buildings	124,285	83,480	510,767	0	0	0	0	0	0	0	0	0	52,864	0	0	771,396
0%	Public lighting	11,303															11,303
0%	Industry (Non-ETS)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%	Industry (ETS (not recommended))	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	297,661	162,177	918,312	0	40,485	0	0	98,320	0	0	0	0	52,864	26,575	0	1,596,393
	TRANSPORT																
0%	Municipal fleet	0		0	0		2,666	866					0				3,532
0%	Public transport	1,245		0	0		14,674	85	0	0	0		1,845				17,849
0%	Private and commercial transport	0		0	3,500		466,798	362,237					4,449				836,983
	Subtotal	1,245	0	0	3,500	0	484,138	363,187	0	0	0	0	6,294	0	0	0	858,364
	OTHER																
0%	Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	298,906	162,177	918,312	3,500	40,485	484,138	363,187	98,320	0	0	0	6,294	52,864	26,575	0	2,454,758

(Source for BEI: 5 SECAP from North-East Region with Commitment for 2020 on CoM: Bacău, Botoșani, Moinești, Roman and Vaslui)

Scenario for 2030

Demand increase	Sector	FINAL ENERGY CONSUMPTION [MWh]															
				Fossil fuels								Renewable energies					
		Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
-10%	Municipal buildings, equipment/facilities	42,864	121,218	78,690	0	152,086	0	0	369,351	0	0	0	0	0	16,614	0	780,823
-5%	Tertiary (non municipal) buildings, equipment/facilities	228,349	43,022	718,960	0	0	0	0	0	0	0	0	0	0	0	0	990,331
5%	Residential buildings	502,693	658,889	589,858	0	0	0	0	0	0	363,033	0	0	363,033	0	0	2,477,506
0%	Public lighting	26,000															26,000
0%	Industry (Non-ETS)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%	Industry (ETS (not recommended))	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	799,906	823,129	1,387,508	0	152,086	0	0	369,351	0	363,033	0	0	363,033	16,614	0	4,274,660
	TRANSPORT																
-10%	Municipal fleet	0		0	0		3,375	1,092					0				4,467
-5%	Public transport	11,494		0	0		12,627	41	0	0	0		0				24,162
15%	Private and commercial transport	321		0	0		310,182	363,707					8				674,219
	Subtotal	11,815	0	0	0	0	326,184	364,840	0	0	0	0	8	0	0	0	702,848
	OTHER																
0%	Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	811,721	823,129	1,387,508	0	152,086	326,184	364,840	369,351	0	363,033	0	8	363,033	16,614	0	4,977,508

(Source for BEI: 11 SECAP from North-East Region with Commitment for 2030 on CoM: Bacău, Botoșani, Bicaz, Iași, Moinești, Piatra Neamț, Roman, Suceava, Siret, Vaslui and Victoria)

Scenario for 2050

Demand increase	Sector	FINAL ENERGY CONSUMPTION [MWh]														
		Electricity	Heat/cold	Fossil fuels							Renewable energies					Total
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	
	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES															
-10%	Municipal buildings, equipment/facilities	21,044	35,487	91,805	0	160,725	0	0	390,332	0	0	0	0	0	44,304	0	743,696
-5%	Tertiary (non municipal) buildings, equipment/facilities	158,826	30,170	718,960	0	0	0	0	0	0	0	0	0	0	0	0	907,956
5%	Residential buildings	378,298	193,520	589,858	0	0	0	0	0	0	363,033	0	0	363,033	0	0	1,887,742
0%	Public lighting	10,426															10,426
0%	Industry — Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%	Industry — ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	568,594	259,176	1,400,623	0	160,725	0	0	390,332	0	363,033	0	0	363,033	44,304	0	3,549,820
	TRANSPORT																
-10%	Municipal fleet	0		0	0		2,584	1,001					0				3,585
-5%	Public transport	10,232		0	0		-7,692	0	0	0	0		0				2,540
15%	Private and commercial transport	303		0	0		286,336	345,965					11				632,614
	Subtotal	10,535	0	0	0	0	281,227	346,966	0	0	0	0	11	0	0	0	638,739
	OTHER																
0%	Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	579,129	259,176	1,400,623	0	160,725	281,227	346,966	390,332	0	363,033	0	11	363,033	44,304	0	4,188,559

(Source for BEI: 11 SECAP from North-East Region with Commitment for 2030 on CoM: Bacău, Botoșani, Bicaz, Iași, Moinești, Piatra Neamț, Roman, Suceava, Siret, Vaslui and Victoria)

Energy Vision:

- The targets set at EU level for 2020, the contribution of energy policies to reducing impact of climate change, have been reached in advance by Romania. The commitment 20% reduction in emissions of GHG compared to the reference year 1990, Romania recorded in 2012 a reduction by 47.96%, compared to the EU level of 82.14%. Romania record in 2016 an increase by 25.03% in the balance of energy from renewable sources in consumption and a reduction in energy consumption of 41.6%, compared to 20% assumed.(Romanian Sustainable Development Strategy Implementation of the 2030 Agenda in Romania)
- The strategy takes into account a reduction in the emissions by 75% in 2050, exceeding this level being conditional on reduced costs technologies more than anticipated in current projections.

Main Energy Challenges Identified:

- a) Increase the energy efficiency in buildings
- b) Improve the mobility of population
- c) Adopt the smart grid Technologies
- d) Increasing the share of RES energy in the mix of electricity

Possible integrated and strategic energy measures Identified:

- a) Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop – HIGH impact.
- b) Reduce the consumption of diesel and gasoline in private and commercial transport with the implementation of energy efficiency interventions or the promotion of a more environmental-friendly fuels such as LPG or natural gas – HIGH impact.
- c) Reduce the consumption of diesel and gasoline in public transport and municipal fleet with the implementation of energy efficiency interventions or the promotion of a more environmental-friendly fuels such as LPG or natural gas – LOW impact.
- d) Increase the use of RES for electricity production due to the electricity consumption in the buildings and in the industrial sector – MEDIUM impact.
- e) Increase the use of RES for heating and cooling in the buildings – LOW impact.

- f) Increase penetration of biofuels in transport sector – MEDIUM impact.

Background information & Conclusions:

Scenario 2020: (description of the scenario)

The scenario 2020 is the projection of only 5 municipalities from our area and it shows that:

Energy savings – 768989 Mw/h

RES production - 93,596 Mw/h

B. Energy supply projection

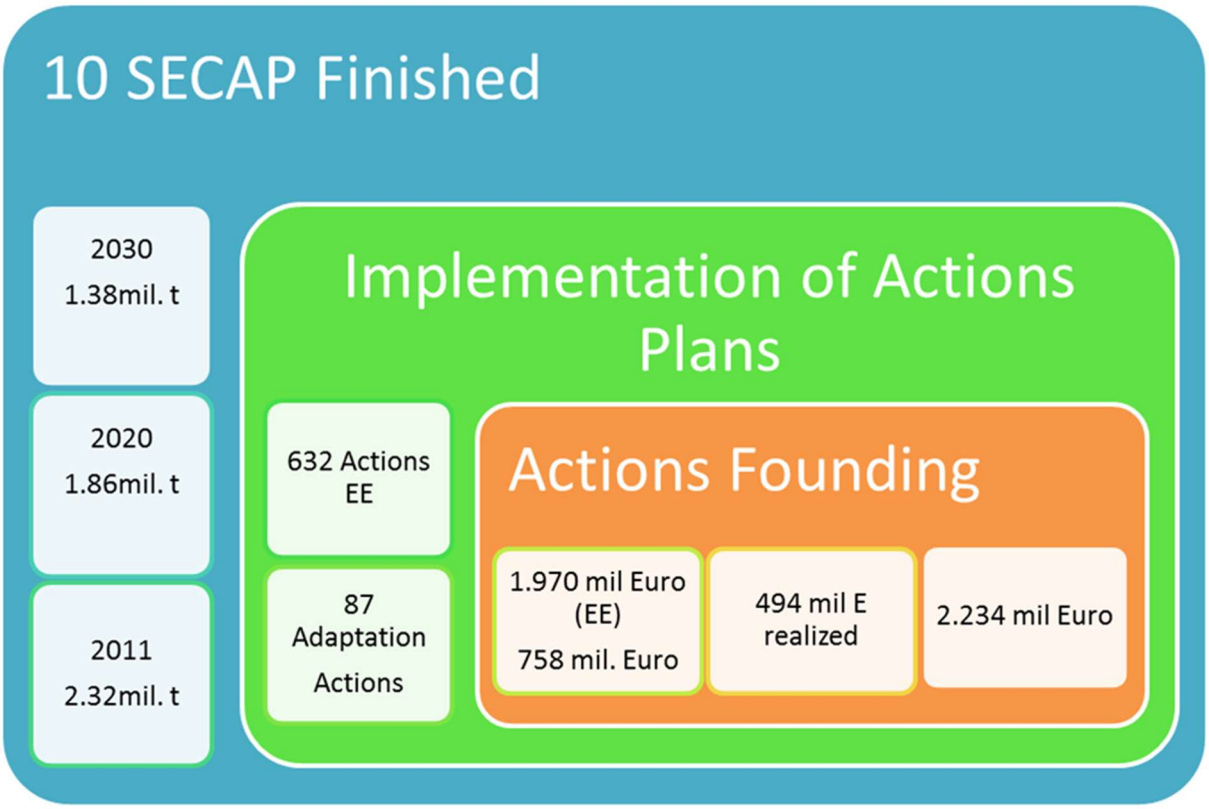
Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	200
Hydroelectric	91,896
Photovoltaics	1,500
Geothermal	0
TOTAL	93,596

GHG emissions avoided 235310 t CO_2 (2016, Romanian mix 1 Mw/h = 306 kg CO_2)

Scenario 2030: (description of the scenario)

The scenario 2030 is the projection of only 11 municipalities from the region and it shows that:



Energy savings – 3241300 Mw/h

RES production - 488904 Mw/h

B. Energy supply projection	
Local/distributed electricity production (Renewable energy only)	
Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	200
Hydroelectric	479,704
Photovoltaics	9,000
Geothermal	0
TOTAL	488,904

GHG emissions avoided 991837 t CO2 (2016, Romanian mix 1 Mw/h = 306 kg CO_2)

Scenario 2050: (description of the scenario)

The scenario 2050 is the projection of only 11 municipalities from our area and it shows that:

Energy savings – 4030249 Mw/h

RES production - 494,660 Mw/h

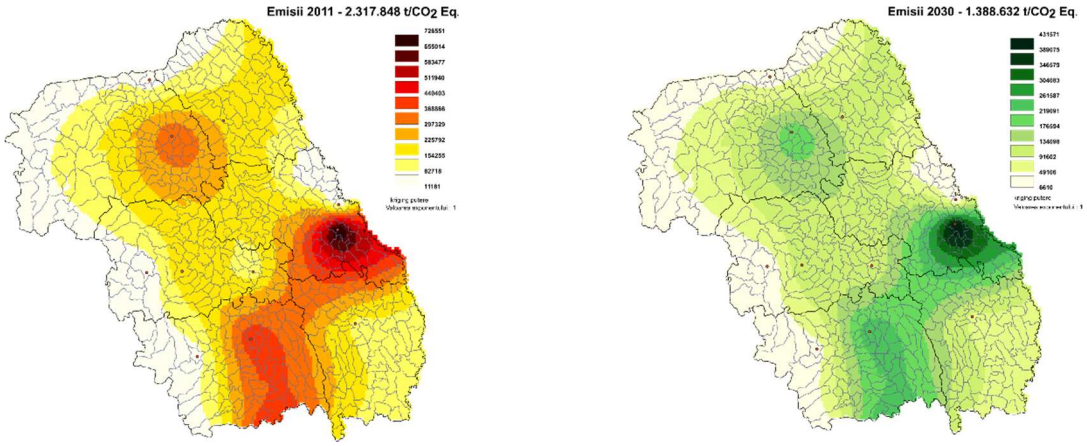


Figure 7 GHG Emission in 2011 A (2.32 mil. t.) And 2030 B (1.38 mil. t.)

B. Energy supply projection	
Local/distributed electricity production (Renewable energy only)	
Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	500
Hydroelectric	483,160
Photovoltaics	11,000
Geothermal	0
TOTAL	494,660

GHG emissions avoided 1233256 t CO2 (2016, Romanian mix 1 Mw/h = 306 kg CO_2)

8 ISTRIA ENERGY VISION TO 2050 (CROATIA)

Energy Vision:

- Description: sustainable, energy independent and CO2 neutral system
- Main objectives:
  - to increase energy efficiency in public buildings as well as in housing sector
  - to increase the use of renewable energy sources in public buildings as well as in housing sector
  - to raise awareness and education level about the importance of energy efficiency and sustainable energy consumption
  - to support and promote more environmentally friendly means of transport
  - to promote energy efficiency, sustainable development, environmental protection and e-mobility as the imperatives of the 21st century

Main Energy Challenges Identified:

a. lack of human resources
b. unavailability of data
c. data exactness and credibility

Possible integrated and strategic energy measures Identified:

a. Increase the use of RES for electricity production due to the high electricity consumption in the buildings – HIGH impact.
b. Increase the use of RES for heating and cooling in the buildings – MEDIUM impact.
c. Substitute heating oil and other fossil fuels in the buildings with a more environmentally friendly fuels such as LPG or natural gas – HIGH impact.
d. Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop – HIGH impact.
e. Reduce the consumption of diesel and gasoline in private and commercial transport including municipal vehicles with the implementation of energy efficiency interventions or the promotion of a more environmental-friendly fuels such as LPG or natural gas – HIGH impact.
f. Increase penetration of biofuels in transport sector – LOW impact.

Background information & Conclusions:

Scenario 2020: (description of the scenario)

Projection of energy consumption was made for all three sectors of final energy consumption: buildings, transport sector and public lighting. The estimated share of building sector with measures implemented in 2020 is 56.49%, while the share of transport sector is 43.11% and

0.40% for the public lighting. Implementation of proposed measures results in energy savings as follows: 3.55% in buildings sector, 9.58% in transport sector and 0.65% in public lighting. In total, estimated energy savings in 2020 in comparison to 2017 are 6.24%.

Projections of CO2 emissions were made for all three sectors of final energy consumption: buildings, transport sector and public lighting. The estimated share of building sector with measures implemented in 2020 is 42.98%, while the share of transport sector is 56.70% and 0.32% for the public lighting. Implementation of proposed measures results in reduction of CO2 emissions as follows: 4.72% in buildings sector, 7.51% in transport sector and 0.65% in public lighting. In total, estimated reduction of CO2 emissions in 2020 in comparison to 2017 is 6.31%.

Scenario 2030: (description of the scenario)

Projection of energy consumption was made for all three sectors of final energy consumption: buildings, transport sector and public lighting. The estimated share of building sector with measures implemented in 2030 is 64.44%, while the share of transport sector is 35.13% and 0.44% for the public lighting. Implementation of proposed measures results in energy savings as follows: 31.63% in buildings sector, 54.22% in transport sector and 32.75% in public lighting. In total, estimated energy savings in 2030 in comparison to 2017 are 41.74%.

Projections of CO2 emissions were made for all three sectors of final energy consumption: buildings, transport sector and public lighting. The estimated share of building sector with measures implemented in 2030 is 42.27%, while the share of transport sector is 57.40% and 0.33% for the public lighting. Implementation of proposed measures results in reduction of CO2 emissions as follows: 40.01% in buildings sector, 40.05% in transport sector and 32.75% in public lighting. In total, estimated reduction of CO2 emissions in 2030 in comparison to 2017 is 40.01%.

Scenario 2050: (description of the scenario)

On national level there was made the Draft of the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050 [Proposal of a Low Carbon Development Strategy of the Republic of Croatia – for public consultations, Ministry of Environmental Protection and Energy, 2018]. There were three scenarios simulated, scenario 0 (S0) – business as usual, scenario 1 (S1) – fast energy transition and scenario 2 (S2) – moderate energy transition. Table gives the comparison of the scenarios for the year 2050.

The Republic of Croatia goals	**Initial state**	**S0**	**S1**	**S2**
Indicator / Year	2016/2017*	2050	2050	2050
Expected savings in GHG emissions**	21.80%	49.30%	74.40%	64.30%

Change in indirect energy consumption* **	-7%	-3.80%	-28.60%	-15%

*initial state is 2017, except for the emissions for which 2016 is relevant
**in comparison to emissions in 1990
***in comparison to energy consumed in 2005

The region of Istria envisages following the national goals as a part of the Republic of Croatia.

9 REGION OF CENTRAL MACEDONIA ENERGY VISION TO 2050 (GREECE)

Energy Vision:

The Region of Central Macedonia (RCM) has structured it Regional Operational Programme 2014-2020 around an ambitious set of objectives more specifically for addressing climate change challenges actions were designed for:

- Transition towards low carbon economy
- Adaptation of climate change and risk prevention/management
- Environmental protection and rational use of resources
- Sustainable mobility and network infrastructure

Building upon this, RCM elaborated a long term vision to shift to a sustainable energy system that relies on maximizing the RES penetration and energy efficiency improvement.

Main Energy Challenges Identified:

The main energy challenges identified:

1. **Improving energy efficiency by refurbishing public buildings.**
2. **Applications of bioclimatic design criteria in new and existing buildings, shell interventions and functional characteristics of the building, with priority being given to large energy-intensive buildings such as: school buildings, gyms, swimming pools etc .**
3. **Promotion of central solar thermal systems in public buildings and public infrastructures.**
4. **Promoting the use of other RES, such as shallow low enthalpy geothermal power in public buildings.**
5. Promotion of High Efficiency Heat (CHP) (eg in hospitals).
6. Traffic management with intelligent transport systems (eg Traffic Management Center).
7. Interconnection of the Public Transport Facilities with mild transport and infrastructure of the city (parking, pedestrian walkways, bicycle paths etc.).
8. Selective catalytic reduction and particulate filters in public motor vehicles.
9. **Introduction and extension of gas application to buses, exploration and other public heavy goods vehicles - Further encourage the use of hybrid vehicles in means of Public Transport.**
10. **Emission limitation technologies in fuels, promoting "clean" low sulfur fuels such as Biodiesel and Bioethanol.**
11. Creation of infrastructure for the development and expansion of urban sea transport in Thermaikos gulf.
12. Creation of cycle paths, pedestrian and mild streets.
13. Implementation of the Management Plans of the Water Districts concerned and the relevant Measures Program for River Basin Districts.
14. River estuary management.
15. Implementation of plans for the management of an international river basin.
16. Implementation of plans to rehabilitate degraded basins (eg lakes).

17. Improve soil management, surface water retention and environmental protection by supporting practices that prevent soil degradation, such as maintaining natural cover in green etc.
18. Support for Integrated Coastal Zone Management Plans Study and promotion of protection projects (eg shields, canopies, reefs, breakwaters), rehabilitation and stabilization projects.
19. Implementation of Flood Risk Management Plans per river basin.
20. Investments, for example, for the formation of rivers / torrents / lakes, for the strengthening of rivers, streams and lakes, etc.
21. Construction of flood protection works in urban and peri-urban areas.
22. Investments to prevent and deal with fires.
23. Strengthen structures and infrastructures of civil protection and risk management bodies associated with climate change.
24. Strengthening systems and equipment for policy makers to prevent and deal with the effects of earthquakes.
25. Actions for the implementation of the Management Plans of the relevant Water Districts, mainly with regard to water and drinking water infrastructure (quality, loss reduction, rational management, etc.).
26. Interventions in World Heritage sites, archaeological sites and monuments, museum infrastructures, as well as new emerging poles of tourist interest, destinations that attract the interest of visitors from the new tourist markets, to ecotourism routes and networks.
27. Actions to protect, rationalize and promote biodiversity in Central Macedonia and Natura 2000 areas.
28. Promotion of rehabilitation projects in specific areas, rehabilitation or exploitation of abandoned industrial areas within urban centers, Action Plans for the treatment of air pollution and noise in urban areas, implementation of priority projects/urban interventions for the implementation of measures of the approved Schemes Action Plan, Spatial Planning and Special Spatial Intervention Frameworks, through Integrated Plans.
29. Promoting innovative solutions to environmental protection and innovative applications to resource efficiency.

Possible integrated and strategic energy measures Identified:

Combining the above mentioned energy challenges that RCM has to face with the methological tool that CRES created for the data collection and BEI calculation that also forecast and shape the energy vision to 2050, RCM identified and concluded to specific energy measures that can shape it's energy vision for 2020, 2030 and 2050. These measures per sector are:

1. **Interventions in building envelope** at sectors of **Municipal Buildings**, **Tertiary Buildings** and **Residential Buildings**.
2. **Promotion of heat pumps** at sectors of **Tertiary Buildings**.
3. **Promotion of NG** at sectors of **Municipal Buildings**, **Tertiary Buildings** and **Residential Buildings.**

4. **Promotion of solar thermal** at sectors of **Municipal Buildings** and **Residential Buildings**.
5. **Promotion of NG vehicles** at sectors of **Municipal Fleet**, **Private and Commercial Fleet** and **Public Transport**.
6. **Promotion of more efficient vehicles** at sectors of **Municipal Fleet** and **Public Transport**.
7. **Promotion of electricity vehicles** at sectors of **Municipal Fleet**, **Private and Commercial Fleet** and **Public Transport**.

Moreover, two more measures are also proposed, in order to produce electricity production through renewable energy resources and to achieve **production of electricity of RES**:

1. The installation of **Wind parks** and
2. The installation of **Photovoltaic stations.**

Background information & Conclusions:

The energy balance that Region of Central Macedonia elaborated, is based on the methodological approach for the SECAP development, by the CoM.

The data that were used for formulating the "Regional SEAP" was gathered from the individual SEAPs of the major municipalities of RCM. These municipalities are:

RCM made the assumption that the summed data of the above mentioned SEAPs represent almost the 80% of the energy data, population and economic activity of the whole RCM and consequently of the "Regional SEAP". Based on this, the data was translated to 100% of the region and the final data of the "Regional SEAP" was produced.
Given these assumptions with regards to the "Regional SEAP", three different scenarios for 2020, 2030 and 2050 were elaborated.

With the measures that described to the above paragraph, the expected results in terms of energy savings, RES and GHG emissions for the three scenarios are as follows:

Scenario 2020

The sectors that affected and formulated the targets and results of scenario 2020 are: a) Municipal buildings, b) Tertiary buildings, c) Residential buildings, d) Public lighting, e) Municipal fleet, f) Private and commercial fleet and g) Public transport.

Scenarios included the measure 'Interventions in building envelope' at 15% of the municipal buildings that results 10% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings. Another measure included is the 'Promotion of NG' substituting 'heating oil' at 15% of the municipal buildings.

Concerning Tertiary buildings "Interventions in building envelope" at 10% of them will cause 25% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings.

Another measure that was included is the 'Promotion of NG' substituting 'heating oil' at 15% of the Tertiary buildings.

A third measure that applied to Tertiary buildings is the promotion of heat pumps that will substitute heating oil at 25% of Tertiary buildings.

Concerning residential buildings "Interventions in building envelope" at 5% of them will cause 10% savings at use of electricity and 40% savings at use of natural gas, heating oil and biomass in the specific buildings. The installation of solar thermal for domestic hot water leads to 5% reduction of the consumed electricity.

As regards Public lighting 30% the installation of high efficient systems will lead to 75% of energy savings.

A variety of measures are also applied to the sector of Municipal fleet. 10% and 5% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively. Moreover, the 'Promotion of more efficient vehicles' at 10% of those that use diesel will bring 30% energy savings.

Regarding the passenger and commercial fleet, 2% of the vehicles that consume diesel and 2% of the vehicles that consume gasoline will be replaced by NG and electricity vehicles respectively.

Finally in the 'Public Transport' sector. three measures namely: 'Promotion of NG vehicles', 'Promotion of electricity vehicles' and 'Promotion of electricity vehicles' are going to be applied.

5% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively.

Finally with the last measure the 'Promotion of more efficient vehicles' at 10% of those that use diesel, will bring 25% energy savings.

According to the selection of measures (as described above) and the implementation of them to methodological tool, this will lead (compared to baseline 2016) to a reduction of C02 at -25% and a reduction of FEC -3% for 2020.

Scenario 2030

The sectors that affected and formulated the targets and results of scenario 2040 are: a) Municipal buildings, b) Tertiary buildings, c) Residential buildings, d) Public lighting, e) Municipal fleet, f) Private and commercial fleet and g) Public transport.

At the scenario was applied the measure 'Interventions in building envelope' at 20% of the municipal buildings that results 10% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings.

Another measure that applied is the 'Promotion of NG' substituting 'heating oil' at 20% of the municipal buildings.

Concerning Tertiary buildings "Interventions in building envelope" at 15% of them will cause 25% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings.

Another measure that applied is the 'Promotion of NG' substituting 'heating oil' at 20% of the Tertiary buildings.

A third measure that applied to Tertiary buildings is the 'promotion of heat pumps' that will substitute heating oil at 30% of Tertiary buildings.

Concerning residential buildings "Interventions in building envelope" at 10% of them will cause 10% savings at use of electricity and 40% savings at use of natural gas, heating oil and biomass in the specific buildings. The 'installation of solar thermal' for domestic hot water leads to 10% reduction of the consumed electricity.

At sector of Public lighting 40% the installation of high efficient systems will lead to 75% of energy savings.

A variety of measures are also applied to the sector of Municipal fleet. 20% and 10% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively. Moreover, the 'Promotion of more efficient vehicles' at 20% of those that use diesel will bring 30% energy savings.

Regarding the passenger and commercial fleet, 5% of the vehicles that consume diesel and 5% of the vehicles that consume gasoline will be replaced by NG and electricity vehicles respectively.

Finally in the 'Public Transport'sector three measures: 'Promotion of NG vehicles', 'Promotion of electricity vehicles' and 'Promotion of electricity vehicles'are going to be applied.

10% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively.

Finally with the last measure the 'Promotion of more efficient vehicles' at 15% of those that use diesel, will bring 25% energy savings.

According to the selection of measures (as described above) and the implementation of them to methodological tool we lead (compared to baseline 2016) to a reduction of C02 at -29% and a reduction of FEC -5% for 2030.

Scenario 2050

The sectors that affected and formulated the targets and results of scenario 2050 are: a) Municipal buildings, b) Tertiary buildings, c) Residential buildings, d) Public lighting, e) Municipal fleet, f) Private and commercial fleet and g) Public transport.

At the scenario was applied the measure 'Interventions in building envelope' at 25% of the municipal buildings that results 10% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings.

Another measure that applied is the 'Promotion of NG' substituting 'heating oil' at 25% of the municipal buildings.

Concerning Tertiary buildings "Interventions in building envelope" at 20% of them will cause 25% savings at use of electricity and 40% savings at use of natural gas and heating oil in the specific buildings.

Another measure that applied is the 'Promotion of NG' substituting 'heating oil' at 25% of the Tertiary buildings.

A third measure that applied to Tertiary buildings is the 'promotion of heat pumps' that will substitute heating oil at 35% of Tertiary buildings.

Concerning residential buildings, "Interventions in building envelope" at 15% of them will cause 10% savings at use of electricity and 40% savings at use of natural gas, heating oil and biomass in the specific buildings. The 'installation of solar thermal' for domestic hot water leads to 15% reduction of the consumed electricity.

In the Public lighting sector 50% the installation of high efficient systems will lead to 75% of energy savings.

A variety of measures are also applied to the sector of Municipal fleet. 30% and 30% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively. Moreover, the 'Promotion of more efficient vehicles' at 15% of those that use diesel will bring 40% energy savings.

Regarding the passenger and commercial fleet, 10% of the vehicles that consume diesel and 10% of the vehicles that consume gasoline will be replaced by NG and electricity vehicles respectively.

Finally in the 'Public Transport sector ' three measures: 'Promotion of NG vehicles', 'Promotion of electricity vehicles' and 'Promotion of electricity vehicles'.are going to be applied

15% of the vehicles that consume diesel will be replaced by NG and electricity vehicles respectively.

Finally with the last measure the 'Promotion of more efficient vehicles' at 25% of those that use diesel, will bring 25% energy savings.

According to the selection of measures (as described above) and the implementation of them to methodological tool we lead (compared to baseline 2016) to a reduction of C02 at -35% and a reduction of FEC -8% for 2050.

10 REGION OF NORTH-HUNGARY ENERGY VISION TO 2050 (HUNGARY)

Energy Vision:

- The region after decades of economic reconstruction –the former polluted industrial area with high emissions– will consciously take a climate-friendly, energy-efficient path towards socio-economic renewal and will become one of the country's flagship areas for climate-conscious and green economic development, achieving objectives such as liveable and healthy communities, as well as increased resilience to extreme weather conditions.
- Main objectives are:
    - electricity generation from renewable energy sources

- low CO_2-emission modes of transport
- energy efficient buildings (energy efficient new construction, building refurbishment)

Main Energy Challenges Identified:

- a)Electricity consumption is significant
- b)The use of coal in residential buildings is high
- c)The rest of the building stock is 40-80 years old, thus energy inefficient

Possible integrated and strategic energy measures Identified:

a) Increase considerably the use of RES for electricity production due to the relatively significant electricity consumption – MEDIUM impact.
b) Minimize the consumption of coal (lignite) in the buildings of the residential sector probably through its substitution with RES (including heat pumps, excluding biomass) – LOW impact.
c) Increase the use of RES for heating and cooling in the buildings (including heat pumps, PVs, excluding biomass) – LOW impact.
d) Reduce the energy consumption of the buildings mainly with the implementation of energy efficiency interventions in the building envelop – HIGH impact.
e) Reduce the consumption of diesel and gasoline in private and commercial transport with the implementation of energy efficiency interventions or the promotion of a more environmental-friendly fuels such as LPG or natural gas (and electricity under the precondition that the penetration of RES will be increased) – HIGH impact.
f) Reduce the consumption of diesel in public transport with the implementation of energy efficiency interventions or the promotion of a more environmental-friendly fuels such as LPG or natural gas (and electricity under the precondition that the penetration of RES will be increased) – LOW impact.
g) Increase penetration of biofuels in transport sector – MEDIUM impact.

Background information & Conclusions:

the main results in terms of energy savings, RES, GHG emissions avoided for the three scenarios

- Scenario 2020: (description of the scenario)

MUNICIPAL BUILDINGS

✓ Interventions in building envelope result in:

Key actions		Electricity	Heat/cold	Fossil fuels			Renewable energies		
				Natural gas	Liquid gas	Heating oil	Other biomass	Solar thermal	Geothermal
Interventions in building envelope	Implementation	45%	45%	45%		45%	45%		
	Savings	10%	40%	40%		40%	40%		

Calculations energy savings (MWh)	Electricity	Heat/cold	Fossil fuels			Renewable energies			Final energy savings (MWh)	CO2eq emission reduction (t)	RES production (MWh)	Cost/Effectiveness Ratio (€/tCO2eq)
			Natural gas	Liquid gas	Heating oil	Other biomass	Solar thermal	Geothermal				
Interventions in building envelope	3212	8121	34679	0	0	269	0	0	46 282	7005	0	0

RESIDENTIAL BUILDINGS

✓ Interventions in building envelope, promotion of biomass result in:

Key actions		Electricity	Heat/cold	Fossil fuels								Renewable energies				
				Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal
Interventions in building envelope	Implementation	20%	20%	20%										20%		
	Savings	10%	40%	40%										40%		
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of biomass for substituting coal	Implementation									30%						
	Savings															
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO
Promotion of biomass for substituting liquid	Implementation				30%											
	Savings															
Substitution	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	NO

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels							Renewable
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other biomass
Total	11129	34102	119732	25	0	0	0	0	28563	70629

MUNICIPAL FLEET

- ✓ Interventions in Promotion of NG vehicles;
- ✓ Promotion of more efficient vehicles
- ✓ Promotion of electricity vehicles result in:

Key actions		Energy savings						Energy supply					
		Electricity	Fossil fuels				RES	Electricity	Fossil fuels				RES
			Natural gas	Liquid gas	Diesel	Gasoline	Biofuel		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation				10%								
	Savings							0%	80%	0%	0%	0%	0%
	Substitution	YES											
Promotion of more efficient vehicles	Implementation				20%								
	Savings				30%			0%	0%	0%	0%	0%	0%
	Substitution	NO											
Promotion of electricity vehicles	Implementation				10%								
	Savings							40%	0%	0%	0%	0%	0%
	Substitution	YES											

Calculations net energy savings (MWh)	Electricity	Fossil fuels				RES
		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Total	-133	-267	0	867	0	0

PRIVATE AND COMMERCIAL FLEET

- ✓ Promotion of NG vehicles
- ✓ Promotion of electric vehicles
- ✓ Promotion of more efficient vehicles

Key actions		Energy savings						Energy supply					
		Electricity	Fossil fuels				RES	Electricity	Fossil fuels				RES
			Natural gas	Liquid gas	Diesel	Gasoline	Biofuel		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation			10%	10%	10%							
	Savings							0%	80%	0%	0%	0%	0%
	Substitution	YES											
Promotion of electricity cars	Implementation			10%	10%	10%							
	Savings							40%	0%	0%	0%	0%	0%
	Substitution	YES											
Promotion of more efficient vehicles	Implementation			20%	20%	20%							
	Savings			30%	30%	30%		0%	0%	0%	0%	0%	0%
	Substitution	NO											

Calculations net energy savings (MWh)	Electricity	Fossil fuels				RES
		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Total	-132137	-264274	7	504885	354000	0

PUBLIC TRANSPORT

- ✓ Promotion of NG vehicles
- ✓ Promotion of electric vehicles

✓ Promotion of more efficient vehicles result in:

Key actions		Energy savings	Energy supply								
		Fossil fuels	Electricity	Fossil fuels							RES
		Diesel		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Promotion of NG vehicles	Implementation	10%									
	Savings		0%	80%	0%	0%	0%	0%	0%	0%	100%
	Substitution	YES									
Promotion of electricity vehicles	Implementation	10%									
	Savings		40%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES									
Promotion of more efficient vehicles	Implementation	20%									
	Savings	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO									
Measure 4	Implementation										
	Savings		0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO									
Measure 5	Implementation										
	Savings		0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO									

Calculations net energy savings (MWh)	Electricity	Fossil fuels							RES
		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Total	-6733	-13466	0	42081	0	0	0	0	-16832

ENERGY SUPPLY

✓ wind parks
✓ photovoltaic stations

Local renewable electricity plants	Electricy Capacity (MW)				Load factor (%)				Electricy production (MWh)			
	Wind	Hydroelectric	Photovoltaics	Geothermal	Wind	Hydroelectric	Photovoltaics	Geothermal	Wind	Hydroelectric	Photovoltaics	Geothermal
Wind parks	50				25%				109 500	0	0	0
Photovoltaic stations			250				18%		0	0	394 200	0
Total	50	0	250	0					109 500	0	394 200	0

RES production (MWh)	109 500	0	394 200	0
CO2eq emission reduction (t)				
Cost (€)				
Cost/Effectiveness Ratio (€/tCO2eq)	0	0	0	0

- **Scenario 2030: (description of the scenario)**

MUNICIPAL BUILDINGS

✓ Interventions in building envelope result in:

Key actions		Electricity	Heat/cold	Fossil fuels			Renewable energies		
				Natural gas	Liquid gas	Heating oil	Other biomass	Solar thermal	Geothermal
Interventions in building envelope	Implementation	35%	35%	35%		35%	35%		
	Savings	10%	40%	40%		40%	40%		

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels			Renewable energies		
			Natural gas	Liquid gas	Heating oil	Other biomass	Solar thermal	Geothermal
Total	2498	6316	26973	0	0	209	0	0

RESIDENTIAL BUILDINGS

✓ Interventions in building envelope, promotion of biomass result in:

Key actions		Electricity	Heat/cold	Fossil fuels			Renewable energies		
				Natural gas	Liquid gas	Coal	Other biomass	Solar thermal	Geothermal
Interventions in building envelope	Implementation	30%	30%	30%	30%		30%		
	Savings	10%	40%	40%	40%		40%		
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO
Promotion of biomass for substituting coal	Implementation					60%			
	Savings								
Substitution	YES	NO	NO	YES	NO	NO	NO	NO	NO
Promotion of biomass for substituting liquid	Implementation				60%				
	Savings								
Substitution	YES	NO	NO	NO	NO	NO	NO	YES	NO

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels						Renewable energies			
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other biomass	Solar thermal	Geothermal
Total	16693	51153	174337	59	0	0	0	0	57126	139337	-42	0

MUNICIPAL FLEET

- ✓ Interventions in Promotion of NG vehicles;
- ✓ Promotion of more efficient vehicles
- ✓ Promotion of electricity vehicles result in:

Key actions		Energy savings		Energy supply					
		Fossil fuels		Electricity	Fossil fuels				RES
		Diesel	Gasoline		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation	20%							
	Savings			0%	80%	0%	0%	0%	0%
	Substitution	YES							
Promotion of more efficient vehicles	Implementation	30%							
	Savings	30%		0%	0%	0%	0%	0%	0%
	Substitution	NO							
Promotion of electricity vehicles	Implementation	20%							
	Savings			40%	0%	0%	0%	0%	0%
	Substitution	YES							

Calculations net energy savings (MWh)	Electricity	Fossil fuels			
		Natural gas	Liquid gas	Diesel	Gasoline
Total	-281	-562	0	1721	0

PRIVATE AND COMMERCIAL FLEET

- ✓ Promotion of NG vehicles
- ✓ Promotion of electric vehicles
- ✓ Promotion of more efficient vehicles

Key actions		Energy savings			Energy supply					
		Fossil fuels			Electricity	Fossil fuels				RES
		Liquid gas	Diesel	Gasoline		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation	20%	20%	20%						
	Savings				0%	80%	0%	0%	0%	0%
	Substitution	YES								
Promotion of electricity cars	Implementation	20%	20%	20%						
	Savings				40%	0%	0%	0%	0%	0%
	Substitution	YES								
Promotion of more efficient vehicles	Implementation	40%	40%	40%						
	Savings	30%	30%	30%	0%	0%	0%	0%	0%	0%
	Substitution	NO								

Calculations net energy savings (MWh)	Electricity	Fossil fuels		
		Natural gas	Liquid gas	Diesel
Total	-264274	-528549	14	1009770

PUBLIC TRANSPORT

- ✓ Promotion of NG vehicles
- ✓ Promotion of electric vehicles
- ✓ Promotion of more efficient vehicles result in:

Key actions		Energy savings			Energy supply								
		Fossil fuels			Electricity	Fossil fuels							RES
		Diesel	Coal	Other fossil fuels		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Promotion of NG vehicles	Implementation	20%											
	Savings				0%	80%	0%	0%	0%	0%	0%	0%	100%
	Substitution	YES											
Promotion of electricity vehicles	Implementation	20%											
	Savings				40%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES											
Promotion of more efficient vehicles	Implementation	30%											
	Savings	25%			0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO											
Measure 4	Implementation												
	Savings				0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO											
Measure 5	Implementation												
	Savings				0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO											

Calculations net energy savings (MWh)	Electricity	Fossil fuels							RES
		Natural gas	Liquid gas	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel
Total	-13466	-26932	0	79953	0	0	0	0	-33665

ENERGY SUPPLY

- ✓ wind parks
- ✓ photovoltaic stations

Local renewable electricity plants	Electricy Capacity (MW)				Load factor (%)				Electricy production (MWh)			
	Wind	Hydroelectric	Photovoltaics	Geothermal	Wind	Hydroelectric	Photovoltaics	Geothermal	Wind	Hydroelectric	Photovoltaics	Geothermal
Wind parks	50				25%				109 500	0	0	0
Photovoltaic stations			250				18%		0	0	394 200	0
Total	50	0	250	0					109 500	0	394 200	0

RES production (MWh)	109 500	0	394 200	0
CO2eq emission reduction (t)				
Cost (€)				
Cost/Effectiveness Ratio (€/tCO2eq)	0	0	0	0

- **Scenario 2050: (description of the scenario)**

MUNICIPAL BUILDINGS

- ✓ Interventions in building envelope result in:

Key actions		Electricity	Heat/cold	Fossil fuels			Renewable energies		
				Natural gas	Liquid gas	Heating oil	Other biomass	Solar thermal	Geothermal
Interventions in building envelope	Implementation	45%	45%	45%		45%	45%		
	Savings	10%	40%	40%		40%	40%		
Substitution	NO	NO	NO	NO	NO	NO	NO	NO	NO

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels	Renewable energies		
			Natural gas	Other biomass	Solar thermal	Geothermal
Total	3212	8121	34679	269	0	0

RESIDENTIAL BUILDINGS

✓ Interventions in building envelope, promotion of biomass result in:

Key actions		Electricity	Heat/cold	Fossil fuels			Renewable energies
				Natural gas	Liquid gas	Coal	Other biomass
Interventions in building envelope	Implementation	40%	40%	40%	40%		40%
	Savings	10%	40%	40%	40%		40%
Substitution	NO	NO	NO	NO	NO	NO	NO
Promotion of biomass for substituting coal	Implementation					90%	
	Savings						
Substitution	YES	NO	NO	YES	NO	NO	NO
Promotion of biomass for substituting liquid	Implementation				90%		
	Savings						
Substitution	YES	NO	NO	NO	NO	NO	NO

Calculations net energy savings (MWh)	Electricity	Heat/cold	Fossil fuels			Renewable
			Natural gas	Liquid gas	Coal	Other biomass
Total	22257	68204	228941	87	85689	185783

MUNICIPAL FLEET

✓ Interventions in Promotion of NG vehicles;
✓ Promotion of more efficient vehicles
✓ Promotion of electricity vehicles result in:

Key actions		Energy savings			Energy supply					
		Fossil fuels			Electricity	Fossil fuels				RES
		Liquid gas	Diesel	Gasoline		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation		30%							
	Savings				0%	80%	0%	0%	0%	0%
	Substitution	YES								
Promotion of more efficient vehicles	Implementation		40%							
	Savings		30%		0%	0%	0%	0%	0%	0%
	Substitution	NO								
Promotion of electricity vehicles	Implementation		30%							
	Savings	30%	30%	30%	40%	0%	0%	0%	0%	0%
	Substitution	NO								

Calculations net energy savings (MWh)	Electricity	Fossil fuels				RES
		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Total	0	-801	0	1702	0	0

PRIVATE AND COMMERCIAL FLEET

✓ Promotion of NG vehicles
✓ Promotion of electric vehicles
✓ Promotion of more efficient vehicles

Key actions		Energy savings			Energy supply					
		Fossil fuels			Electricity	Fossil fuels				RES
		Liquid gas	Diesel	Gasoline		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Promotion of NG vehicles	Implementation	30%	30%	30%						
	Savings				0%	80%	0%	0%	0%	0%
	Substitution	YES								
Promotion of electricity cars	Implementation	30%	30%	30%						
	Savings				40%	0%	0%	0%	0%	0%
	Substitution	YES								
Promotion of more efficient vehicles	Implementation	50%	50%	50%						
	Savings	30%	30%	30%	0%	0%	0%	0%	0%	0%
	Substitution	NO								

Calculations net energy savings (MWh)	Electricity	Fossil fuels				RES
		Natural gas	Liquid gas	Diesel	Gasoline	Biofuel
Total	-396411	-792823	20	1456400	1021153	0

PUBLIC TRANSPORT

✓ Promotion of NG vehicles

- ✓ Promotion of electric vehicles
- ✓ Promotion of more efficient vehicles result in:

		Energy savings	Energy supply								
Calculations net energy savings (MWh)			Electricity	Fossil fuels						RES	
				Natural gas	Liquid gas	Diesel				Biofuel	
Total			-20199	-40398	0	117826				-50497	
vehicles	Substitution	YES									
Promotion of electricity vehicles	Implementation	30%									
	Savings		40%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	YES									
Promotion of more efficient vehicles	Implementation	40%									
	Savings	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Substitution	NO									

ENERGY SUPPLY

- ✓ wind parks
- ✓ photovoltaic stations

Local renewable electricity plants	Electricy Capacity (MW)		Load factor (%)			Electricy production (MWh)			
	Wind	Photovoltaics	Wind	Photovoltaics	Geothermal	Wind	Hydroelectric	Photovoltaics	Geothermal
Wind parks	50		25%			109 500	0	0	0
Photovoltaic stations		250		18%		0	0	394 200	0
Total	50	250				109 500	0	394 200	0

RES production (MWh)	109 500	0	394 200	0
CO2eq emission reduction (t)				
Cost (€)				
Cost/Effectiveness Ratio (€/tCO2eq)	0	0	0	0

11 CONCLUSIONS

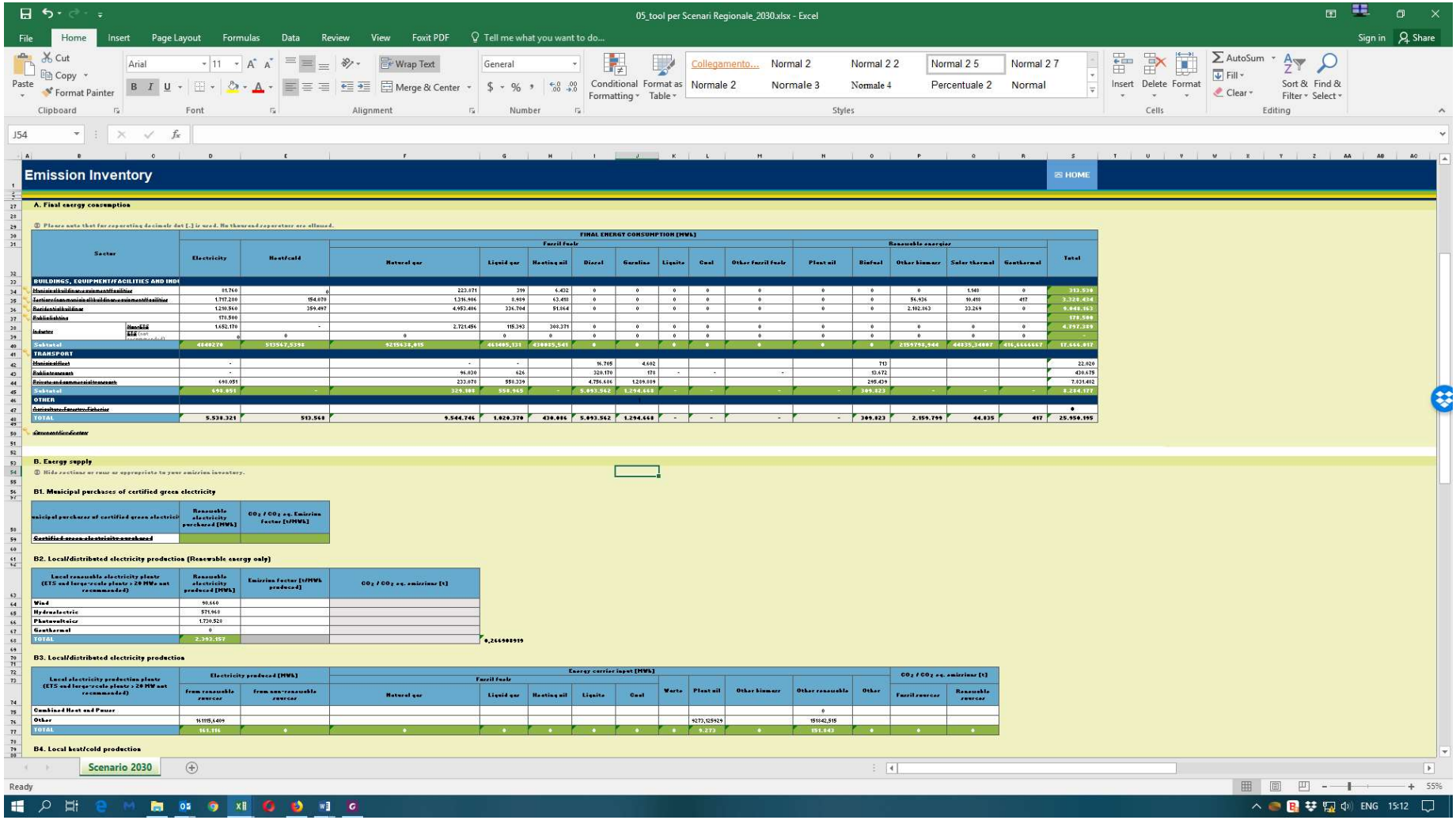
This document is meant to describe the processes followed by the regional project partners and the regional representatives participating in the EMPOWERING project in order to formulate an energy vision towards 2050.

Screenshots for 2030

ANNEX

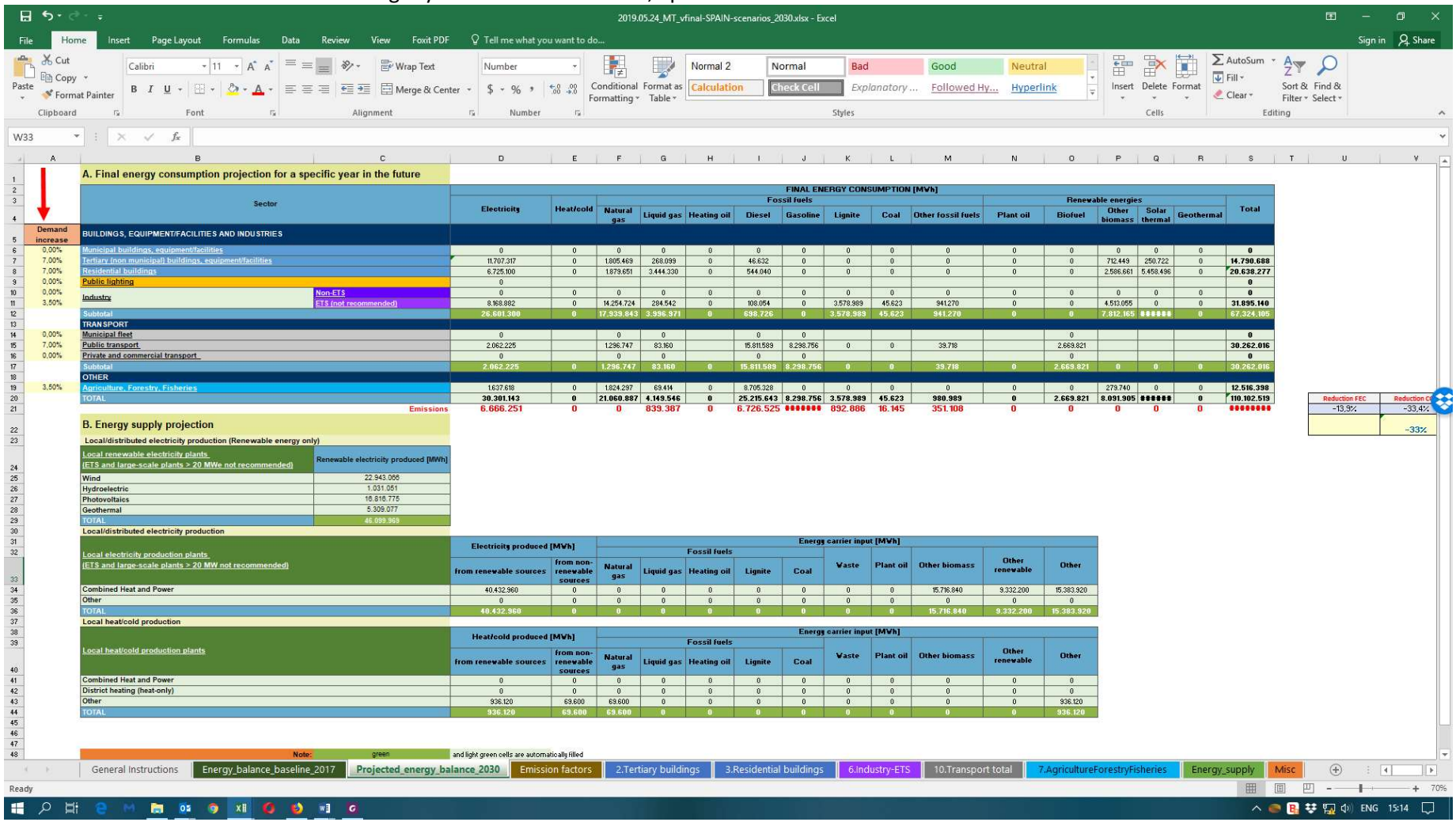
ANNEX I

Screenshot of the scenarios result for target year 2030 for Marche Region, Italy



ANNEX II

Screenshot of the scenarios result for target year 2030 for Andalusia, Spain



2019.05.24_MT_vfinal-SPAIN-scenarios_2030.xlsx - Excel

A. Final energy consumption projection for a specific year in the future

Demand increase	Sector	FINAL ENERGY CONSUMPTION [MWh]																
				Fossil fuels									Renewable energies					
		Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
0,00%	Municipal buildings, equipment/facilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7,00%	Tertiary (non municipal) buildings, equipment/facilities	11.707.317	0	1.805.469	268.099	0	46.632	0	0	0	0	0	0	712.449	250.722	0	14.790.688
7,00%	Residential buildings	6.725.100	0	1.879.651	3.444.330	0	544.040	0	0	0	0	0	0	2.586.661	5.458.496	0	20.638.277
0,00%	Public lighting	0															0
0,00%	Industry – Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3,50%	Industry – ETS (not recommended)	8.168.882	0	14.254.724	284.542	0	108.054	0	3.578.989	45.623	941.270	0	0	4.513.055	0	0	31.895.140
	Subtotal	26.601.300	0	17.939.843	3.996.971	0	698.726	0	3.578.989	45.623	941.270	0	0	7.812.165	######	0	67.324.105
	TRANSPORT																
0,00%	Municipal fleet	0		0	0		0	0					0				0
7,00%	Public transport	2.062.225		1.296.747	83.160		15.811.589	8.298.756	0	0	39.718		2.669.821				30.262.016
0,00%	Private and commercial transport_	0		0	0		0	0					0				0
	Subtotal	2.062.225	0	1.296.747	83.160	0	15.811.589	8.298.756	0	0	39.718	0	2.669.821	0	0	0	30.262.016
	OTHER																
3,50%	Agriculture, Forestry, Fisheries	1.637.618	0	1.824.297	69.414	0	8.705.328	0	0	0	0	0	0	279.740	0	0	12.516.398
	TOTAL	30.301.142	0	21.060.887	4.149.546	0	25.215.643	8.298.756	3.578.989	45.623	980.989	0	2.669.821	8.091.905	######	0	110.102.519
	Emissions	6.666.251	0	0	839.387	0	6.726.525	#######	892.886	16.145	351.108	0	0	0	0	0	########

Reduction FEC	Reduction E
-13,3%	-33,4%
	-33%

B. Energy supply projection

Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	22.943.066
Hydroelectric	1.031.051
Photovoltaics	16.818.775
Geothermal	5.309.077
TOTAL	46.099.969

Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	40.432.960	0	0	0	0	0	0	0	0	15.716.840	9.332.200	15.383.920
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	40.432.960	0	0	0	0	0	0	0	0	15.716.840	9.332.200	15.383.920

Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
District heating (heat-only)	0	0	0	0	0	0	0	0	0	0	0	0
Other	936.120	69.600	69.600	0	0	0	0	0	0	0	0	936.120
TOTAL	936.120	69.600	69.600	0	0	0	0	0	0	0	0	936.120

Note: green and light green cells are automatically filled

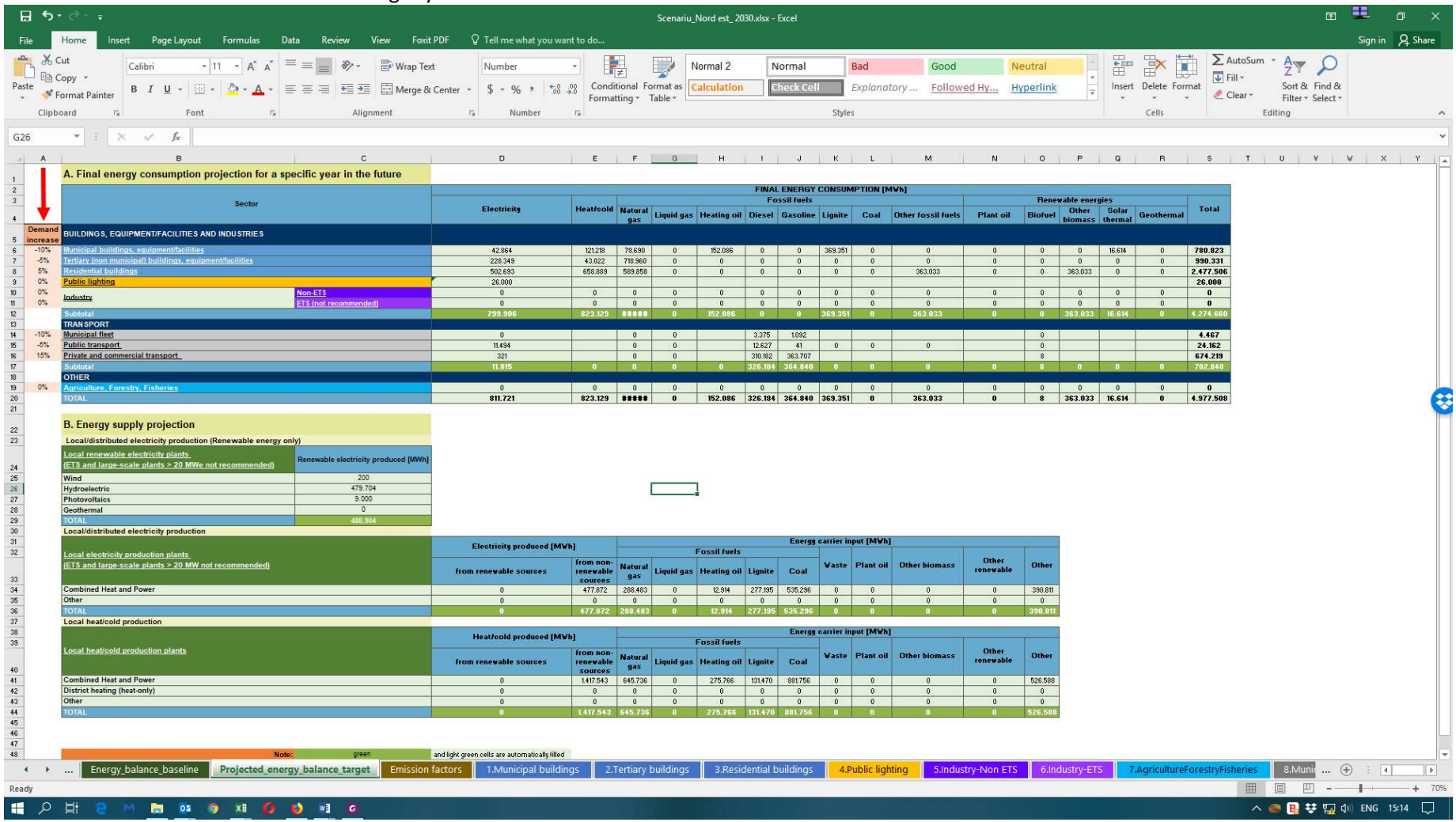
Sheet tabs: General Instructions | Energy_balance_baseline_2017 | Projected_energy_balance_2030 | Emission factors | 2.Tertiary buildings | 3.Residential buildings | 6.Industry-ETS | 10.Transport total | 7.AgricultureForestryFisheries | Energy_supply | Misc

Ready

ENG 15:14

ANNEX III

Screenshot of the scenarios result for target year 2030 for North East Romania



Scenariu_Nord est_ 2030.xlsx - Excel

A. Final energy consumption projection for a specific year in the future

Sector	FINAL ENERGY CONSUMPTION [MWh]																
	Electricity	Heat/cold	Fossil fuels								Renewable energies					Total
			Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	
Demand increase / BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
-10% Municipal buildings, equipment/facilities	42.864	121.218	78.690	0	152.086	0	0	369.351	0	0	0	0	0	16.614	0	780.823
-5% Tertiary (non municipal) buildings, equipment/facilities	228.349	43.022	718.960	0	0	0	0	0	0	0	0	0	0	0	0	990.331
5% Residential buildings	502.693	658.889	589.858	0	0	0	0	0	0	363.033	0	0	363.033	0	0	2.477.506
0% Public lighting	26.000															26.000
0% Industry — Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0% Industry — ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	799.906	823.129	#####	0	152.086	0	0	369.351	0	363.033	0	0	363.033	16.614	0	4.274.660
TRANSPORT																
-10% Municipal fleet	0		0	0		3.375	1.092					0				4.467
-5% Public transport	11.494		0	0		12.627	41	0	0	0		0				24.162
15% Private and commercial transport	321		0	0		310.182	363.707					8				674.219
Subtotal	11.815	0	0	0	0	326.184	364.840	0	0	0	0	8	0	0	0	702.848
OTHER																
0% Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	811.721	823.129	#####	0	152.086	326.184	364.840	369.351	0	363.033	0	8	363.033	16.614	0	4.977.508

B. Energy supply projection

Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	200
Hydroelectric	479.704
Photovoltaics	9.000
Geothermal	0
TOTAL	488.904

Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal					
Combined Heat and Power	0	477.872	288.483	0	12.914	277.195	535.296	0	0	0	0	390.811
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	477.872	288.483	0	12.914	277.195	535.296	0	0	0	0	390.811

Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal					
Combined Heat and Power	0	1.417.543	645.736	0	275.766	131.470	881.756	0	0	0	0	526.588
District heating (heat-only)	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	1.417.543	645.736	0	275.766	131.470	881.756	0	0	0	0	526.588

Note: green and light green cells are automatically filled

Sheet tabs: Energy_balance_baseline | Projected_energy_balance_target | Emission factors | 1.Municipal buildings | 2.Tertiary buildings | 3.Residential buildings | 4.Public lighting | 5.Industry-Non ETS | 6.Industry-ETS | 7.AgricultureForestryFisheries | 8.Muni...

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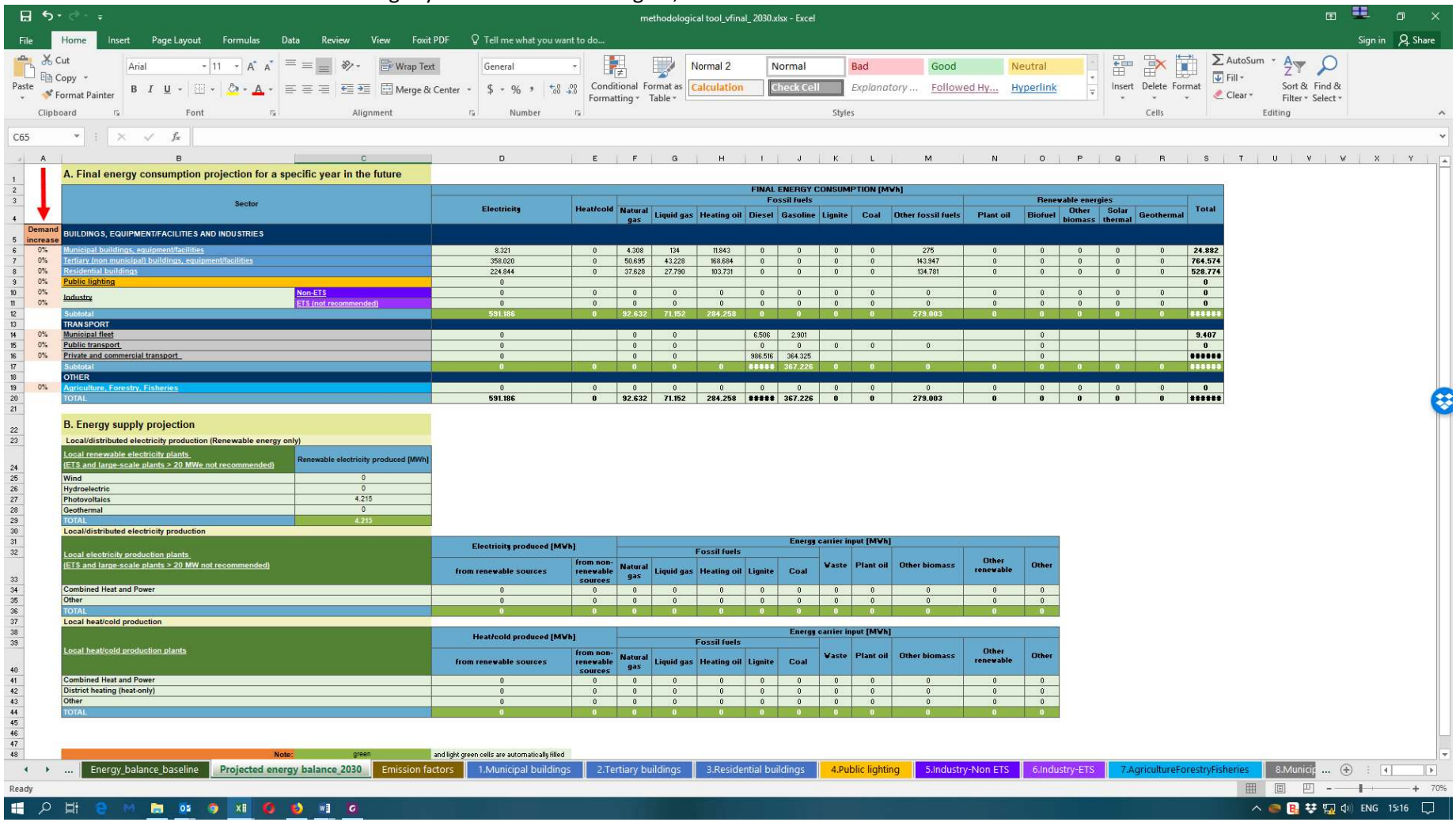
ANNEX IV

Screenshot of the scenarios result for target year 2030 for Istria Region, Croatia



methodological tool_vfinal_2030.xlsx - Excel

A. Final energy consumption projection for a specific year in the future

Sector		FINAL ENERGY CONSUMPTION [MWh]																
				Fossil fuels									Renewable energies					
		Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
Demand increase	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
0%	Municipal buildings, equipment/facilities	8.321	0	4.308	134	11.843	0	0	0	0	275	0	0	0	0	0	24.882
0%	Tertiary (non municipal) buildings, equipment/facilities	358.020	0	50.695	43.228	168.684	0	0	0	0	143.947	0	0	0	0	0	764.574
0%	Residential buildings	224.844	0	37.628	27.790	103.731	0	0	0	0	134.781	0	0	0	0	0	528.774
0%	Public lighting	0															0
0%	Industry – Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%	Industry – ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal	591.186	0	92.632	71.152	284.258	0	0	0	0	279.003	0	0	0	0	0	######
	TRANSPORT																
0%	Municipal fleet	0		0	0		6.506	2.901					0				9.407
0%	Public transport	0		0	0		0	0	0	0	0		0				0
0%	Private and commercial transport	0		0	0		986.516	364.325					0				######
	Subtotal	0	0	0	0	0	#####	367.226	0	0	0	0	0	0	0	0	######
	OTHER																
0%	Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL	591.186	0	92.632	71.152	284.258	#####	367.226	0	0	279.003	0	0	0	0	0	######

B. Energy supply projection

Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	0
Hydroelectric	0
Photovoltaics	4.215
Geothermal	0
TOTAL	4.215

Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0

Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
District heating (heat-only)	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0

Note: green and light green cells are automatically filled

Energy_balance_baseline | Projected energy balance_2030 | Emission factors | 1.Municipal buildings | 2.Tertiary buildings | 3.Residential buildings | 4.Public lighting | 5.Industry-Non ETS | 6.Industry-ETS | 7.AgricultureForestryFisheries | 8.Municip...

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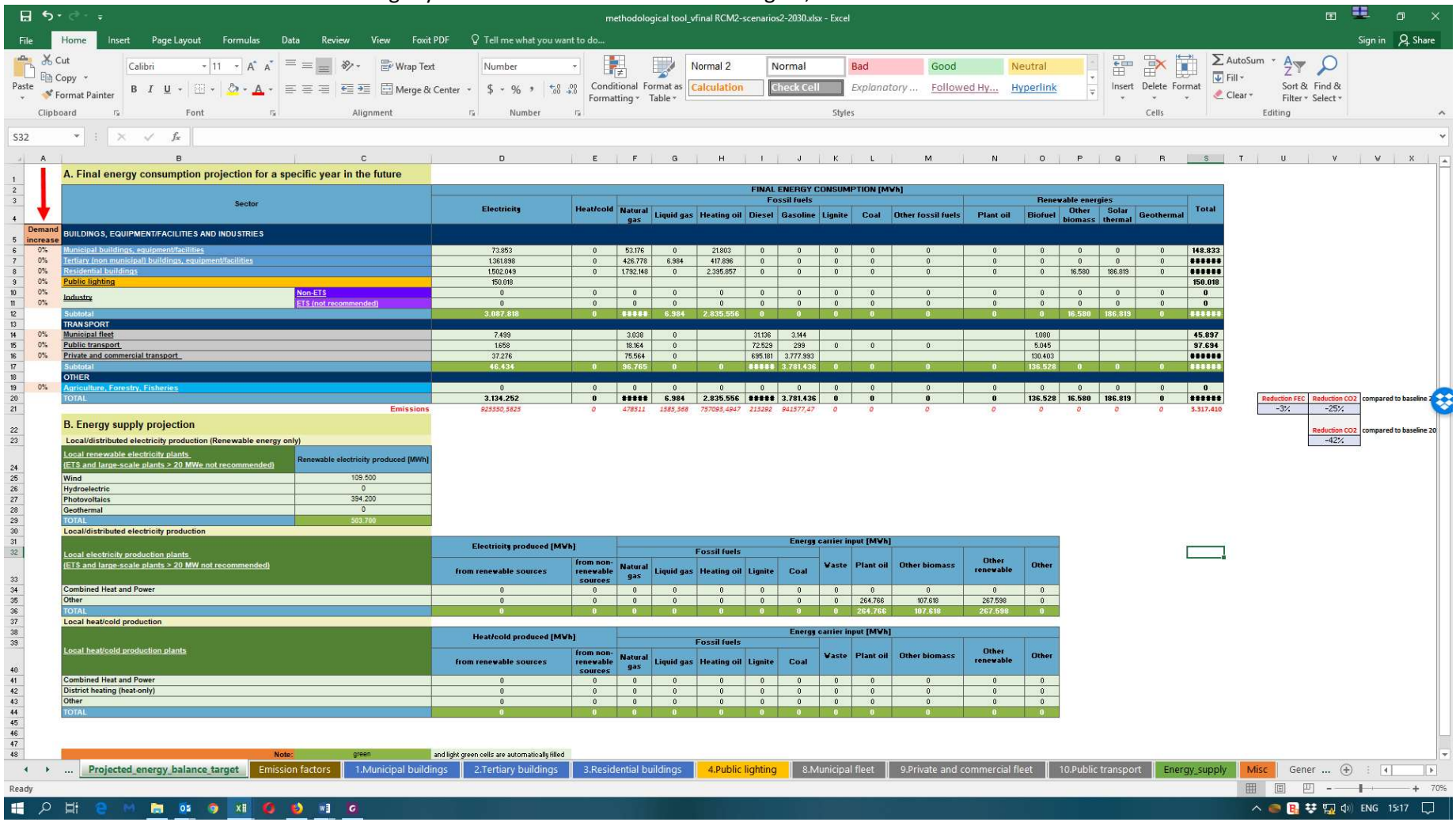
ANNEX V

Screenshot of the scenarios result for target year 2030 for Central Macedonia Region, Greece



methodological tool_vfinal RCM2-scenarios2-2030.xlsx - Excel

A. Final energy consumption projection for a specific year in the future

Sector	FINAL ENERGY CONSUMPTION [MWh]																
	Electricity	Heat/cold	Fossil fuels: Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Renewable energies: Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
Demand increase / BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
0% Municipal buildings, equipment/facilities	73.853	0	53.176	0	21.803	0	0	0	0	0	0	0	0	0	0	148.833
0% Tertiary (non municipal) buildings, equipment/facilities	1.361.898	0	426.778	6.984	417.896	0	0	0	0	0	0	0	0	0	0	######
0% Residential buildings	1.502.049	0	1.792.148	0	2.395.857	0	0	0	0	0	0	0	16.580	186.819	0	######
0% Public lighting	150.018															150.018
0% Industry — Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0% Industry — ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	3.087.818	0	#####	6.984	2.835.556	0	0	0	0	0	0	0	16.580	186.819	0	######
TRANSPORT																
0% Municipal fleet	7.499		3.038	0		31.136	3.144					1.080				45.897
0% Public transport	1.658		18.164	0		72.529	299	0	0	0		5.045				97.694
0% Private and commercial transport	37.276		75.564	0		695.181	3.777.993					130.403				######
Subtotal	46.434	0	96.765	0	0	#####	3.781.436	0	0	0	0	136.528	0	0	0	######
OTHER																
0% Agriculture, Forestry, Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3.134.252	0	#####	6.984	2.835.556	#####	3.781.436	0	0	0	0	136.528	16.580	186.819	0	######
Emissions	925350,5825	0	478511	1585,368	757093,4947	213292	941377,47	0	0	0	0	0	0	0	0	3.317,410

Reduction FEC	Reduction CO2	compared to baseline 2
-3%	-25%	
	-42%	Reduction CO2 compared to baseline 20

B. Energy supply projection

Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants > 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	109.500
Hydroelectric	0
Photovoltaics	394.200
Geothermal	0
TOTAL	503.700

Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants > 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	264.766	107.618	267.598	0
TOTAL	0	0	0	0	0	0	0	0	264.766	107.618	267.598	0

Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
District heating (heat-only)	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0

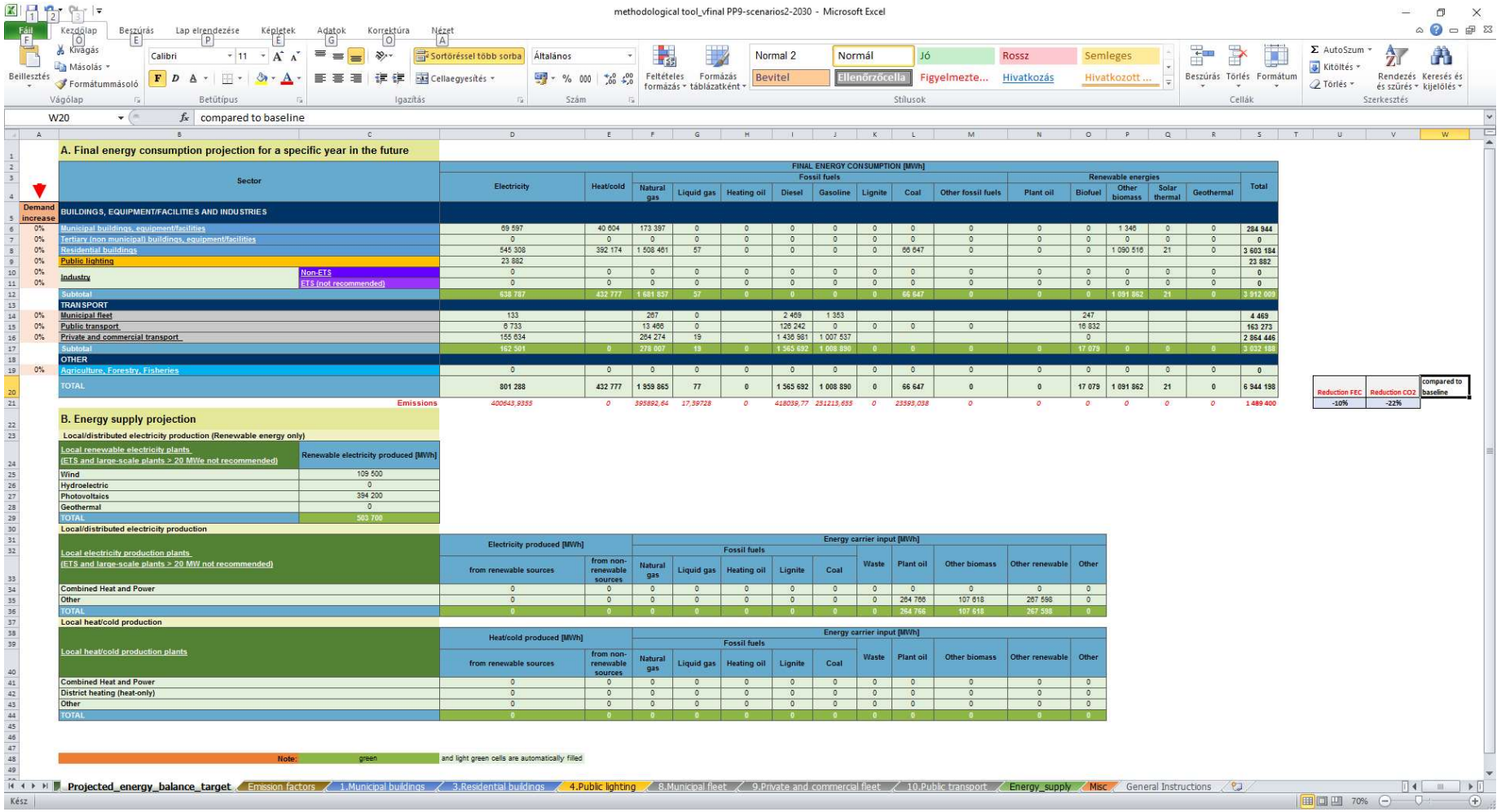
Note: green and light green cells are automatically filled

Sheet tabs: Projected_energy_balance_target | Emission factors | 1.Municipal buildings | 2.Tertiary buildings | 3.Residential buildings | 4.Public lighting | 8.Municipal fleet | 9.Private and commercial fleet | 10.Public transport | Energy_supply | Misc | Gener ...

Ready

ANNEX VI

Financial Instruments mapping & matching worksheet for B-A-Z County, North Hungary



methodological tool_vfinal PP9-scenarios2-2030 - Microsoft Excel

W20 | compared to baseline

A. Final energy consumption projection for a specific year in the future

Demand increase	Sector		FINAL ENERGY CONSUMPTION [MWh]																	
					Fossil fuels								Renewable energies							
			Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
	BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																	
0%	Municipal buildings, equipment/facilities		69 597	40 604	173 397	0	0	0	0	0	0	0	0	0	1 346	0	0	284 944
0%	Tertiary (non municipal) buildings, equipment/facilities		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%	Residential buildings		545 308	392 174	1 508 461	57	0	0	0	0	66 647	0	0	0	1 090 516	21	0	3 603 184
0%	Public lighting		23 882															23 882
0%	Industry	Non-ETS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0%		ETS (not recommended)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Subtotal		638 787	432 777	1 681 857	57	0	0	0	0	66 647	0	0	0	1 091 862	21	0	3 912 009
	TRANSPORT																	
0%	Municipal fleet		133		267	0		2 469	1 353					247				4 469
0%	Public transport		6 733		13 466	0		126 242	0	0	0	0		16 832				163 273
0%	Private and commercial transport		155 834		264 274	19		1 436 981	1 007 537					0				2 864 446
	Subtotal		162 301	0	278 007	19	0	1 565 692	1 008 890	0	0	0	0	17 079	0	0	0	3 032 188
	OTHER																	
0%	Agriculture, Forestry, Fisheries		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TOTAL		801 288	432 777	1 959 865	77	0	1 565 692	1 008 890	0	66 647	0	0	17 079	1 091 862	21	0	6 944 198
	Emissions		400643,9355	0	395892,64	17,39728	0	418038,77	251213,655	0	23593,038	0	0	0	0	0	0	1 489 400

Reduction FEC	Reduction CO2	compared to baseline
-10%	-22%	

B. Energy supply projection

Local/distributed electricity production (Renewable energy only)

Local renewable electricity plants (ETS and large-scale plants ≥ 20 MWe not recommended)	Renewable electricity produced [MWh]
Wind	109 500
Hydroelectric	0
Photovoltaics	394 200
Geothermal	0
TOTAL	503 700

Local/distributed electricity production

Local electricity production plants (ETS and large-scale plants ≥ 20 MW not recommended)	Electricity produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	264 766	107 618	267 598	0
TOTAL	0	0	0	0	0	0	0	0	264 766	107 618	267 598	0

Local heat/cold production

Local heat/cold production plants	Heat/cold produced [MWh]		Energy carrier input [MWh]									
			Fossil fuels									
	from renewable sources	from non-renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal	Waste	Plant oil	Other biomass	Other renewable	Other
Combined Heat and Power	0	0	0	0	0	0	0	0	0	0	0	0
District heating (heat-only)	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0

Note: green and light green cells are automatically filled

Projected_energy_balance_target | Emission factors | 1.Municipal buildings | 3.Residental buildings | 4.Public lighting | 8.Municipal fleet | 9.Private and commercial fleet | 10.Public transport | Energy_supply | Misc | General Instructions

Kész