

— LAYMAN'S REPORT —

GreenStove

Gas Renewable
Eco Energy Nature Stove
[Project title]

LIFE GREEN-STOVE
[Project acronym]

LIFE20 ENV/IT/000190
[Project number]



The LIFE GREEN-STOVE - LIFE20 ENV/IT/000190 project has received funding from the LIFE programme of the European Union.

GreenStove

Project title:

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Coordinating beneficiary

PALAZZETTI

PALAZZETTI LELIO SPA

Associated beneficiary

Atech
electronics

ATECH ELEKTRONIKA D.O.O.

RVDistribution

RVDISTRIBUTION SRL

Project budget and requested eu funding

Total project budget: 2,207,327 Euro

Total eligible project budget: 2,116,727 Euro

EU financial contribution requested: 1,164,199 Euro
(= 55.00% of total eligible budget)

Start date: 01/09/2021

End date: 29/02/2024

SUMMARY DESCRIPTION OF THE PROJECT

In Europe, 77% of thermal energy for heating is generated by boilers, predominantly fueled by fossil fuels (95%), with only 5% powered by renewable energy. Other significant sources include district heating (12%), electric radiators (7%), and stoves (3%).

Biomass emerges as the primary renewable energy source, accounting for 96% of the renewable heat market and dominating direct heating uses. In 2017, approximately 40 EJ of biomass was used for heating in various sectors such as residential, commercial, and agriculture, making up about 95% of its total usage in these sectors.

In Europe, the use of woody biomass and in particular of wood pellets for residential heating has increased in recent years.

In 2019 EU member states produced about 17 million metric tons of wood pellets and consumed about 27 million metric tons, of which 10 were imported mainly from North America and China (source: Bioenergy Europe Report 2019). A significant portion of the consumed pellets (15 million metric tons) went to heat production by pellet stove for residential heating, commercial heating and combined-heat-and-power applications.

Pellets are a versatile solution that can contribute to EU decarbonisation in accordance with the goals of European Green Deal and the overarching objective of a “climate neutral” Europe to reach netzero greenhouse gas emissions by 2050 and a “pollution-free environment”.

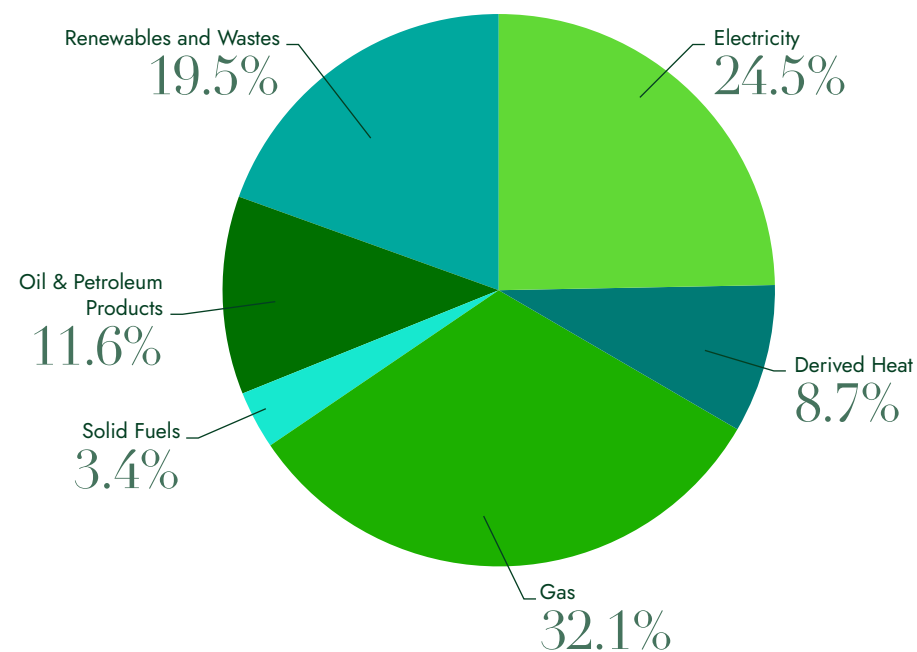
Moreover, the proposed technology is fully in line with 6 out of the 17 objectives of the Sustainable Development Goals (SDG) i.e.: Affordable and Clean Energy (objective n°7), Sustainable Economic Growth (n°8), Industry, Innovation and Infrastructure (n°9), Sustainable Cities and Community (n°11), Responsible Consumption and Production (n°12), Climate Action (n°13).

ENVIRONMENTAL PROBLEM TARGETED

Households use energy for various purposes: space and water heating, space cooling, cooking, lighting and electrical appliances. According to Eurostat, in 2018 households, or the residential sector, represented 26,1% of final energy consumption in the EU.

Households primarily use energy for home heating, accounting for 63.6% of the final energy consumption in the residential sector. Electricity for lighting and most appliances represents 14.1% of usage, with water heating slightly higher at 14.8%. Cooking devices require 6.1% of household energy. Space cooling and other end-uses constitute 0.4% and 1.0% respectively, making heating of space and water combined 78.4% of household energy consumption.

Final energy consumption in the residential sector by fuel, EU-27, 2018



The analysis highlights that residential heating consumes a significant amount of energy, predominantly from non-renewable sources. **The project focuses on encouraging biomass use to enhance the renewable energy share and make heating practices more sustainable.**

Bioenergy is key in achieving the EU's goal of 20% renewable energy by 2020. According to plans set in 2010, the demand for biomass for electricity, heating, and transport is expected to hit 178 million tons of oil equivalent by 2020. Looking to the future, the EU has set a new goal for 32% renewable energy by 2030. The EU considers biomass as carbon neutral, believing that the carbon emitted when biomass is burned will be offset by the carbon absorbed during the growth of new trees.

The energy and climate legislative framework of the EU is pushing for an increased use of biomass for energy purposes, including domestic heating where solid biomass is and will remain a pivotal fuel.

Unfortunately, biomass burning in domestic appliances is known to release substantial quantities of air pollutants. Data from the Emissions Database for Global Atmospheric Research (EDGAR) show that in the EUSDR area, emissions of biomass related PM2.5 in the sector "Energy in buildings" have increased by more than 60% since 1990.

Nowadays, the Ecodesign Directive (EU 2015/1185) is the reference regulation at the European level for defining the emission limits and performance at the product's output that biomass heating appliances must comply with. In Italy, there is also a Legislative Decree (7/11/2017 No. 186) called "5 Stelle Aria Pulita" (5 Stars Clean Air), which is more stringent than the Ecodesign.

The chart reports the main reference parameters for the two legislations:

	ECODESIGN Commission Regulation (EU) 2015/1185	5 Stars Clean Air Legislative Decree (7/11/2017 No. 186)
Efficiency [%]	84	88
CO [mg/Nm³]	300	250
NOx [mg/Nm³]	200	100
OGC [mg/Nm³]	60	10
PM [mg/Nm³]	20	15

CO Carbon Monoxide / NOx Nitrogen Oxides / OGC Organic Gas Compound / PM Particulate Matter

From these values originates the **Life Green Stove project**, which aims to reduce emissions in the field of biomass-burning home heating products.

PROJECT OBJECTIVES

The main objective of LIFE GREEN-STOVE is to strongly reduce the pollutant emission of pellet stoves and optimize the use of biomass to replace fossil fuels in the production of thermal energy for residential heating, working on efficiency, clean combustion and control technologies. **LIFE GREEN-STOVE reduces the risks for health and environmental impacts, fully in line with EU Green Deal goals and the EU Clean Air Policy.**

The core of the project is the realisation of a pellet stove with a completely new combustion process, with the main aim of reducing emissions. Thus, the LIFE GREEN-STOVE project combines for the first-time automation with the gasification process of pellet, generating a class of pellet stoves that combines the advantages of the two technologies in terms of control, efficiency and emissions.

The fundamental principle is based on the separation of the combustion in two stages:

- in the first stage, a partial oxidation process is initiated by a hot mixture containing water vapor, CO₂ and low concentration of oxygen in such a way as to produce a gas (syngas).
- the second stage is based on the syngas combustion, through a hot-air mixture.

This is the main basis innovative technology applied for the project development.

TECHNICAL OBJECTIVES

1. Demonstrating and validating a new biomass downdraft gasification system. **This system decreases pollutant emissions.**

	ECODESIGN Commission Regulation (EU) 2015/1185	5 Stars Clean Air Legislative Decree (7/11/2017 No. 186)	Life Green-Stove Target – Life20 ENV/IT/000190
Efficiency [%]	84	88	92
CO [mg/Nm³]	300	250	100
NOx [mg/Nm³]	200	100	60
OGC [mg/Nm³]	60	10	5
PM [mg/Nm³]	20	15	5

2. As the quantity of emissions and thus combustion residues drops, so does the overall maintenance of the product. **This offers both environmental and technical benefits improving the usability of the product.**
3. The product must integrate with a smart home concept, exploiting IoT technologies. Therefore, **the product is connected to the network, exchanging operating data with other associated devices or systems.**

OUTCOMES

With this purpose, fifty prototypes have been developed and assembled for use in real-life contexts.

Some of these prototypes were installed in both residential and industrial premises, covering a wide range of climate conditions (from Southern Italy to Northern Belgium) and thermal needs (house dimensions and thermal insulation).

The installed prototypes were constantly monitored remotely to verify their proper functioning by logging of technical data about environmental performances. The activity concluded with technical project adjustments that led to the filing of three patents and the CE certification of the product. The technical report which assesses the Green-Stove's performances is "DIN EN 14785 Report No. K3420 20223".

The following table summarises the emissions values

LIFE GREEN-STOVE OUTCOMES DIN EN 14785 Report No. K3420 20223	
Efficiency [%]	90,7
CO [mg/Nm ³]	29
NOx [mg/Nm ³]	77
OGC [mg/Nm ³]	1
PM [mg/Nm ³]	9

Thanks to the efficiency values obtained, it reduces the consumption of pellets for domestic heating, achieving a very high yield for the product class in existence.

The Life Green Stove project has impacts on health and the environment. The individual emission classes have been greatly reduced both compared to the values of the Ecodesign directive and the "5 Stelle Aria Pulita" decree. With reference to the total emissions at the product's exit, the product derived from the LIFE GREEN-STOVE project reduces the cumulative value by 80%, standing at a total of 116mg/Nm³ compared to the 580mg/Nm³ established by Ecodesign. Comparing the value with the "5 Stelle Aria Pulita" decree, the reduction is 69%. The emission classes of greatest interest for these products are those that determine particulate matter such as PM and OGC. The focus on these two categories again highlights the results obtained with the LIFE GREEN STOVE project with a reduction of the total residual outputs, from 80mg/Nm³ established by Ecodesign to a value of 10mg/Nm³. The reduction of particulate classes is -87.5%.

	ECODESIGN Commission Regulation (EU) 2015/1185	5 Stars Clean Air Legislative Decree (7/11/2017 No. 186)	Project Target Life20 ENV/IT/000190	Certification results - DIN EN 14785 Report No. K3420 20223
Efficiency [%]	84	88	92	90,7
CO [mg/Nm ³]	300	250	100	29
NOx [mg/Nm ³]	200	100	60	77
OGC [mg/Nm ³]	60	10	5	1
PM [mg/Nm ³]	20	15	5	9
	580 [mg/Nm³]	375 [mg/Nm ³]	170 [mg/Nm ³]	116 [mg/Nm³]
	-80%			

	ECODESIGN Commission Regulation (EU) 2015/1185	5 Stars Clean Air Legislative Decree (7/11/2017 No. 186)	Project Target Life20 ENV/IT/000190	Certification results - DIN EN 14785 Report No. K3420 20223
Efficiency [%]	84	88	92	90,7
CO [mg/Nm ³]	300	250	100	29
NOx [mg/Nm ³]	200	100	60	77
OGC [mg/Nm ³]	60	10	5	1
PM [mg/Nm ³]	20	15	5	9
	80 [mg/Nm³]	25 [mg/Nm ³]	10 [mg/Nm ³]	10 [mg/Nm³]
	-87,5%			

TRANSFERABILITY

The replicability of this product is enabled thanks to the new production line, which will increase the assembly efficiency, the worker's comfort, the handling of components and the overall quality. This brand new plant allows us to reduce assembly times.

The technical and commercial documents have been redacted, as technicians, technical assistants and commercial staff have been trained specifically on Green-Stove features. A particular focus was dedicated to the two-stages combustion process.

From the very first manufacturing of these prototypes, an appliance was installed within Palazzetti Per Te Showroom, in order to increase its visibility.

Life Cost Analysis and Social Economical Impact have been realized in order to evaluate environmental and social impacts of this innovative stove relying on databases, data collection and a survey purposely created.

CONNECTIONS AND SPREAD

Webpage and social media:

This project is displayed with a reference landing page: <https://greenstove.eu/en> where additional information, material and activities can be found. There were a total of 955 sessions by a total of 413 users.

These are the figures concerning social media:

	Number of posts	Views	Video played	Spreading	Reactions	Interactions	Clics
Meta	25	64732	57052	119	1359	99036	24
Linkedin	12	14145	2879	59	329	1614	804

Press Conference:

The Life Green-Stove has been the subject of press articles in national and international newspapers and magazines since 2021, when the project first started.

Final Conference:

During the press conference on 21st February 2024 in Pordenone, Italy, Palazzetti introduced its LIFE Green-Stove project, a significant step towards reducing emissions and aligning with the EU Green Deal's sustainability goals. The event, featuring speakers from politics, business, and environmental sectors, focused on combating global warming. Palazzetti's project, started in 2021 with Slovenian and Belgian partners, aims to innovate pellet stoves for lower emissions and better integration with SmartHome technologies. Discussions also covered the importance of bioenergy, the strategic role of wood as a biofuel, and future goals for energy efficiency and emission reduction, highlighting a unified approach to achieving EU sustainability targets.

This Press Conference was attended by political personalities such as the Mayor of Porcia Marco Sartini, MEP Rosanna Conte, and we had the pleasure of being greeted by the Deputy Minister of the Ministry of the Environment and Energy Security Vannia Gava.

Ennio Prizzi of Bioenergy Europe addressed us on the role of bioenergy in the European Green Deal, there was a speech by Bernardo Martinez of DG Energy, then another by Annalisa Paniz of AIEL, and finally Chiara and Marco Palazzetti and Nicola Battistella gave a presentation on the Green Stove data.



Networking and sharing

This project allowed us to create connections with other LIFE projects and University, such as:

- LIFE GREEN FACTORY
- LIFE PrepAir
- LIFE ALL-IN
- LIFE CLEAN HEAT
- University of Bolzano

Documentation:

Technical and commercial documentation has been provided to support technicians and commercial network.



Patents:

Three WorldWide patents have been filed to protect the intellectual property of technological innovation and enrich the database available to the scientific community.

The patents are:

- WO 2022/208564 A1
- WO 2022/208565 A1
- WO 2022/208566 A1

Notice board:

The notice board with the project progress report was realized and showed during the public activity of the LIFE Green-Stove.

Fairs and Exhibitions

This innovative stove was showcased at leading trade fairs in Europe.

- Progetto Fuoco May 2022
- Lyon Fair March 21-23 2023
- Leipzig Fair April 17-19 2023
- Valladolid Fair May 9-11 2023

Trade fairs were attended by industry stakeholders such as dealers, technicians, and final users.



A special area was set up for this project during these exhibitions.



SKI
BUM



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