Status of Energy Efficiency in the Western Balkans

A Stocktaking Report

June 15, 2010

Sustainable Development Department (ECSSD)
Europe and Central Asia Region (ECA)

Document of the World Bank

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ABBREVATIONS AND ACRONYMS

ADEME	Agency for the Environment and Energy Management (France)
AEA	Austrian Energy Agency
BCM	Billion Cubic Metres (of gas)
BiH	Bosnia and Herzegovina
CCGT	Combined Cycle Gas Turbine
CEEF	Commercializing Energy Efficiency Financing
CFB	Circulating Fluidized Bed
CFL	Compact Fluorescent Lamps
CHP	Combined Heat and Power
DH	District Heating
EBRD	European Bank for Reconstruction and Development
EC	European Community
EE	Energy Efficiency
EIB	European Investment Bank
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EUROSTAT	Statistical Office of the European Union
FGD	Flue Gas Desulfurization
GTZ	Agency for Technical Cooperation (Germany)
GWh	Gigawatt-hour
HHV	Higher Heating Value
IEA	International Energy Agency
KFW	Kreditanstalt fuer Wiederaufbau (Germany)
Mtoe	Million tons of oil equivalent
MWh (e or th)	Megawatt-hour (electric or thermal)
NEEAP	National Energy Efficiency Action Plan
OCGT	Open Cycle Gas Turbine
RE	Renewable Energy
SME	Small and Medium Enterprises
TA	Technical Assistance
TFEC	Total Final Energy Consumption
TPP	Thermal Power Plant
UNECE	United Nations Economic Commission for Europe
USAID	United States Agency for International Development

Acknowledgements

This study takes stock of the status of energy efficiency in the Western Balkans. It was prepared by a World Bank team comprising Peter Johansen (team leader), Hinderikus Busz and Ana Plecas (consultants). External consultants included the Austrian Energy Agency (lead consultant), Besim Islami (covering Albania), Semin Petrovic (covering Bosnia and Herzegovina), James Myers (covering Kosovo), Rubin Taleski (covering FYR Macedonia), and Nenad Pavlovic (covering Montenegro and Serbia), Aleksandar Kovacevic and Stratos Tavoulareas (covering cogeneration issues). The team wishes to thank Jane Ebinger and Jas Singh of the World Bank for peer-reviewing the draft of this study and providing insightful comments that helped improve the final version of the report.

In addition to doing their own research, the consultants made extensive use of existing data from the most recent reports on energy efficiency in the Western Balkans available, notably those prepared under the aegis of USAID and the World Bank. Throughout the study, close coordination was maintained with other donors and stakeholders such as the European Commission (EC), European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Kreditanstalt fuer Wiederaufbau (KfW), the Energy Efficiency Task Force of the Energy Community, and the United States Agency for International Development (USAID). This ensured that our work was complementary and transparent, and minimized duplication of efforts.

The study was undertaken with significant financial support from ESMAP.

Executive Summary

Across the Western Balkan region, countries exhibit relatively high levels of energy intensity, a high energy savings potential among energy end-users, and heavy dependence on imported hydrocarbons. Energy markets would benefit from enhanced demand-side efforts and integrated energy efficiency measures across all sectors. Since most energy infrastructure was built during the 1960s and 1970s, inadequately maintained since the 1990s, and reaching the end of its useful lifespan, now is a crucial time to consider the way forward in the energy sector. The signing of the Energy Community Treaty in 2003 marked the beginning of systematic energy sector liberalization among Western Balkan countries, allowing them to deal with widespread energy sector problems that included, on the demand side, low energy tariffs, lack of payment discipline and, hence, little incentive for energy users to invest in energy efficiency measures.

Demand for energy will significantly increase in almost every sector over the coming decades. Although the energy efficiency (EE) of demand-side devices will also rise as technologies improve, these future increases in efficiency could be further leveraged: if remedial policy measures were introduced, additional average energy savings of 10-15 percent of current projections could be realized.

Building each component of the strong enabling environment required for increased EE across the Western Balkan countries will need cooperation among decision makers at multiple government levels, and capital investment by stakeholders to support projects that use energy more rationally. Investors are attracted to opportunities where a strong national government role and clear regulatory structures help dismantle barriers, establish clear conditions and standards, provide technical information, and facilitate funding for EE technologies. This study examines the status of the enabling environment for demand-side EE across the Western Balkans, evaluates developments in each country, and offers recommendations on the way forward.

Main Findings

Lack of reliable energy data. The most striking finding is that reliable energy consumption data are close to nonexistent in most countries throughout the region. This has profound implications. First, it is virtually impossible to calculate estimates for EE potential by country or sector, or to establish EE priorities. Second, since most countries lack even the most basic data, including reliable energy balances and sectoral EE indicators, they are unable to prepare high-quality National Energy Efficiency Action Plans (NEEAPs) with monitorable and realistic interim targets, as required by the European Union, to reduce energy consumption by 9.0 percent by 2016.[1] Each country must prepare a NEEAP every three years during 2009-16, but most countries lack data. Therefore, immediate priorities for all countries include an energy data collection frame-

[1] Directive 2006/32/EC of the European Parliament and the Council on energy end-use efficiency and energy services (ESD) requires Members States to prepare three National Energy Efficiency Action Plans for the period 2008- 2016 and report them to the European Commission. The aim is for all Member States to achieve an energy savings target of 9.0 percent of their average final inland energy consumption during 2001-2005 by the end of 2016 (recently updated to 2018). As members of the Energy Community, Western Balkan countries have the same obligations.

work, conforming to EUROSTAT reporting requirements, to facilitate data comparability among EU member countries and accession candidates and inform policy making.

High energy savings potential. Annual energy expenditures could decrease by up to US$3.4 billion across Western Balkan countries if they could realize their estimated energy savings potential through lowering overall annual energy consumption by about 7.0 million tons of oil equivalent by 2020 (at US$65/barrel).[2] That potential could be realized through EE measures in all end-use sectors, although it should be noted that end-use sectors like transport and residential, are particularly hard to deal with. Estimates of the energy savings potential by 2020, compared to a baseline, are shown below; they range widely by sector and country due to country differences and above all, scarcity of reliable data.

Sector	**% Energy Savings Potential**
Transport	10
Residential	10-35
Public	35-40
Service	10-30
Industrial	5-25

Increased energy use in all countries and sectors. Uncertainty surrounds future energy consumption scenarios by country and sector due to lack of reliable data and clear trends, resulting from the breakup of the former Yugoslavia. However what is certain is that, if no measures are taken to improve EE, energy consumption will increase dramatically in the decades ahead. Baseline projections for the SEE region show annual growth of more than 3.0 percent in energy consumption through 2027 (Figure 1). The most rapid growth is expected in the commercial sector (140 percent), followed by the industrial sector (100 percent) and the residential sector (60 percent); even with increased EE in demand devices such as household appliances, energy consumption in the region would increase by at least 2.0 percent per year through 2027[3].

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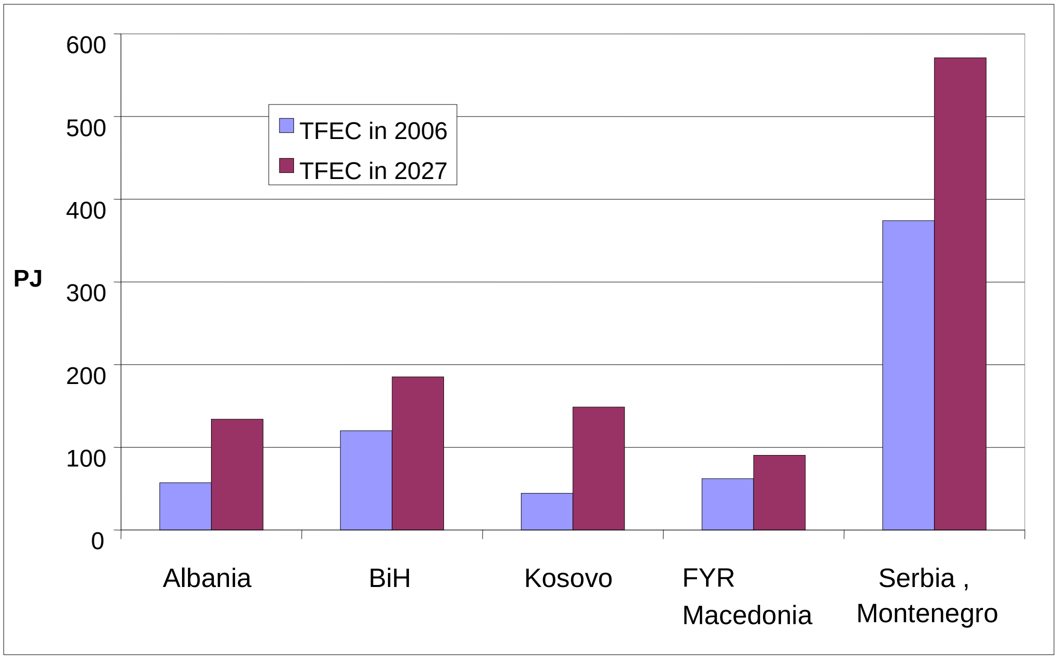
[2] Based on IEA data for forecast energy consumption by 2020 in the six countries and using the mid-range of the energy savings potential for each sector

[3] Source: International Resources Group, *Final report of the Regional Energy Demand Planning Project – Future Energy Scenarios in South East Europe and the Potential for Energy Efficiency*, USAID/IRG, 2008

Figure 1. Total final energy consumption, 2006 vs. 2027



Source: USAID 2008. Note that the category "transport & other" is not included.

Multiple barriers to energy efficiency. Relatively low energy prices, cross-subsidies, lack of individual meters or heat cost allocators for heat consumption, and high levels of non-payment, are major barriers to EE in most countries. Other significant barriers include gaps in the institutional, legal and regulatory frameworks; lack of EE training programs for professionals such as architects, building contractors, and energy auditors; high initial investment costs for EE technologies; a lack of financial, technical, and administrative incentives to introduce EE improvements; and a lack of consumer information and awareness in most sectors.

Energy price adjustments are needed. The Energy Community Treaty requires liberalization of network fuels and all countries have formally liberalized their electricity sectors and unbundled vertically integrated electricity providers. However, energy prices in the Western Balkans are in almost all cases too low and residential consumers are being cross-subsidized by large industrial/commercial consumers; relatively high commercial losses (theft and non-payment of bills) further complicate the picture. Apart from their negative effect on energy efficiency investments, tariff distortions also cause costly distortions in energy infrastructure investments that countries have to live with for decades to come. Tariff levels for each consumer category should be gradually increased to the levels implied by the Energy Community Treaty's anticipated full market opening by 2015. At the same time, Governments should introduce support schemes for the neediest segments of the population. As an intermediate step towards both of these objectives, regulatory authorities could consider introducing block tariff systems where they do not already exist. So far, only Serbia is a significant natural gas consumer; natural gas markets in Bosnia Herzegovina and FYR Macedonia are small; Albania, Montenegro and Kosovo are not gasified.

Capacity building is needed. In all countries the institutional framework for EE requires substantial improvement. Successful institutional frameworks provide an enabling environment for EE through discrete but interlocking elements that must function together to ensure implementation. The latter is critical: without implementation and effective enforcement of codes and standards little will be achieved. Capacity building at all levels is needed urgently throughout government and industry. Governments need an EE "change agent" to coordinate among government entities and ensure compatibility and synergy among all elements of the institutional frameworks and policies. In every country reviewed for this study, the institutional framework for energy savings exhibits shortcomings that impede implementation of EE. Of course, the situation differs by country: Bosnia has the most work to do on its institutional framework, followed in ascending order by Kosovo, FYR Macedonia, Montenegro, Albania and Serbia (Figure 2). This ranking also corresponds with the relative strength of demonstrated interest in EE and existing investment levels in those countries.

Figure 2. Institutional framework by country

	Albania	BIH	Kosovo	FYR Macedonia	Montenegro	Serbia	
Administrative Responsibilities	1	4	1	1	1	1	Policy framework
Legal Base for EE	1	4	4	2	1	1	
Regulations	1	4	4	2	1	1	
Policy goals for EE	2	4	2	2	2	1	
EE Strategy	2	4	2	2	2	1	
EE Action Plans	2	4	3	2	1	1	
Supporting Policy-tools	2	4	3	2	1	1	
Energy Institute	4	4	4	2	4	2	Supporting Structure
Energy Regulatory Authority	1	2	1	1	1	1	
Implementing Agency	1	4	3	2	2	1	
Availability of EE hardware	2	3	3	3	2	2	Implementation and know-how
Quality-assurance for hardware	2	3	3	3	2	2	
Trained experts in technology implementation	1	3	4	3	3	2	
Quality assurance for experts	2	3	4	3	3	2	
Financial institutions familiar with EE	4	3	4	3	3	3	Incentives
Support scheme for implementation	4	3	4	3	3	3	
Sanctions for non-implementation	4	4	4	3	3	3	
Information system for consumers	4	4	4	3	3	2	Information

Legend	
1	Good quality
2	Medium quality
3	Low quality
4	None existing

Source: AEA

Energy Efficiency Potential by Sector.

Residential sector (10-35 percent). The residential sector share of final energy consumption varies by country. On average, 65 percent of residential energy goes to space and water heating, and the rest to appliances, cooking, and lighting. In the Western Balkans, energy consumption per capita and per household is now significantly lower than in the EU15 or the EU27; most Western Balkan households own far fewer appliances, have smaller houses and larger families, and do not heat all of the rooms in their houses (e.g., in Kosovo, on average, only 40 percent of the surface area of a home is heated). However in the coming decades, as economies expand and incomes rise, households will trend toward European averages, substantially raising energy consumption and expenditures, which can be mitigated by increased EE measures. There will also be increased demand for summer cooling as temperatures rise due to climate change.

The most critical measures for the residential sector include the following: (i) develop an accurate database on building stock (size, age, installed heating systems, etc.); and (ii) introduce and enforce modern building codes based on the European Building Directive to replace out-of-date existing building codes. For example, Montenegro's building code requirements should include chimneys so space heating can use fuels other than electricity.

Public sector buildings (35-40 percent). In some countries, health and education sector buildings account for up to two-thirds of national energy consumption, yet official data were scarce and scattered on building surface and volumes, energy consumed, number of beds, number of students, and so forth, despite significant efforts to obtain such data. This reflects three main constraints in the sector to realizing energy savings: first, energy data gathering systems are poor; second, for public institutions, energy consumption sometimes still represents a soft budget constraint; and third, these institutions have little incentive to save energy since existing regulations prevent them from reallocating savings to other areas of their operations. In Bulgaria, Croatia, and Serbia, ongoing public sector EE projects yielded energy savings of about 40 percent; schools and hospitals realized the most savings from installing new roof insulation, energy efficient windows and doors. Serbia's Energy Efficiency Project, supported by the World Bank, yielded average energy savings of 35 percent in hospitals and 44 percent in schools, plus significantly increased comfort levels.

Public and private services sector (10-30 percent). Separate data on energy consumption for these two subsectors are nonexistent in four countries and unreliable in the other two. Implementing systems for collecting standardized consumption and output data on, for example, energy consumed per m^2, per student, or per hospital bed, is essential to determining the highest EE priorities within each subsector.

Industry sector (5-25 percent). Data on energy intensity in specialized industrial sectors are available only for Serbia and Albania. In most countries, industrial sector energy consumption is expected to increase as industries are privatized and economies expand relative to now, when many industries are dormant or barely operational and most equipment is obsolete and poorly maintained. When production eventually ramps up, energy consumption could spike due to energy-inefficient equipment, especially if industries can access energy at preferential tariffs.

Transport sector (10 percent). Transport sector energy consumption could *triple* over the next 35 years if the economic development of Western Balkan countries mirrors that of the EU. Transport has major potential for energy savings compared to a business-as-usual scenario, despite the likelihood of dramatic future increases in total consumption. Recently, the share of road transport for passengers and goods has grown rapidly primarily due to rising vehicle ownership, boosted by somewhat inefficient and uncomfortable public transport. The average age of the vehicle fleet is about 15 years, amplifying transport sector energy intensity. However, this is likely to decline as incomes rise and the vehicle fleet becomes gradually more energy efficient. On the other hand, improved EE will be more than offset by the growing number of cars per household and the projected increase in passenger-kilometers, even with strong EE measures such as mandatory vehicle inspection, strict emission limits, and tax relief or reduced registration fees for low-emissions vehicles. It should also be noted that rising temperatures due to climate change can reduce the efficiency of vehicles, turbines, etc.

Recommendations

Improvements in energy efficiency are important in their own right, in order to reduce expenditures on energy, enhance the competitiveness of the regional economies, and create new employment opportunities in technologically more advanced sectors. Beyond that, and critically, EE reduces the greenhouse gas emissions that cause climate change compared to the business as usual scenario and makes it easier for countries to meet their renewables targets as part of their commitments to the EU. Therefore, EE is a triple-win proposition and scaling up the very modest EE measures and investments that have taken place so far in the Western Balkans is crucial. That will require, inter alia, the following:

- ***Improve data collection.*** Effective policies require sound energy sector data, based on EUROSTAT guidelines. Reliable statistical data are essential to understand the current situation and monitor energy policy effectiveness; this study found that data collection systems must be improved in all countries. Governments should select and fund a ministerial department or EE agency as the responsible authority to improve data collection and management, and to implement comprehensive EE policies.

- ***Adopt robust energy efficiency action plans.*** Action plans should be aligned with EU Energy Services Directive requirements, be coordinated among ministries, and include time-bound, monitorable measures and responsibilities.

- ***Adopt acquis communautaire requirements.*** Besides the Energy Services Directive the countries in the Western Balkans should also actively transpose and implement the other requirements of EU legislation, notably in relation to buildings and space heating. This will also help smooth the way towards eventual EU accession.

- ***Monitor energy efficiency measures.*** The Energy Services Directive requires Energy Community Treaty signatories to assign an entity for overall control and responsibility to oversee action plan implementation. This agency (which could be the same as the one referred to under data collection) should have a political mandate, report directly to parliament and the respective ministry and be adequately staffed and trained.

- ***Adopt exemplary role of public sector.*** In Western Balkan countries, the public sector should be an EE model, focusing on ministries, hospitals, schools, universities, military and police, municipal buildings, among others, by including EE criteria to procure products and technologies, and adopt stringent EE standards for public buildings.

- ***Eliminate energy price distortions.*** Energy tariffs are a politically sensitive issue everywhere in the region. However, low tariff levels and cross-subsidies distort energy markets, encourage waste, and impede market entrance of ESCOs and EE technologies. 'Fuel poverty' is better addressed by governments through targeted support to low-income households.

- ***Incentives of all kinds are needed.*** These should be both of the demand-pull as well as the supply-push variety. Examples of important demand-pull incentives are introducing codes and standards, creating end-user awareness, and making concessionary financing available. These three are separately listed below. Supply side measures involve actions such as providing tax incentives and financing for enterprises, easing import restrictions and duties on importing energy efficient equipment, training of auditors, architects and contractors, etc.

- ***Introduce and enforce modern building codes and EE standards for appliances and equipment***. Building codes should be based on the European Building Directive, while appliance and other equipment standards should seek to introduce EU standards as well. Sustained public information campaigns and national level control mechanisms should be implemented.

- ***Create energy efficiency funds.*** Many EE measures require investments with a payback period that is longer than many consumers find acceptable. EE funds could provide subsidies for implementing EE investments, shortening the payback periods, and help provide access to below-market rate financing where necessary.

- ***Launch targeted information campaigns.*** Such campaigns would raise awareness of the benefits of EE among consumers. Also, training programs should be set up for architects, energy auditors, manufacturers/suppliers, contractors, etc. Surveys should be conducted to determine what incentives would need to be provided to effectuate behavioral change, particularly among residential consumers, to make them save energy,

Move ahead with investments. While improved energy data systems are important, much can and should be done immediately even in the absence of better data. First, the public sector can take the lead in introducing EE demand-side measures in all public buildings, facilities, and rolling stock. Second, countries can take advantage of major supply-side opportunities to save energy, notably by introducing cogeneration of power and heat. International experience shows that serious EE programs frequently trigger development of reliable energy data systems because they have a powerful demonstration effect, thus creating a virtuous circle of better data systems, increased energy efficiency measures, and so on.

1. Introduction

1. The Western Balkan region is characterized by relatively high consumption of energy per unit of GDP, high energy savings potential among energy end-users, and heavy dependence on hydrocarbons imported from outside the region. All energy markets in the region would benefit from enhanced demand-side efforts and energy efficiency measures across all sectors (IEA 2008). Most Western Balkan energy infrastructure was built during the 1960s and 1970s and inadequately maintained starting in the 1990s. Under the Energy Community Treaty of 2003, all countries began to liberalize their energy sector to deal with both supply-side as well as demand-side measures in the provision and use of energy.

2. Energy demand is expected to rise considerably in the coming decades, according to a 2008 USAID-funded study, which notes that in Southeast European countries, including Bulgaria and Romania, demand will likely increase by more than three percent per annum through 2027.[4] The most rapid growth is expected in the commercial sector (140 percent), followed by the industrial sector (100 percent) and the residential sector (60 percent). However, even with increased EE in demand devices such as household appliances, energy consumption in the region would increase by at least 2.0 percent per year through 2027[5].

3. The USAID study also points out that in the future, demand device efficiencies will increase due to technological and economic progress, independent of policy measures. Nevertheless, average overall regional final energy consumption will rise almost 2.0 percent annually through 2027 (USAID 2008, 46).[6] Total final energy demand in Western Balkan countries would increase from around 750 PJ in 2005 (IEA 2008) to around 1250 PJ (USAID 2008, 51).

4. However, if remedial policy measures were introduced, additional average energy savings of 10-15 percent of current projections could be realized (USAID 2008, 61). Achieving greater energy efficiency requires many individual decision makers to invest capital in projects to use energy more rationally. A strong government role and clear regulatory structures can reassure investors in EE by removing barriers, establishing clear conditions and standards, supplying critical information, and facilitating funding for new technologies. Western Balkan countries have substantial work ahead of them to improve energy efficiency and achieve energy savings.

5. Improving EE requires investments and funding but measures to increase EE also yield positive economic value through lower energy bills, reduced energy imports, increased employment and more competitive economies (Table 1).

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[4] The assumption is that without policies or incentives, more efficient demand devices will be unavailable during the planning horizon, primarily due to higher initial costs that deter purchases, despite lifecycle costs that are frequently lower (USAID 2008, 59).

[5] Source: International Resources Group, *Final report of the Regional Energy Demand Planning Project – Future Energy Scenarios in South East Europe and the Potential for Energy Efficiency*, USAID/IRG, 2008

[6] "The most significant growth occurs in the industrial and commercial sectors (90 percent and 88 percent, respectively) followed by the agricultural sector (50 percent). The residential sector is second largest overall but grows relatively slowly (15 percent) and the limited transportation sector remains essentially constant" over the 27 year planning horizon (USAID 2008, 46).

Table 1. Benefits arising from Increased Energy Efficiency

Improvement	**Benefit Range (by 2027)**
Total discounted energy system cost savings	1.5-2.0% (€3.78-6.06 billion) over planning horizon
Change in undiscounted annual costs	
Power plant investment	Decrease of 0.2 – 15% (€5 – 455 million)
Demand-side investment	Increase of 14 – 28% (€ 1.59 – 3.16 billion)
Fuel expenditure	Decrease of 13 – 16% (€ 3.43/3.36/4.04 billion)
Annual energy savings	9 – 18% (417 – 793 PJ)
Annual electricity savings	6 – 11% (17 – 33 GWh)
Reduced imports	16 – 17% (309 – 343 PJ)
Decreased energy intensity	9.4 – 18%

Source: USAID (2008, 36)

6. This study's time horizon is 2020, though its findings and recommendations have relevance well beyond this timeframe. Energy savings refer to a baseline development, meaning that less energy will be consumed when compared to a business-as-usual scenario without additional energy efficiency measures;[7] the European Union has set itself a 20 percent reduction target.[8] Despite energy savings measures, total final energy consumption likely is almost certain to rise among Western Balkan countries.[9]

[7] Hence, an energy saving potential in 2020 of 20 percent *does not* mean 20 percent less energy consumed than in 2009.

[8] See the Council Conclusion from March 2007 (European Council Action Plan 2007-2009). The Council "stresses the need to increase energy efficiency in the EU so as to achieve the objective of saving 20 percent of the EU's energy consumption compared to projections for 2020, as estimated by the Commission in its Green Paper on Energy Efficiency (…)."

[9] Western Balkan countries' figures are compared with European Union and Austria benchmarks. Figures for the EU-27include all member states; figures for the EU-10 include only new member states in Central and Eastern Europe.

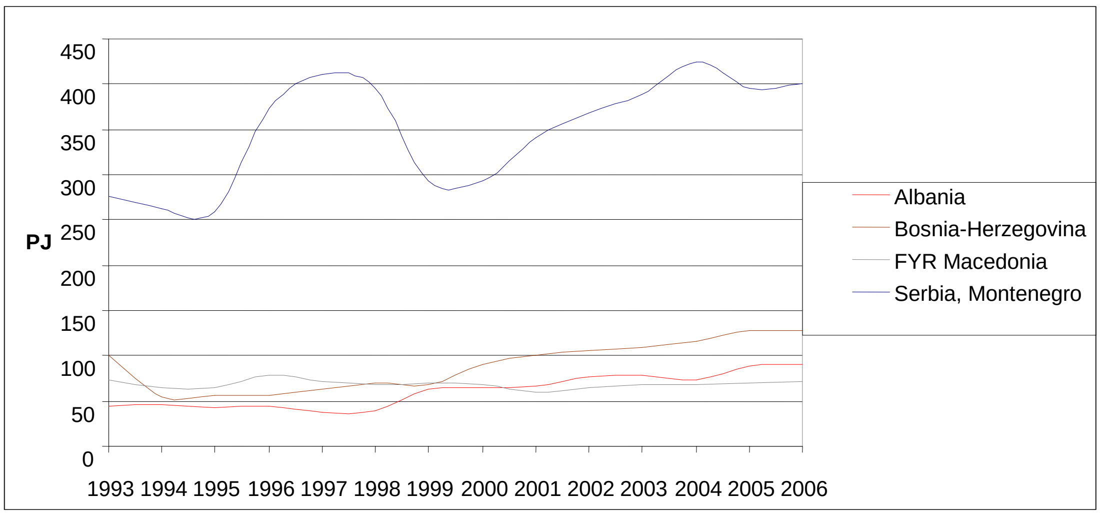
2. Overall Trends

7. An overview of energy intensities among Western Balkan economies was arrived at using aggregate data from Albania, Bosnia-Herzegovina, FYR Macedonia, and for the combination of Kosovo, Montenegro and Serbia. This section assesses some fundamental trends, although available International Energy Agency (IEA) data vary significantly from data provided by the local consultants.

Final energy consumption is increasing

8. Since 2000, total final energy consumption has been increasing constantly in all Western Balkan countries (Figure 3). Due to FYR Macedonia's volatile political situation, energy consumption declined in 2001, but has begun to rise again.

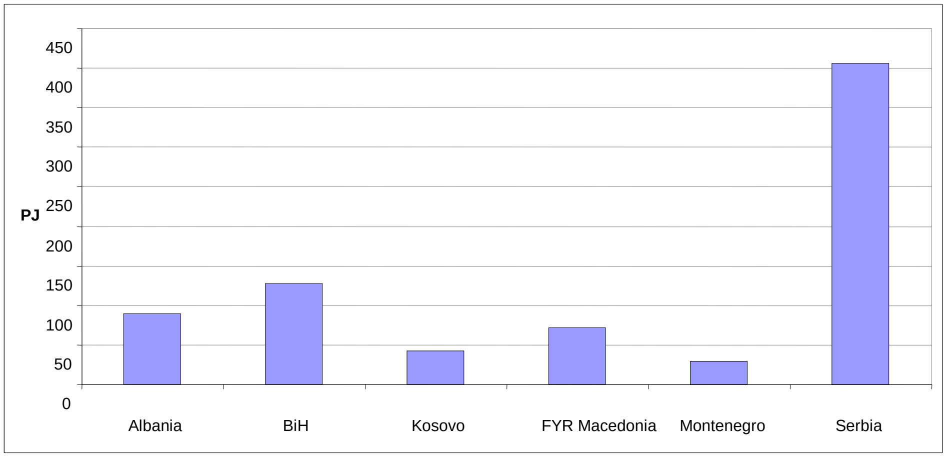
Figure 3. Total Final Energy Consumption in PJ



Source: Enerdata

9. Figure 4 shows total final energy consumption for 2005, according to the International Energy Agency (IEA 2008). In 2005, total final energy consumption of Western Balkan countries was around 750 PJ.

Figure 4. Total final energy consumption in 2005

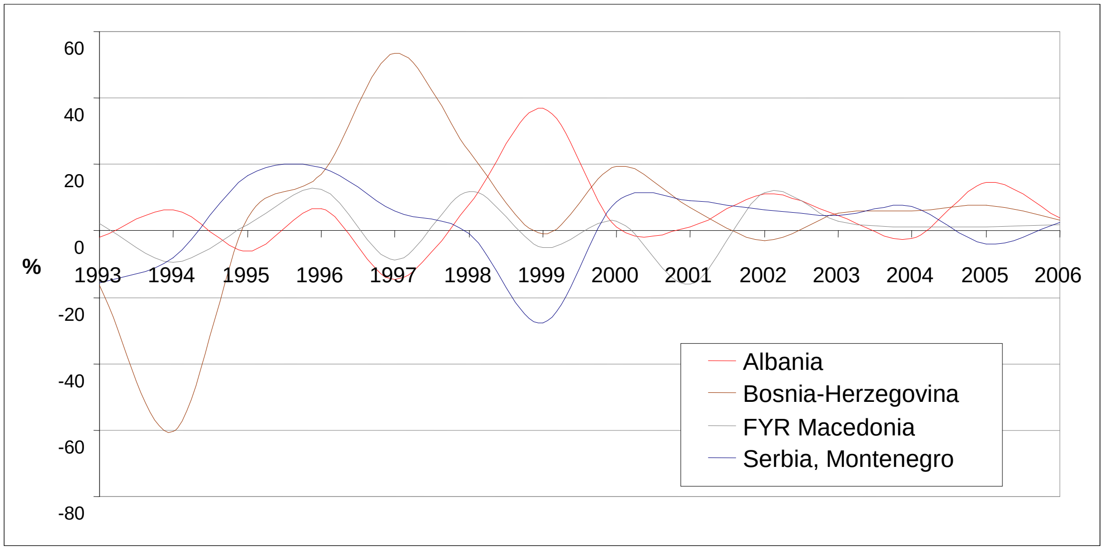


Source: IEA 2008

Energy consumption is volatile

10. Energy consumption in the region was highly volatile due to the events that accompanied the breakup of the former Yugoslavia, though in the case of Albania volatility was caused by the hydrological cycle. Total energy consumption annual growth rates changed by up to 60 percent during the 1990s, so it is difficult to establish reliable scenarios on energy consumption development.

Figure 5. Annual growth rate of total energy consumption

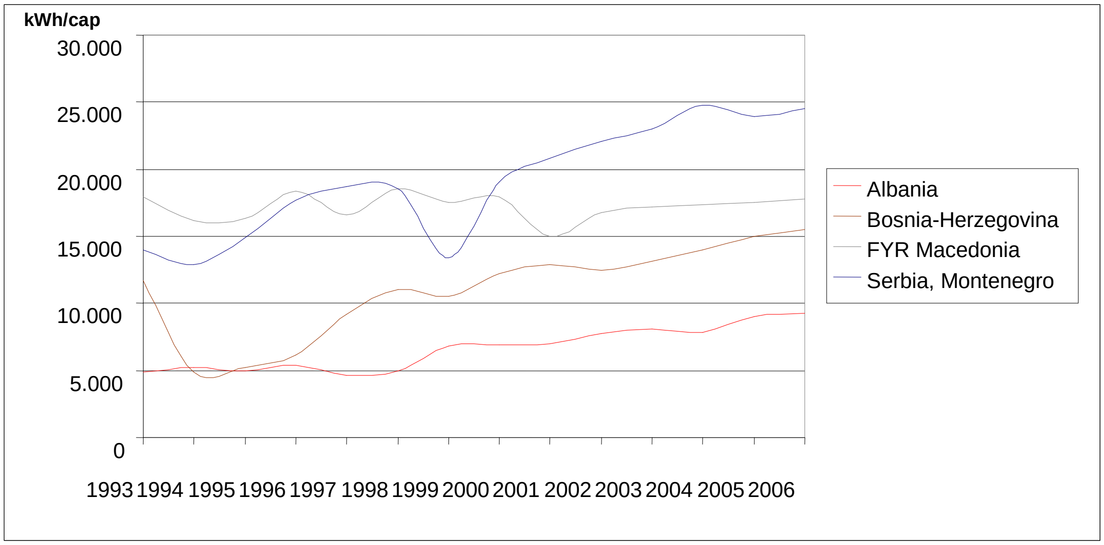


Source: ENERDATA

Growing energy consumption per capita

11. Increases in energy consumption per capita in the Western Balkans are stronger than those of the EU, primarily because energy-consuming goods and services are increasingly being used in the region. Energy consumption per capita is higher in the former Yugoslav republics than in Albania (Figure 6).

Figure 6. Total energy consumption per capita

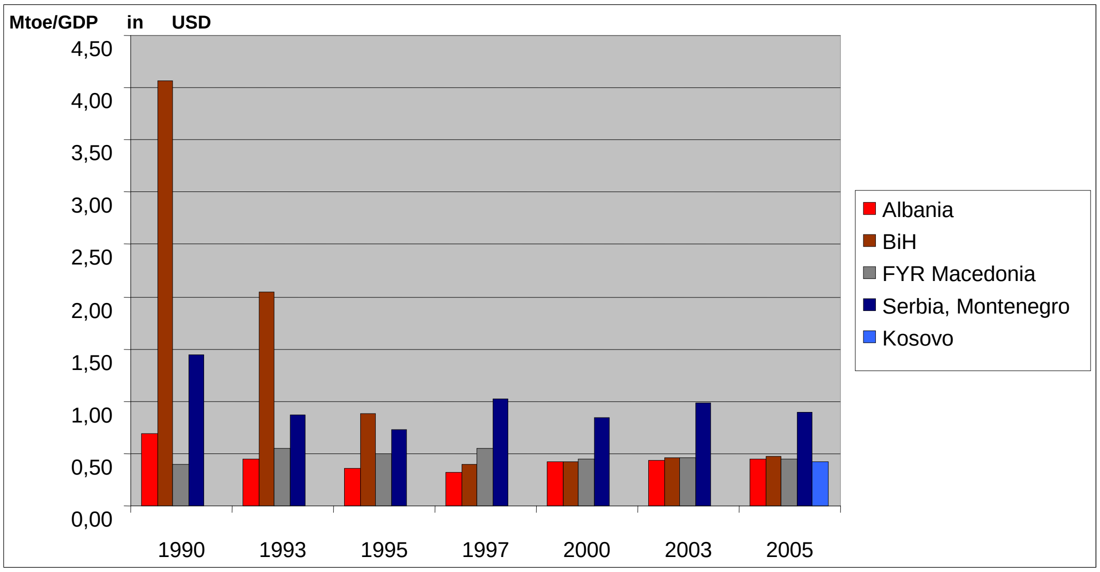


Source: ENERDATA

Development of total energy intensity remains stable

12. According to 2008 IEA data on energy intensity (Mtoe in US$ at year-2000 prices and exchange rates), the energy intensity in most countries has remained steady since 2000, except for Serbia and Montenegro (Figure 7).

Figure 7. Energy intensity of GDP



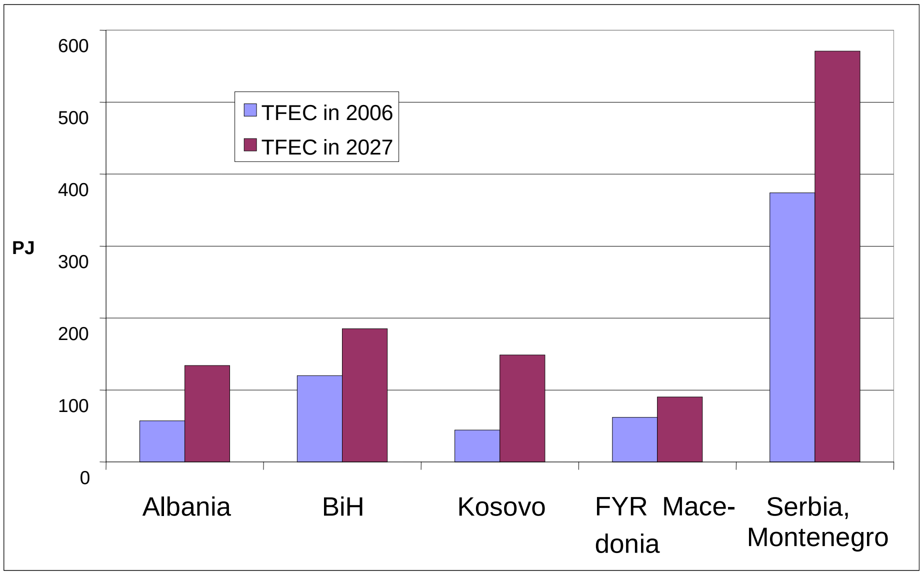
Source: IEA 2008

Total final energy consumption will increase by around 70 percent until 2027

13. According to scenarios from the Regional Energy Demand Planning Project (USAID 2008) developed by the International Resources Group, total final energy demand (excluding "transportation and others") will increase by around 70 percent during 2006-27 (Fig. 8). However, their figures for total final energy consumption differ from those in the IEA report (2008).[10]

[10] For example, figures for final energy demand in Serbian agriculture (Figure G-23) and other sectors do not appear to correspond with the respective shares in total final energy consumption presented in Figure G-2. Moreover, figure G-19 does not correspond with the sectoral figures (Figure G-20–G-23).

Figure 8. Total Final Energy Consumption Projection to 2027



Source: USAID 2008. Note that the category "transport & other" is not included.

2.1 Institutional Framework and Dissemination Support Scheme

14. The institutional framework comprises all elements of an enabling environment to implement, support and diffuse innovative energy efficiency services and technologies; these elements are often interlocking. As an extreme but realistic example, a proposed support scheme for efficient biomass boilers will be successful only if biomass boiler experts are available to plan and install the boilers. Central to the process is an Energy Institute and/or Agency to provide governments with the data to formulate policies, and to be the "change agent" or "champion" to help implement policy and establish and operate the dissemination support scheme for EE services and technologies until they are fully integrated in the energy market. The principal elements of an institutional framework and dissemination support scheme are shown in Figure 9. A typical institutional framework would comprise the following elements:

1. ***Legal and regulatory framework***. This comprises laws and regulations governing energy efficiency, clearly specified responsibilities in the public administration, policy goals and energy efficiency targets, an energy efficiency strategy that includes roadmaps and concrete action plans, and supporting policy tools. They should facilitate expansion of market-based energy savings approaches and private sector participation such as through Energy Services Companies (ESCOs).

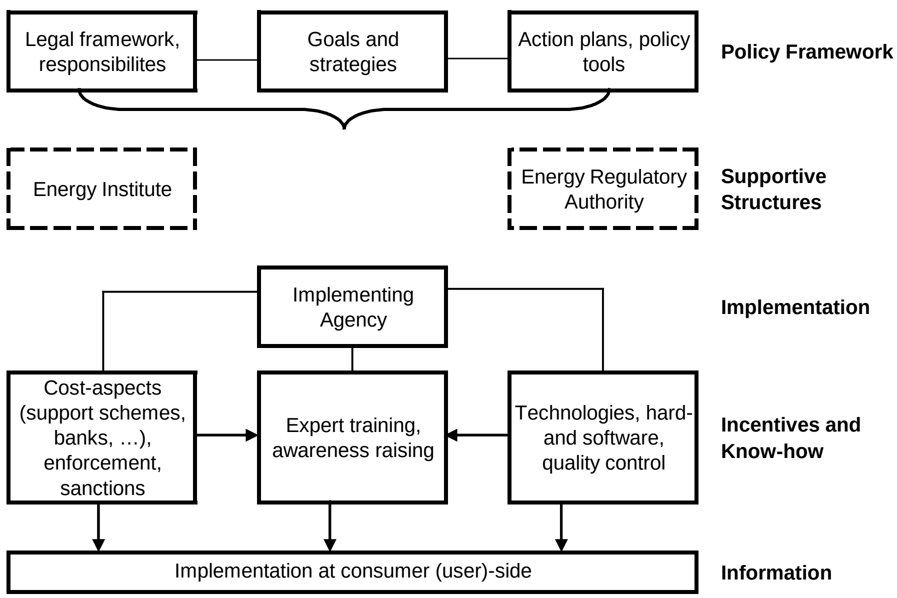
2. ***Supporting structures.*** This could be an energy institute, a regulatory authority, and an implementing agency with sufficient sources of funding at its disposal, plus institutional staff expertise to develop strategies and assist in implementing, where appropriate, enforcing action plans.

3. ***Implementation.*** This includes availability of quality hardware and software, experts to install the hardware and software at the site of the final consumer, and quality-assurance processes. Training of auditors, architects and contractors is an important component of implementation arrangements.

4. ***Incentives.*** Incentives to overcome resistance to adopting innovations in the EE market include funding for energy efficiency services (such as energy auditors and energy services companies) and technologies, codes and standards, tax incentives, voluntary agreements, and eventually sanctions for non-implementation, as appropriate.

5. ***Public information.*** EE technologies cannot succeed without consumer awareness and acceptance, which requires a public information strategy that is thorough and integrated at every step of implementation, including a consumer feedback loop.

Figure 9. Institutional framework and dissemination support scheme



2.2 General findings

15. The process of improving the institutional framework for EE in the Western Balkans gained momentum after the Energy Community Treaty became effective, particularly through work within the Task Force on Energy Efficiency of the Energy Community Secretariat. A 2008 USAID-financed report provides an overview of the legal and regulatory framework, main policies, and programs. Our study provides supplementary and updated assessments on the institutional framework.

16. Each country has a different institutional framework but no single administration has a fully satisfactory institutional environment with regard to all principal elements (Figure 10), as described below.

Figure 10. Institutional framework by country

	Albania	BiH	Kosovo	FYR Macedonia	Montenegro	Serbia	
Administrative Responsibilities	1	4	1	1	1	1	Policy framework
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Policy goals for EE	2	4	2	2	2	1	
EE Strategy	2	4	2	2	2	1	
EE Action Plans	2	4	3	2	1	1	
Supporting Policy-tools	2	4	3	2	1	1	
Energy Institute	4	4	4	2	4	2	Supporting Structure
Energy Regulatory Authority	1	2	1	1	1	1	
Implementing Agency	1	4	3	2	2	1	
Availability of EE hardware	2	3	3	3	2	2	Implementation and know-how
Quality-assurance for hardware	2	3	3	3	2	2	
Trained experts in technology implementation	1	3	4	3	3	2	
Quality assurance for experts	2	3	4	3	3	2	
Financial institutions familiar with EE	4	3	4	3	3	3	Incentives
Support scheme for implementation	4	3	4	3	3	3	
Sanctions for non-implementation	4	4	4	3	3	3	
Information system for consumers	4	4	4	3	3	2	Information

Legend

- 1 Good quality
- 2 Medium quality
- 3 Low quality
- 4 None existing

Source: AEA

Common features of institutional frameworks in Western Balkans countries.

- EE legislation from the EU must be transposed into national legislation and/or implemented fully in all countries; technical assistance for this process should be channelled through EE agencies, which generally require more specialist staff.

- Policies to encourage establishment and growth of EE businesses are generally lacking (e.g., ESCOs, skilled installers, energy advisors, 'green' architects, energy auditors, etc).

- Energy consumers—households, municipalities, enterprises—lack information about the potential benefits of EE measures and technologies.

- Few energy consumers have the financial and technical capability to identify, plan, and implement EE measures, but technical assistance is either not available or scarce.

- To implement consumer-level EE measures, all countries need to improve: (i) supply of EE experts, EE equipment/materials, and quality control; (ii) consumer incentive schemes to adopt EE technology, including technical and financial support; (iii) public information capacity in the implementing agency to manage ongoing consumer information needs related to energy efficiency.

- Capacity building is urgently needed in every country.

Albania and Serbia are rated highest on most of these aspects among the six countries. However, a good framework is only the beginning and needs to be accompanied by strong implementation and enforcement. The delivery of EE results is driven by the ability of public agencies to organize, transform and develop new markets for EE goods and services and for private actors to adopt state-of-the art EE technologies and practices. Weak institutions can undermine otherwise well-designed government policy frameworks and initiatives, so it is in every country's interest to strengthen their EE institutions. More detail on the institutional framework in each country is provided in Annex 1.

2.3 Barriers to energy efficiency in the Western Balkans

17. Since EE is a cross-cutting issue covering several policy areas, competencies and technologies, barriers exist in all principal elements of the institutional framework:

- ***Legal and regulatory frameworks are inadequate***. A clear legal and regulatory framework is a prerequisite for EE investments. All countries (except BiH) now have a basic EE legal framework or are developing one, but more progress needs to be made on the effective implementation of these frameworks.

- ***Incentives of all kinds are lacking.*** These should be both of the demand-pull as well as the supply-push variety. Examples of important demand-pull incentives are introducing codes and standards, creating end-user awareness, and making concessionary financing available. Supply side measures involve actions such as providing tax incentives and financing for enterprises, easing import restrictions and duties on importing energy efficient equipment, training of auditors, architects and contractors, etc. Incentives can help to overcome barriers to entering the market, for example, through special programs offering financial or technical support, or temporary exemptions from standard administrative procedures. As an example of the latter, in Kosovo public sector laws and regulations prevent hospitals, schools and other public buildings to benefit directly from energy savings (owner-user dilemma). Suspending this regulation for a defined period of time could provide a window of opportunity for public sector buildings to adopt EE technology.

- ***Training and know-how are scarce.*** Despite good education systems, professional skills, knowledge, and expertise for technology distribution are scarce. Few architects, engineers, plumbers, and installers have the technical skills or knowledge to exploit energy savings potential and training is unavailable; EE training is not included in most course curriculums. Also, without adequate systems and skills to reliably measure and verify energy savings, EE measures will not be implemented on a large enough scale.

- ***High investment costs for energy efficiency technology.*** New technology costs are high; most new technologies confront this barrier, but in countries facing energy poverty, the shortage of capital and the lure of more lucrative investments deter consumers. Loans to implement EE measures can be difficult to obtain and carry high interest rates. Financial institutions typically consider EE investments high risk compared to traditional asset-based financing, especially where investments cannot be easily repossessed, such as in home insulation investments.

- ***Modern building codes and EE standards for appliances and equipment should be introduced and enforced.*** Such building codes should be based on the European Building Directive, while appliance and other equipment standards should seek to meet EU standards as well. Sustained public information campaigns and national level control mechanisms should be implemented.

- ***Energy efficiency funds should be created.*** Many EE measures require investments with a payback period that is longer than many consumers find acceptable. EE funds could provide subsidies for implementing EE investments, shortening the payback periods, and help provide access to below-market rate financing where necessary.

- ***Targeted information campaigns should be launched*** to raise awareness of the benefits of EE among consumers. Consumers at all levels lack information to support EE behaviour changes. For example, consumers often lack meters or heat cost allocators for district heating and billing information (all forms of energy) that would make them aware of their patterns of energy consumption. As a result, they have no idea how their consumption compares to that of their peers, how their consumption could be reduced, or what the benefits of reduced consumption are.

- ***Energy prices are low and cross-subsidized, while non-payment is a significant issue.*** Energy tariffs are low and cross-subsidized in all countries except Albania; this does not encourage energy efficiency investments, especially since the upfront cost of these investments is often quite high, because it does not help save consumers the full cost of energy avoided. In cases where consumers steal or otherwise don’t pay for their energy consumption, strong incentives to undertake energy efficiency measures are lacking, except as a by-product of measures to enhance comfort in buildings.

3. Residential Sector

3.1 Savings potential in the residential sector

18. Across Western Balkans countries, the residential building sector has a potential for energy savings of between 10-35 percent. Table 2 provides an overview.

Table 2. Energy saving potentials in the residential sector

Country	Savings potential of total final energy consumption (%)	Source
Albania	30-35 under ambitious policy scenario	Besim Islami, local consultant
BiH	20 with modest investment; up to 60 with ambitious investment	Semin Petrovic, local consultant
Kosovo	10-30[11]	World Bank - Kosovo Heat Market Study (2007)
FYR Macedonia	10[12]	Energy Efficiency Strategy of the Republic of Macedonia, USAID, March 2010
Montenegro	10 due to high sector inertia	Energy Efficiency Strategy of Montenegro (2000); Study of energy saving potential, more rational energy consumption and fuel replacement in Montenegro (Electrical Faculty, Podgorica, 2000)
Serbia	17	Energy Development Strategy until 2015, Parliament of Serbia, May 2005

Source: AEA, local consultants

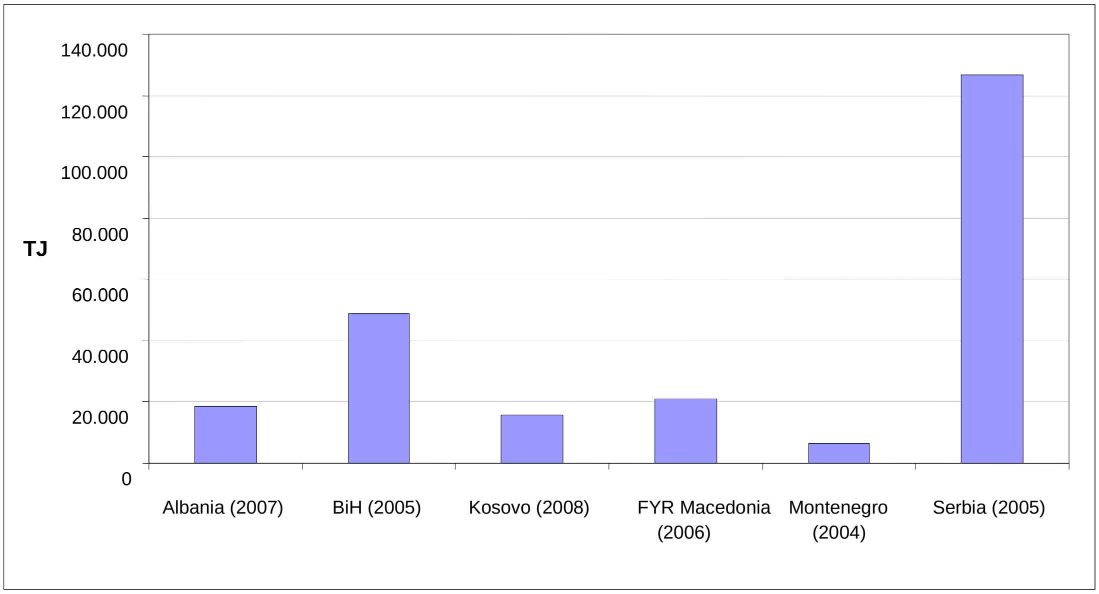
[11] Applying readily available insulation materials and double-glazed windows can reduce individual household energy consumption for space heating by as much as 35 percent. Nation-wide, this would amount to potential energy savings of 500-600 GWh/year, about 15 percent of total present demand. An additional 30-40 GWh/year could be saved in water heating applications through insulating jackets, low-flow heads and timers. Implementing these measures assumes substantial improvement to electricity billing and collection rates. (World Bank 2007).

[12] The energy savings potential is presented as a percentage of an average total final energy consumption during 2002-2006 (USAID 2010)

3.2 Final energy consumption

19. Figure 11 shows total final energy consumption in the residential sector in absolute terms, using the most recent year for which data were available in each country.

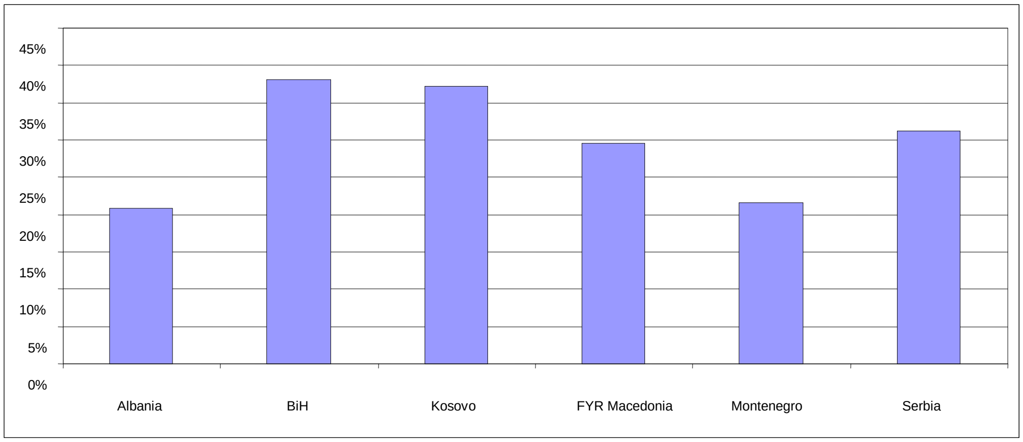
Figure 11. Total final energy consumption in the residential sector



Source: Austrian Energy Agency, Local Consultants

20. The ratio of residential sector final energy consumption to total final energy consumption varies among countries—highest in Bosnia-Herzegovina and Kosovo; lowest in Albania and Montenegro (Figure 12). There are several factors that account for this, among them the size of the industrial sector in a country, energy supply constraints, etc.

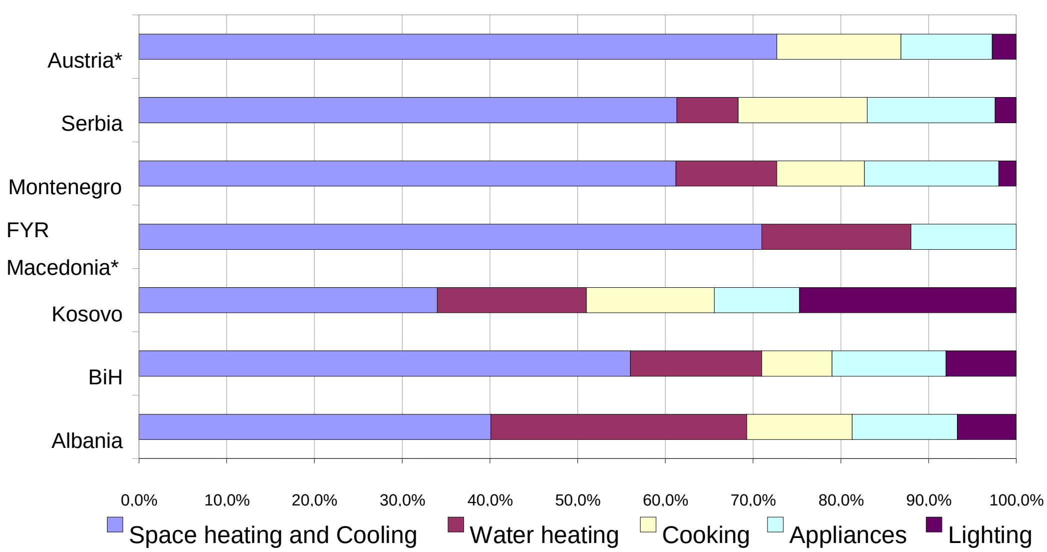
Figure 12. Residential sector energy consumption as % of total final energy consumption



Source: Austrian Energy Agency, Local Consultants

21. In the residential sector, up to 88 percent of final energy is used for heating space and water, although figures vary widely among countries. (Figure 13). The 2008 Kosovo figures were supplied by USAID, but the share of lighting within total final energy consumption in the residential sector seems unusually high.

Figure 13. Energy consumption distribution in private households; Austria as benchmark



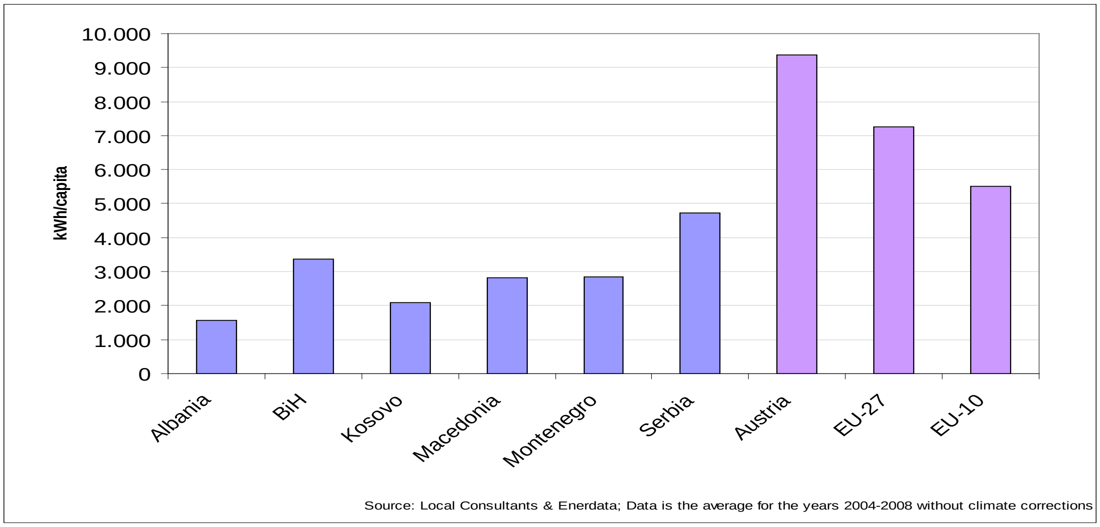
Comment: In Austria, "water heating" is included in "space heating and cooling." FYR Macedonia only distinguishes between "space heating," "water heating" and "appliances." Source: Austrian Energy Agency, Local Consultants.

3.3 Energy intensity

22. Western Balkans countries' residential energy consumption per capita is much lower than in the EU-27 or the EU-10 (Figure 14). An average Austrian consumes more than 9,000 kWh per year, which is high even by EU standards; an average Serbian consumes half of that and an

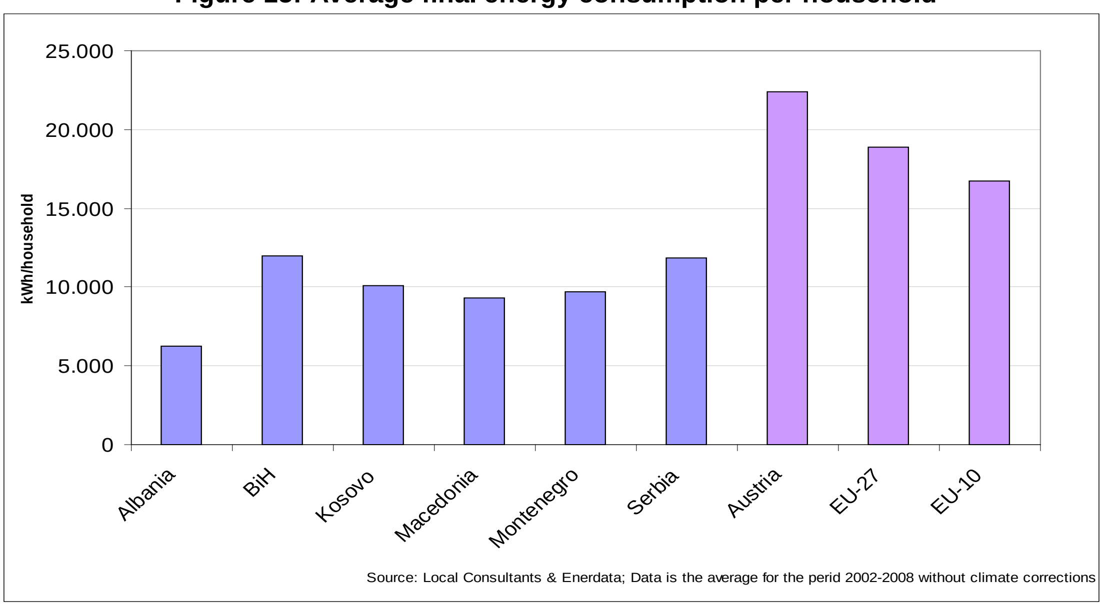
average Albanian only 17 percent or about 1,600 kWh. In the case of Albania and Kosovo, this is clearly a reflection of supply constraints and thus not necessarily of true demand for energy.

Figure 14: Average final energy consumption per capita in the residential sector



23. The average final energy consumption per household yields similar results (Figure 15). Since households tend to be larger in countries such as Kosovo and Albania than households in Serbia and Montenegro, energy consumption per household there is higher relative to European benchmarks than per capita consumption.

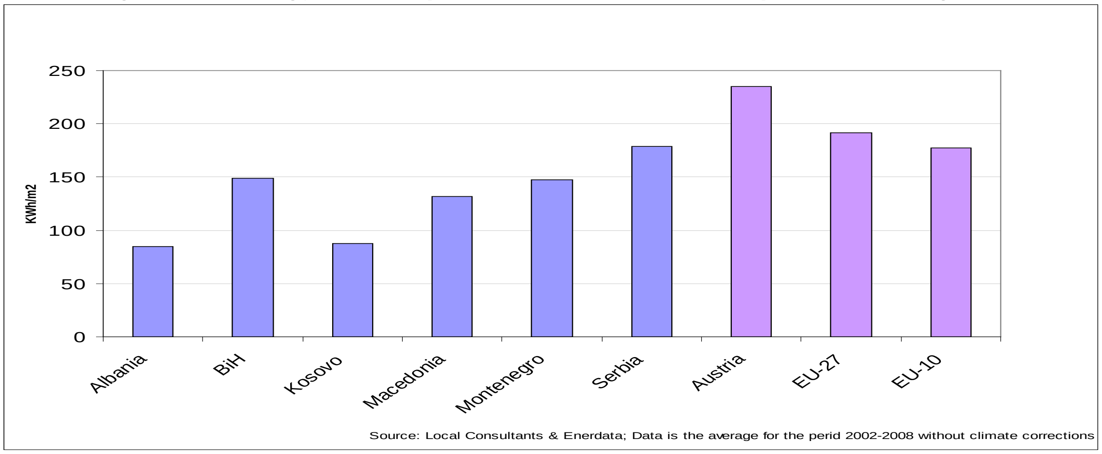
Figure 15: Average final energy consumption per household



24. Residential energy consumption per m^2 of private household living areas is higher in Austria and in the EU-27 than it is in Western Balkans countries (Figure 16). This seems counterintuitive, since Austria's building stock quality is higher than that of the Western Balkans. However, energy consumption figures represent building space heating and cooling *plus* domes-

tic appliances and cooking. Studies have shown that energy consumption rises as incomes rise, since more rooms are being heated or cooled to a comfortable level. Rising temperatures due to climate change will also add to the demand for space cooling.

Figure 16. Energy consumption of residential sector per m^2 of living area

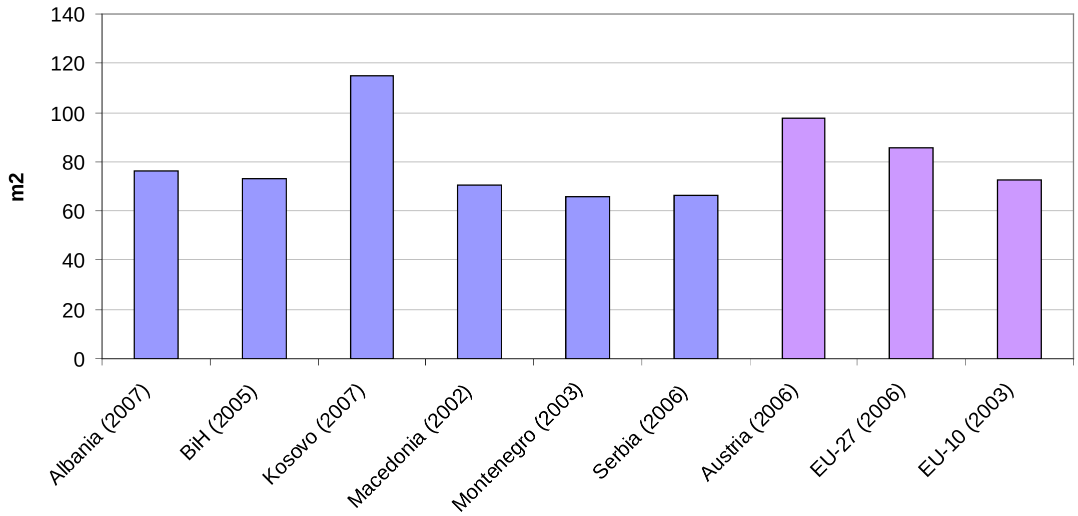


3.4 Drivers of energy demand

25. Demographic changes, economic activity and income factors that affect lifestyle and comfort levels are the most influential drivers of residential building energy demand. For example, in Albania the average living area in private households has increased by 1.8 percent per year since 1990; but at 76 m^2 it remains lower than the average in the EU. However, among Western Balkans countries total living area is expected to increase with economic recovery and rising incomes, which will strongly increase energy demand, especially without measures to increase the EE of buildings and heating systems.

26. Residential energy demand forecasts for the Western Balkans are difficult to develop due to the number of variables. For example, in Kosovo on average only about 40 percent of the residential floor area is currently being heated. Economic growth will cause an increase in the demand for heat and enormous potential exists for energy efficiency improvements, but realizing that potential depends on heating costs, availability of contractors, insulation materials, energy-efficient equipment, and public willingness to adopt new energy technologies (Kosovo 2008, 25).

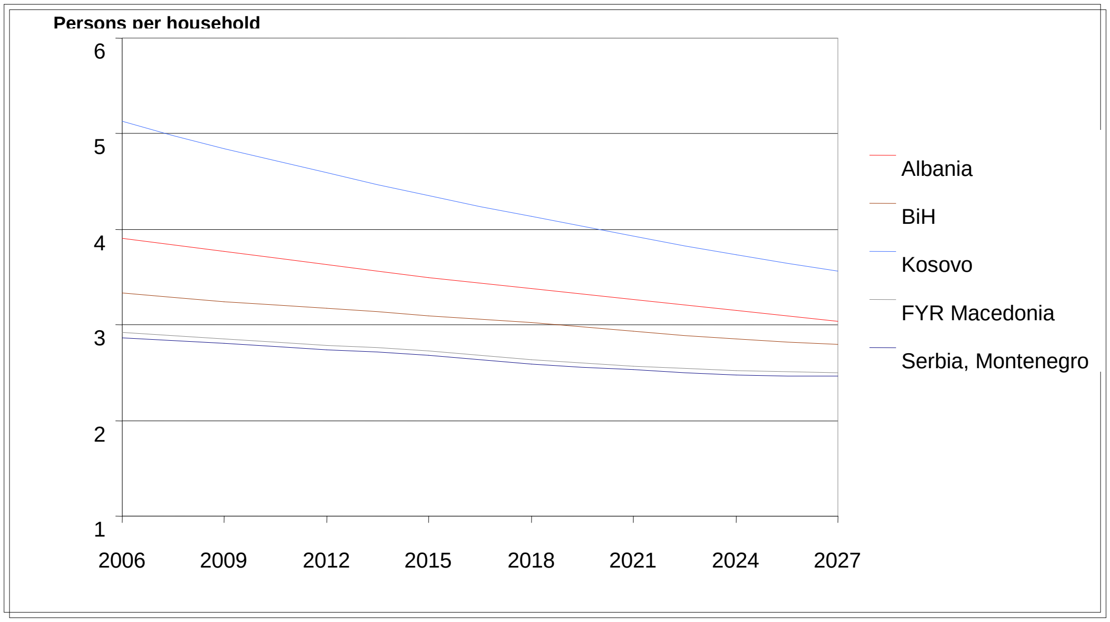
Figure 17. Average living area in private households



Source: Local Consultants; Data was taken from the year of the last available data. The figure for Kosovo was taken from a sample derived for a World Bank sponsored Heat Market Study (HMS). The typical single family home in Kosovo tends to be larger than in other areas across southeastern Europe.

27. Furthermore, the number of people per average household is declining, according to the 2008 USAID-sponsored Regional Energy Demand Planning Project (Figure 18). As Western Balkans populations and national GDPs grow, with fewer people per household final energy consumption in the residential sector is likely to increase significantly, especially if no measures are taken to improve energy efficiency.

Figure 18. Average number of persons per household, 2006-2027

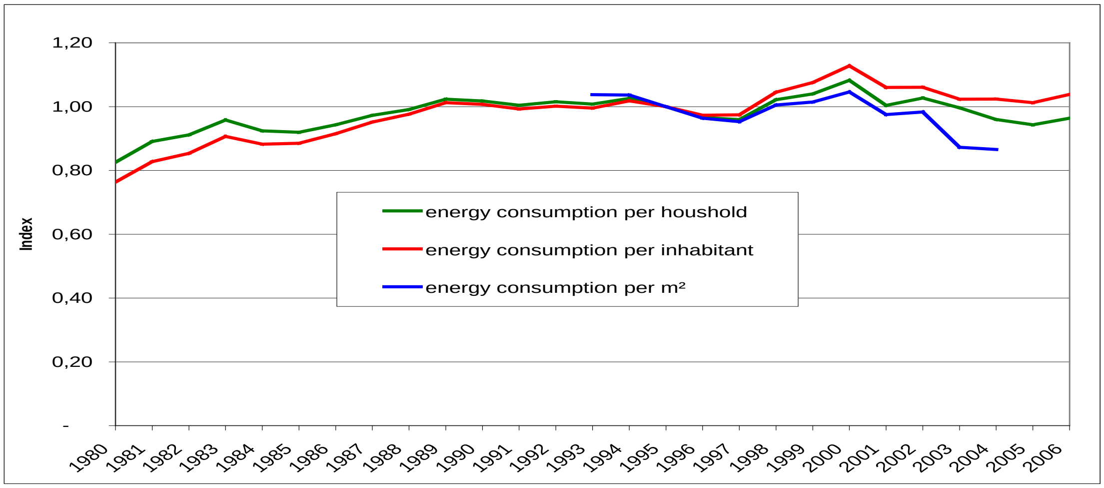


Source: USAID (2008) Final Report of the Regional Energy Demand Planning Project, p. 40.

3.5 Benchmark comparison

28. In Austria, household energy intensity has remained constant since the early 1990s (Figure 19), primarily due to a support scheme for large-scale buildings that shifted the focus from purely social outcomes to EE goals, using thermal insulation and applying EE standards to new construction. Annual financial support for residential building is now about €2.5 billion, which is managed by the nine federal provinces of Austria. Most funding is used for new buildings, but about one-third is used for retrofitting existing buildings. The federal government finances about 70 percent of this residential building support; this represents a generous 2.9 percent of the national budget, highlighting the importance of residential EE to the government. Financial support levels are linked to compliance with energy indices criteria, such as building shell thermal quality.

Figure 19. Energy intensity in private households in Austria, 1980-2006



Source: AEA. In this figure, 1995=1.00

3.6 Building stock

29. Data on building stock and installed heating systems are weak or nonexistent. No data are available on existing building stock heat demand for Albania, BiH, FYR Macedonia and Montenegro. In Kosovo, average building heat demand is estimated are about 204 kWh/m^2/annum in Prishtina, and 230-240 kWh/m^2/annum in the rest of the country. Serbia has the best building stock data, but figures on major building renovation rates could not be obtained.

30. Western Balkan countries' building stock quality varies according to building codes and their enforcement. Albania lacked building standards during 1990-2003; a new building code was finally approved in 2003. The former Yugoslav Republics used the 1987 building code as an interim solution until new codes were established during recent years. Many individual national technical assistance projects are establishing new building codes and transposing EU building directive requirements. By end-2008, FYR Macedonia had developed a new EE building code, which should become effective in 2010.

31. Few annual data are available on major building renovations and thermal retrofitting in these countries, but estimates of new buildings constructed per year range from 0.7 percent of total housing stock in Serbia to 3.0 percent in Kosovo.

32. Clearly all Western Balkan countries should transpose EU building codes and ensure their enforcement, if necessary by setting up regional centers to facilitate enforcement. Setting up large-scale support schemes, including financial support, for thermal retrofitting of existing building stock would be a very important measure because of the sheer size of existing building stock compared to new buildings.

4. Public Sector Buildings

33. The estimated savings potential in public buildings is about 35-40 percent of current energy consumption. EE in the public buildings sector can be mandated more easily than in the private buildings sector; the public sector is, therefore, often a good place to start EE programs.

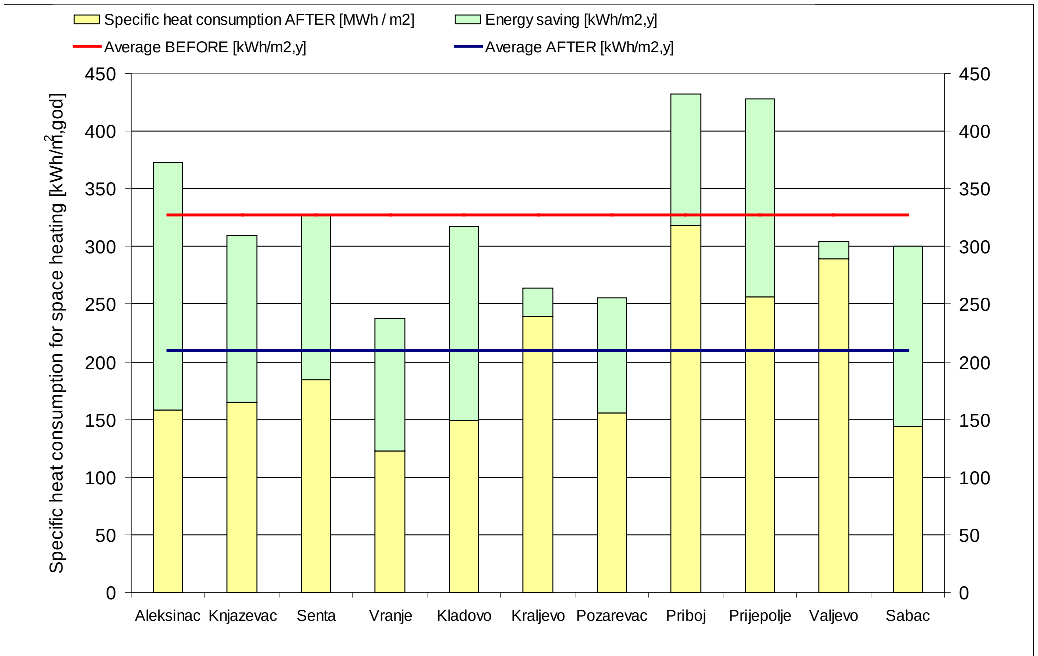
4.1 Savings potential and data availability

34. Systematic data on energy consumption in public sector buildings are not available, despite considerable efforts to obtain them. However, estimates of the savings potential in public buildings are around 35-40 percent of current consumption. For example, Bulgaria demonstrated a savings potential of 40 percent in public school buildings (Energy Charter Secretariat 2008, 20). Savings in Serbia ranged from 39-44 percent. FYR Macedonia's draft Energy Efficiency Strategy expects a savings potential for the entire commercial and public sector combined of about 15 percent (USAID 2010).

35. The first phase of the World Bank-funded Serbian Energy Efficiency Project aimed to improve EE in public hospitals and schools—27 buildings with a heated area of 104,969 m^2 were renovated.[13] Specific building heat consumption dropped from 266 kWh/m^2/annum to 162 kWh/m^2/annum. Annual energy consumption could be reduced by more than 39 percent at investment costs of around 35 EUR/m^2. Hospitals' specific heat consumption could be reduced from 329 kWh/m^2/annum to 210 kWh/m^2/annum (Figure 20). Excluding two hospitals which had only minor works done, annual energy demand for space heating was reduced by 43.8 percent through investments with costs ranging from 21.1 to 58.8 EUR/m^2. Most energy savings derived from roof insulation and new windows and doors.

[13] SEEP–1st phase, Implementation 2005-2006, expected results. Presentation prepared by Nenad Pavlovic.

Figure 20. Improving specific heat consumption in public hospitals in Serbia



Source: World Bank

36. Public school buildings could achieve similar results; average energy demand for space heating could be reduced by 43.4 percent. Overall energy savings for residential buildings, schools, and hospitals in Serbia, based on programs and audits of 11 school buildings and 27 hospital buildings, are in Table 3.

Table 3. Energy savings in public buildings in Serbia

INSTITUTIONIAL BUILDINGS	Energy savings (as % of heating energy)	Heating energy, as % of total energy	Energy savings (as % of total energy)
Schools:			
District-Heated	43.8	70	30.7
Fuel Oil	56.3		39.4
Coal	10		7.0
Hospitals:			
District-Heated	11.7	70	8.2
Fuel Oil	49.3		34.5
Coal	20.5		14.4

Source: World Bank

37. The EU's Energy Services Directive (2006/32/EG) foresees an exemplary role for the public sector. This often requires the following measures: (i) development of a public sector action plan for energy efficiency; (ii) introduction of a public sector energy management scheme including national, regional and local authorities; (iii) modification of public procurement guidelines to facilitate energy service contracting; (iv) introduction of an enabling framework for energy service contracting; (v) establishment of a well staffed EE agency to help implement the EE action plan; (vi) setting up a financing scheme for the public sector EE investments; and (vii) establishing obligatory data collection and reporting mechanisms and a public sector EE database for benchmarking, monitoring and reporting.

5. Service Sector (public and private)

5.1 Savings potential in the service sector

38. The energy efficiency savings potential in the public and private service sector relative to the baseline scenario lies between 10 and 40 percent, depending on what is included in the calculations (Table 4).

Table 4. Energy savings potential in the public and private service sector

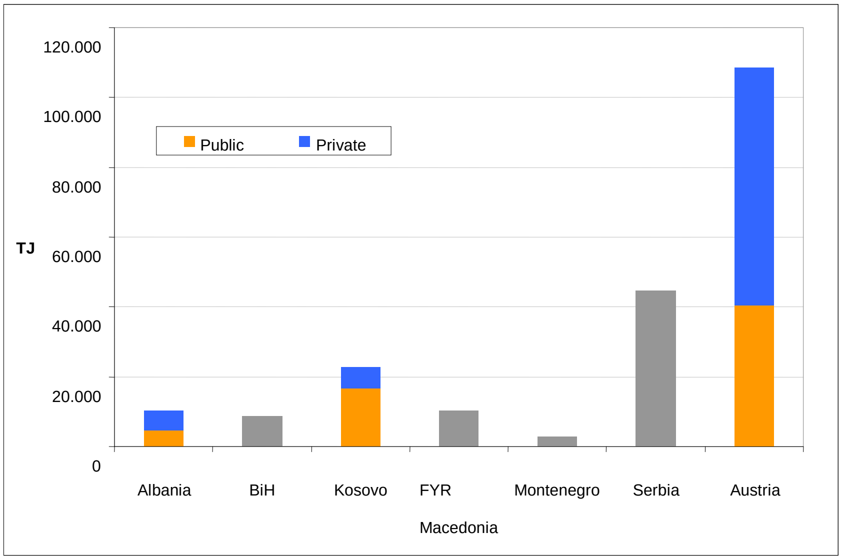
Country	Energy Savings Potential (%)	Source
Albania	35 – 40 in public services; 20 – 25 in private services.	Besim Islami local consultant
BiH	20	Semin Petrovic, local consultant
Kosovo	20 – 30	Ministry of Energy and Mining (2006). Kosovo Programme for Energy Efficiency and Renewable Energy Resources for 2007-2009
FYR Macedonia	15[14]	USAID (2010)
Montenegro	20 in tourism, 30 in public buildings	Energy Efficiency Strategy (2005)
Serbia	no information available	Nenad Pavlovic, local consultant

Source: AEA

39. Four countries lack data for service sector energy consumption disaggregated into public and private services. Hence, no meaningful analysis can be conducted for public and private service sectors' energy intensity. Data are available for Albania and estimates are available for Kosovo. An overview comparison of total final energy consumption for Western Balkans public and private service sectors and Austria is found in Figure 21.

[14] The energy savings potential is estimated for the commercial and public sector (USAID 2010)

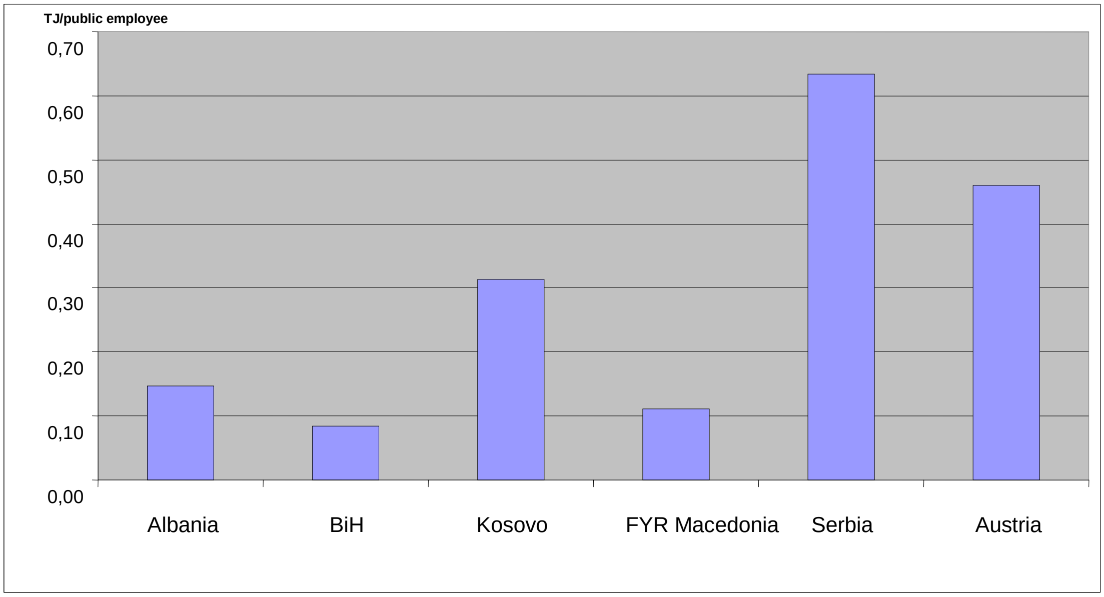
Figure 21. Total final energy consumption in the public and private service sectors (in TJ)



Source: Local consultants; average of existing data in 2000-2006

40. To arrive at an aggregate overview of energy intensity in the public and private service sector (Figure 22) energy consumption was calculated for public and private sector services combined compared to the number of employees in the public administration. On the basis of this calculation, Serbian public and private services appear more energy intensive than their Austrian benchmarks, and almost six times more energy intensive than in FYR Macedonia. However, differing definitions of 'public sector' undermine the accuracy of these calculations.

Figure 22. Energy consumption for services relative to number of public sector employees.



Source: Local consultants; no data is available for Montenegro

41. Data on energy consumption for schools, hospitals, and other public sector buildings are not available, except for Albania, although some rough estimates are available for Serbia and BiH. Generally, existing data are insufficient to assess overall energy efficiency in health, education, and other subsectors.

42. To reduce public and private service sector energy consumption in a strategic fashion, standardized data collection must be established to improve the data situation on energy consumption and related output data. Moreover, to realize the service sector's savings potential, energy managers must be trained, standardized auditing schemes should be developed, and training to certify energy auditors should be provided.

6. Industry

6.1 Savings potential in the manufacturing sector

Table 5. Energy savings potential in the manufacturing sector

Country	Savings potential of total final energy consumption (%)	Source
Albania	25 – 30	Besim Islami, local consultant
BiH	10 – 30	Semin Petrovic, local Consul-tant
Kosovo	5 – 15	James Myers, local consultant
FYR Macedonia	18[15]	USAID (2010)
Montenegro	15 on average 30 in steel industry 13 in non-ferous ind.	Energy Efficiency Strategy of the Republic of Montenegro (2005);
Serbia	12 - 18	Energy Development Strategy until 2015, Parliament of Serbia, May 2005

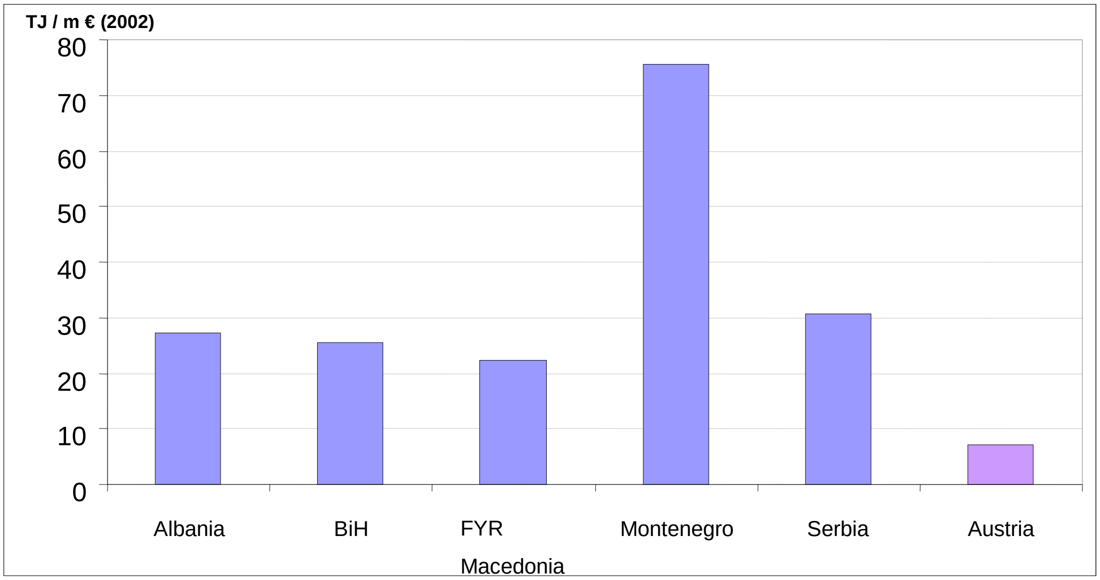
Source: AEA, local consultants

6.2 Energy intensity

43. Energy intensity in Western Balkan countries is 3-4 times as high than in Austria (Figure 23). Montenegro is the exception, since industrial sector energy intensity there is more than double that of other countries in the region and close to ten times as high as in Austria.

[15] The savings potential is estimated for the industrial sector. USAID (2010)

Figure 23. Average energy intensity in the industry sector (2000-2007)



Source: Local Consultants

44. In ***Montenegro***, industrial sector energy intensity is due to the KAP aluminum smelter, which accounts for 39 percent of the country's total final energy consumption and boosts the ratio of electricity consumption to GDP to 0.72 kWh per thousand US$ of GDP and overall consumption to 6,200 kWh per capita. Electricity tariffs are still heavily subsidized, including for large consumers such as KAP. Low energy prices are a disincentive for consumers to pursue EE investments and many areas in Montenegro have a quality of electricity supply that is not good enough to support the use of EE equipment (IEA 2008, 278-289).

45. In ***Kosovo***, manufacturing (including mining) accounts for about 12 percent of total energy consumption. Industrial sector energy consumption is expected to grow by a factor of 4-5 through 2015, since the sector is expected to grow rapidly as some non performing state-owned enterprises are privatized. Currently, many large industries are not operational or have low outputs, so most energy systems such as boiler rooms, steam or hot water networks, compressed air systems and refrigeration plants are oversized, creating low EE indicators. Much industrial equipment is obsolete or derelict (Kosovo, Ministry of Energy and Mining, 2006).

46. In ***FYR Macedonia***, industrial output declined due to economic reconstruction and secession from the Yugoslav Federation. Exports to Greece, the main trading partner, have declined due to political tensions. Since 2001, GDP (in current-value EURs) has grown by some 31 percent; industrial sector energy consumption has grown by 29 percent, demonstrating that energy consumption is still closely linked to economic growth, despite small EE gains. According to the Energy Efficiency Strategy (USAID 2010), significant savings could result from more EE motors, drives, air compressors, etc., but longer payback periods for EE technology means that these investments are less likely to be implemented. Moreover, fewer operating hours increase already longer payback periods.

47. In ***Serbia***, industrial sector energy consumption data are volatile and inconsistent between sources; Enerdata consumption figures are generally much higher. Energy balances during 1991-2000 are unreliable. Similar to other countries in the region, future industrial sector energy consumption is likely to rise. Energy intensity data, disaggregated by industrial subsector, are available only for Serbia and Albania.

48. In conclusion, data collection for the industrial sector is very deficient and must be improved in order to get a better view of the current situation and propose targeted actions to reduce energy consumption. Energy prices must reflect costs in order to provide incentives to reduce energy consumption, particularly in the energy-intensive heavy industries. Finally, establishment of mandatory energy audits for large industries and commercial enterprises consuming more than a specific level of energy per year, has been demonstrated to be a useful initial step towards reducing energy intensity.

7. Transport

7.1 Savings potential

49. Much of the transport sector's energy consumption is individualised and defies conventional methods of calculating potential energy savings, except relative to a business-as-usual scenario (Table 6). If no EE measures are taken, absolute consumption will increase dramatically due to rising incomes and increased levels of private vehicle ownership.

Table 6. Energy saving potentials in the transport sector

Country	Savings potential of total final energy consumption (%)	Source
Albania	10	Besim Islami, local consultant
BiH	up to 8	World Bank (2008) Energy Sector Study in BiH
Kosovo	n.a.	
FYR Macedonia	17	USAID (2010)
Montenegro	10 (road transport)	Energy Efficiency Strategy of the Republic of Montenegro (2005);
Serbia	16	Energy Development Strategy until 2015, Parliament of Serbia, May 2005

Source: AEA, local consultants

50. In ***Albania***, the National Energy Strategy forecasts a decline in passenger/km road transport, an increase in rail transport, and no change in air and sea transport. Similarly, for freight transport, road transport volumes are expected to decline and railway transport volumes, to increase. The National Energy Strategy indicated that savings potential can be met by implementing political measures, but so far no measures have been taken. Future energy consumption is likely to increase, offset by technological progress in the automotive industry that will achieve some EE improvements.

51. In ***BiH***, the World Bank Energy Sector Study (2008, 126) assumes an increase in transport sector fuel consumption linked to GDP increases. The study expects an annual energy consumption in the transport sector to increase by about 5.0 percent per year through 2020; this rate of increase could be lowered to 4.5 percent per year by introducing EE measures.

52. In ***FYR Macedonia***, organized public transportation, buses and taxis, exist in a few larger cities, and only taxis are available in other urban areas. Most vehicles used for public transport

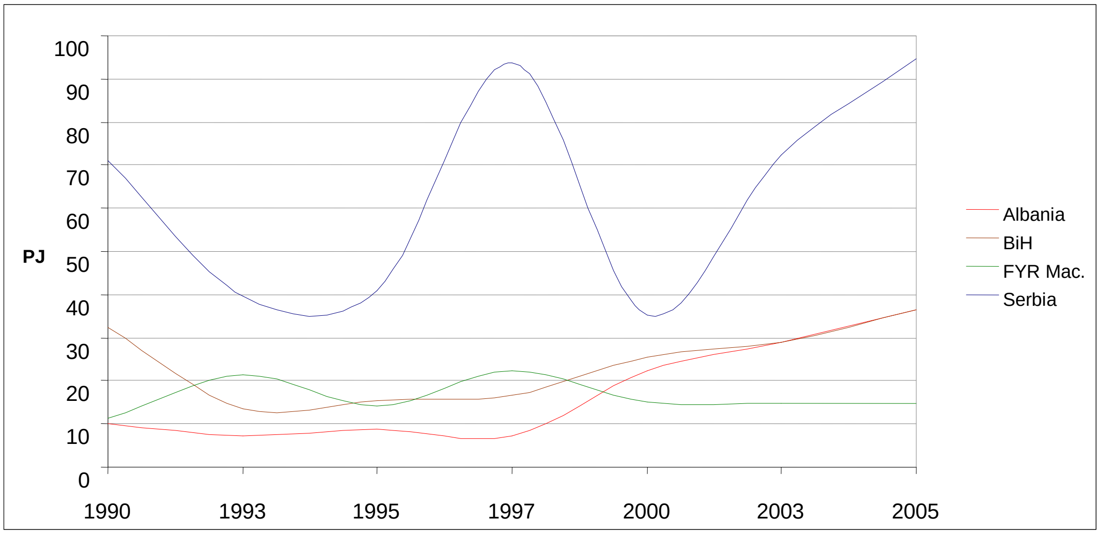
are old, energy inefficient, and polluting. The railways, undergoing unbundling, soon will be privatized; this should make rail an attractive transport option for goods and passengers. Most private vehicles are old, energy-inefficient, imported second-hand vehicles. Despite recent strict Government regulations to limit imports of such vehicles and impose higher taxes, the average passenger or small commercial vehicle is about 15 years old. The Energy Efficiency Strategy (USAID 2010) notes that the primary measures to reduce energy consumption in the transport sector are (i) introduction of integrated traffic management center; (ii) promotion of greater use of railway for intercity travel; and (iii) renewal of the national road vehicle fleet.

53. In ***Serbia***, since 2004, transport sector energy consumption has increased (Figure 21) but, so far, the country lacks an overall strategy for development of future transport modes (air, water/river, road, railway) and infrastructure renewal. Since most of the population is low-income, personal vehicles are on average more than 15 years old, and 20 percent of vehicles are more than 20 years old (about 400,000 units). Thus, an urban public transportation strategy is an energy savings priority, especially since gradually replacing cars by more efficient models contributes only little to reducing overall energy demand by the sector, given expected increases in car ownership and passenger kilometers per person.

7.2 Final energy consumption in the transport sector

54. Energy consumption in the transport sector has grown in most countries significantly since 2000, according to 2008 IEA figures (Fig. 24).

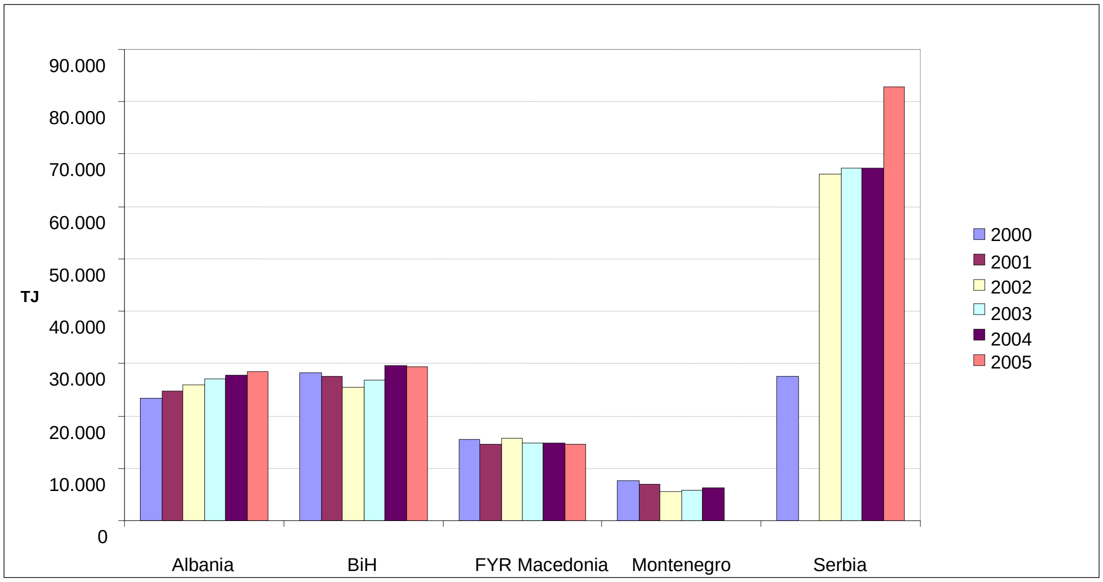
Figure 24. Development of final energy consumption in the transport sector



Source: IEA (2008)

55. Figures supplied by statistical offices in each country from 2000 onwards are shown in Figure 25. Data for Kosovo (available for 2007 only) are shown in Table 7.

Figure 25. Development of final energy consumption for transport 2000-05



Source: AEA, local consultants

56. The transport sector's share of total final energy consumption ranges from a low of about 21 percent in FYR Macedonia to a high of about 41 percent in Albania (Table 7).

Table 7. 2005 Final transport sector energy consumption and share of TFEC

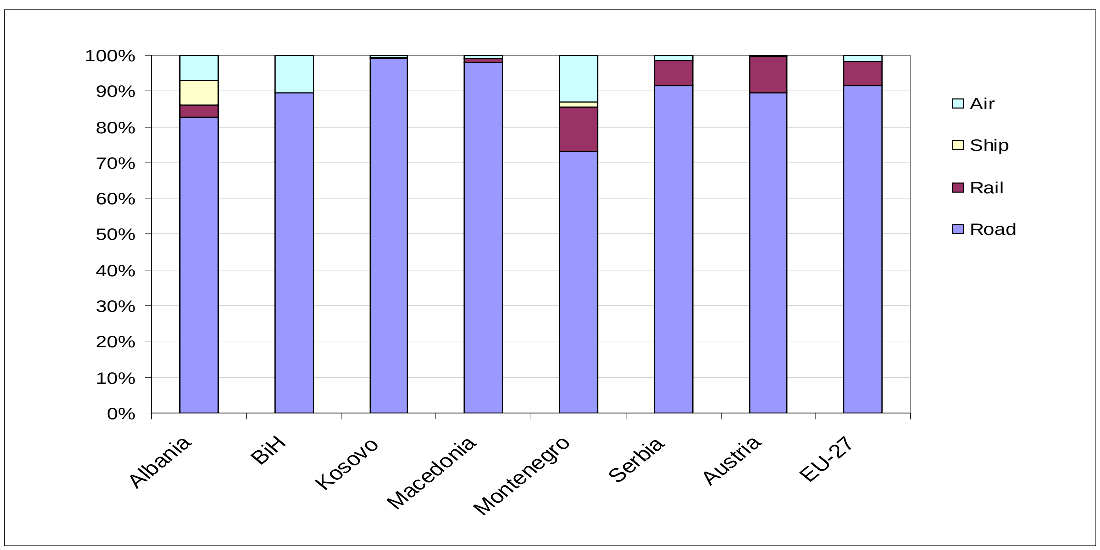
	2005	Share of Transport in TFEC (%)
Albania	36.4 PJ	41
BiH	36.4 PJ	29
Kosovo	14.3 PJ	34
FYR Macedonia	14.7 PJ	21
Serbia	82.9 PJ	21
Montenegro	6.4 PJ	22

Sources: IEA 2008, except for: Serbia (Statistical Office of Serbia, Energy Balance), Montenegro (Statistical Office, Figure from 2004), Kosovo (Unpublished 2007 data, Ministry of Transport).

7.3 Modal split

57. Figure 26 shows that the share of individual road passenger transport in Western Balkan countries has become roughly comparable to the situation in the EU-27, in part due to the lack of efficient, comfortable, and affordable public transport.

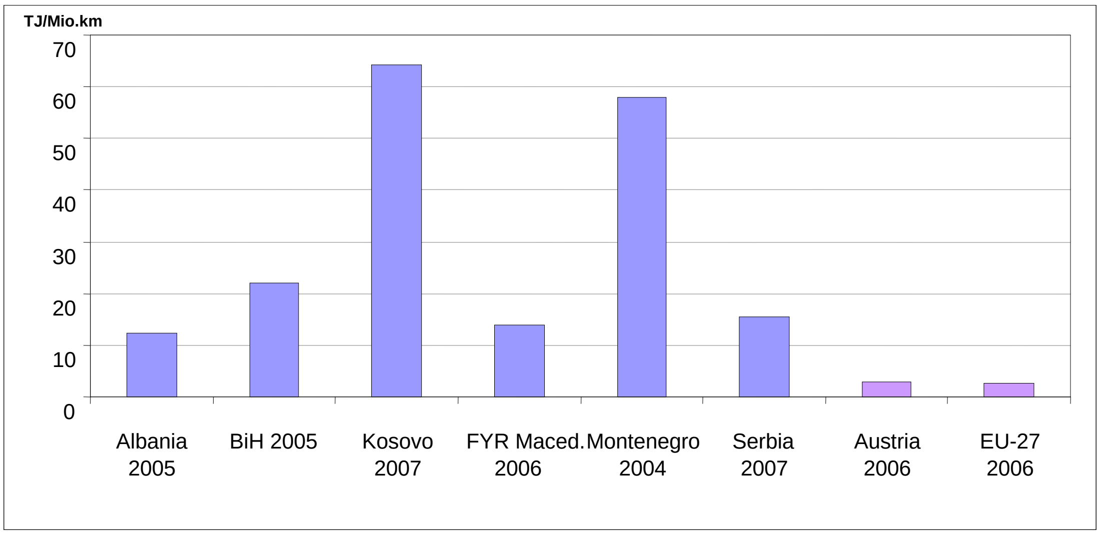
Figure 26. Modal split in passenger traffic



7.4 Energy intensity of transport sector

58. Transport sector energy intensity is calculated as energy consumption/passenger kilometer for road transport; it varies widely among Western Balkan countries. High figures for Kosovo and Montenegro are likely to be due to statistical inconsistencies and lack of data. Nevertheless, Figure 27 shows that a kilometer of road transport in the Western Balkans is much more energy intensive than in the EU. Most indicators that can be calculated in the road sector point to a highly energy intensive and very energy inefficient vehicle fleet.

Figure 27. Final energy consumption of road transport per passenger kilometer



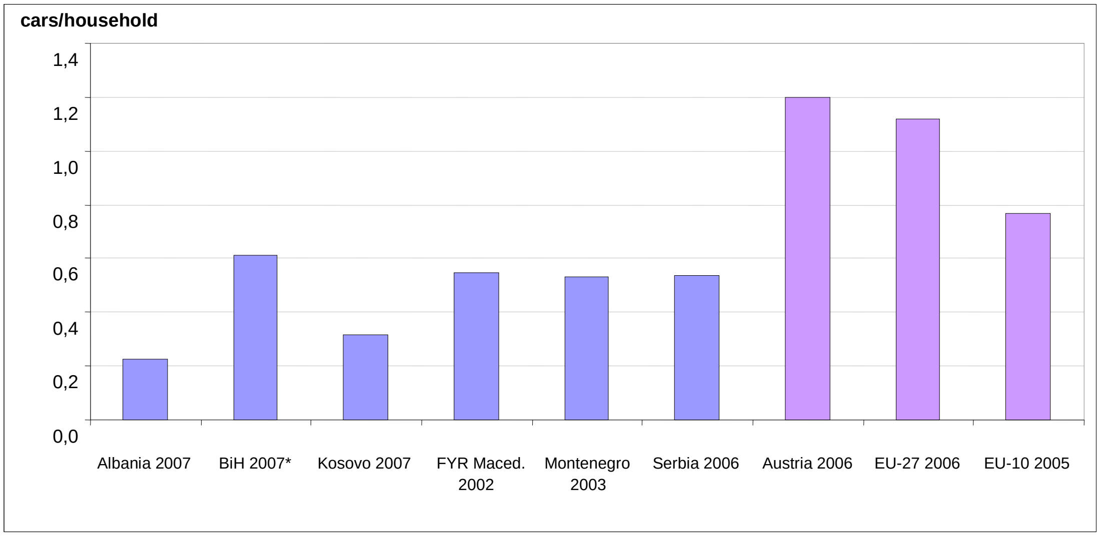
Sources: Data provided by the local consultants and Enerdata. Data for Albania is from IEA (2008).

59. Existing levels of energy intensity of road transport in the Western Balkans are likely to decrease with rising incomes, but the growing EE of the vehicle fleet will be outweighed by the increasing numbers of cars per household and passenger-kilometers.

7.5 Drivers of energy consumption

60. Typically, rising incomes lead to higher numbers of vehicles and person/kilometers. Figure 28 shows that the number of cars per household is still much lower in Western Balkan countries than in the EU as a whole or in new Member States. Similarly, the passenger-kilometers in road transport per capita (Figure 29) and the passenger-kilometers in rail transport are lower (Figure 30).

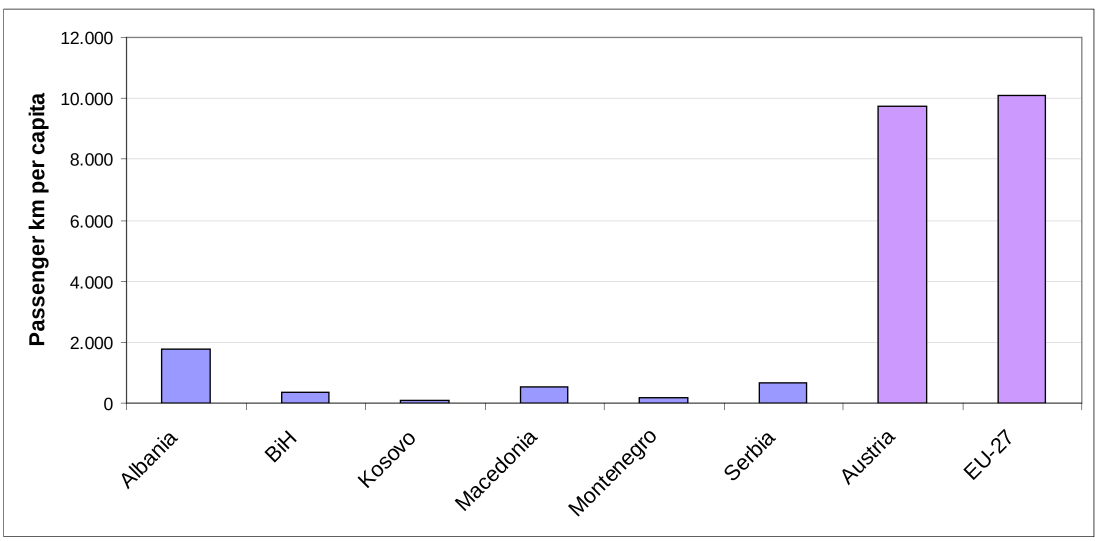
Figure 28. Number of cars per household



* Data on the number of households in 2007 are estimates.

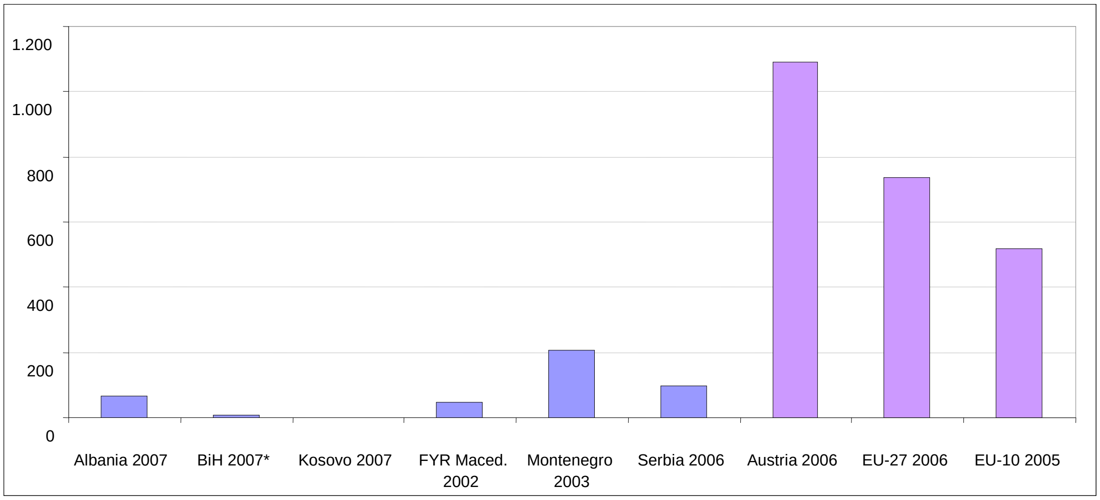
Source: AEA

Figure 29. Passenger-kilometers in road transport per capita



Source: AEA

Figure 30. Passenger-kilometers in rail transport per capita



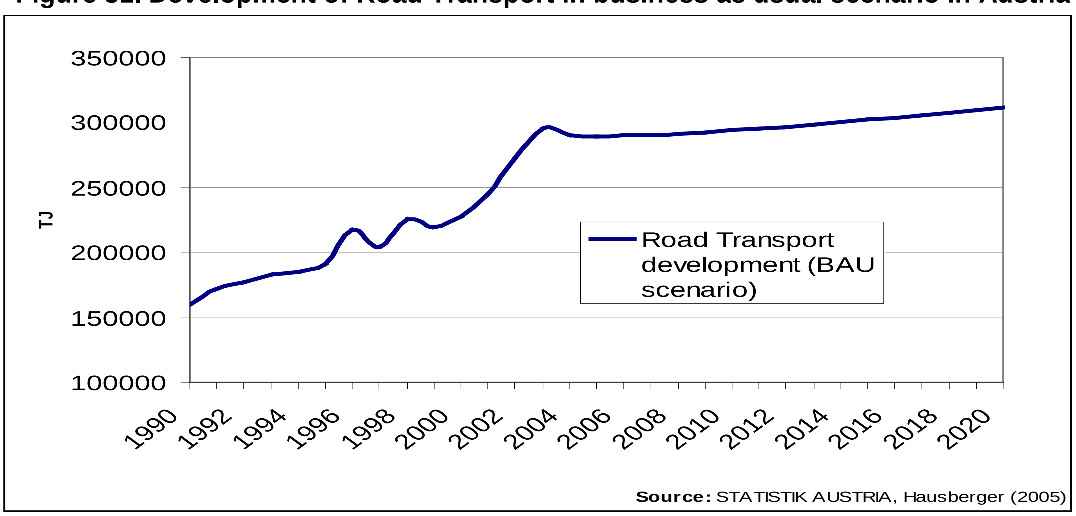
Source: AEA

61. Another contributor to high energy intensity in the transport sector is the age of the public sector vehicle fleet. In FYR Macedonia, for example, organized public transportation using buses and taxis exists only in a few larger cities; intercity passenger transport uses coaches and mini-buses; and goods are transported by truck. Most public transport vehicles are old, pollution-spewing, and much less energy efficient than newer vehicles, as is the case for passenger vehicles. Most passenger and small commercial vehicles are about 15 years old on average.

7.6 Comparison with benchmarks

62. Since 2000, passenger/kilometers in Western Balkans road transport have remained constant, but typically, rising incomes lead to higher numbers of vehicles and person/kilometers, as in Austria. (Figure 31).

Figure 31. Development of Road Transport in business as usual scenario in Austria



63. If the Western Balkans transport sector develops along the lines of the pattern of Western Europe, investing in EE now is crucial. In Austria, for example, transport sector energy consumption has more than tripled since 1970, and even since 2000 energy consumption increased by 25 percent.[16]

64. Vehicle ownership represents for many personal freedom, making it more difficult to influence consumer behavior with regard to reducing energy consumption. Therefore, it is anticipated that transport energy consumption will increase rapidly through 2020, particularly for petroleum products if no measures are taken to increase vehicle efficiency. In 2004, the EU transport sector was 12 percent more EE than it was in 1990, primarily due to more EE vehicles. However, transport sector energy demand has spiked in all new EU Member States, in comparison with the EU-15, due to a modal shift to road transport for both passengers and goods. This trend is also observed in Western Balkan countries and likely to continue. (ADEME 2007).

65. Among new EU Member States, technical regulations for vehicles were implemented around 2001, but legislative-normative measures played a more important role in policy-making. However, only seven percent of these policy measures in the new Member States are considered to have had a major impact, notably fiscal policies such as tax relief for bio-fuels and other clean fuels or legislative-normative policies such as mandatory inspections of vehicles. This share is considerably lower than the 20 percent of the EU-15, which is already rather low. Examples of innovative EE measures that have been implemented in newer EU Member states are tax relief for low-emissions vehicles and/or reduced registration fees for clean cars.[17] For the Western Balkan countries it is critical do develop overall sector transport strategies and EE action plans, review and update sector legislation and regulations to favor EE adoption, and develop incentive schemes for such EE adoption.

[16] This rapid increase in Austria's transport sector energy consumption since 2000 is primarily due to lower taxes than neighbouring countries, creating so-called "fuel tourism."

[17] Cyprus implemented both measures.

8. Energy prices

66. Energy prices vary considerably across Western Balkan countries: prices for most non-network fuels such as oil and diesel are liberalized and determined by the market; oil prices have been volatile in recent years, as in the EU. Natural gas prices are lower than in EU countries; so far only Serbia is a significant gas consumer but it enjoys a special gas supply agreement with Gazprom. However, final consumer prices there appear to reflect purchase price, connection, and delivery costs. Natural gas markets are small in Bosnia-Herzegovina and FYR Macedonia; Albania, Montenegro and Kosovo are not gasified at all.

67. Table 8 compares average electricity tariffs in Western Balkan countries to Austrian tariffs, revealing significant differences not only in absolute tariff levels but also in the relationship between industrial and household tariffs. Tariffs are lowest in Kosovo and in FYR Macedonia and highest in Albania, where the tariff structure is also best—industrial tariffs are lower than household tariffs. The numbers for BiH represent unweighted averages of the tariffs in the three regional electricity enterprises there and are not necessarily representative of actual tariff structures.

Table 8. Average gross electricity tariffs in €cent per kWh

Electricity tariffs in €cent/kWh	**Albania**	**BiH**	**Kosovo**	**FYR Macedonia**	**Montenegro**	**Serbia**	**Austria**	**EU27**
Electricity tariff for industry per kWh	9.0	6.4	6.9	7.8	n.a.	n.a.	8.9	9.6
Electricity tariff for kWh for Households	11.8	6.5	4.7	5.3	7.8	5.7	13.8	12.3
Albania prices are average for 2008 until September; Data for BiH, Kosovo and Montenegro are from September 2008; for Serbia from October 2008; data for FYR Macedonia is for 2010 and Austria and EU27 (Eurostat) are average for 2009 (except for electricity tariff for industry in Austria, which is for 2008).								

68. In ***Albania***, electricity tariffs for households were lower than tariffs for industrial consumers through 2007. However, in 2008 the tariff system was changed: tariffs for households consuming less than 300 kWh per month remained the same; net tariffs for households consuming more than 300 kWh were increased significantly, but the overall tax for the same group was reduced from 15 percent to 10 percent, resulting in a gross price to households of 11,8 €cent/kWh. Non-payment of energy bills is an important issue.

69. In ***Bosnia-Herzegovina***, industry electricity tariffs depend on voltage level, time of day, and season (summer or winter). Low-voltage industry tariffs vary from the summer low of 6,0 €cent/kWh to the winter high of 17,7 €cent/kWh. Households tariffs range from 3,6 €cent to7,2 €cent/kWh in summer; and 4,7 €cent to 9,4 €cent/kWh in winter. Payment discipline varies

among regional electricity companies; collections are highest in the Federation and lowest in Republika Srpska.

70. ***Kosovo's*** electricity tariffs are among the lowest in the region at 6,9 €cent/kWh for industrial consumers and 4,7 €cent/kWh for households. Despite these low prices, the main issue in the sector is non-payment of energy bills. During 2007, about 44 percent of electricity entering the distribution networks was unpaid. Lack of meters at multiple levels makes it difficult to establish where losses occur, and easy for consumers to avoid paying for all or part of electricity or district heating they consume. Lately, however, the situation has been improving and commercial losses are currently about 35 percent. Similar to many other countries, district heating billing is based on the surface area of consumer dwellings, not metered consumption. District heating serves only a small share of the total population, except in Prishtina, where it serves about 20% of the population.

71. ***FYR Macedonia*** also has low and subsidized electricity tariffs. Following a June 2010 tariff increase the current average price for industrial consumers is 7.8 €cent/kWh (a 30% increase) and for households 5.3 €cent/kWh (an 8% increase). Natural gas is used only by Skopje and Kumanovo industrial consumers and the Skopje district heating company; no gas distribution system exists so far, so household consumers cannot switch to other energy sources. Two new Combined Heat and Power (CHP) plants in Skopje will be important gas users from 2010 onwards, and a third CHP plant is being planned.

72. Until 2007, large metallurgical companies paid relatively low electricity prices. In that year, however, large industrial consumers were connected directly to the transmission grid and had to buy 45 percent of their electricity on the regional market. Their average price paid increased from 4.2 €cent/kWh in 2006 to 6.0 €cent/kWh in 2007 (including VAT). Starting in 2008, these consumers had to buy their entire supply on the regional market under bilateral contracts, and typical 2008 prices in the region were around 7-8 €cent/kWh (before transmission costs). Smaller industrial consumers are not affected by this market opening. In November 2008, the Energy Regulatory Commission approved an across-the-board price increase of 13.6 percent for all tariff customers, including industrial consumers up to 35 kV. As indicated above, the average retail price for industrial consumers increased by 30% between 2007 and 2010.

73. Household electricity tariffs have been used as an instrument of social policy, similar to other countries in the region. Despite the fact that the average retail electricity price for households increased by about 8 percent in 2010 compared to 2007, it remains one of the lowest in the region and does not discourage utilizing electricity for heating purposes. The latter increases the gap between electricity demand and supply and leads to more and expensive electricity imports. Another tariff system flaw is that low-voltage consumers pay lower average prices than medium-voltage customers. The Regulatory Commission plans a new tariff system to improve the price relationship between medium- and low-voltage consumers.

74. In ***Montenegro***, residential sector use of electricity for space heating is pervasive because no district heating systems exist, and residential buildings lack chimneys so gaseous fuels cannot be used. This creates an unfavorable environment for EE, and the tariff system provides no dis-

incentives for electric space heating. In 2008, the average residential electricity price was 7.8 €cent per kWh.

75. The Montenegro industrial sector dominates energy consumption. The aluminum factory (KAP) and the steel factory use 55 percent of total final national electricity consumption, while all other industry combined use only 7.0 percent. No information is available on the electricity tariffs for these large consumers.

76. In ***Serbia***, electricity tariffs are not yet at full cost-recovery levels. The state power company, EPS, recommended an average price of 5.0 €cents per kWh in 2006 and 6.0 €cents per kWh in 2008. Residential consumers have a block tariff system with progressively higher prices. The average price for all consumer categories is 5.9 €cents/kWh. The average household price is 5.71 €cent/kWh for an average consumption of 416 kWh per month.

77. Natural gas prices reflect gas purchase, connection, and distribution costs. However, gas prices for all consumer groups were lower than in the EU and neighboring countries, except Bulgaria and Romania, due to a special Gazprom gas supply agreement between Serbia and Russia. In 2008, a new price tariff methodology was implemented, resulting in price increases of about 60 percent for households, and about 30 percent for district heating companies, but having little effect on industry prices.

78. District heating prices generally do not reflect all costs, except in a few cities. Although municipalities set heat prices for cities, they must be approved by the Ministry of Mining and Energy. Recently, the gas price for district heating companies increased by 30 percent, but heating prices increased by only about 6 percent, so operating losses will rise. Since municipalities own most district heating companies, municipal governments will cover the losses using taxpayers' money. Residential district heat consumption is not metered (even heat allocators are not used) and is billed per m^2 of heated area, so consumers have no motivation to save energy. Larger public and commercial consumers are billed based on actual heat consumed plus capacity charges,.

79. Fuel wood prices are market based and stable. In Belgrade, fuel wood costs about 64 Euro per m^3, or 90 Euro/ton, but prices in individual cities and towns depend on location and prices are 25-30 percent lower when closer to forested areas. The fire wood heat price is equivalent to around 6.3 Euro/GJ.

80. In conclusion: energy prices in the Western Balkans are in almost all cases too low and residential consumers are being cross subsidized by large industrial/commercial consumers. Apart from its negative effect on energy efficiency investments, such tariff distortions also cause costly distortions in energy infrastructure investments that countries have to live with for decades to come. Tariff levels for each consumer category should be gradually increased to the levels implied by the Energy Community Treaty's anticipated full market opening by 2015. At the same time, Governments should introduce support schemes for the neediest segments of the population. As an intermediate step towards both of these objectives, regulatory authorities could consider introducing block tariff systems where they do not already exist. The lower block should be limited to basic monthly consumption needs of about 200-300 kWh/month and priced

below cost, while subsequent blocks would be priced at and above the cost of supply, respectively. Also, this measure does not specifically target vulnerable groups and is, therefore, not a substitute for proper social safety nets.

9. The Way Forward

81. Reliable energy input-output data are basic to achieving greater EE in the Western Balkans. European Community Directive 2006/32 on energy end-use efficiency and energy services requires countries to prepare National Energy Efficiency Action Plans,[18] but this work is well behind schedule in the countries covered by this study due to: (i) a lack of energy data, including EE indicators; (ii) a lack of qualified staff; and (iii) limited government support due to lack of good data; hence, governments are unaware of the extent of the problems they face in the energy sector.

82. Setting up energy data gathering and reporting systems consistent with those of EUROSTAT is an EU accession requirement, and therefore the EU and its agencies would be the logical choice to provide financing and technical support for this work. Indeed, EUROSTAT, the expert in this area, has already submitted a project proposal to help set up basic energy data systems in all Western Balkan countries during 2011-12. The input data that need to be collected relate to fuel use (type of fuel, quantity) and surface area heated/cooled, number of beds, number of pupils, number of employees, etc., so that useful energy efficiency indicators can be developed and monitoring becomes a meaningful activity. Odyssee, a detailed database on EE data and indicators for the EU-27 plus Norway and Croatia, provides a useful template in this regard (www.odyssee-indicators.org).

83. However, even without improvements to data systems, tariff structures, and tariff levels, much can and should be done to increase EE. First, the public sector should lead the way by introducing EE demand-side measures in all its buildings, facilities, and rolling stock. Campaigns to raise consumer awareness and seek to effectuate behavioral change in the residential sectors (housing and transport) would be an important part of such a program. Second, governments should exploit major supply-side opportunities to save energy by introducing cogeneration of power and heat wherever possible. Third, introducing efficient wood stove programs, especially for the poor, could be considered as part of a public sector program, as could efficient lighting programs. It should also be kept in mind that energy efficiency improvements do not only result in energy savings, reducing energy bills and greenhouse gas emissions, but that they often result in much increased comfort and health and have social impacts that are harder to measure but no less tangible than energy savings.

84. Recent data obtained for FYR Macedonia indicate pretty good simple payback periods for energy efficiency investments even at current tariff levels: heat allocators for district heating consumers: 6.3 years; social housing retrofits: 6.7 years; new buildings built according to code (heating, solar collectors, new appliances, lighting): 5.0 years; efficient individual boilers: 6.5 years; solar collectors on existing buildings: 14.2 years; efficient street lighting in Skopje: 3.3 years; electrical appliance and equipment labeling: 4.1 years; and hospital retrofits: 3.4 years. [19]

[18] The Energy Community's Energy Efficiency Task Force convenes regular meetings to check on the status of preparation of these NEEAPs .

[19] *Energy Efficiency Strategy of the Republic of Macedonia* (Draft, USAID, March 2010)

Experience elsewhere has shown that once serious EE programs start in these areas, the demonstration effect of the programs will be powerful enough to encourage development of sound energy data systems. Thus, implementing demand- and supply-side EE measures would trigger a virtuous circle leading to better data systems, and more and better-targeted EE measures. Any future analytical work should also focus on preparing detailed roadmaps for individual governments, consisting of short-term measures that they can take to launch meaningful EE efforts while slowly building their long-term EE capabilities. A checklist of EE measures is attached as Annex 2.

9.1 The Public Sector: taking the lead in EE

85. ***Program description***. The EU's Energy Services Directive stipulates that the public sector should lead the way to develop the market for EE investments. In the Western Balkans, taking the lead would include the following: (i) establish building codes and equipment standards and ensure enforcement; (ii) implement public sector EE projects, especially in buildings frequented by the general public, to maximize the demonstration effect and create demand. This would also help countries conform to the EU Directive on building energy performance; (iii) enable start-up and facilitate demand for an adequate number of energy services companies; and (iv) establish programs to train and certify energy auditors, managers, and contractors. In fact, the Government of FYR Macedonia decided in February 2010 to proceed with a comprehensive national program for energy efficiency in the public sector, covering all public buildings at the central and local level. The World Bank will be providing technical assistance and financial support to this program, while other donors and IFIs have expressed interest in providing support and funding for this national program as well.

Inititate public sector EE programs. Governments at all levels should undertake public sector EE programs to demonstrate and disseminate results via long-term public information services. This will stimulate consumer interest and help develop an EE equipment manufacturing industry and ancillary services. Critical steps to develop a sound EE program are to: (i) formulate an EE strategy as part of overall national energy strategy; (ii) create an EE agency or equivalent institution to coordinate government efforts aimed at introducing EE legislation and set minimum EE standards; (iii) establish an EE financing facility; (iv) raise awareness and seek to effectuate behavioral change; and (v) ensure action plan implementation and enforcement of codes and standards. These efforts must be accompanied by firm commitment and actions to eliminate energy price distortions and gradually raise energy prices to cost-recovery levels to enable rational consumer choices among energy efficiency investment options.

86. ***Facilitate public procurement of energy services.*** Most public procurement policies do not permit all-in-one bids for equipment, services, and energy savings performance guarantees, which impedes efficient contracting for EE building upgrades. However, a potential model is ESCO contracting, which typically packages equipment, services, and energy savings performance guarantees, if so requested. Other less comprehensive models can be envisaged and may be more appropriate. Bundling many building upgrades into one procurement package would lead to significant economies of scale and attract strong bidder interest. This type of project would stimulate demand for energy services and attract local and international equipment suppliers, vendors, and contractors into the EE market. Governments, with donor assistance, should

consider modifying their national public procurement policies to enable energy services contracting.

87. ***Schools and Hospitals are Priorities.*** In the short- to medium-term, prospects are slim for major, sustainable EE programs in countries with low energy prices and high commercial losses. Good EE equipment prices tend to be at world market levels or higher, so payback periods would be too long because consumers typically apply high discount rates to these investments, for example, up to 20 percent for households and up to 50 percent for industry.[20] But public-sector programs for schools, hospitals, and government buildings can promote comfort, health, as well as energy savings that will increase over time as energy prices rise. The Serbia Energy Efficiency Project is an excellent example of this (Box 1).[21] Municipal governments have strong incentives for EE investments due to the scale of their public facilities and street lighting systems, and substantial subsidies for district heating systems and heat consumers; however, funding often needs to come from central government. Energy efficiency could also be a cost-effective contribution to the social safety net for the poor (Box 2).

88. ***Increase availability of reliable EE information and training.*** Too little reliable information and too few qualified service providers are major barriers to demand-side EE. It takes a long time to educate consumers, certify energy auditors, manufacturers and contractors, and introduce and enforce energy building codes and efficiency standards for homes, appliances, and vehicles. Such programs should be started as soon as possible and possibly on a regional basis. Well-designed labeling programs would aid consumer choices. Governments, assisted by non-governmental organizations and professional associations that enjoy the public trust, are best placed to provide this information. The IEA could possibly take the lead in disseminating knowledge, for example, by translating EE information into principal regional languages, and showcasing good practices.

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[20] IEA, *World Energy Outlook 2007*. World Bank, *Infrastructure in Europe and Central Asia: Approaches to Sustainable Services*, 2006. McKinsey Global Institute, *Curbing Energy Demand Growth: The Energy Productivity Opportunity*, 2007.

[21] World Bank, *Serbia Energy Efficiency Project*, 2004 (first credit) and 2007 (additional financing).

Box 1. Serbia Energy Efficiency Project

This project aims to improve EE in public buildings, generate cost savings, and benefit the local and global environment by reducing use of 'dirty' fuels for heating buildings. The project has two main components: rehabilitate the heat supply system and implement EE improvements in the Clinical Center of Serbia, plus EE improvements in schools and hospitals across the country. The project began 2004, funded by a World Bank credit of US$50 million, which financed refurbishing for 28 buildings: 12 hospitals and 16 schools.

Component 1—The Clinical Center of Serbia (CCS) in central Belgrade had a heating system comprising 19 separate boiler plants, some more than 40 years old, 14 fired by lignite and heavy oil, costly to operate, inefficient, and unreliable. Air pollution from burning dirty fuels with old equipment was a major concern. This Component included replacing boilers with a gas-fired cogeneration plant, including extending a gas pipeline; reconfiguring and modernizing the CCS heat distribution system; and EE retrofitting the maternity hospital with roof insulation, window replacement, and thermostatic regulators. This achieved heating cost savings of about €1.5 million per year, major emissions reductions of SOx, NOx, ash, and CO2, and improved comfort for patients and health workers.

Component 2—EE improvements in schools and hospitals across Serbia. Eligible measures included insulating and repairing roofs, replacing doors and windows, insulating walls, basement ceilings, and pipes, balancing and thermostatic valves, automatic temperature controls, replacing boilers and/or burners, and installing EE lighting.

Project results were impressive: energy consumption reductions of 44–48 percent, reduced air pollution, and increased comfort for school and hospital occupants. Schools and hospitals now save on average about €70,000 per year on energy with a payback period of about four years. Some municipalities are now using their own funds to replicate these EE results.

Box 2. Energy efficiency investments for the poor

Rather than continuing to subsidize energy consumption for the poor, governments could help the poor reduce their consumption through EE investments. For example, the U.K. government had two million households that were spending more than 10 percent of their income on energy; each year Government paid out about US$4.0 billion on a poorly targeted consumption subsidy. Then, Government decided to provide a one-time grant to make homes more energy efficient: both Government and consumers saved money, while the grant targeted those most in need, created local job opportunities, improved the environment, and addressed health and social justice issues.

9.2 Cogeneration Potential

89. About 50 district heating (DH) systems exist across the Western Balkans; most are in Serbia and in Bosnia and Herzegovina. Some larger systems' heat supply is produced by heat exchangers in nearby power plants, which decreases those plants' power output. It would be much more economic to use power plant waste heat, which would also significantly increase efficiency. Co-firing these power systems with abundant biomass available in the region, but now often wasted, would create further efficiency and environmental improvements.

90. Many existing DH heat supply systems now using fossil fuels could be converted to biomass (co)-fired Heat-Only Boilers or Combined Heat and Power (CHP, or cogeneration) systems. Biomass should of course only be used if the biomass supply is sustainable. Such CHP plants should be built only in areas where additional electricity supply would generate system benefits such as reduced network losses or ensuring stable electricity supply, and where heat utilization would be required for sanitary hot water and applications like biomass drying in the summer. About ten other DH systems, including those of Sarajevo, Banja Luka, Nis and Skopje, could eventually be repowered to CHP systems by using waste heat from the proposed new gas-fired power plants and compressor stations envisaged under the Western Balkans Gas Ring development scenario.

91. Half of the fuel now consumed by district heating supply could be saved through the aggregate effects of using waste heat of power plants, introducing heat storage, and improving heat distribution management. Given this enormous potential for supply-side energy savings, the highest priority bankable projects in cogeneration and district heating were identified in each country. If implemented, these projects could help countries meet EU Directive 2004/8/EC on promoting cogeneration based on useful heat demand.

92. ***Using waste heat from power plants***. Cogeneration is a strategic option promising major energy savings for power and district heating in Bosnia and Herzegovina, Kosovo, FYR Macedonia, Montenegro, and Serbia. Also, cogeneration would help these countries achieve the EE targets that they are committed to under the Energy Community Treaty.[22] More than 50 urban areas across these countries have district heating systems supplied mainly by heat-only-boiler plants built in the 1970s and 1980s, making them an uncompetitive urban heating option compared to modern gas-fired cogeneration plants or high efficiency residential and commercial electrical heat pumps. Very few district heating systems are supplied by cogeneration facilities. Using waste heat from thermal, mostly lignite-fired, power plants would significantly improve overall heat supply efficiency, DH economics, and energy sector environmental impacts.

93. ***Reduced strain on electricity and gas networks***. Throughout the region, power and natural gas systems experience additional peak demand during extreme cold periods[23]. But since volumes are too small to be served economically by existing district heating systems, serving this demand spike is expensive and strains electric power and gas infrastructure in countries that already suffer frequent power outages or gas shortages.[24] Therefore, sourcing heat from cogeneration facilities would help district heat providers cover more heat demand and manage peaks more economically and flexibly. Peak demand reduction and/or peak shifting for heating, electricity, and gas would benefit the region during extreme cold periods, enhance security of supply of electricity and gas, and transform district heating into a competitive option through improved

[22] The agreed target is a 1.0 percent per annum improvement in energy efficiency over 2010-2018.

[23] In future, increased demand for space cooling may create also summer peaks.

[24] Winter peak demand for gas is 15 to 33 times higher than summer demand. Since Gazprom, the main gas supplier, and local gas transmission operators do not opt for take-or-pay and ship-or-pay clauses in gas supply contracts, district heating providers do not face real costs for gas supply consumed, leaving substantial gas transmission capacity unused for extended periods.

design and management (assuming no distortions in pricing policies). Developing cogeneration facilities would also reduce or eliminate the need for subsidies from municipal and national budgets.

94. ***Increased cost-effectiveness of combined heat and power generation.*** Proposed cogeneration facilities would capture economies of scale by using waste heat from power plants for district heating services to supply heat and domestic hot water. Waste heat could also be used to pre-dry lignite and biomass, expanding the cost-effectiveness of cogeneration facilities even more.

95. ***Less heat generating capacity needed.*** Based on market research for this report, most district heating systems in the Western Balkans can be supplied by waste heat from power generation facilities, or use of local fuels such as biomass, or both. Projects envisaged in this study identify about 5,200 MWt of cogeneration capacity, sufficient to replace 8,000 MWt of existing less efficient heat-only production capacity.[25]

96. ***Power plant efficiency gains***. The cogeneration solutions envisaged increase power plant EE by more than 10 percent, depending on amounts of waste heat recovered and investment levels in main power generation assets. Drying lignite would expand the EE of lignite-fired power generation by about 3.0 percent. Waste heat recovery and lignite drying options can be applied to existing and new lignite-fired plants. Rehabilitated or new plants will also substantially increase efficiency, for example from 25-30 percent now to over 40 percent (HHV[26] net), not including the impact of waste heat recovery and lignite drying. Furthermore, since the new plants envisioned will be capable of co-firing biomass, they will be more efficient (because biomass has a higher combustion temperature than lignite and helps improve the combustion of the lignite itself) *and* reduce CO_2 emissions, which will satisfy environmental obligations arising from the Energy Community Treaty, reduce volumes of cooling water needed for the plants and lignite transport costs, and improve lignite stocks and energy security. [27]

97. ***Energy savings and reduced environmental impacts.*** Using waste heat and/or biomass in all projects identified would replace more than one million tons of lignite equivalent, 1 BCM of natural gas, plus almost one million tons of heavy fuel oil now burned each year to provide heat to district heating systems. Using facilities to pre-dry lignite would increase lignite-fired power plant efficiency, save 7.5 million tons of lignite, and reduce CO_2 emissions by 8-9 million tons per year. At current energy prices, this is equivalent to savings of €550 million per year.[28] These savings would further increase if the environmental value of reduced lignite burning in the region

[25] This estimate takes into account greater flexibility of new heat sources, use of heat storage, and better heat distribution in district heating networks. It does not take into account eventual EE improvements in buildings served by district heating systems or other interventions throughout the networks that could be stimulated by better designed DH tariffs.

[26] HHV stands for Higher Heating Value, which is equivalent to the total amount of heat (energy) released when a fuel is burned completely and the products are returned to their natural room-temperature states.

[27] The region consumes about 80 million tons of lignite at about 30 percent efficiency to produce electricity. If lignite drying is used and plant efficiency increases to 33 percent, only 73 million tons of lignite will be needed to produce the same amount of electricity even without change in the main power generation technology.

[28] Lignite priced at €7.00/ton (direct costs only); gas at US$350/TCM; and heavy fuel oil at US$240/ton. More than half of these benefits are accounted for by the proposed investments on the Obrenovac Lignite Power Complex in Serbia.

was added, especially where now used in low-efficiency heat-only boiler plants. In addition, better utilization of hydropower plants for peaking rather than for baseload could offer more power to regional and European markets at significantly higher prices.

98. ***Cogeneration models and pilot projects***. The study proposes introducing four basic standardized cogeneration models to reduce costs and speed project implementation. It advocates using heat storage with all designs to reduce linkages between electricity generation and heat demand; it assigns priorities to the 66 projects analyzed, and suggests proceeding as soon as possible with six pilot projects, particularly Obrenovac in Serbia, and four small biomass projects in Bosnia-Herzegovina and Serbia.

99. ***Accompanying actions needed.*** Several actions must be taken to ensure sustainable use of all types of cogeneration facilities: (i) set tariffs for heating, natural gas, and electricity to avoid distorting investment decisions and consumer choices; (ii) improve efficiency of end-use demand, and heat transmission and distribution networks; (iii) introduce regulations to support cogeneration, for example, countries might set medium-term targets for phase-out of heat-only boilers and replacement with cogeneration facilities; and (iv) increase biomass supply by replacing low-efficiency wood-burning stoves with efficient stoves, which also provides health, anti-poverty, and environmental benefits (see Section 9.3 below).[29] The detailed report on the region's co-generation potential is provided as Annex 3.

9.3 Efficient Wood Stove Programs

100. **Design programs to introduce energy efficient stoves.** Energy professionals and international financial institutions tend to ignore firewood as a fuel in Europe because they focus on network fuels and tend to consider firewood as an undesirable option from the past. However, far from being a thing of the past, consumption of firewood logs and wood pellets in EE stoves is on the increase among the EU-15 and in North America. All Western Balkan countries still make extensive use of firewood for cooking and space heating; about two-thirds of the population and many rural schools use firewood as a primary heating fuel or to supplement electric heating. Firewood consumption and resulting deforestation rates are far greater than necessary due to widespread use of inefficient stoves with conversion efficiencies of only 20 percent or even less. Replacing inefficient stoves with masonry or down-burning stoves with efficiencies over 50 percent is a do-able low-cost EE measure that could provide major benefits for energy poverty, health, and the environment throughout the region. The enabling infrastructure (production of down-burning stoves and installation of masonry stoves) for such a program would develop as the program is being implemented and gains credibility.

101. **Biomass savings.** Replacing inefficient stoves could potentially save the region about 4 MTOE in firewood, or even 5 MTOE if firewood is properly seasoned and dried; that is enough biomass to fuel many of the heat-only and cogeneration plants mentioned above. Designing EE stove programs would require the following steps: (i) conduct a market survey to assess demand

[29] Improved efficiency in fuel wood and overall biomass use, envisaged by this scenario, would enhance the economics of re-forestation projects that are already under consideration in most countries in the region.

at various subsidy levels; (ii) identify potential grant sources to finance subsidies; (iii) prepare implementation plans covering also manufacturing and construction capacities. Potential grant sources could include the Clean Development Mechanism, if national programs are large enough, bilateral donors, or national environment funds.

Box 3. Efficient Wood Stoves in Kosovo

Over 80 percent of Kosovo households use firewood as a primary or secondary fuel for heating and cooking; over half of schools use firewood for heating. Often, electricity is used to supplement heat from wood burning stoves, straining electricity networks during peak winter periods, creating voltage and frequency problems, and requiring expensive electricity imports. Efficient wood stoves would reduce the seasonal strain on the electricity sector, reduce poverty, and improve health and the environment.

Kosovars use about 2.5 million m^3 of firewood per year; firewood is expensive at about €40-50/m^3 and is often smuggled in from Serbia. Most wood burning stoves are poorly made with low efficiencies of 15-20 percent, while masonry and down-burning stoves have efficiencies of 50 percent or higher. Efficient stoves would reduce total firewood demand by about 60 percent, reduce indoor air pollution, and slow deforestation rates. This would make sustainable forestry a realistic proposition; additional EE gains could accrue from combining reforestation and firewood drying, for example, by using waste heat from power plants, which would enhance the wood's heating value and further reduce demand for wood. One efficient stove would cost about €300 if procured in bulk; since annual firewood consumption now averages 10 m^3 per household (4 m^3 in urban areas and 12 m^3 in rural areas), the payback period for consumers would be less than two years. The Kosovo Government could implement a pilot program to introduce efficient wood stoves, initially targeting 100,000 of the poorest consumers. Electricity demand for supplemental heating could be reduced by about 3,840 kWh/year per household, or 384 GWh in total which now needs to be imported at Government expense. A €30 million investment in efficient stoves is less than the €38.4 million cost for electricity imports in the first year alone and would reap large net benefits many years thereafter.

Imported liquefied petroleum gas (LPG) is used for cooking, and space heating in non-residential buildings. Infrastructure to transport, store, and retail LPG in Kosovo is limited but expanding rapidly. LPG is efficient, clean, and safe for small- and large-scale space heating using light combustion stoves up to central heating boilers. Boilers with buffer tanks and instantaneous water heaters can achieve efficiencies of about 90 percent, so LPG is an EE upgrade over efficient wood stoves but its market share is likely to remain small for years to come, in part because it is considered expensive. Natural gas is not an option in Kosovo now since there is no natural gas system; introducing a gas system, possibly in the context of the Western Balkans Gas Ring, is a long-term proposition. Also, similar to gasified countries such as Serbia, most lower income consumers find gas unaffordable since it requires a substantial outlay to connect to the gas distribution system and reconfigure building internals, including installing new gas radiators; even the price of gas is considered too high.

9.4 Efficient Lighting Programs

102. Lighting accounts for a large share (about 20%) of electricity consumption in many countries and most of the lighting in the household sector is provided by inefficient incandescent lamps. Compact fluorescent lamps (CFLs) can provide the same amount and quality of light as incandescent lamps while using only one-fifth the electricity. CFLs can also last 5-10 times longer than incandescent lamps. During the last 15 years, an increasing number of countries have taken steps to implement large-scale energy efficiency programs based on phasing out

incandescent lamps and replacing them by CFLs, often with the assistance of the World Bank Group and GEF. Such programs often serve to achieve multiple objectives of reducing peak loads and investment expenditures, utility losses, customer electricity bills, local pollution and greenhouse gas emissions. At the same time it often reduces government's fiscal deficits due to energy-related public expenditures and improves energy security.

103. Despite the fact that CFL programs present a win-win situation for all parties involved, the implementation of energy-efficient lighting initiatives worldwide has been very slow. Some barriers hindering successful project implementation include the poor quality of some CFLs on the market, the high price of high-quality CFLs compared to incandescent lamps, and the increase in CFL costs resulting from value added tax and import or customs duties. Programs need to be designed to overcome these barriers and provide high-quality CFLs at a reasonable and affordable price to successfully initiate the market shift towards the adoption of this efficient technology.[30]

104. The EU has decided on a gradual phase-out of all incandescent lamps during 2009-2012, starting with 100W bulbs in 2009 and ending with 40W and 25W bulbs in 2012. The Western Balkan countries are likely to be under some pressure to follow the EU's example or to want to do so of their own volition. In countries with severe electricity shortages (Kosovo, Albania, FYR Macedonia, Montenegro) embarking on such a program now, without waiting for gradual phase-out of incandescent lamps, makes eminent sense. For example, in Kosovo the Government is currently subsidizing electricity imports to the tune of about € 50 million (about 500 GWh) per year. In order to reduce electricity imports and the need for corresponding subsidies, the Government should start a nationwide efficient lighting program as soon as possible. One leading proposal would involve the free distribution of four CFLs per household consumer and six CFLs per commercial consumer (both must be up to date in their electricity bill payments). This should be in exchange for an equal number of incandescent bulbs that should be promptly destroyed to prevent them from being re-circulated in the market. Distribution of the new lights (and destruction of the old ones) could be handled by a private firm. Through bulk purchase of high-quality CFLs their cost, including promotion, distribution, etc., could be no more than € 3.00 each. While the one-time cost to the Budget of such a program would be about € 5 million, the annual benefits would be € 19 million, assuming a € 100/MWh price for imported electricity. Energy saved would be equivalent to 191 GWh or about 38% of the quantity of electricity imports in 2009, assuming that the Government will effectively ban the import of incandescent bulbs prior to that in order to avoid the creation of a secondary market in CFLs.[31] After a few years the market for CFLs would become self-sustainable without requiring Government subsidies.

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[30] For an extensive discussion of such programs and best practices in over 30 countries worldwide see Large-Scale Residential Energy Efficiency Programs Based on Compact Fluorescent Lamps (World Bank/ESMAP, December 2009). A web-based toolkit is also available at http://www.esmap.org/news/news.asp?id=126.

[31] Over a five-year period the estimated benefits would be € 76 million compared to a cash investment of a mere € 5 million. This assumes a 5-year lifespan per CFL. However, usage patterns and voltage and frequency drops can affect the lifespan of a CFL.

9.5 World Bank EE Implementation Experience

105. The World Bank Group has been involved in multiple EE projects in Central and Eastern Europe. Lessons learned are highly relevant for designing EE programs in the Western Balkans, including selecting suitable implementation tools. The key lessons learned include the following:

- ***Energy Service Companies (ESCOs)***[32] can help provide off-balance sheet financing for public buildings and SMEs. The ESCOs can facilitate investments in municipalities that have limited implementation capacity, and are unwilling or unable to assume direct loan commitments. Initially, ESCOs need to operate in tandem with public EE programs, and often require concessional loans and/or guarantees to fund their activities because several years are needed to build strong and commercially viable businesses.

- ***Energy Efficiency Funds***[33] can help demonstrate the financial viability of EE. Although EE funds alone tend to have limited reach and market impact, they are useful to focus on market segments not targeted by commercial banks. However, at start-up, EE funds need access to grant financing from global trust funds such as GEF, bilateral donors, national budget funds, or national revenues from environmental taxation. When a market segment is sufficiently developed to attract commercial financing, the EE Fund objective has been reached and it can be phased out over the medium term.

- ***EE Credit Lines***[34] are sometimes efficient tools to reach industrial and commercial market segments. Participating banks can propose EE investments to existing customers, funded from the credit line. One caveat is that credit lines need to be accompanied by training for participating banks and effective marketing campaigns. A prerequisite is access to grant funding to pay for project preparation and energy audits to soften the terms of the loan.

- ***Programs for EE Rehabilitation of Residential Buildings***.[35] Programs include building envelope improvements that achieve 25-30 percent reductions in energy use, and apartment-level demand-side improvements such as metering, thermostatic radiator valves, and consumption-based billing that reduce heat consumption by another 20-25 percent. However, these programs depend on subsidies to attract consumer interest and on setting up technical and financial intermediaries to interface directly with homeowners. Unfortunately, many countries lack strong homeowner associations for multi-unit buildings, which impedes consensus on building improvements and prevents the banks from lending.

- ***State-level Public Building Rehabilitation Programs***.[36] Many administration, health, and educational buildings are under state control and could be used to showcase EE im-

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[32] Examples are IBRD/GEF supported ESCOs in Croatia (HEP ESCO) and Poland (Krakow POE)
[33] Examples are GEF funded EE Funds in Bulgaria and Romania
[34] Examples are an IFC credit line in Russia and an IBRD credit line in Turkey
[35] Example is the GEF funded project in Lithuania (Vilnius Heat Demand Management)
[36] Examples are the IBRD loans to Serbia, Montenegro and Ukraine for EE in education and health facilities

provements and provide the basis for a local service industry that performs energy audits and implements projects, perhaps supported by IFI loans.

106. In all World Bank projects, technical support was provided for project identification, screening/ appraisal, public information, promotion, and marketing. An ESMAP review of 29 EE agencies worldwide emphasized that technical assistance is a crucial component in financing scaling-up of EE activities.[37]

107. The *Commercializing Energy Efficiency Financing (CEEF) project* in Hungary achieved significant results in the residential sector, where financial intermediaries (local commercial banks, ESCOs) channeled funds to households with the support of guarantee instruments and a strong technical assistance (TA) program. The CEEF tailored TA activities to client needs, providing information, training, market development and outreach, and emphasizing strong client relations. The *Vilnius Heat Demand Management Project* in Lithuania improved dramatically after two years of implementation, when it changed from a consultancy-driven approach to a financial intermediary approach (local commercial banks) similar to that of CEEF. The Lithuania program provided free services such as economic, financial, technical, legal, and marketing advice, which were essential to gain stakeholder trust. Also, most projects noted that good demonstration and pilot programs were critical to creating a market, particularly during the early years of operation in new sectors.

Donor/IFI programs in EE

108. This study also reviewed Western Balkan countries' energy efficiency programs undertaken by other International Financial Institutions and bilateral donors as of end-2008.[38] The main findings are as follows:

- There are many multilateral and bilateral efforts to improve EE in the Western Balkans. However, much of the theoretically allocated amount of US$600 million is for *both* renewable energy and energy efficiency. From the commercial and political points of view, renewable energy projects are more attractive because they build new capacity, have therefore greater visibility, and project developers are experienced. This means that most funding will go to renewable energy projects.

- Much of the available funding is structured as credit lines to local banks and is allocated to industry and small and medium enterprises. Public and residential sectors together attract only about 35 percent of funding, despite having 35-40 percent potential for EE improvements in each.

- During 2008 all major IFIs worked on developing new EE and renewable energy facilities that target the Western Balkans region, which calls for improved coordination to

[37] ESMAP, 2008. An Analytical Compendium of Institutional Frameworks for Energy Efficiency Implementation.

[38] Programs with a total value of less than US$1.0 million equivalent are not included in this overview.

avoid overlap and ensure that all sectors with large energy savings potential will be adequately covered.

- Many EE programs in the Western Balkans include substantial amounts of grant funding, reflecting the perception, and often the reality, that EE initiatives are not attractive without strong incentives at this stage.

109. Annex 4 describes all known regional EE programs as well as country-specific EE programs of donors and IFIs active in the Western Balkans.

10. Bibliography

ADEME (2007). Evaluation and Monitoring of Energy Efficiency in the New EU Member Countries and the EU-25. Paris.

Energy Charter Secretariat (2008) Energy Efficiency in the Public Sector. Policies and Programmes in ECT Member Countries. April 2008, Brussels.

Hausberger, Stefan (2005) GLOBEMI – Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor; Institut für Verbrennungskraftmaschinen und Thermodynamik, TU Graz.

IEA (2008). Energy in the Western Balkans. The Path to Reform and Reconstruction. International Energy Agency in Cooperation with the United Nations Development Programme. Paris.

Kosovo (2008). Technical Background Paper Energy Sector, produced by experts funded by the European Commission and the World Bank in consultation with other donors and the Kosovo authorities, 7 July 2008.

Kosovo Ministry of Energy and Mining (2006). Kosovo Programme for Energy Efficiency and Re-newable Energy Resources for the period 2007-2009, November 2006. Prishtina.

UNDP (2007) Energy for Development. Kosovo Human Development Report. Financed by the Swiss Development Cooperation Office. Prishtina.

USAID (2008a). Final Report of The Regional Energy Demand Planning Project, June 2008, Washington.

USAID (2008b). Energy Community Stocktaking on Energy Efficiency. Final Draft. May 2008. Washington.

USAID (2010). E&E Regional Energy Security and Market Development Project. Energy Efficiency Strategy of the Republic of Macedonia. March 2010, prepared by Macedonian Center for Energy Efficiency, Alliance to Save Energy, International Resources Group (IRG; draft version).

World Bank (2007). Kosovo Energy Sector: Heat Market Study, Final Report, March 2007, prepared by ELC-Electroconsult / ERM.

World Bank (2008) Energy Sector Study in BiH. Report written by Energy Institute Hrvoje Požar, Soluziona, Economics Institute Banjaluka. Zagreb.

World Bank (2008). Energy Efficiency in Russia. Untapped Reserves. Report prepared by the World Bank Group in close cooperation with the Center for Energy Efficiency (CENEF). Washington.

ANNEX 1: Institutional Framework

This annex provides additional information for each country on the principal elements of their institutional frameworks and dissemination support schemes, based on the elements listed in Section 2 of this study. These elements are the: (i) legal and regulatory framework; (ii) supporting structures; (iii) implementation arrangements; (iv) incentive systems; and (v) public information system.

Albania

Legal and regulatory framework. Most institutional arrangements are in place. Government has defined public administration responsibilities; approved laws for energy efficiency, energy savings in public and private buildings; and developed a national action plan to implement the National Energy Strategy (2003). Albania is drafting an EE strategy with two scenarios, which should soon be approved. EE action plans are being prepared by KEK, the electric utility; this task should be reassigned to an independent entity. Legislation facilitating the role of ESCOs does not yet exist.

Supporting structures. The existing energy agency responsible for project implementation is well staffed; it could take on the role of an energy institute to advise Government on energy policy and provide and analyze energy data to support policy formulation. and be the change agent to support market dissemination of energy efficiency technologies and. Some EE hardware and software is available and trained EE experts are available for installation.

Implementation. Albania is lagging in implementing existing laws and adopting secondary legislation and supportive policy tools—the country still lacks EE standards for products and appliances, updated building codes, and legislation governing ESCOs. Programs are needed to demonstrate and promote EE in schools, hospitals, and other public buildings.

Incentives. Among other lacking incentives, Albania has not yet introduced financial incentives to promote EE. However, the National Energy Strategy notes that an EE fund should be established, to be used exclusively for EE and energy conservation, and be financed from the state budget, international grants, private sources, and electric utility revenues. The energy utility is not yet promoting energy savings through demand-side management programs.

Public information. Government has not yet developed a public information capacity to promote EE benefits and technologies.

Bosnia and Herzegovina

Legal and regulatory framework. BiH has a complex political structure and it is, therefore, not surprising that it lags the other countries in developing an institutional framework. The country needs to define administrative responsibilities, develop and approve EE legislation, set national goals for EE, and develop an EE strategy and action plan. Legislation facilitating the role of ESCOs does not yet exist.

Supporting structures. BiH needs to create an energy institute to advise Government on energy policy, and provide and analyze statistical data to support policy formulation. Institutions to assess and implement EE measures are also needed; this function is now left to understaffed ministries. State and entity-level electricity regulatory agencies exist but need strengthening; the regulator at the national level is currently weaker than the entity-level regulators.

Implementation. BiH has adopted some EU energy efficiency standards, but most are not yet obligatory. Government needs to implement individual heat metering; develop and implement EE standards for products and appliances and update building codes; and develop and implement programs to promote EE in schools, hospitals, and other public buildings. EE hardware and software are not widely available, and neither are trained experts to install them; training programs are needed to develop such expertise.

Incentives. Most energy efficiency incentives are lacking. BiH needs to introduce financial incentives for EE; the Funds for Environment Protection in both entities could have a role here in the future. Energy utilities are not yet promoting energy savings through demand-side management programs.

Public information. A public information system to educate consumers and promote EE is yet to be created.

Kosovo

Legal and regulatory framework. Administrative responsibilities are clearly defined; some EE policy goals have been set; and an energy law and strategy were passed. In 2007, Kosovo adopted an energy efficiency and renewable energy program. Draft laws on energy efficiency and renewables have yet to be approved.   The EE action plan is awaiting approval, and supportive policy tools still need substantial development. Legislation facilitating the role of ESCOs is being prepared.

Supporting structures. Kosovo needs an energy institute to advise Government on energy policy and to provide statistical data to support policy formulation. Accurate statistical data are currently not available and much work is still needed to establish an EE implementing agency, which could be the same entity as the energy institute.

Implementation. Kosovo has yet to implement concrete EE measures.   Individual metering of heat consumption from district heating systems (limited to only 3% of the population) does not yet exist. Although EE hardware and software is available, Kosovo has insufficient trained experts to install the technologies and training is not yet available.   The education system, policy makers, and energy industries need to cooperate to target priority needs to educate and train future energy sector workers. Kosovo adopted an energy auditing system that includes auditor training and development of standardized auditing methods.

Incentives. Most energy efficiency incentives are lacking. Kosovo needs to introduce financial incentives to promote EE; so far only one financial scheme exists for EE, financed by GTZ. The Assembly of Kosovo rejected creation of an EE fund on the grounds that public entities such as hospitals or schools are not permitted to benefit directly from energy savings—the classic owner-user-dilemma. The energy utility KEK is not yet promoting energy savings through demand-side management programs.

Public information. Public information capacity needs to be built to raise awareness among consumers about the benefits of energy efficiency. Household energy survey results show that most people are at this stage unable or unwilling to invest in longer-term energy savings, or perhaps unaware of potential benefits, and low-income households do not consider it a priority (energy poverty).

FYR Macedonia

Legal and regulatory framework. FYR Macedonia has well-defined administrative responsibilities for EE. The legal basis for EE, regulations, political goals, and an energy efficiency strategy exist and an EE action plan has been drafted. Legislation facilitating the role of ESCOs is being prepared.

Supporting structures. FYR Macedonia established an energy agency in 2007, but it requires strengthening to advise Government on EE policy and provide statistical data to support policy formulation. The implementation of policies is left to understaffed ministries and, as a result, implementation is weak. Experts trained in installing EE hardware and software are scarce, and training is needed for them.

Implementation. Building codes exist but are not enforced. A new building code is being prepared in line with the requirements of the EU directive on the energy performance of buildings (EBPD, 2002/91/EC). Individual metering of heat has not yet been implemented but is a prerequisite for EE measures in district heat. So far, no comprehensive programs exist to promote EE in schools, hospitals, and other public buildings although individual donors are making efforts in this regard.

Incentives. Many energy efficiency incentives are lacking. Financial incentives to promote EE are needed. The energy utility is not yet promoting energy savings through demand-side management programs.

Public information. The government's public information capacity for EE needs strengthening.

Montenegro

Legal and regulatory framework Administrative responsibilities in Montenegro are well defined, but implementation lacks staff and funding. The legal basis for EE and related regulations exists. Policy formulation and strategy need strengthening, but an EE action plan and supporting tools exist. An energy law and a related energy policy document define the responsibilities of the Ministry of Economy with regard to EE. Legislation facilitating the role of ESCOs is being prepared. A regulatory authority and agency exist (inside the Ministry of Economy).

Supporting structures. The Ministry of Economy has established an EE Unit to promote the EE strategy and advise consumers, but due to staff shortages its ability to provide support and advice is limited. Implementation of policies is left to ministries. Creation of an energy institute to advise Government on energy policy and provide data to support policy formulation would be desirable and its functions should be combined with those of the EE Unit, possibly as an agency outside the Ministry of Economy.

Implementation. Montenegro aims to harmonise its policies, laws and standards with those of the EU. That also includes the directive on the energy performance of buildings (EBPD, 2002/91/EC). Montenegro is currently using a mixture of former Yugoslav standards from 1987 and DIN norms. Comprehensive programs promoting EE in schools, hospitals, and other public buildings do not yet exist. As in other countries, data collection is not harmonized with EUROSTAT standards.

Incentives**.** Many energy efficiency incentives are still lacking. A package of financial incentives to promote EE is being prepared. The energy utility is not yet promoting energy savings through demand-side management programs.

Public information. The Government's public information capacity for EE needs strengthening.

Serbia

Legal and regulatory framework. In Serbia administrative responsibilities are well defined and regulations for EE have been implemented. EE policy goals and a strategy exist, as do related action plans, supported by policy tools. However, there is no legal framework for ESCOs and the public procurement law does not recognize them.

Supporting structures. An energy regulatory authority and an EE implementing agency (SEEA) exist. Creation of an energy institute to advise Government on energy policy and provide data to support policy formulation is desirable and SEEA could take on these functions.

Implementation. About 40% of Serbia's 55 district heating companies are equipped with heat substations. However, consumption-based billing has yet to be introduced. Positive EE implementation aspects include availability of hardware and software components and experts to install them.

Incentives. There are no financial incentives to promote EE, but they are under preparation**.** The energy utility is not yet promoting energy savings through demand-side management programs.

Public information. Serbia has a relatively good EE public information system.

ANNEX 2: Checklist of EE Measures for Governments

Energy efficiency is a triple-win for governments, consumers, and public and private market participants, but governments must take the lead. Lessons from countries like Denmark show that progress with EE takes relatively little time if governments (i) are proactive, committed, and develop the legal and institutional basis; (ii) allow energy tariffs to reflect costs; (iii) foster financing mechanisms and provide additional economic incentives; (iv) set and enforce EE codes and standards for homes, equipment, and vehicles; and (v) demonstrate the EE agenda in the public sector and within civil society. The principal elements of a comprehensive EE approach are summarized in the box below.

An energy efficiency checklist for governments

A. Legislation and strategy

Energy law

Energy efficiency law

Energy strategy

Energy efficiency strategy

Law on homeowners' associations

Other enabling legislation

B. Institutional

Energy efficiency agency

Independent energy regulatory agency

C. Energy prices

Relative energy prices right

Absolute energy prices that reflect costs

D. Financing mechanisms

Energy efficiency fund

Commercial bank lending

Utility demand-side management

Energy services companies

E. Public sector as champion

Public buildings program

Energy poverty reduction program

Information campaigns

National spatial plan with a focus on energy efficiency

Urban development plans with a focus on energy efficiency

F. Codes and standards

Buildings

Building codes

Effective enforcement (for example, usage licenses)

Appliance standards

Lighting standards

Industry

Voluntary agreements

Mandatory cogeneration potential review

Transport

Vehicle fuel efficiency standards

Periodic vehicle inspections

Fuel taxes

Labels

Cars

Appliances

Homes

G. Economic incentives

Tax reductions

Vehicle fuel taxes

Interest rate subsidies

Investment grants

Tradable permits

H. Civic

Professional organizations

Environmental nongovernmental organizations

"Soft infrastructure" (energy efficiency brainpower)

ANNEX 3: Cogeneration Potential in the Western Balkans[39]

Study Approach. The study focused on Western Balkan cities with district heating systems to identify cogeneration opportunities. Potential new district heating systems were not analyzed, except for the one in Pljevlja, Montenegro,[40] industrial cogeneration projects were not considered. New district heating systems are unlikely to be competitive urban heating options in areas that are already well supplied by high-capacity electricity or gas distribution networks and where residential and commercial consumers could opt for modern small- to medium-scale heat pumps or co-generation solutions. However, most urban centers in the region with significant building density already have DH systems, so this issue did not arise.

Threshold. To evaluate the competitiveness of potential alternative heat sources for each DH system, a clear threshold was established, namely, that the *procurement cost of district heat should be below the cost of heat provided by a modern electrical heat pump*. This threshold is reached when: (i) a power plant produces high-value peak electricity and heat is a low-value by-product; (ii) a power plant is a highly efficient combined cycle power plant where a relatively small volume of heat (in comparison with power generation capacity) is available at low cost; (iii) a stream of low-temperature waste heat is available from condensing power plants to provide heat inputs for large-scale heat pumps;[41] and (iv) biomass is available.[42]

Standard solutions. Next, technical solutions were standardized to limit investment costs, and it was assumed that district heating systems would be optimized through advanced computerized management and use of heat storage to minimize the required heat generation capacity and reduce investment requirements.

Additional heat utilization options. Finally, heat sources were optimized by introducing heat utilization options beyond the heating season, including use of heat for pre-drying lignite and biomass, providing domestic hot water services, and selling heat for industrial or agricultural applications. Using the advantages of heat storage and low-cost heat, heat production facilities can supply heat for additional economical uses, further increasing plant utilization rates and overall efficiency, and decreasing unit costs.

Standardized models. A review of candidate projects shows that most can be grouped into one of four standardized models:

1. Waste heat utilization, mostly from large lignite-fired condensing power plants supplying hot water to district heating systems using heat pumps and gas engines;

[39] Study prepared by Alexandar Kovacevic (lead author) and Stratos Tavoulareas.

[40] The exception is the city of Pljevlja, Montenegro, where a new district heating system is envisaged and investors in the lignite-fired power plant have agreed to invest in the proposed district heating scheme.

[41] Economies of scale and suitable heat source temperature make these heat pumps competitive with decentralized air source heat pump options available in urban areas.

[42] Taking into account the relatively higher investment costs of these plants, investment costs were moderated by assuming standardization, simplification, and modular prefabricated design.

2. Gas turbine-based cogeneration plants with waste heat utilization and potentially steam extraction as well, depending on the site-specific needs and requirements. Most of these plants are envisioned to be open cycle gas turbines;
3. Gas engine cogeneration plants; and
4. Biomass cogeneration plants

A matrix summarizing the proposed standardized models is shown in Figure A1.

Figure A1: Standardized Cogeneration Plant Models[43]

Model	**Rationale**	**Role of heat storage**
Waste heat utilization in a thermal power plant using large scale heat pumps powered by gas engines	Stream of low temperature waste heat provides high quality energy input for industrial scale heat pump. Quality of heat input and of the use of large heat pumps would enhance competitiveness of this option against individual heat pumps used with outside air	Heat source is base load heat generator. Heat storage should be used to cover demand peaks and add to security of supply.
Gas turbine-based CHP: - Open Cycle Gas Turbine (OCGT) plant	Peak electricity production at larger scale (and higher sales prices) with low cap-ex plant provide low cost heat	Heat storage to be filled during peak electricity production periods and provide heat to district heating as required.
- Combined Cycle Gas Turbine (CCGT) plant	High efficiency electricity generation provides opportunity for low-cost waste heat production at limited scale.	Heat storage only used to de-couple electricity generation from heat demand and cover heat demand peaks using continuous heat supply from CCGT plant.
Gas engine based CHP	Variable electricity production at local scale (and higher sales prices) with low cap-ex plant provide low cost heat.	Heat storage to be filled during peak electricity production periods and provide heat to district heating as required.
Biomass CHP	Sends electricity directly to distribution grid, avoiding most of the transmission network losses and costs. Uses low-cost biomass fuel[44]. Standardized units decrease unit costs.	Heat storage should be used to cover peak demand and add to security of supply.

A few projects fail to fit into one of the above models, for example Novi Sad and Zrenjanin, but even those projects would employ a combination of above options.

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[43] All model plants utilize heat storage to decouple electricity generation from heat demand, although the exact role of heat storage differs by model as discussed in the matrix.

[44] Large-scale use of wood biomass for energy production would require intervention in fuel wood use, forest management, re-forestation, industrial wood use, and waste wood management. Developing biomass-based CHPs should be considered in the context of local development, since it enhances employment, environmental remediation, and efficient residential fuel wood use.

Regional standardization is desirable. Each project has site-specific characteristics and requirements, but many projects have common aspects so the region would benefit from standardized designs for the following reasons:

- Potentially lower unit costs
- Faster project implementation
- Easier access to (and lower cost of) spare parts
- Lower staff training and maintenance costs
- Technical community familiarity with specific plant designs.

Most projects identified by this report assume a standardized design configuration, often comprising multiple units of the standard arrangement, depending on site requirements. This should be considered the base case, since each plant requires a detailed feasibility study to define optimum configuration.

The four standardized cogeneration designs are described briefly below, followed by key findings.

Cogeneration Models

1. Waste heat from thermal power plants utilizing heat pumps and gas engines

Several mostly lignite-fired power plants in the region are within 30 km of large cities, providing an opportunity to utilize power plant waste heat for district heating. Waste heat could be recovered from a plant condenser or flue gas system by adding a heat exchanger; a heat pump could capture condenser heat, increase the water temperature to the desired level, for example from 25^{o}C to 70-80^{o}C, then the heated water can be sent through an insulated pipeline to the district heating system.

The heat pump compressor could be driven by a natural gas engine or electric power. The gas engine would include a heat recovery system to supplement heat generation, increase output temperature to about 120-130^{o}C, and improve overall system efficiency.

A more common alternative to waste heat utilization is steam extraction to provide the required heat, but it reduces power plant efficiency and power output during peak electricity demand periods, and interferes with plant operation. As such, it is an alternative to consider *only* if condenser or flue gas heat recovery is impractical. Waste heat recovery can be applied to most existing and new power plants.

The proposed standardized design consists of:

- 3 gas engines producing:
    - 3X6.9 MWe mechanical energy to drive the heat pump
    - 3X6.9 MWt through a heat recovery system included with the engines; and
- 3 x 24.5 MWt produced by the heat pump.

The above design contains two overlapping co-generation arrangements: (i) waste heat from the power plant is used to provide heat input into a gas engine powered heat pump that increases water temperature; and (ii) heat from the gas engine is utilized to boost the temperature of water delivered to the district heating system. Since both existing and new power plants can be designed to use a significant volume of biomass for co-firing with lignite, a portion of the waste heat generated (5-30 percent depending on the amount of biomass used) could be attributed to biomass.

CFB and Biomass. All lignite-fired boilers in the region are of the pulverized coal type with a fuel efficiency of power generation of 25-30 percent (HHV[45] net). To comply with the EU's Large Combustion Plant Directive by the end of 2017, these plants must be retrofitted with Flue Gas Desulfurization (FGD) systems or be replaced with state-of-the-art power plants. New plants are likely to be of the pulverized coal or Circulating Fluidized Bed (CFB) boiler type; both have much higher efficiency than existing plants, typically around 35-38 percent (HHV net). The CFB option has some inherent advantages: it is more suitable for using Balkan lignite; can burn a variety of fuels; and accommodate co-firing with biomass more easily than pulverized coal plants.

During the months that space heating is not required, waste heat can be used to dry biomass and lignite. This reduces their moisture content from 40-50 percent to 12-20 percent, increases their heating value as a fuel per unit of weight, reduces transport weight, and makes them less expensive to store. Site-specific considerations will determine the feasibility and competitiveness of this option. If biomass is plentiful and relatively close to an existing power plant, reducing transport costs, it is an attractive option.

This study concludes that heat storage can help to significantly reduce peak demand for gas throughout the region, and therefore recommends that heat storage should be combined with all CHP plants, standardized or not. Heat storage will reduce peak demand, improve utilization of existing assets, and reduce the need for investments in new capacity. However, heat storage is typically not part of heat generation facilities but rather of the heat distribution system; it is therefore not included in the standardized designs themselves.

2. Gas turbine with heat recovery and heat storage

Gas turbine-based power plants with heat recovery can be used where natural gas is available and their design adapts well to site-specific needs for heat and electricity demand. The Combined Cycle Gas Turbine (CCGT) is the most widely used arrangement and could be the best option for many sites. However, since the heating season is relatively short, an Open Cycle Gas Turbine (OCGT) plant was also evaluated.[46] For this reason, a standardized design based on OCGT was developed utilizing two aero-derivative gas turbines and heat/steam recovery generators capable of delivering 84 MWe and 106MWt at +15^{o}C ambient temperature. The turbines can increase electricity output at lower outside temperatures and with water injection to 100 MWe. Nominal electricity production efficiency alone is up to 42 percent.

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[45] HHV stands for Higher Heating Value, which is equivalent to the total amount of heat (energy) released when a fuel is burned completely and the products are returned to their natural room-temperature states.

[46] For a description of OCGT versus CCGT plant see Attachment 2 of this Annex.

In addition to the above standard OCGT configuration**,** the following is also assumed:

- Space to add a third gas turbine in the future
- A back-up generator
- Heat storage units (2 x 10,000 tons)
- One heat-only-boiler for back-up or peak supply

If electricity demand is higher, a larger CCGT plant may be more suitable. In that case, a standard 420 MWe CCGT power plant is proposed that would provide up to 100 MWt base heat load suitable for district heating applications, at relatively low temperatures. Envisioned as an intermediate load power plant, this arrangement would require heat storage to cope with heat demand peaks and provide heating when the plant is not operating.

The OCGT configuration is expected to be most competitive in many cases, but CCGT plants may be selected depending on site-specific considerations, notably:

- Prices of electricity and heat
- Price of natural gas
- Need for bulk base-load electricity
- Heat demand amount and profile
- Prices offered for OCGT vs. CCGT plants by equipment suppliers, and plant efficiencies.

3. CHP gas engines

A standardized CHP arrangement with six gas engines is proposed, capable of producing 16.6 MWe and 17 MWt. All engines are equipped with heat recovery systems producing district heating water. Engines are clustered in threes in one machine room with one pack of auxiliaries. Much smaller engines are envisaged for the mechanical drives for heat pumps, but would be clustered in the same way. CHP gas engines are suitable for urban areas where variable load is expected and where transport and site constraints (including particularly low pressure in available gas network) allow installation of these engines.

4. Biomass CHP

A standardized biomass cogeneration plant is proposed, capable of producing 2.7 MWe and 11 MWt. The plant utilizes an inclined bottom fluidized bed boiler that can burn a variety of biomass fuels with variable moisture content. Most biomass will come from forests, including fuel wood, wood residuals, waste wood, and orchard wood, among others; some biomass fuels may come from construction waste wood, agricultural biomass, and so forth. Biomass can also be co-fired with coal in large thermal power plants.

Key Findings

Potential. Western Balkans' potential for cogeneration is substantial; 66 projects were identified, representing an output of approximately 3,300 MWe and 5,200 MWt (see Attachment 1 of this Annex). The district heating capacity of the entire region is 8,000 MWt, but improving heat distribution management and end-use efficiency, and using heat storage would reduce heat generation capacity needs.

Priorities. A priority code was assigned to projects. Priority 1 represent the highest readiness and urgency (21 projects); priority 2 is medium (20 projects); and priority 3 is the lowest (19 projects). In addition, five projects were identified separately as pilot projects, while one *component* of a priority 1 project (Novi Sad) was designated as a pilot. However, priority ratings have the following caveats:

- Priorities are based on the understanding of the consultants, since not all plant stakeholders could be consulted, some priorities may need to be revised. Also, no site-specific economic analyses were carried out, so some priority 2 projects could change to priority 1 or priority 3.
- Priority 3 projects were rated 3 because near-term implementation is unlikely.for several reasons. First, newly established district heating systems are unlikely to change heat supply arrangements in the next few years. Second, the future of waste heat project proposals that rely on constructing new lignite-fired power plants is uncertain and unlikely to be implemented in the medium term.
- All projects identified require detailed feasibility studies as the next step, which may change the proposed configuration and assigned priorities. Some projects have carried out feasibility or pre-feasibility studies, but these must now be updated to reflect the most recent requirements.
- It is recommended that the six projects identified as "pilot projects", are implemented, first to address potential barriers associated with implementing these types of projects. More information on some Priority 1 and Pilot projects is provided below.

1. Belgrade District Heating (Serbia)

The Belgrade district heating system has a peak heat demand of 3,000 MWt; supply is generated by many heat-only boilers, most burn natural gas but some burn coal and/or heavy fuel oil. Peak demand creates a substantial spike in natural gas demand, increasing gas prices and straining natural gas infrastructure. Over the last 20 years, most of the numerous studies on how to optimize the district heating network have focused on a single aspect; these studies now need to be updated and integrated.

Thermal Power Plant (TPP) Obrenovac A. One option with potential to decrease gas consumption and Serbia's gas demand profile is waste heat utilization from TPP Obrenovac A, located 29 km from Belgrade. The potential to utilize heat pumps (standardized design #1) should be evaluated in detail. The preliminary design proposal includes the following components:

- Six standardized components [6 X (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))] capable of delivering 124 MWm energy (to drive the heat pump compressors) and 690 MWt heat. Proposed elements of the system include installation of two gas engine plants (each providing 100 MWe and 100 MWt), one in New Belgrade and one in downtown old Belgrade.[47]

- Insulated pipe to transfer waste heat from Obrenovac A to Belgrade. This pipeline could be constructed along an existing pipeline route to avoid issues related to right-of-way and access.
- Heat storage tanks could be located throughout the city to optimize heat supply.

The estimated project investment cost is US$140 million, excluding hot water pipeline and heat storage system. About 30 km of gas pipeline would be required along the same route to deliver gas from the existing high-pressure line to the Obrenovac A site. In addition to powering heat pumps, gas could be used in existing boilers as a start-up and support fuel and for auxiliary systems and mechanical drives. Project benefits include reduced air pollution from the power plant and increased net electricity output.

Issues and Next Steps: Primary issues include gaining EPS approval (the Serbia power company) for installing required facilities at Obrenovac A; and the potentially immanent retirement or replacement of Obrenovac A units 1 and 2 (210 MW each), operating since 1976/77 and near the end of their useful lifespans. However, since units 3-6 are likely to operate for another 15-20 years, they could supply required heating. If new units replace existing units 1 and 2, the new design could accommodate waste heat recovery, biomass co-firing, and biomass drying, to exploit substantial biomass nearby. The next step would be a detailed feasibility study to identify the optimum design among available options.

The District Heating Company of Belgrade is eager to proceed with such a project. Previous feasibility studies have established the need for heat supply system improvements, and District Heating Company management appears committed to implementation.

Projects similar to the Belgrade project. The arrangement outlined for Belgrade could be developed to provide heat to the following cities:

- Obrenovac (Serbia). This could form part of a larger Belgrade project, using the same thermal power plant for waste heat
- Lazarevac (Serbia)
- Sabac (Serbia)
- Pozarevac (Serbia)
- Kakanj (Bosnia & Herzegovina)
- Tuzla (Bosnia & Herzegovina)[48]
- Pristina (Kosovo)

[47] Several feasibility studies that have focused on CCGT systems in Belgrade have not considered that the natural gas pipelines in Belgrade have low pressure (6 bar); these studies should consider the option of engine-based plants. Taking into account that electricity demand in Belgrade is variable (peak of about 1,700 MW without proper DH services) and that sizeable heat storage capacity needs to be built, gas engine-based plants should be evaluated.

[48] Eventually, if TPP Stanari is built to replace TPP Ugljevik, it could supply heat to the City of Doboj, (TPP Ugljevik uses very high sulfur lignite, which is too expensive and cannot meet environmental requirements with present-day technologies).

- Pljevlja (Montenegro)

The city of **Obrenovac** heat supply could be a pilot demonstration project for this model solution, since all components except the gas engine/heat pump are in place, and the City administration and the district heating company are eager to participate.

The heat supply system intended for **Lazarevac** could be used during the off-peak heating season to provide heat to dry lignite at two or three drying facilities along the pipeline toward the city. (If necessary, combined with partial heat output from Obrenovac and Belgrade systems.)

The same concept could be used in the Obrenovac B power plant to provide heating to the city of **Sabac,** a center for food processing and chemical industries that requires heat provision throughout the year. Some heat should be provided during the off-peak season to dry biomass near Obrenovac B. It is recommended that Obrenovac B be re-powered with CFB boilers with biomass co-firing capability.

The arrangement in **Pozarevac** is similar to that of Obrenovac. A connection to the district heating infrastructure from the Kostolac A thermal power plant is in place and both city authorities and the district heating company are keen to proceed with this improvement.

2. Prishtina (Kosovo)

Since new lignite-fired power plants are planned in Kosovo, the recommendation is to consider using their waste heat to supply the district heating system of Prishtina, similar to the Belgrade concept described above. Alternatively, district heating could be provided from Kosovo B after rehabilitation.

A 2005 feasibility study was prepared on connecting the Prishtina DH system to Kosovo B.[49] The design would require a heat transfer station at the power plant and in Prishtina, and about 2 x 10.5 km of pre-insulated 450 mm diameter heat transmission pipeline, to meet base load heat demand and use existing heavy fuel oil-fired boilers for peaking. Investment costs are estimated at €25 million. If heat pumps are used, Kosovo B units electric power output might not be derated while installation of heat storage could improve efficiency and reduce the need for HFO-fired boilers for covering peak heat demand.

The proposed investment would lower variable heating costs, improve service levels to a 24-hour heat supply, save about 10,000 tons of heavy fuel oil per year, dramatically decrease local pollution levels, and would likely reduce supplementary heating demand on the electric power network by about 10 percent per year—10 GWh/year.

The following is recommended for further consideration:

[49] IBE Consulting Engineers, Slovenia

- Consider standardized CFB plants for repowering Kosovo B and for the New Kosovo Power Plant. A standardized size could be 340 MW for each unit.[50]
- Include waste heat recovery in the design (using heat pumps)
- Consider biomass and lignite drying using waste heat
- Consider using waste heat can for greenhouses and efficient water pumping systems

Issues and Next Steps. Main issues to be resolved include: (i) low collection rates from district heating customers; and (ii) low tariffs for district heating and electricity. The next step should be to develop a single comprehensive investment plan, including an evaluation of the EE and cogeneration options, by updating Kosovo B and NKPP power plant feasibility studies, and Kosovo's proposed gas distribution system. Strategic private investors who finance the NKPP facilities may be interested in Kosovo B, and the interested might be further stimulated if Kosovo B and the new plants have standardized boilers, turbine islands, and potential to co-fire biomass and pre-dry lignite.

3. Kragujevac (Serbia)

Kragujevac, a large industrial city, has an installed capacity of 315 MWt for district heating, 243 MWt fired by coal and the remaining 72 MWt by combined natural gas and heavy fuel oil (HFO).

Developing viable CHP facilities is desirable because coal transported from Bosnia and Montenegro is very expensive and causes serious local pollution. In 2008, HFO was the least expensive fuel; however, historically FBO is expensive, generates heavy pollution, and future availability is uncertain. Therefore, natural gas is the only viable fuel for Kragujevac, but gas should be utilized in efficient facilities, and cogeneration is the most suitable option.

Open cycle gas turbines with heat recovery providing 168 MWe and 168MWt could be considered for a new plant, to supplement several small recently built boilers, which should be adequate city heating needs.

Issues and Next Steps. The main issues to be resolved include: (i) low collection rates from district heating customers; and (ii) ongoing restructuring of the district heating company. The next step is a detailed feasibility study, which the District Heating Company is already considering.

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[50] Studies are available on development of natural gas infrastructure in Kosovo, further development of lignite resources and construction of lignite and hydro power plants, including environmental impact assessments, in addition to the district heating study mentioned above. The proposed hydro power plant Zhur with a capacity of about 300 MWe could be upgraded to 340 MWe with a gas-fired water pumping facility, which would make the plant a suitable strategic reserve for many thermal units of similar size. Kosovo could benefit through decreased investment costs and higher unit efficiency from using units standardized at the regional level and directly replacing boilers at Kosovo B. If district heating uses heat pumps, the same heating facilities could be used for pre-drying lignite and biomass during the off season; heat pumps would enhance cooling and decrease cooling water volumes required for efficient operation of power plants, and improve overall fuel efficiency. Therefore, it would be beneficial to consolidate available feasibility and conceptual studies into one comprehensive investment plan to exploit synergies.

4. Novi Sad (Serbia)

Novi Sad has four heat-only-boiler plants supplying its district heating system, plus one cogeneration facility. Novi Sad CHP features three gas-/HFO-fired steam boilers and two steam turbines with steam extraction for district heating; waste heat remains unutilized (exhaust gas, cooling water). The existing CHP plant has low efficiency, flexibility, and utilization rates; during rare colder periods it is base heat source, although the remaining life of the main machinery is considerable. Two of the four district heating system segments are connected to this conventional gas/HFO-fired CHP; the third one was to be connected in summer 2009. Substantial biomass resources exist in the region from forests, agriculture, and industrial waste (pulp and paper, furniture, etc.).

The proposed system (two cogeneration plants placed side by side) involves:

- Replace existing three boilers with CFBs using the same foundations and auxiliaries, biomass-fired (3 x 80 MWe) with waste heat utilization [3 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))]
- Gas engine CHP plant [6 x (16.6 MWe + 17 MWt)][51]
- Heat utilization from circulating pumps and natural gas compressors

Vojvodina provincial authorities are aware of this opportunity and keen exploit wood biomass to contribute to energy security, employment, transport, and land and water resources. Private investors are interested in building this CHP facility.

Issues and Next Steps. EPS owns and operates the heat and power generation facilities and sells heat to the District Heating Company; any facilities modification requires agreement with both entities and local government. Recently, EPS and the City of Novi Sad formed a joint venture to pursue investment in a new CHP plant, which is encouraging.[52]

Reliable biomass supply at reasonable predictable prices is another issue to be addressed. The region has ample biomass resources, but a detailed site-specific assessment is needed as part of a feasibility study, which is the recommended next step.

A similar, but smaller, opportunity to apply the above concept is in the city of Zrenjanin.

5. Skopje (FYR Macedonia)

Skopje is building a 230 MWe CHP plant, expected to commence operations in 2011, and is planning two more. The first plant is implemented by the District Heating Company (DHC) and private investors through a joint venture that is also planning another CHP plant (160-170

[51] Existing site, grid connection, cooling water and connection to gas network are available.

[52] A narrow selection of CCGT gas fired arrangements was considered in the feasibility studies, while the findings of various studies on biomass availability have not been taken into consideration. At the same time, large CCGT plant is not sufficiently flexible to provide electricity to variable demand in Novi Sad at a low cost. Similarly, the impact of simple heat storage on sizing and utilization of the proposed CHPs has not been considered. Thus there is a clear need to consolidate available documentation and studies into comprehensive investment plan.

MWe). Both plants will utilize the CCGT configuration, with a shorter payback period than open cycle plants, according to Skopje DHC. Nevertheless, the DHC is interested in the heat storage concept and considering open cycle plant options. The third CHP plant (300 MWe and 150 MWt) is planned by ELEM, the electric company that provides heat to part of Skopje.

Skopje heat demand is growing rapidly and electricity supply is constrained. Significant improvements resulted from repairing the heat distribution network and implementing demand-side management measures, and all users were expected to install meters soon. Additional investments are needed in substations and optimization of the heat distribution network, but Skopje district heating system is in much better condition than most other district heating systems in the region.

Issues and Next Steps. Issues to be considered include: (i) underpriced electricity (€ 5.3 cents/kWh) is the main competitor to district heating; to rationalize investment decisions, electricity and heat prices must be adjusted; (ii) most ongoing initiatives are private sector with participation from local electricity and district heating companies; public sector financing or support may be needed, depending on proposed project progress, especially for the ELEM CHP project.

6. Sarajevo (Bosnia Herzegovina)

The Sarajevo district heating company serves about 15,000 apartments, mainly in the city center; the rest of the city on surrounding mountain slopes uses direct natural gas heating. Peak district heating demand is 350 MWt; installed capacity is 500 MWt. About 135 small heat-only boilers supply heat to the city, most are fired by natural gas. Before the war, the ratio of peak-to-base gas demand was 6, since then, the ratio has increased to 33. During the war, several major gas-consuming industries collapsed, reducing industrial demand, but residential demand continues to rise.

After the war, the heat distribution system was reconstructed but not interconnected, and future interconnection is unlikely unless the system is completely changed so that heat is supplied from one or two major sources. Following are several alternatives considered.

- Heat supply from the Kakanj thermal power plant (44 km from Sarajevo). The most recent feasibility study considered building a new coal-fired unit (Kakanj unit #8), which would also provide heat to Sarajevo. However, plans are preliminary and uncertain due in part to lack of adequate local coal supply.

- A waste-to-energy facility. Sarajevo generates about 600 tons of waste per day and a 20 MWe facility is being considered in ongoing discussions.

- The district heating company expressed interest in a CHP plant. A pilot plant has been considered at Dobriniya 3: 5 MWe and 5 MWt, but the project is still in the early planning stages.

- A CHP plant outside Sarajevo has been considered (50 MWe and 50 MWt), but feasibility studies have yet to be undertaken.

Issues and Next Steps. Very low electricity tariffs offer customers a cheap alternative to district heating because most BiH electricity is generated from hydro plants, which have very low production costs, and lignite-fired plants that use subsidized lignite. Gas tariffs are very high.

A comprehensive study is needed to evaluate the CHP potential for the Sarajevo–Kakanj–Zenica area. Options include: (i) a 420 MWe CCGT plant at Rajlovac; (ii) a 84 MWe GT plant at an abandoned industrial site in the City of Sarajevo; (iii) a 84 MWe GT plant in the City of Zenica; (iv) conversion of one unit at TPP Kakanj to CFB with waste heat utilization (option (i) above); (v) integration of heat storage facilities in the Sarajevo DH system; and (vi) a regional municipal waste incineration plant at the site of TPP Kakanj and utilization of heat produced by that plant.

7. Biomass projects

Attachment 1 includes numerous smaller biomass projects for medium- and long- term implementation. If some were implemented as successful pilot projects, a broader deployment of biomass would be possible in the region, and would address key issues associated with long-term biomass supply and pricing.

Projects selected should be used as best practice examples, which would empower municipal authorities to implement similar projects, educate officials and citizens about the potential of biomass cogeneration, and facilitate adoption of standardized solutions. Cities were selected to facilitate maximum impact (Figure 2).

In parallel with these projects, primary biomass issues should be addressed: (i) seasonal fluctuation in wood prices from expensive in winter to cheap in summer; and (ii) lack of a regulatory framework to ensure proper forest management.

Seasonal wood price fluctuations could be reduced by wood storage and long-term wood supply contracts between suppliers and users. Wood supply will improve if efficient residential wood stoves are introduced, comprehensive forest management plans are developed, and appropriate regulations established.

Biomass projects could be linked to a comprehensive program of efficient fuel-wood use by residential consumers. Introducing efficient wood-burning stoves to replace the low-efficiency models in common use across the Balkans is one of most important EE measures for the region, and would improve the environment, human health, and boost anti-poverty efforts. Also, some less desirable types of fuel wood now used for residential heating would become available for centralized CHP applications.[53]

Ideally, developing local biomass CHPs should be coordinated with replacement of low-efficiency residential stoves. However, coordination is not essential where forest cover is over 40

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[53] Including lower-quality wood, wood from irregular forests, orchard waste, and wood residuals. Several studies undertaken for local communities (e.g., Nis, Uzice, and the Zlatibor area) provide further evidence that halving fuel wood use through higher efficiency residential stoves would provide a sufficient volume of wood biomass for potential local CHPs.

percent of the area and wood resources are significant. Market penetration of EE residential stoves will affect fuel wood price and improve CHP projects economics, so implementing cogeneration projects could motivate local administrations to improve EE among the poorest households.

Next Steps. Comprehensive feasibility studies, including biomass supply assessments, are needed. Biomass use in residential wood stoves should be considered along with potential for efficiency improvements and development of local forest resources.

8. Pilot projects. Six projects from those described above are recommended as pilot projects because of their demonstration value, described in Figure A2.

Figure A2: Proposed Pilot Projects

Project	Type	Rationale
Obrenovac (Serbia): 20.7 MWe + 114.9 MWth	Utilization of waste heat through heat pumps and gas engines	This could be the first phase of a larger Belgrade project. Existing DH systems are already connected to Obrenovac A1 and A2 via conventional steam extraction. The project would demonstrate effectiveness of waste heat utilization via heat pumps on a smaller scale than entire Belgrade project. Obrenovac is the most advanced and largest lignite complex in the region. Therefore, demonstrating this model in Obrenovac will be relevant for all lignite fired power plant operators in the region.
Zvornik (B-H) : 5.4 MWe + 22 MWth	Biomass	Small project. Can serve as an example for part of Bosnia Herzegovina and all of Serbia. Small-scale standardized biomass projects are mainly community–based, require local commitment, and facilitate improved fuel wood use. Therefore, pilot projects should address communities with similar cultural background.
Lukavac (B-H): 5.4 MWe + 22 MWth	Biomass	Small project. Can be an example for part of Bosnia Herzegovina.
Gradiska (B-H): 2.7 MWe + 11 MWth	Biomass	Small project. Can be an example for part of Bosnia Herzegovina.
Bor (Serbia): 27 MWe + 110 MWth	Biomass	The existing coal fired heat-only-boiler plant adds to pollution in a city that is already heavily polluted by industrial sources. Coal supply is expensive and creates an unsustainable burden on the local budget. In contrast, use of wood biomass is cheaper and could create jobs. Project would be a good example for Northern and Eastern Serbia – mountainous regions with good forest cover.
Novi Sad (Serbia)	CHP gas engines	The Novi Sad CHP plant needs to be repowered to become a biomass-fired plant. During the repowering process, each boiler will be closed for a while. The city DH system would require replacement heat from the proposed 100Mwe + 100MWt gas engine-based plant, which would also provide variable-load electricity to the local power grid. The project would demonstrate the effectiveness of heat storage. Low-pressure gas supply and a connection to the medium voltage electricity grid are available at the site.Project would support Vojvodina efforts to pursue EE development options.

Supporting Actions to be Taken

Several actions must be taken to ensure sustainable use of cogeneration facilities of all types. The most important actions are as follows:

- *Set appropriate tariffs for heating, natural gas and electricity*. Very often, low electricity and gas tariffs undermine the use of district heating. Appropriate pricing is needed for all forms of energy and energy services, especially for peak demand to rationalize energy use promote sound investment decisions. Appropriate tariffs are critical for natural gas and use of natural gas infrastructure for district heating systems. DH companies should be aware of the full costs of natural gas supply, including seasonal fluctuations, take-or pay clauses, and off-season idled infrastructure capacity.

- *Improve end-use EE and heat transmission and distribution network.* Across the region, most district heating systems have made some improvements but more needs to be done to better manage heat distribution, lower the temperature of the distribution system, and introduce heat storage.

- *Introduce regulation to support cogeneration.* Western Balkan countries should align their regulations with the EU Cogeneration Directive to encourage EE cogeneration. Given the strong economics of cogeneration, countries might set medium-term targets to phase out heat-only boilers and replace them with cogeneration facilities.

- *Replace inefficient wood burning stoves.* Replacement of very low efficiency (<20 percent) fuel wood burning stoves by efficient (>50 percent) stoves throughout the region will increase wood available for biomass CHPs, moderate fuel wood demand fluctuations that affect wood prices, and strengthen the economic rationale for improved forest management and further reforestation.

Implementation of the pilot projects should start in parallel with these actions. Preparing feasibility studies, concept documents, and so forth for pilot projects noted in this report is a first practical step. These studies will involve local stakeholders and create a knowledge base that can be disseminated in similar projects. This process, and project implementation, will also provide impetus to address issues listed above.

Attachment 1: CHP Projects in Western Balkans

Project Name	Priority	Electric Output (MW)	Thermal Output (MWth)	Project Description	Preliminary Project Configuration	Required Investment ($million)	Willingness and ability to carry out project	Project Readiness	Issues	Next Steps	Notes
BOSNIA-HERZEGOVINA											
Sarajevo CHP	1	168	168	Open cycle gas turbine CHP plus heat utilization from Rajlovac CCGT	1 x (2 x GT+ HRSG + heat storage) plus CCGT	165	High	High	0	Update Feasibility Studies already completed; add open cycle comcept. May consider doing a pilot first	Heat distribution network unlikely to be interconnected unless one source of heat starts providing the heat for the whole city
Banja Luka CHO	2	168	168	Open cycle gas turbine	3 x (2 x GT+ HRSG + heat storage)	165	Medium	Medium	0		
TPP / CHP Stanari	3	20.7	114.9	Waste heat utilization w/ heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to waste heat; Power co needs to agree and cooperate	Detailed Feasibility Study	Project going to replace buring coal in heat-only-boiler in Doboj that currently supplies DH system
Tuzla heating plant	1	20.7	114.9	Waste heat utilization w/ heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	Medium	Medium	Access to waste heat; Power co needs to agree and cooperate	Detailed Feasibility Study	Replace steam extraction from the power generation cycle. Save of equivalent volume of lignite.
Zenica heating plant	2	20.7	114.9	Waste heat utilization w/ heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to waste heat; Power co needs to agree and cooperate	Detailed Feasibility Study	Zenica DH plant currently burns 900000 tons of lignite per year in low quality boiler
Kakanj heating plant	2	20.7	114.9	Waste heat utilization w/ heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	Medium	Medium	Access to waste heat; Power co needs to agree and cooperate	Detailed Feasibility Study	Replace steam extraction from the power generation cycle. Save of equivalent volume of lignite.
Travnik CHP	2	2.7	11	Biopower 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Prijedor CHP	2	8.1	33	Biopower 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Gradiska CHP	Pilot	2.7	11	Biopower 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Konjic CHP	2	5.4	22	Biopower 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Lukavac CHP	Pilot	5.4	22	Biopower 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Low	Low	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Pale CHP	2	2.7	11	Biopower 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Istocno Sarajevo CHP	2	5.4	22	Biopower 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Medium	Medium	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
Zvornik CHP	Pilot	5.4	22	Biopower 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	High	High	Forest management plan needs to be developed and implemented	Detailed Feasibility Study	
KOSOVO											
Pristina heating plant	1	20.7	114.9	Waste heat utilization w/ heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to waste heat needs to be assured	Detailed Feasibility Study	Currently burns heavy fuel oil in the heat-only-boiler; significant reduction in emissions/local pollution
MACEDONIA											
Skopje CHP	1	336	336	Open cycle gas turbine	4 x (2 x GT+ HRSG + heat storage)	306	High	High	0	Both ELEM and DH Co are planning CHP (CCGT) Projects privately funded; monitor ELEM project to assess whether WB can support	Macedonia has made the most progress (in the region) in terms of DH DSM and DH-electricity regulations; while more needs to be done, it is in the best position to pursue CHPs
MONTENEGRO											
Pljevlja CHP	1	120	120	120MWe CFB lignite fired unit built at existing infrastructure intended for Pljevlja 2 power plant with electricity powered heat pump	1 x (3 x 24.5 MWt) heat pump + 1x120MWe CFB lignite fired unit	300	Low	Low	Requires development of DH network in City of Pljevlja. Studies available. Should be upgraded. Efficient low temperature district heating concept including sanitary hot water production could be applied.	Detailed Feasibility Study	Montenegro energy strategy envisages second unit at the Pljevlja power plant using already prepared infrastructure. Since availability of economical lignite supply is questionable, new unit to be limite to 120MWe with biomass cofiring and heat utilization. To provide heat for lignite pre-drying and biomass drying as well as industrial wood drying.

Project Name	Priority	Electric Output (MW)	Thermal Output (MWth)	Project Description	Preliminary Project Configuration	Required Investment ($million)	Willingness and ability to carry out project	Project Readiness	Issues	Next Steps	Notes
SERBIA											
Belgrade heating plant	1	124.2	689.4	Waste heat utilization w / heat pump & gas engine driving compressor and generating heat	6 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	140.3	High	High	Access to w aste heat; EPS needs to agree and cooperate	Feasibility Study; many FS have been completed but a new one is needed; Approach EPS to join project development	Pipeline right-of-w ay and land already available. Cost of pipeline is not included in investment requirement
Obranovac heating plant	Pilot	20.7	114.9	Waste heat utilization w / heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to w aste heat; EPS needs to agree and cooperate	Feasibility Study; many FS have been completed but a new one is needed; Approach EPS to join project development	This component could be part of the Blgrade Heating Plant above and the first one to be implemented. Pilot project for technology option 1. Local DH company ready to implement. Mniciapl administration open to support. EPS ready to support since development could enhance pow er generation in short run.
Lazarevac heating plant	1	20.7	114.9	Waste heat utilization w / heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to w aste heat; EPS needs to agree and cooperate	Feasibility Study; many FS have been completed but a new one is needed; Approach EPS to join project development	This component could be part of the Belgrade Heating Plant above
Belgrade CHP	2	100	100	gas engines based CHP plant	6x(16.6MWe+17MWt)	58	High	High	Appropriate pricing of peak electricity	Feasibility Study; many FS have been completed but a new one is needed; Approach EPS to join project development	This component could be part of the Blgrade Heating Plant aboveNot envisaged by DH company so far. Envisaged by electricity distributors and private investors
New Belgrade CHP	1	100	100	gas engines based CHP plant	6x(16.6MWe+17MWt)	58	High	High	Appropriate pricing of peak electricity	Feasibility Study; many FS have been completed but a new one is needed; Approach EPS to join project development	This component could be part of the Blgrade Heating Plant above
Novi Sad CHP	1	330	450	conversion of existing CHP to biomas fired w ith w aste heat utilization + gas engine CHP plant + heat utilization from mechnical drives: circulating pumps and gas compresor	3 x 80 MWe biomass boilers, 3 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt)) heating plant plus 6 x (16.6 MWe + 17 MWt) gas engine plant plus w aste heat from WBGR compressor station	310	High	High	Complex ow nership structure. EPS ow ns CHP plant and the site. DH company controlled by the City purchases heat on ocassion.	Feasibility Study. In parallel, pursue resolution of long-term ow nership issues and identify organizations w hich w ill develop the project	DH very possitive and ready to proceed. Private investor could take majority stake in the CHP plant company that could enter into longer term contract to supply heat to municipal DH company and electricity to provincial electricity distribution to cover both base and variable electricity demand in Novi Sad. Facilitates re-forestation program in Vojvodina that is of high environmental priority.
Nis CHP	3	252	252	Open cycle gas turbine	3 x (2 x GT+ HRSG + heat storage)	247	High	High	Feasibility study on-going; not clear if it includes the proposed configuration here (open cycle plant w ith HRSG+heat storage)	Approach Nis DH Co and Worley Parsons (w ho are carrying out FS) to proposed that they include open cycle plant w ith HRSG+heat storage	
Kragujevac CHP	1	168	168	Open cycle gas turbine	2 x (2 x GT+ HRSG + heat storage)	155	High	High	DH company under restructuring. No high pressure gas	Feasibility study	The project w ill replace coal-firing boilers; substantial environmental improvement
Pancevo IGCC	3	420	150	Pancevo oil refinery integrated integral gasification combine cycle	420 MWe	980	Do not know	Low	Compulsory use of heavy residuals in the refinery and timing w hen refinery should comply w ith the EURO 5 fuel standards as w ell as environmental standards	Make refinery ow ner aw are of options; consider next steps	IGCC technology still expensive. Requires considerable improvement in regulatory and governance response to adjust refinery privatization arrangements to environmental requirements during EU accession
Bor CHP	Pilot	27	110	Biopow er 3 DH CHP plant	10 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	The project w ill replace coal-firing boilers; substantial environmental improvement
Subotica CCGT	1	420	100	CCGT	CCGT 420MWe	316	Low	Low	0	Initiate discussions w ith ow ner	Proposed if electricity supply is not adequate due to lignite repow ering. Sytrong local and strategic support in place.
Krusevac CHP	2	84	84	Open cycle gas turbine	1 x (2 x GT+ HRSG + heat storage)	83	Medium	Medium	Questionable competitiveness		Potentially privately funded. Project to become attractive w hen peak pow er pricing w ill be implemented
Cacak CHP	3	13.5	55	Biopow er 3 DH CHP plant	5 x (2.7 MWe + 11 MWt)	0	Low	Low	0		Unlikely that changes w ill be implemented in the exisitng circumstances. Pilot project elsw here required to motivate.
Pozarevac heating plant	1	20.7	114.9	Waste heat utilization w / heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to w aste heat; EPS needs to agree and cooperate	Feasibility study	Replace steam extraction from the pow er generation cycle. Save of equivalent volume of lignite and enhance pow er generation
Trstenik CHP	1	16.2	66	Biopow er 3 DH CHP plant	6 x (2.7 MWe + 11 MWt)	0	Medium	Medium	DH company under restructuring.	Fesibility Study; biomass fuel logistics to be addressed	The project w ill replace HFO-firing boilers; substantial environmental improvement
Kraljevo CHP	2	13.5	55	Biopow er 3 DH CHP plant	5 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Uzice CHP	1	10.8	44	Biopow er 3 DH CHP plant	4 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	Due to geographical location one of most polluted cities in the country. Priority for comprehensive application of fuel w ood use strategy (efficient stoves + w ood biomass use in the CHP)
Sabac heating plant	2	20.7	114.9	Waste heat utilization w / heat pump & gas engine driving compressor and generating heat	1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt))	23.4	High	High	Access to w aste heat; EPS needs to agree and cooperate	Feasibility study	Could provide heat to food processing industry in Sabac enhancing local economic development.
Sr. Mitrovica CHP	1	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
0		0	0	0	0	0			0		
Pirot CHP	1	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Leskovac CHP	2	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Priboj CHP	2	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Jagodina CHP	2	10.8	44	Biopow er 3 DH CHP plant	4 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Majdanpek CHP	1	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	Currently burns coal. Significatn improvement potential
Zrenjanin CHP	2	80	114.9	conversion of existing CHP to biomas fired w ith w aste heat utilization + heat utilization from mechnical drives & circulating pumps	1 x 80 MWe biomass boilers, 1 x (3 x ((6.9 MWm + 6.9 MWt) + 24.5 MWt)) heating plant	0			0		

Project Name	Priority	Electric Output (MW)	Thermal Output (MWth)	Project Description	Preliminary Project Configuration	Required Investment ($million)	Willingness and ability to carry out project	Project Readiness	Issues	Next Steps	Notes
SERBIA											
Zajecar CHP	**1**	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	Currently burns coal. Significatn improvement potential
Valjevo CHP	**2**	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Kladovo CHP	**2**	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Loznica CHP	**3**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Ruma CHP	**3**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Vrbas CHP	**3**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Kikinda CHP	**3**	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Negotin CHP	**3**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
0		0	0	0	0	0			0		
Sombor CHP	**3**	8.1	33	Biopow er 3 DH CHP plant	3 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Novi Pazar CHP	**3**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Vranje CHP	**1**	5.4	22	Biopow er 3 DH CHP plant	2 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	Large w ood / furniture industry. Could support CHP project.
Gornji Milanovac CHP	**3**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Low	Low	0		
Nova Varos CHP	**1**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Bajina Basta CHP	**1**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	Replace coal boilers; substantial environmental improvement
Kosjeric CHP	**2**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Knjazevac CHP	**2**	2.7	111	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Batocina waste heat from compressor	**3**	0	0	0	0	0			0		
Beocin CHP	**3**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Pecinci CHP	**3**	0	3	0	DELETE???	0			0		
Prijepolje CHP	**3**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	
Grocka CHP	**3**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	Medium	Medium	0	Fesibility Study; biomass fuel logistics to be addressed	
Velika Plana	**3**	2.7	11	Biopow er 3 DH CHP plant	1 x (2.7 MWe + 11 MWt)	0	High	High	0	Fesibility Study; biomass fuel logistics to be addressed	

Attachment 2: Open Cycle and Combined Cycle Gas Turbines

Open Cycle Gas Turbine (OCGT) plant burn natural gas in the gas turbine to generate electricity - a single cycle. High temperature exhaust gas is then channeled into a heat recovery boiler to produce hot water for district heating and heat storage. It is typically a light - aero derivative - gas turbine with an electricity generation fuel efficiency of over 40 percent. It starts quickly and needs only minutes to ramp up to full load. There is sharp decline of efficiency when running at less than full load. Typically, an OCGT plant works as a system-wide peaking facility. Therefore, to use OCGT to supply district heat, heat storage is needed in the plant to capture waste heat when the turbines are running during the relatively brief peaking period and then to release heat as required to the district heating system. This is a low capital cost and technically simple solution. OCGT requires high gas pressure at intake. A number of these plants operate in Russia but without proper management and heat storage facilities.

Combined Cycle Gas Turbine (CCGT) plant burn natural gas in the gas turbine and generate electricity. The turbine is a heavy duty gas turbine with a lower efficiency (20-30 percent) then the OCGT turbine but suitable for continuous operation. The exhaust temperature of the gas is, therefore, much higher than that of an aero-derivative turbine and is able to produce steam in a separate heat recovery boiler. The steam then goes into a steam turbine where it produces additional electricity. The most modern CCGT design consists of a gas turbine, steam turbine and one generator on a single shaft, so total fuel efficiency is in the range of 56-60 percent. A relatively small volume of waste heat is available for district heating from the plant’s cooling system and exhaust, but it is base load. Therefore, use of such waste heat requires heat storage on the side of the district heating system to modulate heat delivery and meet peak demand.

ANNEX 4: Donors/IFI Programs in Energy Efficiency

Regional Programs

EBRD has established the Western Balkans Sustainable Energy Direct Financing Facility of €63 million, comprising up to €50 million in loan funds plus up to €13 million for technical assistance and incentive payments. The Facility will use debt financing for sustainable energy projects such as industrial energy efficiency and small renewable energy projects for local enterprises. Individual loans will range from €1.0 to 6.0 million, and countries included are Albania, Bosnia Herzegovina, Croatia, and FYR Macedonia, Montenegro and Serbia. EBRD also established recently a Western Balkans Sustainable Energy Credit Line Facility, a €60 million credit line to finance smaller energy efficiency and renewable energy projects for SMEs via participating banks.

GTZ is implementing an Open Regional Fund for Energy Efficiency, a €3.0 million grant for EE improvements.

KfW/EIB/EC plus private donors are each contributing €20 million to establish a new €80 million Energy Efficiency Fund using mezzanine financing and equity investing. Market research and evaluation are underway to determine Fund structure and design, which could be credit lines to banks or to ESCOs, and/or equity investments. South Eastern European countries and sectors to be covered are being selected.

UNECE is implementing the "Financing Energy Efficiency Investments for Climate Change Mitigation" project, under which a PPP investment fund called "Eastern Europe Energy Efficiency Fund" will be established. Fund capital commitments will be about €250 million. This Euro-denominated fund offers mezzanine and equity financing for EE/RE projects or companies developing, manufacturing, distributing or installing EE/RE equipment or services in target countries. The minimum investment is €10 million and the Fund will operate in twelve SEE, CEE, and EE countries, including Albania, BiH, FYR Macedonia and Serbia. An estimated is €30 million may be available for these Western Balkan countries.

Country-specific programs

Albania.

KfW has a 'Promotion of RE/EE Facility'; the total program cost is about €9.0 million, comprising €2.0 million for TA, €3.5 million for EE investments, and €3.5 million for RE investments.

Bosnia and Herzegovina. **EC** allocated €10 million in grants for energy efficiency, renewable energy, and technical assistance as part of their EU IPA Program in Bosnia.

IFC launched a program for residential sector EE improvements called 'Loans for Warmer Houses.' The first tranche of €15 million has been spent and IFC is conducting an impact assessment. Local partners were EKI Microcredit Foundation and Raiffeisen Bank.

Kosovo.

EC gave an € 2.0 million grant to Government for public sector energy efficiency improvements. The program comprises three components: EE improvements in five public buildings for €1.2 million; Energy Auditor Training for €0.5 million; and a Public Awareness Campaign for €0.3 million.

GTZ and the Association of Municipalities of Kosovo are co-financing a program of about €1.5 million for EE modernization of municipal service buildings such as schools and hospitals.

KfW is implementing a €30 million lending program in Kosovo, 'Energy efficiency measures for small enterprises and households to promote climate and environmental protection'. The credit line is offered in partnership with ProCredit Bank and Raiffeisen Bank; both are receiving technical assistance in the form of staff training to administer these loans to SMEs and households.

FYR Macedonia.

Government of Austria is executing the Energy Efficiency in Buildings Program for €2.3 million, comprising three components: "Mitigating climate change through improving EE in buildings" for €0.35 million; "Enabling the environment for introduction of EE in buildings in RoM" for €1.725 million; and "EE construction with emphasis on facade technology" for €0.222 million.

Swiss Cooperation Office has a €7.6 million grant program, "Efficient Energy Distribution," for replacing and supplying condenser batteries, installing energy meters, providing assistance for EE measures, and eliminating PCB-contaminated equipment in the ESM electricity distribution and supply company.

SIDA extended a grant of €2.0 million for an "AgroEnergy" project to promote EE and utilization of RE resources in rural FYR Macedonia.

USAID runs the Development Credit Authority Facility for EE Projects in Municipalities, a US$10 million guarantee facility; local partners are Unibanka and NLB Leasing.

World Bank is implementing the GEF Sustainable Energy Project. This US$5.5 million grant has three components: (i) providing technical assistance for market transformation; (ii) developing an ESCO to implement third party financing for EE projects; and (iii) establishing a financing facility to support EE and RE investments.

Montenegro.

GTZ is providing technical assistance to the Ministry of Economic Development's EE Unit. for €1.5 million.

KfW has an EE credit line for €3.0 million that targets SMEs.

Government of Spain granted €1.0 million for an EE retrofit Feasibility Study for the Podgorica Clinical Center.

World Bank is implementing the Montenegro Energy Efficiency (MEE) Project, with a US$9.4 million loan; the Project focuses on financing EE retrofits in public sector buildings, including heating systems, insulation, and thermostatic valves and offers technical assistance for project implementation.

Serbia.

IFC established a US$15 million credit line to finance EE improvements and small renewable energy projects; the local partner is ProCredit bank and the credit line targets SMEs. The first tranche has been disbursed and IFC is doing an impact assessment.

KfW runs the Energy Efficiency Facility, a €45 million credit line to commercial banks, for SME loans. KfW also has extended a €32 million loan to Government for District Heating Rehabilitation, both supply- and demand-side improvements.

World Bank is implementing the Serbia Energy Efficiency Project with loans totaling US$49 million to rehabilitate the heat supply system and other energy efficiency improvements in the Clinical Center of Belgrade, the Clinical Center of Nis, as well as EE improvements in public buildings, mainly schools and hospitals.

Summary Table

A summary table of the IFI/donor EE programs in the Western Balkans is attached.

		An Overview of EE programs in the Western Balkan countries								
				Mln	**Mln**				**Target**	
Country	**Project name**	**IFI/Donor**	**Instrument**	**EUR**	**USD**	**EE**	**RE**	**TA**	**Sector**	**Comments**
Regional	W. Balkans Sustainable Direct Financing Facility	EBRD	loans	61.0		X	X	X	Industry, small RE	budget EUR 50 mln for loans, 11 mln for technical funds
Regional	W. Balkans Sustainable Energy Credit Line Facility	EBRD	credit line	50.0		X	X		SMEs	Participating banks
Regional	Energy Efficiency Fund	EIB	mezzanine & equity	80.0						EIB+KfW+EC+private donors each providing 20 million
Regional	Open Regional Fund for EE	GTZ	grant	3.0		X				N/A
Regional	E. Europe Energy Efficiency Fund	UNECE	loan/equity	30.0		X	X		Ind/SMEs	countries), excluding Serbia and Kosovo; 30 mln est. for W. Balkans
	Total			**224.0**						
Albania	Promotion of RE/EE Facility	KfW	guarantees	9.0		X	X	X	SMEs	Commercial banks
	Total			**9.0**						
Bosnia	EU IPA 2007 funds	EC	grant	10.0		X	X	X		
Bosnia	Loans for warmer households	IFC	loan		15.0	X			Residential	
	Total			**10.0**	**15.0**					
Kosovo	EE measure in 5 public buildings (1.2mln); Energy Auditors training(0.5mln); Public Awareness campaign (0.3mln)	EC	grant	2.0		X		X	Public sector	
Kosovo	EE modernization of municipal service	GTZ	grant	1.5		X			Municipal buildings	Co-financing with Association of Municipalities of Kosovo
Kosovo	EE measures for small enterprises and households to promote climate and environmental protection	KfW	loan	30.0		X			SMEs, Residential	Local enterprises
	Total			**33.5**						
Macedonia	Development Credit Authority facility for EE	USAID	guarantee facility		10	X			Municipalities	
Macedonia	AgroEnergy	SIDA	grant	2.0		X			Agriculture	
Macedonia	Efficient Energy distribution	Swiss Cooperation Office	grant	7.6		X				

Country	Project name	IFI/Owener	Instument	EUR	EE	RE	TA	Sectpr	Comments			
Macedonia	EE in Buildings Programme	Austrian government	grant	2.3		X		X	Consists of three projects; timeline 2009-2013			
	GEF Sustainable Energy Project	Worl Bank	grant		5.5	X	X	X				
	Total			**11.9**								
Montenegro	**Project name**	**IFI/Donor**	**Instrument**	**EUR**	**USD**	**EE**	**RE**	**TA**	**Sector**	**Comments**		
Montenegro	TA to the M. of Economic Development, EE Unit	GTZ	grant	1.5				X				
Montenegro	Credit line for EE SMEs	KfW	grant	3.0		X			SMEs			
Montenegro	Energy Efficiency Project	World Bank	loan		9.4	X			Public sector			
	Feasibility Study for Podgorica Clinical Center Retrofit	Govt of Spain	grant	1.0					Public sector			
	Total			**5.5**	**9.4**							
Serbia	Energy Efficiency Fund	IFC	loan		15.0	X			SMEs	Credit line to ProCredit Bank		
Serbia	Energy Efficiency Facility	KfW	loan	45.0		X			SMEs	Credit line to local commercial banks		
Serbia	District Heating Rehabilitation (covers both supply&demand)	KfW	loan	32.0		X				Credit line to govt		
	Serbia Energy Efficiency Loan	World Bank	loan		49				Public sector			
	Total			**77.0**	**64.0**							
	Grand Total			**370.90**	**103.9**					Exchange rate as of 3.24.2009 EUR/USD		
										1.3523		

Division by target sector (mln):*	USD
SMEs (total)	92.1
Industrial sector (total)	203.7
Public sector (total)	91.1
Residential sector (total)	55.6
* excluded programs where the division is not clear	

Public sector investments by donors (mln):	USD
Austrian government	3.1
EC	16.2
GTZ	2.0
Spanish government	1.4
USAID	10
World Bank	58