

# National Energy Program CROTOK Energy Development on Islands

Historical development of the islands and their present situation can be clearly observed at Figure 1. showing the changes in demographic pattern in the last hundred years. The diagram shows that the decreasing trend is linear and very steep. If the emigration and mortal trends are not changed, the population shall drop very quickly and in 2005 it would be just a half of the year 1921-population level.

**The islands of the Croatian coast enclose a complete compendium of insularity-related problems of energy supply. Of the 717 islands distributed along the coast, all the inhabited ones are the subjects of this ambitious programme**

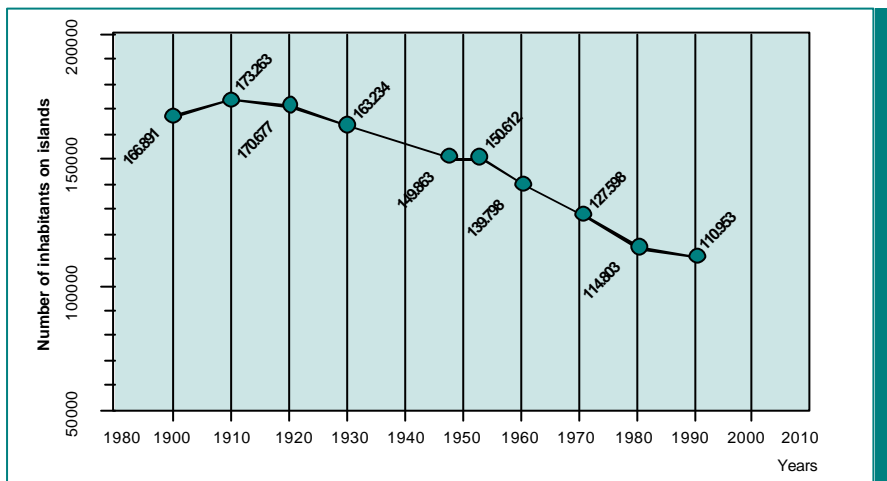


Figure 1: Number of inhabitants on islands (1900-1991)

The upgrading and improvement of living conditions on the islands, economic growth and preservation of environmental values, were the motives to introduce the National Program of Development of Islands. The Program is coordinated by Ministry of Reconstruction and Development of the Republic of Croatia and it systematically takes care of all segments of the problems related to the islands.

The Program recognizes the energy supply of the Croatian islands as a very important infrastructure component, which must be observed in the context of viable growth. That was the reason that the Energy Institute Hrvoje Popar started a specific national program CROTOK. The Program elaborates different aspects of energy

development of the Croatian islands. The Program has been started with the aim to improve energy economy of the islands, use of renewable energy sources, preservation of the environment, and to mobilize experts in accomplishing the tasks within the Croatian energy supply sector.

### Institutional framework of Energy Planning in Croatia

At the beginning of 1994 the Government of the Republic of Croatia adopted a new research project in the energy field called PROHES - Development and Organization of the Croatian Energy Sector. The preliminary results of the project's implementation which were published in 1995. have showed that there is a need for more

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detailed studies considering Croatian development both globally and by sectors. During 1996 seven studies were finished analysing future energy demand in industry, services, transport, building construction, forestry, agriculture as well as global economic development.

In March 1997, Government of the Republic of Croatia and all competent ministries and other state institutions and companies signed the agreement to manage ten national energy programs with the Energy Institute "Hrvoje Popar". The program's objectives are to develop a number of measures to overcome existing barriers for wider implementation of energy efficiency and renewable energy sources. The first phase of research on the projects lasted about one year and preliminary results published in the summer of 1998, served as a basis elements for the Draft study Energy Sector Development Strategy of the Republic of Croatia. The eleventh National Energy Program-CROTOK was started in 1999 as a part of the PROHES project. It is particular

organization of ten others national energy programs whose goals is to provide conditions for increasing energy efficiency, alternative energy use and environment protection on croatian islands.

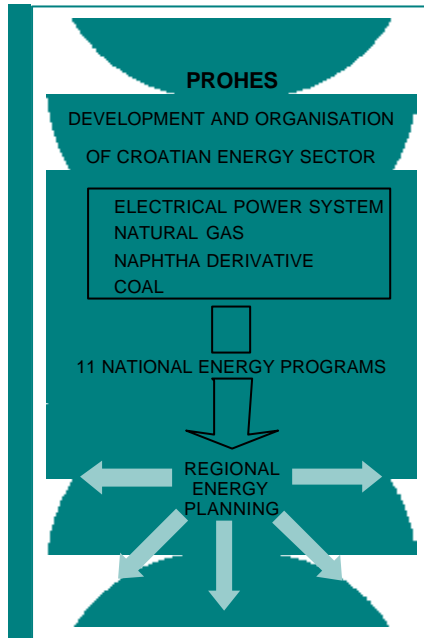


Figure 2:  
Organization of activities in the project PROHES

## National Energy Programs in Croatia

### PLINCRO-Gasification program in Croatia

Program objective is to increase use of gas in energy consumption structure as whole as a prerequisite for gas network expanding to all until now non-gasified regions. Currently, about 15% of Croatian households are connected to gas pipeline system and until 2025 the expected increase is about 40 %.

### KOGEN-Cogeneration Program

Currently, cogeneration plants contribute to almost 10 % of the Croatian electric consumption. Program objective is to obtain all preconditions and take off the obstacles for increasing cogeneration plants construction, everywhere where heat and electricity are used in technological processes.

### MIEE Network of Industrial Efficient Use of Energy

The network installing program objective is

to ensure all institutional, organizational and expert prerequisites for increasing energy efficiency in industry, service and public sector, based in experiences of developed countries.

### MAHE-Small Hydro Power Plants Construction Program

This program aims to provide all conditions for a great number of small plants construction. total amount of the installed power in small hydro power plants is 24 MW and technical potential is estimated at around 150 MW

### SUNEN - Solar Energy Use Program

This program objective is to give all legal, incentive, promotional and other prerequisites for significant solar energy use. At the present level, total potential of solar energy is estimated at 1,4 PJ in 2000, about 5 PJ in 2010 and about 15 PJ in 2020. The potential of passive solar architecture is estimated at about 350 TJ in 2000 and 6430 TJ in 2020.

### BIOEN- Biomass and Waste Use Program

The program plans to use waste-wood, straw, biogas, and other waste, and conversion from biomass to liquid fuel (ethanol, methanol). The total energy resources of biomass in Croatia are at about 50 PJ whereby 39 PJ makes technical energy resource that can be used today.

### ENWIND- Wind Energy use program

The program has shown that the yearly electric energy production from wind energy could be between 380 and 790 GWh on 29 locations analysed. apart from production of electric energy the wind generators can be used in water supply systems (desalination) what is also interested for the Adriatic islands.

### GEOEN - Geothermal Energy Use Program

In Croatia there is e hundreds years old tradition of using geothermal energy from natural resources for medical and bathing purposes. It is also possible to use thermal

potential in agriculture, hospitals, hotels, residential buildings, etc. The amount of geothermal energy resources of the known deposits in Croatia is 812 MWt and 45,8 MWe.

### KUENZgrada- Building Energy Efficiency Program

The program of energy efficiency in building construction includes the changes of regulation in order to favor increase of thermal insulation and reconstruction of existing residence buildings.

### KUENcts-Energy Efficiency in Centralised Thermal Systems Program

The aim of the program is to define all conditions for energy efficiency increase, ranging from thermal consumption measuring to the overall situation in the energy sector in terms of ownership and economy.

### CROTOK- Energy development on islands

The goal of the program of energy development on islands is to ensure institutional, organizational and expert prerequisites for increasing energy efficiency and alternative energy use on islands.

### Energy planning on Croatian islands

Regarding to the specific climate, economy and energy supply system in particular areas in the Republic of Croatia it is necessary to organize regional energy planning. The basic administrative unit of the regional planning of energy sector in Croatia is a county. In addition to that, the area of planning may include more counties at the regional level or certain specific parts of some counties, as for example, the Croatian islands.

However, regional development of energy sector must be in co-ordination with development on national level, especially with electric power and gas system as well as with system for oil derivatives production and distribution.

Energy offices will undertake the responsi-

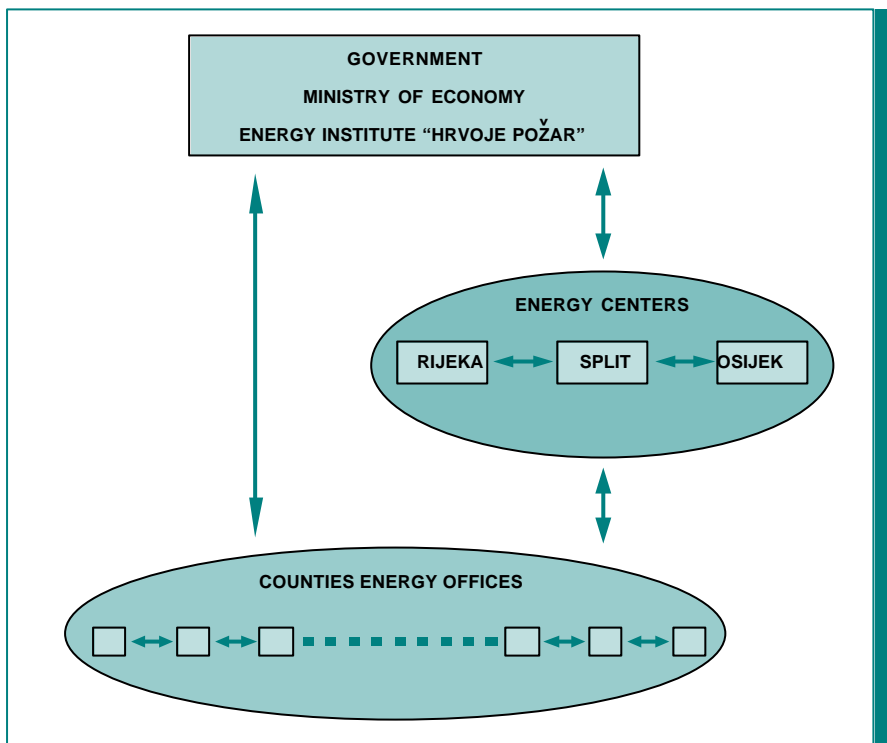


Figure 3: Relations between the country energy offices and regional energy centres

bility for the duration of the process of energy planning in the counties and for the implementation of the plans. Those offices will be given expert and scientific support for their activities by the Energy institute "Hrvoje Popar" and regional centres in Split, Rijeka and Osijek. Basically, a necessary level of uniformity in the methodological part of the co-operation between certain centres and offices would be in charge of Energy institute.

Croatian islands are a specific natural resource of the Republic of Croatia and their geographic and economic characteristics demand a special approach in management of energy generation and consumption. Therefore, they are organized as separate regional entity and corresponding Counties and their energy offices will take responsibility of energy development on islands.

### Methodological concept of energy planning on islands

The methodological concept of the island's energy system development is based on the regional energy system planning in the countries of the European Union using the

Least-Cost Planning and Demand Side Management methods. In Croatia, such experiences were achieved through the project Regional energy planning in Istria (Sinergy, Exergija, EIHP). The development plan evolves in two phases. The first phase is the elaboration of the starting points followed by the definition of the development plan for the improvement of energy efficiency and renewable resource utilisation. Both phases, including the individual steps, are shown in figure 4:

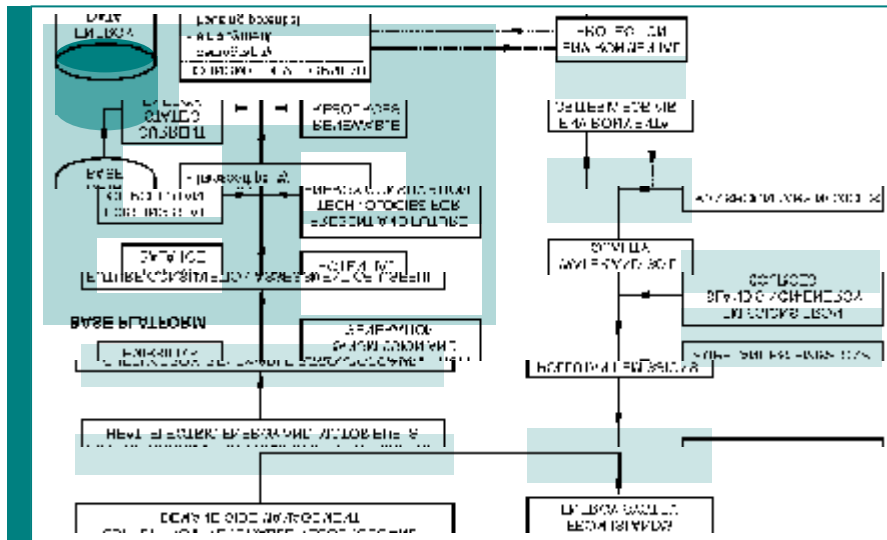
- Economic development of the island determines its energy system development, therefore it is necessary to conduct an analysis of all available resources.
- Energy data base shows the current state of affairs of the energy consumption and at the same time creates the basis for further planning of the island's energy system development. It consists of individual consumer categories and energy consumption according to structure and purpose (heating, non-heating, cooling). Most of the data necessary for the elaboration of the data base can be gathered through public

opinion polls with the authorized institutions furnishing some general data.

- Renewable energy potential is elaborated based on the location records of all possible renewable energy resources.
- Housing potential data review the existing buildings according to their purpose, type, age, heating conditions etc., and are also gathered through opinion polls.
- Pollutant emissions with the existing energy consumption result from the present records and measurements.
- Analysis of current consumption and future needs of useful energy in all consumption sectors is performed by means of several scenarios. It is based on the main economic development guidelines and some other elements such as demography, climate, technological progress, etc.
- Possible renewable resource utilisation and energy efficiency enhancement in order to meet future needs: The competitiveness of the renewable energy potential is compared to the classical supply systems in time sequence. Improved energy efficiency in hotel business, industry and building construction also affects future supply and profitability of investments.
- According to the foreseen scenarios of energy consumption and supply, pollutant emissions create a limiting factor which will bear influence on the structure of the energy consumed.

### Preliminary results of investigation on the project CROKOK

The preliminary results of investigation on the program CROKOK show present energy consumption and predictions of future energy demands until 2020. The year 1996 has been taken as a reference year for which detailed energy consumption data by energy form and energy use are available. Projections of future energy demands have been made according to the general development projections, infrastructure development, the protection of the



## Total thermal energy consumption on islands in 1996

Figure 4 shows total thermal energy consumption on islands according to their geographical position and consumer category in 1996. Total amount of used energy was 1206 TJ, 74 percent belonging to households, 16 percent to services and 10 percent to industry.

## Prediction of future energy demand on islands until 2020

Base year energy consumption is the main prerequisite for the elaboration of energy balances. The table 1 and figure 5 show increasing trends for all three categories of consumption: households, industry and services.

Total end-use energy demand on islands in 2020 will be 2,38 times bigger than in 1996. The highest increase will have the service sector because of the planned intensive development of tourism as a leading economy branch on islands.

With that the share of service sector will increase in total consumption. Energy consumption in households will also rise. Until 2020 their demand will increase about twice. It is predicted that the number of inhabitants on islands will rise. Also, a better living standard is predicted, so the average yearly consumption per households will grow up as well.

Also, energy consumption in industry and agriculture will rise, however their share in total energy consumption will stay the same.

## Conclusion

Croatian islands present an enormous natural resource which requires a special attention and care on the state level. The purpose of the program CROTOK is to help energy system development on the islands in order to create conditions for a high-quality management of energy generation and consumption. Owing to specific geographical and climatic conditions the renewable energy resources and energy efficiency measures are going to play a

human environment, the development of the economic activities as well as the development of social activities.

Energy system on islands is analysed through three consumer categories: households, services and industry.

Agriculture is not developed, so its consumption, compared to others sectors, is not significant.

## Energy consumption on islands in 1996

### Households

Among 717 islands in Croatia 66 of them are inhabited, and 110953 inhabitants live on them. The majority of the population lives on 15 islands while less than 5 percent live on others. The total number of households is 39643, but this number is bigger during the summer period when people from mainland come to their holiday houses.

Households are the major energy consumers on islands. Concerning the energy structure and needs they are in comparison to the continental part of Croatia. Average annual energy consumption in a household is calculated from the data obtained from a questionnaire which was conducted on several islands. Results show that one household needs 46,43 GJ per year for its thermal and non-thermal purposes as well as for the cooling and overall consumption on islands is 1842,17 TJ. The most useful

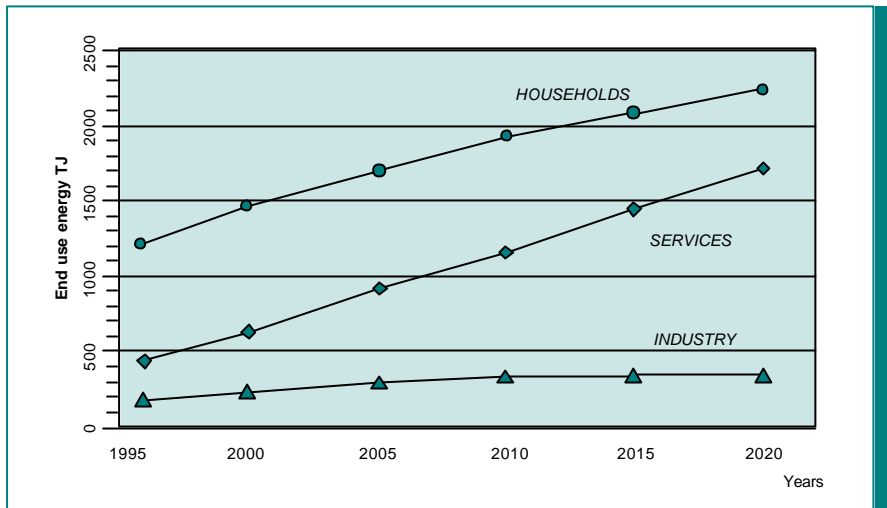
energy source is fuel wood and its share in overall consumption is 50 percent. Electricity has very high share of 36 percent as a result of its intensive use for thermal purposes (heating, cooling and hot water). Light oil and LPG have shares less than 10 percent.

### Services

The service sector on islands comprises tourism and catering, trade, health, education public administration and others. Regarding to the fact that tourism is the most developed branch on islands this sub-sector is the largest energy consumer in service category. Total accommodation capacity on islands is 129 305 beds, and 29 percent of that number belongs to the primary capacities (hotels). Total energy consumption in services in 1996 is 477 TJ, 54 percent of that energy is used for thermal purposes, 38 percent for non-thermal purposes and the rest for cooling. Mostly fossil fuels are used for thermal purposes while other demands are covered by electric energy.

### Industry

Industry on islands is very poorly developed, but there is shipbuilding, textile industry, plastic production, salt industry and architectural and building stones extraction. In 1996, 250 TJ, mostly fuel oil and electricity, in this sector was consumed.



crucial role when defining future development tendencies. They will help develop a system which meets all world standards and regulations in relation to environmental protection and preservation. Apart from positive environmental effects, the program

is expected to have a wide social and economic influence such as an improved standard of living, employment, infrastructural development and modernisation and the enhancement of agriculture, industry and tourism.

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## Basic information on Croatian islands

Croatian Islands are the second largest archipelago of the Mediterranean Sea. They encompass all islands of the Adriatic East Coast and its central zone. There is a total of 1185 islands, including 718 islands, 389 sounds and 78 reefs. They determine the territorial sea of the Republic of Croatia, which makes 37 per cent of its overall territory. The total surface of the archipelago is 3300 km<sup>2</sup>, which is 5.7 per cent of the total national land territory.

They are situated in the area with Adriatic type of Mediterranean climate. Summers are hot and dry, winters are mild and wet, and the insolation degree is high. July average temperature range from 23,7°C to 25,6°C. Croatian islands are among the areas in Europe most exposed to the sun, the annual average of insolation ranges from 2200 to 2650 hours of sunny weather, which means over 7 hours of sun daily. The regime of precipitation is typically Mediterranean. There are 266 to 1141 mm of precipitation. Adriatic Sea belongs to the group of warm seas. The sea surface temperature in winter period does not drop below 10°C and during summer season it can reach up to 25°C.

