

SUNEN - National Solar Energy Program: A Review

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Abstract: *Thermal utilization of solar energy in Croatia has been discussed in the paper. The National Solar Energy Program, SUNEN, has been established to stimulate the solar energy use in order to become more compatible with the present renewable energy sources policy in the EU and Mediterranean countries. The main goals of the program are the assessment of technical and economic solar potential in order to define real objectives and tasks to provide use of this exploitable indigenous clean and renewable energy potential. The Program addresses benefits, the most promising solar applications and solar potential. Much attention has been given also to identification of obstacles and barriers in the process of solar technology dissemination. The program proposes twelve different types of solar thermal energy systems, which could be multiplied up to 28 000 installations until the year 2010 with annual heat recovery of approximately 1,5 TWh (5,4 PJ).*

Key words: solar energy, National Energy Program, thermal conversion, active and passive solar systems

1. INTRODUCTION

The first flat plate collector installation for commercial use in Croatia was installed in the mid- Seventies, and that is recognized as the beginning of research and development process of solar energy technology in Croatia. Since then, approximately 150 000 m² of collectors have been installed, the majority of them on the roofs of private houses and hotels along the Adriatic coast and islands. Although the actual annual capacity of Croatian factories is 20 000 m² of collectors, the production nowadays comprises approximately 5 000 m². To stimulate the solar energy usage, the Ministry of Economic Affairs has established a national energy project - *Development and Organisation of the Energy Sector of Croatia (PROHES)*. The main goal of the Project is restructuring of the present economy and energy sector, which in the future will be compatible with modern development plans of local and regional communities. This Project is divided into ten programs and one of them is the *National Solar Energy Program - SUNEN*. The aim of this program is to assess technical and economic solar potential, to define realistic objectives as well as to formulate tasks, which will provide future use of solar energy. A great part of the Program is concerned with the development of active solar thermal system installations until the year 2010, with a total area of 1 500 000 m² of flat plate collectors, as well as use of passive and hybrid systems. Also, identification of obstacles and barriers in solar technology dissemination has an important role in the Program. Legal, technical, economical and institutional barriers as well as other reasons have recently provoked quite an adverse environment for dissemination of renewable energy sources.

2. PROGRAM BENEFITS

2.1. Energy benefits

Use of clean and indigenous energy sources rather than imports and restrictive saving policy, higher efficiency in energy transformation, transport and distribution and coverage of local energy supply by autonomous energy generation with lower pollution levels that will provide increase in tourism and ecological agriculture and food production are the main local and national energy benefits of the program.

2.2. Economy benefits

The Program supports new clean technologies, reduces construction time and investments payback time to one-fifth using mostly domestic resources, provides numerous opportunities for many small and medium size companies, provides much more investment opportunities, which will attract more capital funds from international resources, improves local infrastructure as well as speeds up technology transfer.

2.3. Social and employment benefits, improving the standard of living

Energy generation based on renewable energy sources together with programs of sustainable development of regional community contributes to better social cohesion and creates many well paid jobs for skilled employees. In the long run, it will slowdown and finally halt migration from isolated rural and island communities.

2.4. Environmental benefits, improving international competitiveness of tourism and agriculture

Solar energy avoids all kinds of adverse emissions like CO₂, SO₂ and NO_x and provides the environment available for development of the ecological agriculture, mariculture and high category tourism. Safe and clean energy supply together with autonomous energy generation will cut energy costs and with lower pollution levels will improve tourism and ecological agriculture.

2.5. Trade and competitiveness

Co-operation with donors of renewable technologies will help in involving Croatia in European markets, and that is the direct way to the EU. At present, Croatia does not have any R&D program concerning renewable energy technologies, but has highly skilled technical manpower in land and abroad, which is quite capable to restore our international status from late Seventies within international programs of technical co-operation.

2.6. Development of national technical standards and legislation

National technical standards and legislation, which are a result of the energy policy characterised by ecological disasters with serious repercussions in many local communities, must be updated according to present European standards.

2.7. Improving health and welfare of local societies

A strategy of substituting conventional energy sources with renewable energy sources, parallel using natural gas, directly contributes to improvement of the environment as well as the health and welfare of the population.

3. OBSTACLES AND BARRIERS

Program implementation will generally be slowed-down by typical obstacles and barriers, which impose quite significant restrictions to any action plan and must be taken into account in every real planning process. These obstacles and barriers have been divided into administrative, institutional, financial, technical, political and economic group.

The administrative obstacles can be disregarded if legal, regulatory and legislative backgrounds have been regulated. Lack of funds for financing program studies and lack of measures for program realization can be recognised as another administrative obstacles.

Lack of professional organisations with specialised services, suppliers of special equipment, as well as lack of support of governmental organisations and institutions are seen as institutional barriers.

Non-existence of financial support for Program and lack of taxation policy cause financial obstacles.

Inadequate professional knowledge, lack of professional human resources, lack of technical and measuring equipment, as well as lack of technical procedures, standards, guidelines represent technical obstacles.

The Croatian Government has not yet made a clear commitment concerning renewable energy sources. The national energy strategy is still in debate. There is not any single governmental instrument or institution that financially supports renewable energy technology and there is a lack of real price policy including external energy costs. State electrical power and oil producing company have not yet given a clear statement in favour of the energy strategy concerning renewable energy sources, which results in a lack of clear commitment to the energy free market or public acceptance of clean energy sources. These all represents political obstacles.

All projects realised hereto based on renewable energy technology are on a small economy scale. There does not exists neither any financing institution to support dissemination of renewable energy technology, neither any private power producing industry. There is not any clear interest of state electrical power and oil-producing company in servicing power plants based on renewable energy technology. The non-existence of a lifelong warranty from Croatian suppliers of renewable energy technology, a manufacturing that is not based on the economic scales, as well as an undeveloped market for renewables can all be perceived as economic obstacles.

4. TECHNICAL AND ECONOMIC SOLAR POTENTIAL

Assessment of technical solar potential in Croatia is based on theoretical potential which, with an average annual solar irradiation on the horizontal surface of 1,4 MWh/m² on an area of 56 610 km², amounts to 79 254 TWh per year. Estimating at least 3% (1 700 km²) area being available for solar installations (2% for thermal conversion and 1% for photovoltaic conversion) and with average annual efficiencies of stand-alone systems (40% for thermal collectors and 10 % for PV installations), technical solar potential would be 792 TWh (2850 PJ).

Economic solar potential has to compete with all conventional energy sources. In the year 2020 it will strongly depend on the availability of conventional energy sources and their respective prices. If only 1% of previously estimated technical potential would be available, economic potential would be 28,5 PJ; the amount which is sufficient to cover all national energy needs. Economic solar potential in the year 2010 will be 15 PJ, and in the year 2020 will be 40 PJ. The estimation comes from a conservative assessment of the solar potential for suitable applications using active solar thermal, photovoltaic and passive solar energy transformation systems. So, a more likely scenario for all three solar potentials has been presented in Table 1.

Table 1. Economic solar potentials

Years →	2000	2010	2020
Solar total (PJ)	1,5	15	40
Low temperature active	1,0	9	20
Low temperature passive	0,5	5	15
Photovoltaics	0,01	1	5

5. THE MOST PROMISING SOLAR APPLICATIONS

According to the Program, the most suitable solar locations with very high annual irradiation are the Adriatic coast and islands. The program aims to investigate and provide optimal solutions for solar energy utilisation in this region. In Table 2, the possible number of solar installations which is planned to be built during the period of the Program until 2010 is shown and these are systems for: hot water preparing, space heating, cooling and air-conditioning in buildings, swimming pool water heating and solar thermal power plant for district heating. An assessment of investment costs for these systems amounts to 480 million DM.

Table 2. Proposed low temperature active solar energy systems for the period until 2010

Project	Output power [kW]	Investment for single installation [1000 DEM]	Energy saving [GWh/a]	Possible multiplication	Program value [Mil. DEM]	Total energy saving [GWh/a]	Energy payback [ann.]
WH*; small system	100	60	0,250	420	23	105	8
Open SP* – family house	13	4	0,040	20 000	80	800	6
Indoor SP - family house	15	10	0,035	5000	50	185	5,5
Open SP – hotel	150	120	0,350	50	6	17,5	5
Indoor SP - hotel	100	70	0,250	50	3,5	12,5	5
WH; medium sized system	1000	200	2,500	25	5	62,5	8
WH; compound large sized system	3000	800	8,000	10	8	80,0	8
Total energy system - hotel		2500	-	50	125	-	5 - 6
Heat pump + SC - family house	20	65	0,050	1000	60	50,0	4 - 5
WH for an autocamp – heat pump + electric heater	85	100	-	1000	10	-	3
HVAC and WH – medium sized system; heat pump and sea water	-	500	-	100	50	-	4 - 5
District solar thermal energy plant	4200	4000	12,500	15	60	187,5	4-5
Total				27720	480,5	1500,0	

*WH - water heating; SP - swimming pool; SC - solar collectors; HVAC - heating, ventilation and air-conditioning

6. TASKS, ACTIONS AND RECOMMENDATIONS

The intention of the Program is to:

- set priorities and clear targets for renewables;
- provide administrative, financial, legal and organisational instruments at national level;
- prepare decisions of national energy strategy based on assessment of energy potential of individual sources and expectations of their respective future availability;
- recommend governmental instruments and incentives;
- identify economically viable applications and set criteria to determine their priorities;
- maximise in a sustainable way the exploitation of domestic sources, both fossil and renewables, with an emphasis on the efficient transformation, transportation and distribution of energy;
- minimise energy impact on the environment during energy transformation and final use of energy;
- maintain transparent information regarding advantages and potential of renewable energy sources;
- increase institutional, scientific and industrial international co-operation and exchange;

- initiate activities and studies in state electrical power and oil producing companies and prepare basic documents for analysis of Pro- and Contra arguments regarding their strategic decision on renewable energy sources.

7. CONCLUSION

The values of solar potential are assessed rather conservatively taking into account all barriers which presently hinder more effective program implementation. In the late Seventies, Croatia was among the very few countries in the world, which initiated a solar energy program, responding to the oil crisis in 1973. In the late Eighties interest in solar energy started to decline. Nowadays, most countries in the world are very much ahead of Croatia and the present situation cannot improve until clear decisions concerning energy strategy are made and until a strong political driving force, based on the national consensus and commitment in favour of sustainable technologies, is activated. The program proposes twelve different types of thermal solar energy systems, which could be multiplied up to 27 720 installations until the year 2010 with an annual heat recovery of approximately 1,5 TWh. An assessment of investment costs for those systems amounts to 480 million DM.

Program *SUNEN* is a way forward to a more widespread use and increased contribution of solar energy. Hereafter, Croatia's energy policy will in the near future become more compatible with the present renewable energy sources policy in EU countries. In order to achieve such an ambitious objective, close cooperation with EU countries and their assistance during program implementation will be most effective.

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