SOLAR ADRIA: 1st technical report

Baseline context analysis

Stakeholder engagement report

SOLAR ADRIA

Project: SOLAR ADRIA: Accelerating solar energy deployment in coastal municipalities of the Adriatic region

Lead partner: Energy Institute Hrvoje Požar, Croatia

Project partners: The Nature Conservancy in Europe gGmbH, Germany

University of Ljubljana (Biotechnical faculty), Slovenia

Environment Programme, Montenegro

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Report: SOLAR ADRIA 1st technical report

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List of abbreviations

DSO – Distribution System Operator

ECS – Energy Concept of Slovenia

ESCO – Energy Service Company

EU – European Union

EUKI – European Climate Initiative

ETS – Emissions Trading System

GHG – Greenhouse gas

HPP – Hydropower plants

LEC – Local energy concept

PV – Photovoltaic

PPP – Public-Private Partnerships

RES – Renewable Energy Sources

SEAP – Sustainable Energy Action Plan

SECAP – Sustainable Energy and Climate Action Plan

Introduction

This is the first report of the SOLAR ADRIA project within the European Climate Initiative (EUKI), financed by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany. With the project, the international team under the lead of Hrvoje Požar Energy Institute (Croatia), aims to accelerate solar power development in the coastal Adriatic municipalities. The objectives of the project are to explore on a municipal level how stakeholders perceive and contribute to energy transition through solar development, to provide solar potential maps for target municipalities and create a match-making platform to connect any interested investors with the municipality administration and other stakeholders.

In this report we outline the existing situation within the pilot municipalities to provide an understanding of contexts in which the project will be carried out and provide a baseline for comparison of the two pilot municipalities. These are City municipality Koper in Slovenia and Municipality Starigrad, part of Zadar County, in Croatia. The report has two parts: first part is a description of solar energy landscape in Slovenia and Croatia and both pilot municipalities, while the second part gives an account of stakeholders' views on solar energy development.

The first part begins by shortly examining the European policies and future energy transition targets, as both countries are EU members states. The national energy situation and plans are then examined, paying special attention to the state of renewables and future scenarios. The national context is also presented for Montenegro, as this is the country in which a capacity building workshop will be held at the end of the project, organized by the project partner from Montenegro (The Environment Program, EnvPro). The national comparisons show diversities and similarities of the past decisions and plans. For example, all countries propose to advance solar development exponentially in the coming years. While Croatia mainly focused on wind in the past, Slovenia has little development of this technology, while solar energy is utilized better. The national situations provide a backdrop to examination of the two pilot municipalities.

The differences here are considerable, mainly since Koper is a regional center and a well-developed city, while Starigrad is a peripheral settlement next to much larger city of Zadar, but nevertheless important for nature conservation and tourism.

Understanding this context was imperative for the next step of the project presented in the second part, in which the municipal administration, non-governmental institutions, developers and the public were engaged. We conducted several interviews and a public opinion survey to gauge their interest, experience, and knowledge about solar power plants as well as which barriers and opportunities they see related to solar energy development. Despite several seemingly important differences observed in the first part of context examination, the stakeholder engagement findings provide a similar picture in both pilot municipalities. Both municipal administrations reported lack of resources, even though institutions competent in the field of energy are available for consultation. Another often mentioned barrier was lack of knowledge among the public, which was confirmed in the survey, but, promisingly, interest to invest in solar power plant was very high.

The findings of both parts are paramount for devising tools to help municipalities with easier and faster development of solar power plants. This will be the focus of next stages of the project.

CHAPTER 1

Baseline context analysis

European outlook

To become the first climate-neutral continent, the European Commission positioned transition towards greater sustainability as one of its main priorities in the 2019-2024 period. This is going to be achieved through the European Green Deal, a new growth strategy that will transform the EU into a modern, resource-efficient, and competitive economy (European Commission, 2019a). Part of the various actions proposed by the European Green Deal is also decarbonization of the energy systems. The key principles of this move towards "clean energy" are to prioritize energy efficiency and develop a power sector based largely on renewable sources, provide a secure and affordable energy supply, and fully integrate, interconnect, and digitalize the EU energy market (European Commission, 2019b).

2020 marks the deadline to fulfil the targets from the Renewable Energy Directive (Directive 2009/28/EC, 2009). This Directive requires the EU to fulfil at least 20 % of its total energy needs with renewable sources. According to Eurostat, in 2019 the overall share of energy from renewable sources was at 19,7 % (Figure 1). The current 2030 goals stand at 32 % share of renewable energy, but the Commission plans to raise the bar further up to 55 %. While renewable energy goals are not yet set for 2050, a strategic long-term vision Going Climate-neutral by 2050 (European Commission, 2019c) envisions at least 80 % of electricity will be produced from renewable energy sources, with electricity providing for half of the final energy demand in the EU. To implement this policy, the European Parliament and the Council on the Governance of the Energy Union and Climate Action stipulated the development of national long-term strategies and national energy and climate plans for the period 2021-2030. These plans are an essential tool for the efficient and coordinated energy transition and provide an overview of the targets for each of the five key dimensions of the Energy Union: 1) energy security, 2) an internal energy market, 3) energy efficiency, 4) decarbonization and 5) research, innovation, and competitiveness.

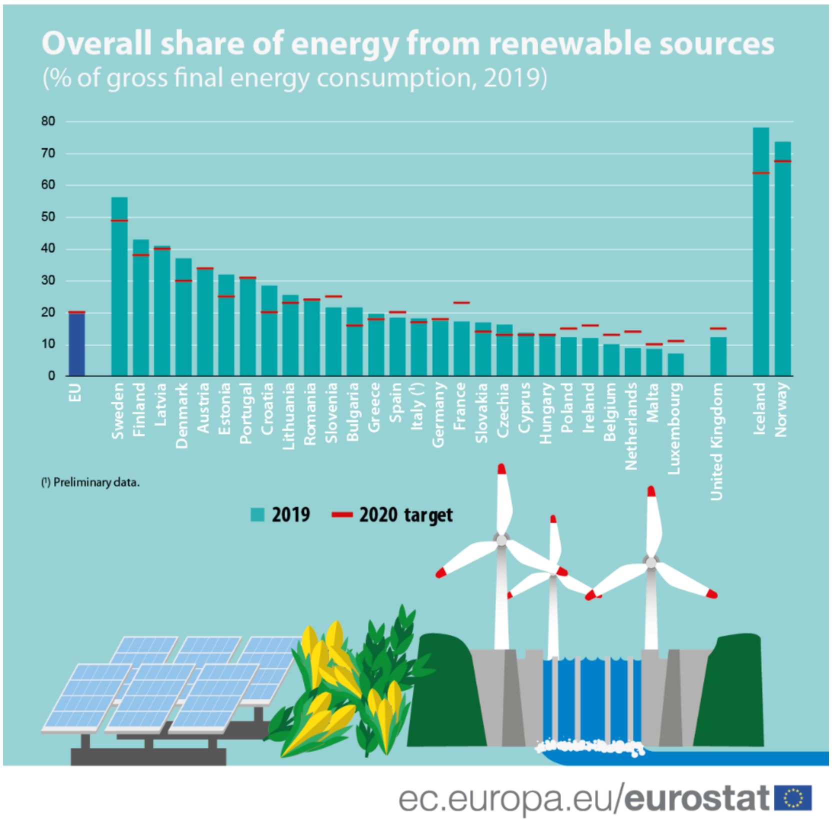


Figure 1: Overall share of energy from renewable sources. Source: Eurostat (2020a)

With the above targets set, it is encouraging that the European-wide trends show a high growth of renewable energy capacity. Electricity generated from renewable energy sources in the last decade shows a large expansion of wind power, but also solar power and biofuels. Currently, wind and hydropower account for approximately two thirds of the total electricity generated from renewable sources (35 % each), the remaining attributed to solar (13 %), solid biofuels (8 %) and other renewables (9 %), according to Eurostat (2020a). Solar power however is the fastest growing source as in 2008 it only accounted to 1 %. In the past ten years, electricity produced from solar grew from 7,4 TWh in 2008 to 125,7 TWh in 2019.

While the best solar potential in the EU can be found on its southern part, including the Adriatic region, comparison of per capita production of solar power reveals that eastern Adriatic countries are ranked below average (Figure 2). This suggests that the barriers for increased development of solar power in the region are not related to natural conditions, but rather to institutional, social, and financial factors, which will be explored in SOLAR ADRIA project and pilot solutions provided. Below, we first outline the national and municipal situations of the pilot municipalities to offer a baseline understanding of the context we will be working in.

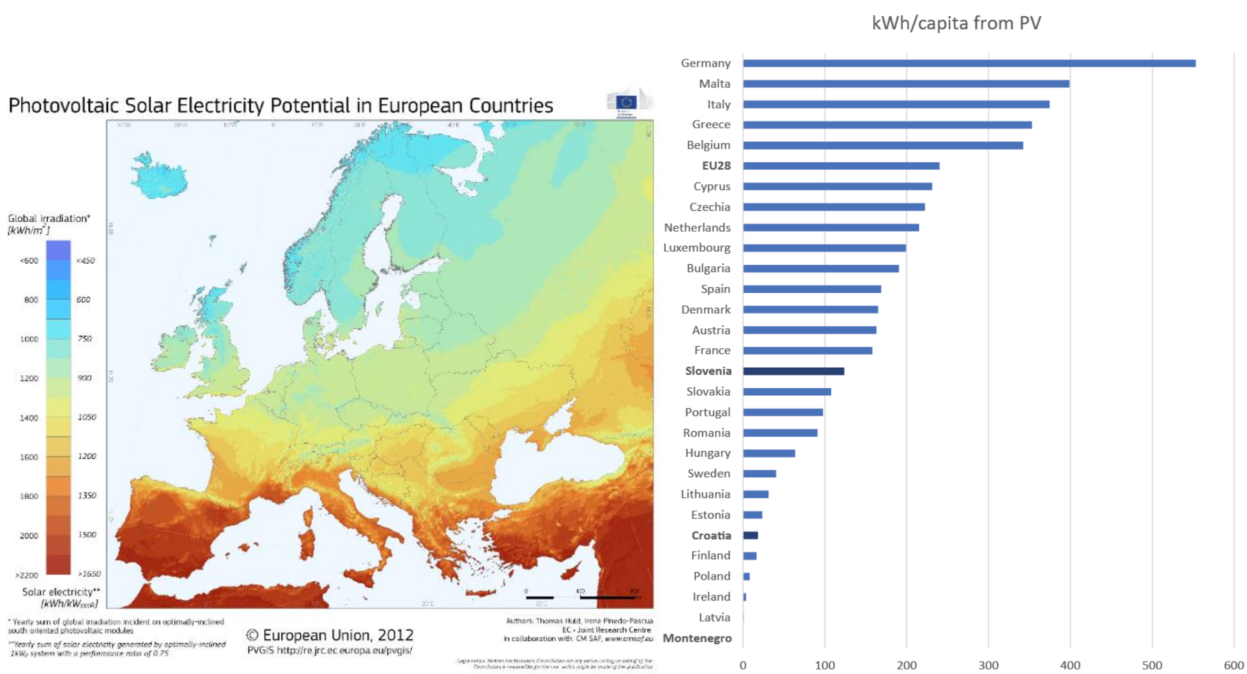


Figure 2: Map of photovoltaic solar electricity potential in European countries (European Commission, 2020) and comparison of electricity produced from PV by country (Eurostat, NDa; NDb).

National outlooks

Croatia

In 2019, the total energy consumption of the Republic of Croatia amounted to 9.690,5 ktoe, with 4.793,8 ktoe of primary energy produced within the country. This puts its import dependence at 50,5 %. The overall renewable sources share was 24,2 %. Domestic supply of electricity amounted to 11.978 GWh, of which 49,78 % where produced from renewable sources (Energy Institute Hrvoje Požar, 2019).

By the end of 2019, the total available capacities of all power plants in the Republic of Croatia amounted to 4.711,8 MW. Out of this amount, 1.781 MW is placed in thermal power plants, 2.199,7 MW in hydro power plants, 646,3 MW in wind power plants and 84,8 MW in solar power plants. These capacities do not include generating units in other countries from which the Croatian power system has the right to withdraw electricity. Hydropower represents the biggest share in produced electricity. It adds an additional dimension to grid stability as nine hydropower plants are accumulations with a total capacity of 1.509 MW. By 2030, the construction of two to three large hydropower plants, several small hydropower plants (on watercourses and water supply systems) and one pumped-storage hydropower plant is expected.

Currently, the photovoltaic systems with an installed capacity of 84,8 MW represent just a small fraction of the total installed capacity in the Croatian power grid. In 2019 Croatia produced 81,3 GWh of electricity from solar power, which is 0,7 % of total domestic production and 2,1 % of electricity produced from renewables. However, given the climate characteristics, the region of Dalmatia is particularly suitable for the development of wind and solar power plants, and there is a strong investor interest in the construction of new facilities in the region. Most of these investors are focused on large scale projects in the Dalmatian hinterlands, connected to the transmission grid. Small scale photovoltaic systems, integrated in buildings, have a significant potential for future solar based electricity generation. According to estimates, the installed capacity of such systems is expected to be around 300 MW in 2030 and they are the focus of the SOLAR ADRIA EUKI project.

Table 1: Energy statistics for Croatia in 2019. Source: Energy Institute Hrvoje Požar, 2019

Total domestic production	4.793,8 ktoe	**Solar electricity production**	81,3 GWh
Total domestic consumption	9.690,5 ktoe	**Domestic supply of electricity**	11.978 GWh
Total energy transformations	6.298,8 ktoe	**RES in electricity production**	44,7 %
Total domestic production	4.793,8 ktoe	**Solar electricity production**	81,3 GWh
Self-sufficiency	49,5%	**Solar installed capacity**	84,8 MW
RES overall share	24,2 %		

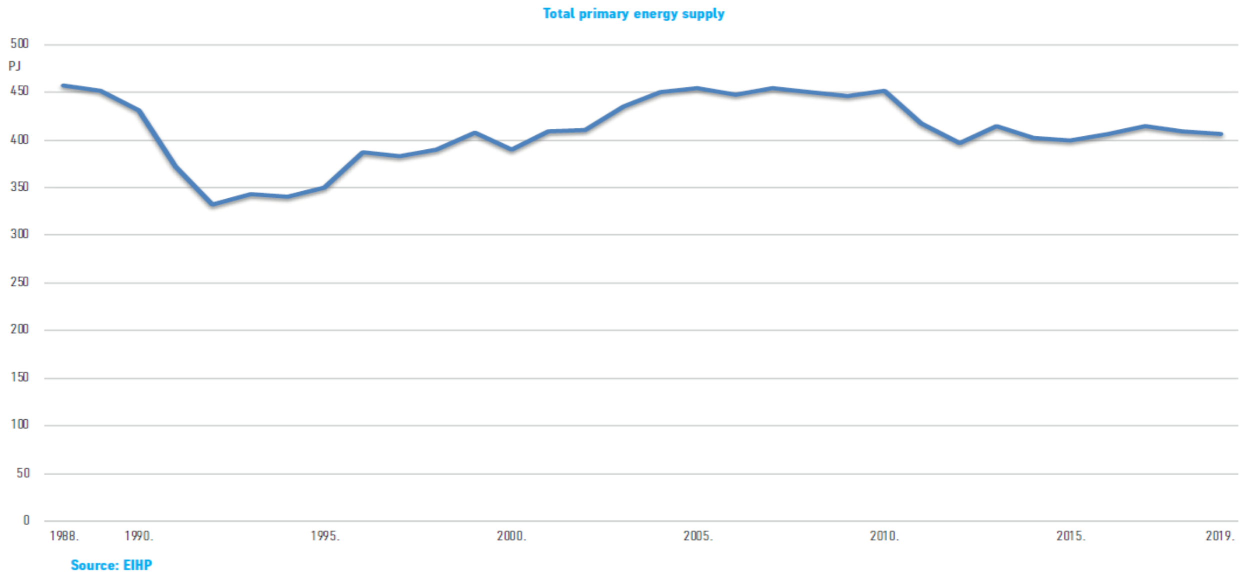


Figure 3: Total primary energy supply of the Republic of Croatia from 1998 to 2019.

Energy strategy

The main legislative energy document on the Croatian national level is the Energy Development Strategy of the Republic of Croatia for period up to 2030 with outlook to 2050. It represents the roadmap towards a successful transition into low-carbon energy sector. The development of the energy sector is analyzed in the context of the global and European energy targets. Hence, it represents Croatia’s contribution to the mitigation of the climate change.

Within the energy strategy, emphasis is placed on the reduction of greenhouse gas emissions (GHG) from the energy sector, considering the guidelines for energy security, energy efficiency, and the increase of total primary energy production in the Republic of Croatia with the focus on renewable energy sources. Three different development scenarios where described, differing mainly in the ambition of the adopted measures and corresponding rates of GHG reductions.

- **Scenario 0 (S0)** represents the base case with the continuation of current policies and measures in the energy sector (business as usual).
- **Scenario 1 (S1)** represents an accelerated energy transition based on the premises that significant international collaboration will be accomplished to achieve the goals of the Paris Agreement. Significant improvements are expected in energy production, transmission, and distribution.
- **Scenario 2 (S2)** represents a moderate energy transition where all premises from the accelerated scenario stay the same, but with the difference of lower targets from the energy renovation of buildings, lower increase in electricity demand, lower increase in solar and wind power capacities and slower transition in the transportation sector.

In the time frame till 2030, the scenarios S1 and S2 are relative similar in terms of key indicators, while significantly greater GHG reduction is accomplished until 2050 in the S1 scenario.

Table 2: Comparison of three different scenarios included in the Energy Development Strategy of the Republic of Croatia for period up to 2030 with outlook to 2050. Source: Vlada RH, 2019

	CURRENT	S0		S1		S2	
	2017	2030	2050	2030	2050	2030	2050
Reduction in GHG emissions	21.8%	32.8%	49.3%	37.5%	74.4%	35.4%	64.3%
Change in electricity consumption	-7.0%	7,3%	-3.8%	2.6%	-28.6%	8.1%	-15.0%
Energy renovation of buildings, annually	0.2%	0.2%	0.2%	3.0%	3.0%	1.6%	1.6%
Share of EVs and hybrid cars	1.0%	2.5%	30.0%	4.5%	85.0%	3.5%	65.0%
Share of RES in total energy consumption	27.3%	35.7%	45.5%	36.7%	65.6%	36.6%	53.2%
Share of RES in electrical energy	45.0%	60.0%	82.0%	66.0%	88.0%	61.0%	83.0%

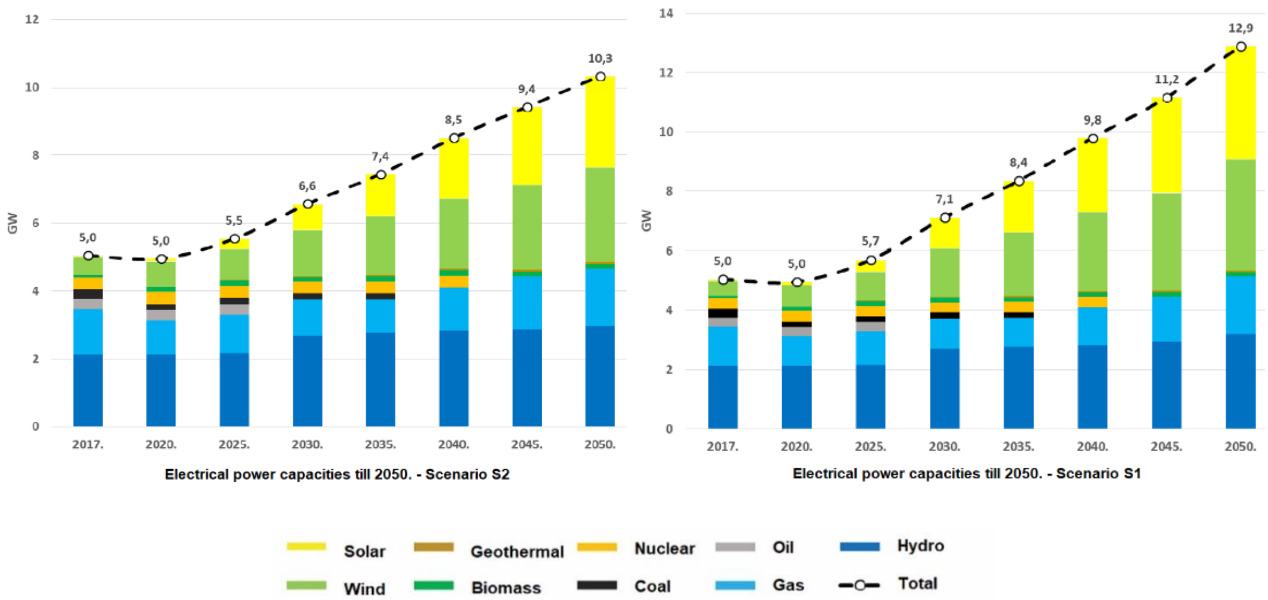


Figure 4: Electrical power capacities by source until 2050 in scenarios S2 (moderate transition) and S1 (accelerated transition). Source: Vlada RH, 2019

The capacities in wind power plants are expected to rise to about 1.360 MW in 2030 and to about 2.700 MW in 2050 according to the scenario S2. On average, an annual capacity increase of 80 MW in wind power is expected for S2 and about 110 MW for S1, which will significantly be dependent on the feasibility of potential locations (Figure 4).

Till the year 2030, the total capacity in solar power plants is expected to be about 768 MW for the S2 scenario (about eight times the value in 2019), and about 1.039 MW for the scenario S1. In both scenarios the photovoltaic systems integrated on buildings should have a capacity of about 350 MW. Till the year 2050, the total installed capacity of building integrated PV is expected to be 2700 MW for the scenario S2 and 3.800 MW for S1.

Integrated Energy and Climate Plan for the Republic of Croatia

The Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030 was published by the Ministry of Environment and Energy in December 2019. The document defines the most important targets by year 2030, which are:

- Reduction in greenhouse gas emissions for the ETS1 sector, compared to 2005: ≥ 43 %.
- Reduction in greenhouse gas emissions for non-ETS sectors, compared to 2005: ≥ 7 %.
- Share of RES in gross final energy consumption: ≥ 36,4 %.
- Share of RES in the gross direct consumption of electricity: ≥ 63,8 %.
- Share of RES in final energy consumption in transport: ≥ 13,2 %.

The Integrated Energy and Climate Plan predicts growth in all renewables except biomass. Among them capacities of solar power plants are going to expand the most, up to eight times (Figure 5).

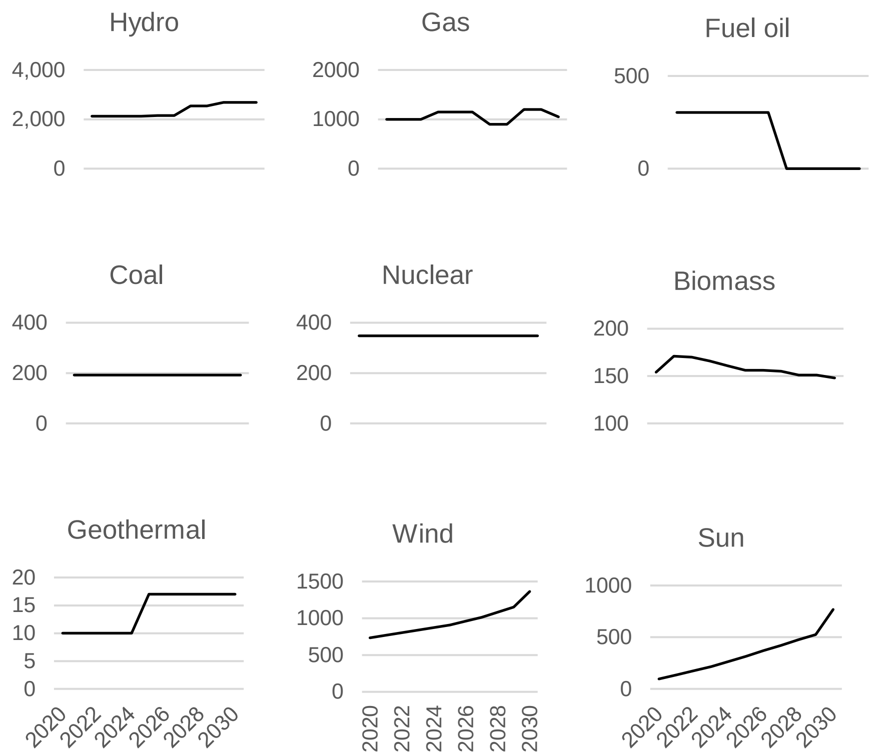


Figure 5: Power plants capacities in MW until 2030 as expected in the Integrated energy and climate plan for the Republic of Croatia. Source: Integrated National Energy and Climate Plan for the Republic of Croatia

1 ETS- European Emissions Trading System

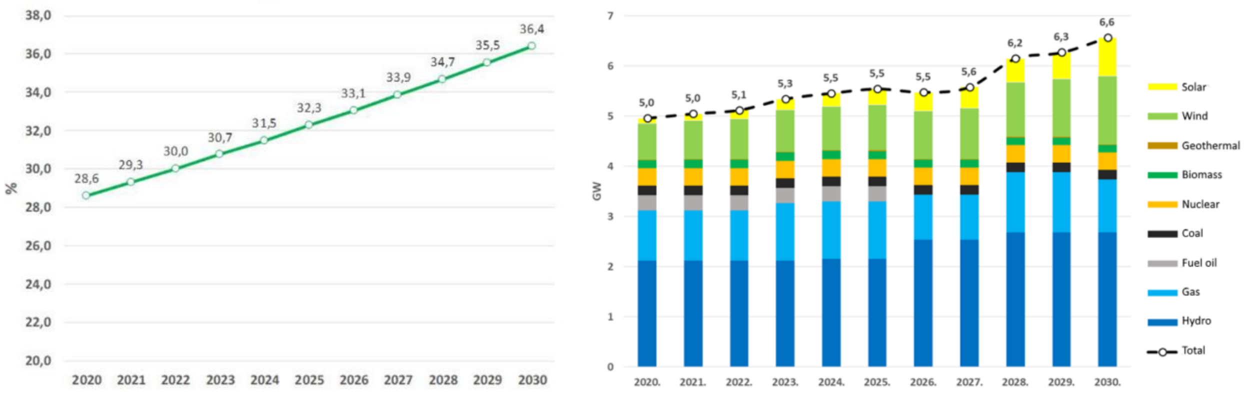


Figure 6: Left: Indicative trajectory of RES shares in the gross final consumption of energy. Right: Predicted installed capacities by source until 2030. Source: Integrated National Energy and Climate Plan for the Republic of Croatia

Croatian legislation for constructing solar power plants

Croatian Government recently announced new RES targets to increase its wind energy capacities by a factor of three and solar energy capacities by a factor of 20 in the next 10 years. With wind, solar and other renewable energy sources, Croatia plans to achieve 36,4 % share of renewables in gross energy consumption by 2030 and at least 65 % by 2050, and the renewable energy transition will help reduce GHG emissions. Clearly, knowing of its huge solar energy potential, Croatia is just at the beginning of its solar power era[2].

Plans for higher use of renewables, alongside with announced premium systems for RES, have attracted a significant number of developers to put their forces into developing RES projects, most notably, wind and solar. Currently, there are more than 7.000 MW of grid connection requests at Croatian Transmission System Operator, with somewhat less than 3.000 MW in solar. However, most of these projects are in an early development phase and it is unclear which projects will be realized. Numerous economical, technical, and environmental requirements must be met to obtain a construction permit and start the construction process.

However, all the above-mentioned projects in development are in the category of large-scale solar power plants, connected to the medium voltage distribution grid or the high voltage transmission grid. The administrative procedure for these projects is complex, as they have a significant impacted on the surrounding area and the electrical power grid. The basic administrative scheme for RES project development is shown on the following figure.

[2] Low Carbon Development Strategy of the Republic of Croatia for period up to 2030 with outlook to 2050

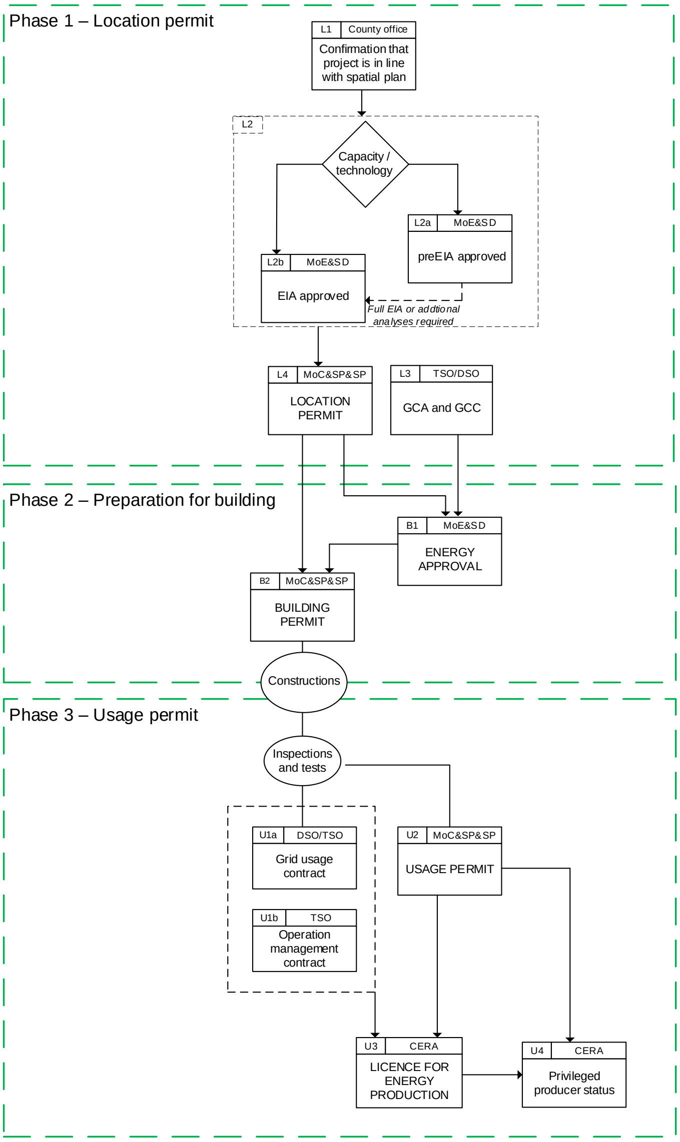


Figure 7: Planning process for energy projects in the Republic of Croatia.

In contrast to large scale solar power plants, the construction of building-integrated photovoltaic systems for self-consumption is considerably simplified. Integrated photovoltaic systems are considered as simple buildings (according to the regulation Pravilnik o jednostavnim i drugim građvinama i radovima NN 112/17, 34/18, 36/19, 98/19 i 31/20) and an official building permit is not necessary. It is expected that the procedural simplification, the net-metering and the price decrease of solar panels and inverters will result in a significant increase for small scale solar projects.

Net metering was recently introduced by the DSO in Croatia (HEP ODS Ltd). It represents a specific way of electricity billing, in which the energy consumption or production is evaluated monthly. This system allows customers to “virtually” store excessive solar power during peak production (during a sunny day) and consume it at a later point where the consumption is increased (during the night).

The administrative steps for the connection of integrated photovoltaic systems for self-consumption are displayed on the Figure 8 bellow. Two technical documents are mandatory, the concept and main design. Based on the information in the concept design, the DSO analyzes the surrounding grid in terms of available capacity and impact the photovoltaic system would have and determines the acceptability of the connection request. It is expected that in the foreseeable future most of the request will get an approval, as the grid is not saturated with distributed energy sources and prosumers. While data is limited, the average cost of 50-500 kW solar power plant is between 800 to 1450 €/kW.

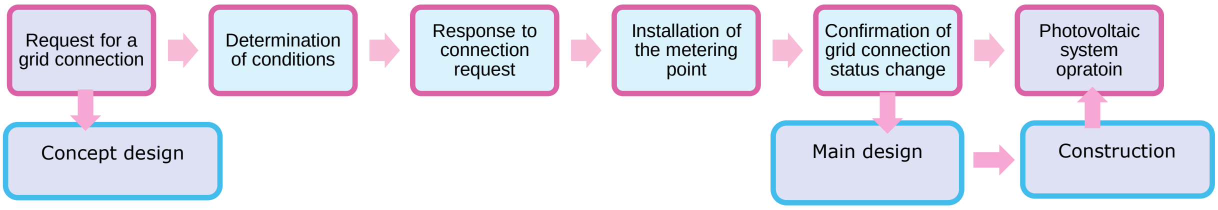


Figure 8: Planning process for the grid connection in the Republic of Croatia.

Slovenia

In 2019 total domestic consumption of energy in Slovenia was 6.672 ktoe and total final consumption was 4.960 ktoe, of which 3.536 ktoe was produced domestically. This puts the import dependance at about 48 %. Overall share of RES was 21,7 %. In the electricity sector, domestic supply amounted to 11.978 GWh, 32,6 % was generated by renewable sources (SURS, 2020). Until 2050, final energy use is forecasted to drop by 30 %, but electricity consumption will nevertheless rise by 40 % relative to 2017. Use of electricity will in this case represent 50 % of total energy use.

Most of electricity (37,5 %) in the Republic of Slovenia is provided by nuclear power plant (one half of the whole energy produced by the nuclear power plant is exported to Croatia). This is followed by renewable sources, including hydro. Coal fired power plants provided 28,9 %, and other sources 0,1 %. Most of the renewable energy come from hydropower (92 % of electricity from all renewables). Solar power plants provide for about 5,6 % of electricity from RES, followed by biomass with 3,9 % and wind energy with just 0,1 % (Agencija za energijo, ND).

The installed capacities in 2019 in the Republic of Slovenia amounted to 3.573 MW. Nuclear power plant has the capacity of 696 MW, but since half of the energy produced is exported to Croatia the amount used in calculations is 348 MW. Hydropower plants, both large and small, contribute 1.340,8 MW. Thermal power plants, including cogeneration of electricity and heat, have the capacity of 1.537,7 MW. Other types of power plants have 347,6 MW of installed power, most of which is represented by solar power at 275,9 MW. The largest planned additions are several hydropower plants, especially on the middle Sava river, which spark a lot of opposition due to nature conservation issues, especially among NGOs. A pressing issue is also the forthcoming expiry of nuclear power plant's lifetime in 2043, which started a debate on possible construction of a second block.

Currently, the solar power systems with an installed capacity of 275,9 MW represent most of the installed RES capacities (excluding hydro). In 2019 Slovenia produced 268,8 GWh of electricity from solar power, which is just over 2 % of total domestic production. While in the European context, Slovenia is not considered as prime location for solar utilization, the climate conditions favor this type of renewable, especially in the Littoral region with a high share of sunny days. This region, however, has the least amount of installed power capacity in the country with 19 MW. Development of solar power systems in Slovenia seems to be mostly dependent on market conditions and subsidy schemes, as the greatest expansion of the technology was when these were most favorable (2009-2011, Figure 9). Future scenarios and plans, as presented in the following sections, base increasing share of RES largely on solar technologies.

Table 3: Energy statistics for the Republic of Slovenia in 2019. Source: SURS, 2020a, 2020b; Agencija za energijo, ND.

Total domestic consumption	6.672 ktoe	**Domestic supply of electricity**	11.978 GWh
Total energy transformations	1.571 ktoe	**RES in electricity production**	32,63 %
Total domestic production	3.536 ktoe	**Solar electricity production**	269,8 GWh
Self-sufficiency	52 %	**Solar installed capacity**	275,9 MW
RES overall share	21,7 %		

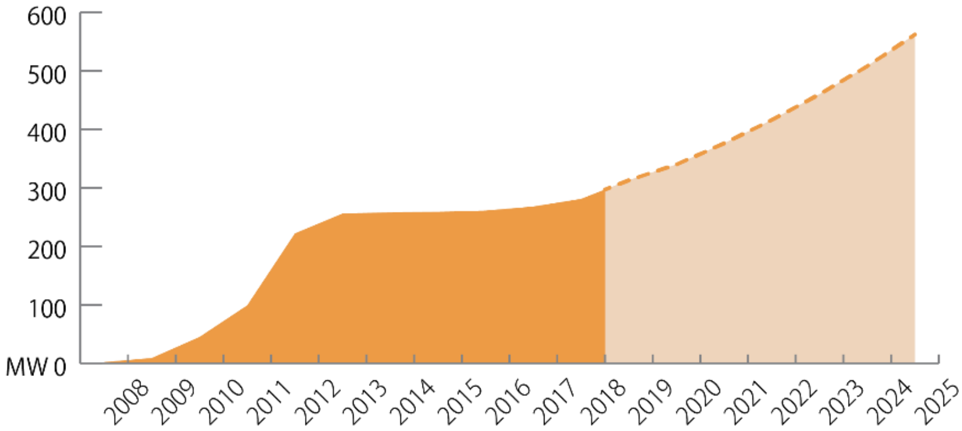


Figure 9: Installed solar capacity (of grid connected power plants) and forecast to 2025. Source: LPVO, 2020.

Long Term Climate Strategy of Slovenia

The Ministry of the environment and spatial planning is currently preparing the Long-Term Climate Strategy of Slovenia to address the commitments of the Paris agreement, and EU regulations on the Governance of the Energy Union and Climate Action (Regulation (EU) 1018/199). The strategy will set several goals related to GHG emissions in different sectors, which will then have to implement the goals into their own policies. A draft of the strategy is currently in the public debate.

The draft of the strategy sets the following goals. By 2050 Slovenia aims to be climate neutral and resistant to climate change, with energy system based on low carbon and renewable sources coupled with storage. Development of RES will be well integrated in the energy system and will synergize with energy reliability, provision of green jobs, cohesive regional development, and multifunctional use of buildings. Greater share of RES will decrease import dependency and diversify the supply (MOP, 2020).

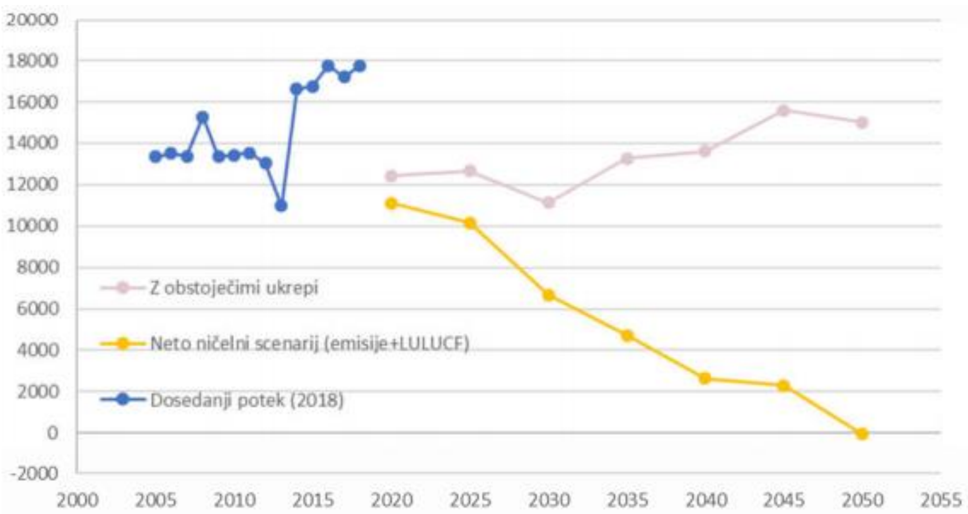


Figure 10: Projections of gross greenhouse gas emissions (in kt CO2 eq) in different scenarios. Blue line shows statistical data up to 2018, pink line shows emission if existing measures continue, yellow line shows emissions if additional ambitious measures are taken.

Share of RES will reach at least 60 % in 2050. In the sector of traffic, RES will account for at least 65 %, in heating and cooling at least 50 % and in gross final electricity consumption at least 80 %. To achieve the goals, Slovenia will stimulate the use of a broad array of RES technologies. To promote the use of RES and storage capabilities for self-efficiency of buildings, neighborhoods and local communities, a support environment will be established on the local level. To advance RES development, pilot projects will be intensively encouraged. Human resources and capacities to develop and implement energy projects on local level will be supported through strengthening local institutions and connecting communities and stakeholders on all levels and phases of project development.

The strategy predicts Slovenia will continue to intensively increase use of solar energy to produce electricity as well as its passive use through adaptation of settlement planning. Use of solar energy will be prioritized in urbanized, infrastructure, and degraded areas. To optimize costs and grid loads, large solar power plants will also be constructed mainly on degraded, industrial, and infrastructure areas.

To reach the goals, research and development of new sustainable RES technologies and business models as well as increase in quality and efficiency of spatial planning will be promoted. This will be especially intensive in the field of local energy communities.

Energy Concept of Slovenia

The Energy Concept of Slovenia (ECS) directs the development of energy system until 2030 with an outlook to 2050. It is still in preparation. One of the key challenges faced by the Energy Concept of Slovenia is the gradual disuse of fossil fuel. The ECS is based on three scenarios with different intensity of measures to achieve the climate targets. All of them include a considerable increase of RES use. The structure of electricity production will have to change towards greater share of RES, particularly solar and wind energy, which will burden the transmission and distribution network. Overcapacity, storage (e.g., pump-storage hydropower) and use of synthetic gas will be needed to offset the loss of stability currently provided primarily by coal-fired power plants.

The ECS also recognizes the important role of local communities and "prosumers", as they can facilitate the dispersion of production from RES. This will however require improvements to the distribution network and development of storage facilities. Solar energy is considered as one of the key alternatives to fossil fuels. In accordance with the Long-Term Climate Strategy of Slovenia, intense implementation of solar energy use, especially for production of electricity but also its passive use, is predicted after 2030 (MzI, 2018).

National renewable energy action plan 2010 – 2020

While the action plan is no longer in force, its goals were to reach 25 % share of RES in final energy consumption by 2020. The statistics for 2020 is not in yet, however it is very likely that this goal was missed by about 3 percent points – share of RES in 2019 was 21,6 % and the increase from 2010 to 2018 was only 0,9 percent point. In the electricity sector the share of RES was at 32,6 % in 2019, compared to the 2020 target of 39 %. The action plan proposed two scenarios of increasing RES in electricity production – one through intense development of wind power and one through intense development of solar power. The solar scenario was more realistic. In it, increase of installed solar power was projected to 360 MW by 2020 and another 498 MW by 2030. Market irregularities were considered as the hindering factor of the development – if measures would be taken to mediate this, solar power plants were expected to develop at a significantly higher rate, even outperforming the set goal (MzI, 2017).

Integrated Energy and Climate Plan of the Republic of Slovenia

Integrated Energy and Climate Plan of Slovenia is a strategic document setting goals, policies, and measures to reach the 2030 goals. It addresses five dimensions: decarbonization, energy efficiency, energy security, internal energy market, and research, innovation, and competitiveness. The priority of development is a transition into low-carbon circular economy and sustainable management of natural resources. It is planned to be renovated in the 2023 and 2024 to adopt changes and goals of the EU Green Deal. Throughout the document comparisons are made between business-as-usual scenario and scenario adopting the measures proposed in the plan.

It sets a goal of reducing use of fossil fuel by 30 % until 2030 and increase share of RES in final energy consumption to 27 %. In 2030 RES should provide at least 43 % of electricity in the final consumption, most of it to be added by new solar power capacities. When adopting measures in the field of RES, special attention will be paid to the debureaucratization and appropriate integration of RES into buildings, space, and the energy system, as well as to the spatial planning process. At least 75 % of total electricity consumed will come from sources within the country.

Until 2030, RES should contribute additional 2.223 GWh of electrical energy. Solar energy production is projected to rise from 36 ktoe in 2020 to 160 ktoe in 2030. Electricity production in solar power plants represents the largest environmentally acceptable development potential for increasing electricity production from RES in Slovenia. From the point of view of sustainable use of space, future development is focused on the integration of solar power plants into buildings, where the technical potential of electricity production is estimated at more than 20 TWh. The key limitation is the ability to integrate solar energy into the grid. In the analyzed solar energy development scenarios, different intensities of solar development were analyzed, which by 2030 increase the production of electricity from solar power plants from 0,6 to 1,9 TWh (between 492 MW and 1.650 MW installed power) and by 2040 to between 0,9 and 5,4 TWh (between 742 MW and 4.400 MW installed, Figure 11). By 2030, this would require the annual installation of 20 to 125 MW of solar capacity, of which about 80 % should be medium and large solar power plants (100 and 600 kW, a smaller share of ground-mounted solar power plants of 1.000 kW at degraded or industrial sites), and the rest are solar power plants for self-sufficiency in households.

As RES in electricity production requires significant investments, incentive legislation is planned that will accelerate development of local communities, communal power plants and focus investments into areas that do not require significant grid expansion. In the dimension of research and innovations, cooperation between public and private sector will increase, and pilot projects will be encouraged.

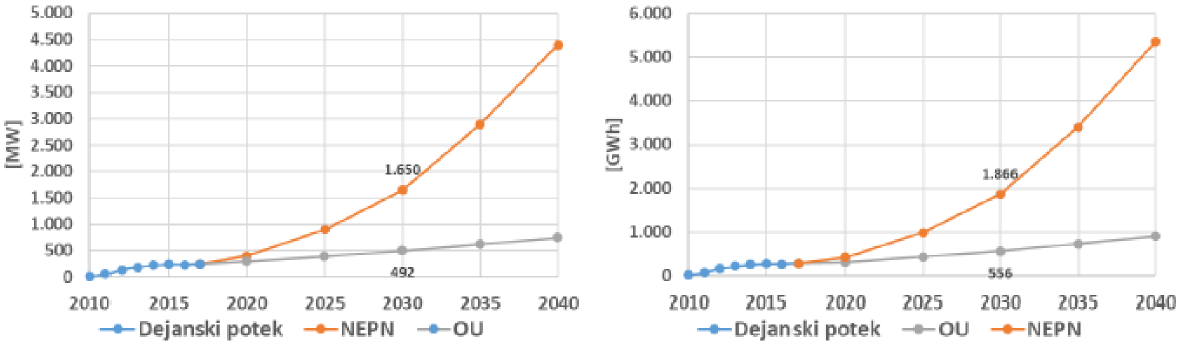


Figure 11: Progression of installed capacities of solar power plants until 2040. The blue dots show past data, orange line is prediction if proposed measures are taken, grey line is prediction if no new measures are adopted. Statistics for 2019 are closer to grey line. Source: Vlada RS, 2020.

Slovenian legislation for constructing solar power plants

Solar power plants up to 1 MW of installed power are considered less-demanding structures. Above this threshold they are considered demanding structure. Most of the legislation for both is the same, however less-demanding structures do not require a technical inspection before beginning of operation (unless requested by the investor). Both require a building permit, registration of start of construction and use permit. If, however the RES facility is constructed on, in or next to existing building which has all the required permits with the intent of self-supply, it is considered as maintenance works and does not require building permit. Nevertheless, it must obey the regulations set by (municipal) spatial plans and other legislation. Before the construction of power plants above 1 MW of installed capacity an energy permit is required. To connect to the grid, the developer must also get connection permit from the grid operator. RES facilities above 10 MW of installed power are planned through national spatial plans. If the solar power plant is ground mounted and has installed power over 250 kW or is larger than 0,5 ha it must undergo a pre-EIA process to determine the need for an environmental impact assessment and is the subject of regular building legislation. A current proposal of the Law for promoting use of renewable energy sources proposes that ground-mounted solar power plants on construction plots will not need to abide by other limitations proposed by municipal spatial plans.

When installing solar power on existing structures the following assessments must be done: statics assessment, fire safety assessment and assessment of lightning protection and suitability of low-voltage electrical installations. If the area of building is within safety zones of any regimes (e.g., nature protection, cultural heritage) or less than 1,5 m away from plot border, additional permits must be acquired. If the above assessments and conditions are met, the DSO can issue a permit to connect the facility to the grid.

The legislation for using RES for self-supply is provided by the Decree on the self-supply of electricity from renewable energy sources (2019). The decree defines possibilities for creation of RES communities, which are a group of households connected to the same RES facility. However, to date, only one such community (Ajdovščina) was established in late 2020. A municipality constructed PV power plant and connected seven surrounding households to it. The new Law for promoting use of renewable energy makes establishing RES communities easier by lifting the limitation where members of the community had to be connected to the same transformation station.

There are several incentives offered by state for solar installations. Affordable credits for initial investments are offered by state-financed Eco-fund and some banks. Each year, the Energy Agency also issues a public call for investors to enter support schemes. Two different, mutually exclusive, supports are offered for PV. The first is a guaranteed purchase by the Agency’s Support Center of electricity from PV systems up to 500 kw installed power. Those entering must state the price at which they could sell the produced electricity commercially and if it is bellow a reference market price, determined by the Energy Agency, they are entitled to this support. For installations above 500 kw nominal power, operating premium for all the net electricity output sold by producers on the market or used for their own consumption are offered instead. The price of a small integrated solar power system is around 1500€/kW.

Montenegro

Currently, the main source of energy in Montenegro is a mix of lignite and hydro capacity. The total coal-fired power plants capacity currently installed is 219 MW and will need to be decommissioned by 2023 according to national plans, which is also in line with Energy Community Acquis commitments. Hydropower contributes about 1.621,1 GWh of electricity, wind about 293,4 GWh and solar 2,3 GWh. Renewable energy sources in Montenegro are already in an advantageous position due to a large share of hydro capacities.

Table 4: Energy statistics for Montenegro in 2018. Source: EUROSTAT, 2020c.

Total domestic consumption	1.078,2 ktoe	**Domestic supply of electricity**	3.615 GWh
Total energy transformations	552,7 ktoe	**RES in electricity production**	52,4 %
Total domestic production	733 ktoe	**Solar electricity production**	2,3 GWh
Self-sufficiency	69,7 %	**Solar installed capacity**	n/a
RES overall share	50,1 %		

Energy strategy

Montenegro, as one of the signatories of the Agreement on the Establishment of the Energy Community, has obligations to harmonize its legislation with EU directives in the field of energy. For the field of renewable energy sources (RES), the most important is the Directive 2009/28 / EC on the promotion of energy from renewable sources. Montenegro has used RES in the form of hydropower to produce electricity and firewood in the last decade. The use of hydropower in conditions of unpredictable hydrology shows significant oscillations and indicates clear consequences (positive or negative) on electricity system and security of supply.

National target for the use of energy from renewable sources (Ministarstvo ekonomije, 2014) set the share of RES in gross final consumption of energy was established by the ministry in charge of energy to implement the EU Directive on the promotion of renewable energy sources (2009/28/EC). The national target for the use of energy from renewable sources by 2020 is 33%, in the sector of electricity 51,4 %. According to the EUROSTAT energy statistics, which puts the RES share at 50 %, the target was well exceeded. The 2030 target is also set at 33 %.

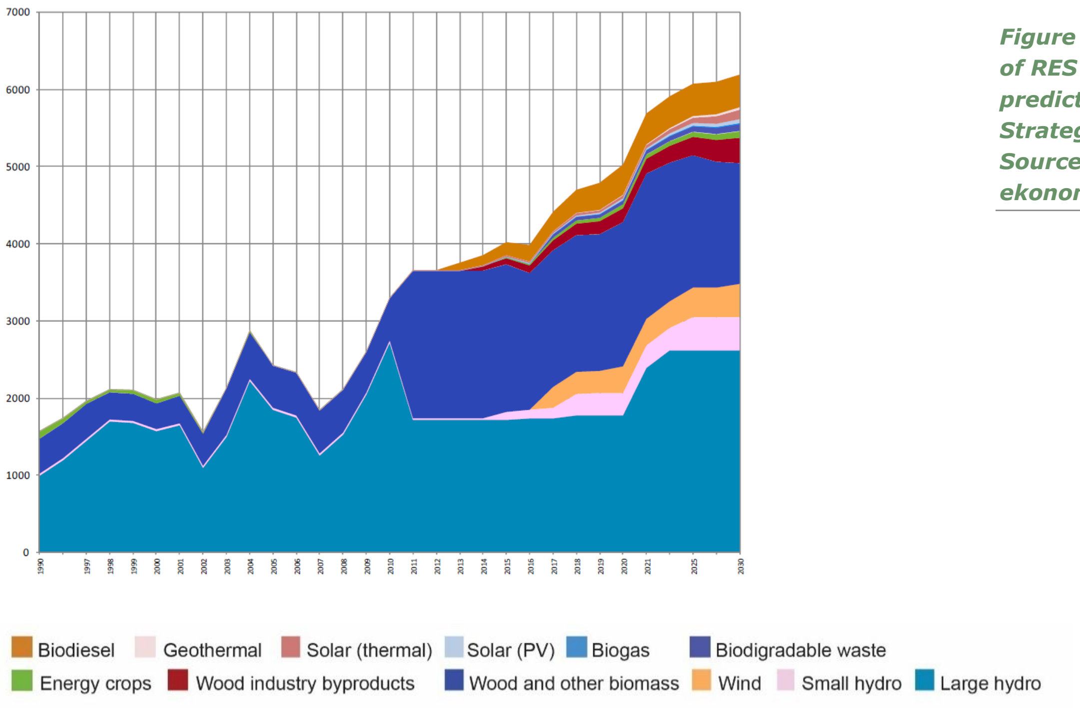


Figure 12: Total use of RES in the past and prediction of the Strategy (in GWh) Source: Ministarstvo ekonomije, 2014.

The future or Montenegrin energy system was assessed through three possible scenarios, covering the electricity and gas markets, the transmission network and macro-economic system. The "no target" scenario reflects the implementation of current energy policy combined with a CO_2 price but no 2050 CO_2 targets in the EU or Western Balkans. The "decarbonization" scenario reflects a long-term strategy to significantly reduce CO^2 emissions according to indicative EU emission reduction goals for the electricity sector by 2050, driven by the CO^2 price and a strong continuous RES support. The "delayed" scenario envisages an initial implementation of current national investment plans followed by a change in policy from 2035 onwards that leads to the same emission reduction target by 2050 as the "decarbonization" scenario.

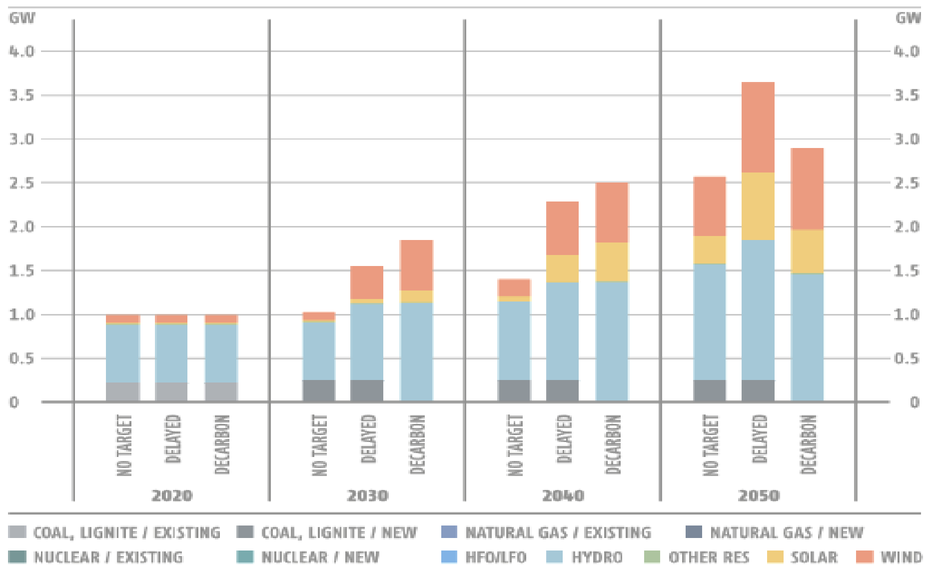


Figure 13: Predicted installed capacities in the three possible future scenarios until 2050 in Montenegro. Source: Szabo et al., 2017

According to national action plans, current total installed capacity of lignite-powered power plant, 219 MW, will need to be decommissioned by 2023. Despite investment in new lignite capacity in the "no target" and "delayed" scenarios, the contribution of lignite to electricity generation by 2050 is predicted to be less than 4 % in both scenarios, and this is due to high prices of carbon. With current share of 62 % hydro remains Montenegro's main source of power generation. In the "decarbonization" scenario the share of wind power in total generation rises to 23 % by 2050 from only 4 % in 2020, but it will also reach 19 % under the "no target" scenario. The predicted share of RES in electricity consumption will reach approximately 125 % in 2050 in the "no target" scenario, while in the "delayed" and "decarbonization" scenarios the RES share is 165 % and 147 %, respectively.

By 2030, two large hydropower plants (HPP on Morača, HPP Komarnica) are to be built along implementation of a program to construct several small hydropower plants (425 GWh/year) and wind power plants (436 GWh/year). A significant contribution will also be made by biomass (2.716 GWh/year) in various forms, mostly (about 80 %) used for thermal needs. The remaining domestic renewable sources will consist of solar energy (173 GWh/year) and geothermal energy (36 GWh/year). Imported biofuels used in transport will amount to 252 GWh in 2030. According to the national strategy the total use of RES in 2030 will amount to 6.659 GWh.

Due to the high solar potential in Montenegro, solar-thermal technology is very well known in the territory of Montenegro for household water heating and in hotels and accommodation facilities. Solar-thermal technology is recognized as the most efficient technology for energy saving measures in the current building sector. Switch to solar collectors for heating water would lead to a reduction in electricity consumption and an increase in the use of RES. In the final energy consumption forecasting model, a significantly increased development of solar collectors is predicted. It is assumed that by 2030, about 11 % of the useful heat for hot water preparation will be produced from solar collectors. That means 28 % of all housing units will be equipped with collectors, a total of about 39.000 housing units, or about 2.000 housing units per year. For such a high proportion of solar collectors, additional incentives will be needed, and only a small part could be realized without incentive measures.

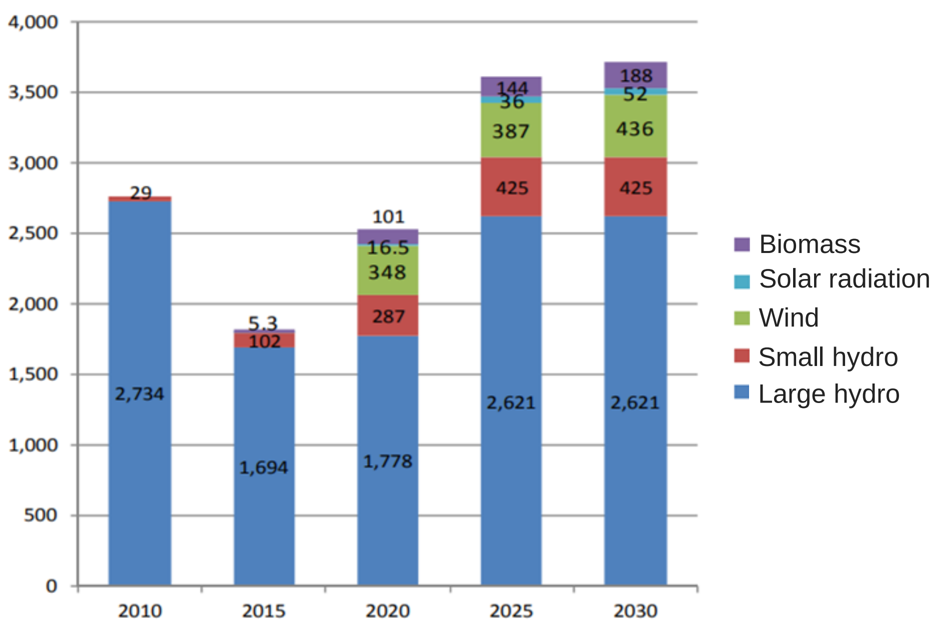


Figure 15: Prediction of electricity production (GWh) from RES until 2030. Source: Ministarstvo ekonomije, 2014

Municipal outlooks

Starigrad, Croatia

Physical description

Starigrad is a coastal municipality in the northern part of the Zadar county. Sometimes it is referred to as Starigrad Paklenica, in order not to be confused with Stari Grad on the island of Hvar. The literal translation of its name "Old Town" as it has been inhabited since the Roman Empire. The Starigrad municipality covers a large area, with a relatively small population. All the territory is within the Natura 2000 network, one part in the National park Paklenica and the other in the Nature Park Velebit, designated for protection of natural and cultural values of the area. The Velebit is the largest mountain range in Croatia, as part of the Dinaric Alps. In the Starigrad municipality the Velebit mountain range meets the Adriatic Sea, forming steep mountain slopes which continue well into the depths of the sea. This combination of vastly different geographical features on a small area result in unique wind type with extremely strong wind gusts (of up to 300km/h). This wind is one of the key contributors to the bare (desert like) landscape of the surrounding areas, like on the island Pag. However, the Bora wind has significant wind power potential, which has resulted in a growth of wind power installations in the area.

Table 5: Statistics for the Municipality Starigrad. Source: Croatian chamber of economy, 2019

Surface area	170 km^2	**Population density**	11 inh/km^2
Total population	1.876	**Average net income**	721€

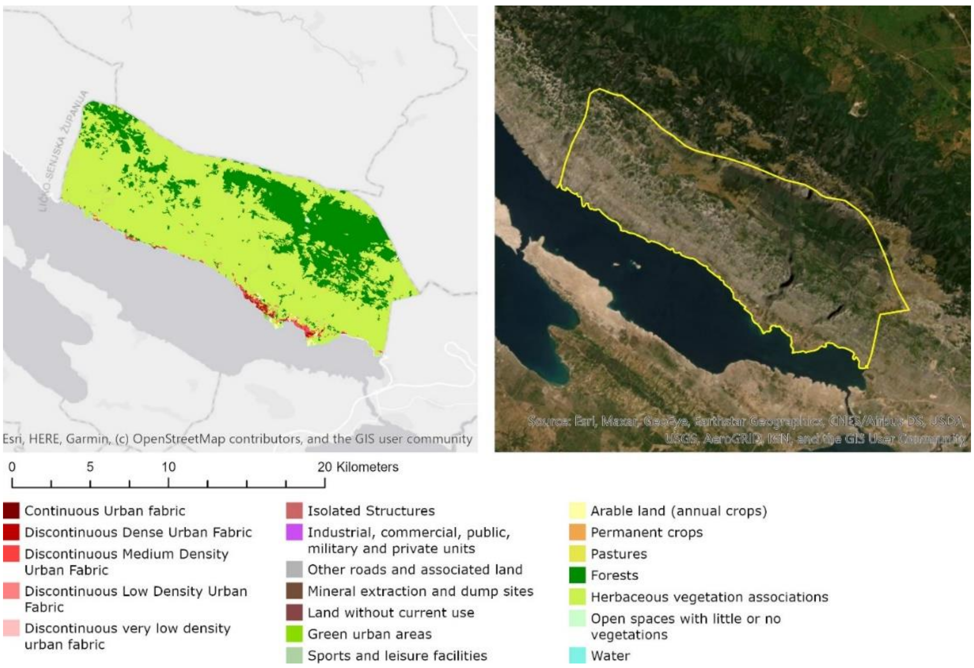


Figure 16: Land cover map of the Municipality Starigrad. Data source: Copernicus, 2020

Sustainable Energy Action Plan

The targets of the National energy and climate plan and the Energy Development Strategy will be incorporated in development on the county and municipality level. Sustainable Energy Action Plans are voluntary documents developed by the signatories of covenant of Mayors. SEAP is considered a valid document in terms of regulatory obligation (SEAP). Cities can in a way define the SEAP that suits their own circumstances and the general development plan. Counties develop their Sustainable Energy Action Plans which municipalities incorporate into their strategic development programs. This top-down approach is suitable for implementing minimum requirements, while lower government levels are free to push for even higher targets.

Given that the documents on the national level in Croatia are relatively new, the concretization on county level is ongoing. The current Sustainable Energy Action Plan for Zadar city covers the period from 2020 to 2022. The plan for Zadar county covers the period from 2017 to 2019, while the document for 2021 onward is being developed.

The Zadar county development strategy (ZADRA NOVA, 2016) emphasizes the importance of energy efficiency and its potential for reaching national energy targets. According to the strategy, most of the energy needs within the county are met with fossil fuels (59,0 %), followed by electrical energy (21,3 %) and a relatively high share of biomass (16,9 %). A significant number of tourist facilities uses solar thermal systems for building and water heating. The installed capacity in solar thermal collectors on tourist facilities was about 3.000 m^2 in 2016, while heat pumps accumulated a capacity of about 5.500 kW. The energy balance for Zadar city if listed on the table below, as there is no detailed data available for the municipality of Starigrad individually. The energy balance for the city of Zadar is calculated by adding the consumption in different consumption sectors, as shown in ***Table 6***.

Table 6: Energy balance of the city of Zadar. Source: ZADRA NOVA, 2016

	Industry [TJ]	Transportation [TJ]	Houeholds [TJ]	Services [TJ]	TOTAL [TJ]
Natural gas	27.7	0.0	23.0	48.8	99.5
Biomass	0.0	0.0	495.0	7.2	502.2
LNG	0.0	12.5	7.3	31.4	51.2
Petroleum	0.0	460.4	0.0	0.0	460.4
Diesel	7.9	670.4	0.0	0.0	678.3
Extra-Light Heating Oil	8.6	0.0	21.3	168.4	198.3
Heating Oil	3.2	0.0	0.0	0.0	3.2
Electrical energy	125.4	0.0	604.4	339.8	1069.6
Heat energy	176.0	0.0	0.0	0.0	176.0
Other	0.0	0.0	0.4	0.0	0.4
TOTAL	348.8	1143.3	1151.4	595.6	3239.1

The structure of energy consumption is further divided into subcategories (*Table 7*). For example, the energy consumption can by analyzed in detail for buildings managed by the city.

Table 7: Structure of energy consumption by building type in the city of Zadar. Source: ZADRA NOVA, 2016

	Electrical energy [kwh]	Exta-Light Heating Oil [kwh]	Natural gas [kwh]	Biomass [kwh]	TOTAL [kwh]
Kindergarten	553804	701117	190890	0	1445811
Elementary schools	856417	2489228	0	27600	3373245
Sport facilities	1932034	326053	2670613	0	4928700
Cultural institutions	471969	341710	0	0	813679
City administration	258407	112200	0	0	370607
Public companies	7453923	611425	4864	48300	8118512
TOTAL	11526554	4581733	2866367	75900	19050554

On a national level a system for the acquisition and monitoring of energy consumption on buildings was established (https://www.isge.hr). The cities are responsible for the data entry and energy information analysis. Based on this information, the above shown table can be further subdivided and analyzed on a building level. For example, the bellow Figure 17 illustrates the energy required for heating in public buildings (y axis) and the specific consumption per m^2. By comparing key indicators in a specific category for individual buildings, it is possible to define a priority list of investments. However, although solar power projects are feasible within 6-8 years, public investments are focused on building renovation as this activity is considered a higher priority.

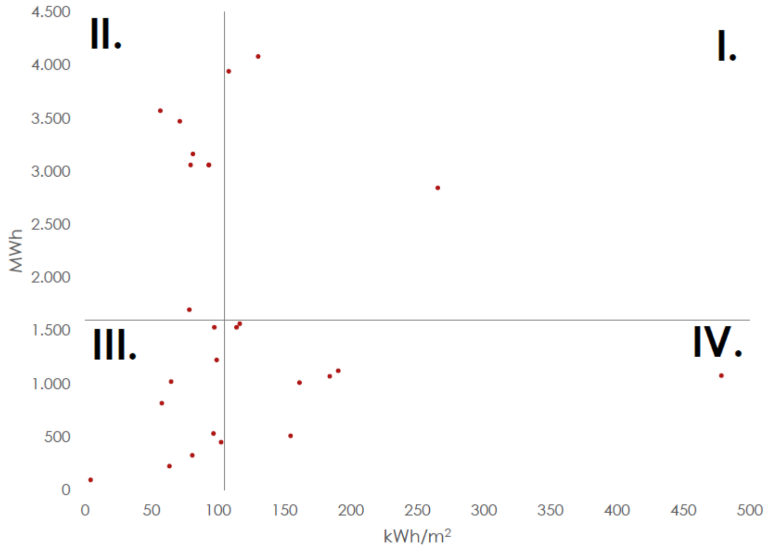


Figure 17: Example analysis of energy consumption on building level. Source: ZADRA NOVA, 2016

According to the Zadar county development strategy, the county – including the municipality of Starigrad – has great RES development potential, with wind power being the most pronounced. At the time of writing the strategy, 29 photovoltaic projects were under development, with a total capacity of 20MW. Some projects like the "The Greeting to the Sun" in Zadar, area mayor tourist attraction (Figure 18). However, there is a significant increase in large scale ground mounted solar projects in Zadar county. In contrast to solar power projects, the number and capacity of wind power plants has been on the rise, with over 10 operating plants with a capacity of 265,95 MW in 2016. In the meantime, new turbines have been installed, increasing the total by an additional 58,00 MW.

Figure 18: The Greeting to the Sun, sculpture on Zadar's waterfront with photovoltaic modules underneath glass plates. Source: https://commons.wikimedia.org/wiki/File:Zadar_Lichtspiel-Monument.jpg

Existing and past initiatives for constructing solar capacities

Numerous initiatives and programs have been organized to incentivize the construction of solar power projects. One of these projects is CB GREEN with Zadar city as the project coordinator with five project partners. The overall project goals were to increase the share of RES and with that contribute to environmental protection in Zadar county. Within the project an action plan was developed for the increase of energy efficiency in Zadar with a set of project ideas and concepts. These ideas will be further analyzed, developed, and completed. An example project is the replacement of existing public lighting with an energy efficient LED system in two historic parks (Queen Jelena Madijevka Park and The Park of Vladimir Nazor in Zadar). The new lighting will save up to 80 % of energy. Another example is the construction of solar power plants on roofs of public buildings owned by the city of Zadar. The total installed capacity would be around 200 kW with an annual production of 40.729.90 kWh and a decrease of GHG emission by 13,44 tCO_2.

In 2011, a Solar education center, equipped with then state of the art technology in the domain of RES and energy efficiency, was established in Zadar. The main purpose of the center was to raise public awareness and to bring new technologies closer to the public. The Solar education center was managed by the development agency for Zadar county ZADRA NOVA, but it was later shut down.

The project IRENE – Interregional Renewable & Energy efficiency network was completed in 2019. It was within the European Territorial Cooperation program with international collaboration between Croatia, Bosnia and Herzegovina, and Montenegro. The main project goals were environmental protection and the sustainable use of natural resources in joint development of cross-border areas.

The first draft of the Sustainable Energy and Climate Action Plan (SECAP) for Zadar city has been recently published. It sets concrete measures for tackling climate change on the city level, like incentives the construction of 100 solar power plants on family homes (~15kW), 30 solar power plants on commercial buildings (30kW) and 10 solar power plants on public buildings (~30kW) by 2030.

Koper, Slovenia

Physical description

City municipality of Koper is the largest City municipality by area in Slovenia. It is one of the best developed municipalities due to the large international Port of Koper. The main city – Koper – is the fifth largest city in Slovenia with a population of just over 23.000. The dense old medieval town, protected as cultural heritage, was built on an island which was later connected with the mainland through land reclamation. The reclaimed land is now mostly built up with commercial, industrial, and port areas on the east and recreation and residential areas on the south and west. Beyond the commercial outskirt of the city is a lagoon protected as a natural reserve. The hinterland of the city is hilly with dispersed settlements, small villages, and intense agriculture, often in the form of vineyards, where natural conditions are favorable. Predominating land uses are shown on the map below (Figure 19).

Table 8: Statistics for the City Municipality Koper. Source: SURS, 2020

Surface area	303 km^2	**Population density**	174 inh/km^2
Total population	52.773	**Average net income**	1176€

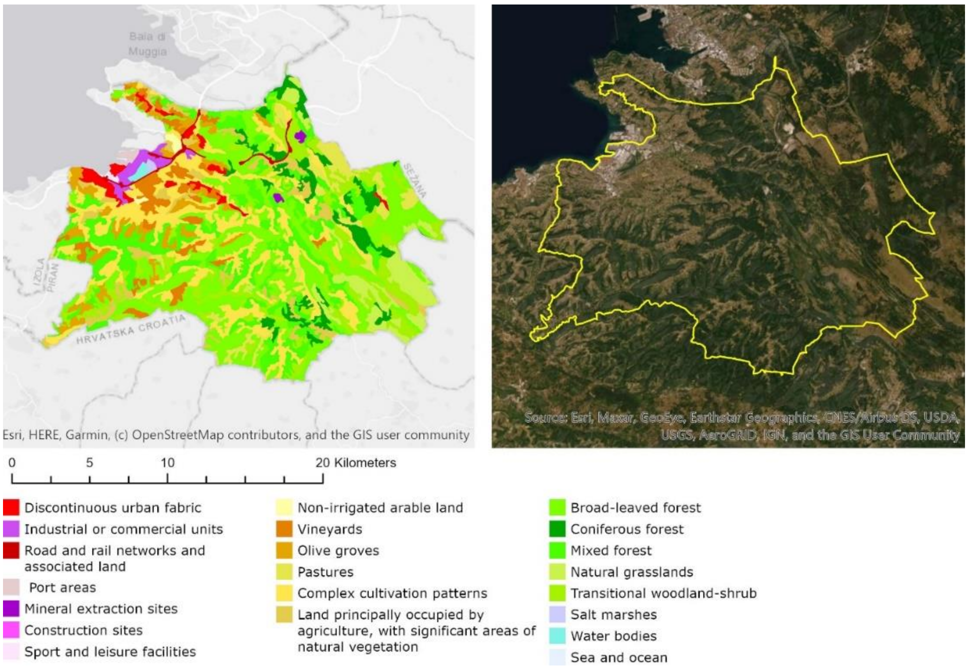


Figure 19: Land cover map of the City Municipality Koper. Data source: Copernicus, 2020

Table 9: Renewable energy statistics for the City municipality Koper. Source: LIFE Climate Path 2050, ND

Production of electricity from renewable sources in support scheme	73,7 kWh/capita	**Number of solar power plants in support scheme**	29
Total installed capacity of solar power plants in support scheme	3,14 MW	**Total production from solar power plants in support scheme**	3785 MWh/yr

Share of energy renovated public buildings	21%	**Share of public buildings with energy bookkeeping**	100%
Household investments in efficient use of energy and renewable energy	23,11 €/capita	**Paid subsidies for efficient use of energy and renewable energy**	3,23€/capita
Share of renewable energy in industry	0%		

Local Energy Concept of the City Municipality Koper

Municipalities in Slovenia are required to prepare and implement Local Energy Concepts (LEC), which evaluate the state of energy production and consumption, define potentials and future goals, and provide measures to achieve them. In 2010, the year of analysis for LEC preparation (Boson, 2013), about one third of whole energy used was attributed to households, followed by businesses and services (29 %), traffic (22 %) and industry (10 %). Public buildings and lightning accounted for about 7%.

Table 10: Primary energy consumption in 2010 in the City Municipality Koper by sector. Source: Boson, 2013

	Primary energy consumption [GWh/a]	Share of total primary energy consumption in the municipality [%]	CO2 emissions [t/capita]
Households	432,48	32,2	1,55
Public buildings	82,51	6,16	0,34
Public lighting	12,85	0,96	0,05
Industry	131,43	9,76	0,55
Businesses and services	385,72	28,78	1,59
Traffic	269,2	22,08	1,51
TOTAL	1340,45	100	5,58

The SWOT analysis in the LEC shows, that key strengths of Koper are dense built areas, which mean a good potential for distributed heating system, relatively efficient use of energy and trends of disuse of oil for heating. The opportunities were found in increase of RES facilities, especially utilization of solar energy, decentralization of production, increase in energy efficiency and raising awareness of users of buildings. LEC identifies buildings owned by the municipalities to have a high potential for increasing energy efficiency and serve as a good practice example for the public. The weaknesses on the other hand are trends of increase of energy consumption, lack of distributed heating, high reliance on oil and electricity for heating, negligible share of RES and poor river conditions, hindering possibilities of hydro utilization. The threats were found in poor ratio of new versus renovated buildings, ageing of population, increase of use of electricity, hindering RES development due to legislation and bureaucracy, lack of interest of politics, grid suppliers and the public in the energy transition and lack of interest among citizens to invest in individual solar power plants.

Since LEC was prepared 10 years ago the realization of above-mentioned opportunities and weakness will be one of the key topics to discuss in the stakeholder engagement phase of the project.

Among renewable sources, solar energy is identified as the main potential in the municipality. It has a high share of annual sunny days and there are not many limitations for installing small individual solar heating systems (Figure 20). The solar insolation of buildings was estimated at 3.382,67 GWh annually. Considering the technology available then, theoretical heating potential was estimated at 783,60 GWh and theoretical electricity potential at 261,20 GWh annually. While this calculation includes roof exposition, it does not include protection regimes such as cultural heritage.

With good natural conditions, the key proposed measures to increase solar development were education and awareness raising of citizens, pilot projects on publicly owned buildings and selected individual houses. A pilot project of solar energy use on a public school or kindergarten was recommended. LEC also recommends finding possible locations for solar power plants to facilitate their development, implementing a pilot project with interested investors and offer support with the planning and permitting processes.

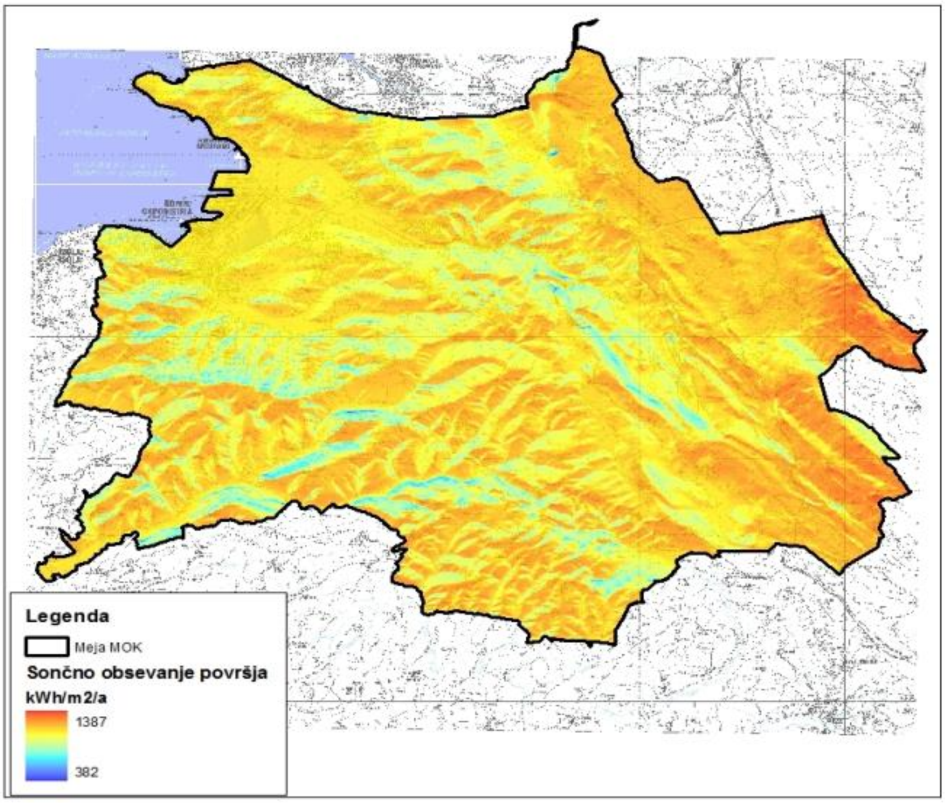


Figure 20: Annual solar irradiation in the City Municipality Koper (kWh/m2/a). Source: Boson, 2013

Based on the analysis and other national and EU legislation, LEC put forward next strategic goals:

- 25 % share of RES in final consumption by 2020.
- 20 % improvement of energy efficiency until 2020 relative to 2010.
- Reduction of GHG emissions by 30 % until 2020.
- Efficient energy planning in the local community.

To reach these goals the following measures related to RES and solar were recommended:

- Solar energy collectors for heating on all new buildings (6m^2 per apartment, 7,71 GWh/a) and a share of existing buildings (0,25 m^2 per capita, 6,26 GWh/a).
- Solar PVs on existing buildings (0,5 m^2 per citizen, 4,25 GWh/a).
- Solar PVs on five publicly owned buildings (healthcare center, fire station, three kindergartens; 1,1 GWh/a).
- Solar PV and heating on 10% of usable industrial rooftops (5,21 GWh/a).
- Development of two charging stations for electric vehicles with 40 m^2 of PV on each (0,01 GWh/a).
- Development of a small hydro power station (200 kW, 0,87 GWh/a).
- Development of city wind turbines on 5-10% of buildings (3,5 GWh/a).
- Education, promotion, and awareness raising of RES and efficient use of energy.

While 2020 statistics are not yet available on municipal level, it seems that most of the targets and measures described will not be fulfilled.

Existing and past initiatives for constructing solar capacities

Most of the existing solar capacities in the City municipality Koper are in the city of Koper. Several commercial and industrial buildings have roof-installed PV. One of the largest is installed on a shopping mall and has the capacity of 315 kW.

In 2009 an initiative was proposed by the Port of Koper, which is a significant industrial area in the city with a lot of roof surface from storage and warehouses. The plan was to install a solar power plant with a capacity between 2 and 2,4 MW. The contract to install the power plant was given to a local company, Robotina, which specializes in smart control systems and infrastructure, including solar power plants. A company created to realize the project (Adriasole) however quickly fell into financial trouble due to poor management practice and the idea was never finalized. Some legal disputes between Adriasole, Port of Koper and Robotina followed.

In 2006 a local energy agency GOLEA was established which also includes the City municipality Koper. Local energy agencies perform energy management on the regional (inter-municipal) level, collect energy data and inform, promote, and accelerate good practice. Part of GOLEA's activities is also promotion of renewable energy. From 2010-2015 the agency had a project to promote RES in Littoral municipalities of Slovenia, in which an innovative solution of installing PV panels on noise barrier next to highway was implemented. Municipality of Koper participated in the project activities, but no projects were implemented in its territory.

Comparison

Being member states of the EU, both Croatia and Slovenia must follow the climate and energy regulations and directives and contribute to RES targets set by the EU. The overall share of RES set for 2020 in the EU was 20 % and the realization came in just short of the target at 19,7 %. Croatia overachieved its target with overall RES share of 24,2 % (target was 20 %). Slovenia, on the other hand, came short of its target (25 %) with the overall RES share at 21,7 %. Looking at the electricity sector, Croatia's goals was 35 % share of generated electricity from RES, with statistics for 2019 showing 44,7 %, with a dominant share in large hydropower production. Slovenia's goal for 2020 in the electricity sector was 39 % and in 2019 32,6 % where actually generated from RES (Table 11). Montenegro set its goal of RES at 33 % overall and 51,4 % in the sector of electricity. Thanks to high production from hydropower both targets were achieved (over 50 % overall RES and 52,4 % of electricity).

Targets for 2030 are more ambitious. The current EU target stands at 32 % share of renewable energy, with ambition to increase it to 55 %. In a science report for the European commission (Banja and Jegard, 2017) that would mean at least 54 % of electricity generated from RES. Croatia set its benchmark at 36,4 % of overall energy from RES, and 63,8 % in the sector of electricity. Slovenia is a bit more modest with 27 % of overall energy from RES and 43 % in the sector of electricity. 2050 targets are not yet set in stone, but a vision by the European Commission proposes at least 80 % of electricity should come from RES by then and the Union's energy system should produce net-zero GHG emissions. Both Croatia and Slovenia prepared a set of scenarios of RES development until 2050. The most ambitious of them predict 65 % of overall energy from RES and 88 % of electricity for Croatia and 60 % of overall energy from RES and 80 % of electricity for Slovenia. In any case, an increased development of solar capacities is predicted in both countries. Montenegro overall RES share for 2030 remains at 33 %.

The current installed capacity of solar power plants is the highest in Slovenia (about 280 MW), predominantly represented by roof-integrated PV systems. While Croatia has less installed capacity (about 85 MW) it is more focused on larger utility-scale ground mounted systems. Prices of (roof) integrated solar power plants are comparable at around 1500€/kW.

Comparing current state and plans of the pilot municipalities is less straightforward than the national level. The pilot municipality Starigrad in Croatia is a peripheral municipality of the much larger city Zadar, which is also the administrative center of the Zadarska county. The county has some authority over energy planning, including setting county goals for use of RES. Starigrad must follow these goals. The county strategy recognizes great solar and wind potential of which only the former is being intensively utilized. There were several large-scale solar proposals, but most were not realized. There is no data of solar utilization for Starigrad individually.

Conversely the City municipality Koper is a regional center and the largest city on Slovenia's coast, with one of most important industrial sites in the country – the Port of Koper. With no intermediate governance level between national and local scale, municipalities in Slovenia are required to create their own local energy concepts. Koper's local energy concept recognizes solar as renewable source with great potential and even proposes several municipal pilot installations of PV or heat collectors on publicly owned buildings. There are also some PV installations (up to 500 kW) on commercial buildings. There are 29 solar power plants that are included in the national support scheme with installed capacity of 3,14 MW, producing 1785 MWh annually.

Planning of solar energy facilities is similar in both countries. For building-integrated solar installations, no building permit is needed. Several assessments must be made within the electrical design documentation to ensure safety of the installation which are the base to issue grid connection permit if the system will be connected to grid. In both countries there are incentives offered and a net-metering scheme possible. For installments over certain power threshold (e.g., 1MW in Slovenia) building and energy permits are also required. If solar system is ground mounted, it must abide by the respective building legislation and can be a subject of an environmental impact assessment. The administrative procedure for the development of ground mounted solar power plants differs in Croatia and Slovenia. All ground mounted plants in Croatia must perform an environmental pre-assessment and depending on the results they might have to perform and environmental impact assessment. In Slovenia only ground mounted plants with an installed capacity of over 250 kW or larger than 0,5 ha must undergo an environmental pre-assessment to determine the need for an environmental impact assessment.

Table 11: Comparison of energy targets and statistics between Croatia, Slovenia, and Montenegro

indicator	EU	Croatia	Slovenia	Montenegro
Overall RES target 2020	20,0 %	20,0 %	25,0 %	33,0 %
Overall RES share 2019	19,7 %	24,2 %	21,7 %	50,1 %[5]
Electricity RES target 2020	35 %	35 %	39 %	51,4 %[2]
Electricity RES share 2019	34 %	44,7 %	32,6 %	52,4 %[5]
Overall RES target 2030	32 %	36,4 %	27 %	33 %
Electricity RES target 2030	54 %[2]	63,8 %	43 %	n/a
Overall RES target 2050	net-zero GHG emissions	65 %[4]	60 %[4]	n/a
Electricity RES target 2050	80 %[3]	88 %[4]	80 %[4]	165 %[4]
Installed solar 2019 [MW]	130.700	84,8	275,9	84,8
Production from solar 2019 [GWh]	125.700	81,3	269,8	2,3
Predicted solar capacity in 2030 [MW]	339.700	768-1.039	492-1.650	n/a
Predicted solar capacities, long-term [MW]	1.940.000	2.700-3.800 by 2050	742-4.400 by 2040	n/a
Overall RES target 2020	20,0 %	20,0 %	25,0 %	33,0 %

[1] In the time of writing this report, the European Commission proposed the increased target, but it was not yet formalized. [2] As predicted in Banja and Jegard (2017). [3] Not a formal target but mentioned in the vision Going Climate-neutral 2050. [4] As predicted in the most ambitious scenario or draft targets. [5] Stated values are for the year 2018.

CHAPTER 2

Stakeholder engagement report

Initial stakeholder mapping

One of the main goals of the project is to consult stakeholders and map their views on development of (integrated) solar energy systems. The aim of stakeholder inclusion is to better identify existing barriers and potentials to overcome them, which will in turn inform the development and optimization of tools in later stages of the project. The selection of the stakeholders to include was derived from the project's focus on the municipal level. We identified three main groups of stakeholders as the most relevant: decision-makers, developers (including both investors and solar industry) and the wider public. Methodology of engagement was tailored to each group, as described more in detail in the chapter Methodology.

Decision-makers group consisted of the municipal administration of Koper (SI) and Starigrad (HR), Zadar county (in Croatia, as Slovenia does not have regional government), local energy agency GOLEA (in Slovenia) and the Zadar county development agency - Zadra NOVA (in Croatia). These are the stakeholders that can influence the development of their corresponding territory through policies and (public) projects. Municipalities in Slovenia and Croatia, and counties in Croatia have a high degree of autonomy on planning the spatial development and an obligation to pursue energy targets, which are however determined on the national level. In Slovenia, representatives of the City municipality of Koper from Department of Economic Activity, Sustainable Mobility and Environment, Department of Spatial Planning and Development, and Department of Strategic Planning and Development Projects were included in a group interview. In Croatia interviews were conducted with the representatives of the Municipality of Starigrad (Head of the Municipality and Head of the Single Management Department) and Zadar county (Head of the Department for Economy, Tourism, Infrastructure and EU funds).

While local energy agencies in Slovenia and county development agencies in Croatia do not poses decision-making powers by themselves, they are a non-governmental public entity who advise and help municipalities and counties plan their development and policies and can as such serve as a link between national and local policies as well as an important support for implementation of those policies. They are active participants in the decision-making process, so they were also included in this group of the stakeholder engagement. In Slovenia, we interviewed a representative of the GOLEA Local Energy Agency, which covers the coastal municipalities of Slovenia and focuses on energy. In Croatia we conducted an interview with representative of Zadar County Development Agency ZADRA NOVA (Head of the Department for Project and Program implementation).

The group of developers consisted of both investors from the pilot municipalities, who already installed or plan to install solar soon, and solar industry representatives who provide technology and expertise to clients who wish to install solar power plants. Developers are a group of stakeholders that has a high interest in solar energy development but little leverage to influence decision making, however they are most influenced by it. They have experience in the concrete implementation of the policies and execution of projects. In Slovenia, we invited three developers from City municipality of Koper who already installed solar energy on their premises and only one (Port of Koper) responded, whose representative was then interviewed. Port of Koper covers a large industrial area of Koper municipality and has extensive warehouses and other storage facilities at their disposal. Additionally, three solar industry companies mainly specialized in private investments and offering solar power plants on the turn-key basis were interviewed. In Croatia, we conducted interviews with a construction company specialized in solar power plants and six developers who have installed or planned to install solar on their houses and/or their apartments. The developers are from the Zadar county and have different approaches and experiences in developing solar projects.

The final stakeholder group consisted of wider public – residents of pilot and other coastal municipalities. The aim was to identify their level of knowledge, opinions, attitudes, and beliefs about solar energy. The public is the main target audience of the project, so the survey was intended specially to inform the development of tools in the later stages of the project by identifying the main knowledge gaps and concerns about solar power plants that the public has. While the other two stakeholder groups were engaged directly (in-person, albeit digitally) through interviews and focus groups, the public was surveyed using an online questionnaire to reach a wide audience. In Slovenia, 255 residents of all four costal municipalities (Piran, Izola, Koper, Ankran, total population 202.799) were surveyed, while in Croatia 43 residents of the pilot municipality Starigrad (total population 1.876) were reached.

Table 12: Engaged stakeholders

	Stakeholder group		
	Decision makers	**Developers**	**Public**
Slovenia	City municipality Koper: • Department of economic activity, sustainable mobility, and environment, • Department of spatial planning and development • Department of strategic planning and development projects Local energy agency GOLEA: Deputy director	Port of Koper: • Energy manager Enerson d. o. o.: • Director Enertec d. o. o.: • Director ECE d. o. o.: • Head of development department	255 respondents from municipalities of Piran, Izola, Koper and Ankaran (cumulative population 202.799)
Croatia	Municipality Starigrad • Head of the Municipality • Head of the Single Management Department Zadar County • Head of the Department for Economy, Tourism, Infrastructure and EU funds Zadar County Development Agency ZADRA NOVA Head of the Department for Project and Program Implementation	6 private owners of integrated solar power plants	43 respondents (cumulative population 1.876)
Target indicator value for output I	3 interviews per municipality	2 participants per municipality	50 responses per municipality
Realized indicator value for output 1	1 group interview (4 people) and 1 individual interview in Koper (total 5 people)	4 in Koper, 6 in Starigrad Note: due to organization issues, focus group was	164 in Koper (+91 in other coastal Slovenian municipalities) 43 in Starigrad

	Stakeholder group		
	Decision makers	**Developers**	**Public**
	1 group interview (2 people) and 2 individual interviews in Starigrad (total 4 people)	replaced with individual interviews, see next chapter	Note: for Starigrad the sample size was 2,3 % of the total population which is a good response even though the target indicator value was not reached due to small population.

Methodology of stakeholder engagement

The stakeholder engagement methodology was designed hierarchically. First, we devised a set of common concepts and related questions we wished to explore with the stakeholders. The selection of stakeholders as well as research questions aimed to provide a comprehensive picture on what different actors think about solar development. Additionally, the questions were formed with keeping in mind the tools we aim to develop later in the project to make the tools as useful as possible to the stakeholders. The general research question, provided in Table 13 and Table 14, were customized to each stakeholder group's specifics and additional concepts or questions added, with most customization and additional concepts needed for the public survey. All the methods were focused on integrated solar power plants (development on already built surfaces, such as buildings and parking lots).

At first, we planned to conduct focus groups with decision makers and developers, but the response rate, availability of participants and the situation arising from the COVID pandemic forced us to use group and individual interviews instead. We assume this did not affect the results in a meaningful manner. All the interviews and the public survey were conducted online or through telephone calls due to pandemic restrictions.

Group and individual interviews

The main factor driving the development of methodology was achieving an appropriate balance of standardization and comparability between the countries on one side, and flexibility to explore and adapt to specific local contexts. The group and individual interviews were thus done using a semi-structured questionnaire. This way we were able to keep the conversations centered around common themes and research questions, while still allowing a degree of flexibility. The concepts explored are showed in Table 13. The full questionnaires are available in APPENDIX 1: Interview questionnaires.

Table 13: Concept and research questions addressed in interviews.

Concept	Concept description	Research questions
Interest	Describes the level of interest and intentions of a stakeholder or their clients to plan, support or develop solar power capacities.	How interested are different stakeholders in increasing solar energy capacities?
Effort	Describes the level and kind of effort put into realizing the interest, be it through concrete policies, programs, tasks, or developments.	What kind of efforts do stakeholders put into realizing their interests?
Role and power	Describes what is the role of the stakeholder in the development of solar capacities and the level and kind of power a stakeholder has to influence the development.	How can different stakeholders influence solar development? How do they exercise their power?
Barriers	Describes the barriers impeding solar development as perceived the stakeholder.	Which barriers do stakeholders see in the way od realizing their interest and increasing solar energy deployment?

Concept	Concept description	Research questions
Opportunities	Describes the opportunities to accelerate deployment of solar capacities as perceived by the stakeholder.	Which opportunities do stakeholders to realize their interest and accelerate solar energy deployment?

The interviews with representatives of the municipalities focused mainly on their own interest to develop solar power plant as well as on their possible role of a regulator and promotor of the solar to citizens and developers.

Interviews with the energy and development agencies mainly addressed questions about county and municipalities' interests and efforts, legislative situation, and agencies' own role in development of both projects as well as policies.

The two types of developers – investors and technology providers – also called for two distinct focuses. Interviews with investors mainly focused on their motivations, experience, and perception of the process, while interviews with technology providers posed questions about the state of the solar market, their client's interests and perceptions, own perception of the permitting process and cooperation with their public sector.

Public opinion survey

The public opinion questionnaire explored different concepts as we expected lack of knowledge and experience with solar power plants. These concepts were based on a review of predictors of decision behaviour of residential solar photovoltaics adoption (Alipour et el., 2020). In the review, 333 predictors from 173 studies were identified and classified, out of which we chose a subset of those with greatest predictive power and applicable to a public survey of residents. The predictors were grouped into concepts shown in Table 14. The full questionnaire is available in Appendix.

In Slovenia, the questionnaire was distributed by a public opinion agency Valicon d.o.o to a subset of their online panel (residents of costal municipalities over 18 years of age). 255 responses were obtained. To achieve representativeness of the population, responses were weighted by age, gender, and level of education.

In Croatia, reaching the target population proved more difficult due to small population size of the pilot municipality (1.876 inhabitants). The municipality advised to distribute the questionnaire via Starigrad Paklenica Tourist Board, as they have the largest database of contacts. Tourism is a vital source of employment and income for the municipality and reaching the inhabitants through this channel guaranteed the good response rate. In total 43 responses were obtained which is 2,3 % of the population of Starigrad.

The questionnaire was divided in three parts. In the first part, questions were related to people's self-reported knowledge about technical and administrative aspects of solar power plants as well as interest to install solar power plants in the future. The second part consisted of rating level of agreement with several statements, aimed at discovering attitudes, beliefs, and stereotypes about solar power. The last part consisted of obtaining demographic data. Most responses were measured using Likert scales with 5 or 7 levels. This way it is possible to obtain both the direction of respondent's attitude as well as intensity of the conviction.

An SPSS database was created from both surveys for analysis. The analysis was done by observing descriptive statistics of each item, charting for visual inspection and comparison and analysis of variance (ANOVA) of chosen variables and groups, as described in the results section.

Table 14: Concepts and research questions addressed in public survey.

Concept	Concept description	Research questions
Knowledge and experience	Describes self-reported level of knowledge about technical and administrative aspects of solar power plants and the amount of experience with them.	How knowledgeable are respondent about solar power plants? How much experience do they have with them?
Interest	Describes the interest to install or participate in installation of solar power plant and the factors influencing the interest (more in the methodology section below).	How interested are the respondents in installing solar power? Which factors influence the interest?
Attitude	Describes the general attitude of respondents towards solar energy.	What is respondents' attitude towards solar energy?
Belief	Describes the beliefs held by respondents about solar energy, such as how efficient and environmentally friendly they are.	Which beliefs do respondents hold about solar power plants? How pervasive are stereotypes?
Behavior	Describes the consumer behavior and factors influencing it related to solar energy	Which factors motivate the respondents to be more likely to invest into solar power plant?
Demography	Describes demographic variables of the respondents.	How are demographic variables related to other variables?

Interview results: The views of the decision makers and developers

Slovenia

Decision makers

City municipality Koper

The municipality's interest to encourage solar development mainly comes from obligations by the national policies, reduction of operating costs by increasing energy efficiency of municipality owned or operated buildings and achieving social benefits for residents by reducing energy poverty and costs.

The main type of solar development they are interested in are roof installations on larger public and commercial buildings. They see potential in covering parking lots with solar panels, but only if they would be sure this will not cause additional heating of the area. The municipality is often addressed by investors interested in developing larger ground based solar power plants, which is why they are currently performing a study of suitability for this type of installations.

At the time of the interview, the municipality was preparing or adopting several policy documents that also deal with solar power. For a new *Local Energy Concept* ('LEC') several analytical studies were made about energy consumption and provision, but no concrete measures were yet proposed. The new LEC is being created through a wide participation process which should ensure that all stakeholders agree and aspire to achieve the goals to be put forward. At the same time *Sustainable energy and climate action plan* ('SECAP') was being prepared which addresses similar topics. The municipality was also in the middle of adopting a municipal spatial plan, which recommends installing solar power on buildings but with no concrete or spatially explicit measures. A study of suitability for ground mounted solar power plants was made to better understand how these could fit into the spatial plan, but showed that solar installations mounted on buildings have better potential, also due to extensive nature protection areas (e.g., Natura 2000) present in the municipality.

While the previous LEC included several measures to increase photovoltaics ('PV') in the municipality (see chapter 1: Municipal outlooks for detailed description), most of them proved too ambitious. However, the municipality managed to realize two solar power plant projects on two kindergartens and a solar thermal heating system on a school through contracts with energy service company ('ESCO'). When they tried to develop a solar power plant on another school, the pupils' parents posed several questions about radiation and fire safety, but unsuitable construction of the roof prevented installation in the end.

The municipality is active in an international project funded through the INTERREG program in which they aim to study possibilities for creating an energy cooperative. Three possible sites were located and conversations with the local communities were ongoing, albeit slowed by the pandemic at the time of the interview. The possible locations were found through identification of a public building of suitable size and the number of consumers sharing the transformation station who can be included in the cooperative. The current legislation only allows people sharing the transformation station to be included in the same energy cooperative, which proved as the most limiting factor in search of the location.

Several other efforts are being put into efficient use of energy. The municipality educates managers and users of public buildings about how to better save energy and increase energy efficiency, but there was no effort specifically targeted at solar power. Smart systems for heating and public lighting are being gradually introduced and the public services are buying electric vehicles. Most of the municipality owned buildings were renovated for better energy use and ESCO contracts were set up for energy management of buildings and public lighting. The municipality did not yet consider investing into their own solar power.

While there are several efforts put into advancement of solar energy in the municipality, they are non-strategic, dispersed, and reactive rather than proactive. At the time of the interview, the municipality mainly lacked a dedicated person or office with appropriate vision, knowledge, skill-set and available workhours to plan and lead the development more comprehensively. This somewhat diminished the role the municipality could have in development of solar in its territory and hindered the decision-making power that the municipality has. The various departments were not conscious about the (solar) energy goals which left several opportunities unrealized (e.g., when constructing a new school). However, they plan to fill this gap after adopting the new LEC by hiring a new person with appropriate skillset and knowledge about energy development to be responsible for implementation of the policy.

While the main identified barrier to better solar development was lack of staff capacity and cross-departmental cooperation, the municipality also regrets there is not more effort put in by the state to (financially) support municipal solar developments. Due to lack of systemic funding, the municipality must seek other sources for investments such as international projects (e.g., INTERREG, as described above). The municipality also feels solar development is not sufficiently integrated into other policies, e.g., when building new public social housing the main goal is to achieve lower cost per square meter through which solar technology cannot get implemented, even if increasing solar capacities is a national strategic goal. They feel that if state ambitions are not high enough with provided funding, the municipality will also not set higher goals and develop mechanisms to achieve them. More ambitious national state goals would allow the municipality to also enforce more decisive regulation for development of solar on new buildings and include solar power in municipal co-financing mechanisms offered to residents (e.g., co-financing change of asbestos roof cover could also include solar installations). However, some hope is placed in the upcoming *Law on the promotion of renewable energy use*, which could facilitate development of solar communities and cooperatives.

The municipality also does not see public-private partnerships (‘PPP’) as something of a strategic importance. They would prefer to develop solar through their own measures, within the owned housing stock, but if opportunity for a PPP would arise, they are open to it.

The municipality sees greatest opportunities in developing solar both in the urban areas and the rural hinterland. The main barrier in the urban areas is cultural heritage protection, which calls for tight cooperation with cultural heritage agency and development of innovative and creative solutions. More effort could also be put into proactively pursuing installation of solar power in multiapartment buildings where the municipality or the state *Housing Fund* owns apartments. In this case the municipality could start the initiative and discussion among the residents, especially where energy renovation is still needed. The main goal, also emphasized through the participatory process of drafting new LEC, is to establish a commonly agreed upon goals and thus create better conditions for cooperation. In this regard, the municipality sees the tools intended in SOLAR ADRIA project as welcoming addition to create a knowledge base and connect different stakeholders through the matchmaking portal.

A recap of findings about the concepts is shown in ***Table 15: Views of City municipality Koper.Table 15***.

Table 15: Views of City municipality Koper.

Interest	Fulfilling national goals Energy savings in municipally operated buildings Socio-economic benefits for residents Solar power on public and commercial buildings and parking lots Energy communities
Effort	Adoption of new Local Energy Concept (LEC) through participatory process Adoption of Sustainable energy and climate action plan (SECAP) Municipal spatial plan recommends roof-installed solar. Solar utilization on two kindergartens (PV) and one school (heating), through ESCO contracts Actively seeking options for solar energy cooperative Other efficient energy use and electrification measures
Role and power	Initiator of solar energy cooperative project Spatial development regulation Possibilities of co-financing for residents Possible initiator of solar installations in apartment buildings where municipality owns some apartments or other good practices
Barriers	Lack of institutional capabilities, cooperation, and knowledge base Stereotypes and lack of information among users of public buildings National plans not ambitious enough and without financial support to implement the measures. Roof statics on older buildings Extensive areas under cultural heritage and nature protection regimes
Opportunities	Improvement of staff capacity and knowledge Shared goals and better cooperation between departments and other institutions Industrial and commercial buildings and parking lots More and clearer funding support from national level Innovative and creative solutions in areas with cultural heritage regime

Local energy agency GOLEA

Local energy agency GOLEA consults, connects and educates 22 municipalities of the Slovenian Littoral region about energy. GOLEA is actively included in preparation of most LECs (prepared 15 to date), formation of municipal energy goals and is also an energy manager for most municipalities in the region. Their main interest is to provide municipalities with knowledge and help them connect different stakeholders to improve the energy consumption and production in the region. Besides preparing LECs, GOLEA also participates in other national and international projects aimed at empowering local communities. Recently they prepared economic calculations for an energy cooperation and coordinated inclusion of three municipalities into the *Covenant of Mayors for Climate & Energy Europe*. Additionally, they offer technical consultation with concrete projects and try to connect various stakeholders for realization of energy related projects. All this positions GOLEA as one of the main stakeholders who has comprehensive knowledge on how energy infrastructure is being used and developed in the littoral region of Slovenia. They are the main expert institution to which the municipalities turn when they are faced with energy issues or wish to conduct a project.

Through its work, GOLEA observes varying interest for solar development among the municipalities. Most of the municipalities are inclined to increase solar use, but the degree of implementation varies based on available staff and financial capabilities. Municipalities are very efficient at improving energy efficiency of owned buildings, but less intensely address the question of privately owned buildings (residential and commercial) in their municipality, which are the biggest energy consumers and even slightly increased their green hose gas ('GHG') emissions in the past years. Energy adaptions of municipality owned buildings on the other hand were encouraged by national financial subsidies within which it would also be possible to co-finance solar installations, but most municipalities were not aware or chose not to utilize this option. Mobility also remains mostly unaddressed until now. Most LECs of the first generation did not emphasize the importance of energy-efficiency measures in mobility, but this is now becoming an increasingly important topic.

GOLEA sees main barriers for quicker advancement of solar energy in lack of municipalities' staff capabilities and available funding. Municipalities have a lot of tasks and limited workforce, so some choose not to prioritize solar energy or other energy infrastructure simply because they cannot fit it into their worktime. Thus, municipalities often miss or are not aware of funding opportunities or lack the time to pursue them. There are also no state-wide studies to direct solar development or aid municipalities when setting their goals which could help create better LECs. An example of such nation-wide study is the register of oil-heating devices which facilitates analysis and decision making for municipalities by providing data. What is especially missing are spatially explicit studies of potential for different energy sources, which municipalities could use to inform their LECs as well as their spatial plans.

There are also some regulative barriers that inhibit better energy planning and development. Regulations of LECs are putting increasing administrative load into the document, which makes it less clear and harder to implement (the last prepared LEC has 400 pages). To implement energy adaptation or construct solar installation in apartment buildings, the apartment owners need to vote unanimously for the project, which is practically impossible to achieve.

While GOLEA advocates for solar development on roofs, they also see potential for on-ground installations if appropriate location can be found. However, bigger ground-mounted solar projects often have difficulties with implementation, because they do not include local communities at an early enough stage of the process. Investors usually come with a very clear idea of what they want, often even with prepared documentation and want to force the development which triggers a lot of community resistance. Local ownership should therefore be encouraged, and development based on studies of suitability.

With increased development of solar power, grid capacity will also become a barrier as these are volatile sources causing difficulties to the grid operator. The municipalities should explore options for community solar power plants more, which could join several energy users. However, the mayors face the difficulty of how to justify where to establish community solar power plant and which residents will benefit from it – this can prove as another administrative barrier.

Most of opportunities GOLEA sees for advancing solar are in the increased cooperation of different stakeholders. Municipalities should reach out and encourage or help residents with energy adaptation and solar development of private buildings. As GOLEA has the required knowledge and technical expertise, more and better communication between them and the municipalities is desired. They also see potential for reaching energy goals in public-private partnerships, but expectations between both partners must be clearly understood and agreed upon. Better networking and cooperation could also improve success rate of applications to tenders, which increasingly call for consortia of applicants and cooperation of multiple stakeholders (e.g., recent call for smart cities and communities required a consortium of at least four municipalities).

GOLEA also sees a lot of remaining potential in increasing knowledge base and publicly available studies, especially on mapping potentials, but also match-making networks that could bridge the gap between stakeholders. These tools would be a valuable addition to LECs which are also becoming more concrete and targeted at specific projects.

Table 16: Views of the energy agency GOLEA

Interest	Creating connections (networking) among stakeholders Creating achievable energy goals for municipalities Increasing knowledge base and tools for energy planning
Effort	Energy management for municipalities Consulting municipalities and preparing Local Energy Concepts Conducting national and international projects related to energy. Differing level of efforts among municipalities, different priorities
Role and power	Consultant and external expert for municipalities Main energy stakeholder which municipalities turn to Prepares LEC, which is municipalities main action plan related to energy. Little decision-making power, but can influence municipalities decision making through consultation, LEC and other projects
Barriers	Lack of municipalities capabilities and cooperation Lack of knowledge about funding possibilities Lack of energy related studies and tools Strict and extensive administrative regulations
Opportunities	Better cooperation and wider networks of stakeholders Municipalities should focus energy-efficiency measures more on private buildings Public-private partnerships Energy potential studies and tools

Developers

Port of Koper

Currently, Port of Koper has 268 kW of installed solar power, producing about 1% of their annual electricity consumption. They have a plan to install more each year and have also prioritized on which buildings to install them. All the solar is roof-installed.

The main motivation for increasing solar power capacities is reduction of environmental impacts and achieving greater self-sufficiency. Port of Koper is one of largest consumers of electricity in Slovenia so they plan to add another 1,25 MW of solar capacities by 2025 for a total of 4 MW by 2030, which would mean about 15% of self-sufficiency. Long term strategic plan (beyond 2030) is to reach 50% of self-sufficiency with electricity. Development of solar technology is reducing installation costs and increasing returns on investment, making them economically feasible even without subsidies. The solar power plants are financed directly by Port of Koper and sometimes through EU programs (e.g. Interreg).

Port of Koper falls directly under national jurisdiction, so its development does not need to go through local level. A national spatial plan was adopted for the area of Port of Koper which gives it a lot of autonomy when planning spatial development within. They also possess the required knowledge and skills for both planning and installing solar power plants, so they often only buy components and conduct the permitting process and install the power plant by themselves. They would not change the administrative process in any significant way, as that may lead to poor quality of installations.

To plan solar effectively, Port of Koper conducted a study of PV potential for their buildings, showing that even some north-facing roofs with low slopes have a good potential. The biggest current barrier are unsuitable constructions of older warehouses. Reinforcing the structures would considerably prolong the payback period of the installation, which is why new installations are mainly planned for newer or yet to be built buildings. The long-term risk is related to regulation of self-supply of electricity if they would become a large producer. The main concern is keeping the investments economically sound and if electricity market would change the conditions under which it is possible to sell the surplus of electricity that could make additional investments economically unviable.

Table 17: Views of Port of Koper

Interest	Self-sufficiency and reduction of environmental impacts
Effort	Strategic plan for increase of installed capacities Study of feasibility for existing buildings
Role and power	Autonomous in the port area, subject to agreement of the government Have administrative and technical knowledge to design and implement the project on their own. Clear goals, decision criteria and division of tasks reflect in long-term and sustained development
Barriers	Unsuitable construction of older buildings Uncertainty about future regulation of electricity market (surplus selling)
Opportunities	Technological advancement which reduces initial investment and improve efficiency (also for storage) New buildings are being built with solar power capacities in mind

Solar industry representatives

The solar industry representatives provided very similar opinions and views to one another of the current situation in Slovenia. They all feel there is currently a lot of demand for household solar power plants, which they mainly attribute to favourable conditions set by the *Decree on the self-supply of electricity from renewable energy sources*, providing regulatory base for net-metering. At the same time, the national *Eco Fund* offers credits for installing solar power plant for self-supply with low interest rates. The current rise in demand is posing challenges to certain parts of the grid, where the capacities for connecting solar power plants are exhausted. This is especially evident in some rural parts.

Most of the demand comes from private households, which is different from the first wave of expansion (around 2011) triggered by feed-in tariffs that mainly sparked construction of large ground-mounted solar power plants. The interviewees' clients are mainly interested in roof installed power plants, while there is little interest from small and medium businesses. Some of the companies also got inquires for solar on parking lots, but these are generally rare and there are some legislative uncertainties about construction. Most clients invest their own funds for construction and get *Eco Fund* crediting. Some companies also offer payment in several instalments. They also feel that inclusion of solar power plants into *Eco Fund* schemes give certain legitimacy to solar power plants as they are showed as green, environmentally friendly investments.

All the companies think that administrative process to get permits for a solar power plant is extensive and could be rationalized without losing on quality control. There is a lot of paperwork and forms to submit, of which some data/checks are duplicated. This makes it very difficult for a private investor to lead the process on his own and the companies fill this gap by providing turnkey solutions. With increased development the outcome of the process is also becoming increasingly uncertain as the grid operators sometimes do not issue permits for the applied power due to grid capacities.

While all the companies report that the customers are becoming better informed about solar power plants, there are still occasional concerns about electromagnetic radiation, fire safety and recycling after deconstruction, but not to a point where this would change the intention of a client. The greatest and not yet completely resolved issue is the longevity of the current regulations and uncertainty about the future regulation of self-supply and net-metering conditions. When it comes to innovative solutions, such as establishing solar on parking lots or degraded sites, the regulation and municipal spatial plans are often not clear which might hinder development of such projects, which in turn still have a large potential.

The main opportunity they see is in a stable regulative framework that gives investors certain security and certainty. Under such conditions they already see some larger investments and interest. While some companies think there is no need for feed-in tariffs anymore, others see them as a good stimulation for larger installations, but they must be designed very carefully and comprehensively to not distort the market.

While the interviewees represent companies that are mainly focused on smaller and medium private investments (both individuals and legal entities) they think that municipalities and public institutions could play a larger role in development of solar power. This is especially true when it comes to energy communities where there are more stakeholders to include and coordinate, which could be a task performed by the municipality. While there were some public calls for solar power plant instalments, the companies who we interviewed chose not to participate or were not competitive as they offer higher-quality services, while public calls prioritize lower costs. One of the companies, for example, offers optimization of installed capacities based on detailed measurements of building's electricity consumption.

Experience from another company, which created an online calculator for estimating return on investment and saw a rise in inquiries also shows how such self-serve tools can help customers to think about an investment. Additionally, it would be very helpful if grid operators would provide some publicly available data about grid capacities which would allow the developers to better estimate how much capacities can be installed at a certain location. This is currently the main barrier, and some developers think that increasing the demand is not viable until this is solved.

Interestingly, one of the companies who also participates in projects in Croatia commented that merging both markets would create and ideal market. Croatian projects are mainly larger while Slovenian project are predominantly smaller.

Table 18: Views of solar industry representatives.

Interest	High among small and medium investors Mostly rooftop installations, some also for parking lots High interest (demand) is curbed by grid capacities
Effort	A lot of effort for administrative procedures Development of own tools, such as online investment calculator and optimization based on consumption measurements
Role and power	Provide turnkey solutions as the administrative burden of a project is too complex for individual investors Could have a promotor role in public private partnerships if municipalities would be open to the idea
Barriers	Complex administrative procedure In some places, especially rural, grid is not suitable for large amount of distributed solar power plants Uncertain future of self-supply regulations and market
Opportunities	Better promotion of energy communities and active role of municipalities Medium and large businesses Stability of regulatory framework Streamlined administrative procedures

Croatia

Decision makers

Municipality of Starigrad

Municipality of Starigrad sees significant potential for ground mounted solar power plants in commercial areas and for integrated systems on family houses but does not see any potential in other areas (e.g., parking lots, as there are not any large ones, and the geography of the county is such that there is little potential for development). They recognize that coastal areas have better solar insolation than continental regions of Croatia, with up to 20% more energy yield. The air in the municipality is also clean without much dust and particles, which also means solar power plants need to be cleaned less often. They believe that solar power plant development should be encouraged in the municipality. While there are no commercial solar projects, some family houses already have solar panels on roof, including one of the municipality’s representatives. His solar power plant is financed as a roof rental project. The municipality is also interested in installing solar power plant on roofs of municipal buildings, but only two are suitable (a kindergarten and administrative building). Most of energy related municipal measures have been focused on implementing and supporting tenders for the renovation of family houses through the *Environmental Protection and Energy Efficiency Fund* (‘FZOEU’).

The municipality identified low interest among residents as the reason for lack of solar power development. They believe that residents base their opinions on situation few years ago when the costs were higher are not aware of the actual construction costs, reliability and returns on investment that could increase the interest. There are also some concerns due to strong, gusty winds (bora) that blows in the coastal areas and might damage the installations and rise constructions costs to make them safe. Moreover, the municipality lacks (human) resources to spread awareness, educate, assist, and inform resident about solar power systems, even though they see this as means to initiate development. Additionally, the municipality recognizes the great importance of tourism and the potential of installation of solar power in tourist objects, especially due to seasonality of tourism. Due to proximity of Paklenica National Park there is a concern for developments with high visual impacts (such as wind power plants and to extent also ground mounted solar power plants).

While the municipality currently does not actively promote use of renewable energy sources (RES) or define it as a priority, the spatial plan of the municipality dedicates certain plots (around 8 ha) near transmission infrastructure to the construction of large-scale ground-mounted solar and/or wind power. Potential investors already expressed some interest to develop these locations, but the projects halted due to unresolved property ownership issues. The land in question is state owned by *Croatian Forestry*, so the municipality has no authority over these plots to push the development. Buying the plots is too expensive. Similar problems are present in several municipalities in the Zadar county, but is left to municipalities to deal with them on their own.

Currently the municipality doesn’t actively seek any programs to (co)finance solar power developments due to lack of human resources nor is familiar with any national or EU subsidy schemes. They are interested in public-private partnerships (‘PPP’), especially for projects on municipal buildings (available area of about 200 m^2). They are also interested in large scale solar systems which could provide additional income to the municipality. Currently they are not active in any PPP.

The main opportunity the municipality sees for advancing solar energy development is awareness raising and more resources/time for the municipal administration to address this development. They see tourist accommodation providers, listed in the *Tourist Board,* as a possible partner in developing solar capacities.

Table 19: Views of the Municipality Starigrad

Interest	High to develop solar on two municipally owned buildings or participate in public-private partnerships.
Effort	Spatial plan dedicates certain plots for large-scale energy development. Generally low due to lack of resources. Focus on energy renovation of family houses.
Role and power	Must fulfill national and county obligations. Could help residents with tenders if they would have more human resources, like the current energy renovation of houses. Can dedicate areas to energy development through spatial plan, but this mechanism can be restricted by land ownership issues.
Barriers	Low interest of residents due to lack of awareness and information. Lack of human resources in the municipal administration. Unresolved land ownership issues. Strong winds increase solar power installation costs to ensure safety. Visually sensitive area in proximity of Paklenica National Park
Opportunities	Education and awareness raising among residents. Public-private partnership for development of two suitable municipal buildings. Cooperation with tourist accommodation providers, which are included in a municipal tourist board.

Zadar County

Zadar county is responsible for concretizing state level strategic guidelines and legislative frameworks. It is thus also responsible for setting renewable sources goals that municipalities must consider. While the county is the main policy setter for municipalities in their scope, most of the tools and consultation to the citizens and developers is done by The Zadra NOVA Development Agency, so most county's positions towards solar power are the same as those of the development agency (see next chapter).

Nevertheless, the county observes great interest from investors for the construction of large ground mounted photovoltaic systems. Some projects have already received building permits and are currently in construction. In addition, there is significant interest for integrated systems on public buildings, especially schools. Managers of the public buildings are preparing technical documentation to apply for funding. Development of solar power plants is also planned together with the upcoming renovation projects of public buildings. Currently, they have an active tender for the co-financing of electric charging stations.

A potential obstacle to the development of integrated solar power plants that the county recognized is the ownership structure of the buildings. There are frequent problems with the reconstruction or renovation of roofs due to unresolved ownership relations.

Table 20: Views of the Zadar County

Interest	High
Effort	Planned development of solar power plants together with public building renovations. Tender for co-financing electric charging stations. Spatial planning with dedicated locations for large scale wind and solar power plants
Role and power	Main policy maker for municipalities. Must concretize national strategies to local level. Interested parties are directed to Zadra NOVA development agency.
Barriers	Unresolved ownership issues.
Opportunities	None given

Zadra NOVA development agency

Zadra NOVA development agency is the stakeholder that prepares policy suggestions for the County to adopt and thus has a good overview of the county renewable energy situation. They are currently preparing The Development plan of Zadar County for the period from 2021 to 2027. The plan is not yet available publicly, but the agency states that renewable energy sources are an integral and key segment of the development strategy. The greatest emphasis in the plan will be on the installation of solar power plants in combination with hydrogen production systems. They are collaborating with a ferry company to introduce hydrogen-powered ferries on the bussies ferry line in the county. Similarly, they also plan to establish hydrogen powered busses.

The agency also participates in several projects, mostly co-financed by the *Environmental Protection and Energy Efficiency Fund* (FZOEU), the *Ministry of Regional Development* or EU funds. One of these projects was i-SCOPE in which they mapped the solar potential of roofs in the City of Zadar and made a photovoltaic potential calculator, which is still online but no one uses it. Their experience shows that people are only interested in these kinds of projects when they are ongoing and is talked about, but after the project is completed, the tools are mostly not used and are forgotten.

In the county of Zadar, there are several integrated (rooftop) photovoltaic projects, however the agency believes they are not as popular as they could be. Most of the solar power plants on family homes are located south of Zadar (opposite direction of Starigrad). The key reason for this is the proximity of northern parts (where Starigrad is) to the Velebit mountain range which causes frequent and intense gusty Bora wind. While this presents some additional risks to installing rooftop solar power plants, it is still possible to construct them, however at a higher price as it is necessary to ensure proper mechanical stability. Commercial investors are also interested in the development of larger, utility-scale solar power plant projects. Currently there are five locations under development. Off-grid systems are common on remote locations on islands and in isolated areas without access to the power grid. Besides solar, there are also numerous wind power plant already in operation or in development.

There is also a big potential for solar power on the roofs of facilities in business zones. This is already recognized by some developers, and projects are under development.

The public is interested in RES in principle, but the development agency recognizes that citizens do not have enough information on the administrative and technical procedure of projects. To remedy this, the Solar Educational Center was established in 2011, however, it is currently closed. Nevertheless, the agency regards this center as an example of good practice to spread information about solar power plants. This is also where the agency sees most opportunities to advance development of rooftop solar. They suggest organizing workshops and preparing information materials for the public. Currently, most of the information is being disseminated informally, from mouth to mouth. The train of thought of the public as observed by the agency is as follows: people see that their neighbour has a solar power plants so they will install the same. They would even use the same construction company and thus almost all solar power plants were installed by a single company, because everyone trusts them. Most common installations are solar power plants of about 5kW as they are the easiest to install. The agency observes that people in general are poorly informed and distrustful to rent the roof and let an investor on their roof and prefer to install the system themselves. It is therefore necessary to provide people with additional information. As already mentioned above, some tools were already developed to provide more information, but they are not popular enough. The agency sees the upcoming Solar Adria workshops as a good device to spread information across the whole county, not just the pilot municipality.

The Agency has big aspirations for development of RES and energy efficiency, but it does not have sufficient technical capacity in terms of electrical engineers. Depending on the activities, external experts are sometimes hired for certain tasks. Recently they had a public tender in which the Energy Agency North was chosen for technical assistance in project implementation.

The Agency supports municipalities, individuals, and legal entities in applying for projects to various funds. Anyone with questions about solar power plants and potential sources of funding can contact the agency for help. They do not participate in public-private partnerships nor does the agency have a particular stance towards them. While there are known locations for development of large-scale solar power plants, the agency does not have any special strategy to attract or advance the development of these areas. However, upon inquiries from investors, they offer information about potential locations and contacts of landowners or existing projects. While this support is offered also to municipalities and citizen, they mainly get inquiries from investors about large-scale solar and none about integrated solar power plants. Occasionally the agency or the county also publish tenders for financing and co-financing solar power plants.

There were also recent (2020) tenders for installation of solar power in tourism and agriculture by *Environmental Protection and Energy Efficiency Fund* (FZOEU), the *Ministry of Regional Development.* The tender (at country level) resulted in little interest in Zadar county due to its unfavourable condition, mostly that all produced electricity must be self-consumed. This is possible during summer when demand is high, but out of the season, this makes little sense because self-consumption is at very low levels.

While the agency observes lack of information as the most pressing barrier to advancing development, there is also a lack of data on public buildings that could be equipped with solar power plants. The agency is currently looking especially at schools in Zadar county that could host solar power plants and they would benefit from having a general overview of existing public buildings that are suitable for solar power. Until now, renovated public buildings where not equipped with solar panels. They have renovated about 20 public buildings in the county (with the funds of the FZOEU), including several schools. In the future, such renovations could be joined with installation of solar power plants. Many public buildings are still to be renovated, so it makes sense to install integrated solar power plants at the same time. Some of the existing roofs might not have a suitable structural load capacity for the construction for solar power so this could also be solved through renovation. There is a total of 64 public buildings in the county and only about 24 have been renovated, so there is considerable potential. Several schools have however already installed solar power on their own initiative and with their own funds to cover their electricity needs, which is usually the results of a proactive principal.

Table 21: Views of Zadra NOVA development agency

Interest	High, must include RES in county development strategy. Solar, combined with hydrogen storage, is seen as key RES potential for the future. Gets a lot of interest from potential investors into utility-scale solar, but non from private investors for household rooftop solar.
Effort	Solar included in county development strategy as key technology. Offers consultations and information to any interested party (investor). Participates and conducts projects for advancing solar, e.g., ISCOPE which created online solar calculator, but the tool is not popular or widely used.
Role and power	Prepares and suggests policy documents. Can direct development through consultation and information to investors. Offers tenders for (co-)financing solar.
Barriers	Lack of information of the public. Lack of data on solar suitability of public buildings.
Opportunities	Increased awareness raising activities and popularization of tools. Need for renovation of public buildings, that could be accompanied with solar power plant installation. Hydrogen storage in combination with solar power plants, to fuel public transport (buses and ferries).

Developers

Investors

Interviews were conducted with six private investors who already installed or plan to install solar power plants on their roof in the Zadar county. Most solar systems are for self-supply and are in the power range between 3,6 to 8,2 kW, while one of the interviewees has two systems of 10 kW and is connected to the grid with the electricity producer status. The interviewees with solar power systems for self-supply are not allowed to sell surplus to the grid. They see solar power plants mainly as means of saving on electricity costs and a favourable investment due to incentives (especially the interviewee with the 20kW solar power plant who also recognizes financial gains). Most installations were co-financed by FZOEU, only the biggest producer paid the installation cost exclusively with his own money. They all commented that there is not a lot of developments like theirs in the county and that they regret this. One however noticed that the public is becoming more interested and there might be more development in the future.

The process of installing solar power plants went smoothly by all the investors, even though some expected more complications. They acknowledge that there is a lot of paperwork to be submitted and this can be complicated if dealing with it themselves. Interestingly, they explicitly mention that while the distribution system operator, that gives permits (HEP), took long to complete the procedure, they did not cause any problems. This might give some insight into how the public conceptualizes administrative affairs and dealing with the state agencies – slow and burdensome, even if in practice this might not (always) be the case. One of the interviewees also stated that about 50% of the funds in the subsidy tender were not used due to low public interest. A reason for this given by one of the interviewees is also that distribution system operator ('DSO') is slow to give permits which are needed to apply for the tenders. If the permit is given to late, investors cannot participate in the tender. Additionally, the DSO may give permits only under certain additional measures – such as installing a new power cabinet for the meter – which may cause additional work, cost, and time delays to the investor.

While the co-financing fund was paramount for the completion of the project, the fact that you must pay the costs in advance and are reimbursed the money after this posed some challenges to some. The investors consider this an obstacle for more investments, as many people who could have solar power plant cannot provide the initial capital to pay for it. The FZOEU tender provides up to 80% of the final costs, so paying in advance could significantly reduce financial strain on the investor. At the same time, the investors we interviewed believe the public should be better informed about the technical as well as administrative aspects of solar power plants.

These investors were generally satisfied with the whole process and functioning of the solar power plants up to a point where they would possible consider installing another one, especially those who have additional real-estate, such as apartments that they rent out. Only one interviewee said he will not be investing in another one, while one is already preparing a new project, and the other would do another one when they would have enough capital for it. All of them also recognize great potential for more solar in the county.

Table 22: Views of investors

Interest	High because of electricity cost reduction and as financial investment.
Effort	The administrative procedure requires a lot of effort.
Role and power	Dependent on DSO and tenders.
Barriers	Tenders only reimburse costs after completion which might present difficulties for financing if not enough initial capital is available. Slow procedures of the DSO. Lack of information.
Opportunities	Increased awareness raising activities. Better co-financing schemes.

Comparison of the interviewed stakeholders' views

The comparison of stakeholders of Slovenia and Croatia will be done by segments. First the decision-making segment of stakeholders will be compared, then the investor landscape will be evaluated. The comparison will follow the four established categories namely: Effort, Role and power, Barriers and lastly Opportunities.

Decision-making stakeholders' comparison

Due to different decision-making organization of Croatia and Slovenia it is hard to compare equivalent decision-making levels as they have different competences. For example, Slovenia does not have regional decision-making level, whereas Croatia has counties (regional administrative units consisting of municipalities). Therefore, in this comparison local and regional decision making will be bundled together and compared, adduced in-line which is compared. In addition, to the decision makers the GOLEA regional agency in Slovenia and Zadra NOVA in Croatia will be added to the comparison as they are tightly connected to the respective decision makers producing and assisting in implementation of the main spatial documents and material that is adopted in local and regional legislation.

INTEREST

The interests of both countries when it comes to solar power are differently shaped. The municipality of Koper's main interest is to fulfil national goals set forth by national legislation and provide social benefits to its residents. This includes LEC and administrative obligations for which they employ the GOLEA development agency. Similar is the condition in Croatia where the county of Zadar employs the Zadra NOVA agency. In terms of strategic approach, we can already observe a first important difference in support of large-scale solar plants. Whereas the support and administrative will to implement this type of solar energy utilisation is high in Croatia, in Slovenia the approach is more reserved and the environmental and greenfield development reservations are adduced. The latter is keener on small integrated solar energy systems. The interest in development of integrated solar on publicly owned housing stock is similar when compared between Koper municipality and Zadar County; both entities show interest, whereas due to the lack of appropriate housing stock in Starigrad, the interest of the Croatian municipality is lower. Another difference is in terms of PPP project support and interest. If Koper does not give emphasis on PPPs to develop projects, Starigrad is very keen and interested in them. However, both municipalities do not actively seek such collaborations, perhaps due to capacity constraints. In terms of outreach, Koper has a running cooperation project for an energy cooperative. In Croatia education and support centre was active on county level, however at the time of research, the centre does not operate.

EFFORT

On the strategic level, both countries seem to be doing similarly, as the GOLEA and Zadra NOVA agencies both consult and produce strategies and consultations for solar power implementation to municipalities and county respectively, or to any interested public or private party. The difference is in the national goals, whereas in Slovenia they presuppose a LEC strategy, in Croatia there is provision in spatial plans for large scale wind and solar power plants. On the implementation level of actual projects, we can see a significant difference between the municipalities. In Koper, the municipality mainly focuses on managing their own housing stock to satisfy national and other prescribed legislation, whilst in Starigrad they chiefly support implementation on resident's buildings as the housing stock of municipality is scarce and cannot support integrated solar power systems. However, on the level of Zadar County, we can observe more proactive approach vis-à-vis Koper municipality with reported planning for solar power as part of the public building’s renovation programme. Both municipalities lack dedicated staff and knowledge, which is usually cited as reason for lack of effort and limited scope of engagement in the solar power domain.

ROLE AND POWER

Role and powers are differently distributed in both countries between administrative levels. In Slovenia, the emphasis is on the municipality level, where we can see Koper being active in public engagement projects such as energy cooperative however, they have some success with implementation of solar on their housing stock. Despite all decision makers identifying lack of public awareness as one of the main barriers to solar energy development, neither municipality actively promotes integrated solar to the inhabitants due to lack of capacities. In terms of administrative responsibilities, the Koper could be compared to Zadar County, instead of Starigrad municipality, however size difference is a factor. Whereas Zadar County is main policy maker and believes in proactive role in development, the Koper municipality is more interested in managing their own needs and does not see themselves as a proactive proponent of broader adoption of the technology. On the other hand, GOLEA in Slovenia picks up that role regionally, like Zadra Nova in Croatia. However, due to lack of administrative power, GOLEA is left with consulting and soft approaches through consultancy and writing policy papers for the municipalities. Starigrad municipality noted that they would like to play a more proactive role but are limited by their capacities.

BARRIERS

Barriers in both countries are very similar and no differentiation was uncovered except for unresolved ownership issue in Croatia. In both countries, there is a huge lack of institutional capacities, cooperation, and knowledgebase on the municipal level for running, implementation and strategic planning of solar energy projects. In addition, a misalignment between the departments within the same level of administration has also been observed. Similar is the case with the lack of awareness amongst general population, which is connected to weak promotion of the technology that can be traced back to limited funds and resources. At the same time, a chronic lack of funds is cited, however this might again be due to low capacities and administrative effort required for applying for subsidies rather than the financial instruments offered by the EU or the two states respectfully. An exception to this are tenders for integrated solar energy systems offered by Zadra NOVA, but not all funds from the tender are used beacuse of lack of interest. Another similarity is visual sensitivity due to protection, in Croatia due to Nature Park Paklenica, in Koper chiefly due to heritage protection of the old city core. Lastly, both countries lack the energy related studies, maps and tools that could help with the spatial placement and decision-making on the solar power, however Croatian spatial plans have a special category for designating areas for renewable energy development.

OPPORTUNITIES

The outlined barriers represent opportunities for improvement. Common opportunities for both municipalities are shown through increasing the staff capacity and knowledge on one hand, and education and awareness raising amongst residents on the other. Further common opportunities emerge through better cooperation between stakeholders and networks, and more favourable legislation with less administration barriers would be very beneficial. Additionally, a chronic lack of energy related studies, maps and tools show an important opportunity for the aspect of this research.

Other opportunities diverge. Whereas in Koper they see opportunity on commercial and public parking lots, in Starigrad they see opportunity more on privately owned touristic accommodations reached via the tourist board. The seasonal character of the Croatian tourist sector is also well aligned with the dynamics of solar energy system production. If the Zadar County supports PPPs, GOLEA in Slovenia suggest a more proactive role for Koper in such roles. If Zadra NOVA sees a need for renovation of public buildings GOLEA believes a better focus on privately-owned housing stock is needed.

Investor stakeholder's comparison

In Slovenia, the interviews were conducted with port of Koper with a unique administrative position followed by interviews with solution providers that normally provide turnkey solutions to private owners. In Croatia, the investor landscape is different in that the individual private owners start the investor process with whom the interviews were conducted. Direct comparison between investors in Slovenia and Croatia is hence difficult due to different investor types and their roles that result in different problem focus of the interviews. Nonetheless some reciprocities and similarities are still identified here.

INTEREST

The solution providers in Slovenia report high interest especially amongst small and medium investors for mostly rooftop conversions. This interest might even be too high for the grid capacity to support. While the main motivation for interest identified in both countries is electricity cost reductions and financial subsidies, there is less demand for small integrated solar systems in Croatia than in Slovenia.

As a separate entity, port of Koper is also mainly interested in their self-sufficiency and to lowering the environmental impact of their operations as per national energy transition goals. They consume large amount of electricity, so this motivation is strong.

EFFORT

The solution providers in Slovenia as well as individual owners in Croatia, both stress the tediousness of administrative procedures for the solar projects that hinder their efforts. Additionally, one of the solution providers in Slovenia developed their own online investment calculators to attract investors which is a good practice example for increasing interest.

Port of Koper is a good practice example with their own solar study method and long-term strategic plan of implementation based on the study. However, they do not use this for promotion of their company, as they mainly do it for economic reasons.

ROLE AND POWER

Role and power of different stakeholders in the interview is very varied. Port of Koper is motivated by self-interest to develop within their area so no visible power and role in the wider solar power landscape can be ascribed, although this could be used as a success story and good practice example to also promote the technology among residents in the municipality. The most interesting to address are the solution providers in Slovenia that provide turnkey solutions. They can also act as promoters of the technology.

BARRIERS

Apart from Port of Koper that has concrete problems with loadbearing of old structures, there are mainly administrative problems and barriers. For all three stakeholders the most common is the uncertain market regulation and governing market laws on which depends the return on investment and viability of the installations for individuals. The individual investors in Croatia as well as the solution providers in Slovenia cite as the most hindering the lengthy administrative procedures and the paperwork accompanying installation. In Croatia tender retroactivity of reimbursement is cited as problematic. In Slovenia the infrastructural limit of the grid for distributed power production is also quickly becoming problematic.

OPPORTUNITIES

In both countries a streamlined administrative process would be useful. In addition, better co-financing schemes would be positive. In Slovenia, a more stable regulatory framework would help with planning of return on investments. Additionally, a better promotion amongst communities would help move the sector onwards in both countries. In Slovenia, systematically addressing grid capacity through maps or other indication of possibility of further development would help better target projects and identify problematic areas quicker in the process.

Survey results: views of the public

In this chapter the results of the public opinion from both countries will be discussed jointly. The labels Slovenian and Croatian will be used to discern between the two survey samples; however, they do not represent the population of the whole countries but rather from the coastal municipalities in Slovenia and from municipality Starigrad in Croatia. The differences between respondents from Slovenian municipalities were not statistically significant, so their results are reported together throughout.

One of the assumptions when designing the survey questionnaire, based on the interviews, was that the public is generally not well informed about solar power system. The self-reported technical and administrative knowledge of survey respondents in both countries confirms this assumption (Figure 20). Most often chosen level of knowledge was none both for technical and administrative knowledge. The Croatian respondents reported somewhat higher level of technical knowledge (mean 2,93) than Slovenians (mean 2,36), however this difference is not statistically significant (p = 0,069, equal variance not assumed). It is also noteworthy that there were many missing answers in the Croatian sample to the question on rating administrative knowledge (35% missing values).

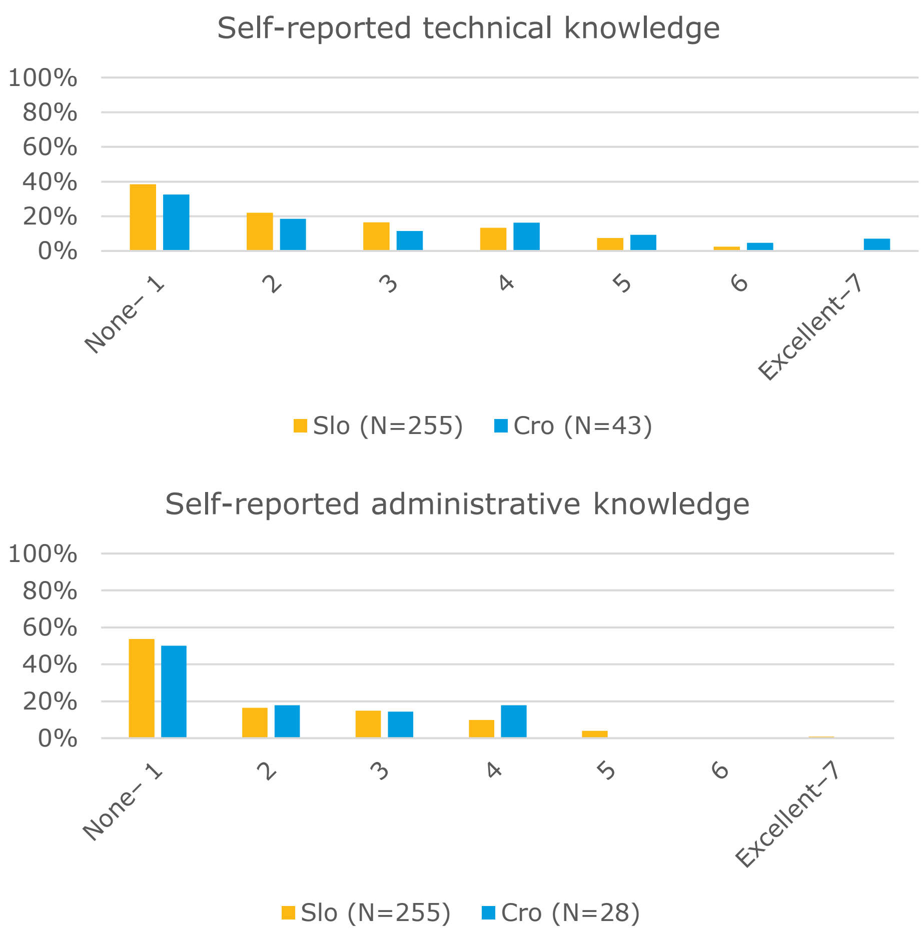


Figure 20: Self-reported level of technical and administrative knowledge about solar power plants.

With the self-reported level of knowledge in mind, it is not surprising that respondents also report little experience with solar power systems. Again, the mean of Croatian sample is slightly higher than the Slovenian (1,83 vs. 1,40) and this difference is statistically significant (p = 0,032, equal variance not assumed), which is interesting as Slovenia has far more solar power systems installed than Croatia. The local context might play an important role in this case.

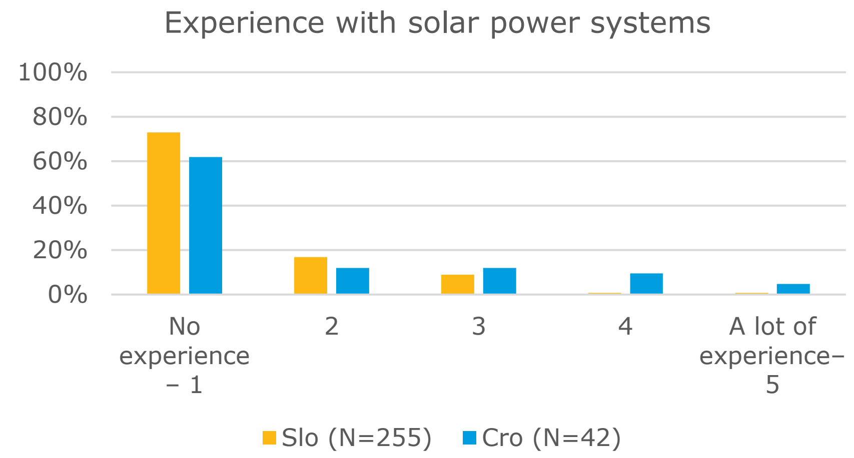


Figure 21: Self-reported level of experience with solar power plants.

Despite low levels of reported knowledge and experience, the respondents expressed a lot of interest to install solar (Figure 22). In the Slovenian sample 82,3 % stated they are either very interested or partially interested in installing solar power system on the roof of their residential building. In the Croatian sample this share is 88,4%, with more respondents being very interested. 2,7 % in Slovenian sample and 4,7 % in Croatian sample already installed a solar system. Those who chose the option Other (3,5% of Slovenian sample) most often commented that they would like to have solar system but since they live in apartment building, they are skeptical whether they would get support from other residents.

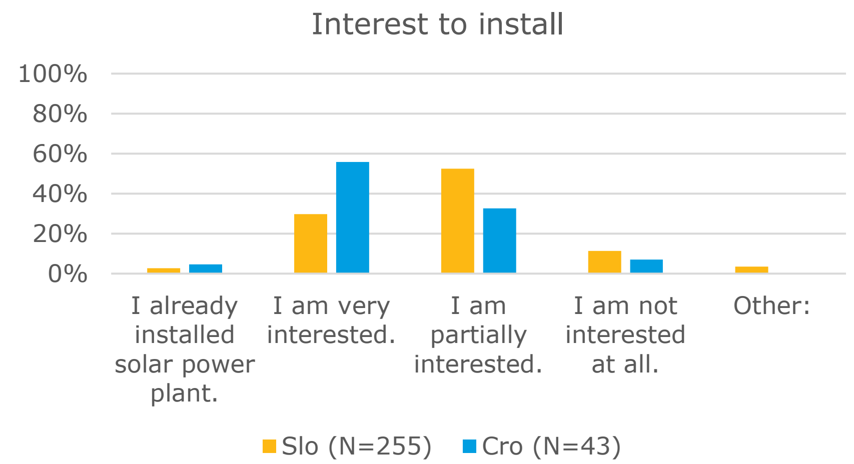
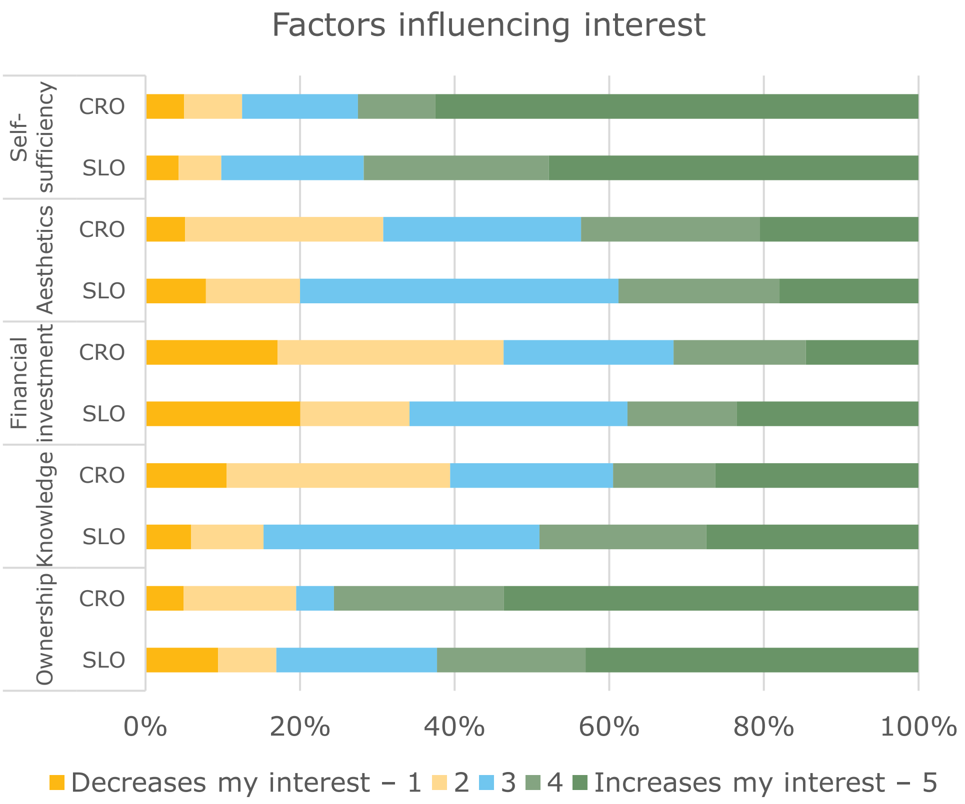


Figure 22: Interest to install solar power plant

The two factors that increase the interest to install solar system the most are self-sufficiency of the investor and ownership of the building (Figure 23). Financial investment on the other hand decreases respondent's interest. In line with reported knowledge, this also appears as one of the factors that can deter people from investing, which is especially evident in the Croatian sample. The aesthetics of building after installing also seems more problematic in Croatia, which might be due to the importance of tourism and presence of a National Park in Starigrad. Among other factors that the respondents provided a lot mentioned the nature protection aspect of installing solar (less GHG emissions) and again the fact that those living in apartment buildings would need to get unanimous agreement from other owners to install solar.

Figure 23: Factors influencing interest to install solar power plant



Both respondents from Croatia and Slovenia mostly think that public policies should encourage the use of solar energy and that it should be subsidized. While both also feel that more buildings in the respondent's municipalities should be equipped with integrated solar power system, this attitude is especially strong among the Croatian sample (73% vs 55% for answer Completely agree). There were no significant differences in answers to this item among Slovenian respondents from different municipalities. While the respondents also seem to agree that more solar power should be installed over parking lots, they felt less strongly about this. More respondents from Slovenian sample chose Completely agree with solar over parking lots than their Croatian counterparts (47% vs 37%). This might be explained by the fact that there are no extensive parking lots in Starigrad, while there are numerous large parking lots next to shopping malls and industrial areas in the Slovenian coast. The picture turns again when talking about ground-mounted greenfield solar power systems. More Croatians agreed with this type of installation - 67% chose answers indicating some level of agreement while 21% chose answers on the disagreement side of the specter, 13% were chose neutral. In Slovenian sample, 47% were on the agreement side and 33% on the disagreement side, with 20% neutral. This points out the potential controversy of ground-mounted greenfield solar power systems.

Beliefs about solar power systems are also quite similar between Croatian and Slovenian sample. Both respondents believe that installing roof solar requires a large financial investment. Slovenians seem to hold this belief more strongly than Croatians. Slovenians however more strongly believe that solar power systems reduce electricity costs for the final consumer, about 10% of Croatians disagreed with this statement. On the other hand, Slovenians are less convinced that solar power systems are cost effective, almost a quarter of the respondents chose the neutral answer, while Croatians were more likely to agree strongly with the statement (44% chose Completely agree). Both group of respondents believe that solar power plants contribute to environmental protection, and strongly believe that solar power plants are not a health hazard – about 5% of Croatian respondents and 9% of Slovenian respondents disagreed with this. The belief about required amount of paperwork was the weakest in the group of belief statements. While it gravitates more towards the belief that a lot of paperwork is required, a significant number of answers were allocated to the neutral answers (35% of Slovenian sample, 31% of Croatian sample). About one fifth on answers from both samples was given to the extreme answer Completely agree. A similarly undetermined belief can be observed with the statement that solar power systems require a lot of maintenance work. 41% of Slovenians did not decide whether they agree or not with this versus 23% of Croatians. However, both lean more towards disagreement with this statement (i.e., believe that not a lot of maintenance is required). Croatians also more strongly believe that integrated solar power systems increase property value, but Slovenians also agree with this statement, albeit less decisively. Both, but especially Croatian sample, strongly believe that their respective national coastal area has a good solar potential.

The rating of the statements is consistent with the previous answers (Figure 24). Low self-reported levels of knowledge can explain weak beliefs about certain technological and administrative aspects of solar power (e.g., level of maintenance or required paperwork). However, the general belief about solar power seems to be positive which is also consistent with high interest among respondents to install solar power system in the future. The technology is perceived both as economically sound and environmentally friendly.

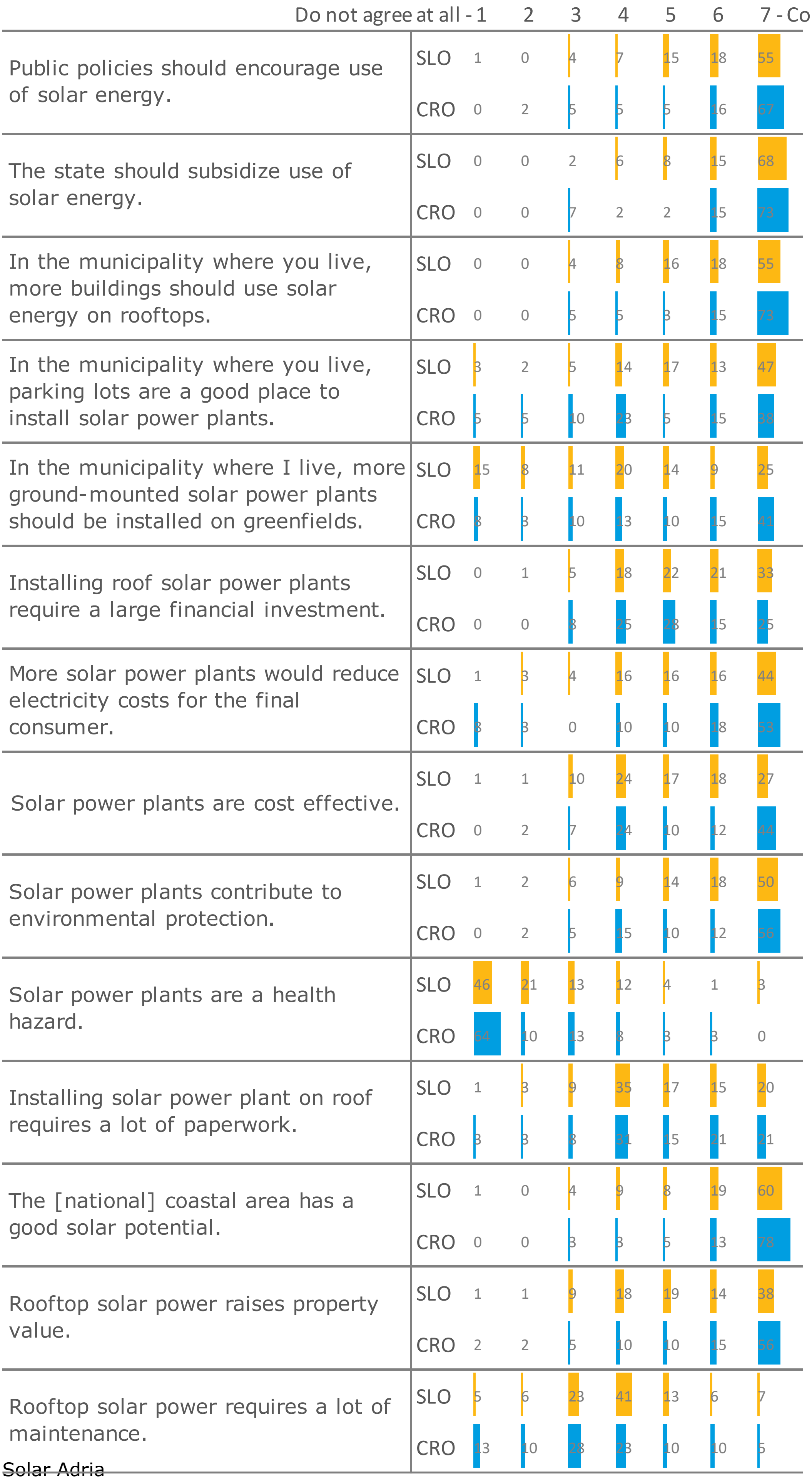


Figure 24: Levels of agreement with attitude and belief statements in the survey.

The positive attitudes and beliefs about solar power systems are reflected also in the intended behaviour of the respondents. While the respondents are not entirely certain they would invest into a municipal (community) solar power plant, especially in Croatia where answers are quite evenly distributed across the possible answers, there is a strong conviction that they would invest into their own integrated solar power system to cover own energy needs. While a greater share of Croatian respondents completely agreed with this statement, the share of those who didn't agree was also higher than in the Slovenian sample, who however tend to agree with the statement, albeit less strongly. Self-interest (covering one's own energy needs) seems to be the strongest motivator for possible investments in solar power systems as the other two statements about contributing to community's energy needs and selling the energy to the grid got less decisive agreement – however, the respondents agreed more than disagreed. The difference is most evident in the Croatian sample. The respondents were however more sceptical about renting the roof of their residence to other investors to install solar power system on it. Again, the Croatian respondents were more convinced about this – 62% would not agree to such an arrangement, compared to 36% of the Slovenian sample. In this categories of statements, Slovenian respondents were quite often undecided (neutral answer getting between 14% and 28%), while Croatians seem surer about their answers (more often picking answers at the far ends of the scale). The difference between both samples is most evident at the statement about renting the roof to someone else. Interestingly, Croatians report more environmentally friendly behaviour (reportedly more often buying products with smaller environmental impact even if they are more expensive) than Slovenians, who again most often chose the middle answer.

The difference in strength of reported behaviour is consistent with differences in the reported knowledge and experience – perhaps Croatians who reportedly know a little more about solar power systems are more likely to consider investing into it than their Slovenian counterparts, who might still need more information (Figure 25). Another possible explanatory variable is the higher share of respondents who live in single-family houses in the Croatian sample (69%) compared to the Slovenian sample (25%), who more often reside in multifamily houses or apartment buildings (57%) and are thus not the sole party who decides on investments into the building. This was also the most often exposed issue and uncertainty about installing integrated solar system in the other comments provided by the Slovenian respondents. The Croatian sample also reports high shares of income from renting apartments to tourists, mostly in the summer when costs of air-conditioning mostly run on electricity are high. Their motivation for saving on electricity costs might therefore also be higher and more tangible.

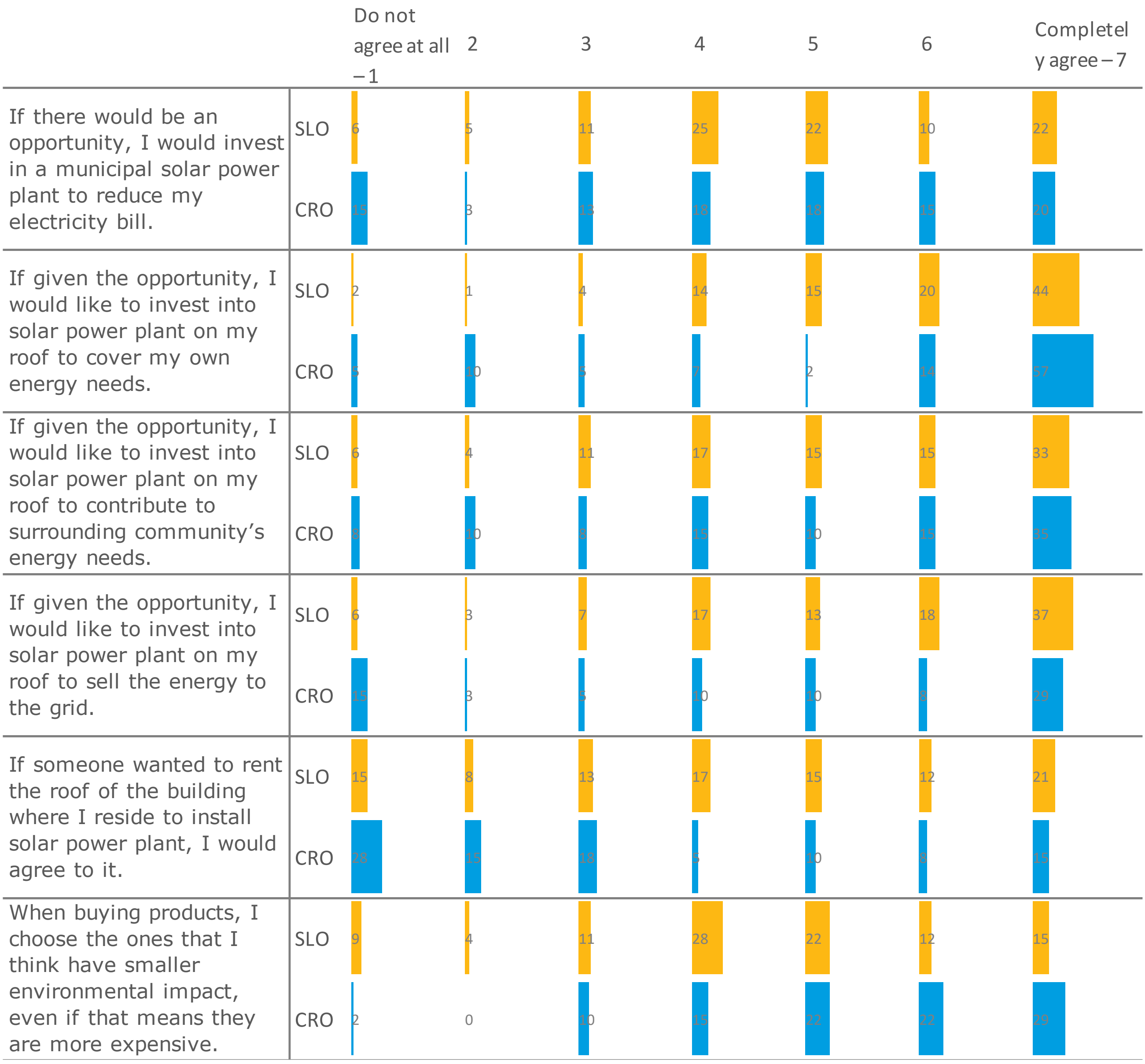


Figure 25: Levels of agreement with behavior statements in the survey.

Demography

The population from which Croatian and Slovenian samples were sourced are different (in Slovenia dense towns, predominantly urban; in Croatia less dense, suburban) and thus we expected some differences in the demographic variables to be present, which is confirmed by the analysis. In the following section we will also report on any statistically significant differences in the sample, if p values were less than 0,05 at 95% confidence level.

In the Slovenian sample, women are represented almost twice as much as men (65% vs 35%), while the Croatian sample is more balanced (47% women vs. 53% men; Figure 26). While no significant differences were found between genders in Croatian sample, men from Slovenia rated their knowledge technical and administrative knowledge higher than women. No difference was found in expressed interest to install solar power system or when rating statements.

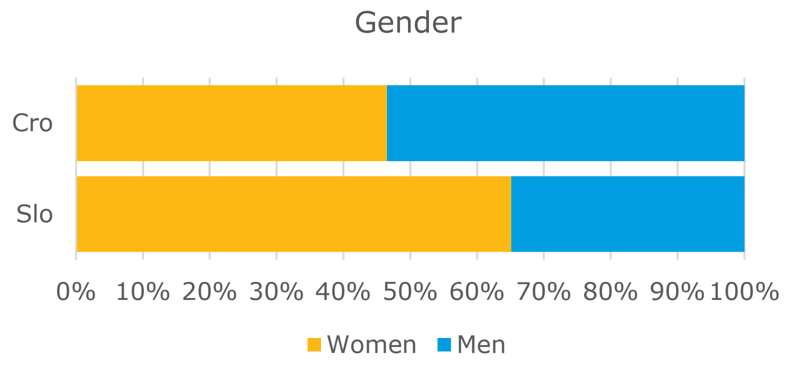


Figure 26: Survey sample by gender

Structure of respondent by age is also different among the two samples (Figure 27). The mean age of Slovenian respondents was 47 years, while the mean of Croatian sample was 55. The Slovenian sample was also somewhat more educated, with higher share of respondents with finished University degree. This category was the most represented in Slovenian sample, while in the Croatian sample most reported finishing high school.

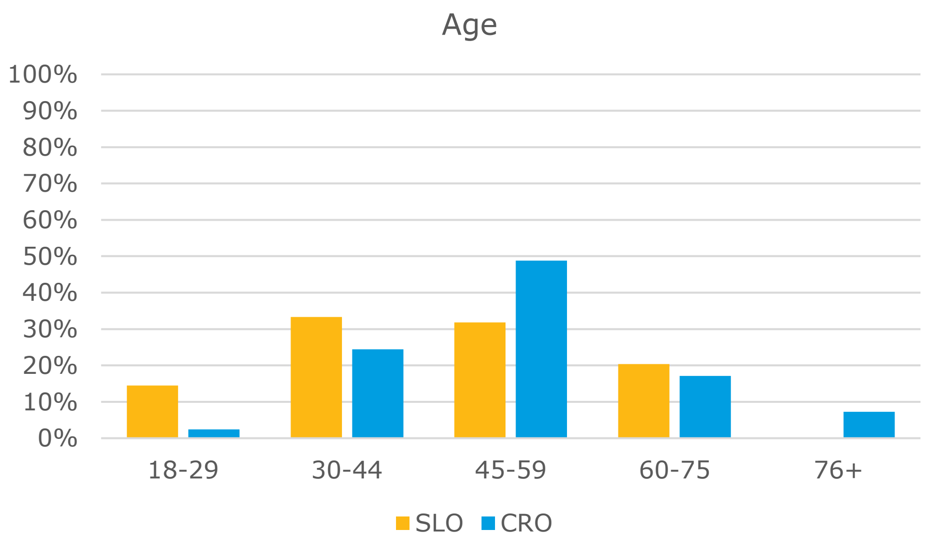


Figure 27: Survey sample by age

There were some statistically significant differences between age groups in both samples. The younger Croatians tend to agree more with the statement that they would invest into solar power to cover their energy needs. More differences were observed in the Slovenian sample, probably due to larger number of answers. Interestingly, younger people less strongly agree that public policies should encourage use of solar power. Older respondents also more strongly believe that integrated solar power raises property value. Belief that solar power plants contribute to environmental protection exhibits a U shape – the middle age group agree less with this than younger and older respondents. Younger Slovenians also agree less with the statement that they buy products with lower environmental impact. In the Slovenian sample we also found that less educated seem agree more with the statement that more ground-mounted systems should be developed than more educated. Similarly, those with less formal education also more strongly agree with the statement that integrated solar power system requires a large financial investment (Figure 28).

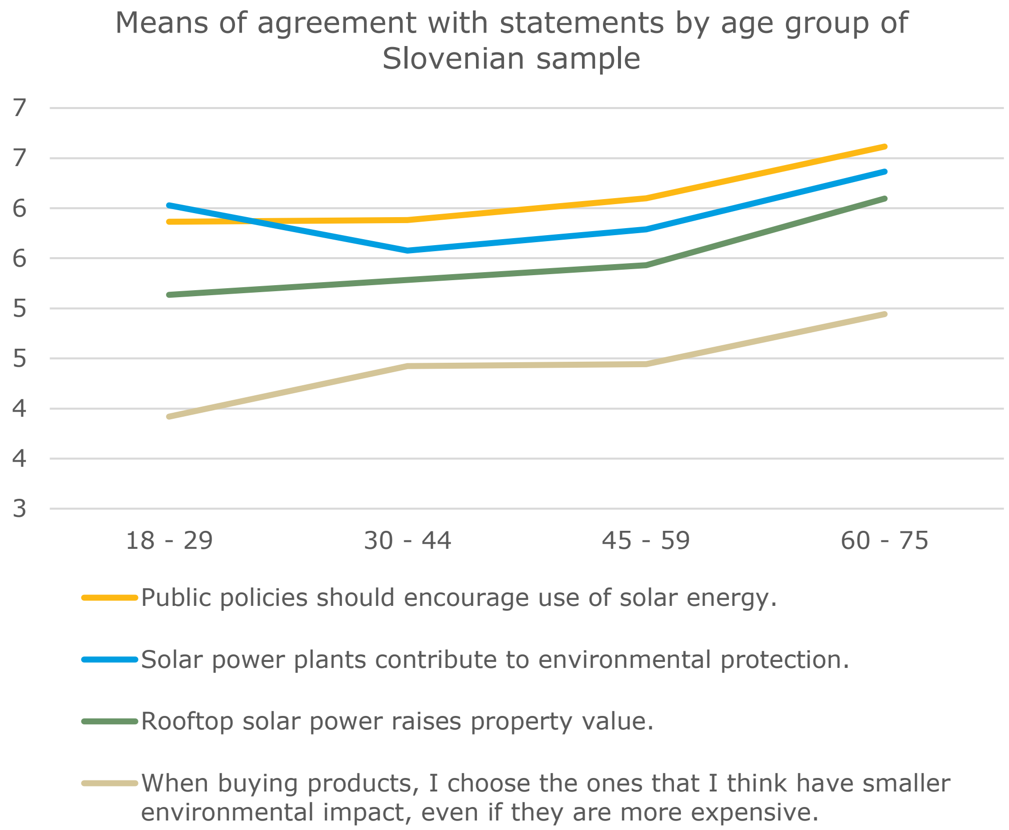


Figure 28: Means of agreement with statements by age group of the Slovenian sample.

There is also a lot of differences in the average household income between the Slovenian and Croatian sample (Figure 29). The Croatians most often reported income of up to 1000€ while categories from 1000€ to 3000€ were most often reported in the Slovenian sample. Expectedly, those with higher income in the Slovenian sample buy products with lower environmental impacts even if they are more expensive more often. Less expectedly, they are also less interested in installing solar power system on the roof of their residence. This further suggests that the main motivation for installing solar system is savings in energy costs, as those with less income might be more motivated to find additional means to achieve this (Figure 30). This difference in income is especially important since the average (family house) integrated solar energy system cost is about the same in both countries, as found in Chapter 1 (around 1500€/kW)

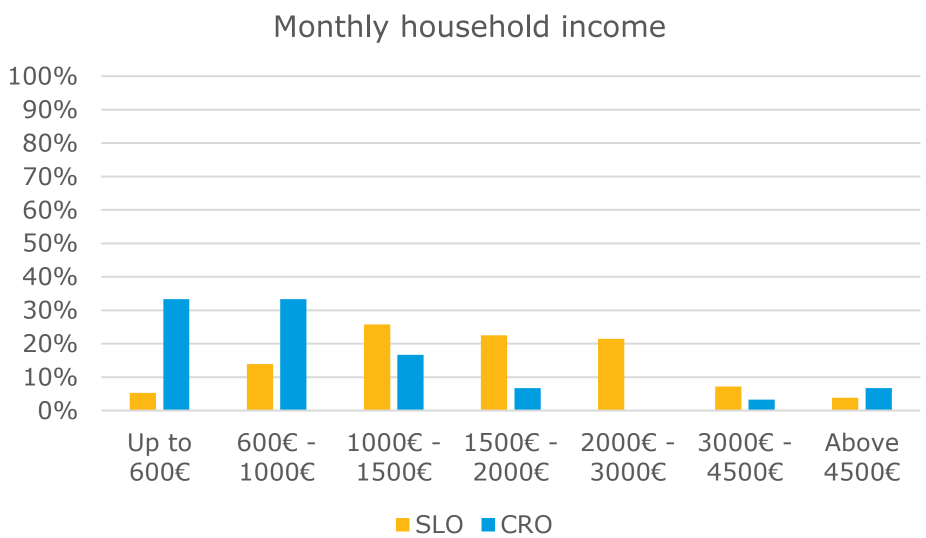


Figure 29: Survey sample by monthly household income.

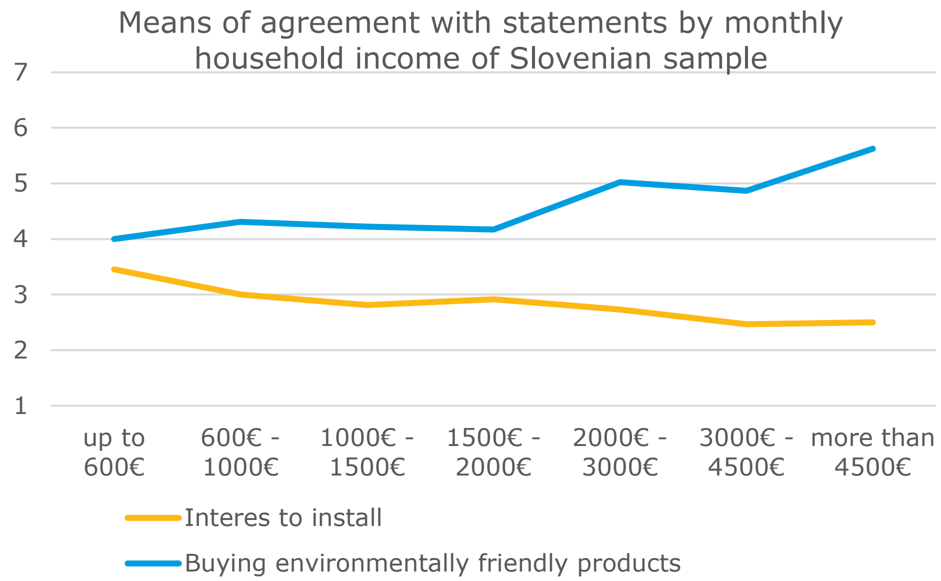


Figure 30: Means of agreement with statements by monthly household income of the Slovenian sample.

In both samples most of the respondents were the (co)owners or lived together with the owner of the place where they live (100% of Croatian respondents and 83,1% of Slovenian respondents). The average household size in both samples was between 3 and 4 people. Most of Slovenian respondents live in apartment buildings (31%) or multifamily houses (31%), while most Croatian respondents live in single-family houses (67%). In the Slovenian sample this share is 25%. There are statistically significant differences in level of interest to install solar between those living in apartment buildings and those in single-family houses. Single-family dwellers are more interested than apartment building dwellers. As mentioned before, difficulties of getting unanimous agreement on development in apartment buildings was frequently given in open ended comments.

In both samples most people were employed in the tertiary sector (30% in Slovenia, 39% in Croatia) followed by quaternary sector (23% in Slovenia, 24% in Croatia) or retired (19% in Slovenia, 24% Croatia). 65% of Croatian respondents also reported secondary income from tourism, which is expected given that the sample was gathered through the Starigrad Tourism Board. Most Slovenians (88%) do not receive secondary income.

Synthesis of stakeholders' views

Despite different physical and administrative specificities of the pilot municipalities, the shortcomings of integrated solar energy systems development seem to be similar. While both municipalities show high interest in it and believe it is strategically important, a systematic approach to planning integrated solar power systems is lacking. This is mainly due to the lack of administrative capacities. As a consequence, both municipalities leave the project initiative to other stakeholders; non-government institutions and market actors. This lack of active role and strategic planning of solar power systems is further reinforced by general weak knowledge on, and awareness of the solar power benefits by the public. However, high levels of expressed interest to install such systems by the public points to a great potential for development, one that is already being realized in Slovenia. Looking at the macro-level of the whole integrated solar power ecosystem, most of the elements to foster a successful solar transition (e.g. interest, providers, incentives, know-how etc.) are already present, however they are not adequately connected. The solar systems technology providers are apt in developing products and solutions, such as tools for investment calculation, to facilitate decision making for their clients. There are several funding schemes in place to encourage investments, albeit they might need more explicit focus on solar and less paperwork to attract interest, a better outreach and support effort would also help. On the other hand, the development agencies possess the knowledge and skills to offer advice to a broad spectre of interested parties, from public to private and are willing to help if the interest would be more proactive.

In addition to these general observations, some specifics emerged following the engagement process and analysis. Even though municipalities in Slovenia do not enforce or promote use of solar energy, the demand for small integrated solar energy systems in the country is rising. The main barrier to sustaining the levels of interest are grid capacities and uncertainties about future legislation. In Croatia, the main reported issue is inability of people in the Starigrad to carry the initial investment of integrated solar energy system as subsidies are paid in the form of reimbursements. Furthermore, in Slovenia most of municipality owned housing stock was energy-renovated in the past years, missing the opportunity to also equip some buildings with solar energy systems. While in Starigrad this opportunity remains open, the lack of buildings adequate for rooftop installations limits its possible effectiveness. Thus, in both pilot municipalities private (family) housing stock and small to medium businesses seem appropriate areas of focus, alongside large parking lots in Koper. While such areas cannot be developed directly by the municipality, they represent a "common ground" for incentives, consultations, initiation of projects or promotions. All this would be possible, if municipalities and other stakeholders would be properly equipped with tools and associated data as well as have adequate human resources, as exemplified by the Port of Koper case. A stakeholder that would perform the above tasks and services would also facilitate solving the issue of acquiring a unanimous agreement when installing solar energy systems on apartment buildings, which was often expressed as a hinderance in the Slovenian survey.

These findings are summarized by the five key concepts below.

Table 23: Summarized views of the stakeholders.

Interest	General high interest in integrated solar energy systems of all stakeholders.
Effort	Occasional participation of municipalities in solar related projects, otherwise low. Development agencies put a lot of effort into preparation of policies and consultations. Private investors are generally interested but administrative and knowledge barriers hinder action.

Role and power	Municipalities do not leverage their role of managing local communities, although they have the power to do so. Development agencies play a decisive role by providing knowledge but have little decision-making power.
Barriers	Understaffed and under skilled municipalities. Lack of knowledge and awareness in the public. Complex administrative procedure, especially in apartment buildings, and inappropriate funding dynamics.
Opportunities	More should be done across all (public) stakeholders for promotion. Platforms for informing, raising awareness and connecting stakeholders. Using existing good practice examples for promotion of the technology and tools (e.g., Port of Koper)

Several implications can be drawn from the stakeholder engagement process that will inform further development of the Solar Adria project. The aims of this project seem to well address the main issues exposed by the stakeholder engagement process. The core tool to be developed – the match-making portal – is indeed aimed at resolving the main issue found throughout the interviews, which is lack of connection between different stakeholders. We additionally revealed that the tools should have a strong informational and promotional role. This will be partially addressed through municipality-wide mapping of solar energy potential, which could be additionally equipped with provisional economic calculations. Further, the pilot projects in each municipality will serve as a capacity building examples for the municipal administration. As longevity and promotion of the tool ate paramount to its success, we will encourage the municipalities and development agencies to actively back the platform as a carrier of its promotion.

Solar insulation studies which we aim to develop in the next phase should be easily accessible online and presented through clear, laymen terms for the wider public to understand. Besides the solar energy potential, the map must be equipped with known and possible restrictions in each municipality. Grid capacity or limitations would also greatly benefit planning development if such data can be obtained, as it can serve to quickly identify problematic areas.

The process from deciding to invest into integrated solar energy system to its realization should be diagrammatically outlined step-by-step and accompanied with price ranges and possible sources or models of financing. There should be some indication of what the basic technical requirements are to make installation of solar power plant possible (e.g., appropriate roof structure, free grid capacities) for investors to understand what need to be checked and better anticipate possible difficulties. Additionally, a register of solar technology providers could be established to facilitate acting on information from the insulation potential maps. Potential areas for integrated solar energy systems should be extended to parking lots, where applicable. Possible impacts (negative and positive) of such installations should be clearly presented. This content should be easily available online as well as possibly included in the workshops aimed at presenting the project's tools and results.

Conclusion

In the first technical report we provided a basic description of the two pilot municipalities' context and surveyed stakeholders involved with solar power development. While the context comparison shows plenty geographic and administrative differences between the pilot municipalities, the stakeholder engagement process provided more similarities than differences when it comes to the scope and focus of this research. While Slovenia has seen a quick spread of integrated solar power plants, which are the focus of this project, Croatia prioritised larger ground-mounted systems. What is especially important for continuation of the project is the finding that in both municipalities there is a growing interest to (further) develop integrated solar power across all stakeholder segments. The interest is not only for the roof development but also for development on parking lots, especially in Koper which has extensive parking areas. In line with the novel legislation that facilitates creation of energy communities, currently being adopted in both countries, the project seems timely and important as it provides some crucial support tools and mechanisms to enable further development of the solar market.

The following stages of SOLAR ADRIA project will attempt to leverage the opportunities and overcome barriers we found in this first analysis. We will use the findings to develop useful and helpful tools, targeted specifically at municipalities and citizens. What became clear in the analysis is that these tools must have a significant informational and promotional role to spread awareness about solar energy benefits. In addition, they must address possible administrative hurdles and technical limitations to make the process of investing into the technology as predictable and manageable as possible.

To reach the above, we will expand the scope of mapping solar energy potential in Koper (Work package 2) also to parking areas and seek cooperation with the grid operator to fit the map with areas of limited grid capacity. Activities in Work package 3, which are mostly targeted at the economic aspects, will also expanded to include administrative and technical aspects, and present the whole procedure. Based on the stakeholder findings the workshop in Work package 3 is also an important aspect that will seek to better connect stakeholders and share knowledge and experience. Its invitation should also be extended to cultural heritage and nature protection agencies, as both have important roles in the pilot municipalities. The findings also have direct implications for Work package 4, responsible for dissemination, as it directly dictates which content should be included in the website and "How to" guide (e.g., information on procedure of installing integrated solar power plant, benefits and impacts of parking lot solar power plants, possible sources of incentives etc.). This work package will additionally seek support from the pilot municipalities or development/energy agencies to inherit the developed tools and keep them available to their citizens after the project ends.

In conclusion, stakeholder engagement and baseline context review support most of the starting points and assumptions of the SOLAR ADRIA project team detailed in the proposal. Several aspects, such as level of knowledge of the public and most pressing barriers identified by municipalities, further clarify where the proposed tools should be targeted and how they should be designed. This report will now serve as one of the main inputs to next Work packages that will use this knowledge to advance solar energy development in pilot municipalities of the Adriatic region.

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APPENDIX 1: Interview questionnaires

Decision-makers

Concept	Questions
Interest	How do you see the current and potential role of solar power plants in the municipality/county/region?
	What is the significance of SPP development for the municipality/county/region – indicate potential benefits and drawbacks, if any?
	How would you rate the potential for solar energy development in the municipality/county/region?
	Do you think development should be accelerated? How?
Effort	How do you promote use of renewable energy, especially solar, in the municipality/county/region?
	What kind of tools are used for the promotion?
	Are there any good practices that were developed in the past year? What makes them a good example?
	Do you have a strategy for funding solar or other forms of incentives?
	Do you apply for incentives, subsidies?
	Do you offer incentives/subsidies to citizens or companies?
	How do you see the role of public-private partnerships (PPP)?
Role and power	What are the plans on the field of solar energy by the municipality/county? How much are you dependent on county/state influence (decisions, plans, procedures)? In what way?
	What measures does the municipality/county take to increase the implementation of solar?
	Does the municipality/county restrict development in any way?
	Have you received any inquiries from companies regarded sites for SE development on municipality owned/managed land and buildings?
Barriers	What hinders the development (what did so far, is this expected also in the future and do you expect some new barriers to emerge)?
	How can we address these barriers and who has power to do so?
	What do you think is the public perception of solar in the municipality?
	Which incentives/subsidies do you know of (local, regional, national, EU)?
	Do you have enough man-power to apply for funding?
Opportunities	What should be done to accelerate the development of solar?
	What kind of tools would you need to better aid the interested citizens or developers?
	Where do you see solar could be developed in the future?
	Where in the city do you see a good potential for PVs?

Investors

Concept	Question
Experience / effort	Did you finish / are you building a solar power plant?
	What kind is it? (roof, parking, size/power)
	Why did you decide to set-up the solar power plant?
	Will you be selling the power or using for your own needs?
	How did you fund the investment?
	How would you comment the current state/county/municipal support and incentives for solar?
Barriers	What problems did you face/are facing during the project?
	What are the main concerns you have related to implementation of solar projects?
	Have you noticed any stereotypes when building (by municipality, by the public, by technology providers)? Any opposition?
	What administrative barriers did you have when implementing solar projects?
	Are municipalities open to PPPs? Are you open to PPPs? Would you start one? Why not?
	Where do you see main value of the solar power plants?
Opportunities	What do you believe should be done to ease the process and accelerate development of solar projects?
	Will you be investing / building another one? Why?
	Do you think that projects, like yours, have a large potential in the coastal municipalities?

Solar industry

Concept	Question
Experience / effort	How would you describe the current state of solar market in the region/county? Is the demand rising or falling?
	What kind of projects are most interesting to investors?
	How would you comment the current state/county/municipal support and incentives for solar?
	How do you select preferable sites for solar development- what is your procedure and main conditions to start with?
Interest	Looking at pilot municipality, do you see potential for SPP development? Why yes or not?
	What conditions would you prefer to have there in place to engage in the SPP development (that are currently not in place)?
Barriers	What does deter investments into more solar projects?
	What are the main concerns investors or clients have related to solar projects?
	What kind of stereotypes are still pervasive among the public?
	What administrative barriers do you see in implementing solar projects?
	Are municipalities open to PPPs?
	Are you open to PPPs? Why not/where do you see its main value?
Opportunities	What do you believe should be done to accelerate development of solar projects?
	What would increase demand?
	What kind of projects do you think have the most potential in the future in the coastal area?

APPENDIX 2: Public opinion survey questionnaire

Please use the below scales to rate your knowledge about technical aspects of roof solar power plants and (legal) procedure to install it.

	None– 1	2	3	4	5	6	Excellent–7
Technical knowledge							
Knowledge about process to install							

Please use the below scale to rate your experience with roof solar power plants. Here, experience is meant as any form of previous interaction with solar power plants be it as your own investment or installation, at your place of work or other.

No experience – 1	2	3	4	A lot of experience– 5

How interested are you in installing solar power on the roof of the place you live in?

I already installed solar power plant.
I am very interested.
I am partially interested.
I am not interested at all.
Other:

How do the following factors impact your interest for installing solar power plant?

	Decreases my interest – 1	2	3	4	Increases my interest – 5
Ownership of the property.					
Knowledge about solar power and/or procedure to install it.					
Financial investment					
Aesthetics of the building					
Need for self-sufficiency					
Other:					

Please rate on the scale below how much you agree or disagree with the following statements:

	Do not agree at all – 1	2	3	4	5	6	Completely agree – 7
Public policies should encourage use of solar energy.							

The state should subsidize use of solar energy.							
In the municipality where you live, more buildings should use solar energy on rooftops.							
In the municipality where you live, parking lots are a good place to install solar power plants.							
In the municipality where I live, more ground-mounted solar power plants should be installed on greenfields.							
Installing roof solar power plants require a large financial investment.							
More solar power plants would reduce electricity costs for the final consumer.							
Solar power plants are cost effective.							
Solar power plants contribute to environmental protection.							
Solar power plants are a health hazard.							
Installing solar power plant on roof requires a lot of paperwork.							
The [national] coastal area has a good solar potential.							
Rooftop solar power raises property value.							
Rooftop solar power requires a lot of maintenance.							

Please rate on the scale below how much you agree or disagree with the following statements:

	Do not agree at all – 1	2	3	4	5	6	Completely agree – 7
If there would be an opportunity, I would invest in a municipal solar power plant to reduce my electricity bill.							
If given the opportunity, I would like to invest into solar power plant on my roof to cover my own energy needs.							
If given the opportunity, I would like to invest into solar power plant on my roof to contribute to surrounding community's energy needs.							
If given the opportunity, I would like to invest into solar power plant on my roof to sell the energy to the grid.							
If someone wanted to rent the roof of the building where I reside to install solar power plant, I would agree to it.							
When buying products, I choose the ones that I think have smaller environmental impact, even if that means they are more expensive.							

Are there any other opinions about solar power plants you would like to express that we did not ask about? If so, please write your comment in the box below.

We would like to get to know more about experiences with installing solar power plants of those that already did so. If you own or rent your roof for solar power plant and would like to participate in an interview about it, please write your email below and we will contact you about it:

What is the highest level of education you achieved?

(Un)finished primary school
Trade/technical/vocational school
High school
University degree (Bologna bachelor's or master's degree)
Master’s or Doctorate degree (scientific)

What is your gender?

Female
Male

What year were you born in?

What is the average net monthly income of your household?

Up to 600€
600€ - 1000€
1000€ - 1500€
1500€ - 2000€
2000€ - 3000€
3000€ - 4500€
Above 4500€
I don’t wish to answer

How many people live in your household?

1
2
3
4
5
More than 5

Do you own the place where you live?

Yes, I (co)own the place,
No, but another member of my household is the owner.
No, I rent the place.

What kind of place do you live in?

Apartment block
Multifamily house (up to 3 families in a single house)
Row house
Single family house
Other:

Which of the below sectors are you employed in?

Unemployed
Pupil or student
Retired
Primary sector (agriculture, forestry, fishery, mining, …)
Secondary sector (industry, construction, …)
Tertiary sector (services, transport, tourism, commerce, …)
Quaternary sector (education, healthcare, science, public sector, culture, …)

Which of the below secondary sources of income, if any, do you have? [multiple answers]

Agriculture
Tourism (renting accommodation)
Tourism (offering services)
Fishery
Food and beverage services
None
Other: