

# Sustainable energy for public building, Example of the City of Rijeka

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## ABSTRACT

Sustainable energy development becomes one of the crucial issues for every municipality. Reductions of fossil fuels which are used in public buildings together with grow of investments in energy efficiency and renewable energy creates strong challenge for local municipality government. Preservation of local cultural heritage and local architecture recognition could be in danger by non organized investments in "green" technology. Simultaneously, overprotected and overregulated reconstruction of cultural heritage buildings usually do not lead to diminishment of energy consumption. Authors of this paper analyzed recent sustainable energy project in the city of Rijeka Municipality building, which was originally built in 1915. Although Municipality building is located in the center of the city and protected as cultural heritage, Conservatory department in Rijeka and Municipality, together with investor Energo Ltd. created solutions which have satisfied all included parties. In the year 2009 first photovoltaic power plant of 9.9 kWp has been installed and put in service on the upper terrace of the building. That was technically and financially acceptable for the owner of the building, as well as for the investor. Next year, City of Rijeka accepted Sustainable energy action plan (SEAP) and started with implementation of smart metering in that same building. Further analyses of those projects lead to conclusion that similar investments could be carried out in order to match energy sustainability and economic feasibility in cultural protected buildings.

**Key words:** city, solar energy, energy efficiency, smart metering, energy management, feasibility

## 1. INTRODUCTION

The coexistence of the energy and the city, represent a condition of sustainable development of urban areas. Reductions of fossil fuels which are used in public buildings together with grow of investments in energy efficiency and renewable energy creates strong challenge for local municipality government. The process of liberalization of energy markets in most of the European countries enables consumers to choose between types of energy or energy companies.

Gathered literature and field research led to conclusion that energy liberalization empowers the customers' position and allows open market game between competitors. Recent liberalization of the Croatian energy market characterize privatization of utility energy companies, attempts for energy market regulation and beginning of competition that will led to transformation in the electricity, gas and district heating companies. Taking into consideration other energy market literature [1,2] statistical data and field research, certain conclusions appear where this research indicates that Croatian market liberalization is undeveloped and strictly regulated by the government regulated market although legal framework is more almost similar to European. Local government should put great efforts in making energy strategy that will satisfy future energy needs and protect environment of urban areas. Therefore, City of Rijeka adopts Sustainable energy action plan (SEAP) measures which are significant management tool. Authors of this paper analyzed recent sustainable energy project in the City of Rijeka Municipality building, which was originally built in 1915. Further research results enhance benefit of the investment in the photovoltaic power plant and implementation of smart metering. Further analyses of those projects lead to conclusion that similar investments could be carried out in order to match energy sustainability and economic feasibility in cultural protected buildings.

## **2. SUSTAINABLE ENERGY IN THE CITIES**

The advantages of energy efficiency have been quantified on the local level as tons of air-pollutants avoided and money saved. Reduction in global GHG emissions is also quantified with the benefit of reduced warming affect. Sustainable Energy Communities can be defined as: local communities in which politicians, planners, project developers, market actors and citizens actively co-operate to develop high degrees of intelligent energy supply, favoring renewable energy sources, together with a conscientious application of energy efficiency measures<sup>1</sup>.

Local community planning for the efficient use of energy, renewable energies and associated mobility stimulate local energy planning and integration of energy plans in the local development scheme. Also, actions reinforce the energy sustainable development plans targeted for local level that launch concrete projects for the establishment of sustainable energy communities [3].

The Covenant of Mayors (CoM) represents unconditional commitment of cities and regions to cut their CO<sub>2</sub> emissions at least by 20 percent, by the year 2020. Also it demonstrated the strong local support for active involvement in sustainable energy planning, as well as reduction dependence on foreign energy and increase of energy efficiency. In January 2011 more than 2181 cities around Europe signed the Covenant of Mayors<sup>2</sup>. The CoM must be used as a successful multilayer governance test in the energy and climate field, and cities must be given their rightful place in it. Rijeka is among the first Croatian cities that have signed the Covenant of Mayors, with the objective of bringing together European cities in a permanent network to exchange experiences on improving the energy efficiency of urban areas and reducing CO<sub>2</sub> emissions by more than 20%. This movement of European cities

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<sup>1</sup> Intelligent Energy Europe (IEE), Sustainable Energy communities, Brussels, 2006.

<sup>2</sup> <http://www.eumayors.eu> (January 2011)

indicates how local community's power can become a significant body in the decision making policy for energy management and sustainable development. It could also be seen as the implementation of a "bottom-up" principle of management and a decision making process for energy questions regarding the community. National or federal action plans that enhance energy and environment problems cannot be taken into consideration separately from the local community's needs and priorities. Interdependence and diversification of energy supply and energy distribution represent the crucial issues for every future sustainable development planning of local communities. The Mayors nowadays have the opportunity to start a new energy policy based on energy efficiency, renewable energy resources in order to diminish emissions of CO<sub>2</sub> and thus to have an impact on the climate change initiative [4]. In essence, the city's energy management should represent a combination of activities that will bring together the community's needs and strategic goals of most energy organizations, which are: profitability and growth in the market share. A successful sustainable development strategy requires consideration of those influences which integrate various management functions into a sustainable community.

Critical point in each local government's energy management is planning and development of its own Sustainable Energy Action Plan (SEAP). In principle, it is anticipated that most SEAPs will include actions in the following sectors: built environment; municipal infrastructure (district heating, public lighting, smart grids, etc); land use and urban planning; decentralized renewable energy sources; public and private transport policies and urban mobility; citizen and, in general, civil society participation; intelligent energy behavior by citizens, consumers and businesses. The SEAP should include actions concerning both public and private sectors. Quality city energy management becomes not only matter of future prosperity but also a matter of economic, social and intellectual development of each urban area. Several European cities already have imposed strong will and high standards in energy management, in order to diminish GHG emissions and support control of climate change.

The energy consumption review of the above sectors produced input parameters for the Baseline CO<sub>2</sub> Emissions Inventory for the City of Rijeka in 2008. Consequently, the respective quantities emitted and the shares of the individual sectors in the City's total emissions are as follows [5]:

- Buildings – 200.358 t CO<sub>2</sub> or 53%;
- Transport – 175.224 tCO<sub>2</sub> or 46%;
- Public lighting – 2.688 tCO<sub>2</sub> or 1%.

Measures to improve energy efficiency for the buildings, transport and public lighting sectors of the City of Rijeka have been selected and outlined in the Measures and Actions Plan to reduce CO<sub>2</sub> emissions by 2020 according to the methodology developed to elaborate this Action Plan and in line with European Commission guidelines.

As a significant operational advantage city of Rijeka remained majority of ownership in regional energy company of Energo, which is gas and district heating distributor and public lighting management company. Several sustainable energy projects in the city of Rijeka have been done in last five years like: building of gas distribution network and automatic control of district heating plants, energy consultancy and

energy auditing of building, metering and cost allocation for district heating or cogeneration, but in this paper further analysis of feasibility and environmental impact will be given renewable solar energy production and smart metering.

### 3. ENERGY MANAGEMENT OF THE CITY OF RIJEKA

Rijeka City council building was the first example of the new sustainable energy policy proclaimed by the city government. Building was built in 1914, in late historicism style, for the original owner Cassa Comunale di Risparmio - Ugarska banka, Fiume. Over the years building functionality and its location, in the main pedestrian street in Rijeka, create important part of city identity. Two sustainable energy projects were made in this building: renewable photovoltaic (PV) electricity production and smart metering, which are going to be discussed in this chapter.

According to Croatian national energy strategy supports production of renewable energy through subventions, Feed-in tariff [6] for every registered renewable energy power plant. Production of electricity from sun power is categorized in three tariffs, with different purchase price, dependable upon installed power of the plant. Renewable energy sources represent new energy future for cities. Use of renewable energies offers the opportunity to diminish energy dependence, reduce the emission of CO<sub>2</sub> and create new employment. City of Rijeka declared to support renewable energy use by investing in photovoltaic energy plants up to 30 kW of installed power on public buildings roofs.

Figure 1: PV system on city of Rijeka Municipality building

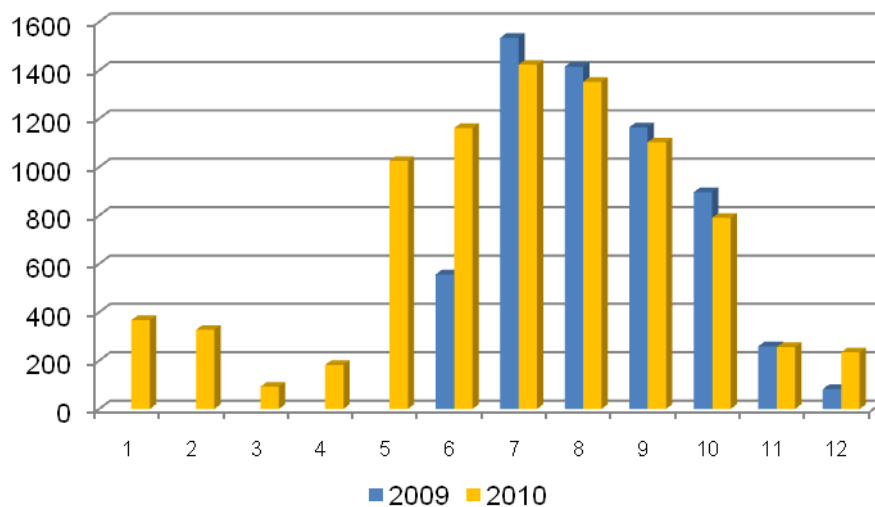


Source: Energo and City of Rijeka, May 2009

First solar power plant was built in June 2009 on the Municipality building, in the centre of Rijeka. This project was bright example of mutual understanding between Conservatory department, Municipality and Energo as investor, due to a fact that Municipality building is in the culturally protected area of the city, which bans PV installations on the buildings roofs. Three parties made an agreement to install PV equipment on upper terrace of the same building, which has same insulation during the day. Total installation power is 9,9 kW and year predicted electricity production is around 12.000 kWh. Figure 2 demonstrates actual annual electricity production in kWh, which was in 2010 approximately 9.000 kWh. Difference between predicted and actual production was due to a minor technical problems with the system, and consequently lower electricity production in March and April. Nowadays, total

electricity production is used for building electricity needs while the process of feed-in tariff registration is still going on.

Figure2: Total PV electricity production in kWh



Source: Energo, January 2011

Further research of PV investment feasibility demonstrates positive net present value and solid 9,17 percent of IRR. Calculations were made with the feed-in tariff selling price of 0,51 EUR per kWh electricity production and sale to the grid, for the next 12 years, according to the Croatian regulations. After that period all electricity produced will be used inside the building for domestic needs. Depreciation period of the plant is 20 years, but after that period efficiency of the plant will decrease to 80 percent of energy production, so energy production will not be lost, newer the less, that production represents future revenues.

Croatian Government and United Nation Development Programme (UNDP) project "Bring your house in order"<sup>3</sup> aims to improve energy efficiency through reduction of energy consumption in national, regional and local government buildings. In order to process monitoring and automated analysis of energy consumption first pilot project of remote reading of energy consumption, among few other government buildings, was carried out in the city of Rijeka Municipality building. Project will allow automated collection of consumption data of electricity, gas and water. Smart metering appliance is configured to communicate with a central unit for data collection and processing. Electrical part of the installation consists of a communication device and LCD graphical and tabular view of all metering quantities. The system works on the principle of the common practice in the collection of consumption quantities, using industry standards. Data collecting of the size scale of energy consumption is carried out through CPU which is integrated locally and through communication device which sends data to the central system of UNDP. Collected data also could be seen and run locally on the above-mentioned LCD display accessible also to the public. Particular attention in this case deserves a separate system for the production of electricity from renewable sources which is used as the basis of photovoltaic panels mounted on the terrace of the building. Described smart metering system will help

<sup>3</sup> <http://www.energetska-efikasnos.undp.hr> (January 2011)

City government to monitor building consumption in order take measures of the energy efficiency, according to a Rijeka's SEAP.

#### 4. CONCLUSIONS

The instability of energy market and environmental issues has brought out to surface importance of local government management in order to establish sustainable energy development of urban areas. Considering all presented facts, it is safe to assume that investments in green energy will represent an important factor in future economy and development of local community [7]. Because of the increasing demand for energy in public sector and citizen lifestyle, additional infrastructure has to be built to guarantee a high level of public service. Further conclusion indicates that energy planning initiatives, undertaken by the local community government and networking established through Covenant of Mayors becomes operating management issue for local sustainable energy development. Local community renewable and energy efficiency projects in the cities could be feasible and environmentally friendly at the same time. That conclusion is given thought taken analyses of two energy projects in the Croatian city of Rijeka: photovoltaic electricity production and energy efficiency through smart metering. That is why example of city of Rijeka could be taken as a key model for the other cities. Thus, as a final conclusion, sustainable energy in public buildings should be under serious analysis and action planning of every local community government in order to develop carbon free society.

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