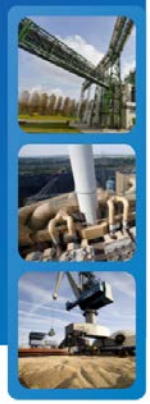
SECTOR STUDY ON BIOMASS-BASED HEATING IN THE WESTERN BALKANS



ENERGY EFFICIENCY COORDINATION GROUP - VIENNA, 9 MARCH 2017

WORLD BANK GROUP
Energy & Extractives

Western Balkans Investment Framework WBIF

Energy Community

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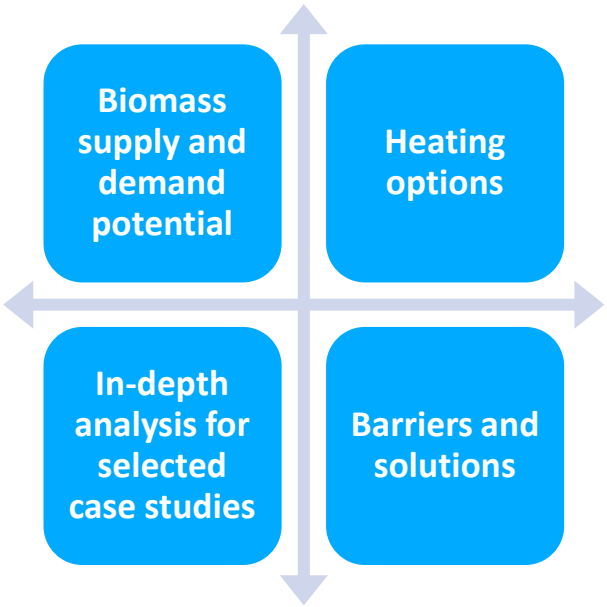
OBJECTIVE AND SCOPE OF THE STUDY

Objective: Identify viable **investment options** and **policy measures** to increase the use of biomass for heating in the region in a **sustainable** manner

Scope:



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CONSULTANT ORGANIZATION
Tractebel Engie - Part of ENGIE Group
Centre for Renewable Energy Sources and Saving (CRES) - Greece
South East European Consultants - Serbia

The project activities have been divided into six tasks

(Task 1) **Analysis of the biomass supply potential**

(Task 2) **Assessment of heating systems in the target countries**

(Task 3) **Assessment of economically viable biomass options for heating**

(Task 4) **Analysis of key barriers and measures to increase the share of sustainable biomass-based heating**

(Task 5) **Detailed assessment of using biomass for heating in selected cities/sub-regions – Case Studies**

(Task 6) **Stakeholder roundtables/workshops at regional and country-level**

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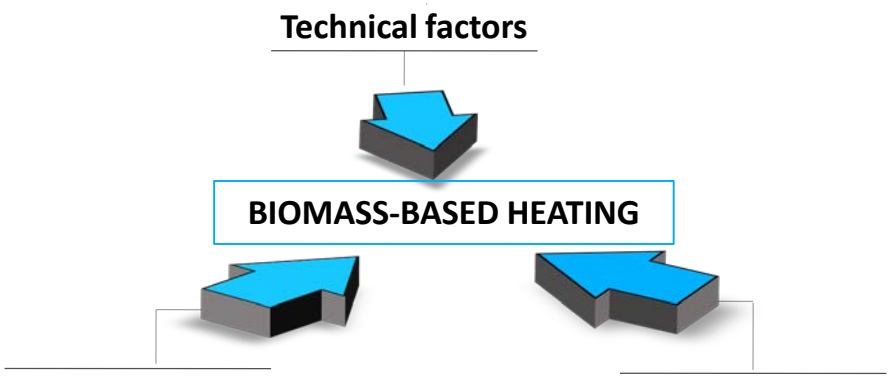
KEY FACTORS THAT IMPACT INCREASE OF BIOMASS USE FOR HEATING

Availability of sustainable biomass sources
Biomass fuel supply logistics
(convenience of supply, fuel quality, labelling, technical standardization)
Heat demand
Heating technologies

Technical factors



Economic / Financial factors

Transparency of biomass fuel prices (stability)
Cost competitiveness
(capital costs, O&M costs, fuel costs)
Access to/Cost of capital
Taxes, Incentives

Organizational factors

Regulatory framework
Awareness / Social acceptability
Technical skills and know how

Overview of Biomass Use in the Western-Balkans

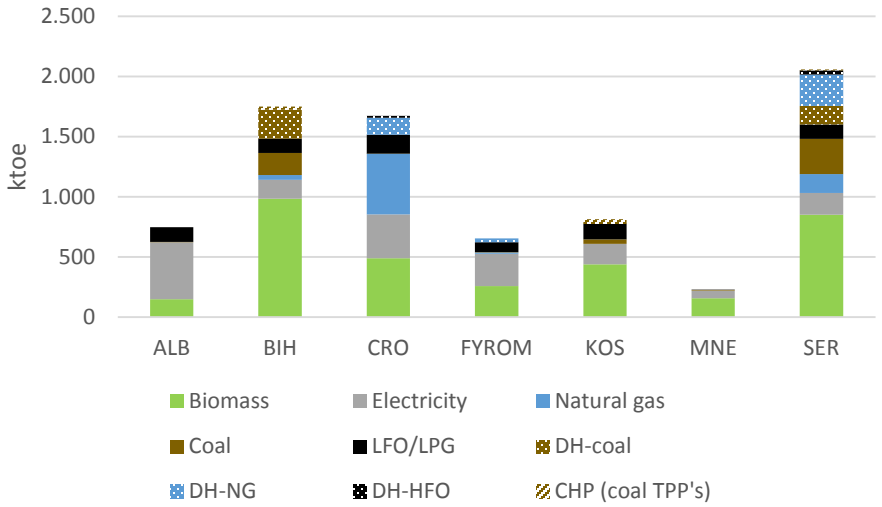
OVERVIEW OF BIOMASS USE FOR HEATING IN THE WESTERN BALKANS

Annual Heat Demand in the W-B estimated to 8 Mtoe

Space heating focus of the study

53% of annual heat demand coming from multistory buildings, and 47% from stand-alone buildings

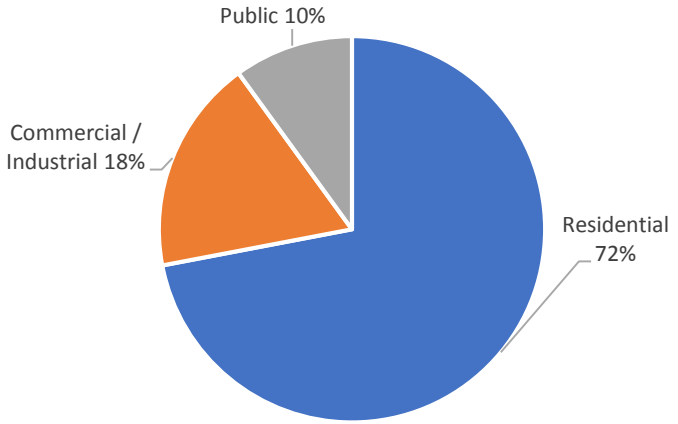
Annual Heat Demand in the W-B



Residential sector accounts for more than 2/3 of annual heat demand

- Residential sector – 72%
- Commercial/industrial sector - 18%
- Public sector – 10%

Heat Demand per sector of consumption in the W-B



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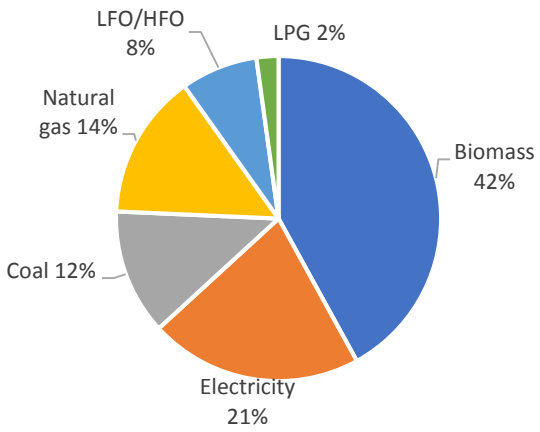
OVERVIEW OF BIOMASS USE FOR HEATING IN THE WESTERN BALKANS

High use of traditional woody biomass (firewood) for heating purposes – 42% of total heat demand in the W-B

54% of stand-alone and 31% of multistory buildings used wood – mainly wood stoves & wood-log small boilers, wood-pellet & wood chips appliances are less common

Used inefficiently due to outdated equipment and lack of proper drying of wood

Use of fuels for heating in the W-B

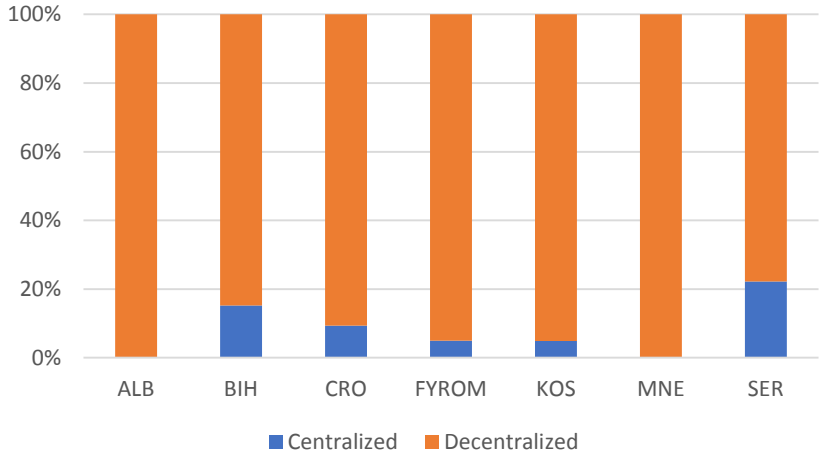


% of heat demand covered by biomass	
MNE	68%
BIH	56%
KOS	54%
SER	41%
FYROM	39%
CRO	29%
ALB	20%

88% of the buildings in the W-B use decentralized heating systems – small HOBs, stoves, and electric devices

Only 12% of buildings connected to DH (with no DH developed in ALB, and only small DH system in MNE town of Pljevlja)

Centralized vs. decentralized heating systems in the W-B



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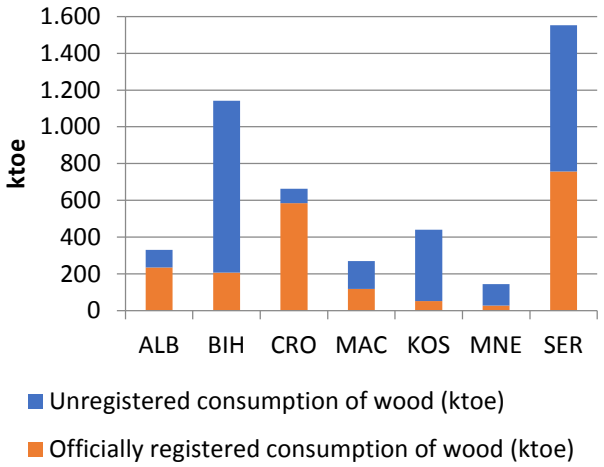
OVERVIEW OF BIOMASS USE FOR HEATING IN THE WESTERN BALKANS

58% of wood consumption in the W-B is coming from unregistered logging

In ALB & KOS consumption unsustainable as use 46% and 56% more than annual growth of forest stand – challenge is that consumption relies on stem wood, without use of logging residues

Majority of sustainable woody biomass potential is already used, except in MNE and CRO



Low level of utilization of logging residues, thinning, landscape wood (wood outside of forest)

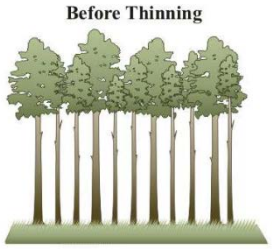
Most of logging residues simply left in the forest, to rot

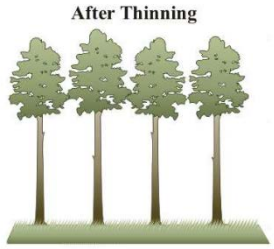
Thinning of growing stand is not a common practice in the region; would improve productivity and value of growth

Currently, only stem wood (high quality wood) is used for heating purposes

Logging residues

Stem wood





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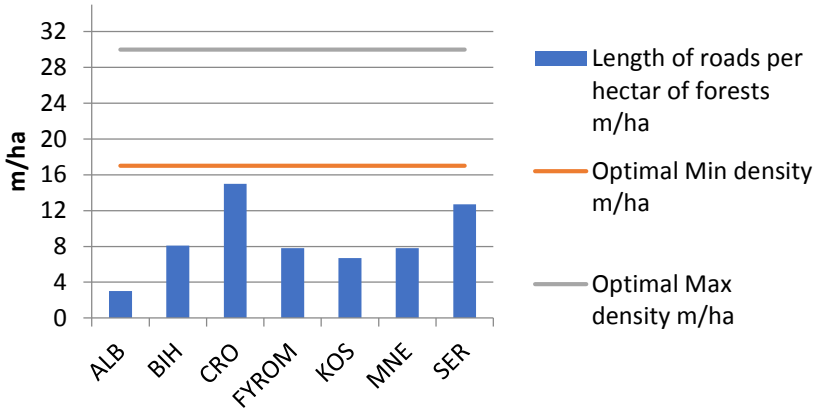
OVERVIEW OF BIOMASS USE FOR HEATING IN THE WESTERN BALKANS

Insufficient accessibility of forests from the production perspective

Investments required to improve the forest infrastructure – forest roads, road side chipping locations, fire protection

Density of forest roads is lowest in ALB, highest in CRO

Significantly lower density of forest roads in low forests (e.g. coppices) – that are more suitable for bioenergy



Existing potential of agricultural residues is largely unexploited in the W-B

Agricultural residues account for 29% of sustainable technical potential of biomass (when excl. energy crops)

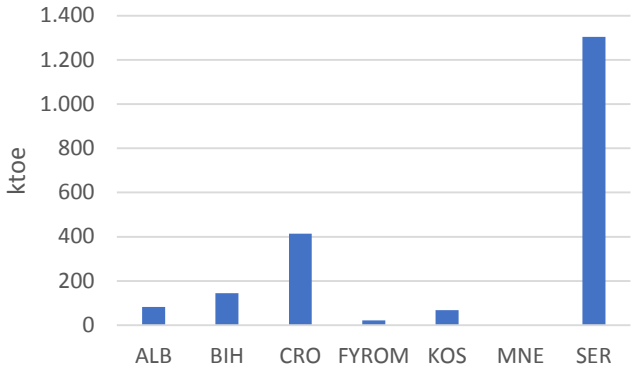
7.3 m tons of agricultural residues annually available for bioenergy

Potential is concentrated in SER, CRO, and BiH

Only existing agricultural residue heating use in Vojvodina (Serbia) (straw, sunflower husks)

Small part of maize cobs and tree prunings used by households and small farms for heating and drying

Sustainable technical potential of agricultural residues



In FYROM use of straw foreseen for other purposes – animal husbandry, and production of cellulose

IN MNE competing uses represent more than 90% of the available straw - negligible potential for bioenergy

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Biomass Supply and Heating Technologies

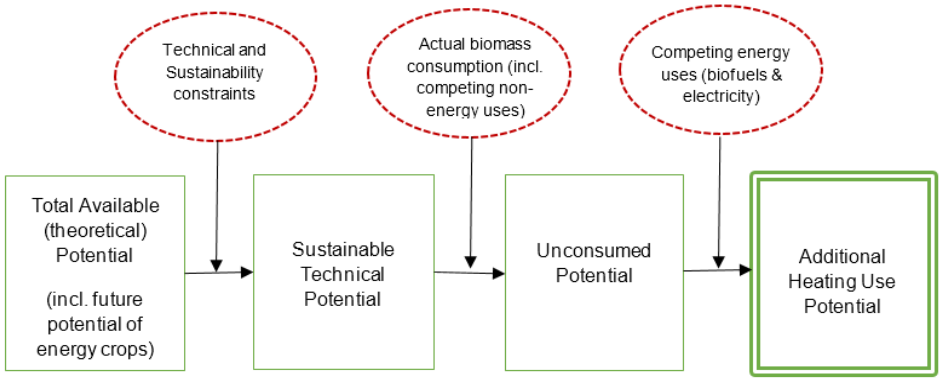
BIOMASS SUPPLY

The study assessed the availability of biomass suitable for heating use:

Woody biomass, agricultural biomass - field crops (straws) and arboricultural (prunings), and dedicated energy crops (Miscanthus)

Additional heating use potential comprises wood residues and agricultural residues only

Stem wood is not included in additional heating use potential as creates more added value when used for other purposes



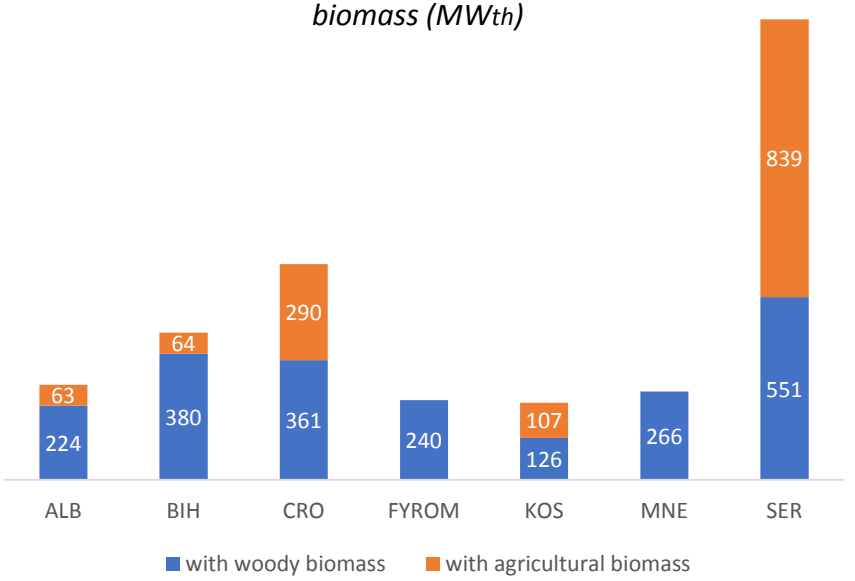
17.6 Mtoe | *13.5 Mtoe* | *2.6 Mtoe (excl. energy crops)* | *1 Mtoe (excl. energy crops) ≈21% of current use for heating*

With additional heating use potential - more than 3,500 MWth of heating capacities could be fueled with biomass

2,148 MWth with woody biomass

1,363 MWth with agricultural biomass

Heating capacities that could be additionally fueled with biomass (MWth)



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BIOMASS SUPPLY

Longer term potential to increase sustainable biomass production based on energy crops

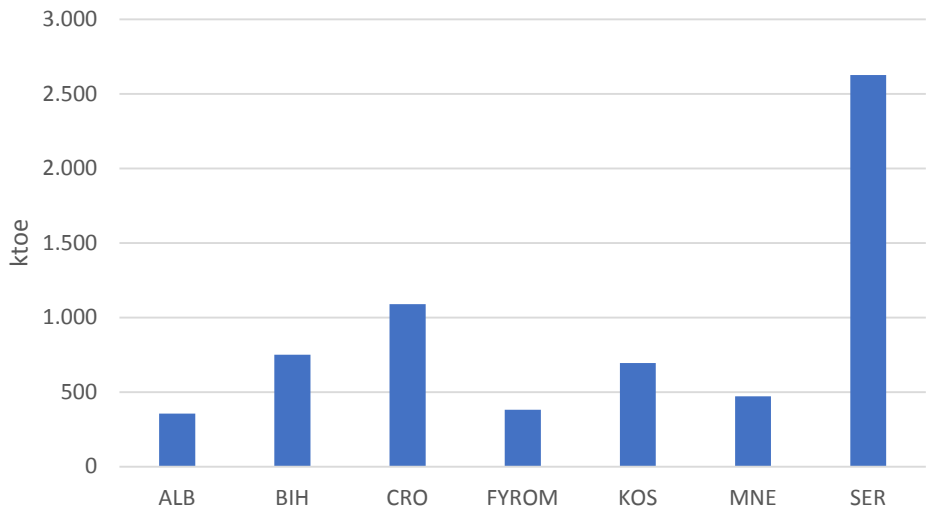
One third of all agriculture land (3.9 million hectares) is unused in the W-B (FAO estimate)

Potential to produce 6.4 Mtoe of energy crops (Miscanthus) - equivalent to 140% of current woody biomass use

Mapping of marginal land (abandoned/degraded) suitable for energy crops – further research is required

However, would require significant effort and time to bring to market and was therefore not assessed in detail

Theoretical potential of growing energy crops on unused agricultural land



BIOMASS HEATING TECHNOLOGIES

Production of biomass-fueled heating appliances

Developed in BIH, CRO, FYROM, and SER (private sector – key role)

Declared efficiency often significantly higher than operating efficiency

Efficient heating appliances – produced locally for exports EU only; at local markets available from import only, with significantly higher prices

Average operational efficiency of non-certified stoves in the W-B 30-40%

60-70% of biomass energy is wasted

Efficiency of highly efficient biomass heating appliances up to 85%

Certification and labelling of biomass fuels and heating appliances

Lack of certification against EU technical standards

Production of certified, efficient heating appliances – 50% higher costs

Consumers lack awareness on significance of certification – non-certified fuels and appliances could undermine confidence in the efficiency of biomass heating

Biomass logistics and trade centers could create incentive for certification of biomass fuels (if centers only sell labeled/certified fuels)

Best practice examples

European Commission

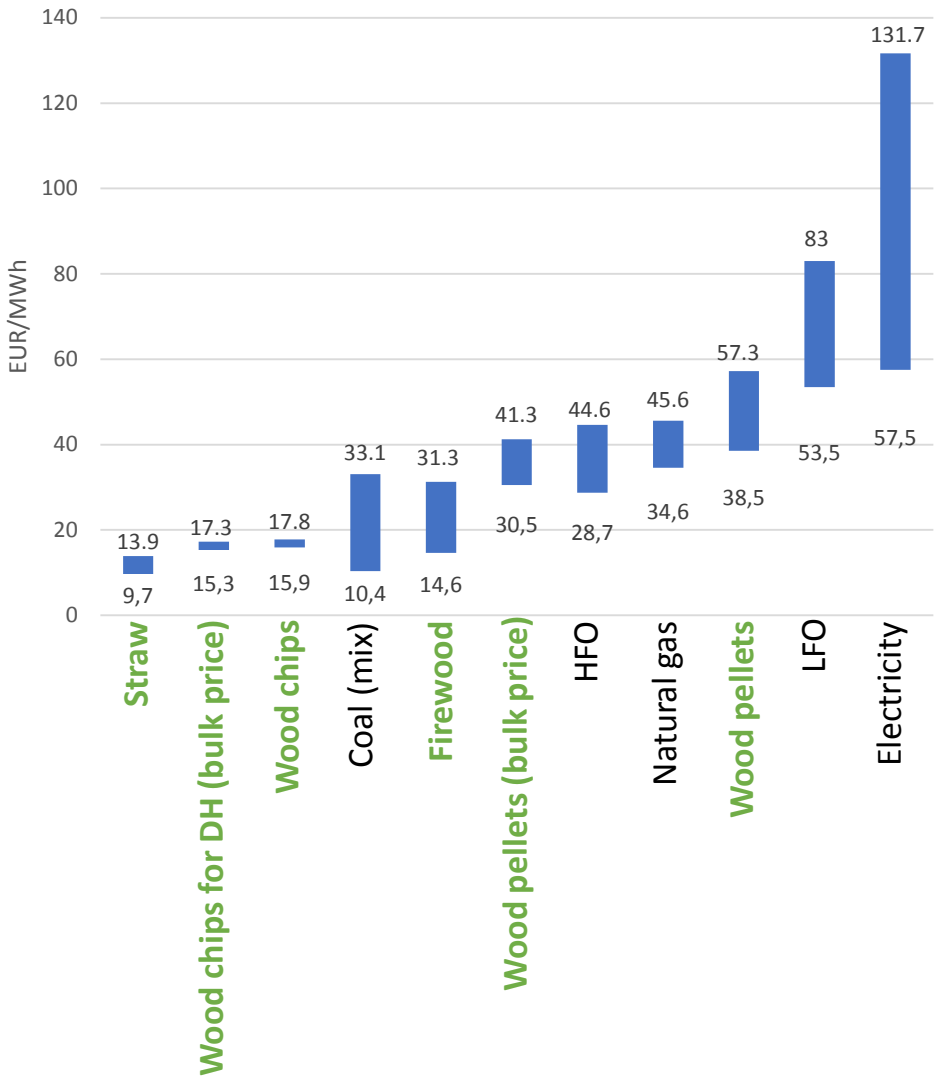
EU Ecolabel
www.ecolabel.eu

US EPA

Economic and Financial Analysis

ECONOMIC AND FINANCIAL COMPETITIVENESS OF BIOMASS HEATING

Market prices of traded biomass and conventional fuels in the W-B, VAT incl.



The biomass market in the Western Balkans needs further development

Straw and wood chips are the most competitive heating fuels (electricity by far the most expensive option)

Several biomass fuel types not traded yet (prunings, thinning, corn stover, energy crops)

Most processed fuels are exported

Non-transparent markets (buyers has difficulties in finding the right quantity and quality biomass)

Lack of long-term biomass contracting

Volatile prices (e.g. Serbia, winter season 2016/17 – price of pellets rose 50% season start to mid-season)

Need to develop biomass logistics & trade centers (currently in Croatia only) - biomass “service station”

Increasing competition between producers of wood fuels and wood processing companies

Lack of knowledge and experience related to complexity of biomass fuels storage and logistics

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ECONOMIC AND FINANCIAL COMPETITIVENESS OF BIOMASS HEATING

The economically viable heating options in the W-B

Coal
most competitive with biomass heating

Electricity and LFO
not competitive with biomass options

Natural gas (where currently available)
competitive to wood pellets

For stand-alone buildings
- **efficient firewood stoves**
- **wood-chip–fired small HOBs**

For multistory buildings
- **conversion** of coal / LFO / LPG / NG-fired small HOBs **into wood-chip–fired small HOBs**
- **wood-chip–fired small HOBs**

From the perspective of the heat consumers (private costs) – significant savings on heating costs could be achieved

FINANCIAL SAVINGS

by replacing electric appliance with efficient firewood stove → 40-74%

by replacing LPG and LFO HOBs with wood chips → 49-70%

For conversion of coal based stoves, small HOBs, and DH to wood chips – **incentives would be needed** (economically viable – but do not provide attractive financial savings)

ECONOMIC AND FINANCIAL COMPETITIVENESS OF BIOMASS HEATING

Upper limit MWs of economic potentials in main technologies,
(based on currently used biomass volumes and potential additional volumes)

	ALB	BIH	CRO	FYROM	KOS	MNE	SER	W-B
Conversion to efficient biomass stoves (Replacement of inefficient stoves) - MW	990	2,180	420	1,110	1,470	360	1,170	7,700
Switching from electric heating appliances to efficient firewood stoves (MW)	0	39	0	0	0	175	313	527
Switching from electric heating appliances to wood chip fired HOBs (MW)	224	342	361	240	126	91	238	1,622
Switching to biomass in DH and construction of new biomass DH	0	64	290	0	107	0	839	1,300

If potential of additional volumes of biomass is realized – increase in biomass-based heating

ALB	BIH	CRO	FYROM	KOS	MNE	SER	W-B
5%	5%	7%	8%	7%	28%	20%	10%

Barrier Analysis and Roadmap of Recommended Actions

BARRIERS

TYPE	Identified barriers
TECHNICAL BARRIERS	Biomass supply infrastructure Control of fuel quality Lack of sustainable forest management Unregistered logging Use of moist wood
FINANCIAL BARRIERS	Lack of cost-reflective energy tariffs Lack of financial investment capability of households, homeowners' associations, Municipalities
POLICY AND REGULATORY BARRIERS	Lack of overall heating strategy – regional, and at country level Lack of incentives for biomass heating Certification and standardization of biomass fuels and heating appliances not developed
INSTITUTIONAL BARRIERS	Lack of national registries on public and commercial buildings, project pipeline, marginal/abandoned land Low public awareness regarding cost-efficient biomass technologies
MARKET-RELATED BARRIERS	Limited availability of affordable high-efficiency stoves and equipment Lack of regional market structures and practices (e.g. BT&LC)

ROADMAP TO INCREASE BIOMASS-BASED HEATING IN THE WESTERN BALKANS

- The report includes a detailed roadmap of recommended actions, addressing the identified barriers and economic investment opportunities/priorities
- Includes 3 pillars, components and subcomponents, and is split into short term (2020) and medium/long term measures (2030)
- Indicative budgets for recommended actions – meant as a point of reference

Pillar	Component
1. Biomass Supply (416 M EUR)	1.1 Planning and monitoring
	1.2 Sustainable forest management
	1.3 Enabling environment for agricultural biomass and energy crops
	1.4 Creation of transparent biomass market
2. Investments in efficient heating technologies (1,379 M EUR)	2.1 Technical standardization
	2.2 Investment Initiatives for (a) electric heating appliances to efficient biomass stoves and (b) inefficient to efficient biomass stoves in stand-alone buildings
	2.3 Investment Initiatives for electric heating appliances to wood-chip–fired HOBs in multistory buildings
	2.4 Investment Initiatives for switching existing DH boilers from fossil fuels to biomass and the development of new biomass based DH
3. Framework conditions (29 M EUR)	3.1 Regulatory framework
	3.2 Data collection and monitoring
	3.3 Awareness
	3.4 Capacity Building

ROADMAP TO INCREASE BIOMASS-BASED HEATING IN THE WESTERN BALKANS

Pillar	Examples of recommended actions
1. Biomass Supply	•Preparation of forest road master plans
	•Action plan for sustainable forest management
	•Mapping of abandoned/damaged (marginal) land, and Action plan for the potential of energy crops
	•Establishment of a quality label for biomass fuels
	•Development of biomass trade centers
2. Investments in efficient heating technologies	•Harmonization of the technical standards with EU
	•Establishment of certification / labeling schemes for biomass heating appliances
	•Support the accreditation of testing laboratories
	•Investment Initiatives for stand-alone buildings, multistory buildings, and DH
3. Framework conditions	•Preparation of legislation and regulatory proposals
	•Legislation related to certification of biomass fuels
	•Legal provisions for “green” public procurement
	•Awareness campaigns for proper wood drying
	•Trainings for stakeholders

ROADMAP IMPLEMENTATION

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
PILLAR I – Biomass Supply														
PILLAR II - Efficient Biomass Heating Technologies														
PILLAR III – Framework Conditions														

TOTAL BUDGET (PILLAR I + II + III) :
to 2020 – 415 M EUR
to 2030 – 1,409 M EUR

Country	Until 2020 (M EUR)	Until 2030 (M EUR)
ALB	19	96
BIH	87	242
CRO	113	355
FYROM	31	110
KOS	53	152
MNE	11	63
SER	100	391

ROADMAP IMPLEMENTATION

FINANCING SOURCES

Necessary mobilization of broad spectrum of financing sources

WBIF
IFI's
Bilateral Donors
IPA (EU)
National Governments
Private investors

<u>POSSIBLE</u> FINANCING MECHANISMS

For investments in stand-alone and multistory buildings

- Regional financing facility with financing from various sources channeled through intermediaries (local banks and/or funds), coupled with TA
- Could e.g. be modeled on the successful experience from REEP

For investments in DH

- National or regional financing facilities with financing from various sources provided through a budget capture mechanism

ROADMAP IMPLEMENTATION

Implementation of the Roadmap at country level requires cross-sectoral approach coordinated by the Government

Good practice example: Institutions involved in the preparation of Biomass Action Plan for Serbia

Ministry of Agriculture and Environmental Protection
Ministry of Mining and Energy
Ministry of Economy
Ministry of Trade, Tourism and Telecommunications
Ministry for Construction, Transport and Infrastructure
Ministry of Interior
Ministry of Health
Provincial Secretariat for Agriculture, Forestry and Water Resources
Provincial Secretariat for Urban Planning, Construction and Environmental Protection
Provincial Secretariat for Urban Planning, Construction and Environmental Protection
Provincial Secretariat for Energy and Mineral Resources
Public Enterprises for forest management
National parks
Private forest owners associations
DH associations
Institute for Public Health
Institute for Technical Standardization
Representatives of the biomass equipment/appliances manufacturers
Standing Conference of Cities and Municipalities

Summary and Concluding Remarks

SUMMARY AND CONCLUDING REMARKS

Biomass supply

- Potential to increase woody biomass use in some countries, in others critical to change structure of use to ensure sustainability
- In all countries forest residues should be used more
- Significant agriculture biomass potential, concentrated in a few countries
- Significant energy crops potential but would require concentrated effort for years to bring to markets
- Supply infrastructure and biomass fuel markets need to be developed

Demand and technologies

- High use of biomass for heating already, but almost all of it very inefficient
- Limited availability of locally manufactured efficient technologies needs to be addressed

Significant economic investment opportunities on the demand side

- Efficient household firewood and pellet stoves
- Efficient wood chip HOBs in multistory buildings
- Switching electric devices
- Fuel switching in existing DH systems

SUMMARY AND CONCLUDING REMARKS

Financing should be coupled with TA related to barrier removals

- Use broad spectrum of financing sources available to W-B countries
- Experience of financing mechanisms for EE projects in W-B exists, and most successful financing initiatives should be replicated for financing increase of biomass heating

Many barriers exist, but can be gradually addressed through implementation of a long term road-map of actions:

- Start with improving framework conditions, increased awareness, and gradually build up investment from pilots to country and regional level projects and programs
- Roadmap primarily to be implemented at the country level, but regional coordination and financing instruments would also important
- Role of the Energy Community and the Sustainability Charter of W-B6?

THANK YOU FOR YOUR ATTENTION

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Annex slides

BARRIERS

Technical Barriers

Supply	
Biomass supply infrastructure necessary to support the biomass fuel supply	Inadequate supply of biomass at economical price; lack of logistics infrastructure (e.g. forest roads, BT&LC)
Control of fuel quality	Lack of certification of biomass fuels
Lack of comprehensive forest strategy and management capacity for sustainable forest management	Lack of comprehensive forestry management plans and implementation of sustainable forest management techniques; in BIH, CRO, and SER, preparation of detailed management forest plans is ongoing; however, implementation of sustainable forest management techniques (i.e. thinning) is not common;
Equipment for agricultural biomass	Lack of equipment for agricultural residues collection and processing
Prevalence of illegal and unregistered logging	High rate of unregistered logging
Lack of knowledge on energy crops	Pilot and demonstration projects in CRO and SER only
Demand	
The building stock in the region comprises high shares of old buildings which, combined with poor building maintenance and under-heating, hinder the uptake of efficient technologies	Poor existing heating infrastructure in buildings (lack of efficient heating appliances); only in CRO, presences of installed efficient heating appliances is higher compared to other W-B countries
Poor metering and control of heating systems	Introduction of consumption based billing not completed
Use of moist wood by residential consumers	Lack of proper drying of wood fuels used for heating
Lack of production and distribution of DHW in DH systems	DHW supply exist in only in some DH systems in CRO and SER (minor share)

BARRIERS

Financial Barriers	
DH sales revenues due to lack of implementation of consumption-based billing and full cost recovery tariffs	Financial sustainability of DH companies is challenging, except in CRO, where tariff reform provided full cost recovery
Poor credit rating of municipalities and municipality-owned companies	Lack of creditworthiness of local governments and public companies
Strict rules for public budgets	Limited borrowing capacity of the municipalities
Lack of access to, and high cost of, capital	Lack of investment capacity and higher costs of capital because of perceived higher country risk
Low energy tariffs and lack of consumption-based billing for heating and norm-based billing systems (i.e. billing by square meter rather than by actual supply)	Prices of DH regulated at municipal level, typically not at cost-recovery level
Lack of financial investment capability of households and homeowners' associations	Due to low income of households, and lack of creditworthiness of homeowner's associations
High and rising prices in traditional agricultural markets, which may discourage farmers from committing to bioenergy cultivation	Prevent deployment of long-term biomass supply contracts

BARRIERS

Policy and regulatory barriers	
Lack of overall strategy for heat in the region	Lack of heating strategies - especially related to residential heating, (only some references in countries where DH is available - BIH, CRO, FYROM, SER)
Low or no inclusion of biomass heating equipment in public procurement	Lack of legal provisions related to "green" public procurement
Lack of legal provisions for heat pricing	Legal provisions and methodologies for biomass heating pricing not developed; unclear and undeveloped administrative procedures;
Lack of incentives	Croatian EE and EP Fund provide incentives for biomass heating; in other countries (BIH, SER, FYROM, MNE) only occasional, declarative, media actions through public statements
Lack of certification and standardization of biomass fuels and biomass heating appliances	Lack of mandatory certification of biomass heating appliances
Insufficient building code enforcement – lack of secondary legislation	Lack of legislation for small-scale heating; in ALB and BIH - non-efficient decision making requirements for homeowner's associations (75% majority in ALB, 100% in BIH)

BARRIERS

Institutional barriers	
Insufficient and non-complete data on biomass supply and consumption across various feedstock and products	Insufficient statistical data on heating and biomass feedstocks
Poor access to up-to-date monitoring/ census data	Public access to existing data not sufficient, especially related to consumption
Lack of national registries on public and commercial buildings, projects pipeline, marginal/abandoned land	National registries of public and commercial buildings in development; lack of mapping and data on marginal/abandoned land
Low awareness across stakeholder groups regarding policy on, supply of, and demand for cost-efficient biomass technologies and the related benefits	Public awareness of different efficient heating technologies and their costs and benefits is low
Lack of training courses for professionals and lack of skills for residue harvesting	Certification of installers of biomass heating appliances exists only in CRO and SER
Lack of knowledge/information tailored for investors	Lack of knowledge-sharing on best biomass heating practices and successful business models
Insufficient legislation on environmental issues related to production and use of biomass for energy	Lack of legislation related to land use and land use change, greenhouse gasses and climate impacts, water usage, biodiversity, except in CRO, which harmonized its legislation with the EU

BARRIERS

Market-related barriers	
Low organizational capability of both district heating and forestry companies (low availability of skilled personnel, know-how) and inadequate management of complexity	Lack of knowledge of biomass DH and organization of biomass supply chains
Limited availability of affordable high-efficiency stoves and equipment in the local market	High efficiency biomass heating equipment available from import only, despite existing local production of heating appliances
Lack of regional market structures and practices (e.g. BL&TC)	Non-transparent biomass market, lack of established biomass trade and logistics centers

ROADMAP TO INCREASE BIOMASS-BASED HEATING IN THE WESTERN BALKANS

Pillar	Component	Sub- component	Until 2020	Budget	Until 2030	Budget	Note
1. Biomass Supply	1.1 Planning and monitoring	1.1.1 Forest Logistics infrastructure	Preparation of forest road master plans in W-B countries Identification of the forest road rehabilitation projects Best practice forest roads rehabilitation guidelines	1,250,000	Implementation of forest roads master plans	351,000,000	These amounts are at acceptable levels to improve planning and monitoring (CRO has advanced master plan for construction of forest roads, and in BIH there is ongoing project) . If it is, though, necessary to plan forest roads construction too, additional 455 M EUR is estimated for the period 2018-2030 (35 M EUR/year)
	1.2 Sustainable forest management	1.2.1 Monitoring and collection of data	Preparation of monitoring systems for deforestation, degradation, illegal logging and land use change	1,750,000	Focus on implementation of monitoring systems	7,000,000	Monitoring and detection activities
		1.2.2 Multi- purpose forestry demonstration techniques	Action plan for sustainable forest management in W-B region Improving silviculture and the sustainability of forest management through demonstration activities	3,500,000	Continue awareness raising on the benefits of efficient use of biomass resources	3,500,000	Demonstration activities for both periods in consultation with public forest companies
		1.2.3 Forest fire management	Best practices and new technologies (software) about monitoring and prevention of forest-fires Develop synergy with the European Forest Fire Information System (EFFIS), managed by JRC - http://forest.jrc.ec.europa.eu/effis/	1,400,000	Improvement of monitoring, surveillance and detection of the fires through provision of equipment and vehicles for forest-fires fighting	1,400,000	Education, monitoring, surveillance and detection activities
		1.2.4 Unregistered logging	(see 3.1.1 below)		Development of community-based forest cooperatives	14,000,000	
	1.3 Enabling environment for agricultural biomass and energy crops	1.3.1 Knowledge for energy crop/ tree species	Action plan for the potential of energy crops, prepared in collaboration with the Ministries in charge for Agriculture	700,000	Establish Western Balkans technology platform for biomass	400,000	Demonstration of different species and cultivation techniques at large pre-commercial scale
		1.3.2 Use of marginal land	Definition and mapping of abandoned/damaged (marginal) land	2,100,000	Demonstration activities on energy cropping	2,100,000	
		1.3.3 Commercial conversion technologies for agricultural biomass	Improve market for commercial technologies for agricultural biomass through preparation of the list of recommended technologies for utilization of agricultural residues and dissemination of obtained results from demonstration projects	500,000	Support R&D activities for the combustion of agricultural biomass in order to develop local industry	3,000,000	Focus on cross-border region of BIH, CRO, SER - that belong to Pannonian Basin
	1.4 Creation of transparent biomass market	1.4.1 Biomass fuels labelling	Support establishment and promotion of a quality label for biomass fuels	700,000	Continue promotion of established biomass labels	700,000	Creation of regional (W-B) biomass fuels labells would stimulate development of regional biomass market
		1.4.2 Biomass supply infrastructure	Develop biomass trade centers	7,000,000	Provision of equipment/mechanization to improve logistics Training of local actors	14,000,000	
TOTAL BUDGET - PILLAR 1				18,900,000		397,100,000	

Pillar	Component	Sub- component	Until 2020	Budget	Until 2030	Budget	Note
2. Efficient biomass heating technologies	2.1 Technical standardization	2.1.1 Adopt & transpose technical standards	Harmonisation in the respective standards and regulations according to the European requirements Establish national certification scheme for biomass heating appliances stoves, including Energy labelling	700,000	Continue harmonization and implementation of Energy labelling	700,000	
		2.1.2 Testing infrastructures	Improve quality of infrastructure (technical rule book, laboratories, testing, etc.) for laboratories for testing of biomass stoves, HoBs according to CEN technical standards	1,400,000	Ensure consistent update according to EU and CEN Continue support to the work of the national standardisation technical committees	1,400,000	
	2.2 Investment Initiatives for (a) switching from electric heating appliances to efficient biomass stoves and (b) conversion from inefficient to efficient biomass stoves in stand-alone buildings	2.2.1 Financing facilities for biomass heating in stand-alone buildings	Establish financing facilities for biomass heating in stand-alone buildings Initially through pilot projects (incuding TA), building towards country and region wide financing facilities/programs Identification and selection of local banks Training for bankers	83,600,000	Continued Program implementation, aiming at scaled up country and region level programs and facilities	333,500,000	
		2.2.2 Develop customer oriented services for local banks participating in financing Program	Information on certified equipment suppliers Guidebooks, Best practices, Case studies Online calculators for biomass heat	700,000	Program monitoring and continued support	700,000	
	2.3 Investment Initiatives for switching from electric heating appliances to wood-chip–fired HOBs in multistory buildings	2.3.1 Financing facilities for biomass heating in multistory buildings	Establish financing facilities for biomass heating in multistory buildings Initially through pilot projects (incuding TA), building towards country and region wide financing facilities/programs Identification and selection of local banks Training for bankers	32,400,000	Continued Program implementation aiming at scaled up country and region level programs and facilities	129,300,000	
		2.3.2 Develop customer oriented services for local banks participating in financing Program	Information on certified equipment suppliers Guidebooks, Best practices, Case studies Online calculators for biomass heat	700,000	Program monitoring and continued support	700,000	
	2.4 Investment Initiatives for switching existing DH boilers from fossil fuels to biomass and the development of new biomass based DH	2.4.1 Improve infrastructure for DH	Improve tariff regime for DH Improve/ renovate both plants and distribution systems Collaboration/risk-sharing - with KfW that has experience and program for upgrade of DH plants in several W-B countries	192,000,000	Upgrade of existing DH systems and construction of new	230,000,000	Until 2020: Budget estimated based on the experiences of KfW for rehabilitation of DH sector of Serbia (90% of the plants rehabilitated - 134 M EUR investments)
		2.4.2 Financing facilities for biomass DH	Establish financing facilities for conversion of existing DH boilers from fossill fuels to biomass heating and construction of new DH plants	74,200,000	Continued Program implementation aiming at scaled up country and region level programs and facilities	296,500,000	
TOTAL BUDGET - PILLAR 2				385,700,000		992,800,000	

Pillar	Component	Sub- component	Until 2020	Budget	Until 2030	Budget	Note
3. Framework conditions	3.1 Regulatory framework	3.1.1 Forestry	Certification of biomass fuels Improve legislation to prevent unregistered production/consumption of wood fuels, based on best practices Define levels of allowed annual cut in W-B countries Regulate mandatory performance of National Forest Inventory	1,680,000	Law enforcement	2,100,000	Foreseen budget is estimated based on assumption that one person should work on each topic in the responsible Ministries (man year - approx. 30,000 EUR)
		3.1.2 Biomass heat	Legal provisions for "green" public procurement that would include biomass heating Legislation related to price regulation of heating	840,000	Follow developments in the EU legislation Monitoring of Strategy implementation	2,100,000	
		3.1.3 DH	Develop heat pricing policies in W-B countries, with clear provisions and guidelines for third party access to DH networks, construction of new DH networks Include DH in the jurisdiction of Energy Regulatory Agencies in the W-B	600,000	Policy improvements	2,100,000	
		3.1.4 Buildings	Ensure appropriate transposition of Eco-design Directive (2009/125/EC) and any actions/ regulations relevant to biomass heat Ensure compliance with European Energy Performance of Buildings Directive- EPBD (2010/31/EU)	840,000	Follow up and transpose all relevant directives and EC regulations	2,100,000	
		3.1.5 Air quality	Application of provisions of Law on Air Protection to residential sector Align legislation on Air quality with the EU	840,000	Follow EU legislative development on Air quality	2,100,000	
	3.2 Data collection and monitoring	3.2.1 Buildings	Develop database/registry of building stock, heating systems in public/institutional sector Establish database/registry of small HOBs in residential buildings	2,400,000	Monitoring and updating	2,100,000	
	3.3 Awareness	3.3.2 Campaign for promotion of biomass heating	Organise campaigns to increase awareness for the benefits of efficient biomass heating and proper drying of wood fuels	350,000	Follow up campaigns based on market requirements	700,000	Coordinated centrally- incl. various forms of communication promotion
	3.4 Capacity Building	3.4.1 Local stakeholders in the forestry and agricultural sector	Training, workshops for cost-effective residual biomass harvesting and/or upgrading technologies	700,000	Further focus, tailor and adjust campaigns considering technology, market and policy developments.	1,400,000	Foreseen budget is estimated based on assumption that one person should work on each topic in the responsible Ministries (man year - approx. 30,000 EUR)
		3.4.2 Municipalities	Training, workshops for efficient biomass technologies that offer higher efficiency, cost-savings and flexibility compared to conventional fossil fuel-based electricity systems	350,000		1,400,000	
		3.4.3 Professionals	Training for stoves and boilers producers on the benefits from technical standardization	700,000		1,400,000	
		3.4.5 Stakeholders from government	Develop cross ministerial and institutional collaboration to build the capacity for legislation development, transposition of the relevant European Directives, compliance with certification, standardization and sustainability rules.	600,000		1,400,000	
TOTAL BUDGET - PILLAR 3				9,900,000		18,900,000	

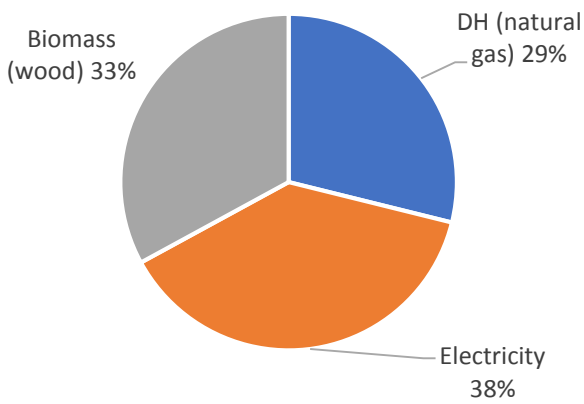
CASE STUDY 1
Replacement of old/traditional wood boilers and stoves with efficient models, with a focus on Skopje

40% of households in Skopje, that use biomass for heating, are heated with wood stoves/furnaces (ovens)

Average age
- Wood stoves – 13 years
- Wood furnaces – 18 years

Efficiency of the wood stoves/furnaces 40-50%

Use of fuels for heating in Skopje



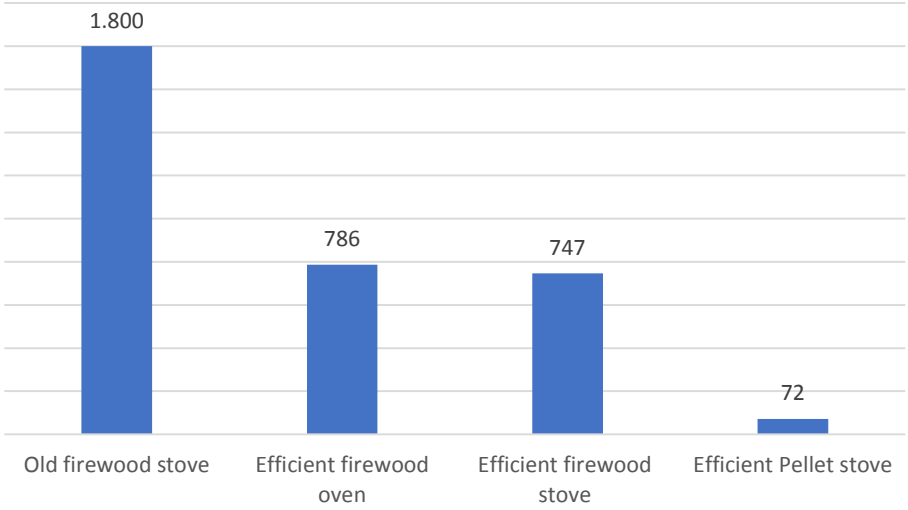
Significant air pollution in Skopje during heating season from old biomass heating appliances

Assessed potential for replacement – 65,000 appliances

36,400 old stoves/furnaces with efficient firewood stoves in rural parts of Skopje – Investment:13.5 M EUR

28,600 old stoves/furnaces with efficient wood pellet stoves in urban parts of Skopje (limited storage space) – Investment: 29 M EUR

Annual Particulate matter (PM) emissions from different biomass heating appliances in Skopje



Calculated based on average yearly consumption of 4.6 m³ of wood fuels

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CASE STUDY 1
Replacement of old/traditional wood boilers and stoves with efficient models, with a focus on Skopje

Economic viability

Strong economic viability of replacing old firewood stoves/furnaces with efficient ones - 33% lower cost per MWh

Economic viability of replacing old firewood stove with efficient wood pellet stove – less attractive (6% lower cost)

Financial viability

Replacement of old firewood stoves/furnaces with efficient firewood stoves – financially viable

Replacement of old firewood stoves with efficient wood pellet stoves – not viable

With implementation of proposed Incentive program of the Government of Macedonia, replacement of firewood stoves with wood pellet stoves becomes financially viable too

Announced incentives for biomass heating (Government of Macedonia):

- 70% investment grant for purchase of efficient wood pellet stoves (max. €500 per household)
- VAT reduction from 18% to 5% for the purchase of efficient biomass stoves
- 20% increase in the price of firewood (currently not cost-reflective)

Estimated investments for the replacement of old firewood stoves/furnaces with efficient firewood and pellet stoves – 204 M EUR (incl. Skopje)

Replacement would reduce PM emissions from wood heating appliances for 75%
(≈1,100 t in Skopje / 6,700 t in FYROM)

CASE STUDY 2
Opportunities for Using biomass in Existing DH systems in Bosnia and Herzegovina

Focus on one municipality in each entity – Tešanj in FBiH and Šipovo in Republika Srpska

Tešanj (FBiH)

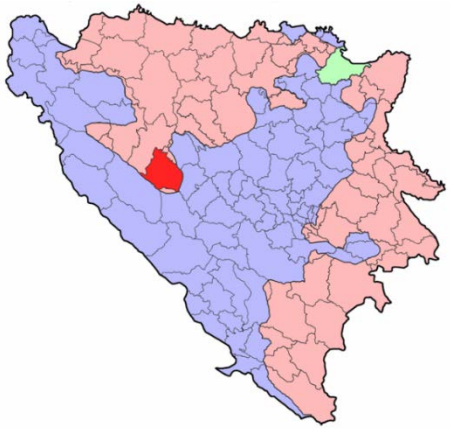
Population – 46,135 (13,500 households)
Current DH consumers – 572 households, 72 commercial/public
Current Heat Demand (DH) – 19 GWh_{th}
Heat Demand Forecast until 2030 – 22% increase

Proposed switching from coal to wood chips
HOB – 10 MW_{th}

Savings on fuel costs (compared to coal only) – 22-27%

Šipovo (RS)

Population – 10,820 (3,703 households)
DH out of operation since 2000.
Pipeline requires reconstruction, trenches exist



Two options analyzed, fueled with wood chips
HOB – 2 x 4 MW_{th}
CHP - 4 MW_{th} + 1 MW_e

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CASE STUDY 2
Opportunities for Using biomass in Existing DH systems in Bosnia and Herzegovina

	Tešanj (FBiH) HOB (10 MW_{th})	Šipovo (RS) HOB (2 x 4 MW_{th})	Šipovo (RS) CHP (4 MW_{th} + 1 MW_{e})
CAPEX (VAT incl.)	3.5 M EUR	3.5 M EUR	5.7 M EUR
Annual Generation	19 GWhth (15.3 GWhth biomass + 3.7 GWhth coal)	15 GWhth	15 GWhth + 6.8 GWhe
Annual wood chips consumption	5,795 t	6,237 t	11,664 t
Proposed Heating Tariff	79.87 EUR/MWh + 0.32 (0.77 per commercial) EUR/m^2	65 EUR/MWh	65 EUR/MWh
FNPV (C) for d=4%	5.3 M EUR	1.6 M EUR	17.3 M EUR
FRR (C) for 20 years	32.7%	7.9%	27.5%
Payback period (years)	4.7	13.9	4.1
Emissions reduction (tCO_2 eq/year)	7,740	n/a	n/a

Proposed implementation arrangements

Tešanj (DH company borrowing capacity 1 M EUR)

I – Combined use of Environmental Protection Fund FBIH financing (40% investment grant), and dedicated Municipal EE/RE credit lines (available from EBRD's WeBSEFF, GGF, EIB)

II – Public-private Partnership (PPP) between Municipality of Tešanj and private investor

Šipovo (lack of creditworthiness of Municipality)

I – Public-private Partnership (PPP) through Concession Agreement between Municipality of Šipovo and private investor is the only financing option in the near future

Estimated replication potential in BIH ≈150 MW (HOB)
Required investments 65 M EUR

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CASE STUDY 3
Supply Options for District Heating using Forestry and Agricultural Residues in Gjakova, Kosovo

Gjakova
Population – 94,556 (16,303 households)
DH Gjakova
Current DH Consumers – 1,055 households, 795 commercial/public
Current Heat Demand – 22.6 GWh_{th}
Heat Demand Forecast (5 year) – 75% increase (based on activation of currently connected, but not active consumers)
Primary fuel – HFO

Proposed switching from HFO to biomass – 2 options analyzed (HOB and CHP)

Additional Heating Use Potential of biomass in Gjakova, to supply DH, estimated to 58,372 MWh (15,536 t)

Straw (35%), corn stover (31%), logging residues (18%), vineyard prunnings (16%)

Annual fuel costs – 212,000 – 335,000 EUR (depending on the penetration rate of consumers)

	HOB (2 x 8 MW_{th})	CHP (9.8 MW_{th} + 1.5 MW_e)
CAPEX (VAT not incl.)	6.2 M EUR	13.6 M EUR
Annual Generation (with fully re-connected consumers)	45 GWh_{th}	45 GWh_{th} + 6.2 GWh_e
Annual biomass consumption	15,533 t	16,019 t
Proposed Heating Tariff	58 EUR/MWh + 5.46 EUR/MW	
FNPV (C) for d=4%	11.1 M EUR	9.3 M EUR
FRR (C) for 20 years	17.8%	10.2%
Payback period (years)	6.6	10.5

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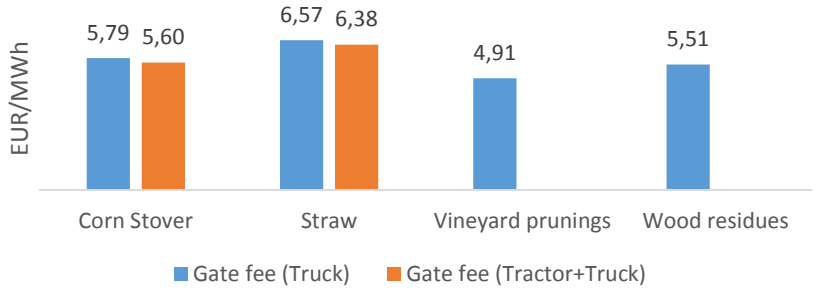
CASE STUDY 3
Supply Options for District Heating using Forestry and Agricultural Residues in Gjakova, Kosovo

For the development of biomass supply chains – wood chips from vineyard prunings is priority (lowest cost per MWh)

Biomass gate fee at DH Gjakova, in EUR/MWh



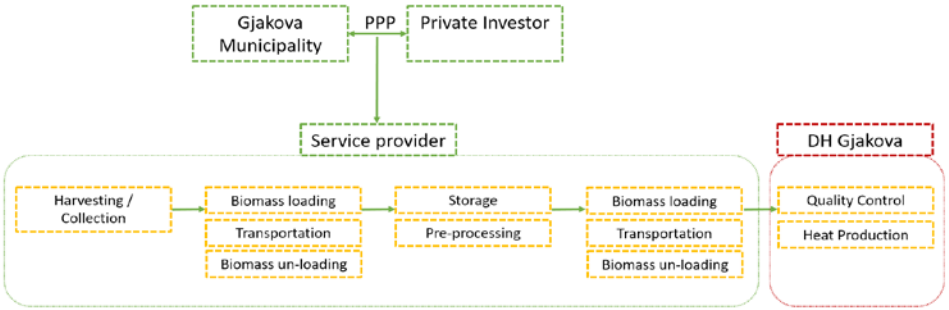
Proposed Biomass Supply Chain for DH Gjakova

Municipality of Gjakova and private partner jointly establish a biomass supply entity

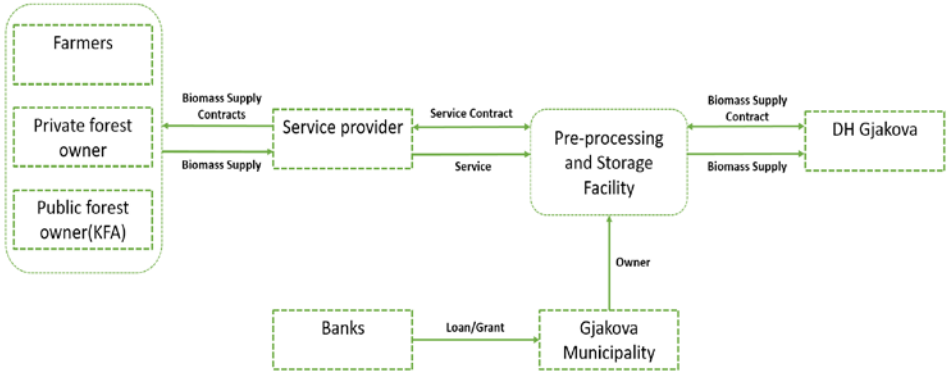
Municipality provide funding for the site area, buildings and machinery for the storage/collection facility

Private partner undertakes the daily operation and management of the facility

PPP model for biomass supply chain



Business model for biomass supply to DH Gjakova



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CASE STUDY 4
Evaluation of the Possible Replacement of Fossil-fired with Biomass Boilers in schools in Pristina, Kosovo

76 schools in Pristina

Most of the schools are heated with LFO and electricity

Energy Audits performed in 5 schools – currently use LFO and firewood for heating

Thermal comfort – not sufficient

Analyzed option to switch to biomass heating using wood chips

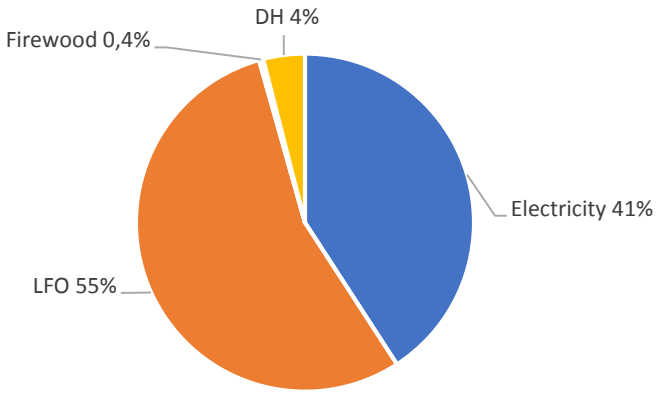
Biomass heating with wood chips boilers - economically and financially viable compared to current heating

Required investment for introduction of biomass heating based on the performed Energy Audits
26 EUR/m² of heated area

Best results if coupled with additional EE measures

Lack of suppliers of wood chips in Pristina and Kosovo – mainly because of lack of demand

Use of fuels for heating in Pristina schools



Heating appliances in Teuta School, Grashtice Village

20% of Heat Demand in Pristina schools could be covered using available wood residues

Investment – 0.8 M EUR

40% of Heat Demand in Kosovo schools could be covered using available wood residues

Investment – 12.8 M EUR

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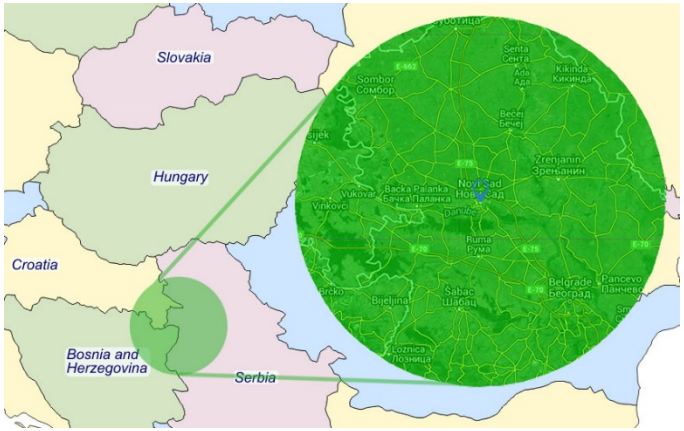
CASE STUDY 5

Use of Agricultural Waste and/or Energy Crops for Sustainable, Efficient, Renewable Heating Solutions in the Cross-Border Region of Bosnia and Herzegovina, Croatia, and Serbia

Most of the potential of field crop residues in W-B concentrated in the region of fertile Pannonian Basin

Cross-border region encompasses:
BIH - 6 municipalities in RS – Bijeljina, Gradiste, Laktasti, Lopare, Srbac, and Ugljevik; District Brčko; Posavski Canton (FBIH)
CRO - Osijek-baranja and Vukovar-syrmia County
SER – Vojvodina Province and Mačva County

Population – 3.1 M (1.1 M households)

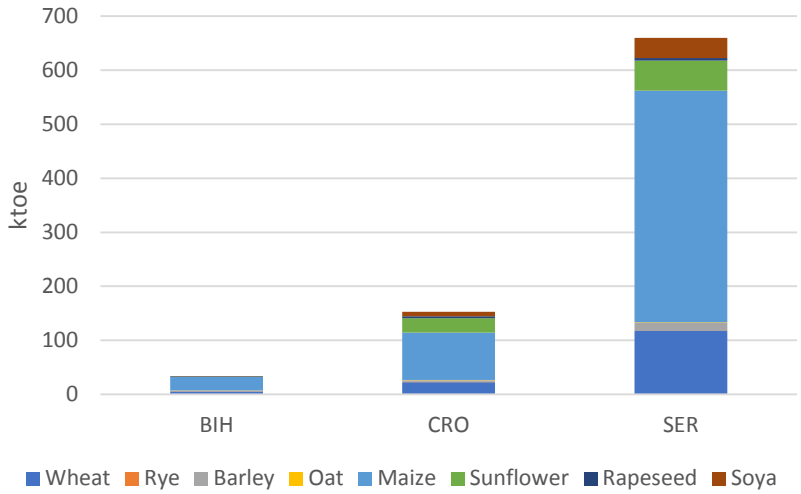


Out of 11.1 M tons of different agricultural residues available annually, 2.5 M tons could be used for heating purposes

Sustainable technical potential of agricultural residues estimated to 847 ktoe (42% of sustainable potential of agricultural residues in the W-B)

Corn stover – the largest potential

Sustainable Technical Potential of agricultural residues in the cross-border region of BIH/CRO/SER



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CASE STUDY 5
Use of Agricultural Waste and/or Energy Crops for Sustainable, Efficient, Renewable Heating Solutions in the Cross-Border Region of Bosnia and Herzegovina, Croatia, and Serbia

Good potential for waterway transport of agricultural residues – connections through Danube, Sava, Drava rivers, and hydro system Danube-Tisa-Danube

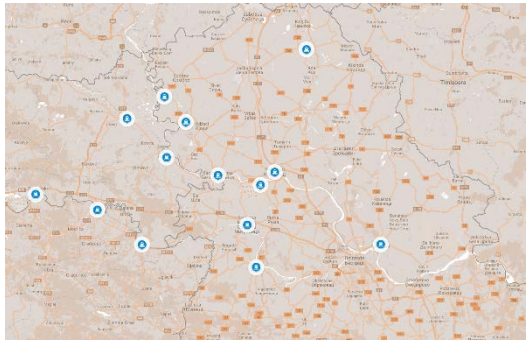
Storage capacities available in ports

Good connection with European waterway network

Estimated costs of transport of agricultural residues (straw)

60% lower compared to road transport

Network of connected ports for waterway transport in the cross-border region of BIH/CRO/SER



1 ship + 1 barge = 393 tons of straw
1 truck = 8 tons of straw

Priority should be on best practice dissemination, R&D, and knowledge development and sharing related to use of agricultural residues for heating, e.g.

DH with sunflower husks in Sremska Mitrovica (Serbia)

Production of agri-pellets (currently not developed in BIH and CRO)

Agri-pellet production facility in Zrenjanin (SER)

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