DELIVERABLE D.T2.2.5

Split and Dalmatia Energy Report *Version n°0.1/2019*

D.T2.2.5: Split and Dalmatia Energy Report

A.T2.2 State of the art regional report drafting

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Table of contents

1. EXECUTIVE SUMMARY

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

The population of Split-Dalmatia county is 454.798 and represents ~10% of population in the Republic of Croatia, however, marks a negative trend in number of inhabitants in the past years following the population decline trends in the Republic of Croatia. in The County, the average size of a household is 3,00 while the population density is higher than the national average, accordingly 100,2 inhabitants per km^2. According to the 2011 Census of Population, 77% of the total population lives in 16 county's cities, while the other 23% are settled in 39 county's municipalities. In the County capital Split lives 39,16% of the county's population.

The share of the regional economy in the national GDP is around 8,4% according to the Croatian Bureau of Statistics. With regard to the intra-regional development which directly followed the national, after the decrease trend till 2012, an increase trend has been registered in the time span from 2013 to 2016.

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

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

As far as surface area coverage is considered, rail transport is not the common type of transport within the Split-Dalmatia county although the County has the biggest road network in the Republic of Croatia. The Split Airport is the second busiest airport by passenger traffic in the Republic of Croatia. The number of total passengers increased by almost two million from 2010, largely due to significant increase in tourism. Regarding maritime liner transport, ferries, liner transport lines, high-speed lines navigate seasonally and through the entire year in Split-Dalmatia county. The city of Split has two seaports: city port on the south (passenger-ferry port) and north port (commercial port). Moreover, under Harbour Master's Office of Split there are 15 harbours. The 2nd most visited seaport was Split with 104 visits from January to June 2019. Out of a total of 272 journeys of foreign vessels on cruise the Split-Dalmatia County has a share of (25,3%).

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

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

In terms of prices, electricity prices for households, in Croatia, are far more volatile than the prices for natural gas. There is currently an increasing trend in gas prices, with 37,5 €/MWh in the first semester of 2019. On the other hand, electricity prices (including taxes and levies) have been fluctuating ± 14 € around the average value of 129,8 €/MWh, while are currently around ~132 €/MWh in 2018 with a slight expected increasing trend. Likewise, mostly because of taxes and levies, prices levels for natural gas and electricity in the industrial sector are remarkably lower than in the residential one. The wholesale price for electricity is currently around 60 €/MWh (reaching peaks of 115 €/MWh during the intra-day market).

Considering that official energy balances for a NUTS 3 region are not existent, the regional energy demand has been calculated based on the Energy Efficiency Action Plan for 2016 developed by EIHP in 2015. The total amount is ~5.607 GWh. The share of the regional consumption is 7% of the total national final consumption. The largest share is accounted for by crude oil and petroleum products, followed by electricity while minor shares are accounted for renewable energies, gas and derived heat. The share of renewables in the total final consumption is 11% and mainly covered by the residential sector, mainly due to use of wood for heating purposes since there are not district heating systems in Split-Dalmatia county.

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

The CO_2 emissions in Split-Dalmatia are estimated at 1,2 million tons per year, whit the share of 8% in the national. As expected, the major share of regional emissions is derived from transport (59%), followed by residential (15%) and service (14%) while the industry represents solely 8%.

2. INTRODUCTION

The Split-Dalmatia county is the pilot region in the Republic of Croatia participating in PROSPECT2030 activities implementation.

According to the main criteria (population size) the entire territory of the Republic of Croatia represents NUTS level 1, while existing counties such as the Split-Dalmatian county are categorized with NUTS level 3. It is important to point out that there are no administrative territorial units that correspond to NUTS level 2, which is the main framework for the implementation of regional policy and the analysis of regional problems (1). Since the Split-Dalmatia County is a NUTS 3 region, data on regional level delivered to EUROSTAT are limited.

For purposes of D.T2.2.5 Split and Dalmatia Energy Report publicly available data from EUROSTAT, Croatian Bureau of Statistics, National Energy Balances, Energy Efficiency Action Plan for 2016 developed by EIHP, Split-Dalmatia County, Croatian Agency for Liner Maritime Transport, Ministry for Internal Affairs and Ministry of Public Administration have been used. Collected data has been analysed trough an Excel file provided by the WP 2 leader European Center for Renewable Energy Güssing Ltd. (EEE) and accordingly reviewed.

3. General description of the region

3.1. Geographical situation

The Split-Dalmatia county is the largest Croatian county, geographically located in the southern part of the country and in the central part of the Adriatic coast. The Split-Dalmatia county is speeding between Vrlika in the north to the furthermost Croatian island of Palagruža in the south, thus from Marina in the west to Vrgorac in the east (Figure 1).

The Split-Dalmatia county is covered by land and sea with a total area of 14.106,40 km^2, according to the County Department for Physical Planning[1]. The land and islands are covering 4.540,0 km^2 (~32% of total area) while the remaining 68% is represented by the sea.

Table 1 Area for Split-Dalmatia County [source (2)]

	Republic of Croatia	**Split-Dalmatia County**
Area (km²)	56.594,0[2]	4.540,0[2]

As shown in Figure 1, most of the land area consists of the hinterland (59,88%) following with the coastal area (21%), while the islands make up a lower proportion of the land surface area (19%)[1].

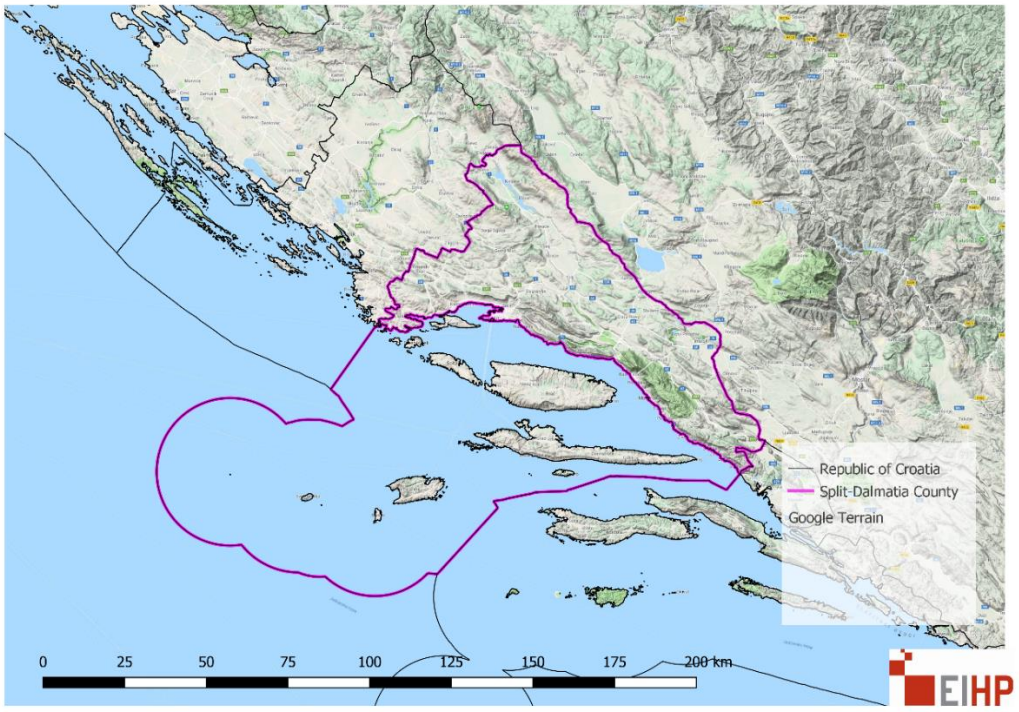


Figure 1 Split-Dalmatia County land and sea boarders on Google Terrain

[1] Data from County Department for Physical Planning, Physical Planning, Book 3, Split, 2002.

[2] Data of the Surveying and Mapping Authority of the Republic of Croatia (calculated from the graphical database of the official records of territorial units), situation as on 31 December 2002, refer to the land area.

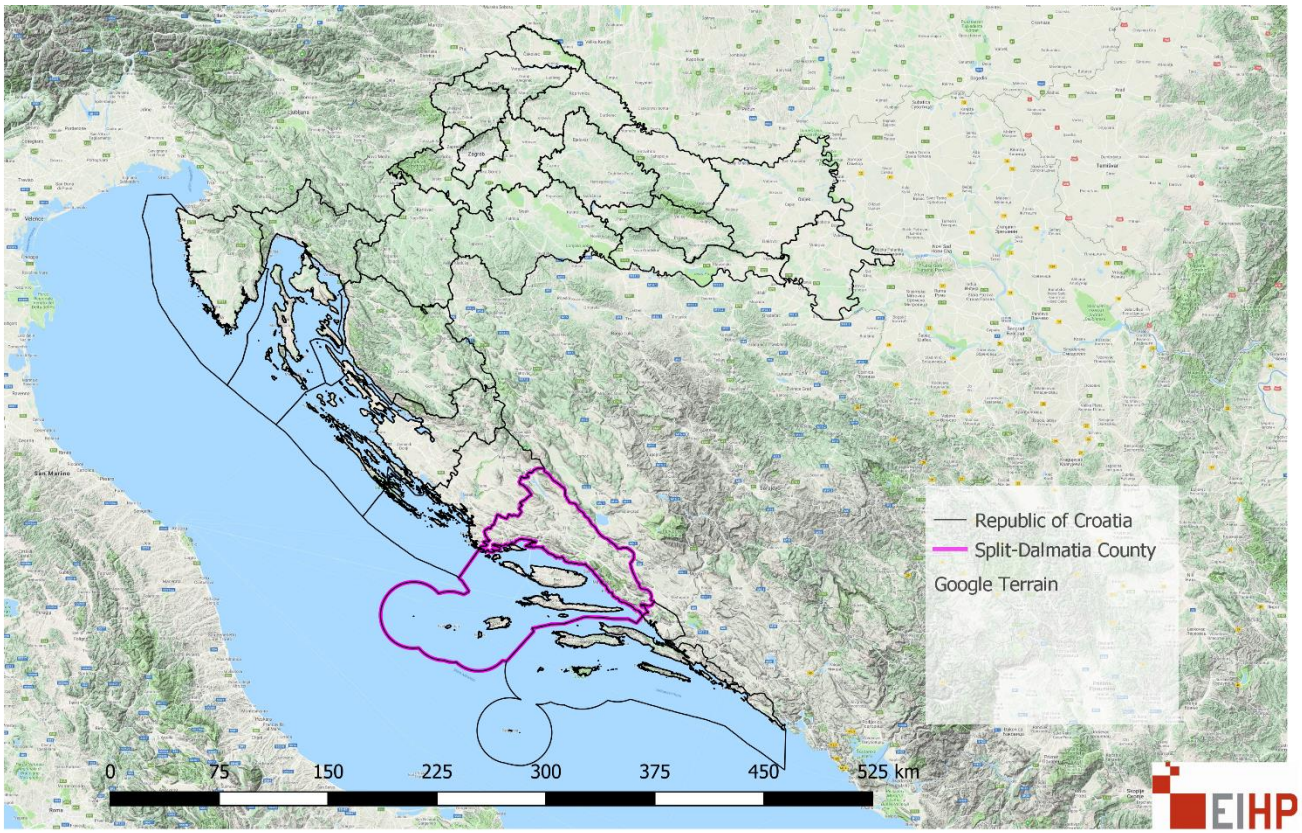


Figure 2 Split-Dalmatia County geographical position on Google Terrain (Zoom-out)

Split-Dalmatia county borders on the north with the Republic of Bosnia and Herzegovina, on west with Šibenik-Knin County and on the east with Dubrovnik-Neretva County and extending south to the border of Croatian territorial waters (Figure 2).

The hinterland, in the continental part of the County, is crisscrossed by mountains that run parallel to the coastline, while the coastal area makes a narrow strip along the coast between the mountain ranges and the sea (Figure 3).

The island area of the County is made up of 74 islands and 57 islets and reefs. The largest ones are the most populated, such as Čiovo, Šolta, Brač, Hvar and Vis, and only additional 6 are inhabited (Veli Drvenik, Mali Drvenik, St. Clement, Šćedro, Biševo and St. Andrew) (3).

The largest island in Split-Dalmatia county is Brač with a surface area of 395.57 km^2, the largest County's lake is Peruća with a surface area of 13 km^2 and the Cetina river is the longest in the County with a length of 101 km. The highest peak in the County is 1762 m while the highest Croatian peak is the Dinara with a height of 1830 m.

Geomorphologically, the County's terrain composition is dominated by karst and limestone, with numerous karst forms with karst fields as the main phenomenon. Atmospheric and inaugural effects resulted in the appearance of abrasion, denudation, accumulation, sliding, subsidence, and erosion. In terms of mineral resources, stone, cement marl, clay, gypsum, gravel, sand, dolomite are used.

In terms of hydrogeology and water resources, karst fields are highlighted in the coastal area as catchment areas, but from which water is drained by underground flows. On the coast, except for surface water flows (Cetina, Jadro and Žrnovnica rivers), there are larger inflows of groundwater from the karst coast (ie. the

Vrlika and Matica sinkholes in Imotski respectively Vrgorac fields). There are no surface waters on the islands, groundwater is modest and often mixed with salt water (4).

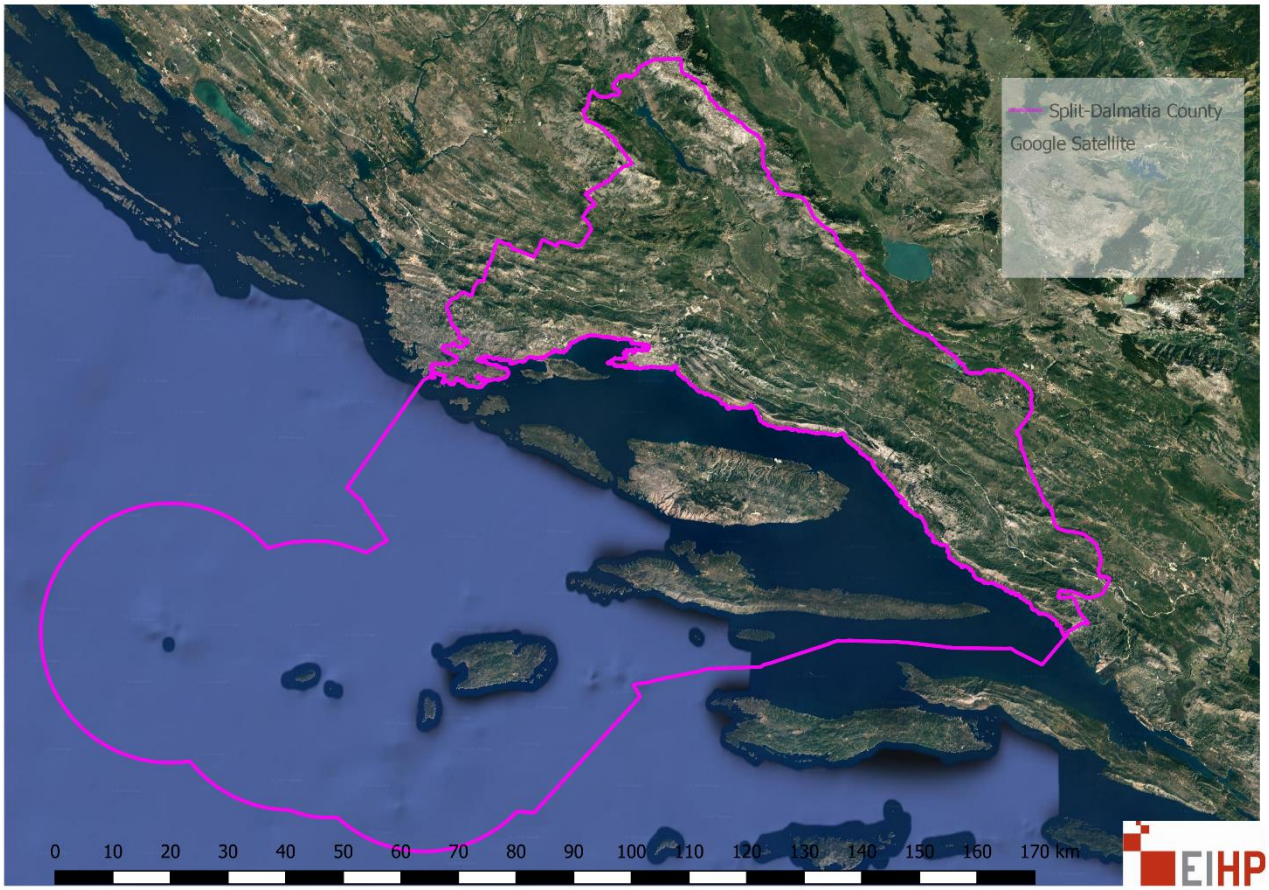


Figure 3 Split-Dalmatia county geographical position on Google Satellite 2019 (Zoom-in)

The County is located in the area of the Adriatic type of Mediterranean climate whose basic characteristics are dry and hot summers and mild and humid winters. When moving from island, coastal to hinterland area the average annual temperatures are falling, and the rainfall increases. The climate on the island area is warm with plenty of sunshine characterized by temperatures that rarely fall below zero and low precipitations. On the contrary, in the hinterland the temperatures often fall below zero during autumn and winter months and significant rainfalls are recorded. The coastal climate is characterized by maximum rainfall in the cold season and hot and dry summers.

The temperatures in the coldest month ranges between -3°C and +18°C while the average temperature of the hottest month is greater than +22°C. Dominant winds are “bura” and “jugo”, with a frequency of 33 to 55% annually. The Adriatic Sea, as a natural reservoir of relatively warm water (with a temperature from 10 to 26°C), is the most important indicator for climate characteristics in the wider area of the County (5).

3.2. Demographic structure and development

According to the data from Census of Population, Households and Dwellings from 2011, the population of Split-Dalmatia county is 454.798, and represents ~10% of population in the Republic of Croatia.

Table 2 Population and settlement data for Split-Dalmatia county [source (2)]]

Settlement structure	National	Regional
Population (thousands)	4.284,9[3]	454,8[3]
Number of cities/towns (total)	128	16
Number of municipalities (total)	428	39
Number of settlements (total)	6.771	379
100.000 to < 500.000	/	1
10.000 to < 50.000	/	7
5.000 to < 10.000	/	5
1.000 to < 5.000	/	34
< 1.000	/	8

The Split-Dalmatia county marks negative trends in number of inhabitants from 2014 till 2018, -0,34% annually according to the Croatian Bureau of Statistics yearly assessments delivered to EUROSTAT. These trends follow the population decline trends in the Republic of Croatia shown in Figure 5.

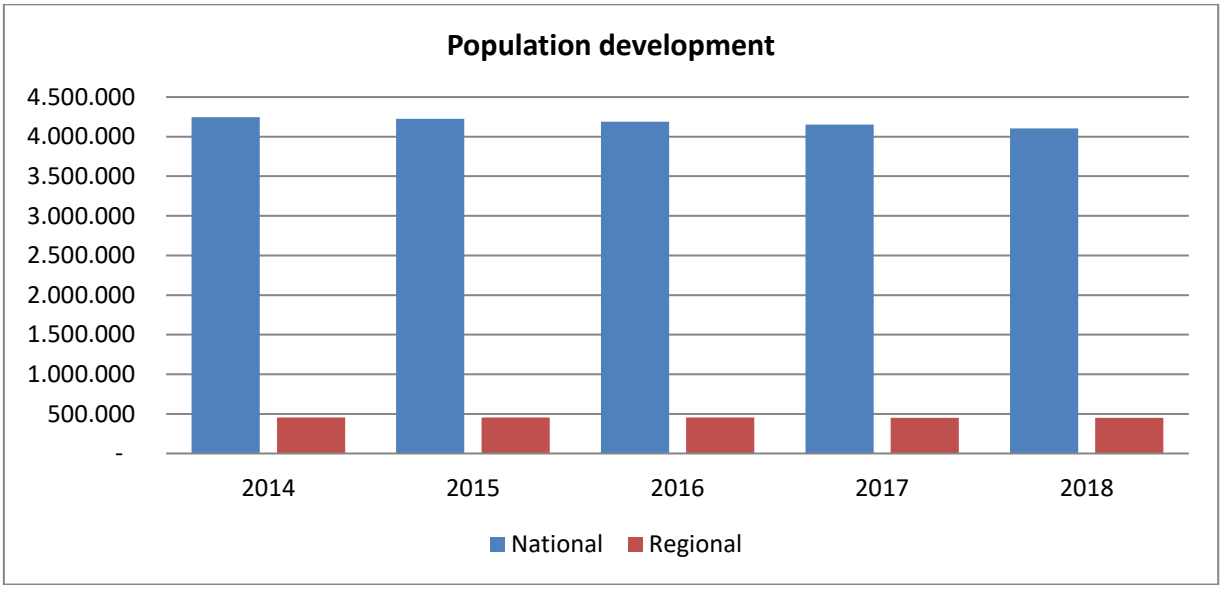


Figure 4 National and regional population development [source: (6)]

[3] Population number taken over from the 2011 Census of Population

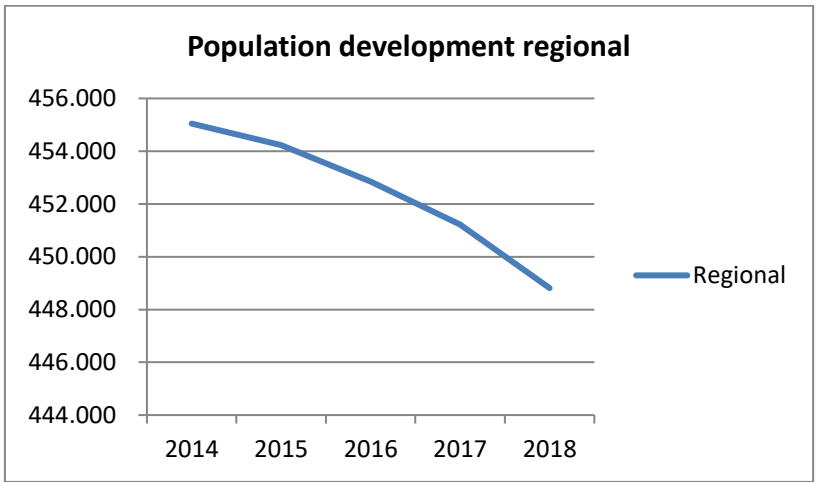


Figure 5 Regional population development [source: (6)]

According to the Census data, the average size of a household is greater than the national average (3,00 compared to the national od 2,80 in 2011) even though it follows the national decreasing trend (from 3,21 in 2011 to 3,00 in 2011) as shown in Figure 6.

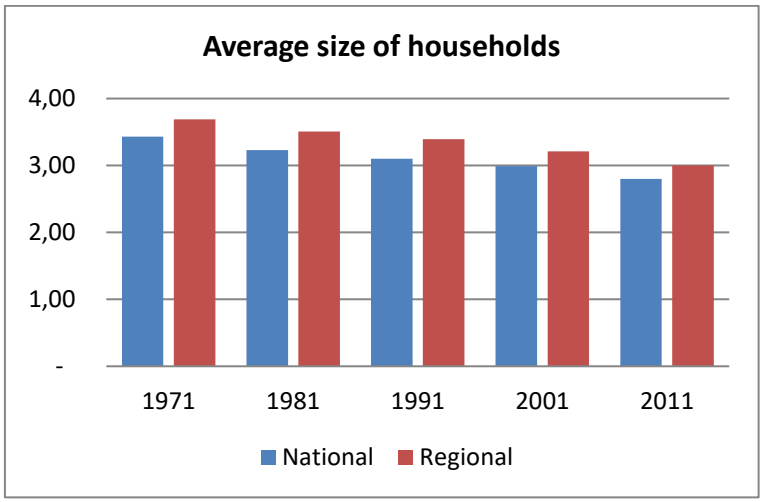


Figure 6 Avarage size of housholds [source: Croatian Bureau of Statistics]

The population density in the Split-Dalmatia county is higher than the national average, accordingly 100,2 inhabitants per km^2 compared to 75,7 on the national level. However, the population is not homogenously distributed through the entire County: the continental part or hinterland and islands are sparsely populated while coastal area is highly urbanized.

Islands such as Čiovo, Šolta, Brač, Hvar and Vis are the most populated, while solely additional 6 are inhabited (Veli Drvenik, Mali Drvenik, St. Clement, Šćedro, Biševo and St. Andrew) (3).

According to the 2011 Census of Population, 77% of the total population lives in 16 county's cities, while the other 23% are settled in 39 county's municipalities. In Split lives 39,16% of the county's population, followed by the town of Kaštela with 8,5%, Sinj 5,46% and Solin 5,26%. The smallest administratively categorized city is Vrlika with solely 2.177 inhabitants. Podstrana is the largest municipality with a population of 9.129, while the smallest with only 281 inhabitants is Zadvarje

3.3. Economy

The regional economy in this chapter is described based on three parameters:

- Gross domestic product (GDP)
- Gross value added (GVA)
- Number of employees.

The share of the regional economy in the national GDP is around 8,4% according to the Croatian Bureau of Statistics. With regard to the intra-regional development which directly followed the national (*Figure 7*), after the decrease trend till 2012, an increase trend has been registered in the time span from 2013 to 2016 (Figure 8).

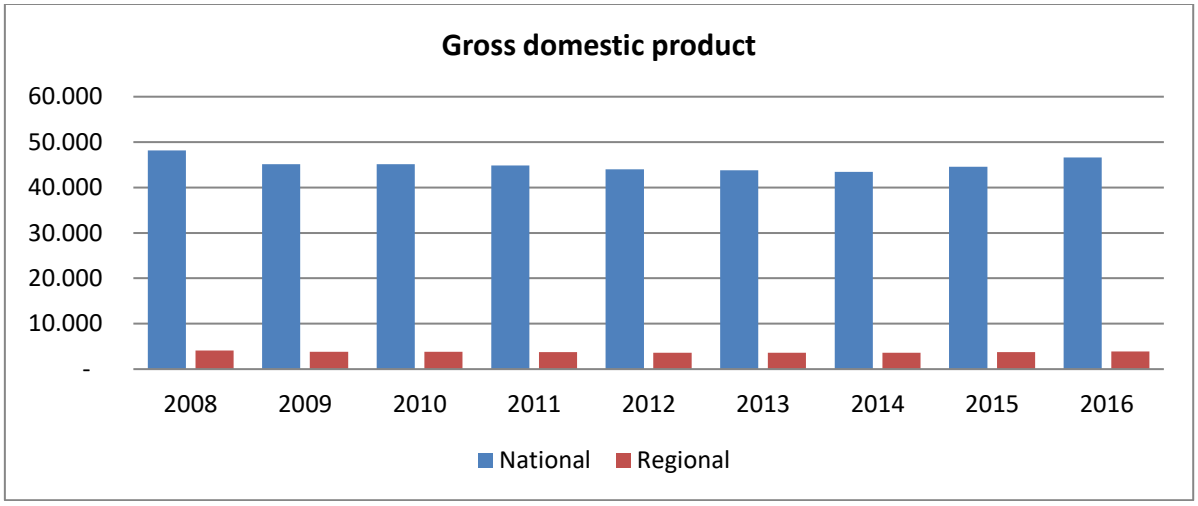


Figure 7 National and regional GDP development [source: Croatian Bureau of Statistics]

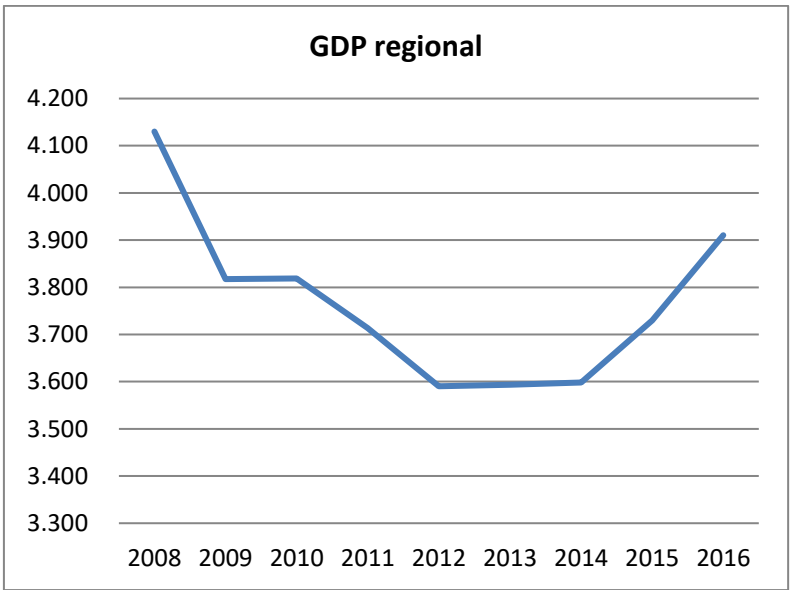


Figure 8 Regional GDP development trend [source: Croatian Bureau of Statistics]

In the Split-Dalmatia county the GDP per capita was in 8.723 € in 2016 and the absolute value was 3.910 million € (6) which is ~94% of the value in 2008.

The gross value added GVA is the measure of the value of goods and services produced in an area, industry or sector of an economy. Unlike the GDP, the GVA data is available for sectors active in the County (6). Figure 9 is giving a comparative overview of the GVA on national and regional level, with 2016 as reference year.

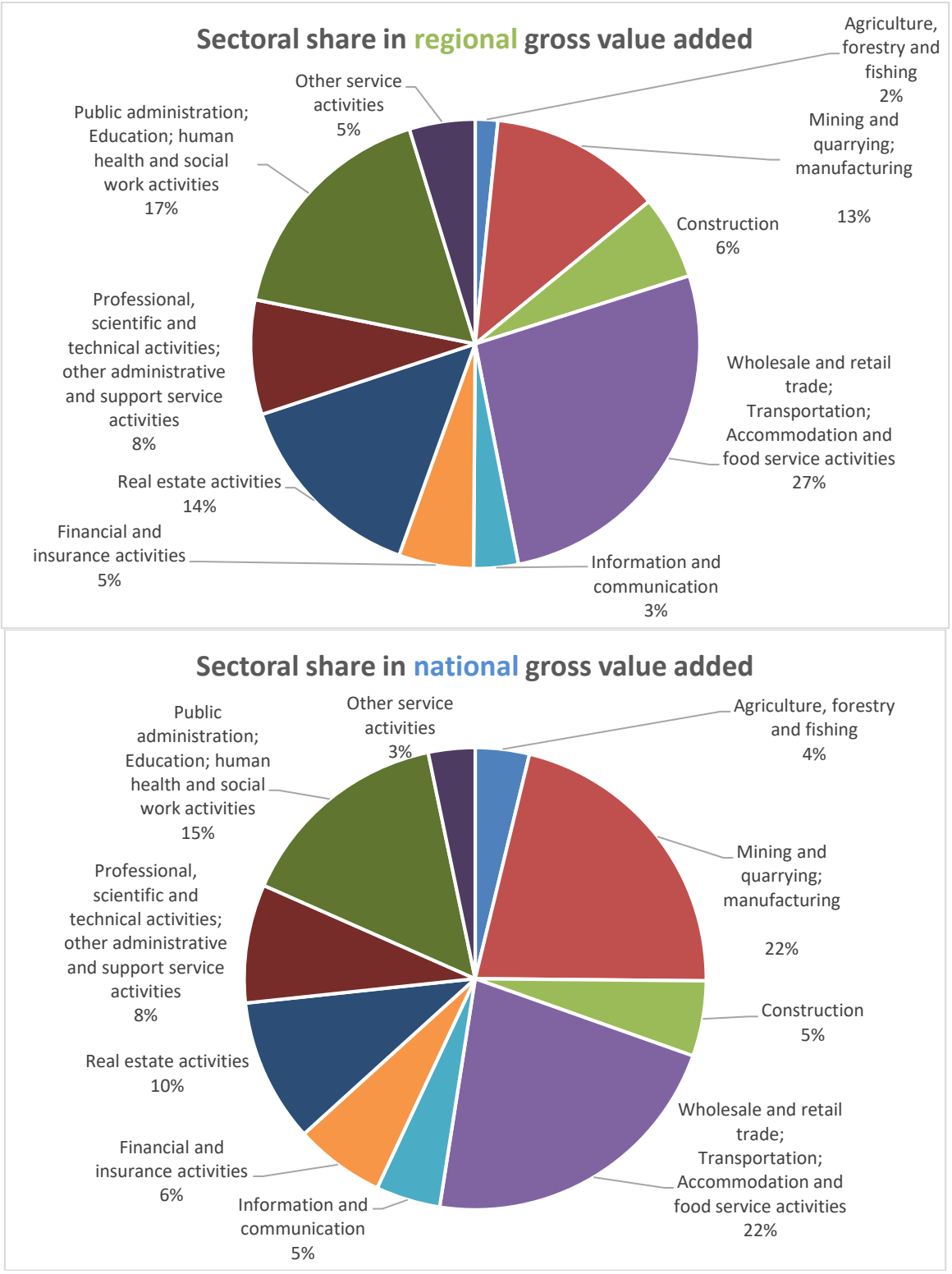


Figure 9 Comparative overview on the GVA on national and regional level [source: (6)]

As shown in Figure 9, there is a slightly major portion in GVA of "Wholesale and retail trade, Transportation, Accommodation and food service activities" on a regional level (27%) compared to the national (22%) while the industry is undoubtedly less present regionally (22% on the national level compared to 13% in the county). Moreover, real estate activities have a more significant portion (14%) on a regional level compared to the national (10%).

These results are expected since the Split-Dalmatian county is a touristic oriented county being the 2nd in Croatia by the number of beds (239,329), following the Istria County (7). The registered overnights in Split-Dalmatia accounted for 14,881 thousand in 2016, while in 2017 reached 16,596 thousand having a split of ~19% in the national share (29,5% is the biggest share reached by Istria) (7).

The Split-Dalmatia county has 8% of share in the total national employees. The rate of employees by sector (Figure 10) is showing a similar distribution as the sectoral share in the GVA where "Services" are dominant. However, it is important to emphasize that employees numbers (8) and GVA data (6) provided by the Croatian Bureau of Statistics are differently categorized, more precisely some sectors are merged (i.e. "Wholesale and retail trade"; "Transportation"; "Accommodation and food service activities").

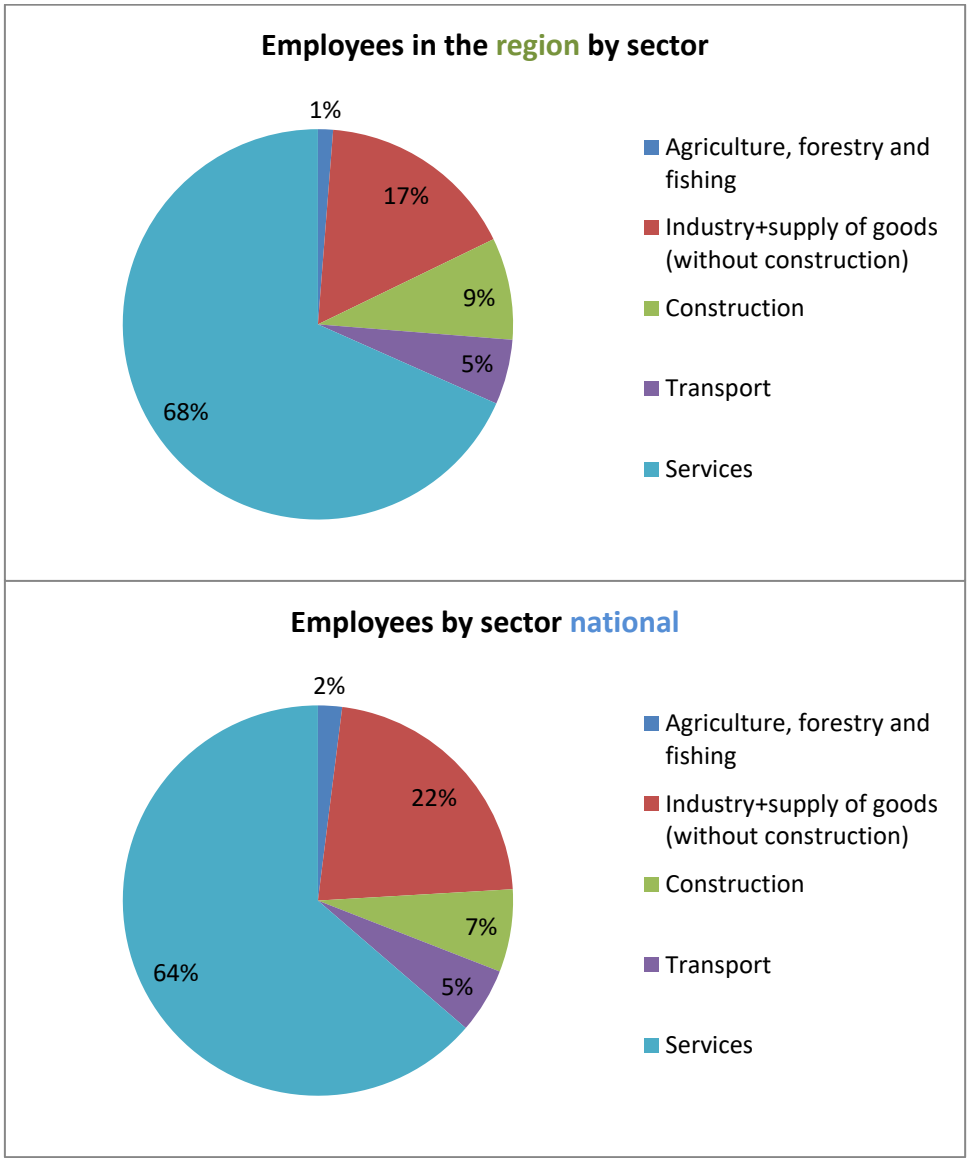


Figure 10 Comparative overview of employees by sector [source: Croatian Bureau of Statistics]

According to (9) positive trends are registered in terms of number of employees increase in almost all activities and decreasing numbers of unemployed (~16,1% less than the previous year). The average annual registered unemployment rate, as an indicator of unemployment persons in active population (employed and unemployed), at county level decreased from 17% in 2017 to 14,3% in 2018, and at the national level with 12,1% in 2017 to 9,7% in 2018. Nevertheless, the average monthly net earnings in Split-Dalmatia county are below the national average for ~12.1% (9).

The highest development index is mainly recorded by cities and islands with significant tourism revenues. The least developed units, on the other hand, are located in the hinterland, especially in the wider area of Imotski (5).

As stated in (5) besides good geostrategic position, transport connectivity, investment in education and basic infrastructure, for attracting investments purposes a stimulating the closed-by business environment, hence easiness of business for entrepreneurs are required. Thus, necessary administrative barriers should be minimized, and business service providers should be developed. A positive business factor for entrepreneurs in Split-Dalmatia is above average availability of a highly educated workforce (5).

3.4. Infrastructure

3.4.1. Energy related infrastructure

3.4.1.1. Electricity grid infrastructure

The Croatian Transmission System Operator (TSO), Hrvatski operator prijenosnog sustava d.o.o. (HOPS), is responsible for all transmission activities, including maintenance, development, construction and operation of the transmission system network and operates on 400, 220 and 110 kV levels. The Croatian electric power system is interconnected to the power systems of Bosnia and Herzegovina, Slovenia, Serbia and Hungary. Based on the situation in December 2018, the transmission grid in in the region is presented in *Figure **11*** (10). As presented, in the Split-Dalmatia all voltage levels (400, 220 and 110 kV) are operating and a major transformation substation 400/220/110 kV Konjsko is operational, hence the transmission network is directly interconnected with the Bosnia and Herzegovina transmission network.

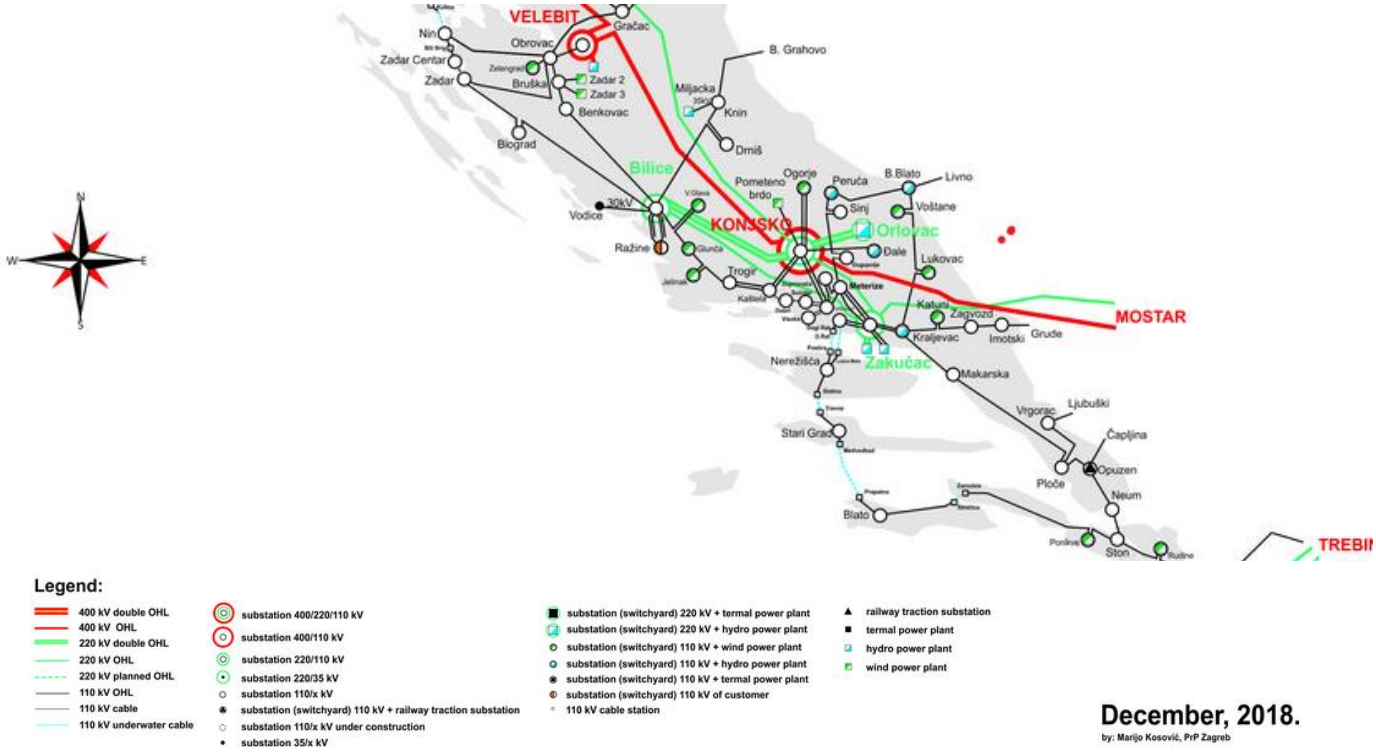


Figure 11 Electric power grid transmission system [source: Croatian TSO, HOPS (10)]

HEP operator distribucijskog sustava d.o.o. (HEP-ODS), is the single distribution system operator (DSO) and is responsible for the operation, maintenance, development and construction of the Croatian distribution system. The Croatian DSO operates on 35, 10(20) and 0,4 kV and the distribution network development for Split-Dalmatia DSO subunit from 2018 to 2028 is shown in Figure 12 (11).

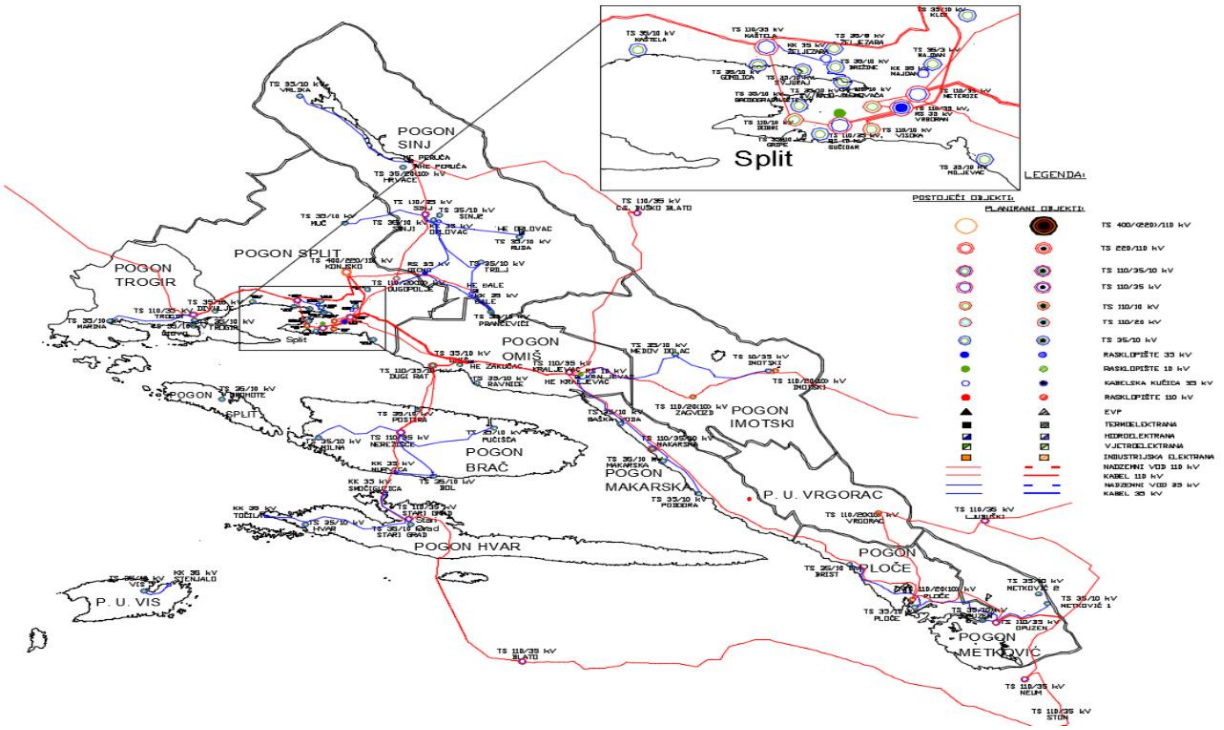


Figure 12 Distribution network 110 kV and 30(35) kV development for Elektrodalmacija Split (11)

3.4.1.2. Gas grid and district heat infrastructure

The gas grid network in 2016 of the Split-Dalmatia county is shown in Figure 13. In the Croatian Gas Supply Program 2002 – 2011, gasification of the Split-Dalmatia county is defined as one of the priority development projects. Its realization is carried out in stages and in the context of its development is part of wider Adriatic-Ionian international pipeline development.

The first phase gasification (from spring 2013) included: Cities of Split (settlements Kamen, Split, Stobrec and Zrnovnica), Solin, Kaštela and Trogir (settlements Trogir, Plano and Divulje) and parts of Municipalities Dugopolje, Klis and Seget (settlements Dugopolje, Klis, Seget Donji and Seget Vranjica) and the City of Sinj with larger settlements. The first connected users were in the commercial zone of Dugopolje in 2015. According to sources (12), more than 130 kilometers of gas distribution network in Split-Dalmatia has been built so far. The commercial zone in Dugopolje is the first zone in Dalmatia to have a fully developed gas network. At the end of 2016, a gas network was built in the centre of Dugopolje, to which Dugopolje Elementary School was connected – being the first public institution in Split-Dalmatia County to use gas. After Dugopolje, works have on the high-pressure gas pipeline towards Split have started along the EVN began work on the construction of a high-pressure gas pipeline towards Split (passing through Klis and Solin).

The current (2018) gas grid network is shown in Figure 14. The second phase of hinterland gasification is depending on the dynamics of realization of the main pipeline Dugopolje – Ploče.

On April 2019 the first three gas were connected to the gas network: KBC Split in Firule, Ravne Niva Elementary School and Kindergarten Little Prince.

Figure 13 Gas grid infrastructure in the Split-Dalmatia county (2016) [source: (12)]

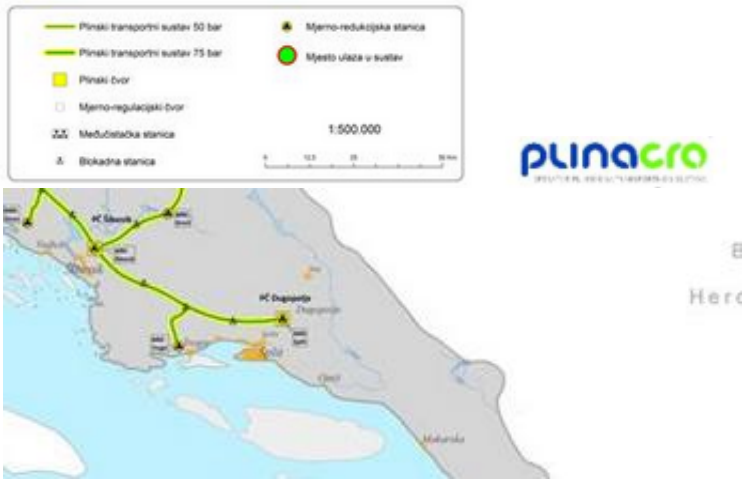


Figure 14 Gas grid infrastructure in the Split-Dalmatia county today [source: (13)]

Further then recent gas distribution network, there is no district heat infrastructure in the Split-Dalmatia county.

3.4.2. Mobility and transport related infrastructure

3.4.2.1. Rail network

As far as surface area coverage is considered, rail transport is not the common type of transport within the Split-Dalmatia county. The only municipalities connected to the town of Split are the municipalities Primorski Dolac and the Town of Kaštela, to the west of Split, continuing to the north through the counties of Šibenik-Knin and Zadar, ultimately connecting Split to Zagreb.

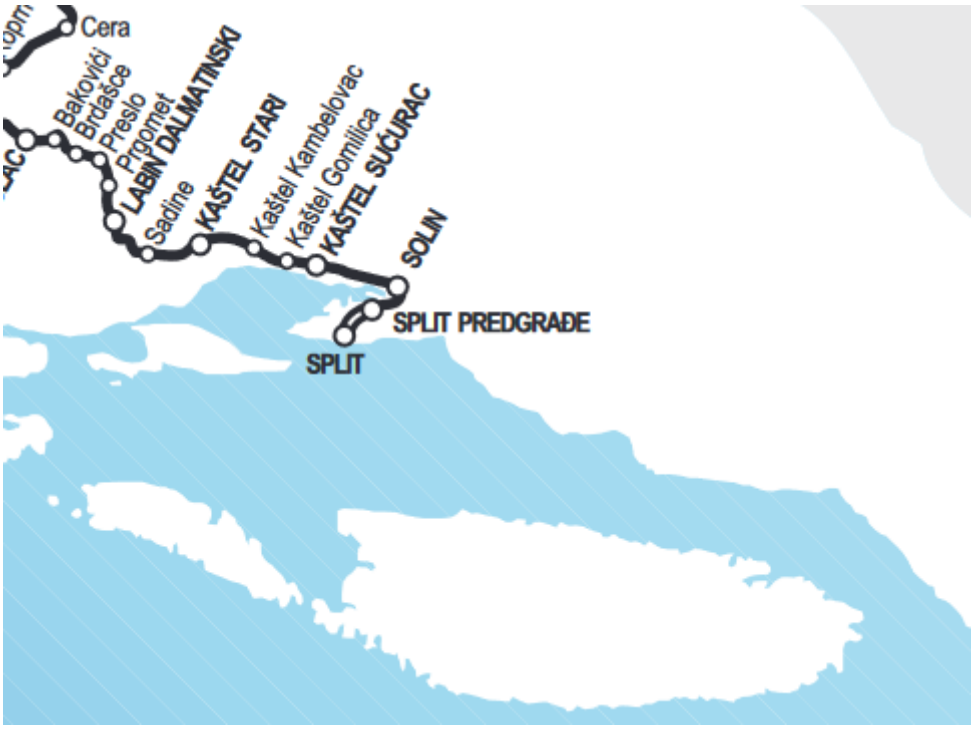


Figure 15 The railway system in Split-Dalmatia county [source: (15)]

3.4.2.2. Road network

The Split-Dalmatia county has the biggest road network in the Republic of Croatia: 122 km of motorways, 770 km of state roads and 1,749 km of county and local roads (15). The road network of the county is shown in Figure 16.

The A1 motorway passing through the Split-Dalmatia county is the longest motorway in Croatia and has the major purpose to connect Zagreb, the nation's capital, to Split (and Ploče from 2013). The motorway represents a major north–south transportation corridor in Croatia and a significant part of the Adriatic–Ionian motorway. National significance of the motorway is reflected through its positive economic impact on the cities and towns it connects as well as its importance for tourism.

Figure 16 Road network in Split-Dalmatia - blue: motorways, red: state roads, green: county roads, yellow: local roads [source: (15)]

3.4.2.3. Aviation

Split Airport is the second busiest airport by passenger traffic in the Republic of Croatia. The total passenger number in 2018 was 3,124,067, which amounted to a 10% increase from 2017 (17). The number of total passengers increased by almost two million from 2010, largely due to significant increase in tourism, resulting in further infrastructure developments – a new section of the passenger terminal was opened in July 2019. The plan is to additionally connect the airport with the passenger harbour of Split by rail.

3.4.2.4. Waterways infrastructure

The city of Split (Split-Dalmatia capital) has two seaports, located in the southern and northern part of the Split Peninsula and for different purposes: city port on the south (passenger-ferry port) and north port (commercial port) as shown in Figure 17. The city port of Split (passenger-ferry port) is located in the central part of the Croatian coast where larger inhabited islands (Brač, Hvar, Vis, šolta, Korčula and others) gravitate and main maritime traffic routes are located between Rijeka and Dubrovnik, respectively Venice, Ancona and Pescara (Italy). The commercial port, located on the norh part of the peninsula is intended for loading/unloading of general cargo, storage of various cargo (cereals, coal, oil etc.) and loading/unloading of freight from railway wagons.

Figure 17 City of Split ports

Ferries, liner transport lines, high-speed lines navigate seasonally and through the entire year in Split-Dalmatia county. The maritime lines map is shown in Figure 18, excluding cruise lines and private transport service providers. Under Harbour Master's Office of Split there are 15 harbours: Bol, Hvar, Jelsa, Komiža, Makarska, Milna, Omiš, Rogač, Split, Stari Grad, Sućuraj, Sumartin, Supeter, Trogir and Vis.

Considering a very long and rugged coastal line nautical tourism represents a promising segment of the overall tourist offer of the Split-Dalmatia county. Since the Croatian Bureau of Statistics is not monitoring data on the tourist traffic in nautical ports since 2009 its scope is difficult to estimate. However, according to data of the Croatian Chamber of Commerce there were 21 nautical ports in 2014 in the region (16).

According to (19) in the period from January to June 2019, there were 54 foreign vessels on cruise that arrived in Croatian seaports, which raised on 272 journeys. The 2nd most visited seaport was Split with 104 visits from January to June 2019. Out of a total of 272 journeys of foreign vessels on cruise the Split-Dalmatia County has a share of (25,3%).

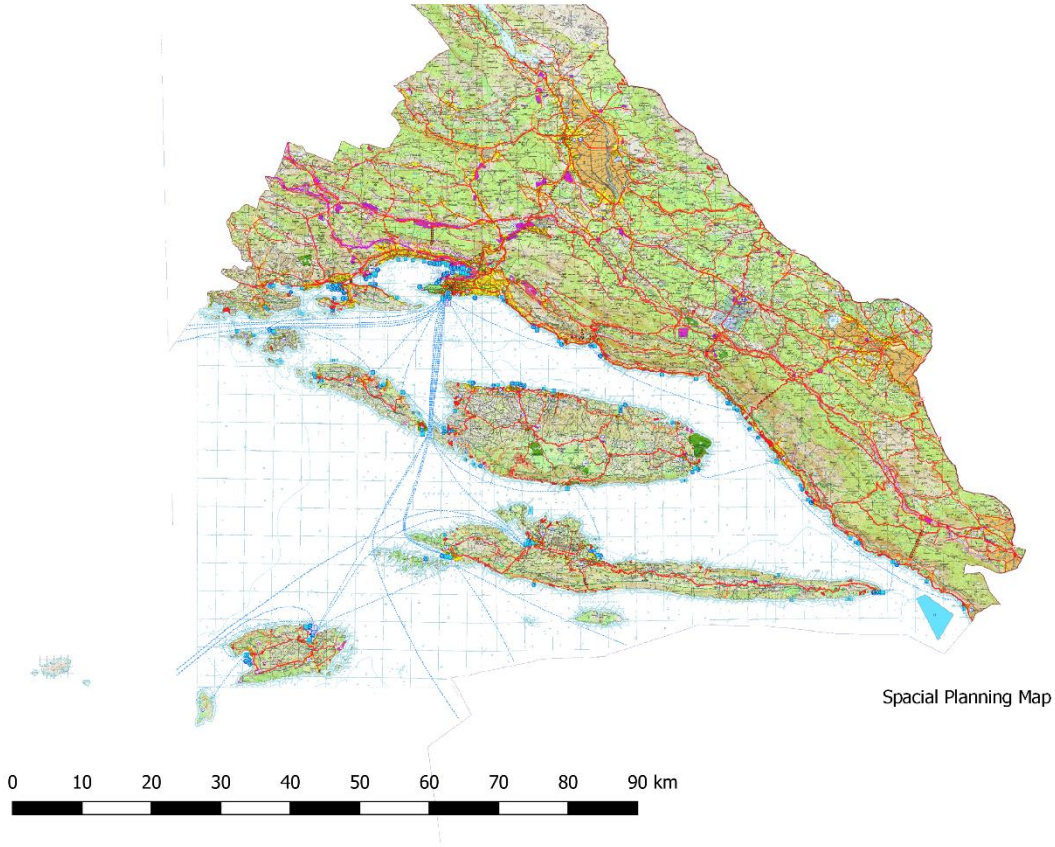


Figure 18 Spatial Planning Map - Maritime transport (lines in blue)

4. Transport

4.1. Basic data and modal split

Regarding the modal split in passenger and freight transport, there are only data available on national, but not on regional level (Figure 19).

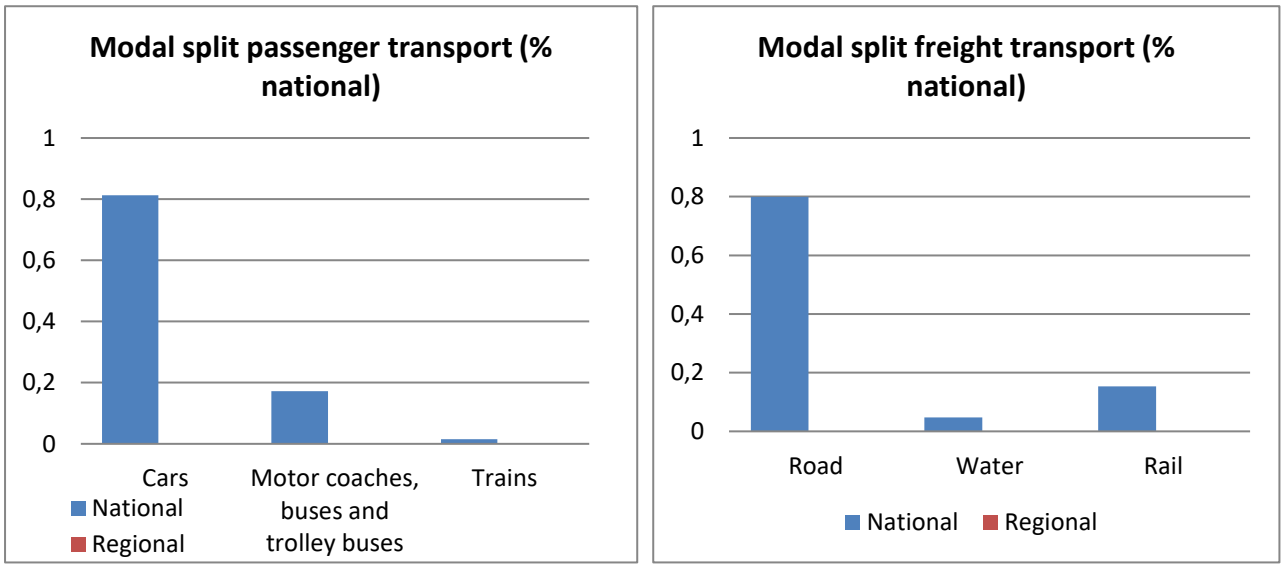


Figure 19 Modal split passenger and freight transport (national)

As can be seen in Figure 19, the main focus on national level in passenger transport is on cars, with a share of app. 80% on national level. For freight transport the modal split is ~80% road transport, followed by rail (~15%) and water (~5%).

Considering that Split port is the first port in Croatia for passenger traffic, and railway transport is underdeveloped with regard to continental Croatia, national statistics share by type of transport cannot be applied regionally. For a more accurate transport share overview, further analysis on regional level are required.

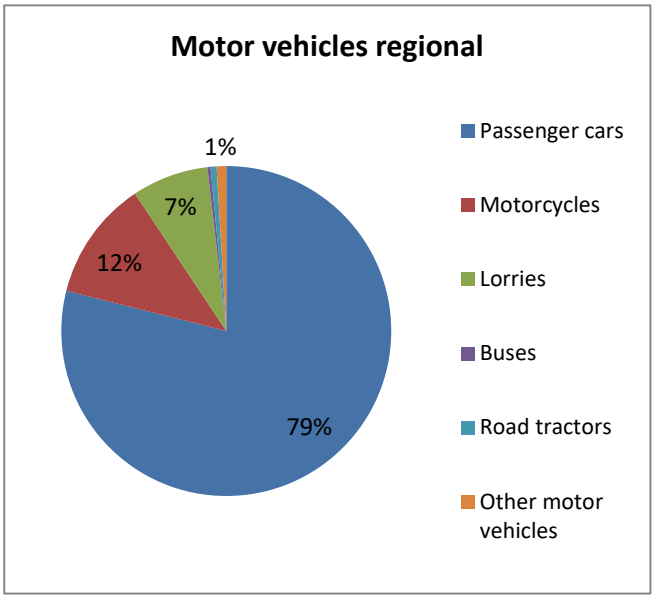
4.2. Road transport

4.2.1. Motor vehicles by type and fuel

The registered stock of motor vehicles in Split-Dalmatia county is 224,818 based on EIHP data from 2017. The regional stock represents ~10,8% of the national vehicles. Regarding the general fuel usage in the motor vehicles (such as e.g. the use of electricity or natural gas for transporting goods, electric motorcycles etc.) there are, currently, no data available. Table 3 is giving an overview on the number of motor vehicles by type, while Figure 20 is illustrating the contents of Table 3.

Table 3 Motor vehicles by type on regional level

Motor vehicles by type	Regional	National
Passenger cars	177418	1605013
Motorcycles	26399	156334
Lorries	16873	155636
Buses	687	5683
Road tractors	1333	16497
Other motor vehicles	2108	130362
Total	224818	2069525



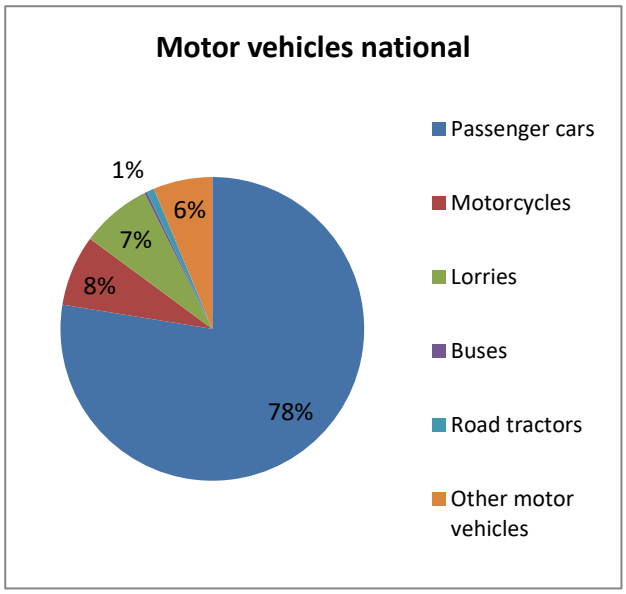


Figure 20 Motor vehicles regional and national share

4.2.2. Passenger cars by fuel, kilometre and fuel performance

As shown in Table 3 the amount of passenger cars in Split-Dalmatia county is 177,418, representing ~11% of the total fleet of passenger cars in Croatia. The per capita cars on regional level is 0,39 and its higher than on the national level (0,37 cars per capita). Table 4 is giving an overview on the passenger cars by fuel on national and regional level.

Table 4 Overview on the passenger cars by fuel on national and regional level

Passenger cars by fuel (number)	National	Regional	Average annual km/car	Average Consumption (l/100 km; or kWh/100 km)
Petrol	780.855	87.540	9.939	7,9
Petrol-flex fuel				
Diesel	771.375	83.885	15.548	6,2
Electric	286	13		18

Liquefied petroleum gas				
Natural gas	179	13	3.749	5,6
Petrol / Liquefied petroleum gas (bivalent)	49.831	5.684	16.027	9,2
Petrol / natural gas (bivalent)				
Petrol / electric (hybrid)	2.331	259	12.744	5
Diesel / electric (hybrid)	156	24	12.744	5
Hydrogen / fuel cell	-	-		
Total	1.605.013	177.418		

A graphic view of passenger's cars by fuel usage split on regional level is shown in Figure 21. Dominant is petrol (87.540), followed by diesel (83.885) while smaller shares refer to petrol/LPG (bivalent), petrol/electric (hybrid) and diesel/electric (hybrid). According to EIHP data, there are 13 electric and 13 natural gas fuelled vehicles in Split-Dalmatia county.

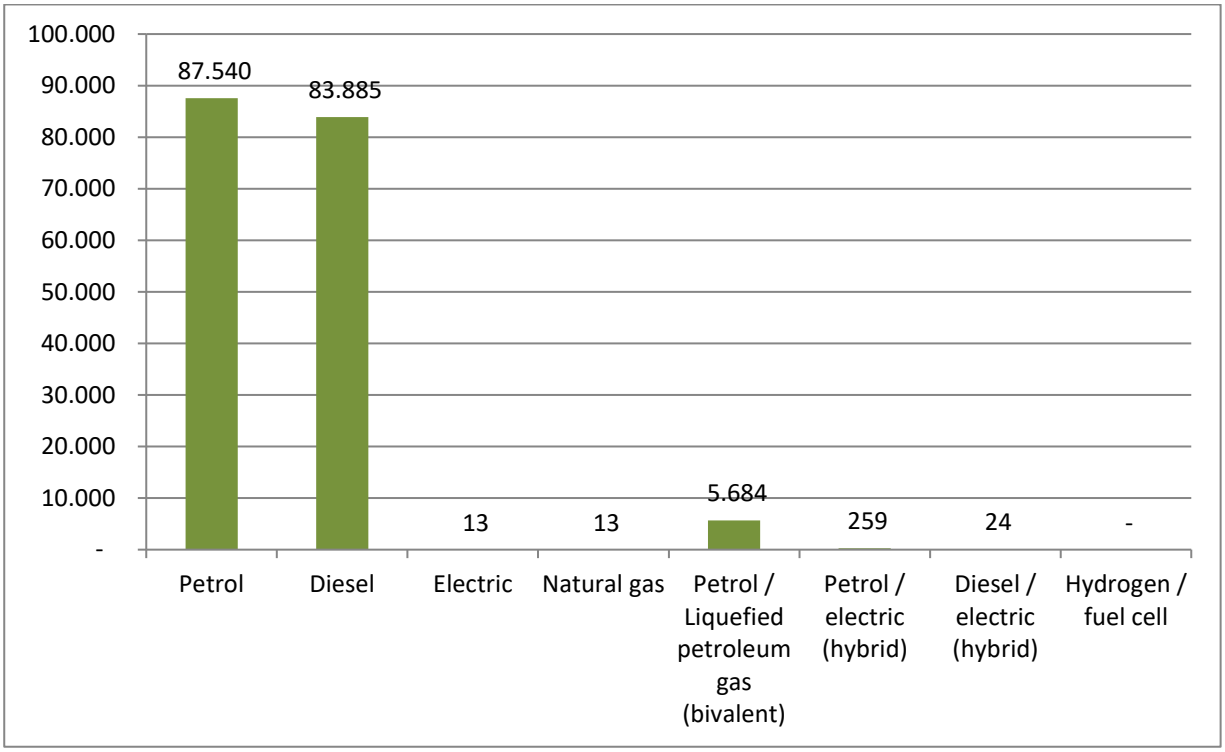


Figure 21 Cars by fuel in Split-Dalmatia county [source: EIHP 2017]

4.2.3. Passenger and tonnes kilometres

As the modal split gives an impression of the share of use of means of transport, passenger and tonnes kilometres are providing information on the intensity of the use. On regional level, there is no information on this issue available, nevertheless Figure 22 visualizes the information available on national level.

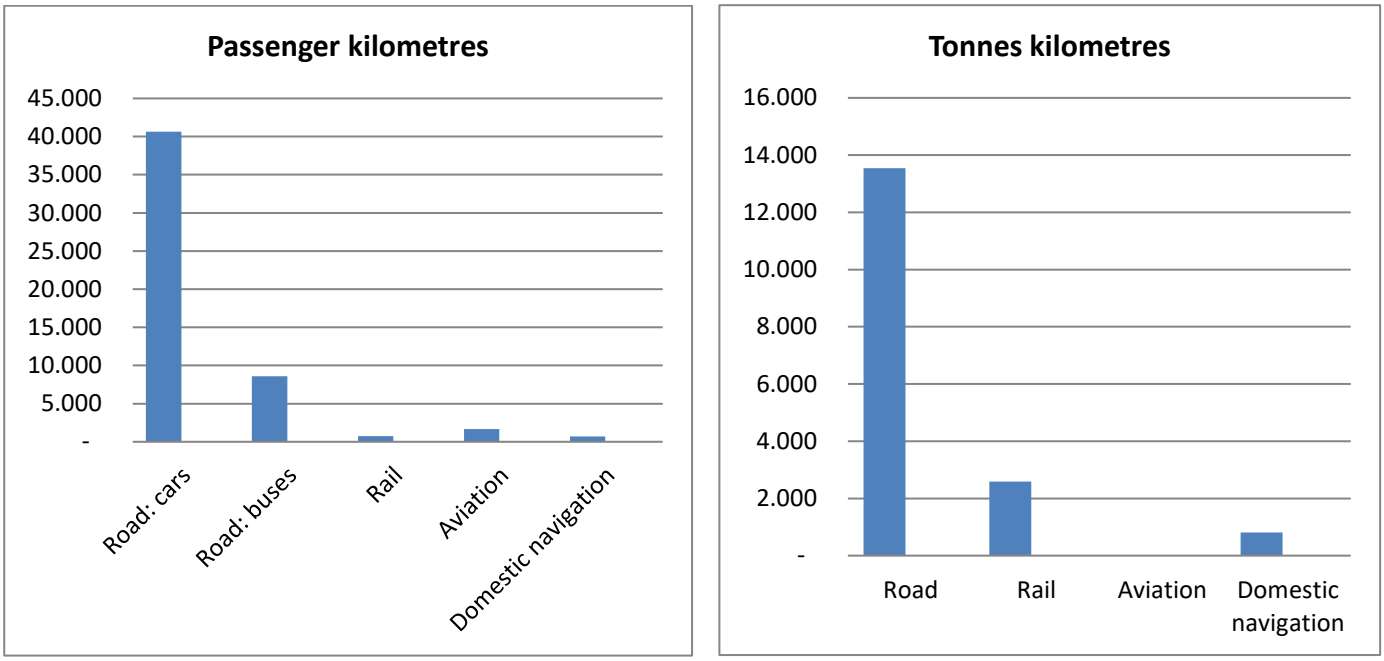


Figure 22 Passenger and tonnes kilometres on national level

4.2.4. Particularities

Apart from cases were regional data are available, the national data can only be seen as a framework thus not applicable to the regional case.

4.3. Rail transport

4.3.1. Passenger and tonnes kilometres

The respective information on national level is already comprised in chapter 4.1 and no further regional data is available.

4.3.2. Development of passenger and goods transports

On regional level, there is no such information available, thus Figure 23 is visualizing the development of passenger and freight transport from 2010 till 2017 on national level. As can be seen, due outdated rail infrastructure, the dropping trend is evident both in freight and passenger transport. The passenger transport share has dropped 3,5 times in 2017 compared to 2010.

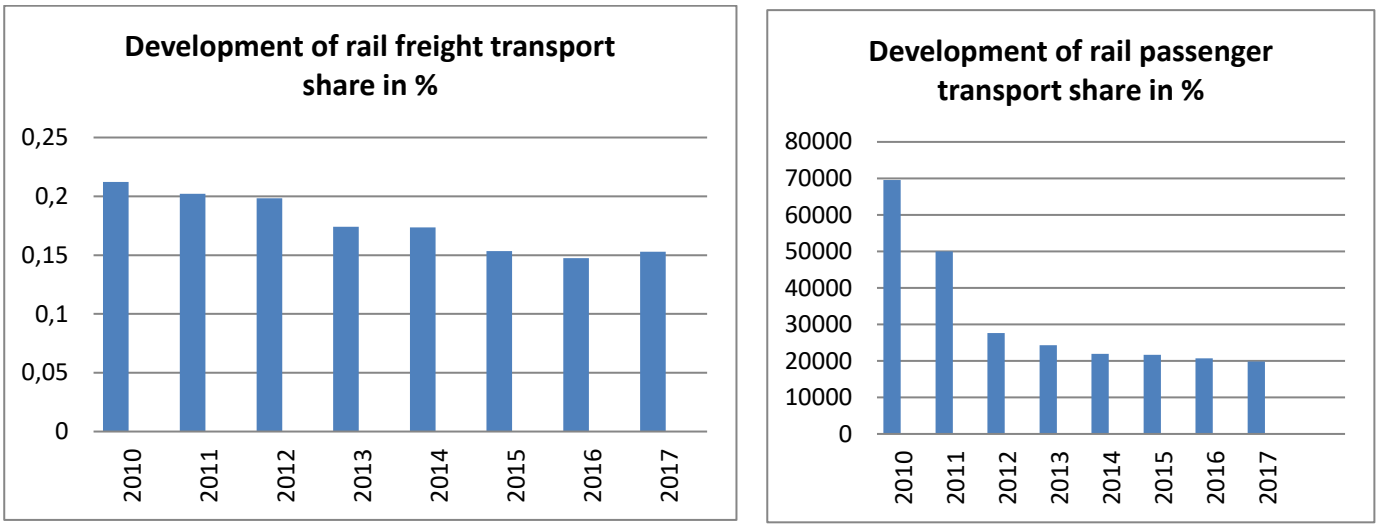


Figure 23 Development of freight and passenger transport on national level

4.3.3. Particularities

As stated for road transport, national statistics on rail transport are not applicable on regional level.

4.4. Air and waterway transport

4.4.1. Air Transport

In the period from 2011 till 2017 passenger transport in Croatian airports has grown by 71% (21). Based on the number of arrivals (Figure 24), the Split-Dalmatia county is the 2nd in Croatia, with the share of 29,6% in air transport.

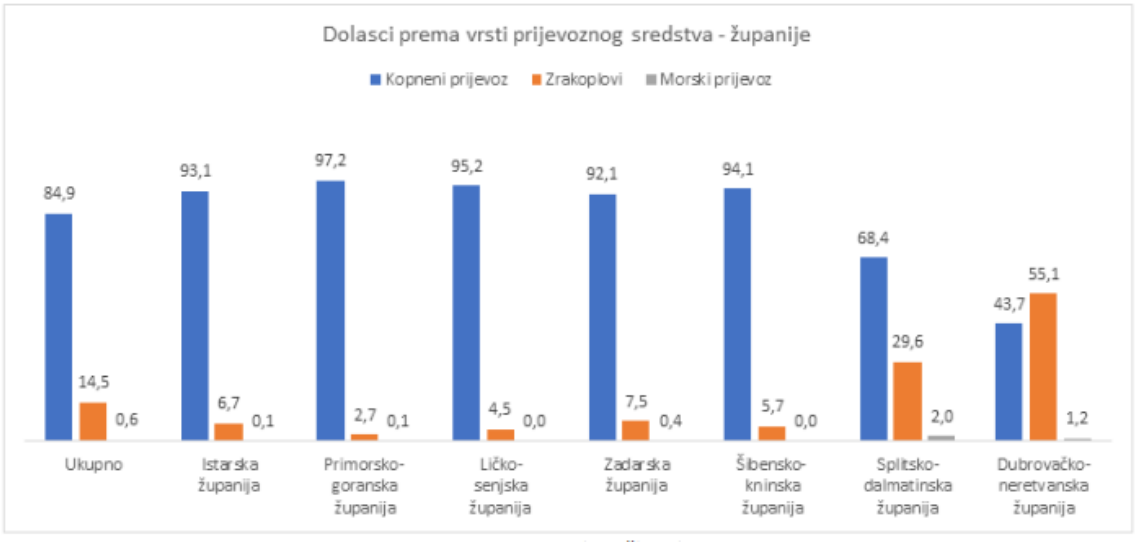


Figure 24 Arrivals by type of transport per counties (blue: road transport, orange: air transport, grey: maritime transport) [source: (21)]

While analysing solely the total number of passengers per airport, the Split Airport is the 2nd most visited in Croatia (Figure 25) but with the highest growing rate in the country.

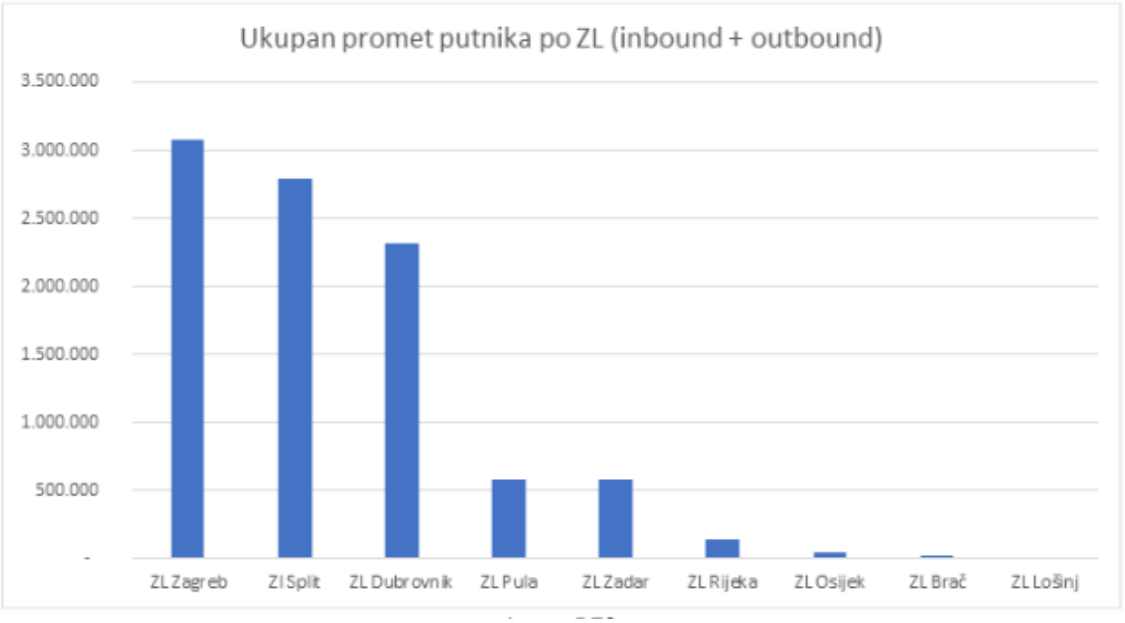


Figure 25 Total number of passengers per airports [source: (21)]

Thus, in is shown the number of passenger development over months and years in the Split Airport. According to (21) the growing trend is registered during high seasons, especially in June and partly in August and September.

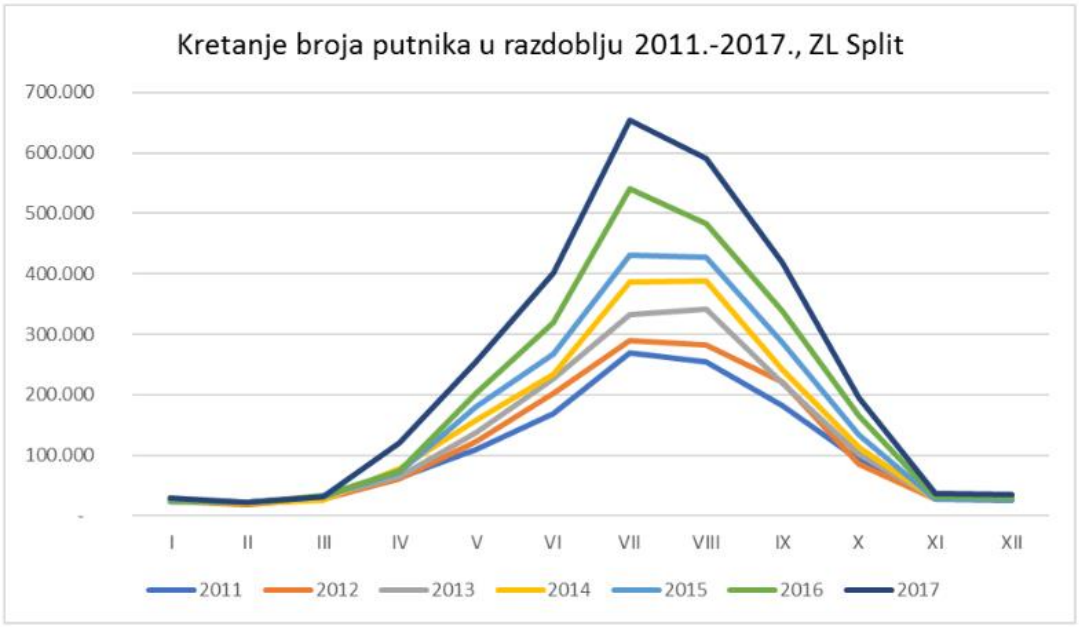


Figure 26 Number of passengers in Split Airport [source: (21)]

As the number of passengers is intensively increasing each year, air transport in Split-Dalmatia county needs to be consider as one of the highest growing types of transports.

4.4.2. Waterway transport

Considering that 68% of the Split-Dalmatia county is covered by sea: ferries, liner transport lines, high-speed lines navigate seasonally and through the entire year.

Even though statistical data for maritime liner transport lines are not publicly available, for Prospect2030 purposes, data for Split-Dalmatia county has been provided from the Croatian Agency for Liner Maritime Transport hence analysed by EIHP.

Data provided by the Croatian Agency for Liner Maritime Transport are related to type of transport, total miles travelled, number of travels, nautical miles (Nm) per travel, type of fuel, average fuel consumption (l/Nm) and total fuel consumption (l) with the reference year of 2018.

Average fuel consumption for regular ferry, passenger boats and high-speed passenger services is shown in Figure 27. Regular ferries have highest nautical miles travelled, followed by high-speed passenger boats. Fuel consumption applies accordingly, with the average consumption of 44 l/Nm for ferries, followed by high speed passenger boats (25 l/Nm) and passenger boats with 5 l/Nm.

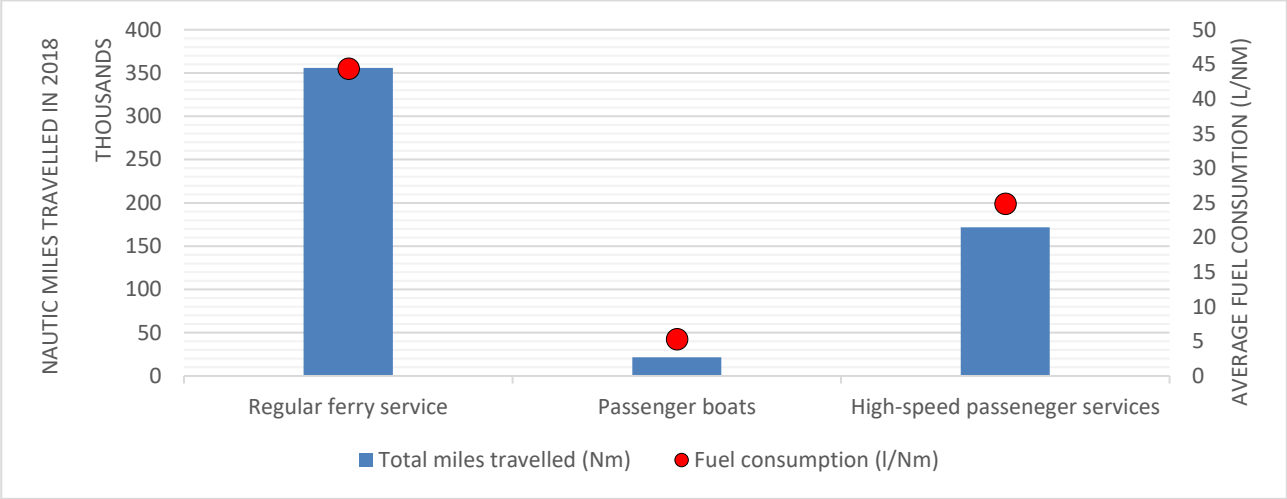


Figure 27 Average fuel consumption in maritime liner transport

Regular ferries travelled miles vs. average fuel consumption in Split-Dalmatia county is shown in Figure 28. Ferries such as Split – Stari Grad, Lastovo – Vela Luka – Split, Split – Supetar have the highest nautical miles. On the Other hand, there is an obvious inconsistency in average fuel consumption, depending on the type and age of the ship, load, etc. Highest average fuel consumption is registered on the ferry Split – Stari Grad with 72 l/Nm, followed by Lastovo – Vela Luka – Split (55 l/Nm) while lowest consumption ferries are Makarska – Sumartin with 13 l/Nm, followed by Drv V. - Drv M. - Trogir – Split with 14 l/Nm and Drvenik Sućuraj with 18 l/Nm.

Data for two passenger boats has been delivered, accordingly for Komiža – Biševo and Trogir – Slatine Split average fuel consumption, 4,7 and 5,5 l/Nm (Figure 29).

High-speed passenger data is shown in Figure 30. As for ferries and passenger boats travelled miles vs. average fuel consumption widely differ. However, average fuel consumption is assessed to be 56% of ferries.

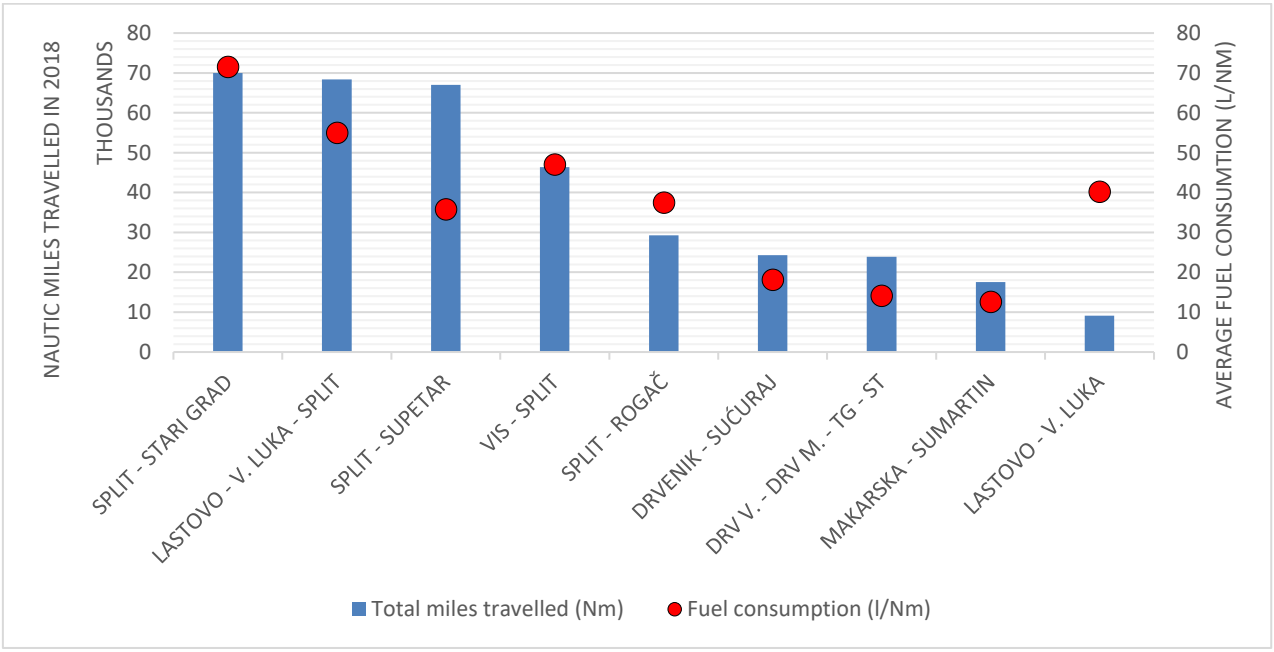


Figure 28 Regular ferry services miles vs. average fuel consumption

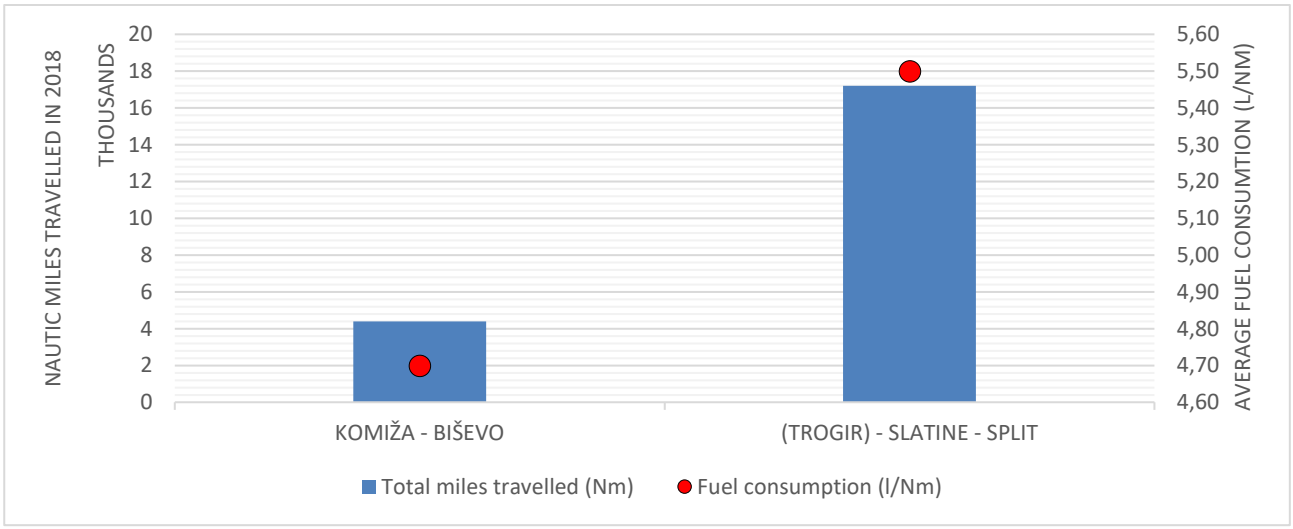


Figure 29 Passenger boats miles vs. average fuel consumption

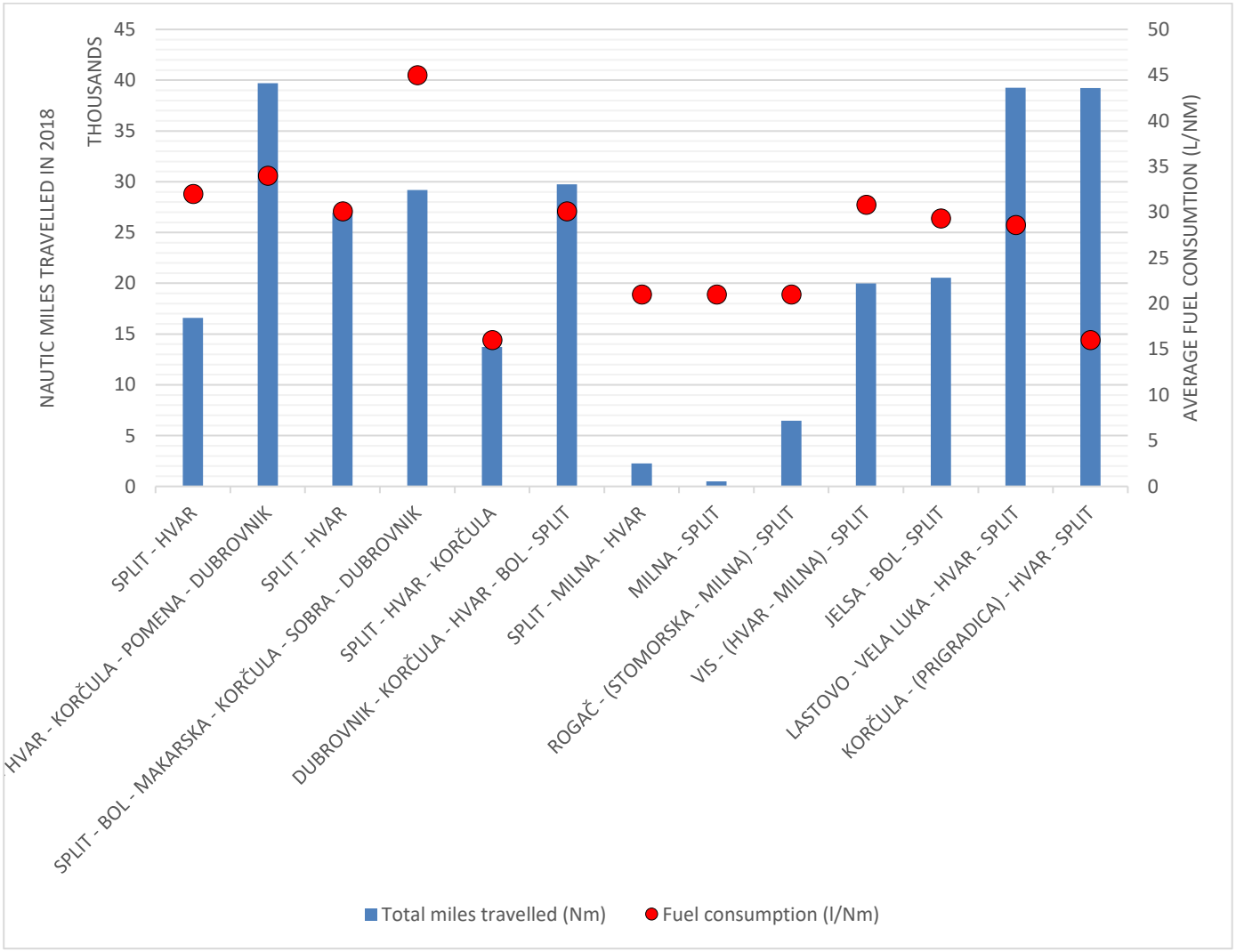


Figure 30 High-speed passenger service miles vs. average fuel consumption

4.4.3. Particularities

As it can be deducted from the previous chapters, besides road transport, aviation and maritime transport have significant shares in the total transport of passenger and goods on regional level. Growing trends for the previous mentioned transport types are registered each year.

5. Energy status

5.1. Energy in the European and national context

Figure 31 is giving an overview on the shares of basic energy carriers in the European, National and Regional final energy consumption. As can be seen, the regional final energy consumption is mirroring the infrastructure regarding energy supply and mobility.

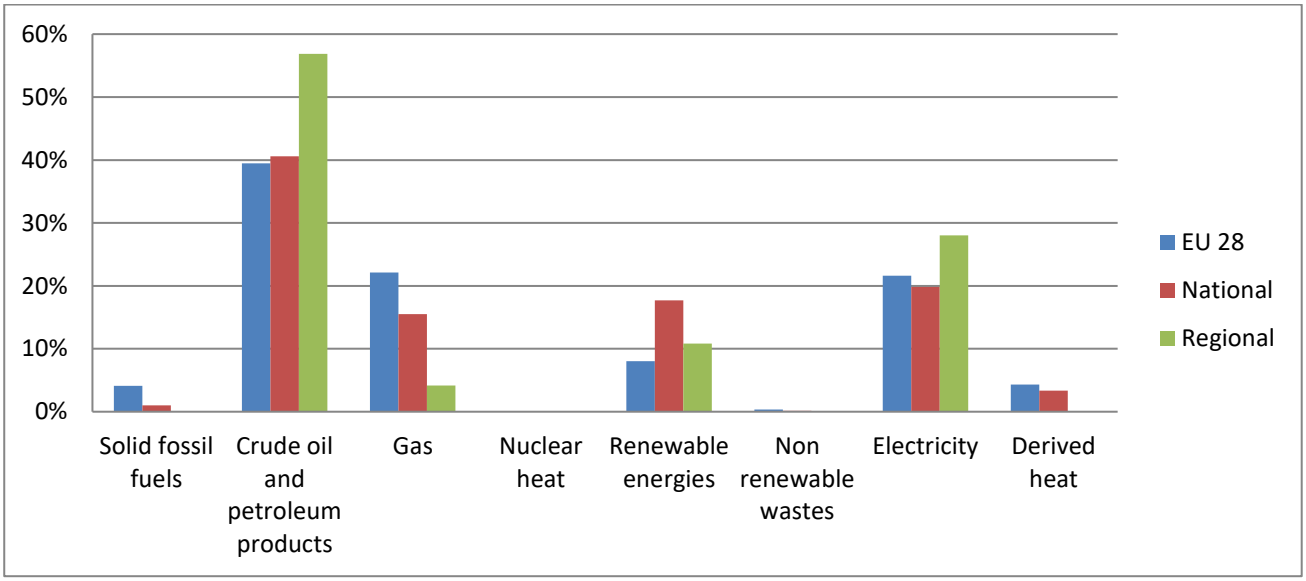


Figure 31 Comparison of shares in final energy consumption

The following paragraphs are containing graphs regarding the main parameters of the respective simplified energy balances. The abbreviations in the graphs need to be read as follows:

- PP: Primary production (blue bar)
- GC: Gross consumption (red bar)
- TI: Transformation input (green bar)
- TO: Transformation output (violet bar)
- FEC: Final energy consumption (light blue bar)

5.1.1. Simplified energy balance of EU 28

Figure 32 is showing the simplified energy balance of the EU 28. It shows, that EU is highly dependent on imports of crude oil and petroleum products, natural gas and solid fossil fuels.

Regarding nuclear heat and non-renewable wastes, the consumption, respectively the transformation output thereof, in the form of electricity and, to a small part, also derived heat) equals the primary production. The demand of renewable energies is almost covered by the primary production.

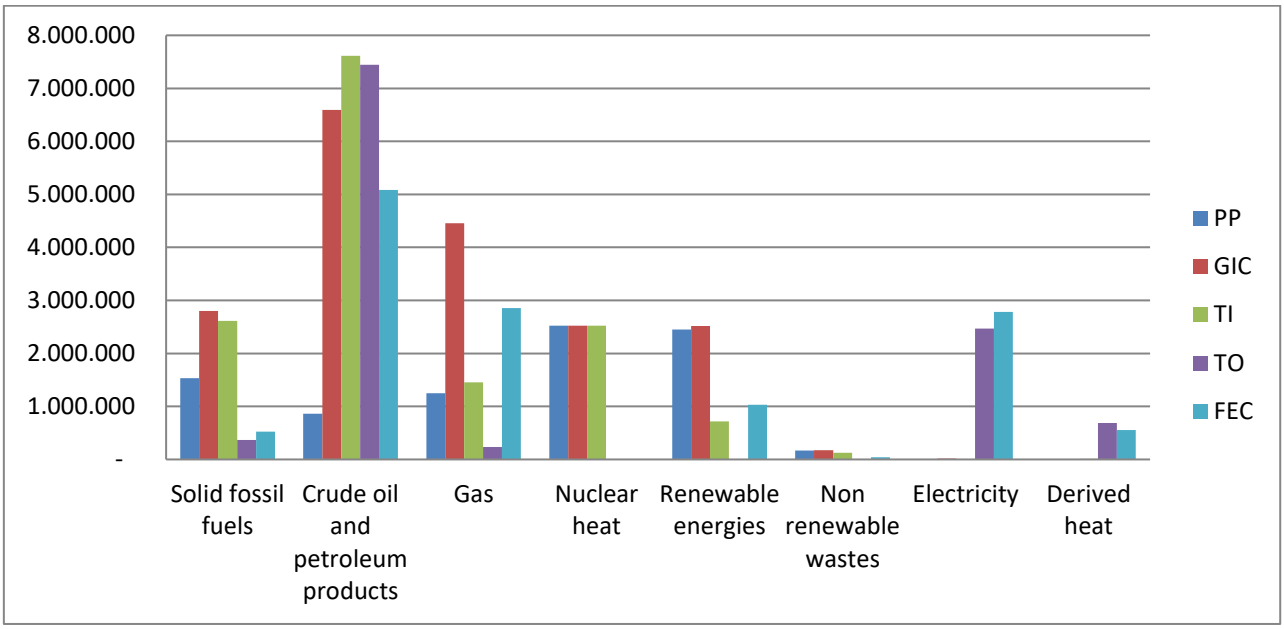


Figure 32 Simplified energy balance EU28 in GWh

5.1.2. Simplified national balance

Regarding solid fossils, natural gas and Crude oil products, the situation is similar to the one of the Union. A particularity of Croatia is that the energy generated from the nuclear power plant of Krško (which is located on the territory of Slovenia) is treated as imported energy thus there is no energy generation from nuclear heat in the national balance. The utilization of renewable energies is higher than in the Union due to a considerable amount of hydro power in national primary energy production.

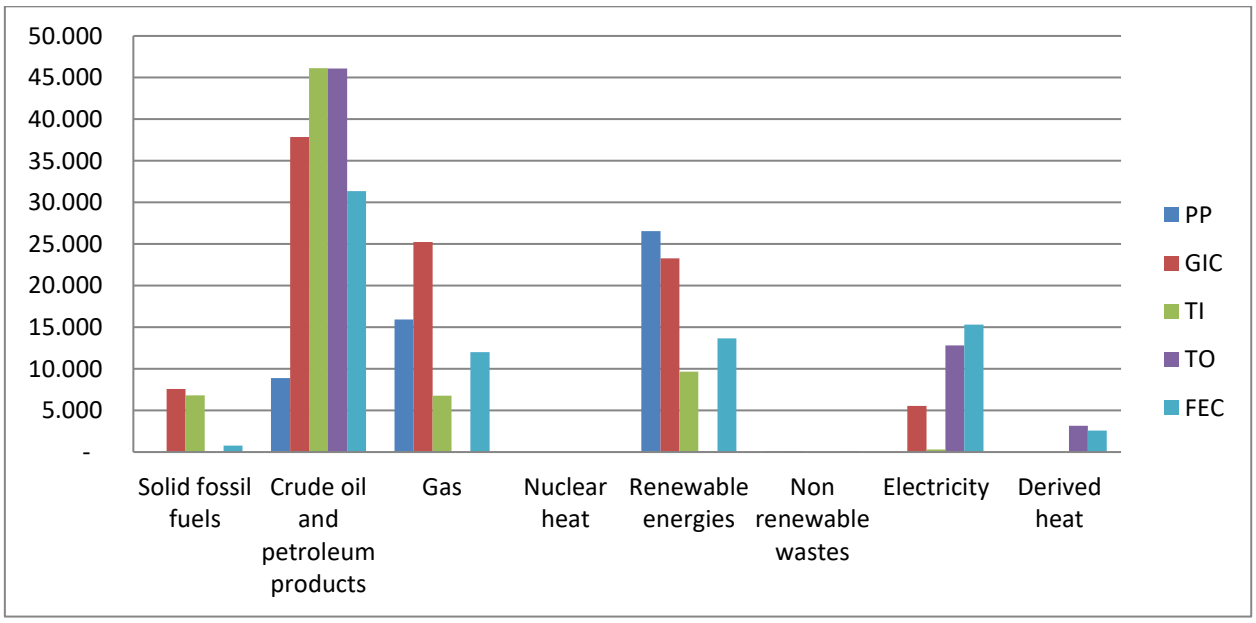


Figure 33 Simplified energy balance of Croatia in GWh

5.1.3. National electricity fuel mix disclosure

Croatian national fuel mix for electricity generation is characterized by a share of renewable sources, due to the richness in water and, in consequence, production of electricity from large hydro power plants (Table 5). In 2016, 33,15% of the generated electricity was from fossil sources. Due its characteristics, a hydro-power based power system causes high dependence on imports reaching even ~80% of final energy consumption in 2016.

Table 5 National electricity fuel mix disclosure

Electricity fuel mix disclosure (national average)	**%**
Large hydro	54,88
Small hydro	0,17
Wind	7,91
Solar	0,51
Solid biofuels	1,51
Liquid biofuels	1,85
Solid fossil	18,49
Gaseous fossil	14,67
Total	100,00

Figure 34 Is visualising the contents of Table 5.

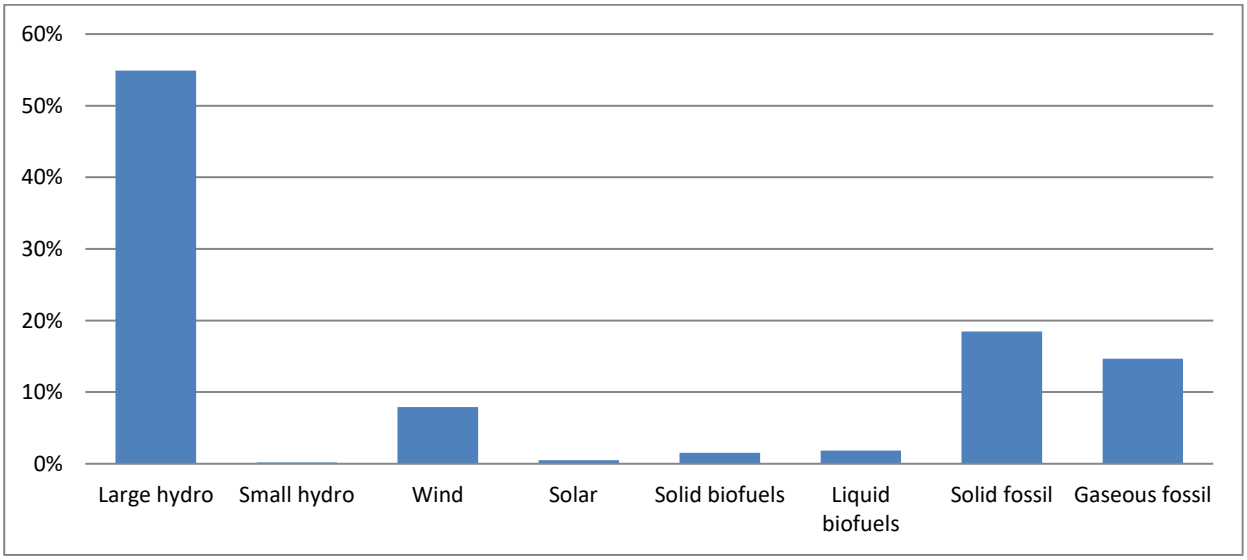


Figure 34 National electricity fuel mix

5.1.4. Time series of national final energy consumption

Due to various socio-economic factors, final energy consumption trend has not been linear over the time slot from 1990 to 2016. From 1990, especially as a consequence of war years, there was a significant decreasing trend in final energy consumption till 2000. From 200 till 2005 high increasing trend has been registered while dropping from 2005 to 2014 to the values of year 2000. Moreover, after 2014 a slight grow of FEC has been recorded.

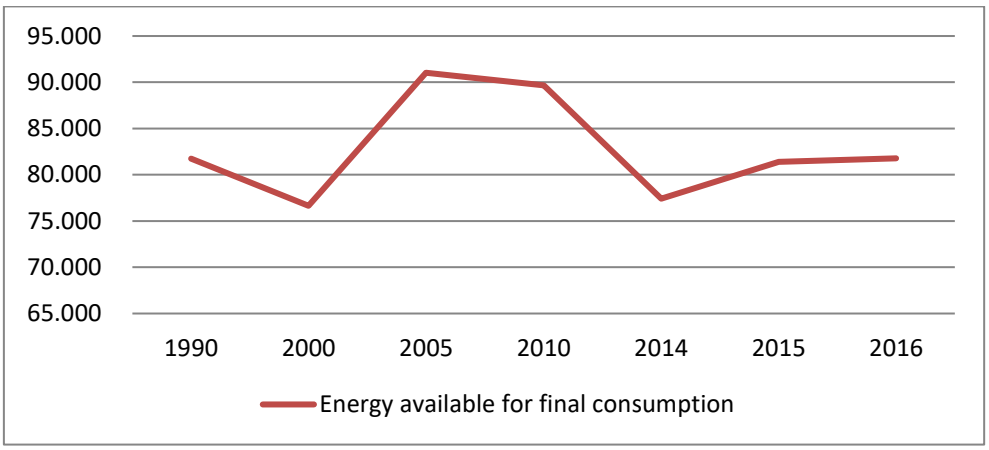


Figure 35 Development of FEC in GWh/a

Figure 36 andFigure ***37*** are giving a deeper insight into the main components of the consumption spectrum. As shown in Figure 36, there was an increase share of renewables in the final consumption from 1990 till 2010, followed by a decreasing/increasing trend till 2016, while waste has minimum values. However, the main part of final energy consumption is covered by non-renewables.

Figure 37 shows, that the main part of used renewables is represented by solid biomass, followed by a small portion of other renewables, which are mainly wind and solar based (hydropower is factored in the category “electricity”, not in “renewables”) and liquid biofuels.

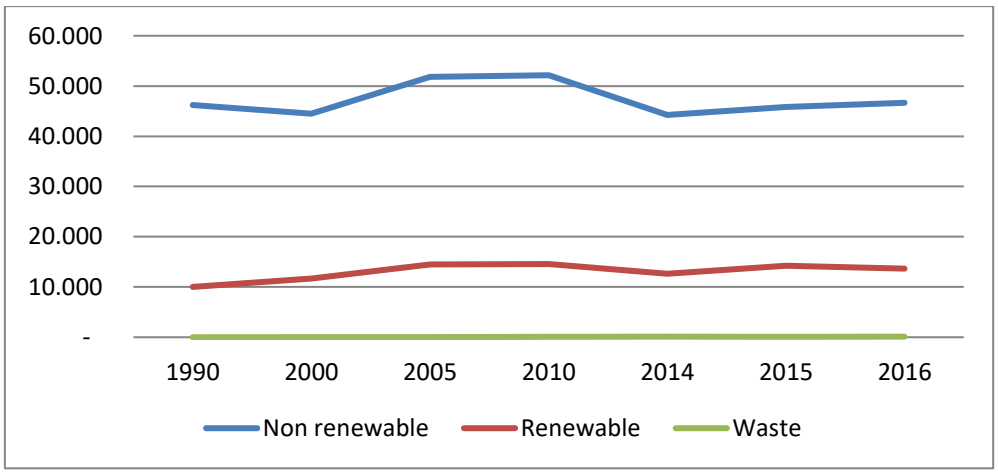


Figure 36 Energy available for national final consumption (GWh/a)

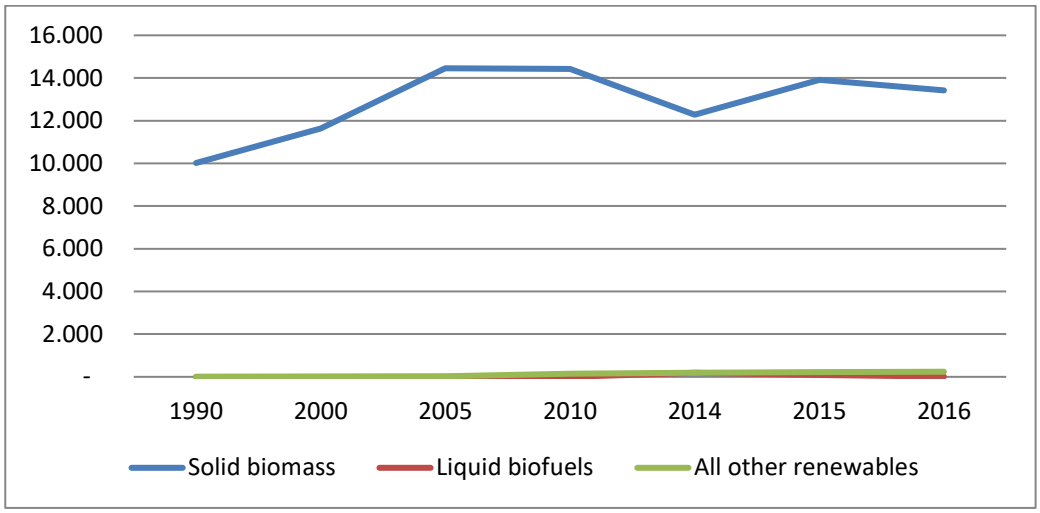


Figure 37 Development of RES in national final consumption (GWh/a)

Figure 38 is tracing the development of efficiency in transformation processes and distribution in the period from 1990 to 2016. Efficiency in transformation has decreased from 1990 till 2005 due oldness of equipment, thus an increasing trend has been registered till 2010 due replacement activities. However, transformation efficiency has been decreasing since 2010, falling at 89,2% in 2016. On the other hand, distribution losses have increased till 2000, reaching app. 4,14%, while current trend is positive (decreasing losses).

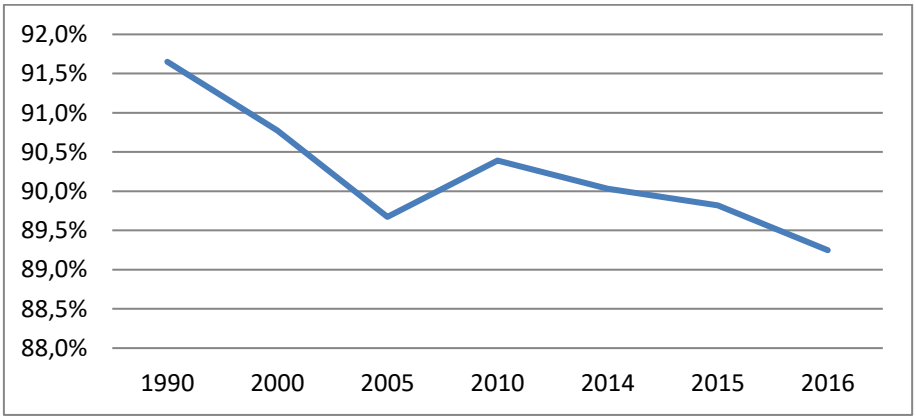


Figure 38 Transformation efficiency

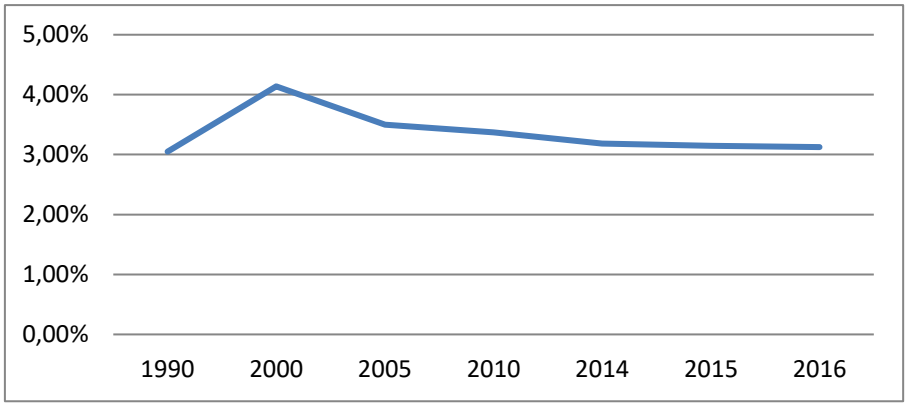


Figure 39 Distribution losses

5.1.5. Energy prices – status quo and development (2014 S2 to 2019 S1)

Electricity prices, in Croatia, are far more volatile than the prices for natural gas. The gas prices including taxes and levies (Figure 40) have decreased from 2016 (47 €/MWh), reaching even 35,9 €/MWh in the first semester of 2017, thus increasing in the second semester (36,8 €/MWh) and afterwards dropping again at 36 €/MWh in the second semester of 2018. There is currently an increasing trend in gas prices, with 37,5 €/MWh in the first semester of 2019.

On the other hand, electricity prices (including taxes and levies) have been fluctuating ± 14 € around the average value of 129,8 €/MWh (Figure 41), dropping at 119,6 €/MWh in the first semester of 2017 and afterwards reaching its previous values of ~132 €/MWh in 2018 thusly being currently stable with a slight increasing trend.

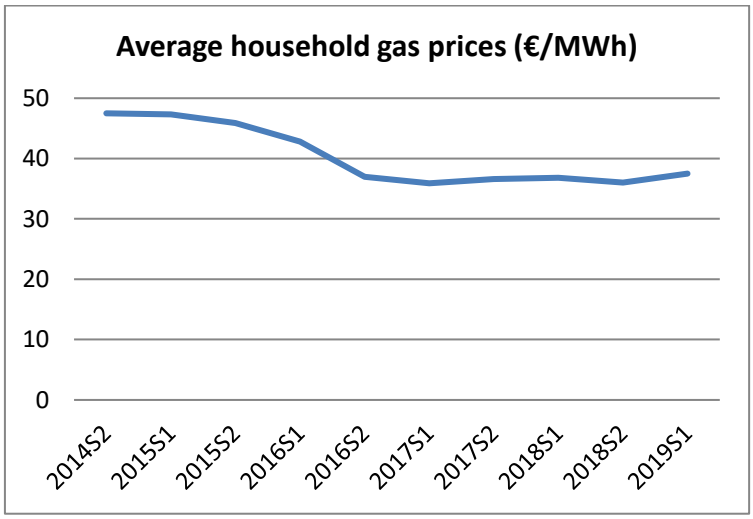


Figure 40 Average household gas prices (€/MWh)

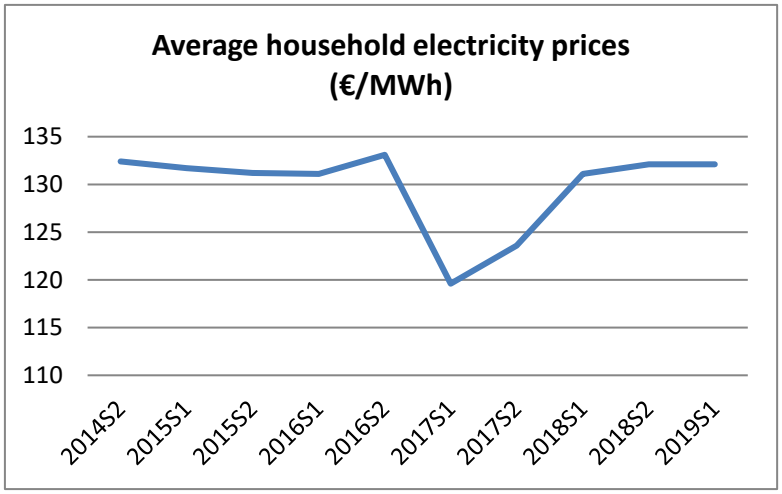


Figure 41 Average household electricity prices (€/MWh)

Mostly because of taxes and levies, prices levels for natural gas and electricity in the industrial sector are remarkably lower than in the residential one.

Electricity

The wholesale price for electricity is currently around 60 €/MWh (reaching peaks of 115 €/MWh during the intra-day market). The working price average is 75 €/MWh in industry and 88 €/MWh for households. Taxes and levies are additionally 6% for industry and 34% for households.

Natural gas

Regarding natural gas, the wholesale price is around 20 €/MWh. The working price average for industry is 25 €/MWh and for households 36 €/MWh. Taxes and levies are additionally 8% for industry and 20% for households.

District heat

There are two types of district heating plants in Croatia. The first type is cogeneration (CHP) and the second is the conventional with production of thermal solely. It is important to mention that none of the previously mentioned are located in the Split-Dalmatia county. Of course, prices widely differ: for CHP household prices are around 6 €/MWh (in Zagreb) and for cities with conventional plant (such as Karlovac) are around 12 €/MWh reaching almost the price of electrical energy.

Oil and petroleum products

Table 6 is giving an overview at the current prices (in €cent/kWh) of the most common oil- and petroleum products. As can be seen, the taxation of transport in Croatia is significantly high, indeed higher than for fuels for stationary combustion.

Table 6 Oil and petroleum products prices

Oil and petroleum products					
Final consumption (€ cent/kWh)	Net price	Customer end price (incl. taxes and levies)	Share of taxes and levies	Energy content	
Petrol	6,36	16,30	61%	8,1	kWh/l
Diesel	5,76	13,40	57%	9,8	kWh/l
Heating oil	3,48	6,00	42%	9,8	kWh/l
LPG	3,07	5,80	47%	12,8	kWh/kg

Electricity and gas grid injection tariffs

Injection tariffs are bound to contracts regarding renewable energies. If there is no such contract, the remuneration for injection is based on the wholesale price. The tariffs are also dependent on the type of generation as well as on the amount of energy fed into the grid.

Table 7 Electricity grid injection tariffs RES

Electricity grid injection tariffs renewables	€/MWh
Hydro *small hydro	125,974953
Wind	102,6358183
Solar photovoltaic	267,6224576
Solid biofuels	165,0498338
Biogases	170,60

Concerning gas injection tariffs for renewables, in Croatia only biomethane (landfill gas) is applicable with 58,57 €/MWh.

5.2. Regional energy demand

Considering that official energy balances for a NUTS 3 region are not existent, the regional energy demand has been calculated based on the Energy Efficiency Action Plan for 2016 developed by EIHP in 2015. Demand calculations for purposes of the Energy Efficiency Action Plan covered industry without ETS, transport, services and households while agriculture, forestry and fishing and construction demand estimations were missing. Estimations for agriculture, forestry and fishing and construction sectors where performed for the purposes of Prospect2030 using modelled data based on official national statistics delivered to EUROSTAT.

5.2.1. Regional energy demand by fuel and sector

Table 8 is showing the final energy consumption estimation for Split-Dalmatia county for 2016. The total amount is ~5.607 GWh. The share of the regional consumption is 7% of the total national final consumption. The largest share is accounted for by crude oil and petroleum products, followed by electricity while minor shares are accounted for renewable energies, gas and derived heat.

The share of renewables in the total final consumption is 11% and mainly covered by the residential sector, mainly due to use of wood for heating purposes since there are not district heating systems in Split-Dalmatia county. On the other hand, renewables such as solar heat pumps account for less than 1% in the total share of renewables in the residential sector.

Table 8 Estimation of regional energy demand

Estimation of regional energy demand (GWh)	**Total**	*Solid fossil fuels*	*Crude oil and petroleum products*	*Gas*	*Nuclear heat*	*Renewable energies*	*Non renewable wastes*	*Electricity*	*Derived heat*
Final energy consumption	**5607**	0	3189	234	0	606	0	1572	4
Agriculture, forestry and fishing	**86**	0	71	10	0	2	0	2	2
Industry (without construction), energy, water sewage etc	**418**	0	122	13	0	10	0	274	0
Construction	**108**	0	100	0	0	0	0	7	0
Transport	**2891**	0	2759	81	0	50	0	0	0
Services	**735**	0	134	50	0	3	0	546	3
Residential	**1369**	0	3	81	0	543	0	742	0

The final consumption by fuel and share is visualized in Figure 42.

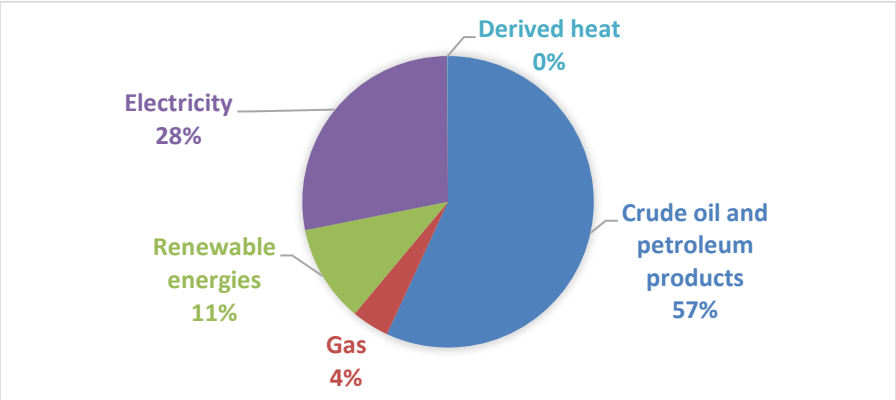


Figure 42 Final consumption by fuel - Split-Dalmatia

A graphic overview on the total final consumption by sectors is given in Figure 43. The largest share is accounted for by the traffic and transport sector (52%), followed by the residential sector (24%). The share of industry in total final consumption is just 7%.

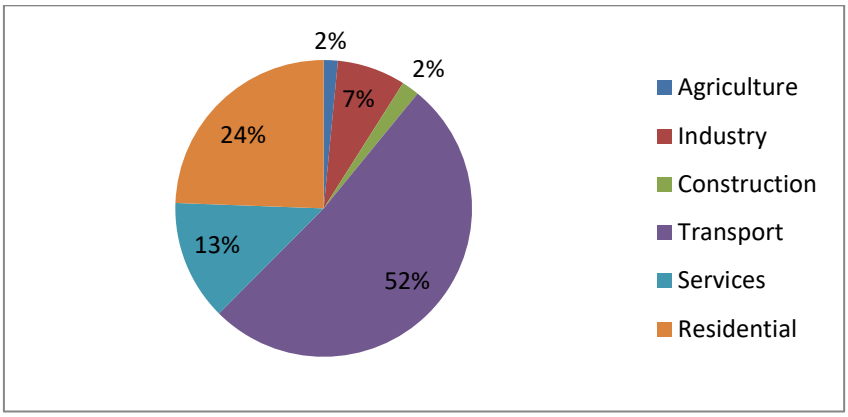


Figure 43 Share of sectors in total regional final energy consumption

The distribution of renewable and non-renewable energy within the respective sectors is visualized in Figure 44.

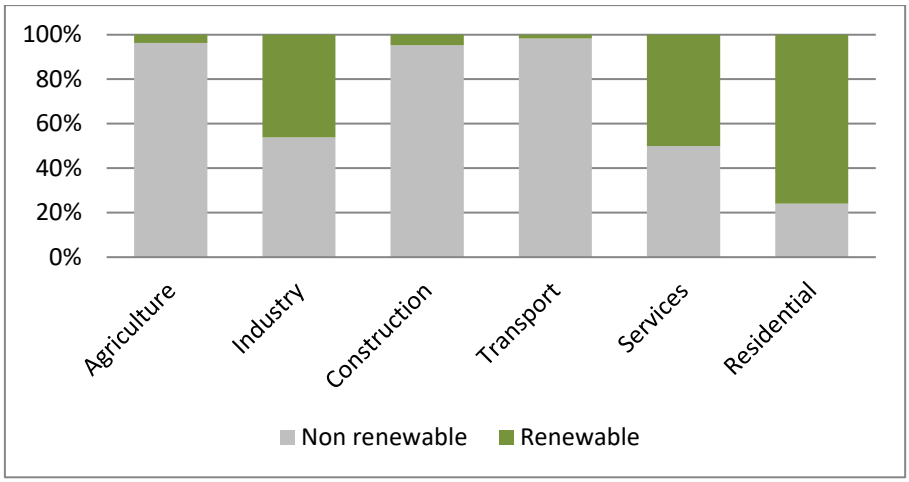


Figure 44 Share of renewables in total sectoral consumption

5.2.2. Regional particularities of energy demand

The main regional particularity is the absence of district heating systems. Even though as shown in chapter 3.4.1.2, the gas grid reaches the county due to infrastructure investment projects there were no massive customers connections till now. Moreover, traditionally in cold seasons heating is mainly derived from electricity, wood or diversified substation powered by fossil fuels, thus cold water is being prepared by electric boilers.

Another crucial characteristic is that transport, which represents 52% of regional final energy consumption, is mainly road-based and maritime which makes the region highly depended on fossil fuel and related prices.

5.3. Regional energy supply

The regional energy supply has been evaluated based on actual regional installed capacities.

5.3.1. Regional generation by source, capacity and output

Table 9 is showing the energy generation in Split-Dalmatia county by source, installed capacity, generated energy and number of facilities by type.

Since there are no CHP nor district heating systems in the region nor feed-in tariffs for small distributed heating facilities have been provided, the installed distributed heat generation capacities have not been analysed for these purposes.

Table 9 Energy generation in Split-Dalmatia county

Electricity generation	*Installed capacity (MW_{el})*		*Energy generated (MWh per year)*	*Number of facilities*
Source	*Electricity only*	*Combined heat-power*	*Electricity*	
Hydro	919	-	2.426.000	5
Wind	226	-	545.500	8
Solar photovoltaic	30	-	42.326	24
Total	**1.176**	**-**	**3.013.826**	**37**
thereof non renewable	-	-	-	-
thereof renewable	*1.176*	-	*3.013.826*	*37*

Installed hydro, wind and solar power plants are presented in Figure 45, Figure 46 and Figure 47.

Figure 45 Installed capacity – hydro

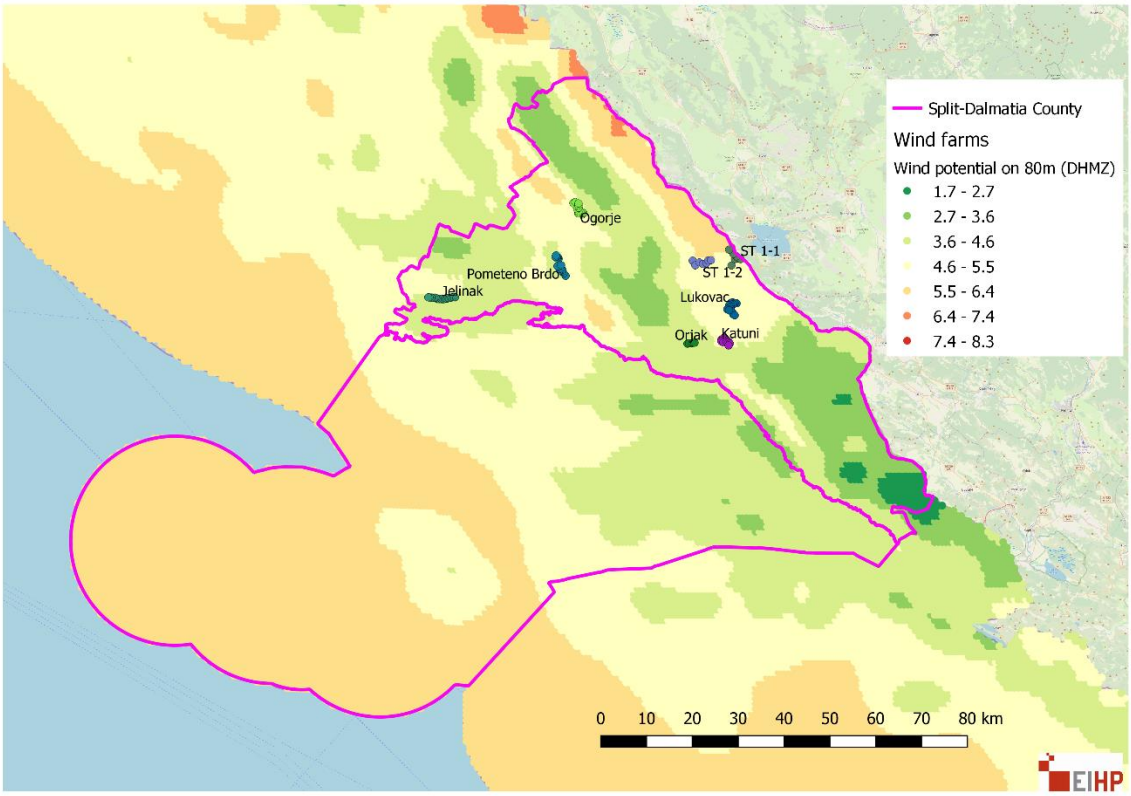


Figure 46 Installed capacity – wind

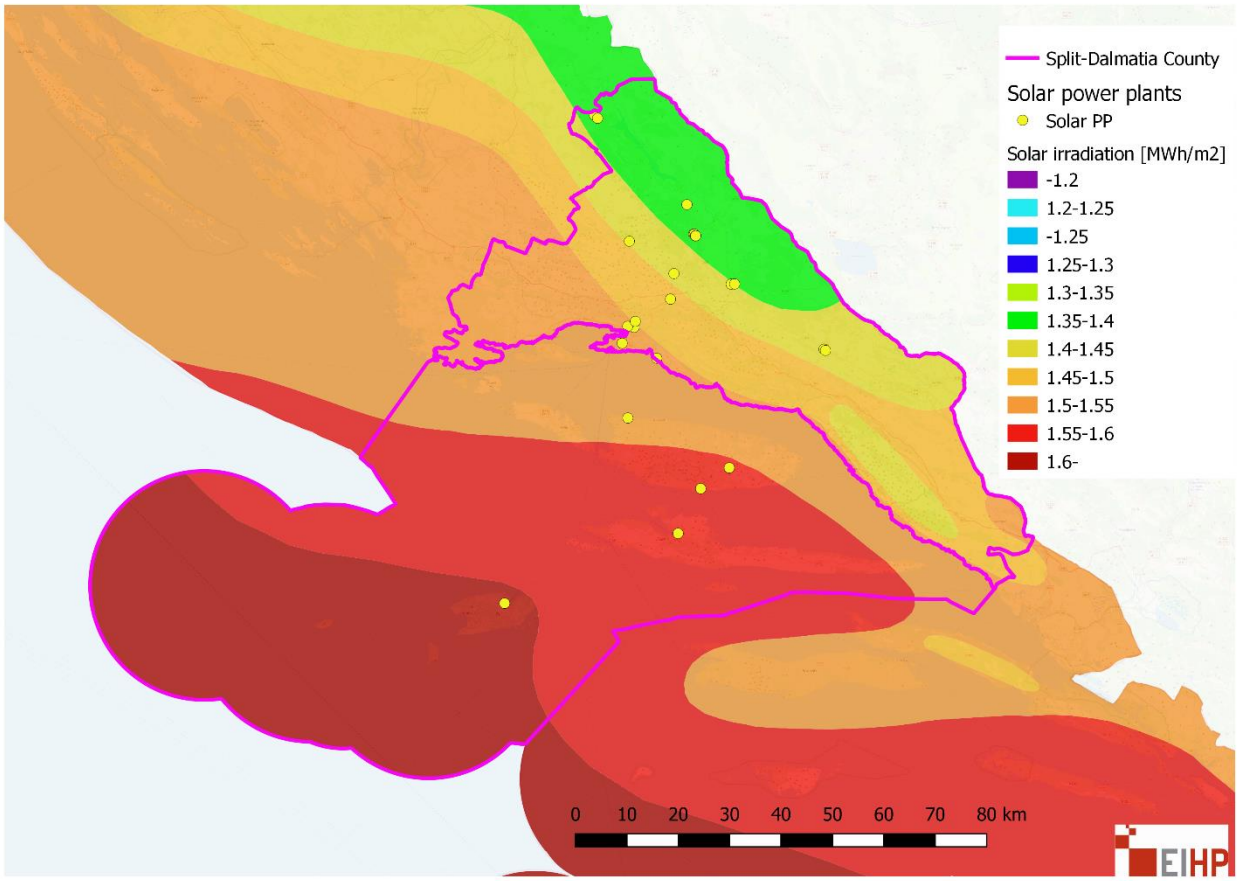


Figure 47 Installed capacity – solar PV

5.3.2. Supply mix

As shown in Table 9 within the region electricity is generated exclusively renewable energy sources solely, respectively hydro, wind and solar photovoltaic. The electrical energy generated per year is ~80% from hydro, ~18% from wind and ~2% from solar photovoltaic power plants. Obviously, energy generated by hydro is highly depended on the hydrological conditions but theoretically electricity final energy demand could be covered by renewables solely.

In terms of supply mix for electrical energy, the installed capacities in Split-Dalmatia county are producing almost double in relation to the actual electricity demand. Moreover, due to the absence of district heating plants electrical energy is used for heating purposes. As follows, 100% share of renewables in electricity generation means that the national fuel mix disclosure (Table 5) is not applicable for the region.

5.3.3. Energy storage

There are no energy storage facilities in Split-Dalmatia county.

5.3.4. Regional key technologies for supply

Key technologies for the Split-Dalmatia supply mix are hydro wind and solar. The total installed capacity of hydro power plants in Split-Dalmatia is 919 MW and is based on the hydropower system of the river Cetina

which includes: HPP Peruća, HPP Orlovac, HPP Đale, HPP Zakučac and HPP Kraljevac and small HPP Prančevići.

Even if PV solar energy is used in minor share, high values are registered for solar irradiation (1,35 to 1,6 MWh/m^2) and number of sunny days (reaching ~2700 on the islands) which is favourable for PV farms.

For the use of wind energy, the power carried by constant and moderate winds is favourable. In Split-Dalmatia local coastal circulation triggers such winds that blow from land to sea at night and from sea to land during the day. The installed wind capacities with the related potentials (m/s) at 80m of altitude are shown in Figure 46.

5.4. Regional demand-supply balance and development potentials

5.4.1. Regional-self supply rate

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

5.4.2. Energy efficiency potentials

The potential for increasing energy efficiency can be considered in three major sections, buildings, industry and transport.

The highest potential for increasing efficiency is always allocated to buildings with high percentage of usage (24/7). These are residential buildings, health institutions and care centres for young and elderly population. HVAC and lighting systems use to largest amount of final energy consumption and in these systems are highest potential for savings. Each building is specific and to allocate real potential is necessary to perform quality energy audit that will define and calculate potential and energy efficiency measure that can be applied. The most common energy efficiency measures are insulation of building envelope (and window replacement), installation of LED lighting system and increasing efficiency of HVAC systems.

The state and regional aid for implementing efficiency measures is often available and it helps presented efficiency measures to be more economically feasible.

The increase of energy efficiency in industry is mainly observed through increasing production process efficiency (device replacement), waste heat utilization projects and increasing efficiency of lighting systems. Increasing efficiency in transport is highly dependable of cities/municipalities action plans. The aim should be to increase percentage of electric vehicles in public transport and number of fast charging stations for electric cars.

5.4.3. Resource potentials

The largest resource potential in county are solar and wind energy. Biomass and hydro potential are also considerable as valuable resource potential as well as exploiting sea in the process of production heating and cooling energy (heat pumps).

5.4.4. Technology potentials

The heat pump technology is a big potential for increasing energy efficiency in buildings (residential and non-residential). The most common technology is air to air heat pumps, but highest potential can be achieved while using sea for cooling of condensate (in cooling season).

The waste heat utilization project in different fields of industry (fishery, meat and milk industry) also have large potential for future exploitation.

The technologies for using solar energy in heating, cooling and production of electricity as well as usage of wind power have high potential.

6. CO_2 Emissions

The CO_2 emissions on national level are currently around 15,8 million tons per year. The share of Split-Dalmatia is estimated at 1,2 million tons per year, whit the share of 8% in the national. As expected, the major share of regional emissions is derived from transport (59%), followed by residential (15%) and service (14%) while the industry represents solely 8%.

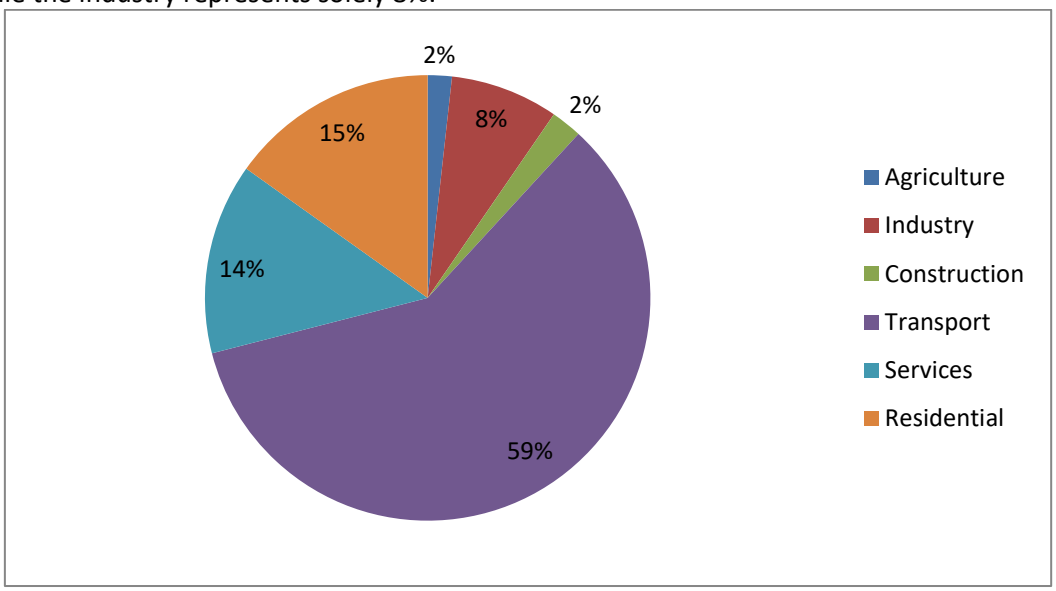


Figure 48 Share of sectors in regional CO_2 emissions from energy consumption

7. Key figures and bottom line of the situation

The Split-Dalmatia county is the largest Croatian county, with the population density (100,2 inhabitants per km^2) over the national average. However, it is experiencing negative trend in number of inhabitants in the past years following the population decline trends in the Republic of Croatia (-0,34% annually).

Regarding the GDP, the share of the regional economy in the national GDP is around 8,4%. Since the Split-Dalmatian County is a touristic oriented county being the 2nd in Croatia by the number of beds, the highest share of GVA on regional level is dedicated to Wholesale and retail trade, Transportation, Accommodation and food service activities (27%) while the industry is undoubtedly less present regionally compared to the national share. Moreover, real estate activities have a more significant portion (14%) of GVA on a regional

level compared to the national. Nevertheless, the average monthly net earnings in Split-Dalmatia county are below the national average for ~12.1% (9).

The highest development index is mainly recorded by cities and islands with significant tourism revenues. The least developed units, on the other hand, are located in the hinterland, especially in the wider area of Imotski (5).

Even though the national electricity mix disclosure is characterized by a high share of renewables ~67%, mainly due large hydro power plants (~54% of the total share), the share of renewables in national final energy consumption ~22% mainly due to the use of biomass. On regional level, the share of renewables in final energy consumption is even higher is app. half of the national, equal to ~30%.

The share of the transport sector in the total final energy consumption is 52%, followed by the residential sector with 24%.

As the only sources of supply located in Split-Dalmatia are hydro, wind and solar power plants, all energy generated on regional level is from renewable sources, even though mostly generated from large hydro power plants of the Cetina river.

The per capita rate of generated energy in Split-Dalmatia is 12,33 MWh/cap for electricity.

Regarding energy storage there are no such facilities in Split-Dalmatia county.

The transport sector is characterized by the dominance of road and maritime transport for both passengers and freight, while the number of tourist passengers in the Split Airport are intensively increasing each year.

The CO_2 emission value per capita is 2,8 tonnes per year regarding the whole final consumption and 0,4 tonnes per year in the residential sector only.

8. CONCLUSIONS

Considering that electricity has been the main source of heat energy in Split-Dalmatia over the years, decentralized systems such as heat pump technology or waste heat utilization in different fields of industry (fishery, meat and milk industry) have large potentials for future exploitation.

Forasmuch as the use of renewables final energy consumption, solid biomass has been the forefront source of heat energy over the past decades. Despite extremely favourable climate with high values of sunny hours during the year, solar energy for both electrical and thermal energy production have currently minimal shares in self-consumption.

In order to follow the path of achieving a low-carbon region, technologies for using solar energy for heating, cooling and electricity production, as well as wind power should be exploited along with smart decentralized energy planning.

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LIST OF FIGURES

LIST OF TABLES