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Renewable Energy Sources and Energy Efficiency and their role in SEE Energy Security

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The present Working Paper refers to the Renewable Energy Sources and Energy Efficiency and their Role in SEE Energy Security and is based on a presentation by the author, Costis Stambolis, Executive Director and Deputy Chairman of IENE, at a conference on "Energy Security as a Security Challenge in Southeast Europe?", organised by The Aspen Institute Germany in Alt Madlitz, Brandenburg, Germany (October 16 and 17, 2013).

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Abstract

SE European countries, notably those in the East Balkans, the East Mediterranean and Turkey have seen a steep rise in RES applications over the last ten years. Especially during the last three years (2009-2012) RES' input has started registering in several countries' energy mix. This is an important departure on account of the energy policies adopted with important long term implications.

Among others the present paper will seek to clarify the following:

(a) The incentives adopted by the various countries which have enabled RES development and the launching of Energy Efficiency programmes and the impact of EU policies (i.e. 20-20-20)

(b) To what extent RES participate today in the various countries' energy mix and what are the prospects for further penetration (tables and charts to be presented showing the state in the various countries)

(c) Summary presentation of energy efficiency programmes adopted by selected countries in the region (i.e. Greece, Bulgaria, Romania, Serbia and Croatia) and their impact in terms energy conservation.

(d) Indentify and discuss the biggest potential in the region for RES applications and energy efficiency in both geographic and technology terms.

Following the presentation of the prevailing picture in RES and Energy Efficiency applications in the various countries of SEE the role of RES and Energy Efficiency will be discussed in terms of energy security. Experience so far shows that because of the increased participation of RES in the energy mix renewable sources can play an important role in strengthening energy security at both country and regional level. Large scale application of Energy Efficiency measures can also contribute greatly toward energy security by curtailing energy demand; however their contribution is not easily quantifiable. The extent to which RES can contribute in bolstering energy security depends on three key factors. Firstly, the installed electricity capacity of RES and its relation to the overall electrical capacity of the country concerned, secondly the grid development and its operational level which allows for maximum utilisation of the electricity produced, and thirdly the availability of energy storage mechanisms.

Today we witness various levels and speeds of RES at Energy Efficiency development in the different countries of SE Europe both in terms of installations and participation in the energy balance. In fact there is considerable divergence between the various countries as it is shown in the data to be presented. The same applies for

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the state of the electricity grids of the various countries. Consequently the role of RES in the integration of regional energy markets (i.e. electricity and gas) is marginal at this stage since the focus is, and will remain at least until 2020, on grid upgrading and further expansion. However, the anticipated addition of sizeable energy storage capacity in conjunction with further RES development is likely to propel RES in the front line of power generation and participation in the national energy mix. The addition of energy storage is thus expected to correct and improve the intermittent nature of RES power generation, thus improving predictability of RES availability in the context of daily electricity market operation.

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Introduction

SE European countries, notably those in the East Balkans, the East Mediterranean and Turkey have seen a steep rise in Renewable Energy Sources (RES) applications over the few last years. Especially during the last three years (2009-2012) RES' input has started registering in several countries' energy mix. In view of this is notable departure, on account of the energy policies adopted with important long term implications, the following observations are pertinent:

(a) RES growth in SE Europe is the result of various incentives adopted by the different countries which have enabled rapid RES development and the launching of large scale Energy Efficiency programmes.

(b) Most of these incentives were adopted following EU's pro-environment policies and in particular Directive 2009/28/EC where the 20-20-20 goal was stated. Some countries, notably Greece, Bulgaria and Romania had already adopted a number of support measures going back many years.

(c) As RES installations have risen in numbers and installed electricity capacity their contribution to both the electricity mix and the energy mix in the various countries of the region has increased considerably. The contribution of RES electricity capacity to the total electricity capacity in most countries of SE Europe is high, on average above 35%.

(d) The contribution of RES in the various countries' electricity mix is at discernible levels but far smaller when compared to the overall energy balance.

(e) A comparison of the energy efficiency programmes adopted by selected countries in the region (i.e. Greece, Bulgaria, Romania, Cyprus and Serbia) reveals wide variation in terms of scope, objectives and policies applied. Almost all programme focus on the building sector which has been identified as the most promising in terms of applications and user involvement.

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The High Energy Dependency of S.E. Europe

The growth of Renewable Energy Sources (RES) in terms of applications and installed electricity capacity in SE Europe must be examined in the context of the region's very high dependency on imported energy as follows:

- Almost all countries in SE Europe rely highly on oil and gas imports, with most of them being above 90% dependent. Fig.1 shows the overall energy dependency of selected countries
- As oil and gas prices have moved at historically high levels, this dependence has become more acute with dire financial consequences. The average Brent oil price for 2010 was $79,50/ bbl, $ 111,26/ bbl for 2011, $ 111,67/ bbl for 2012 while for 2013 it is estimated to be $108,0/ bbl. High oil prices also mean high gas prices, since almost all gas that is used in the SE European region is based on oil indexed contracts.
- The need to increase indigenous energy production, including RES, becomes all apparent together with the need to diversify energy resources by broadening the energy mix.
- High levels of local energy production together with a balanced energy mix is key to a successful energy security strategy.

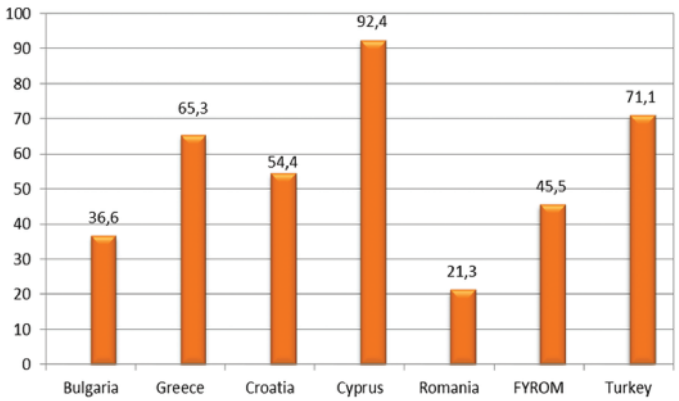

Figure 1: SE Europe Energy Dependency, 2011 (%) Source: Eurostat, IENE

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With the exception of Romania all other countries in SE Europe suffer from a highly unbalanced energy mix where solid fuels, and particularly lignite, and imported oil dominate energy consumption as can be seen in Table 1.

Table 1- Energy Mix of selected countries in SE Europe (in %)

	Solid Fuels	Oil Products	N. Gas	Nuclear	Electricity	RES
Bulgaria	35.5	34.0	21.0	5.5	—	3.5
Croatia	5.0	69.0	10.0	—	—	16.0
Greece	28.0	49.0	14.0	—	1.0	8.0
Romania	19.5	25.8	30.1	8.4	--	16.3
Turkey	29.0	31.0	31.0	—	5.0	6.0

Renewable Energy Sources

Table 2 shows the installed electricity capacity from various forms of RES notably Hydro, Wind and Photovoltaics in the different countries together with the corresponding total installed electricity capacity of each country's interconnected grid. This comparison reveals rather high RES penetration in the electricity mix of the various countries ranging from 28% in the case of Turkey to 96% in the case of Albania. It is characteristic of the West Balkan region that hydro is the predominant form of RES to the almost exclusion of all other types, save biomass, which is used for space heating and cooking purposes, which in most cases remains unaccounted for due to lack of verifiable data. However, biomass, especially in the case of West Balkans could turn out to be a significant RES resource with good potential for commercial exploitation. In the case of hydro it is important to note that the installed capacity as it appears in the above Table 2 shows the installed electricity capacity from various forms of RES notably Hydro, Wind and Photovoltaics in the different countries together with the corresponding total installed electricity capacity of each country's interconnected grid. This comparison reveals rather high RES penetration in the electricity mix of the various countries ranging from 28% in the case of Turkey to 96% in the case of Albania. It is characteristic of the West Balkan region that hydro is the predominant form of RES resource with good potential for commercial exploitation. In the case of hydro it is important to note that the installed capacity as it appears in the above table includes both large and small hydro plants.

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Table 2 - Installed Electricity Capacity in SE Europe, and the share of RES in electricity generation (2012)

	Hydro[1] (MW)	Wind (MW)	PV (MW)	Total RES (MW)	Total Electricity (MW)	RES (total %)
Albania	1.466	0	0	1.466	1.496	96%
Bosnia & Herzegovina	2.058	0	0	2.058	3.803	53%
Bulgaria	2.183	682	980	3.874	13.759	29%
Croatia	2.112	180	2.9	2.295	4.268	54%
FYROM	580	0	1	581	1.600	36%
Greece	3.060 + 218	1.750	2.600	7.673[2]	17.700	44%
Montenegro	660	0	0	660	870	73%
Romania	6.400	2.095	94	8.640[3]	17.360	50%
Serbia	2.831	0[4]	2	2.833	8.360	34%
Turkey	14.000	2.312	2	16.500[5]	60.121	28%

1. Including both large and small hydro
2. Including some 50 MW of biomass installation
3. Including some 40 MW of biomass installation
4. A wind farm of 120 MW is under construction since September 2013
5. Including 180 MW of geothermal power plants

The participation of RES in the total electricity mix of the various countries of the SEE region varies considerably and ranges from 28% in the case of Turkey to 96% in Albania as shown in Table 2. Given EU's goal for an optimum 20% RES penetration in the energy balance by 2020 the situation in most SEE countries is far from satisfactory especially for countries like Greece, Bulgaria and Cyprus. On the other hand Croatia and Romania are very near in achieving their target. Overall one could say that RES development in SEE has now been established on a firm footing although considerable challenges remain in view of required revision(s) to the scale of incentives applied, especially Feed in Tariffs, as latest experience in Bulgaria and Greece suggests (see http://www.iene.gr/bulgaria-res2012/) for the situation in Bulgaria and http://www.iene.gr/viosimotita-ape/ for the situation in Greece).

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As can been seen in Figures 2 to 4 the RES installed electricity capacity has risen steeply in Bulgaria, Greece and Romania from 2009 onwards mainly on account of photovoltaics and wind. In Turkey RES applications have also risen fast over the last five years on account of hydro, wind and geothermal. According to latest information and in view of extensive revisions in the Feed in Tariff system, RES's growth trend in Greece and Bulgaria is to be seriously curtailed over the next few years during which time we shall see a rationalisation in the RES market with a more normal growth pattern returning after 2016.

In terms of energy security Renewable Energy Sources in SEE Europe already contribute to a fair extent mainly through the participation of hydro units, both large and small, and their key role in maintaining storage capacity. For wind energy systems to be effective in terms of energy security they will have to be linked to pumped storage schemes. Unfortunately very few such projects are currently being developed. On the other hand photovoltaics although they do not offer storage capability are effective with a predetermined power generation profile in that they help meet peak electricity demand quite effectively during the hot summer months, when electricity loads to the grid system suddenly increase due to the operation of thousands of air conditioning units.

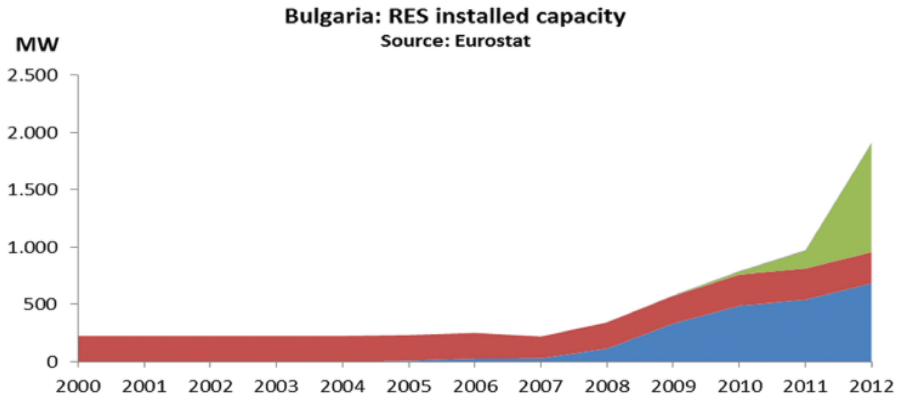

Fig. 2

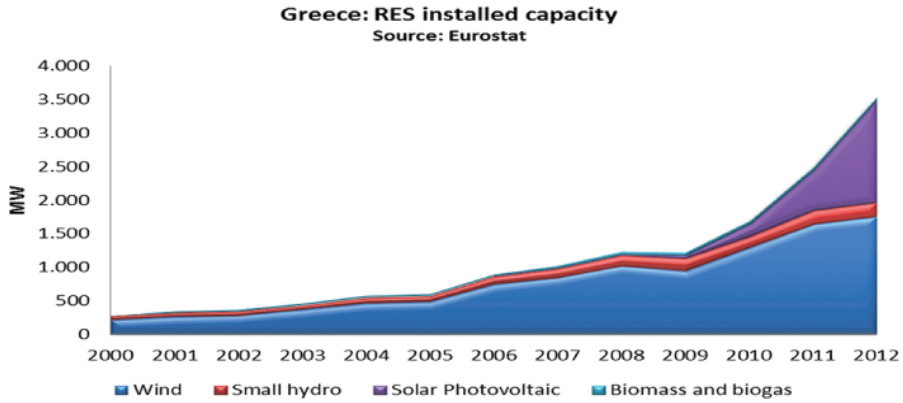

Fig. 3

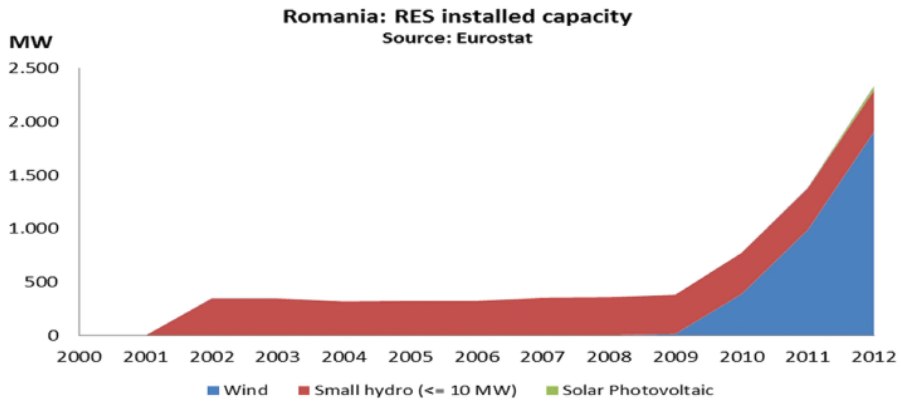

Fig. 4

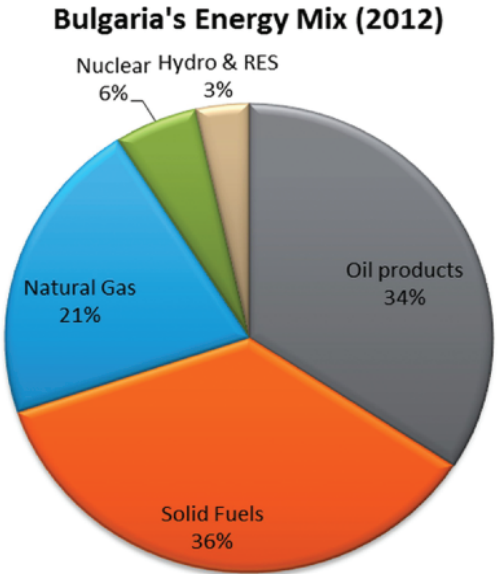
Bulgaria's Energy Mix (2012)
Nuclear 6%
Hydro & RES 3%
Oil products 34%
Natural Gas 21%
Solid Fuels 36%

Fig. 5

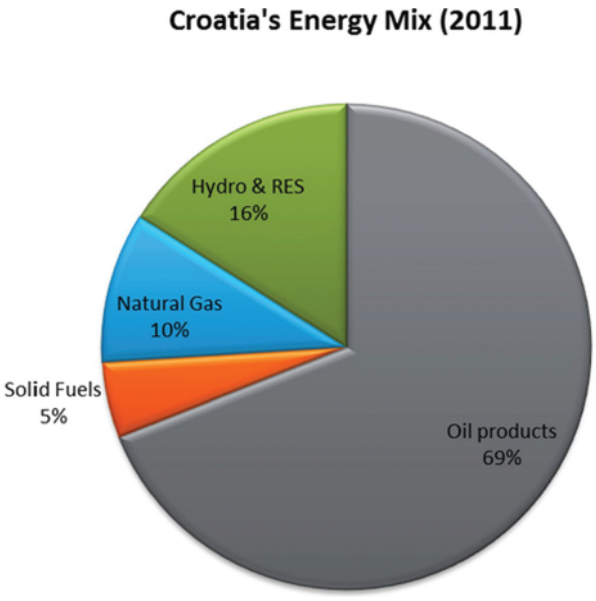
Croatia's Energy Mix (2011)
Hydro & RES 16%
Natural Gas 10%
Solid Fuels 5%
Oil products 69%

Fig. 6

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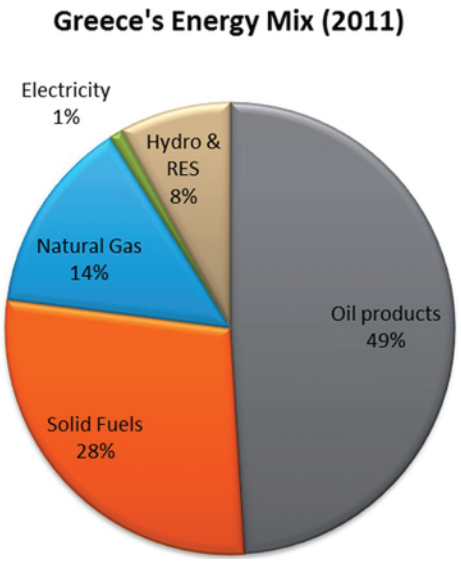

Fig.7

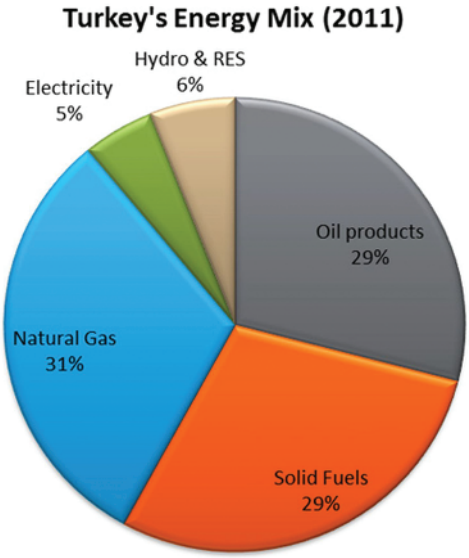

Fig.8

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Energy Efficiency

The Following the introduction of EU's Energy Performance of Building Directive (2010/31/EU) and the Directive 2012/27/EU on Energy Efficiency plans have accelerated in EU member countries across SE Europe which aim to introduce energy efficiency measures in the building sector. These plans include inter alia the detailed application in practice of the definition of nearly zero-energy buildings (including a numerical indicator of primary energy use expressed in kWh/m2 per year), intermediate targets for improving the energy performance of new buildings by 2015, and information on the policies and financial or other measures aimed at promoting NZEBs

At the same time the latest Energy Efficiency Directive lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, while it provides for the establishment of indicative national energy efficiency targets for 2020. Measures include the legal obligation to establish energy efficiency obligations schemes or policy measures in all Member States.

The introduction of energy performance certificates for buildings in EU and countries in SEE is considered as key instrument in achieving the goals of implementing energy efficiency measures. In this respect some countries in SEE have introduced systematic energy inspections of buildings undertaken by trained energy inspectors. Energy inspectors and the award of an energy certificate are necessary for the granting of financial assistance to householders. Greece, followed by Romania, is leading the energy efficiency market in SEE having already approved more than 40,000 buildings energy improvement schemes corresponding to more than 400 million euro financial support (since the start of the programme in 2011). In SEE already these measures drive energy efficiency improvements in households, industries and transport sectors. Other measures include an exemplary role to be played by the public sector and a right for consumers to know how much energy they consume.

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Table 3 – Summary of Key Grant Schemes For Improving Energy Efficiency in Buildings in SEE countries

Country	Description of Grant Scheme
Cyprus	– Encouraging the use of renewable energy sources for natural and legal persons and public entities engaged in economic activity – Scheme for subsidizing CFL lamps – Government grants scheme for energy savings/RES for the public sector and wider public sector
Bulgaria	–Demonstration projects for housing renovation in Bulgaria and financing building insulation for energy efficiency –Residential Energy Efficiency Credit Facility (REECL)
Greece	–Exoikonomo Katoikon (Saving Energy at Home) –Exoikonomo (Saving) for application in public buildings –Installation of residential photovoltaic systems (FIT)
Romania	–LGGE Improving Energy Efficiency in Low-Income Household and Regions of Romania –Casa Verde Program –Thermal rehabilitation of housing stock financed by bank loans with government guarantee –Multiannual national programme for increasing the loan energy performance of block of flats/houses

Today there are well established and co-ordinated efficiency programmes in Greece, Bulgaria, Romania and Cyprus while Turkey offers too various incentives to house owners for thermal insulation and the installation of Solar Water Heating systems. Table 3 presents a summary of current programmes in selected countries. Most of these programmes focus on the building sector with household applications corresponding to the largest share in terms of eligible financial support. Applications in public sector buildings are also attracting financial support and are considered important because of their demonstration value.

As these energy efficiency programmes are still in their initial stages (i.e. in their 2nd or 3rd year in most cases) proper field assessments are still lacking and therefore it is difficult to predict their likely input in terms of energy savings on a country to country basis. However, quantifying the potential energy saving contributions of existing building stock in the various countries of SEE is necessary if we are to assess their role from an energy security point of view.

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Solar Thermal

Solar water heating systems (SWH) for domestic and industrial hot water requirements is another important and established area of energy efficiency. Two countries in particular in SE Europe, Greece and Cyprus, have a long track record in this area as SWH systems represent a sizeable energy input in terms of energy savings. Given their high levels of solar radiation Greece and Cyprus, and lately Bulgaria and Croatia, are utilizing solar energy to substitute conventional electricity boiler type systems for water heating. In terms of total installed capacity, Greece now counts 2.9 GW (4.1 mio m2), representing an increase of 1%. Bulgaria has some 122,100m2 of glazed collectors contributing 85,470 KW (th) while Cyprus totals 707,776 m2 of collectors contributing some 495,443 KW (th). It must be noted that Cyprus and Greece along with Austria have some of the highest solar thermal capacity in operation in the EU, and worldwide, ranging from 250 to 580 KW per 1,000 capita (see Fig. 9).

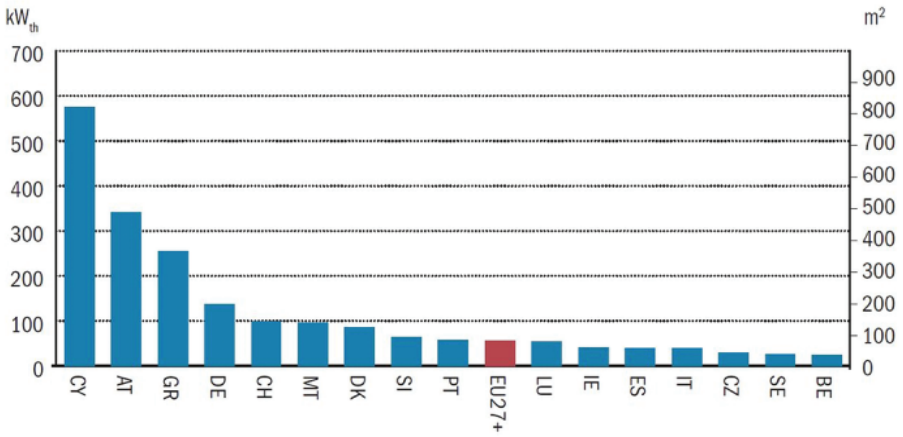

Fig. 9 Solar Thermal Capacity in Operation in Europe (per 1000 Capita)

Greece has the second largest total installed capacity in the EU, after Germany and is almost level with Austria. In fact, Greece is in a unique situation in this regard. In the early 1990s, the annual installed capacity was already similar to current levels (Fig. 10). Bearing in mind that the average lifetime of a system considered for sta-

tistical purposes is 20 years, it means that in the Greek market the total installed capacity has stabilized over recent years. This is a situation currently particular to Greece but which will become applicable to other countries in the future. Therefore, it should be better understood and the rate of replacement of old systems studied in depth.

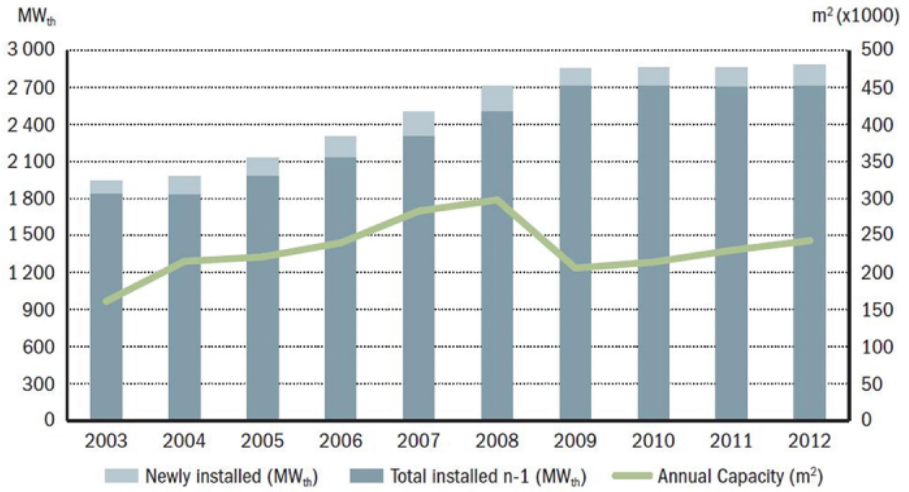

Fig. 10 Solar Thermal Market in Greece total and newly installed capacity (lased collectors)

The solar thermal market in EU27 and Switzerland is characterised be great dynamist as can been seen in Fig. 11. Solar thermal systems constitute a mature RES market and already contribute sizeable energy inputs directly related to electricity generation since the operation at Solar Water Heating systems conserve electricity which would have been otherwise used for water heating by means of electrical appliances. At the end of 2012 solar thermal systems contributed more than 28,000 MW. As Balkan and SE Europe countries integrate more into the European market solar thermal applications are expected to grow according to European norms. As can be seen in Fig. 12 in the case of Croatia this young solar thermal market is already developing at a fast pace.

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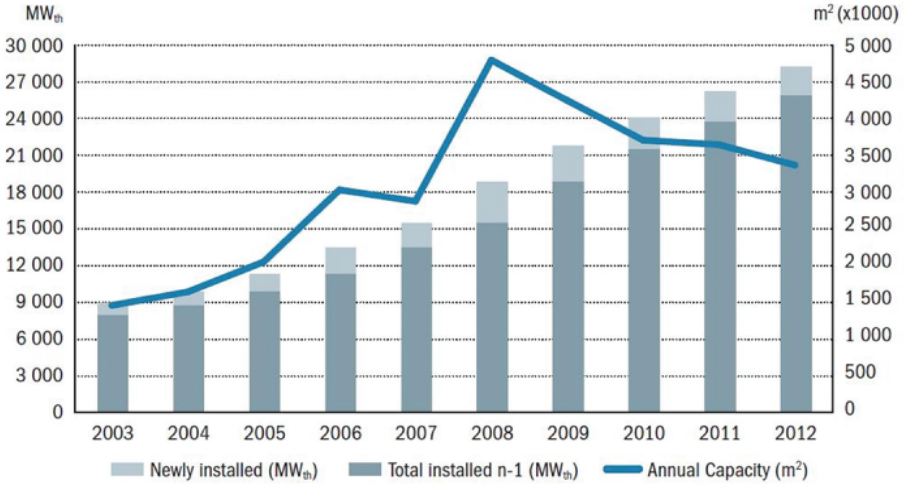

Fig. 11 Solar Thermal Market in EU27 and Switzerland total and newly installed capacity (glazed collectors)

Fig. 12 Solar Thermal in Croatia total and newly installed capacity

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Energy Security

A discussion on energy security and the role of a particular form of energy in strengthening it or in mitigating any associated risks should start with some definitions. The IEA defines energy supply to be "secure" if it is adequate, affordable and reliable while the European Commission in its Green Paper (EC, 2000), defines energy security as the "uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers (private and industrial).

In view of the above observations, energy security risks can be identified as follows:

(a) Energy market instabilities caused by unforeseen changes in geopolitical or other external factors, or compounded by fossil fuel shortages including disruptions of supply
(b) Technical failures such as power "outages" (blackouts and brownouts) caused by grid or generation plant malfunction
(c) Physical security threats such as terrorists, sabotage, theft or piracy, as well as natural disaster (earthquakes, hurricanes, volcanic eruptions, the effects of climate change etc.)

Consequently a number of strategies and policy responses in addressing energy security risks are called for. The wider use of RES in only one of these responses which in fact presupposes a commitment to a long term strategy for their development and penetration into the energy mix. The most effective policy response aims at a diversification of energy inputs, with RES one of them. The following comments are relevant:

- Renewables in one of several options for a successful diversification of the energy mix

- Energy efficiency improvements through demand side management and technological innovation can cost-effectively mitigate the large-scale impact of energy supply disruption in the electricity and heat sectors, and to a limited degree in the transport sector too

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- A combination of demand side management and energy efficiency measures can reduce the dependence on fuels for the production of electricity, heat and transport fuel

As a general observation one could say that the increased participation of RES in the energy mix can play an important role in strengthening energy security at both country and regional level. In the energy mix of Bulgaria, Croatia, Greece and Turkey for 2011 and 2012 are shown where RES's contribution in the overall energy balance appears extremely limited. In that sense there is still considerable ground to cover for increasing RES contribution in the energy mix of SEE countries. Large scale application of Energy Efficiency measures can also contribute greatly toward energy security by curtailing energy demand; however their contribution is not easily quantifiable.

The energy security implications of renewable energy technologies can therefore be summarised as follows:

- Renewable energy sources (RES) are typically indigenous resources and can reduce dependence on energy imports

- RES are widely (though unevenly) distributed and their use for electricity generation can minimize both transmission losses and costs when they are located close to the demand load of end-users: so called " distributed" generation

- Relatively high capital costs per unit of capacity installed remain for many RETs – in spite of significant cost reductions as a result of learning experience – this is offset to some extent by a zero fuel cost over the life of the system

The extent to which RES can contribute in bolstering energy security depends on four key factors. Firstly, the installed electricity capacity of RES and its relation to the overall power generation capacity of the country concerned, secondly the grid development and its operational level which allows for maximum utilisation of the electricity produced, thirdly the availability of energy storage mechanisms (both dispersed and pumped storage) and fourthly the actual contribution of RES in each country's energy balance.

Today we witness various levels and speeds of RES and Energy Efficiency development in the different countries of SE Europe both in terms of installations and participation in the energy balance. In fact there is considerable divergence between the various countries as it is shown in the data presented. The same applies for the

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state of the electricity grids of the various countries. Consequently the role of RES in the integration of regional energy markets (i.e. electricity and gas) is marginal at this stage since the focus is, and will remain at least until 2020, on grid upgrading and their further expansion. However, the anticipated addition of sizeable energy storage capacity in conjunction with further RES development is likely to propel RES in the front line of power generation and participation in the national energy mix of the SEE countries. The addition of energy storage is thus expected to correct and improve the intermittent nature of RES power generation, thus improving predictability of RES availability in the context of daily electricity market operation.

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Conclusions

In general, large scale RES development and introduction can contribute towards improving the energy security situation of SEE countries. However, the degree to which RES can bolster energy security depends greatly on the type RES used, their connectivity to the national grid, their synchronicity to consumption patterns and their storage capability. If RES development is to be pursued from an energy security perspective, then emphasis will have to be placed on dispersed and pumped storage schemes so as to overcome the drawback from the intermittent nature of renewable energy sources, notably wind and solar. Energy efficiency applications can also help lessen a country's dependence on fossil fuels and/or imported fuels. However, considerable work is still required if one is to assess with any precision their potential impact in terms of improving energy security.

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He studied Physics and Architecture at the University of London and North East London Polytechnic respectively. He holds a Graduate Diploma in Architecture and Energy Studies (AA Dip. Grad) from the Architectural Association, London (1983) and a professional practice license from the Technical Chamber of Greece (TEE)(1987).

He has carried out numerous studies and projects on Renewable Energy Sources in developing countries with emphasis on solar energy. He has consulted widely on solar building applications in Greece both for private and institutional clients. He has worked as a consultant on solar energy, natural gas, oil markets and energy security issues for large multinational companies and international organizations. He worked as consultant for a number of international companies, advising them on policy and licensing issues, during the period of natural gas introduction to the Greek energy system (1984 – 1996).

He has lectured widely on energy issues. He has organised several national, regional and international conferences, seminars and workshops. He has pursued a parallel career as a specialized technical writer. For many years he was Athens correspondent for the Financial Times Newsletters and the Athens Daily "Kathimerini". He coordinated the introduction of the highly successful joint FTSE/ASE-20 index in the Athens Stock Exchange (1997/1998). He has edited several books, conference proceedings and has published many specialized papers and studies on energy policy, solar energy, RES and energy markets. "The Greek Energy Directory" (1984), "The Greek Energy Market" (2001) and the "S.E. Europe Energy Outlook 2011", all edited by Costis Stambolis, are considered basic references on energy policy in Greece and SE Europe. Since 2001 he supervises and edits daily Greece's foremost energy site www.energia.gr . He is a founding member of the Institute of Energy for South East Europe (IENE), where he was elected twice as its Chairman (2003, 2005). He is currently IENE's Deputy Chairman and Executive Director. He is a member of the Institute of Energy (UK), The Technical Chamber of Greece (TEE), The Foreign Press Association (Greece) and the Chartered Institute of Journalists (UK).

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