



PERMANENT COUNTRY REPORT

Croatia

Developed within the project Performance Risk Management for Energy Efficiency through
Training – PERMANENT – IEE/08/657/SI2.528420

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1. INTRODUCTION TO THE PROJECT

1.1 Investment Potential in Energy Efficiency

More details are in Section 1.

1.2. Key Barriers To Investing in Energy Efficiency – HEP ESCO

Energy efficiency (EE) investments are not being made at a fast rate for many reasons, as summarized below.

BARRIER (“X” = MAJOR DEFICIENCY)	“EE” STAKEHOLDERS AFFECTED				
	Energy Users	Lenders (Debt)	Investors (Equity)	EE Product & Service Suppliers	Public Interest NGOs & Gov’t Agencies
Fragmented and diverse industry of energy users and product/service suppliers	X	X	X	X	X
Inadequate legal/regulatory framework	X	X	X	X	X
Lack of knowledge of EE benefits and techniques for managing risks	X	X	X		X
Lack of commercially viable financing (unattractive terms & tenor)	X		X	X	X
Small investments and benefits, and high transaction costs	X	X	X	X	
Complex transactions with energy service companies (ESCOs)	X	X	X	X	
Some complex technologies	X	X	X	X	
Low priority and rates of return	X	X	X		
Limited technical capabilities	X		X	X	
Low (subsidized) energy prices				X	X

One of the most significant barriers is a lack of commercially viable financing for EE activities. The shortage is *not* caused by a lack of funds per se, but rather by the inability of energy users to access existing funds at local financing institutions (LFIs) on commercially attractive terms. This lack of access is caused by a “disconnect” between the traditional lending practices of LFIs and the financing needs of EE projects. LFIs typically apply traditional “asset-based” corporate lending approaches for EE projects, lending a maximum of 70%-80% of the value of assets financed (or collateral provided). Unfortunately there is often little or no collateral value in EE equipment once installed in a facility. Rather, the value is in the certainty of future cash flow generated by project

installation and transparent documentation of actual savings. To date, most LFIs (due to lack of knowledge) have not recognized, nor appear to believe that meaningful cash flow can be generated from EE projects, or that such cash flow can be relied upon to repay the related loans. Consequently, LFIs generally assign no collateral value to the future cash flow generated and require energy users to encumber their other credit capacity for the full value of the EE installation. This requirement for additional credit capacity is usually reason enough for energy users to not use commercial financing.

Common to many of the barriers is *disbelief* that planned project results will be achieved and can pay back the investment in a sustainable manner. Lack of confidence in project savings impedes investment even where energy audits or other engineering analyses demonstrate sound investment opportunities. However successful energy efficiency projects, mainly Third Party Financing (TPF or ESCO) projects, have demonstrated some key techniques for managing risks through: measuring project results, verifying achievement of guaranteed savings, and financing energy savings projects *without* the need for collateral beyond that of the savings cash flow from the project itself.

One of the main goals of the Permanent Country Report is the identification of barriers to investments in energy efficiency and renewable energy projects in the project region, in order to develop recommendations for problems on how to overcome them. The identified barriers are classified in three groups:

- Legal, institutional and administrative barriers;
- Economic and financial barriers;
- Lack of awareness, human capacities and professional skills.

Legal, Institutional and Administrative Barriers

Legal, institutional and administrative barriers can be manifold and very difficult to address because of the different administration and policymaking levels involved. The most frequently encountered barriers of this kind in the project region are:

- Complexity and lack of transparent structure of the regulatory framework;
- Regulatory instability and discontinuity, caused either by political instability in the country and/or frequent and uncoordinated updates and revisions of the current policy framework;
- Lack of secondary legislation and operational instructions, tools, standards and procedures necessary to implement primary legislation or strategic programmes;
- Excessive bureaucratic obstacles, non-transparent administrative procedures and complex and cumbersome authorization procedures for new projects;
- Absence of dedicated public procurement guidelines for acquisition of energy-efficient equipment and requests for provision of energy services to public entities;
- Inefficient or limited use of public tendering processes for energy efficiency and renewable energy projects;
- Lack of cooperation between different ministries and agencies involved in energy policy as well as between authorities at the national and at the local level;
- Unresolved property issues in multi-resident apartment buildings and significant

fragmentation of land property, which significantly limit feasibility of energy efficiency investments in the housing sector and increase costs for the development of renewable energy projects.

Economic and Financial Barriers

Many economic barriers that hinder financing and implementation of attractive projects come from inefficiencies in the structure of the energy markets:

- State intervention in the price formation, artificially low tariffs for final customers and cross subsidies between customer segments;
- Energy tariffs which do not fully cover costs and therefore limit the profitability of energy efficiency projects; furthermore these tariffs do not take into account the environmental costs of energy supply and do not offer incentives for a change of behaviour of the final consumers;
- Environmental and economic efficiency of energy efficiency and renewable energy projects is hindered by obsolete and insufficient infrastructure for transmission and distribution of energy (grid losses, lack of adequate grid connection, lack of metering), even when the business case for the project itself is attractive;
- Local utilities and distribution companies that are facing serious profitability problems regarding insufficient payment rates and/or unprofitable regulated customer tariffs do not have adequate financial means for infrastructure improvement and are therefore reluctant to support or push forward even promising energy efficiency projects;
- Public ownership of the energy companies, which creates a conflict of interest between the company profitability and the pursuit of political interests through socially popular pricing policies;
- Insufficient availability of public funds for financing of initiatives and programmes: premium tariffs for renewable energy sources are developed but often not operational and are frequently of limited extent (e.g. they apply only to certain technologies or have restrictive requirements). Energy efficiency funds, if they are operational, have limited resources; alternative incentive measures such as dedicated credit lines providing soft loans, tax exemptions or support schemes for third-party financing are often not in place;
- Small size of energy efficiency and renewable energy projects, resulting in relatively high evaluation and transaction costs per project;
- High interest rates applied by local banks to medium- and long-term loans and restrictive requirements for collaterals.

Lack of Awareness, Human Capacities and Professional Skills

These barriers comprise all stakeholders involved in identification, development, financing and implementation of energy efficiency and renewable energy projects and require extensive work of awareness-raising and capacity-building to achieve tangible results:

- Insufficient political commitment to implement the necessary policy reforms;
- Lack of qualified human resources and insufficient professional expertise among local authorities for implementation of identified projects;

- Lack of experience in financing energy efficiency and renewable energy projects and lack of awareness of possible economic benefits arising from energy efficiency and renewable energy projects among commercial banks;
- Lack of training and education possibilities for the formation of professionals with adequate skills for conducting energy audits, identification of attractive project opportunities, and preparation of bankable project proposals;
- Lack of awareness on the side of consumers, which are used to regard energy more like a public service than a valuable good and are very reluctant to change their consumption behaviour unless this implies a tangible improvement of their living standard;
- Limited or absent demand for the services of Energy Service Companies.

The administrative barriers for energy efficiency and renewable energy projects in Croatia are mainly identified in the complex authorization procedures for energy efficiency and even small renewable energy projects as well as lack of coordination between different governmental agencies involved in energy efficiency and renewable energy policies.

Another barrier specifically related to the development of wind projects, which could however have significant effects on the implementation of the overall renewable energy strategy, is limited capacity of the power transmission grid to accommodate new wind power generation.

The current grid capacity for new wind power plants is estimated at a maximum of 360 MW, compared to the already expressed interest of 5,000 MW.

Finally, despite the availability of credit lines from the Croatian Government and from international financing institutions, the promotion of funds for energy efficiency and renewable energy projects among bank customers is virtually non-existing on the part of commercial banks.

As a result, available financing mechanisms remain unused. This indicates the necessity of awareness raising and capacity building among local financing institutions.

1.3. The Role of PERMANENT

The PERMANENT project aims to significantly enhance the rate of investment in EE projects in new European Member States by educating key stakeholders about how perceived risks in the EE projects can be managed. This education process addresses the common concern for performance risk by:

- Adapting the widely used International Performance Measurement and Verification Protocol (IPMVP) and the International Energy Efficiency Financing Protocol (IEEFP) to local conditions and language. With these protocols, EE can be seen as a significant investment opportunity, and thereby encourage the establishment of commercial EE lending products that are attractive to end users.
- Training instructors to impart knowledge on performance risk management, during and after the life of the PERMANENT project.
- Educating energy end users, financiers and energy services suppliers on ways to manage the risks in EE project design, implementation and measurement. Education will be at varying levels of detail, first creating awareness of the opportunity and needs. Further details will be provided in followup half day, one day or two day training in relevant topics for target audiences.

1.4. Target Audiences for Training in Croatia

Target market sectors are, in general:

- Users of large amounts of energy: industrial, commercial, multiple residential, institutional (e.g. education, health care), and Public Sector establishments (e.g. defence, prisons, etc.).
- Financiers: local financial institutions (LFIs)
- Governments as both consumers of the knowledge for their own facilities and enablers of markets.

Financing messages will be delivered in half hour and half day sessions to:

- CEOs within LFIs, to encourage them to approve introduction of a new lending products
- Senior lending officers within LFIs, to encourage them to establish a plan to develop a new lending product
- CFOs within large energy users, to help them appreciate the opportunities, risk management methods and new financing strategies for energy efficiency projects.
- Senior managers within governments and regulatory bodies, to help them understand their roles in removing barriers to energy efficiency through encouraging or regulating proper performance risk management.

Technical messages about transparent reporting of actual energy and money savings will be delivered in half hour, half day, one day or two day sessions to:

- Senior managers, middle managers and project/plant managers and engineers within
 - large energy users, and

- suppliers of energy efficiency services and products to help them understand best practice in ‘measuring’ savings and transparent reporting of results.
- Senior policy advisors and program designers within governments and regulatory bodies to alert them to best practices, and to help them properly specify use of best practices in ‘measuring’ savings and transparent reporting of results.

More details are in Section 5.

2. DETAILS OF COUNTRY ANALYSIS

2.1. Market Potential

Energy efficiency plays an important role in Croatian energy policy, as has been formalized through the official Strategy for the Energy Sector. One of the strategic goals defined in the energy sector development strategy is improvement of energy efficiency in every part of the energy sector. An energy efficiency master plan was finished in 2008 as a comprehensive basis to define future EE policy developments and set out specific policy instruments. In 2008 an Act on Energy End-use Efficiency was adopted, and a number of specific by-laws entered into force.

The National Energy Efficiency Action Plan (NEEAP) was prepared to comply with the requirements in Article 14.1 of EU Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services. Within the negotiation process for EU membership, the Republic of Croatia has committed to transposing the requirements of the Directive into its legislative framework and to produce its first NEEAP. The NEEAP contains a description of measures to improve energy efficiency in Croatia that are planned in order to achieve the indicative targets for 2010 and 2016, and to comply with the requirements regarding the exemplary role of the public sector. It also contains the initiatives and measures already being applied in Croatia.

Croatia has created a transparent legislative framework in the field of renewable sources and introduced obligations to purchase all electrical energy from privileged energy producers. The aim is to have renewable sources by 2010, without any large hydro-electricity plants, make up 5.8% of the total electricity consumption. In 2004, these sources accounted for 0.8% of consumption. According to estimates, the share of production of renewable energy sources – including large hydro-electric plants – in total consumption will increase from 34.7% in 2006 to 36.0% in 2010.

Croatia has adopted a national indicative energy savings target of 9% of the final inland energy consumption by 2016 (1% average reduction per year), which means that the country should ensure energy savings of at least 19.77 PJ (Average consumption over a 5-year period was 219.72 PJ). The intermediate target in 2010 is 3% (6.59 PJ).

Overall Market Potential was estimated in 'ESCO market assessment' report by MARBEK done for Hrvatska Elektroprivreda (Croatian Power Utility, mother company of HEP ESCO) in 2002.: The total estimated ESCO sales potential amounts to a range of between U.S. \$ 184 million to \$ 424 million. Of this total, the DH system upgrade and buildings energy efficiency market together represent considerably more than 50% of the market potential. The DH market considered for the study is potentially attractive to the ESCO industry because the projects are capital intensive. The energy efficiency market is understandably more diffuse and each individual project is far less capital intensive than in the DH market.

2.2 Energy Efficiency Policy

In the legislative framework including the *Energy Act* (OG 68/01, 177/04, 76/07), *Electricity Market Act* (OG 152/08, 177/04, 76/07) and *Act on the Regulation of Energy Activities* (OG 177/04, 76/07) and strategic documents concerning development of the energy sector in the Republic of Croatia (Energy Sector Development Strategy of the Republic of Croatia – OG 38/02, national energy programmes), energy efficiency is designated as a special interest of the Republic of Croatia, in line with the present state of the energy sector and the commitment to development. One of the priority tasks was the creation of a legislative framework for the application of renewable energy sources and an increase of energy efficiency.

In the document *Update/upgrade of the energy strategy* (in reality a new energy strategy!), an increase of energy efficiency in all segments of the energy sector, especially in the final energy demand and primary energy production sectors (in power generation facilities design and operation stages) is considered as an additional and new source of energy and as a basic permanent, long-term principle applying to the functioning and development of the energy system. The goal of the Strategy is to reduce the energy consumption by implementing costeffective measures of energy efficiency.

Within the negotiation process for European Union (EU) membership, the Republic of Croatia has committed to transposing the requirements of the Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services into its legislative framework and to produce its first *National Energy Efficiency Action Plan* (NEEAP). The NEEAP contains a description of measures to improve energy efficiency in Croatia that are planned in order to achieve the indicative targets for 2010 and 2016, and to comply with the requirements regarding the exemplary role of the public sector. It also contains the initiatives and measures already applied in Croatia.

It must be emphasised that in Croatia significant potentials for efficiency improvement exist, especially in the building sector. Therefore, NEEAP will enable a more focused implementation of energy efficiency policy and better monitoring of its success in the next three years. The NEEAP is adopted on the Government level and it is expected that it will be adopted by the Croatian Parliament in June.

In 2011 a second NEEAP will be submitted as required in the Directive.

The energy intensity and structural macroeconomic effects are presented in Figure 15. Here, the realised energy intensity is compared with the 1995 energy intensity level; this indicator shows what energy intensity of the economy would have been with structural changes, but

with 1995 energy efficiency levels. In this way, the influence of structural effect, i.e. the market characteristic indicator, is distinguished from the influence of unit consumption effect, i.e. the energy efficiency indicator.

2.3. Legal Framework

The legal framework for energy efficiency is composed of the following **laws**:

- Act on Energy End-use Efficiency (OG 152/08)
- Physical Planning and Building Act (OG 76/07, 7/2007)
- Act on the Environmental Protection and Energy Efficiency Fund (OG 107/03)
- The respective by-laws include:
 - Ordinance on Certification of Energy Performance of Buildings (OG 113/08)
 - Ordinance on the Requirements and Criteria to be met by Energy Auditors and Energy Certifiers of Buildings (OG 113/08)
 - Technical Regulations Concerning Energy Economy and Heat Retention in Buildings (OG 110/08)
 - Technical Regulations on Heating and Air-conditioning Systems of Buildings (OG 110/08)
- Ordinance on Energy Efficiency Requirements

2.4. Energy Efficiency Targets

The calculation of the national indicative target has been carried out according to the methodology of EU Energy services directive 2006/32/EC. The national target has been calculated on the basis of the average final consumption of energy for the last five years for which data are available. In the case of Croatia, this period is 2001-2005. The target is expressed in the absolute amount of PJ to be consistent with national statistics. Croatia has adopted a national indicative energy savings target of 9% of the final inland energy consumption by 2016 (1% average reduction per year), which means that the country should ensure energy savings of at least 19.77 PJ (Average consumption over a 5-year period was 219.72 PJ). The intermediate target in 2010 is 3% (6.59 PJ). Regarding CO₂ emissions, the target is a reduction of almost 800,000 tonnes per year. The national allocation plan of emission permits has not yet been adopted by the Croatian authorities and only a preliminary list of installations to be involved in emissions trading is currently available.² According to this list, there are 45 installations that may be involved in the EU ETS. Twenty-two of them fall into the category of heat/electricity producers and oil refineries, while 23 fall into the category of final energy consumers – predominantly from the industrial sector. Only one installation is in the service sector. The energy consumption of these 23 installations has been determined based on the available data obtained by the Central Bureau of Statistics and subtracted from the total final energy consumption. It still remains to be seen whether all installations on the preliminary list will be included in the ETS. Energy consumption within the scope of the Directive on Energy End Use as well as the National Energy Savings Target can be determined precisely only after the final decision on this issue is made.

Table 1 Summary of Measures in the National Energy Efficiency Action Plan

National indicative annual energy savings target 2016 (PJ)		19.77
National intermediate indicative annual energy savings target 2010 (PJ)		6.59
Measures to improve energy efficiency planned for achieving the target	Annual energy savings expected by end 2010 (PJ)	Annual energy savings expected by end 2016 (PJ)
Package of measures in the residential sector	2.62	7.17
Package of measures in the tertiary sector	1.14	3.68
Package of measures in industry (non-ETS)	1.24	4.05
Package of measures in the transport sector	1.60	6.59
Total ESD energy savings expected:	6.60	21.49

2.5. Energy Efficiency Priorities

The increase of energy efficiency is a necessity in all areas. Some important priorities (set by the National Energy Efficiency Action Plan, the Act on Energy End-use Efficiency (OG 152/08) and the existing energy strategy) are:

- Improved energy performance of buildings through use of better building materials,
- Establishing an energy audit scheme for industry,
- Increased awareness and changed behavior of end-users,
- Energy management in cities and counties (Establishment of the organizational structure, energy manager and energy management team),
- House-in-Order project (improvement of energy efficiency and introduction of EMS to government facilities).

Institutions involved in the energy sector are well organized within Croatia. Clear roles for these institutions are defined in the primary legislation. These are:

- **Ministry of Economy, Labour, and Entrepreneurship (MoELE)** is responsible for the national energy policy, action plans, primary legislation promotion, and EU energy legislation implementation at the national level.
- **Ministry of Environmental Protection, Physical Planning and Construction (MoEPPPC)** is responsible for improved energy performance of buildings through use of better building materials.
- **Ministry of Agriculture, Fisheries and Rural Development (MoAFRD)** has a role in developing agro-industrial bio-fuels.
- **Croatian Energy Regulatory Agency (CERA)** is the energy sector regulator responsible for promoting and implementing the secondary legislation, licensing

procedures, commercial electricity and gas codes, tariff setting, certification of eligible producer status, etc.

- **Croatian Energy Market Operator (HROTE)** organises the energy market based on the rules defined by CERA. HROTE collects fees for RES support and co-generation incentives from suppliers and then passes these fees to eligible RE producers with adequate certifications of origin.
- **Transmission/Distribution System Operator (TSO/DSO)** has the role of operating the electricity grid and is the guardian of the green energy certification.
- **Environmental Protection and Energy Efficiency Fund**, with a role for financial support for RES and EE projects.

Other important energy related institutions are:

- State Inspectorate
- Croatian Compulsory Oil Stocks Agency (HANDA)
- State Office for Nuclear Safety (SONS)
- State Office for Radiation Protection (SORP)
- Croatian Competition Agency
- Energy Institute Hrvoje Pozar (EIHP)
- Croatian Environment Agency
- State Institute for Nature Protection

A) Potential annual cost savings (in euro), at 5 and 10 year payback (if available) in small residential, large residential, commercial buildings, and industrial sectors.

B) Potential EE investments (in euro), by sector, for 5 and 10 year payback.

Estimation was made based on extrapolation of results for two cities in Croatia (Zagreb and Osijek).

		Total Unweighted Sales Potential	Total Weighted
Energy Efficiency	U.S. million \$	153	75.2
	Kn million	1305	641.4
Street lighting	U.S. million \$	32-68	16-34
	Kn million	279-577	139.5-288.5
District Heating	U.S. million \$	143	71.5
	Kn million	1221	610.5
Cogeneration	U.S. million \$	42-60	21-30
	Kn million	359-513	179.5-256.5
Total	U.S. million \$	370-424	183.7-210.7
	Kn million	3164-3616	1570.9-1796.9

2.6. EE Stakeholder Identification

List all of the major governmental, non-profit and private sector entities in the local market that have influence over energy efficiency, environmental, finance, legal or banking policy and commercial market activities, with a focus on those entities that have an interest in M&V or EE project financing:

- Ministry of Economy
- Ministry of Finance
- Fond for environmental protection and Energy Efficiency
- UNDP Croatia
- HBOR (Croatian Development Bank)
- Local Energy and Development Agencies (AZRA, MENE, REGEA, etc)
- HEP ESCO
- Large EE Vendors and Contractors
- Other Government Agencies and bodies

Note the people who can guide the project (Local Advisory Group) in Appendix A.

Note the specific financing persons to review financing materials (IEEFP Working Group) in Appendix C.

2.7. Best Practices and Barriers

Current lending procedures for EE projects in Croatia

Insurance of appropriate financing for EE projects represent one of the biggest barrier in their implementation. Potential source of financing include state budget, budget of local municipalities, commercial funding, international source of financing, etc...

Current sources of financing EE projects in Croatia are following:

- **Budget** – state, local municipalities;
- **Special purpose funds** – Environmental protection and Energy efficiency Fund (EPEEF), Fund for regional development;
- **Programmes from Croatian Bank for research and development (HBOR)** – Programmes for financing projects for environmental protection, energy efficiency projects and renewable energy projects;
- **ESCO companies** – HEP-ESCO, EETEK
- **Commercial programmes for financing** – loans from local financial institutions;
- **International source of financing** – EBRD, IBRD, EU programmes – IPA, FP7, IEE, ...
- **Others** – third party financing, public-private partnership, Local Energy and Development Agencies (AZRA, MENE, REGA, etc)...
- *Budget – state, local municipalities*

Considering a fact that EE Projects are financially demanding, it is obvious that the State institutions should take an initiative in implementing this kind of projects. Units of local and regional self-government have very significant role, because on the local level positive results from EE Projects through the demonstration effect may be easiest to transfer to private sector. This accomplishment is possible to realize only in the case of specific changes in the local budgets so that EE Projects could be encouraged. It is necessary to implement several measures so that Units of local and regional self-government could take an adequate leading role in promoting EE Projects. After the adjustments in their Budgets according to proposed Guidelines State and local municipalities Budgets will be significant source of financing EE Projects.

- *Environmental protection and energy efficiency Fund (EPEEF)*

Fund for environmental protection and energy efficiency is first and only extra budgetary special purpose fund for financing project, programmes and measures for environmental protection, energy efficiency and renewable energy in Croatia. Primary objective is conducting politics and strategies for environmental protection, which has been accomplished by giving financial support for investments in environmental protection, energy efficiency and renewable energy. It can support up to 40% of the total investment under the following conditions:

- Loan – zero interest rate, repayment period (payback 5 years, grace period 2 years), maximum EUR 230.000 per project
- Interest subsidy – 2 per cent decrease of the market interest rate (bank loan)
- Financial aid (grant) – only local/regional authorities are eligible

Allocation of funds

- Funds are allocated to the following categories based on public procurement announced by Fund:
 - Units of local and regional self-government
 - Companies, craftsmen, other legal entities and natural persons
 - Other legal persons
 - Private persons

General conditions for allocation of funds

- Legal and private persons are generally financed up to 40% of acceptable eligible cost
- Units of local and regional self-government are cofinanced:
 - Areas of special state concern up to 80%
 - Mountain and island areas up to 60%
 - Other areas up to 40%

Special criteria for allocation of funds

1. Project preparedness
2. Degree of beneficial impact on the environment and energy efficiency
3. Quality of offered technical solution
4. Degree of endangerment of environment
5. Financial capability of user of funds for investment and repayment (if recovery is contracted)

Eligible for financing

Industry, service and public sector – public lighting, change of fuels, and utilization of heat waste

Energy reviews and demonstration activities

Cogenerations

Central heating systems

Buildings/sustainable construction – low-energy and passive buildings, installation of new and/or change of existing materials, components and appliances, use of renewable energy

Clean transport – organizational and technical measures, utilization of alternative fuels, and procurement of EURO 5 vehicles

Forms of financing projects

Loans

- 0% interest rate
- term 7 years (grace period 2 years, repayment 5 years)
- up to 1,7 mln kuna

Subvention of interest rates

- Reduction of contracted interest rate for 2%
- up to 1,0 mln kuna (**irreversibly**)

Financial help - aid

- Just for units of local and regional self-government
- up to 1,7 mln kuna (**irreversibly**)

Donations

- preparation of studies and/or for scientific research institutions and individuals, non-profit institutions and organizations
- up to 200 000 kuna (**irreversibly**)

Before signing Contract with Fund (or latest before disbursement of funds)

- Technical documentation with associated permits
- Evidence of conducted public (in accordance with legal obligation)
- Act approving the construction according to the Law on Physical planning and construction
- Contractual quantities and prices of equipment and work with recapitulating quantities
- Data on collateral instruments (in case of loan)
- Other documentation on the Fund request

Total investments of Fund in EE Projects

- **In 1.100 EE Projects investments were 326,61 mln. kn**

Programmes from Croatian Bank for research and development (HBOR) – Programmes for financing projects for environmental protection, energy efficiency projects and renewable energy projects;

Aside from Fond, significant source of financing EE Projects are Programmes for financing projects for environmental protection, energy efficiency projects and renewable energy projects from Croatian Bank for research and development. Objective for this Programme is realization of investment projects which includes remediation of the landfill, encouragement of clean production, protection and preservation of biodiversity and landscape diversity, implementation of National energy programmes, encouragement of using renewable energy, sustainable construction, encouragement of clean transport, energy efficiency, etc..

It is important to emphasize that Croatian Bank for research and development participated in Energy efficiency project in Croatia financed from World Bank loan

and Donation from Global Environmental Fund, conducted by HEP-ESCO d.o.o. With this Programme it was scheduled formatting Guaranty Programme as a support to local financial institutions for financing energy efficiency projects. This programme is designed for issuance of partial guarantee to cover the credit risk of commercial banks. Project ends on 30. of June 2010.

HBOR supports the preparation of documents and studies up to 50% of the total eligible costs of design documents. The maximum loan is \$150.000 with a grace period of up to one year and a disbursement period up to two years. Under the Loan Programme for the financing of projects of environmental protection, energy efficiency projects and renewable energy, there is no limit to the loan amount, but it depends on HBOR financing capabilities, investment project, creditworthiness of the borrower and quality of security offered. HBOR can finance up to 75% of the estimated investment value with a maximum of one year for disbursement, a grace period of one year and repayment period up to 12 years, including the grace period. The interest rate varies from 4% to 6% based on the borrower. Sixteen commercial banks are cooperating with HBOR on this loan programme.

However there is a lack of request for these instruments from HBOR. HBOR representatives were not able to identify specific obstacles and bottlenecks that prevent wide use of these loan programmes in Croatia. Lack of specific EE and RES targets, skilled resources for EE and RES project development and a clear understanding of how these financial mechanisms work are the most likely causes.

Loan Programme for the Financing of Projects of Environmental Protection, Energy Efficiency and Renewable Energy Resources

1. Final Borrowers

- units of local and regional self-government
- utility companies
- companies, craftsmen, other legal entities and natural persons

2. Purpose of Loans

Fixed assets:

- initial funding
- land plots
- buildings
- equipment and devices

Not eligible for financing:

- purchase of real estate and immovable property from associated persons
- purchase of real estate and immovable property from associated persons
- purchase or construction of office premises
- investments already started and investments under way, the refund of already invested funds
- investments already started and investments under way, the refund of already invested funds

3. Manner of Implementation

- financing borrowers via commercial banks
- direct lending

4. Loan Amount, Disbursement Period and Repayment

The loan amount is not limited

Depends on HBOR's financing capabilities, the investment project, the creditworthiness of the borrower and quality of security offered; generally, loan applications lower than HRK 100,000.00 shall not be considered; HBOR finances up to 50% of the estimated investment value, VAT not included

Disbursement period up to 12 months

Grace period up to 2 years

Repayment period up to 12 years, including grace period

5. Interest

4% p.a.

Borrowers investing in a region of special state concern or hill or mountain area or the islands or borrowers having proven their competitiveness by successful sales figures in domestic and/or foreign markets or SMEs

6% p.a. or

three-month EURIBOR + 2% b.p. annually to all other borrowers

Remark: Should the Environmental Protection and Energy Efficiency Fund approve the interest subsidy, the above interest rate shall be reduced by 2% or by the amount of the approved subsidy.

6. Loan Application Fee

0.8% one-off, charged on the committed loan amount

7. Commitment Fee

0.25% p.a. charged on the committed undisbursed loan amount, starting 30 days after the loan contract date

8. Security

For securing due fulfilment of loan obligations, HBOR shall accept:

- bills of exchange and debentures
- pledge of property
- bank guarantees
- guarantees issued by the Croatian Agency for Small Businesses (HAMAG),
guarantees issued by the Republic of Croatia,

- other customary security in the banking operations

ESCO companies

HEP ESCO d.o.o. is an energy service-providing company which develops, executes and finances energy efficiency projects on a commercial basis. Projects include modernization, reconstruction and refurbishment of existing plants and facilities. Areas of business can be divided into public and private sectors, covering buildings, public lighting, industry and energy supply systems. In a wider context, HEP-ESCO is the implementing agency for Energy Efficiency Project Croatia which was initiated by the World Bank (IBRD) and Global Environment Facility (GEF) in cooperation with Hrvatska Elektroprivreda (HEP) and Croatian Bank for Reconstruction and Development. The company was founded with the aim of becoming the key creator of the market for energy efficiency projects in Croatia. For this purpose, HEP and/or HEP ESCO received a World Bank loan in the amount of 4.4 million euro and a GEF grant in the amount of 5 million US dollars. The total value of the Project is estimated at 40 million US dollars over a period of six years.

The final result expected from the implementation of the entire Project is a reduction in energy consumption and consequently a reduction in emissions of greenhouse gases in our region. HEP ESCO as a company should prove, in the period of 6 years, that energy efficiency projects are profitable and that ESCOs can successfully operate on a commercial basis.

Users of HEP-ESCO services are end users of electricity and heat energy, in both private and public sectors, and project partners are consulting, design and engineering firms, small and medium enterprises, equipment manufacturers and contractors, and domestic commercial banks.

HEP-ESCO offers financing for energy efficiency at less than 5% interest rate, with a maximum payback period of 8 years for the governmental sector and five years for the private sector. However, almost all the project implemented up to date is in the governmental sector.

HEP ESCO projects are financed based on loans. HEP ESCO's funding sources for project financing include:

- IBRD loan (initially USD 5 million), entirely devoted to project implementation.
- GEF grant (initially USD 5.8 million), USD 1.4 million of which was reserved for technical assistance. GEF fund could be used for project development and implementation.
- Loan with kfw in the amount of EUR 10 million that was negotiated and signed at the end of 2008.
- Loan with Splitska banka in the amount of EUR 3 million that was negotiated and signed at the end of 2008.
- The cash flow generated by HEP ESCO operations, which include profit generated on previous projects and recycling of grant money from the GEF fund. This also includes

cash flow generated by customer payment while the loan for project realization included a grace period and long repayment conditions.

EETEK is a private company based in Hungary providing direct equity investments in Central and Eastern Europe. It is trying to offer ESCO services in the Croatian market. So far it has implemented one project in renewables (biomass) and one on energy efficiency (with a ceramic manufacturer, initial investment of \$ 0,7 million). Lack of energy efficiency regulation and administrative barriers are cited as main obstacles to investment projects. In Croatia EETEK is looking for a project portfolio of up to \$ 20 million per year where it can provide about 30 % of the investment.

A. Commercial programmes for financing – loans from local financial institutions

Banking sector

Through the HBOR programmes a number of commercial banks are formally involved in the EE and RES projects as indicated above. However the level of utilization of existing financing mechanism remains very low.

International source of financing

EBRD activities in Croatia are diversified and investment is mainly made in the infrastructure projects. The Bank sets an objective of promoting EE and focuses on infrastructure needed for security and diversity of supply, including renewable energy projects. In 2007. EBRD signed a commitment to finance up to EUR 25 million for the Private Equity Fund dedicated to investing in RES and EE projects in Central and South-Eastern Europe. The Fund invest in Central and Eastern Europe and South-Eastern Europe including Bulgaria, Serbia, Croatia, Macedonia and Ukraine, in projects qualifying as power projects that contribute to specific EU targets for the Kyoto Protocol and have predictable and legally binding long-term off-take agreements. Regarding the structure, the Fund invests on its own or jointly in projects where equity returns can be enhanced by optimal degrees of debt using various financing structures.

The World Bank supported the establishment of HEP-ESCO in 2004. UNDP is implementing a GEF project “Removal of barriers for energy efficiency in Croatia”. The main objective is to implement economically feasible EE technologies and measures in the residential and service sectors. The project is divided into two major activities: pilot project “House-in-order” and “Energy management in cities”.

International cooperation presents important activity in the manner of exchanging experiences, transfer of knowledge and introduction on situation and trends in this area. Additional benefit is introduction to method of works different institutions and international associations and also creating a network of possible partners for further cooperation. Most significant benefit from international cooperation is usage of different financial instruments available for energy efficiency projects.

By having the status of candidate for EU membership, Croatia has access to funding in the process of adjustment for membership. The most significant EU programme in energy efficiency field is **Programme Intelligent Energy Europe (IEE)**, as one of the component Framework Programme for Competitiveness and Innovations (CIP). Programme is valid for the period 2007.-2013. and under this programme are financed energy efficiency projects and renewable energy. For the implementation of this programme is responsible Executive Agency for Competitiveness and Innovations (EACI).

Programme INTERREG have started in 1990. with the objective for development of cross-border cooperation with the possibility to register project in the energy field.

Also Croatia have access to the **Instrument Pre-Accession assistance (IPA)**, for the period 2007.-2013. which replace previous programmes CARDS, PHARE, ISPA and SAPARD.

It is important to emphasize that the preparation and nomination of the project for different competition, European and world funds is highly complicated and requires work with consultants for elaboration on Terms of references, large number of institutions ask for support from the EU state members so that project could be approved, which means that the lobby is necessary for the interest from possible partners, very often international project team should be defined with the clear and detailed project assignments with the financing scheme. It is necessary to overcome specific methodology for the international cooperation to be launched, which means that the interesting project content is indispensable but insufficient to be accepted.

B. Current level of understanding of EE projects in local financial institutes

Banks lack knowledge of energy efficiency technology, and (reasonably) consider such specialized knowledge outside scope of their operational interest. Existing procedural frameworks within banks vary and banks are reluctant to alter them. To be operationalized effectively, new lines of business must be fit into existing systems. Customer relations are important and strategies of banks to attract and retain customers often dictate areas of interest in new business lines.

C. Current barriers to financing of EE projects

Energy efficiency projects often represent a relatively small niche business for major banks. Local banking sectors tend not to prioritise energy efficiency finance, due to inexperience and lack of competition in the area, high transaction costs associated with smaller projects and risks associated with assessing and securitising revenues generated through energy savings.

Most significant barriers to financing of EE projects are following:

- Lack of interest in the commercial banks sector
- Banks do not recognize EE projects as an separate product with totally new market
- There is no recognition that providing financing for energy-efficiency projects represents a distinct market niche.

- Lack of awareness and experience among financiers of potential financial returns
- Lack of knowledge on energy efficiency and EE technologies
- Lack of appropriate financial mechanisms
- Traditional commercial financing
- No difference between traditional financing of companies from financing EE projects
- Lack of financial incentives
- Perception of higher risk
- Too much effort for too little profit

M&V:

There is no particular M&V practice or legislation in Croatia. HEP ESCO is producing M&V plans for its own purposes and not for performance contracting. See two example M&V Plans and Savings Reports in Appendix B.

IPMVP and IEEFP Adaptation Activities:

- See Appendices F and G for recommended amendments/additions to IPMVP and IEEFP. Include materials for IPMVP Vol I, Appendix C

These amendments will be reviewed in the Zagreb meeting and finalized with EVO thereafter.

Training Target Audiences:

- Target audience groups and ways to access each on topics of:
- M&V – Energy Professionals, Designers, Consultants, Energy Users, Energy Agencies
- Financing (current financiers and those not engaged already) - Commercial Banks
Ministry of Finance, Fund for Energy Efficiency, EBRD
- List in Appendices D & E those people or organizations to reach/engage

3. APPENDICES

- A. **Local Advisory Group (“LAG”)** – list of targeted people from the EE Stakeholders’ list that will help promote the PERMANENT program and its events
- B. **M&V Plans and related Savings Reports** - two examples of each by candidate trainers
- C. **IEEFP Working Group** – list of people to be targeted to help develop and promote the local presentations and workshops (may include LAG members)
- D. **M&V Trainees** - list of people to be targeted for training
- E. **IEEFP Introduction Participants** - list of people to be targeted to attend the first “IEEFP Introduction Forum”
- F. **Recommended IPMVP Amendments** - specify recommended changes to current text of IPMVP. Show page reference, current text, proposed text and reasons for change.
- G. **Recommended IEEFP Amendments** - Specific changes recommended to current text of IEEFP. Show page reference, current text, proposed text and reasons for change.

A. Local Advisory Group (“LAG”)

– list of targeted people from the EE Stakeholders’ list that will help promote the PERMANENT program and its events

	Institution / address	Contact Person	e-mail	web	phone
1.	FOND ZA ZAŠTITU OKOLIŠA I ENERGETSKU UČINKOVITOST Environmental protection and energy efficiency Fund Ksaver 208 10 000 ZAGREB	mr. sc. Željko Kučiš	zeljko.kucis@fzoeu.hr	www.fzoeu.hr	+385 1 5391 928
2.	ENERGETSKI INSTITUT HRVOJE POŽAR Energy Institute Hrvoje Požar Savska cesta 163 10 000 ZAGREB	dr.sc. Marina Malinovec Puček	mmalinovec@eihp.hr	www.eihp.hr	+385 1 6326 181
3.	FAKULTET ELEKTROTEHNIKE I RAČUNARSTVA Zavod za visoki napon i enegetiku Unska 3 10 000 ZAGREB	mr.sc. Vesna Bukarica	vesna.bukarica@fer.hr	www.fer.hr	+385 1 6129 986
4.	FAKULTET STROJARSTVA I BRODOGRADNJE Faculty of Mechanical Engineering and Naval Architecture Katedra za toplinsku i procesnu tehniku Ivana Lučića 5 10 000 ZAGREB	dr. sc. Marino Grozdek	marino.grozdek@fsb.hr	www.fsb.hr	+385 1 6168 564
5.	UNDP Croatia Projektni ured Bednjanska 14/I 10 000ZAGREB	Goran Čačić	goran.cacic@undp.hr	www.ee.undp.hr	+385 1 6331 885

B. M&V Plans and related Savings Reports

Measurement and verification Plan No.1

Date 14. February 2010.

Project: Office building heating system modernization

1. Description

Building is located in business center city of Zagreb, Croatia. It has 6 floors and total heated area is 5.500 m². Building was built in 1990. Now it has been occupied 8-20h on working days, weekends are non working time. Heating is provided through gas fired boiler room for whole building, as well as for preparation of sanitary hot water. Local gas distributor is responsible for gas supply and invoicing is monthly based on reading from gas meter.

2. Description of ECMs

ESCO engineers proposed following ECMs:

- a. Installation of heat recuperation units in five air handling units (design positions K1, K2, K3, K4 and K5). AH units K1-K5 regulate air quality (temperature and humidity) throughout the year (heating and cooling). Intention is to supply air of same quality and quantity, but with less energy consumed for air preparation. Preliminary designs verified feasibility for installation of recuperation systems in all five AH units. This will not change set point temperatures in office spaces. Heat exchangers are plate type, so there is no direct mixing of inlet and outlet air, which means no need for additional monitoring of air quality. It is estimated that heating energy can be reduced 20% by installation of heat recuperators.
- b. Installation of solar panels on the building roof. Solar panels are connected to two large (5m³ each) buffer water tanks and are used to preheat water. It is calculated that solar heating can cover 25% of total yearly heating load.
- c. Reparation of indoor thermo controllers. Some 20 out of total 80 controllers are out of function. Temperature measurements in areas with broken controllers showed that temperature was 2-4 degrees C higher than 21 degree C, which was set temperature. By reparation of controllers it is estimated that temperatures will be reduced to 21C. Also controllers have built in programmers, so temperature can be reduced after working time (to 18C). Savings will be 5%.

Total savings are estimated at $\{1-(1-20%)*(1-25%)*(1-5%)\}= 43\%$

3. Measurement boundary

For selected ECM's the IPMVP Option C will be used (IPMVP Volume I EVO 10000-1:2009). Measurement boundary is whole building.

4. Baseline Period

Baseline period is from 1st of January 2008 until 31st of December 2009. which is one whole year.

Energy Consumption for the Baseline is given in following table:

month	2009	
	NG consumption /m3	NG consumption /kWh
January	19.935	184.600
February	17.315	160.338
March	14.210	131.584
April	8.894	82.354
May	4.787	44.324
June	3.152	29.186
July	2.783	25.773
August	2.643	24.472
September	4.400	40.747
October	9.118	84.432
November	13.072	121.051
December	18.482	171.139
TOTAL	118.790	1.100.000

- Total baseline consumption is 118.790 m³ of Natural gas, H_D=9,26 kWh/m³.
- HDD for baseline period was 2.540.
- Occupation hours for baseline period was 3.000 hours. Facility was used 50 weeks a year (two weeks in August were non-working for all employees), mon-fri, 12 hours per day with full occupancy.
- Number of employees working in building was 200 on average (based on monthly figures).
- Measured indoor temperatures were: 23C for offices, 22C for meeting rooms, 20C for halls, toilets and other spaces. Spaces were overheated during baseline measurements (required temperatures are 21C offices, 19C for meeting rooms and 18C for halls). After the project is completed, ESCO will restore temperatures at required levels. Number of air changes was 0,7 per hour, and it will remain the same due to air quality requirements.
- Total heated area was 5.500 m².

5. Reporting Period

Reporting and measurement period is one year after commissioning of new equipment. During that period, monthly bills for gas consumption will be collected, as required in Option C (IPMVP Volume I EVO 10000-1:2009). During one year, monthly reports will be prepared based on baseline data and actual data.

6. Basis for adjustments are baseline data.

7. Analysis Procedure

Input actual data:

1. monthly gas consumption measured from the utilities gas meter
2. actual HDD (from outside temperature monitor) calculated by National meteorological methodology, baseline value for each month is in Appendix (validity range for each monthly value is $\pm 10\%$ deviation from baseline data).

Savings normalization formula:

$$E_s = 1.100.000 - E_a * \frac{HDD_{ref}}{HDD_{act}} [kWh]$$

Where is:

E_s	energy savings
E_a	actual energy consumption
HDD_{ref}	number of heating degree days in baseline period (one year)
HDD_{act}	number of heating degree days in measurement period (one year)

3. indoor temperatures from 10 measurement devices at three areas (n=1 for offices, n=2 for meeting rooms, and n=3 for halls).

$$T_{Sn} = \frac{T_{Sn1} + T_{Sn2} + \dots + T_{Snm}}{m}$$

Where is:

T_{Sn}	average temperature for selected area (n=1 for offices, n=2 for meeting rooms, and n=3 for halls)
T_{Snm}	measured temperature at n-th point
m	total number of measurement points

Validity range is $\pm 5\%$ deviation from baseline data.

4. Total number of employees (validity range is 150-250) is calculated base on following formula:

$$N = \frac{\sum E_n}{m}$$

Where is:

N	average monthly number of employees in the building
E_n	number of employees for each day of the month

m total number of days in the month

5. Occupation hours is total monthly number of hours when building is min. 80% occupied, baseline value is 3000 (range is 2900-3100).

Procedure for savings report:

1. Check if independent variables are within range
2. If variables are within range, actual consumption shall be calculated regarding normalization of HDD from actual values to baseline values
3. If independent variables are outside of the range, actual consumption for that month shall be calculated as baseline consumption*(1-savings (43%)).
4. Calculate actual savings

8. Energy Prices

Calculations of savings are based on gas prices valid at 2nd of April 2010 (2,37 Kn/m³ VAT excluded). Savings (in Kn) will change if price of gas changes based on following formula:

$$E_s [Kn] = E_s [kWh] * P_{av}$$

Where is:

$E_s[Kn]$ energy savings in monetary units
 $E_s[kWh]$ energy savings in energy units
 P_{av} average price of gas for measurement period based on annual report of Chamber of Commerce

9. Meter Specification

Utility meter will be used for measurement of actual consumption of natural gas. Reading will be taken 1st day of each month at 8:00 am and written in log book.

Temperature meters are located indoor and one temperature meter is outside at north side of building. Meters shall have valid official certificate for calibration. Readings are continuous and saved in database.

If data from temperature meters are lost, for calculation purposes baseline data will be used.

10. Monitoring Responsibilities

Monitoring of:

- utility gas meter shall be done by housekeeper as described in Bullet no. 9.
- temperatures shall be done by ESCO, remotely.
- Employee number is done by automatic registration software (building management system) and saved in the database. ESCO shall have continuous access to that information

- Occupation hours logging is done by Building management system. ESCO shall have continuous access to that information
- Heated area will be done by ESCO once a year by visual audit.

11. Expected Accuracy

Evaluate the expected accuracy associated with the measurement, data capture, sampling and data analysis. This assessment should include qualitative and any feasible quantitative measures of the level of uncertainty in the measurements and adjustments to be used in the planned savings report (See Chapter 8.3 and Appendix B).

12. Budget

Initial budget for measurement equipment and installation is 10.000 Eur. Yearly cost of M&V is 5.000 Eur.

13. Report Format

Reports shall be submitted by Email in .pdf format. Sample report is given in Appendix.

14. Quality Assurance

All input data shall be confirmed by customer's representative. Savings report shall be verified by the customer's representative.

Savings report template

No. 2/10

Date 14. February 2011.

Project: Office building heating system modernization

Project commissioning date: 31st of December 2010.

1. Measurement period: 1st of January 2011-31st of December 2011.
2. Actual energy consumption:

month	2011	
	NG consumption /m3	NG consumption /kWh
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
TOTAL		

3. Independent variables:
 - Total actual consumption was _____
 - HDD for actual measurement period was _____
 - Occupation hours for baseline period was _____ hours. Facility was used _____ weeks a year.
 - Number of employees working in building was _____ on average (based on monthly figures).
 - Measured indoor temperatures were: ____C for offices, ____C for meeting rooms, ____C for halls, toilets and other spaces. Additional remarks:_____. Number of air changes was _____ per hour.
 - Total heated area was _____ m².

5. Changes and adjustments of independent variables

Describe if any.

6. Energy prices

Show trends in gas prices over measurement period. Show

7. Baseline adjustments

Describe if any baseline adjustments were performed.

8. Energy Savings

Energy savings are computed according to following formula:

$$E_s = 1.100.000 - E_a * \frac{HDD_{ref}}{HDD_{act}} [kWh]$$

Energy savings are: _____ kWh

Energy savings are: _____ Kn.

Measurement and Verification Plan No.2

Project: Public lighting of city Duga Resa

1. Description and ECM Intent

Public lighting of city Duga Resa, in Croatia is 30 year old and has many problems. Inadequate and outdated lighting needs reconstruction because maintenance problem and the problem of excessive energy consumption due to lighting effects achieved. The whole system of public lighting of city Duga Resa consists of 655 pieces of lamps are arranged at 21 measuring points.

ESCO engineers proposed following ECM:

- Complete reconstruction retrofit of public lighting of the central part of the city Duga Resa and suburbs. The ECM would also solve the problem of inadequate and outdated lighting, sometime earlier and more than 30 years that the system creates a maintenance problem and the problem of excessive energy consumption due to lighting effects achieved. Along with energy efficiency measures taken into account the satisfaction of the technical and lighting conditions so that in certain areas due to raising illumination there was an increase in consumption. In addition to energy savings should be taken into account the savings in maintenance for the proposed measures. Total savings are estimated for 38%.

2. Selected IPMVP Option and Measurement Boundary

For selected ECM the IPMVP Option A will be used (IPMVP Volume I EVO 10000-1:2009). Measurement boundary is drawn to include the lighting fixtures connected to system of public lighting.

HEP-ESCO will perform measurement and verification (M&V) activities for ECM in order to estimate the actual cost savings achieved in the project.

Table 2 M&V Plan Summary

ECM	ECM description	M&V option used*	Summary of M&V plan
Lighting Retrofit	Retrofit of existing lighting fixtures with high-pressure sodium lamps	A	Measurements of total installed fixture wattages on every metering spot; stipulated yearly hours of lamp operation.

3. Baseline: Period, Energy and Conditions

Baseline period is from 1st of January 2008 until 31st of December 2008, which is one whole year.

Table 3 Annual consumption according bills

No.	Annual consumption 2008 [KWh]	Number of lights on the meter	Installed power on the meter [kW]	Estimated consumption of the meter [kWh]
1	23.392,00	18,00	5,30	21.462,66
2	26.608,00	47,00	7,85	31.808,15
3	29.271,00	40,00	7,44	30.144,19
4	46.695,00	49,00	12,73	51.606,85
5	31.742,00	25,00	6,59	26.695,69
6	14.002,00	12,00	3,12	12.660,56
7	17.919,00	32,00	4,72	19.123,47
8	17.483,00	27,00	3,30	13.359,90
9	17.814,00	32,00	5,02	20.329,24
10	4.586,00	18,00	3,66	14.830,94
11	47.942,00	59,00	10,41	42.201,86
12	19.937,00	31,00	4,58	18.568,82
13	31.374,00	42,00	12,38	50.159,93
14	21.286,00	33,00	4,99	20.208,66
15	16.015,00	20,00	3,15	12.781,14
16	14.838,00	41,00	8,07	32.724,53
17	27.843,00	42,00	10,27	41.623,09
18	2.928,00	10,00	1,80	7.282,84
19	10.053,00	17,00	2,70	10.948,37
20	16.258,00	24,00	3,72	15.072,09
21	50.994,00	36,00	10,44	42.322,44
TOTAL	488.980,00	655,00	132,23	535.915,42

Annual electricity consumption (according to the bills for 2008.) amounts to 488,980 kWh per year. It should be noted that the energy consumption of public lighting by electricity bills, and does not include the consumption of lamps that are not operational.

Simulation of the system was determined by the annual electricity consumption of 535,915 kWh per year. This figure represents the simulated consumption measurement system of 21 seats if all lights were working.

The M&V Plan for the lighting efficiency retrofit of the public lighting system in the city of Duga Resa will follow IPMVP M&V Option A. The variables affecting savings from this lighting project are fixture powers and hours of operation. Fixture powers will be measured before and after implementation.

Operating hours will be acquired from the measured data of the working hours provided by HEP d.d. The acquired operating hours will then be used to estimate the energy and demand savings during performance period and will not be adjusted even if the actual operating schedules change.

Option A has been selected for this retrofit due to the option’s relatively small cost of savings determination, and due to the high confidence with which the fixture demand and operating hours may be determined. Equipment numbers and locations will not vary, and operating hours are not projected to change after the project is implemented.

The M&V Plan for this retrofit assumes:

- Operating hours will be acquired before the retrofit. The hours for the lighting fixtures will be the same before and after the equipment retrofit for the purpose of energy savings calculations.
- Fixture powers before and after the retrofit will be measured.

Table 4 Baseline

2008		
Number of lights on the meter	Installed power on the meter [kW]	Estimated consumption of the meter [kWh]
655	132,23	535.915

Calculations were performed on a single system operating time of 4.053 hours per year and technical specifications and measured installed power of lamps.

4. Reporting Period

Reporting and measurement period is one year after commissioning of new equipment. During that period, monthly bills for gas consumption will be collected, as required in Option C (IPMVP Volume I EVO 10000-1:2009). During one year, monthly reports will be prepared based on baseline data and actual data.

5. Basis for Adjustments

Basis for adjustment is baseline period.

6. Analysis Procedure

Lighting retrofit

The baseline and post-installation demand for each measuring spot will be determined using Equation 1.

Equation 1:

$$S_n \text{ [kWh]} = (P_b - P_a) * h$$

where:

$S_n \text{ [kWh]}$	=	kilowatt-hour savings realized during one year post-installation
P_b	=	measured load of the metering spot before ECM implementation
P_a	=	measured baseline load of the metering spot after ECM implementation
h	=	operating hours

The annual energy savings will be determined using Equation 2.

Equation 2:

$$\text{Annual Energy Savings} = \sum S_n \text{ [kWh]}$$

where:

Annual Energy Savings	=	total annual energy savings of the entire project
$\sum S_n \text{ [kWh]}$	=	sum of all kilowatt-hour savings realized during one year post-installation on all measuring spots

The annual cost savings will be determined using Equation 3.

Equation 3:

$$\text{Annual Cost Savings} = [\text{Rate}_{\text{kWh}} \times \sum S_n \text{ [kWh]}]$$

where:

Annual Cost Savings	=	total annual cost savings of the entire project
Rate_{kWh}	=	price of 1 kWh in kunas

$\sum S_n$ [kWh] = sum of all kilowatt-hour savings realized during one year post-installation on all measuring spots

Should the city of Duga Resa make any changes of the public lighting system, it assumes the risk that the savings calculated by this plan may not materialize.

7. Energy Prices

Calculations of savings are based on electric energy prices valid for 2009 (0,58 Kn/kWh VAT excluded).

8. Meter Specification

A Nanovip single phase power meter will be used for all measurements. Measured lighting fixtures will be in operation at least 10 minutes prior to measurement in order to achieve typical operating temperature. The Nanovip will be used to measure actual wattage, which considers volts, amperes, and power factor.

Meters shall have valid official certificate for calibration. Readings are saved in database.

9. Monitoring Responsibilities

Monitoring of:

- Number of working number of lamps will be done by maintenance staff twice on year.

10. Expected Accuracy

Evaluate the expected accuracy associated with the measurement, data capture, sampling and data analysis. This assessment should include qualitative and any feasible quantitative measures of the level of uncertainty in the measurements and adjustments to be used in the planned savings report (See Chapter 8.3 and Appendix B).

11. Budget

Initial budget for measurements is 10.000 Eur.

12. Report Format

Reports shall be submitted by Email in .pdf format. Sample report is given in Appendix.

13. Quality Assurance

All input data shall be confirmed by customer's representative. Savings report shall be verified by the customer's representative.

Savings report template

No. 2/10

Project: Public lighting of city Duga Resa

Project commissioning date: 31st of December 2010.

1. Measurement period: 1st of January 2011-31st of January 2011.

2. Actual energy consumption:

No.	Number of lights on the meter	Installed power on the meter [kW]	Estimated consumption of the meter [kWh]
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
TOTAL			

9. Changes and adjustments of independent variables

Describe if any.

10. Energy prices

Show trends in gas prices over measurement period. Show

11. Baseline adjustments

Describe if any baseline adjustments were performed.

12. Savings

Energy savings in kWh are computed according to following equation 1:

Energy savings are: _____ kWh

Energy savings in kn are computed according to following equation 3:

Energy savings are: _____ Kn.

C. IEEFP Working Group

-list of people to be targeted to help develop and promote the local presentations and workshops (may include LAG members)

LAG plus:

1. Igor Raguzin MINGO
2. Nada Marđetko Škoro – MZOPU
3. Željka Hrs Borković – Energy Institute ‘Hrvoje Požar’

D. M&V Trainees - list of people to be targeted for training

LAG plus:

1. Igor Raguzin - MINGO
2. Nada Marđetko Škoro – MZOPU
3. Željka Hrs Borković – Energy Institute ‘Hrvoje Požar’
4. Marko Capek – UNDP
5. Igor Biščan – UNDP
6. Đorđe Balabušić – MINGO
7. Nikola Kučiš – Agency for Energy Efficiency
8. Julije Domac - Agency for Energy Efficiency
9. Mladen Boršić – Regional Energy Agency
10. Valdimir Soldo – Faculty of Mechanical Engineering
11. Ivica Skorić – HEP Supply

E. IEEFP Introduction Participants - list of people to be targeted to attend the first “IEEFP Introduction Forum” – HEP ESCO

1. Commercial Bank Board Members – Zagrebačka Banka, Reiffeisen Bank, Privredna Banka, Splitska Banka, HBOR
2. National Fund for Energy Efficiency
3. EBRD Croatia
4. UNDP
5. Ministry of Finance

F. Recommended IPMVP Amendments – No propositions so far**G. Recommended IEEFP Amendments - No propositions so far**