LOCAL GOVERNMENTS' ENERGY MANAGEMENT IN THE EXAMPLE OF THE CITY OF RIJEKA

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Abstract:
Challenges of climate change, new environmental legislation and the liberalization of energy markets encouraged local government to practice energy management. Therefore, the subject of this research is investment feasibility into the public sector of energy efficiency. That investment represent important strategic goal for local community's sustainable development. This paper analyse feasibility and environmental impact in the example of the city of Rijeka investments in public lighting and solar electricity production. Authors made financial analysis together with energy consumption and environmental impact research which carried out feasibility and environmental acceptance of those investments.

Keywords: management, energy efficiency, solar, local government and feasibility

Introduction

Consequences of climate change have daily impact in lives of all inhabitants on our planet. In year 2009 for the first time number of the total urban population exceeded total number of rural areas population. Facts that more than three billion people live in urban areas, such as the megalopolis, capitals or cities, and that their number increase each day creates preconditions for the new management of energy market by the local government. Serious threat of fossil fuels disappearance and high level of greenhouse gas (GHG) emissions from oil, gas and coal caused liberalization of energy markets, energy coalitions between states and energy companies plus acceleration of renewable energy sources market growth.

The world energy sector relates to the emissions more than 65 percent. In 25 European countries even 80 percent of all emissions come from energy conversion, mostly from electricity production and transport.[1] Such a situation represents a serious problem for local governments and calls for new sources that do not pollute the environment or have low emissions of green house gases. The relation between the energy consumption and environmental protection represents challenge for local government sustainable development. Therefore, constant research and financial inputs in renewable energy sources (solar, wind

[1] Novak P., (2008), Transforming Europe to a Competitive Low Carbon Society – Why not?, *International Congress Energy and Environment*, Vol.1., Opatija, pg. 1-12.

and water power), energy efficiency and other alternative methods of energy production will create a new energy market together with a new energy customer.[2] Recent movement of European cities, empowered by signing of the Covenant of Mayors (CoM)[3] indicates how local government's power can become significant body in the decision making policy for energy management and sustainable development. Further research in this paper will analyze several energy projects in the city of Rijeka, such as public lighting, and renewable electricity production from solar power. Further survey will discuss feasibility of those projects and their correlations with environmental impacts as an added value. Also, management methods of local government will be stressed out.

Accordingly, research conclusions indicate that energy management of local government can contribute to significant reductions in the consumption of energy in public services, and have great impact on sustainable energy development for the local community. The purpose and the aim of the research are closely connected and they concentrate on necessity of local government's energy management methods and strategies during the energy market liberalization process. Furthermore, environmental measures and carbon-dioxide (CO_2) emissions restrictions and trading are examined to determine their connection with the energy market liberalization. These factors where taken into account in the interdependence analysis and will be carried out by testing the following hypothesis: local government's investments in sustainable energy projects can be both: cost effective and environmentally acceptable.

The subsequent sections of this paper are organized as follows: the second section discusses the influence of energy market liberalization and local government answers to that challenge; section afterwards brings city of Rijeka energy projects feasibility and environmental impact analyses. The concluding section summarizes research results and states the paper's conclusions.

Energy and the City

The coexistence of the energy and the city, represent a condition for sustainable development of urban areas. The process of liberalization of energy markets in most of the European countries enables consumers to choose between types of energy or energy companies. Technology development allows citizens that in the 21 century produce energy in their homes or buildings and than resale it to the free energy market. Local government, as representatives of the citizens, but also as large consumers of energy for the public sector, should work hardly on energy strategy that will satisfy future energy needs and protect environment of urban areas.

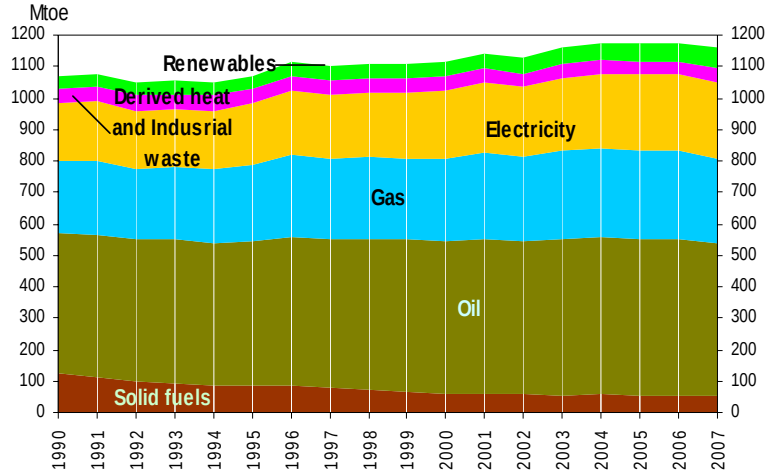
Liberalization of the Energy Market

Early in 2007 the European Union proposed a new Energy policy[4] as a first resolute step towards becoming a low-energy economy, whilst making the energy we do consume more

[2] Benthien, J., (2007), Energy and environment, *Focus Denmark*, Ministry of Foreign Affairs of Denmark, The Trade Council, March, Copenhagen.
[3] http://www.eumayors.eu (21.12.2009.)
[4] European Commission (2007), An Energy Policy for Europe, *Communication for the Commission to the European Council and the European parliament*, COM, January, 1 final.

secure, competitive and sustainable. A common policy is the most effective way to tackle today's energy challenges, which are shared by all member states and local municipalities. The policy puts energy back at the heart of EU action. The aims of the policy are supported by market-based tools (mainly taxes, subsidies and the CO_2 emissions trading scheme), by developing energy technologies (especially technologies for energy efficiency and renewable or low-carbon energy) and by Community financial instruments.

Figure 1: Final Energy Consumption –EU27 (Mtoe)



Source: Eurostat, May 2009; http:www//ec.europa.eu/energy/publications/statistics/statistics_en.htm (10.01.2010.)

Presented data in Figure 1 and Table 1 indicate larger percentage of fossil fuels consumption together with significant growth of renewable energy, especially in the most developed European countries. Ambitious goals of new EU Energy policy will encourage energy investments in energy efficiency and green energy production such as renewable and nuclear energy. Those trends should be followed or established in every city energy strategy.

A systematic reform of the energy market comprises the decentralization and the liberalization of energy production, distribution and sales. The major issue of such a reform is to diminish the monopoly in the distribution of electricity and gas. The process of liberalization aims at empowering the position of the customer in the market and to open the market game among competitors.

The electricity and gas producers and distributors were not as long ago considered as utility companies owned mostly by the city or county government. The privatization of energy utility companies and their legal transformation from public into open economy businesses have put cities under a great responsibility for their future sustainable development. Cities or regions could not grow and have sustainable development without their impact on energy management. This thesis could be acknowledged by the example of the State of California and its 21st century electricity market crises situation, where the community's rapid demand for electricity was not followed by proper private electricity company investments, with the aim to satisfy the needs of the community[5].

[5] Block, M. K., (2001), California's electricity crisis and the law of unintended but predictable effects, The progress and freedom foundation, Progress on Point 8.10, Washington D.C., May 2001

Table 1: Gross Energy Inland Consumtion per EU27 Country and Croatia in 2007 (Mtoe)

Country	All fuels	Solid fuels	Oil	Natural gas	Nuclear	Renewable	Other*
BE	57,4	4,6	22,6	14,9	12,4	1,8	1,0
BG	20,3	7,8	5,1	3,0	3,8	1,0	-0,3
CZ	46,2	21,4	10,0	7,2	6,8	2,2	-1,3
DK	20,5	4,7	8,3	4,1	-	3,6	-0,1
DE	339,6	87,0	112,7	76,6	36,3	28,1	-1,1
EE	6,1	3,7	1,2	0,8	-	0,6	-0,2
IE	15,9	2,3	8,7	4,3	-	0,5	0,1
EL	33,5	10,8	17,2	3,3	-	1,7	0,4
ES	146,8	20,2	70,8	31,9	14,2	10,3	-0,5
FR	270,3	13,4	90,9	38,5	113,4	19,0	-4,9
IT	183,5	16,8	80,3	69,5	-	12,7	4,1
CY	2,7	0,0	2,6	-	-	0,1	0,0
LV	4,8	0,1	1,6	1,4	-	1,4	0,3
LT	9,2	0,3	2,8	2,9	2,5	0,8	-0,1
LU	4,7	0,1	2,9	1,2	-	0,1	0,3
HU	27,0	3,1	7,6	10,7	3,8	1,4	0,4
MT	0,9	-	0,9	-	-	-	-
NL	84,5	8,4	37,2	33,4	1,1	3,0	1,5
AT	33,8	3,9	13,9	7,0	-	8,0	1,0
PL	98,0	55,5	25,1	12,4	-	5,0	0,0
PT	26,0	2,9	14,0	3,8	-	4,6	0,6
RO	40,1	10,2	10,2	13,0	2,0	4,8	-0,1
SI	7,3	1,6	2,6	0,9	1,5	0,7	0,0
SK	18,1	4,0	3,9	5,1	4,0	1,0	0,2
FI	37,6	7,2	11,0	3,7	6,0	8,5	1,1
SE	50,6	2,7	13,9	0,9	17,3	15,6	0,1
UK	221,1	38,7	78,7	82,0	16,3	4,6	0,8
EU27	**1806,4**	**331,2**	**656,9**	**432,4**	**241,3**	**141,0**	**3,5**
HR	9,4	0,7	4,7	2,7	-	0,7	0,5

Source: Eurostat, May 2009; http:www//ec.europa.eu/energy/publications/statistics/statistics_en.htm (10.01.2010.)
*Electrical energy and industrial waste

These transformations of the energy market are reflected more clearly on daily bases of the local communities. How to overpass the energy market liberalization barriers and at the same time not to endanger the cities' sustainable development and meet the needs of the population? Possible solution could certainly be an energy efficiency management of public services or buildings under the city authority and new investments in renewable energy for local needs.

Privatization and liberalization create incentives for outsourcing services on a competitive basis. As energy trading rising and markets become more liberal, more innovative pricing options and financial instruments are being developed to manage price risks over time. Together the structural changes increased the international role of energy services to support competitive markets of oil, gas, electricity and other energy products.[6]

[6] Dahl, C. A., (2008), Međunarodna tržišta energije – cijene, politike i profiti, Kigen, Zagreb.

According to other author the energy efficiency in the cities can certainly make changes in environmental protection and it could reduce the energy needs of the city for future sustainable development.[7] Also, new environmental movements have created legislation and trading system for GHG emissions, moving toward the renewable energy sources and the energy efficiency. The emissions trading regime for Europe, according to some literature will conform to energy liberalization and will become subject to energy markets, particularly with respect to the upstream energy sector and electricity generation.[8] Other authors (Ilie, 2007., Bazart, 2003.) suggest that the liberalization of the energy market is a long process and its overall aim is to increase efficiency through competition. Greater efficiency leads to lower costs and prices, which improves competitiveness that is crucial for energy companies competing in a global market.

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 (Stanić, 2007., Višković, 2008.), statistical data and field research, certain conclusions appear that Croatian market liberalization is undeveloped and strictly regulated by the government, although legal framework is almost similar to European.

Gathered literature and field research led to conclusion that energy liberalization empowers the customers' position and allows open market game between competitors. It also improves the security of supply by encouraging investments in facilities, in order to prevent interruptions of energy supply, and at the same time diversifying the transport routes and energy sources. The existence of a truly competitive energy market goes in favour with sustainable development, notably by enabling suppliers of renewable energy electricity to enter the market.

Sustainable Energy Communities

The advantages of energy conservation have been quantified on the local level as tons of air-pollutants avoided and money saved. Reduction in global GHG emissions are also quantified with the benefit of reduced warming affect. Sustainable energy communities (SEC) 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.[9]

Benefits of SEC when fighting the climate change and improve the security of energy supplies could be:

- Communities will benefit from visibility as forerunners in the field of intelligent energy management.
- Adoption of SEC strategy documents will lead to smarter and better targeted local development.

[7] Rajan, G. G., (2002), *Optimizing Energy Efficiency in Industries*, McGraw-Hill, New York.
[8] Muir, M., (2002), European Energy Liberalization and the Integration of Eastern Europe with EU Energy Markets and Environmental Initiatives, *ENERGEX Conference*, Krakow.
[9] Intelligent Energy Europe (IEE), (2006), Sustainable Energy communities, Brussels; http://www.ec.europa.eu/energy/intelligent (22.12.2009.)

- Implementation of sustainable energy actions will lead to cleaner more pleasant local environment.
- Involvement in the SEC-network will provide opportunities for know-how exchange on intelligent energy initiatives.

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 component of sustainable development plans targeted at local level and launch concrete implementation measures for the establishment of sustainable energy communities.

The Covenant of Mayors (CoM) represents unconditional commitment of cities and regions to cut their CO_2 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. Since February 2009 more than 1220 cities around Europe signed the Covenant of Mayors[10]. 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.

This movement of European cities 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 can not 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_2 and thus to have an impact on the climate change initiative. In essence, the city's energy management should represent a combination of activities that will bring together the community's needs and profitability.

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 civil society participation, consumers and businesses. The SEAP should include actions concerning both public and private sectors.

Energy Management of the City of Rijeka

Quality energy management in the city 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,

[10] http://www.eumayors.eu (10.01.2010)

in order to diminish GHG emissions and support control of climate change. Some cities, like Helsinki seeks to reduce CO_2 emissions per capita by 39 percent by the year 2030 in relation to 1990 level[11]. Other European cities, like Freiburg or Barcelona, set up similar goals to be achieved.

Republic of Croatia considers sustainable development and future national and community energy consumption planning as a matter of national priority. Project "Systematic energy management in cities and counties of the Republic of Croatia" organized by United Nations development program (UNDP) Croatia, with support from Croatian Government, started in year 2006.[12] Results of the project indicate that without local community's support for energy efficiency, relevant changes in city energy consumption behavior could not be done. Croatian pioneer city in energy efficiency and energy management is the city of Rijeka.

Similar to other European former heavy industrialized cites in the 20th century, with population around 150.000 people, Rijeka is trying to implement sustainable energy action plan combining three mayor goals to be achieved by the year 2012. Those goals are:

- to increase energy efficiency by 10 percent
- to increase use of renewable energy by 10 percent
- to diminish CO_2 emissions in public transportation by 10 percent.[13]

City of Rijeka has majority of ownership in regional energy company of Energo, gas and district heating distributor and public lighting management company. Also, city of Rijeka was among the first European cities that signed the CoM and become a member of European energy cities association "Energie-Cites", in 2007. 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 were made on public lighting and renewable energy production with photovoltaic system.

Sustainable Public Lighting

Public lighting in urban areas represents significant cost to municipality year budget, taking approximately three or four percent of the city total electricity consumption. The city of Rijeka starts in 1998 with energy efficiency public lighting project. The main objectives of the project were reduction of energy consumption in public lighting and diminishment of lighting pollution. Other objectives were promotion of energy efficiency methodologies, monitoring and public lighting management.

Project was divided into three different phases: a) management of the project and development of Geographic information system (GIS) infrastructure; b) investment and maintains (financial) planning; c) measurement and evaluation of the project. The fourth phase, communication campaign, started by the end of 2007 in order to disseminate the information of the project and to promote this project methodology to other municipalities in

[11] Helsinki Metropolitan Area Climate Strategy to the Year 2030, http://www.ytv.fi/climatechange (15.01.2010)
[12] http://www.energetska-efikasnost.undp.hr (21.12.2009.)
[13] City of Rijeka, (2008), Energy Development of the City of Rijeka – Four years plan of activities, Rijeka.

the region. Public lighting solutions in the city of Rijeka where recognized worldwide as energy efficient and sustainable public lighting.[14]

Table 2: Public lighting in the City of Rijeka (2003-2008)

Year	Number of public lights in city of Rijeka					Total electricity consumption in public lighting per year (kWh)	Average year electricity consumption per public light (kWh)
	Total	EE* public lights	%	Non EE* public lights	%		
2003	11.572	6.627	57%	4.945	43%	8.643.000	746,89
2004	11.920	7.511	64%	4.393	36%	8.570.000	718,96
2005	12.141	8.309	68%	3.832	32%	8.635.000	711,23
2006	12.459	9.233	74%	3.226	26%	7.720.000	619,63
2007	12.627	9.695	77%	2.932	23%	8.284.000	656,05
2008	12.765	10.185	80%	2.580	20%	8.322.000	651,94

Source: Energo Ltd., (2008), Public lighting year report, Rijeka.
*EE – energy efficiency

Modernization includes the replacement of environmentally unacceptable lamps by those with less installed power and better illumination characteristics. Old non energy efficient mercury bulbs were replaced with more efficient sodium lamps. Also, control of the light flow was improved plus late night hour's reduction of damping consumption was implemented, especially when traffic intensity is rare. All those changes contribute to a large savings in maintenance because sodium lamps have almost 100 percent longer lifetime then mercury lamps and lower electric consumption for 30 percent. As an added value, efficiency of the entire system was improved. Significant fact represents average efficiency per public light, which is 94,95 kWh per year in 2008 in relation to year 2003. That is 13 percent of efficiency improvement directly linked with costs saving for electricity. Today's average price for public lighting in Croatia is 1,5 cents per kWh[15] (VAT included). From now on, savings on total electricity consumption (revenues), without any new investment in Rijeka's public lighting are approximately 150.000 Euro per year.

In the beginning of 2003 there were 11572 public lights in the city of Rijeka and only 57 percent of them were energy efficient. During the period of six years, city of Rijeka invested in new public lighting more than 2.500.000 EUR. Today Rijeka's public lighting represent almost 13000 lights, 150 km of electricity grid with total installed power of 2,4 MW.

Table 3 brings financial analysis of this project with horizon period of 20 years, as well as predicted depreciation period. Net present value of this project is negative while internal rate of return (IRR) is only 0,81 percent which brings conclusions that this project is hardly feasible concerning only benefits from electricity consumptions efficiency.

[14] http://www.philips.com/lighting (16.09.2008.)
[15] http://www.hep.hr/opskrba/uravnotetenje.aspx (10.01.2010.)

Table 3: Feasibility of investments in energy efficiency public lighting in the city of Rijeka

INVESTMENT					
Number of EE lights	10.185				
Average price per 1 EE light	245,46 €				
Average efficiency per light in kWh/a	94,95				
Total consumption in kWh/a	8.500.000				
Price of 1kWh of electricity	0,15 €				
Depreciation and horizon period (years)	20				
Depreciation per year (EUR)	125.000 €				
TOTAL INVESTMENT	2.500.000 €				
INCOME STATEMENT -years		**2009**	**2010**	**2011**	**…2028**
REVENUES		148.372 €	148.372 €	148.372 €	148.372 €
COSTS (Maintains 0,05% of invest.)		12.500 €	12.500 €	12.500 €	12.500 €
EBITAD		135.872 €	135.872 €	135.872 €	135.872 €
DEPRECIATION		125.000 €	125.000 €	125.000 €	125.000 €
EBIT (OPERATING PROFIT)		10.872 €	10.872 €	10.872 €	10.872 €
INTERESTS		0 €	0 €	0 €	0 €
EBT		10.872 €	10.872 €	10.872 €	10.872 €
-TAX		0 €	0 €	0 €	0 €
NET INCOME		10.872 €	10.872 €	10.872 €	10.872 €
CASH FLOW					
NET INCOME + DEPRECIATION		135.872 €	135.872 €	135.872 €	135.872 €
INVESTMENT	-2.500.000 €				
TAX (CAPITAL LOSS)	0 €				
NET PRESENT VALUE	**-1.259.689 €**				
PAYBACK PERIOD IN YEARS	**18,40**				
INTERNAL RATE OF RETURN	**0,81%**				

Source: The author's research results

Other important aspect of this investment represents diminishment of GHG emission in Rijeka's public lighting. Table 4 indicates fact that almost 100 tons of CO_2 is reproduced less per year than in year 2003, when there were almost 1.200 more lights in the City. There were several methods for calculation of CO_2 emissions but presented data in table 4, took factor of 0,53 kg of CO_2 emission for 1 kWh of spent electricity.[16]

Table 4: Public lighting emission of CO_2 in the city of Rijeka (2003-2008)

Year	Number of public lights in city of Rijeka	Total year public light CO_2 emission (t)	Average year CO_2 emission per public light (t)
2003	11.572	4.581	0,3959
2004	11.920	4.542	0,3810
2005	12.141	4.577	0,3770
2006	12.459	4.092	0,3284
2007	12.627	4.391	0,3477
2008	12.765	4.411	0,3455

Source: Energo Ltd., (2008), Public lighting year report, Rijeka.

[16] Official Gazette (2008), Pravilnik o energetskom certificiranju zgrada, *Sabor Republike Hrvatske*, Zagreb, NN 113/08, 91/09, pg. 22

Average year emission of CO_2 per city light is also dropping from 0,3959 t in year 2003 to 0,3455 t in year 2008, which represents significant improvement of 14,6 percent. Only in year 2006 average CO_2 emission fell to 0,3284 t per light which is better then other years, mostly due to a higher number of substitutions of mercury 400W bulbs with sodium bulbs with 250W but with additional energy adjustment reduction up to 150W power. Those results lead to conclusion that energy and sustainable urban development are mutual ongoing processes influenced one by another. Side effects of this project, as an added value, were also: positive reactions of citizens and media plus good public image.

Thus, given hypothesis could be accepted because development of technology and massive interest for green energy in future will provide fair costs of investments for eligible pay back period. Analysis of energy efficiency public lighting in the city of Rijeka demonstrate long term fulfillment of city energy needs and environmental issues.

Solar Energy for City Electricity

Renewable energy sources such as sunlight, wind power and bio-mass already represent new energy force for the future. Several changes took place in energy sector as a result of renewable energy and implementation of new clean technologies. The use of renewables offers the opportunity to diminish energy dependence, reduce the emission of CO_2 and create new employment.

Different types of solar collectors are used to meet different energy needs. Passive solar building designs capture the sun's heat to provide space heating and light. Photovoltaic cells convert sunlight directly to electricity. Croatian national energy strategy supports production of renewable energy through subventions called Feed-in tariff[17] for every registered renewable energy power plant. Production of electricity from sun power is categorized in three tariffs, with different selling price, dependable upon installed power of the plant.

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. First solar power plant already produce electricity since May 2009 installed on City Council upper terrace, in the centre of Rijeka. Total installation has power of 9,9 kW and predicted year electricity production will be around 13.000 kWh. Table 5 demonstrate feasibility of that investment. Today's market price of investment is approximately 46.560 EUR. Given items in table demonstrate 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 of electricity which will be distributed to the grid, for the next 12 years, according to the Croatian regulations. After that period all produced electricity 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 only 80 percent of energy production, so energy production will not be lost, newer less future revenues in the year 2029 will be 1.554 EUR.

[17] Official Gazette, (2007), Zakon o energiji, Tarifni sustav za proizvodnju električne energije iz obnovljivih izvora energije i kogeneracije, *Sabor Republike Hrvatske*, Zagreb, NN 68/01, 177/04, 76/07.

Table 5: Feasibility of investments in renewable solar energy in the city of Rijeka

INVESTMENT					
Photovoltaic -equipment	43.560 €				
Price of 1kW peak power	4.400 €				
Connection costs	3.000 €				
Power installed in kW	9,9				
Feed-in tariff selling price of kWh	0,51 €				
Actual purchase price of kWh	0,15 €				
Depreciation and horizon period (years)	20				
Depreciation per year	2.328 €				
Total Investment	46.560 €				
INCOME STATEMENT - years		**2010**	**2011**	**2012**	**… 2029**
REVENUES		6.523 €	6.458 €	6.393 €	1.544 €
Revenues from electricity sales		6.523 €	6.458 €	6.393 €	0 €
Revenues from electricity produced		0 €	0 €	0 €	1.544 €
COSTS		233 €	233 €	233 €	233 €
Other costs		0 €	0 €	0 €	0 €
Maintenance costs (5% of investment)		233 €	233 €	233 €	233 €
EBITAD		6.290 €	6.225 €	6.160 €	1.312 €
DEPRECIATION		2.328 €	2.328 €	2.328 €	2.328 €
EBIT (OPERATING PROFIT)		3.962 €	3.897 €	3.832 €	-1.016 €
INTERESTS		0 €	0 €	0 €	0 €
EBT		3.962 €	3.897 €	3.832 €	-1.016 €
-TAX		0 €	0 €	0 €	0 €
NET INCOME		**3.962 €**	**3.897 €**	**3.832 €**	**-1.016 €**
CASH FLOW					
NET INCOME + DEPRECIATION		6.290 €	6.225 €	6.160 €	1.312 €
INVESTMENT	-46.560 €				
TAX (CAPITAL LOSS)	0 €				
NET PRESENT VALUE	**441 €**				
PAYBACK PERIOD	**7,67**				
INTERNAL RATE OF RETURN	**9,17%**				

Source: The author's research results

Environmental issue of Rijeka's solar investment also has huge impact on sustainable development. Renewable electricity year production of 13.000 kWh will preserve 6,8 tons of CO_2 emissions to atmosphere. In next 20 years that amount will raise up to 123 tons of CO_2 emissions saved form polluting. Those results, similar to public lighting project, also lead to conclusion that energy sustainable development is possible.

Other conclusion refers to Feed-in tariffs lasting period because they are ''start-up'' type of subventions, designed only to develop renewable energy market in Croatia. Considering given hypothesis of this project, results of the research demonstrate that besides GHG emission free status, investment in solar energy is respectably cost effective only with subvention on selling electricity price. Consequently, worldwide demand for solar equipment will continue to grow plus further technology development will lead to fair price of solar equipment which is going to become feasible investment, without need for national subventions.

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. 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.

Presented analyzes of the energy liberalization brings up the conclusion that the European Union has become the leading new energy market in the world, committed to continue in the process of energy market liberalization and the implementation of more efficient energy legislation. A free competition approach to the energy market is the most significant step ahead that influences energy prices and service liberalization. Simultaneously citizens and all other energy consumers expect cheaper prices, better services and energy supply stability.

Local community efficiency and renewable energy projects could be feasible and environmentally friendly at the same time. That conclusion is given through taken analyses of two energy projects in the Croatian city of Rijeka: energy efficiency public lighting and sun power electricity production. Positive net present value for renewable energy project indicates importance of feed-in tariff selling price and significant IRR. Thus, negative net present value in energy efficiency public lighting has important cost benefit in significant diminishment of CO_2 emissions. Further result of this research undertakes local government to lead similar projects forward good community perceptions and communication dissemination. That is why example of city of Rijeka could be taken as a key model for the other cities.

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