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# Action Plan

Region of Päijät-Häme
Innovation and Skills in Finland 2021 – 2027
Finland's Structural Fund program

Developed by the partner:
**LAB University of Applied Sciences**

LAB University of Applied Sciences

Low-carbon economy

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# I. AP CONTEXT OF RES IN INDUSTRY

## I.I. AP GENERAL INFORMATION

| | |
|---|---|
| Project | RESINDUSTRY |
| Partner organisation | LAB University of Applied Sciences |
| Other partner organisations involved (if relevant) | Regional Council of Päijät-Häme<br>Juha Hertsi, Regional Development Director<br>juha.hertsi@paijat-hame.fi |
| | |
| | |
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| NUTS2 region | Etelä-Suomi |
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## I.II. CONTEXT OF LAB RES ASSESSMENT

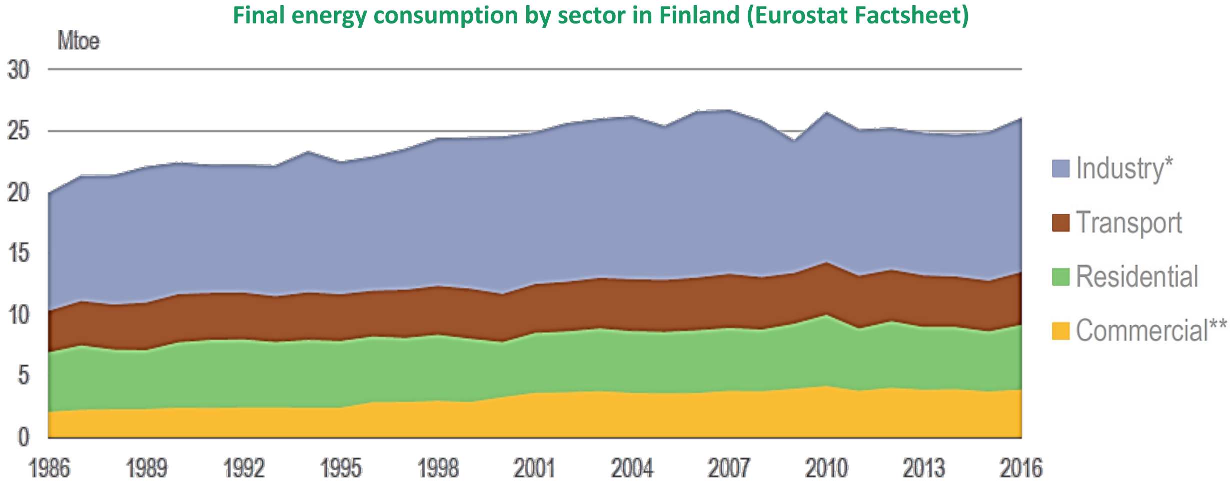
Energy consumption in the industrial sector

The industry sector is the largest energy consumer in Finland, accounting for nearly half the energy final consumption. Large shares of biofuels, electricity (nuclear) and district heating in the energy supply make the industry sector a relatively small emitter of carbon dioxide (CO2), compared to the heat and power, and transport sectors.

Facts:

- ✓ Final energy consumption in the industry: >13 Mtoe (biofuels and waste, together with electricity and oil account for more than 80% of total consumption)
- ✓ Share of total final consumption: 47.8%
- ✓ Share of energy-related CO2 emissions: 16.4%

**Final energy consumption by sector in Finland (Eurostat Factsheet)**




Final energy consumption of industry by sources are:

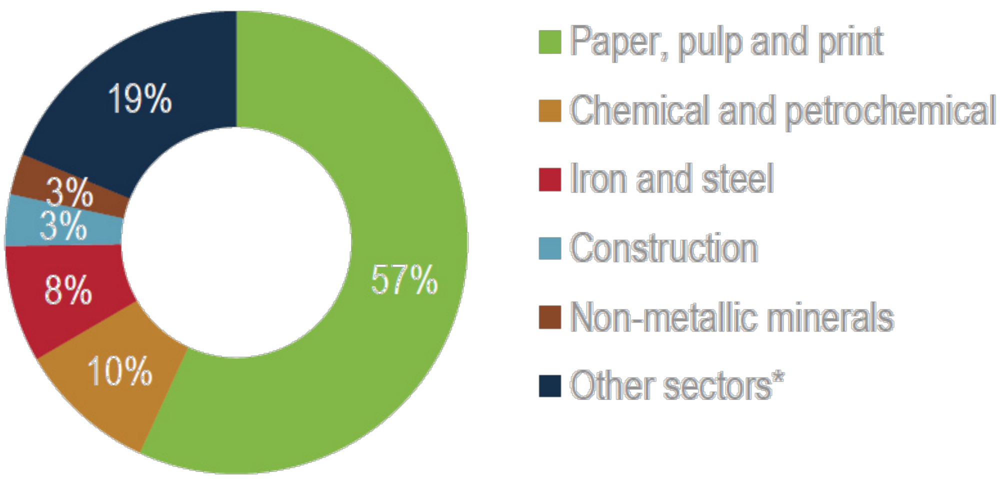
- Biofuels and electricity are the fuels most used in industry, together accounting for 57% of total energy demand in the sector.
- Oil is the third-most used fuel, accounting for around 24% of consumption, of which half is for non-energy use.
- District heating accounts for 11% of energy use in industry,
- The remaining consumption is made of small shares of natural gas, coal and peat.

National profile of the industrial sector

Finland is a country rich in forest resources, which is reflected in industrial production. The paper, pulp and print industry is by far the largest in terms of energy consumption and accounts for more than 50% of energy final consumption in the industry. Thanks to a large reliance on biofuels, however, the paper industry accounts for less than one-third of industrial CO2 emissions. Other industry sectors that depend more on fossil fuels, such as construction, metals and minerals industries, are relatively heavy emitters.

Finland's tax policy has affected the competitiveness of natural gas, and gas use in CHP/district heating is not affordable compared to coal, peat and bioenergy (energy tax, including the CO2 tax, for natural gas has sharply increased since 2011).

**Final energy consumption by industrial sector 2016 in Finland (IEA 2018)**




Energy intensity in industry

In Finland, although primary energy intensity decreased over the 2005-2015 period, it remains above the EU average, and it decreased at a slower pace. A sectoral assessment shows that the **energy intensity of Finland's industry** is one of the highest in the EU and has been quite stable over the last ten years. This is also, to a lesser extent, true in the services sector, and the energy intensity of households is also above the EU average.

Additional efforts could therefore be envisaged to improve energy intensity in these various demand sectors but keeping in mind that certain industrial processes (i.e., steel) are already very efficient and so the potential for additional improvements remains limited.

In the last 10 years, industrial energy intensity decreased by 1.5 per cent/year. Efficiency gains were mainly reported in the cement industry (1.7 per cent/year decrease in the energy consumption per ton of cement). However, a slight increase was seen in the unit consumption of the two largest energy-intensive branches, namely paper (1 per cent/year hike between 2000 and 2010) and steel (+0.7 per cent/year).

Even if the overall energy intensity of industry is gradually decreasing, this does not apply to all sectors. In addition to paper, other non-metallic industries increased their energy intensity over the last period.

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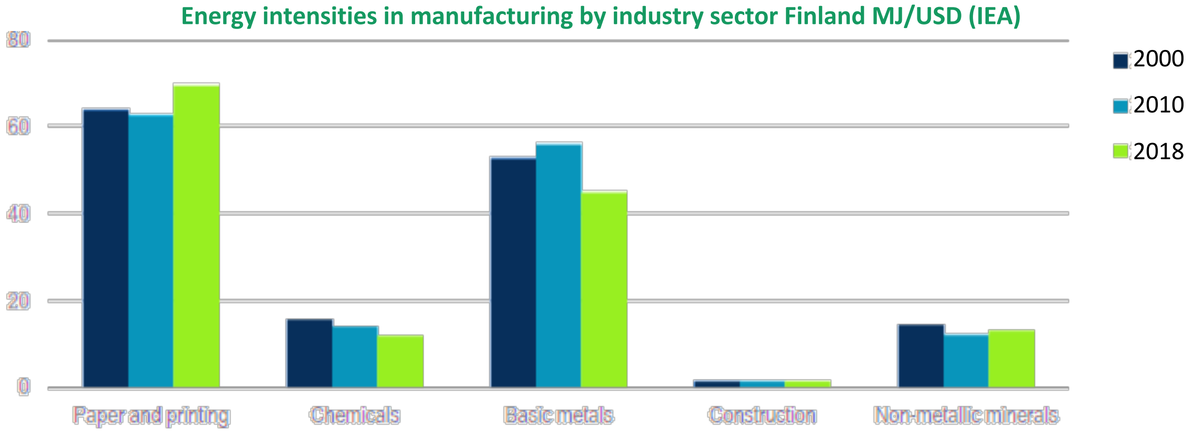
**Energy intensities in manufacturing by industry sector Finland MJ/USD (IEA)**




Energy intensity in terms of energy consumption per value added in industry differs a lot for different industry sectors. Overall, the energy intensity in manufacturing industries has declined over the last decade and a half, indicating more efficient production.

In certain sectors such as the paper industry, however, the trend has been increased energy intensity. This can be explained by structural changes in the industry, as demand for more expensive printing paper is declining while demand for cheaper packaging material is increasing.

In relation to the added value that the different industries provide at the national level, it is interesting to identify that the sectors with the highest energy intensities cover only a small share of gross value added.

On the other hand, other non-intensive energy consumer industries, such as machinery, provide more than 30% of the total industry added value, while consuming less than 1/3 of the average intensity of the total national industry.

On the opposite, the metal industry provides an energy intensity 8 times the national average, while the added value of this industry at the national level is less than 5%.

**Energy intensities trend in manufacturing by industry sector 2000-2015 (Eurostat)**

| | Energy intensity (toe/1000 €) | GVA share |
|---|---|---|
| Metals | 1,68 | 3% |
| Chemical and Petrochemical | 0,65 | 4% |
| Non-Metallic Minerals | 0,63 | 4% |
| Paper, Pulp and Print | 0,51 | 3% |
| Wood and Wood Products | 0,33 | 2% |
| Food and Tobacco | 0,22 | 6% |
| Textile and Leather | 0,23 | 1% |
| Transport Equipment | 0,06 | 20% |
| Machinery | 0,06 | 30% |
| Non-specified (Industry) | 0,12 | 10% |
| Mining and Quarrying | 0,10 | 2% |
| Construction | 0,03 | 16% |
| **Total Industry average** | **0,19** | **100%** |

Renewable energy use in the national industry

Biofuels account for the largest share of energy final consumption in the industry sector. Most energy consumed in industries, except for electricity, is used for producing heat to heat processes and buildings.

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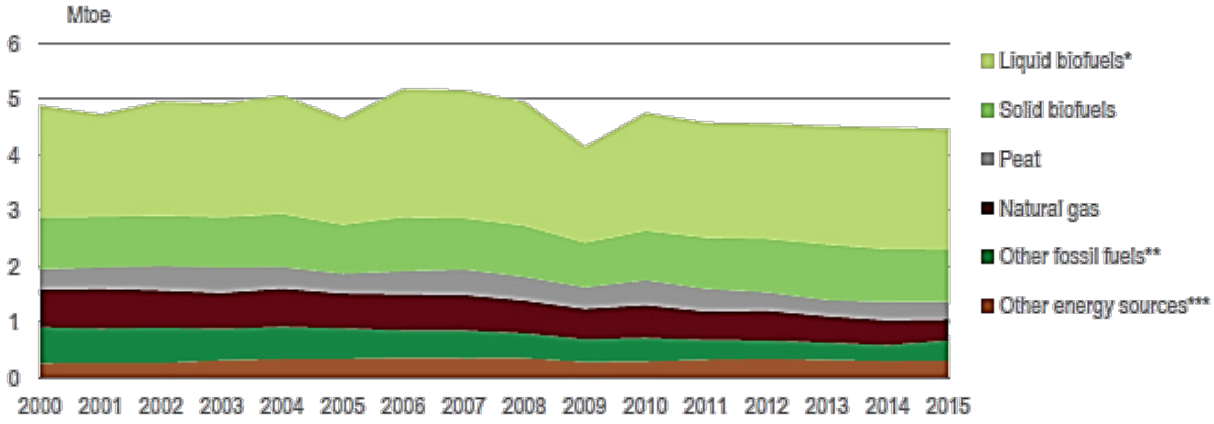
**Industrial heat production by source, 2000-15 (Statistics Finland 2017)**




Industrial heat production is heavily dominated by biofuels, of which black liquor accounts for the largest share. Black liquor is mainly produced and used internally in pulp and paper industry processes. In 2015, liquid biofuels accounted for 47% of total heat produced in industries, and solid biofuels for another 21% (Statistics Finland, 2017).

The share of biofuels has increased from 60% in 2000 to 70% in 2015. However, 24% of industrial heat is still produced with fossil fuels. There is potential for further growth in biofuels, e.g. to replace peat, which accounts for 7% of heat production in industries.

The industrial sectors selected.

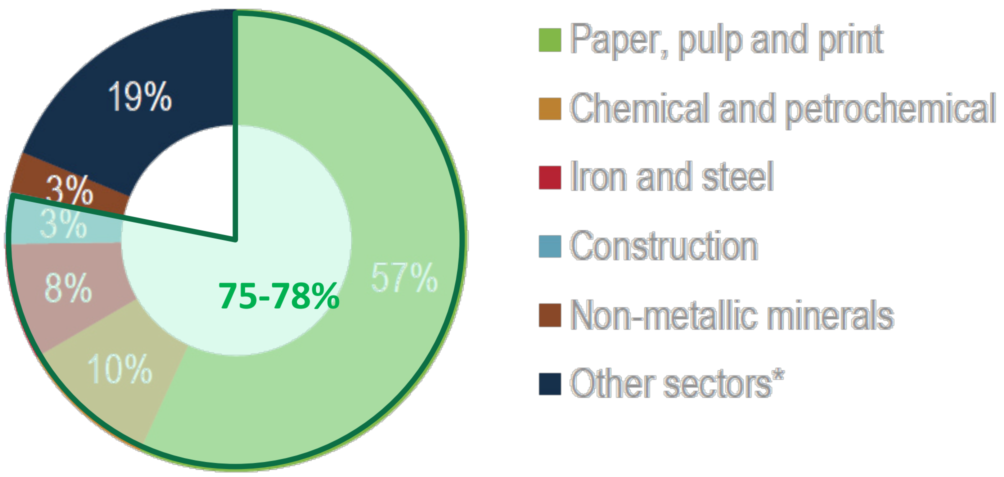
The Market Analysis carried out in the Regional Assessment of the industrial energy sector, has provided a detailed view of the energy consumer sectors of the national and regional industry, with the information necessary to propose a measure to integrate renewable energies in these industries.

In the market analysis, 4 of the major energy-consuming sectors of the industry were selected to be analysed in detail:

- Paper
- Chemical
- Steel and metals
- Non-metallic

These sectors reach 78% of the total industrial energy consumption, being the most consuming sectors of the industry at the national level.

**Sectors selected and their final energy consumption share (IEA 2018)**



The Key Performance Indicators (KPI) analysed

In the Market Analysis, KPIs were defined in order to make easier the comparisons with the energy consumption between industrial sectors, or even between national sectors at the EU level, trying to provide conclusions on the different countries. KPIs support decision making by defining frames where the total energy consumption of the industries can be disaggregated by potential RES technology.

KPIs have been applied to a range of well-developed and sustainable renewable technologies that can provide electricity and heat in a cost-effective way when conditions are favourable. Such sources can provide electricity and heat directly to the industry through on-site technologies, or via centralised district networks.

As the analysis must be made from the point of view of the public administration, where public funding is to be allocated to leverage private investment, in the "conclusions" chapter, these KPIs have been transformed into impacts for each public euro invested. The conclusions have provided final KPIs for the public administrations in reference to every 1.000€ invested of public money:

| KPI indicator (for every 1.000€ of public funding) |
| --- |
| RES supported (kWth) |
| RES produced (kWh th) |
| Full-time employment (FTE) |
| Avoided emissions (Ton CO2) |

## II. POLICY CONTEXT

| Name of the policy instrument addressed |
|---|
| Innovations and Skills in Finland 2021–2027 (Uudistuva ja osaava Suomi 2021-2027), Finland's Structural Fund programme |

| The Action Plan aims to impact: | X | Investment for Growth and Jobs programme |
|---|---|---|
| | | European Territorial Cooperation programme |
| | | Other regional development policy instruments |

### II.I. DETAILS OF THE OP ADDRESSED

The policy instrument addressed is the continuation of Sustainable growth and jobs 2014–2020, Finland's Structural Fund programme originally listed in the application form of RESINDUSTRY for LAB University of Applied Sciences. The original policy instrument funding period has ended, and we were not able to achieve any policy change with it and so are unable to further influence it. However, the programme continues with the new funding period 2021–2027 which this action plan will influence.

The Innovations and Skills in Finland 2021–2027 program contains six policy lines in total. In the context of renewable energy, the relevant policy lines are Innovative Finland (1) and Carbon neutral Finland (2), both funded by the European Regional Development Fund (ERDF):

- Innovative Finland (1): The aim is to promote the research and innovation capacity of regions and companies based on business and working life and the introduction of new technologies. Funding will increase the growth and competitiveness of SMEs.
- Carbon-neutral Finland (2): The aim is to promote energy efficiency and a circular economy and to reduce greenhouse gas emissions. Funding will also be allocated to preparing for climate change.

They contain the following relevant specific objectives for this action plan:

- 1.1 Improving research and innovation capacity and uptake of advanced technologies: the key objective is to increase RDI intensity and promote business-driven innovation, considering climate and sustainable development objectives.
- 2.1 Promoting energy efficiency measures and reducing greenhouse gas emissions: the objective is to promote a transformation of the energy system towards a rapid and significant reduction in greenhouse gas emissions. The systemic change will affect the energy-intensive industry, the building stock and energy production, among others.

Especially specific objective 2.1 is aligned with regional strategies by supporting low-carbon solutions to reach the national RES (38%), EE (310 TWh), and CO2 reduction (-16%, outside emission trade) directive targets for 2020. In Päijät-Häme, the investments in RTD remain under 1% of GDP and require more RES project investment to foster the RTD.

Päijät-Häme is Finland's 2$^{nd}$ largest regional centre of cleantech business, internationally known for expertise and solutions. Päijät-Häme is a region with traditions in triple helix cooperation of higher education, businesses, funding institutions and relevant public sector in cooperation with the Regional Council of Päijät-Häme (RCPH). The region hosts experienced RDI in environmental technology as well as several medium and big businesses in circular economy including the energy sector. Also, the development of energy storage technologies and solutions is in line with the program.

There is high potential in the regional SMEs, such as in the sector of hybrid renewable energy solutions. Energy and RES are prioritized in the following ways in Päijät-Häme:

- Regional strategy (2018-2021)[1]: The previous regional strategy. Circular economy, including energy, is one of the core themes. RES is the main implementation tool for the low-carbon lifestyle. Development for refining opportunities, including intermediates such as bio-oil and methane, as the municipal waste is just incinerated. Decentralized energy production and industrial symbiosis.
- Regional strategy (2022-2025)[2] and implementation plan (2021)[3]: The new regional strategy contains a “reforming, carbon-neutral Päijät-Häme 2030” framework to facilitate the green transition. Energy

and resource efficiency is a cross-sectional smart specialisation spearhead. The goal is to decrease energy use and carbon emissions while following zero-loss principles through circular economy.
- Climate action roadmap (2020)[4]. Supporting energy efficiency improvements, production of renewable energy, clean electrification, and promotion of heat pumps. Seven municipalities in the region (Asikkala, Hartola, Heinola, Hollola, Kärkölä, Lahti, Orimattila, and Padasjoki) have signed a voluntary 7,5 %energy efficiency improvement agreement for the period 2017-2025.

[1] https://paijat-hame.fi/wp-content/uploads/2020/02/Maakuntastrategia_ja_ohjelma_2018-2021_nettiin.pdf
[2] https://paijat-hame.fi/wp-content/uploads/2021/12/171121Maakuntastrategia_2022-2025.pdf
[3] https://paijat-hame.fi/wp-content/uploads/2021/03/Toimeenpano_ja_selviytymissuunnitelma2021.pdf
[4] https://paijat-hame.fi/wp-content/uploads/2022/03/Climate_Action_Roadmap_english-update.pdf

## II.II. PROPOSAL OF IMPROVEMENT IN THE APPLICATION FORM

The application form defined the expected improvement that the project activity would be able to apply to the Policy Instrument, by describing the necessities to cover and the type of actions foreseen to be implemented at the end of the project, in phase 2.

In the LAB case, the necessities to be covered and the expected changes in the Policy Instrument are:
- ✓ Efforts are needed to intensify collaborations between R&D institutions and SMEs, to build sustainable networks and ecosystems able to join transnational value chains.
- ✓ Critical mass needs to be created via combining complementary capacities and joining value chains in circular economy practices.
- ✓ The operating conditions of companies should be improved; Transnational/international support is needed for boosting innovation and brokering new connections, facilitating start-ups and spinoffs to ensure regeneration and new energy for the economy.
- ✓ Päijät-Häme is seeking to establish an innovation platform around environmental technology including also the energy sector.

Even if Specific Objective 3.2 focuses on the promotion of REs in all sectors, the investment in industry and business is low and must be increased taking as reference the good samples of the paper industry. Public and private efforts must be doubled to decrease energy intensity and reach the national RES targets.

Biomass technology must be boosted ahead, but other technologies will have to be analysed based on the EU samples coming from other regions.

Through the learning process and the Action Plan activities, the project is expected to influence the Policy Instrument. In terms of results, the influence on policy instruments can be produced in various ways which can sometimes be interconnected. The program Manual pre-identify some influences to be achieved in phase 2:

- ➢ Type 1: implementation of new projects, where managing authorities and other relevant bodies can find inspiration in other regions and import new projects to be financed within their programmes.
- ➢ Type 2: change in the management of the policy instrument (improved governance), where cooperation influences the way policy instruments are managed. New approaches are adopted thanks to the lessons learnt in other regions.
- ➢ Type 3: change in the strategic focus of the policy instrument (structural change), which is the most challenging since it requires a change in the operational program. Integrating the lessons learnt from the cooperation means that authorities modify existing measures in their program.

Following these guidelines and predefined improvements, LAB identified several potential improvements to be achieved in its Policy Instrument:

A) TYPE 1: IMPLEMENTATION OF NEW PROJECTS
The policy instrument may provide funding for the project proposals focused on RES applied to the industry, which will lead to RTD activities or triple helix cooperation to promote start-ups and growth companies in the field of cleantech including RES technology, and applied integration of these solutions to the industry sector.

Higher RES investment and higher RTD activities integrated into the industry will support the decrease of the energy dependency of the finish industry sector.

B) TYPE 2: CHANGE IN THE MANAGEMENT OF THE PI / IMPROVED GOVERNANCE.
Different managing authorities of the ERDF in the region (Regional Council and regional state authorities) should increase discussion and management of the environmental dimension of the OP. It is possible to launch new thematic calls focused on RES investment in industry, integrating objectives and KPIs of R&D&I activities or triple helix cooperation to promote start-ups and growth companies in the field of cleantech (inc. RES and EE solution).

The onsite demonstration of the RES innovations is one of the key factors to introduced technology in the markets, so the link between RES investment policies and RTD development policies should be coordinated. The outcomes of "Strategic Analysis of RES Technologies applied in industries", with a report of KPIs, and the proposed "Monitoring system for calculating the long-term impact of SF" will help improve the management of OP.

The application form has also included some specific indicators which helped to analyse the level of success in the improvement of the policy instruments, both for the evaluation of the final improvement and the intermediate steps to achieve this improvement.

In terms of the final aim of the RESINDUSTRY project, the measure must be the increase in energy independence of the European industry sector through higher integration of Renewable Energy Sources, by improving or launching new policies for RES promotion supported by SF. Thus, the primary impact is to improve the use of Structural Funds or other policy instruments.

In this framework, RESINDUSTRY had to improve the implementation of more than 8,1 M€ of SF:

- Czech Republic SO 3.2 with € 418,577,442 is expected to influence a 0,1 % (4,185M€)
- Päijät-Häme SO 3.2 counts on 18,46M€ expect to influence a 5% (0,846M€)
- Extremadura ROP, IP4.1. with 6.571.952 € expect to influence a 10% (657.195 €)
- Estonian Cohesion OP SO2.4.4. with more than 150 M€ is expected to influence 1M€.
- ROP Świętokrzyskie Region priority 3 with 12% of 980M€, expect to act over 1% (1,3M€)
- Vorarlberg ROP, with more than 50M€ in M02, expects to influence 0,1% (0,4M€)
- Gozo fund to create an Eco-Island is expected to influence 2,5M€

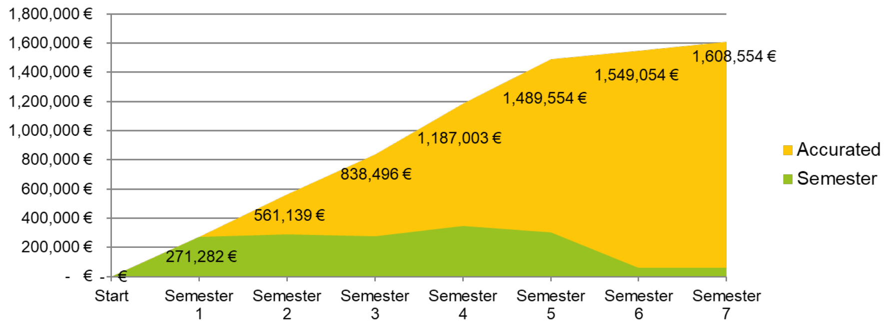
In order to achieve the final indicators of Structural Funds improvement, other indicators were defined to assure the final objective:

- Output indicators
- Self-defined (RES mainly) indicators
- Economic indicators

| OUTPUT INDICATOR | TARGET |
|---|---|
| Number of policy learning events organized | 83 |
| Number of good practices identified | 10 |
| Number of people with increased capacity due to participation in cooperation activities | 90 |
| Number of action plans developed | 7 |
| Number of appearances in media (e.g. press) | 60 |
| Average number of sessions at the project pages per reporting period | 800 |

| SELF DEFINED INDICATOR | TARGET |
|---|---|
| kW RES power installed in industry | 6.600 |
| Number of projects of RES in the industry | 10 |
| Number of enterprises receiving support | 60 |
| Number of industries with new RES | 15 |

| ECONOMIC INDICATORS PHASE 1 | | | | | | PHASE 2 | |
|---|---|---|---|---|---|---|---|
| Start | Semester 1 | Semester 2 | Semester 3 | Semester 4 | Semester 5 | Semester 6 | Semester 7 |
| - € | 271.282 € | 561.139 € | 838.496 € | 1.187.003 € | 1.489.554 € | 1.549.054 € | 1.549.054 € |
| - € | 271.282 € | 289.857 € | 277.357 € | 348.507 € | 302.551 € | 59.500 € | 59.500 € |



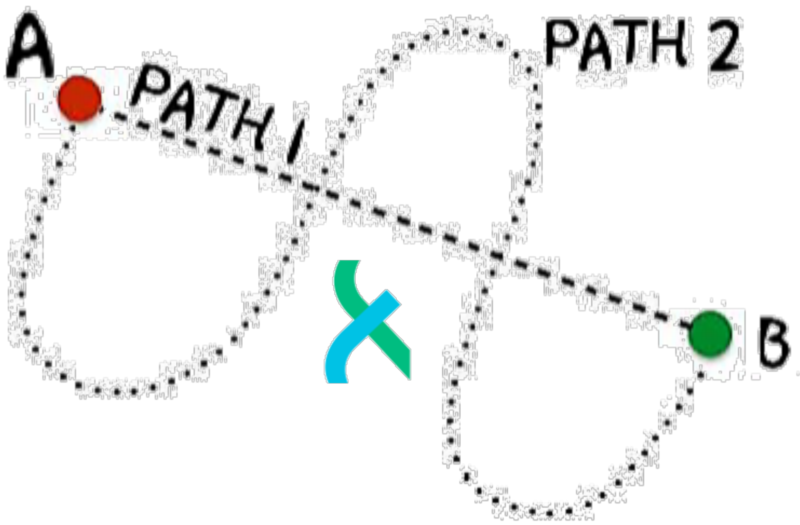
## III. THE LEARNING PROCESS OF LAB

Phase 1 of LAB has followed the indications of the learning process and approach described in the application form, which was also a transcription of the minimum structure that a learning process should have based on the Program Manual.

Phase 1 of LAB has been focused on promoting the exchange of experience with the rest of the partners through an interregional learning process. This learning process has been the main catalyst for generating the knowledge that LAB required for achieving the expected policy change in its Policy Instrument.

The LAB learning process has been based on the identification of necessities, analysis and exchange of knowledge with the rest of the partners and selection of best policy practices of Renewable energies applied in industries.

The best practice identification, analysis and selection, have been one of the main axes of work in the RESINDUSTRY project. RESINDUSTRY partners have analysed the experiences and practices in each region, exchanged them within the projects and disseminated the most interesting findings.




The learning actions planned and implemented.
RESINDUSTRY counted on partners that had participated in previous Interreg Europe projects and had provided specific knowledge to design the project approach. Their conclusions were:

- Interregional workshops are more valuable when there is time enough for stakeholders' face-to-face talks.
- Study visits require prior information about study sites, with an initial explanation of the visit, the content and the technical data the visit will show.
- There must be designed new specific tools to increase the capacity of a large group of stakeholders from the same region.

As a result, RESINDUSTRY designed in the application form a series of already known and new activities to assure a proper learning process for the project participants:

- INTERREGIONAL WORKSHOP (IW): interregional technical meetings of stakeholders, consisting of half-day face-to-face work of staff and stakeholders, in small groups, for core technical activities and decision making of the project.

- STUDY VISITS (SV): interregional exchange of knowledge, consisting of half-day visits to identify best practices of interest for the consortium, including a previous explanatory session during IW.

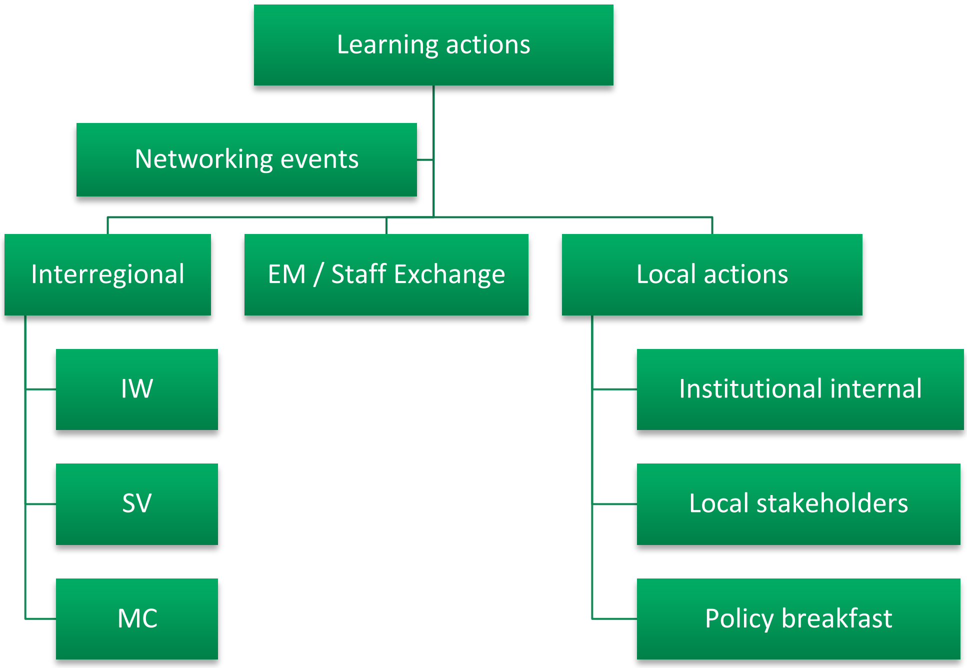
- MASTER CLASS (MC): one day of interactive tuition and training focusing on core project topics, and developing capacities. The format of the classes includes lectures, workshop activities, and case studies from experts and organisations relevant to RES project investments.

- EXPERT MISSIONS (EM): as a result of Study Visits partners will be able to require the mission of one expert from the institution which provided the best practice, to provide tailor-made training.

- LOCAL STAKEHOLDER SEMINAR (LSS): consists of 20 partner staff and stakeholders participating in any consortium learning activities will meet at LSS at the end of each semester to discuss progress, and provide feedback.

- POLICY BREAKFAST (PB): partners will organize a meeting with high policy representatives to speak about one key outcome of the project, obtain feedback about products or present a policy recommendation.

- INSTITUTION INTERNAL MEETING (IIM): staff participating in any consortium and partner learning will gather with other colleagues at the end of each semester to report the activities.




## III.I. THE APPROACH OF LAB TO THE POLICY INSTRUMENT IMPROVEMENT.

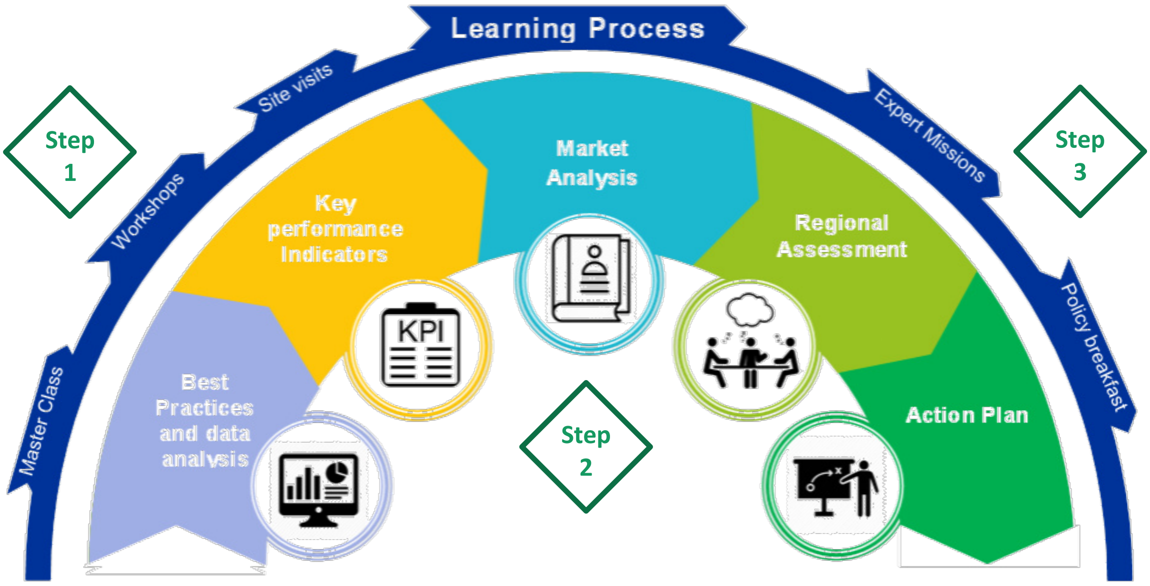
To ensure a successful learning process for LAB, even if each activity planned in RESINDUSTRY was defined in a robust quality manner, each partner defined an integrated approach where all activities are logically interlinked. Successful approaches usually follow a logical path.

LAB integrated approach to the learning process has the following 3 simple steps:

- Step 1: analysis of partner situations, and identification of valuable experiences.
  The standard approach is to start with the analysis of the different partners' situations and the identification of valuable experiences and practices.

- Step 2: experience further analysis through activities.
  This valuable experience is then further investigated through activities such as study visits and thematic workshops.

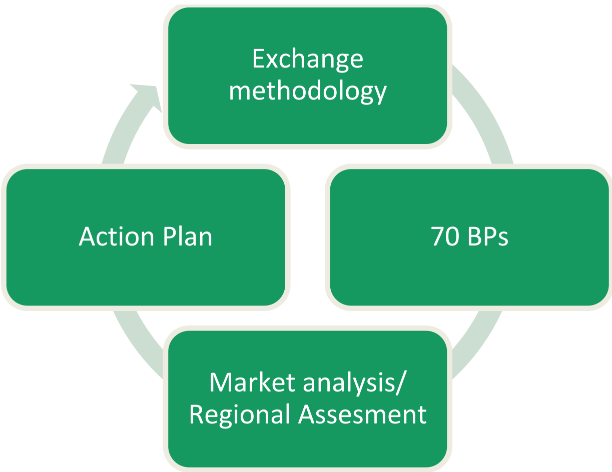
- Step 3: preparation for the transfer of practices summarized in action plans.
  Finally, the transfer of knowledge and practices is mainly prepared through the elaboration of the action plans (but can also occur during the exchange of experience phase of the project).




LAB has implemented the different steps through activities that resulted in tangible products and deliverables, which have also supported further activities with a final result of the present Action Plan.

The **main products** produced by LAB have been:

- The Exchange Methodology.
- The Market Analysis
- The best practices list and final selection.
- The Regional Assessment
- The current Action Plan



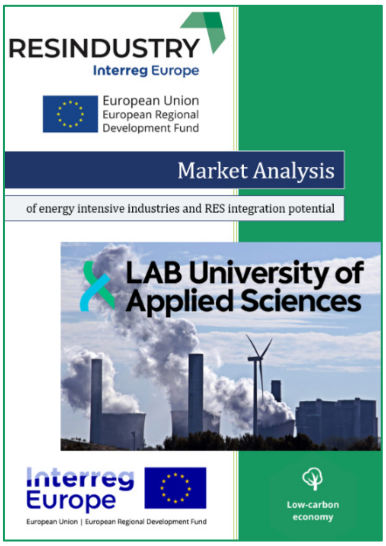

## LAB MARKET ANALYSIS

In order to reach the long-term objective of RESINDUSTRY, the project focuses on improving the efficacy of public financing and public tools which support the RES implementation in the industry sector.

The first step in this process was to identify the current situation of the sector in the area to be influenced. The current situation analysis is called in many ways in the Interreg Europe community, such as regional identification, state of art, regional analysis, etc. and the name provided in RESINDUSTRY is Market Analysis.

The Market Analysis includes a macro analysis of the industrial sector, identifying the industry energy consumption profiles, and analysing the RES technologies with the potential to be applied in the national industries. Both, the industry profiles and RES technologies, are analysed using macro data, from national official sources, and they are completed when other official local or regional data is available or supplied by local actors.

The energy consumption of the industry, in each region and country, defer greatly depending on the availability of the resources (gas, coal, nuclear, etc.), either national or from the neighbourhoods, while the future perspective will only depend on the natural resources available on the spot.



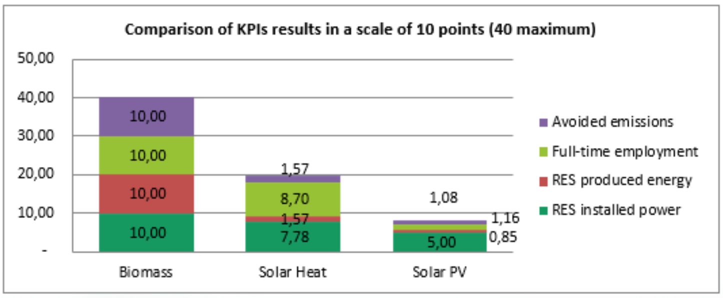

Market Analysis Objective

The Market Analysis is also referred to in the RESINDUSTRY project as a "Strategic Analysis of RES Technologies applied in industries". This analysis provides each partner with a report of energy and socioeconomic Key Performance Indicators (KPIs) which will be used to review grants management in the P.I., so the Market Analysis will improve the way thematic calls are organised and/or the way projects are selected.

This analysis provided, for each technology with the capacity to be integrated into the national/regional industry, a description of KPI indicators in terms of energy generation, value-for-money, jobs creation, environmental impact, etc. Market Analysis is the base source of information for the Regional Assessment, where the partners integrated the information coming from the Best Practices and the Market Analysis data and obtained the final situation of the regions.

Key Performance Indicators (KPIs) vary between partners because they analysed the specific region necessities/resources and provided customized solutions to confront the RES benefits vs the policy investment.

**Sample image of KPIs analysis in LAB Market Analysis**




Similarly, the current profile of the industrial energy consumption will be the main baseline condition for the identification of RES technologies with the best economic opportunities, the natural resources available in each region will influence the efficiency of technologies, resulting in different KPIs for the different partners.

Market Analysis Conclusions

The Market Analysis conclusions provide a view of macro data related to national industrial energy, proposing a list of RES technologies and KPIs in the area. The Market Analysis, together with the Best Practices, fed into the Regional Assessment, which is the departing point for the Action Plan.

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## LAB BEST PRACTICES

The exchange of experience among RESINDUSTRY partners was the main catalyst for generating policy changes among participating regions. The learning process is based on the identification, analysis and exchange of knowledge and practices in the RESINDUSTRY policy field.

In the RESINDUSTRY case, good practices must aim at the identification of renewable technologies implemented in industries, especially if they have been supported by public funds.

The samples focused on the local resources and available technologies, so the results differ between countries and partners, but the global results allow the comparison and the transfer of knowledge among regions. The best practices show a minimum of information in order to create a baseline of comparison among country practices and project practices.

LAB produced 10 practices to be exchanged with RESINDUSTRY partners and described the practice following the project template, which included technical data defined by the consortium, especially reference to KPIs also included in the Market Analysis. Some of the data in each practice are:

- Identification of the current energy baseline (fuels, energy consumption, etc.)
- RES technology definition (fuel, installed power, generated energy, CAPEX, simple payback, etc.)
- Results in terms of energy, economic and environmental achievements.

**List of LAB practices**

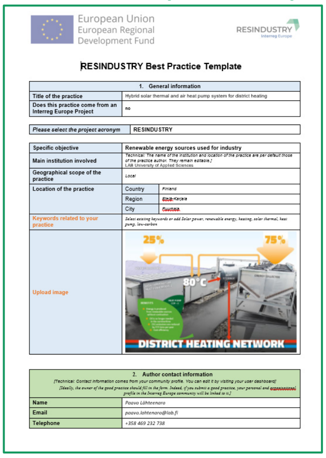
| Title of practice selected by LAB, location and technology | Place | RES |
|---|---|---|
| Concept for a carbon-neutral grocery store | Lahti | PV |
| Biofuel production from food industry residues | Lahti | Biofuels |
| Hybrid solar thermal and air heat pump system for district heating | Puumala | ST + HP |
| Biomass Heating Production in Food Industry | Lahti | Biomass |
| Geothermal heating of factory using heat pumps | Lahti | Geothermal |
| Solar power plants integrated efficiently with commercial real estate | Lahti | PV |
| Utilization of biowaste streams - bio-based industrial symbiosis as RES | Lahti | Biogas |
| District heating production from renewable sources | Lahti | Biomass CHP |
| Biogas from wastewater sludge as a replacement for fossil fuels in burning | Heinola | Biogas |
| Biomass boiler for the efficient drying process | Lahti | Biomass |

Key Performance Indicators (KPIs), calculated in the Market Analysis were calculated on officially available data, while the best practices are real data from practical samples on the region or the country. This provided the opportunity to adjust the KPI by comparing the results from the Market analysis with the results from the best practices.

In order to compare best practices among each other, special indicators were developed among partners on a regular base just adding the scoring of the different evaluation criteria. Partners evaluated each practice following the proposed criteria, identifying those practices with higher replication potential.

RESINDUSTRY Interreg Europe | European Union European Regional Development Fund | Interreg Europe European Union | European Regional Development Fund

### Sample of best practices, and best practices scoring based on replication indicators

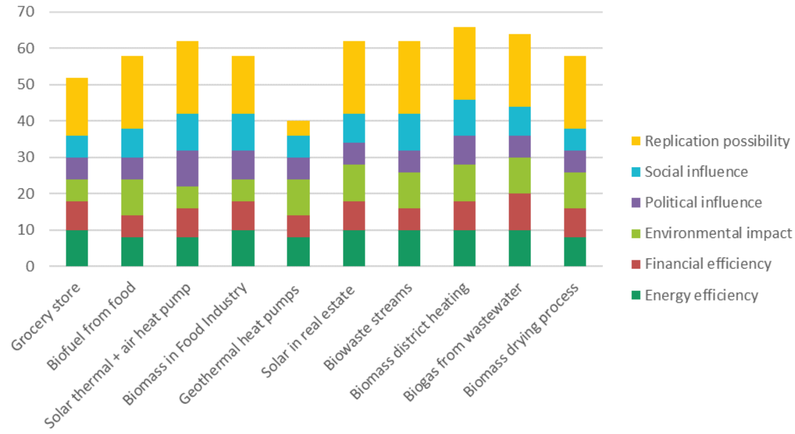

European Union European Regional Development Fund

RESINDUSTRY Best Practice Template

| 1. General information | |
|---|---|
| Title of the practice | Hybrid solar thermal and air heat pump system for district heating |
| Does this practice come from an Interreg Europe Project | no |
| Please select the project acronym | RESINDUSTRY |
| Specific objective | Renewable energy sources used for industry |
| Main institution involved | LAB University of Applied Sciences |
| Geographical scope of the practice | Local |
| Location of the practice | Country: Finland; Region; City |
| Upload image | |



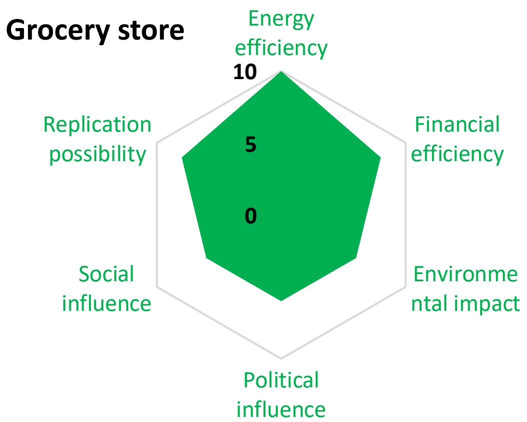
| 2. Author contact information | |
|---|---|
| Name | |
| Email | |
| Telephone | |

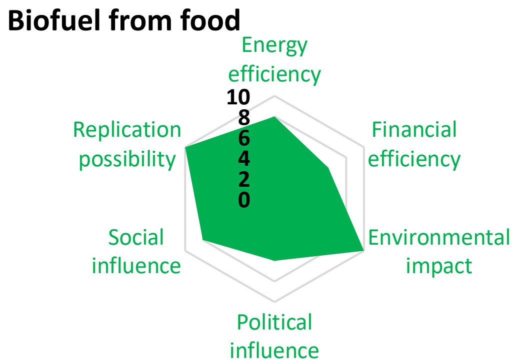


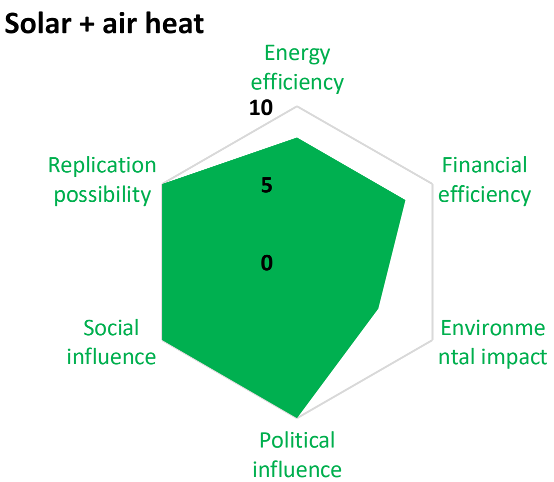

The replication indicators were applied to each practice, allowing a deep understanding of the potential impact if applied to other industries or places in the region, allowing also a better comparison with existing practices in other partner countries.

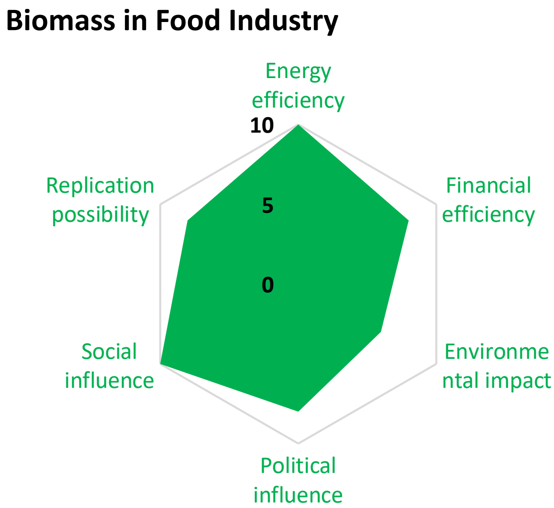
The results from the best practices comparison were gathered in a specific deliverable to be used by LAB stakeholders and the rest of the partners.

### Sample of best practices analysis on replication indicators



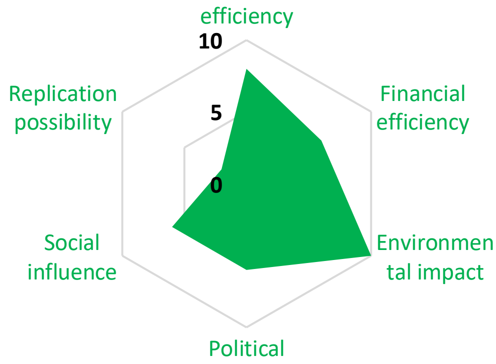



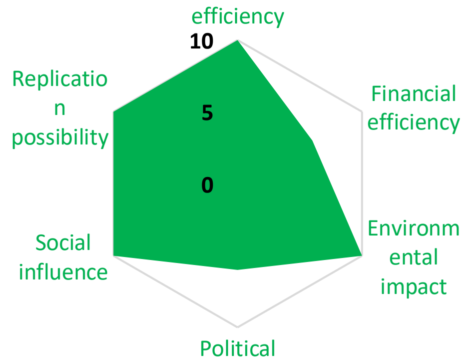
Action Plan



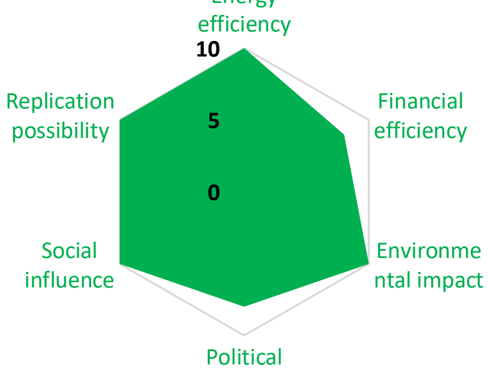
**Geothermal pumps**



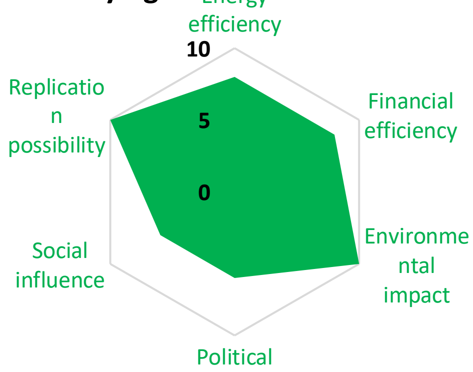

**Biowaste streams**



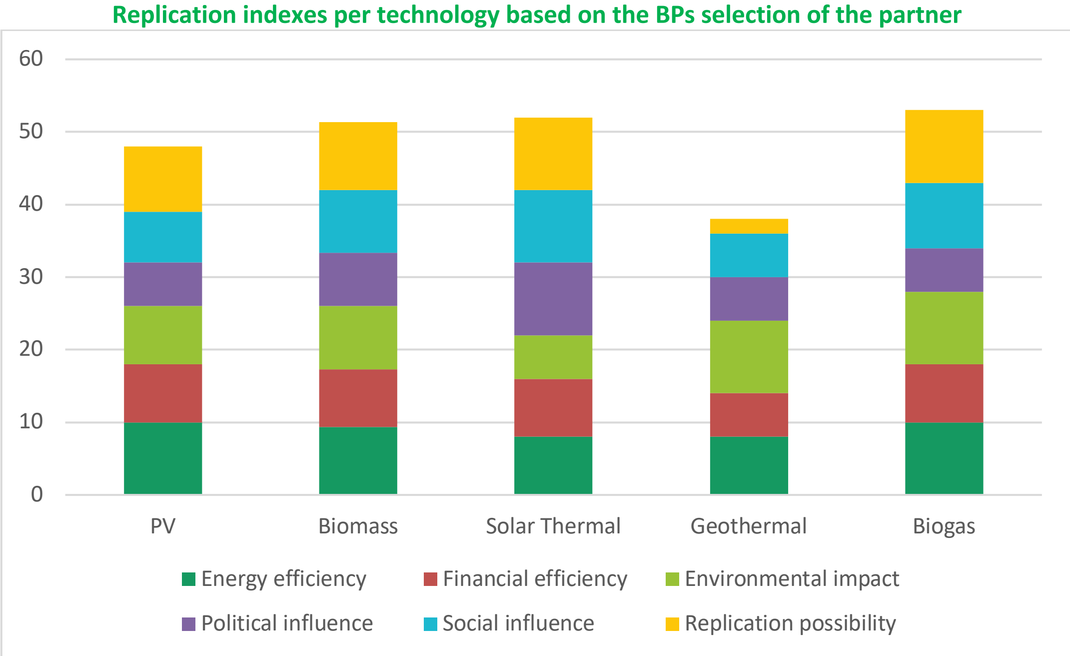

**Biomass district**



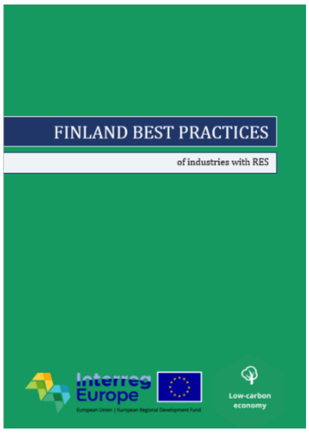

**Biomass drying**




**Replication indexes per technology based on the BPs selection of the partner**




Low-carbon economy

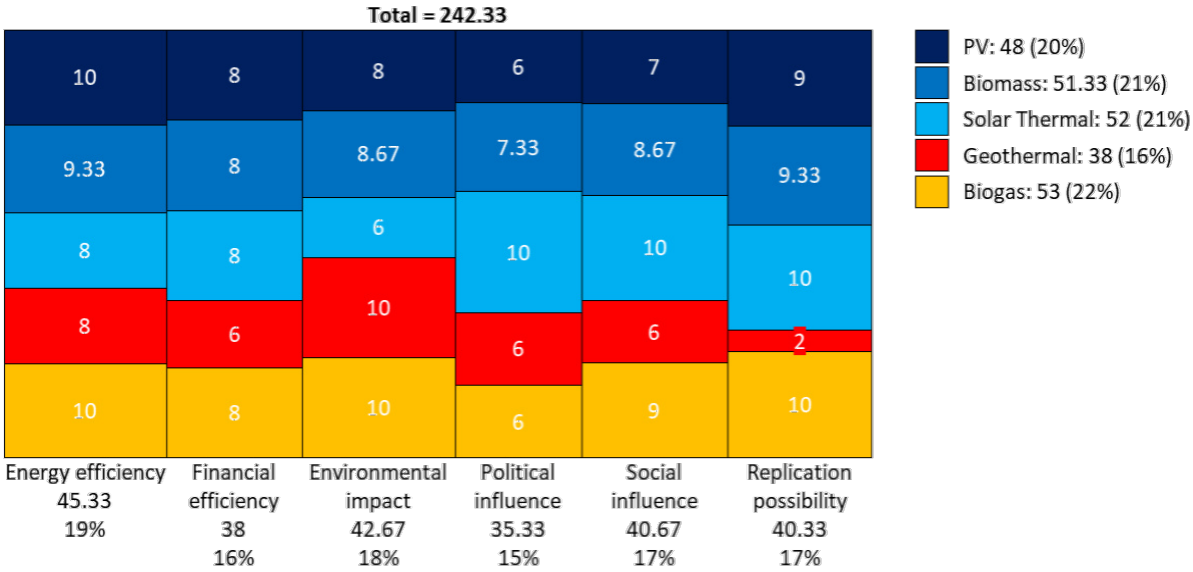



In terms of technology, the replication potential has been calculated as an average of the 10 practices and the 2 practices from the Interreg Platform.

Per technology, and without application of any leverage factor, the results show that biomass technology and solar thermal technologies reach higher scoring than the rest of the technologies, being PV and biogas just after the 2 first.

The relation between the technologies and the criteria used for scoring shows again the biomass and solar as higher scores, but also provides that the energy efficiency and the environmental impact are the criteria which afford higher benefits in the best practices, being the financial efficiency one of the less influencing criteria. The following Sankey chart shows the relations among the technologies and their influence on the different criteria.

**Best practices comparison report and a sample of analysis**



RESINDUSTRY Interreg Europe

European Union European Regional Development Fund

Interreg Europe European Union | European Regional Development Fund

## LAB REGIONAL ASSESSMENT

PART 1 – MAIN ECONOMIC INDICATORS IN THE REGION

| | | | | | |
|---|---|---|---|---|---|
| Gross Domestic Product in EURO | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 6,289,500,000 | 6,489,100,000 | 6,567,800,000 | 6,710,900,000 | data unavailable |
| Gross Domestic Product per capita in EURO | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 40,258 | 41,284 | 42,534 | 43,117 | 43,563 |
| Inflation % | 2015 | 2016 | 2017 | 2018 | 2019 |
| | -0.2 | 0.4 | 0.7 | 1.1 | 1.0 |
| Unemployment rate % | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 9.4 | 8.8 | 8.6 | 7.4 | 5.9 |
| Monthly salary in EURO (Median) | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 2,963 | 3,001 | 3,018 | 3,079 | 3,140 |
| Sold production of industry per capita in EURO | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 14,181 | 14,196 | 15,695 | 16,656 | 16,830 |
| Renewable energy share in electricity production % | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 35 | 34 | 37 | 46 | 43 |
| Emission of CO2 tons/year | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 55.1 | 58.1 | 55.4 | 56.4 | 52.8 |
| Planned emission reduction by 2030 at the national level % | 55% | | | | |
| Share of Industry to total GDP | 2015 | 2016 | 2017 | 2018 | 2019 |
| | 37 % | 36 % | 38 % | 39 % | 39 % |

PART 2 – INDUSTRY AND RES POTENTIAL IN THE REGION

| | |
|---|---|
| Predominant industry sectors in the region | 1.Machinery and metal products<br>2.Forestry (Paper Pulp and Lumber)<br>3.Food<br>4.Chemicals |
| Type and share of energy sources used in industry | coal 10 %<br>natural gas 9 %<br>petroleum 11.2 %<br>RES 65 %<br>other, what kind? Peat...................5%<br><br>Regional data is non-existent, using national data |
| A type of renewable energy used in industry | √ solar energy<br>√ geothermal energy<br>√ environmental energy<br>√ biomass<br>√ biogas<br>√ wind energy<br>☐ hydropower<br>☐ other, what kind? ............................................... |
| Installed capacity at individual sources in the region, including data source [MW] | 0.5 MW - Biogas power plants<br>19 MW( Heinola fluting) 190 MW 8 MW 12 MW 3 MW (Adven Heinola) Biomass power plants<br>1,2 MW + numerous small ones totalling maybe 10 MW Solar power plants<br>0 MW - Wind power plants<br>Only tiny ones >1 MW are not worth listing - Hydroelectric power stations<br>160 MW Power plants implementing co-firing technologies (voimalaitosrekisteri, powerplant registry, Finnish Energy Agency) |

| | |
|---|---|
| Total installed capacity of renewable energy sources in the region in MW | ~400 (estimated including small solar, hydro and industrial biomass burning) |
| PREDOMINANT INDUSTRY SECTOR No. 1 (for example FOOD INDUSTRY)<br>Machinery | |
| Investment costs in EURO | 36 M€ |
| Investment scope | (For example, modernization of technological lines, technological heat recovery, heating / DHW / cooling (heat pumps, solar collectors, PV, thermal modernization, trigeneration), lighting (energy-saving power supply), energy monitoring) |
| Energy efficiency % | data unavailable |
| Annual Energy efficiency in MWh/year | data unavailable |
| Reduction of Energy costs | Companies prefer to keep their energy prices secret, industry-specific data NA |
| Reduction of CO2 Emissions tons/year | 567 (From SYKE numbers calculated from the period of 2005-2018) |
| Reduction costs calculated by the DGC method tons/year | data unavailable |
| Type and % share of energy consumption in key industry sectors | space heating<br>domestic hot water<br>technological goals<br>ventilation / air conditioning<br>transport |

| | |
|---|---|
| PREDOMINANT INDUSTRY SECTOR No. 2<br>Forestry | |
| Investment costs in EURO | 29,5 M€ |
| Investment scope | (For example, modernization of technological lines, technological heat recovery, heating / DHW / cooling (heat pumps, solar collectors, PV, thermal modernization, trigeneration), lighting (energy-saving power supply), energy monitoring) |
| Energy efficiency % | data unavailable |
| Annual Energy efficiency in MWh/year | data unavailable |
| Reduction of Energy costs | Companies prefer to keep their energy prices secret, industry-specific data NA |
| Reduction of CO2 Emissions tons/year | 464 |
| Reduction costs calculated by the DGC method tons/year | data unavailable |
| Type and % share of energy consumption in key industry sectors | space heating<br>domestic hot water<br>technological goals<br>ventilation / air conditioning<br>transport |

PART 3 – RES FUNDING SOURCES IN THE REGION

| | |
|---|---|
| What were the sources of renewable energy financing in the industry in the region in 2014-2020?<br>The amount of funds in EURO | Business Finland Energy aid<br><br>14 000 000 €<br>(approximated from total funds for all energy investments in the period) |
| Type of beneficiary (SME, large industry, agriculture) | SME, large industry |
| What was energy efficiency financing in the industry in the region in 2014-2020?<br>The amount of funds | 9.6 M€<br>(approximated from total funds for all energy investments in the period) |
| Type of beneficiary (SME, large industry, agriculture) | SME, large industry |
| What are the planned sources of renewable energy financing in the industry in the region in 2021-2027, and the planned amount of funds?<br>The amount of funds in EURO | From Business Finland estimated 4,4 M€ (From portion previously granted to Päijät-Häme, estimated future funding per year and portions of funding going to energy efficiency versus going to renewable energy. |
| Type of beneficiary (SME, large industry, agriculture) | SME, large industry |
| What is the planned energy efficiency financing in the industry in the region in 2021-2027, and the planned amount of funds?<br>The amount of funds in EURO | From Business Finland estimated 3 M€ (From portion previously granted to Päijät-Häme, estimated future funding per year and portions of funding going to energy efficiency versus going to renewable energy. |
| Type of beneficiary (SME, large industry, agriculture) | SME, large industry |

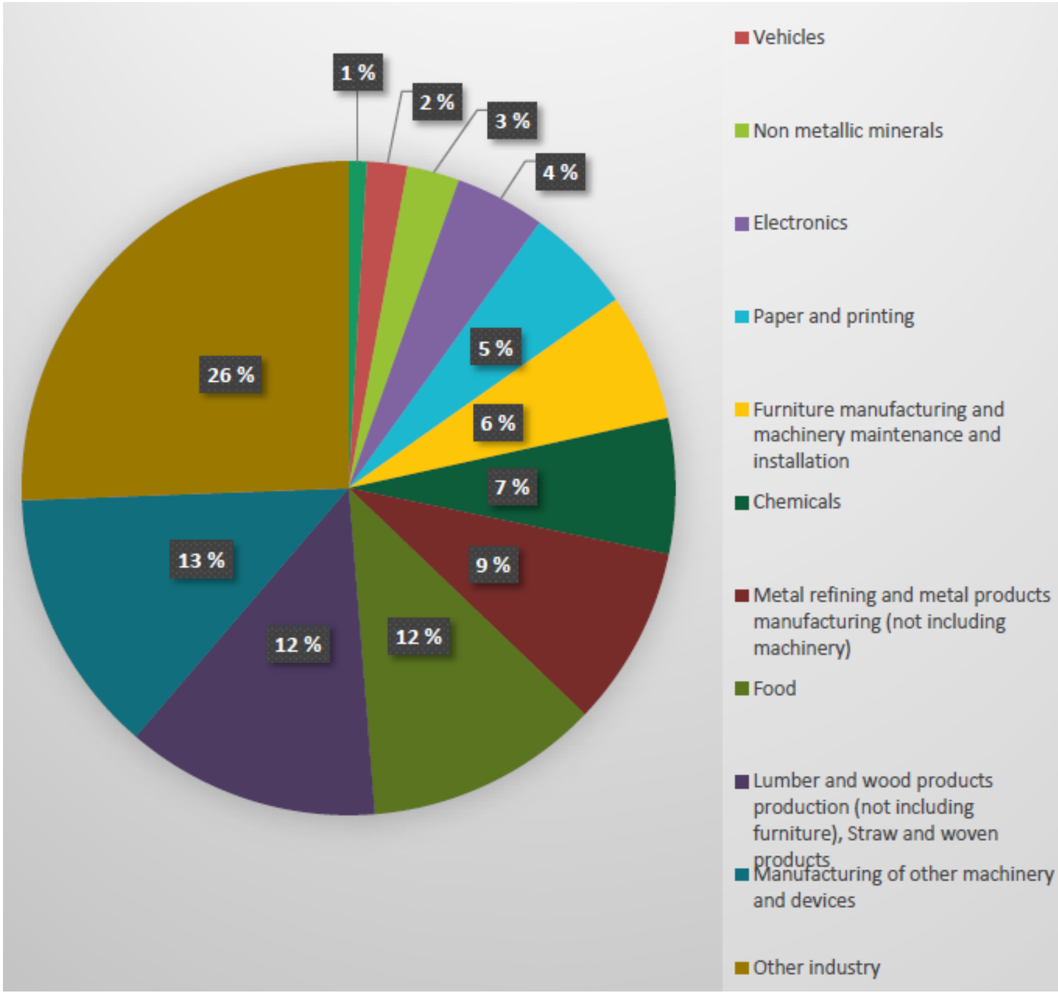
PART 4 – COMMENTS ON THE RA IN THE REGION

Try to evaluate the RES in your region by the SWOT analysis, where do you see the strengths, opportunities, weaknesses and threats for the usage of the RES in your region.

| | **Helpful**<br>(to achieve the objective) | **Harmful**<br>(to achieve the objective) |
|---|---|---|
| **Internal origin**<br>(attributes of the RES usage in the industry) | STRENGTHS<br>✓ Availability of biomass | WEAKNESSES<br>✓ Very little hydropower<br>✓ Weak sun<br>✓ Limited aid to biogas |
| **External origin**<br>(attributes of the environment) | OPPORTUNITIES<br>✓ Biogas<br>✓ Wind power | THREATS<br>✓ Forestry restrictions<br>✓ The difficulty of permits for RES (wind and biogas) |

Industry in Päijät-Häme

The size of industrial sectors was estimated based on data from Statistics Finland (Tilastokeskus). Sectors can be seen in the graph below:




Predominant industries were determined to be in order from larger to smaller:

- ✓ Machinery and metal products
- ✓ Forestry
- ✓ Food
- ✓ Chemicals

Because national-level data was on the level of the forest industry in general, we didn't consider lumber, pulp and paper to be separate industries but all part of the forest industry, as that was the level, we had data on. The constant issue with analysis was the lack of data, including lack of regional-level data and sometimes total lack of data at all.

The type and share of energy sources used by the industry were determined using national data. This skews the results as, for example, natural gas use is expected to be a greater portion in Päijät-Häme than it is nationally as large parts of northern Finland do not have access to the natural gas grid limiting its use by industry there.

National data was following:

| | |
|---|---|
| Coal | 10 % |
| Natural gas | 9 % |
| Petroleum | 11,2 % |
| RES | 65 % |
| Others | 5 % |

Attempts were made at trying to determine regional statistics for the share of different fuels used in industry but were frustrated by government statistics only existing for certain fuels and statistics mixing energy production and industrial use of fuels. Industry in Finland often is not only an energy consumer but a net energy producer. Specifically, this is common in pulp production but also many factories sell excess heat for district heating purposes. Therefore, it is hard to separate the consumption and production of energy in the Finnish industry specifically.

In total according to statistics, Finland's industry in the region uses 2230 GWh of energy annually, of which 670 GWh are electricity, the rest being heat.

Current state of Renewables production in the region

**Wind power**

In Päijät-Häme, there is no current wind power production. However, there are current wind power projects. One in Iitti with 20 MW peak power has gained construction permits. Another in Padasjoki with 36–60 MW peak power is in the land use plan process. As of writing these are in the planning stages. One already permitted project in Hartola with 7 MW peak power was cancelled in 2022.

**Hydropower**

There are numerous small dams, some of them already decommissioned in the region. However, all of them are very small, none of them larger than 1 MW. All added together they don't produce more than the estimated 2 MW power production making them quite insignificant.

**Solar power**

In Finland in 2019 total solar power production is estimated at 200 MW. Of this, approximately 10 MW are in Päijät-Häme. Counting all solar power is difficult and data is not readily available, yet we know of a few larger installations, as well as information from grid company Elenia, which publishes that its grid, which covers the northern half of the region, has a total of 2.6 MW of grid-connected solar energy production.

Outside this production, we know that various companies including S-Group, K- Group and Tokmanni have invested in rooftop solar for their properties. From these, we estimate roughly 10 MWs.

**Biomass**

Biomass makes up the vast majority of the region's renewable energy production. From the national powerplants registry we have made a list of the region's biomass burning plants:

| Plant | Fuel | Power |
|---|---|---|
| Kymijärvi III | Forestry waste | 190 MW |
| Stora Enso Heinola Fluting | Black liquor and bark | 19 MW |
| Fazer | Oat hulls | 8 MW |
| Viking Malt | Wood chips | 12 MW |
| Adven Heinola | Biomass | 3 MW |
| Kymijärvi II | Co-firing waste | 160 MW |

Some other small biomass heating plants exist for the industry but are not large enough for the registry and thus unaccounted for.

In total, the electricity production in Finland is approximately 85 % carbon neutral as of 2020. RES makes up around 51 % with 34 % nuclear power of total production. Separating Päijät-Häme from national statistics in carbon neutrality of electricity is impossible as the whole country is part of one national grid.

Calculations are further complicated by imported electricity, which makes up on average approximately 20 % of the national demand, and the carbon neutrality of which varies wildly depending on the country it is imported from, with Norwegian and Swedish electricity production being large carbon-neutral due to hydropower and nuclear power but Russian electricity being still heavily dependent on coal and only estimated 36 % carbon neutral.

RESINDUSTRY Interreg Europe

European Union European Regional Development Fund

Interreg Europe European Union | European Regional Development Fund

**Biogas**

The region has 4 active biogas production plants totalling approximately 60 GWh of annual production. Research done as part of RESINDUSTRY indicates wastewater, municipal biowaste and industrial biowaste are already highly utilized in biogas production with not much more room for growth in production and ever shortages of material, but lots of untapped material potential in agricultural biowaste, limited only by the economics of harvesting and transportation to production sites.

Industry analysis

The two most prominent industries in Päijät-Häme are machinery and forestry. Analysis performed on these industries included estimates on annual investments, as well as annual reduction of CO2 emissions.

Other figures planned for the analysis we were not able to present, such as energy cost reductions and industry-wide energy efficiency figures as such figures companies prefer to keep secret for reasons of competition. The figures we did gather are presented below in a table.

| Type | Machinery | Forestry |
|---|---|---|
| Annual investment costs in EURO | 36 M€ | 29,5 M€ |
| Reduction of CO2 Emissions tons/year | 567 | 464 |

We also looked into the past and future financing of renewable energy and energy efficiency measures in the region, with the information provided by Business Finland, which is tasked with the distribution of energy aid to suitable renewable energy and energy efficiency projects in Finland. The periods examined were 2014-2020 and 2021-2027.

The amounts were estimated as follows: 14 million € for renewable energy and 9,6 million € for energy efficiency in the past 7 years. in the next 7 estimated 4,4 million € will be given to renewable energy projects and 3 million € for energy efficiency projects.

SWOT analysis

A SWOT analysis was also performed as part of the greater regional analysis. This analysis is presented below.

| | **Helpful**<br>(to achieve the objective) | **Harmful**<br>(to achieve the objective) |
|---|---|---|
| **Internal origin**<br>(attributes of the RES usage in the industry) | STRENGTHS<br>✓ Availability of biomass | WEAKNESSES<br>✓ Very little hydropower<br>✓ Weak sun<br>✓ Limited aid to biogas |
| **External origin**<br>(attributes of the environment) | OPPORTUNITIES<br>✓ Biogas<br>✓ Wind power | THREATS<br>✓ Forestry restrictions<br>✓ Difficulty of permits for RES (wind and biogas) |

Low-carbon economy

## LAB ACTION PLAN


Produced in close cooperation between LAB and the Managing Authority, the present action plan is a document providing details on how the lessons learnt from the cooperation will be exploited in order to improve the policy instrument defined.

The present Action Plan specifies the nature of each action to be implemented, the timeframe, the players involved, the costs (if any) and funding sources (if any).

A sample template for the action plan is provided in the programme manual and has been considered for the definition of some chapters of this document, even if the final structure has been enlarged to explain the whole process followed by LAB to reach the present final document.

The structure of the Action Plan has been enlarged with the objective to create a full view of the deliverable produced by LAB and the activities where the staff and stakeholders have been involved.

The Action plan has described the following blocks of information:

- The context of the RES Assessment is based on the Market Analysis (National and regional).
- The Policy Instrument content and expected improvements.
- The deliverable produced by LAB through the project.
- The learning actions where LAB staff and stakeholders participated.
- The conclusions from the previous documents and activities.
- The proposed actions to create the policy change.

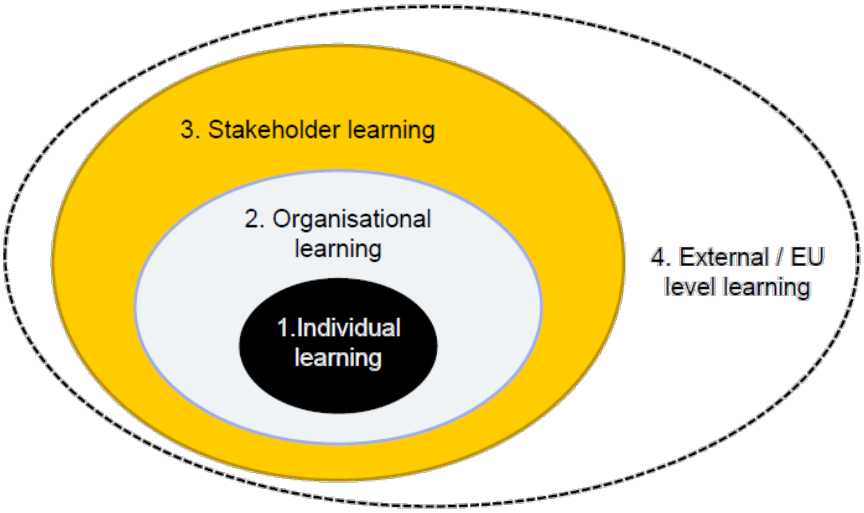
The content of this action plan has been submitted to the programme and published on the project websites.

## III.II. LAB ACTIVITIES AND LEVELS OF LEARNING COVERED

Through the implementation of the project actions, and the delivery of project products, LAB has achieved to produce a process of policy learning covering each of the expected 4 levels of learning. In this section, some samples of the learning activities are displayed.

Some of the LAB activities cover one single level of learning, but most activities achieve to cover several levels at the same time, especially individual learning which is always included.

When designing RESINDUSTRY methodology to carry out the interregional exchange of experience, partners paid particular attention to the multidimensional aspect of the learning process, so the learning process covered the four different levels.




This section shows how each of the deployed project activities has influenced several of the learning levels.

## INTERREGIONAL WORKSHOP (IW) AND STUDY VISITS (SV)

The main interregional face to face exchange was based on the workshops and study visits where stakeholders and staff from every partner region met to work on technical documents, share views and opinions, and visit new practices from the hosting partner. Each visit consisted of (due to the COVID crisis some of these activities had to change into virtual activities):

- Interregional technical meetings of stakeholders, consisting of half-day face-to-face work of staff and stakeholders, in small groups, for core technical activities and decision making of the project
- Interregional exchange of knowledge, consisting of half-day visits to identify best practices of interest for the consortium, including a previous explanatory session during IW.

Each interregional action has a dossier published on the website, where the information of the technical action is summarised. Additionally, this report is used for other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DOSSIER
1ST RESINDUSTRY MEETING
Prague, Czech Republic
22 – 23 October 2019

FH Vorarlberg

RESINDUSTRY – Policies for Renewable Energy Sources in industry | 1 / 22


European Union
European Regional
Development Fund
RESINDUSTRY

TROIL
INTERREGIONAL WORKSHOP (IW1) – BEST PRACTICE



Development of pilot plant for biogas production
- 60,000 tons of annual treatment with the possibility of 80,000 tons/ year

Grants: Decree 115/2015
- Investment cost 1 475 403 €
- Grant- 40% (300 000 €)

RESINDUSTRY – Policies for Renewable Energy Sources in industry | 20 / 22

The IW and SV have been technically developed as expected, with the exception of those face-to-face actions which had to be replaced for online activities due to COVID restrictions. The exchanges produced were:

INTERREGIONAL WORKSHOP IW1 ON BEST PRACTICE (BP) AND STUDY VISIT SV1
The half-day workshop where partners worked on the templates of the BPs to be produced, and another half-day seminar to introduce the local BP, and posterior site visits.

INTERREGIONAL WORKSHOP IW2 AND STUDY VISIT SV2
Hosted and led by FHV, a half-day workshop to present 5 draft practices per region, with a process of peer-review between partners and stakeholders, and a later half-day seminar to introduce the local BP and posterior site visits.

INTERREGIONAL WORKSHOP IW3 AND STUDY VISIT SV3 – postponed to sem 6 as a face-to-face meeting.
Hosted by GOZO, but led by TLP (CTU UCEEB), interregional workshop to work on the 70 BPs. A process of presentation, scoring and filtering produced a selection of top 10 good practices for the Policy Platform. This process was also the initiation of the selection of 1 practice per partner to receive the Expert Mission. Another half-day seminar introduced the local BP.

INTERREGIONAL WORKSHOP IW4 AND STUDY VISIT SV4
Hosted by TLP of Regional Assessment (MOSR), a one-day online workshop for revision of draft RA. Working groups compared KPIs from different Analyses, and conclusions were debated about the KPIs divergences, during the half-day seminar.

INTERREGIONAL WORKSHOP IW5 AND STUDY VISIT SV5
Hosted by Agenex, but led by TREA, after MC3, stakeholders worked in groups reviewing the Draft AP. The results were presented and discussed with all participants, including half-day seminars and site visits.

The levels of learning achieved by this action are:

- Level 1: Individual learning of the project staff participating in the action, both from hosting and visiting partners.
- Level 3: Stakeholder learning of the stakeholders from the visiting partners and the local stakeholder group of the hosting partner.
- Level 4: External learning created by the dissemination previous to the visit and after the visit, both at the local and regional levels using the local media and also on the EU level through the project website.

For each of the actions the involved learners were:

- Individual level of learning: 2 staff per partner
- Stakeholder level of learning: 2 stakeholders per partner + full local stakeholder group (20)
- External level of learning: 1-2 staff of Interreg EU projects related to RES (validated by JS)

## MASTER CLASS (MC)

Master Classes had been designed as a point of departure for the development of important products or deliverables, so each MC was placed in advance to the starting of desk work.

The general structure of the classes consisted of one or two days of interactive tuition and training, with a focus on topics which were to be developed in the coming months, such as market assessment, RES project identification, financing solutions and other related topics. The format of the classes includes lectures, workshop activities, case studies and guest lectures from experts and organisations relevant to RES project investments.

MASTER CLASS (MC1) ON EXCHANGE METHODOLOGY.
Task Leader Partner (TLP), coinciding with Lead Partner (LP), CTU UCEEB hosted a Master Class on Exchange Methodologies. During the 2 days, the consortium detailed each partner's strategy for the learning process. 2 staff per partner, guided by an external expert attended the event, hosted by LP.

MASTER CLASS MC2 ON REGIONAL ASSESSMENT RA.
Coinciding with the Gozo online event (due to COVID restrictions), TLP (MOSR) coordinated a Master Class on Regional Assessment definition, led by experts and consisting of 1,5 days of lectures, workshops and case studies on RA definition.

Partners worked on a template of RA, including a “Strategic Analysis of RES Technologies for the regional industry”. The results will be environmental and socioeconomic Key Performance Indicators (KPIs) which vary from region to region depending on the natural resources available, the regional and national legal framework, etc.

MASTER CLASS MC3 ON ACTION PLAN.
TLP of AP (TREA) coordinated a Master Class MC3 on AP definition, hosted by Extremadura, consisting of 1,5 days of work on activities definition. The class included training, workshop and case studies. Led by experts the staff defined the Draft AP using final RA and Policy Breakfast feedback.

The levels of learning achieved by this action are:

- Level 1: Individual learning of the project staff participating in the action, both from hosting and visiting partners.
- Level 4: External learning created by the dissemination previous to the Master Class and after it, both at the local and regional levels using the local media and also on the EU level through the project website.

For each of the Classes the involved learners were:

- Individual level of learning: 2 staff per partner
- External level of learning: 1-2 staff of Interreg EU projects related to RES (validated by JS)

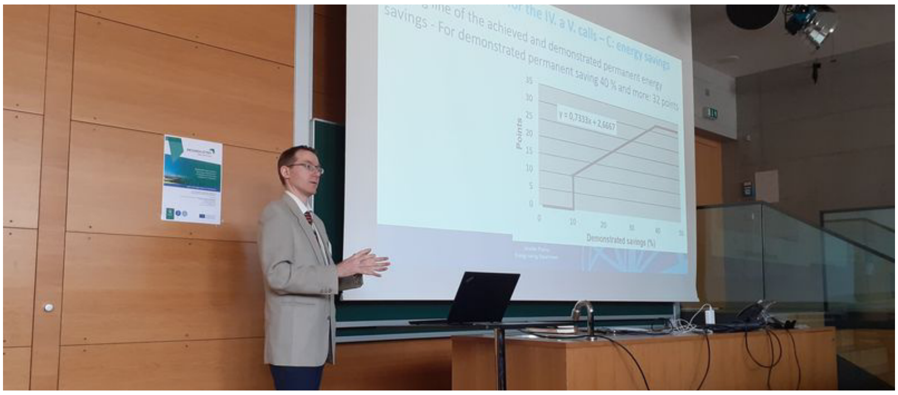
## EXPERT MISSIONS (EM)

As results of the Study Visits, partners were able to require the mission of one expert from the institution which provided the best practice, to provide tailor-made training.

The expert mission provided one-day specific learning to a large group of staff and stakeholders of the same region. Based on the selected BP, partners required the mission of one expert from the institution, company or region which provided the best practice.

Expert Missions are different from Master Class because they focus on the specific necessities of each partner, allowing a deep capacity building of a large group of stakeholders of a unique PI. As result, a group of local stakeholders and staff is able to cover specific necessities on a selected thematic, being the missing tool that previous cooperations have found as lacking in the learning process.

The local stakeholder group and the partner staff were able to select specific best practices among the 70 defined by the project partners, and full training was prepared to cover any missing technical or political information related to the selected practices. Expert Missions were conceived as the final learning tools in the process prior to the definition of the Final Action Plan.



The levels of learning achieved by this action are:

- Level 1: Individual learning of the project staff participating in the action.
- Level 3: Stakeholder learning of the stakeholders from the local stakeholder group.
- Level 4: External learning created by the dissemination previous to and after the Mission, both at local and regional levels using the local media and also at the EU level through the project website.

For each of the Missions the involved learners were:

- Individual level of learning: 10 staff from the partner hosting the EM
- Stakeholder level of learning: 10 stakeholders from local stakeholder group

## LOCAL STAKEHOLDER SEMINAR (LSS)

As a part of increasing the learning process at the stakeholder level, a seminar has been organized regularly among the local stakeholder group.

This Seminar consists of 10 to 20 partner staff and stakeholders, who participated in project learning activities, meeting at the end of each semester to discuss progress, provide feedback and review advances.

The objective of these seminars was to follow up on the advances of the project among the stakeholders, update the project achievements and share the learning outcomes with them.


These seminars have been the second main tool of learning among the stakeholders, just after the study visits, because they assured that the information gathered on the project reached the local stakeholder group.

Stakeholders have been in a position to receive up to date information about the project, providing any comments and potential improvements to the project activities, assuring that both Regional Assessment and Action Plan were aligned with the Policy Instrument.

The levels of learning achieved by this action are:

- Level 1: Individual learning of the project staff organizing the action.
- Level 3: Stakeholder learning of the stakeholders in the local stakeholder group.
- Level 4: External learning created by the dissemination previous and after the seminar, both at the local and regional levels using the local media and also on the EU level through the project website.

For each of the Seminar the involved learners were:

- Individual level of learning: 5-10 staff from a partner.
- Stakeholder level of learning: 5-10 stakeholders from local stakeholder groups.

## POLICY BREAKFAST (PB)

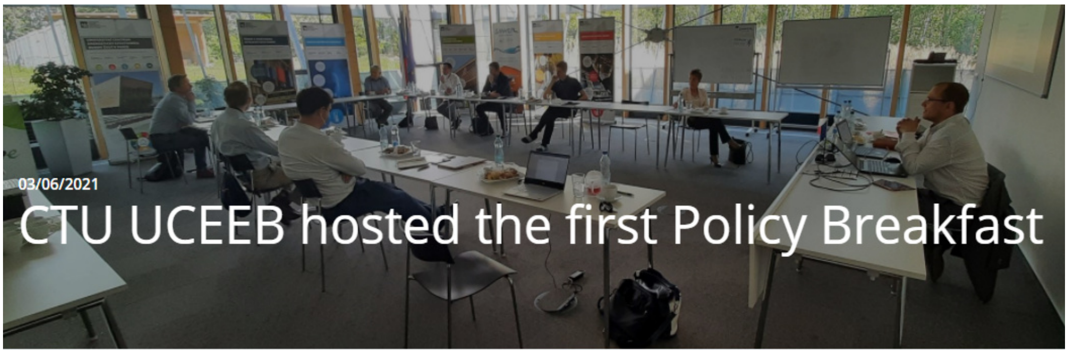
Policy breakfasts have been designed as a supporting tool in the process of policy influence and Managing Authorities involvement in the process of policy instrument improvement.

The policy breakfast is a working meeting, which, placed in a more relaxed environment, seeks to keep policy representatives informed of the project achievements, assuring the alignment of the project actions to the future will of policy makers when improving the policy.

Through this simple action, the partner assured a better integration of the actions described in the Action Plan, because the actions were previously validated and confirmed in several breakfasts with the policy representatives.

Every partner has organized a meeting with high policy representatives to speak about the different project outcomes of the project, obtain feedback about products or present a policy recommendation.

To optimize the impact of interregional learning and to make sure the activities of the action plan were to be implemented later on, these meetings involved not only policy makers but a wide range of players, as it was rare that one single organization could promote a thematic policy improvement.




## INSTITUTION INTERNAL MEETING (IIM)

In order to reach the second level of learning, the project designed specific Organizational or institutional learning. Such learning occurs when the new knowledge does not remain at the level of individuals alone but is also shared within the organizations these individuals are working for.

Organizational learning increases the chance that the learning gained from the cooperation had an impact on the regions. The way to enlarge this organizational learning was to design a unique learning action.

Usual tools are internal reporting meetings where the staff members directly involved in the cooperation report back to the relevant colleagues, managers, and elected representatives of the organisation. These key interested parties were in many cases directly involved in the interregional exchange of experience activities when needed, but also this meeting assured a complete exchange of experience.

Following these guidelines, RESINDUSTRY staff participating in any consortium and partner learning gathered with other colleagues at the end of each semester to report the project activities, achievements, and future actions. These regular meetings facilitated the planning of the project, and the participation of different staff and produced an easier internal and external coordination of the actions.

## COMMUNICATION AND DISSEMINATION

LAB has implemented the corresponding activities required to achieve the main objective of the communication strategy, which was to disseminate the Project´s results to stakeholders and the general public, but also to inform about the Interreg objectives and benefits of cooperation among EU regions and countries.

The RESINDUSTRY Communication and Exploitation Strategy were elaborated at the beginning of the project to set guidelines for the organization of dissemination activities and elaboration of dissemination materials.

The Communication and Exploitation Strategy objective was to assure that the process of policy learning occurs at 4 levels, made through 4 sub-objectives:

1. To achieve internal communication (individual and organisational learning)
2. To assure the involvement of stakeholders (Regional Stakeholders learning)
3. To transfer the learning outcomes to other EU stakeholders (external/EU learning)
4. To produce awareness among the citizens about the project (external/EU learning)

Communication is a min tool to achieve Level 4 of learning, the External learning. The fourth level refers to learning beyond the regions. External learning is certainly the most challenging 'type' of learning, but it is also less crucial for the projects since it does not directly impact policy change in the participating regions.

In a capitalisation programme like Interreg Europe, it was important that the lessons learnt at the project level were also exploited at the programme level in order to be of benefit to other public authorities in Europe. The communication strategy of RESINDUSTRY considered all these parameters when defining the minimum tools and outputs to be achieved by the consortium.

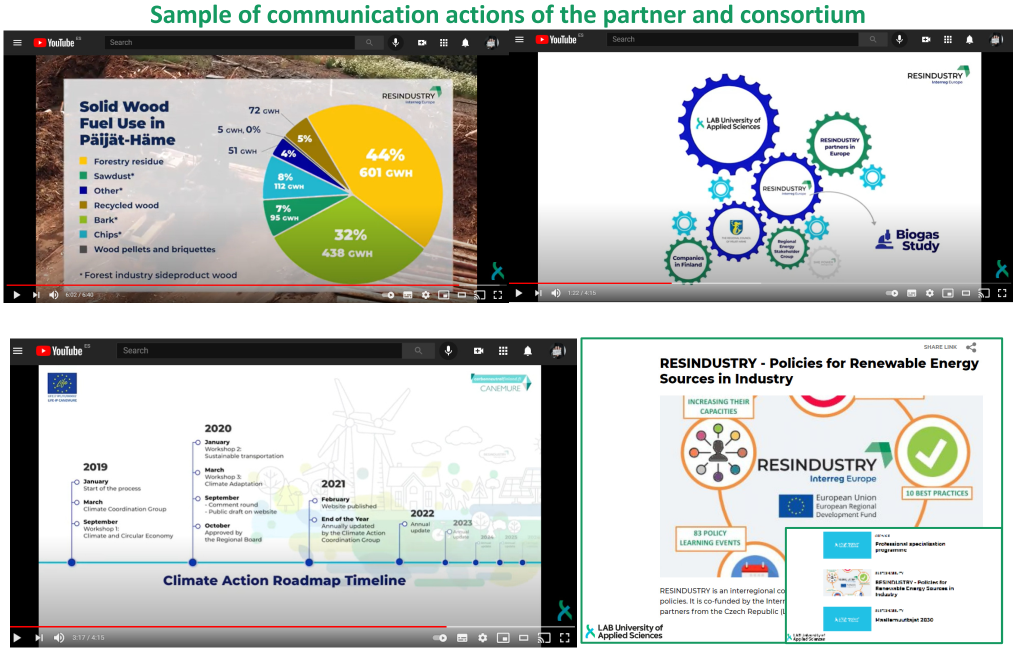
Communication Outputs:

- One detailed Dissemination Strategy, Internal Database and Mailing List
- Website, leaflets, posters, and rollup, 4 project newsletters
- 5 study visit dossiers by the host partner
- One Local Dissemination Event per partner in S5, open to the public with 40-60 key actors.
- One final Conference in phase 2

LAB has actively participated in the communication process of the project, promoting the project at local, regional, national, and European levels. Some of the main used tools have been news, press releases and emails/bulletins, where the partner described the project achievement and the future results to be achieved.

As a special mention, LAB has produced specific videos for communicating in a more effective manner.

**Sample of communication actions of the partner and consortium**



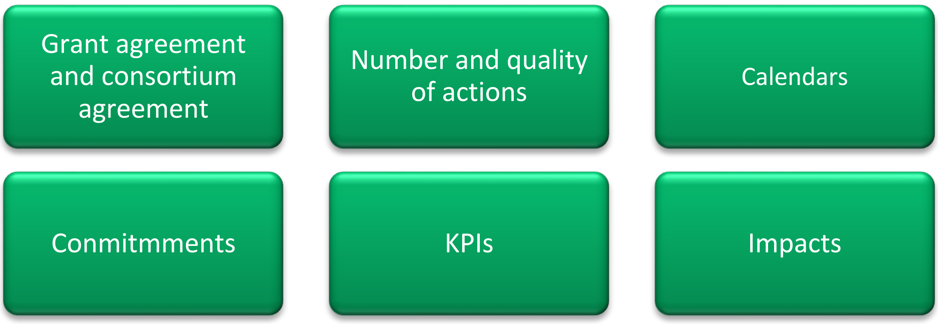
## III.III. THE QUALITY OF THE PARTNER LEARNING

Each partner had a predefined structure of quality assurance provided by the project, including specific internal and external quality evaluation tools, which has supported the consortium in the achievement of high-quality standards during the learning process.

RESINDUSTRY has created a Robust Quality Unit (RQU) composed of TLP and external experts to support partners in learning activities. Past experiences showed partners tend to focus resources on technical deliverables, turning aside from the assurance of the learning quality process.

The beneficiary's Quality Assessment systems sought to support the correct application of the technical work included in the application form and specified for the beneficiary. This support was reflected through work evaluation and monitoring systems, acting in a similar way to a Project Management system for any service project.

In RESINDUSTRY, the beneficiary's Quality Assessment system took the commitments acquired in the Grant Agreement with the coordinator and transferred them to technical working documents for the partner, subsequently evaluating their implementation.




Thanks to the project structures, the exchange of experience activities has been of robust quality, being a pre-condition to an efficient learning process. So, each action has been properly prepared, implemented, documented and monitored.

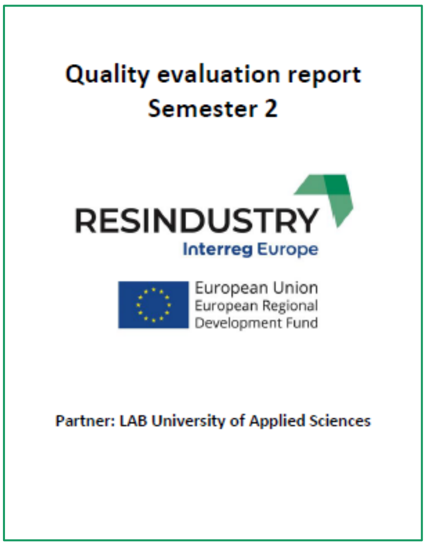
The UNIT, composed of TLP CTU UCEEB, MOSR and TREA, with the support of external experts at the national level, assured that the activities are properly prepared, implemented, documented and evaluated:

- Preparation: all the information needed to carry out the activities must be made available in advance. In particular, the objectives and agenda of each activity need to be clear and shared with the participating partners. If needed, partners can also be asked to send their contributions before the activity takes place.
  RESINDUSTRY preparation required on-time preparation of a full explanatory document for each event by the host partner, incl. learning objectives for IW and SV, which have been evaluated after each action.
  Following the Exchange Methodology, the host partner prepared (1 month in advance) a full explanation document for each event to be implemented in the project.
  Additionally, each Methodology defined per partner was designed to assure the learning process: 1) achieving 4 levels of learning; 2) assuring the quality; 3) integrated approach. Going further than this application form, it described each activity in detail, with a foreseen agenda and content.

- Implementation: each organiser had to ensure proper management of the activity. The quality of a moderator, issues such as languages or intercultural context, etc. were taken into account in each panned activity. Depending on the activities, innovative techniques were used to ensure interactivity and the involvement of all participants in the exchange of experiences.

- Documentation and monitoring: after each key action, a report summarising the main outcomes were produced. For example, after each SV one publishable dossier in English was produced by the host partner summing up all activities. This information was both used internally in the different stakeholders' meeting and used for dissemination.

All these steps have been evaluated through the RQU structure, both internal and external, assuring that the project actions were achieving the expected level of quality. Therefore, an extra level of quality evaluation has been applied:


Quality evaluation report
Semester 2

RESINDUSTRY
Interreg Europe
European Union
European Regional
Development Fund

Partner: LAB University of Applied Sciences

- Evaluation: the quality of each learning activity has been measured by survey per participant, resulting in a quality assurance report per semester. The evaluation of each activity (through a simple satisfaction questionnaire) has helped in the improvement of the activities, allowing a continuous upgrading of future activities.

LP has evaluated the quality of the learning activities of each partner, supported by the external expert and coordinated with the rest of the national external experts on quality of learning. Through questionnaires, the LP and the quality expert measured the quality of the learning actions per participant, resulting in quality reports. If deviations were identified, the expert launched warning reports or some contingency Plan, however, this contingency was not necessary during project phase 1. Every six months, the Robust Quality Unit has delivered a quality assurance report including the analysis of the results from questionnaires of learning activities.

**Role of experts**

There was no obligation to involve experts in the exchange of experience process, but external assistance was considered to be helpful and a way to professionalise this process (e.g. by supporting the exchange methodology definition and follow up). External input was also needed to ensure more in-depth coverage of certain aspects of the topic tackled by the project or to help partners that are less experienced in the joint working process.

Experts have been contracted by each partner, in order to assure that each participant passed both an internal project evaluation and an external evaluation.

**Quality Evaluation Report**

The evaluation report compiles the project's objectives, the project's actions, and the beneficiary's capacities, to apply an evaluation methodology and ensure that the expected impacts are achieved.

The quality report focuses on evaluating and quantifying certain key parameters or key productivity indicators, which serve to measure the success of the project in reference to what was defined in the proposal submitted to the Program. Offer a list of key productivity indicators, as well as systems to quantify them and thus be able to analyse their level of performance.

The evaluation analysed a list of key productivity indicators, as well as systems to quantify them and thus be able to analyse their level of execution. The project parameters that will be evaluated through key productivity indicators are:

- The quality of the learning actions
- The calendar evolution of indicators
- The delivery of learning products.
- Communication and economic indicators

Following this objective, the structure of the evaluation report was:

- Group 1. Quality level in learning actions
- Group 2. Level of learning
    - Stakeholder participation
    - Technical products delivery
- Group 3. Transversal communication and coordination
- Group 4. COVID's effect on the learning process

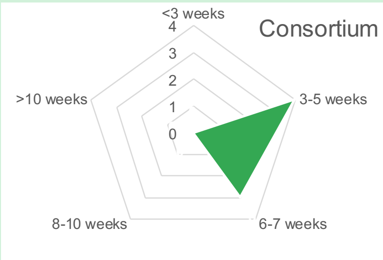
The Group 1 question has evaluated that the activities are properly prepared, implemented and documented.

**QUALITY EVALUATION REPORT, RESINDUSTRY PROJECT**

**Semester: 2 Partner: LAB**

## Group 1. Quality level in learning actions

IW2 + SV2 - PREPARATION - How many weeks in advance was the information received in order to analyse it and invite stakeholders?

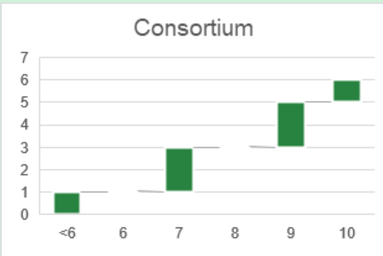



| Answer | LAB | 3-5 weeks |
|---|---|---|

**<3 weeks is considered as not reaching the quality requirements**

Sample of evaluation of implementation in IW.

IW3 - IMPLEMENTATION - The theoretical contents were clearly explained during the IW3 and the contents were enough to achieve the event objectives.

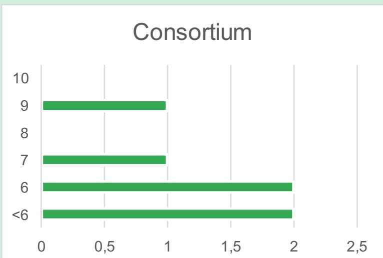



| Answer | LAB | 4 |
|---|---|---|

**Average consortium scoring** 7,7

Sample of questions or evaluations related to Master Classes.

MC2 - IMPLEMENTATION - The theoretical contents were clearly explained during the Master Class and the contents were enough to understand the work to do in the Regional Assessment.




| Answer | CTU UCEEB | 6 |
|---|---|---|

**Average consortium scoring** 5,0
(10 maximum)

The Group 2 question analysed the Level of learning, based on the follow up of stakeholder participation and the achievement of learning actions.

In this aspect, the number of stakeholder participation has been analysed in each semester, evaluating if the project reached 90 participants with increased capacity thanks to exchange experiences, 10 stakeholders (regional stakeholder group) per partner and 20 staff (3 per partner).

Low-carbon economy

The Group 2 question also analysed the number of learning activities in each semester, evaluating if the project reached the 83 learning activities:

- Five Study Visits, Interregional Workshop and Master Classes MC (Exchange Methodology, Regional Assessment, Actions Plan) (5)
- Four Institutional Internal Meetings, and four Local Stakeholder Meetings per partner (4x7+4x7)
- A minimum of one Expert Mission per partner (1x7)
- Two Policy Breakfasts per partner (2x7)
- One partner meeting in Phase 2

5 SV and IW (5)

MC1, MC2, MC3 integrated in the SV and IW (0)

Networking Event 1, 2 and 3 as communication (0)

4 local Stakeholder Meetigs per partner (28)

4 Institutional internal meetings per partner (28)

Expert Mission per partner (7)

Two policy breakfast per partner (14)

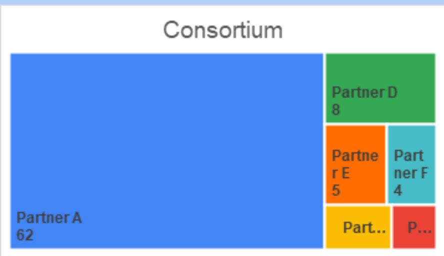
One partner meeting in Phase 2 (1)

**Total of learning activities = 83**

## Group 2. Level of learning

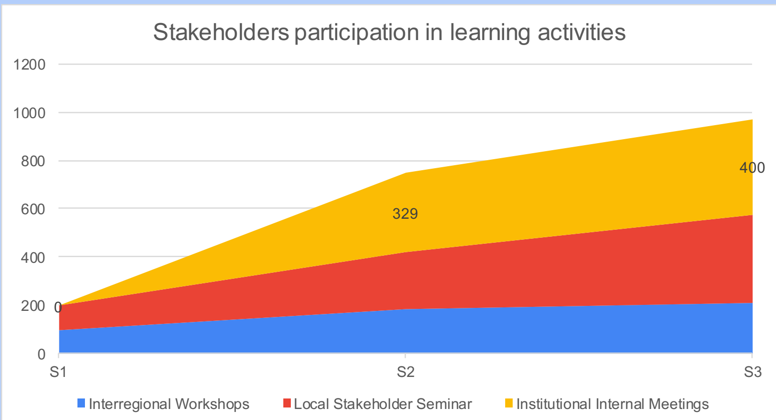
**Stakeholder participation**

How many stakeholders and staff were online connected to the IW3?




| Answer | LAB | 3 |
|---|---|---|

This activity expect the following attendance:
Individual level of learning: 2 staff per partner
Stakeholder level: 2 stakeholders per partner + full local stakeholder group (20)
External level: 1-2 staff of Interreg EU projects related to RES (to be validated)
**Less than 4 staff+stakeholders per partner is to be compensated.**

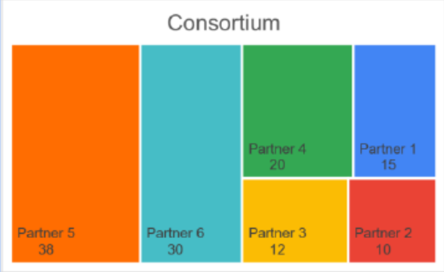



**207 stakeholders in IW and SV**

**366 stakeholders in Local Sakehholders Seminar**

**400 stakeholders in Institutional Internal Meetings**

How many stakeholders and staff participated in your first Local Stakeholder Seminar LSS1?




| | | |
|---|---|---|
| Answer | **LAB** | **12** |

**10** per partner are expected to meet each semester, lower numbers are to be compensated.

The Group 3 question has evaluated whether the project coordinator and the rest of the partners with key roles, either technical, economic or communication, were correctly implementing the expected duties.

In terms of Coordination, some milestones were analyzed:

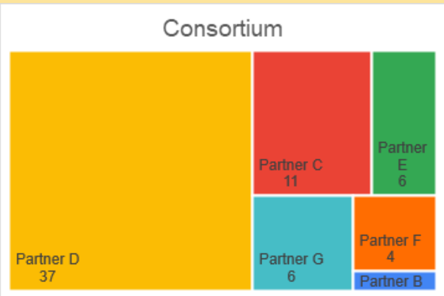
- Subsidy Contract, Partnership agreements, Project handbooks, and day-to-day management structures.
- Methodology for quality monitoring
- 5 SC and 5 skype PCU meetings.
- 5 quality assurance report

In terms of communication, some milestones were analyzed:

- One detailed Dissemination Strategy
- One Internal DataBase and Mailing List
- Leaflets, Posters, and rollup
- Website
- 4 project newsletter
- 5 study visit dossier by the host partner
- One Regional Dissemination Event per partner in S5, open to the public with 40-60 key actors.
- One final Conference in phase 2

## Group 3. Transversal communication and coordination

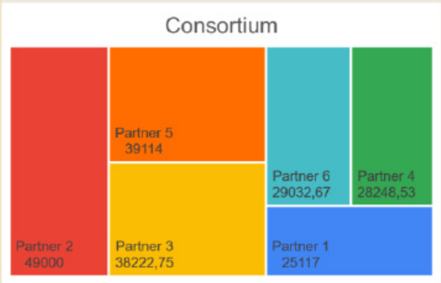
How many appearances in media have you promoted in online sites by month 12?




| | | |
|---|---|---|
| Answer | **LAB** | **11** |

**2 to 4** **Each partner is expected to promote 2 to 4 media appearances per semester at national, regional or local level. The final objective being 10 per partner.**

How much budget was executed and reported in semester 2?




| Answer | LAB | 38.222,75 |
|---|---|---|
| Objective | | 52.638,00 |

| Answer | Consortium* | 208.734,95 |
|---|---|---|
| Objective | Consortium* | 289.857,00 |

* One partner data is missing (€26,175) so a potential answer of € 234.910 could be reached, which is €55,000 below objectives

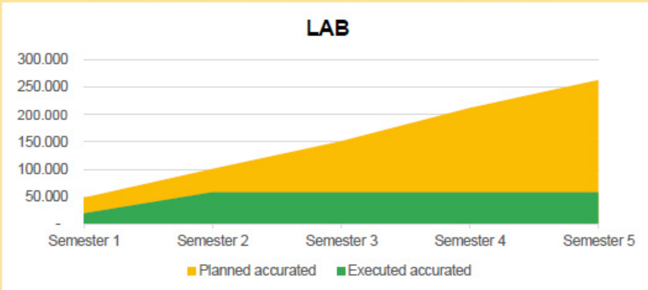
**LAB**

**Semester 2 execution VS planned execution is** **72,6%**

**Accurated execution for all semesters is 57,78% of planned.**

**The partner is exposed to a descertification of budget at the end of phase 1, corresponding to**

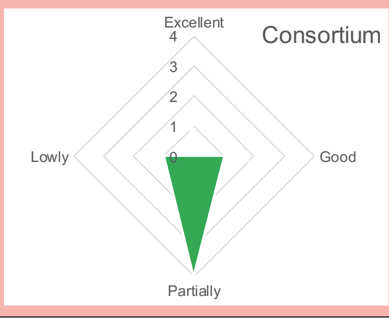
| € | 42.463,29 |
|---|---|




The Group 4 question has evaluated the impact of the COVID crisis over any of the previous key aspects of the project implementation and expected results.

## Group 4. COVID effect over learning process

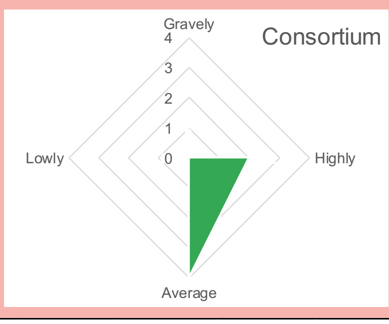
IW and MC are supposed to be a key project moment for staff and stakeholders sharing knowledge. In which degree the exchange of experiences was produced among online participants?




| Answer | LAB | Partially, the exchange formatting does not allow good interaction |
|---|---|---|

**Average opinions are "partially, the exchange formatting does not allow good interaction"**

COVID crisis will keep affecting 2021 activities, both economic and social. How do you consider that your technical activities had been affected in this semester?




| Answer | LAB | Average, actions were affected but contingency actions were implemented |
|---|---|---|

**Average opinions are highly - average, which highline that a contingency strategy will be an added value for the project**

# IV. CONCLUSIONS FROM THE LEARNING PROCESS

## IV.I. OPPORTUNITIES OF THE SECTOR

The cold climate, low population density, energy-intensive structure of the industry and natural resources of the country have affected the development of the Finnish energy system. The notable indigenous energy resources are hydropower, wood, peat and wind energy.

Finland's energy policy is a result of its geographic location, its innovative business sector and commercial strongholds. With over one-third of its territory located above the Arctic Circle, the country is largely rural and sparsely populated, except for its southern tip. Finland has long, cold winters, and is 72% covered with forests. It has a large energy-intensive business sector.

Finland has a strong forest industry and a developed domestic supply chain, from timber to pulp and paper, woodchips for energy production and second-generation biofuels. The forestry sector accounts for about 20% of GDP. At the same time, the country can rely on the significant role of forestry as a carbon sink.

Finland's energy supply relies on nuclear energy and biomass for electricity and heat production, on oil for transport and on extensive use of CHP production based on a mix of coal, natural gas, peat and biomass. Biomass has grown steadily, reducing the contributions of coal and natural gas.

There are good opportunities in the current situation of the energy sector, and the political decisions established at the national level, to promote the integration of Renewable Energy Sources in the industry:

- The Government wants to work to ensure that Finland is carbon neutral by 2035 and carbon-negative soon after that. They will do this by accelerating emissions reduction measures and strengthening carbon sinks.

- Finland aims to develop the EU's long-term climate measures so that the EU can achieve carbon neutrality before 2050. This means tightening the emissions reduction obligation for 2030 to at least 55% below the 1990 emissions level.

- Finland has already adopted legislation to phase out the use of coal in energy production by 2029. The Government Programme also foresees i.e. a stepwise phase-out of the use of oil for heating by the beginning of the 2030s and a halving of the use of peat in energy production by 2030.

- Despite the phase-out of coal, the country continues to rely on peat as domestic security of supply resource; the National Energy and Climate Strategy for 2030 sets out the share of peat to amount to 20 TWh in 2020 and 15 TWh in 2030. These fundamentals make Finland's energy mix unique in Europe.

- In the National Energy and Climate Strategy for 2030, the government expects wood fuels to increase by 30% by 2030 while phasing out coal in energy production and halving domestic use of oil by 2030.

- The Government Programme states: Electricity and heat production in Finland must be made nearly emissions-free by the end of the 2030s while also taking into account the perspectives of security of supply.

- There is significant scope for using carbon taxation across the economy. The IEA sees ample opportunities for further aligning taxation and subsidies to climate and energy objectives, for instance in the taxation of natural gas and peat, and CO2 tax reduction and feed-in premium for the use of wood chips used in CHP generation.

- The reform of the subsidy scheme in 2018 with half the investment aid given to innovative and new technologies is a welcome step since the market for flexibility needs to evolve as higher shares of renewable energy are being deployed and consumer preferences are changing.

- Finland is part of the Nordic collaboration on energy, placing the region in an excellent position to take the lead in global energy system transformation.

## IV.II. DEFINING INDICATORS FOR POLICY EVALUATION

One of the aims of the project is the definition of a series of energy indicators in which the total energy consumption of the industries can be disaggregated by potential RES technology. These indicators are called Key Performance Indicators (KPI) and they are useful in making comparisons of the energy consumption of factories that operate in the same field, and with other technologies.

A typical KPI used in the industrial field is defined as the primary energy consumption scaled on the number of factory outputs (KPIs) so that the energy consumption of the factory can be correlated directly to the number of outputs produced. In most cases the primary energy consumption tends to decrease with the increase of the output production, being the evidence of a primary energy consumption independent from the industrial production volumes. However, this KPI must be identified from industry to industry and cannot be generally calculated.

There is a range of well-developed and sustainable renewable technologies that can provide electricity and heat in a cost-effective way when conditions are favourable. Such sources can provide electricity and heat directly to the industry through on-site technologies, or via centralised district networks. The main sources of renewable energy sources to be analysed at the national level are:

- solar thermal energy
- bioenergy
- solar photovoltaic energy

Regarding KPIs of every technology, and potential savings to be achieved, there are several main aspects to consider that have a bigger impact on the comparable costs of the energy produced by technologies, when placed in the same location. These are the initial cost of the system, the lifetime of the system, the cost of maintenance or the system performance.

Moreover, production will depend on the location (affecting climate, insulation, taxes, cost of living, etc.) and the quality of the system (affecting performance, lifetime, and cost). This can vary significantly from region to region or from country to country, so the specific analysis must take into account these parameters.

The Market analysis has selected a minimum of KPIs that are required to be known for each selected technology. These KPIs provide a common ground for analysis of the technologies. The KPIs selected are:

| |
|---|
| CAPEX, measured as €/kWth or KWp depending on the technology |
| OPEX, measured as €/kWth or KWp depending on technology. But expressed as a % of CAPEX |
| Fuel supply cost, measured as €/MWh, for those technologies requiring fuel provision |
| LCOE, measured as €/MWh, either thermal or electric |

| |
|---|
| Direct labour intensity, measured as FTE/MW of installed power, either thermal or electric |
| Indirect labour intensity, measured as FTE/MW of installed power, either thermal or electric |
| Emissions, measured as kg CO2/kWh for the different fuels to be replaced |
| Lifetime (years) |

As the analysis was to be made from the point of view of the public administration, where public funding is to be allocated to leverage private investment, these KPIs have been transformed into impacts for each public euro invested. The conclusions have provided final KPIs for the public administrations in reference to every 1.000€ invested of public money:

| KPI indicator (for every 1.000€ of public funding) |
|---|
| RES supported (kWth) |
| RES produced (kWh th) |
| Full-time employment (FTE) |
| Avoided emissions (Ton CO2) |

RESINDUSTRY Interreg Europe
European Union European Regional Development Fund
Interreg Europe European Union | European Regional Development Fund

## IV.III. RES INDICATORS PER TECHNOLOGY

### BIOMASS IN FINLAND

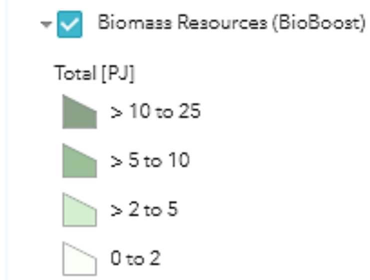
In Finland, bioenergy has a key role in the production of renewable energy. Bioenergy production is largely integrated into the forestry and forest industry. Wood is the most important source of bioenergy in Finland. Forestland covers almost 90% of the country's land area, and the national forest industry sector is extensive. Almost 80% of the wood-based energy is recovered from industrial by-products and residues. Due to the forest industry, black liquor represents the largest source of wood energy. The forest industry is also the most important user of wood fuels: almost 70% of wood fuel consumption takes place in the forest industry.

Plenty of wood material is produced in forestry management operations and timber harvesting that is not suitable as raw material for wood processing, or for which there is not enough demand. By means of different policy measures, this forest biomass will be channelled to replace imported fossil fuels in heating, CHP production and biofuels for transport.

The indigenous production potential of bioenergy is not utilised in its entirety. Forest chips from logging residues, stump and root wood and small-diameter energy wood constitute the largest underutilised biomass potential. There is also potential to increase the use of agro-biomass and biogas, but not on the same scale as forest chips.

**Biomass resources available in Finland and Päijät-Häme region (Heat Roadmap Europe 4 HRE4)**


| Technical and economically available biomass in the Päijät-Häme region | |
|---|---|
| NUTS3 ID | FI1C3 |
| NUTS3 region size in km² | 6,252 |
| Straw [PJ] | 0.71 |
| Pruning residues [PJ] | 0.00 |
| Forest residues [PJ] | 4.04 |
| Biowastes [PJ] | 0.21 |
| Total [PJ] | 4.96 |

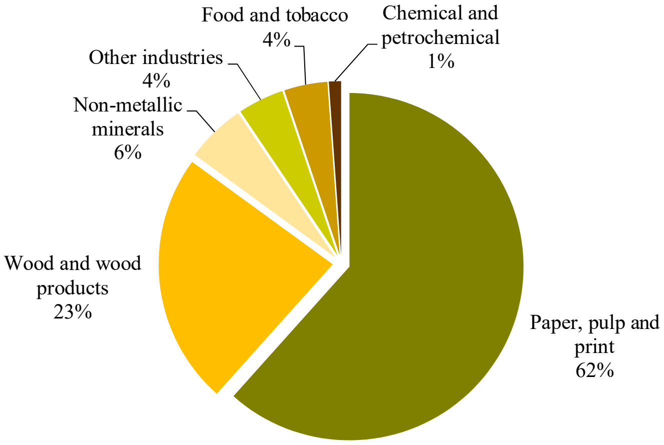



Typically, wood energy resources are used in highly efficient district heating (DH) systems and combined heat and power (CHP) plants. Most of these rely on direct combustion, but the most modern CHP plants use fluidised bed boiler or circulating fluidised bed technology to gasify a wider range of low-quality forest residues, reducing operating costs. Gasification also allows forest residues to displace coal in coal-fired CHP plants, which cannot use residues directly.

In 2017 the industrial sectors that consumed the most solid biomass for process heat are those that generated biomass residues, such as the pulp, paper, and wood products industries, which were responsible for 85% of the industrial biomass final energy consumption.

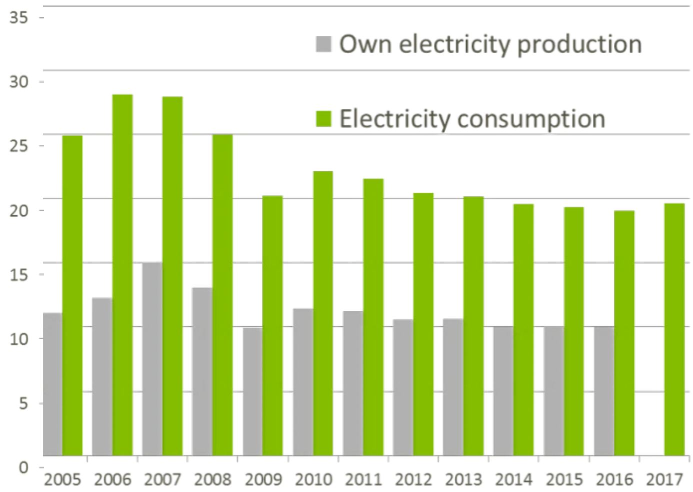
Modern paper and pulp factories and sawmills operate with an integrated approach using waste liquors and residues such as black liquor, bark, sawdust and process waste, and recycled wood for the production of heat and power or biofuels and bioliquids. As a result of the positive trend in the forest industries, the consumption of roundwood in Finland is higher than before, meaning that more by-products are also available for energy production. In recent years, the growth in the consumption of wood fuels in Finland has been based especially on an increase in burning forest industry by-products and wood residues.

**Solid biomass use as final energy consumption for process heat by industrial sectors 2017 (Eurostat)**




Additionally, to heat, some industrial establishments are auto producers and produce electricity and heat, which is in part delivered to users outside the plant. This is common, for example, in the pulp and paper industry, and in the production of wood-based panels, where solid biomass is often used in CHP systems.

**Electricity production and consumption in the Finnish forest industry TWh (FFI)**




KPI indicators for biomass

| | |
|---|---|
| CAPEX for <1MWth (€/kWth) | 800 |
| CAPEX for >1MWth (€/kWth) | 350-500 |
| OPEX (% of CAPEX) | 3% |
| Supply cost (€/MWh) | 20-40 |
| LCOE (€/MWh) | 78 |

| | |
|---|---|
| Labor intensity (FTE/MWth) | 60 |
| Lifetime (years) | 25 |
| Indirect labor intensity (FTE/MWth) | 52,2 |
| Emissions (kg CO2/kWh) avoiding coal | 0,325 |
| Emissions (kg CO2/kWh) avoiding natural gas | 0,181 |

If the analysis is made from the point of view of the public administration, where public funding is to be allocated to leverage private investment, the KPIs have to be shown as **impacts for each public euro invested**.

| KPI indicator | KPI on lifetime |
|---|---|
| Public investment | 1.000 € |
| RES supported (kWth) | 2 |
| RES produced (kWh th) | 300.000 |
| Full-time employment (FTE) | 5,61 |
| Avoided emissions (Ton CO2) | 1.358 |

## SOLAR ENERGY IN FINNISH INDUSTRY

**Solar thermal** can fulfil a substantial amount of heat demand in a wide range of industries in Finland. However, most of the opportunities are already covered for more cost-effective technologies such as biomass.

For processes not requiring high temperatures, there is a place for analysis, when not already covered by the District Heating network providing low price heat (either from fossil or biomass fuels).

For small- and medium-sized enterprises, rooftop space and finance opportunities for the upfront costs are the key barriers, so the opportunity is to integrate solar thermal heating plants during the construction of new industrial plants. The challenge is to maximise the share of heat provided by solar heating. This means that solar heating needs to be accompanied by storage to allow process heating during non-sun hours.


Cost-effective opportunities are, however, limited due to the low solar resources in some locations, if compared with other heating technologies.

In Finland DNI average is 850 kWh/m2 with variations of 10% depending on specific locations. These values are calculated for horizontally mounted modules, but they can be improved to 150 kWh/m2 if the modules are placed in an optimally inclined position. In any case, these values make applications of solar energy, both solar heat and solar PV, limited and less cost-effective than other current technologies.

KPI indicators for solar thermal heat.

| | |
|---|---|
| CAPEX for <10.000m2 (€/m2) | 800 |
| CAPEX for >10.000m2 (€/m2) | 600 |
| OPEX (% of CAPEX) | 2% |
| Supply cost (€/MWh) | 0 |
| LCOE (€/MWh) | 97 |

| | |
|---|---|
| Labour intensity (FTE/MWth) | 60,58 |
| Lifetime (years) | 25 |
| Indirect labour intensity (FTE/MWth) | 27,26 |
| Emissions (kg CO2/kWh) avoiding coal | 0,325 |
| Emissions (kg CO2/kWh) avoiding natural gas | 0,181 |

If the analysis is made from the point of view of the public administration, where public funding is to be allocated to leverage private investment, the KPIs have to be shown as **impacts for each public euro invested**.

| KPI indicator | KPI on lifetime | KPI on lifetime |
|---|---|---|
| Public investment | 1.000 € | 1.000 € |
| RES supported (m2 & kWth) | 2,2 | 1,56 |
| RES produced (kWh th) | 47.222 | 47.222 |
| Full-time employment (FTE) | 4,88 | 4,88 |
| Avoided emissions (Ton CO2) | 214 | 214 |

For **PV electricity**, the consumer price of electricity for households in Finland is below the EU average. In 2017, Finnish households paid on average 16 cents per kWh for electricity (EU average 20 cents per kWh).
The price of electricity for other than households, such as industry, in Finland was about 7 cents per kWh (EU average 11 cents per kWh).

These prices make it difficult to achieve electricity generation with other technology in a cost-effective way. However, without speaking of the feed-in tariff, the competitiveness of an individual industry in terms of the price of energy also partly depends on the granted electricity tax reliefs and refunds.

In Finland, the energy-intensive industry is entitled to a tax refund if a company has paid fuel and electricity consumption taxes of more than 0.5% of its annual value-added. It can apply for an 85% refund on the share of paid taxes which exceeds 0.5%. In addition, the refund will be paid only on the share which exceeds 50.000€ and it excludes excise taxes on motor fuels.

KPI indicators for solar PV electricity.

| | |
|---|---|
| CAPEX for the industrial site (€/kWp) | 1.200 |
| OPEX (% of CAPEX) | 1% |
| Supply cost (€/MWh) | 0 |
| LCOE (€/MWhe) | 260,0 |

| | |
|---|---|
| Labour intensity (FTE/MWp) | 15 |
| Lifetime (years) | 30 |
| Indirect labour intensity (FTE/MWp) | 6,75 |
| Emissions (kg CO2/kWhe) avoiding electricity | 0,191 |

If the analysis is made from the point of view of the public administration, where public funding is to be allocated to leverage private investment, the KPIs have to be shown as **impacts for each public euro invested**.

| KPI indicator | KPI on lifetime |
|---|---|
| Public investment | 1.000 € |
| RES supported (kWp) | 1,0 |
| RES produced (kWhe) | 25.500 |
| Full-time employment (FTE) | 0,65 |
| Avoided emissions (Ton CO2) | 146 |

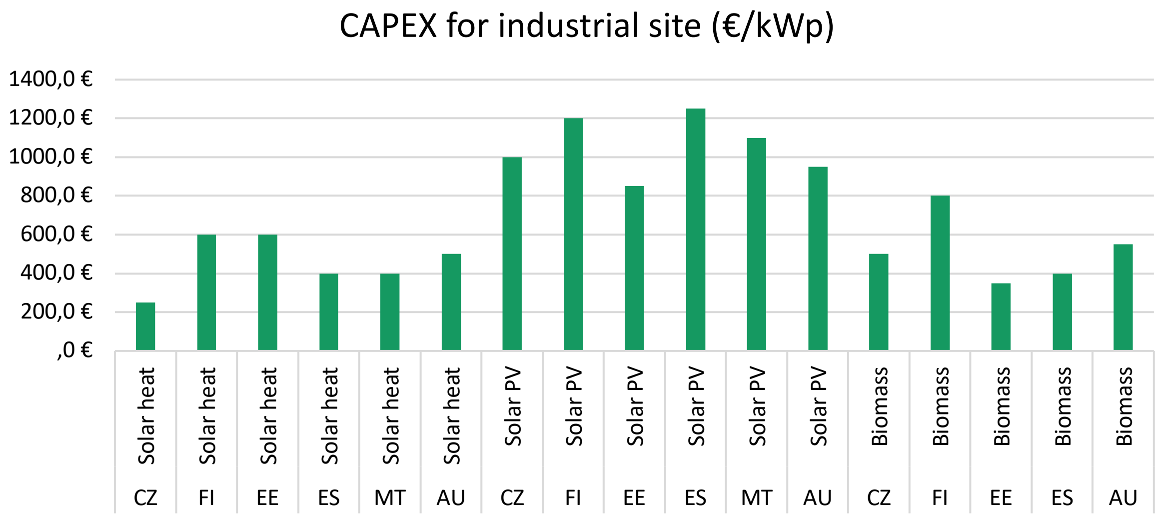
## COMPARISON OF INDICATORS PER COUNTRY

Similar Key Performance Indicators have been calculated for each country of the consortium, so a potential comparison of values can be reached, in order to create a baseline for the later conclusions per country.

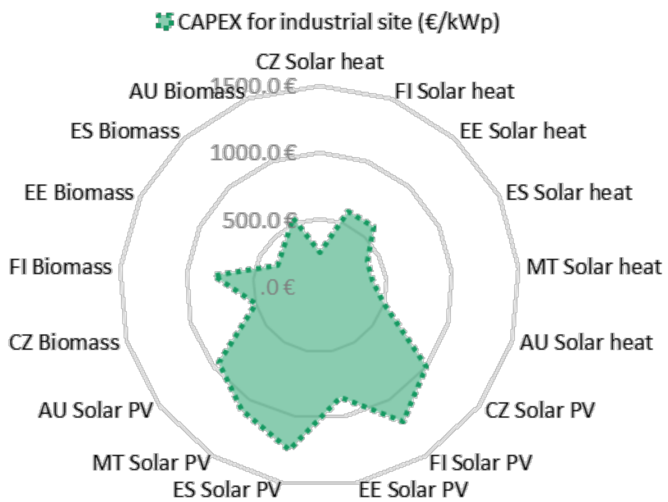
Capital Expenditure (CAPEX) has been calculated as an indicator which measures how much energy power investment can be achieved with public support. In this sense, it is important for the administration to promote as much Renewable Energy Power as possible, in order to cover the peak energy demand that the energy system will require at specific moments.

CAPEX has been used to calculate the KPI related to the Watt peak which can be introduced into the energy system.
As the objective is to introduce in the energy system as much RES power as possible, lower CAPEX allows more power installation with the same capital, so lower CAPEX is beneficial for the system.

**Comparison of CAPEX calculated per country and technology in RESINDUSTRY**




Even if considering global markets, CAPEX can vary importantly between countries for the same technology, such as biomass, where prices in Spain or Estonia are half the price for an installation in Finland. This will significantly affect the profitability of the country's investment if the final energy produced is taken into account as the main KPI.




For instance, with the same 100.000€ of public support, and having similar natural resources, countries such as Finland and Estonia will have to design different support tools for reaching the same results.

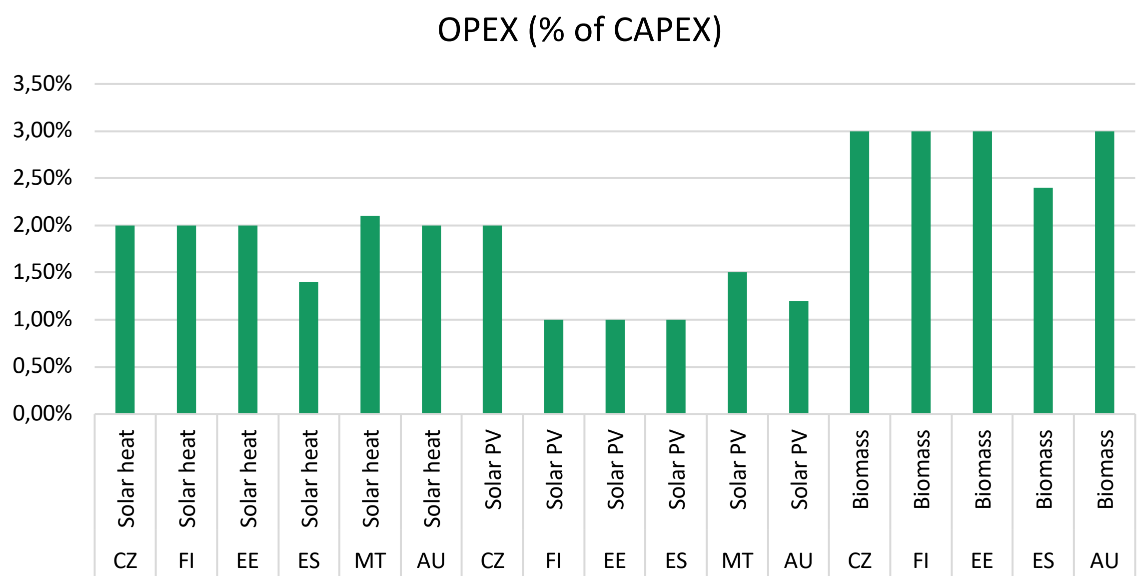
If the current country strategy would be to install as much RES power as possible in order to cover the peak demand of the country, then different indicators have to be considered when designing the policy support:

- Estonia and Finland have similar CAPEX in solar heat, 600€ / kWp while in biomass Estonia has 350€/kWp versus nearly 800€/kWp in Finland.
- Just considering the promotion of installed power capacity, Estonia will have to include biomass as key technology while Finland should consider solar technology as the prime promoter.

However, to consider one indicator as a unique strategy promoter is done in very scarce strategies. The common design must include several indicators, where not only the power installed is considered, but other indicators such as the final energy delivered of the economic impact of the final investment.

The Operational Expenditure (OPEX) is established in the most cases as a reference to the initial capital expenditure or CAPEX, as a % of this amount.  This economic value can be considered as not interfering with the decision of the public policy, but in the final term it will affect the final energy price, which is a key indicator used in the promotion of renewable energies for the last year all over Europe, so OPEX must be considered as a value interfering final decisions of public support.

**Comparison of OPEX calculated per country and technology in RESINDUSTRY**



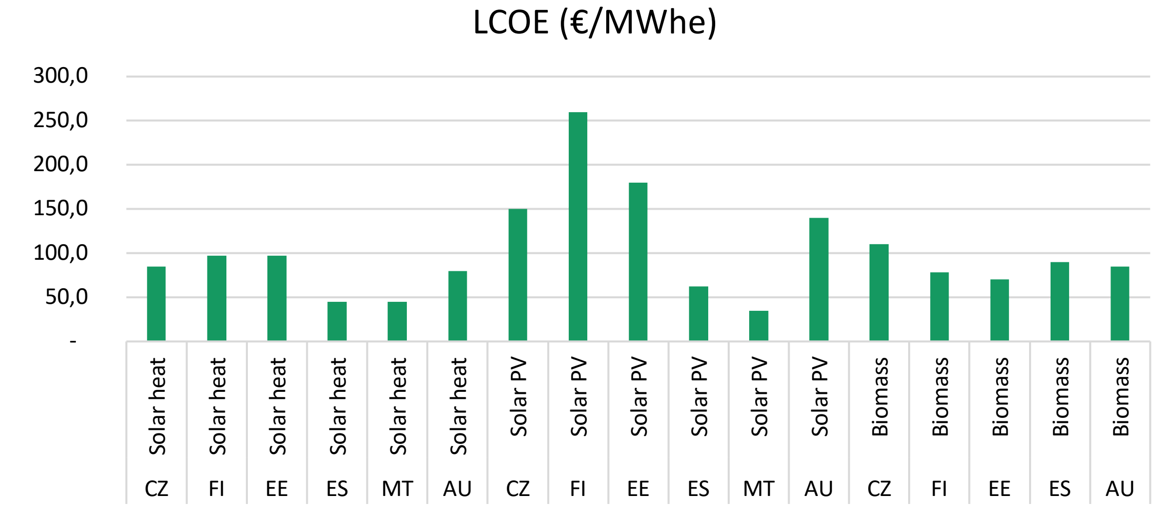

Similarly than CAPEX, even if considering global markets, OPEX can vary importantly between countries for the same technology, such as Solar PV, where prices in the Czech Republic can double prices in Spain or Finland. However, in this case, as it will be displayed in the calculation of the final energy prices, OPEX does not affect significantly the final energy produced as the main KPI.

Levelized Cost of Energy (LCoE) is one of the main key indicators to be considered, both by the private investor and the public supporter because it calculates the energy cost as the sum of costs over a lifetime, divided by the sum of energy produced over the same lifetime.

LCOE does not represent the cost of energy for consumers, but it is a key figure from the investor's point of view. On the other hand, care should be taken in LCOE values if compared among different studies, because LCOE for a given energy source is highly dependent on the assumptions, financing terms and technological deployment analysed.

In any case, if similar references and data sources are taken into account for the calculation of LCOE in different technologies, thus LCOE allows the comparison of different technologies (e.g. wind, solar, natural gas) of unequal life spans, project size, different capital cost, risk, return, and capacities. This is the reason for proposing LCOE as the main KPI in the RESINDUSTRY analysis of technologies.

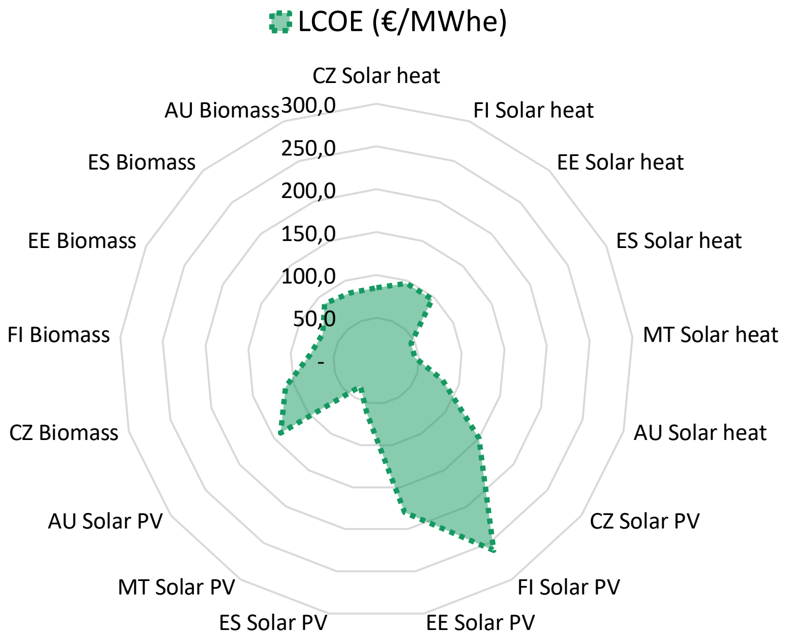
**Comparison of LCOE calculated per country and technology in RESINDUSTRY**




Logically, LCOE is the result of a calculation taking into account many different factors, where the natural resources available is one of the main parameters influencing the result, together with the investment cost per technology, the operation cost, etc.

Public authorities could use these parameters when analysing which technology can provide the political objectives at the national level, using the public resources in a more cost-effective way. For example, in a single country, such as Finland, some technologies provide energy with a cost doubling other technologies, so the public support would be more effective if streamed to technologies with the lowest LCOE.

However, political support to technologies has also to consider the diversification of the energy mix, together with the capacity of each technology to generate specific energy types, due to some technologies such as CHP can generate both heat and electricity while PV can generate just electricity.




In the general project analysis, some technologies are exceptionally well placed in the generation of energy in a cost-effective way, such as:

- Solar, both PV and heat, in Malta and Spain
- Biomass in Finland and Estonia

## BEST PRACTICES POTENTIAL IMPROVEMENT TO MARKET ANALYSIS

For most KPIs, the data provided in the Best Practice process didn't provide any review of the proposed indicators of the Market analysis, thus the results remain the same for many KPIs:

- Kg $CO^2$ avoided
- RES produced (kWhe or kWhth)
- Full-time employment (FTE)
- Avoided emissions (Ton CO2)
- OPEX (% of CAPEX)
- Supply cost (€/MWh)
- LCOE (€/MWhe)

**CAPEX for the industrial site (€/kWp)**

The Best Practices have provided data for 5 technologies, which together with the 2 good practices from the Interreg database, have produced the following results.

| | €/kw | | | | | €/kw | | |
|---|---|---|---|---|---|---|---|---|
| | BP 1 | BP 2 | BP 3 | BP 4 | Average | Interreg 1 | M.A. | Potential review |
| PV | 833 | 806 | | | 820 | 1.364 | 1.200 | 1.001 |
| Biomass | 1.000 | 947 | 750 | | 899 | 1.571 | 500 | 1.067 |
| Solar Thermal | 1.300 | | | | 1.300 | | 700 | 1.000 |
| Geothermal | 1.759 | | | | 1.759 | | | |
| Biogas | 2.159 | 7.500 | | | 4.829 | | | |

This potential review of CAPEX per technology could influence the KPI indicators calculated from the point of view of the public administration, where public funding is to be allocated to leverage private investment.

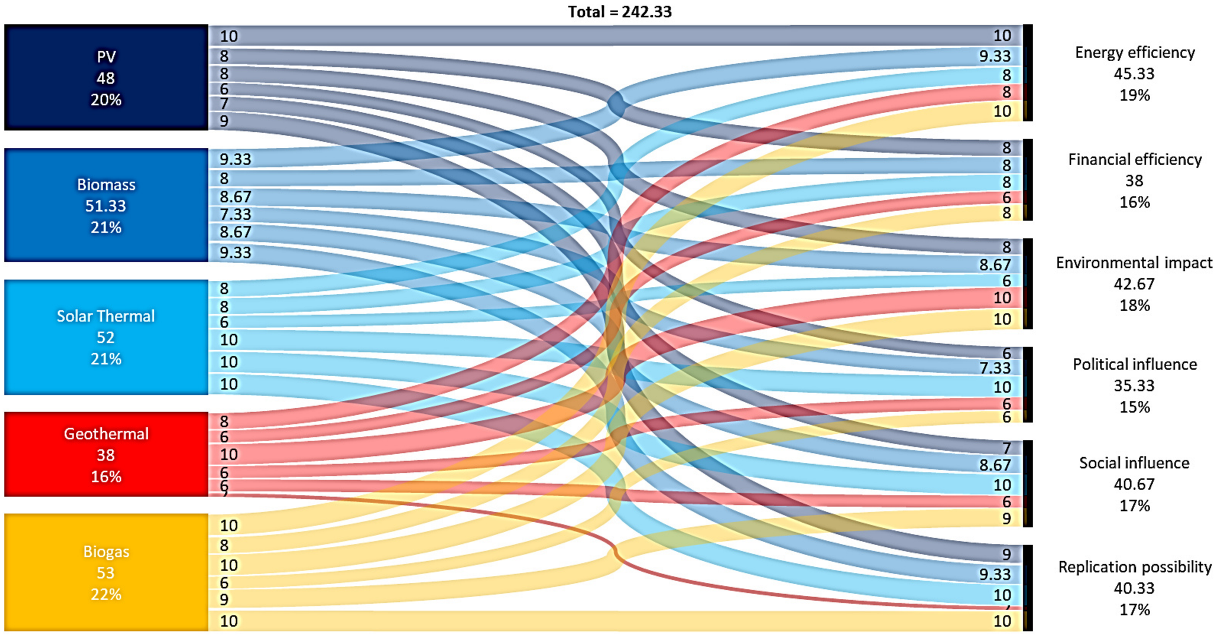
Again, if the KPIs are calculated on the base of influence achieved for every 1.000€, the following new KPIs result:

| SOLAR PV | M.A. | M.A. Revision |
|---|---|---|
| KPI indicator | KPI on lifetime | KPI on lifetime |
| Public investment | 1.000 € | 1.000 € |
| RES supported (kWp) | 0,8 | 1,0 |
| RES produced (kWhe) | 21.250 | 25.475 |
| Full-time employment (FTE) | 0,54 | 0,65 |
| Avoided emissions (Ton CO2) | 122 | 146 |

| SOLAR THERMAL | M.A. | M.A. Revision |
|---|---|---|
| KPI indicator | KPI on lifetime | KPI on lifetime |
| Public investment | 1.000 € | 1.000 € |
| RES supported (kW th) | 1,6 | 1,4 |
| RES produced (kWh th) | 30.357 | 21.250 |
| Full-time employment (FTE) | 3,14 | 2,20 |
| Avoided emissions (Ton CO2) | 137 | 96 |

| BIOMASS | M.A. | M.A. Revision |
|---|---|---|
| KPI indicator | KPI on lifetime | KPI on lifetime |
| Public investment | 1.000 € | 1.000 € |
| RES supported (kW th) | 2,2 | 0,9 |
| RES produced (kWh th) | 333.333 | 140.581 |
| Full-time employment (FTE) | 6,23 | 2,63 |
| Avoided emissions (Ton CO2) | 1.508 | 636 |

As the number of best practices has not been large, the potential modification may not be considered until the data from other practices is analysed and a good sample is gathered. Therefore, the Market Analysis data must prevail until a larger data of practices is collected. In this sense, Managing Authorities has surely data from previous practices funded by public lines, so this contract can be done with historical data from their database.




## NATIONAL PUBLIC INVESTMENT INDICATORS

Once every technology has been shown in terms of similar KPIs, a comparison can be made among the different impacts achieved by technologies when they are supported similarly by public funding.

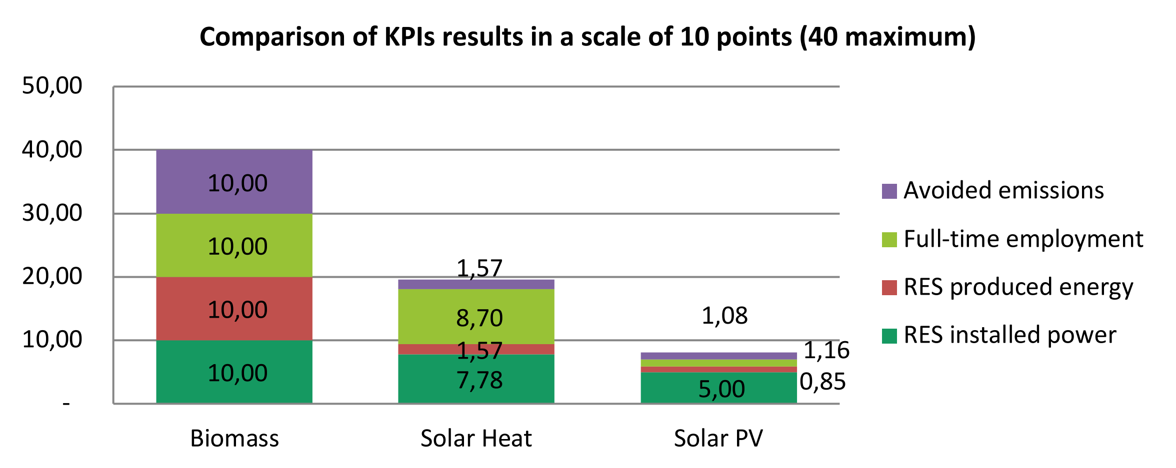
| KPI indicator (values on lifetime) | Biomass | Solar Heat | Solar PV |
|---|---|---|---|
| Public investment | 1.000 € | 1.000 € | 1.000 € |
| RES power (kW th; kW th; kWp) | 2,00 | 1,56 | 1,00 |
| RES produced (kWh th; kWh th; kWhe) | 300.000 | 47.222 | 25.500 |
| Full-time employment (FTE) | 5,61 | 4,88 | 0,65 |
| Avoided emissions (Ton CO2) | 1.357,50 | 213,68 | 146,12 |

| | RES installed power (kW th; kW th; kWp) | RES produced energy (kWh th; kWh th; kWhe) | Full-time employment (FTE) | Avoided emissions (Ton CO2) |
|---|---|---|---|---|
| Biomass | 2,00 | 300.000 | 5,61 | 1.357,50 |
| Solar Heat | 1,56 | 47.222 | 4,88 | 213,68 |
| Solar PV | 1,00 | 25.500 | 0,65 | 146,12 |

If a simple conversion system is applied to the technologies and their achieved indicators, trying to compare the results achieved, by providing 10 points to the highest impact achieved and applying a simple linear conversion rule of three to the other impacts, the following values result.

| | RES installed power | RES produced energy | Full-time employment | Avoided emissions | TOTAL |
|---|---|---|---|---|---|
| Biomass | 10,00 | 10,00 | 10,00 | 10,00 | 40,00 |
| Solar Heat | 7,78 | 1,57 | 8,70 | 1,57 | 19,62 |
| Solar PV | 5,00 | 0,85 | 1,16 | 1,08 | 8,09 |

Graphically, the results are favouring the biomass technology in every KPI, while solar heat gets the second position with half the impacts of biomass, while Solar PV remains in the third position with close to ¼ of the impacts achieved by biomass.




## COMPARISON OF NATIONAL PUBLIC INVESTMENT INDICATORS

As a final review, the Key Performance Indicators have been redefined for each country of the consortium, calculated on a public investment base.

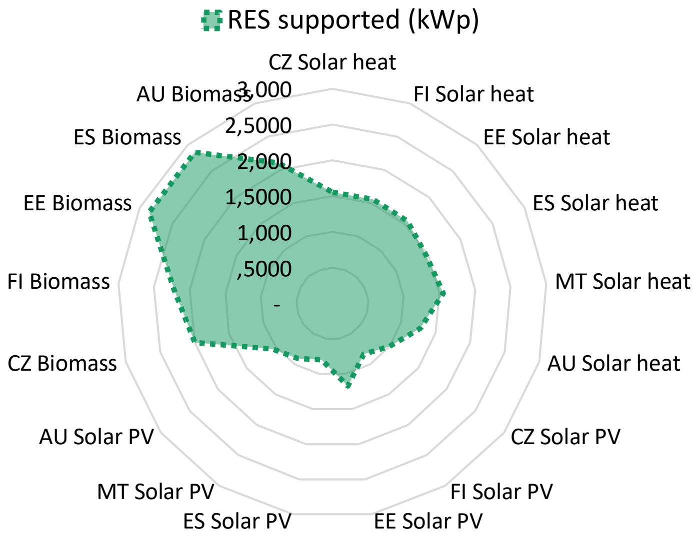
This country base KPI allows a potential comparison of values can be reached, in order to create a baseline for the later conclusions per country.

Power installed, calculated as the number of kW peak power which can be installed with a 1.000€ investment, even if the rate of public funding has not been predefined, has been calculated as the main KPI.

The Power installed has been calculated as an indicator that measures how much energy power investment can be achieved with public support. In this sense, it is important for the administration to promote as much Renewable Energy Power as possible, to cover the peak energy demand that the energy system will require at specific moments.

Power installed has been used to calculate the KPI related to Watt peak which can be introduced in the energy system.

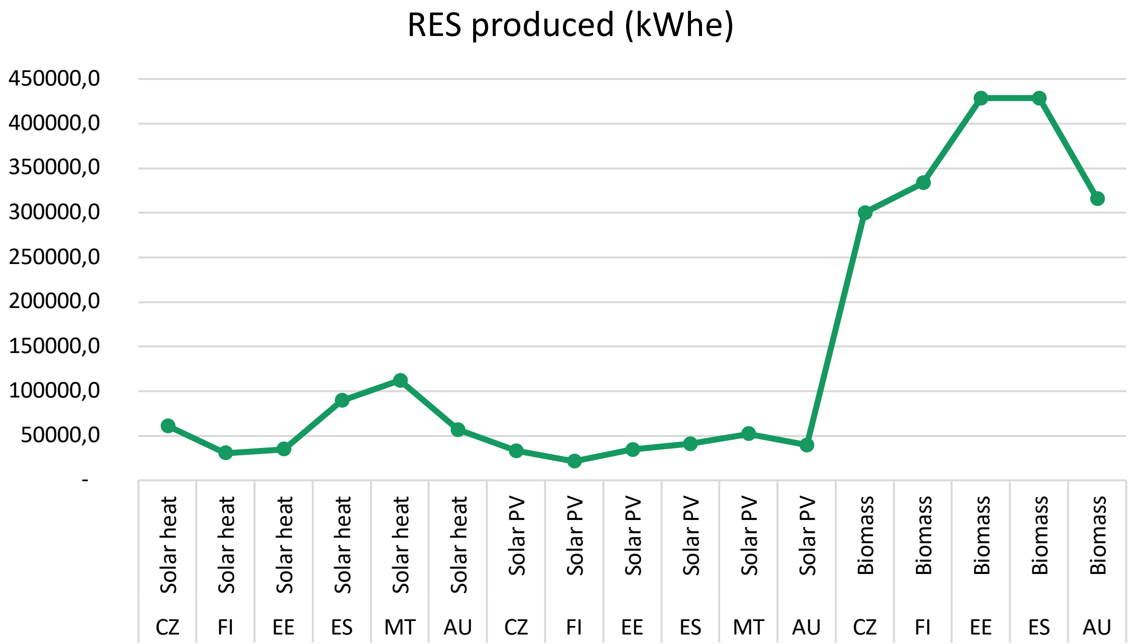
**Comparison of power installed with 1.000€ investment per country and technology in RESINDUSTRY**



The primary energy produced in kWh could be the final key indicator to be considered, both by the private investor and the public supporter because it calculates the energy to be delivered in a base of 1.000€ invested.

On the other hand, care should be taken in this indicator to other related data such as the cost for operation and maintenance of this energy produced, so in a way, this indicator should be considered together with LCOE, because LCOE for a given energy source is highly dependent on the assumptions, financing terms and technological deployment analysed.

**Comparison of energy produced with 1.000€ investment per country and technology in RESINDUSTRY**



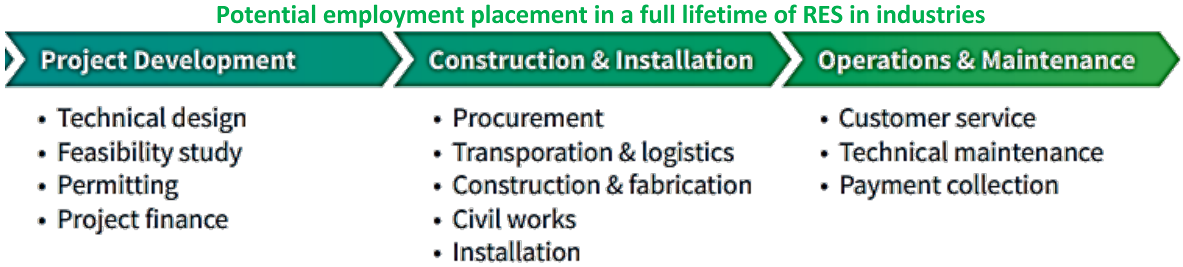

Other indicators have been analysed and included in the different country descriptions, in order to enlarge the references that the Managing Authority can use when analysing the public investment benefit.

One important indicator has been employment, which in most literature refers to job creation per sector of renewable energy (labour intensity). Labour intensity has been defined as jobs/MW (or FTEs/MW), and later transferred into jobs per 1.000 € of investment.

The employment effect is defined as the direct and indirect employment related to the added RES capacity, O&M and exploitation of RES.

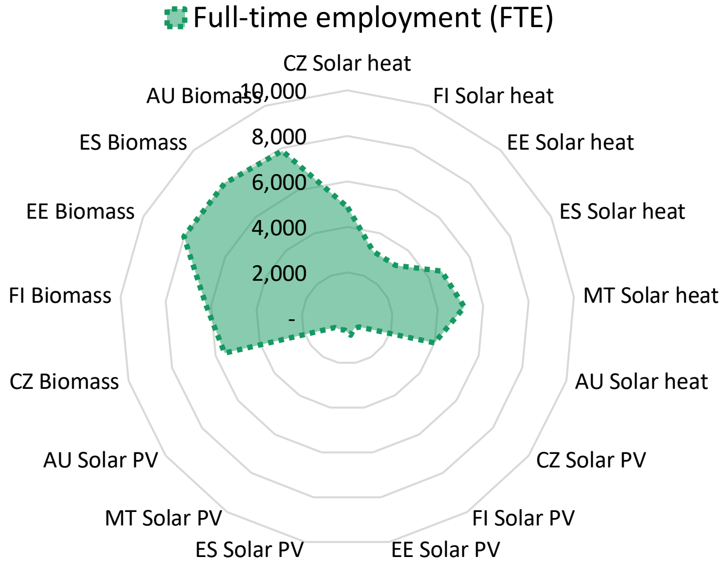
- Direct jobs are those created through contractual or non-contractual engagement with an incorporated company
- Indirect jobs are the formal and informal jobs created by vendors and suppliers who serve the sector upstream or provide services for day-to-day operations either with or without a contract.
- Induced jobs are those created through forwarding linkages as workers in the sector spend salaries on goods and services throughout the larger economy.

**Potential employment placement in a full lifetime of RES in industries**



RESINDUSTRY Interreg Europe | European Union European Regional Development Fund | Interreg Europe European Union | European Regional Development Fund

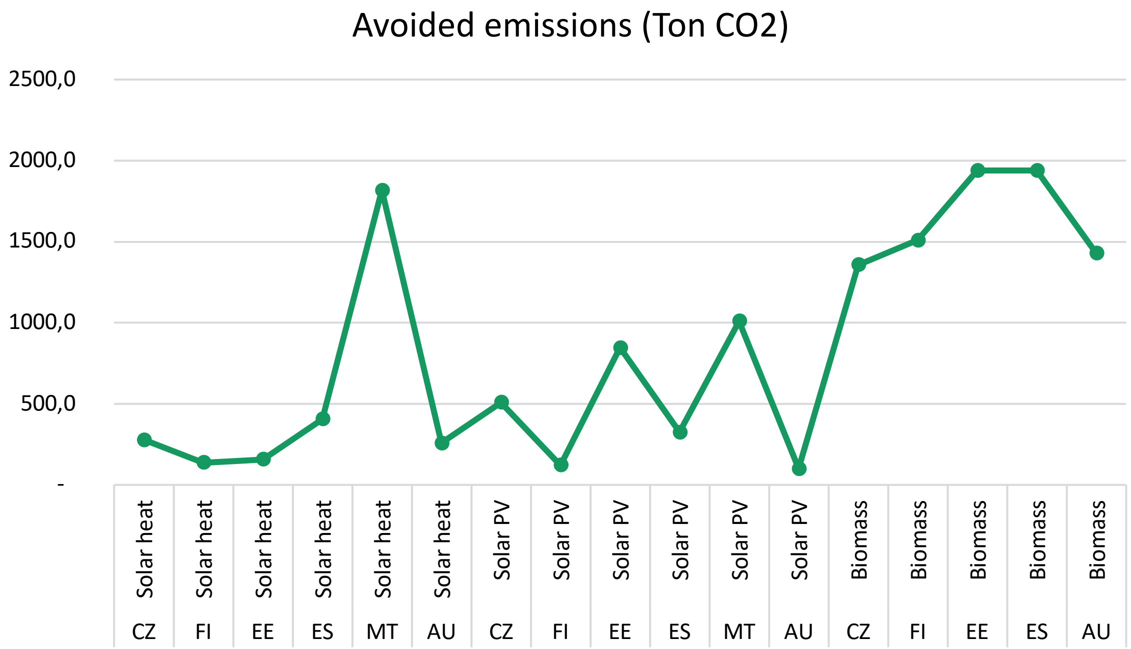
**Comparison of employment produced with 1.000€ investment per country and technology in RESINDUSTRY**




In every country, the main technology in terms of FTE has been biomass, especially due to the production of biomass feedstock. Biomass analysis of employment presented additional job creation structures, especially on the fuel supply side, which had important impacts on the final job creation factors.

In relation to the environmental KPIs, renewable energy sources contribute to improving air quality and human health, for instance by supplying electricity or heat without combustion. Technologies such as solar PV electricity, geothermal energy, heat pumps or solar thermal energy are therefore most effective at cutting the air pollutant emissions that are associated with most burning processes.

**Comparison of CO2 avoided with 1.000€ investment per country and technology in RESINDUSTRY**




Relation between countries and technologies is not direct, because each country has different emissions levels due to the current energy mix, with Malta having a high rate of emission for each kWh produced, and thus being the most benefited country for introducing any RES technology.

On the technology side, biomass is generally the technology achieving more emissions reduction.

Low-carbon economy

RESINDUSTRY Interreg Europe | European Union European Regional Development Fund | Interreg Europe European Union | European Regional Development Fund

## V. DETAILS OF THE ACTION ENVISAGED

Below are described the planned actions to be carried out during the RESINDUSTRY monitoring phase 2 taking place in 2022–2023, during which the implementation and effects of the actions will be reported to the Interreg Europe program. For actions 1–4, performance will be assessed using the accepted self-defined performance indicator relevant to the relevant policy instrument (Finland's Structural Fund programme / ERDF): the number of enterprises receiving support. The progress monitoring will be facilitated by LAB University of Applied Sciences and assisted by the Regional Council of Päijät-Häme (the regional funding agent, stakeholder member) and other relevant authorities including the city of Lahti, as well as regional development entities, such as LADEC. Additionally, assistance from other project partners will be used to assess the effectiveness of the actions.

In addition, each project reports its progress by its own mid-term and final reporting according to the instructions and indicators of relevant policy instruments. In case the funding agent is the Regional Council of Päijät-Häme, the report is sent to them. As separate monitoring will be done in each action project, no further resources are needed in the context of RESINDUSTRY, as projects monitor their effectiveness individually.

The planned regional development ERDF project, marked as RES-PH (working name) is comprehensive, addressing all actions of the RESINDUSTRY action plan described below. Actions 2, 3, and 4 contribute to the strategy level represented by action 1, specifically to the Päijät-Häme Regional Development Strategy 2022–2025, including the Climate Action Roadmap, Circular Economy Roadmap, and the Smart Specialisation Spearhead (Sustainability).

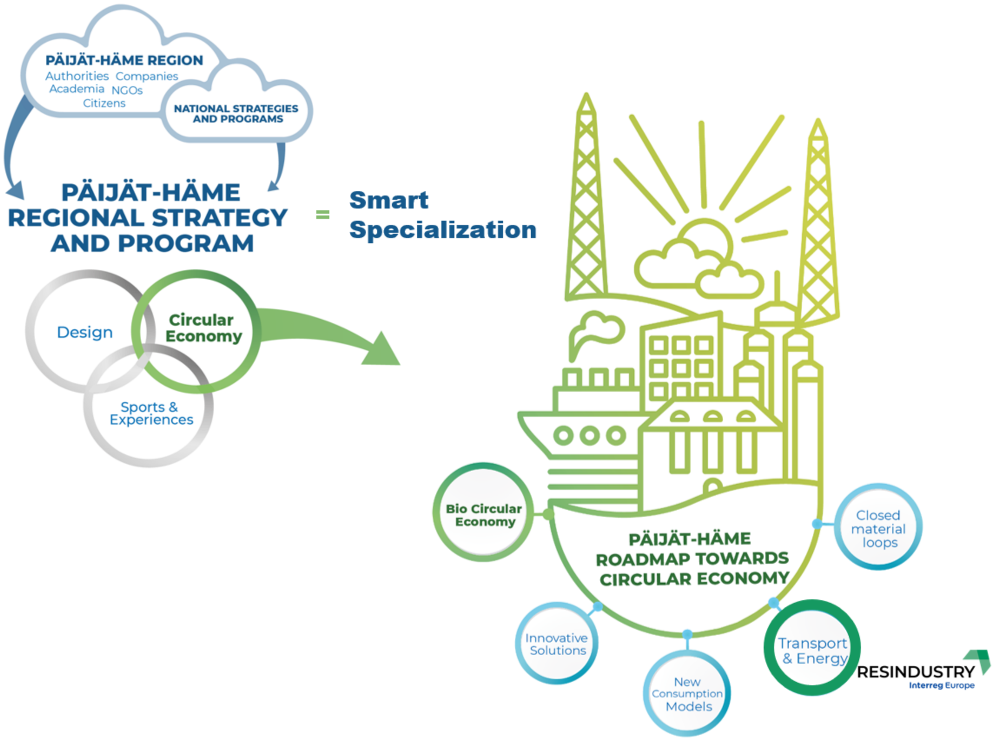
### V.I. ACTION 1: INFLUENCING RENEWABLES ON STRATEGY LEVEL

#### BACKGROUND

The main task of the Regional Council of Päijät-Häme (RCPH) is to define, update, maintain and implement the general Regional Development Strategy of the region. The strategy draws the guidelines for future regional development. The strategy defines goals and measures for different development programs (including EU Structural Funds implementation) and the Regional Plan.

The earlier Päijät-Häme Regional Development Strategy and Plan 2018–2021 included RIS3 spearheads that were developed under the smart specialization concept initiated by the European Commission. In Päijät-Häme, they were 1) circular economy 2) design 3) sports and experiences (Picture 1). Specialization in circular economy (CE) continues the regional efforts on environmental protection and cleantech promotion. In Päijät-Häme, CE means material and energy efficiency and new bio-economy solutions, including bioenergy, that lean on regional strengths and know-how. To support and focus the circular economy spearhead, it was decided to set up the Päijät-Häme Roadmap towards Circular Economy, which at the same time acts as the regional CE strategy.

**Links between the Päijät-Häme Regional Strategy and Plan 2018-2021, the Circular Economy Roadmap, and RESINDUSTRY (Oona Rouhiainen 2018)**




## ACTION

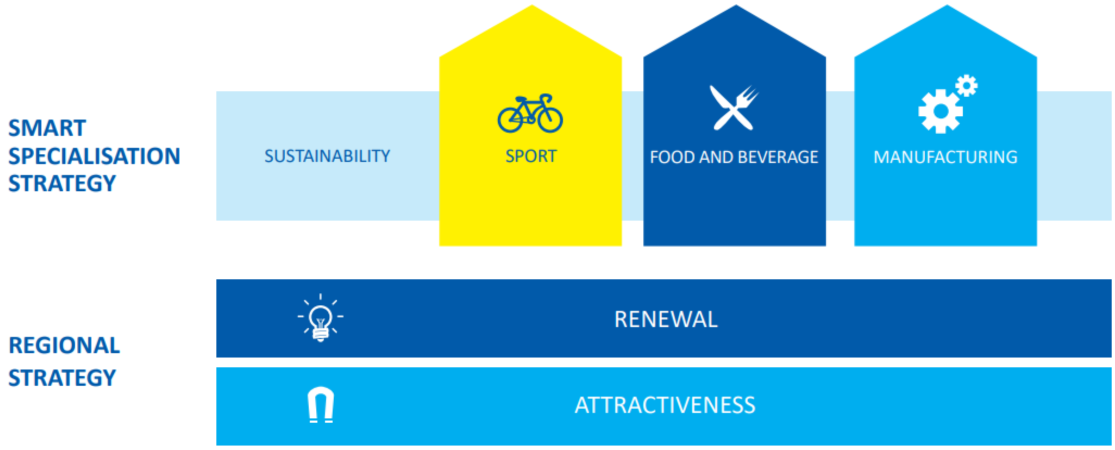
Päijät-Häme Regional Development Strategy and Plan 2018–2021 is the original policy instrument in the regional context of RESINDUSTRY and Action 1. It has been replaced by a new strategy, Päijät-Häme Regional Development Strategy 2022–2025. There was a commenting round on the new strategy, in which RESINDUSTRY participated. On 29.10.2021, RESIDUSTRY commented and proposed a focus on renewable energy in the section “Renewable carbon-neutral Päijät-Häme 2030” (directly referring to the Climate Action Roadmap), by adding references to the potential of renewable energy, for example:

- We will reduce energy consumption and related greenhouse gas emissions, adding "and increase the uptake of renewable energy solutions”.
- We are implementing the 2030 vision of circular economy in Päijät-Häme “Päijät-Häme is the successful resource efficient region in Finland”, adding "the introduction of renewable energy solutions and the recovery of by-products."

The new strategy was approved on 3.12.2021. Unfortunately, RESINDUSTRY’s addition proposals (above) were not implemented, but energy issues are still emphasized. The Climate Action Roadmap and Circular Economy Roadmap (presented in more detail below) are part of the new strategy in the cross-cutting theme of Sustainability, which incorporates the two previous regional S3 spearheads: design and circular economy. The new S3 spearheads are 1) sport, 2) food and beverage, and 3) manufacturing (Picture 2).

RESINDUSTRY Interreg Europe | European Union European Regional Development Fund | Interreg Europe European Union | European Regional Development Fund

**Päijät-Häme Regional Development Strategy 2022–2025 and RIS3 spearheads (Regional Council of Päijät-Häme 2022)**




**Päijät-Häme Climate Action Roadmap**[1]

The Päijät-Häme Climate Action Roadmap was developed in the LIFE+ funded CANEMURE project, aiming to make a major contribution to the implementation of the Finnish climate change policy and reaching carbon neutrality in the Päijät-Häme region by 2030. The roadmap was originally published on 12.8.2020 and will be updated annually. The first update was published in March 2022, available online[2]. Monitoring of climate work in various sectors will be specified.

The Climate Action Roadmap impacts all three spearheads with the goal of the region to become carbon neutral by 2030. Climate and energy goals are more cross-cutting, and, on the other hand, smart specialization choices must also support climate goals and measures.

RESINDUSTRY has been in close cooperation with the RCPH and the Climate Action Roadmap development. RESINDUSTRY has contributed to various parts of the roadmap and thanks to the collaboration, the roadmap now directly mentions renewable energy use as a focus area. Findings from the RESINDUSTRY biogas study were used and partly incorporated into the Climate Action Roadmap. RESINDUSTRY contributed to the roadmap themes of Energy, Circular Economy, and Agriculture, in the form of including renewable energy specifically as a focus area, as well as the findings of the Päijät-Häme biogas potential study, which have affected the roadmap goals of new biogas production. LAB on behalf of RESINDUSTRY will participate in the annual update expected at the beginning of 2023.

The Climate Action Roadmap consists of six themes: Energy, Transport, Circular Economy, Agriculture, Forests and land use, and Leadership, as well as seven sub-goals which are as follows:

1. We will reduce energy consumption and related greenhouse gas emissions
2. We will reduce greenhouse gas emissions from transportation
3. We will implement the vision of the Päijät-Häme Region Circular Economy Roadmap
4. We will reduce GHG emissions from agriculture and increase carbon sinks
5. We will reduce GHG emissions from forestry and land use, and increase carbon sinks
6. We will promote climate issues as a central part of municipal decision-making
7. We will work to improve climate change adaptation and resilience

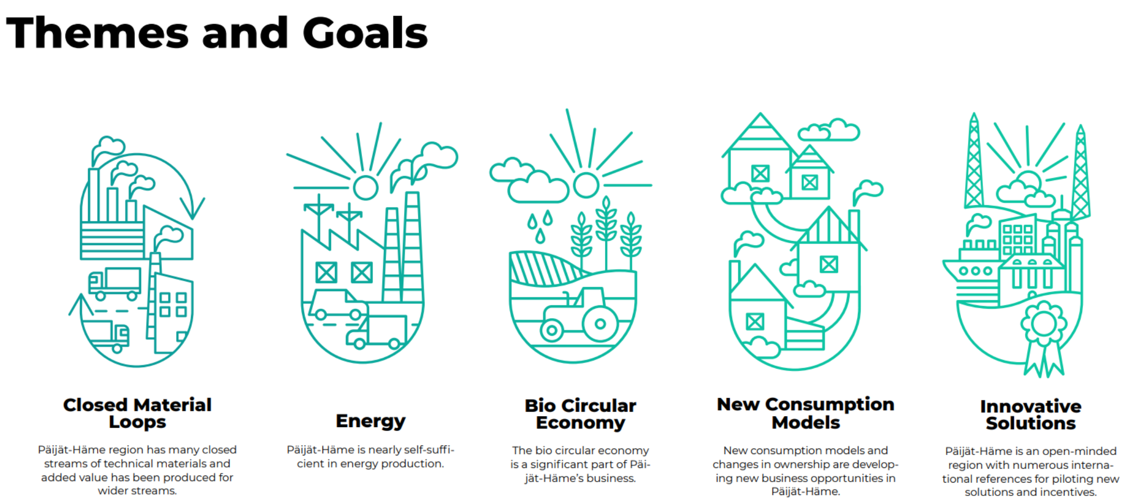
An annual meeting concerning the Climate Action Roadmap update was organized on 12.11.2021 by RCPH. RESINDUSTRY was invited to the meeting to inform about the ongoing Action Plan development and planning of new projects implementing the actions of the Action Plan. All comments have been summarized and sent to the participants to have a final say by 21.1.2022.

[1] https://paijat-hame.fi/en/climate-action-roadmap/
[2] https://paijat-hame.fi/wp-content/uploads/2022/03/Climate_Action_Roadmap_english-update.pdf

**Päijät-Häme Circular Economy Roadmap**[3]

The third sub-goal of the Climate Action Roadmap is closely related to the fulfilment of the Päijät-Häme Circular Economy Roadmap. RESINDUSTRY has contributed to the Circular Economy Roadmap sub-themes. The Päijät-Häme Regional Circular Economy Strategy, including Circular Economy Roadmap, was published for the first time in 2017. It was compiled in collaboration with stakeholders in the region. The roadmap defines the objectives and actions for achieving a circular economy in the Päijät-Häme region.

**Päijät-Häme Roadmap towards Circular Economy. Themes and Goals (Regional Council of Päijät-Häme 2022)**




RESINDUSTRY has contributed to the Circular Economy Roadmap by impacting its themes of energy and bio-circular economy with the findings of the Päijät-Häme biogas potential study (figure above). For example, RESINDUSTRY Good Practices have been integrated into the roadmap as regional activities in the theme "Energy" ("Promoting renewable energy and energy efficiency in companies through international cooperation"). Furthermore, RESINDUSTRY Good Practices are relevant to the theme "Innovative Solutions" ("Internationally interesting circular economy reference sites"). RESINDUSTRY contributions were mentioned in the webinar "Päijät-Häme Smart Specialization Workshop III" on 4.11.2020 organized by RCPH. The latest version is available online[4].

[3] https://paijat-hame.fi/en/smart-specialisation-and-innovation-environments/circular-economy/
[4] https://paijat-hame.fi/wp-content/uploads/2021/03/Roadmap_CE_eng.pdf

## PLAYERS INVOLVED

Regional Council of Päijät-Häme (facilitator)

LAB University of Applied Sciences (contributor), together with the RES group aims for new regional development projects, implementing the regional strategy, roadmaps, and this action plan.

## TIMEFRAME

2019–2030

## COSTS

No direct costs as such

## FUNDING SOURCES

Not applicable

## V.II. ACTION 2: PROMOTING BIOMASS PRODUCTION AND UTILIZATION

### BACKGROUND

As part of the RESINDUSTRY regional analysis, LAB University of Applied Sciences conducted a study into the biogas potential in the region of Päijät-Häme. The study indicated that while conventional raw materials for biogas, such as wastewater and municipal waste, have already been highly utilized in the region, other raw materials from the region's agriculture could also have biogas production potential.

Conclusions, therefore, advocated for farm-based biogas production in the region. The production must by necessity be geographically distributed as it is not efficient or profitable to transport the raw materials (straw, turf, various agricultural side-products, animal manure, and others) over long distances. The materials must be collected from a radius of approximately 15 km in the specific circumstances of Finland. The most suitable area for this activity in the region was identified to be the municipality of Orimattila. It already has a pre-existing natural gas infrastructure and a higher density of agriculture than other parts of the region.

These findings were presented to the Regional Council of Päijät-Häme (RCPH) on 9.9.2020 and to the RES stakeholder group on 14.10.2020, which inspired some of the stakeholders into a new joint effort. Subsequently, the results were also presented at the Agro-Climate Solutions webinar on 24.11.2020 by the RCPH together with the Regional Council of Häme, MTK Häme (Federation of Agricultural and Forestry Producers), and LUT University.

These meetings inspired the RCPH to consider supporting a large biogas concept plant in the region. Moreover, the Good Practice from Spain identified in the RESINDUSTRY project regarding small-scale serial production biogas plants (LA LAPA'S Mini plant biogas station[1]) inspired the design of similar small-scale equipment in the Päijät-Häme region.

Furthermore, there were ambitions of proceeding even further with efficient biomaterial flow utilization. Ideas emerged of pinpointing and efficiently extracting valuable materials specifically from the local sludge flows, such as adsorbents, polymers, chelating agents, fertilizers, hydroxy acids, biogas, and biosolids. The deployment of the idea was decided to be pursued as a cooperative innovation project, involving several research organizations, companies, and cities. In the long-term, the goal is an overarching biogas utilization and logistics concept to implement and demonstrate in the region.

[1] https://www.interregeurope.eu/good-practices/la-lapas-mini-plant-biogas-station

### ACTION

**SaMaRa**

A new project SaMaRa (*Sarjavalmisteinen maatilakokoluokan ravinnekierrätyslaitoskonsepti*, serial production farm-scale nutrient recycling plant concept) has been inspired by the RESINDUSTRY biogas study. SaMaRa's goal is to create a ready concept for a small biogas and fertilizer production facility from existing technology, suitable for serial production and deployment on individual farms for biogas production and waste biomass recycling into fertilizer. Part of the design will also be the capture of carbon capture as part of the plant concept.

The main material to be used is animal manure, which is traditionally used as fertilizer. However, 99% of manure is spread in unstabilized form, in which the energy it contains is lost as methane emissions. By processing the manure in a biogas reactor, the energy contained is can be utilized. The resulting waste can then be used as fertilizer. Processing manure in such ways will then also help reduce the emissions from cattle raising.

By making a standard design serial production plant, costs can also be significantly reduced and the design and permitting process for a biogas plant simplified, thus making adoption of these plants by farms much easier. Design is expected to reduce the costs of a farm-scale biogas plant from 600 000 € to 420 000 €.

The project includes:

- Study into the availability of different biomasses and their nutrient contents
- Plant design and benchmarking
- Research about the potential of carbon dioxide separation from biogas for use in greenhouses
- Study into the rules regulating the recycling of biomasses and determining the pilot area
- Pilot plant

**5R Refinery**

The 5R Refinery project was materialized as a next-step continuum for both the RESINDUSTRY biogas study and the SaMaRa project. The project aims to develop an internationally competitive overarching concept for efficient local biomaterial flow utilization with innovative circular economy solutions. The project aims to enable efficient circular economy solutions in five ways: repurpose industrial waste, remove pollutants directly, redesign processes and products, recycle polymers, and reuse sludge nutrients.

**RES-PH**

The new project idea is based on a vision to generate a regional biogas generation concept to harness all available regional biomass potential as efficiently as possible and generate a generalizable biomass flow concept, including economic and environmental views. The RESINDUSTRY biogas study (2021) facilitated the following actions:

1. Define regional material (garden, manure, field) properties and quality necessary for the overarching concept, aiming for maximum value addition
2. Develop a roadmap for the biomass utilization concept and an overall picture of the economic impacts and benefits for the operators. Define technical and economic thresholds for the concept.
3. Visualize regional synergies on a map with other ecosystems and viable investments identified. Confirm the concept of replicability in the region. Illustrate the logistics possibilities (fuels, CO2, smart grids).

## PLAYERS INVOLVED

**SaMaRa**

LAB University of Applied Sciences research and expertise, Sauter Biogas Finland Ky biogas reactor manufacturer, Viitos-Metalli Oy heating process expert, and Ophi Technologies Oy innovation and product development company.

Additional collaborators: EnergyShift (biogas equipment importer), Lujabetoni (supplier for concrete silos), One1 Oy, Lake Vesijärvi Foundation (collaboration on the potential for aquatic biomass use), The Central Union of Agricultural Producers and Forest Owners Heinola: MTK Heinola (shares information on local agriculture), Finnish Food Authority

**5R Refinery**

Research organizations: LAB University of Applied Sciences, LUT University, Natural Resources Institute Finland (Luke)

Companies with their own RDI projects: Flowrox, Operon Group, and Materflow

In-kind organizations: Versowood, Stora Enso, city of Heinola (each has operations or location in Päijät-Häme), Metsä Fibre, Kiilto Clean, city of Lappeenranta

**RES-PH**

Research organizations: LAB University of Applied Sciences

Collaborators: City of Orimattila, several local enterprises as stakeholders

## TIMEFRAME

**SaMaRa** 1.1.2021–31.8.2022
**5R Refinery** 1.1.2021–31.12.2023
**RES-PH** planned 2022–2025

The aimed funding call of the new programme has been postponed several times with the latest expectations planned for May 2022 – Aug 2022. The project application will be left once the call opens. The start of the project, therefore, depends on when the call for proposals will open and when the funding decisions will be made. The available funding amount for the specific objective is not yet certain, however, according to preliminary information, the total sum will be approximately 0,5 M€.

## COSTS

**SaMaRa**
Total budget 400 000 €

**5R Refinery**
Total budget 7 190 000 €, of which LAB University of Applied Sciences budget 500 000 € and LUT University budget 1 250 000 €

**RES-PH**
Planned budget 200 000 €

## FUNDING SOURCES

**SaMaRa**

Policy Instrument: The aim of the *RAKI program (Ravinteiden kierrätyksen kokeiluohjelma 2020–2022, Nutrient recycling pilot program 2020–2022*) is to develop replicable nutrient recycling technologies/ solutions. Removing bottlenecks and barriers will promote the use of recycled fertilizers. The SaMaRa project has been approved and is ongoing. The funding rate granted by the Finnish Ministry of the Environment is 65%.

**5R Refinery**

Policy Instrument: *Bio & Circular Finland, Co-Innovation project, Business Finland*. The program supports the development of innovative bio and circular economy solutions and ecosystems that offer solutions to global environmental challenges and are competitive for global markets. The 5R Refinery project has been approved and is ongoing.

**RES-PH**

Policy Instrument: *Innovations and Skills in Finland 2021–2027 (Uudistuva ja osaava Suomi 2021-2027*), Finland's Structural Fund programme. European Regional Development Fund. Funding 70% of the total project budget.

Specific objective 2.1 Promoting energy efficiency measures and reducing greenhouse gas emissions: the objective is to promote a transformation of the energy system towards a rapid and significant reduction in greenhouse gas emissions. The systemic change will affect the energy-intensive industry, the building stock, and energy production, among others.

RESINDUSTRY Interreg Europe
European Union European Regional Development Fund
Interreg Europe
European Union | European Regional Development Fund

## V.III. ACTION 3: PROMOTING WIND ENERGY

### BACKGROUND

The Regional Council of Päijät-Häme, a RESINDUSTRY stakeholder and regional authority conducted a wind power area study[1] already in 2012, which identified suitable areas for wind energy in Päijät-Häme. Since then, wind power technology has developed, and the heights and powers of wind power plants have increased, and therefore, wind power plants could be feasible to deploy in new areas. However, as confirmed by the up-to-date RESINDUSTRY Regional Market Analysis in 2021, there was still no wind energy production in the region despite its high potential.

While Päijät-Häme is a feasible area for wind power technically and economically, social and citizen opposition has been prevalent in form of landscape and noise concerns. Nevertheless, as of writing, one 20 MW wind power farm project in Perheniemi, Iitti has passed the construction permit process, and the aim is to deploy the wind farm into production in 2024. The project would become the first successful wind energy project in Päijät-Häme. To facilitate more wind energy, the region would need to support new projects. This action aims to map and find solutions for the identified technological and social issues.

[1] https://paijat-hame.fi/wp-content/uploads/2020/02/maka2014_paijat-hameen_tuulivoimaselvitys.pdf

### ACTION

The wind power study conducted by RCPH aims to map and pinpoint further areas suitable for wind power deployment in the region of Päijät-Häme. It will support both public and private organizations through the following actions:

- Explore new locations suitable for wind power production throughout the Päijät-Häme region (using external consultants).
- Serve as a background study for the next comprehensive regional plan. The regional plan only controls the location of regionally significant wind power production areas: the implementation of smaller wind power production areas is possible through general planning.
- Include social interaction and bird assessments
- Cooperate with the municipalities to avoid possible obstacles in wind energy implementation

To raise awareness of wind power possibilities to the public and facilitate technological development, a LAB–LUT cooperation project RES-PH involving wind energy usage in Päijät-Häme is being prepared for spring 2022 ERDF funding. The project will include the following actions:

- Research to develop novel technological solutions to efficiently utilize the available wind power, to broaden the location scope of possible wind power projects via more efficient capital and energy flow use.
- To combine multiple optimization and incentive targets in new wind power projects
- Enable broader wind power deployment, enable new business models potentially involving novel energy storage technologies, and increase the utilization efficiency of interoperable energy systems through producing value and benefits for several industry fields

### PLAYERS INVOLVED

Regional Council of Päijät-Häme (facilitator)
LUT University (research)
LAB University of Applied Sciences (RDI)
City of Heinola (collaborator)

RESINDUSTRY Interreg Europe

European Union European Regional Development Fund

Interreg Europe European Union | European Regional Development Fund

## TIMEFRAME

**RCPH wind power study**
The started in the late summer of 2020 and was extended in to last until the end of 2022. The first public event[2] about the study results was held in March 2022.

[2] https://paijat-hame.fi/wp-content/uploads/2022/03/FCG_Tuulivoimatuotantoon_soveltuvien_alueiden_selvitys_290322-2.pdf

**RES-PH**
The LAB–LUT cooperation project involving wind energy usage in Päijät-Häme is being prepared for the to-be-announced 2022 ERDF call. The project is expected to start in late 2022 and last until 2025.

## COSTS

**RCPH wind power study**
The budget for the initial wind power study project is 50 000 €. RCPH received an additional grant of 40 600 € for extended social interaction and bird assessments, amounting to 90 600 € in total.

**RES-PH**
The planned budget for the wind power research and development part is 200 000 €.

## FUNDING SOURCES

**RCPH wind power study**
Policy Instrument: *Grants for wind power planning*. The total budget of the initial wind study was estimated at 50 000 € (a special grant of 35 000 € received from the Ministry of the Environment, RCPH self-financing contribution of 15 000 €). An additional grant of 40 600 € was later announced by the Ministry of the Environment.

**RES-PH**
Policy Instrument: *Innovations and Skills in Finland 2021–2027 (Uudistuva ja osaava Suomi 2021-2027)*, Finland's Structural Fund programme. European Regional Development Fund. Funding 70% of the total project budget. The aimed funding call of the new programme has been postponed several times with the latest expectations planned for May 2022 – Aug 2022.

Specific objective 2.1 Promoting energy efficiency measures and reducing greenhouse gas emissions: the objective is to promote a transformation of the energy system towards a rapid and significant reduction in greenhouse gas emissions. The systemic change will affect the energy-intensive industry, the building stock and energy production, among others. The project application will be left once the call opens.

## V.IV. ACTION 4: RENEWABLE ENERGY STORAGE

### BACKGROUND

Inspired by the Good Practice in the Czech Republic (MALFINI – hybrid photovoltaic system with accumulation in batteries[1]), LAB University of Applied Sciences cooperated with the Czech Technical University in Prague in an Expert Mission to the MALFINI warehouse to gain additional insights into energy storage to serve as inspiration for local projects in the field of renewable energy storage and carbon-neutral buildings. LAB University of Applied Sciences representative and two stakeholders visited the MALFINI warehouse on 10.2.2022 on RESINDUSTRY Expert Mission and were inspired by the visit.

Inspiration and expertise gained from the Expert Mission at MALFINI are manifesting in regional ideas of broad and novel energy storage technology and control integration. The target is to combine techno-economic and regional potential studies, also considering circular economy viewpoints, to generate more value and a competitive edge for the whole region.

[1] https://www.interregeurope.eu/good-practices/malfini-hybrid-photovoltaic-system-with-accumulation-in-batteries

### ACTION

The regional development project (ERDF) RES-PH is planned to consider various energy storage technology options in the context of both building-level and grid-level implementations. The studied technologies will include but are not limited to:

- Batteries (lithium-ion, NaS, flow battery, etc.)
- Power-to-gas
- Power-to-heat (high-temperature heat pumps)
- ACAES, LAES, PHS, etc.

The RDI concentrates on RE–storage–grid interactions and their economic and technological feasibilities. The project entity aims to support SMEs and provide them with practical research-based knowledge of how to better implement and manage the storage technologies to facilitate broader RE usage.

### PLAYERS INVOLVED

LUT University
LAB University of Applied Sciences
Regional Council of Päijät-Häme
Stakeholders: enterprises operating in the region interested in RES

### TIMEFRAME

Planned 2022–2025

### COSTS

Planned 200 000 €

## FUNDING SOURCES

Policy Instrument: *Innovations and Skills in Finland 2021–2027 (Uudistuva ja osaava Suomi 2021-2027)*, Finland's Structural Fund programme. European Regional Development Fund. Funding 70% of the total project budget.

Specific objective 2.1 Promoting energy efficiency measures and reducing greenhouse gas emissions: the objective is to promote a transformation of the energy system towards a rapid and significant reduction in greenhouse gas emissions. The systemic change will affect the energy-intensive industry, the building stock, and energy production, among others. The project application will be left once the call opens. The aimed funding call of the new programme has been postponed several times with the latest expectations planned for May 2022 – Aug 2022.

On behalf of the Regional Council of Päijät-Häme, I agree to support and promote the implementation of the action plan detailed above.

Date:

Name: Niina Pautola-Mol, Region Mayor
The Regional Council of Päijät-Häme

Signature: ______________________

Stamp of the organisation (if available):


On behalf of LAB University of Applied Sciences, I agree to support and promote the implementation of the action plan detailed above.

Date: 15.06.2022

Name: Sami Luste, Chief specialist, Bio-based material cycles
LAB University of Applied Sciences

Signature: ______________________