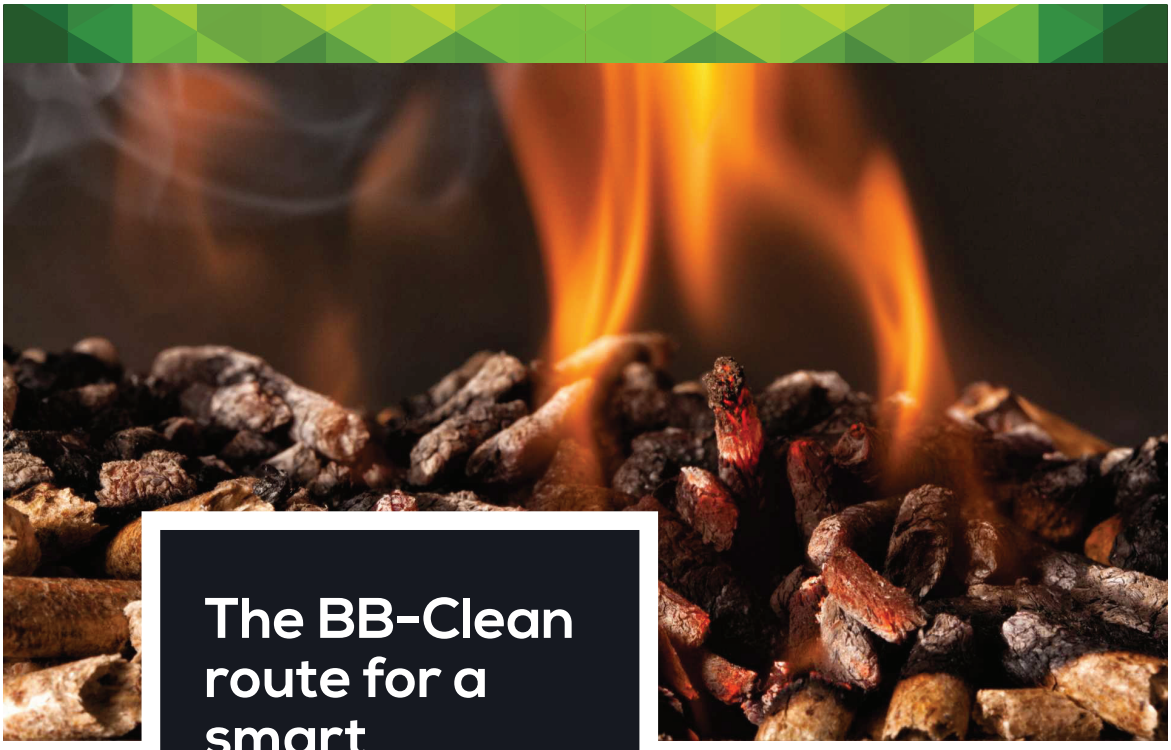
Interreg
Alpine Space

EUROPEAN UNION

BB-CLEAN

European Regional Development Fund



The BB-Clean route for a smart biomass burning

This project is co-financed by the European Regional Development Fund
through the Interreg Alpine Space Programme.

Interreg
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BB-CLEAN
European Regional Development Fund

CONTENT

INTRODUCTION

The Alpine Region climate is characterized by cold winters which imply a considerable energy demand for domestic heating.

Biomass is a local and affordable renewable energy source and its combustion avoids CO_2 emissions from fossil fuels. For these reasons, **biomass use as a fuel for energy production is strategically important** in the framework of low carbon policies to be implemented in the Alpine Region.

However, due to the abundance of air pollutants emission (first of all, PM), **biomass burning is potentially harmful to both the environment and human health.**

The 8 partners of the BB-Clean project, from 5 Countries of the Alpine Macro-region, worked together to develop **a proposal of a shared strategy to support a sustainable use of biomass for domestic heating**. Actually, the aim of BB-Clean was to minimize the negative impact of biomass burning on air quality, human health and climate change, and fostering a better use of local resources towards the increase of energy self-sufficiency.

In the following a brief description of the 5 Workpackages foreseen by the BB-Clean project is reported, along with representative results achieved by each of them and their specific contribution to the fulfilment of the final project aim.

In particular, starting from the state-of-the-art of small scale biomass appliances, regulatory and funding schemes and air quality monitored in specific alpine areas (WP1) the project went through the development of awareness raising campaigns to sensitize citizens towards a more sustainable biomass combustion (WP2). In order to drive a change in citizens behavior, the development of a weather forecast model coupled to a pollutants dispersion model was implemented over specific Alpine case studies to feed the BB-Clean web app, a smart tool able to change the diurnal working operation of biomass technologies and improve the local air quality (WP3). But a significant improvement in air quality is only possible with the help of high efficient biomass technologies, new regulations, innovative funding schemes that became the focus of WP4. Nevertheless, the real effort put by all partners in the BB-Clean project becomes evident in WP5 where all the aforementioned work is translated into modeling scenarios to evaluate the environmental benefits due to the implementation of specific policies thus leading to the definition of harmonized policies for the Alpine Region in the framework of small scale biomass combustion.

BB-Clean was cofunded by the European Union in the framework of the Interreg Alpine Space Programme.

01 KNOWLEDGE BUILDING

Knowledge is the essential starting point to involve citizens, public and private stakeholders in the process of changing attitude towards energy saving, heating efficiency and pollution reduction.

Clean biomass burning can be one of the key solutions towards decarbonization , both from the environmental and economic points of view. Population, companies and public administrators have to be more and more involved in order to obtain a real change of habits in their lives and activities towards a sustainable acting.

Saint-Marcel pilot area – View of the equipped mobile monitoring station and PM10 samplers.

Arpa Valle d'Aosta has coordinated **the evaluation of the biomass burning effects** in the Alpine Region. The impact on air quality has been investigated through the implementation of a monitoring campaign. A focus on **the best available technologies** in domestic biomass-powered heating plants and on **the wood supply chain** in the project pilot areas **has been conducted too**.

A vademecum on the **incentives and financial schemes,** that can be used around Alpine Space to deploy local biomass sources and to support the renovation of existing biomass heating plants, and a survey of the **EU policy framework** to increase sustainable biomass use complete this investigative part of the project.

Finally, the partners have developed the **EEA-Tool**, a transnational analysis tool for the economic and ecological evaluation of financial and regulatory policy in the framework of biomass domestic heating.

The **"Biomass chain knowledge platform"** is the main output: a multilevel document where end users and stakeholders can find all information and references they need on the biomass burning sector.

https://www.alpine-space.eu/projects/bb-clean/en/activities-results/implementation-by-work-package/t1---knowledge-building

"This knowledge platform is a fundamental basic tool to approach the issue of wood biomass, taking into account all possible implications. ARPA Valle d'Aosta is extremely pleased to have coordinated and contributed to this work, bringing its relevant technical expertise related to air quality, enhanced by the monitoring activities accomplished in Saint-Marcel pilot area"

(Manuela Zublena – ARPA Valle d'Aosta)

THE KNOWLEDGE BUILDING PROCESS

01

Carbon emissions from BB domestic heating in the Alps

Wood fuel combustion, while being a renewable energy source and carbon neutral, considering air quality involves the emission of particulate matter containing micro-pollutants that are harmful to the environment and health. This report gives an overview on the actual emissions from biomass burning in domestic heating and their impact on air quality in the Alpine Regions.

02

Boiler characteristics

Among energy technologies, burning wood involves big environmental issues, especially in the Alps Region, where customs, wood availability, energy needs often have to deal with pollution levels, such as PM concentration. Burning wood with good rates of air emissions is possible. This booklet on boiler characteristics describes the technical features of a wide variety of boilers already available on the market.

03

Availability of local biomass in selected areas

This report offers some local biomass supply chain analysis, as collected by project partners and observers for the areas of Chamonix Valley Municipalities, Slovenia and Aosta Valley. The purpose is to benchmark, when possible, the state-of the-art of wood supply chain by a “SWOT” analysis.

04

Economic and financial tools used in the Alpine Region for domestic heating systems

According to the European framework, Member States can use different kinds of incentives and market tools to support the deployment of biomass sources in the heating market. The vademecum gives an overview on the economic and financial tools used in the Alpine Regions involved in the project, to support low carbon domestic heating.

05

Regulations about BB regarding both appliances and fuels

Solid fuel combustion in households represents about 2.6% of total energy consumption in the EU but contributes more than 46% to total emissions of fine particulate matter. The policy framework of the EU offers several instruments for dealing with emissions of domestic biomass burning. This report summarizes the regulations on biomass burning in the participating Alpine countries/regions at national and local level.

06

Transnational Economic and Ecological Analysis (with the EEA-Tool)

Actually, there is no transnational analysis on the efficiency of regulations and financial support instruments in the context of clean biomass burning. With the EEA-Tool it will be possible for policy makers and experts to perform a first evaluation of new or improved measures in biomass burning (BB) sector, thus leading to a better appreciation of the related effects and benefits before their implementation.

02 AWARENESS RAISING

Burning wood produces dangerous pollutants when not properly used and citizens often ignore this impact since they associate it with naturalness, good moment with family and contrast with the industrial era that brought along all the pollutants.

As a **prerequisite for success in reducing BB combustion impacts, it is important that the population becomes aware** of these effects on human health, natural ecosystems and climate change.

Therefore awareness-raising campaigns were performed under the supervision of Atmo AuRA in the Mont-Blanc Countries (CCPMB, Arve Valley, France), in the province of Styria (Austria) and in Aosta Valley (Italy) to improve the knowledge of citizens and public authorities on the challenges of using wood for energy production in the Alpine valleys.

To reach this goal different approaches were tested:

- **people were engaged in the recording of air quality data using portable particle micro-sensors.** In this way, they were able to observe exposure to PM emitted by different biomass appliances in domestic and outdoor environments.

Citizen PM measurement to understand the impact of wood burning on air quality

- **Then they took part in workshops** aiming at the demonstration and explanation of existing solutions to reduce PM emissions due to BB, to local target groups.

Workshop in France: "How to talk to children about air quality"

- **All data** and real time fraction of PM due to BB **were shown on screens** of both municipalities and local environmental agencies.

Monitor in Italy to present Air quality information

The campaigns allowed to:

- **contribute** to the development of citizens' expertise on air quality
- **promote** the best practices in terms of durable wood energy
- **encourage** dialogue in regions where the issue of pollution is at the heart of the debate

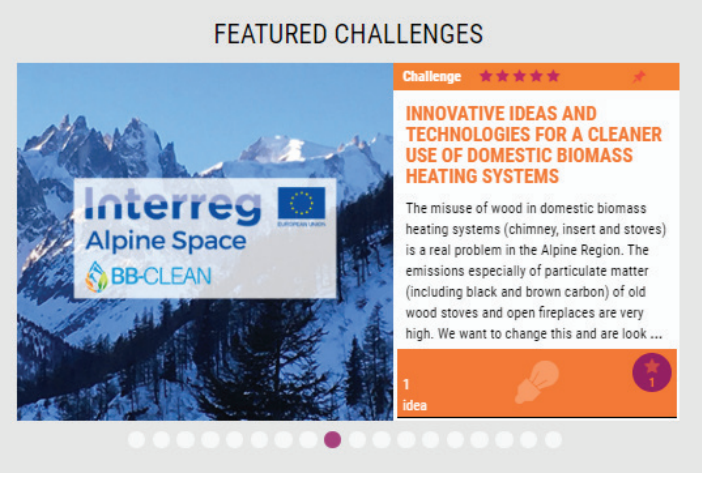
Workshop in France to "Understand the management of a pollution episode"

A sociological study of the awareness campaign in France showed:

- 80% would be willing to try again the experimentation
- 70% say they have implemented actions to improve the environmental impact of everyday life
- 86.4% now think that wood heating is the primary source of fine particle pollution in winter, compared to 52.4% before the experiment
- the role of an air quality expert accompaniment has been essential to enable citizens to reach conclusions adapted to the measurements carried out
- the role of local territory and wood experts to promote good practices, the use of certified biomass, funding schemes whose knowledge can be spread among citizens are believed to be essential contributions to a durable change in the habits.

A **crowdsourcing platform** was created in order to give various stakeholders, especially citizens and local administrators, the possibility to share their direct experience, discuss challenges, find solutions and attract interest on the topic, not only in Alpine regions but also in other areas where BB is commonly practiced.

The crowdsourcing platform was used to push 3 challenges related to BB and create **Virtual discussion rooms to enable the exchange among experts on policy development.**



"Those campaigns have proven that the use of personal particle micro-sensors coupled to expert air quality accompaniment, made a great impact for raising public awareness on air quality issue. It made people aware that air pollution, even if invisible, exists and often reaches high levels precisely in situations that are not imagined, and seems to be, today, a decisive turning point to change people attitude. This approach will be pursued by partners and particularly by Atmo AuRA with the Regional development of its Captotheque device."

(Julie Cozic, Atmo AuRA)

03 TOOLS

Nowadays all people own smart devices and accessing the net is a routine action, for a living and for leasure.

Cellphones or desktops can become strategic tools towards an effective change in citizens' habits to reduce the impact of biomass burning from domestic heating on air quality.

To reach this goal it is necessary to implement **science-based web and mobile apps** that can give easy instructions to the end-user.

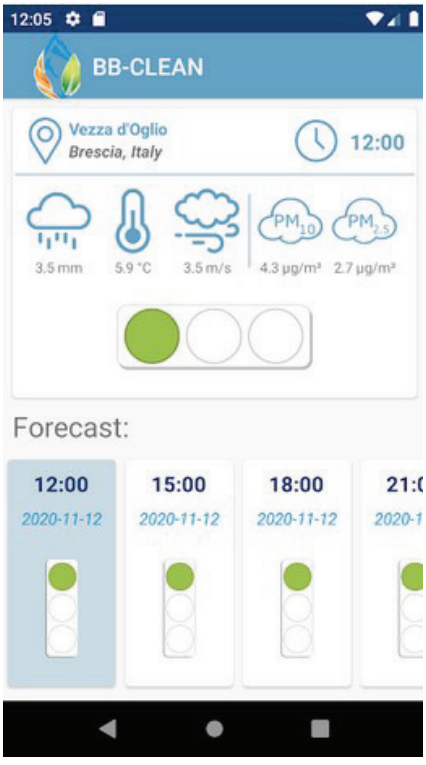
Experimental set up for PM fluxes measurements at ground level

Therefore researchers have developed a **modelling chain** (tailored on the aims of BB-Clean and on the target areas), which is able to produce a **48-h forecast of meteorological conditions and pollution dispersion**.

Tethered balloon soundings to characterize the atmospheric thermodynamic properties

The modelling chain has been defined and **calibrated following the comparative analysis between the model output data and the results of the experimental monitoring campaigns** held by UCSC in Storo (Province of Trento) and Vezza d'Oglio (Province of Brescia). Ground level measurements of PM fluxes as well as the characterization of the gradient of temperature, relative humidity and PM concentrations along the slope of the mountains or through tethered balloon measurements let the researchers go deep into the understanding of PM emission and deposition processes as well as into atmospheric properties that characterize the Alpine Region both in Summer and in Winter. The monitoring campaigns were held in Summer 2019 and Winter 2020.

The comparative analysis between modelling output data and experimental results evidenced that the original modelling chain gave good meteorological prediction but tended to underestimate PM concentrations, mainly due to the complex orography of the two investigated domains.



BB-Clean web app developed for the Vezza d'Oglio (BS) and Storo (TN) case studies

Fixed monitoring station along the slope of the mountain to characterize PM concentrations and meteorological parameters

The app translates all data into user-friendly indications for the best timing for biomass combustion in home appliances. **A specific algorithm implements a "Traffic Light Index"**, and the three colours red, yellow and green clearly suggest the best daily hours for a sustainable biomass burning. In particular, a red traffic light discourages the citizens of the Alpine Region to burn biomass for residential heating in favour of more environmental friendly solutions (i.e. natural gas boilers).

Another fundamental output is **the transferability of the modelling chain** developed in the framework of BB-Clean **to Alpine Regions different from the two specific case studies** of Storo and Vezza d'Oglio.

The source code of the model and the package with all input data are provided in a manual that describes to expert modellers installation steps, application procedures, and which input data should be modified to perform the simulation over different areas.

"The development of a modeling chain, calibrated with local experimental results, to forecast meteorological parameters as well as PM dispersion in different Alpine valleys led to the development of a smart and user friendly tool (the web app) that will drive citizens living in the Alpine Region to burn biomass in a more sustainable way following the indications of the traffic light but even adopting heat storage solutions to improve the efficiency of their appliances and/or changing obsolete and inefficient small combustion appliances with new generation boilers and stoves"

(Maria Chiesa, Università Cattolica del Sacro Cuore.)

04 TECHNICAL SOLUTIONS

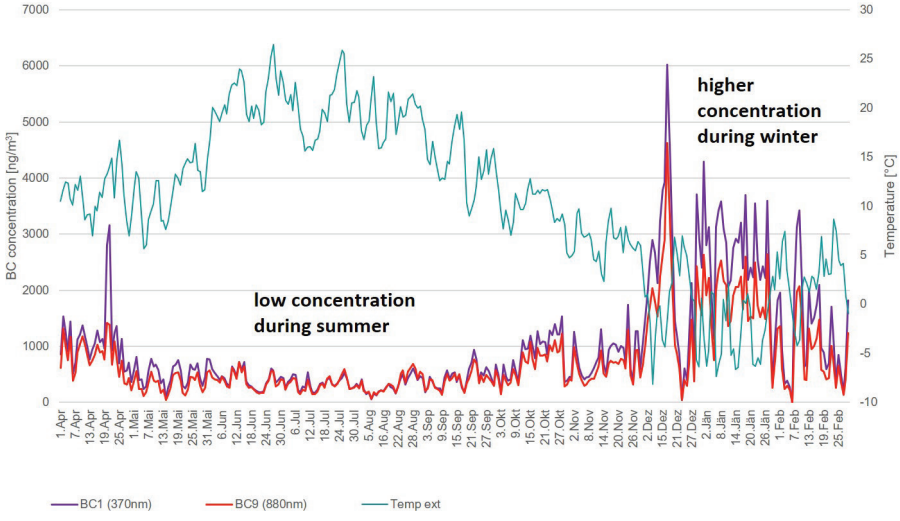
If we want **citizens to give their contribution** to a sustainable use of biomass in their homes, we must provide them **with appropriate technological innovative solutions** and **financial tools** to push the technological change.

The results of the technical issues have become brochures about:

- Clean Heating with Biomass Fuels
- Replacement of Heating Systems
- How to Build a Fire and Light it in a Fireplace
- Suitability of Heating Systems

These guidelines have been published on the project frontpage to be downloaded by end users. They were also distributed to different energy consulting agencies in the partner countries.

A novelty was the installation of the Black Carbon Monitor in the alpine area.



Brown carbon (biomass – violet line), black carbon (fossil – red line) emissions and average temperature (blue line) over one year

This BC monitor allows a selective measurement of the particulate matter sources, allowing to distinguish between emissions from fossil fuels combustion (car exhaust) and those from biomass combustion appliances.

This output has been achieved through a comparative analysis between a region characterized by a high share of biomass heating systems with another one close to a high traffic road.

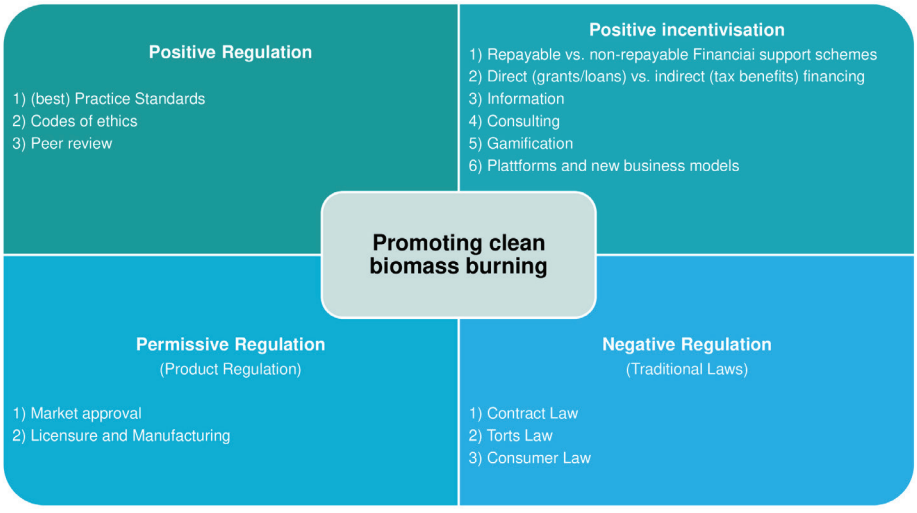
The population can observe the particulate matter situation in real time also thanks to the creation of a specific home page.

"If a tree is burned, the amount of CO_2 released is equal to the one that the tree absorbed during its growth. A forest also filters gaseous pollutants through the stomata in the leaf surface by absorbing the pollutants from the air. Help keep the air clean by proper biomass combustion!"

(Christof Sumereder – FH Joanneum)

Cleaner biomass burning can be enhanced also by developing **new business models** for the companies that operate in this field. Two slogans emerge: **"rent instead of buy"** and **"clean heat as a service"**. Both approaches reduce the initial investments by the end user, and the companies get a higher return a long term by the monthly fees of the users. One example is presented below:

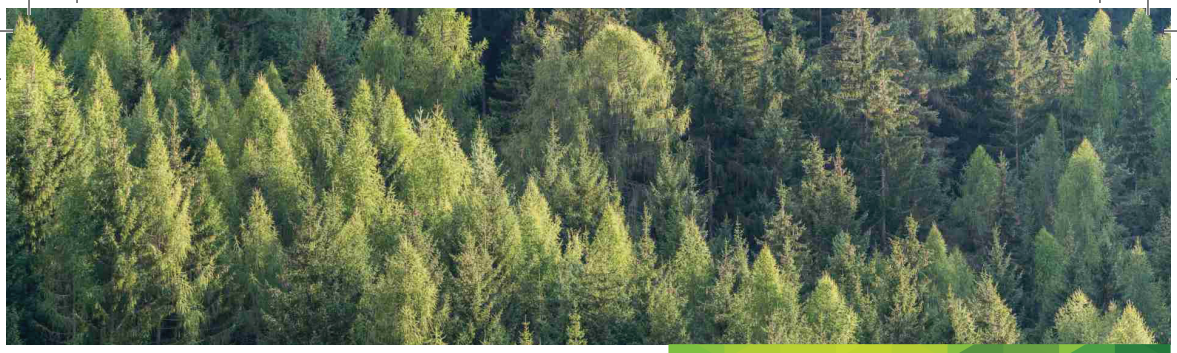
	Old business model	New Business Model
Who (Target Group)	Any private household	Convenience and "luxury" or elder or efficiency focussing private households
What (Products/Services)	Consulting and delivery of the oven	Full service: consulting, delivery, mounting, optimization of fire materials, delivery, cleaning, optimization of usage towards convenience; energy optimization
How (ressources, network)	Internal ressources, network to oven producer	Defined an entire ecosystem along the entire value chain, strong partner network, digitalization of entire sales
Why (return model)	Payment by product	Payment by product + Full service contract discussion on rent instead of buy "selling convenience heat" also efficiency optimized



Therefore researchers have created **an innovative, unique framework** to identify the general directions of potential support instruments, combined with a holistic **analysis tool**, **the EEA-Tool, which is able to identify the most effective option** in each situation. It is an open tool.

"If you really want to change the industries dominant logic towards more sustainable solutions, you have to disrupt the business model to enable new customer experiences, cost optimisation and platform based solutions. This could turn much more efficient than governmental financial incentives to only one member of ecosystem"

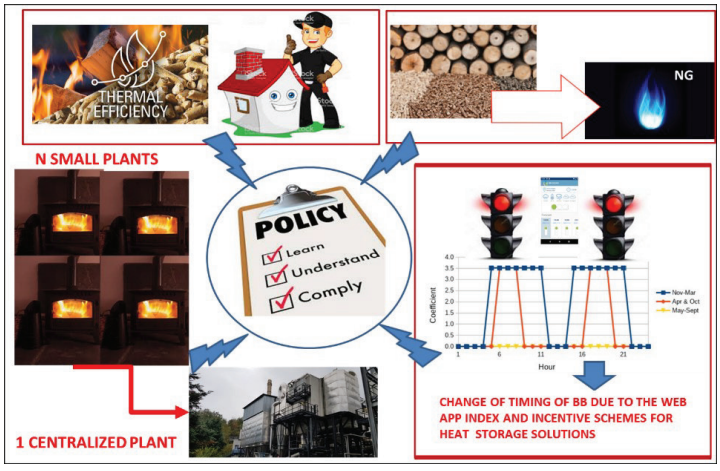
(Marc Tobias – Econcept)



05 POLICIES

EU policy framework offers several instruments to deal with emissions of domestic biomass burning, starting from legislation stimulating technological improvement, such as the EcoDesign and Energy labelling directives.

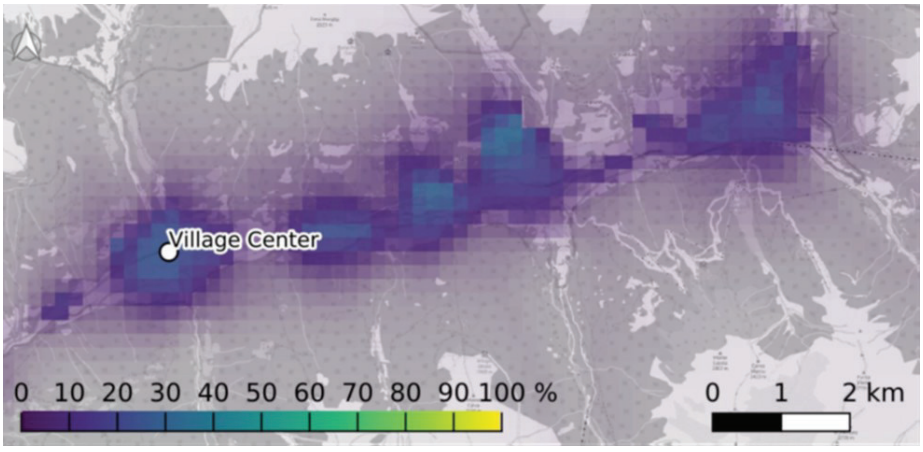
Nevertheless, **a transnational approach to reduce PM concentrations does not exist, at the moment**, the same for common policies of pollution abatement.



Representative policies translated into modeling scenarios

The challenge faced in this WP is the attempt to develop integrated regulations for cleaner BB for the Alpine Region, minimising the environmental burdens and costs, and to model different possible scenarios, along with various clean biomass-burning solutions.

International experts belonging to both public and private sectors coming from Austria, France, Germany, Italy and Slovenia have been involved in the task.

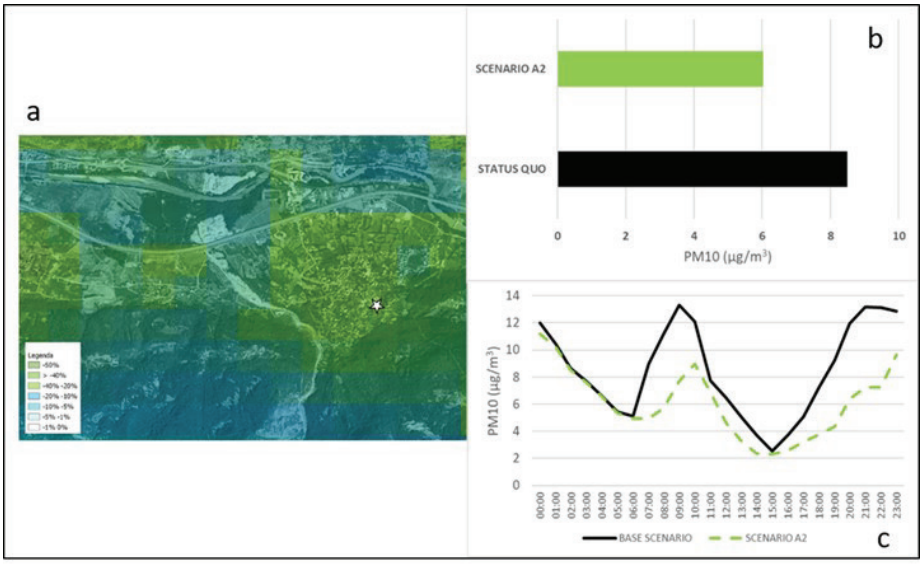


Percentage reduction of PM10 average monthly concentration with respect to the status quo scenario due to the implementation of policy B2 (best practices abate 40% of PM10 emissions due to biomass plants) in the Vezza d'Oglio territorial domain (BS, Italy).

The discussion has brought to the creation of eight different scenarios (A1-F).

The solutions emerged from the modelling simulations of the above scenarios and their potential realistic implementation were discussed in the international round table at transnational level.

The policy scenarios were grouped into short-term and long-term solutions, taking into account their suitability for dense or sparse populated areas, also considering that the applicability of some scenarios is not feasible in some regions (e.g. 100 % conversion to pellets).



Results of the implementation of policy A2 (substitution of obsolete biomass plants by 100% with new generation pellet boilers and stoves) in Saint Macel (AO, Italy):

a) percentage reduction of average monthly PM10 concentrations in Saint Marcel (AO, Italy) with respect to the *status quo* scenario;
b) abatement of average monthly PM10 concentrations in absolute values with respect to the *status quo* scenario;
c) change in the average daily trend of PM10 concentrations with respect to the *status quo* scenario

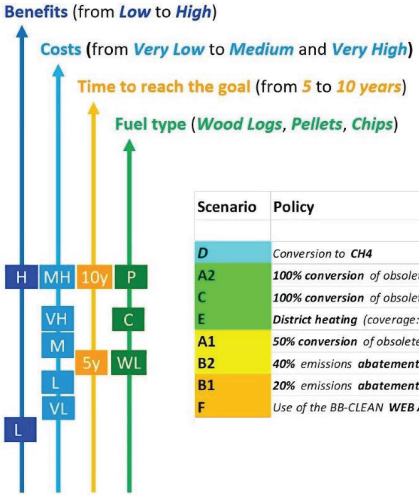
A very important role was assigned to best practices and trainings.

Lack of awareness, cultural barriers, costs and bureaucracy have been identified as main obstacles for the implementation of clean biomass burning policies.

The steps needed for overcoming these obstacles are education, communication and fines / restrictions.

As a result of the international roundtables, a harmonized policy solution was proposed aiming towards:

- (where feasible) realization of a centralized biomass plant with district heating to cover by 70% the current heat demand due to small scale appliances, the rest (30% of households with solid fuel appliances) change their appliances to new generation ones (introducing also heat storage systems)
- In other areas – complete replacement of old appliances.



Interreg Alpine Space BB-CLEAN

Ranked summary

Scenario	Policy	% Reduction of PM10 concentrations			CO_2 emissions
		Storo	*Vezza*	*S. Marcel*	*all sites*
D	*Conversion to **CH4***	-67	-69	-30	↑
A2	***100% conversion** of obsolete plants to pellet*	-55	-60	-29	↓
C	***100% conversion** of obsolete **primary** plants to pellet + **ESP***	-57	-60	-16	↓
E	***District heating** (coverage: 70% of the citizens)*	-47	-60	-16	↓↓↓
A1	***50% conversion** of obsolete plants to pellets*	-27	-30	-14	↓
B2	***40%** emissions **abatement** with **best practices***	-23	-25	-12	↓
B1	***20%** emissions **abatement** with **best practices***	-11	-12	-6	↓
F	*Use of the BB-CLEAN **WEB APP** by 30% of the citizens*	-9	-6	-1	=

An action plan has been developed which contains a checklist of the steps that need to be completed on local / regional or national level in order to achieve the goals set in the harmonized policy. An action plan and the proposed policy solution were discussed in workshops with policy makers in Italy, Slovenia and France.

A very important role in the implementation of EcoDesign and energy labelling directives is also placed in the non-technical measures, for example information campaigns about replacement of old appliances, improvement of energy efficiency, the proper use of the stoves and boilers fuelled with biomass.

Therefore **a transnational biomass burning policy observatory will be established** with priorities in awareness raising, air pollution monitoring, sustainable business models, education and engagement of stakeholders.

It will serve as a centre for policy-oriented guidance for governments, with input from a broad spectrum of external actors.

The observatory will also provide practical guidelines in order to implement the Ecodesign regulations and help decision makers as well as end users to reach the target goals for clean biomass burning in the future years.

"Policy and harmonization work package is the most cross-cutting of all and it enables strategic positioning as well as sustainability of project results. Biomass should be perceived as important sustainable source of energy in Alpine space and should be given priority over non-renewable sources. For clean biomass-burning all relevant stakeholders have to participate to achieve comprehensive and lasting results"

(Darko Ferčej, E-zavod)

06 CONCLUSION

The main aims of the project were **to drive a change in people behaviour** towards the sustainable use of small scale biomass technologies, **by increasing their awareness** on pros and cons of biomass burning, **by supplying citizens with smart tools** to address the sustainable use of biomass and **by providing policy makers with short-to-mid-to-long-term solutions** to foster the change.

During the three years of the project, the BB-Clean partners developed important outputs whose life expectancy will go beyond the project timeline and will represent a reference model for the whole Alpine Region.

In particular, the BB-Clean Project outputs dealt with the development of Biomass Chain platforms, a Mobile App that suggests how to burn biomass at best according to a 48-h forecast of the diurnal change of the dispersion level of pollutants, detailed transferability Manual to implement the forecasting model in other areas of the AR and the guidelines for Energy Counselling Services that will foster the promotion of good practices, energy saving and the implementation of new efficient technological solutions for small scale biomass combustion in the Alpine Region.

The **integrated activities** foreseen by the different WPS as well as the **wide variety of competences** brought by the BB-Clean partners into **the project were the key of the project success**.

In particular:

a) the active involvement of citizens in the project activities;
b) the intensive monitoring campaigns performed in different Alpine valleys that saw the deployment of integrated monitoring systems at both ground level and along vertical profiles;
c) the constant mutual exchange between the project partners and the Observers of the project (representative of a wide variety of stakeholders interested in the project results);
d) the adoption of both bottom-up and top-down approaches in dealing with finding solutions to the big challenges faced by BB-Clean;
e) the creation of technological, economic and informative tools to foster low carbon policies

were the pillars that guided BB-Clean till the project results.

All BB-Clean partners now hope to reap the rewards of their hard work.

For all the details visit the BB-Clean website at: www.alpine-space.eu/project/bb-clean.

PARTNERS

UNIVERSITÀ CATTOLICA del Sacro Cuore

ucsc.it

Università Cattolica del Sacro Cuore is one of the most important Catholic Universities in Europe. It has 4 campuses in Milan, Rome, Brescia and Piacenza-Cremona. At the Department of Mathematics and Physics (Brescia Campus) a research group focused on Atmospheric Physics has a big expertise on air quality monitoring and gases (O_3, CO_2,NO_X) and PM exchange between the surface and the atmosphere thanks to a 20 years experience of National and EU projects linked to the mitigation of air pollution both in urban and alpine environments.

ARPA Valle d'Aosta

arpa.vda.it/en/

The Regional Environmental Protection Agency of Aosta Valley (ARPA VDA) is an instrumental body of the Aosta Valley Autonomous Region. The Air and Atmosphere Office is in charge of monitoring the air quality in Aosta Valley, operating within the regulatory framework which derives from the European guidelines. The Energy Office is aimed to give technical and scientific support to Regional Administration, specifically on energy efficiency and renewable energy sources development.

Pays du Mont-Blanc
communauté de communes

ccpmb.fr

The CCPMB is a public authority regrouping 10 municipalities located in the Northern French Alps. It deals with environmental protection, transport, territorial development and waste management and it carries out environmental awareness campaigns. Two pilot actions are in progress to reduce the impact of biomass combustion on air quality: specific subventions for wood craftsmen companies and the implementation of an air ambassador program to raise citizens' awareness.

votre parten'air
Atmo
AUVERGNE-RHÔNE-ALPES

atmo-auvergnerhonealpes.fr

Atmo Auvergne-Rhône-Alpes is the observatory approved by the Ministry of Ecology, Sustainable Development, and Energy to monitor and provide information about air quality in the AuRA Region, with 5 missions: observe AQ through a monitoring system; help decision-makers develop medium/long-term action plans; inform citizens and encourage them to act at improving AQ; plan ahead through partnerships in EU programs; manage regional coordination and share resources to ensure consistency with national guidelines.

KSSENA

kssena.si

KSSENA offers a substantial amount of expertise relevant to the project proposal, gained trough the successful implementation of activities in the field of energy efficiency, exploitation of renewable energy sources and energy management of local communities. The Agency has experience in the development of local energy concepts, sustainable energy action plans as well as providing feedback on proposed national energy strategies.

ezavod.si

The mission of the E-institute is to support sustainable development focusing on environmental, economic and social aspects. E-institute follows major European and global trends and is striving to transform them into the applied projects performed on international and national level. Within the past 15 years E-institute implemented more than 50 international projects focusing on minimizing climate change, introduction of smart cities, supporting circular economy and using open innovation.

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FH JOANNEUM (FHJ) was established in 1995. With its 50 degree programmes in the area of Management & Technology, Architecture & Civil Engineering, Business, Information Engineering, Media & Design and Social & Health Services it is one of the leading universities of applied sciences in Austria. Research and development is a core area of activity with the aim of contributing to social development and solving complex problems and issues of our time.

ec[o]ncept
agency for sustainable design

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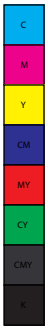
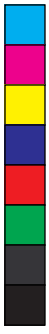
We understand us as enabler for all types of sustainable innovation and design for sustainability. Since more than 20 years we are supporting our clients around the world in developing environmentally friendly products, concepts, designs and visionary scenarios. We have assembled an extensive Ecodesign toolbox that we use as needed. We have been appointed by various companies and political organizations as experts, have done various sustainability projects, and developed long experience on business model innovation.





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