Intelligent Energy Europe

PV-NMS-NET

STATUS OF PHOTOVOLTAICS 2009 IN THE EUROPEAN UNION NEW MEMBER STATES

Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia with Croatia and Turkey

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Edited by:
Stanislaw M. Pietruszko
Kamila Blazejewska
Warsaw University of Technology

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Warsaw University of Technology
Koszykowa 75, 00-662 Warsaw POLAND
phone: +48 605 099 781
www.pv-nms.net

Cover photo: 200-kW PV plant in Zornitza, Bulgaria

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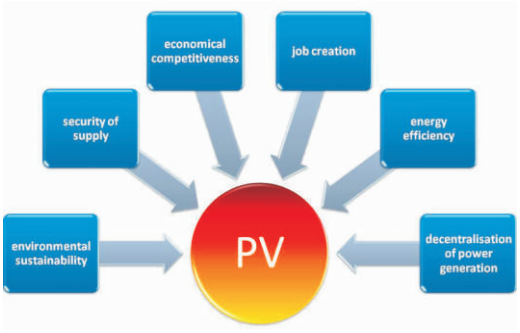
1. INTRODUCTION

There is no need to persuade anybody that electric energy is basically what makes societies develop and economies grow. The fact that the global demand for it is constantly growing is also commonly known. Fossil or nuclear source of energy are not the answer for obvious reasons. The only truly environmentally friendly way of producing electric power is the renewable way. However even among renewable energy sources, there are those which fulfil the sustainability criteria better than others (Fig. 1). The Sun is providing the Earth with the amount of energy that would easily meet global demand for it. Thus, what we need is a massive scale-up in photovoltaic (PV) deployment, for the sake of nature and for our own sake.

The purpose of this report is to present market conditions, legal frameworks and political strategies of photovoltaic sector in the European Union 12 New Member States (NMS): Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. To get the wider overview of the status of PV, two countries associated with EU have been included: Croatia and Turkey.

Status of Photovoltaics in the EU New Member States comes out since 2003 and you are holding its 7th consecutive edition. It constitutes a part of PV-NMS-NET project within the EU Program Intelligent Energy Europe. Key data for this publication come mostly from national survey questionnaires supplied by the representatives of each NMS. On account of cooperation between the partners, this report contains coherent and up-to-date information.

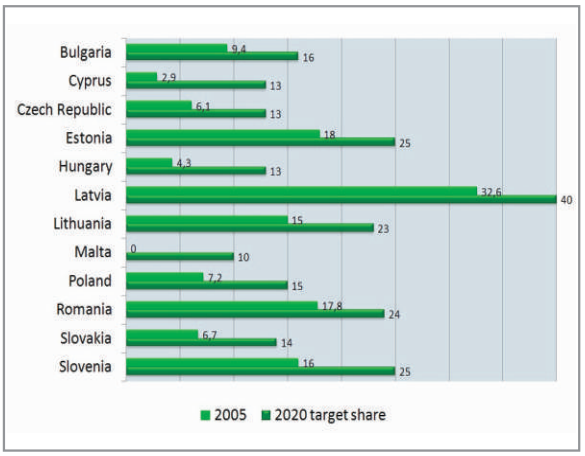


Benefits of photovoltaics

The latest Assessment Report of IPCC (Intergovernmental Panel on Climate Change) “Climate change 2007” induced fear of global warming and suggested undertaking measures to prevent it. This message resulted in fact that year 2007 can be regarded as a turning point in Europe's energy and environment policies. Undertaking of measures preventing further climate change could not be neglected any further.

In March 2007 the European Council agreed to endorse ambitious strategy of slashing carbon gas emissions, raise energy efficiency and increase the use of RES in the entire EU, all by 20% by 2020 (reference year is 2005). This initiative spawned the latest Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

This legislative act went into force on 25th June 2009 and shall be implemented by every European Union Member State by December 2010. It sets individual overall national target for the share of renewables in the final gross energy consumption for every Member State (Fig. 2). Actually, five Member States (Czech Republic, Romania, Bulgaria, Slovakia and Poland) with the lowest targeted increase in the share of RES (no more than 7,5%) are the NMS. Nevertheless, achieving the goal set in the RES directive constitutes a considerable effort and state-level responsible decision-making in the entire EU. The European Commission left the Member States a free hand to decide which mix of renewables to pursue.

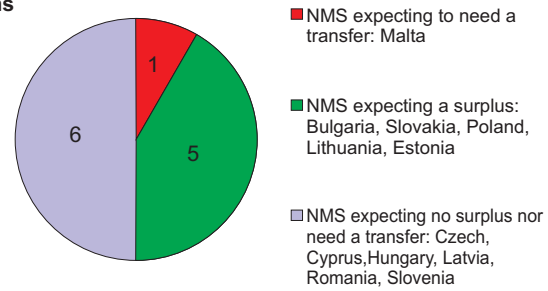


NMS: Targets of RES in 2020

According to the article 4 of the new RES directive, Members States are due to submit a National Renewable Action Plan (NREAP) setting out the national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020. Notified to the Commission by the end of June 2010, NRAP include measures to be taken in order to achieve the national overall targets. One of the major stipulations of reporting countries is a need to improve the electricity grids' ability to manage and balance electricity. New infrastructure is essential for both: meeting the target and, in case of need, transferring the energy to those who need it.

Noteworthy, according to the Member States forecast documents submitted in December 2009 five out of all twelve NMS (Fig. 3) will exceed their targets and announce readiness to transfer their surplus of green energy. Only Malta does not have optimistic prognosis and predicts already its failure to fulfil the RES directive obligations. According to the new RES directive in case the Member State is not capable to meet national target with homeland resources, it must transfer the equivalent the missing amount of green energy statistics either from another Member State or from a third country supplying the equivalent green energy to the EU community.. Expectedly, by 2020 no more than 1% of total energy needed by EU will be transferred under this cooperation mechanism.

NMS expectations (NRAP forecast)



In order to eye the strategy's development, the European Commission wishes to be handed from each Member State special reports on progress in the promotion and use of energy from RES. Such obligation is set out in the new RES directive with precise deadline of 31st December 2011 for the first report and then every two years for the subsequent ones.

PV and other RES are subjects of interest of multiple cooperation programmes within EU. Research, development and deployment of renewable energy production benefits from financial and know-how support inspired mostly by the European Commission. In order to put the suitable perspective for PV status in the NMS, taking some of these programmes into account is recommended.

Established also in 2007, the Strategic Energy Technology Plan (SETPlan) opened the pathway for low-carbon technologies development. Energy supplies disruptions, volatility in energy prices and climate change are three major factors that pushed the EU to adopt such strategy.

One of the key points of SET plan is to earmark more funds for the industry, especially in terms of RTD innovations. In October 2009, the European Commission complemented the SET Plan with a communication on "Investing in the development of low carbon technologies", which highlights the need to invest additional 50 bn EUR in low carbon technologies during the next decade.

One of new priority initiatives is Solar Europe initiative oriented at large-scale demonstration of commercial readiness of PV and concentrated solar power. Solar Europe initiative aims also at reinforcing of European energy research capacities and networking through wide-scale programmes like European PV Technology Platform and ETAP, all by engaging human and financial resources. One of such programmes, the Environmental Technologies Action Plan (ETAP) was set up in January 2004.

ETAP is oriented at overcoming of financial and administrative barriers that hinder wider spread of new technologies. ETAP emphasizes the importance of cost-effectiveness of environmental technologies considering it as a prerequisite for sustainable growth and development. Implementation of ETAP is facilitated by the Eco-innovation funding scheme. This scheme incentivizes innovative products, services and technologies based on natural resources exploitation and cutting greenhouse gas emission. The Eco-innovation funding scheme is an integral part of EU's Competitiveness & Innovation Programme and its budget reaches nearly 200 million EUR over 2008 2013 period.

Another PV friendly initiative is the European Energy Programme for Recovery (EEPR). In 2008, the European economy faced a significant downturn as a result of the global financial crisis. To deal with the problems it brought the Economic Recovery Plan has been established, EEPR being its operational instrument. Incentivizing the defined strategic sectors such as energy infrastructure is supposed to safeguard jobs and help the entire economy. Beneficiaries of the EEPR receive grants from the EU helping them to strengthen the security of energy supply and secure investments in energy sector. Energy infrastructure contributing to economic recovery in the EU is subject to financing under EEPR. In March 2009 the EU set aside 3.98 billion EUR to assist European economic recovery, more than half of this amount is earmarked for gas and electricity infrastructure projects.

Intelligent Energy Europe (IEE) is another crucial for PV sector initiative in the framework of the Competitiveness & Innovation Programme managed by the Executive Agency for Competitiveness & Innovation (EACI). IEE general objective is to promote innovation and competitiveness of energy sector. It hosts smaller campaigns oriented on more specific targets, such as public awareness or energy efficiency. Noteworthy IEE is also backed by the Managenergy initiative that provides all the entities involved in energy sector with practical data on case studies, good practices, European policy and legislation.

Last but not least, the 7th Framework Programme for Research and Technological Development (FP7) emphasizes the importance of

development innovative PV equipment production. Energy research under FP7 promotes, inter alia, a uniform and secure building PV components and promotion of PV technology in general. There is also a longer term strategy of supporting the next-generation PV systems. The EU Member States and the European Parliament have earmarked 2.35 billion EUR for funding the Energy research over the duration of P7 (2007-2013).

These are just a few from many examples of European actions and programmes dedicated to fight against global warming. Unfortunately, for the time being there is no international binding agreement in this matter. In December 2009 at the 15th Conference of the Parties to the United Nations Framework Convention on Climate Change, negotiations about concrete obligations of cutting greenhouse gases emissions failed. Global major economies abandoned EU with its ambitious goals of reduction carbon dioxide. Thus, the EU Member States have been burdened with great challenge and historic responsibility.

Climate change caused by the carbon gas emissions is not the only problem that bothers the EU authorities and its citizens. One of major issues is also the security of energy supply, menaced by the unstable partnerships and finiteness of fossil fuel resources. Today no country can take its energy security for granted anymore.

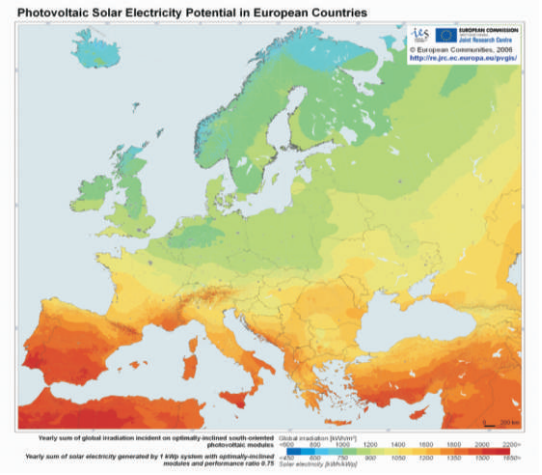
Moreover, there is a pending need to boost the economic development, create jobs and electrify remote areas without increasing the carbon gas emissions.

With regard to challenges mentioned above, PV represents a complex opportunity (Fig.1.). Not only is it a source of most desired renewable energy, it boosts hi-tech industry sector, supporting competitiveness and labour market within EU. Decentralisation of power generation improves national energy security of the member state. Seeming state-level, national energy security strengthens the entire EU as the recently ratified Lisbon Treaty introduced the principle of energy solidarity.

Obstacles that hamper PV sector growth do not stem from technology. The main reason of low PV deployment is a relatively high price of the systems. Yet, money spent on PV installations shall not be considered just a cost, as it is a sheer investment which scale is proportional to profits it brings. In addition, quick technological development in this field along with growing volume of PV installations trigger a decrease in PV systems' prices. According to the European Photovoltaic Industry Association (EPIA) the prices of installations are to fall by 8% every year. Such trend is not observed in any other pricing of technologies based on renewable energy sources (RES).

Converting sunlight into power depends strongly on irradiation of the territory. That is why many citizens of NMS do not consider their countries as sufficiently sunny in order to utilize solar to far greater extent. Map presenting photovoltaic solar electricity potential in Europe (Fig. 4) comes from the Joint Research Centre, Ispra database. As it is immediately noticeable southern parts of Europe rejoice the best irradiation which guarantees a high effectiveness of PV power installations. Five NMS (Cyprus, Malta, Bulgaria, Romania and Slovenia) and the three associated with EU partners (Croatia, Serbia and Turkey) actually have such advantageous exposure. Even with smaller PV electricity output potential, the rest of NMS benefits from sufficient irradiation to develop a successful PV market.

Briefly, PV technology is cost-effective and economically viable on all of the NMS' territories. It is important to raise awareness about this among doubting this fact political decision makers and other stakeholders.

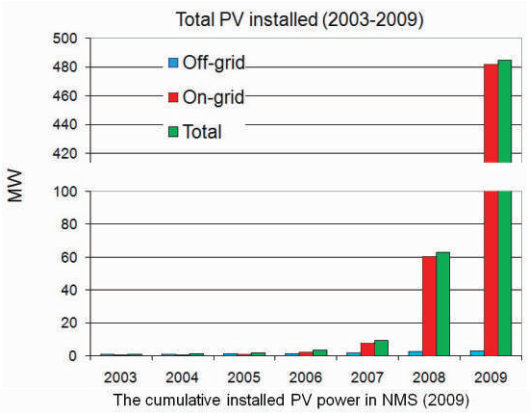


PV potential in Europe

Deployment of PV is undoubtedly conditioned by economic situation on the local, national, European and global level. Financial crisis affected all of the EU Member States; almost all of them noted negative growth in GDP (the only country to report actual uptake in its economy is Poland). Crisis had its roots outside Europe, but this continent suffered heavily from its difficult to predict repercussions. The most flaring is the loans hold-up policy of banking sector, preventing potential investors from realizing their plans. Investing became a luxurious action for the richest. This, obviously, did not inhibit RES market development.

2. PV CAPACITY INSTALLED

Photovoltaic market grew in NMS from 63 MWp in 2008 to 485 MWp of cumulative installed power in 2009. Although the PV NMS market is still rather small, it is growing rapidly proving its vast potential to become a considerable part of RES market in the EU. However it is necessary to note that this grow is mainly (84%) due to 408 MWp installed in the Czech Republic.



Trends in total installed PV power in NMS (2003-2009)

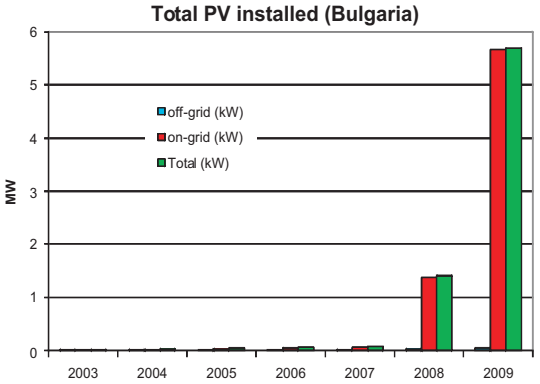
Cumulative installed PV power in NMS (2009)

For the time being, barriers that hinder PV sector progress are still numerous. Disbelief of the general public that PV electricity can make a significant contribution to overall energy need at sensible price is one of the impediments to hamper the PV development. Lack of political support, strong nuclear and coal lobbies, improper design of support schemes, poor consumer awareness and prejudice within utility sector are only some major obstacles for PV sector advancement.

Until 2006, in NMS prevailed small off-grid PV installations. Big-scale on-grid installations took over recently. The most spectacular in this matter was the Czech Republic. Such a growth of the annual PV markets is due to a successful implementation of support mechanisms. Market leaders such as Czech Republic, Slovenia, Cyprus and this year Bulgaria owe their growth to effective PV support mechanism, especially adequate Feed-in Tariff systems.

Bulgaria

PV market in Bulgaria grew by about 4,3 MW, so the total accumulated PV capacity reached about 5,7 MWp. The lion share of this number is provided by the 2 MWp solar grid-connected plant with Si modules built in village Botevo. Another installation 1 MWp solar plant (thin films amorphous silicon) was built in Paunovo village close to the capital Sofia, by Intersol company. In the first stage of the project "North-Est 1", PV plant with installed power of 338 kWp was build in a village Jankovo, close to the town Shumen and connected to the grid in July 2009. The installed amorphous silicon modules were produced by the Bulgarian company SolarPro. The whole system "North-Est 1" will have a capacity of 2,404 MW and will be the biggest PV park in Bulgaria in 2010.



Total PV power installed in Bulgaria (2003-2009)

State	2003	2004	2005	2006	2007	2008	2009		
	Total [kW]	Total [kW]	Total [kW]	Total [kW]	Total [kW]	Total [kW]	off-grid **[MW]**	on-grid **[MW]**	Total **[MW]**
Czech Republic	330	363	470	740	5 361	54 674	0,4	462,9	463,3
Slovenia	51	96	200	405	1 025	2 146	0,1	7,9	8
Bulgaria	20	33	43	66	75	1 407	0,04	5,66	5,7
Cyprus	254	340	518	1 028	1 403	2 186	0,63	2,7	3,33
Malta	4	9	15	48	97	238	0	1,53	1,53
Poland	107	234	291	438	640	1 011	1,08	0,3	1,38
Hungary	100	138	155	250	350	450	0,2	0,45	0,65
Romania	50	86	101	190	300	450	0,41	0,23	0,64
Slovakia	10	15	20	20	46	66	0,03	0,18	0,21
Estonia	17	17	19	40	55	55	0,05	0	0,05
Lithuania	17	17	19	40	55	55	0,07	0	0,07
Latvia	3	3	3	3	4	5	0,005	0,003	0,008
Total	948	1 336	1 837	3 233	9 368	62 700	3	482	485

Table 1. Cumulative installed PV power in NMS (2003-2009)

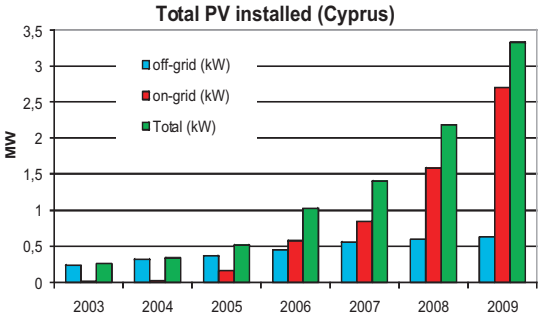
Cyprus

In 2009 Cyprus total installed PV capacity attained 3,3 MWp. Cyprus energy market still is dominated by the oil products. With one of the highest irradiation indicator, PV could easily supply the overall Cyprus electricity demand.

According to the unofficial expectations of the Energy Service of Cyprus, the Cyprus Institute of Energy and the PV industry representatives in Cyprus the total PV installed power shall increase by 3 MWp annually.

Cyprus industry representatives assume that PV may account to 5 MWp by 2010 and 30 MWp by 2020.

Total PV power installed in Cyprus (2003-2009)



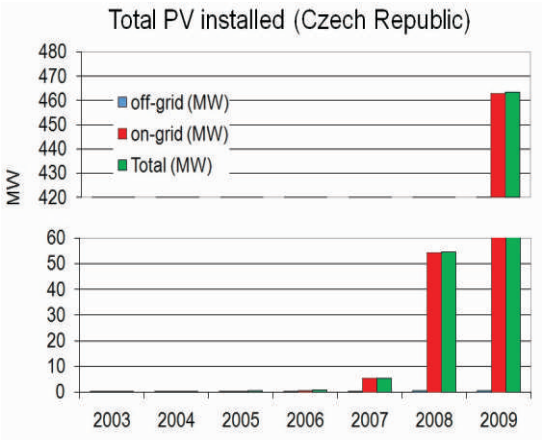
Czech Republic

With 463 MWp of cumulative installed solar capacity Czech Republic is the leader of the region. The sector developed to the extent where the growth restriction had to be considered. Transmission and distribution grids are overloaded with new PV powers. Czech solar market owns this staggering take-up to favourable FIT with small yearly digression and stronger national currency as well as falling the price of modules.

The Parliament has not been able to modify the 5% year to year digression for almost a year, what has opened (in combination with the above mentioned aspects) an extremely good business opportunity for those wishing to invest in the solar field.

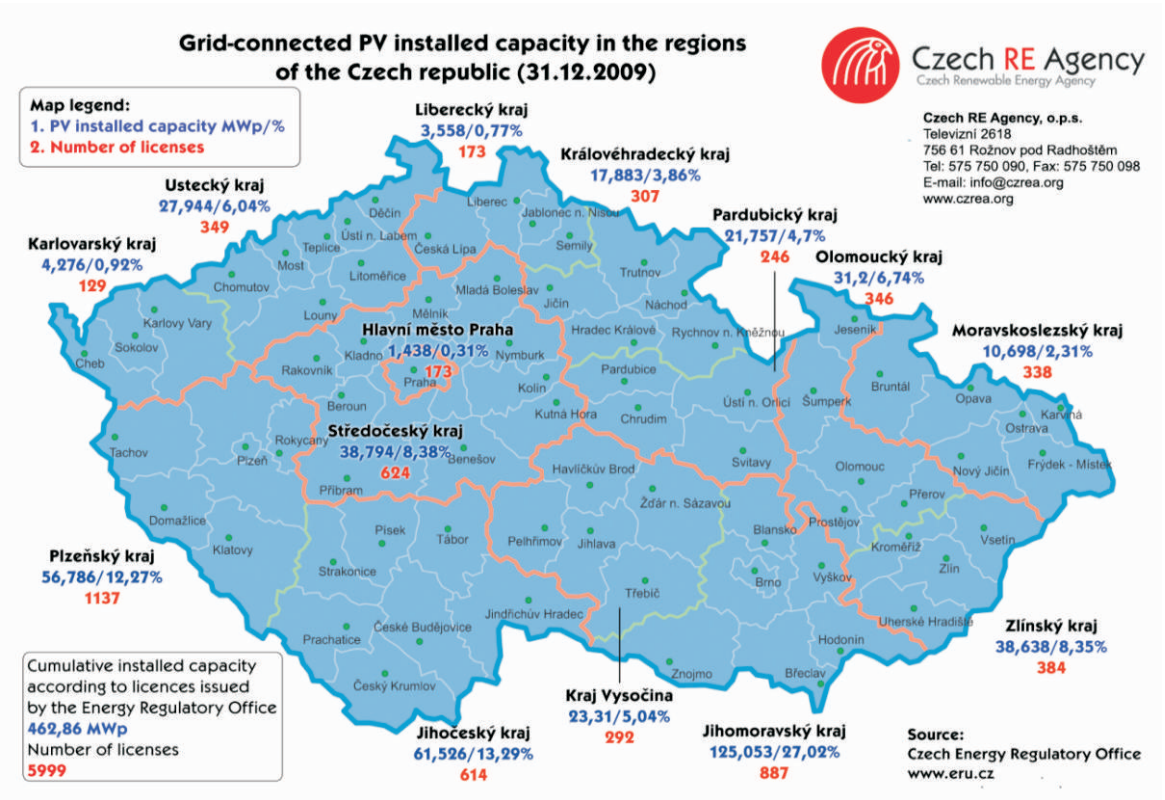
Additionally, the Czech market has become really overheated and many speculative permits allocation for PV systems grid connection has appeared. At this time there are some 6,000 MWp of registered systems on distribution system operators lists, mostly speculative.

Nonetheless both, transmission and distribution systems operators are seriously worried about stability of the grid, even if only 20% of this figure will prove to be real power application. A result of that, there is current moratorium on all new PV system connection applications.



Total PV power installed in Czech Republic (2003-2009)

Major PV systems installed in the Czech Republic



Estonia
In 2009 Estonia did not register any growth in use of PV for energy production maintaining 15 kW of total cumulative capacity. All installed PV systems are stand-alone and mainly directed for demonstration of PV benefits to public.

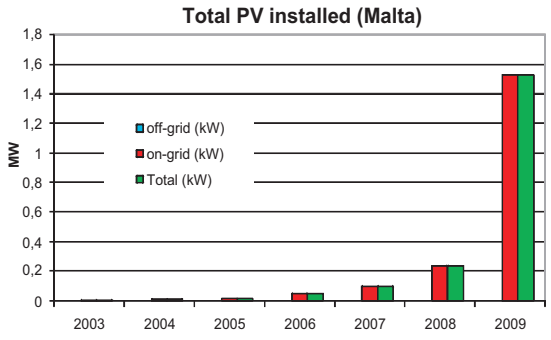
Hungary
Hungarian PV sector is growing slowly but the trend is stable. Year 2009 slightly better in this matter, instead of usual 100 kW, market grew by 200 kW and reached 650 kW.

Latvia
Latvia's PV sector, like in all of the Baltic States, is in the doldrums. PV installed capacity at the end of year 2009 was 8 kW. FIT adopted at the beginning of 2009 could foster the growth of PV installations in Latvia.

Lithuania
Although during 2009, as in the previous years, the Lithuanian PV sector experienced negligible growth and still amount to mere 10 kW, all off-grid. Significant changes in this field are expected however. FIT and the PV market entry of several manufacturers are likely to stimulate development of this sector.

Malta
1,53 MW of installed PV capacity in 2009 is a considerable growth for Malta being almost entirely dependent on energy import. Since the introduction of the on-grid PV technology the capacity growth trend has been quite slow with a slight rise in late 2008 following the authorisation of a few installations. A very sharp rise however in 2009 came as a result of the support instruments provided by the European Regional Development Fund scheme managed by Malta Enterprise (ME) for commercial and industrial sector. Even though residential installations in Malta still prevail these account for 9% of total installed PV capacity.

Total PV power installed in Malta (2003-2009)



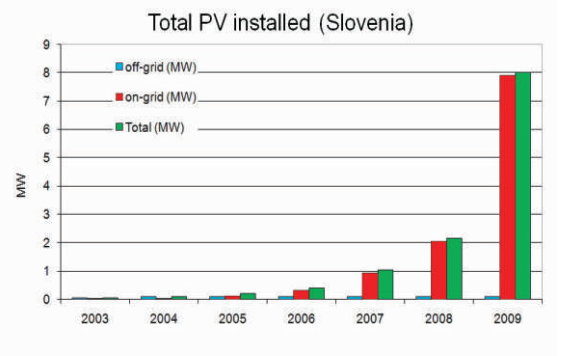
Poland
Year 2009 did not bring any uptake on Polish PV market. With about 370 kWp of new capacity. Currently the total installed power amounts to 1,38 MW, mostly off-grid. The major obstacle is the lack of feed in tariffs for PV (and other RES too). Only this incentive can drive the strong growth of PV sector in Poland. For the time being however, PV module prices are too high to become real alternative to cheap and abundant coal in Poland.

Romania
Moderate development of PV market in Romania pales in comparison to Bulgaria's uptake, considering similar irradiation of the two countries. In 2009 Romania reported 635 kW of total installed PV capacity. The reason why the majority of installations are off-grid is the fact that the law 220/2008 introducing significant subsidies for grid connected systems has not entered yet into force (it will in the second half of year 2010).

With financial aid provided by the European structural funds - European Regional Development Fund - and support from national budget several new plants will be installed in the nearest future. According to what is already planned, 300 kWp capacity systems have to be installed in 2009 and up to 10 MWp by 2011.

Slovakia
180 kW of PV power capacity has been installed in Slovakia in 2009 (among others: 100 kW installed in July on the roof of Commenius University). In 2009, Slovakia introduced favourable FIT so the significant change is yet to come. It is regrettable however that in the same time 120 MW limit for PV have been set by Slovak authorities.

Slovenia
Slovenia learns quickly how to use the Sun to its benefit. 8 MW cumulative installed PV power (almost three-quarter of which is on-grid) in 2009 only is a remarkable upswing. In 2008 the biggest PV plant was 100 kW and in early 2009 with the capacity of 220 kW.



Total PV power installed in Slovenia (2003-2009)

Main investors of PV plants are energy companies, other companies and institutions, farmers and individuals. Farmers' interest in PV installation grow thank to the investment subsidy from regional fund for RES projects. For installation of PVS on the roof the formal procedure is quite simple, without the construction permit and without the limitation regarding installed capacity. For ground PVS installation a construction permit, together with al related procedures are requested. Additionally there is a cap of 5 MW per year for ground PVS installations. That means that only the first PV plants connected to the grid, up to cumulative 5 MW per year, could get the guaranteed higher FIT tariff.

3. CURRENT SCHEMES OF SUPPORT

PV exploitation is highly beneficial but its deployment meets numerous bottlenecks. Countries willing to advance the share of PV, and more generally, of RES in their energy mix, need to implement the support mechanisms. Support is essential at the beginning of PV market take-up. In the long run, it is predicted to become self-regulating and competitive. For the time being however, development of PV sector depends strongly on well-aligned support mechanisms.

The most popular are financial incentives. Purchase aids such as rebates, grants, loans subsidies attract investors in every NMS. Feed in Tariffs (FIT) is considered most effective in this matter so it is also most desirable. FIT is advantageous especially for small scale PV installations. To pecuniary incentives belong also tax exemptions or tax refunds.

Another type of support mechanisms are quantitative obligations on share of RES in the overall energy mix. Usually such requirements take the form of Renewable Portfolio Standards (quota system).

As shown in Table 3. Almost every NMS incentivises the PV investment costs either with the investment subsidy or favourable loans conditions. Moreover, two thirds of the NMS introduced FIT to support the PV generation.

Estonia however did not assign any FIT for PV power whereas the FIT in Hungary occurred to be ineffective. Poland and Romania staked the most important part of PV support on quota system and associated to it green certificates.

Multiple factors decide whether incentive is considered as well-designed. Not only should it be sufficient in size and scope, but also self-correcting and sustainable. Czech FIT is an example of ill-engineered incentives that got beyond control, overheating the market.

Bulgaria

PV investors in Bulgaria are eligible for investment subsidies, preferential loans and FIT. This last incentive is particularly interesting for PV producers.

Every year (before the 31st of March) the State Energy and Water Regulatory Committee determines the FIT based on the following: The FIT rate is derived from 80% of the average electricity price in the previous year. A variable surcharge is added that cannot be less than 95% of the previous year's level. That means the PV FIT could also increase as electricity prices have raised sharply in Bulgaria in the past years.

Contracts on PV are guaranteed for 25 years which is more than the period of obligatory purchase for the electricity from almost all the other RES (only geothermal sources benefit from the same guarantee period).

Energy suppliers in Bulgaria must collect all of the energy that is fed into the grid by RES producers. Failure to comply with this obligation is subject to heavy fines up to 75 000 EUR.

Smaller systems (<5 MW) are connected to the low and medium voltage grids operated by small energy suppliers, who pay the corresponding FIT to the system operators. Bigger systems (>5 MW) are connected to the high voltage grid, provided they got approval of the National Electricity Company. Utilities have two weeks to respond to the motions tendered by investors willing to get a connection point to the grid. If it is accepted, connecting of such installation shall not last longer than 90 days. Any delay is subject to another fine of about 25 000 EUR. Bulgarian investors are well protected indeed. Even the grid extension cost is covered by the utility.

Country	Investment subsidy	Beneficial credit terms	Tax incentives	Feed-in-Tariff	Quota system	Net metering	Cost benefit analysis
Bulgaria		✸		✸			
Cyprus	✸	✸		✸			✸
Czech Republic		✸	✸	✸			
Estonia				✸			
Hungary	✸	✸		✸		✸	✸
Latvia	✸			✸	✸		
Lithuania	✸	✸	✸	✸			
Malta	✸	✸	✸			✸	
Poland	✸	✸	✸		✸		
Romania	✸		✸		✸	✸	
Slovakia	✸	✸		✸			
Slovenia	✸	✸		✸			
Croatia	✸	✸		✸	✸		
Turkey	✸			✸			

Table 2. Measures of RES support in NMS

In November 2008 the duration of FIT payments was changed from 12 to 25 years. From 1st April 2009 only systems of a maximum 10 MW capacity are eligible for FIT.

Apart from FIT, Bulgarian PV sector is supported with preferential soft loans allocated by private banks.

Renewable and Alternative Energy Sources and Biofuels Act came into force in November 2008. Its main objective is to promote RES generation technology development and implementation. By virtue of this act public national information system will be created, research and development in the field of RES will be supported mechanisms for promoting the production and use of clean energy will be introduced. Moreover obligations and competences of executive authorities and local governments have been clearly described to allow efficient implementation of the state policy measures.

In Bulgaria, 20% of the project investment can be financed with financial resources from a reduced interest loan offered by the Bulgarian Energy Efficiency and Renewable Energy Credit.

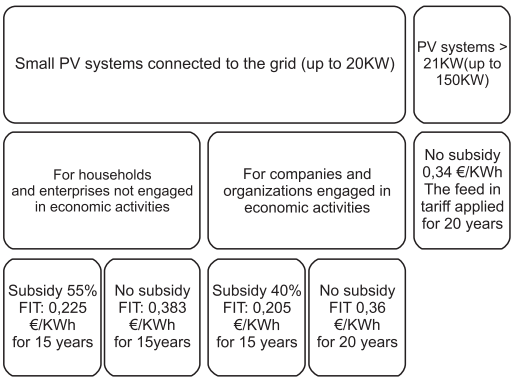
Cyprus

The Grant Scheme for the Promotion of Energy Conservation and the use of Renewable Energy Sources is the core document regulating incentive mechanism in Cyprus.

Small systems (up to 20 kW) installed by households or non-profit organisations are eligible for the maximum of 65 000 EUR of subsidy. For same installations managed by organisations engaged in economic activities, amount of 48 000 EUR is the maximum. Investors who want to install systems with power greater than 20 kWp must obtain a permit from the Cyprus Energy Regulations Authority (CERA). If the installation's capacity is greater than 150 kW no subsidy is allocated. Despite this, electric power can still be sold for a normal price and fed into the grid (price in 2009 was about 0,09 EUR per kWh). Obviously, it is not enough for such investment to bring profits.

The application period for the existing RES grant scheme is 2009-2013. Adjustments to the Grant Scheme may occur on a yearly basis with relation to the current situation and available budget.

The feed in tariffs are paid from a Special Fund for the promotion of RES and Energy Conservation and the Electricity Authority of Cyprus.



Subsidies and FIT in Cyprus

In Cyprus, the use of the electric energy produced in one's own appliances is not profitable. In order to take full advantage of electricity generation, investors should feed it to the grid.

Net metering is applied only on several grid connected PV systems that were installed before the Grant Scheme. The small number is due to the fact that the produced electricity under the FIT scheme is sold at much higher price than the price which a householder or a company pay for electric power.

All ground installations in Cyprus require a permit from municipal planning authorities as well as a building permit. Also installation in areas of special interest can be subject to additional permits from respective authorities. Vast majority

Table 3. Feed-in tariffs for PV in NMS

Country	Feed-in-Tariff afor PV (EUR/kWh)	Granting period (years)	Degression	Electricity price for households (EUR/kWh)	Electricity price for industry (EUR/kWh)
Bulgaria	<5kW 0, 428 >5kW 0,380	25	5%	0,09	0,07
Cyprus	min.0,36 max.0,38 if subsidized min. 0,20 max. 0,22	15 or 20	No	0,12	0,11
Czech	< 30 kW 0,4712 > 30 kW 0.4673 or green bonus < 30 kW 0,4338 > 30 kW 0.4300 exchange rate 26 CZK/EUR	20	no from 2011	0,171 - 0,182	Base load: 0,04 - 0,05 Peak load: 0,06 - 0,07
Hungary	0,10	investment payback	slightly corrected yearly	0,16	0,18 or 0,14
Latvia	0,43	20	No	0,11	0,07
Lithuania	0,46	10	No	0,13	0,11
Slovakia	0,43	15	10%	0,15	0,14
Slovenia	min.0,27 max.0,48; if subsidized then: min. 0,20 max. 0,36	15	7%	0,09	0,08

of roof PV installations however do not require building permit. The installations are controlled by the Electricity Authority and the Cyprus Institute of Energy Bureaucracy in combination with the administrative procedures cause long waiting time before the permit attribution. This is considered a major detected bottleneck for PV investments development. Other obstacles are inefficient collaboration between concerned institutions and clear guidelines regarding PV investment

Czech Republic
PV investors in Czech Republic do not receive subsidies under the European Structural Funds nor within any national programme any more. RES scheme of support was introduced in 2005 by the Act on Promotion of Use of Renewable Sources. Feed-in tariff exists in Czech Republic since 2002. The new RES Act brought up another measure of support, a green bonus extra payment on top of the market price. PV electric energy producers can choose between FIT and green bonus, both paid by the distribution system operator. The prices may not be lower than 95% of the value of the year before. According to debated regulations however by 1st January 2011 it will possible to reduce FiT more than 5 % (probably up to 40 %) The Energy Regulatory Office determines the FIT and the green bonus rates every year. Digression may change on a yearly basis, too. FIT is guaranteed over 20-year period.

Green bonus scheme brings a bigger risk factor for the producer, as free market is unpredictable, and the green bonus rate can change substantially every year. This risk is compensated by higher potential revenues. In Czech Republic no income tax is levied on the incomes from RES related activities for 5 years since the connection year plus the year in which the system has been connected.

Czech RES support mechanisms occurred to be so efficient that the market got overheated. However, since that situation was caused mostly by speculators, it may well be that Czech system of incentives was not well-designed. In order to preserve PV sector's sustainability, the law on FIT should be amended so that digression rate for FIT would slow the booming. FIT for 2009 has already been decreased by 5% in accordance to the maximum allowed by law. At the same time the Czech crown value went down. Even though, PV investment is still considered very profitable, especially for foreign investors. Compared to Germany, where FIT has been decreased by some 11% as of Jan. 2009, German FIT is almost 40% lower.

For these reasons, many foreign investors, especially from Germany and Spain started PV projects in 2009 in the Czech Republic. It is therefore expectable that the installed PV capacity in this country will exceed 1000 MWp by the end of 2010, or even 1500 MWp considered the previous year experience.

Czech experts named the most significant barriers slowing PV sector. These include discriminative conditions for small installations low carrying capacity of new buildings, restrictive bank requirements speculative prices of land, lack of consensus in the stakeholders trio: grid operators, the Ministry of Industry and Trade and strong nuclear lobby. The Czech enthusiasm towards renewables is clearly dying out; the political will follows this negative tendency.

Estonia
Nordic geographical location, not favourable radiation situation and lack of FIT for PV make Estonia not beneficial country for investors willing to start up PV energy production business. Currently there are awareness raising activities in place aiming at Estonian governmental administration to understand the benefits of PV power generation and a need for FIT. This persuasion process, however, takes time before the outcome become tangible.

Hungary
Hungarian PV investors can benefit from subsidies, preferential loans and slender FIT. Moreover, net-metering is applied to about 60% of PV systems measuring the surplus of power production for households in Hungary. Net-metering system favours only the 2/3 of the entire volume of the electric energy that is consumed by the producers.

Subsidies for private investments are granted in the frame of National Energy-saving Program and does not exceed 35% of eligible cost (about 5200 EUR). This programme is coordinated by the Ministry of Transportation Telecommunication and Energy. Another PV relevant scheme is the Environment and Energy Operating Programme (coordinated by the Ministry of Environment and Water) from which up to 70% of investment expenses can be covered (max 3,6 mio EUR). In 2009 only one PV project received the subsidy 106 000 EUR.

Small FIT rates change every year, but they are not profitable for the potential investors.

100-kW system on supermarket, Hungary

Latvia
Year 2009 is considered to be revolutionary when it comes to Latvian's policy and approach towards solar energy. New regulations on RES were adopted in February 2009. Due to these laws, transmission grid operator is obliged to pay the FIT to PV electricity producers.

Purchase price of solar power is 0,427 EUR/kWh and the payments will continue for the guarantee

period of 20 years. The expenses of such procurement shall be covered by all electricity end users in Latvia in proportion to their electricity consumption by purchasing from the public trader a definite part of RES electricity, or by compensating the expenses of the public trader.

The licences for electricity production from RES (with 614 MWh quota for solar stations in 2010) were issued in December 2009 for two private companies. Quota system for electricity produced from RES exists already in Latvia. The new "Law on Renewable Energy Resources" is currently under preparation.

Lithuania
Eventually, at the end of 2009, Lithuania introduced FIT for the electricity produced from PV. For the 10 year period FIT for the PV plants smaller than 100 kW is 0,47 EUR/kWh, for the plants with the installed power in the range from 100 kW to 1 MW is 0,45 EUR/kWh, and for the larger than 1 MW installations 0,44 EUR/kWh.

These tariffs are much higher than the present electricity price for the consumers (about 0,13 EUR/kWh); therefore, FIT introduction has significantly contributed to the rise of the awareness of PV positive aspects both among the Lithuanian business representatives and the general public. The first licences for grid-connected PV facilities have already been issued. There are plans to build the PV plants in the Western part of Lithuania, in the unused land sites beneath the wind power plants and on the rooftops of the industry enterprises in Vilnius.

The year 2009 brought another breakthrough in the PV development in Lithuania the first industrial producer of silicon solar cells has started its activity. It is expected that in 2010 it will be followed by another two companies producing solar modules.

Malta
Since November 2008 there are two schemes of support for PV in Malta. The first one is oriented on residential installations and it consists of 50% coverage of the eligible costs, but no more than 3000 EUR. Second scheme supports enterprises with also 50% investment costs grant, for energy efficiency and renewable sources projects of capital investment within 25 000 EUR and 100 000 EUR. All PV installations in Malta should comply with official guidelines of the Malta Environment and Planning Authority.

One local bank in Malta offers beneficial credit terms for the residential installation projects, the maximum granted loan is 60 000 EUR. The interest rate is 3% lower than the usual one, payback period of such a credit is 10 years.

Non-residential PV installations take advantage of tax waivers up to 243% of investment value. However the Malta's Government's intention is to support the residential sector.

Poland
Lack of FIT for PV keeps Poland, the biggest country of the region, far behind its neighbours. Except from abovementioned FIT, PV investors in Poland are encouraged with several investment subsidies, Green Certificates, preferential loans and a tax waiver.

The National Fund for Environmental Protection and Water Management (NFOSiGW) with the Voivodeship Funds for Environmental Protection (WFOŚ) are the major instruments of financing RES projects on the state-level. The National Fund grants come from its own budget and from external sources.

In 2005 Poland introduced a tradable green certificates mechanism in order to comply with obligations set in the Directive 2001/77/EC. Green Certificate (GC) is a document that proves that the produced electricity comes from RES. GC is issued by the President of the Energy Regulatory Office (URE). Polish companies dealing with production, supply and sale of electricity have a duty to obtain and submit to termination a mandatory number of GC. Thus, there is a constant demand for these certificates on the energy market. The certificates represent property rights and as such are traded on the Polish Power Exchange.

Power plants, utilities and grid operators have to prove the RES origin of certain percentage of the electric energy they sell. This renewable sources portfolio imposes 10,4% by 2010, but there are no specific provisions for PV. This target however is unlikely to be achieved without revolutionary take-up on RES market in Poland. To render the system more flexible, there is a choice: instead of purchasing a GC it is possible to pay the replacement fee.

In order to sell energy, the concession is required even for the smallest system. The procedures are very difficult and take a long time. At the moment Energy Regulation Office registered only one (18 kW) PV system.

The strategic document *"Energy Policy of Poland until 2030"* hardly mentions photovoltaics giving prospect of 2 MW in 2010 and 32 MW by 2030 of PV installed capacity.

Polish PV investors are eligible also for grants financed through the Green Investment Scheme (GIS).

The National Fund's sources of income are fees paid for use of the environment for economic activity; penalties paid for violation of the ecological law.

The two major RES incentivizing European level funds are: the Cohesion Fund, European Regional Development Fund. The second one functions in form of Operational Programmes co-financed from EU and Polish budget. Investment cost in order to be subsidized from the Operational Programme Infrastructure and Environment, This is the most important source of RES investment financing in Poland, it is highly regrettable that PV is excluded from this support scheme. Only heat production from solar power is eligible for these grants.

Switzerland supports Poland with a total amount of 304 mio EUR over five years 2008 2012. These funds are part of the Swiss contribution to the ten states that joined the EU on 1st May 2004. Swiss contribution is likely to be a considerable source of funding for PV investments in Poland.

RES investments in Poland have been promoted through EEA and Norway grants, last financing period being 2004-2009.

Sixteen Provincial Funds for Environmental Protection and Water Management award soft-loans for small and medium PV investments. Only new plant construction projects submitted by legal entities or natural persons are eligible for the loan.

The Environment Protection Bank with the support of the National Fund for Environmental Protection and Water Management gives credits for the projects in line with one of the priority programmes set by the Fund (max. granting period is 10 years). Unfortunately PV is not mentioned as one of the prioritised electric power generation source.

The Environment Protection Bank with the support of the Provincial Funds for Environmental Protection and Water Management act locally, supporting regional investments with preferential loans. The Environment Protection Bank's credit facilities can be utilized by entrepreneurs, local government units, and retail clients.

The same bank in cooperation with the National Property Bank (BGK) gives 5-years soft loan (usually at a half of the commercial rate), covering up to 25% of the investment cost on energy efficiency upgrading using RES. The form of preference apart from a lowered rate of interest in comparison to commercial credits is a chance to obtain a grace period in the repayment of the principal. During the first six months of the year 2008 more than 2700 loans have been granted (total amount > 580 mio PLN), but none on PV. There are also some preferential loans from other commercial banks.

Polish scheme of state support for foreign and domestic investors includes initial investment support (material and non-material assets) and subsidy for, the parallel to this investment, jobs creation. Only investments within regions where GDP rate is lower than the average GDP in EU countries. Initial investment support consists on tax exemptions or governmental money grants.

Romania

Main axis of RES support policy in Romania is the Operational Programme “Competitiveness and Economic Growth” supported from Structural and Cohesion funds. From all of the 5 main priorities of this programme, the 4th is relevant for the purpose of this document. Called *“growth of energetic efficiency in the context of fighting against the climatic changes”* provides a few subsidies destined to foster RES investments. Within the 4th priority there are three sub-domains, the second one being called “increase exploitation of RES”, which refers to investments in the modernization and building of new plants to produce thermal and electrical energy from biomass, hydro power units (installed capacity <10 MW), solar, wind, geo-thermal resources and other renewables.

Small companies are eligible for subsidies covering up to 70% of the succumbed costs, medium size companies can get 60%, and large ones are offered the subsidy covering half of their eligible costs. The only exception to these payments are the investments realized within the capital city Bucharest, where subsidies are slightly lower than everywhere else (60% instead of 70%, etc.). Up to 98% of costs can be covered if the investor represents local authorities.

The overall budget in 2008 year was about 70 mio EUR, the minimum single subsidy was 100 000 EUR and the maximum one 50 mio EUR. There was a single project in the field of PV application approved for financing in 2009 (PV power plant of around 250 kWp owned by the Municipality of Alba Iulia).

The second call deadline is 30 April 2010 and the list of approved project will be announced by the end of 2010. VAT is not an eligible cost nor is a purchase of second-hand photovoltaic modules. Main obstacle is the inertia of evaluation team not able to examine all of the applications in due time.

In Romania there is a mandatory quota system accompanied by Green Certificates (GC) system. In 2008, the mandatory quota of RES in national gross electricity consumption was 5,26%. In 2010 the quota is 8.3%. Over 2008-2014 period, the GC value will range between 27 EUR and 55 EUR. In November, 2008 GC value reached 38,87 EUR/MWh. In December 2009 the value of GC was 55 EUR. The solar electricity producers get 4 Green Certificates for every MWh (more than for any other RES). Distributors who would fail to meet the quota are subject to a 70 EUR fine per each missing GC.

Another incentive is the Romanian government's guaranty for 50% of the total loan amount on long term. Investors benefit also from the income tax waiver in the first 3 years of RES plant operation. Favourable tax discount is provided for private investors producing more than 20% of their energy consumption from RES. In their case, the total annual income used for tax evaluation is reduced by 50% of the value of the RES system components. Net metering applies to less than 50% of PV s with installed power smaller than 1MWp.

The producers are also not obliged to pay some fees for the unbalance of electrical parameters they induce in the electrical energy transport system if the peak power of the installation is lower than 250 kWp.

Existing system promoting RES is roots in the Law No 220/2008. New legislation act amending this legal background is under preparation.

Slovakia

Effective since 2009 generous FIT rates have been warmly welcomed by PV investors. FIT in Slovakia vary among the sources, PV payments

are divided in dichotomous way. One is for systems which capacity does not exceed 100 kW. The FIT for such installations is 0,43 EUR/kWh. The second group of beneficiaries are producers utilizing systems bigger than100 kW who get 0,425 EUR/kWh. FIT are guaranteed over 15-year period decreasing by the maximum of 10% each year. Nevertheless, there is one black cloud on this new PV friendly horizon. In 2009 the Slovak Electricity Transmission System office introduced the limit of 120 MW for PV installations. As a consequence all investors willing to install over 1MW must register their projects in this office and only a few of them will be authorized.

Except from FIT, RES investment in Slovakia can be supported by the European Structural funds. Especially under the scheme 2.1. *Increase of energy efficiency in production and consumption and setting up new progressive technologies in power engineering*. Maximum support 6 mio EUR varies upon geographical region (max. 40 - 50% of the eligible costs in less developed regions e.g. eastern and central part of Slovakia).

Subsidies are earmarked for private companies that do not employ more than 1000 people and which yearly turnover does not exceed 49,8 mio EUR. Noteworthy these subsidies are not available for projects in autonomous region Bratislava.

Slovakia, just like in many other NMS there is no PV specific investment subsidy although general RES support scheme exists. The background law of this scheme is the Act on Investment Support, focused on regional development and creation of new employment opportunities in general.

Slovenia

Slovenia already introduced the FIT as the main fiscal measure of RES support, with guaranteed minimum prices and premiums in 2001. From 2004 the tariffs for electricity from PV plants were adequately high, so the development of the sector started to grow fast and stable.

Following the request of the DG Competition the FIT had to be reorganised according the rules for state aids. As a result new regulations entered into force bringing considerable changes for PV market stakeholders. First of all the time of support has been prolonged from 10 to 15 years, the collection of the money for the FIT scheme has been changed from the fee to kWh consumption to lump sum on connection and the whole system is managed by an independent institution Centre for State Aids.

	FIT [EUR/kWh]			
Type	<50 kW	<1 MW	<10 MW	<125 MW
Roof	0, 42	0,38	0,32	0,28
Roof-integrated	0,48	0,44	0,36	0,32
On-ground	0,39	0,36	0,29	0,27

Table 4. FIT in Slovenia

The Centre is obliged to purchase all the RES electricity and sell it on the market. For plants with nominal power up to 5 MW the producers have the choice to select between fixed purchase prices or fixed operating support. Above 5 MW the producers have the right to get the operating support and have to sell the produced electricity on the market themselves. The tariffs are calculated for 15 years pay-back period divided in size classes: up to 50 kW, 1 MW, 10 MW and 125 MW.

Investor benefiting from investment subsidy gets lower guaranteed price or operational support. The actual rates of support PV plants entered in operation in 2009 or before in Slovenia are shown in the table. For PV plants which will enter in operation in 2010 and after a yearly degression of 7% is foreseen for the next five years.

Subsidies for RES including PV are granted by the Ministry of Agriculture. Its regional fund through Agency for Agricultural Markets and Regional Development (AKTRP), grants subsidies for RES, including PV. Such a subsidy amounts to 50% of the investment cost (without VAT). The investment must be implemented out of defined urbanized localities. Maximum investment of the plant is 480 000 EUR and subsidy is limited to 200 000 EUR. The subsidy scheme applies for the period 2007-2013.

Apart from subsidies, PV investors can apply also for a preferential loan provided by The Environmental Fund of the Republic of Slovenia (Ekosklad). Ekosklad grants low-interest loans to RES projects covering up to 90% of investment expenses (2 mio EUR) at annual fixed nominal interest rate of 3,9% for individuals and 1% for companies, Loan has to be redeemed in 10 years, Eligible projects must be put forward by public or private legal entities or individual persons. In 2009 the PV plants represented the far biggest share of the loans given by this found. In 2009 also a few commercial banks started to open special loan lines for RES and especially for PV projects.

Main obstacle identified by the PV investors in Slovenia is the long average lead time for obtaining Support Scheme Contract, without this document investors can not perceive FIT payments. Another diagnosed problem occurs while building bigger on-ground systems requiring a building permit. The FIT for on-ground systems is limited to first 5 MW installed plants yearly. Since 2009 Slovenia does not support RES with tax incentives any longer.

4. GRID CONNECTION

According to the article 16 of the new RES directive, all of the EU Member States should develop their transmission and distribution grid infrastructure, intelligent networks, storage facilities and the electricity system. These requirements came as a result of growing need for RES grid connecting. The same article establishes obligation to undertake appropriate measures with regard to facilitating of grid connection procedures. Further provisions relate to mandatory state-level security of proper

transmission and distribution of renewable energy, for which at least guaranteed access to grid is provided.

Transmission and distribution system operators shall set up and make public their standards on costs and technical adaptations. These rules should be based on objective, transparent and non-discriminatory criteria. Noteworthy, these criteria need to be adjusted also to the producers in remote areas and in regions where the population is rather low.

Thanks to the new RES directive, PV investors have guaranteed access to information about grid connection details such as costs and timetables, dispatched by the transmission and distribution system operators.

Apart from the new RES directive, there is also the new directive on the internal market in electricity adopted as part of the EU's third internal energy market package in June 2009. It aims at unnecessary barriers removal that would facilitate green energy access to the grid. This directive introduces a general obligation to consider the 20% of RES target in all the decisions concerning constructing of new power plants.

Standardisation of economic and technical grid connection requirements seems to be crucial for PV development. Unnecessary multiple interconnection conditions based on onerous criteria are part of obstructive policy blocking access of PV and other RES to the grid. Expertises required in such procedure get the investment costs even much dearer.

Table 5 contains information about PV electricity access to the grid in NMS. Positive signal for investors is the legally guaranteed access to the grid, transmission and distribution of energy from RES in every NMS. The principle of non-discrimination applies to PV generated electricity, but only Slovakia, Slovenia, Romania, Malta, Cyprus and Czech Republic favour PV giving it the priority.

Investors pay attention to the complexity of the proceedings, if they are too long, it can be a considerable obstacle that can potentially even discourage some entrepreneurs. While Hungary, Lithuania and Malta judged their procedures as reasonable, the rest of NMS still consider them difficult. Even though most of NMS are gradually removing administrative bottlenecks, there are also technical barriers that efficiently handicap the grid connection. In most NMS adjustment of the utility and its modernization may only be made on PV systems operator initiative and partly at his expense. One-step authorization is still out of reach in NMS, but some positive trends can be observed.

Bulgaria

The administrative and investment steps are stated in the special regulation for the Investment Process for Utilization of Solar Energy.

Here, only interconnection with grid is described. A written request for the study of conditions and way of connecting to the grid should be submitted in order permits and licenses to be issued. According to the Regulations for connecting producers and users of electric energy to the transmission and distribution electric grid, for plants of installed power equal or less than 5 MW the written application is submitted to the distribution company located near the place of the plant, while for plants of higher power to the regional sub-unit of the transmission unit located near the place of the plant. The application form contains data and documents, as specified under the Regulations.

The permit for connection is signed after the approval of the investment project and issue of construction permit. After that a written request for signing an agreement for connection is submitted to transmission or the respective distribution company, after the connection agreement conclusion, elaborates and coordinates the building connection equipment working plans.

Besides, an environment assessment from the Bulgarian Ministry of Environment and Water is needed.

Systems below 5MW are connected to the low voltage grids or mega-volts grids operated by small energy suppliers, which have to pay the corresponding FIT to the system operators. A standpoint is required from the energy distribution company which is to purchase the produced electric energy. In the standpoint the requirements are formulated which the owner of the PV plant has to obey.

The National Agency of Energy and Water Regulation issue a license for electric power production. The PV plants of 5MW power and above are connected to the high voltage grid (110 kV), which is owned by the National Electric Company (NEC). For that reason permit for connection has to be given by NEC. Such permit is given provided there is a technical possibility availability of a 20 kV/110 kV substation to which the PV plant to be connected to.

System developers aiming at getting a connection point to the grid, have the right to get an answer from the utility within two weeks; and to have the installation connected to the grid within 90 days if required. The possible extension of the grid (transmission and/or distribution) will be covered by the utility. Only the part which is in the producer land will be cover by the electricity producer.

The transmission and distribution companies are obliged by the Law to take 100% of the power that is fed into the grid. Else they can face fines of up to 150 000 BGN (~ 70 000 EUR).

It is necessary to perform ecological assessment for the possible development of the RES together with planning of the development of the electrical grid in Bulgaria. The critical points to be considered are: evaluation of the environment impact, changes of the status of the agriculture area, priority of the connection to the electrical grid.

Cyprus
In Cyprus, Electricity Authority of Cyprus (EAC) is obliged to buy in priority all the PV electricity produced by independent producers at a fixed price based on its marginal power production cost that is set by the Cyprus Energy Regulatory Authority.

For small PV systems (<20kW) the administrative procedure is relatively simple, as only two applications are needed and the whole process takes less than 4 months. For PV systems with power greater than 20 kWp the procedure is more complex and time consuming. For PV systems with power exceeding 100kWp the environmental authorities' approval is also required. In Cyprus, every PV ground installation needs a building license. For small PV system the total connection cost is born by the electricity authority.

For the large RES system or when expansion of the grid is required the connection cost is shared between the owner of the system and the electricity authority. The basic obstacle in the connection procedure is a long waiting time in order to get all the required documents (especially the building license). Moreover, there is little experience in grid connecting of large-scale systems.

Czech Republic
The speculative grid connection permits leading into a virtual risk of the electricity system instability. Until March 2010 the permits were provided at no charge and no verification by distribution system operators (DSOs) whether there is real project behind the application. Currently (May 2010) no new grid connection permit applications are accepted by any DSO.

To connect a PV system to the grid can be delayed for months by the DSO. The delay could even be 11 months; PV systems developed this year could therefore be connected to the grid in the next year.

There is an urgent need to introduce procedures what would inhibit speculations with the grid connection permits. For higher market penetration of the small roof-top systems (segment A) what would most likely reduce transmission loses and transmission system load it is crucial to reduce administrative severity of the PV system development process. Especially investors of the smallest PV systems (less than about 5 kWp) should be allowed to conduct simpler accounting procedures. The electricity production licence should not be seen as an ordinary trade one and especially unemployment benefits should not be restricted to its holders.

Estonia
Estonia has still no experience in connecting PV systems to the grid. The list of necessary documents concerning production and sale of electric energy from RES is defined by Estonian governmental regulation. Cost of connecting a RES energy installation to the grid is relatively high.

Hungary
Although in principle the access to the grid for solar systems in Hungary is guaranteed by law, systems which capacity exceeds 500 kWp need to permit from the Hungarian Energy Office. Small installations are subject to utility operator permit. There are six utility operators in Hungary, the biggest one - ELMÜ was pioneer in introducing simplified procedure for PV grid connection. As a result, most of the on-grid PV systems are located in the central region for which ELMÜ is responsible (over 70 with 200 kWp). Other utilities try to harmonize their procedures with this operator. The producer should declare that the electricity fed into the grid will not exceed 2/3 of the electric energy that he consumes. If it is not the case, than such installation would be treated like a small electric power station and stricter grid connecting technical requirements would apply.

Major obstacle in grid connecting process in Hungary, same for systems of every size, is the Hungarian Certificate of the inverters. Such certificate is required by utilities operators before opening the access to their grid. Certificates are issued by Hungarian Testing Laboratory. This requirement results in extra costs for investors.

Latvia
Latvia had none experience in connecting PV systems to the grid connected until December 2009, when two private companies got the licenses for electricity production from solar energy. The list of necessary documents concerning \production and sale of electric energy from RES is defined in governmental regulation. In order to feed the electric power to the grid in Latvia the electricity production license is required and the procedure preceding its issuing is rather complicated. The costs for grid connection in Latvia are relatively high and are covered by PV installers. The other barriers for grid connected PV are very long connection period; and refusal of buying the full amount of produced electricity (the quota system for electricity produced from RES exists).

Lithuania
Lithuania has introduced FIT for PV producers only at the end of 2009, thus there are no on-grid installations yet. Nevertheless, in theory grid-connecting procedure would not take longer than 6 months and 60% of the costs are born by the producer.

Malta
In Malta solar power is given priority in grid connection and dispatch, the average lead time of such process is comparatively short (from 1 to 6 months). So far as a net-metering mechanism is utilised, PV producers have no interest in generating electricity unless it is not deducted from the own overall consumption. Hence applying for an importexport power meter is crucial for an on-grid system. Such application can not be processed without the approval of the 'Notification' or 'Authorisation to construct a generation plant' from the Malta Resources Authority. Since due to net-metering, the generation capacities do not exceed the consumption capacities, there are rare cases where physical connection requires upgrading by utility or otherwise.

Poland
In Poland there are no clearly specified standards for grid connection. The PSE Operator body responsible for the Polish Power System operation is legally bound to establish precise conditions for grid connecting, upon an individual submitted application. Such application is a complex document requiring numerous obligatory attachments. In reality, even fulfilling the established previously conditions does not guarantee a grid connection. Grid operator may withdraw previously established conditions, due to any technical disability to connect new system. Very often meeting grid connection requirements demands additional costly investments in modernization and/or extension of the grid born by the energy producer. Settling body of litigations on this ground is the Energy Regulatory Office. Since its ruling is based on data provided by the grid operators, the outcome is usually unfavourable for the small producers.

Romania
Romania favours largely solar electric power allowing it prioritized grid accession. PV producers whose systems do not exceed 10 MW do not need to pay for such connection. However, in order to connect to the grid, investors must obtain a lot of permits and licenses, namely the generation license, the qualification certificate for the electricity priority production, registration at the Electricity Market Operator. Systems exceeding 250 kW require also installation approval from ANRE (the National Agency for Energy Regulations).

In Romania there are only 10 PV grid connected systems with installed power higher than 10 kWp, the highest one is 30 kWp.

Slovakia
Getting connection to the Slovakian grid is considered to be difficult. Not only can it take up to 6 months, it is also financed entirely by the PV electricity producer. Despite governmental plans to simplify the procedure, grid access is still a result of very complex tasks and requirements to fulfil. Distribution System Operator in Slovakia is the responsible body for dispatching the information concerning grid connecting conditions. Systems bigger than 5MW are subject to more restrictive control as environmental impact assessment measures need to be undertaken. With all this obstacles, the priority in grid accession for solar power seems to be negligible advantage.

Slovenia
No simplified procedure for grid connection of solar electricity generation systems in Slovenia are the reason why the complete procedure can take up to 1 year and compared to other NMS is quite complex. The major problem is the lack of reliable information, many institutions involved and many procedures and documents required. Contract with Slovenian distribution operator is just the top of the iceberg of permits and certificates to obtain (from the Regulatory Energy Agency and the Centre for Subsidies) before the FIT is formally operative and paid to producers Positive side is that PV power and other renewables are prioritized in accessing the grid.

Table 5. Grid connection processes in NMS

Country	PV priority access to the grid	simplified procedure	number of institutions conditioning approval	complexity of the procedure	overall proceedings lead time	costs covered by PV producer
Bulgaria	yes	no	6	difficult but improving	6-12 months	shared
Cyprus	yes	yes	2 to 8	difficult but improving	1-6 months <20kW 6-12 months - biger	shared/none <20kW, grid extension costs always shared
Czech	yes	no	4 to 7	difficult but improving	6 months	depends on connection type and voltage level
Estonia	no	no				total
Hungary	no	yes	1 to 23	reasonable	1 to 6 months	none under 3x16A
Latvia	no	no	3 to 6	difficult but improving	3 to 6 months	total
Lithuania	no	no	1	reasonable	1 to 6 months	shared (PV producer pays up to 40%)
Malta	yes	yes	1 to 3	reasonable	1 to 6 months	total
Poland	no	no	> 10	difficult	> 1 year	shared (PV producer pays 50%)
Romania	yes	no	3 to 6	difficult but improving	6 months	none/ shared for plants >10 MW
Slovakia	yes	no	> 10	difficult	> 1 year	total
Slovenia	yes	no	3 to 5	difficult but improving	6 to 12 months	shared

5. FUTURE DEVELOPMENT SCENARIOS

In accordance with the new RES directive all Member States have submitted documents giving their forecast of the expected use they will make of the cooperation mechanisms contained in the Directive. Following future development scenarios are mainly based on these forecasts, but they are also supplemented with prospects of national PV sector representatives.

Bulgaria
Bulgarian forecast document reflects the perspective to prioritize hydropower generation. Interestingly, in this well-irradiated country PV power generation is considered four times more expensive than power produced in hydro power plants. Second source if RES to be developed in Bulgaria is biomass. Even with steep growth curve of the two sources, achievement of Bulgaria's 16% national RES target is at risk. This is why national authorities emphasize another priority - significant raise in energy efficiency. According to the forecast document solar energy's potential is 389 ktoe and it represents 9% of RES mix generation.

Cyprus
According to the unofficial expectations of the Energy Service of Cyprus, the Cyprus Institute of Energy and the PV industry representatives in Cyprus the total PV installed power shall increase by 3MWp annually. Industry prognosis: 30 MWp by 2020, 5 MWp by 2010. The only relevant information is that Cyprus does not consider transferring RES energy and intends to meet the target of 13% by 2020 with its own domestic resources.

The official National Action Plan for RES will be prepared by Cyprus Energy Service in co-operation with all the other associated authorities such as Cyprus Energy Regulatory Authority, Electricity Authority and transmission system operator. PV systems are expected to have small contribution in the total renewable energy mix due to their high cost in comparison with other technologies. Mainly small BIPV systems (roof installation) will be supported by the RES scheme rather than large scale PV parks. Even though Cyprus RES development will focus mainly on cheaper wind energy and solar thermal concentrator stations the gradual cost reduction of PV panels is expected to increase the PV market in Cyprus in the future.

Czech Republic
The Czech Republic PV sector showed strong growth in 2009 with over 462 MW of installed power capacity and is expected to continue growing in the nearest future. According to some predictions it is likely to hit even 1200 MW by the end of 2010. The PV sector is likely to shrink in 2011 because of the measures undertaken to steady the overheated market. The Czech parliament is debating a bill to reduce regulated prices for solar energy by more than the 5%/year (according current law). Currently prices are about 8 times higher than those on the market and if nothing changes, such unsustainable situation can cost consumers up to 47 bln EUR over the next 20 years (according to CEZ). Official forecast document preceding NRAP does not mention PV; demand for RES power is expected to be satisfied with domestic generation. There is no specific action plan for PV.

Czech RE Agency has organised a workshop in cooperation with EREC and other RES associations. It has been confirmed that the forecast document is satisfactory and can very well serve as NRAP.

1.8 MW, Myšteves, Hradec Králové, Czech Republic

Estonia
Estonia will reach its national target of 25% share of energy from renewable sources in gross final energy consumption by 2020 by using its own potential and measures. The only RES mentioned in the forecast document is wind (off-shore parks).

Hungary
According to Hungarian NREAP PV will be developed in order to advance electrification of remote areas. Hungary sees an opportunity for further PV deployment in the provisions of the Directive 2002/91/EC on the energy performance of buildings. Most of the domestic applications were designed to provide autonomous power supply by using suitable storage batteries. FIT rates still do not satisfy the investors. Solar power reaches 16,5 GWh in the forecast use of RES sources by 2020 (with 15 MW of installed PV capacity). RES production in Hungary is and will be based on solid biomass. Forecast document mentions the positive implications of probable decrease in the mid-term and long term costs of solar cells production.

Latvia
Ministry of Economy unofficial estimates show that over 900kW of PV capacity will be installed 2010. Adopted in February 2009 the new Regulation Regarding Electricity Production from Renewable Energy Resources introduced attractive FIT for PV power (0,426/EUR). According to Latvia's forecast document more than 57% of electric energy will come from RES (no PV specific information). The 40% target of RES share by 2020 is most likely to be met.

Latvia's Ministry of Economy issued also administrative permits for construction of two new solar power plants. Both on-grid, they will have capacity of 0,1 and 0,8 MW. Considered these project and the fact that FIT introduction into PV market has been accepted in Latvia, solar power sector in this country is most likely to grow in the coming years.

Lithuania
The closure of the Ignalina nuclear plant on 31st of December 2009 has created a completely new situation in the electrical energy market of Lithuania. This plant was by far the largest electricity producer in the country; therefore, its switch-off has raised concerns on energy security and pinpointed the importance of alternative electricity sources, the renewable energy sources, in particular.

No PV specific provisions in the forecast document (focused on hydro and wind power generation). Lithuania was heavily affected by financial crisis noted 15% of negative economy growth. Expected generous FIT (0,46 EUR/kWh) for PV did not come into force in 2009. Despite this, Lithuania expects to produce a surplus of energy from RES under RES Directive commitments and is ready to make statistical transfers to the countries in need. Maybe governmental project of buildings modernisation can advance PV sector (70% of existing houses are to be renovated by 2020), but it is not sure, as the priority in this programme is energy efficiency.

Malta
According to Malta's forecast document a conservative figure of 29MWp MWp of PV capacity will be installed by 2020. Malta is the only NMS to predict already its anticipation not to fulfil the RES directive obligations from domestic means (9,2% instead of 10%). The document "National Strategy for Policy and Abatement Measures Relating to the Reduction of Greenhouse Gas Emissions however recommends an optimal scenario that 4% of the electricity in 2020 should be generated by PV systems. Roughly, this share can represent about 78 MWp.

Poland
Poland needs to secure 15% share of RES in overall national energy consumption by 2020 and 20% by 2030. Interestingly, Poland expects to produce more energy form RES than it is indicated in the national target in RES Directive. Poland forecast document estimates show the possible surplus of energy generated from renewable sources (15,5% instead of targeted 15% by 2020).

The fulfilment of these objectives does not include PV power contribution. Poland stakes on bioenergy. The Strategy of the Development of Renewable Energy Sector sets the target of 2MW of PV capacity by 2010, and according to Polish Energy Policy it is going to account for 32MW by 2030.

Recently, Polish authorities started to consider stronger support for solar heat generation. 75% of Polish citizens would like to benefit from solar power and heat their houses in this way. Although it does not directly concern PV, it may be a good step forward dissemination of solar energy use and one day a twin initiative will occur in the field of solar electric power generation.

Romania
According to Romania's forecast document its solar potential reaches 60 PJ/year (1,2 TWh). By 2020 share of electric power from RES is expected to account for over 38%. Latest research indicate that Romania's PV annual potential is 1200 GWh (103,2 toe). Romania considers that it can just reach the overall target by relying exclusively on domestic production.

The recent forecasts show that Romania has to develop approximately two thirds of the total potential of its RES. Thus, in the nearest future Romania will have to make significant efforts to reach higher levels of efficiency in utilization of every available source of green energy. It seems that the prioritised RES will be hydro, wind and biomass with smaller focus on PV. PV potential in Romania is estimated to reach at least 500 MW in 2020 most of the installation will be on the roofs. Fast growth can be limited by the fact that until 2020 the grid capacity cannot support more than 3000 4000 MW.

Slovakia
Forecast document does not mention PV, includes only heat purposes as to solar potential. Slovakia expects to meet the 14% RES target and even transfer it to other Member States. According to this document „a smaller growth in the use of RES is expected in electricity production. This is because RES has lower technical potential for electricity.

A crucial document suggesting a definite RE mix in order to meet the 2020 targets should be the National Renewable Energy Action Plan. It is expected that photovoltaics will be included in this document, since in 2009 there has been a slight development of PV support. According to current projects in progress, one can expect around 200 MW to be installed in the next years. Once the NREAP is out, the prognosis of Slovak Ministry of Economy (which is in charge of this paper) will be known and PV support. The paper should be prepared by the end of June 2010.

Slovenia
Slovenia is ready to adopt a programme of joint projects in order to meet its 25% target share of RES by 2020. For the time being, Slovenia does not expect any surplus or deficit of renewable energy production. The share of electricity coming from RES in 2010 is likely to account for 33,6% of national gross electricity consumption.

According to its forecast document Slovenia is able to fulfil the requirements with domestic generation capacity. 5,847 MW of annual growth

in 2009 places Slovenia among leaders in the PV power generation sector within NMS. Slovenian PV platform prognosis show that followed the most optimistic scenario PV capacity in Slovenia can touch up to 890 MW (470 MW in the less optimistic one by 2020.

PV on facade of transformer station, Elektro Ljubljana, Slovenia

6. TRAINING, EDUCATION, OUTREACH

Without effective promotion of PV power generation it is impossible to gain public acceptance of general society. Public opinion drives political will without which favourable conditions for PV development can not be created. Thus it is crucial to diffuse information about solar electric power potential so that it reaches every group in society. Special trainings should be provided to public administration workers and potential investors. Better education is crucial for future energy market actors mainly installers.

Art. 14 of the new RES directive say that Member States shall ensure that by the end of 2012 installers of PV can benefit from certification schemes. In Annex IV of the new RES directive it is clearly stated that PV installers shall be certified by an accredited training programme. Such training should give an overview of the market situation of solar products and cover ecological aspects, components, characteristics and dimensioning of solar systems, selection of accurate systems and dimensioning of components fire protection, related subsidies, as well as the design, installation, and maintenance of PV installations. The training should also provide good knowledge of any European standards for technology, and certification such as Solar Keymark, and related national and EU laws.

Another strategic target group for which education is highly important are academic researchers and students. Positive trend in this matter has already been observed as growing number of NMS invest in scientific human resources, with regard to PV technology improvement that could one day render this energy source achievable for almost every household.

Bulgaria

The Central Laboratory of Solar Energy and New Energy Sources at the Bulgarian Academy of Sciences (CL SENES) and more exactly its integral unit - the Bulgarian Centre of Excellence of Solar Energy, is the leading institution dealing with education and training of young researchers in the field of solar energy in Bulgaria. The Centre organizes specialized workshops, conferences and schools on PV energy conversion contributing in this way not only to the scientific knowledge and technological know-how of solar energy conversion but also raising awareness about solar energy technologies and their environmental impact. The CL SENES along with Bulgarian universities and high schools signed agreements on joint educational program implementation in the field of RES and more specifically research dedicated to solar cells technologies

Several Bulgarian universities (e.g. Gabrovo Technical University, South-West University in Blagoevgrad) offer special courses on PV materials, solar cells and PV systems in the curricula of their studies. Plentiful opportunities are open especially to PhD students, young researchers and engineers, namely workshops, special Advanced Studies Institutes at the Bulgarian Academy of Sciences with educational programmes in the field of PV, International Scientific Forums and Schools. For this purpose a considerable financial support has been assigned, one of its source being the European Social Fund (operational program “Development of Human Resources”) which started in 2008. Noteworthy, some Bulgarian high schools also introduced PV dedicated programme called “Solar technician”.

Cyprus

In Cyprus many information seminars are organized in order to inform the public about the use of PV technology and the exploitation of renewable energies in general. At the department of Electrical Engineering in the University of Cyprus there is PV dedicated part of educational program at both: undergraduate and postgraduate level. Moreover in department of Geotechnical Sciences and Environmental Management of the Cyprus University of Technology and in the electrical department of private colleges there are studies and research programs in RES including PV.

Additionally Cyprus Energy Service organizes meetings and information seminars in schools in order to increase the student's awareness regarding the PV systems and the rest of RES. Also in 56 schools a special educational model has been introduced, it provides the students with up-to-date information on different aspects of PV systems (functioning, efficiency, optimum slope, orientation etc.).

Czech Republic
In Czech Republic there are conferences and seminars dedicated to PV and RES in general almost every two weeks. Czech RE Agency organizes special workshops for designers of PV plants. Workshops are accredited by the Czech Chamber of Certified Engineers and Technicians Engaged in Construction. The Faculty of Electrical Engineering at the Department of Electrotechnology at Czech Technical University in Prague is the academic centre of PV-oriented education.

3,16 MW in Syrovice, Czech Republic

Estonia
The new international curricula Program for Master studies were opened at Tallinn University of Technology, concentrating on different alternative energy sources with the main attention to PV. During the first year 20 students from different countries (Estonia, China, Nepal, Mexico, Russia, and Latvia) were accepted. The aim of the Master's programme is to provide an academic education on all possibilities to minimize and optimize the use of energy based on thorough applied and practical interdisciplinary skills.

The students can specialize in Materials and on Processes for Sustainable Energetics with the special focus on the PV energy. Whereas the specialisation on Materials will lead to a deep level of scientific knowledge on this subject, the specialisation on Processes gives broader and more general overview of all aspects of sustainable PV energy conversion, transport, storage and use enabling students to coordinate and lead specialists to work together to create optimized systems and thereby provide best solutions for the customer, i.e. planning organisations, private and industrial users of energy as well as energy contractors and providers.

Due to integrated teaching of general, core, and special courses in science, engineering, economic and crosscutting fields such as project management, quality control and social skills the students will acquire very complex, thorough knowledge.

Several PV panels have been installed in different parts of Estonia, aiming mainly to introduce PV to Estonian public. Two different projects of RES demonstration centres in Estonia have already been prepared and are at the stage of experts' evaluation at the moment. Several consultation meetings have been organised by the scientists from Tallinn University of Technology PV Testing Centre to provide information about the market situation of solar panels as well as ecological benefits of PV use. During these seminars questions like how to select PV systems for private use as well as how to design, install and maintenance of planned PV installations have been answered.

Hungary
The Budapest University of Technology and Economics offers separate teaching subject entitled *Solar cells and Renewable energy sources*. The aim of the subject is to give an overview of the RES with special regard to the EU standards and to spread specialist knowledge in the field of operation, construction and manufacturing of solar cells. The subject is facultative for both bachelor and master degree students of Electrical Engineering & Computer Sciences Faculty (open also to interested students from other faculties).

Scheduled for four lessons per week, this subject relates in 90 % to PV. The teaching languages are Hungarian and English and students' practical skills are also taking into account as they need to manufacture simple c-Si solar cells based on planar technology. Small groups of students work on technology up-grade in frames of their project laboratory task or thesis writing.

Other academic institutions providing education on PV subjects is the Szent István University. Focus on solar electric power generation is integrated in more general master curriculum - Energy and Environment.

In Hungary there is also a post-graduate course on Solar Engineering. This course is concerned with energy use, general aspects of the use of renewables, phototermic systems, photovoltaic systems, passive applications, autonomous systems. Concerning to the photovoltaic part of the course it relates to: basic terminology, solar cells and applications. Grid connected PV systems are discussed. Modelling and simulation are also the part of the course.

Year 2009 was also very intense when it comes to dissemination of solar advantages. Many workshops and conferences have been accompanied by PV-dedicated presentations, press releases, interviews and documents. To name just a few: Passive house Conference (February 2009), the first meeting for Hungarian RES Law preparation in the Hungarian Development Bank (March 2009), Hungarian Regula (March 2009), First National PV Platform Conference (March 2009), ERRA Course RES Regulation (November 2009), General Assembly Meeting (November 2009), Autonomous House Workshop (December 2009)

Latvia
The Faculty of Building and Civil Engineering at Riga Technical University provides lectures for students on subject “Renewable Energy Resources for Buildings Energy Supply”. The objective of the lecture is to give students knowledge about RES use in building, such as. alternative heating systems, energy balance, designing of electrical heating system, BIPV. Students can learn also about solar energy heating systems: liquid systems, collectors, array design and many more related topics.

When it comes to Latvia's demonstration, the Solar Energy Use Testing Polygon - the installation of PV batteries with total capacity of 1,315kW was located on the roof of the Institute of Physical Energetics. The main goal of this Solar Energy Use polygon is PV batteries and solar collectors testing in real conditions in order to obtain a potential of solar energy use and for further development of solar energy use in Latvia. Data on real solar radiation and other Climate conditions is collected and analysed.

Lithuania
PV is a part of the master study curriculum on Optoelectronics at the Physics department of the Vilnius University. This program was introduced with the support from the EU structural funds; these sources have also supported the publication of two new textbooks in Lithuanian: G. Tamulaitis and G. Juska “Energy-saving semiconductor technologies” and A. Krotkus “Semiconductor optoelectronics devices and systems”. In the future a new study program dedicated to PV device and system production and application is going to be introduced at the Vilnius's Technical University.

Noteworthy in 2009, the Lithuanian Science Council put PV on the list of topics of national research programs called “The future energetics”.

Malta
PV penetration in the local market was given birth mainly through demonstrative installations in public buildings and by a relatively few pioneers who due to their environmental concerns installed a PV system. Nowadays, the promotion of such systems as a cleaner source of the ever increasing cost of energy is more promoted and suppliers of such technologies have increased providing the public with more awareness and benefits of this technology. Various energy related seminars and conferences being held on the island commonly address and explain PV systems and the developments of such technologies, highlighting the barriers still to be addressed for a self sustaining PV market.

Poland
The main PV promoting institutions in Poland are Warsaw University of Technology and Polish Society for Photovoltaics. Not only do they organize education and outreach programmes within Poland, they also sponsor lectures, classes, laboratories and trainings targeted on academic and general public. They advocate the widespread use of PV energy, relentlessly presenting it as as realistic, reliable, and economic source of energy. Fighting with well anchored clichés of expensive and unprofitable in Polish conditions, thy encourages integration of PV energy into Poland's research, economy and everyday life.

In October 2009, the Conference on PV took place in Krynica. It was organized by the Institute of Metallurgy and Materials Science of Polish Academy of Sciences from Cracow. The Photovoltaic Laboratory in Kozy manages an educational programme „Dissemination of Polish and world achievements in the field of PV in the higher education process” during 2009-2010.

The National Fund of Environmental Protection and Water Supplies Management provides also some support for education initiatives and demonstration RES projects, but not PV-specific.

Romania
In Romania there are several university centres which provide higher education in the field of RES, like Universities of: *Politehnica* from Bucharest, *Transilvania* from Brasov, *Valahia* from Targoviste, where master and doctoral programs are also organized.

630 kW tracking system in Sluneta-Dobrany, Czech Republic

Slovakia
Since 2008 the Department of Experimental Physics at Faculty of Mathematics, Physics and Informatics at Comenius University in Bratislava holds an academic accreditation for new study programs, which include PV research for both Bachelor's and PhD programs. The two curricula are: Renewable Energy and Experimental Physics (Bachelor) and a New and Renewable Energy Sources (PhD). The doctoral program is largely focused on nanotechnologies, new trends in material technology and RES. PV is an independent and obligatory subject within the program. The department is willing to strengthen applied research in PV so PhD students are offered new subjects on PV research (mainly third generation technology).

The rising trend of applied PV research will be supported by the new centre of excellence with a laboratory for testing PV materials a 100 kW installation has already been introduced and operates on the roof of the Faculty since the beginning of 2009.

At the Slovak University of Technology there is project of Renewable Energy Sources - Centre of Excellence, with funding of 1, 5 mio EUR since 2008. Research of PV is supported by new devices oriented on electric measurements, organic semiconductors and transparent conductive materials. Several departments and faculties of the University have joined the project including Faculty of Electrical Engineering and Information Technology. Another academic centers dealing with PV are Faculty of Management at the Comenius University and Slovak Academy of Science.

Slovak RE Agency educational activities Slovak RE Agency since its foundation in 2006, has contributed greatly to the public education of PV, as well as development of various projects supporting PV awareness in Slovakia. Currently, it is the only organization in Slovakia, providing a series of workshops and seminars focused strictly on PV issues. In 2009 Slovak RE Agency carried out several round tables on Slovak legislation regulating renewables. In December 2009 PV dedicated conference „Photovoltaics, our sunny future" took place, and it was the biggest conference ever organized in Slovakia on this subject.

Slovenia
At the time being there is no formal education program for PV in Slovenia. It is incorporated into the Electrical Engineering Programs both: academic and secondary education levels.

The medium technical school Šiška-Ljubljana organizes one or two weeks seminars and trainings for PV installers. The school is trying to introduce a regular curriculum for solar technician. Many of the Slovenian schools with collaboration with energy companies succeed to develop demonstrational PV plants. These companies invest and manage the plant; the schools have accession to online visualization of operation for analysis and education.

The University of Ljubljana offers special PV specialized program for PhD students. It is conducted by the Faculty of Electrical Engineering, which is linked to the research activities at the Laboratory of Photovoltaics and Optoelectronics.

Slovenia promotes PV successfully via press, audio and video media. With some newspaper houses like Finance, we succeed to develop in the last three years a special Supplement on PV, the last one on 16 pages. Updated information concerning PV is available on the Slovenian PV platform website.

There are some private initiatives for the business approach education. For instance the Agency Poti is organizing one day education on construction, buildings integration and economy PV plants, for interested experts, 5 times a year.

7. RESEARCH AND DEVELOPMENT

In the NMS research is conducted mostly by academic institutions. They are represented by centres of excellence, the major centres are located in Bulgaria (Central Laboratory of Solar Energy and New Energy Sources at the Bulgarian Academy of Sciences), Lithuania (Applied Research Institute for Prospective Technologies), Poland (Warsaw and SolarLab, Wroclaw), Romania (Academy of Scientists from Romania - AOSR), Czech Republic (Academy of Sciences of the Czech Republic), Estonia (Tallinn Technical University. Also a member of Nordic PV Centre of Excellence along with Sweden, Finland, Norway and Russia), Slovenia (Laboratory for Photovoltaics and Optoelectronics at Faculty of Electrical Engineering, University of Ljubljana) and Hungary (Technical Material Science Institute Budapest)

Cyprus
Cyprus research and technology development in PV sector is limited. However various training programs and seminars are carried out aiming to train the engineers and technicians in the planning and installation of PV systems. The main leader in research in the sector of PV is the University of Cyprus. The Photovoltaic Technology Group of the electrical department of the Cyprus University carries out a strong scientific research in the field of PV performance, in collaboration with other foreign Institutes. The main aim of this group is to evaluate and monitor the performance of PV systems in Cyprus environment by analyzing the data taken from a small PV research park.

This PV park is located at the premises of the University and is constituted of 14 different types of PV systems, examined under various parameters such as weather conditions, irradiation, performance reduction, etc. The results are used to provide information for the establishment and further research towards PV systems efficiency improvement. This project is funded by the German Ministry of Environment.

20-kW system, Cyprus

20-kW on tracker, Cyprus

Estonia
Despite negligibly low installed PV capacity in Estonia, the RTD sector is growing rapidly. In May 2009 the 3rd Nordic PV Conference took place in Estonian capital Tallinn. It was the biggest conference on PV ever organized in Estonia.

In the middle of 2009 an impressive amount of 2.5 million euro has been earmarked to the spin-off company from Estonia Crystalsol. Crystalsol was created as a result of cooperation of local academic researchers and investors from abroad. The money comes from two Nordic venture capital funds (Conor Venture Partners and Energy Future Invest) and from one of the largest institutions within the national support system promoting business and regional development in Estonia - Enterprise Estonia.

Crystalsol, promotes powder based photovoltaic technology new semiconductor material, copper zinc tin sulfoselenide (CZTS). With the predicted production cost lower than 0.5 EUR/Wp, Crystalsol is likely to become a leader in the PV modules sector. Thanks to the massive pecuniary support and business know-how, pursuing of its ambitious projects is no longer constrained.

Latvia
PV research field is developed in the Institute of Physical Energetics (IPE). One part of the State Research Programme "Development of modern methods and technologies, rational use of energy and improvement of security of energy supply" is programme "Research and Development of RES effective use and new technologies for RES" includes research on PV use for electricity production in Latvia. Solar Energy Use Polygon is built up on the roof of IPE for the research work on solar energy use and for testing of different equipment for solar energy use in real climate conditions.

Research relates also to the organic cells for PV in IPE. The best results are achieved for composites of polygeksilitiofenu and soluble fullerene. The purpose of the research now is to find new composite material which structure includes organic electron-donor and electronacceptor molecules with practically constant photosensitivity.

Lithuania
Two new directions of PV solar cell research were initiated in Lithuania in 2009. At the Institute for Applied Research (IAR) of the Vilnius University, new metal-organic chemical vapor deposition (MOCVD) reactor was installed that will be used for growing In, Ga, and Al nitride structures for multi-junction solar cells. Energy bandgap in nitride semiconductors changes over an extremely wide range from 0.7 eV for InN to 6 eV (AlN), thus it covers the whole solar spectrum and can be exploited for efficient light harvesting.

Another research group at IAR, together with the scientists from the Organic Chemistry Department, Kaunas Technological University, and a company “Tikslioji sinteze” has created a consortium that will develop organic solar cells. Electrical and optical characteristics of the molecular crystals necessary for these devices have been investigated by different Lithuanian research groups for several years already; presently this research has reached the stage, when the device structures will be manufactured and characterized. This will be possible thanks to new equipment for organic material casting and contacting that has been acquired by the research group at IAR.

Malta
In Malta, so far no industry is involved in the manufacturing or testing of photo-voltaic systems, though the knowledge base is present as indicated through other hi-tech industries in electronics and semiconductors operating on the island. All photo-voltaic systems are imported in the case of Malta.

Research is mainly carried out by a few institutions, and a particular industry, driven by university academic staff. One particular faculty is involved in power inverters technology, whereas one local manufacturing company, Abertax (Malta) Ltd., specializing in components for energy and renewable sources markets, is doing particular design of experiments on the various systems and technologies installed at its premises. The scope is to investigate the performance of various technologies and their adequacy in the Maltese climate and environment.

45,4-kW system on car service station, Malta

Poland
The fundamental photovoltaic research is being carried out at the university level by groups working on different materials. The investigations concentrate on thin film materials. The research on $CuInSe_2$ and related compounds is conducted at the Department of Physics, Warsaw University of Technology. At the AGH University of Science and Technology in Cracow there is also a group working on CIS and amorphous silicon devices and photovoltaic structures. In Poznan and Gdansk Universities of Technology there are groups working on organic photovoltaics.

The out-door testing and monitoring is carried out in several groups (the most advanced at the Solar Lab in Wroclaw, Warsaw University of Technology,

AGH Cracow, Opole, and others). The Warsaw University of Technology has an Outdoor Test Facility. The OTF possess state-of-art measurement equipment made by world-class producers, allowing for detailed research of cells, modules, and systems.

There are more than 20 teams in Poland directly involved in PV-related RTD work at the universities and research institutes across the country. There are about 60 scientists and 40 technical staff employees. The existing intellectual potential is significant and has been better exploited since the EU enlargement process started, mostly through research projects within the 5tt, 6th and 7th EU Framework Programme for Research and Technological Development and Intelligent Energy Europe EACI Program (PV-NMS-NET, PV BLOOM, PV LEGAL).

Romania

In Romania the research in the field of solar cells and modules is conducted by the National R&D Institute for Microelectronics and the University of Bucharest. The main field of research are solar cells based on organic semiconductors, CIS, CdTe, dye sensitized cells, high efficiency cells based on crystalline Si and nanostructured oxide materials.

Research in the field of PV systems is conducted also by the New Energy Sources Laboratory of the Research Institute for Electrical Engineering (NESL-ICPE), a research centre founded 30 years ago.

Another Romanian important research institution is the Product Design Center for Sustainable Development at *Transilvania* University of Brasov and the Institute for Electrochemistry in Timisoara. Their area of focus are PV hybrid systems, backup systems and PV-hybrid micro-grid systems). Research in the field of grid connection systems is also performed by the University *Politehnica* Bucharest, University *Valahia* Targoviste, NESL-ICPE and University *Dunarea de Jos* Galati.

Advancements in RTD are made thanks to numerous programs providing financial back-up for researchers. Partneships, PhD and post-docs education as well as entire educational institutions in Romania are subject of support coming from national and European level funds.

Exemplary PV demonstration project has been accomplished by Transylvania University of Brasov where a green energy independent campus with PV solar park has been created.

Table 6. Producers of PV systems' components

Country	Producers of:			
	c-Si wafers	**solar cells**	**Modules [production/capacity]**	**BOS**
Bulgaria	• Institute of Non-ferous Metals, Plovdiv		• SolarPro [18 MW] • BG Solar Panels [10 MW] • Energy Solutions [10 MW]	Many small companies propose such kind of activities
Cyprus			• Enfoton [30 MWp]	
Czech		Solartec [70/? MW]	SchottSolar [600/200 MW] Kyocera [500/120 MW] O&M Solar [60/30 MW] Fitcraft production [90/20 MW] LinTech Solar [60/20 MW] Celkem [1500/390 MW]	• Poulek Solar Co. Ltd, tracking systems • Cz Elektronika, tracking systems • FRONIUS CZ, inverters transformers
Estonia				
Hungary			• Sanyo [160 MW] • Korax [10 MW] • Genesis PV [300 MW] under planning	
Latvia				
Lithuania	• UAB Saules energia [-/ 30kW]	• UAB Precizika-MET		
Malta				
Poland	• SILIMAT.CZ ingots and wafers		Vetro Polska 3 module's plant will start in 2010	GTB Solaris, controllers
Romania			DGM SOLARSYSTEMS (-14 MW) crystalline	
Slovakia				• SolarNed (BP Solar) • ACERA • Schueco International KG • Delta Electronics
Slovenia			• Bisol[15-50MW] • Trimo	• ETI, ISKRA, Kon Tiki Solar, controllers and electronic equipment • TAB, batteries

Slovakia
National Center for Research and Application of Renewable Energy Sources was established at the Slovak University of Technology in Bratislava. The Centre is supported by the European Regional Development Fund within Operational Program Research and Development. Four faculties of SUT are involved in the Centre.

The Center's objective is to increase the research potential of the SUT and the integration of scientific teams focused on new, environmentally acceptable renewable energy sources.

Slovenia
The production of PV modules in the Slovenian company Bisol is gaining in quality and quantity. In 2009 the company expanded its production from 15 MW to 40 MW per year and is planning further growth. Bisol is organizing its business network of certified installers. General manager of the company Bisol become the Slovenian Entrepreneur of 2009. The company ApE was awarded for the best RES project of 2009, for installation of a 70 kW roof-integrated PV plant, together with the wood biomass heating and production of wood chips on an ecological pharm.

In 2009 the Faculty of Electrical Engineering, which is linked to the research activities at the Laboratory of Photovoltaics and Optoelectronics has participated (apart from the research program "Photovoltaics and Electronics" funded by Slovenian Research Agency) in two FP7 projects: IP Athlet and STREP Solamon, both related to advanced thin-film photovoltaics, including optical and electrical modeling, simulations and characterization.

SUMMARY

According to the European Photovoltaic Industry Association (EPIA) the global solar PV industry experienced strong growth in 2009. Unprecedented 6.4 GW of new installed capacity is a significant yearly uptake, considering t the global downturn. Adding up the past years growth, global PV industry exceeded 20 GW of total capacity and it continues to grow by at least 40% in 2010. Nevertheless solar energy still provides less than 1% of energy sold globally. According to estimates of the International Energy Agency (IEA) solar power could provide even 11% of global electricity production in 2050. In order for this to happen PV systems prices must drop and grid parity achieved.

EPIA remains optimistic about European PV market, predicting it will grow despite the credit crunch and the economic turmoil. As both climate change issues and security of supply concerns speak for further RES development, no responsible state-level decision maker will exclude PV from national energy mix. Especially noting that it is capable of strengthening the market competitiveness and creating jobs and growth.

For these reasons NMS' energy markets should evolve in such a direction that they do not miss this great opportunity..In order for such scenario to happen, PV-oriented legislation should be implemented, especially with regard to FIT introduction in those of the NMS which do not guarantee a preferential rate for green electricity yet. Obviously, support measures shall include well designed investment grants and stable crediting opportunities. Only then can PV be regarded as well-anchored in European markets and stimulate the economy with significant growth records.

During the first six months of 2010 the EU will be under the Spanish presidency. Together with Belgium and Hungary, which will preside the EU next, Spain's ambition is to implement a programme that includes energy issues with regard to sustainable development. This project relates also to possibility of Climate and Energy Package review, thus it is not indifferent for PV sector.

Spanish presidency will bring adoption of a new 2010-2014 Energy Action Plan for Europe. This document contains strategy of European transformation to the low carbon economy, especially via instruments provided already in the before-mentioned SET plan. Also, the Solar Energy Industry Initiative, is to be started by the end of the Spanish term of office. According to SET plan, 12% of European energy demand can be met with PV generation. This ambitious goal is called a "paradigm shift" and is 3 times higher than the business as usual scenario.

Meanwhile, every EU Member State submitted already a national forecast document preceding due by June 2010 National Renewable Energy Action Plans. As for now, with the estimates based on the national forecast documents, NMS surely will not contribute to the "paradigm shift". Even though, this paper shows clearly that in the 12 Member States that joined the EU in 2004 and after, Sun is slowly gaining stable position as a direct source of electric power.

There are immense disparities in cumulative installed capacity between the leaders and the rest of NMS. Even among the leading countries, there is a giant gap between the Czech Republic, which was on 3rd place in EU-27 regarding the installed PV power in 2009, and the next that is the third PV energy producer in the entire EU-27.and the next major PV markets like Slovenia and Bulgaria.

Thus, pointless to compare, it is highly recommended for stakeholders to base their future decisions on the experience mainly from different NMS PV markets. Another conclusion induced from this report shows that it is not irradiation that is the key driver for solar power generation sector. The Czech Republic deploys solar on an enormous scale, meanwhile Polish decision makers still restrict PV growth explaining such policy with "no enough Sun" excuse. There is an old proverb saying "who wants, searches for how, who doesn't want, searches for why".

SUPPLEMENT

Croatia

In 2004 Croatia became the EU official candidate member state. Its young and promising market is a challenging opportunity for investors.

Despite Croatia's great solar potential, its cumulative on-grid PV power capacity in 2009 totalled 120 kWp, of which only 18 kW (2 installations) receive subsidized electricity price (feed-in tariff). Off-grid capacity is estimated to the 500 kW. High irradiation in Croatian coastal area gives hope that the future of PV market in Croatia would be brighter.

Given the data provided by the Croatian Ministry of Economy, Labour and Entrepreneurship the cumulative capacity of all the registered projects amount for 24 MWp. To spice this forecast up, provisions contained in a draft of new Croatian Energy Strategy (established in late 2008) indicate that PV capacity shall account for 45 MWp by 2020

At the time being, the share of PV and all the other RES except from hydropower is imperceptible. Thus the objective set by the Croatian Energy Strategy to achieve the 5,8% share of RES (excluding large-scale hydro) by 2010 seems barely attainable. Moreover, while PV remains stagnant, wind power generation is developing.

Since 1997 Croatian energy market is under constant development and modernization. First National Energy Programmes marked the beginning of new era in Croatian energy sector, especially in terms of RES development. Along with the very first National Energy Programme established in 1997, the Croatian Solar Energy Utilisation Programme was adopted. This unprecedented document in Croatia was oriented on research, development and deployment of PV. The real landmark however has not come until the adoption of three crucial for RES legal acts: the Energy Act, the Electricity Market Act and the Energy Activities Regulation Act. Their provisions have been adapted to EU directives requirements in the following years

FIT for RES have been introduced in 2007. In order to be paid the guaranteed price, PV producers in Croatia must acquire a status of so called “eligible producer”. The status can be gained only through rather long and complicated procedures. Even the smallest PV producers need to follow them in exactly same way as those who want to connect bigger systems. Administrative barriers are likely to deter those who do not have patience or time (it can take up to 3 years actually). The only positive side is that being an eligible producer is equal to having the certificate of origin for the electricity.

FIT in Croatia favour especially household generation, with 0,51 EUR/kWh for small installations (up to 10 kW). Bigger systems receive guaranteed payment of 0,45 EUR/kWh (up to 30 kW). Power plants which capacity exceeds 30 kW (but is not bigger than 1MWp) benefit from the smallest FIT of 0,31 EUR/kWh. PV installation with capacity reaching more than 1 MWp are not eligible for FIT, which is a highly discouraging factor for potential investors. FIT in Croatia are guaranteed over the 12-year period (by Croatian market operator HROTE), with no degression. Although the FIT in Croatia appear to be well designed and generous, there is still no regulation about what happens after the guaranteed period of 12 years.

Grid connection procedures in Croatia are complicated and time-consuming. All the technical parameters of connecting the installations to the grid are clearly described in a document issued by the Croatian Distribution System Operator. It is the PV producer who pays all of the grid connection costs.

Energy operators and grid utilities are bound to purchase all of the generated electricity until the overall national target of 5,8% share of RES (excluding large-scale hydro) is obtained. Similarly to most of former Soviet Union block countries, the heritage of monopolized energy market have been left by the ancient regime's centralized economy Entirely state owned Hrvatska elektroprivreda (HEP) is the major player on the energy market. Opening of the energy market will progress along with appearance of new acting subjects.

Upon individual request, the state level support is provided to PV investor, granted by the Fund for Environmental Protection.

PV systems in Croatia need a building permit or at least they are obliged to apply to get it. There are some positive signals from Ministries that this permit would be left out for smaller installations. Only PV installations with the capacity exceeding 10 MW need to carry out the environmental impact assessment.

Noteworthy, Croatia supports its energy efficiency development and the use of RES through “Approximation of EU Renewable Energy Legislation and Energy Efficiency Labelling” project. Under this EU co-financed initiative a platform of cooperation and advise have been created so that the new investors are not longer left alone.

EIHP

Andro Bačan, Dipl. Eng. Energy Institute Hrvoje Po ar Department for Renewable Energy Sources and Energy Efficiency Adress: Savska cesta 163 HR-10001 Zagreb, Croatia.
Telephone: +385 1 6326 158, Fax: +385 1 6040 599
E-mail: abacan@eihp.hr URL: http://www.eihp.hr

Turkey

Since October 2005 the EU leads official talks on potential membership with Turkey. Bottlenecks such as trade issues with Cyprus are multiple and after 5 years of diplomatic negotiations, EU membership of Turkey is still uncertain. European Commission Turkey progress report established in October 2009 shows that significant progress has been made on Turkish electricity market. The successful implementation of reforms made it more competitive and led to large-scale privatization of power plants and distribution facilities.

In September 2009 Turkey started negotiations willing to become a party to the Energy Community Treaty. Partnership implied by this treaty means that Turkey would step in the pathway of further development of internal energy market and RES sector. According to the Turkish National Energy Strategy energy security and sustainable growth will be the focus areas of energy policy in the coming years. Turkey also agreed provisionally to ratify the Kyoto Protocol and minimize the energy related greenhouse gas emissions.

At the end of 2008, 17% of generated electricity in Turkey came from RES. The revised strategy paper for the electricity sector set a target of producing 25% of the country's electricity from RES by the end of 2020, with no specific targets for PV. Consumption in Turkey grows rapidly, thus a 25%-share of RES is a highly ambitious target. The estimates contained in the official energy report Strategy Document for Electrical Energy Market and Supply Security show that the share of all RES in overall energy consumption will reach at least 30 % in 2023. Unfortunately for solar power generation, hydro, wind and geothermic lead the way to achieve this target. PV is slightly neglected in Turkish prognosis, as no specific figures related to this source of energy have been targeted.

Nevertheless, those who doubt the Turkish solar potential should look up any travel agency's offer to get the sense of perfectly irradiated territory of this EU neighbour. Although there is no official data on the total installed PV capacity in Turkey, estimated PV installed power in 2009 was about 5 MW (1 MW of annual growth). Noteworthy, there is a dynamic Turkish Photovoltaic Technology Platform (UFTP) uniting public bodies, universities, local authorities, trade and professional chambers and industrial companies.

According to its baseline scenario PV capacity will total 1 GW in 2020. Accelerated growth scenario indicates that achieving 10 GW of PV installed capacity in 2020 is possible.

Feed in tariffs can help to achieve this goal. The Energy Market Regulatory Authority sets the purchase price for RES electric energy. Usually it is the average of Turkish wholesale price announced in the previous year. In fact, producers sell their electric energy to the Market Financial Reconciliation Centre, which offers the highest price in Turkey due to a recent supply deficit. FIT for RES electricity is equal average wholesale price for electricity (0,05 EUR) and it's guaranteed over 10-year period. Draft proposal for significantly higher purchasing price for PV is under consideration at the Turkish Parliament.

Access transmission and distribution are guaranteed by law. Access for power from solar sources is even prioritized. Procedures as to how get the grid connection access should be defined in 2010. Currently in order to get a grid access permit for plants with capacity exceeding 500 KW it is necessary to tender a motion. All of the applications are then evaluated by the Energy Market Regulatory Authority.

There are three PV module manufacturer in Turkey: Aneles DATATSP And Terasolar. The module prices in these local manufacturers were 2-2.5 EUR/Wp in 2009. Those three companies employ about 20 people.

There are also negative aspects of Turkish energy policy such as the fact that state level aid for PV and other RES investments is still lacking coherence and transparency and investors can not profit from tax incentives nor beneficial credit terms.

Even though Turkish energy market can still be regarded as promising, as it is changing fast and will soon catch up with its modern neighbours.

Prof. Dr. Sener Oktik, Rector. Mugla University Adress: 48000 Mugla, Turkey
Telephone: +90 252 211 10-12, +90 252 223 92 74, Fax: +90 252 223 92 74
E-mail: oktik@mu.edu.tr URL: http://www.mugla.edu.tr/en

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For further details, please contact:
Dr. Stanisław M. Pietruszko, Warsaw University of Technology
Address: Koszykowa 75, 00-622 Warsaw, Poland
Telephone: +48 22 2347530, mob. +48 605 099 781
Fax: +48 22 234 7530, e-mail: pietruszko@pv-poland.pl
URL: **http://www.pv-nms.net**

Prof. D.Sc. Doriana Malinovska, Prof. Petko Vitanov. Central Laboratory of Solar Energy and New Energy Sources at the Bulgarian Academy of Sciences (CL SENES BAS)
Address: 72 Tzarigradsko chaussee Blvd, 1784 Sofia, Bulgaria Telephone: +359 2 8778 448
Fax: +359 2 8754 016 E-mail: doriana@phys.bas.bg URL: http://www.senes.bas.bg

Mr. Alexandros Stylianides, Energy Officer. Cyprus Institute of Energy,
Address: Agapinoros 2, Iris Tower 1st floor, 1076 Nicosia, Telephone: +357 22 606060,
Fax: +357 22 606001 E-mail: asc.cie@cytanet.com.cy URL: www.cie.org.cy

Ing. Martin Müller, Czech Renewable Energy Agency, o.p.s. Address: Americká 17,
120 00 Praha 2, Czech Republic, Telephone: +420 222 512 764 Fax: +420 222 512 774
Mobile: +420 724 757 384 E-mail: martin@czrea.org URL: http://www.czrea.org

Prof. Enn Mellikov. Tallinn University of Technology (TTU)
Address: Ehitajate Street 5, 19086 Tallinn, Estonia, Telephone: +372 6202798
Fax: +372 6203367 E-mail: ennm@staff.ttu.ee URL: http://www.ttu.ee

Mr. Miklos Palfy. Solart-System Engineering Ltd. (SOLART-SYSTEM Ltd.)
Address: Gulyas Street 20, H-1112 Budapest XI, Hungary Telephone: +36 1 2461 783
Fax: +36 1 2461 783 E-mail: palfymiklos@solart-system.hu URL: http://www.solart-system.hu

Prof. Dr. Peteris Shipkovs. Institute of Physical Energetics (IPE)
Address: Aizkraukles Street 21, LV-1006, Riga, Latvia, Telephone:+371 6755 3537
Fax: +371 6755 3537, E-mail: shipkovs@edi.lv URL: http://www.innovation.lv/fei

Prof. Dr. Arunas Krotkus. Center for Physical Sciences and Technology, Semiconductor Physics Institute (SPI), A. Gostauto 11, 01180, Vilnius, Lithuania Telephone: +370 5 2616821
Fax: +370 5 2627123 E-mail: krotkus@pfi.lt URL: http://www.pfi.lt

Ing. Peter Mifsud. Malta Resources Authority Address: Millenia, Aldo Moro Road, Marsa, MRS 9065 Malta Telephone: +356 2295 5166 Fax: +356 2295 5200
E-mail: peter.mifsud@mra.org.mt URL: http://www.mra.org.mt

Prof. Dan Teodoreanu. New Energy Sources Laboratory (NESL) - Research Institute for Electrical Engineering (ICPE) Address: 313, Splaiul Unirii, 030138 Bucharest, Romania
Telephone/Fax: +40 21 589 3472 Mobile: +40 745 122863 E-mail: danteo@icpe.ro

PhDr. Zuzana Voderadska. Slovak RE Agency, n.o.
Address: Prepoštská 8, 811 01 Bratislava, Slovak Republic. Telephone: +421 915 200 610
Fax: +421 254 433 746 E-mail: zuzana@skrea.sk URL: www.skrea.sk

Mr. Franko Nemac. Agencija za prestrukturiranje energetike, d.o.o. (APE d.o.o.)
Address: Litijska Street 45, 1000, Ljubljana, Slovenia Telephone: +386 1 5863871,
Fax: +386 1 5863879 E-mail: franko.nemac@ape.si URL: http://www.ape.si

www.pv-nms.net