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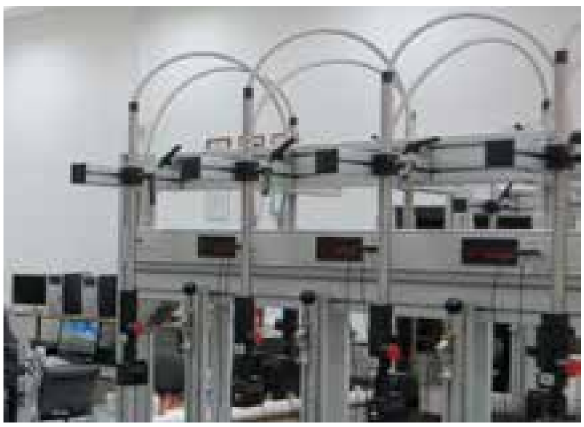
Institute of Metals and Technology

INCREASED USE OF LOW-CARBON TECHNOLOGIES AND DEVELOPMENT OF QUALITY INFRASTRUCTURE IN ECONOMIC SECTORS IN BOSNIA AND HERZEGOVINA

FINAL REPORT





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INCREASED USE OF LOW-CARBON TECHNOLOGIES AND DEVELOPMENT OF QUALITY INFRASTRUCTURE IN ECONOMIC SECTORS IN BOSNIA AND HERZEGOVINA

FINAL REPORT

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VIENNA, APRIL 2015

TABLE OF CONTENTS


KHS

EXECUTIVE SUMMARY

In 2013, annual global climate finance flows totaled approximately USD 331 billion, falling by USD 28 billion below 2012 levels. The good news is that the overall decrease is mainly due to the decreasing cost of some renewable energy technologies, particularly for solar photovoltaic technologies. This implies that in some cases, more renewable energy is being deployed with lower investment levels. Despite such successes, however, the International Energy Agency (IEA) estimates that an additional USD 1.1 trillion in low-carbon investments is needed every year on average between 2011 and 2050, in the energy sector alone, to keep global temperature rise below two degrees Celsius. In cumulative terms, the world is falling further and further behind its low-carbon and climate-resilient investment goals.

Energy production, distribution and its associated activities are one of the largest global industrial sectors worldwide and therefore also form a priority sector for Bosnia and Herzegovina. Any development process towards a sustainable re-industrialization of the country would need to tap into low-carbon growth, emphasizing energy efficiency and renewable energy.

Bosnia and Herzegovina has a significant potential in terms of energy saving, as is demonstrated by the pilot project carried out under this study, but likewise on renewable energy – be it in upgrading the eixtsing small hydro power capacity, in solar, wind or bio-energy. In addition, the country could position itself as a regional hub for services related to quality infrastructure, meaning standardization and certification. Finally, a number of enterprises produce high quality products, including smart meters and LED lights which suggests growth potential in the national and regional export market.

Renewable energy, energy efficiency, as well as the accompanying quality infrastructure have thus far been dealt with on a fairly small scale in Bosnia and Herzegovina, mainly due to limited economic growth and lack of financial resources. A strengthened and more enabling policy and regulatory framework is required as well as enhanced capacities of decision makers and institutions in their efforts to develop the deployment of low-carbon technologies in the country. The implementation of the action plans prepared in the past is small, while many other documents, strategies and policies have yet to be adopted, taking into account relevant national environmental protection laws.

For a country like Bosnia and Herzegovina it is important to decide which infrastructure projects create the greatest impact in terms of economic growth. This decision and planning have to be followed by national needs and capabilities but can also supported by global strategies and initiatives. For instance, with the national market clearly geared towards the EU, relevant EU Directives can act as a driver to inspire policy development in areas of low-carbon technologies and quality infrastructure. In order to modernize the structure of the electricity system and allow for the introduction of new and decentralized technologies, new legislation and appropriate measures will be required to remove regulatory and other barriers to the promotion of renewable energy and energy efficiency. When done carefully and at the right pace and sequence, such transition can generate significant economic benefits, while at the same time lowering the environmental impact, as such realising the concept of low-carbon economic and industrial growth.

This present project is financed by the Republic of Slovenia, cofinanced and implemented by the United Nations Industrial Development Organisation (UNIDO), and builds on the significant potential of the country's industrial and economic sectors for an increased application of energy efficiency measures and renewable energy technologies to reduce or substitute the use of fossil fuels, thus lowering costs and increase the competitiveness of the local economy.

This study on an increased use of low-carbon technologies and development of quality infrastructure in economic sectors in Bosnia and Herzegovina, is based on studies and analyses, a pilot project in a target enterprise, and discussions with a wide range of stakeholders at both government and private sector levels. This project was implemented under the overall coordination of UNIDO, with strong support from the Institute of Metals and Technology (IMT) in Slovenia, and the companies Mikroelektronika and Banjalućka Pivara in Bosnia and Herzegovina for the smart metering pilot project. Based on the identified needs and the demonstrated benefits as part of the pilot project, the purpose of this project is to trigger follow-up technical assistance projects to promote renewable energy and energy efficiency, thus providing a specific contribution to the government's efforts to elaborate a low-carbon energy strategy for the country.

The first section of the study assesses the existing quality infrastructure for low-carbon technologies (with focus on solar energy and smart meters) based on a methodology developed by UNIDO. The applied methodology for this assessment followed a relatively simple questionnaire based on which the current status of a country's quality infrastructure can be evaluated, after which a number of recommendations can be formulated for the country's policy makers. Based on the details of testing and the country situation in terms of capabilities in relevant laboratories, more efforts are necessary to fulfill basic requirements in the area of quality infrastructure. The case study of capabilities in Bosnia and Herzegovina for testing solar thermal equipment shows which facilities would be necessary for testing and certification of solar thermal systems, as well as other renewable energy technologies and smart meters. While many of the components of the quality infrastructure exist and relevant bodies are in place, tailored actions to allow for specific testing, verification or calibrations are not defined, and simply not practiced. Additional efforts would be required to be ready for providing services in this field, to create sufficient customers confidence, and ultimately, act as a regional service hub in this area.

The second part of the study is a piloting use of smart metering in the brewery Banjalućka Pivara which produces 400,000 hectoliter of beer per year for the national and export market. In consultation with Mikroelektronika, the local provider of the smart meters and the software, the brewery installed 15 smart meters at the key production facilities and in substations.

The results on the enterprises's indoor and outdoor lighting, as well as the compensation of the reactive power have had a direct impact on the brewery's energy use, and - especially in case of the reactive power - a direct and significant financial benefit. In addition, the pilot project enabled the technical staff to get an improved and detailed insight in the different parts of the brewing process and the enterprises's overall operation. The information received from engineers also yielded some unexpected and additional benefits:

- The system allows measuring, control and tracking of the energy consumption throughout the productions and it provides information about all characteristics of the energy (active energy in both tariffs, reactive energy in tariff one, 15-minutes maximum demand, etc.).

- The energy profile gave insight into the profile of archived 15-minute maximum. Now it is known exactly which consumption point participate in the reached maximum. It is especially important that now it is clear what percentage of the maximum is reached by consumption points which do not participate in the production (such as heating, cooling, etc.). Based on this information, immediate actions were taken so that production facilities are organized in different order and some have been separated into different schedules, in order to lower maximums. Also, after learning about some failures in air compression units and other consumers which do not participate in production processes directly, and by fixing these problems, additional efficiency has been accomplished. All these activities resulted in lowering the electric energy consumption from 17.2 kWh/hl down to 14.3 kWh/hl, even though an additional production line has been installed into the production, and this additional can filling line has installed power of approximately 75kW.

- Additionally, measurements showed that compensation for reactive energy was not set properly and that the brewery had approximately EUR 15,000 of yearly expenses due to the reactive energy. Now these mistakes have also been fixed and currently the brewery has no expenses related to reactive energy. This saving on its own, already covered the whole investment.

Within a short measuring and monitoring period of two months, this pilot project provided surprisingly good results which demonstrate and underline the benefits of smart meter usage and expert analysis. Indeed, having a smart meter (set) will not automatically reduce the electricity use and save money. It is as important to interpret and use the information from the smart meters or energy display to work out where own energy use can be reduced and the energy bill cut accordingly. The combined expertise of the enterprise's technical staff who know the industrial process and the facilities, and the experts on smart metering and measuring, is critical to maximize the results of a smart metering measuring campaign.

Still, such investments may be a barrier for Small and Medium-sized Enterprises, which is why this project was supported and the results of this pilot project are hoped to trigger and stimulate replication in other enterprises. Indeed, it can reasonably be expected that similar energy and cost savings can be realized in similar enterprises, in sectors such as beverages, distilleries, food-processing, leather and furniture.

An increased and standardized use of (smart) meters again emphasizes the need for an appropriate quality infrastructure. In that sense, the Government of the Republic of Slovenia and the Institute of Metals and Technology (IMT) from Ljubljana in the past has supported the development of laboratory infrastructure in Bosnia and Herzegovina in fields closely related to the certification of specific parameters for renewable energy and energy efficiency, and established six laboratories which are currently in the process of international recognition (laboratory for testing of electromagnetic compatibility, laboratory for calibration and testing of electrical power meters, national laboratory for electrical quantities (electrical current, voltage and resistance), national laboratory for time and frequency, national laboratory for vacuum and national laboratory for pressure).

This study is intended to provide an initial guidance to parties with an interest in low-carbon technologies such as renewable energy, energy efficiency and the accompanying quality infrastructure in Bosnia and Herzegovina, by providing background information, case studies and suggested follow-up proposals.

The combined expertise of IMT, UNIDO and national companies and institutions has proved a key success factor for this study, and has built a platform for future technical cooperation activities in the country and the region. This work was supported by a team of national and international experts and managed by UNIDO.

LIST OF ABBREVIATIONS

BATA:	Accreditation body of Bosnia-Herzegovina
BiH:	Bosnia-Herzegovina
CB:	Certification Body
CDM:	Clean Development Mechanism
DNA:	Designated National Authority
EE:	Energy Efficiency
EC:	European Commission
ESMIG:	European Smart Metering Industry Group
FBiH:	Federation of Bosnia and Herzegovina
HPP:	Hydropower Plants
IMBiH:	Institute of Metrology of Bosnia and Herzegovina
IMT:	Institute for Metals and Technology
PV:	Photovoltaic
QI:	Quality Infrastructure
RE:	Renewable Energy
RES:	Renewable Energy Sources
REQI:	Renewable Energy Quality Infrastructure
RS:	Republic of Srpska
SME:	Small and Medium-sized Enterprise
TPP:	Thermal Power Plants
UNIDO:	United Nations Industrial Development Organisation

1. INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

UNIDO's global vision on "Inclusive and Sustainable Industrial Development (ISID)" aims to promote sustainable and resilient economic and industrial growth for poverty reduction that goes hand in hand with economic, social and environmental dimensions of sustainable development.

Industry plays a decisive role in stimulating economic growth. Global experiences have shown that countries with high levels of socio-economic development have reached this stage by having a developed and advanced industrial sector. However, industrial sector growth is conventionally linked with excessive environmental pressures such as resource depletion, air pollution at the local / regional level and negative impacts in terms of global climate change. In order to minimise environmental damage, while meeting the global objectives of eradicating poverty and reducing income disparity, industrial development must become sustainable and inclusive. Thus, UNIDO aims to achieve inclusive sustainable industrial development which means:

- Every country achieves a higher level of industrialization in their economies, and benefits from the globalization of markets for industrial goods and services.
- No one is left behind in benefiting from industrial growth, and prosperity is shared among women and men in all countries.
- Broader economic and social growth is supported within an environmentally sustainable framework.
- The unique knowledge and resources of all relevant development actors are combined to maximize the development impact of ISID.

UNIDO, in delivering its mandate in the context of ISID, has developed and implemented responses by sector and region in developing and transitional countries. The focus is mainly on small- and medium-sized enterprises to improve their competitiveness and market access, by simple and practical approaches to improve productivity and meet environmental requirements. UNIDO has long recognised that renewable energy technologies have to be promoted at a local level, and pays attention to their use in industrial applications for the benefit of people and enterprises. In order to secure the achievement of the ISID vision, UNIDO focuses on the following aspects of renewable energy:

- Mainstreaming the use of renewable energy in industrial applications, in particular for small and medium-sized enterprises (SMEs), thereby also increasing their competitiveness and reducing their dependence on fossil fuels.
- Creating business development opportunities aimed at increasing access to energy and boosting the use of renewable energy mini-grids.

- Strengthening of the impact of rural electrification on poverty reduction and sustainable development.

- Providing policy advisory services to create an enabling policy and institutional environment for coordination, coherence, integration and knowledge management within concrete renewable energy projects at local and regional level

Renewable energy technologies provide different benefits which greatly contribute to achieving inclusive and sustainable industrial development. Their roles related industries can be separated into four pillars:

- Growing renewable energy industry (from renewable energy components manufacturing to energy production industry) in itself;

- Increasing local productive activities through providing sustainable energy access;

- Promoting renewable energy for industrial applications;

- Producing and consuming (prosuming) renewable energy in industries simultaneously.

An increased use of renewable energy sources and other low-emission technologies are critical parts of the puzzle to achieve sustainable development and the Millennium Development Goals. International trade, as an engine for development, reaffirms the need for a universal, rules-based, open, non-discriminatory and equitable multilateral trading system. It stands to reason therefore, that energy and trade are the two essential pillars of sustainable development and low-carbon growth that should be addressed in nexus, to target synergies and avoid potential pitfalls. An integrated approach towards addressing sustainable energy will serve to inform more effective national policies, regulations and standards.

2. INTRODUCTION

This document is the Final Report of the project entitled "Development of a Full-Scale Proposal on Increased Use of Low-Carbon Technologies and development of Quality Infrastructure in economic sectors in Bosnia and Herzegovina" (hereafter called "the Project"). The Project, financed by the Republic of Slovenia (EUR 60,000) and the United Nations Industrial Development Organisation (UNIDO – EUR 15,000), and implemented by UNIDO, builds on the significant potential of the country's industrial and economic sectors for an increased application of energy efficiency (EE) measures and renewable energy (RE) technologies to reduce or substitute the use of fossil fuels, thus lowering costs and increase the competitiveness of the local economy.

The purpose of this preliminary project is to prepare a full-scale project to strengthen the country's capacities in developing low-carbon energy quality infrastructure (QI), which will as a tool to trigger the transfer of knowledge and introduce innovative technology in different sectors of the national economy. The initial focus will be on solar energy technologies and energy measuring equipment, as representative test cases to carry out a needs and capacity assessment in the field of market penetration and QI of these technologies.This project is to be considered as a preparatory phase aiming to create a momentum for a larger-scale project to promote access to and transfer of RE and EE technologies, and spreading the scope towards full implementation at national level, as well as reaching out to the regional level, on the basis that the methodology on improvement of quality infrastructure for renewable energy technologies and energy measuring equipment, would benefit not only the recipient country and the sectors concerned, but the whole region, hence the emphasis on regional collaboration through the cooperation with Slovenian partners in this project.

This study on an increased use of low-carbon technologies and development of quality infrastructure in economic sectors in Bosnia and Herzegovina, is based on studies and analysis, a pilot project in a target enterprise, and discussions with a wide range of stakeholders at both government and private sector levels. This project was implemented under the overall coordination of the United Nations Industrial Development Organisation, with strong support from the Institute of Metals and Technology (IMT) in Slovenia, and companies Mikroelektronika and Banjalućka Pivara in Bosnia and Herzegovina for the smart metering pilot project. Based on the identified needs and the demonstrated benefits as part of the pilot project, the purpose of this project is to trigger follow-up technical assistance projects to promote renewable energy and energy efficiency in the country, thus providing a specific contribution to the government's efforts to elaborate a low-carbon energy strategy for the country.

The Project's activities started in September 2014 were completed in March 2015 after the Project results have been disseminated at the wrap-up workshop in Banja Luka on 24th March 2015.

The Project specifically aimed to:

1. Carry out a needs and gaps assessment on RE and EE Quality Infrastructure (standards and conformity assessment) with focus on solar energy and smart meters in BiH

2. Launch a pilot project on smart energy measuring systems in a representative enterprise (beer brewery)

3. Share experiences of different partners and formulate concrete recommendations (validation workshop in Banja Luka in march 2015)

4. Formulate targeted follow-up project concepts based on identified gaps and needs

The study will first analyse capacity and needs of QI for renewable energy, with a particular focus on solar energy and smart meters. The second part of the study looks into the results of the use of smart meters in a brewery in BiH. This case study is focused on energy consumption management examining benefits that can be gained if a company introduces smart metering in their facilities to measure electricity consumption at key phases of the industrial process. Finally, this report provides comprehensive follow-up proposals based on the preceding findings.

3. ENERGY POLICY CONTEXT IN BOSNIA-HERZEGOVINA

3

According to the Dayton Agreement, the implementation of energy and environmental policy in Bosnia and Herzegovina (BiH) is under the jurisdiction of the entities and the district government in Brčko District. Competence of the BIH administration in the energy and the environment is very limited and reduced to functions that are primarily related to international cooperation and co-ordination. There is a lack of both cooperation and vertical and horizontal coordination between competent institutions, and these mechanisms are of particular importance for international activities. In accordance with applicable law, the preparation of many strategies and plans is required.

BiH is an open economy with GDP per capita of approximately US$4,300. Some 65% of value added is created in service sectors (retail trade, public administration and financial services, etc.) while the remaining 35% is split between manufacturing (25% industry, construction and energy production, and 10% agriculture).In 2010 the main exports were base metals (aluminum, iron and steel at 18% of total exports); mineral fuels, oils and products (10%); machinery and mechanical appliances (9%); furniture (8%) and other wood products (7%). In 2010, BiH exported roughly €3.5 billion, with its neighboring countries Serbia, Croatia, Slovenia and Montenegro accounting for 40% of total exports, and Germany, Italy and Austria an additional 35%.

The energy sector in BiH is characterized by high energy intensity, high carbon emissions, and significant potential for improving energy efficiency and increasing the use of renewable energy. BiH's power sector is not only able to meet domestic demand in full but also to export a substantial share of its electricity production to the regional market.

The main sources of energy in BIH are hydro power (HPP) and thermal power plants (TPP). Installed power in HPP is bigger than in TPP but the annual production is bigger in TPPs (see Table 6). Both HPP and TPP have been in operation for decades and need basic reconstruction as well as investments to improve their operational efficiency. Such measures could provide a substantial increase of installed capacity and provide a relatively quick and easy revenue stream for the utility and BiH. Currently BiH is in a position to export part of its electricity generation due to an under-developed industrial base and consequently limited industrial energetic comnsumption.

The hydropower potential is exploited mainly in large plants by BiH's three power utilities. The total estimated average production of small hydro power (SHP) plants stands at 963 GWh a year (initial national communication of BiH under the UN framework convention on climate change (UNFCCC) 2009).

Table 1 Hydro Power Plants in BiH

Watershed	Power plant	Installed power (MW)	Pmax on the grid (MW)	Average annual production (GWh)
Trebisnjica	Trebinje I	2x54+1x63	171	370-420
	Dubrovnik*	2x108	108	1168
	Čapljina	2x220	440	400
Neretva	Rama	2x80	160	731
	Jablanica	6x30	180	792
	Grabovica	2x57	114	342
	Salakovac	3x70	210	593
	Mostar	3x24	72	310
Vrbas	Jajce I	2x30	60	247
	Jajce II	3x10	30	157
	Bočac	2x55	110	307
Drina	Višegrad	3x105	315	1108
Lištica	Mostarsko Blato	2x30	60	
Tihaljina	Peć-Mlini	2x15,3	30,6	72-80
Total Pmax			2060,6	

*Production of the generator number 2 from HPP Dubrovnik belongs to ERS

Table 2 Thermal (coal fired) Power Plants in BiH

Power plant	Block-Unit	Installed power (MW)	Pmax on the grid (MW)	Apparent power (VA)	Coal type Lignite Brown coal	Possible production (GWh)
Tuzla	G3	100	85	118	LB	462.00
Tuzla	G4	200	175	235	LB	1078.00
Tuzla	G5	200	180	235	LB	1078.00
Tuzla	G6	215	190	253	B	1103.00
TUZLA total		715	630	921		3721.00
Kakanj	G5	118	103	134	B	627.00
Kakanj	G6	110	85	137.5	B	478.00
Kakanj	G7	230	205	270.5	B	1227.00
KAKANJ total		450	385	693		2332.00
Gacko	G1	300	276	353	L	1149.40
Ugljevik	G1	300	279	353	B	1457.70
Total			1568			8660.10

With about 50% of the country area covered by forests BiH has a remarkable potential of bio-energy. In addition, there is significant potential in organic residues form the agricultural and agro-food sector. The use of biomass is usually for thermal needs and implies traditional exploitation of wood as solid fuels in households and local boilers in a typically inefficient and unregulated manner.

As for wind energy, larger wind capacities may have a negative effect on the performance of the regulatory system, so it is necessary to provide increased secondary reserve to compensate unwanted fluctuation in power caused by the varying intensity of the wind. There is a study defining an upper limit of wind power plants on 350 MW. Ministries agree to 120 MW belongs to the RS, and 230 MW FBiH.

As for solar energy BiH is one of the most favorable locations in Europe ; with an annual solar irradiation of about **1**,240 kWh of energy per m^2 in the north of the country, and about 1,600 kWh of energy in the south .

In January 2014 the EC launched a framework for reducing greenhouse gas emissions by 40% below the 1990 level, as well as an EU-wide binding target for RE of at least 27% and renewed ambitions for EE policies up to 2030. The strategic goals of EU 20-20-20 can act as a policy driver for the country to improve the legislative framework. These goals imply an increase of the use of RE sources. As such the deployment of RE technologies should be a key priority in BiH, as it will contribute to a more environmentally sustainable and efficient energy sector by supporting private investments in greener energy with a particular focus on supporting the construction of new SHPs, bio-energy and wind and solar projects.

BIH currently has a draft National Energy Efficiency Action Plan (NEEAP) but no RE action plan yet.

On May 2011, the Government of the Federation of Bosnia and Herzegovina (FBiH) adopted the Regulation on Renewable Energy Sources (RES) which regulates the modalities of using RES and cogeneration plants. In addition, the Regulation defines the groups of plants, minimal ratio of electrical energy produced in plants which use RES in total consumption, providing incentives for production of electrical energy from RES, analysis of RES potentials, construction of RES plants, purchase of electrical energy and compensation, connection of the RES plants to the electrical and energy network.

At its 26th session held on 25th April 2013, the National Assembly of the Republika Srpska adopted the Law on Renewable Energy Sources and Efficient Cogeneration (Official Gazette of the Republic of Srpska, no. 39/13), and at its 32nd session held on 28th November 2013, the Law on Amendments to this Law (Official Gazette of the Republic of Srpska, no. 108/13).

At its 61st session held on 15 May 2014, the Government of the Republic of Srpska adopted the Republic of Srpska Action Plan for Use of Renewable Energy Sources.

In accordance with the Law, the Regulatory Commission for Energy of the Republic of Srpska has passed the following secondary legislation:

- Rulebook on Incentives for Generation of Electricity from Renewable Sources and in Efficient Co-generation (Official Gazette of the Republic of Srpska, no. 114/13),
- Rulebook on Issuance of Licenses (Official Gazette of the Republic of Srpska, no. 114/13) and amendments to this Rulebook (Official Gazette of the Republic of Srpska, no. 65/13),
- Rulebook on Issuance of Certificates for the Generation Facility which Generates Electricity using Renewable Energy Sources or in Efficient Co-generation (Official Gazette of the Republic of Srpska, no. 112/13),
- Rulebook on the Issuance of Guarantees of Origin of Electricity (Official Gazette of the Republic of Srpska, no. 1/14),
- Decision on the level of guaranteed redemption prices and premiums for electricity generated from renewable energy sources and in efficient cogeneration (Official Gazette of the Republic of Srpske, no. 116/13).

Pursuant to Article 40, paragraph 2 of the Law on Renewable Energy Sources and Efficient Cogeneration (Official Gazette of the Republic of Srpska, no. 39/13), Minister of Industry, Energy and Mining has issued Guidelines on keeping the register of projects from renewable energy sources and in efficient cogeneration (Official Gazette of the Republic of Srpska, no. 76/13).

Second National Communication of BiH under the UN framework convention on climate change and Climate Change Adaptation and Low-Emission Development Strategy for BiH adapted on Council of Ministries of BiH on 8th October 2013.

Using RES is of public interest for the FBIH, and its goal is to encourage increased production and consumption of energy from RES in the internal electrical energy market, and the development of regulatory and technical infrastructure for RES. Bylaws to this regulation still do not exist so the implementation of this regulation is limited.

Despite its potential the PV market in BIH is still in its infancy. A few procedures are established and initial legislation in one part of BIH is in place. Additional incentive mechanisms would be required to kickstart the demand and establish the market.

In a Rule book on incentives for generation of electricity from renewable sources and in efficient co-generation (RS) (29) it is noted that:

The distribution system operator develops at its own expense the analysis that the generator/ investor submits evidences on plans for construction of the following:

- Electricity Generation facility using RE sources in a cost-effective way and complying with protection of the environment as follows:
  - » Hydro power plant up to and including 10 MW capacity
  - » Wind farm up to and including 10 MW capacity
  - » Solar photovoltaic system with installed capacity up to and including 1 MW
  - » Geo-thermal facility with installed capacity up to and including 10 MW
  - » Facility using solid biomass with capacity up to and including 10 MW
  - » Facility using agricultural biogas with capacity of up to and including 1 MW

In addition it is noted that the generator of electricity from RE sources or in efficient co-generation is entitled to the premium for generated electricity which is used for consumption for its own needs or sale at the market, if it meets prescribed criteria and conditions of this Rule and if it hasn't got the right to the obliged redemption at the feed in tariff. Apart from the generator, the right to the premium is also assigned to the generator of electricity from efficient co-generation facility when the installed capacity is more than 10 MW, and less than 30 MW and generator of electricity from generation facility for wind which installed capacity is more than 10 MW, if it has Certificate and meets prescribed criteria and conditions.

System operator is responsible for verification of the characteristics and reading of all metering devices which serve for measuring of electricity which was generated at the generator, net generated electricity which was delivered to the network, electricity used as the auto-consumption exclusively for the needs of operation of the generation facility of its own and electricity used for the own needs which is used in the generator's structures for other purposes. Calculation of electricity delivered in the system from the generation facility for which the right of the obliged redemption at feed-in tariff is granted, the right of the obliged redemption for old facilities in exploitation or the right to the premium is made on the basis of the read net generated electricity, measured at the metering point as stated in the Certificate and contracts concluded with the System operator and System operator for incentives.

Calculation of electricity delivered for consumption for auto-consumption from generation facilities which are granted the right to the premium is made on the basis of reading of energy metered at the metering point which has been separately installed for metering of consumption for the own needs.

The means for stimulating generation of electricity from renewable sources and in efficient co-generation is provided from the fees for renewable sources and efficient co-generation which is calculated to all end users of electricity. From the fees for renewable sources, it is provided the means for: total amount of the calculated premiums for electricity generated in renewable sources and efficient co-generation; covering costs of settlement of not-intended deviations of generators that get the right to the obliged redemption at guaranteed feed in tariff or the right to the obliged redemption for old facilities (balancing costs); financing of operation of the System operator for incentives; covering of costs for improvement of the energy efficiency measures.

The energy payback times (EPBT) of PV systems will continue to decrease through reduction in material usage (e.g. thinner silicon wafers, thin-film modules), higher system efficiencies for converting solar energy into electricity, improved manufacturing processes resulting in increased throughput and yield, a reduction in energy usage, and recycling of materials and PV systems. The continuation of significant improvements to PV EPBT will depend on reductions in the energy requirements to produce commodity materials such as glass, semiconductor materials, and foils.

There were few small initiatives and projects like the first solar power plant in BiH that was put into operation in March 2012, with EUR 400.000 invested in the project of the solar power plant construction. One company is also trying to develop a solar park in BiH with an initial target capacity of 1-5 MW. The site will be in the south of the country where the average annual irradiation is more than 1,500 kWh/m^2.

BiH is a decentralized country comprising two entities (the Republic of Srpska and the Federation of Bosnia and Herzegovina) and Brčko District. The two entities and Brčko District manage environmental issues through laws, regulations and standards.

Up until 2009 BiH was amongst the bottom four countries in the world regarding the level of fulfillment of the UN Framework Convention on Climate Change (UNFCCC) commitments. In 2009 prepared the First BiH National Report in accordance with UNFCCC. In 2010 the first designated national authority (DNA) for implementation of clean development mechanism (CDM) projects of Kyoto Protocol was established. The designated UNFCCC focal point and DNA for the CDM is the Republic of Srpska Ministry for Spatial Planning, Civil Engineering and Ecology.

BiH on a state level do not have responsible ministry for set up or management of issues related to energy policy, energy efficiency or renewable energy sources. The BiH Ministry of Foreign Trade and Economic Relations (further referred to as “the Ministry”) is responsible for the coordination of activities and harmonizing of plans of the entities’ governmental bodies and institutions at the international level, in energy, environmental protection, development and the exploitation of natural resources. The Ministry is coordinating many actions in these fields but still many activities are under responsibility of entities, i.e. the Federation of Bosnia and Herzegovina (FBiH) and Republic of Srpska (RS).

The competent ministries in the energy sector of BiH that operate on entity level are:

- Ministry of Energy, Mining and Industry of the FBIH, and
- Ministry of Industry, Energy and Mining of RS.

The Commission for Concessions of BiH is an independent regulatory legal entity set up to carry out its competences in the capacity of the Commission for Granting Concessions of BIH or in the capacity of the Joint Concession Commission. The Commission functions in the capacity of the Commission for Granting Concessions of BiH when it performs duties and gives authorizations pertaining to concession granting that fall under the exclusive competence of BIH.

The Law on Concessions of FBiH regulates the subject, modalities and the conditions concerning the granting of concessions to domestic and foreign legal entities providing infrastructure and services, exploitation of natural resources, financing, design, construction, rehabilitation, maintenance and/or operation of such infrastructure and all accompanying facilities in the sectors that are under jurisdiction of the FBiH, as well as the establishment of the Commission for Concessions of FBiH, the tendering procedure, contents of the concession agreement and other issues. The purpose of this Law is to create a transparent, non-discriminatory and clear legal framework for setting the conditions under which local and foreign legal persons may be granted concessions in FBiH and to encourage the investment of foreign capital.

The decision to grant a Concession in RS is made by the Government of RS, on the basis of which the Government, or, upon the Government's authorization, the competent ministry and/or local authorities and/or a public enterprise which is in charge of managing the subject of concession, concludes the Concession Contract. Upon the proposal of the Commission, the Government grants a Concession to the most favorable bidder having met and satisfied all the criteria set out in the public invitation and being of a higher rank compared to all other bidders.

Regulators in BiH are:

- **SERC -** The State Electricity Regulatory Commission (SERC) is an independent institution of Bosnia and Herzegovina, which acts in accordance with the principles of objectivity, transparency and equality, and has jurisdiction over and responsibility for transmission of electricity, transmission system operation and international trade in electricity. SERC was established by the Parliamentary Assembly of BiH by adopting the Law on Transmission of Electric Power, Regulator and System Operator of BiH, and appointment of the Members of the Commission.

- **FERK -** The Regulatory Commission for Electricity in the FBiH, established by the Electricity Law, is a specialized, autonomous, independent and non-profit organization in FBIH.

Laboratorium at Institute for Metrology in BiH (IMBiH)

The Regulatory Commission's jurisdictions are:

- Supervision and regulating the relations between power generation, distribution and electricity customers including power traders
- Prescribing methodology and criteria for defining the prices for supplying of non-eligible customers
- Defining of tariffs for distribution systems users and tariffs for non-eligible customers
- Issuing and revocation of licenses for generation, distribution and tariffs for non-eligible customers
- Issuing the preliminary construction permits and licenses for usage of power facilities except the facilities for power transmission
- Defining General Conditions for Electricity Supply
- **RERS** - Regulatory Commission for energy of Republic of Srpska performs its competences in accordance with the Law on Energy and other energy-related laws in order to provide transparent and non-discriminatory position for all participants in the energy market in RS. Operations from the competences of the Regulatory Commission are as follows:
  - Supervision and regulating the relations within the generation, distribution, and customers of electricity, including the traders of electricity;
  - Prescribing of the methodologies and criteria for setting of the price for using distribution network and price for the electricity supply of the non-eligible customers and methodology for determination of fee for connection to the distribution network;
  - Making tariff system for sale of electricity and use of the distribution network,
  - Determination of tariff rates for distribution system users and tariff rates for non-eligible customers,
  - Making decision on issuance, extension, amendment, transfer and revocation of the licenses for doing activities of generation, distribution, supply and trade of electricity,
  - Issuance of licenses for construction of the electric power facilities;
  - Prescribing criteria for getting a status of eligible customers;
  - Determination of the general conditions for delivery of the electricity,
  - Settlement of disputes regarding: the right to be supplied with electricity, the right to access distribution network, obligation to deliver electricity, tariffs at which electricity is delivered, terminations in electricity supply, refusal to deliver electricity and quality of electricity supply.
- **ISO BiH** - Independent System Operator in BiH (ISO BH) was developed on the way of building BiH as a modern and integrated European country. It was established by the Parliamentary Assembly of BIH on the basis of the Law on Establishing the Independent System Operator for the Transmission System in BIH. ISO BiH, as the transmission system operator in BiH, is responsible for granting cross-border transmission capacities between the electrical and energy system of BiH and neighboring systems.

Companies for production of electrical energy:

- **Elektroprenos BiH** is a company for transmission of electric power in BiH. The Company's task is to transmit electric power produced in power plants to power distribution areas or large industrial consumers, as well as to connect the BiH power system with power systems of the neighboring and other countries and, in that manner, enable export, import and transit of electric power.

- **Elektroprivreda BiH** is a public company for generation, distribution and sale of electricity. It is the largest electric utility in BiH with more than 695 thousand customers and capital exceeding 2.150 billion KM. Elektroprivreda BiH is active in the area of seven cantons in the FBIH. Regarding the ownership structure, Elektroprivreda BiH d.d. is a joint stock company with 90% shares of the FBiH. The basic capital of Company is 2.155 billion KM. Elektroprivreda BiH disposes with 1.682 MW installed generation capacities and supplies app. 690 thousand tariff customers in seven cantons in FBIH.

- **Elektroprivreda of Republika Srpska** (ERS) was established as a public enterprise, pursuant to the Law on Enterprises and the Law on Public Enterprises, has been organized through the Combined Holding "Elektroprivreda" of Republike Srpska joint stock company Trebinje. MH ERS comprises five enterprises which deal with the production of electrical energy, five enterprises for distribution of electrical energy and an R&D Center IRCE a.d. which deals with research, analysis and development of electrical and energy equipment.

- Activities of MH Elektroprivreda RS are production of electrical energy and exploitation of raw materials which are necessary in the production of electrical energy, distribution and sale, management of the electrical and energy system of RS, management and implementation of projects in the energy sector in RS.

- Public Enterprise Elektroprivreda HZ HB d.d. Mostar is one of the three public electrical and energy enterprises in BiH which deal with the production, distribution and supply of electrical energy. It was established on 28 August 1992 and since then the enterprise has been operating in 35 municipalities on the territory of the FBiH. As of 28 April 2004, it has been operating as a joint stock company, and the initial capital of the enterprise comprises of 10 % of shareholders' and 90 % of state-owned capital. Public Enterprise Elektroprivreda HZ HB d.d. Mostar produces electrical energy in seven hydropower plants with installed capacity of 860 MW.

- In the Law of energy in RS it is declared that: Use of RE sources and efficient cogeneration are of general interest. Using RE sources and efficient cogeneration provide decrease of use of fossil fuel and negative impacts on environment, as well as effective use of energy; stimulates development of new technologies, diversification of energy sources and increases safety of supply, and it also decreases dependence on import of energy on long-term basis. The government shall, at the proposal of the Ministry, make a decree prescribing measures that contribute to achievement of aims, which are related to the increase of:
  a) total generation of energy from renewable sources,
  b) a share of consumption of electricity generated from renewable sources and efficient co-generation facilities and total consumption of electricity in RS;
  c) a share of consumption of bio-fuel in total consumption of transport fuel;

It is also mentioned that efficient use of energy is of general interest for RS and it represents the contribution to the global intention to decrease adverse effects on environment and to contribute to sustainable development, and prudent and cost-effective use of energy sources. Programs of improvement of energy efficiency are carried out pursuant to the energy policy , energy development strategy and regulations of RS.

Programs of improvement in EE form an integral part of the energy development strategy and are harmonized with other programs of sustainable development. Measures for improving EE are as follows:

a) Establishment of favorable conditions for investment through the programs for increase of EE, through public-private partnership, development of financial cooperation and investment fund;
b) Provision of cooperation between customers, generators and suppliers of energy, as well as the sector of public services and local authorities' institutions in order to achieve the prescribed level of energy efficiency;
c) Realization of the requested levels related to energy efficiency through decrease of energy losses, decrease of energy consumption by introducing new technological solutions in different sectors (public sector and sector of public services, civil engineering, agriculture, industry, traffic, etc.);
d) Education of customers and raising awareness of customers on necessity to decrease consumption (saving) of energy and methods for reduction of consumption;
e) Establishment of the verification system and compulsory labeling of devices with the energy level class, as well as certification of buildings regarding their energy characteristics;
f) Making regulations within the scope of energy efficiency in order to establish methodology of proving effects of measures and mechanisms to increase energy efficiency; and
g) Realization of the international cooperation regarding energy efficiency;

4. CAPACITY AND NEEDS ASSESSMENT ON QUALITY INFRASTRUCTURE

4

4.1 UNIDO METHODOLOGY

Standards in RE and EE in particular are instrumental in achieving national and international energy and trade objectives as they represent policy-driven market-based tools that are voluntary in nature, that increase competitiveness for industry and facilitate international trade and fair market access. However, policy makers and the private sector in many countries are facing numerous challenges in implementing such standards, including effective conformity assessment services as well as technical know-how on how to adopt them. While national and sectorial initiatives are being developed, the harmonization of international standards and their adoption at national adoption often requires tailored support. Indeed, returning challenges to be addressed have been previously identified as:

- Lack of internationally recognized training or certification programs for auditors, assessors and national experts
- Development of credible certification systems for companies, including measurement and verification of performance
- Diversity of national approaches for certification of renewable energy and energy efficiency standards and related workforce
- Growing concern about credibility of certification schemes in some countries and the associated risk of undermining overall global impact

For example UNIDO has been assisting countries with the ISO 50001 Energy Management System standard. Furthermore, UNIDO may assist stakeholder groups in developing their capacities for implementing sustainable energy targets, including policies, standards and regulations. As for RE, UNIDO is currently implementing more than 60 projects in around 50 countries worldwide, and with quality infrastructure emerging as an area where tailored support is required, UNIDO has been developing a consistent approach and a strategy on standards and conformity assessment for selected RE technologies, to facilitate their uptake by developing countries and emerging economies. REQI covers specific aspects which are relevant to the successful introduction of RE technologies, and includes adoption of relevant standards and acceptance ("buy-in") by the key parties involved in a particular renewable energy sector, infrastructure for implementation of RE technologies as well as the process for testing and certification of products used in RE applications. Capacities for performing conformity assessments (including physical infrastructure and human skillsets) are also included.

This quality infrastructure (QI) is an essential tool for developing countries and emerging economies wishing to enter the global market. REQI is thus defined as the combined set of capacity related to renewable energy technologies, including access to standards and technical regulations, metrology, testing procedures, quality assessment, certification and accreditation. It is in this context that UNIDO has developed its Methodology for evaluation of QI for renewable energy technologies in developing countries and economies in transition.[1]

The following sections will evaluate the current level of Renewable Energy Quality Infrastructure (REQI) for solar energy and (smart) meters in BiH, and propose potential lines of actions to bridge the identified gaps ad needs.

For the purpose of this report solar energy is covering both solar photovoltaic (PV) for power production (converting solar radiation directly into electricity) and solar thermal systems for hot water and process-heat generation (converting solar radiation to heat). Concentrated solar power (CSP) is not covered.

The level of usage of solar photovoltaic (PV) systems in BiH is very low, almost negligible. A rough estimate of installed PV capacity is around **2** kW or 2.2 MWh annual production. Initial national communication of BiH under the UN framework convention on climate change (UNFCCC) 2009). Also solar thermal applications presently have limited application in the country, even though there is potential and an increasing interest from both industrial, commercial and households.

Given the currently low application of solar energy, it should come as no surprise that the QI is not strongly developed either. Indeed, the need for tailored QI typically becomes apparent when a product market is initiated and technology demand is growing. On the other hand, a strong and well-functioning QI is critical to make an initial market grow in a sustainable manner, with quality and safety assured to underpin consumers' confidence.

4.2 RESULTS OF REQI ASSESSMENT BASED ON UNIDO METHODOLOGY

In order for such REQI assessments for a given country to be made in a systemic way UNIDO developed a methodology to evaluate capabilities and needs in a given country for a selected RE technology. The methodology follows a relatively simple questionnaire based on which the current status of a country's REQI can be evaluated, and based on which a number of recommendations can be formulated for the country's policy makers.

In Table 3 below the answers to the questions based on UNIDO methodology.

1 Methodology for evaluation of Quality Infrastructure for Renewable Energy technologies; Discussion paper for UNIDO Expert Group Meeting, November 2014, Vienna

Table 3 Evaluation of BiH answers on questions based on UNIDO methodology

KEY SITUATIONAL COMPONENT 1: TECHNICAL CAPACITY OF HUMAN RESOURCE		**Rating scale** C=3 (compliance) PC=1 or 2 (partial compliance) NC =0 (noncompliance)
Institutional	Are there any regulations or initiatives promoting training and informational support for inspectors and installers?	0
	Are there existing programs to license and/or certify installers of RE systems?	0
	If answer to above Q is no: Is there institutional / government capacity to support a personnel (installers and inspectors) certification programme?	1
	Are there national codes or regulations to ensure that RE installations are performed by installers who are trained to understand:	0
	The operational and design requirements of the RE technology	0
	The specific safety concerns related to electrical and fire hazards?	1
	Is there a (government) organization willing and dedicated to hosting the certification effort for the long term (beyond 5 years)?	1
	Are there subject matter experts and individuals from various related fields who are willing to participate in developing training programs?	1
	Is there a national strategic framework that supports experts' involvement in the standardization process?	1
Technical	Is training available (at universities, research institues, industry associations etc) within the subject country for design and engineering of RE systems?	0
	Is there significant dependence on foreign consultants in these areas?	3
	Are there sufficient trained installers for the existing and future capacity?	0
	Is there sufficient capacity in national laboratories to perform the testing/sampling/analysis required by relevant standards?	1
	Is there adequate training of laboratory personnel as necessary for understanding of test procedures and expected results?	1
	Is there a program for education of national experts on the relevant conformity assessment processes and system requirements?	1
	Total for component 1	**11**
KEY SITUATIONAL COMPONENT 2: TECHNICAL PERFORMANCE		
	Are relevant standards readily available for test & measurement of the RE technology?	2
	Are there local test and calibration laboratories for the RE technology?	1
	Do they have documented test methods, necessary equipment, and appropriate laboratory facilities to perform these tests?	1
	Is their sufficient availability of equipment, instrumentation and laboratory facilities for performing standard tests?	1
	Is the available equipment, instrumentation and laboratory facilities for performing standard tests of sufficient quality?	1
	Can laboratories undertake calibration efficiently and effectively?	2
	Are the laboratories properly constituted in accordance with Labnetwork (UNIDO) and/or accredited internationally?	1
	Is there local test capability to perform field-testing for system output?	0
	Total for component 2	**9**
KEY SITUATIONAL COMPONENT 3: DEVELOPMENT AND ADOPTION OF STANDARDS		
	Is there a promotion and knowledge dissemination mechanism in place that facilitates the access and understanding of the relevant standards for all the stakeholders involved?	2
	Are there any nationally developed standards (where an international standard does not exist for example) for small-scale off-grid applications?	0
	Are there any other regional standards adopted by the country for the RE technology?	0

KEY SITUATIONAL COMPONENT 1: TECHNICAL CAPACITY OF HUMAN RESOURCE		**Rating scale** **C=3** (compliance) **PC=1 or 2** (partial compliance) **NC =0** (noncompliance)
	Is there demand for these standards from small RE stakeholders (consumers, project developers, manufacturers) in the country?	0
	Is the country a member of the international relevant ISO/IEC technical committees mentioned in the list of standards?	3
	Is there a national mirror committee for ISO/IEC TCs from the country?	2
	Does the country participate in the IEC Affiliate Country program?	1
	Is there participation by country experts at IEC meetings?	1
	Is there a national standards body?	3
	Are they financially independent?	3
	Are they politically independent?	3
	Have they been accredited by international accreditation bodies?	0
	Do they have capacity to monitor and implement market adherence to legal standards & regulations?	1
	Do they have the capacity to undertake (alone or in collaboration with other stakeholders) metrology services?	0
	Have they been accredited by international metrology institutes?	0
	Total for component 3	**19**
KEY SITUATIONAL COMPONENT 4: CONFORMITY ASSESSMENT		
	Are there any certification programs based on the adopted standards?	2
	Are there national certification and/or inspection bodies?	2
	Are the bodies properly constituted in accordance with Labnetwork (UNIDO) and/or accredited internationally?	1
	Are there any conformity tests for the standards?	1
	Are there organizations to develop, implement or provide conformity testing against the standards?	1
	Does the country participate in an international conformity assessment system (such as IECRE) with mutual recognition of certification bodies?	1
	Is there an advisory committee within the country that reviews the technical and administrative requirements for conformity assessment?	1
	Are there incentive programs to encourage both suppliers and consumers to comply with established requirements?	0
	If answer to above Q is yes:	
	Do the incentive programmes have sufficent capacity to monitor and enforce compliance to the certification scheme requirements?	0
	Is the incentive programme able to undertake certification nationwide?	0
	Total for component 4	**9**
ADDITIONAL QUESTIONS RELATED TO: PRODUCT MANUFACTURING QUALITY 5		
	Is the country manufacturing the RE technology?	1
	If Y answer the 3 questions below; if N go the the "IMPORTER" questions	
MANUFAC-TURER	Is there a sufficient share of them undertaking conformity assessment?	1
	Do they have a sufficient level of understanding on standards and conformity tests?	1
	Do they have their own conformity assessment procedures and capacity?	0
	Is the country importing the RE technology?	3
IMPORTER	Is there a sufficient share of them undertaking conformity assessment?	0
	Do they have a sufficient level of understanding on standards and conformity tests?	1
	Do they have their own conformity assessment procedures and capacity?	0

KEY SITUATIONAL COMPONENT 1: TECHNICAL CAPACITY OF HUMAN RESOURCE		**Rating scale** C=3 (compliance) PC=1 or 2 (partial compliance) NC =0 (noncompliance)
	Are there specific import inspection requirements for the RE technology?	0
	If so is there a government body regulating against these requirements?	0
	If so is there a government body inspecting against these requirements?	0
	Are these import inspection requirements based on any of the relevant standards?	1
	Does the country aspire to manufacture the RE technology?	1
	Total for component 5	**9**
	Total for all components	57

According to Gradual Assessment Grid 57 points represent Level 0 which means:
Not enough provisions for compliance with ISO IEC 17025 requirements.

4.2.1 STANDARDISED TESTS: THE CASE OF SOLAR THERMAL ENERGY

Standardized tests are the basis for certification. The procedures for certification are quite different from one case to another. For solar energy equipment the certificates are issued by different certification bodies (CBs) and the tests are performed by laboratories which are sending the test results to the CB. The requirements on the testing and calibration laboratories are accreditation according to ISO/IEC 17025 and accreditation to perform tests according to the relevant standard. The test laboratories shall be recognized by one or more CB.

As an example the list of necessary tests to be performed as part of the certification procedure of solar thermal energy systems is given below:

Random selection of test samples
The solar thermal collectors being submitted for tests should be selected randomly by the designated representative of the test laboratory or certification body. According to prescribed rules, performance test shall be carried out for the smallest and for the largest collector in a lot. Therefore at least 3 collectors (one smallest for the performance tests and two of the largest collector for parallel performance and reliability testing) shall be picked out at the factory/stock. It is also appropriate to make measurements of length, width and height of all other collector sizes in the collector lot.

Requirements on re-testing are minimized
Changes in design, components or materials used in a collector often occur as a result of product development. If the collector is certified the modification must be assessed by the CB before it is implemented in a new product. Depending on which type of changes the manufacturer plans to do, the CB can either approve the change without any requirements for re-testing or require that some or all tests are carried out again on the modified collector.

Reliability tests
Purpose and “time” schedule for the different tests

During the collectors’ life time some severe climatic and working conditions will be met. It is required that the collectors do not suffer Major Failures when these conditions are met. The reliability and durability tests were designed to reproduce the most probable extreme conditions that a collector will be subjected to. For each test, the standard describes in a very simple way the conditions that are intended to be simulated by each test.

In order to shorten the time necessary for tests it is possible to have three samples (collectors) tested:

One collector for thermal performance
The standard indicates that the thermal performance test shall be carried out on a collector that has not been used for the other tests. This collector is only submitted to a short preconditioning with five hours exposure to irradiance above 700 Wm^{-2} before measuring the performance.

One collector for high-temperature resistance, exposure, thermal shocks together with a final inspection
The standard does not impose a sequence on the durability tests but indicates that high-temperature resistance and exposure test shall be carried out on the same collector. The standard also indicates that thermal chocks may be combined with the high-temperature resistance and exposure test, which is a good compromise between the number of samples to be tested and the time needed for testing.

One collector for mechanical loads and rain penetration
Although the present version of the standard allows the use of a third collector for the mechanical load and rain penetration test, this third sample shall be submitted to a pre-conditioning in the case of rain penetration.

During the reliability tests no Major Failure shall occur. These definitions and tests where they are most likely to be identified are shown in the table below.

Thermal performance tests
Two generically different methods are available in the standard to determine the thermal performance characteristics of solar collectors: The Steady state method and the Quasi dynamic method, hereafter generally abbreviated SS and QDT. Both methods are principally ok to use when testing for certification.

SRCC certification however only relies on the Steady state method for certification of non-concentrating collectors and on the QDT for concentrating collectors.

Steady state testing has been used since decades whereas the QDT was introduced when the first edition of EN 12975 was published in 2001. Both methods have their advantages and drawbacks, however in terms of results the two methods are considered to give comparable results for most collectors available in the market.

In a performance test, optical and thermal properties of the collector are determined. Additionally, the Incidence angle modifier (IAM) is a correction factor representing how the angle of incoming radiation affects the performance. Depending on the collector type, additional correction factors can be of importance.

Comparing different collectors
It is not appropriate to compare different collectors by comparing single model parameters (coefficients or correction factors) from testing. The parameters are first of all useful in a complete collector model for calculation of energy gained and for power output from the collector in different kinds of installations. The best way to compare collectors to each other is therefore to calculate the useful energy from a square meter of collector or a whole module under equivalent climate- and load conditions.

The power curve
The power curve is an alternative way of showing the collector efficiency. It shows the power of

a solar collector in dependence of the temperature difference between the mean temperature of heat transfer fluid t_m and the ambient temperature. The temperature difference is plotted on the x-axis and the power of the collector on the y-axis of the graph. For unglazed collectors three power curves are plotted showing results at different wind speeds.

The power curve is calculated out of the efficiency parameters at normal incidence and based on the collector module and not on a certain area. The power values are normalized to an irradiation of 1000 W/m². The highest power is delivered at the point where no temperature difference between the mean temperature of the heat transfer fluid and the ambient temperature exist (t_m-t_a=0).

Annual energy output

Another way of illustrating the collector performance is by calculating the annual energy output from the collector using collector model parameters derived from performance tests together with well-defined climate data and operating conditions. From 2012, all new collector datasheets include annual energy output figures for four locations and three operating temperatures.

Optional pressure drop

For designers of solar collector systems, the pressure drop across a collector may be of importance (e.g. for sizing of pumps).

The pressure drop between the collector inlet and the collector outlet is shown in the pressure drop curve at different flow rates. The pressure drop curve is normally a quadratic function of the fluid mass-flow rate, which means, that the pressure drop increases with the square of the mass flow rate.

Durability and reliability test results

According to the standard, the test reports will include a table containing the performed tests, date performed and a summary of the main results. In the ”Summary of main test results”, the test laboratory will indicate one of the following options; No failure or Pass, No Major Failure or Pass otherwise Major Failure or Fail.

In the case of no major failure or major failure reference to the section of the test report related to that test will be given. In this section description of the occurrence during the test is given. In case of Major Failure the manufacturer will determine what corrections are needed in the Product or in the Manufacturing process and new tests will be necessary for final approval of the product.

In the case of No major failure, a minor problem has occurred. The manufacturer should analyze carefully the description of the problem given by the Laboratory and see if he should introduce corrections in the Product or in the Manufacturing process. If this is done, the Certification body has to be informed in order to evaluate with the Laboratory the need to repeat tests.

Measurement and calculation uncertainties

The overall standard uncertainty in solar collector efficiency values determined by an accredited test laboratory is about 3 %. The uncertainty in calculated energy gain is even higher and could exceed 10 % depending on the operating temperature and test method applied. This must always be taken into consideration when reading test reports and designing solar thermal installations. One should also keep in mind that the uncertainty of final results contains many components: Measurement uncertainty during testing, model uncertainties, manufacturing/ material property uncertainties, etc.

Above listed necessary testings show how many work have to be done in BiH to start using solar PV on the way that is already in practice and regulated in EU.

Listed testings consider measurements which means that next what has to be developed are necessary laboratories where such measurements and testings will be performed. BiH do not have such laboratories and only what BiH have at this moment are state laboratories where physical standards that will be part of the equipment of future laboratories can be calibrated.

Summary of tests and in house testing possibilities described in the EN 12975, which is relevant for testing of solar thermal equipment:

Test	Purpose
Internal pressure	Can the absorber withstand the pressures which it might meet in service?
High-temperature resistance	Can the collector withstand stagnation under high irradiance levels without failures?
Exposure	A short term ageing test aimed at sorting out low quality products. Collector in stagnation for minimum 30 days
External thermal shock	To assess the capability of a collector to withstand a severe thermal shock that can result from a sudden rainstorm on a hot sunny day.
Internal thermal shock	To assess the capability of a collector to withstand a severe thermal shock that can result from an intake of cold heat transfer fluid a hot sunny day
Rain penetration	To assess if glazed collectors are substantially resistant to rain penetration.
Freeze resistance	To assess if a collector which is claimed to be freeze resistant can withstand freezing and freeze/thaw cycling.
Mechanical load	To assess the extent to which the transparent cover and the collector box are able to resist the positive pressure load due to the effect of wind and snow
Impact resistance (optional)	To assess the extent to which a collector can withstand the effects of heavy impacts caused by hailstones
Final inspection	Are there any severe failures such as permanent deformation of components resulting from the tests above?
Thermal performance	How must energy can be gained from the collector at different temperatures, irradiances and more

4.2.2 CONCLUSIONS

In order for the available potential of solar energy to be deployed a number of actions are required to facilitate the demand and market development. Based on the results of the questionnaire a number of generial recommendations on the QI for (smart) metering can be formulated. It should be ensured that:

- Information on support measures is made available.
- Information on the net benefits, cost and EE of equipment and systems is made available.
- Certification schemes or equivalent qualification schemes is made available.
- Customers of utilities are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use. Such a single meter must always be specified when:
- An existing meter is replaced, unless this is not possible or not cost-effective in relation to the estimated potential savings in the long term technical;
- A new link in a new building or a building undertakes major renovations.

The use of smart meters in industrial processes can also increase awareness on other types of energy consumption, and inspire additional energy savings measures, such as more efficient lighting, as has been shown in the case of the pilot project in the beer brewery (see section 5). In that sense this methodology and the case study demonstrate the need for an initiative to come up with a strategic approach to energy efficient lighting. Such strategy should ensure that all relevant policy elements related to energy efficient lighting are taken into account. This includes four strategic priorities:

- Minimum energy performance standards,
- Supporting policies and other facilitating mechanisms,
- Monitoring, verification and enforcement,
- Environmentally sound management.

Specific objectives on QI are:

For solar thermal energy:

- Promote the development and the application of certification schemes for solar thermal equipment
- The success criteria for solar systems (both PV and solar thermal) are present, including solar irradiation, existing tariff (in the case of PV), capital expenditure, political stability, and local knowledge. The missing part is experience through demonstration projects, and a further refined regulatory framework to promote solar energy, and the quality infrastructure in particular.

For smart metering:

- Increase capacity to reduce technical losses and adjust the grids to absorb RE (verification of "traditional" and "smart"meters)

On QI development for both solar thermal energy and smart metering:

- Development of a regional traceability framework for solar irradiation
- Development of measurement capabilities for defining the thermal properties of materials (absorption, conductance)
- Improvement of the competences for traditional energy meter verification
- Improvement of the technical competence for measurements of transmission and distribution of energy (power quality, phasors, transformers)
- Improvement of the technical competences in new technologies of intelligent energy meters (software & communications, hardware)
- Improvement of the regional traceability framework for the magnitudes required by the tests which are necessary for labeling the energy efficiency of the household appliances
- Improvement of the regional traceability of the measurements dedicated to the improvement of the energy efficiency (for instance thermal isolation)
- Develop capacities to improve accreditation service for the relevant CABs (laboratories, inspection and certification bodies) and support CABs to develop the competences in their corresponding activity
- Evaluate the competence of the CABs (PTs – except for thermosolar)
- Diagnosis / Coordinate compilation of information (data) in standardization
- Promote the participation of small countries
- Capacity Building
- Promote the participation of governmental representatives in the regional standardization process

Indicators:

Solar Thermal Energy:

- No. of certification schemes applied to solar thermal equipment grids
- No. of laboratories that have developed and implemented verification services for energy meters (traditional / smart)
- No. of laboratories applying traceable power quality measurements

- No. of certificates of calibration and testing of equipment for smart grids

Based on the details of testing and the country situation in terms of capabilities in relevant laboratories, more efforts are necessary to fulfill basic requirements in the area of QI. The case study of capabilities in BiH for testing solar thermal equipment shows which facilities would be necessary for testing and certification of solar thermal systems. The analysis shows which capacities of QI in the country are needed to initiate and accelerate the deployment of solar technologies, other RE technologies as well as smart meters. While many of the components of the quality infrastructure exist and relevant bodies are in place, tailored actions to allow for specific testing, verification or calibrations are not defined, and simply not practiced. Additional efforts would be required to be ready for providing services in this field, to create sufficient customers confidence, and ultimately, act as a regional service hub in this area.

While the current recommendations may still remain rather general and somewhat fragmented, this initial assessment can form the basis for a more thorough analysis and concrete improvementys as part of a larger technical assistance project to strengthen the countries' quality infrastructure for low-carbon technologies.

4.3 RELEVANT INSTITUTIONS IN THE FIELD OF QUALITY INFRASTRUCTURE

4.3.1 LABORATORY CAPACITY IN BOSNIA-HERZEGOVINA

In the past, the Government of the Republic of Slovenia and IMT supported the development of BiH laboratory infrastructure in related fields and established two testing laboratories in the premises of Mikroelektronika a.d. in Banja Luka and four national laboratories in the premises of Institute of Metrology of Bosnia and Herzegovina (IMBIH) in Sarajevo.

These six laboratories (laboratory for testing of electromagnetic compatibility, laboratory for calibration and testing of electrical power meters, national laboratory for electrical quantities

Institute for Metrology in Bosnia-Herzegovina (IMBiH) in Sarajevo (electrical current, voltage and resistance), national laboratory for time and frequency, national laboratory for vacuum and national laboratory for pressure) are currently in the process of international recognition.

This process implies that they have to provide evidences that all standard meters in these laboratories are calibrated and their certificates of calibration can demonstrate traceability of measurements of related quantities (electrical quantities, pressure, and vacuum) to the international measurement units. When this is fulfilled these laboratories have to provide evidence that they successfully participated in an international scheme of laboratory inter-comparisons (proficiency testing schemes or key laboratory inter-comparisons run by EURAMET).

These laboratories also have to provide written evidence about dissemination of measurement units to the lower level of calibration/measurements. Then these laboratories have to approve their quality systems through peer review by a third party or by an accredited body.

In each step of this internationally established procedure for recognition of certificates it is necessary to keep records about training of the laboratory's staff and to keep records about calibration/testing/measurements they laboratory is performing. This procedure is running in each of the mentioned laboratories.

In the case of a national quality infrastructure (QI), the country should: ensure access to international standards and technical regulations, guarantee reliable measurements, and set up a system that will allow accreditation of their testing and certification facilities in such a way that the results of these bodies will be internationally accepted. A QI also supports local industries and consumers. In most cases, the countries have to enforce standards and technical regulations that conform to international requirements.

A national QI will help to improve and implement the legal framework for standardization, metrology, accreditation and certification of products and bring it them in line with EU standards and international best practice.

Harmonization of technical regulations with those of the acquis, enhance the capacity of the QI management institutions and ensure continuing progress in adopting European and international standards.

This will also ensure that the market surveillance agency is functioning better and continues to take steps to establish a market surveillance structure responding to the requirements of the acquis on free movement of goods.

The Laboratory established in IMBiH provides traceability to international system of units and dissemination of these units to lower levels of laboratories and their standard meters. It is not possible to provide certificates in one country whci will be recognized internationally if the system of national laboratories with recognized calibration and measurement capabilities is not internationally. recognized It is in this context that the six laboratories were established and will help processes of recognition of certification, including in solar energy and smart metering. These laboratories (i.e. laboratory for electrical quantities, laboratory for testing electrical meters, aboratory for testing of electromagnetic compatibility,national laboratory for electrical quantities (electrical current, voltage and resistance), laboratory for testing of electromagnetic compatibility, laboratory for calibration and testing of electrical power meters, national laboratory for time and frequency, national laboratory for pressure) are all directly linked with measurements and certification of different performances of solar PV devices and electrical smart meters.

Laboratorium at Institute for Metrology of Bosnia-Herzegovina (IMBiH)

The conformity assessment has the role within a quality system of differentiating those goods and services that conform to a standard and those that do not.Without such differentiation, standards are of limited use and the economic benefits associated are not reaped. Therefore, the importance of the conformity assessment is directly related with the impacts that metrology and standardization are supposed to bring by increasing their magnitude.

Number of written standards relevant to RE is sufficient as precondition for development other QI elements. It is necessary that those that are interested in certification in RE relevant standards and find measurements, testing, verification or calibration requirements in them and then to develope laboratory that will make specific assessment. Such laboratory then has to apply for accreditation if willing to issue certificates that will be accepted also outside of BiH. In this procedure of recognition all calibration equipment has to have proven traceability up to the measuring unit realization. For this part of work such laboratories has to contact and ask for assistance from IMBIH.

It is of BiH that have developed state institutions that are working in the field of metrology, standardization an accreditation on good level and all of them are part of international relevant organizations.

Inventory of BAS (BIH standards) photovoltaic standards, CEN and IEC photovoltaic standards that are in use and in procedure to be adopted in BiH, was done and given here under References.

4.3.2 MAIN INSTITUTIONS ACTIVE IN THE FIELD OF CONFORMITY ASSESSMENT

The main relevant institutions (in-country or regional) which develop, implement, or provide conformity assessment against the standards or are otherwise active in the field of quality infrastructure and efficient energy management are listed and described below:

WTO – TBT Agreement, Article 6: Recognition of Conformity Assessment by Central Government Bodies – Article 6.1.1 requires:

- Adequate and enduring technical competence

- Confidence in the reliability of conformity assessment results
- Verified compliance through accreditations
- With relevant guides and recommendations issued by international standardizing bodies

BiH has an infrastructure of institutions responsible for international participation, plans of development, coordination and implementation of actions in field of renewable energy. This infrastructure has to continue with own development to provide support on higher level for customers and citizens.

As it is mentioned before the most relevant institutions and companies in RE in BiH are:

Responsibility for international participation:

- The designated UNFCCC focal point and Designated National Authority (DNA) for the Clean Development Mechanism (CDM) for BiH is the Republic of Srpska Ministry for Spatial Planning, Civil Engineering and Ecology.

State level:

- Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina
- The Commission for Concessions of BIH

Entity level:

- Ministry of Energy, Mining and Industry of the FBIH
- Ministry of Industry, Energy and Mining of RS

Regulators in BIH are:

- **SERC -** The State Electricity Regulatory Commission (SERC)
- **FERK -** The Regulatory Commission for Electricity in the FBIH
- RERS - Regulatory Commission for energy of Republic of Srpska
- **ISO BiH -** Independent System Operator in BiH (ISO BH)

Companies for production of electrical energy:

- Elektroprenos BiH
- Public Enterprise Elektroprivreda BiH
- Elektroprivreda of Republika Srpska (ERS)
- Public Enterprise Elektroprivreda HZ HB d.d. Mostar

In addition to the above listed institutions and companies a country will need institutions responsible for development of each element of quality infrastructure.

Technical Regulations should be based on ISO standards and Codex alimentarius recommendations. One National Standards Body elaborates national standards – Responsible ministries issue Technical Regulations and notify to the secretariat of the WTO Committee on TBT and in case of sanitary and phyto-sanitary measures to the secretariat of the WTO Committee on SPS. National Standards Body of BiH is Institute of Standardization of Bosnia and Herzegovina. This institute is a member of CEN (European committee for standardization).

Physical and chemical measurements should be traceable to National Metrology Institute (National Reference Laboratories) under BIPM-MRA.

Testing and analysis should be conducted by accredited laboratories.

Certification Bodies for products and management systems should be accredited.

National Accreditation Body should be internationally recognized for all required types of accreditations by ILAC and IAF-MLA. Institute of accreditation of Bosnia and Herzegovina is NAB of BiH. This institute fulfilled requirements to become BLA Signatory of EA (Bilateral agreement with European cooperation for Accreditation)

Regulatory Bodies should use the national QI infrastructure (with its components internationally recognized).

Quality infrastructure services such as testing, inspection, certification, and accreditation rely on accurate measurements. The metrological and calibration activities are typically performed by the National Metrology Institute (NMI). The role of a NMI is to obtain, conserve, develop and disseminate the basic measurement units and the highest level of calibration standards. It provides traceability to the national system and it ensures that international technical guidelines are followed for the metrological performance and testing procedures of measuring instruments subject to legal controls, and from the point of view of manufacturers it ensures that their products meet international specifications for metrological performance and testing.

With well-functioning NMI, it is easier for companies, research institutes, testing labs, universities, to interact and collaborate, find more efficient production processes and new products for the markets. The quality of the goods produced will be more consistent, hence facilitating commercial transactions and allowing their regulation – the creation of new standards.

Above mentioned is what has been done and developed in BiH but additional efforts has to be done to complete and fill all needed gaps to have QI elements ready for needed measurements and certification. What is needed in BiH is the system of testing, verification and calibration laboratories with proven procedures to work on testing, verification calibration with necessary certifications.

Metrology, standardization, testing, certification and accreditation as parts of quality infrastructure are vital for production and trade of products in a modern state.

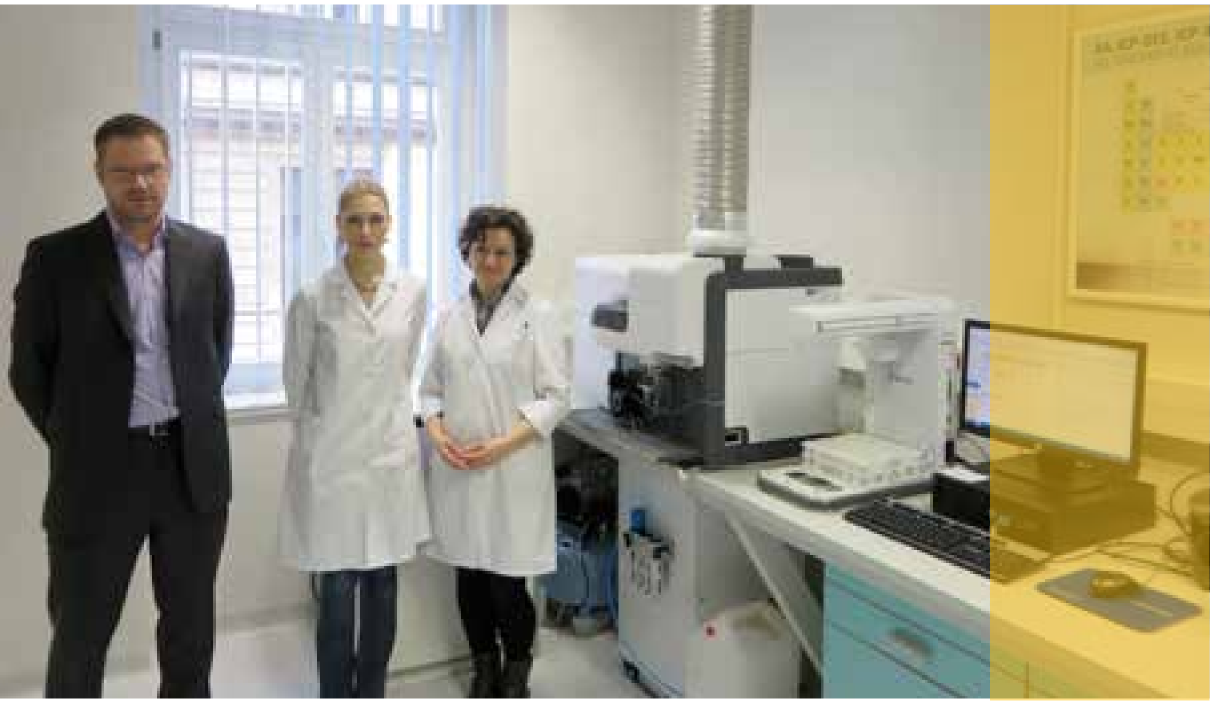
BiH's main entities on QI consist of:

- Institute of Metrology of Bosnia and Herzegovina
- Institute of Accreditation of Bosnia and Herzegovina
- Institute of Standardization of Bosnia and Herzegovina
- Market surveillance Agency of Bosnia and Herzegovina
- Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (as coordinator)

Since the measurement of the consumption of energy basically is linked to metrology and to the activities of national metrology institutes and national metrology infrastructure it is important here to provide more information about organization of metrology of BIH.

The current institutional structure of the metrology system in B&H is as follows:

- Institute of Metrology of Bosnia and Herzegovina (IMBIH)
- Bureau of Metrology of FBIH
- Republic Bureau for Standardization and Metrology of RS
- Nominated metrology laboratories (in field of verification)
- Bodies for conformity assessment of measuring instruments
- Calibration laboratories (accredited)



Laboratorium at Institute for Metrology of Bosnia-Herzegovina (IMBiH)

IMBIH is responsible for coordination of distributed national metrology system in BiH. Their primary task is development of national metrology infrastructure which shall meet the needs of their economy and assure safety and healthy living of their citizens. Accurate and reliable measurements of different physical quantities, which are possible only with traceably calibrated measuring instruments, are important for a breakthrough of BiH economy into a global market.

IMBiH have 25 laboratories that nominated for different fields in metrology to work in the name of the state necessary measurements, verifications and calibration of meters (http://met.gov.ba/obrasci_uputstva/default.aspx?id=1382&langTag=bs-BA).

IMBiH have their own 23 state laboratories that are responsible for realization and maintenance of national physical standards and for providing traceability to international standards. Laboratories for time, frequency, electrical quantities, temperature, heat, humidity, density, volume, for chemical quantities represent good infrastructure for needed measurements in the PV field.

Accreditation body of BiH (BATA) accredited more than 70 testing and calibration laboratories (http://www.bata.gov.ba/bapdf/List-of-accredited-bodies.pdf) and three of them with their scope are closely linked to the needs for here related measurements and calibrations:

1. JOINT-STOCK COMPANY FOR PRODUCTION AND REPAIR “ORAO” - Metrological laboratory Šabačkih đaka bb, 76300 Bijeljina, with scope: complies with requirements of BAS EN ISO/IEC 17025:2006 for competence to carry out calibration of electricity (DC/LF), length, mass and related quantities (pressure, force, torque, flow rate of liquids, hardness), thermometry, time and frequency

2. BNT- MACHINES AND HYDRAULIC FACTORY - Calibration Laboratory, Mehmeda Spahe 1, 72280 Novi Travnik, with scope: complies with requirements of BAS EN ISO/IEC 17025:2006 for competence to carry out calibration of length, angle, and pressure

3. UNIVERSITY OF ZENICA, INSTITUTE OF METALLURGY “KEMAL KAPETANOVIĆ”, Mechanical

laboratory, Travnička 7, 72000 ZENICA with scope: complies with requirements of BAS EN ISO/IEC 17025:2006 for competence to carry out calibration of temperature and pressure

The Institute for Accreditation of Bosnia and Herzegovina (BATA) is an independent administrative and non-profit organization that conducts the accreditation of conformity assessment bodies in Bosnia and Herzegovina.

The Institute for standardization of BiH is an autonomous institution of government administration for affairs related to standardization area.

Market Surveillance Agency of BiH is an independent administrative organization and it is responsible for its work to the Council of Ministers of Bosnia and Herzegovina.

Analyzing the capabilities of laboratories in BiH that can provide services in the field of solar energy certification and smart metering certification it can be recognized that these laboratories are missing or should be improved:

- Laboratory for certification in the field od light intensity (national level an lower level),
- Laboratory with greater capabilities in certification/verification of smart meters,
- Laboratory for additional testing necessary for type approval certification of smart meters,

Existing laboratories in IMBIH, Iskra Emeco, ME should continue with development of own capabilities and with procedures needed for international recognition.

5. PILOT PROJECT ON ENERGY MEASURING EQUIPMENT

5

5.1 INTRODUCTION TO PILOT ENTERPRISE BREWERY BANJALUĆKA PIVARA

Banjalućka Pivara ad Banja Luka produces and distributes beer under the brand names Nektar and Crni Đorđe, as well as other soft drinks, malt and brewers' yeast. It is active both on the domestic market and abroad in United Kingdom, Canada, and the United States. Its major shareholder is Altima Global Special Situations Fund Ltd. The brewery employs 238 staff. The company was founded in 1873 and is based in Banja Luka, Bosnia-Herzegovina. Banjalucka Pivara reported earnings results for the first half of 2014. The company's net profit jumped to BAM 1.6 million in the first half of 2014 from BAM 321,600 a year earlier.

Banjalucka Pivara was chosen as a place for pilot project because of technical and practical reasons. The basic idea of this pilot project in smart metering was to test the possibilities of better measurements and to improve control of engines by using smart meters to understand the consumption of electrical energy in the entire brewing process and enterprise operations. Pivara has different devices in production and measurement systems and it is possible to make different measurements on one place. These possibilities helped to decide to ask Banjalučka Pivara to participate in this project and fortunately this was accepted. Several (15) meters were installed and monitored.

Banjalučka Pivara

When it comes to industrial processes, the quality of energy consumption measurement is crucial. The brewery has been experiencing several problems for which this pilot project intends to provide a solution. The first problem is the high peak consumption (15-min power demand) due to non-optimized power consumption and resulting in an unnecessary high electricity bill. It is very important to understand the production process in order to optimize power consumption while maintaining the quality of the product and the separate processes at the same time. Optimization starts by knowing when and how exactly the energy is being used. Afterwards it will be quite simple to manage power consumption within the factory. The second problem is the assumption that power consuming machines work under their capacities, sometimes shut down or even break down for longer time because the quality of the delivered electric energy does not meet standards and requirements (e.g. fluctuations in frequency of the electricity provided). By recording all necessary information regarding the quality of delivered electric energy, the brewery would have technical input to make their case and protect their legal rights towards the provider of electric energy.

The technical partner to install and operate the smart metering system is company Mikroelektronika. Mikroelektronika (ME) started in 1975 as a part of a large industrial complex - Rudi Čajavec. Rudi Čajavec was a leading company in the field of military electronics and produced 70% of total electronics in the former Yugoslavia whose major export product was the military technology. After developing and implementing thick and thin films' technology, ME became responsible for producing state of the art electronics for radar systems, fighter airplanes' technical equipment, armed vehicles, tanks etc. Being a leader prior to 1990's, ME exported its knowledge, technologies and products to Soviet Union. Since the nineties, many local companies formerly active in the military complex, reoriented themselves towards civil applications. Also ME is now a commercially oriented company. ME prepared the project with the main goal to reduce costs for electricity per hectoliter of sold beer.

Banjalučka Pivara

Road map of pilot project implementation:

1. Make energy-map of the brewery to provide information about:
   - Payment electricity shares (active energy for tariff 1 and 2 and reactive energy consumption in tariff 1) of every part of the brewery and payment terms.
   - Registered monthly 15-mins maximum demand shares of each part of the brewery.
   - Set target range for consumed energy for every part of the brewery. Once set, by continuous monitoring of energy consumption and power demands, aim to prevent exceeding the given range, if possible, without disturbing the brewing process or enterprise operations.

2. Suppress the losses of control of air along the air installation of the brewery since it directly affects the energy consumption.

3. Create a map of the lighting in the brewery and make suggestions to save electricity in this section.

4. Check if installed units for reactive power compensation at transformer substations are correct and service them if needed. Add compensation unit in Transformer Substation 1 (TS1). Goal is to achieve the level of reactive power consumption at metering point for which the brewery will not have any costs.

5. In coordination with technologists, try to move some of the technological processes to lower tariff and try to make time-share of the largest consumers within the brewery in order to cut-off maximum 15-minutes maximum demand.

This pilot project suggests that the potential for energy saving in industrial and economic sectors is significant, especially in energy-intensive Small and Medium-sized Enterprises (SMEs). In the EU context it can be pointed out that in the Green Paper, the European Commission (EC) estimates that the EU energy consumption must be reduced by 20% by the year 2020, which would release a total of 60 billion euros per year for other investments. Such a level of saving would have a positive impact on EU citizens in two ways. It would strengthen the competitiveness of European industry in the context of the Lisbon agenda and could be used for the creation of one million jobs in related fields lead (transportation management, high energy-efficiency technologies, etc). In addition, there is clearly an important benefit in reduction of energy production, which will result in preservation of the environment.

If current trends continue, energy consumption in Europe will increase by 10% over the next fifteen years. The EC intends to reverse this trend by addressing the most important forms of energy savings. A metering device is the place where electricity is delivered and place of separation of responsibilities for given, i.e. taken electricity between distributor and distribution system licensee.

A 'Smart Meter' is defined as an electronic device that can measure the consumption of energy, adding more information than a conventional meter, and can transmit data using a form of electronic communication. A key feature of a Smart Meter is the ability to provide bi-directional communication between the consumer and supplier/operator, and all information can be provided just-in-time, so that reactions can also be instantaneous, whether manual, or even automatic when programmed. The most recent smart meters can combine data from electricity, heat and water consumption.

It should also promote services that facilitate energy savings in households. In addition to bi-directional communication, a Smart Meter may have any or all of the other additional functionalities but have to be connected to an interface. Where roll-out of Smart Meters is assessed positively, at least 80% of consumers shall be equipped with intelligent metering systems by 2020.

In order to meet requirements, electricity meters nowadays must be highly sophisticated devices with a high level of quality and precision. Industrialised countries have recognized the importance of these new products and standardised technical specifications in order to avoid potential monopolistic behavior. Today, the meters are being tested and certified by international laboratories. There is one laboratory in BiH (i.e. Iskraemeco) for testing and verification of electrical meters and it is situated in Sarajevo. This laboratory is part of the national metrology infrastructure since it is authorized by IMBIH to carry out verification work in legal metrology business. This laboratory is now looking for accreditation from BATA. The current capacity of this

left:
Smart metering devices used in Banjalučka Pivara

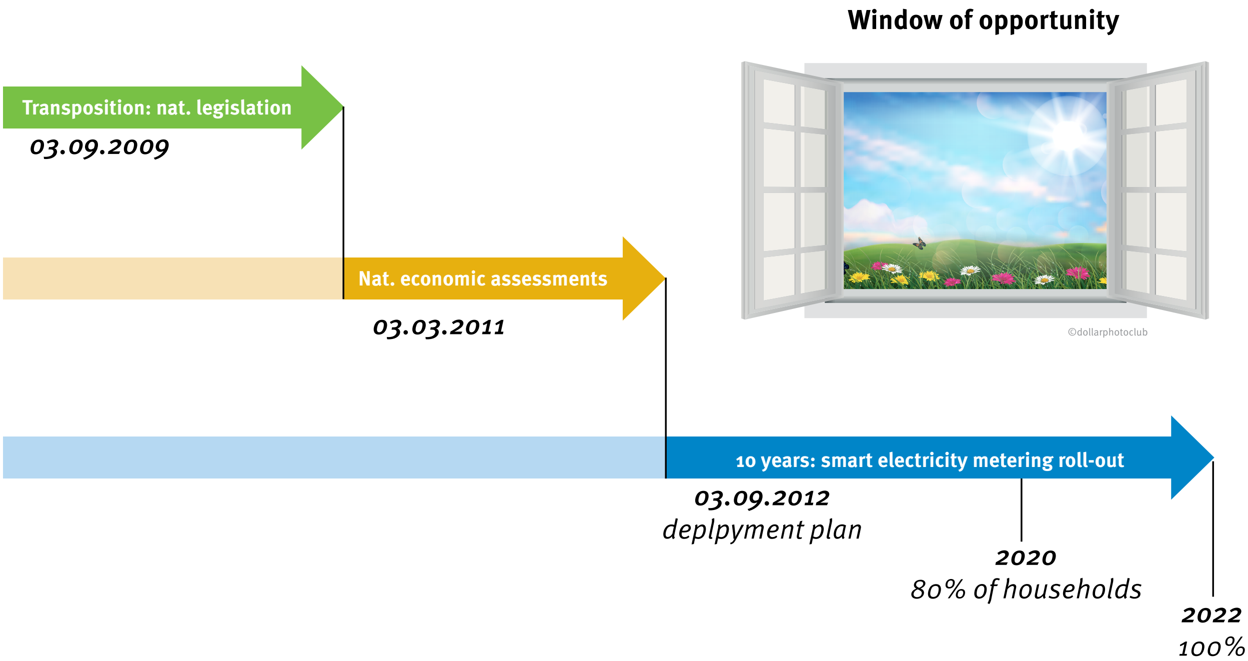
right:
Opening of the EMC laboratory in Mikroelektronika

laboratory is not sufficient to fulfill requirements for periodical verification of about 1,2 million electrical meters in BiH. Another laboratory in the field of electrical meters in BiH is the laboratory of Mikroelektronika in Banja Luka. This laboratory can perform type approval testing of electrical meters and it is also in the process of proving its competences towards the national accreditation body - BATA.

Improvements in EE can lead to considerations for RE investments as well. For instance the brewery's management is now looking into the use of bio-energy, and potentially solar thermal applications to provide process-heat. Production of energy from RE sources often depends on local or regional SMEs for manufacturing, installing, operating and maintaining, but also sales, distribution and consulting services. The opportunities for growth and employment, to bring investments into regional and local production of RE sources, can thus contribute to innovation and new job opportunities. In developing a market for RE technologies, it is important to take into account the positive impact on regional and local development opportunities, export prospects, social cohesion and employment opportunities, particularly for SMEs and independent power producers. To reduce greenhouse gas emissions and dependence on energy imports, the development of energy from RE sources should be closely linked with increased EE. The move towards decentralized energy production can have many advantages, including the use of local energy sources, increased local security of energy supply, shorter transport distances and reduced energy transmission losses. Such decentralization also promotes community development and cohesion by providing income sources and creating local jobs. While these additional benefits are typically not quantified in individual investments, it provides the justification for policy makers to support the demonstration and commercialization phase of decentralized RE technologies. Setting mandatory national targets is one way to support the deployment of RE sources – if the country is deemed ready for it – and could provide certainty for investors and project developers to initiate renewable energy projects.

Pilot project results can encourage further research into and debate on the best use of Smart Metering technologies in BiH. Feedback and discussion on the report's findings or future research topics are thus very welcome and would be appreciated. If the economic assessment is negative, this would certainly mean that the 80% target by 2020 does not apply; it may even affect the overall roll-out plan. If no national economic assessment is made, this does not affect the specific timeline and targets set for the implementation of intelligent metering systems.

Figure 2. Smart Meters road map



The European Smart Metering Industry Group (ESMIG) is the European industry association that provides knowledge and expertise on Smart Metering and energy-related consumer services within the Smart Grid area at a European level.

ESMIG covers all aspects of multi-commodity metering and consumer energy management. Member companies cover the entire value chain from meter manufacturing, software development, installation and consulting to communication services, home energy management products/services and system integration. BiH did not implement smart metering systems so far. Further step in smart metering technology is evolution from smart metering to smart grids. Evolution from smart metering to smart grids should pass the following phases:

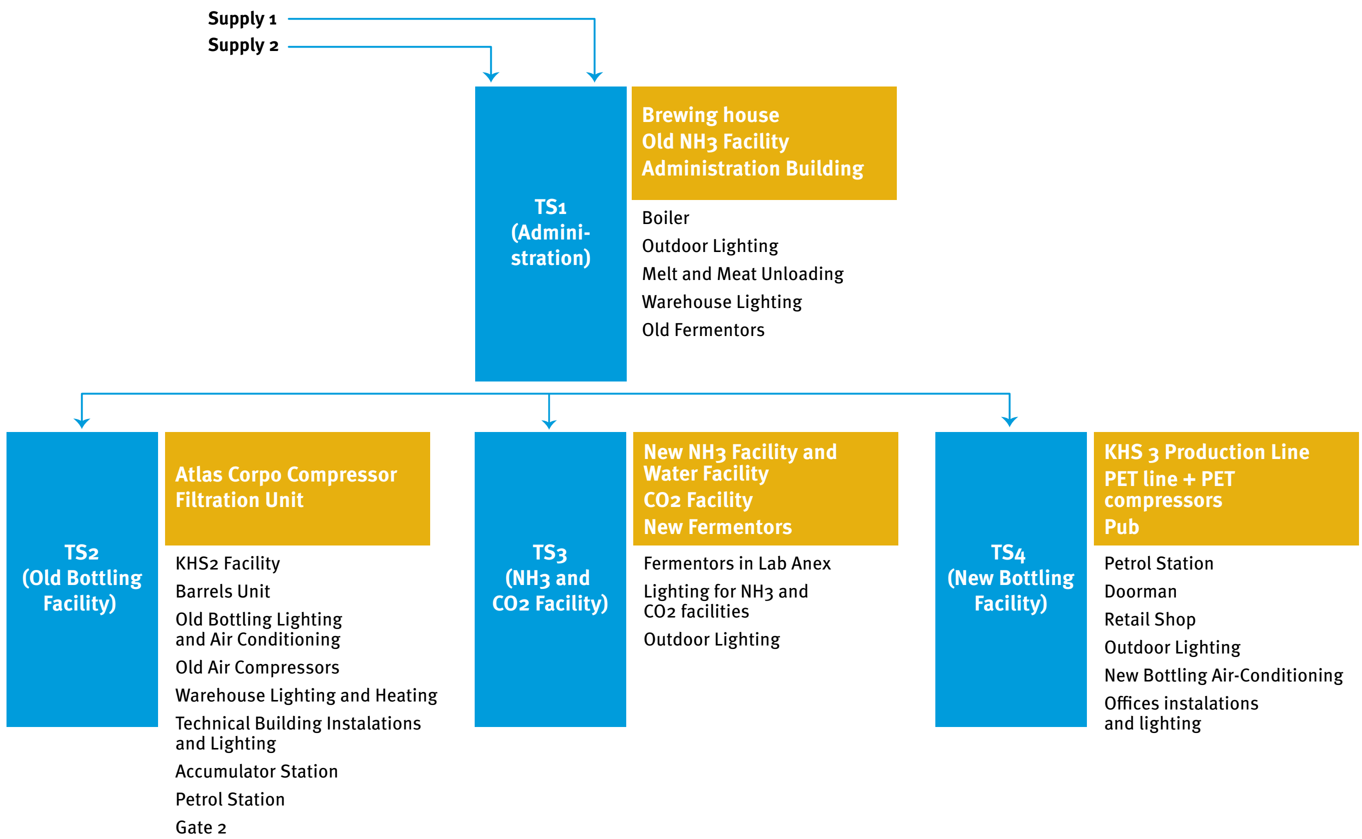
- AMR (Automatic Meter Reading)
- AMM (Automatic Meter Management)
- AMI (Advanced Metering Infrastructure)
- Smart Grid

Elektroprivreda BiH is running a pilot project aiming to gain experience in smart metering by installing approximately 4000 electrical meters provided by three different producers. The company will be able to analyze interoperability between different meters and to start practicing smart metering. The intented next step is to start the replacement of 120,000 standard electrical inductive meters with smart meters, and is planned for next year.

5.2 ENERGY MAP OF THE BREWERY

There are four transformer substations (TS1, TS2, TS3, TS4) within the brewery which provide electricity to separate production units. Transformer substation TS1 is double-fed and supplies the other three substations as shown in Fig. 3. Indirectly connected electricity meter are owned by local distribution company Elektrokrajina (as a single-point of measurement for whole factory) and is located at TS1 together with the control meter of the same characteristics.

Figure 3 Transformer stations and its production units within "Banjalučka pivara"



After consultation between ME and engineers from the brewery, some assumptions were made on what the major points of electricity consumption would be in the brewing process and the entire enterprises'operations, and the CT operated semi-direct meters were accordingly installed at those targeted facilities. Metering results were obtained for the period September to October 2014 (see Table 1).

CT operated semi-direct meter are designed for measuring active and reactive energy, maximal power of the above stated energies, registration of load curves and quality parameters of supplied electric energy in three-phase four-wire networks, with nominal frequency of 50 Hz.

About active and reactive energy consumption:

The active/reactive energy is recorded as cumulative values in the memory of the meter and the old value of energy is continuously replaced with the new value. The consumption during a period (September - October) is obtained from the difference between the new (recorded 1.10.2014 in 00:00:00 h) and the old value (recorded 1.09.2014. in 00:00:00h) (see Table 2).

Notes about Table2:

1. The First column is the name of internal meters
2. Total Controlled Facilities is sum of energy measured by internal meters.
3. Total Brewery is energy measured by main meter (electricity meter owned by local distribution company Elektrokrajina)
4. Controlled Facilities % is the percentage value of Total Controlled Facilities
5. *Active Energy T1 [KWh]* is active energy consumption in first tariff (T1 – high tariff) measured by internal meter for period of September to October 2014
6. *Active Energy T2 [KWh]* is active energy consumption in tariff two (T2 – low tariff) measured by internal meter for period of September to October 2014
7. *Reactive Energy T1 [kvarh]* is reactive energy consumption in first tariff (T1) measured by internal meter for period of September to October 2014
8. Active Energy T1+T2 [KWh] is sum of active energy consumption T1 and active energy consumption T2.

Table 4 Electricity consumption for Sep - Oct 2014

	Active Energy T1 [kWh]	Active energy T2 [kWh]	Reactive Energy T1 [kvarh]	Active Energy T1+T2 [kWh]
MG6 – NH3	89,992.0	97,803.8	45,088.8	187,795.8
MG2 – Atlas Copco	68,483.4	53,185.3	51,229.8	121,668.6
MG7 – KHS	65,715.8	20,838.6	33,717.1	86,554.4
MG8 - PET	49,594.4	7,670.0	34,954.8	57,264.4
MG1 – Brewing house	16,055.4	11,780.0	9,895.1	27,835.4
MG5 – CO2	17,931.2	17,363.0	9,914.4	35,294.2
MG9 - Pub	13,483.0	9,690.4	3,421.6	23,173.4
MG4 - Fermenters	4,713.6	4,795.4	1,846.8	9,509.0
MG3 – Filtration unit	3,958.2	3,991.4	2,102.6	7,949.6
MG10-Old NH3	30,525.6	15,855.4	31,375.4	46,381.0
Total Controlled Facilities:	360,452.6	242,973.4	223,546.5	603,425.9
Total Brewery	507,748.0	361,388.0	290,348.0	869,136.0
Controlled Facilities %	71.0	67.2	77.0	69.4

From the results it can be cleary seen what the biggest consumers of active and reactive energy are and but also that there is a lot of remaining active and reactive energy consumption coming from not controlled facilities within the factory. This led to another objective of the pilot project, namely to locate this unknown consumption so that the related cost can also be lowered.

In addition, it was found that that the active energy consumption in tariff one is bigger than active energy consumption in tariff two. It can thus be considered to organise work in some parts of the factory during the period of tariff two (since the price for energy consumption in tariff two is lower than price for energy consumption in tariff one). This measure should also lower the cost of energy.

The diagrams below show the relation between active energy consumption in tariff one and the sum of active energy consumption in tariff one and tariff two.

Figure 4 Structure of Active Energy Consumption (Sep – Oct 2014)

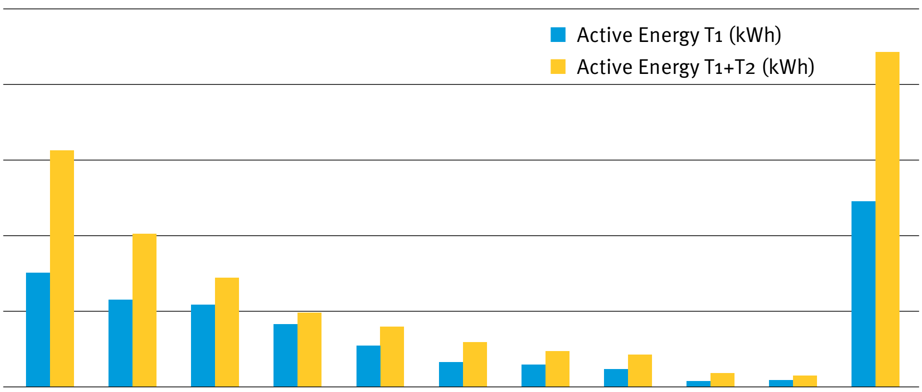
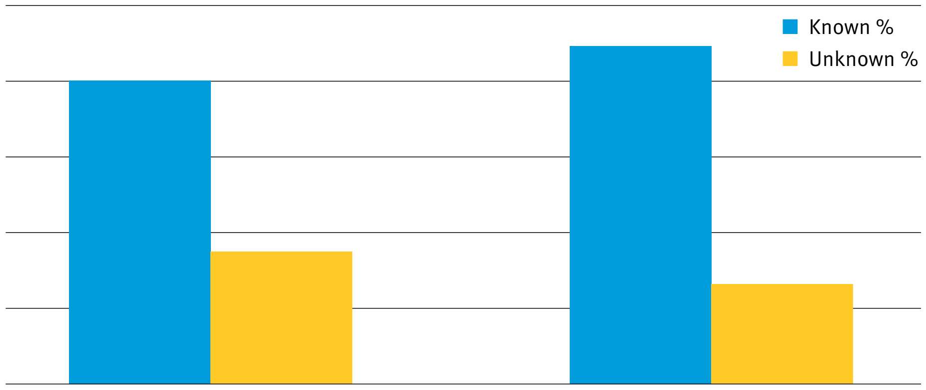


Figure 5 shows the relation between known active/reactive energy consumption in tariff one (active energy measured by internal meters) and unknown active/reactive energy consumption in tariff one (active and reactive energy consumption coming from not controlled facilities within the factory).

Figure 5 Known/Unknown energy consumption (Sep-Oct 2014)

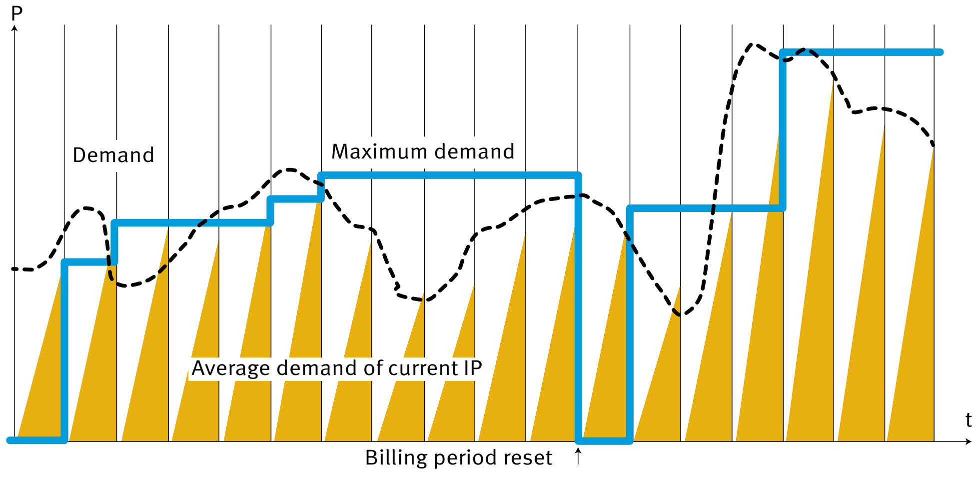


From Figure 5 it is clear that there is a lot of remaining active and reactive energy consumption coming from not controlled facilities within the factory. One suggestion would be to make portable measuring device which will be used to measure unknown energy consumption, and depending on results suggestions can be formulated on where to install new internal CT operated semi-direct meters.

About Maximum power demand:

Maximum power demand is the highest average value of demand determined during the entire billing period.

Figure 6 Maximum power demand



At the end of each integration period, the meter compares the current average value of demand with the previously highest average value of demand for the current billing period.

- If the current average value is less than the highest average value, the maximum demand remains unchanged.
- If the current average value is equal or greater than the highest average value, the meter stores the current average value as new maximum demand and simultaneously records the time (date and time-of-day) at which the new maximum occurred.

Therefore, the meter determines a high number of average demand values during the entire billing period, but normally only records the highest value. All other values are lost, unless they are stored to the load profile. The important information for the utility (in terms of charging the consumer) is this maximum recorded value. The utility always charges the consumer for this peak in consumption. In some cases, the high maximum power demand can add up to 30% of the monthly bill, when the registered peak is too high, which is why this information was a crucial result from the energy measuring campaign, as it enables to define a way to lower this peak by controlling the consumption within the production.

15-mins maximum power demand for September and October is shown in table below (Tab.3):

Notes about Table 2:

1. ***On invoice*** is maximum power demand measured by main meter

2. ***Measured by internal meters*** is sum of maximum power demand measured by internal meters

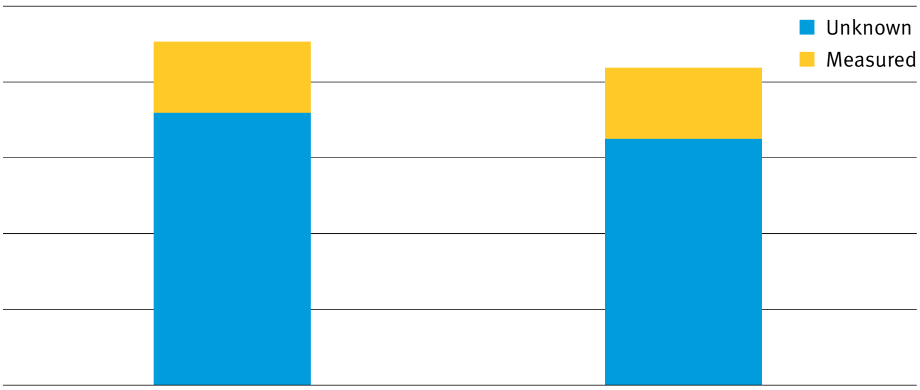
3. ***Unknown*** is maximum power demand measured by unknown consumers

Table 5 Maximum power demand (Sep - Oct 2014)

	Sep 2014 Pmax [kW]	Oct 2014 Pmax [%]	Oct 2014 Pmax [kW]	Oct 2014 Pmax [%]
On invoice	1406.00	100.00%	1316.8	100.00%
Measured by internal meters	1117.39	79.47%	1023.56	77.73%
Unknown	288.61	20.53%	293.24	22.27%

On the side of registered 15-mins maximum power demand, we saw that more than 20 % of them were coming from unknown consumers (see Figure 7):

Figure 7 Maximum power demand structure (Sep - Oct 2014)

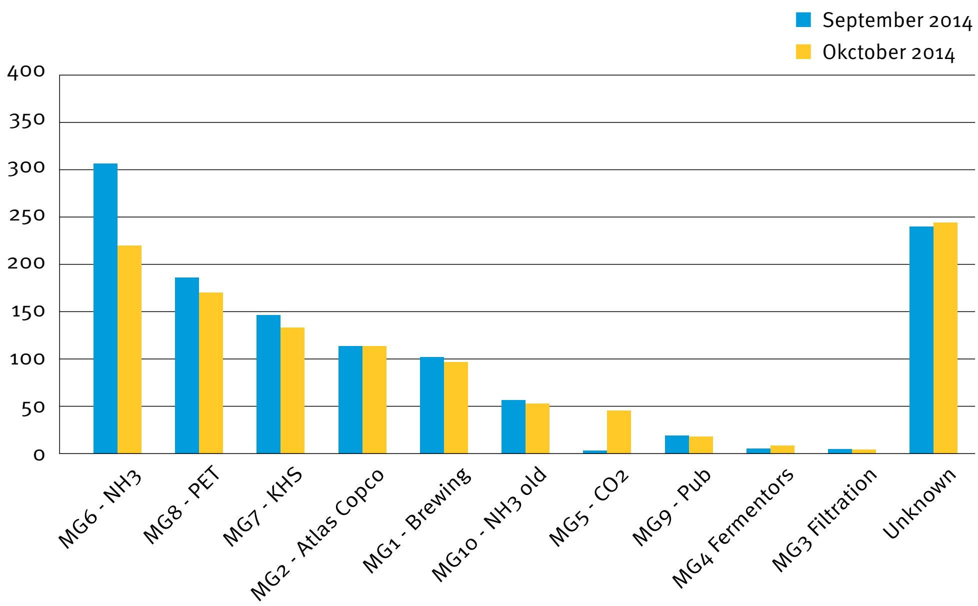


Registered maximum demand of power structure is shown in Table 3 and Figure 8.

Table 6 Maximum power demand structure (Sep - Oct 2014)

	Sep 2014 Pmax [kW]	Oct 2014 Pmax [kW]
MG6 - NH_3	366.76	261.72
MG8 - PET	222.12	203.18
MG7 - KHS	177.02	158.77
MG2 - Atlas Copco	133.02	133.92
MG1 - Brewing house	118.75	119.09
MG10 - NH_3 old	65.94	64.26
MG5 - CO_2	2.83	52.93
MG9 - Pub	20.80	19.81
MG4 Fomenters	5.96	8.22
MG3 - Filtration	4.19	1.66
Unknown	288.61	293.24

Figure 8 Power demand structure (Sep - Oct 2014)



5.3 RESULTS OF TWO MONTHS PILOT-PROJECT

Having installed the first group of CT operated meters within the factory on major production units, the engineers from brewery came up with the following suggestions for maximum power demand decrease:

1. Try to organize work of PET and KHS facilities in different work-shifts

2. If possible, organize work of brewing house during weekends, while PET line and KHS line are out of service

3. Try to arrange fermenter cooling during nights and weekends

4. In the long term, the brewery should replace the existing air compressor with a new one which is frequency regulated. Also, reducing losses of air along the installation would result in shorter active work-time of compressor, which would decrease the probability of its participation in the registered maximum power demand. When replacing old equipment with new, it is also suggested to procure energy efficient equipment

5. Create a map of the lighting in the brewery and make suggestions to save electricity in this section (Indoor and Outdoor Lightening)

Note that measures 2 and 3 would also produce more electric energy to be consumed in low tariff, which would result in electricity bill regarding active (and reactive) energy consumption.

5.3.1 INDOOR AND OUTDOOR LIGHTNING

Electricity for lighting accounts for approximately 15% of electricity consumption and 5% of CO_2 emissions worldwide. If not addressed properly, global energy consumption for lighting will grow by 60% by the year 2030. This would have dramatic consequences for climate change. The phase-out of inefficient incandescent lamps and their replacement with higher efficiency products, such as light emitting diode lamps, provides one of the most straightforward and cost effective ways to significantly reduce carbon emissions.

LED lamps are an excellent example of energy savings through technology innovation. With 20 percent of the world's electricity used for lighting, it's been calculated that optimal use of LED lighting could reduce this to 4 percent. The LED lamp holds great promise for increasing the quality of life for over 1.5 billion people around the world who lack access to electricity grids: due to low power requirements it can be powered by low cost local solar power.

LED lighting can be a straightforward and practically easy energy efficiency measure with immediate impact on electricity costs, in different sectors of the economy in BiH. The existing legislative framework recognizes the necessity of EE improvements as is demonstrated by the statement that "the realization of the requested levels related to energy efficiency through decrease of energy losses, decrease of energy consumption by introducing new technological solutions in different sectors (public sector and sector of public services, civil engineering, agriculture, industry, traffic, etc.)" and there is also some recently established production of LED lamps in BiH.

Current lighting being considered for replacement by more efficient LED lighting

From Table 4 it is evident that the consumption of electrical energy in industry is not the biggest part in total consumption, because of the currently limited development of industrial activity in BiH. The main part of consumption is currently from the categories "Households" and "Other consumption", implying that it can be reasonably foreseen that lightning is and will remain a big consumers of energy in BiH. Any strategy to reduce energy consumtion in BiH would thus be able to relatively easy achieve a direct impact by focusing on more efficient lightning.

Table 7 Final consumption of electrical energy structure in BiH in the period 2010–2011

Year	2010.	2011.
Industry total (GWh)	3692	4131
Industry (%)	35.8 %	38.3 %
Transportation (GWh)	136	139
Transportation (%)	1.3 %	1.3 %
Households (GWh)	4542	4541
Households (%)	43.8 %	42.1 %
Construction (GWh)	127	84
Agriculture (GWh)	89	94
Other consumers (GWh)	1761	1799
Other consumption total (GWh)	1977	1977
Other consumption total (%)	19.1 %	18.3 %
Consumption total (GWh)	10347	10788

Installed power of all lightning equipment within the brewery is given in Table 5.

Table 8 Installed power of all lightning equipment

Facility	Total power in Watt
New Bottling	19326
Old Bottling	47900
Brew house	14568
Filtration	8188
Compressor station	6.018
Old brew house, road to TPV	452
Barrels house	3308
Heating substation at Old Bottling	5870
Offices and doorways – Old Bottling	2140
Annex – Old bottling	5524
Gate 2	2739
Turners workshop	2504
Boiler	4399
Garages	1050
Old fermenters	4244
New fermenters	7212
Water treatment	1200
Laboratory	5520
Retail shop	1420
Gate 1	3124
Transformer substations	1476
Warehouse	1908
Beer tapping apparatus service	884
Outdoor lightning	16800
Administration unit	33431
Total power of lighting within the brewery:	200321

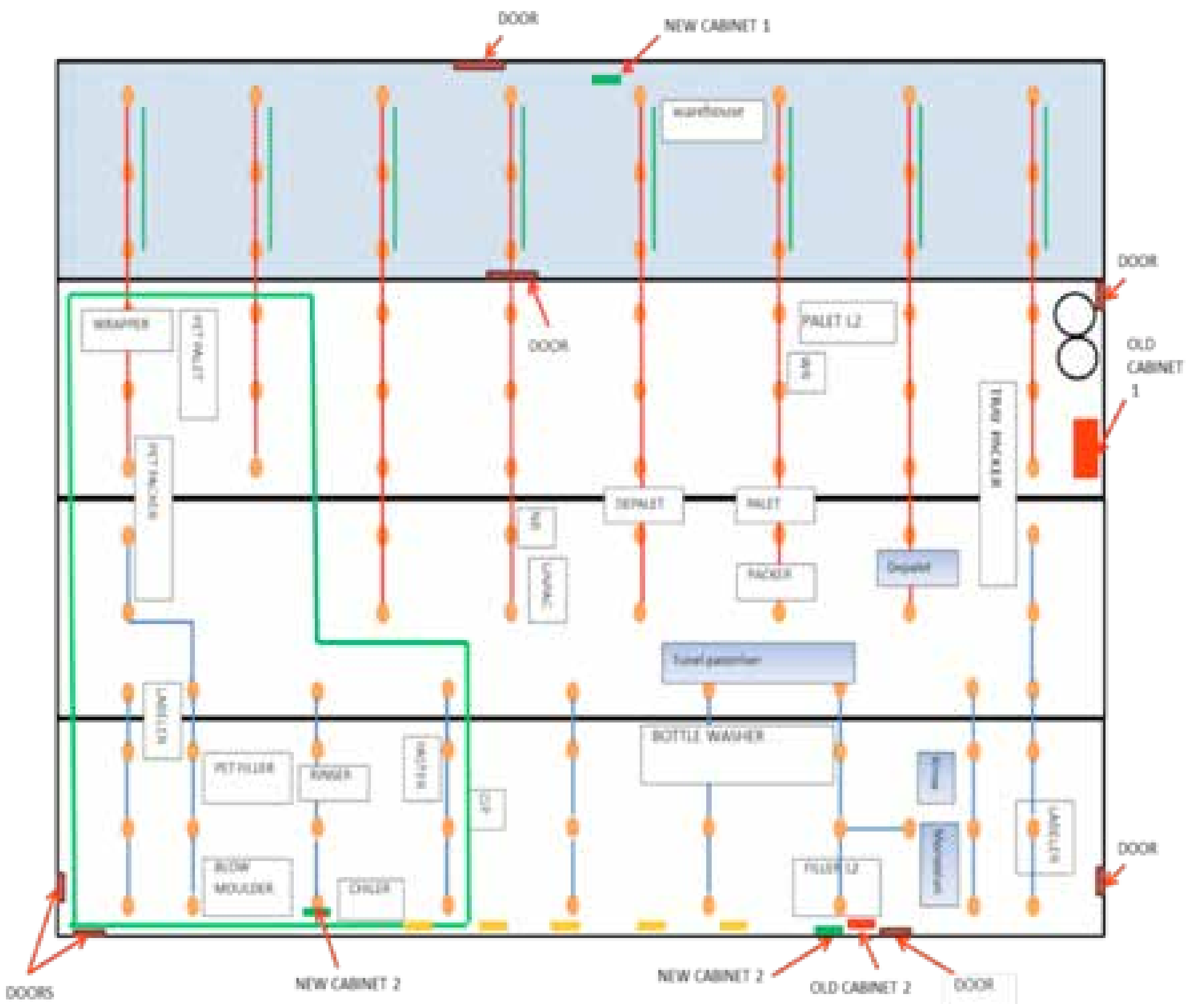
Instead of the current solution of switching on and off all lights at once within the unit or sometimes half of them at once, lighting should be divided into more sections based on requests of facility managers. Proposal for Old Bottling unit is shown in Figure 9.

This solution would result in a more logical lighting control (turning on lights as and when needed) and thus add savings to monthly costs for electrical energy. The same principle has to be applied in other units.

Hg-bulbs of 400W or 250W power should be replaced by 125W energy saving bulbs. This replacement should not be a massive and immediate measure, it could be done gradually by replacing defunct bulbs with new ones.

The option of LED lighting would actually result in significantly higher electricity reductions but it requires a significant upfront investments. The factory cannot afford this investment at present but may consider it later.

Figure 9 Old Bottling Unit Lighting Modification Proposal



5.3.2 COMPENSATION OF REACTIVE POWER

There are three Reactive Power compensation units located at:

- TS1 without any documentation
- TS3 – 2x50 kVAr, active from 2000
- TS4 – 200 kVAr unit, active from 2004

Despite having these compensation units, monthly costs for reactive energy are significant; last year the cost of reactive energy was approximately EUR 15,000. Such figure suggests that the compensation units are not appropriately or actually working. If this can be fixed it would result in zero or very low costs for reactive energy. Total investments (if needed) would be paid-back in one year only. Adding a compensation unit in TS2 was also identified as a necessary measure.

5.3.3 CONCLUSIONS OF THE PILOT PROJECT

The results on the enterprises's indoor and outdoor lighting, as well as the compensation of the reactive power have had a direct impact on the brewery's energy use, and - especially in case of the reactive power - a direct and significant financial benefit. In addition the pilot project enabled the technical staff to get an improved and detailed insight in the different parts of the brewing process and the enterprises's overall operation.

The information received from engineers also yielded some unexpected and additional benefits:

- The system allows measuring, control and tracking of the energy consumption throughout the productions and it provides information about all characteristics of the energy (active energy in both tariffs, reactive energy in tariff one, 15-minutes maximum demand, etc.).

- The energy profile gave insight into the profile of archived 15-minute maximum. Now it is known exactly which consumption point participate in the reached maximum. It is especially important that now it is clear what percentage of the maximum is reached by consumption points which do not participate in the production (such as heating, cooling, etc.). Based on this information, immediate actions were taken so that production facilities are organized in different order and some have been separated into different schedules, in order to lower maximums. Also, after learning about some failures in air compression units and other consumers which do not participate in production processes directly, and by fixing these problems, additional efficiency has been accomplished. All these activities resulted in lowering the electric energy consumption from 17.2 kWh/hl down to 14.3 kWh/hl, even though an additional production line has been installed into the production, and this additional can filling line has installed power of approximately 75kW.

- Additionally, measurements showed that compensation for reactive energy was not set properly and that the brewery had approximately EUR 15,000 of yearly expenses due to the reactive energy. Now these mistakes have also been fixed and currently the brewery has no expenses related to reactive energy. This saving on its own, already covered the whole investment.

- Rescheduling one of the breweries sprang; they lowered the bill for the electric energy even more.

After all expected results were accomplished, engineers went even deeper into reports provided by smart meters and some interesting conclusions came out of this. Some of these could be quite useful for any production factory with similar problems or intentions:

- By having an insight into each individual point of consumption within the factory and the profile of the consumption, the engineers learned that the air compression unit had extremely high electric energy consumption when it was in standby mode. Calculations suggested that the investment in a new air compression unit will add to the savings and therefore the investment was granted by the management and consumption is lowered in this section of the brewery, as well.

- Currently, smart meters are installed to register the consumption of the lighting within the factory and analyses are in progress, in order to decide on switching to LED and choosing the best solutions in this area.

- Now engineers in the brewery have all relevant information about the energy delivered by the utility. Specifically, it is important to know the quality of delivered energy and profile of consumption. This information will be very useful now that industrial consumers got the right to choose the provider of electric energy.

- Existing installed smart metering system in the Brewery is designed to provide all information collected by central software. All installed meters communicate with central software through GPRS communication. Location of the Brewery does not allow good GPRS connections as the network is not of very good quality. Therefore, it is not possible to collect all information from meters instantaneously, at any moment needed. Plus, this communication is also charged by the mobile operator. The first next step will be the change in the communication. Meters will be connected by cables, so that the central computer will get all needed information just-in-time. Together with Mikroelektronika they will define some specific measuring schedules of maximum demand, so that the profile of maximum will be created. In this way, engineers will have an opportunity to prevent potential peaks by activities within the defined 15-minute period. For example, if the profile of the consumption will show that maximum demand is rising above some the set limit, the system will alert the engineers to intervene by switching off some of the consumers which will not affect the production. The next step will be programming the system to perform such actions automatically.

Within a short measuring and monitoring period of two months this pilot project provided surprisingly good results which demonstrate and underline the benefits of smart meter usage and expert analysis. Indeed, having a smart meter (set) will not automatically reduce the electricity use and save money. It is as important to interpret and use the information from the smart meters or energy display to work out where own energy use can be reduced and the energy bill cut accordingly. The combined expertise of the enterprise's technical staff who know the industrial process and the facilities, and the experts on smart metering and measuring, is critical to maximize the results of a smart metering measuring campaign.

It can reasonably be expected that similar energy and cost savings can be realized in similar enterprises, in sectors such as beverages, distilleries, food-processing, leather and furniture. Recognised and future additional benefits of smart meters include:

- Faster resolution of problems – where there are technical problems and faults with the supply of energy, smart meters would make it easier and quicker to identify and fix the problem. This means less inconvenience and may mean less time without energy supply

- The smart mMeter will report back on electricity issues (such as periods of low voltage) to deliver better quality of supply

- Could help save money – by having an idea of which appliances use the most energy, it may be possible to reduce energy usage and save money
- Accurate bills – the smart meter will send information to the energy supplier on how much energy is used. There will be no more estimated readings. Customer will be billed for what is actually used in the billing period.
- It facilitates pre-payment schemes. Possibility to choose to change from a prepayment to a credit meter, and vice versa
- It streamlines the process of moving in and out of a property
- Smart Metering allows customers to better manage their own electricity costs
- It provides consumers with precise details of their consumption patterns, allowing them to better manage their use of electricity
- It will facilitate the use of home energy management systems
- It will enable ways in which consumers can manage their electrical use remotely
- A standard in-home energy display which shows how much energy the customer is using at any one time. It will give information on how much energy was used in a previous period, so it is possible to keep track of energy usage and budget more easily
- Energy suppliers can offer additional services to help to understand how much each device is using, such as online information, more detailed bills
- Micro-generation – if one generates part of its own electricity (e.g. solar panels or a wind turbine), a meter will be installed at the point of generation to measures how much electricity is being generated. In addition, a smart meter will be able to record and monitor how much energy is sold back to the grid. However, the standard energy display will not show this information.

After two months of measurements and analyses it has proved possible to make very precise decisions about necessary measures for instant savings and increase of efficiency. The demonstrational value of this project is significant since engineers working with the same facility were not in position to analyze the consumption pattern with the same level of precision since they were not equipped with the appropriate meters and the according software that is used.

The pilot project was carried out with a relatively small investment, which turned out to be paid back in approximately 3 months. The pilot project was carried out in a cost effective way, from installing the meters, functioning wireless connection, validated software.

Still, such investments may be a barrier for SMEs, which is why this project was supported and the results of this pilot project are hoped to trigger and stimulate replication by other SMEs. Thanks to this pilot project the brewery managed to reduce its product energy intensity from approximately 17 kWh per hectoliter to 14 kWh per hectoliter, which equals a reduction of close to 20%. The international benchmark of under 10 kWh per hectoliter is still a far-away goal, but is typically applicable in very large breweries procuding over 1 million hectoliter of beer. This brewery produces approximately 400,000 hectoliter of beer.

5.4 TRAINING OF TARGET ENTERPRISE STAFF ON ENERGY MEASURING EQUIPMENT

5.4.1 TRAINING ON ENERGY MEASURING EQUIPMENT

The training for employees in target enterprises in the area of handling energy measuring equipment (and the potential of using solar energy as a further option) as well as efficient energy management was provided alomng with the purchased demonstration equipment. After installation of measuring equipment at the brewery, a training was organised for the brewery's employees. It was demonstrated how parameters can be read from the meter via GPRS modems using their central software.

Once communication with the meter is established it is possible to:

- Read out the meter (clock read out, tariff table read out, read out the state of security switches, read out all kinds of energy, read out all kinds of power, read out archive for billing, read out fifteen-minutes load profile, read out event log, read out network quality parameters)
- Parameterize the meters (parameterization of clock, parameterization all parameters of the tariff profile)
- Perform some action (reset of maximum power, reset of security switches, etc.)

In Banjalučka pivara, the visitor can learn about the reasons for installation of control meters and about the results they got. The most important result is the ability to lower maximum demand by knowing exactly how much power is being consumed in the plant at any given time.

As maximum demand measured in the 15-minutes period is used by to utility to charge the consumer, and in most cases this element of the electricity expense is extremely high, it is one of the most important issues to deal with. Banjalučka pivara can now lower this cost significantly simply be reorganizing the usage of machines and systems.

It is interesting to also learn about additional benefits from this pilot project. For example, engineers learned about some old machines which used too much of the energy and the calculation based on this information showed that investment in new equipment will save additional money. Some information showed that there was equipment which was no longer functional and by returning that equipment back into the system, it became even more efficient (Reactive Power compensation units in TS3 and TS4).

The staff received information about benefits they could get by usage of smart meters, efficient energy management and potential of using solar energy by installing photovoltaic cells or solar thermal equipment.

Since Mikroelektronika has a cooperation with IMBiH – the National Metrology Institute – the training was organized with particular focus on smart metering, as well as on smart grids as an advanced section. Presentation for training the people is attached to the report.

5.4.2 VISIT TO MIKROELEKTRONIKA'S PRODUCTION FACILITY

In addition a half-day training in Mikroelektronika's production area was organized in February 2015. Participants got a chance to get familiar with the process of production and final product verification, labeling and packaging. As Smart metering is one of major topics in EU and world-wide, ME provided all necessary information for the visitors to learn not only about the products, but also about related industries such as IT and communications, as these will open even additional opportunities for development and improvement of the technologies.

Project team in front of the brewing house

Below is a list of training activities with approximate times spent for each of planned activities:

1. Welcome words from General Manager during which participants are introduced with history of company, actual projects and future plans (30 min)

2. Visit to Production Department with presentation of each step in production of smart meters: SMD line, automatic and manual soldering, mechanical assembly units, firmware writing unit, calibration, final verification and packaging (30 min)

3. Visit to Service Department (15 min)

4. Lunch or coffee brake (30 min)

5. Visit to Research and Development Department: In ME R&D, visitors have an opportunity to realize why this department is one of ME greatest strengths and how quickly ME teams can respond to requests and needs of customers. These teams cooperate and multifunctional personnel deals not only with current projects, but they all also constantly learn about markets, trends and new technologies which ME tend to implement whenever possible and as fast as possible. Visitors can learn more details about current projects in this Department and what they plan to do in future. They can also have an opportunity to hear briefly about the development tools such as "Altium Designer" (Altium Designer is an electronic design automation software package for printed circuit FPGA and embedded

software design), "SolideWorks" (SolidWorks is solid modeling computer-aid design software), Kail (C compiler for 8051 microcontroller and ARM processor). (30 min)

6. Visit to Test Laboratory was organized with the presentation of the equipment in the EMC (Electromagnetic compatibility) lab and demonstration of some of the tests. The EMC laboratory as a part state metrology infrastructure has been a great addition to ME R&D as it speeds significantly the processes of development and it also helps prepare for international certification. (30 min)

7. Presentation about Smart metering and Smart grids: As this is one of the most important elements of the presentation, being one of very important global project, it was provided presentation about smart meters (benefits of smart meter usage), AMR (*Automated Meter Reading*), AMM (*Automated/Advanced Metering Management)*, AMI (*Advanced Metering Infrastructure)*, *Smart grid* systems and presented characteristics of ME devices (smart meter, modems, concentrator (AMRC), system etc.). ME also focused on some of the major problems related to the energy worldwide and all the issues which those governments and utilities need to deal with. Systems for management of energy consumption are designed to solve these problems and aid to the energy efficiency and protection of the environment, as well as to industrial and market development. (30 min).

8. Debated on actual situation in electricity meters industry:
   - Advanced Measurement in BiH - current status and dynamics
   - Dynamics of the implementation of the advanced measurement by EU Directives
   - Benefits of foreign Manufacturer/ Distributor/Supplier
   - Benefit to foreign Buyers/ Consumers (30 min or more if needed).

5.4.3 EXPERT GROUP MEETING WITH TARGET ENTERPRISE

Early March 2015 an expert group meeting was organized in Banja Luka on the premises of Mikroelektronika a.d., where the preliminary results were presented to representatives of the target enterprise, i.e. the brewery Banjalučka pivara. The presentation given during this seminar is attached to this report.

Results of the smart metering in the brewery will be used to increase awareness on energy efficiency potential in similar enterprises in industry, in both BiH and the region.

From the side of industrial development this pilot project can help companies to decide to start and develop production that is in line with requirements set up by modern and relevant regulations. This will help the realization and promotion of production and development of companies and society, and implementation of relevant directives. This pilot project will help promotion of energy efficiency and energy savings, environmental sustainability and industrial development.

A key outcomes of this project is the clearly demonstrated financial benefit which can hopefully attract and convince partners to invest in projects to replicate such initiatives, ultimately assisting technology and business innovation in BiH and other emerging economies. Indeed, while the potential is available in BiH, regional export opportunities for products such as smart meters, LED lighst and related products can easily be envisaged. For instance Mikroelektronika is expecting commercial opportunities in participating countries by direct sale or, more preferably, through joint investments in new facilities for production of Mikroelektronika meters under license.

The first meeting stressed basic idea of the project with some outcomes that will be ready for presentation and the final workshop. The final workshop will provide a detailed explanation of outcomes to the potential partners and donors, and will present the purpose of this pilot project, as well as ideas and draft terms of reference for new follow-up projects.

5.5 PURCHASE, INSTALLATION AND MONITORING OF MEASURING EQUIPMENT

The target enterprise for demonstration of measuring equipment, installation and monitoring was brewery in Banja Luka – Banjalučka pivara. CT operated semi-direct electricity meters equipped with GPRS modems were used. Meter parameters (measuring registers, Load profile, Hourly profile, Daily Profile, Data of billing period etc.) were set in cooperation with engineers from Banjalučka pivara and in accordance with their central software requirements. Also, GPRS modem parameters (IP address, APN, username, password etc.) were set in cooperation with engineers from Banjalučka pivara and mobile network operator Mtel.

The meter was configured using the software application µMeter. µMeter is an application designed for direct communication with the electric meters which support DLMS standard. The application is easy to use and it does not require a deeper knowledge of DLMS standards. It was used for reading or parameterization of meter via optical sensors or remote.

It was demonstrated how engineers from Banjalučka pivara perform reading or parameterization of meter parameters using application µMeter.

All hardware was tested and software functions of CT operated semi-direct electricity meter: display, battery, tariff outputs, relay outputs, etc.

The communication between the meter and the center (in this case it will be µMeter) via GPRS modem was tested.

The brewery received information about benefits they could get by usage of smart meters (faster resolution of problems – where there are technical problems and faults with the supply of energy, smart meters should make it easier and quicker to identify and fix the problem, the Smart Meter will report back electricity issues , such as periods of low voltage, to deliver better quality of supply, could help to save money – by having an idea of which appliances use the most energy, you may be able to reduce your energy usage and save money, etc.).

Purchased demonstration measuring equipment was installed in the target enterprise on those places which are important to control the production processes and on the places interesting for legal matters that are regulated by law.

6. POTENTIAL FOLLOW-UP PROPOSALS

6

Based on the results of this initial study a number of concrete follow-up proposals have been formulated, to build on the results and take these further, both on the government side (in terms of improving the quality infrastructure and regulatiory framework, and on the industrial and commercial side, by replicating the positive results of the pilot project in Banjalućka pivara, and tap into the regional export opportunities of BiH companies producing high level products such as smart meters and LED bulbs.

The project framework shown below can serve as the backbone af an integrated follow-up proposal for a single donor. Likewise, specific components or outputs can be singled out for funding in line with priorities or available budget.

Table 9 Indicative framework for follow-up proposal(s)

Project Component	Key outputs	Indicative budget (in $)
1. POLICY AND REGULATION Refined policy and regulatory framework to enable transformation across sectors	1. Quality Infrastructure on RE and EE improved 2. Roadmap towards regional centre of excellence in place	800,000
2. TECHNOLOGY: Demonstration of innovative technologies in selected sectors	1.1 State-of-the art EE and RE technology interventions in selected industrial and commercial sectors prepared – focus on LED and smart metering, solar, bio-energy and SHP 1.2 Highly replicable demonstration projects in targeted sub-sectors realised as pilot facilities	1,000,000
3. CAPACITY BUILDING AND REPLICATION Capacity base strenghtened and awareness raising increased	3.1 Capacity and awareness strengthened at industry, economic, public and academic level 3.2 Outreach to regional market for export promotion	200,000
TOTAL		**2,000,000**

Other project proposals are presented below (as well as in ANNEX2 to the study) and should be seen as the result of brainstorming sessions during the course of this project. These proposals have been elaborated in varying degrees of detail. They are not polished yet in terms of scope and budgeting, and should be seen as a resource of ideas which can be taken up as per the preferences, priorities and funding of donors or other interested parties.

The application of a refined QI methodology to SHP for BiH is one of the activities which may still be funded under the current study, if funding allows, and as such would accelerate future work in the area of QI for SHP, and would probably benefit other small-scale RE technologies. It would be added as an additional ANNEX to the study once completed.

This piece of work could also strengthen related and ongoing initiatives such as the regional Balkan Renewable Energy Program (BREP) which focuses on small hydro power (SHP) plants. The Project in BiH expected to leverage more than US$ 120 million in financing, including US$ 15 million from IFC, to support the construction of 40 SHPs with a total installed capacity of 80 MW and potential for green-house-gasses emission reduction of 0.5Mt CO_2/year. Through this project IFC will contribute to improving the existing regulatory framework to enable financing in RE projects, assist the sponsors to strengthen their designs and business plans, and improve the capacities of selected financial institutions to evaluate and finance SHPs and other RE projects. These activities would be complemented with workshops and seminars targeting sponsors, financial institutions and the wider public to create a comprehensive framework to support the development and implementation of RE projects. IFC will provide long-term financing to the local banks interested in financing RE projects. Also, as an IDA country, BiH can benefit from IFC's Infra Venture facility that assumes joint work with a sponsor on project development and/or financing.

Respecting present problems in integration of energy production from renewables to existing system, one problem can tackle the following issue:

1. ***Integration of energy from renewable sources into the transmission and distribution system and the use of energy storage systems for integrated intermittent production of energy from renewable sources (problems of unmanaged resources and negative effects on the performance of the regulatory system).***

There is no overall supervision system to collect data from the environment, which leads to a lack of systematic information on environmental protection.

Parallel to this project it is needed to have as a plan realization of:

2. Photovoltaic and wind farms energy integration in the grids

For this project these actions should be considered:

- Form groups and reach agreements among policy makers and with relevant stakeholders including industry members, consumers, investors, and others,
- Communicate knowledge about renewable energy resources, technologies and issues to create awareness on all levels,
- Clarify the goals, set targets on all levels of government, and recommend policies to achieve goals,
- Integrate renewables into policymaking and take advantage of relations with energy efficiency,
- Optimize policy frameworks by building on own policies or other proven policy mechanisms and adapting them to specific circumstances,
- Defuse disadvantages in the open market, such as misconceptions of costs.

Arrangement of related activities could be realized through:

- Industrial investment,
- Research, development and innovation,
- Technology development,
- Education and training,
- Human capacity development.

In many sites of BiH the necessary preconditions for solar PV plants are present; there is high solar irradiation, and local knowledge and investment partners could in principle be triggered into such projects. What is missing is an enabling regulatory framework and experience through demonstration projects.

With recent advancements in lighting technology, the most efficient lamps use one-fifth of the energy to produce the same amount of light as the least efficient lamps. They also can last up to 35 times longer. Most of the lighting in the domestic sector in developing countries and emerging economies is still supplied by inefficient lamps and many countries throughout the world have yet to transition to efficient lighting. This may be due to many factors including: uncertainty on the part of governments about how to begin a phase-out program; lack of information about alternative products; capacity issues; skepticism about the potential benefits of efficient lighting; and the lack of the necessary resources to effectively implement a transition.

To follow requirements given in EU relevant normative documents BiH should ensure that:

- Certification schemes or equivalent qualification schemes for installers of small or biomass boilers and furnaces, photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps are made available.

- Final customers of electricity, natural gas, district heating and domestic hot water are provided with competitively priced individual meters which accurately reflect the final customer's actual energy consumption and provide information on actual time of use insofar as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings. Such a single meter must always be used when:
  (a) An existing meter is replaced, unless this is not possible or not cost-effective in relation to the estimated potential savings in the long term technical;
  (b) A new link in a new building or a building undertakes major renovations.

Where BiH implements smart metering systems and roll out smart meters, it will ensure:

(a) that the metering systems provide to final customers information on actual time of use and that the objectives of energy efficiency and benefits for final customers are fully taken into account when establishing the minimum functionalities of the meters and the obligations imposed on market participants;

(b) the safety of smart meters and data communications, and privacy of the end users, are in accordance with relevant data protection laws;

(c) in the case of electricity and at the request of the final customer, meter operators will ensure that the meter or meters can account for electricity put into the grid from the final customer's;

(d) they shall require that appropriate advice and information be given to customers at the time of installation of smart meters, in particular about their full potential with regard to meter reading management and the monitoring of energy consumption.

Respecting specifics related to deploying renewables, energy efficiency, measuring equipment and laboratory infrastructure and acknowledging information and position of QI in these activities it will help progress if one comprehensive methodology will be developed. Such methodology will deal with linkage between RE and EE with QI issues in general and in details when it comes to specific field of RE (wind, solar, SHP, or so). It means that one additional and very complex project can be recognized:

3. Development of a refined methodology of QI for RE and EE

Since BiH has the necessary preconditions for an increased deployment of RE and EE technologies, the following next proposals are formulated to tap into this potential and provide significant benefits and impacts.

4. Renewable energy and energy efficiency supportive and development measures (Small hydro power plants, On-grid and off-grid lighting technology programs, and Smart metering deployment through QI development)

5. Scaling up energy efficiency and renewables in key economic sectors in BiH and in region (ToR)

An important driver to additional emphasis on EE is the new EU EE Directive, which entered into force on 4 December 2012. Most of its provisions will have to be implemented by the Member States by 5 June 2014. This Directive establishes a common framework of measures for the promotion of EE within the EU in order to ensure the achievement of the EU's 2020 20 % headline target on EE and to pave the way for further EE improvements beyond that date. All EU-28 countries are thus required to use energy more efficiently at all stages of the energy chain – from the transformation of energy and its distribution to its final consumption. The new Directive will help remove barriers and overcome market failures that impede efficiency in the supply and use of energy and provides for the establishment of indicative national energy efficiency targets for 2020.

New measures include:

- The legal definition and quantification of the EU energy efficiency.
- The obligation on each Member State to set an indicative national energy efficiency target in the form they prefer.
- The obligation on Member States to achieve certain amount of final energy savings over the obligation period (01 January 2014 – 31 December 2020) by using energy efficiency obligations schemes or other targeted policy measures to drive energy efficiency improvements in households, industries and transport sectors.
- Major energy savings for consumers: easy and free-of-charge access to data on real-time and historical energy consumption through more accurate individual metering will now empower consumers to better manage their energy consumption.
- The obligation for large enterprises to carry out an energy audit at least every four years, with a first energy audit at the latest by 5 December 2015. Incentives for SMEs to undergo energy audits to help them identify the potential for reduced energy consumption.
- Public sector to lead by example by renovating 3% of buildings owned and occupied by the central governments starting from 01 January 2014 and by including energy efficiency

considerations in public procurement – insofar as certain conditions are met (e.g. cost-effectiveness, economic feasibility) – so as to purchase energy efficient buildings, products and services.

- Efficiency in energy generation: monitoring of efficiency levels of new energy generation capacities, national assessments for co-generation and district heating potential and measures for its uptake to be developed by 31 December 2015, including recovery of waste heat, demand side resources to be encouraged.

LED lighting is a relatively easy example of energy efficiency (EE) measures gained through technology innovations. BiH is also establishing initial regulatory preconditions and has local and high quality production of LED lamps. The core objective of this project will be an increased application of LED lamps especially in industrial and commercial sectors accompanied with tailored regulatory support in preparing missing regulations and awareness raising campaigns. A number of expected challenges include:

- Institutional, financial, technical, technological and geographical challenges
- Barriers related to scaling up deployment renewable energy technologies
- Lack of affordable up-front finance
- High cost of technology and high operational and maintenance costs
- Grid network, connections and dispatch issues
- Supply and demand imbalance
- Lack of tailored R&D to suit local conditions such as high temperature, which have impact on efficiency of some of the technologies
- Lack of capacity to develop and implement stable policy options
- Lack of access to information;
- High transaction cost of small-scale renewable energy systems.

Various policy options, actions and technologies are available to assist countries in addressing the challenges and removing barriers faced in scaling up deployment of renewable energy technologies. There is no one size fits all policy and technological solution and the choice of policy and technology depends on the country's national circumstances. Because of this point it is useful to explore specifics of BiH as much as possible. This proposal is elaborated more precisely and with additional details in ANNEX2 to this study.

Combining previous ideas and information one project that will produce a study that will provide insight on here mentioned proposals and challenges, and preconditioning documents for establishment of office which will provide continuous support in RE, EE and QI activities can be prepared under title:

6. Scaling up energy efficiency and renewables in key economic sectors in BiH and in region

This proposal is elaborated more precisely and with additional details in ANNEX2 to this study.

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7. FINAL WORKSHOP AND COMPANY VISITS

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The results of the study were presented at the Final Workshop on 24th March 2015 in a conference room of Government of the Republika Srpska. The logistical organization of the event was kindly taken care of by the Ministry of Physical Planning, Civil Engineering and Ecology. The event was opened by Ms. Srebrenka Golić, Deputy Prime Minister and Minister of Physical Planning, Civil Engineering and Ecology and Focal point of BiH under UNFCCC, who pointed out that this project is a first step to launch the country towards a path of sustainable re-industrialisation, trigger innovation and create jobs. Thanks to this initial project, the conditions have been established for the continuation and replication of such initiatives. Presentations on the project reults and wider context were delivered by Ministry of Economic Development and Technology from Republic of Slovenia (Mr. janez Rogelj), UNIDO (Mark Draeck), IMT (Mr. Janez Šetina), IMBiH (Mr. Zijad Đemič), Mikroelektronika (Mr. Dragan Praštalo) and Banjaluća Pivara (Mr. Vitomir Tepić). The workshop was attended by approximately 25 participamnts, including from the national public and private sector, as well as from development partners such as GiZ, USAID and UNDP, and the Delegation of the EU. The general feedback was positive, with some suggestions on refinements for future projects, and requests to obtain the detailed report and results for integrating in ongoing and future project programming. The presentations are added as an Annex to this report.

Final workshop in Banja Luka, March 2015

The final presentation of results was accompanied by a visit to Mikroelektronika AD, Banja Luka, where UNIDO representative learned about production facilities, capacities, and most importantly, potential of R&D and production of Smart meters. During the visit, new technologies were presented, opening new opportunities, especially for countries where matching energy production and consumption remains a challenge. This Visit was scheduled and took place on 23rd March 2015.

On 24th March 2015, representatives of Mikroelektronika, together with visitors from UNIDO, IMT Slovenia, Ministry of Economic Development and Technology from Republic of Slovenia and Institute of Metrology of BiH, visited Banja Luka Brewery to see installed equipment and learn about improvements accomplished. During the visit, engineers from Brewery took all representatives to see installed equipment. Currently, after having seen the positive results and potential for additional benefits, the brewery has installed 15 smart meters at the key production facilities and in substations. The information received from engineers show that installation of smart meters provided the expected results, but also some unexpected and additional benefits:

- System allows measuring, control and tracking of the energy consumption throughout the productions and it provides information about all characteristics of the energy (active energy in both tariffs, reactive energy in tariff one, 15-minutes maximum demand, etc.).

- Energy profile gave the insight into the profile of archived 15-minute maximum. Now they know exactly which consumers participate in the reached maximum. It is specially important that now it is clear what percentage of the maximum is reached by consumers which do not participate in the production (such as heating, cooling, etc.). Based on this information, immediate actions were taken so that production facilities are organized in different order and some have been separated into different schedules, in order to lower maximums. Also, after learning about some failures in air compression units and other consumers which do not participate in production processes directly, and by fixing these problems, additional efficiency has been accomplished. All these activities resulted in lowering the electric energy consumption from 17.2 kWh/hl down to 14.3 kWh/hl, even though an additional production line has been installed into the production, and this additional can filling line has installed power of approximately 75kW.

- Additionally, measurements showed that compensation for reactive energy was not set properly and that the Brewery had approximately 15000 Euro of yearly expenses due to the reactive energy. Now these mistakes have also been fixed and currently Brewery has no expenses related to reactive energy. This saving on its own, already covered the whole investment.

- Rescheduling one of the breweries sprang; they lowered the bill for the electric energy even more.

After all expected results were accomplished, engineers went even deeper into reports provided by smart meters and some interesting conclusions came out of this. Some of these could be quite useful for any production factory with similar problems or intentions:

- By having an insight into each individual point of consumption within the factory and the profile of the consumption, the engineers learned that the air compression unit had extremely high electric energy consumption when it was in standby mode. Calculations suggested that the investment in a new air compression unit will add to the savings and therefore the investment was granted by the management and consumption is lowered in this section of the brewery, as well.

- Currently, smart meters are installed to register the consumption of the lighting within the factory and analyses are in progress, in order to decide on switching to LED and choosing the best solutions in this area.

- Now engineers in the Brewery have all relevant information about the energy delivered by the utility. Specifically, it is important to know the quality of delivered energy and profile of consumption. This information will be very useful now that industrial consumers got the right to choose the provider of electric energy.

- Existing installed smart metering system in the Brewery is designed to provide all information collected by central software. All installed meters communicate with central software through GPRS communication. Location of the Brewery does not allow good GPRS connections as the network is not of very good quality. Therefore, it is not possible to collect all information from meters instantaneously, at any moment needed. Plus, this communication is also charged by the mobile operator. The first next step will be the change in the communication. Meters will be connected by cables, so that the central computer will get all needed information just-in-time. Together with Mikroelektronika they will define some specific measuring schedules of maximum demand, so that the profile of maximum will be created. In this way, engineers will have an opportunity to prevent potential peaks by activities within the defined 15-minute period. For example, if the profile of the consumption will show that maximum demand is rising above some the set limit, the system will alert the engineers to intervene by switching off some of the consumers which will not affect the production. The next step will be programming the system to perform such actions automatically.

Expert presentations at Final workshop in Banja Luka, March 2015

As noted on the beginning, this study did not elaborate all of numerous requirements that are coming from EU legislative framework in energy, energy efficiency, renewables, quality infrastructure and related issues but this study learned and answered some important questions. Indeed this study is in line with some newest measures that are planned by New Energy efficiency Directive, as well as with specific renewable energy deployment issues linked to Quality Infrastructure and its further development.

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148. BAS EN 62124:2010
Photovoltaic (PV) stand alone systems - Design verification

149. BAS EN 62253:2012
Photovoltaic pumping systems - Design qualification and performance measurements

150. BAS EN 62446:2010
Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection

151. BAS EN 62509:2012
Battery charge controllers for photovoltaic systems - Performance and functioning

152. BAS IEC 62116:2010
Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters

153. BAS IEC/TS 62257-1:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 1: General introduction to rural electrification

154. BAS IEC/TS 62257-12-1:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 12-1: Selection of self-ballasted (CFL) lamps for rural electrification systems and recommendations for household lighting equipment

155. BAS IEC/TS 62257-2:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 2: From requirements to a range of electrification systems

156. BAS IEC/TS 62257-3:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 3: Project development and management

157. BAS IEC/TS 62257-4:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 4: System selection and design

158. BAS IEC/TS 62257-5:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 5: Protection against electrical hazards

159. BAS IEC/TS 62257-6:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 6: Acceptance, operation, maintenance and replacement

160. BAS IEC/TS 62257-7:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 7: Generators

161. BAS IEC/TS 62257-7-1:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 7-1: Generators - Photovoltaic generators

162. BAS IEC/TS 62257-7-3:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 7-3: Generating set - Selection of generating sets for rural electrification systems

163. BAS IEC/TS 62257-8-1:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 8-1: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid betteries available in developing countries

164. BAS IEC/TS 62257-9-1:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-1: Micropower systems

165. BAS IEC/TS 62257-9-2:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-2: Microgrids

166. BAS IEC/TS 62257-9-3:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-3: Integrated system - User interface

167. BAS IEC/TS 62257-9-4:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-4: Integrated system - User installation

168. BAS IEC/TS 62257-9-5:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated system - Selection of portable PV lanterns for rural electrification projects

169. BAS IEC/TS 62257-9-6:2012
Recommendations for small renewable energy and hybrid systems for rural electrification - Part-9-6: Selection of photovoltaic individual electrification systems (PV-IES)

CEN photovoltaic standards:

170. CLC/TS 50539-12:2013 (WI=23884)
Low-voltage surge protective devices - Surge protective devices for specific application including d.c. - Part 12: Selection and application principles - SPDs connected to photovoltaic installations

171. EN 15316-4-6:2007 (WI=00228028)
Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-6: Heat generation systems, photovoltaic systems

172. EN 16603-20-08:2014 (WI=JT005017)
Space engineering - Part 20-08: Photovoltaic assemblies and components

173. EN 50539-11:2013/A1:2014 (WI=25185)
Low-voltage surge protective devices - Surge protective devices for specific application including d.c. - Part 11: Requirements and tests for SPDs in photovoltaic applications

174. EN 50618:2014 (WI=24019)
Electric cables for photovoltaic systems

175. EN 60269-6:2011 (WI=22687)
Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems

176. EN 61427-1:2013 (WI=24062)
Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application

177. EN 61427:2005 (WI=16077)
Secondary cells and batteries for photovoltaic energy systems (PVES) - General requirements and methods of test

178. Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing

179. EN 61850-7-420:2009 (WI=20656)
Communication networks and systems for power utility automation - Part 7-420: Basic communication structure - Distributed energy resources logical nodes

180. EN 62124:2005 (WI=15334)
Photovoltaic (PV) stand-alone systems - Design verification

181. EN 62253:2011 (WI=23093)
Photovoltaic pumping systems - Design qualification and performance measurements

182. EN 62446:2009 (WI=21367)
Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection

183. EN 62509:2011 (WI=22213)
Battery charge controllers for photovoltaic systems - Performance and functioning

184. EN 62670-1:2014 (WI=24302)
Photovoltaic concentrators (CPV) - Performance testing - Part 1: Standard conditions

185. EN 62716:2013 (WI=24250)
Photovoltaic (PV) modules - Ammonia corrosion testing

186. FprEN 62670-2:2014 (WI=25225)
Concentrator photovoltaic (CPV) performance testing - Part 2: Energy measurement

187. FprEN 62759-1:2014 (WI=25202)
Transportation testing of photovoltaic (PV) modules - Part 1: Transportation and shipping of PV module stacks

188. FprEN 62817:2014 (WI=24760)
Solar trackers for photovoltaic systems - Design qualification

189. FprEN 62852:2014 (WI=24829)
Connectors for DC-application in photovoltaic systems - Safety requirements and tests

190. FprHD 60364-7-712:201X (WI=24482)
Low-voltage electrical installations - Part 7-712: Requirements for special installations or locations - Photovoltaic (PV) systems

191. FprHD 60364-9-1:2013 (WI=24973)
Low-voltage electrical installations - Part 9-1: installation, design and safety requirements for photovoltaic systems (PV)

192. HD 60364-1:2008 (WI=16500)
Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions

193. prCEN/TR 15316-6-6 (WI=00228073)
Heating systems and water based cooling systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 6-6: Accompanying TR to EN 15316-4-3 (Heat generation systems, thermal solar and photovoltaic systems)

194. prEN 15316-4-3 (WI=00228062)
Heating systems and water based cooling systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-3: Heat generation systems, thermal solar and photovoltaic systems

195. prEN 50583-1:2014 (WI=23051)
Photovoltaics in buildings - Part 1: Modules

196. prEN 50583-2:2014 (WI=25383)
Photovoltaics in buildings - Part 2: Systems

197. prEN 50XXX (WI=25385)
External fire exposure to roofs in combination with photovoltaic (PV) arrays – Test method(s)

198. prEN 62788-1-2 (WI=59338)
Measurement procedures for materials used in photovoltaic modules - Part 1-2: Encapsulants - Measurement of volume resistivity of photovoltaic encapsulation and backsheet materials

199. prEN 62891 (WI=58760)
Overall efficiency of grid connected photovoltaic inverters

IEC photovoltaic standards:

253. IEC 61173: Overvoltage protection for photovoltaic (PV) power generating systems – Guide

254. IEC 61277: Terrestrial photovoltaic (PV) power generating systems - General and guide

255. IEC 61703: Susceptibility of a photovoltaic (PV) module to accidental impact damage (resistance to impact test)

ANNEX 1

UNIDO Workshop Banja Luka 2015

ANNEX 2

1. *Renewable energy and energy efficiency supportive and development measures (Small hydro power plants, On-grid and off-grid lighting technology programs, and Smart metering deployment through QI development)*

2. *Scaling up energy efficiency and renewables in key economic sectors in BiH and in region (ToR)*

   A. Background information about deployment of solar energy
   B. Background information about QI
   C. About relevant QI institutions in BiH
   D. Supporting information and wider follow-up proposals

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