D.T2.4.6

Split and Dalmatia Energy Action Plan	Version n°2: 03/2020 (rev. 2021)

D.T2.4.6 Split and Dalmatia Energy Action Plan

A.T2.4 Regional Energy Action Plan definition

Partners involved

PP4 + PP 7 - EEE Güssing

Interreg CENTRAL EUROPE

Priority:	2. Cooperating on low-carbon strategies in CENTRAL EUROPE
Specific objective:	2.2 To improve territorial based low-carbon energy planning strategies and policies supporting climate change mitigation
Acronym:	PROSPECT2030
Title:	PROmoting regional Sustainable Policies on Energy and Climate change mitigation Towards 2030
Index number:	CE1373
Lead Partner:	Piemonte Region
Duration:	01.04.2019 30.09.2021

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1. EXECUTIVE SUMMARY

The Split-Dalmatia County is the largest Croatian county, geographically located in the southern part of Croatia and the central part of the Adriatic coast. The land and islands are covering around 32% of the total area while the remaining 68% is represented by the Adriatic Sea.

The official energy balances at the NUTS 3 region are not available in Croatia so the regional energy demand was modeled and calculated by the Energy Institute Hrvoje Požar for this report in The Low Emission Analysis Platform (LEAP). The regional supply mix is based exclusively on renewable energy sources, respectively hydro, wind, and photovoltaic powerplants. The total installed capacity of hydropower plants in Split-Dalmatia is 923.4 MW out of which the majority comes from the hydropower system of the Cetina river. The installed renewable energy capacities in Split-Dalmatia County are producing almost double the actual electricity demand which is slightly higher than 3 TWh/a. Moreover, this is interesting due to fact that electricity is also used mostly for heating purposes.

The energy balance of Split-Dalmatia County is presented in the table below. The table presents the total primary supply, total transformation, and total demand for the fuel group.

Table 1-1 Split-Dalmatia County energy balance table for 2019 baseline year

	Solid Fuels	Natural Gas	Hydropower	Renewables	Biomass	Electricity	Oil Products	Heat	Total
Production	-	-	2.644,6	549,2	940,9	-	-	-	4.134,7
Imports	735,4	15,1	-	-	-	-	3.115,8	5,0	3.871,4
Exports	-	-	-	-	-	-1.121,3	-	-	-1.121,3
Total Primary Supply	**735,4**	**15,1**	**2.644,6**	**549,2**	**940,9**	**-1.121,3**	**3.115,8**	**5,0**	**6.884,8**
Electricity Generation	-	-	-2.644,6	-525,9	-	3.170,5	-	-	-
Transmission and	-	-	-	-	-	-184,4	-	-	-184,4

Distribution									
Total Transformation	-	-	-2.644,6	-525,9	-	2.986,1	-	-	-184,4
Households	-	6,3	-	20,7	931,5	927,7	152,9	-	2.039,1
Services	0,0	7,3	-	2,5	2,8	626,8	107,2	5,0	751,8
Industry	735,4	1,5	-	-	6,6	232,2	157,2	-	1.132,8
Transport	-	0,1	-	-	-	78,1	2.698,5	-	2.776,7
Total Demand	735,4	15,1	-	23,2	940,9	1.864,8	3.115,8	5,0	6.700,4

The table shows that all the solid fuels, as well as oil products and natural gas, are imported. The electricity demand is fully covered by indigenous renewable sources and a large part of it is being exported (used in other Croatia regions or exported to neighboring countries). From the demand side perspective, the transport sector accounts for the largest share in energy consumption and is followed by households, industry, and services in the baseline year.

2. INTRODUCTORY OVERVIEW

2.1. Status quo summary

The Split-Dalmatia County is the largest Croatian county, geographically located in the southern part of the country and the central part of the Adriatic coast. The land and islands are covering around 32% of the total area while the remaining 68% is represented by the sea. The hinterland, in the continental part of the County, is crisscrossed by mountains, while the coastal area makes a narrow strip along the coast between the mountain ranges and the sea. The island area of the County is made up of 74 islands and 57 islets and reefs. The County is located in the area of the Adriatic type of Mediterranean climate whose basic characteristics are dry and hot summers and mild and humid winters.

In 2019, the population of Split-Dalmatia County was 454,798 and represents around 10% of the population in the Republic of Croatia, however, marks a negative trend in the number of inhabitants in the past years following the population decline trends in the Republic of Croatia. The average size of a household was 2.94 in 2019, while the population density is higher than the national average, accordingly 100.2 inhabitants per km^2. According to the 2011 Census of Population, 77% of the total population lives in 16 county's cities, while the other 23% are settled in 39 county's municipalities. In the County capital Split lives 39.16% of the county's population.

The share of the regional economy in the national GDP is around 8.4% according to the Croatian Bureau of Statistics. Regarding the intra-regional development which directly followed the national, after the decreasing trend till 2012, an increasing trend has been registered in the period from 2013 to 2016.

Since the Split-Dalmatian County is a touristic oriented county being the 2nd in Croatia by the number of beds, the highest share of GVA on a regional level is dedicated to wholesale and retail trade, transportation, accommodation, and food service activities (27%) while the industry is undoubtedly less present regionally compared to the national share. Moreover, real estate activities have a more significant portion (14%) of GVA on a regional level compared to the national.

Concerning power system infrastructure, the Split-Dalmatia County all high voltage levels (400, 220, and 110 kV) are operating and a major transformation substation 400/220/110 kV Konjsko is operational, hence the transmission network is directly interconnected with the Bosnia and Herzegovina transmission network. On medium voltage level, the Croatian DSO operates on 35, 10(20), and 0,4 kV. While looking at the gas grid infrastructure, even if the gas network reaches the County, solely a few commercial and public building users have been connected so far.

As far as surface area coverage is considered, rail transport is not the common type of transport within Split-Dalmatia County although the County has the biggest road network in the Republic of Croatia. The Split Airport is the second busiest airport by passenger traffic in the Republic of Croatia. The number of total passengers increased by almost two million from 2010, largely due to a significant increase in tourism. Regarding maritime liner transport, ferries, liner transport lines, high-speed lines navigate seasonally and through the entire year in Split-Dalmatia County. The city of Split has two seaports: city port on the south (passenger-ferry port) and north port (commercial port). Moreover, under the Harbour Master's Office of Split, there are 15 harbors. The 2nd most visited seaport was Split with 104 visits from January to June 2019. Out of a total of 272 journeys of foreign vessels on a cruise, Split-Dalmatia County has a share of (25.3%).

Regarding the type of transport, there are only data available on national, but not on the regional level. However, transport is solely road and maritime-based with a significant increase in air passenger transport each year.

Croatian national fuel mix for electricity generation is characterized by a share of renewable sources, due to the richness in water and, in consequence, production of electricity from large hydropower plants. Due to its characteristics, a hydropower-based power system causes high dependence on imports reaching even ~80% of final energy consumption in 2016.

Considering that official energy balances for a NUTS 3 region do not exist, the regional energy demand has been calculated based on the Energy Efficiency Action Plan for 2016 developed by Energy Institute Hrvoje Požar in 2015 and the Comprehensive assessment of national heating and cooling potentials developed in 2021. The final result is presented in Table 1-1 which shows that the total amount of demand is ~6,700 GWh. The share of the regional consumption is around 7% of the total national final consumption. The largest share is accounted for by crude oil and petroleum products, followed by electricity while minor shares are accounted for biomass, gas, and derived heat. The share of renewables in the total final consumption is 11% and is mainly

covered by the residential sector, mainly due to the use of wood for heating purposes since there are no district heating systems in Split-Dalmatia County.

The main regional particularity is the absence of district heating systems. Even though the gas grid reaches the county due to infrastructure investment projects there were no massive customers connections till now. In terms of regional supply mix, electricity is generated exclusively by renewable energy sources solely, respectively hydro, wind, and solar photovoltaic. The electrical energy generated per year is ~80% from hydro, ~18% from wind, and ~2% from solar photovoltaic power plants. The total installed capacity of hydropower plants in Split-Dalmatia is 919 MW and is based on the hydropower system of the Cetina river. Concerning self-supply of electricity, the installed capacities in Split-Dalmatia County are producing almost double the actual electricity demand (generated capacity of 3014 GWh/a). Moreover, due to the absence of district heating plants electrical energy is used for heating purposes.

The CO_2 emissions in Split-Dalmatia are estimated at 1.2 million tons per year, whit a share of 8% in the national. As expected, the major share of regional emissions is derived from transport (59%), followed by residential (15%) and service (14%) while the industry represents solely 8%.

2.2. Current development trends

The region is still characterized by a shrinking population, lack of workplaces, a high share of commuters, and infrastructural remoteness to urban spaces. However, through its administrative departments and institutions, Split-Dalmatia County has actively and constantly invested in the balanced development of the county through several most essential categories. Split-Dalmatia County has the most local governments, with as many as 16 cities and 39 municipalities, including county projects and investment programs. For better project visibility, a map of development projects of Split-Dalmatia County was made (shown in the figure below).

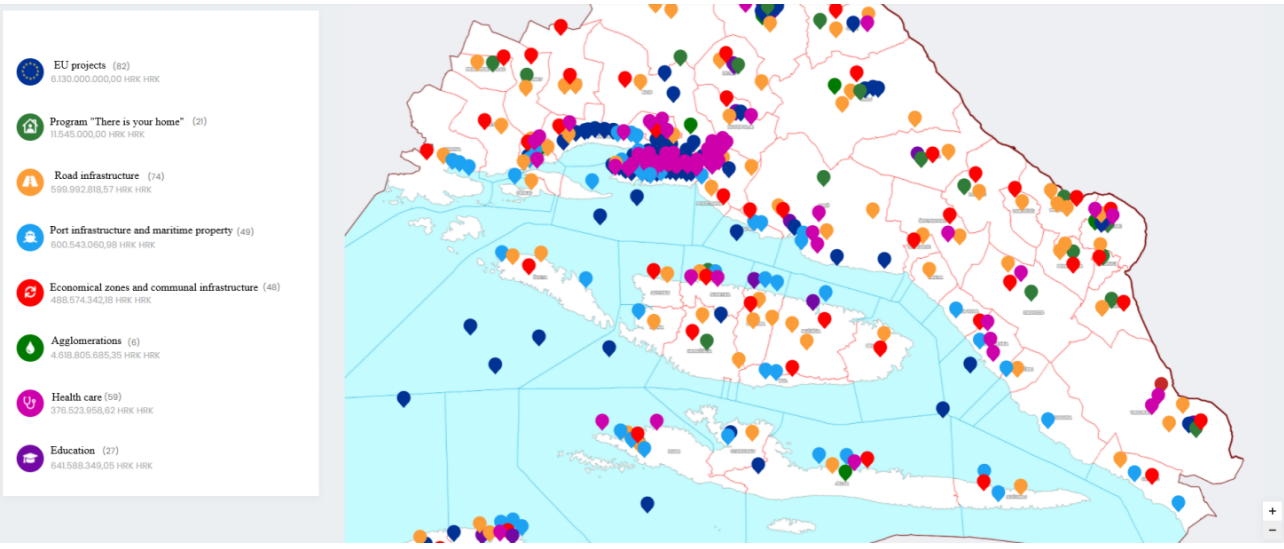

Figure 2-1 Map of development projects of the Split-Dalmatia County

Eight categories refer to the most critical areas of investment, so it is evident that in recent years almost 600 million HRK has been invested in road infrastructure through numerous projects

of the competent county administrative department, projects of the County Road Administration, but also the most critical projects of Croatian Roads. Port infrastructure and maritime property, in a county that is largely oriented towards the sea, is a significant development resource, so through this category, more than 36 million HRK has been invested in the maritime domain, in the areas of various local governments in the coast and on islands.

Economic zones and communal infrastructure were developed through 48 individual investments worth more than 34 million HRK.

In the county's area, six investment projects in water supply and drainage have been launched, which, with the partnership and support of the county services, are being implemented by Croatian Waters. These are projects worth more than four billion HRK.

Health care has been a current topic before, and especially in recent years, with constantly growing needs, to which the county responded with projects of almost 377 million HRK. Investments were made in 12 branches of Health Centre facilities. KBC Split, as the backbone of the health system, in cooperation with the County, is implementing projects worth more than 427 million HRK. The Split-Dalmatia Pharmacies made a significant step forward with the realized project of building and equipping the Galenic-Analytical Laboratory worth 70 million HRK.

As one of the categories, the map shows education, i.e., projects of construction, rehabilitation, reconstruction, and energy renovation of schools and dormitories, 17 facilities, a total of 105,694,040.02 HRK, and two projects of regional centers of excellence - Tourist School Split - 170 million HRK and Crafts - technical school Split - 82 million HRK. The projects carried out by the University of Split are also presented, and which were also realized with the support and partnership of the county.

Although the map defines the category "There is your home," the program that encourages demographic renewal through incentives for young families from rural areas to build and adapt houses, where a total of 120 individual contracts are visible distributed in 21 local government units, demographic renewal of rural areas is encouraged through several other measures and incentives.

One of the crucial categories on the map is EU projects. Those projects in which the holder or partner is a county or one of the county institutions are presented, and they relate to various economic and social sectors. Numerous projects listed in other categories are financed from EU funds, such as some significant road and port infrastructure projects, energy renovation projects of schools, construction and equipping of branches of the Health Centre, or projects of KBC Split, University of Split, and agglomerations. EU funds are the flywheel and wind in the back of many Counties' development projects, and over the past year, the county has gathered staff in its services who successfully implement the started and prepare new EU projects. In Split-Dalmatia County, more than 6 billion and 130 million HRK worth of projects financed from EU funds have been contracted so far.

2.3. Development potentials

The potential for increasing energy efficiency can be considered in three major sections, buildings, industry, and transport. The highest potential for increasing efficiency is always allocated to buildings with a high percentage of usage (24/7). These are residential buildings, health institutions, and care centers for the young and elderly population. HVAC and lighting systems use to largest amount of final energy consumption and in these systems are the highest potential for savings. Each building is specific and to allocate real potential is necessary to perform a quality energy audit that will define and calculate potential and energy efficiency measures that can be applied. The most common energy efficiency measures are insulation of building envelope (and window replacement), installation of the LED lighting system, and increasing efficiency of HVAC systems. The state and regional aid for implementing efficiency measures are often available and it helps present efficiency measures to be more economically feasible. The increase of energy efficiency in industry is mainly observed through increasing production process efficiency (device replacement), waste heat utilization projects, and increasing efficiency of lighting systems. Increasing efficiency in transport is highly dependable on cities/municipalities' action plans. The aim should be to increase the percentage of electric vehicles in public transport and the number of fast-charging and destination-charging stations for electric vehicles.

Self-supply can only be considered for electrical energy since there are present uniquely electrical power plants in the region. As follows, regional electricity demand is 1571 GWh annually in comparison with the generated capacity of 3014 GWh which makes a covering rate of 192%.

The largest resource potential in the county is solar and wind energy. The hydro potential is also considered as valuable resource potential as well as exploiting sea in the process of production heating and cooling energy (heat pumps). Offshore wind energy should also be taken into consideration.

The heat pump technology is a big potential for increasing energy efficiency in buildings (residential and non-residential). The most common technology is air to air heat pumps, but the highest potential can be achieved while using the sea for cooling condensate (in cooling season). The waste heat utilization project in different fields of industry (fishery, meat, and milk industry) also have large potential for future exploitation. The technologies for using solar energy in heating, cooling, and production of electricity as well as usage of wind power have high potential.

3. MISSION STATEMENT

3.1. Key energy priorities, priority matrix, and timeframes

The representatives from Split-Dalmatia have focused on their Programme for Energy Management to increase energy efficiency and the use of RES through its territory since 2014. The Programme is directly financed through the County’s budget, and it’s not related to any EU funding programs. As stated during the stakeholders' meetings (on 11.12.2019 and 9.11.2021), there are approximately 150 applications each year and 90 of them meet the tender

requirements thus are eligible for the dedicated grants. The usual hardship for potential appliers is legal ownership issues.

Key technologies identified and agreed on are:

- Photovoltaic, solar collectors, wind power – with a focus on small solutions for households,
- Exploiting sea in the process of production heating and cooling energy (heat pumps),
- Smart decentralized systems, related to the high potential in demand-response for electricity.

A general plan is to promote low-carbon pilot and demonstration projects in the next programming period to implement show-cases that will enable peer-to-peer learning and good-practice transfer. Moreover, continuous education on existent financial instruments is required for both local and regional authorities.

One of the key energy priorities should be to continue with the Programmes that will co-finance various low-carbon projects that would be implemented by various private and public stakeholders. Besides the continuation of such funding Programmes it is also recommended that the County establishes the Regional energy agency that would serve as a non profit institution focused on renewable energy sources and energy efficiency and fully or partially funded by projects.

3.2. Compliance with European and national targets and strategies

To achieve the best possible impact of the REAP, all relevant strategic and regulatory framework documents have been taken into consideration. The basic structure is given by the Clean Energy for all Europeans Package, in particular the Directives on Renewable Energy, Electricity, Energy Performance in Buildings and Energy Efficiency. In the meantime, all directives have been integrated into national law, the last was the Renewable Energy Development Act, which came into force in July 2021, thus, only towards the end of PROSPECT 2030. This act was the long-time missing legal basis for the implementation of energy communities.

At the national level, the Republic of Croatia has adopted the standardization of nZEB (nearly Zero Energy Buildings) buildings. Thus, all buildings that will be newly constructed or reconstructed will have to meet the standards prescribed by the Rational Use of Energy and Thermal Protection in Buildings (Official Gazette no. 128/15, 70/18, 73/18, 86/18, 102/20).

So, the measures and priorities defined at the regional level are compliant with the overall European and National strategies aiming at setting a reduction target of greenhouse gas emissions by at least 55% by 2030 and a long-term vision to reach climate neutrality by 2050.

4. MISSION MAPPING

4.1. Levels of policy/governance

In the process of drafting this document, a consultation process has been performed to involve

regional stakeholders belonging to the following target groups:

- Regional public authorities,
- National public authorities,
- Sectoral agencies,
- Higher education and research,
- Infrastructure and (public) service provider,
- Local public authorities,
- General public,
- Large enterprises,
- SMEs.

Energy Institute Hrvoje Požar animated the discussion about potential burdens and problems in financing low-carbon projects with the following outcomes:

- Non-regulated ownership of households for application to various funds.
- Unfamiliarity with the topic and recognition of potential benefits by the general public.

A general suggestion from the stakeholders is to promote a low-carbon pilot and demonstrate projects in the next programming period to implement show-cases that will enable peer-to-peer learning and good-practice transfer.

In the up-to-now energy planning practice, a sectoral approach was usually pursued, in which individual measures for supply and efficiency were then embedded. In contrary to this development planning, the European Green Deal is aiming at transition. One of the core elements of this transition is sector coupling, which requires the activation of synergies and connection of potentials yet not tapped. Therefore, during the development of the energy action plan of Split-Dalmatia County, the key action was to sectors coupling to better implement the measures listed below.

4.2. Spatial focus

All proposed measures under this document are addressed for both rural and urban areas.

4.3. Specific measures for the transition

According to the priorities highlighted following measures for the energy transition are envisaged:

- Promote the energy management practice at the municipal level – Using the national Energy Management Information System (EMIS),
- Energy audits of public buildings and deep renovation of public buildings and facilities,
- Retrofit of public lighting systems,
- RES spatial planning,
- The technology of using the thermal energy of the sea for heating, DHW preparation, and cooling,
- Replacement of fossil fuel boilers in households and the service sector (public and

commercial buildings) - Increasing the share of RES,
- Development of regional E-mobility roadmap,
- E-mobility: charging infrastructure development,
- E-mobility: EV promotion,
- E-mobility: education and awareness-raising,
- Electricity storage pilot projects implementation,
- Smart grid pilot projects implementation.

4.4. Enabling and restraining factors

For each measure listed in the previous chapter, a SWOT analysis was performed and shown in the tables below.

Title of measure:	**Promote the energy management practice at the municipal level – Using the national Energy Management Information System (EMIS)**	
SWOT	Description of factors	Weight
Strengths	• EMIS is already used by all Croatian municipalities, cities, counties, and ministries • EMIS is well-recognized energy management tools • Most of the energy data is automatically gathered (energy utility and various distributors are automatically transferring energy bills)	2 - medium
Weaknesses	• lack of well-trained municipal staff that has the know-how on how to use the EMIS tool and all its functionalities • formal energy management team across the overall region is not established and organized well	2 - medium
Opportunities	• possibility to get structured energy consumption data and all sorts of other relevant data for energy planning. • train municipal employees to better plan all the maintenance processes and energy retrofit actions of municipal buildings • budget savings, conservation, and upgrade of municipal buildings • digitalization of the public sector	1 - high
Threats	• wrong data entry which would mislead all the energy planning • difficult to have an equally trained energy manager at the municipal building level responsible for energy management • lack of funding possibilities and shortage of qualified personnel that would have the right capacities to further improve the municipal energy management	2 - medium

Title of measure:	**Energy audits of public buildings and deep renovation of public buildings and facilities**	
SWOT	Description of factors	Weight
Strengths	• some best practice examples of buildings being fully retrofitted are available around the region and these should be presented all across the region • more funding opportunities in the future EU funding period 21-27.	1 - high
Weaknesses	• lack of local experts that are capable of making detailed energy audits • lack of municipal employees that have the know-how on energy data analysis and that could develop the right public procurement for deep retrofit of their municipal buildings	2 - medium
Opportunities	• to have most of the public buildings retrofitted • improve quality of life, health, and well-being for the public sector employees as well as citizens using these buildings • prolong the lifetime of municipal buildings • achieve energy and financial savings • increase the capacities for public authorities and training for workers • creation of new green jobs in the construction sector • reduce emissions and energy use to support climate targets	1 - high
Threats	• lack of funding possibilities for deep retrofit of public buildings • lack of grants and incentives for energy retrofit of municipal buildings • lack of knowledge regarding complex financing mechanisms and other alternative funding possibilities (green bonds, etc.) • lack of political commitment to energy-related issues	1 - high

Title of measure:	**Retrofit of public lighting systems**	
SWOT	Description of factors	Weight

Strengths	• recognition of implemented pilot and demonstration projects regarding newly retrofitted lighting systems • electricity consumption savings • development of alternative funding schemes (ESCO, green bonds, etc.)	1 - high
Weaknesses	• low financial resources for the implementation of street lighting retrofit • lack of financial incentives and other alternative funding schemes	2 - medium
Opportunities	• possibility to develop local SME sector that might invest in the lighting system retrofit as ESCO • development of green bonds market where local stakeholders could invest in new lighting systems	2 - medium
Threats	• lack of political commitment to energy-related issues • unstable environment regarding national funding (rarely there are incentives to develop such EE projects)	2 - medium

Title of measure:	**RES spatial planning**	
SWOT	Description of factors	Weight
Strengths	• The combined use of methods and tools was outlined as effective - It could address all the energy planning problems and aspects • Through prioritization, it is possible to determine the phases of RES implementation	1 - high
Weaknesses	• Integrated scenarios are quite difficult to foresee • Difficulties in data collection - the possibility of delivery of incorrect data • The accuracy of the assumptions on which the estimates are based	2 - medium
Opportunities	• Possible application in a longer period - phase by phase implementation • Successful integration optimal solution could inspire other counties to adopt RES spatial planning • Environmental protection	1 - high
Threats	• Administrative boundaries • Lack of professional resources • Unstable environment for interventions in energy because of changes in legislation	2 - medium

Title of measure:	The technology of using the thermal energy of the sea	
SWOT	Description of factors	Weight
Strengths	• High efficiency compared to conventional heat sources • Multi-purpose device - with one device it is possible to heat the space during the winter, cool the space during the summer and prepare DHW (sub-cooler, desuperheater) • Economic savings for consumers • Environmental protection (reduction of greenhouse gas emissions) • Safety (no fuel combustion, no emissions) • Advances in technology development and availability	1 - high
Weaknesses	• Investment costs • Installation costs • Heat pumps are suitable for thermally insulated buildings due to the low-temperature mode of operation • Knowledge and skills of the installers	2 - medium
Opportunities	• Policy and legislation (incentives to increase energy efficiency and use renewable energy sources at national and EU levels) • Research and development (increasing the energy efficiency of heat pumps, new refrigerants) • Development of the new construction building market and renovation of existing buildings	2 - medium
Threats	• Increased requirements for working fluids (F-gas regulation EU 517/2014) • A combination of rising electricity prices and falling natural gas prices • Unexpected and extreme occurrences such as strong storms (risk for investors due to the possibility of destruction of technology or individual components)	2 - medium

Title of measure:	Replacement of fossil fuel boilers in households and the service sector (public and commercial buildings) - Increasing the share of RES	
SWOT	Description of factors	Weight
Strengths	• Economic savings for consumers • Environmental protection (reduction of greenhouse gas emissions) • Safety (no fuel combustion, no emissions) • High efficiency compared to conventional heat sources	1 - high
Weaknesses	• Investment costs • Installation costs	2 - medium
Opportunities	• Policy and legislation (incentives to increase energy efficiency and use renewable energy sources at national and EU levels) • Development of the new construction building market and	1 - high

	renovation of existing buildings	
Threats	• A combination of rising electricity prices and falling natural gas prices	2 - medium

Title of measure:	**Development of regional E-mobility roadmap**	
SWOT	Description of factors	Weight
Strengths	• A holistic approach to the development of e-mobility that includes a wide range of aspects will allow implementation without unnecessary delays and barriers.	2 - medium
Weaknesses	• A more thorough approach as in the description of the measure requires the engagement of significant resources and the involvement of a very large number of stakeholders, which may mean that this will be a lengthy and exhausting process. • Also, it is necessary to make a comprehensive technical groundwork that consists of many analyses, both the current situation and needs and projections of future demand.	1 - high
Opportunities	• Coordinated and well-balanced development of all elements of e-mobility will enable the realization of key synergies with the tourism sector as well as with the integration of renewable energy sources	2 - medium
Threats	• Collecting all the necessary data for analysis can be a challenge in the process of roadmap development (unavailable data, out-of-date data, poor estimates, etc.), so certain values will need to be determined by model	2 - medium

Title of measure:	**E-mobility: charging infrastructure development**	
SWOT	Description of factors	Weight
Strengths	• Creating conditions and supporting the expansion of the charging station network opens wide perspectives to the business sector that can recognize the space for the introduction and application of new innovative business models (e-car sharing, e-taxi, and similar). Furthermore, it is certainly necessary to consider the tourism component that will bring with it an increasing demand for charging services, and the availability of charging infrastructure may motivate some tourists to come and stay in Split-Dalmatia County.	2 - medium
Weaknesses	• Setting charging points is an investment-intensive project, and some elements of the regulatory framework at the national level still represent significant barriers and therefore discourage investors.	2 - medium

Opportunities	• Opportunities are mostly manifested in synergies with the tourism sector. Providing charging services as well as branding the entire region as green and environmentally aware will surely make great contributions in this branch of the economy.	2 - medium
Threats	• In the short term, it is still difficult in Croatia to establish business models for building and managing charging points on market principles. Therefore, in the first phase, a stronger engagement can be expected only from players who generally consider engaging in this activity in the long run.	2 - medium

Title of measure:	**E-mobility: EV promotion**	
SWOT	Description of factors	Weight
Strengths	• The technical characteristics of electric vehicles and their availability for purchase have advanced significantly in recent times. The still existing difference in the purchase price can therefore be compensated by creating certain privileges for users of electric vehicles.	2 - medium
Weaknesses	• Certain technical limitations allow the implementation of specific actions in favour of electric vehicles (for example, an insufficient number of public parking lots to be reserved for EVs, the impossibility of restricting traffic for other vehicles in certain zones).	2 - medium
Opportunities	• The implementation of the measure would result in a larger number of electric vehicles, which further entails consequences for the business sector, where opportunities for new business models open up. Of course, the environmental aspects are clear.	1 - high
Threats	• The implementation of most specific measures is the responsibility of local governments and therefore requires good co-operation and their willingness to implement.	2 - medium

Title of measure:	**E-mobility: education and awareness-raising**	
SWOT	Description of factors	Weight
Strengths	• In general, education about e-mobility has very important effects, there is great interest from target groups, and it can be organized at an acceptable cost.	2 - medium
Weaknesses	• The measure needs to be implemented continuously and to reach as many people of the target groups as possible, which in organizational terms can be very complex.	3 - low
Opportunities	• It is a special opportunity to include the youngest age in age-appropriate education because, in the long run, it will	2 - medium

	significantly facilitate the acceptance of new technologies and thus e-mobility in everyday life.	
Threats	• Sometimes there are barriers for procedural reasons to implement the measure within official educational institutions (schools, kindergartens).	3 - low

Title of measure:	**Electricity storage pilot projects implementation**	
SWOT	Description of factors	Weight
Strengths	• Mature and well-established technology • Potential for high-density energy storage • Increase RES penetration in electricity systems • Ideal for integration with intermittent RES • Balancing the system • Avoid network reinforcement	1 - high
Weaknesses	• Procurement cost • Short-term electricity storage • Age resulting in a decreasing storage capacity • High costs • Lack of practical experience • Hazardous materials cause environmental impact • Regulation	1 - high
Opportunities	• Innovation related to the make-up and management of complete battery packs • Suitable for large scale markets • Development and diversification of companies involved in the energy sector • New job opportunities • Attract new investments and funding • Business and economic growth for the community • New recyclable material	1 - high
Threats	• The emergence of large-scale markets for competing technologies • Short-term application • Noise level of the main competing systems • Negative environment impact	2 - medium

Title of measure:	**Smart grid pilot projects implementation**	
SWOT	Description of factors	Weight

Strengths	• Simplified electrification process • Long haul electric networks • Achieving energy savings • Reducing greenhouse gas emissions • Potential to utilize the technological advancements	1 - high
Weaknesses	• Aged transmission lines • Lack of adequate planning • Huge capital investment is required for system deployment	2 - medium
Opportunities	• Strong potential to invest in research and development programs • Upgradation of existing electric infrastructure • Technology advancement & Innovation • Raising the consumers' awareness about energy efficiency and demand management • This example can serve as an example of good practice for other counties and municipalities in the Republic of Croatia • Strong incentives to invest in the Smart Grid field • Opportunity for individual customers to access their data in real-time	1 - high
Threats	• Lack of cost-effective generation and energy storage options • Infrastructure and technology immaturity • Lack of consumers participation in DSM programs • Implementation complexities • System vulnerability to cyber attacks • Lack of long-term policies and regulations	2 - medium

Title of measure:	**Digitalization of the power sector and smart city concept pilot activities**	
SWOT	Description of factors	Weight
Strengths	• Established infrastructure • The rising rate of investment in renewable energy • Increasing network stability • Increased adoption of better and energy-efficient technology • A high degree of control • Using advanced automation in various units of electric network	1 - high
Weaknesses	• Growing demand for energy • A high increasing rate of electric consumption and a proper energy management regulation • Damaged and non-standard equipment existence in region and not devoting enough budget for replacing it • High costs • Lack of knowledge and experience	2 - medium

Opportunities	• Whole society depending on the electricity and its extending day by day • Electricity substitution instead of other energy types • Using renewable energies such as Solar, Wind • Extending demands • A modern economy based on digital systems and the necessity of quantitative and qualitative development of electric energy	2 - medium
Threats	• Non-technical losses in distribution networks • Infrastructure and technology immaturity • Implementation complexities • System vulnerability to cyber attacks	2 - medium

4.5. Challenges, estimation of efforts, and impact

All the above measures in the previous chapter can be aggregated into four basic categories, as shown in Figure below.

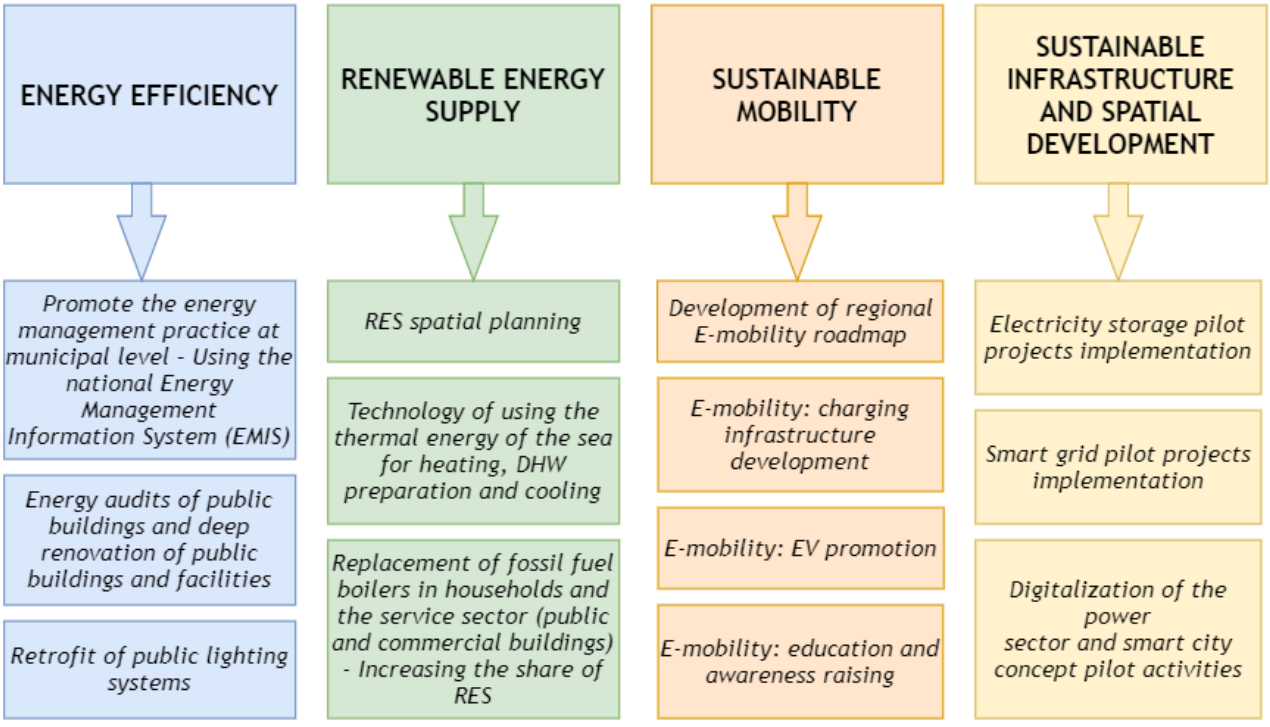

Figure 4-1 Four basic categories of measures

An impact efforts assessment of all the categories has been implemented, where the methodology foresaw the qualitative scoring (high, medium, low) of the SWOT analysis. The qualitative assessment was translated into numbers (1, 2, 3). The Impact was based on the scores assigned to Strengths and Opportunities, whereas the Efforts based on the scores to Weakness and Threats. The following figure shows the result of the assessment.

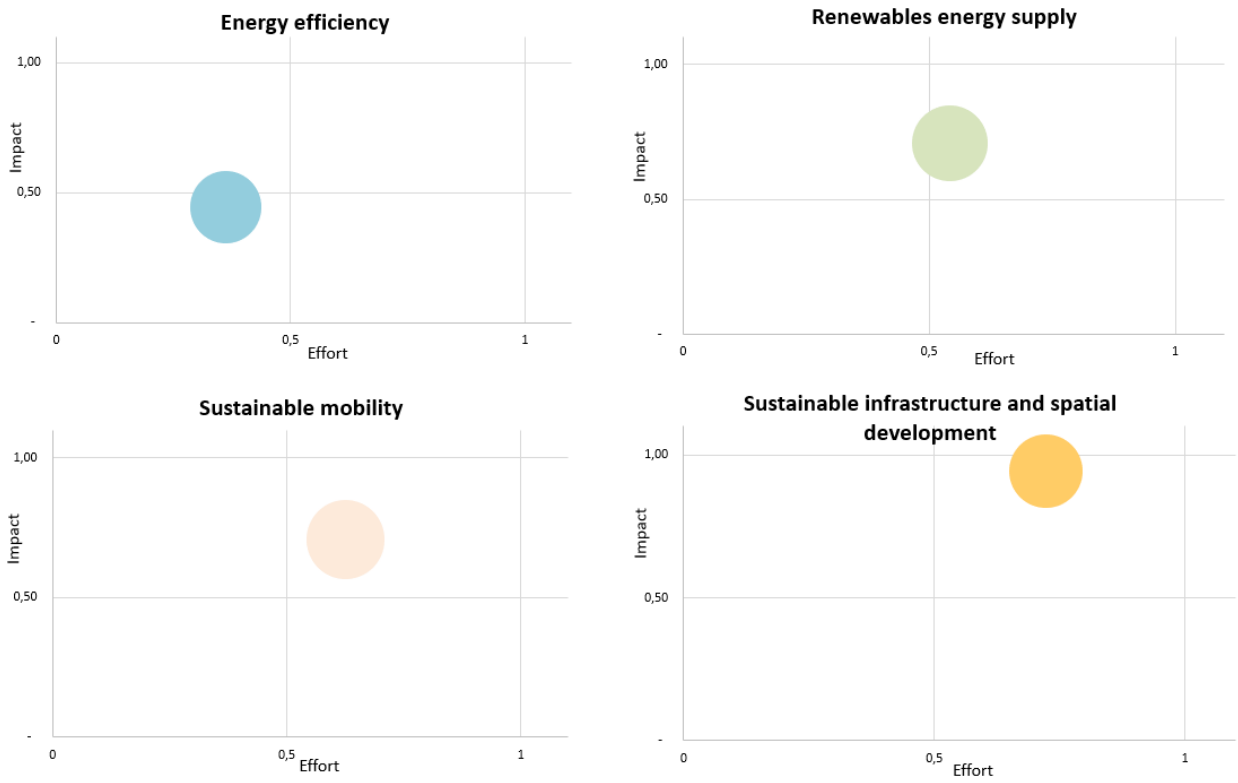

Figure 4-2 An impact efforts assessment of four basic categories of measures

5. ACTION DEFINITION

Based on the measures described beforehand, it is possible to identify several actions to be put in place. These actions are grouped and described below according to the following categories:

- Energy efficiency,
- Renewable energy supply,
- Sustainable mobility,
- Sustainable infrastructure and spatial development.

5.1. Energy efficiency

Measure	Promote the energy management practice at the municipal level -

	Using the national Energy Management Information System (EMIS)
Priority	Territorial coordination
Description	Energy Management Information System (EMIS) is a web application used for monitoring and analysis of energy and water consumption in public sector buildings. EMIS provides a transparent oversight and control of energy consumption, making itself an inevitable tool for systematic energy management. The use of EMIS is accompanied by a legal basis for the Energy Efficiency Act, rules, and methodology that follow the law. This measure is about establishing well-educated municipal energy management teams that will continuously monitor and analyze the energy consumption, report to all the relevant target groups and stakeholders on how the energy is used in the public sector, propose energy management measures, and identify and implement the necessary energy efficiency measures. In addition to the above, it is necessary to promote these systems for other buildings, not just public ones.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Establish municipal energy management teams and clearly define their roles and responsibilities • Training for energy managers at all levels (building, village/city, county) should be intensified and continuously available • Provision of standardized and automatic data collection procedures for Municipalities • Identification and promotion of good practices for energy management (procedures, contract templates, the network of energy managers, evaluation studies, etc.) • Construction/promotion of energy mapping of public buildings and streetlight • Promotion of energy audit campaign for public buildings/street light systems • Promotion of the use of smart metering and monitoring campaign for groups of Municipalities • Provide support at the governmental and utility level to boost the usage of automatic meter reading systems

Measure	Energy audits of public buildings and deep renovation of public buildings and facilities
Priority	Provide financial support to municipalities
Description	A thorough energy assessment of each municipal building should be

	made so that municipalities have a clear overview of which buildings should firstly be retrofitted.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Develop projects that would serve as best practice examples by co-financing of the deep and thorough retrofit of specific types of public buildings • Provide technical assistance for preparation of projects and monitoring of results (energy audits, feasibility studies, development of templates and guidelines, etc.) • Develop tools that would use multi-criteria analysis methodology for faster recognition of buildings that are critical and should be retrofitted immediately • Design the new terms of reference of the calls trying to reduce the administrative burden and make possible the use of more innovative financing schemes whenever useful

Measure	Retrofit of public lighting systems
Priority	Energy-efficient lighting systems, savings
Description	By assessing the energy consumption patterns and defining the priority areas, a detailed energy plan for street lighting retrofit should be developed. Based on this plan, old lightning systems should be fully retrofitted with the new LED lighting systems. Where possible, the lighting polls should be equipped with various sensors (rain, fog, etc.) that would dynamically manage the lighting systems.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• develop projects that would serve as best practice examples for municipalities • develop financial mechanisms that would fund the capital investments and where the energy savings would serve as the returns on these investments • help the government understand the need to finance such investments with future ESIF

5.2. Renewable energy supply

Measure	RES spatial planning
Priority	An overview of the use of renewable energy sources in the region
Description	Increase the efficiency of climate action policy-making by integrating the RES spatial planning procedures at the regional and

	local levels. Establishing an integrated approach to climate and energy policy in Split Dalmatia County by promoting environmental sustainability, combating climate change, and fostering investments. With proper mapping and potential assessment, it is possible to choose the optimal solution in the whole set of possible solutions, all to reduce pollution and increase energy independence. Without careful planning, RES can have tremendous negative impacts on sites of high ecological and social value.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Provide a team of experts to conduct proper prioritization • Establish municipal energy management teams and provide continuously available training • Emphasize the importance of projects to better energy planning through workshops • Provide correct data for better RES spatial planning

	The technology of using the thermal energy of the sea for heating, DHW preparation, and cooling
Priority	Renewable energy sources
Description	The use of thermal energy of waves and sea energy is considered a good solution because of the geographical position (proximity to the sea) of Split-Dalmatia County. Due to its high heat capacity and liquid state, seawater is the most suitable source for the application of a heat pump. Heat pumps are suitable for lower power in private commercial and residential buildings. Due to its economic operation, but also the use of energy, which is mostly free (20% of electricity consumption and 80% of energy from the sea), heat pumps are considered one of the ecological sources of heat for heating systems. They do not pollute the environment with gases, chemicals, and noise. In addition to the above, it is possible to create a small district heating/cooling system that uses the same heat pump and provides energy for heating, DHW preparation, and cooling to several buildings.
Actions to take (policy, technical, financial) to	• Establish municipal energy management teams and clearly define their roles and responsibilities

promote S&O and to minimize W&T	• Training for energy managers at all levels (building, village/city, county) should be intensified and continuously available • Provide a team of experts in this field • Carry out all necessary studies before the implementation of heat pumps (feasibility study, design calculations,..) • Encouraging investment in new technologies through education and workshops - research and development

Measure	Replacement of fossil fuel boilers in households and the service sector (public and commercial buildings) - Increasing the share of RES
Priority	Replacement of fossil fuel, increasing the share of RES
Description	Combustion of fossil fuels leads to major environmental pollution. Fossil fuel boilers, in addition to polluting the environment, also have relatively low efficiencies (0.80 -0.90) compared to, for example, heat pumps (3.50 – 4.50). Therefore, fossil fuel boilers need to be replaced with other energy sources, and renewable energy sources (water, air, modern biomass) are considered the best solution.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Introduction of rules that provide, for existing residential buildings, mandatory minimum quotas, progressive over time, of production from renewable sources. • Determining maximum, progressive energy consumption limits for buildings that will replace the traditional heating and DHW system with a renewable energy system • Technical facilitation of the use of heating systems and preparation of DHW for renewable energy sources • Definition of free but mandatory training courses for project implementers

5.3. Sustainable mobility

Measure	Development of regional E-mobility roadmap
Priority	e-mobility, roadmap
Description	The development of a strategic document that will provide guidelines for the comprehensive development of e-mobility is

	necessary because it will be based on analyses of the current situation, real needs, development scenarios and is therefore tailor-made for the Split-Dalmatia County. This will enable the identification of key opportunities for related sectors of the economy, which applies to the further development of the tourism sector.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• development of technical groundwork that will be the basis and provide guidance for the implementation of all other measures • analysis of all existing studies, strategic documents, expert articles in the relevant field to use all existing analyses and available data

Measure	E-mobility: charging infrastructure development
Priority	charging infrastructure
Description	Although there are certain measures at the state level to encourage the development of EV charging infrastructure (periodic public calls for co-financing), regional and local self-government units wishing to exploit the maximum potential of the benefits of e-mobility must further implement certain measures to support EV infrastructure development. The installation of charging stations on motorways and key road routes is most often a priority for market players involved in the installation and management of charging infrastructure, so regions should focus on supporting the installation of charging stations at the locations of certain travel destinations. In this sense, the Split-Dalmatia County will develop models and options to encourage the installation of infrastructure for EV charging within existing service facilities (hotels, restaurants, other services) where users stay for a longer time and will consider a model to encourage private apartment renters to allow guests to charge electric vehicles as part of their facilities.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• organization of regular stakeholder meetings and the involvement of all stakeholders to find the best solutions through multilateral communication and to encourage the development of EV charging infrastructure • Create a simple and useful handbook that contains the basic information needed by anyone who wants to set up an EV charger. This includes technical, legal (procedural), and financial information that is relevant to the process of

	purchasing, setting up, and managing an EV charging station.

Measure	E-mobility: EV promotion
Priority	EV promotion
Description	This measure aims to increase the attractiveness of the procurement and use of electric vehicles by increasing its comparative advantages over conventional vehicles. This can be seen through the establishment of different models to encourage the purchase of vehicles themselves, and a wide range of possibilities exist to provide certain privileges for users of electric vehicles. Namely, there are several examples of good practices in urban and other areas, such as the reservation of parking spaces, the establishment of low emission zones, special permits for driving on-road lanes, various other benefits, etc.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Organizing working meetings with local government representatives to assess and improve project cooperation • Conduct a survey among local administration as well as among citizens to identify the best specific measures to support greater use of EV.

Measure	E-mobility: education and awareness-raising
Priority	education and awareness-raising
Description	Since the concept of e-mobility represents a completely new paradigm of transport, it implies significant changes in the habits and behavior of end-users. Therefore, it is important to actively involve end-users in the process of e-mobility development through various promotional and educational activities. It is crucial to present to end-users what they can expect, what benefits they can have, and what is required of them in terms of certain skills and changes in common habits. It is also important to communicate the reasons for the introduction of e-mobility and the wider benefits for society. It is possible to introduce the younger population to the topic of e-mobility within the preschool education system (in kindergartens), of course in an age-appropriate way.
Actions to take (policy, technical, financial) to	• examining the possibility of introducing embolism education in regular programs of the education system, especially for

promote S&O and to minimize W&T	preschool children • holding public workshops and seminars on the development of emotionality • organization (e.g., every 2 years) of a conference on e-mobility with a strong focus on local challenges and opportunities for improvement.

5.4. Sustainable infrastructure and spatial development

Measure	Electricity storage pilot projects implementation
Priority	Sustainability, independence, infrastructure
Description	Batteries are at present the most common, practical, and widely form of storing electrical energy. The potential for electricity storage in battery systems can increase RES penetration in electricity systems, especially in islands and isolated regions. Given the fact that Split Dalmatia County has a lot of islands and isolated regions, the use of batteries as electricity storage is considered a good solution.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Decrease procurement costs • Increase lifetime of electricity storage • Decrease cost for small scale application • Bring new business opportunities • Raise public awareness for battery acceptance through workshops, publications, etc. • Use of rechargeable battery and news recyclable materials • Provide a team of experts

Measure	Smart grid pilot projects implementation
Priority	Introduction of new technologies, distribution systems, monitoring
Description	This measure includes the introduction of new technologies (mostly IT-based) into distribution systems. By installing smart equipment, it is planned to achieve monitoring the load of transformer substations, calculation losses in the distribution network, detecting and reducing losses in the grid, reducing CO2 emissions,

	better maintenance of the distribution network.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Establish energy management teams and clearly define their roles and responsibilities • Provide a team of experts • The coordinative efforts and strong initiatives - a collaboration with research institutions and non-governmental organization • Raise public awareness through workshops, publications, etc.

Measure	Digitalization of the power sector and smart city concept pilot activities
Priority	Digital infrastructures
Description	The digital revolution is slowly taking over the power sector. The power grids of the future will be digital infrastructures, meaning they will be highly connected and automated. The digital transformation can improve the efficiency of power generation and the transmission and distribution of electricity, all while providing consumers with more capabilities and choices around their energy use. All of this accelerates decarbonization because less fuel is needed to produce the same amount of power. Digital tools also enhance operation throughout the electricity value network, which increases grid reliability and security, and reduces the cost to generate, transmit, and deliver electricity.
Actions to take (policy, technical, financial) to promote S&O and to minimize W&T	• Establish energy management teams and clearly define their roles and responsibilities • Provide a team of experts • Raise public awareness through workshops, publications, etc. • The coordinative efforts and strong initiatives • Provide funds for the reconstruction of the existing network

6. SCENARIOS

6.1. Overview on main actions and measures on the time scale

All the suggested actions aim to increase the power generation by renewable energy sources and to electrify, as much as possible, other energy sectors like transportation, heating, and cooling. In this view, two scenarios (business as usual scenario and scenario with integrated measures) have been formulated to estimate how defined actions impact the energy plans of Split – Dalmatia County. These scenarios are based on projections of demographic trends, projections of

the national building stock, GDP growth projections, projections of technology progress, projections of the renovation of the building stock, which is taken from the Energy Strategy of the Republic of Croatia, and the National Energy and Climate Plan.

Energy efficiency measures in the household and service sector include the replacement of fossil fuels with renewable energy sources, the introduction of more efficient technologies such as condensing boilers and heat pumps (air source heat pumps and seawater source heat pump), the use of solar energy for heating and DHW preparation.

Lighting in the household and service sectors assumes the use of more efficient equipment, as well as more efficient lighting (e.g., LED lamps). Also, in cooking, the use of more efficient equipment is assumed, as well as greater use of electricity instead of the current use of fossil fuels.

The increase in energy efficiency in-vehicle devices has also been taken into account in the transport sector and will be achieved equally in both scenarios. However, the scenario with measures relies on stronger electrification of road traffic, which implies the creation of preconditions for this, such as the development of infrastructure for EV charging and the adoption of various measures to encourage e-mobility.

Two scenarios are shown below (both in the time frame until 2030):

- Business-as-usual scenario – a scenario that implies development with the application of existing measures, and
- S1 scenario – a scenario with the application of additional measures according to the *National Energy and climate plan of the Republic of Croatia*.

For each scenario, projections of final energy trends are shown below. The overview includes the distribution of final energy by sectors, purpose, and energy sources.

6.2. Scenario 2030

6.2.1. General description: Actions and measures in the scenario

The national energy and climate plan of the Republic of Croatia provides an overview of national goals for each of the five key dimensions of the Energy Union and appropriate policies and measures to achieve these goals, where special attention is paid to:

- reducing greenhouse gas emissions,
- increasing renewable energy sources,
- energy efficiency, and
- electricity interconnection.

The key document for the energy efficiency dimension is the Long-Term Strategy for Encouraging Investments in the Reconstruction of the National Building Fund of the Republic of Croatia until 2050, which promotes the need to invest in the building fund. The strategic goal of the Long-Term Strategy for the Renovation of the National Building Fund until 2050 is to raise the

renovation rate of buildings from the current 0.7% per year to 3% by 2030 while maintaining the rate of 3% until 2050. In the BAU scenario, the minimum energy efficiency measures that need to be implemented due to the existing legal frameworks and planning documents are assumed. In addition, regular replacement of currently used heat generation equipment with more efficient equipment is envisaged because for a certain part of the installed capacity the service life expires during the observation period.

In the S1 scenario, in addition to the minimum measures, additional measures are assumed:

- implementation of the continuous energy management,
- revitalization of the lighting system and establishment of the CNUS control system,
- installation of thermostatic radiator sets and valves for hydraulic flow balancing,
- thermal insulation of the external walls of the building,
- revitalization of glass areas (lower U-value),
- replacement of fossil fuel boilers with heat pumps,
- installation of solar collectors for DHW preparation,
- installation of PV modules for electricity generation on site.

It is important to mention that an increase in the national fund of buildings, i.e., households and the service sector, was assumed for both analyzed scenarios. Given this fact, despite the increase in energy efficiency measures, there may be an increase in energy demand. The results of the implementation of the described measures are shown in the diagrams below (by sectors, purpose, and energy sources).

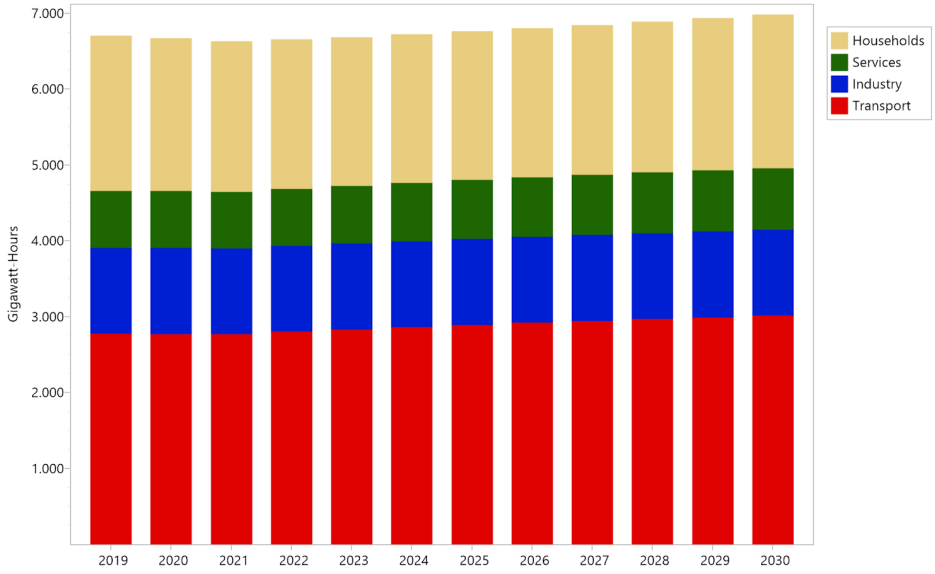

Figure 6-1 Final energy demand by sectors (Business-as-usual scenario)

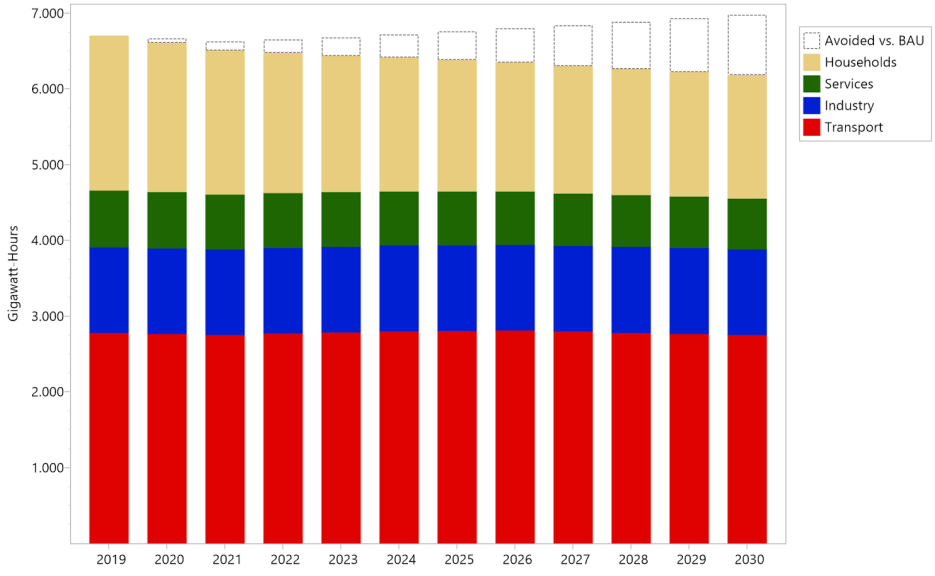

Figure 6-2 Final energy demand by sectors (S1 scenario vs. BAU)

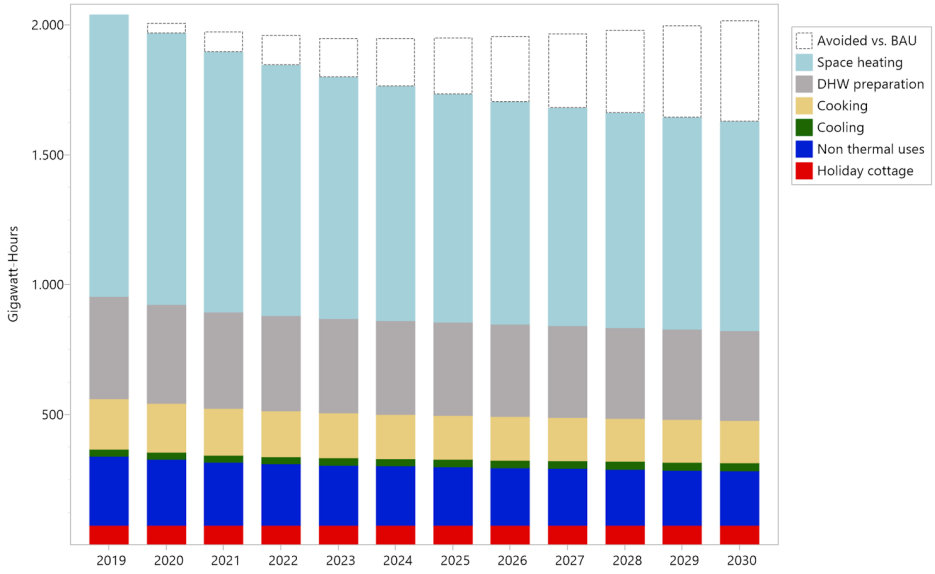

Figure 6-3 Final energy demand of the households' sector by purpose (S1 scenario vs. BAU)

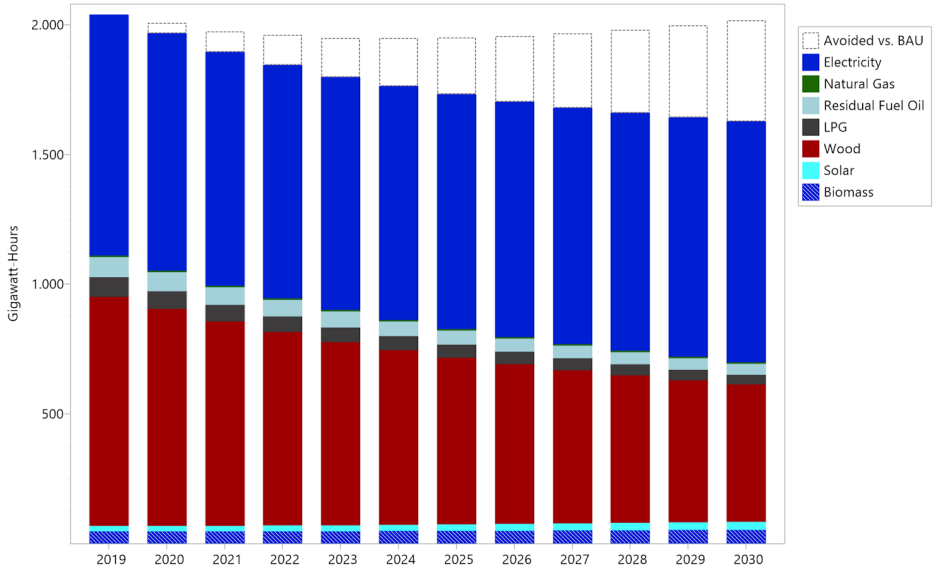

Figure 6-4 Final energy demand of the households' sector by purpose (S1 scenario vs. BAU)

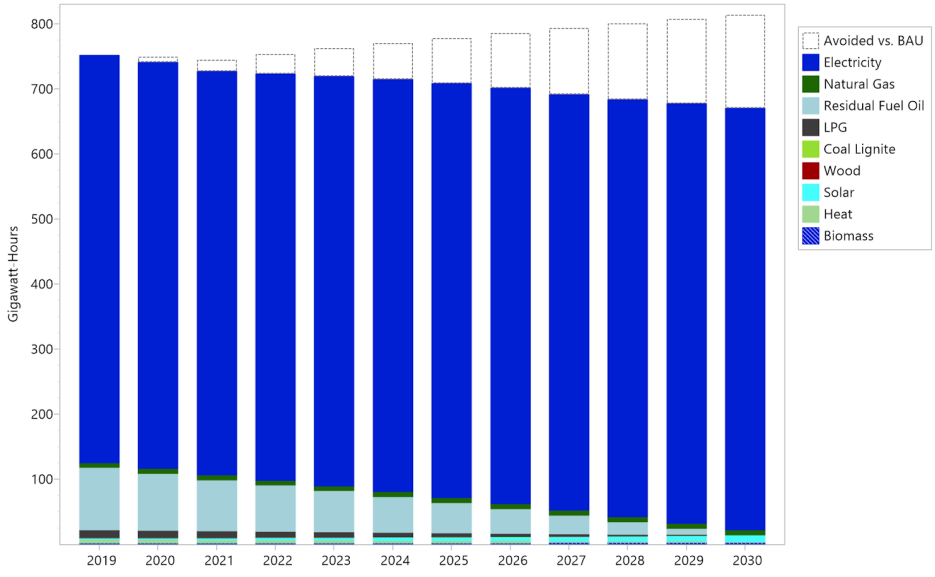

Figure 6-5 Final energy demand of the services sector by fuels (Business-as-usual scenario)

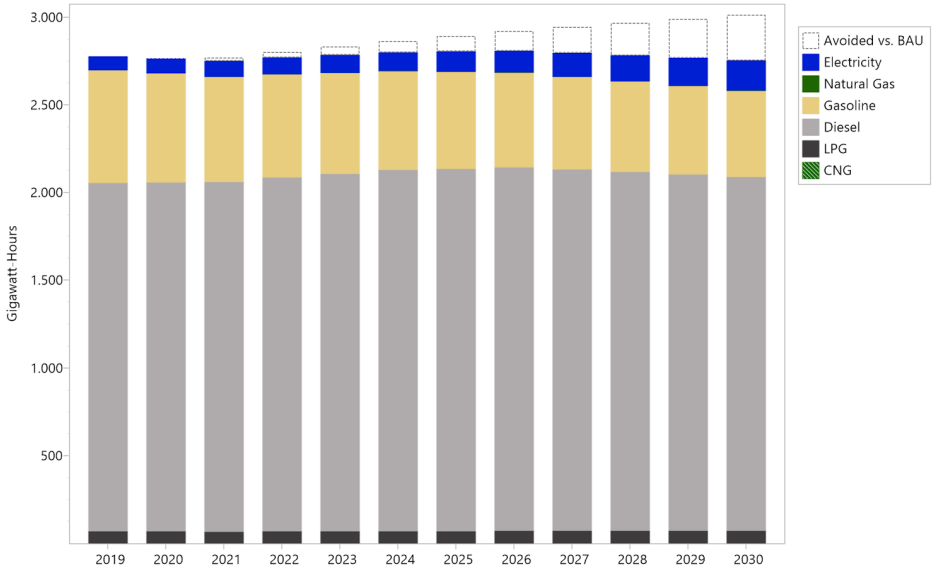

Figure 6-6 Final energy demand of the transport sector by fuels (Business-as-usual scenario)

6.2.2. Required investments

The costs of investing in measures related to decentralized systems have been estimated empirically and based on data from energy producers/suppliers. Capital expenditures are divided into the following categories of reconstruction:

- integral reconstruction – includes a combination of several energy renovation measures and must include measures on the building envelope, and
- deep reconstruction -includes energy efficiency measures on the envelope and technical systems and results in a reduction of energy consumption for heating ($Q_{H,nd}$) and primary energy (E_{prim}) at the annual level [kWh/(m^2a)] of at least 50% compared to energy consumption before renovation.

The amounts of estimated capital expenditures depending on the types of reconstruction and the sector are shown in the table below.

Table 6-1 Unit prices of investment by types of reconstruction and sectors

Type of reconstruction	Year	Household sector [HRK/m^2]	Service sector [HRK/m^2]
Integral reconstruction	2019	1.500	2.500
	2030	2.380	3.970
Deep reconstruction	2019	2.500	3.500
	2030	3.950	5.554

The amount of capital costs for the installation of heat pumps is assumed based on available data from the manufacturer, and amounts to HRK 4,413 per installed heat capacity, while the amount of costs for the installation of solar collectors is HRK 5,000/m^2.

For energy efficiency measures related to the buildings owned by the Split-Dalmatia County there is an estimation of around HRK 150 million to reach the savings of 75.8 TJ. The measures related to the retrofit of street lighting require more than HRK 250 million in CAPEX where Split-Dalmatia County should support the street lighting owners (municipalities and cities) to boost the energy retrofit of street lighting by providing minor financial and technical support. All the other measures should be supported more indirectly by providing technical and administrative support.

6.2.3. Final energy consumption and GHG emissions

Results of the analysis are displayed in standard format energy balance tables that closely match the types of tables used by organizations like the IEA and Eurostat as well as many national energy ministries. The energy balance table below is divided into 3 main sections: supply, transformation, and demand.

Supply is the first section that shows indigenous production of primary resources as well as imports and exports. The table below shows that Split-Dalmatia County is highly dependent on solid fuels, oil products, and natural gas imports. It also shows that the electricity is 100% renewable and that it comes from indigenous renewable sources such as hydropower, wind, and solar energy.

The second section shows the energy consumed and produced during the conversion of primary resources into secondary fuels, as well as the energy lost during the transportation and distribution of fuels. Energy inputs to a module are shown as negative values, outputs are shown as positive values, and the net losses from each module are thus shown in the total column on the far right of the balance.

The last section presents the demand side where each row of the demand section shows the sum of final demand in one of the top-level branches of the demand tree.

Table 6-2 Split-Dalmatia County energy balance table for 2030 (S1 scenario)

	Solid Fuels	Natural Gas	Hydropower	Renewables	Biomass	Electricity	Oil Products	Heat	Total
Production	-	-	2.644,4	567,2	591,0	-	-	-	3.802,5
Imports	735,4	16,6	-	-	-	-	2.818,3	2,2	3.572,5
Exports	-	-	-	-	-	-997,9	-	-	-997,9
Total Primary Supply	735,4	16,6	2.644,4	567,2	591,0	-997,9	2.818,3	2,2	6.377,0
Electricity Generation	-	-	-2.644,4	-526,0	-	3.170,3	-	-	-
Transmission and Distribution	-	-	-	-	-	-195,5	-	-	-195,5
Total Transformation	-	-	-2.644,4	-526,0	-	2.974,8	-	-	-195,5
Households	-	6,2	-	31,3	582,4	927,4	80,1	-	1.627,4
Services	-	7,7	-	9,9	2,0	648,3	-	2,2	670,1
Industry	735,4	1,5	-	-	6,6	232,2	157,2	-	1.132,8
Transport	-	1,2	-	-	-	169,0	2.581,	-	2.751,

	Solid Fuels	Natural Gas	Hydropower	Renewables	Biomass	Electricity	Oil Products	Heat	Total
							0		2
Total Demand	735,4	16,6	-	41,2	591,0	1.976,9	2.818,3	2,2	6.181,5

6.2.4. Sankey diagram

The Sankey Diagrams presented in this chapter are a type of flow diagram made of nodes connected by links, in which the width of the links is shown proportional to the energy flow being represented. They provide an overview of energy flows of Split-Dalmatia County from resources through each transformation module to energy demands. They include a representation of such details as imports, exports, stock changes, statistical differences, and losses.

The following Sankey diagrams represent the baseline 2019 year, the business-as-usual scenario, and the S1 scenario.

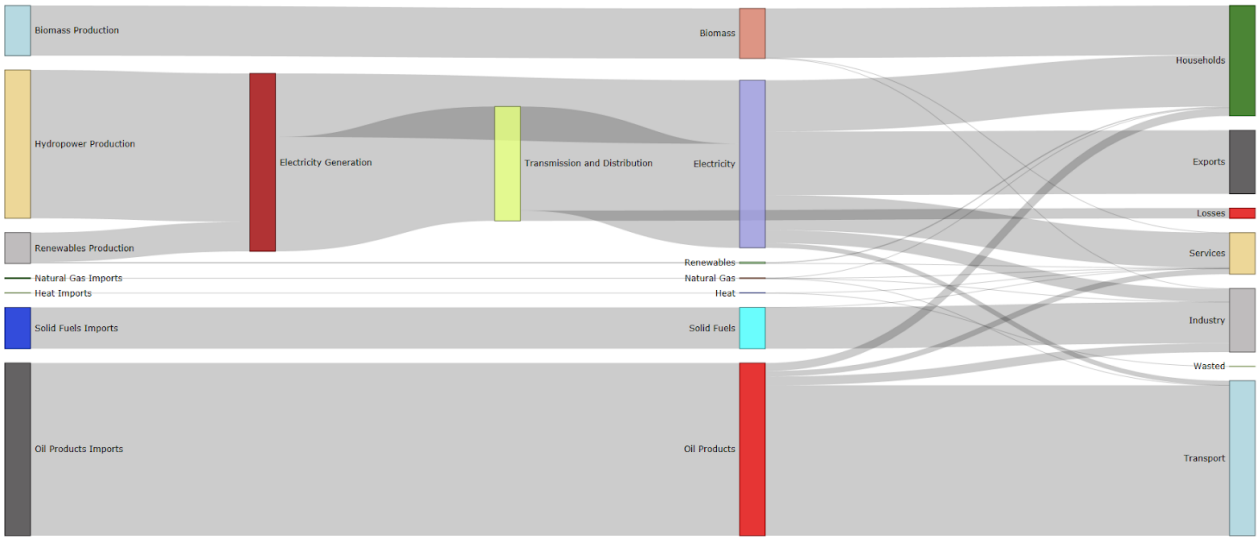

Figure 6-7 Baseline year

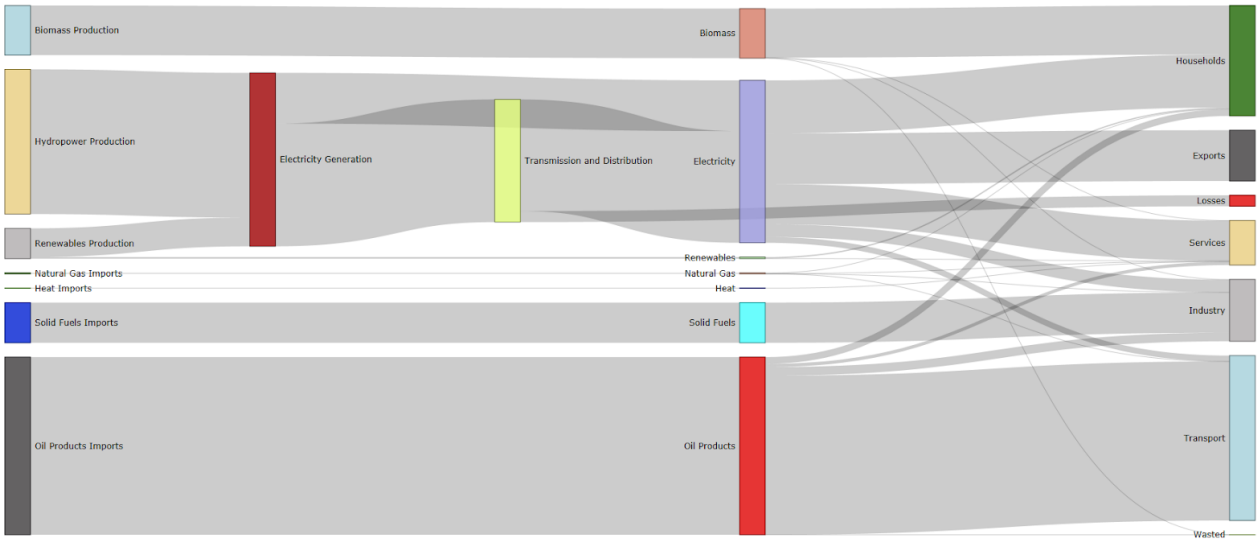

Figure 6-8 Business-as-usual scenario

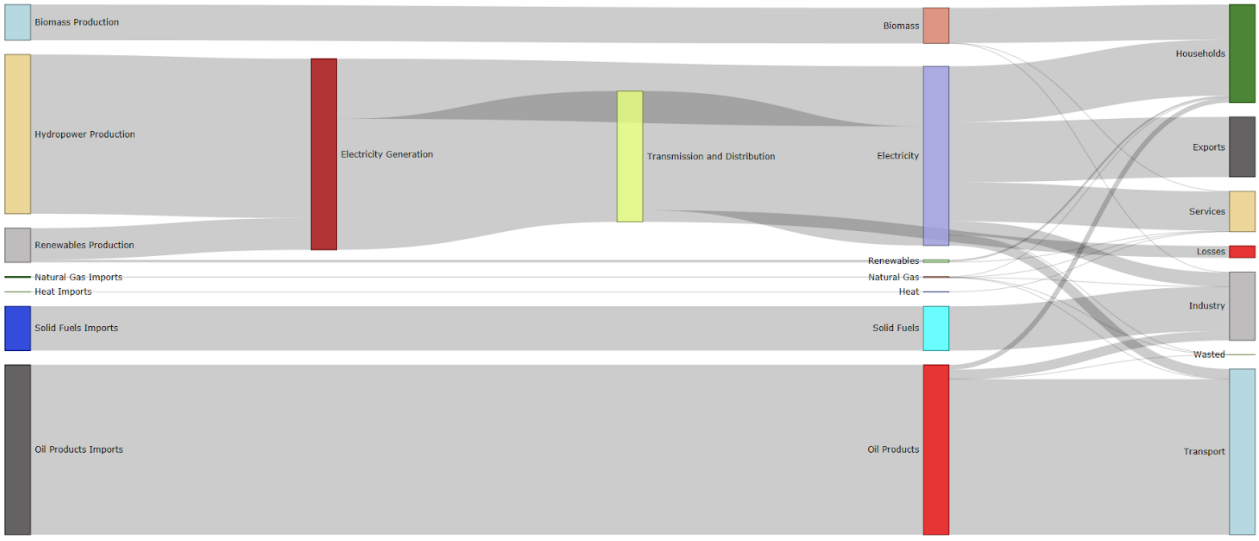

Figure 6-9 S1 scenario

7. IMPLEMENTATION MONITORING AND KPIs

7.1. Evaluating body and evaluation periods

At the NUTS-3 level, the Split-Dalmatia County will be the monitoring and evaluation body even though such process is still not officially defined or legally binding. Therefore, it would be wise to establish the regional energy agency that would besides other activities be responsible for the

monitoring and evaluation of implemented measures defined in this energy action plan.

7.2. KPIs for impact monitoring

The main KPIs for impact monitoring are as follows:

- renewables in general consumption (primary and final)
- renewables in electricity supply
- renewables in final electricity consumption
- renewables in final thermal consumption
- renewables in transport
- electricity in final consumption
- electricity in transport
- Investments in energy-decarbonization
- carbon emissions and Emission reduction (also certificate- value)
- emission costs per capita

8. ASSESSMENT OF SUITING BUSINESS MODELS AND FUNDING SCHEMES

The European Union has a leading role in the world in efforts to mitigate climate change and is focusing its economy on low-carbon development based on new technologies. Therefor, the revision of the ETS Directive also establishes the **Innovation Fund**, which is available to all Member States. It will fund projects to support innovation in low-carbon technologies and processes, environmentally friendly carbon capture and use, innovative technologies for renewables and energy storage.

By 2020, the Republic of Croatia has committed to increasing its investment in research, development and innovation to 1.4% of GDP. Investment in the science and technology system should steadily increase and ultimately reach the EU average of 3% of GDP at the national level. Key development technologies enable the transition from a traditional economy to a low carbon economy based on knowledge. Since the Smart Specialization Strategy is one of the basic strategic documents in the field of technological development and innovation, this created the initial preconditions for the **transition to a low carbon economy** and for the participation of institutions responsible for supporting business investments in research, development and innovation (Ministry of the Economy, Entrepreneurship and Crafts, HAMAG-BICRO). Most of the funds for the implementation of the Smart Specialization Strategy will be secured from the European Structural and Investment Funds.

8.1. Existing business models with regional relevance for low carbon energy supply and development potentials

It is expected that in the forthcoming financial period the main source of financing will also be

ESI funds and funds from auctions of CO2 emission allowances and ETS funds dedicated for modernization. The revision of the ETS Directive established a financial mechanism to support the modernization of the energy sector and industrial plants for the period 2021 – 2030, in the ten EU Member States whose GDP per capita according to the marked prices was below 60% of the EU average, including the Republic of Croatia (**Modernisation Fund**). The funds of the Modernisation Fund will be used for investments in modernization of industrial production, production and use of electricity from renewable sources, improvement of energy efficiency, energy storage and modernization of energy grids, energy efficiency in transport, buildings, agriculture and waste management.

In the period 2021-2030, for the financial measures envisaged by this energy action plan, national as well as EU funds should be used. These involve previously described EU funds (i.e. ESI funds for the new programming period 2021-2027), together with national funds from sale of emission allowances, along with other revenues from the Environmental Protection and Energy Efficiency Fund.

The Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030[1] published in December 2019 clearly lists all the relevant low-carbon measures that are inline with the measures listed in this study and presents funding possibilities for each measure.

8.2. Alternative business models and regional applicability

New business models are slowly being available also in the Split-Dalmatia County. The most prominent alternative funding possibilities are as follows:

- P2P trading business models where online trading platforms can enable better management of decentralised renewable energy sources by always matching local demand and supply

- Community based distributed ownership and management which is only recently available in Croatia and regulated by the secondary energy legislation.

- Pay-as-you-go business models that are targeting the sector of electromobility.

The regional applicability for these business models is depending on a well-developed digital infrastructure of the County.

8.3. Usable funding schemes: applicability and possible gaps to be filled

Most of the funding schemes are centralized in Croatia so the County is fully dependant on the national and EU funds. The County however published a programme that provides certain funding for low-carbon technologies successfully and should continue to do so in the future as well. It is important to complement the regional and national based incentives and ensure to generate a positive cumulative effect. In the future we can expect more regionally based funding possibilities.

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1 https://mingor.gov.hr/UserDocsImages/UPRAVA%20ZA%20ENERGETIKU/Strategije,%20planovi%20i%20programi/hr%20necp/Integrated%20Nacional%20Energy%20and%20Climate%20Plan%20for%20the%20Republic%20of_Croatia.pdf

9. CONCLUSIONS

9.1. Summary of findings

The Republic of Croatia and the Split-Dalmatia County follow the EU climate policy, with the aim of minimizing greenhouse gas emissions by 2030 and achieving net zero greenhouse gas emissions by 2050. EU targets have been set for 1990 emissions. Due to the lack of necessary data for 1990, the targets for the Split-Dalmatia County were set in relation to the base year 2019.

According to the Scenario with Measures (S1), it is possible to achieve a reduction of greenhouse gas emissions from energy sectors in the Split-Dalmatia County by 5.30% by 2030 compared to the level of emissions in 2019, while in case of non-implementation of active energy policies in the same period emissions increased by 3.6%. Active energy policy implies the implementation of a series of support and executive measures in the field of energy statistics, energy efficiency, renewable energy sources and sustainable mobility. In addition to implementing support measures such as establishing data collection for energy statistics, preparing the annual energy balance and educating the energy team and improving systematic energy management in public sector buildings in Split-Dalmatia County, it is important to develop a concrete long-term plan for construction and reconstruction of public buildings. The plan for the renovation of the fund of buildings owned by the county should be prepared on the basis of actual data obtained from the implementation of the aforementioned support measures.

9.2. Challenges for the regional authorities and stakeholders

To facilitate the implementation of the proposed measures, one of the basic goals in the coming period must be the establishment of a regional energy agency. The Regional Energy Agency would operate within the county, and potentially beyond, in the field of energy and environmental protection by implementing programs and projects to encourage the use of renewable energy sources and energy efficiency in all sectors. Funding for the agency's regular activities would be dominant at the program and / or project level, with only a small part covered by the county and possibly larger cities.

In addition to the establishment of a regional energy agency, it is good to continue the current good practice by enacting a new program of co-financing energy efficiency and renewable energy measures to be implemented by citizens, cities or municipalities, co-financed from the county budget. The new program must be innovative and in line with the objectives and measures highlighted in this energy action plan and would cover the three-year period from 2022 to 2025.

9.3. Expected impact on the regional economy

The impact of the energy transition on the regional economy is hard to estimate. All measures related to energy efficiency and shift from fossil fuels to renewable energy will generate positive monetary effects and positively impact the overall regional economy. The scope of this energy action plan was limited so the economical evaluation was not performed.

9.4. Gaps to fill for proper implementation (technical, regulatory, financial)

Historically the Split-Dalmatia County has been powered by renewable energy exclusively because of large hydropower plants that were built. Now the time has come to fully electrify the heating and cooling sector as well as transport by 2050 with high efficiency technologies. The full electrification will require speeding up the implementation which requires good preparatory work. Measures emphasized in this energy action plan are essential steps to achieve the carbon-neutrality targets by 2050.