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The Future of Power Storage in South Eastern Europe

Proceedings of the Enlargement and Integration Action Workshop
Tirana, 21st and 22nd October 2014

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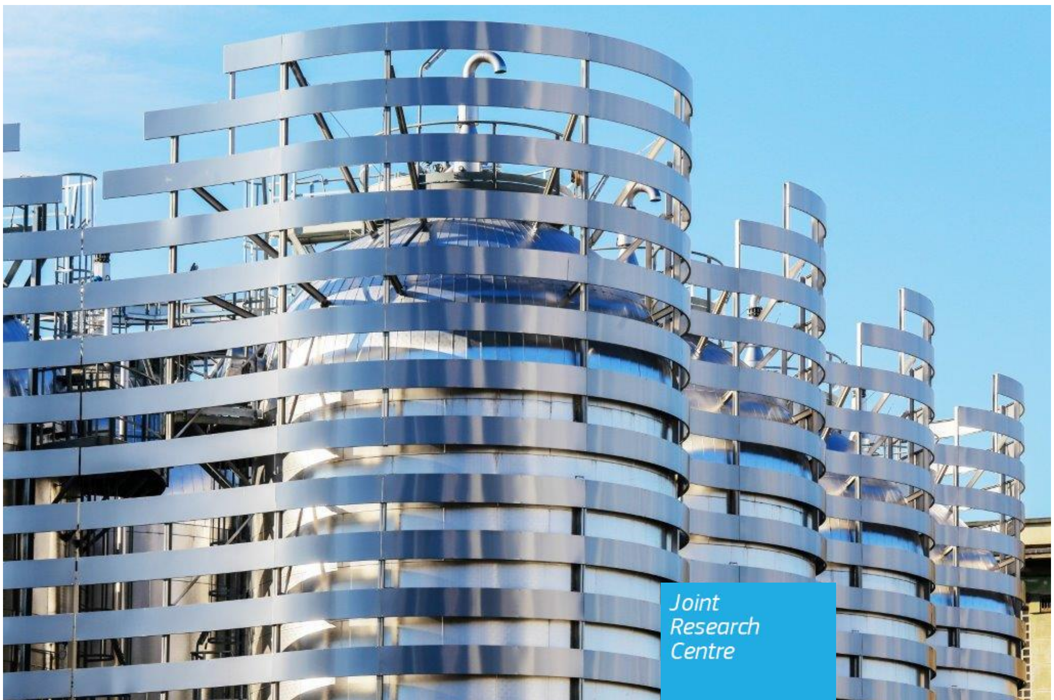

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Abstract

The European Commission's Joint Research Centre (JRC) and the Ministry of Energy and Industry of Albania held a joint workshop on the future role of energy storage in South Eastern Europe on 21 -22 October in Tirana. The workshop was attended by 40 specialists from academia, government, regulatory bodies, power industry and consultancies from both EU accession and candidate countries as well as from EU Member States. The participants actively discussed the technical, financial and regulatory challenges of the energy systems of the Western Balkans, and options of how these could be overcome. The event served as a forum for sharing and critically reflecting experience gained in Western Europe during the last decade. The workshop held in Tirana was part of the Enlargement and Integration Action. The present report summarizes the interventions of the participants, the discussions and conclusions of the workshop.

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Energy Technology Policy Outlook

Enlargement and Integration Action

Proceedings of the Workshop on:

The Future Role of Energy Storage in South Eastern Europe

Tirana, 21st – 22nd October 2014

in collaboration with:

the Ministry of Energy and Industry of the Republic of Albania

REPUBLIKA E SHQIPËRISË
MINISTRIA E ENERGJISË
DHE INDUSTRISË

1 INTRODUCTION

1.1 PURPOSE OF THE WORKSHOP

The objective of this 1 ½ day workshop was to understand the potential future role of energy storage in the evolving South Eastern European energy economy, in particular in the context of

- a gradual opening of candidate countries energy wholesale markets (members of the Energy Community) to competition
- a significant and not yet developed potential of hydro-power (also allowing the development of pumped hydro storage) in the region
- a significant and not yet developed potential of other renewable energy sources (e.g. solar energy) both in South Eastern Europe or in neighbouring regions
- a need for renewal of ageing energy generation and transport assets
- the regional and pan-European integration of power markets

On the example of power storage, the workshop contributed to an exchange on methodology for the quantitative evaluation of energy storage benefits and to a feedback lessons learnt in different regions of the EU with regard to RES-E support policy, RES-E market integration, and efficient market liberalisation and cross border aspects. Chatham house rules applied for the workshop allowing all participants to speak as individuals.

Figure 1 Opening of the workshop

1.2 JRC SUPPORT TO ENLARGEMENT

The Joint Research Centre (JRC) is playing an important role in providing scientific and technological support for the European Union enlargement and integration process. The JRC (along with other Directorates General of the European Commission) supports DG ELARG in the framework of the accession negotiations.

All candidate countries, the potential candidate countries and the associated countries to Horizon 2020 (or those in the process of association) have their representatives within the JRC Board of Governors. The Board helps with JRC strategic decision-making on scientific, technical and financial management. Individual Board members have also an important role in presenting the JRC activities in their respective countries. Moreover there is an intensive networking activity with the JRC Enlargement National Contact Points (NCPs) appointed by the enlargement countries. Every year during the Annual Meeting with Enlargement NCPs the on-going cooperation is presented and discussed. The annual meeting is particularly relevant for further strengthening and improving the on-going cooperation with the Enlargement countries, for exchanging information about the activities JRC and the Enlargement countries are carrying out, discussing about priorities and plans. This year the Annual Meeting took place in Italy on 5 March 2014.

Since 1999, through its Enlargement and Integration Action (E&IA) JRC gives scientific and technical support to countries on the road towards EU membership, New Member States and Associated Countries to the Research Framework Programmes. The JRC supports the transposition of the EU laws (Acquis Communautaire) to national legislation and facilitates scientific and technical exchange.

Within this Initiative the JRC organises every year different actions: the E&IA workshops and trainings; the E&IA Study Visits and the so called E&IA posts. The workshop "The Future Role of Energy Storage in South East Europe" is part of the Enlargement and Integration Action 2014 (E&IA 2014) for the part of workshops and trainings.

1.2.1 Workshops and trainings

The JRC organises annually, through its Institutes, around 50 workshops and trainings in specialised areas for Scientific & Technical support to EU policies, which correspond to well-established JRC core competencies. The main objective of these workshops is to assist the competent organisations with the scientific and technical methods and techniques underpinning EU policy implementation, to learn about the methods currently available in the Enlargement Countries of the EU and discuss future implementation.

The beneficiaries of this Initiative are experts from research organisations, public administration bodies, national enforcement laboratories and scientists from the new Member State (Croatia), Candidate Countries, Potential Candidate Countries, Associated Countries to the Research Framework Programmes, and on an ad-hoc basis European Neighbourhood Policy Countries.

In 2014 the E&IA Initiative committed 1,750,000 Euro to support a total of 55 workshops and trainings. The selection of the activities proposed by the JRC Institutes has been made on the basis of eligibility criteria (adherence to the JRC key orientation and work programme and adherence to target countries priorities) and selection criteria concerning quality, topics, regional approach and budget. As a general principle, apart from the workshop/trainings, the organisation of the activities in the target countries has been encouraged in order to increase the number of participants from those countries.

Moreover the Institutes were strongly encouraged to present projects for activities that can boost the regional cooperation, promoting the creation of common projects, networks, and the cooperation among target countries.

1.2.2 Enlargement and Integration posts

Within the E&IA, JRC offers altogether 40 temporary positions for experts from research organisations, public administration bodies, national enforcement laboratories and scientists from the Enlargement and Associated countries.

All the information can be found at JRC Science Hub, webpage:

https://ec.europa.eu/jrc/en/working-with-us/enlargement-and-integration

For more information and contacts:

Jrc-enlargement@ec.europa.eu

Figure 2 Participants at the workshop

2 Sessions of the Workshop

2.1 Session 1 – Introduction

2.1.1 RES-E potential and integration challenges in the context of E&I countries (Igor Kuzle, University of Zagreb, Croatia)

The share of renewable energy sources for electricity (RES-E), especially wind power plants, in the global power system has been increasing very fast in the last years and is still keeping the fast growth rate. It is just a matter of time that the RES-E share will be comparable to that of conventional power generation. The predictability of power sources (location and levels of power injections) decreases when a significant amount of variable power generation is connected to the system. Transmission system operators must then be more able to handle sudden drops or rises in electricity network injection, which were not foreseen in their usual way of managing electricity systems. Moreover, large wind power plants production sites may be very often located far away from electricity consumption sites.

A significant potential for wind energy exists in South Eastern Europe but the development is very different across the region. Croatia has a current installed capacity of 330 MW but plans to develop 1200 MW by 2020 and 2000 MW by 2030. First study of energy potential of wind in 2002 Serbia has an estimated potential of 1.300 MW of wind energy which is currently undeveloped due to an unfavourable tariff system, complex development procedures and a limited (frequency) reserve capacities. Bosnia and Hercegovina, the Former Yugoslav Republic of Macedonia and Albania have no operating wind farms but a number of projects exist in all of these countries. All countries of South Eastern Europe also have a significant potential for solar PV and solar thermal energy. While still underutilised on the regional scale, the first private financed solar PV plants have been developed, e.g. in the Former Yugoslav Republic of Macedonia. Grid codes, technical requirements and connection application procedures constitute a framework for the integration of RES-E into an electric power network. Regulation, however, is not uniform across the region of the Enlargement and Integration Countries of South Eastern Europe as can be observed on the example of ancillary services (see Table 1). Market features are not publicly very well known for many of the SEE countries. Total costs for the system range between 0.5 €/MWh (GR, SI) and 3 €/MWh (BG). The services are often provided on bilateral contracts and from the incumbent utility. Furthermore, there is very little cross-border exchange of such services. The latter is at least partially a consequence of the fact that the EU cross-border rules (which also apply to the SEE via the Energy Community Treaty) actually prevent transmission capacity reservations for non-dispatchable products.

Over the region, there is a lack of available secondary reserve, which will probably limit the RES integration unless more reserves are made available. Reasons for the current lack of capacity can be found in little new generation capacity, also due to insufficient funds, the unsatisfactory equipment of the present generation capacity and SCADA requirements not yet met. In order to enable a sustainable RES development physical resources for system reserves will have to be increased.

	Existing ancillary services tariffs	Description	Methodology	Average values
Albania	YES (planned)	---	Regulator determines the prices	Not yet calculated
Bulgaria	NO	---	---	---
Romania	YES	---	---	2.5€/MWh
Greece	YES	Is charged to providers and consumers proportional to total consumption	Best prediction and benchmarking based prices	Tariff for providers 0.35€/MWh
Kosovo	NO	---	---	---

Table 1: Pricing of ancillary services in selected markets of South Eastern Europe

2.1.2 Storage capacity required under large scale RES penetration (Kostas Tigas, Centre for Renewable Energy Sources and Saving, Greece)

The ProPSim model was developed at the Greek Centre for Renewable Energy Studies. It allows combining the expansion planning of a power system with the hourly simulation of the generation system including ancillary services. The model is suited for reliability analysis under wide-scale RES-E penetrations. It can determine the reserve capacity required related to both peak load demand and to hourly variations of the equivalent load; the storage capacity required to balance the energy curtailment due to non-dispatchable renewables

The PropSim model applies a Residual Load Duration Curve which is defined as the residual load that remains after the convolution of the customer load with the generation from variable renewables (non dispatchable) and small CHP.

As presented earlier after elaboration of wind generation statistics the PDF of wind generation can be simulated as:

$$f_{wind}(x) = \sum_{i=1}^{k} p_i \cdot \delta(x - C_i^{wind})$$

The above expresses the fact that generation from wind can take several values with a specific probability each. The residual load obtained through the convolution of the wind generation with the customer load is then

$$I_{L-wind}(x) = 1 - F_{L-wind}(x) = \sum_{k=1}^{n} p_k^{wind} I_L(x + C_k^{wind})$$

The reserve capacity required due to Residual Load Variations is modelled according to the assumption that a load shedding incident can happen if:

- The variation of the residual load L_{res} is greater than the reserve R_h
- The previous case can happen together with a generator trip

The probability for the variation of the residual load L_{res} to exceed the reserve required R_h in the time interval h can be modelled with a normal distribution :

$$Prob[L_{res\_variation} \geq R_h] = 1 - \emptyset(\frac{R_h}{\sigma_{L_{res,h}}})$$

STORAGE CAPACITY REQUIRED TO BALANCE THE ENERGY CURTAILMENT DUE TO NON-DISPATCHABLE RENEWABLES

The basic random variable of the problem is the hourly variation of the residual load which follows a Gauss distribution. For a specific time interval where L_r is constant $L_{r,final}$ also follows a Gauss distribution.

$$L_{r,final} - L_r = \Delta L_r$$

This leads to the following equations regarding the storage required R_{st}

$$Prob\left[L_{L_{r,final}} \leq C_{thermal\_min} - R_{st}\right] = CDF_{L_{r,final}}(C_{thermal\_min} - R_{st})$$

This expresses the probability that the hourly variation of the load leads to curtailment as a function of the storage capacity required Rst. Storage required per hour can be calculated by assigning a constant value for probability for energy curtailment:

$$PEC_{h,R} = \left(\prod_{i=1}^{G}(1 - FOR_{i,h})\right) \cdot (F_{L_{r,final}}(C_{thermal\_min} - R_{st})$$

and then R_{st} is calculated. New storage required is given by

$$R_{new,storage} = R_{st} - R_{st,existing}$$

Pumped storage is also used as reserve for peak load or variations:

$$R_{new,generation2} = R_{new,generation1} - \eta R_{new,storage}$$

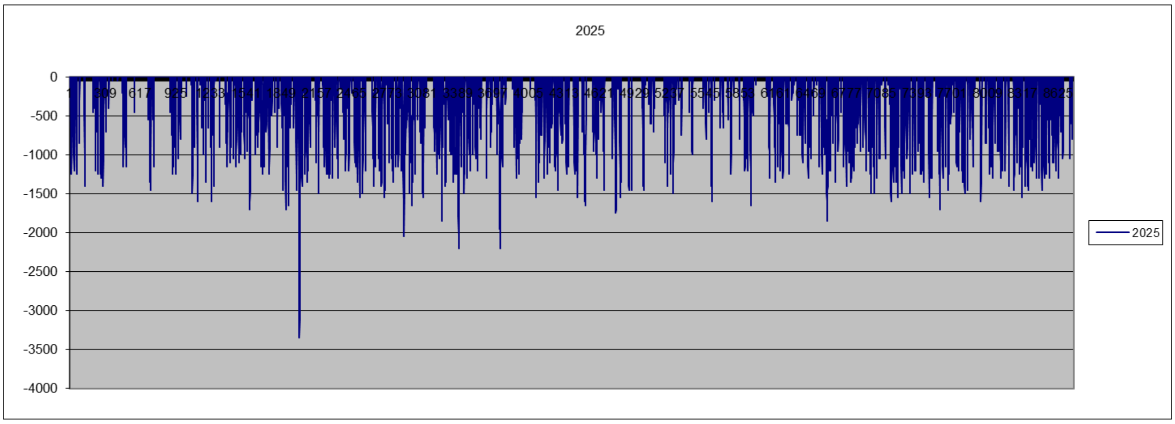


Figure 3 2025-Greek Energy System-Pumped Storage Capacity Required

Figure 3 shows the results obtained for the Greek energy system in 2025. An investment decision will ultimately depend on the economics of a project. A decision regarding the construction of a pumped storage plant can be based on the level of the Probability for Energy Curtailment which can be used as a Reliability Index. Although, pumped storage plants are sometimes very expensive one has to consider that they can be used both for pumping or generation related to peaks and variations. To evaluate the economics we have to compare the cost of the system expansion with and without the construction of the pumped storage plant.

2.1.3 Storage for non-mainland grids and other special situations (Stathis Tselepis, Centre for Renewable Energy Sources and Saving, Greece)

A particular feature of the Greek power system consists in the existence of a relatively large part of non-interconnected island systems which are not connected to the mainland and thus to the Central European Power System. The non-interconnected system has 18 autonomous island power systems with peak demand of less than 10 MW, 10 medium sized systems with a peak demand below 100 MW and only 2 islands with a peak demand exceeding 100 MW. The total installed capacity of these systems is 1721 MW thermal and 446 MW of RES-E generation.

For many years these non-interconnected islands, due to the high cost of electricity production and more recently due to environmental policy, have been the ground for implementing and testing hybrid systems and microgrids. They have been supported with preferential policy measures for RES deployment. The introduction of large variable RES-E production in these power systems required to have storage along with generation and load control.

Electrochemical storage technologies are considered expensive and short lived under deep cycling. For small scale applications electrochemical storage is cost effective but for large scale it is only economically viable through Pumped Hydropower systems usually in the mainland, where the available surface area and geological formations permit.

The achievement of a 100% renewable electricity penetration is costly as it involves oversized renewable power and storage capacity. The storage technology has to perform all functions of conventional generators offer and more (fast up and down ramping, power quality, etc.). The large scale integration of RES in the Non-Interconnected Power Systems, i.e. Islands leads to Storage needs for balancing and other ancillary services.

Examples of island and autonomous power systems cases presenting high RES penetration are:

- Kythnos island Hybrid Power System (in operation between 1998 and 2006)
- Kythnos island, Gaidouromantra Microgrid (in operation since 2001)
- Crete Island Power System
- Ikaria Wind-Hydro Pumped Storage Hybrid System (under construction, operation in 2015)
- Agios Efstrations – Green Island (construction to start in 2015)

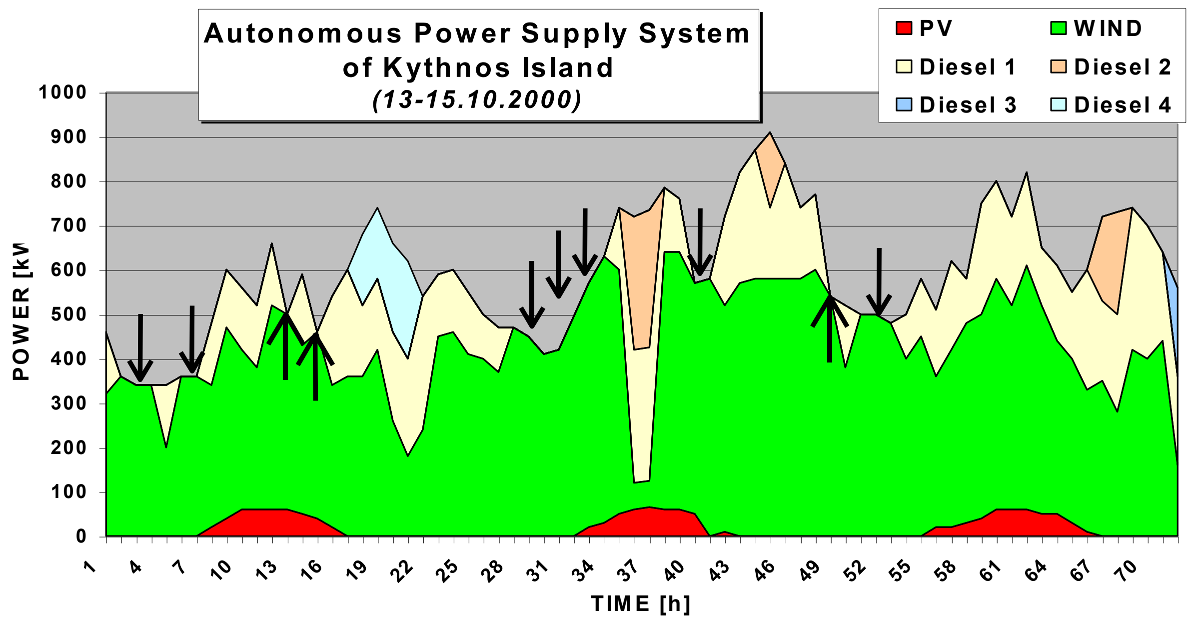


Figure 4 Operation of the autonomous power system of Kythnos Island, 13-15/10/2010.

A number of lessons could be learnt from the operation of these island networks.

- There is a coincidence in the islands of seasonal peak of PV and Wind energy production during the tourist high demand season in the summer
- Photovoltaic systems are complementing Wind turbines' energy production in Greek autonomous island Electric Systems up to annual RES energy penetration of about 15% without any control requirements
- In the annual RES energy penetration range from 15 to 30%, monitoring and control set-points to wind parks' power output and next day forecasting of Wind and distributed PV plants permits scheduling planning of thermal power plants for stable operation and voltage support in the LV grid. This control and scheduling operation allows sometimes instantaneous RES power penetration to exceed 60%.

Further variable renewable energy systems penetration in islands requires either the connection to a larger electrical system such as the mainland system in Greece that works as a buffer for electricity flows or integration of storage, demand response, generator production control and of course in parallel introduction of intelligence and communication functions in monitoring and controlling the grid, distributed resources and loads (i.e. Smart Grids).

2.1.4 Discussion

RES-E POTENTIAL AND INTEGRATION CHALLENGES IN THE CONTEXT OF E&I COUNTRIES

Several participants recommended considering benefits of storing RES E in the form of thermal energy to be used by heat pumps or for heating of sanitary water when optimising energy systems. A combination of solar energy for electrical energy and heating was considered effective. Furthermore, an upgrade of today's grids to "smart" ones was regarded necessary. Smart should be understood in a way that components in a grid collect and distribute information on prices and usage pattern. This information can then be used via user independent automation or control systems to balance electricity supply and demand and consequently enable a more efficient and more cost effective use of electricity.

STORAGE CAPACITY REQUIRED UNDER LARGE SCALE RES PENETRATION

The verification and validity of the simulation model presented by Kostas Tigas was discussed, in particular whether the implementation of the model was correct with respect to the conceptual model. The author of the presentation confirmed that the verification and validation of the simulation model has been done and the model matches specifications and assumptions deemed acceptable for the given purpose of application. The processes and techniques used to assure that model matches specifications and assumptions were not specified.

STORAGE FOR NON-MAINLAND GRIDS AND OTHER SPECIAL SITUATIONS

The possibility of using seawater for hydro pumping stations was discussed. The Greek experience shows that due to environment, safety fishery and touristic constrains the water of see is usually not allowed to be used. The benefits of connecting isolated island networks with the mainland were also discussed. A connection would indeed be positive and increase the efficiency of utilization of island RES-E capacity.

2.2 Session 2 – Case Studies Part 1

2.2.1 Hydro pumped storage – lessons learned from large-scale alpine pumped storage and the future role of energy storage in South Eastern Europe (Dietmar Reiner, Verbund AG, Austria & Energji Ashta, Albania)

The Austrian utility company VERBUND operates and owns 127 hydro power plants in Austria and in the neighboring German region of Bavaria, one plant in Albania. Furthermore, Verbund also operates a hydro power plant in Turkey. The group also operates and owns 154 wind power plants and two solar parks which are located in Austria, Germany, Romania, Bulgaria and Spain with a total capacity of 416 MW.

At the present date, Pumped Hydro Energy Storage (PHES) system is the most established and efficient technology for storing large amounts of electrical energy for a long time. Especially high alpine pumped storage power plants due to their topography have the advantages of large reservoir volumes for seasonal and day-ahead energy reallocation. This advantage allow PHES to use natural inflows and natural valleys in alpine regions, high pressure heads and a variety of different products for future, spot and intraday markets as well as ancillary services. PHES provide important support for the integration of wind and solar power, security of supply and grid stabilisation. They offer flexibility on all time scales in the form of transactions on futures markets, day-ahead markets, intraday markets and markets for ancillary services such as primary, secondary and tertiary control. In addition, PHS can contribute to the operating reserve; congestion management; provide reactive power, black start capability as well as energy and power in emergency situations.

Most PHESs in Europe were built before electricity market liberalization. Nowadays, in liberalized electricity markets, storage have to operate on price spreads. In Europe, price spreads have been decreasing significantly since 2008 with the consequence of decreasing revenue possibilities for

PHES. Decreasing demand and increasing capacities of wind and solar energy have led to a disappearance of price peaks at noon led to a further erosion of revenue possibilities for PHES.

In Europe, there is a potential for new PHES of 250 TWh/a yet the environment for new built is difficult. Challenges result from environmental legislation (water framework directive, NATURA 2000, etc.), the duration of permitting procedures (including Environmental Impact Assessments) and the abovementioned difficult market Environment. On a global scale a significant amount of hydro potential could still be developed. The economically feasible hydropower potential is about 2.5 times the production of 3,700 TWh in 2011; the technical feasible potential is at more than 4 times this level. There is a high geographic concentration with 10 countries producing about 70% of all hydropower.

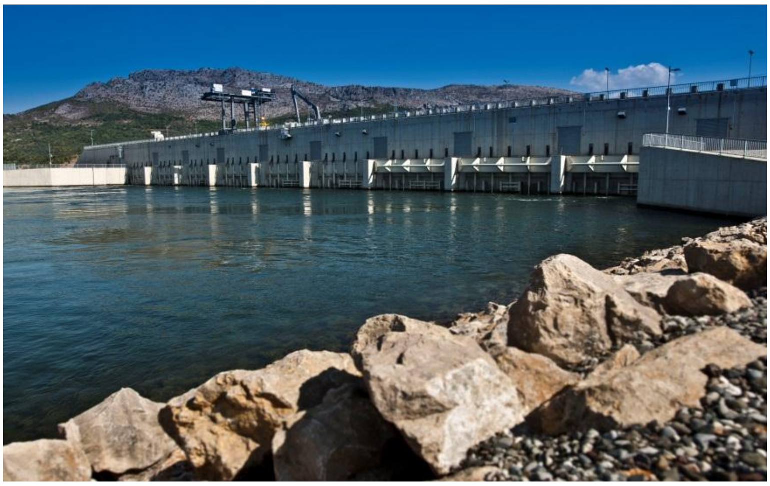


Figure 5 The Ashta hydropower plant

South Eastern Europe still presents good opportunities for the development of hydropower plants. Verbund also owns and operates the 53 MW Ashta (run of river) hydropower station in Albania. With an investment exceeding €200 m, it is the first new built hydropower plant in the country since 1980. Construction took place between 2010 and 2013. The power is sold to the Albanian power company (KESH) with an offtake agreement. In its first 12 months of operation, the pant generated 267 GWh of electrical energy without incidents.

Albania has an installed capacity of 1.6 GW of hydro power plants which produced around 4.7 GWh of electrical energy[1]. The country currently uses only about 35% of its hydro-energetic potential, well above the current power imports of 2.5 GWh. The status quo could be changed by developing the remaining hydro power potentials and possibly other forms of electricity production. Albania needs both additional generation as well as additional storage capacities for gaining a higher flexibility. In order to trade the electricity, the development of cross border transmission capacities is a necessity. Further improvements are needed in an increase of transparency in trade and in the energy distribution if a competitive energy market is to boost competitive investments.

[1] All figures from 2012

2.2.2 PUMPED HYDRO – TECHNICAL CONCEPTS, DESIGN CRITERIA AN CURRENT DEVELOPMENT OPTIONS (BENEDIKT SANDER-KESSELS, E.ON KRAFTWERKE GMBH)

E.ON with its Joint Venture Partner currently operates a European hydropower portfolio totalling more than 6,400 MW with plants located in Germany, Sweden, Spain, Italy and Turkey. In addition to operating hydropower plants, the group also supports technology and innovation activities such as the assessment of alternative storage concepts, the development of valuation methodologies for pumped storage plants and the hydro specific knowledge transfer in relevant stakeholder fora.

Currently, PSPs are the only mature large scale option to store energy which can react flexible on the system demand. Basically there are four types of PSP concepts which are distinguished by the water regime: off-stream, pump-back, diversion type and seawater pumped hydropower stations.

To develop a PSP project the design criteria have to be transferred into a technical concept. The design criteria are mainly derived by the power market and operational demands as well as actual site characteristics including environmental aspects (see Figure 6). There is no common approach to transfer design criteria to develop a PSP project. It is a "puzzle" of engineering judgment and knowledge transfer as well as experience.

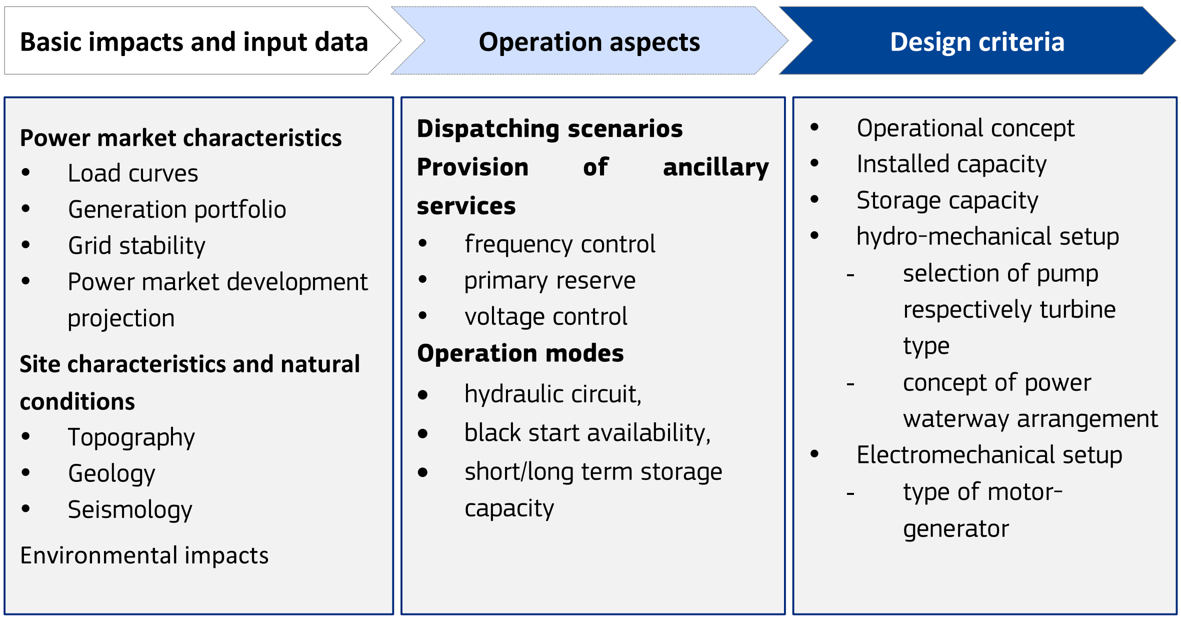


Figure 6 Design criteria derived from power market demands

A selection of mandatory design aspects that need to be evaluated in details are: site characteristics, machine type selection criteria, dispatching scenarios and the transient analysis. Desirable *site characteristics* are determined by geological conditions suitable for watertight reservoirs, sufficient head, a short water conduit and adequate size for the power installation. Also, a site should be close enough to load centres or transmission corridors. Available *machine types* differ in their flexibility to participate in the reserve markets and in their investment cost so an optimum needs to be found between investment and revenues. However, the power market demands and operation aspect determine the *machine configuration* and the required *storage volume*. An analysis has to be made about how much additional pumped storage fits into a particular market. Finally, *transient analysis* during pumping must be evaluated on a case by case basis in order to avoid disturbances in the water conduit as hydro characteristics in pumping mode differ significant to turbine mode.

Finally, future system demands require highly flexible PSP for the integration of renewable energy by optimised revenues and cost structures. The future role of pumped hydro is likely to become even more complex than today but the basic technological principle is expected to remain unchanged as it will not be outperformed by alternative hydro storage concepts such as underground storage plants or hydraulic gravity storage.

Concluding, the current market environment for pumped-storage plants is difficult. To promote system-relevant pumped storage plants, market mechanisms would have to be changed in such a way that all services are fairly remunerated, so that investment security and profitable operation is given.

2.2.3 Discussion

HYDRO PUMPED STORAGE – LESSONS LEARNED FROM LARGE-SCALE ALPINE PUMPED STORAGE AND THE FUTURE ROLE OF ENERGY STORAGE IN SOUTH EASTERN EUROPE

Several participants agreed that long permitting processes, partly related to environmental legislation as well as the significant initial investment and the resulting long-payback period for constitute barriers for hydropower projects in the EU; as a result hydropower is currently not used to its full potential in Europe. Uncertainty regarding future RES-E policy can prevent generation companies from investing in PHS as expressed by one participant.

Countries of SEE region are regarded as potential candidates for the development of hydropower. Albania is one of the countries with high potential for hydropower development. However, the development of electricity generation systems in SEE countries should be in accordance with the development of transmission capacities and the establishment of an energy market which is integrated with the EU.

The participants discussed different remuneration mechanisms which could give investors more security to recover the significant investment costs for pumped hydro storage. Ensuring security of supply could be another motivation for investing in storage rather complementing the optimisation of the power production. Such functionality will however require a different from of remuneration than the current price arbitrage model Possible storage remuneration mechanism proposed included to allow negative power prices, allocate the full balancing responsibility to the producer of RES-E, the adoption of the European grid codes in SEE countries as well as capacity markets. There was no agreement on a particular remuneration mechanism as all provide potential downsides. All participants agreed however that the security of investments, transparency of regulation policy and governance has to be improved in SEE countries to create a more attractive business environment for foreign investments.

The perspectives for storage investments look better for island micro grids as the competing fossil technology are relatively expensive diesel generators. The further development of battery technologies, in particular Li-ion, could lead to a replacement of the still predominating Pb-acid batteries in the Greek Island microgrids. The price for PHS on islands is relatively very high and not a feasible option for all grids.

There was an overall agreement that energy storage technologies will increasingly be regarded as a new component of an increasingly complex sustainable energy system.

PUMPED HYDRO – TECHNICAL CONCEPTS, DESIGN CRITERIA AN CURRENT DEVELOPMENT OPTIONS

A discussion emerged on the technical concepts and design criteria between existing and recent Pumped Hydro. The earliest designs (the earliest PHS in the world appeared in the Alpine regions of Switzerland, Austria, and Italy in the 1890s) use separate pump impellers and turbine generators. The development of PHS remained relatively slow until the 1960s. The pumps and turbines in these early plants were installed as individual units. These plants did not use reversible pump-turbines that are now standard in pumped storage plants. In some cases the plants had physically separate motor driven pumps and separate turbine driven generators. Other plants used a tandem type unit consisting of a generator-motor and separate pump and turbine mounted on a common shaft. Many of the early plants used motor-pump and turbine-generators on horizontal shafts and required large machine halls. The use of large reversible vertical shaft machines is now the preferred configuration. These early pumped storage plants, with individual pumps and turbines, had high overall cycle efficiencies because pumps and turbines could be designed for maximum efficiency at the single synchronous speed of the generator/motor. However, the electrical-mechanical equipment costs for these plants, as a percentage of the total plant cost, was high due to the separate pump-motor and turbine – generator installations. From the 1960s to 1980s, PHS projects were intended to support large base-load nuclear or coal-fired generation, absorbing excess electricity generated during off-peak hours and delivering stored energy during peak hours. These plants also provided ancillary services. The design concept for these plants was a reversible pump-turbine, operating at a single speed, it represents a compromise between efficient pumping operation and efficient turbine operation. A limitation of the single speed reversible pump/turbine is that it can only provide frequency regulation in the generation mode. In the early 1980s adjustable synchronous speed machines were developed using a three-phase low-frequency alternating current excitation on the rotor. The latest technological evolution came with the introduction of multi-level voltage source inverter (VSI) excitation and Pulse Width Modulation (PWM) techniques. Now the adjustable asynchronous speed machines can be used instead of synchronous machines. Their ability to operate at the lower power levels than synchronous machines results in a savings in water to be used for later generation. Cost gap between asynchronous and synchronous machines is estimated at 20%.

2.3 SESSION 3 – CASE STUDIES PART 2

2.3.1 SMALL RESIDENTIAL VERSUS LARGE SCALE STORAGE WITH FOCUS ON AUTO-CONSUMPTION – EXPERIENCE GAINED IN THE CLUBEN INITIATIVE (SERGIO OLIVERO, SITI AND POLITECNICO DI TORINO, ITALY)

CLUBEN (Clustering Business for Energy) is an initiative integrating small scale, energy-based actions, creating larger endeavours attractive for private investors. CLUBEN addresses business models devoted to connecting local ecosystems to a European market of smart city solutions. Due to budget constraints, public money is scarce. However, finance for investment is available by international and local investors, but small scale energy projects or investments in new technologies are not attractive enough due to perceived high risks. CLUBEN is a risk mitigation approach generating value for investors and limiting or eliminating local costs.

CLUBEN is at its core a technology market: it aims at equipping buildings with devices (PV, micro wind, geothermal, batteries, thermal storage, smart inverters, etc.) transforming those in "prosumers" (energy producers and users) acting as nodes of smart energy networks. Each building requires an investment worth several thousands of € in technology, and the aggregation of thousands of building units creates a market worth several million € for technology providers and investors. Profitability increases due to the savings from large bulk purchases.

CLUBEN also promotes the creation of new smart SMEs and new qualified jobs, involving local SMEs for installation and maintenance, stimulating local economy. It creates a local ecosystem that is managed by a local Energy Governance Entity (EGE), with innovative local partnerships: citizens, SMEs, local banks, real estate, municipalities, technology providers, ICT operators are integrated along sustainable value added energy supply chains (see Figure 7). The business model is based on a detailed analysis of local energy conditions.

CLUBEN is oriented to creating value for investments and reducing, even eliminating public expenditure: public funding (if and when available) is to be considered as a catalyst, while business processes rely on private investors play a major role. It has a social dimension, creating new business opportunities and generating jobs. Its project aggregation approach helps to achieve a critical mass to lower prices of the components. Regulations and standards are anticipated, in the sense that CLUBEN enables the investigation of medium-to-long term possible impacts of technology innovation on existing business models in the energy sector.

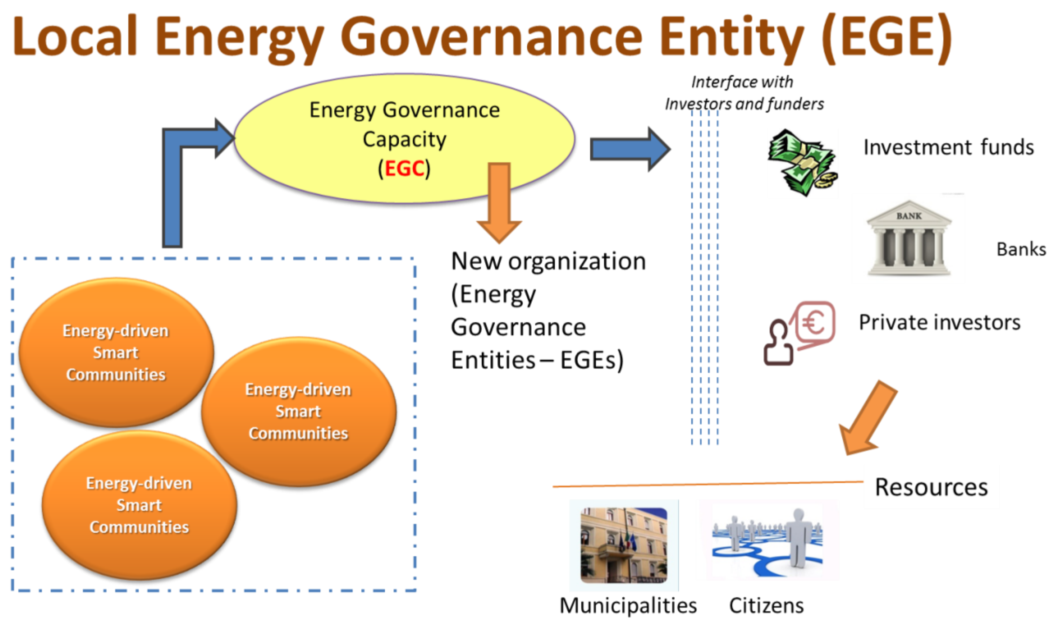


Figure 7 CLUBEN: The concept of local energy governance entities

CLUBEN mobilizes demand, creating local markets for integrated solutions for energy in smart communities. It is oriented to interoperability and one of its primary objectives is to create an open environment for competition avoiding vendor lock-in. CLUBEN is therefore looking to attract private investors, proposing an innovative sustainable approach to energy for smart communities, and seems replicable in the Balkan and Albanian context. The network of prosumers resulting from the integration of thousands homes represents an energy storage capacity that can play a role in energy sector, including balance and stabilizing issues.

2.3.2 Strategies for energy efficiency improvement in residential and office buildings: their role at building and country scale (Carlo Micono and Guido Zanzottera, AI Group, Italy)

A particular feature of the Albanian power system is the high share of residential load, which is at 53% of the total consumption thus almost the double compared to the worldwide average of 27%. The explanation for this high domestic share is to be found in mainly electrical heating and cooling systems. As a result, the typical Albanian yearly load profile shows a maximum in the heating season and a further relative peak in the summer. This consumption could be significantly reduced by adopting HVAC technologies requiring less power; by exploiting geothermal energy solutions, PV systems and a better buildings construction technology based on high performance envelopes. Also thermal storages could be a useful tool to reduce and shift the peak, making production capacity available for other purposes.

More generally, there is a strong case for improving energy efficiency in buildings. Within a holistic approach, different energy efficiency interventions can be act to improve the energy performances of buildings: reducing the demand (improving insulation and replacing windows), recovering waste energy from the HVDC system (recovering the energy content of exhausted air by increasing the inflow temperature), enhancing the efficiency of the HVDC (e.g. electronic fan control) and using renewable energy (PV systems and solar thermal collectors).

It is estimated that a 15% reduction in building's energy consumption would lead to a reduction in Albanian total consumption close to 8%. The use of renewable energies, applied locally in a diffuse-production scenario, could be an effective means to reduce the electricity imports or the need for new generation capacity. A strong penetration of renewables in Albanian energy network could, on the other hand, raise problems in terms of overload of power lines. As a remedy, storage technologies could be included in the electrical network or in local applications so that self-consumption could be enhanced without overloading the distribution network.

Two case studies were carried out, assessing the potential of batteries and thermal storage for different scale buildings: a medium size house and a high rise office building. The calculation of energy needs has been carried out using a Dynamic Energy Modelling tool (IES <Virtual Environment), which simulates with a one hour time-step the interaction between outdoor environment, building envelope and HVAC systems, also considering occupation and internal gains hourly profile. The results obtained from dynamic simulation in standard conditions have been compared to the results obtained in the following options.

Option 1 consists of PV panels combined with battery storage. The PV is sized to match the 20% of peak power required by the building, the battery storage is able to store the energy ideally produced by the PV plant in 12h peak power. Heating and cooling is provided by a water-to-water heat pump (with fan-coils, COP = 4). For lightning, a full LED system with dimming (7 W/m2) is used. In Option 2, solar collectors and thermal storage are deployed. The solar collectors are covering the same area as the PV system in Option 1. The thermal storage sized considering conventionally 75 l per m2 of collector. Heating and cooling are provided by the same water-to-water heat pump as in Option 1. Lighting is also identical to the solution chosen in Option 1.

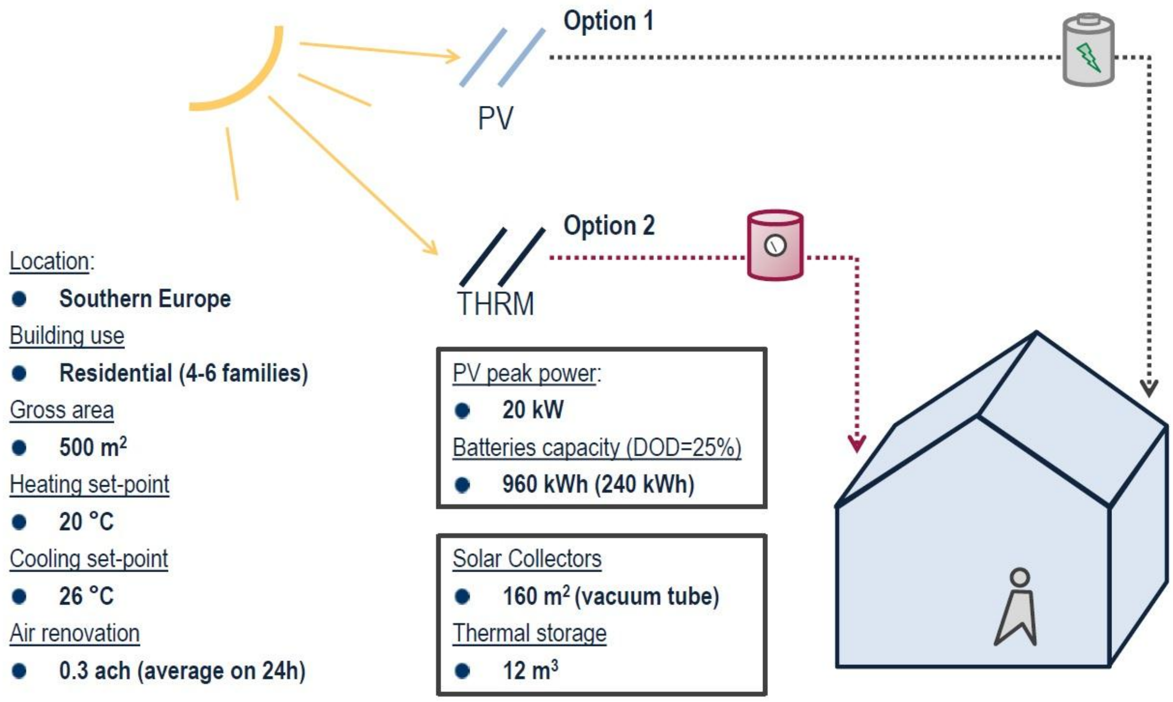


Figure 8 Options for the residential case

In case of a residential building, Option 1 saves 20% of energy (compared to the baseline), while option 2 lowers the energy consumption by 28%. For an office building, Option 1 reduces energy consumption by 33%, while Option 2 reduces the consumption by 29%.

The results show the pros and cons of using solar thermal energy and storage vs PV with battery storage. While the integration of solar thermal energy is energetically more advantageous in the domestic case, PV-panels combined with electrical storage reduce consumption further in the case of an office building.

2.3.3 Discussion

SMALL RESIDENTIAL VERSUS LARGE SCALE STORAGE WITH FOCUS ON AUTO-CONSUMPTION – EXPERIENCE GAINED IN THE CLUBEN INITIATIVE

The question was raised how the building upgrade investment strategies presented by CLUBEN could be replicated to other markets. Converting a building to a "prosumer" is considered much easier for social housing given the already existing relationships between government and private cooperation in that case. The CLUBEN strategy seems replicable in SEE and in the Albanian context with details to be adapted to the country.

STRATEGIES FOR ENERGY EFFICIENCY IMPROVEMENT IN RESIDENTIAL AND OFFICE BUILDINGS: THEIR ROLE AT BUILDING AND COUNTRY SCALE

The discussion focused on the relationship between the cost of the investment and the energy efficiency of the proposed system. The behaviour of the house user was regarded as crucial for the success of the proposed system. Participants agreed that the optimum strategies for building energy efficiency can differ from place to place. Also, it should be considered starting with simple systems when introducing energy saving and to start implementation in public buildings as a first step.

2.4 SESSION 4 –SOUTH EASTERN EUROPEAN PERSPECTIVE PART 1

2.4.1 ELECTRICITY MARKET AND POLICY DEVELOPMENT IN THE ENERGY COMMUNITY (JASMINA TRHULJ, ENERGY COMMUNITY SECRETARIAT, VIENNA, AUSTRIA)

The Treaty establishing the Energy Community was signed in 2005 and extended in 2013 until 2026. The signatory parties to the Treaty are European Union and Energy Community Contracting Parties, namely Albania, Bosnia and Herzegovina, Kosovo[*], FYR of Macedonia, Moldova, Montenegro, Serbia, and Ukraine. The treaty is aiming at extending the EU internal energy market to South East Europe and beyond; creating stable regulatory and market framework for attracting investments; enhancing security of supply and competition; improving the environmental protection and bringing the Contracting Parties closer to their accession into the European Union. The deadline for implementation of the 3rd Energy Package in the Energy Community is the 1st January 2015. Regulation (EC) No 347/2013 (TEN-E) is expected to be adopted in the first half 2015 in order to facilitate the implementation of Projects of Energy Community Interest (PECI) followed by Regulation (EC) No 543/2013 (Transparency).

The installed electricity generation capacity in the Energy Community in 2013 was 73 GW. The combined generation portfolio deviates strongly from the situation found in Western Europe. One striking difference is the relatively high share of coal (including lignite) fired power plants which is around 50% (46% excluding Ukraine). The aged coal fired stations are largely non-compliant with European environment protection requirements; last capacity additions were undertaken in 1991. In 2013 new capacity additions were limited to RES-E: 680 MW in total (of which 54 MW of hydropower in Albania). Large hydro power plants constitute another important source of generation with a 19% share over the total region. Natural gas fired plants do not play a significant role in the Energy Community. Nuclear has a 19% share but this is located entirely in Ukraine. The annual production in 2013 was 253 TWh exceeding consumption so that the Energy Community was a net exporter of electricity.

The power systems of the Western Balkans Contracting Parties to the Energy Community fall into the synchronous area of ENTSO-E CE while Ukraine and Moldova operate in the synchronous mode with the United Power System (UPS) of the Russian Federation. The Energy Community Contracting Parties together with the EU Member States Italy, Slovenia, Croatia, Hungary, Romania, Bulgaria and Greece are also part of the 8th Region established in order to facilitate the creation of a common procedure for electricity transmission capacity allocation and congestion management and the integration of national electricity markets. The target model of the EU/Energy Community foresees the creation of regional electricity markets for forward, day ahead, intraday and balancing products. Except for balancing, trading platforms are to be implemented by 2015. Seven TSOs (HOPS, NOS BiH, CGES, KOSTT, OST, IPTO, TEIAS) are shareholders in a regional capacity allocation platform SEE CAO with first yearly auctions expected in November 2014. The capacity allocation procedures are currently characterised with NTC-based auctions applied on an annual and monthly basis on all interconnectors and auctions on a daily and intraday basis only on some

[*] This designation is without prejudice to position on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence

interconnectors. Common coordinated auctions between two TSOs are applied on four interconnectors while split auctions exist on other interconnectors. No regional day-ahead and intraday market platforms exist so far.

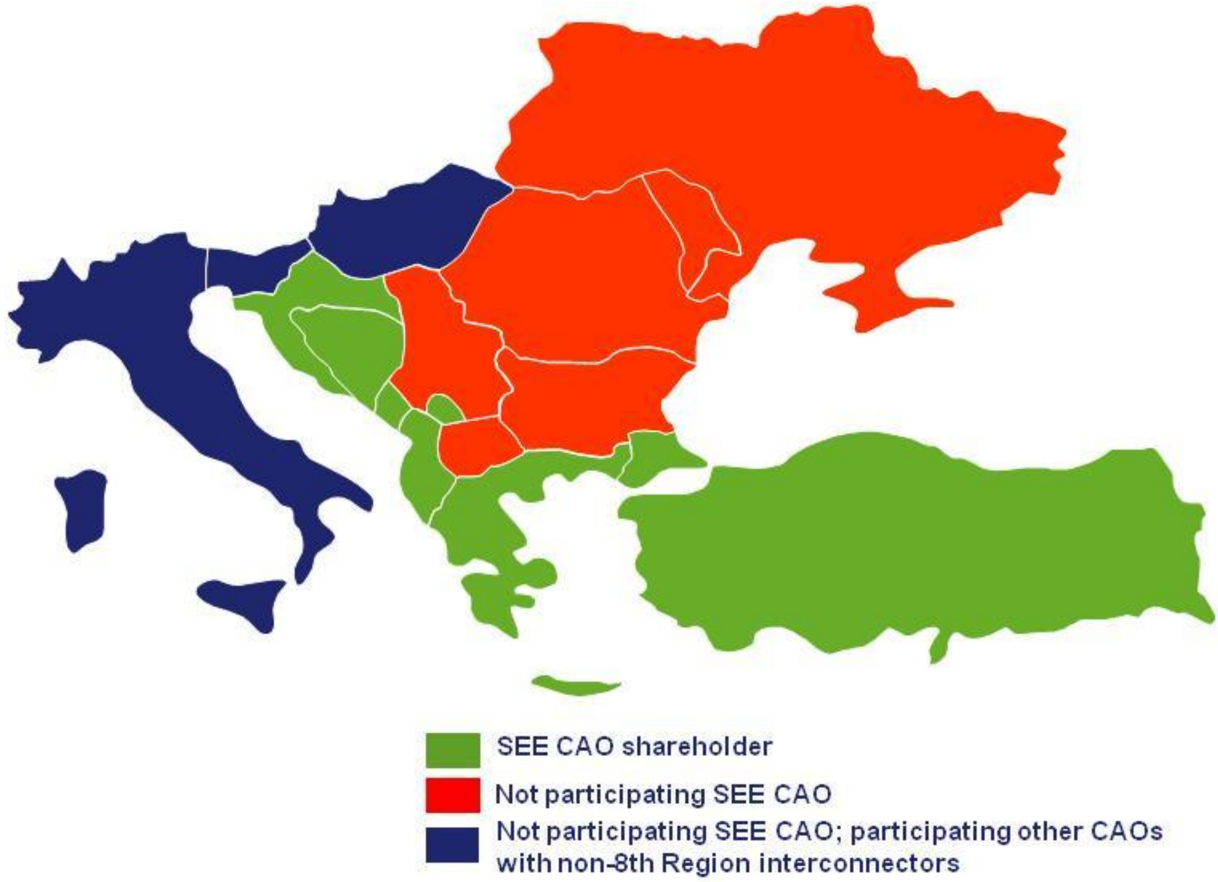


Figure 9 Capacity allocation in the 8th Region

Day-ahead markets are operational in most of the EU MSs participating 8th Region while the Contracting Parties to the Energy Community are currently considering the establishment of Power Exchanges; e.g. EMS and EPEXSPOT signed principles of cooperation on the establishment and operation of Power Market Exchange in Serbia. Currently, the wholesale markets of the Energy Community are nationally oriented; there is a lack of competition, a lack of liquidity and inadequate market price signals. As a result wholesale prices diverge strongly (average prices over a quarter can vary by a factor of 4) between countries.

Balancing markets remain largely undeveloped except for Serbia; elsewhere the service is provided on a regulated basis. In consequence, the balancing services provision in the Energy Community lacks non-discriminatory and transparent rules, balance responsibility obligations, a reference price for imbalance settlement. As a result, there is a lack of balance service providers and of balancing reserve across the region.

Retail markets show a low level of opening across the region with regulated end user prices and no competition; only 0.8% of the eligible customers were active in the Energy Community (ex. Ukraine and Moldova) in 2014. End user prices vary between less than 50 to above 90 €/MWh across the region. Regulated production and end user prices and an excessive public service obligation constitute a barrier to the development of electricity market.

Attracting investments is one of Energy Community objectives (given the abovementioned age structure of the production park) yet private investments are far below the level expected. The Investors Advisory Panel identified political interference, unstable legal and regulatory frameworks, a lack of well-functioning national and regional electricity markets and currently low energy prices as the main obstacles. Currently there are 14 power plant and 9 grid related investment Projects of the Energy Community Interest.

The High Level Reflection Group of the Energy Community issued a report in May 2014[1]. The creation of the Energy Community is regarded as a success story but needs improvement to achieve its goals. The shortcomings are to be found in a lack of implementation by the Energy Communities Contracting Parties, a lack of private investments, a lack of flexibility, a too narrow scope and weak enforcement mechanisms. The report recommends improvements of the legal perspective, conditions for investments, geographical scope, and the institutional set-up.

2.4.2 Energy policy options for Montenegro (Nikola Martinović, Law firm Martinović, Montenegro)

Elektroprivreda Crne Gore A.D. – Nikšić (EPCG) is a vertically integrated company in Montenegro dealing with electricity generation, distribution and supply. The capital of EPCG is hold by the state (55%), Italy based utility A2A (43.7%) and additional legal and physical entities. The company possesses capacities for electricity generation in Montenegro whose gross installed capacity amounts to 870 MW of which 651 MW in hydro power plants and 219 MW in the thermal power plant (TPP) Pljevlja. The total power generation was at 3.8 TWh in 2013 (46% up from 2.6 TWh in 20120). Total demand for power was 3.5 TWh in 2013 (10% down from 3.9 TWH in 2012). The hydrological situation was favourable and it resulted in significantly increased generation from hydro power plants compared with the planned one. The TPP 'Pljevlja' generated 1.311,4 GWh, which was 6.8% less than planned.

The number of customers in Montenegro, as of December 31, 2013 amounted to 378,073, including 4 direct customers, 344,589 households and 33,480 other consumers. The Kombinat Aluminijuma Podgorica (KAP) aluminium plant is the single largest consumer in Montenegro with an annual consumption of 549 GWh (contracted from EPCG) in 2013 down from 1.1 TWh in 2012. The consumption of KAP reported by the TSO (CGES) in 2013 amounted to 734.9 GWh. The difference included quantities indirectly purchased from EPCG as well as deviations. The electricity balance in 2013 was characterised by an uncertainty in terms of consumption of 'KAP' which, despite continuous updating of plans, restricted the possibility of optimization of available resources in certain periods.

The highest monthly consumption was realised in January (341 GWh), the lowest in May (201 GWh), the highest daily consumption on February 10th (12.2 GWh), and the lowest on May 6th (7.4 GWh). The highest average hourly load was registered on February 10th in the 21st hour (612 MWh/h), and the lowest on May 22nd in the 5th hour (227 MWh/h), excluding days in which load was lower due to disturbances in energy system.

Power is purchased by a total of 18 companies of which no company has a considerable percentage share in the overall electricity turnover. This indicator leads to a conclusion that trading

[1] An Energy Community for the Future, report by the High Level Reflection Group of the Energy Community, May 2014

is performed in a public and transparent manner, in line with the Procedure on Electricity Sales. In 2013, 1235 GWh was taken from the Electric Power Utility of Serbia on the basis of the Contract on Long-Term Business and Technical Cooperation. 622.57 GWh was exported in 2013. 142.1 GWh was delivered to the Montenegrin National Transmission System in 2013 for coverage of losses in the EPCG transmission network, what constitutes 4.3% of electricity taken for the requirements of the entire Montenegro's consumption, being 1.6% (2.3 GWh) less than planned, i.e. 11.7 GWh (7.6%) less than in the previous year. 479,6 GWh are the total 2013 distribution network losses, including unauthorized consumption, i.e. 18.96% of electricity taken from the Montenegrin National Transmission System A.D. 461.17 GWh are the 2013 distribution system losses, corrected by unauthorized consumption, what is 61.6 GWh less than in 2012.

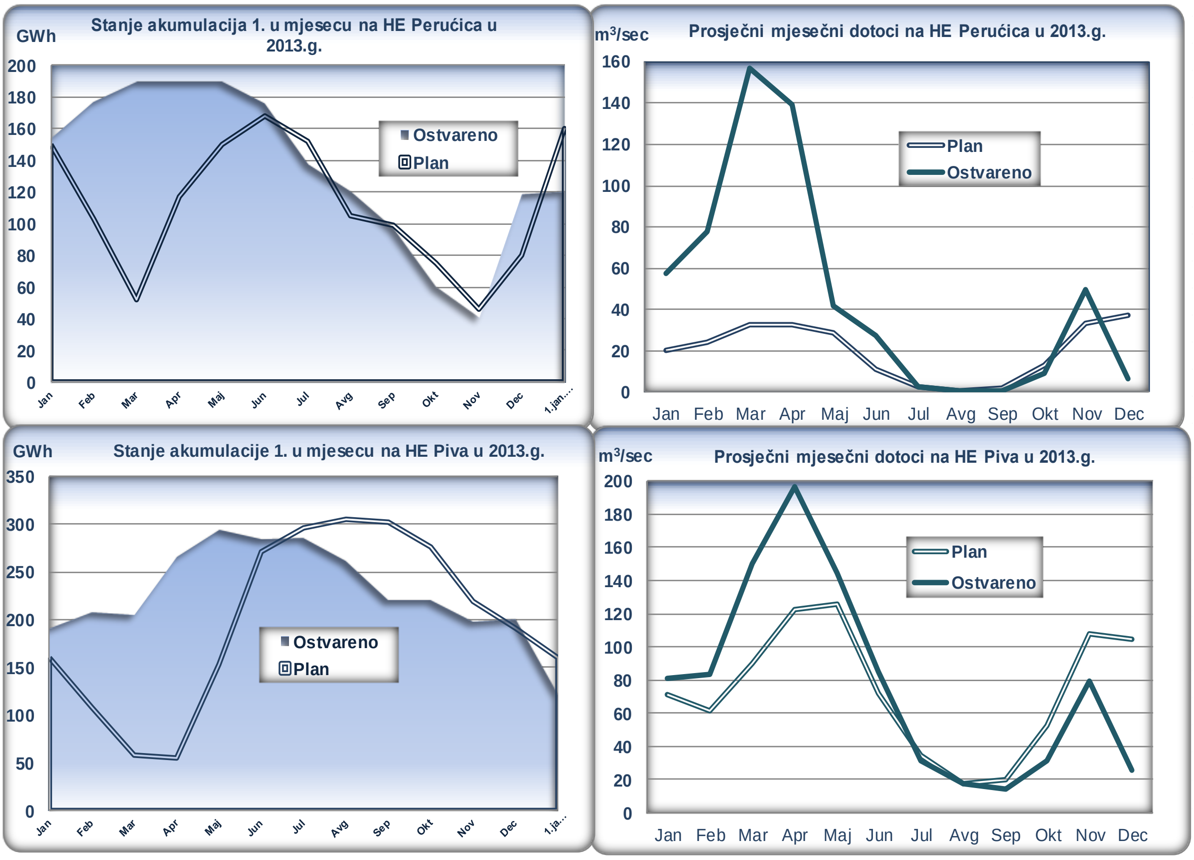


Figure 10 Production and reservoir level of HPP in Montenegro

At the beginning of 2013, the level of reservoirs of HPP Piva amounted to 153.6 GWh, insignificantly more than planned. The level of reservoirs at the end of the year stood at 79.8 GWh, i.e. only 53% of the planned quantity. HPP Piva operated at medium monthly elevation of 647.68 m.a.s.l. in December (the lowest) up to 673.28 m.a.s.l. in May (the highest), and the medium annual elevation was 663.13 m.a.s.l. The medium annual inflow was 78.38 m^3/s (approx. 7% more than planned). At the beginning of the year there were 190.59 GWh in the reservoir, i.e. 19.1% more than planned, and 120.67 GWh at the year end, i.e. 25% less than planned.

1,311.4 GWh generated by TPP Pljevlja, what is 6.8% less than planned, required totally 1.666 kilotons of coal, what means that average specific consumption amounts to 1.27 kg/kWh. In 2012, specific consumption stood at 1.37 kg/kWh. In 2013, the thermal power plant operated 7.817

hours. The overall stoppage of the plant in 2013 lasted 1.573 hours, of which the planned stoppage lasted 936 hours, and non-planned stoppage (extended overhaul, caused by failures) lasted 637 hours.

2.4.3 Lessons learnt from deregulation in Western Europe on the example of energy storage (Christian Egenhofer, Centre for European Policy Studies (CEPS), Brussels, Belgium)

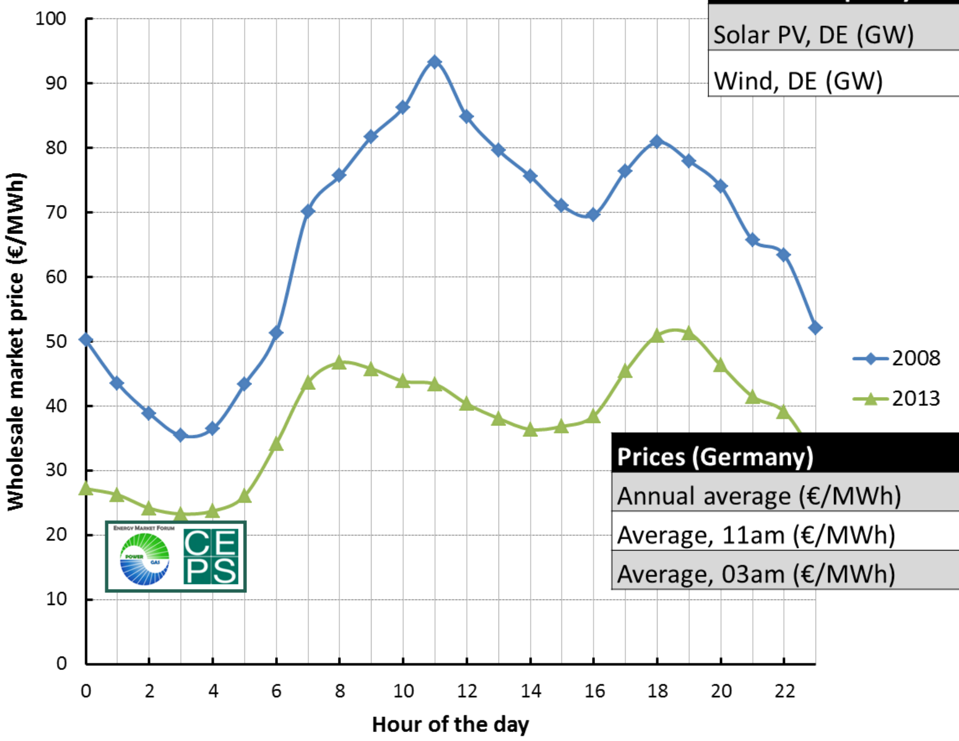
Three main phases can be distinguished for the deployment of energy storage in Western Europe: (i) the regulated market phase which lasted until 1990s, (ii) the liberalisation phase between the 1990s and 2009 and (iii) the renewable energy boom phase that started around 2009.

During the first phase, pumped hydro storage constituted one option to optimise the production of the then newly installed nuclear power plants; the other option pursued was to shift consumption of heating loads to the night hours. Additional options pursued during this phase were to provide light to motorways (Belgium) or to export large quantities of base-load electricity (e.g. from France to Italy). During this phase of regulated and vertically integrated systems, the value of storage was implicit and given by the regulator who had to approve or reject investments.

During the second phase (following the liberalisation), the value of storage could be determined by the power market while functionality remained largely the same. Storage operators would profit from daily price spreads to buy at low prices and sell at high prices. The price pattern was overwhelmingly driven by the variation of demand within a day: low prices resulted from low demand causing the dispatch of base-load plants (hydro, nuclear, lignite) only which have low variable production costs. High prices would occur when high demand leads to the dispatch of peaking plants with higher variable costs (open cycle gas turbines). This pattern would occur on a daily basis allowing regular revenues. The introduction of the Emissions Trading System in the EU in 2004 even widened the spreads in those countries, where baseload generation was based on nuclear power, further increasing the profitability of pumped hydro storage.

The functionalities of storage have not changed in the third phase (after the renewable boom) relative to the second phase but the value has decreased significantly. The cause is that daily price spreads are no longer caused by demand only but also by the variable and stochastic nature of wind and solar energy. Figure 11 shows the price profiles and installed PV and wind power capacities on the example of German for the years 2008 and 2013. Two effects can be observed: The absolute level of power prices has decreased (in the aftermath of the crisis) and the shape of the price curve has changed. Following a six fold increase of PV capacity, there is no longer a price peak at noon but a rather a small price depression. As a result, the existing pumped storage business model does not work any longer. To overpass the situation a new business model for EU energy has to be developed.

A number of lessons can be learned from this situation regarding the energy deregulation in the European Union: Energy policies of EU member states are defined at the level of Member States as far as the energy mix is concerned (Art. 194 of II Lisbon Treaty). Different EU member states have been developing very different energy policies during the period following the liberalisation of the system: Germany has strongly supported the deployment of renewable energy while France has continued giving nuclear energy an important place in the national energy mix. But the integration of energy markets has led to a loss of autonomy for the Member States. While cost reflective prices should remunerate the full costs of an investment, cross border trades only take marginal costs into account. The massive addition of (subsidized) energy sources in one country thus impacts the case of investments in another. A review of market designs, as already pursued by some Member States, will remain on the energy policy agenda within the European Union. New electricity market designs should ensure: a full remuneration of generators, avoid the creation of overcapacities and allow a carbon price to send meaningful signals. The integration of renewable energies into the market will have to be ensured, in particular regarding the balancing responsibility and the provision of ancillary services. Finally, renewable support systems need to be reformed ensuring market mechanisms lead to cost optimum deployment.



Installed capacity	2008	2013
Solar PV, DE (GW)	6	36
Wind, DE (GW)	24	33

Prices (Germany)	2008	2013
Annual average (€/MWh)	65.7	37.8
Average, 11am (€/MWh)	93.3	43.4
Average, 03am (€/MWh)	35.4	23.3

Figure 11 Daily price pattern before and after the renewables boom

2.4.4 Discussion

A number of participants agreed that there is a lack of remuneration for new investments in the European power sector. Investors have stayed absent even in countries, where capacity additions were regarded necessary, such as Belgium and the UK. Participants agreed that a lot of alternatives for encouraging investments are available but all of them need to be guaranteed by governments. One participant suggested that there might also by a need for improvements in the regulation of competition and possibilities for more fruitful collaboration between private and public sector.

The electricity production energy from RES is very high in some countries of the EU. As a consequence, it becomes difficult for these countries to balance their energy production without trading power with other EU Member States. The participants agreed that it is a necessity in EU and SEE countries to go toward a common and open market for electrical energy trade.

2.5 Session 5 – South Eastern European Perspective Part 2

2.5.1 Pumped Hydropower Energy Storage (PHS) in Albania (Piercarlo Montaldo, AI Group, Italy)

At the moment almost the entire electricity production in Albania is originating from hydropower plants (HPP). About 85% of the total amount is generated by KESH through the Drini cascade system. The Drini cascade production is affected by the seasonal rainfall, by the dam safety management and by the support provided for the minimisation of flood risks. The remaining 15% of energy is produced by run-of-the-river HPP strongly affected by seasonal rainfalls and river flows as well. The average annual production during the last 30 years has been of around 4.6 TWh (2012 with a production of 4.7 TWh can thus be considered an average production year).

The electricity demand is steadily growing over the years. Since 1997 the demand overtook the average year production (4.6TWh/year). Residential customers are responsible for a relatively high share of demand (53% compared to the 27% worldwide average). This value is, very likely, due to the heating and cooling systems, most of them powered by electricity. The consumption could be reduced by adopting more energy efficient HVAC technologies. Since 1999 (with the exception of the 2010, where hydropower production reached a historical maximum) Albania was forced to import electricity. In 2012 (a year with average hydropower generation) the import of energy was again 2.9 TWh. In 2014, the average energy import ranged between 370 MW in autumn and 470 MW in spring. The daily profile of power imports is flat along the 24 hour horizon and the power price is fixed accordingly. Pumped Hydropower Plants could add flexibility to the system and thus allow Albania to optimise the trading position.

A number of options exist for increasing the domestic electricity generation: A new HPP (the Skavica dam) could be built on the Drini cascade adding another 350 MW of capacity or ~1 TWh of annual production. Albania could add gas fired CCGT to its generation portfolio once the Trans-Adriatic Gas Pipeline (TAP) starts operation. The coal (lignite) reserves which are available in the region could be explored. These three options can only be realised through mid-long term programs. A further option worth considering is the installation of a set of small PHS plants, optimised for a daily cycles, that would satisfy part of the peak demand and help reducing import costs. Albania could profit from existing assets as more than 600 barrages with small reservoirs were realised thirty to forty years ago for irrigation purposes. Their storage capacity of millions cubic meters can be the most valuable aspect of a PHS system. The potential for the construction of PHS in Albania was also confirmed in an assessment carried out by the European Commission's Joint Research Centre[2].

Presently, most of the existing reservoirs are almost abandoned in very poor conditions. They were built more than forty years ago and nowadays they are not fitting with the international dam safety rules. Spillways and discharge outlets are inadequate and in many cases they even don't exist. Intakes are not properly maintained. During the last decades many houses and villages were built downstream of the barrages in danger areas. In case of barrage collapse they are at risk so as the life of the inhabitants (as can be seen in Figure 12). Extreme weather events could increase the odds of dam breaks. In some cases, the lakes are kept empty or almost empty in order to reduce the risk of collapse and flooding and as a consequence cannot be used for irrigation purposes.

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[2] Gimeno-Gutierez et Lacal 2013, Assessment of the European potential for pumped hydropower energy storage

Figure 12 Example of reservoir situated close to Tirana International Airport

The uncertainties in the energy market do not always encourage investments in PHS. A thorough cost-benefits analysis will thus be required. A few upsides can however be already identified for the Albanian reservoir rehabilitation cases: these would combine the value created from the PHS energy business with the risk reduction for a large number citizen and the improvement of the agricultural economy thanks to the irrigation. Albania owns a strategic asset of hundreds reservoirs with millions cubic meters of storage capacity which deserves to be better investigated and possibly exploited.

2.5.2 Legal Framework and Establishment of the ECO Fund in Albania (Gjergji Simaku, Albanian Ministry of Energy and Industry, Tirana, Albania)

In order to transpose the EU Acquis Communautaire in terms of energy policy, Albania has drafted a new national energy strategy, a new power sector law (transposing the 3rd package legislation), an energy efficiency law in line with directive 2012/28 EC, an energy performance in buildings law addressing directive 2010/31 EC and an amendment of the renewable energy sources law 138/2013 addressing feed-in tariffs (FIT). The Albanian government has explicitly acknowledged the potential of renewable energy to bring benefits to consumers, reduce emissions and have an immediate contribution to security of supply. The Albanian National Renewable Energy Action Plan (NREAP) target for the period of 2011-2020 is set at 38%, the 2011-12 target of 31.2% is already fulfilled.

The application has been facing some delays. Albania did not submit an NREAP by 30 June 2013 under Directive 2009/28/EC resulting in the Energy Community Secretariat launching an infringement procedure in February 2014. Also the provisions related to possible cooperation mechanisms between Albania and the Contracting Parties (of the Energy Community) or EU Member States have not yet been transposed. Also, Directive 2009/28/EC (on the promotion of the use of energy from renewable sources) yet needs to be transposed by Albania. The timeframe for applications and the coordination between different institutions will be positively affected by the National Centre for Energy Applications, the one-stop-shop for renewable energy projects.

The Law on Renewable Energy provides for priority access of renewables to the network. Secondary legislation will be developed. Under the current legal framework, renewable energy producers may claim compensation in case of lack of grid capacity. In practical terms, transmission and distribution system operators have to improve transparency in terms of the costs of connection to the grid or grid reinforcements. Currently, Albania fails to comply with the requirements related to grid access. Legislation related to issuing, transfers and cancellation of guarantees of origin will be adopted The Law in 2008 had foreseen the renewables share of the transport fuel market at 5% in 2010 which was in line with Directive 2003/30/EC. The new Law on Renewable Energy transposes the 10% target from Directive 2009/28/EC. The existing Law on Bio-fuels of the year 2008 will be amended to transpose the requirements for the sustainability regime and to establish a certification scheme and the relevant body as required by Article 18 of Directive 2009/28/EC.

Hydropower offers a significant potential for the development of renewable energy sources. The rivers of Drini (flowing from Macedonia to the Adriatic Sea) and Vjosa (originating in Greece and flowing into the Adriatic Sea) still offer significant additional renewable energy resources in Albania, the Drini river being the more important of the two. Three hydropower plants (Fierza, Komani and Vau i Dejes) have been constructed on the Drini watershed. The Skavica hydropower plant is foreseen to be built on the upper part of the cascade. In addition to the production of electricity, it will be designed to support the water regulation in the cascade and act as a preventive measure against floods in the sub Shkodra region. A preliminary feasibility study has been carried out. The most likely scenario would have two HPPs: one in Skavica and another nearby at Katundi i Ri. The added capacity would be 181 MW and 694GWh of annual production at costs of 337m. This alternative is favourable from the point of view of electric power production and regulatory role of Skavica reservoir but it has high environmental and social impact as well as high financial costs of expropriations. The Vjosa River is located in South Albania. There are no existing hydropower plants on it until now but there is a possibility of to construct up to 9 HPPs on the watershed.

An eco-fund has been set up facilitating investments in energy efficiency and renewable energy. The model is based on lessons learnt and recommendations from the IEA and the World Bank. Five different delivery mechanisms are made available: Technical Assistance is provided for project identification and preparation for loans or public procurement. A market is created for Energy Service Companies (ESCO) with performance contracting and third-party financing. Legal obligations are put on utilities which can trade certificates. Energy-eco-funds including revolving funds will be provided. Finally there exist provisions for voluntary agreements and non-financial incentives. On the institutional side, the eco-find will be supported by an energy agency and public ESCOs. The vision is to construct an energy system allowing smart Interactions between all connected parties to deliver sustainable, economic and secure electricity supply.

2.5.3 Regulatory incentives to facilitate storage investments (Goran Krajačić, University of Zagreb, Zagreb, Croatia)

Hydropower has been used for more than 100 years. Other renewable energy sources have been developed more recently and nowadays, the share of renewable energy within the European mix varies between a few percentage points and 100% of consumption (in the case of Norway). It can be questioned if renewable energy usage can grow above a certain level in the absence of storage and subsidies. The support provided to wind has led to a rapid build-up of the installed capacity (from a few thousand MW in 1995 to more than 80 GW in 2010) which was underestimated by almost all of the projections. It need to be taken into account that subsidies have been provided in some form to almost all generation technologies as recently described in a report to the European Commission [3] Fossil fuel subsidies have been reported to achieve double digit GDP rates in several countries of the Western Balkans[4]. Finally, due to taxes, levies and some geographical constraints, end user prices differ by +/- 50% compared to the average despite the introduction of the Internal Energy Market in Europe. The integration of variable RES-E requires sources of flexibility in the power system. Four basic options could provide this flexibility: dispatchable power plants, storage, interconnection and demand side measures. The flexibility requirements of a particular power system can be assessed e.g. the FAST method developed by the IEA. This method provides a first approximation to what is possible in a power system with a given flexible resource, from a technical perspective.

If sufficient storage is available systems with 100% renewable energy are possible, as can be seen on the example of the island of El Hierro. The commissioning in June 2014 of a pumped hydropower plant with a pumping capacity of 6 MW and a production capacity of 11 MW combined with a total wind farm capacity of 12 MW will allow to supply entirely renewable electricity (the existing diesel-powered 12.7MW thermoelectric power plant will become a back-up system that can be used in case of emergencies only). Preliminary results of an analysis of the South East European Energy system show that a 100% RES electricity supply in 2050 could be realised with the installation of 100 GW of pumped hydro storage with a combined reservoir capacity of 45 TWh.

Within the continental European energy system, pumped hydropower stations have recently been developed for adding flexibility to the existing system as e.g. the 180 MW PHS AVCE that was built between 2005 and 2009 in Slovenia. Large potential for further development of PHS exists in Croatia as recently identified by a GIS based analysis[5]. The study identified potential 13 sites with a combined total capacity of 60 GWh. Environmental constraints (mainly from the Natura 2000 directive) have a considerable effect by disqualify over half of (otherwise) suitable sites. Two different topologies were identified in the study: linking one existing to a new reservoir or linking two existing reservoirs. No suitable sites that fall into the latter category could be identified for Croatia. Besides the existing PHSs, the state owned Croatian power utility HEP is considering the construction of 4 new PHS with a total capacity exceeding 1400 MW. There are also some other private PHS initiatives. Pumped hydropower stations might face difficulties in financing given the uncertainties found in power markets.

In order to overcome these, a feed-in-tariff scheme could be introduced that would secure revenues for the PHS investor as shown in Figure 13. The system is based on the tracking of green obligations (GO) or feed-in tariffs ensuring that RES-E energy produced by a pumped hydropower does not lose the remuneration. In this way, twofold counting of produced RES-E is avoided and it is possible to track RES-E, thus organising payments according FIT. Market operators at the end of each month or any other agreed payment period could easily calculate what amount of money, according to prescribed FIT, should be given to RES and PHS producers. As is also shown in Figure 13, it is then possible to show final consumers the amount of GO and RES consumed therefore

[3] Subsidies and costs of EU energy, An interim report, Ecofys 2014 by order of: European Commission
[4] Fossil Fuel Subsidies in the Western Balkans, A Report for UNDP, December 2011
[5] Gimeno-Gutierez et Lacal 2013, Assessment of the European potential for pumped hydropower energy storage

validating their payments. The resulting FIT for a PHS would depend on the operation of the plant and on the underlying technology. This relationship could be simplified by assuming a two-step tariff, depending on whether the full load hours for the storage exceed a particular duration. Depending on CAPEX, interest rates and payback periods, storage FIT between 40 and 400 €/MWh could be determined for the case of Croatia.

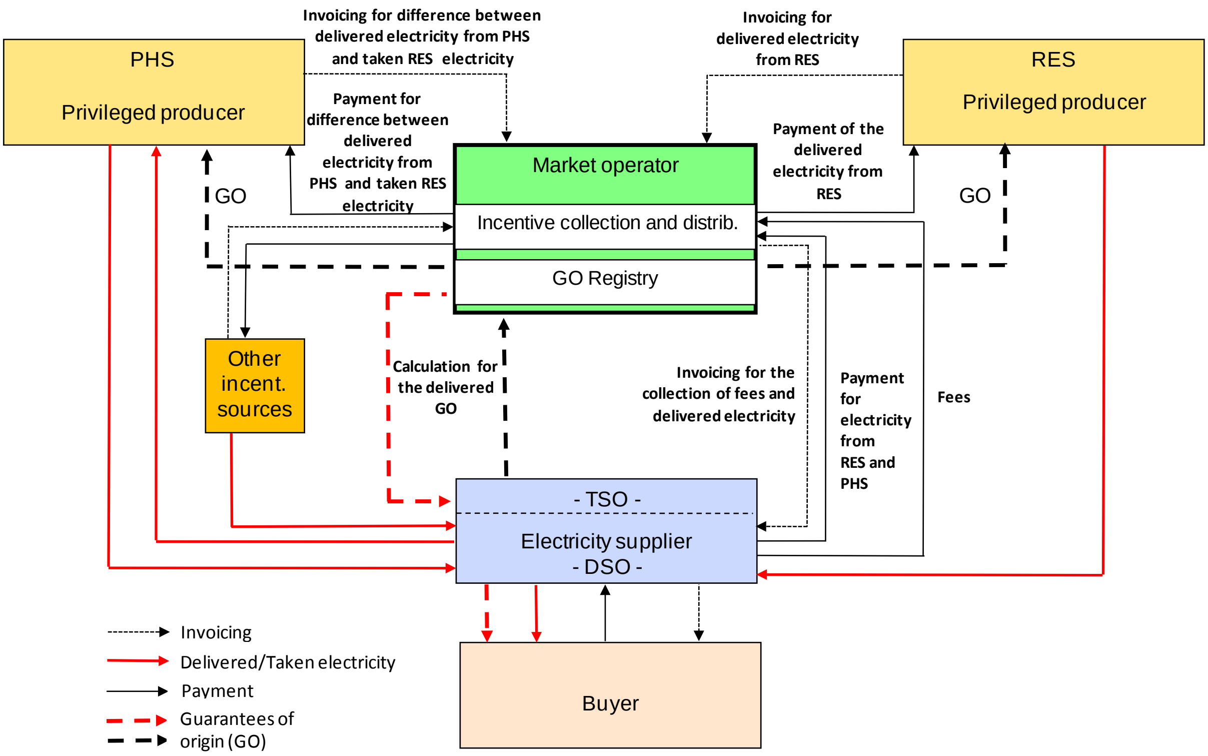

Figure 13 FIT scheme for pumped hydropower stations

It should not be forgotten, that PHS also provided benefits outside of the power system such as irrigation, flood protection. On the other hand, PHS also face environmental impacts, long construction times, high investment costs, are subject to complex legislation and regulation and face the risk of electricity markets. For a given system, the flexibility of existing power plants, electricity export and trade, Electric vehicles and demand side response should be evaluated as alternatives for integration of variable RES.

2.5.4 Discussion

The suitability of the existing irrigation reservoirs of Albania as a source for pumped power storage was discussed. Indeed, the usage for pumped storage is not the only driver for the consideration of these reservoirs. At the present moment, the constructive situation of irrigation reservoirs is dangerous and urgent rehabilitation is needed for safety purpose. The rehabilitation of irrigation systems may be considered as a potential upside to the financials of a pure hydropower system. The main motivation for exploring the possibility of using these for electricity production are the optimisation potential in combination with other considerations such as the deployment of renewable energies, the development of smart grid technology. No show-stoppers have been identified but the economic viability clearly has to be established in a feasibility study.

Along with an increasing penetration in the energy system, RES-E investments cannot be discussed on a project level. A successful development of has to be in line with the planning of the overall electrical system.

2.6 Session 6 – Investor's perspective

2.6.1 Common Electricity Market Kosovo – Albania (Naim Bejtullahu, Kosovo System and Market Operator (KOSTT), Pristina, Kosovo[6])

Kosovo became Contracting Party of the Energy Community on 1st July 2006 and committed itself at implementing the Acquis Communautaire, creating a single mechanism for cross-border transmission and electricity trade aiming at an increase of investments. Since 2003, the Kosovo government has developed primary legislation in the energy sector; the development of secondary legislation for market designs, market rules and technical codes take place as well KOSTT. The Kosovo TSO is shareholder and founder of The Coordinated Auction Office for South East Europe (SEE CAO) which ensures the coordinated cross border capacity allocation.

The current cooperation between Albania and Kosovo is based on different bilateral agreements between governments, regulators and power generation and transmission companies. Establishing a common power market between Kosovo and Albania is expressed by the MoU that was signed between two governments. Process of establishment of the common electricity market will pass some phases. The Steering Committee will be set up and process of contracting the feasibility study that will comprise certain road map will take place. This process will comprise legal and any other organisational actions that might needed to be taken as well..

The power markets of Kosovo and Albania have similar characteristics: both markets are small; there is a lack of generation capacity to meet the growing demand; the generation portfolios are not diversified (mainly lignite in Kosovo vs hydropower in Albania); wholesale activities are limited to import and exports; regulated electricity tariffs are below recovery cost in both countries., long term supply arrangements are in place between supplier and state owned generators while short term markets in Kosovo and Albania are immature with no real trading activities taking place.

An integrated market could improve security of supply, send better signals for investments in power generation and power networks, optimise the use of generation resources and import export needs, increase the reliability of both power systems. The operation as a single bidding zone would allow the efficient and optimal use of generation resources, reserves and the transmission network. The joint operation of baselaod oriented lignite in Kosovo and flexible hydropower could provide annual benefits estimated at 24 M€ as it shown below just in the exercise of the power import in the regime of joined operation. The regions could be coupled with other zones (Greece, Montenegro, Serbia, FY Republic of Macedonia) on the day ahead and intraday markets; cross-border capacities with other zones would be allocated in line with the Forward Network Codes.

The joint optimisation of the two power systems for a high demand day is shown in Figure 14. It can be seen that Kosovo would export baseload to Albania and import peakload from Albania. In the absence of a joint market, Albania purchases power from Kosovo at 68 €/MWh (while the export price in Kosovo would be 31 €/MWh) while Kosovo would import peak power at 80 €/MWh.

[6] This designation is without prejudice to position on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo declaration of independence

Establishing a joint market for both power systems and treating the interconnector between the markets as an internal grid would save up to 93 k€ per day in this situation. Similar, on a low demand day (not shown here), Kosovo would export throughout the day leading to a reduction of hydropower dispatch in Albania. Integrating the markets would generate daily benefits of 158 k€ in this situation. Assuming that in 85% of the days there are benefits from optimized import and export, yearly benefit will be around EUR M€ .

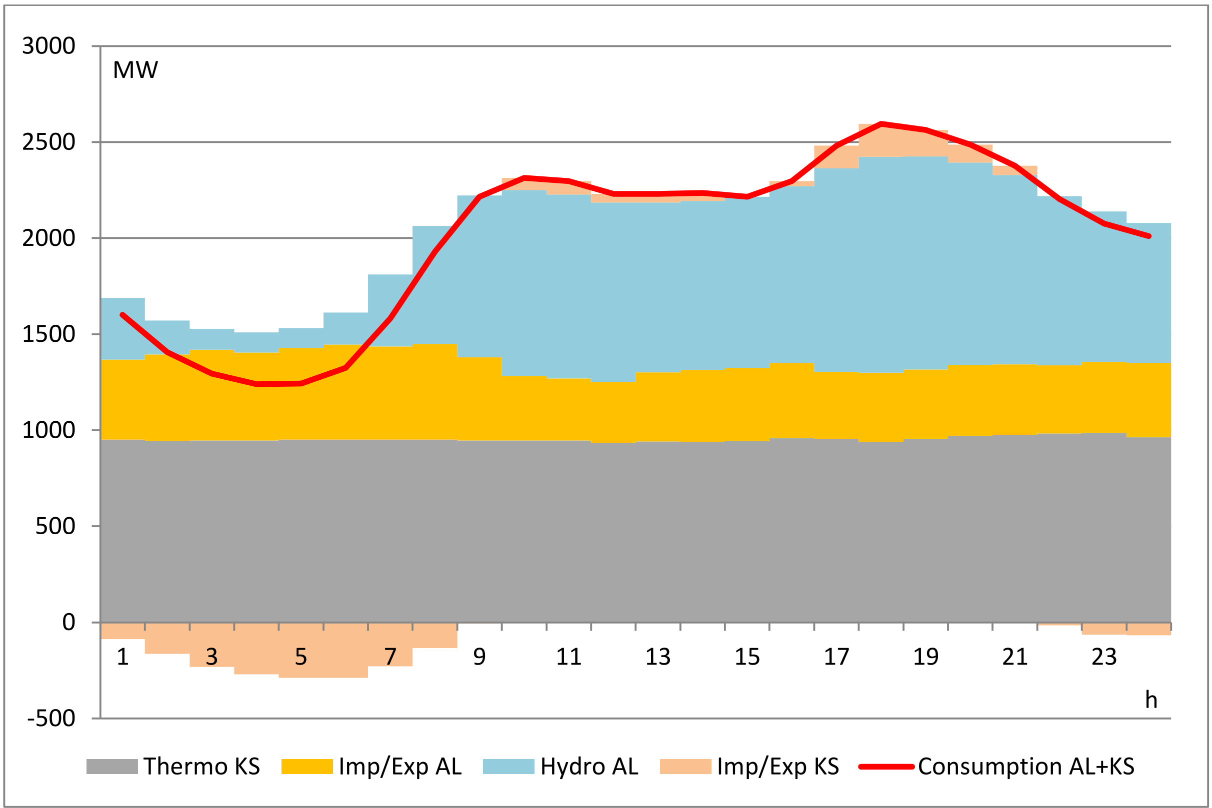

Figure 14 Joint optimisation of the power systems of Kosovo and Albania for a high demand day (31/12/2012)

In order to establish a common market between Kosovo and Albania, a harmonisation of legal, regulatory, market and operational frameworks is needed. This would require a harmonisation of both the primary legislation of the two contracting countries, the establishment of a legal structure of the common market and of a joint regulatory mechanism, a coordination of tariff reforms in both Kosovo and Albania and the development of markets for all timeframes (day ahead, intraday, reserve) as well as retail markets. In conclusion, the creation of a common power market for Kosovo and Albania would be in line with the EU target model and be flexible enough to integrate into a future regional market.

2.6.2 Heat storage and hydroelectric storage - an operator perspective in a challenging electricity market (Enrico Clara, IREN Group, Torino, Italy)

IREN, a Turin based multi-utility company listed on the Italian Stock Exchange, is active in the sectors of electricity (production, distribution and sale), thermal energy for district heating (production and sale), gas (distribution and sale), the management of integrated water services, environmental services (collection and disposal of waste) as well as services for municipal authorities. The group operates 2700 MW of electrical and 2300 MW of thermal capacity and is

Italy's 1st operator in district heating. The power generation fleet includes CHPs (1300 MW), CCGTs (800 MW) and hydropower plants (600 MW).

Since 2009, the Italian electricity market has seen a decline in demand. On the supply side, operators strongly invested both in RES and in combined cycle gas-turbine (CCGT) power plants. Margins for CCGTs have come under pressure both in Italy as well as in the continental energy market and plants are nowadays often running for only 1000-2000 hours per year unless operated as combined heat and power plants. A large part of the remaining margin is generated from ancillary services provided to the TSO (Transmission System Operator), however these revenues are not sufficient for full operating cost recovery. When the DH (District Heating) is supplied by thermoelectric plants the electric variable margin is added to the heat margin but the two markets may diverge strongly in terms of time distribution of peak/off-peak demand. CCGT plants that serve in CHP mode district heating networks have to carefully program electricity and heat production in order to optimise revenues from heat and power sales. By adding heat storage to the CHP, selling power during hours of low prices can be avoided. During times of low heat demand and high electricity prices, thermal energy is stored. When electricity prices are low, the CCGT is switched off and the heat is provided by storage. The operation of the Turin DH for a winter day is shown in Figure 15. The combined operation leads to a total efficiency of 85-90%.

The Turin district heating (DH) system comprises two CHP plants (responsible for 83% of the annual production of 3073 GWh of thermal energy) and five heat-only boilers plants. The grid operates with superheated water at a delivery temperature normally between 105°C and 120°C, with the possibility of reaching a maximum temperature of 135°C in the winter and a minimum of 85°C in the summer. The DH is based on a typical interconnected grid at the transport level and a radial grid at the distribution level. A heat accumulation system stores thermal energy produced by the co-generators overnight, when the demand for heat is lower to make it available during the hours of maximum load of the district heating system, reducing the use of the integration boilers to a minimum. The heat accumulator systems are operated by remote control rooms. Based on the service needs, the accumulation tanks may be filled and emptied several times a day. A typical system is made up of six pressurised tanks with a height above ground of 26 m and a capacity of 840 m^3 each. Inside each accumulation tank, a water distribution system is active in both directions, to ensure a maximum capacity of 185 kg/s, so as to prevent the risk of remixing. All the elements inside the tanks (pipes and distribution system) are made of stainless steel. The pumping station is made up of a set of 8 identical pumps in parallel with variable speeds obtained by varying the power supply frequency of the electric motors. The pumps of the Pumping Station have a nominal capacity between 340 and 700 kg/s.

IREN also own and operate several hydro storage in the North West of Italy. The hydroelectric system of *Pont Ventoux* is located in the North West of Italy, close to Turin. The intake facilities are situated at Pont Ventoux in the Oulx area on the river Dora Riparia (1,046m a.s.l.). An upstream dam, forming a small reservoir of 40,000 m^3, allows a max flow rate of 33 m^3/s. A pressured tunnel (4.3km) link the Clarea reservoir (capacity of 560.00 m^3) to the surge chamber, from which start the subsurface penstock (1.3km, max net head 503m). Downstream, a pressured tunnel (1.6km) returns the diverted water to the Gorge reservoir (capacity of 420,000 m^3). The plant with a production capacity of 150 MW and a pumping capacity of 78 MW plant started operation in 2004. The concession will end in 2034 with Green Certificates (GC) granted until 2019. The hydroelectric system of *Valle Orco* is located in the North West of Italy, close to Turin. It consists of seven plants and of six artificial reservoirs for a total installed capacity of 296MW, mostly built between 1930 and 1970 and repowered between 2000 and 2010. The *Valsoera – Telessio pump-storage plant* with seasonal regulation reservoirs uses the water from the torrents Piantonetto, Valsoera and Balma stored in the Valsoera reservoir situated at 2,412 m a.s.l. and capable of containing 7.7 million m^3 of water. The Telessio power plant is in a cavern houses and it has a maximum net head of 555 m. The unit is a ternary horizontal type with an installed capacity of 38 MW in generation mode and 34 MW in pumping mode and a power output of about 40 GWh/year (of which 13 GWh/year from natural runoff and the rest from pumping). Downstream of the plant, the water is returned to the Telessio reservoir from which it can be pumped back into the Valsoera reservoir so that it can be used to produce energy during the daytime when the prices is higher. The Telessio reservoir is a seasonal regulation one, situated at 1,917 m a.s.l. and capable of containing 23 million m^3.

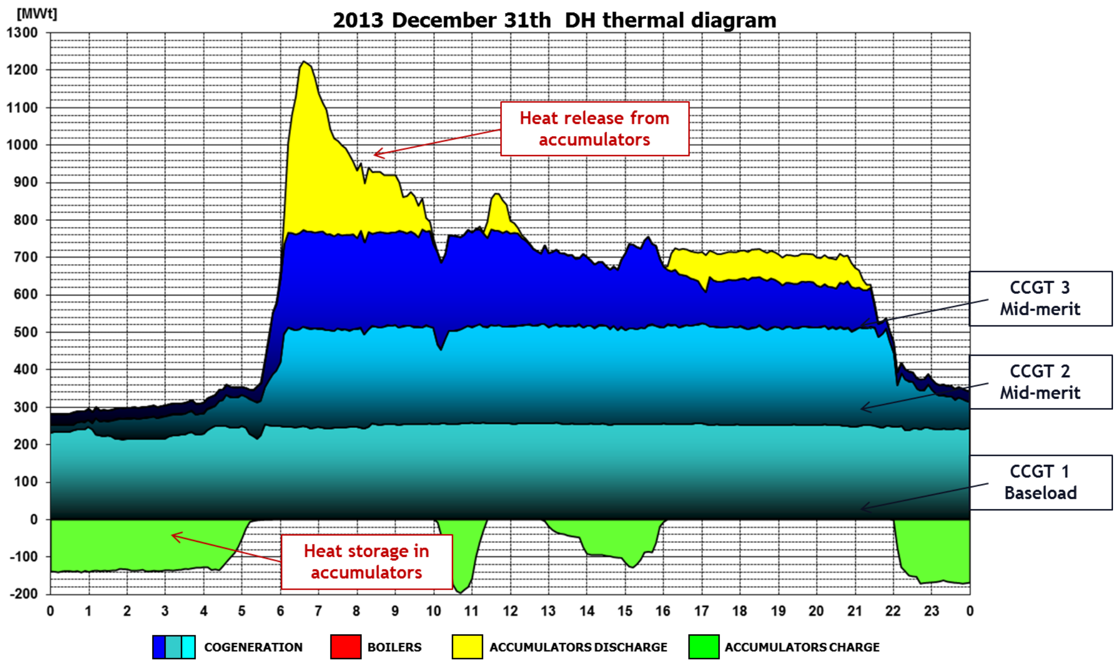

Figure 15 Dispatch of CCGTs and heat storage in the Turin DH system

Pumped hydro plants are profitable if the spread between peak prices and off-peak prices is above 25-30%. In Italy in the day-ahead market such spread has been reducing dramatically from 100% before 2008 to less than 20% today .The average premium in 2014 is below 10 €/MWh, and has been below 6 €/MWh during the summer at the peak of solar photovoltaic production. Since 2013 the Valsoera – Telessio pumping system is requested from the Transmission System Operator for ancillary services. When the TSO, under specific condition, needs to balance the network load with power generation, it asks IREN to switch on the pumping mode in order to absorb electricity. Up to 70% of the production has been performed in this mode during the summer of 2014.

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2.6.3 Creating new business models for energy systems in the context of E&I countries (Jorge Núñez Ferrer, Centre for European Policy Studies (CEPS), Brussels, Belgium)

It is a challenge to finance renewable energy or energy efficiency projects in the Enlargement and Integration context. Grants provided in the framework of Instruments for Pre-Accession (to the

European Union) will not likely provide a source of finance for energy systems. The current Indicative Strategy Paper for Albania (2014-2020)[7] does not foresee explicit funds for Energy investments. The only option for IPA grants would be the combination of energy investments with environment & climate adaptation for which a total of 68 M€ is budgeted for 2014-20.

Emerging and smart energy systems linked to RES-E require a rethinking of business models: Infrastructure has been build and managed by independent utilities with a silo approach. These were thus separated value chain segments. The energy and climate change challenge, combined with the financial implications require an integrated infrastructure approach and new business models. The emergence of prosumers is de facto blurring the limit between the supply and demand side in the energy sector, while efficiency in managing infrastructures is requiring an ever more integrated planning and managing approach for different services.

The role of the public sector in procuring services, technologies and infrastructures has changed and the consequences are considerable in terms of financial planning. Procurement has to integrate the overall lifecycle costs of infrastructures and include externalities to the costs and benefits analysis, avoiding the procurement of the cheapest solution in mere terms of initial capital costs. Business models not only *can* generate new value by monetising externalities, but *have to do so* if we are to address the multiple challenges ahead. This is a complex process and compounded by a shift of costs from OPEX (operation) to CAPEX (capital expenditure). This often requires large financial resources short term with only a medium term recovery. A change in business models will also affect established interests and may thus be difficult to bring through. Moreover, it is difficult to raise finance even if return (social or financial) is positive compounded by the lack of public sector resources and guarantees, the business models will often be considerably more complex and require the building up of the administrative capacity of the public sector and the skills of companies involved.

Three basic sources of finance are available for smart energy investments: the public sector, the banking sector and private investors. Public sector budgets are strained. Some EU funding is available but this should be seen primarily as a means for de-risking leveraged investments. The banking sector shows a differentiated picture: Large private banks apparently are moving away from infrastructure investments in many countries while public banks like WBIF, EIB, KFW, EBRD etc. have energy as a priority in their portfolio, but perceive a lack of attractive projects. Finally, private investors are constantly looking for investments but need to address different needs: insurance companies or pension funds are risk averse, while large fund holdings or venture capitalists may be interested only if returns are high. Targeting the source of funds, needs innovative tailor made contractual procedures and cost recovery mechanisms.

The logical approach would thus be to attract private investors using public funds and public banks as leverage generators – but this requires a commercial approach and project planning and execution capacity. Projects will have to be defined according to the needs of financiers. This requires a shift from the use of 'traditional' public resources to contractual models of Public Private Partnership (PPP) and from a taxpayer charge to a debt based charge and user fees. For energy efficiency in public buildings the most appropriate models are based on PPPs, for this the EIB's EPEC (European PPP Expertise Centre) has recently produced specialised guidelines and case studies.

[7] http://ec.europa.eu/enlargement/pdf/key_documents/2014/20140919-csp-albania.pdf

IPA grant funding is generally not focused on the energy sector (no budget for energy investments in Albania as described above) and aims mainly building up capacity. As mentioned earlier, possibilities may exist when combining hydropower generation with investment to regulate water flows, i.e. combining energy investments with innovative financial instruments with grant investments into environment & climate adaptation. The Green for Growth Fund Southern Europe (see Figure 16) is an example for the financial instruments that can be used.

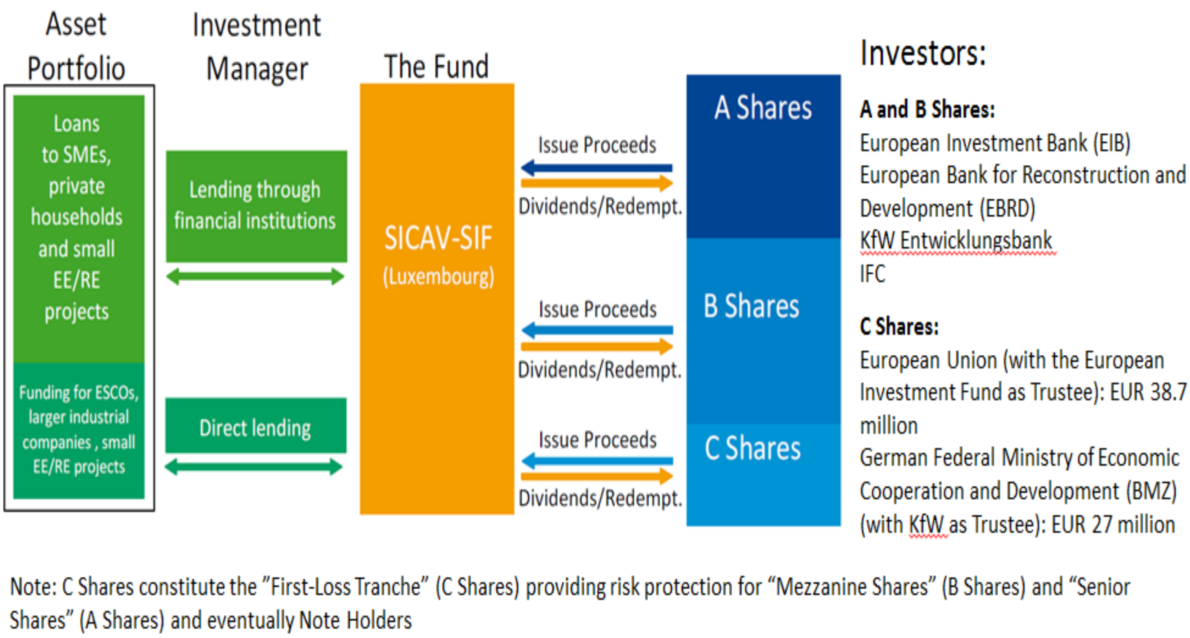

Figure 16 Example of funding source structure, Green for Growth Fund Southeast Europe

Loans are provided to financial institutions, energy supply and service companies, municipalities as well as direct investments into smaller energy projects (e.g. wind farm not exceeding an installed capacity of 30 MW or hydro dams with a head of up to 15 m). The current investment portfolio amounts to 230 M€. The fund makes use of a tiered risk sharing structure, designed to attract commercial capital from multilateral and private institutional investors. Other examples for existing financing structures active in South Eastern Europe are the EBRD Regional Energy Efficiency Programme (REEP), loans provided by KFW, the Financing Energy Efficiency Investments for Climate Change Mitigation (FEEI). Funds for investments are also provided by Technical Assistance organisations such as the GIZ Open Regional Fund or the CEI Trust Fund Italian Government at EBRD.

Bringing together investors and projects requires solving size and governance barriers. Five major types of stakeholders are essential in EE/RES energy projects: *Promoter Bodies* promote the implementation of 'smart' EE/RES initiatives (infrastructures, new services, etc.); *Achieving Bodies* are in charge of physically building infrastructure and of ensuring efficiency; *Financial institutions* aggregate flows of investment by private capital through the PPP mechanisms; *Certification Authorities* tare able to evaluate the effectiveness of initiatives and *Guarantor Bodies*, provide coverage of private investments made through PPP mechanisms through systems of insurance policies.

Focusing on the long-term objectives while taking a step-by-step approach is mandatory if 'soon-to-be-obsolete' solutions are to be avoided. What matters is avoiding costly mistakes and generating value with new opportunities.

Finally, the developments in cities need to be a central focus of attention. Without focusing on cities, none of Europe's ambitions for jobs, growth, climate and energy can be achieved. The reason is simple, cities generate 85% of global GDP, employ the biggest share of the population and are responsible for the largest use of energy and emissions directly or indirectly. Much is said of the hipped word "Smart Cities", which seems to be only for costly investment in high tech in large cities, the fundamentals, however, are much more sober. Increasing the efficiency of infrastructures is necessary and many solutions exist already to have better and cheaper systems. To implement many of those, energy investments should not be considered in isolation but combined with projects for other infrastructures (ICT, transport, water, businesses of prosumers, other services, etc.). Much does not require expensive or overly complex projects, but a reform on how things are implemented and handled. For much that can (and has to) be done the word *smart* actually means *appropriate*.

2.6.4 Discussion

For the Enlargement and Integration countries, it was suggested to consider investments into building integrated PV, possibly in public buildings. Israel provides a good example by using the roof of schools for PV systems. Business plans could be developed for such investments along the logic presented by Mr Núñez.

Heat storage is often overlooked in energy storage considerations. The reason could be that heat storage is not considered a technological innovation. The experience gained in Italy shows that heat storage in a heat distribution network is a very effective means for optimising the usage of a combined cycle plant. The combination of heat networks with power generation allows a utility company to leverage experience and capabilities. This may not necessarily be the case for the installation of rooftop-PV panels.

Participants discussed whether leveraged investments (recommended for renewable energy and energy efficiency schemes) could also guarantee security of supply, i.e. finance the construction of large power generation. This is not only an issue in South Eastern Europe but can be observed in Western Europe, where several European Union Member States (e.g. the UK) are intervening in power markets for supporting new investments.

The case of Kosovo as a small power market was discussed. In such a case it is difficult to invest in new plants for generation. The proposal of Kosovo government for unifying the system network with Albania and creating new interconnection possibilities with neighbouring countries could incentivise new investments.

3 CONCLUSION

3.1 TECHNOLOGY

Hydropower has been used for more than 100 years. At the present date, Pumped Hydro Energy Storage (PHES) is the most established and efficient technology for storing large amounts of electrical energy for a long time. Especially high alpine pumped storage power plants due to their topography have the advantages of large reservoir volumes for seasonal and day-ahead energy reallocation. In Europe, there is a significant potential for new PHES (expected at 250 TWh/a), yet, the environment for new build is difficult. The technical concept of a PHES project will be derived from a number of design criteria, in particular: site characteristics, machine type selection criteria, dispatching scenarios and the transient analysis.

An increasing share of renewable energy can provide a motivation for the development of PHES, in order to provide flexibility to the power system. Understanding the requirements from a system planning perspective requires the modelling of the energy and reserve taking the stochastic nature into account.

Storage is already a reality in non-interconnected systems (e.g. Greek Islands) where systems based on renewable energy and storage can be a competitive alternative to fossil (diesel) fuel. Island systems will provide valuable knowledge about distributed storage technologies, in particular batteries. If sufficient storage is available systems with 100% renewable energy are possible, as can be seen on the example of the island of El Hierro.

Thermal storage can be another source of flexibility, both on the grid and the household level. District heating systems with attached storage provide an efficient option for optimising the dispatch of CHP plants. Thermal storage can also be added to buildings for either renewable energy or in order to optimise the use of electrical heating systems or possibly combinations of both.

There are a growing number of opportunities for upgrading existing buildings into "prosumers". Adding power generation or storage technologies could transform these into nodes of a smart energy network. Two storage options are available on the building level: storage for solar thermal energy or battery storage for PV generated electricity. The economic benefits of either solution can depend on the size and function of a building.

Cities generate 85% of global GDP, employ the biggest share of the population and are responsible for the largest use of energy and emissions directly or indirectly. To implement smart city concepts, energy investments should not be considered in isolation but combined with projects for other infrastructures (ICT, transport, water, businesses of prosumers, other services, etc.).

3.2 ENERGY IN SOUTH EASTERN EUROPE

The combined generation portfolio in South Eastern Europe is dominated by coal and hydropower generating 47% and 48% of electricity respectively. RES-E deployment (excluding hydropower) is at a relatively early stage in South Eastern Europe generating less than 1% of the electricity but a significant potential for both wind and solar energy has been identified and capacities are expected to increase in future. The challenge of integrating intermittent energies into the energy systems of the region might open options for solutions such as (pumped) hydro storage for which there are still opportunities that could be developed.

All countries of the Western Balkans have committed themselves to adopting the European Union Acquis Communautaire in term of Energy by signing the Treaty on the Energy Community in 2005. Currently, the wholesale markets of the Energy Community are nationally oriented; there is a lack of competition, a lack of liquidity and inadequate market price signals. As a result wholesale prices diverge strongly (up to a factor of 4) between countries. Balancing markets remain largely undeveloped except for Serbia; elsewhere the service is provided on a regulated basis. This poses a barrier to the development of storage and to a cost efficient integration of RES-E.

3.3 Lessons learnt from the EU Member States in Western Europe

The support provided to wind has led to a rapid build-up of installed capacity (from a few thousand MW in 1995 to more than 80 GW in the EU in 2010) which was underestimated by almost all of the projections.

In Europe, price spreads in the electricity wholesale market have been decreasing significantly since 2008 with the consequence of decreasing revenue possibilities for PHES. Decreasing demand and increasing capacities of wind and solar energy have led to a disappearance of price peaks at noon and have caused a further erosion of revenue possibilities for PHES. New pumped hydropower investments are difficult to justify given the uncertainties found in power markets. Incentive schemes specifically designed for pumped hydropower stations could improve the economics.

A review of market designs, as already pursued by some Member States, will remain on the energy policy agenda within the European Union. New electricity market designs should ensure: a full remuneration of generators, avoid the creation of overcapacities and allow a carbon price to send meaningful signals while being compatible with the Third Package legislation. The integration of renewable energies into the market will have to be ensured, in particular regarding the balancing responsibility and the provision of ancillary services. Finally, renewable support systems need to be reformed ensuring market mechanisms lead to cost optimum deployment and avoid market fragmentation across the EU.

Margins for Combined Cycle Gas Turbines (CCGTs) have come under pressure across Europe and plants are nowadays often running for only 1000-2000 hours per year unless operated as combined heat and power plants.

3.4 Business models for RES-E and energy efficiency

It is a challenge to finance renewable energy or energy efficiency projects in the Enlargement and Integration context. Three basic sources of finance are available for smart energy investments: the public sector, the banking sector and private investors. Due to budget constraints, public money is scarce. Some EU funding is available but this should be seen primarily as a means for de-risking leveraged investments. Large private banks apparently are moving away from infrastructure investments in many countries while public banks have energy as a priority in their portfolio. Finance for investment is available by international and local investors, but small scale energy projects or investments in new technologies are not attractive enough due to perceived high risks. A risk mitigation approach is key for generating value for investors and can limit costs for local authorities. The Green for Growth Fund Southern Europe is an example for the financial instruments that can be used.

3.5 Implications for Albania

Albania has an installed capacity of 1.6 GW of hydro power plants which produced around 4.8 TWh (7.0 TWh) of electrical energy in 2012 (2013). The country currently uses only about 35% of its hydro-energetic potential, which is well above the current power imports of 2.3 TWh (3.2 TWh). Hydropower offers a significant potential for the development of renewable energy sources. The rivers of Drini (flowing from Macedonia to the Adriatic Sea) and Vjosa (originating in Greece and flowing into the Adriatic Sea) still offer significant additional renewable energy resources.

Albania could also profit from converting more than 600 existing barrages with small reservoirs, which were realised thirty to forty years ago for irrigation purposes, into small hydro schemes. A detailed feasibility study will be necessary as presently, many reservoirs are in rather poor conditions and might pose safety hazards as houses and villages were built downstream during the last 2 decades.

Albania and Kosovo could further optimise the usage of power generation systems by creating a common power market which would be in line with the EU target model and be flexible enough to integrate into a future regional market.

The high share of residential load (53% vs. 27% on global average) caused mainly by electrical heating and cooling systems suggests there is potential for investments into energy efficiency and decentralised RES.

In order to transpose the EU Acquis Communautaire in terms of energy policy, Albania has drafted a new national energy strategy, a new power sector law (transposing the 3rd package legislation), an energy efficiency law in line with directive 2012/28 EC, an energy performance in buildings law addressing directive 2010/31 EC and an amendment of the renewable energy sources law 138/2013 addressing feed-in tariffs (FIT).

Transparency in trade and in the energy distribution would be beneficial if a competitive energy market is to boost investments.

Annex 1 – Schedule

Day 1 Tuesday, 21st October 2014

Welcome and Opening		
13:00 – 13:10	*Welcome from the EU JRC*	*Christian Thiel, European Commission JRC*
13:10 – 13:20	*Welcome from the Albanian Ministry of Energy and Industry*	*Mr. Ilir Bejtja, Deputy Minister, Albanian Ministry of Energy and Industry.*
13:20 – 13:30	*JRC Support to Enlargement - Opening of the workshop*	*Andreas Zucker, European Commission JRC*
Session 1 –Introduction		
13:30 – 14:00	*RES-E potential and integration challenges in the context of E&I countries*	*Igor Kuzle, University of Zagreb, HR*
14:00 – 14:30	*Storage capacity required under large scale RES penetration*	*Kostas Tigas, CRES, GR*
14:30 – 15:00	*Storage for non-mainland grids and other special situations*	*Stathis Tselepis, CRES, GR*
15:00 – 15:30	*Coffee Break*	
Session 2 – Case Studies Part 1		
15:30 – 16:00	*Hydro pumped storage – lessons learned from large-scale alpine pumped storage and the future role of energy storage in South Eastern Europe*	*Dietmar Reiner, VERBUND Hydro Power, AT*
16:30 – 17:00	*Pumped Hydro – technical concepts, design criteria an current development options*	*Benedikt Sander-Kessels, E.ON Kraftwerke GmbH*
17:00 – 17:30	*Discussion*	
17:30 – 18:00	*Wrap up day and conclusions day 1*	

Day 2 Wednesday, 22nd October 2014

Session 3 – Case Studies Part 2		
09:00 – 09:30	*Small residential versus large scale storage with focus on auto-consumption – Experience gained in the CLUBEN initiative*	*Sergio Olivero, SITI, Politecnico di Torino, IT*
09:30– 10:00	*Strategies for energy efficiency improvement in residential and office buildings: their role at building and country scale*	*Carlo Micono, Guido Zanzottera, AI Group, IT*
10:00 – 10:15	*Discussion*	
10:15 – 10:30	*Coffee break*	

Session 4 –South Eastern European Perspective Part 1		
10:30 – 11:00	*Electricity market and policy development in the Energy Community*	*Jasmina Trhulj, Energy Community Secretariat, AT*
11:00 – 11:30	*Energy policy options for Montenegro*	*Nikola Martinović, Law firm Martinović, Montenegro*
11:30 – 12:00	*Lessons learnt from deregulation in Western Europe on the example of energy storage*	*Christian Egenhofer, Centre for European Policy Studies (CEPS), Brussels, BE*
12:00 – 12:15	*Discussion*	
12:15 – 13:15	*Lunch*	
Session 5 – South Eastern European Perspective Part 2		
13:15 – 13:45	*Pumped Hydropower Energy Storage (PHS) in Albania*	*Piercarlo Montaldo, AI Group, IT*
13:45 – 14:15	*Legal Framework and Establishment of the ECO Fund in Albania*	*Gjergji Simaku, Albanian Ministry of Energy and Industry*
14:15 – 14:45	*Regulatory incentives to facilitate storage investments*	*Goran Krajačić, University of Zagreb, HR*
14:45 – 15:00	*Discussion*	
15:00 – 15:15	*Coffee break*	
Session 6 – Investor's perspective		
15:15 – 15:45	*Common Electricity Market Kosovo – Albania*	*Naim Bejtullahu, Kosovo System and Market Operator (KOSTT)*
15:45 – 16:15	*Heat storage and hydroelectric storage - an operator perspective in a challenging electricity market*	*Enrico Clara, IREN, IT*
16:15 – 16:45	*Creating new business models for energy systems in the context of E&I countries*	*Jorge Núñez, Centre for European Policy Studies (CEPS)*
16:45 – 17:00	*Discussion*	
17:00 – 17:30	*Wrap-up and closing remarks*	*Andreas Zucker*

ANNEX 2 LIST OF PARTICIPANTS

Name	Country	Affiliation
BANJA, Manjola	Italy	European Commission JRC
BEJTJA, Ilir	Albania	Ministry of Energy and Industry
BEJTULLAHU, Naim	Kosovo	Kosovo System and Market Operator
BUNDO, Alfred	Albania	Ministry of Energy and Industry
CICAKO, Valentin	Italy	IREN Group
CLARA, Enrico	Italy	IREN Group
EGENHOFER, Christian	Belgium	Centre for European Policy Studies
GÖKTAŞ, Engin	Turkey	Energy Market Regulatory Authority Turkey
HUSEINAGIC, Indira	Bosnia and Herzegovina	International University Sarajewo
ISMAILI, Lumturi	Albania	Independent consultant
JANJIC, Aleksandar	Serbia	University of Nis
KONA, Maksim	Albania	Studio di ingeneria Kona
KOTE, Adrian	Albania	KESH
KOVAČEVIĆ, Igor	Montenegro	Independent consultant
KRAJAČIĆ, Goran	Croatia	University of Zagreb
KUZLE, Igor	Croatia	University of Zagreb
LUSJENA, Cakeri	Italy	A.I. Engineering
MARTINOVIĆ, Nicola	Montenegro	Law firm Martinović
MICONO, Carlo	Italy	A.I Engineering
MIFTARI, Enkelejda	Albania	KESH
MITRUSHI, Edlira	Albania	KESH
MONTALDO,Piercarlo	Italy	A.I Engineering
NÚÑEZ, Jorge	Belgium	Centre for European Policy Studies
OLIVERO, Sergio	Italy	SITI
POCHETTINO, Enrico	Italy	IREN Group
RAKOCEVIC, Lucija	Montenegro	Independent consultant
REINER, Dietmar	Austria	Verbund
ROSMIDE, Anna	Kosovo	Kosovo System and Market Operator
SANDER, Benedikt	Germany	E.ON
SHABANI, Aulon	Albania	Polytechnic University of Tirana
SIMAKU, Gjergj	Albania	Ministry of Energy and Industry
THIEL, Christian	The Netherlands	European Commission Joint Research Centre
TIGAS, Kostas	Greece	Centre for Renewable Energy Sources
TRHULJ, Jasmina	Austria	Energy Community Secretariat
TSELEPIS, Stathis	Greece	Centre for Renewable Energy Sources
ZANZOTTERA, Guido	Italy	A.I. Engineering
ZAVALANI, Orion	Albania	Polytechnic University of Tirana
ZUCKER, Andreas	The Netherlands	European Commission Joint Research Centre

Annex 3 – Speaker CVs

Name	Short CV
Clara, Enrico	As Head of Thermoelectric Maintenance, Enrico Clara is currently responsible for the maintenance of the thermoelectric plants of IREN (1.200 MW of electric capacity and 1.800 MW of thermal capacity). He was responsible for the latest projects of repowering and green field development in IREN, and in particular was the project manager for the construction of new plant “Torino Nord”, 400 MW of cogeneration capacity connected with the biggest district heating network of Italy (around 550.000 inhabitants served). Before moving to the thermoelectric field, he covered important roles in repowering the hydroelectric plants of IREN and for the development of advance automation systems.
Egenhofer, Christian	Christian Egenhofer has more than 20 years' experience working with EU institutions on numerous policy areas. Over the last decade he has been specialising in EU energy and climate change policy, with a particular focus on the EU energy, climate and transport policies. He is currently Senior Fellow and Head of the Energy, Climate and Environment Programme at the Centre for European Policy Studies (CEPS), a Brussels-based think tank. Christian is also Visiting Professor at the College of Europe in Bruges (Belgium) and Natolin (Poland), SciencesPo (Paris/France) and LUISS University in Rome/Italy. From 1997 to 2010 he was Senior Research Fellow and Jean-Monnet Lecturer at the Centre for Energy, Petroleum and Mineral Law and Policy at the University of Dundee in Scotland/UK (part-time). Christian Egenhofer holds a Master's degree in Administration from the University of Konstanz as well as a Public Law degree.
Krajačić, Goran	Goran Krajačić is Assistant Professor at University of Zagreb for which he has been working since 2004 as researcher at the Department of Energy, Power Engineering and Environment at the Faculty of Mechanical Engineering and Naval Architecture. He has been involved in various EU projects (among them AEG, STORIES, GERONIMO, STORIES, SMART, BIOSIRE, FLICK THE SWITCH, JoRIEW , DISKNET and 4DH), both as a participant as well as in the preparation and implementation. Prof Krajačić has also participated in Croatian projects on Smart Grids, storage and E-vehicle integration Results of his work have been published in 16 papers in CC/SCI database and have been cited more than 200 times. He reviews papers for Energy, Energy Policy and Applied Energy. He participates in teaching the courses Introduction to Energy Management, Energy Economics and Energy Planning

Name	Short CV
Kuzle, Igor	Igor Kuzle is Associate Professor at the University of Zagreb Faculty of Electrical Engineering, Department of Energy and Power Systems. His scientific interests include problems in electric power systems dynamics and control, power market, unit commitment, maintenance of electrical equipment, as well as smart grids and integration of renewable energy sources. He participates as coordinator or researcher in more scientific projects (mostly FP7). He was project leader for more than 50 practical projects for industries and electric power companies. As associate editor or member of editorial board he serves in 13 international journals. Igor Kuzle published three books and more than 200 journal and conference papers including technical studies for utilities and private companies. He is an active member of IEEE, CIGRE, and several national bodies. Prof Kuzle teaches several courses on electric power markets, systems and operation at University of Zagreb.
Martinović, Nicola	Nikola Martinović is active as business, corporate lawyer and real estate and ownership issues related lawyer with 16 years long experience. He also participates in the development of the new Montenegro legal background as the outside collaborator of the Faculty of Political Sciences and Faculty of Economy cooperation and he is a collaborator at the Faculty of Political Science in Podgorica, a member of the Board of directors of the Association of jurists in Montenegro, member of the Commission for the civil control of the police - Parliament of Montenegro, the member of the Board of directors of the Elektroprivreda Crne Gore (Montenegro national electricity company), a member of Team of experts for monitoring the implementation of contract on privatization of AD Kombinat aluminijuma- Podgorica (Aluminum Plant Plc.), AD Rudnici boksita – Nikšić (Bauxite mines Plc.) and AD Željezara Nikšić (Niksic Ironworks Plc.). He actively participates in creation of the Montenegro energy sector policy and legal and regulatory background.

Name	Short CV
Micono, Carlo	Carlo Micono, architect and PhD, is Junior Partner of Ai Studio and teacher at the Faculty of Architecture at Politecnico di Torino. He currently works with Ai Engineering, in the “Energy and MEP Engineering” department. Over the projects involved in the different phases, from the tender proposals to the construction, we can mention top names of Italian architecture, such as Massimiliano Fuksas, 5+1AA and Cino Zucchi. His professional and research activity concerns the evaluation of thermal, visual and energy performances of innovative building envelope systems, the energy design of buildings, energy audits and the use of renewable sources. From 2008 until now he has followed over 100 projects, from urban to building scale. He is a freelance journalist. He collaborates with the magazine “Il Giornale dell’Architettura” - Allemandi editor, where he is curator of the pages of “Technology and Materials”.
Montaldo, Piercarlo	Piercarlo Montaldo is CEO of Turin based A.I Engineering S.r.l. , a subsidiary of A.I. Group. As such, he has a special mandate for international business development of the A.I. group. He is a member of the board since 1990. During the last 25 years, as project manager, he led many important consultancy services related to studies, designs and site supervisions in the field of infrastructures related to water and energy services efficiency. Piercarlo Montaldo holds a Master Degree in Civil- Engineering from the Polytechnic of Torino.
Núñez, Jorge	Dr. Jorge Ferrer is an independent analyst and consultant associated with the Centre for European Policy Studies (CEPS). He started his career as analyst of the EU budget and financial instruments in 1998. Between the years 2000-2004 he worked as a specialist on EU funds and the enlargement process in the European Commission's Economic and Financial Affairs Directorate General. In 2011 and 2012 he was to coordinator of working groups of the Smart Cities Stakeholder Platform and Chair of the Finance Group. In 2013, he was been member of the European Commission's Steering Committee on Adaptation that assisted in drafting the present adaptation strategy for the EU. He has been a consultant and advisor to various member states, the European Commission, the European Parliament, the FAO, the World Bank, the Asian Development Bank and the International Trade Centre of the UN and has published in various think tanks.

Name	Short CV
Olivero, Sergio	Sergio Olivero graduated in Electronic Engineering in 1988. From 1989 to 2001 he worked with Telecom Italia Group, the major telecommunication company in Italy. Until 1995 his responsibilities were in the field of planning and design of telecommunications networks. From 1996 to 1999 he was the director of the quality department of the north western branch of the business division. In 1999 he was responsible of several project in civil protection context. In 2001 he left Telecom Italia and joined private companies in Milan to work in the field of security and civil protection. In 2004 he entered SiTI (Higher Institute on Territorial Systems for Innovation, where he is today Head of the Energy&Security Research Area. He manages research projects in the following areas: energy governance, innovative business models for investments in energy sector, smart grids, virtual power plants, energy storage, security of critical infrastructures (energy networks, water networks, etc.), security and risk assessment methodologies and tools, cyber-security of control systems and indicators systems. He is a member of the "Sherpa Group" of the European Innovation Partnership (EIP) on Smart Cities and Communities, where he is co-chairing the Action Cluster "Business Models". In the field of energy governance, he is the scientific coordinator of many projects and initiatives: among them, RENGOV Project (www.rengov.eu), funded by the Autonomous Region of Friuli Venezia Giulia (North-Eastern Italy, near Austria), that is designing new approaches for energy governance at local level and paving the way to cooperation on energy between Italy and the Balkans. He is a member of the Italian National Association of Engineers.
Pochettino, Enrico	Enrico Pochettino is currently the Head of Mergers and Acquisition in IREN Group. In this function he is following the internationalization process of IREN business. Mr Pochettino has 15 years of experience in the energy sector in financial modelling, financing and planning and he has acquired a deep knowledge on the energy markets and on the effects of energy scenario on economics and financials. He started his work experience in the Finance department of IREN dealing with financial planning, investment and project evaluation, strategic planning and assisting on investor relations activities. In 2006 he was appointed Investor Relation Manager of the company and was in charge for financial planning for the IREN Group.

Name	Short CV
Reiner, Dietmar	Dietmar Reiner has been working for VERBUND AG in international business since 2008, and is currently responsible for the company's business in Albania (construction, power generation and sales). He is also Managing Director of Energji Ashta Shpk (the Albanian affiliate of VERBUND Hydro Power AG and EVN AG). He has 25 years of international experience in project development, sales and engineering, procurement and construction of thermal and hydro power plants (for companies like ELIN, VATECH, SIEMENS, VERBUND) in countries like Turkey, Italy, USA, Northern Ireland, Germany, Malaysia, Hungary, Romania, France and Albania. Mr. Reiner is a mechanical engineer and Graduate of the Executive MBA (PGM) -Program of the Executive Academy of the Vienna University of Economics and Business.
Sander, Benedikt	Benedikt Sander currently works in the coordination of Hydro Expertise for E.ON Kraftwerke GmbH in Landshut, Germany. He held positions for international Engineering companies Pöyry, Björnsen Consulting Engineers and Lahmeyer International. He has more than 15 years of experience in international project management, concept studies, project development, as well as in the design and construction supervision for large projects. He has developed strategic objectives for (hydropower) utilities, carried out due diligence for planned, new build projects and for hydropower plants in operation, steered international and interdisciplinary teams and experts. Mr Sander has a profound knowledge in hydropower plant design and dam engineering, rehabilitation of dams, seismic assessments and dam safety monitoring and energy economics. Mr Sander holds a degree in Civil Engineering from Aachen University of Technology (RWTH).
Simaku, Gjergj	Mr Simaku is Head of Renewables and Energy Efficiency at the Albanian Ministry of Energy and Industry. He is also Research Coordinator for Polytechnics Studies at the Polis University of Tirana. Mr Simaku has over 15 years of experience with energy policy, energy strategy drafting, energy action plans drafting and hands-on experience with the implementation of donor assistance and coordination. Furthermore, Mr Simaku has over 25 year of experience with designing and implementing energy efficiency and HVAC systems for public operators.

Name	Short CV
Tigas, Kostas	Kostas Tigas is the Director of the Division of Energy Policy and Planning of CRES. He holds a Mechanical Engineering Diploma (1984, equivalent to Masters Degree) from the National Technical University of Athens. His professional interests include electricity economics, energy efficiency economics and energy policy. He is in particular interested in problems related to the large-scale penetration of RES and Energy Efficiency in energy systems. In the fields of his activities at CRES he has been the scientific leader of more than 50 national and international projects. A short selection of projects as scientific leader include: a) Energy roadmap of Greece towards 2050 b) National Energy Planning Studies of the years 2007, 2008, 2009 and 2011 c) National Renewable Energies Action Plan (NREAP) for the years 2010-2020 d) 1st and 2nd National Energy Efficiency Allocation Plans e) Assessment of the National Potential of CHP in Greece and Cyprus f) Development of stochastic methodologies for the large scale penetration of RES in electricity generation systems g) Development of computerized methodologies for the assessment of RES-e potential h) Development of National Information Systems for Energy Efficiency. Kostas Tigas is with the Centre for Renewable Energy Sources since 1989. Between 1993 and 1998 he was the Head of the Energy Planning Unit. Between 1998 and 2006 he was the director of the Division for Energy Planning. Since 2006 he is the Director of the Division for Energy Policy and Planning which was formulated in 2006. He has been a member of the National Committee for the 20-20-20 Energy Policy Targets and a deputy member of the National Committee for Energy Strategy twice. On the European level he has been the chairman of the European Energy Network (EnR) for the year 2012. He is the author of 24 publications related to his professional interests. He is a member of the IEEE.
Trhulj, Jasmina	Jasmina Trhulj is a power system engineer employed at the Energy Community Secretariat in Vienna as the energy market expert. She is responsible for monitoring, analysis and reporting on the market development in the Energy Community Contracting Parties, as well as for assisting electricity sector authorities and companies in transposition and implementation of the applicable EU acquis. Jasmina Trhulj graduated from the School of Electrical Engineering of the University of Belgrade. Fifteen-year professional career in the energy sector started as a research and development assistant on the power system operation and control projects at Mihajlo Pupin Institute in Belgrade. Seven-year regulatory experience in development and monitoring of the electricity market obtained at the Energy Agency of the Republic of Serbia (AERS) as the senior expert for electricity.

Name	Short CV
Tselepis, Stathis	Dr. Stathis TSELEPIS is the Head of the Photovoltaic Systems and Distributed Generation department at CRES, the National Hellenic Centre for Renewable Energy Sources and Saving. In the last 20 years he has been involved in projects dealing with design, development, monitoring and evaluation of Photovoltaic systems, Hybrid systems, Microgrids with distributed energy resources, PV cell and module testing, electric vehicle monitoring systems development and evaluation. He is a member and participating in various European institutions, such as: EPIA, the European PV Technology Platform, a national expert in the European Electricity Grid Initiative (EEGI) and a member of the Solar European Industry Initiative (SEII) team for photovoltaic and concentrated solar power.
Guido Zanzottera	Guido Zanzottera works as an Energy Engineer at AI group since 2011. He specialised as a Sustainability Consultant and Energy Modeller, working on various projects over the Italian territory and abroad; he is also tutor of the academic course in "Sustainable Architecture" at Polytechnic of Turin. He is a LEED Accredited Professional with specialty for Existing Building Operation and Maintenance and he has been part of the team which worked on a LEED Platinum Certified building. Mr Zanzottera holds a degree in Energy Engineering from Polytechnic of Turin.

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