R-ACES
Energy Cooperation Platform

D3.1 Validation methodology report

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Technical References

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

[2] R= Document, report
DEC= Websites, patent fillings, video, etc.
DEM= Demonstrator, pilot, prototype
OTHER=other

Document history

	Date	Author (name, organisation)	Description
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Project Summary

The R-ACES project is an initiative promoted by 7 partners from 6 European countries, with the vision to support high-potential industry parks and clusters to become fully fledged ecoregions that reduce emissions by at least 10 %. R-ACES means a step-change in the contribution of European Industry to the climate targets of the EU. The industry sector after all represents 25% of all energy demand – and 50% of the total cooling and heating demand on the continent; yet only 16% comes from renewables. By focusing on collective measures and clustering, the efficiency of industry can be drastically increased.

The focus of R-ACES therefore is to turn high-potential, high-impact industrial clusters into ecoregions that achieve at least a 10% reduction in emissions. They do so by exchanging surplus energy, making extensive use of renewables and tying everything together with smart energy management systems. An ecoregion is a geographic area where energy and information exchanges occur between various companies and actors to reduce waste and energy consumption. Ecoregion can be centred on an (eco-)industrial park or (eco-) business park, linked to its surroundings by a 4th/5th generation district heating/cooling network.

R-ACES is the capping stone, condensing the knowledge and experience gathered throughout EU and national projects into a set of three focused tools, namely a self-assessment tool, a legal decision support tool, and a smart energy management platform for clusters. The tools are embedded in support actions built around peer-to-peer learning, more formal coursework and webinars, and serious games. Together they enable a cluster to really become an ecoregion and set up meaningful energy collaboration. The entire package of tools and support is aimed at the high-potential clusters identified in the European Thermal Roadmap. It will be validated in three ecoregions, actively deployed in another seven regions, and disseminated to identified ninety regions European wide. In addition, the tools and support methodology will be made available to third parties in a sustainable way after the end of this project.

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Partners

Institute for Sustainable Process Technology	https://ispt.eu/
Condugo	https://www.condugo.com/
Spinergy	http://www.spinergy.it/
energy CLUSTER DENMARK	https://www.energycluster.dk/
LE2C LOMBARDY ENERGY CLEANTECH CLUSTER	http://www.energycluster.it/en
pom antwerpen	https://www.pomantwerpen.be/
ESCI European Science Communication Institute	https://www.esci.eu

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Executive Summary

The R-ACES project intends to pave the road for effective energy exchange in industrial clusters and business parks in Europe by providing a self-assessment tool, legal decision support tool, and an energy management platform. The tools are embedded in support actions built around peer-to-peer learning, more formal coursework and webinars, and a serious game. Together they enable a cluster to really become an ecoregion and set up meaningful energy collaboration. The entire package of tools and support is aimed at the high-potential clusters identified in the European Thermal Roadmap. It will be validated in three ecoregions, actively deployed in another seven regions, and disseminated to identified ninety regions European wide.

In this context, the purpose of the present report is to establish a validation methodology concerning the application of the three tools designed by the R-ACES project (see Work Package 2 "Developing tools and models for energy cooperation").
The proposed methodological framework considers all aspects that are important for energy cooperation and are, therefore, important outputs of the tools:

- Quantifiable energy saving;
- Quantifiable saving related to the usage of other resources;
- Overall efficiency gains of plants producing waste heat;
- Cost reductions or other gains in the provision of energy from other stakeholders;
- Managerial issues (ease of operations and human factors) related to the introduction of new procedures both at the plant and other stakeholder's sites;
- Data management issues and related security aspects;
- Overall acceptance among the users and third parties, including citizens of the area surrounding the involved industrial park

Key Words

Tools, Validation Methodology, Validation Criteria, High Priority, Medium Priority, Low Priority, Criteria Internal, Criteria External, Scores, Checks

Disclaimer

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1 Introduction

1.1 Objective of Work Package 3 and of Task 3.1

The objective of work package 3 (WP 3) is to set up the three ecoregions in Belgium, Italy and Denmark. More specifically, it consists of coordinating the efforts leading to the creation and development of the ecoregions and establishing at the same time a comprehensive validation methodology concerning the application of the solutions co-designed in WP2, in the realistic environments provided by the consortium.

As the impact of R-ACES application in industrial sites must be evaluated in the context of:

- Improving the management of energy saving;
- Making profits from the waste heat produced by energy intense industrial production processes;
- Improving at the same time environmental performances

In the scope of WP 3 "Waste heat-based energy cooperation and transfer pilots", we aim to define a series of validation criteria concerning the application of the three tools developed in WP2.

The three tools are:

- **Self-Assessment tool** (an assessment framework that covers multiple themes. Provides best practices, check lists to users & means to scan energy reduction potentials.);
- **Legal decision support tool** (investigates how to build a practical and simple-to-use decision-support tool for management to decide on the required legal framework for energy cooperation);
- **Energy management platform** (EMP) (an ICT-tool that makes energy flows transparent; allows energy consumption and production to be allocated to specific installation, stakeholders and notes; and identifies anomalies and opportunities).

For each of the three tools above, a validation report will be provided during the project (M24). In this way we could provide a validation manual providing also potential adopters of the R-ACES tools with guidance on the monitoring ad assessment of changes in their waste heat valorisation processes.

1.2 Objective of this deliverable

The purpose of the present deliverable D3.1 is to identify a series of validation criteria concerning the application of the tools designed in WP2 and produce a validation methodology report. The validation methodology considers objective and subjective categories relevant to the project. These categories were identified during two stages: (1) the interviews conducted to identify the requirements for the three tools, and (2) the grant agreement. The validation is required to assess the viability and the effectiveness of the three proposed tools.
The validation methodology considers technical, economic, managerial aspects related to the deployment of the tools; social, cultural and legal aspects of energy cooperation at local level.

Among the other aspects that the validation methodology will look at are:

- Estimated energy savings
- Estimated savings related to the usage of other resource
- Estimated overall efficiency gains (if any) of plants producing waste heat
- Cost reductions or other gains in the provision of energy from other stakeholders
- Managerial issues (ease of operations and human factors) related to the introduction of new procedures both at the plant and other stakeholders' sites

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- Data management issues and related security aspects
- Overall acceptance among the users and third parties, including citizens of the areas surrounding the involved industrial parcs

At the end of validation phase, reports will be issued pointing out the results of the validation process and suggested steps and improvements to be undertaken (D3.2; D3.3; D3.4).

2 Methodology

The methodology elaborated to the validation of tools are developed within WP2. For each tool (self-assessment tool, legal decision support tool, energy management platform) the validation criteria are presented below.

The evaluation process is divided into three phases:

- **Definition phase** - definition of validation criteria, timeframe to be respected and calculation method used for the validation of each tool);
- **Analysis phase** - level of final end-user satisfaction, evidence of the algorithms used to process the results obtained;
- **Final report** (for each of the tools developed).

2.1 Definition phase

The first phase of this methodology for validating tools is called the "definition phase". In this phase are presented the validation criteria, the timeframe to be respect and the calculation method. These will allow the three different tools to be validated.

As a first step towards the definition of the validation criteria, we asked the partners of the project to propose criteria that they thought the tools should address: A list of the criteria that the tools should have met, translated into the necessary conditions for the validation of the tools, was then identified by all participants. This information, shared with the working groups, has been reworked with the aim of obtaining a guideline for the validation process and the related evaluation methodology. To this end, a matrix system has been created in which the different criteria have been defined according to two main factors:

1. the level of priority of the criterion over the tool;
2. the need to obtain feedback from internal users (operators and working groups of the Project) or external users (end users and/or beta-users).

The first one provides for the association with one of the following priority categories: **high, medium** and **low**. Each of them is assigned a different specific weight in the processing and analysis of results obtained from user feedback.
The second, as explained, requires that the assessment of the criterion is carried out by internal or external operators, based on the characteristics of the criterion and the tool in validation. Based on this need, internal and external criteria have been defined.
The **externa**l criteria are those criteria that will be evaluated by the beta-users, as they require a direct feedback from the user, investigate the experience that each individual user has had with the application of the tool. The **internal** criteria are those criteria that will be evaluated by the WP 3 leader, as they aimed at investigating topics and themes of which only internal partners of the project are aware (ex. KPIs).

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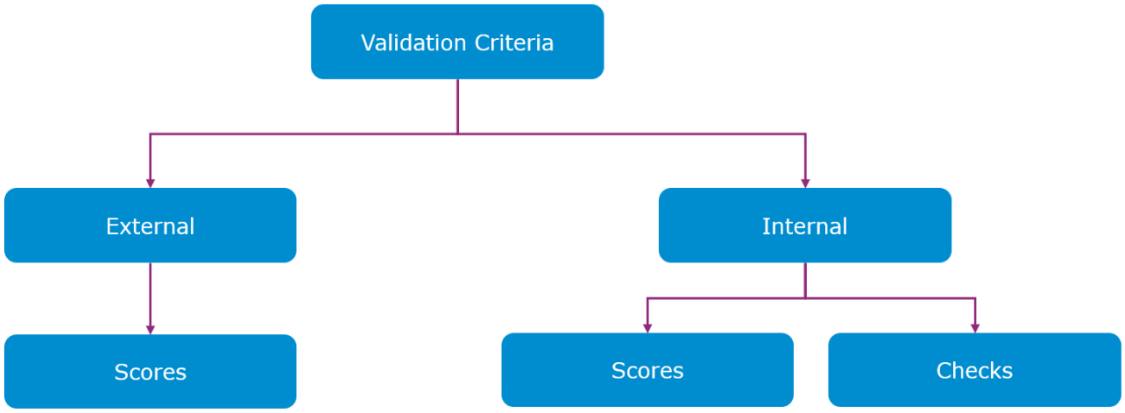
2.1.1 Validation criteria

The validation criteria identified are set out in Annex 02. For each tool, the criteria defined for validation will be reported divided by priority.
The priority of each criteria has been defined and approved by the partners (during the WP 3 progress meeting held on 26th October 2020).

Some criteria will be common to all three tools, others will be specific to each tool.
A further subdivision of the criteria has also been introduced: **internal** and **external** criteria.
The external criteria are those criteria that will be evaluated by the users of the tools, as they require a direct feedback from the user, investigate the experience that each individual user has had with the application of the tool. The internal criteria are those criteria that will be evaluated by the WP3 leader, as they aimed at investigating topics and themes of which only internal partners of the project are aware (ex. KPIs)

Figure 1: Validation criteria and method of calculation



2.1.2 Timeline

Once the tools have been developed, they will undergo a testing phase before being validated. Initially, the tools will be distributed to the three pilot ecoregions and then to the other 7 ecoregions identified by the project partners. Please note that the tools only be tested in the pilot regions on selected *beta-users* (the detailed contact excel file can be found in Annex 03 – Table for Contact). Beta users are those users identified in the three pilot ecoregions, to whom prototypes of the tools will be administered and who will be asked to express their opinion on the use of the tools themselves.

External Criteria
During this testing phase using external criteria, **Google Forms** surveys (see Annex 4) will be periodically sent to the users/facilitators of the tools (in case tools are applied by these), through which they will be able to express their opinion on the application of the tools (Calculation method: "scores").
The first surveys will be sent **one month** after the application of the tool. If the surveys provide positive results (in compliance with the parameters set out in the calculation methodology), the tool will not be modified, and users will be asked to continue to provide feedback on a **two-monthly basis/scheme**. If any issues are identified (the parameters imposed will not be respected), we will conduct targeted interviews to investigate the reasons for the issues and modify the tool accordingly. The leader of WP 3 will endeavour to work with the tool developers to implement the appropriate changes as quickly as possible so that the modified tool can be reapplied. Once the tool has been reapplied, feedback will be requested again **one month** after the new application and **every two months** thereafter, if no further problems are found.
Until month 22 for Legal Decision Support tool and EMP. At **22th month** validation reports will be produced for each tool.

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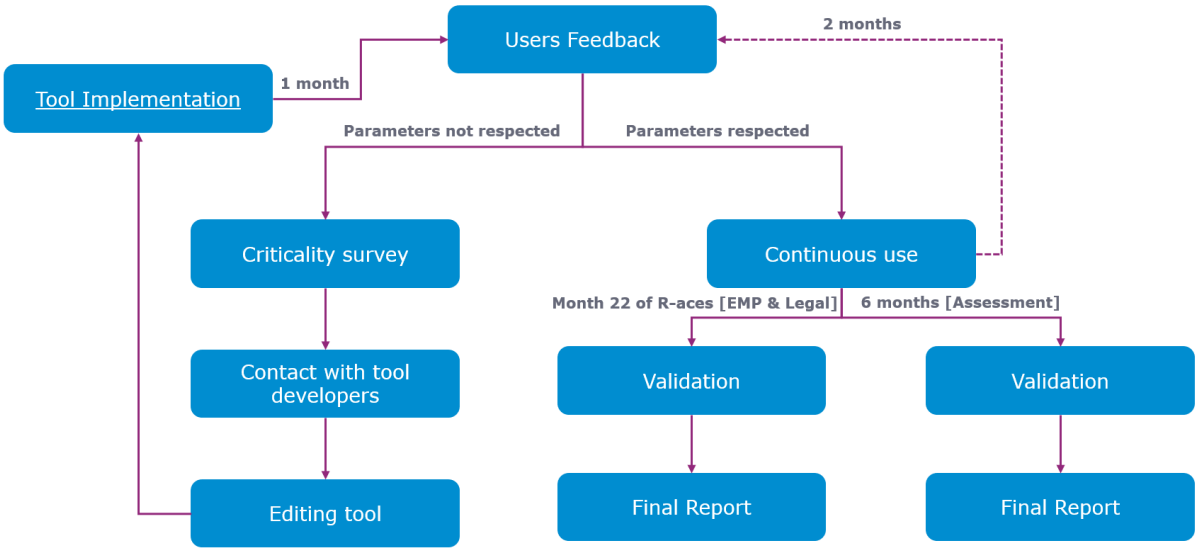
For the Self-assessment tool, it was decided to stop the validation cycle only **6 months** after the first application. This decision was made since this tool will be applied only in the initial months.
Last it is specified that some criteria will be judged only at the six months of use of the tool, as they will investigate energetic savings obtained from the application of the tools, that they would not be evaluable in the immediate (ex. Energy & costs saving).

Figure 2: Flow map



Internal Criteria
Two methodologies will be used for internal criteria: "Checks" and "Scores".
The criteria that will be judged through the assignment of a score from 1 to 10 will use the same calculation algorithm and the same timing of the external criteria (see the previous flow map).
Criteria that will be judged though method defined "checks" will use the same times and the same steps of the previous criteria, it will only change the algorithm used.

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2.1.3 Method of calculation

- **Scores**

Once the tools have been developed and distributed to the different users to proceed with the testing phase, monthly feedback will be requested. The users/facilitators will give their opinion on the tested tools by expressing on a **scale from 1 to 10** the level of satisfaction according to the identified criteria. The score 1 will represent the highest level of dissatisfaction, 10 the highest level of satisfaction (this procedure will also be carried out for internal criteria evaluated by "scores" method by the leader of WP 3).
Once the survey data has been collected, an average of the degree of satisfaction for each criteria of each tool will be calculated. In this phase a criterion will be considered satisfied if the average of the votes expressed for it reaches the grade of:

Table 1: Criteria sufficiency level – Feedback phase

Criteria priority	Sufficiency level
High	7
Medium	6,5
Low	6

It was decided to give a different threshold of sufficiency depending on the category of the criteria because we believe that criteria falling into the "High Priority" category are of greater importance. Therefore, if a High Priority criterion does not reach sufficiency it will certainly be more serious than a Low Priority criterion and will certainly lead to the use of more resources to solve the problem.

If one or more of the criteria do not reach sufficiency, the motivation will be investigated, and a solution sought.

Based on the prioritisation of the criteria (high, medium, low), each of the three categories is given a different level of importance. The weight of each category was defined by the leader of WP 3 after careful consideration:

Table 2: Priority weight

Criteria priority	Priority weight
High	8
Medium	5
Low	3

The weight of each criteria will be of relevant importance in the algorithm that will lead to the validation of the tools in month 22.

At the end of the 22 months, the leader of WP 3 will group the results obtained in the testing phase: the average of all the results (previously calculated averages) obtained from the Google Forms surveys ("scores") will be calculated for each single criterion of each tool using the Excel formula:

[F2] = AVERAGE (C2:E2)[1]

(Example of average calculation for Criterion 1; this calculation will be replicated for each Criterion defined for the validation of the tool).

Once the average of the feedback for each criterion has been obtained, this average will be weighted on the weight of the criterion. As defined above, each criterion belongs to a different category (High Priority, Medium Priority, Low Priority) which is given a different weight (Table 2). This process will allow to give more relevance to high priority criteria in the final validation process.

[1]Formula referred to the example shown, cell references may change during actual calculation

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Below is the Excel formula that will be used to calculate the weighted average:

[G2] = SUMPRODUCT (F2:F8; G2:G8)/SUM (G2:G8)[2]

This calculation will be performed for all three tools separately, both for the external criteria and for the internal ones judged by "scores".
The tools will be able to move on to the final validation phase when the priority criteria return a result greater than or equal to **6**.

Table 3: Validation limit tool – "scores" method

Tool	**Sufficiency for the validation**
Assessment tool	6
Legal framework tool	6
Energy management platform	6

If at the end of the validation process it emerges that one or more tools do not reach the threshold of sufficiency, the tools in question will not be validated.

Below is a general example for a single tool to better clarify the calculation process performed for validation. The formulas above refer to this example. As a result, the tool would go to the final validation phase because the weighted avarage of all criteria defined for the tool was 6.76 and therefore higher than the minimum value imposed for validation.

Table 4: Weighted average calculation example for tool

	A	B	C	D	E	F	G
1	**Priority**		**Feedback1**	**Feedback 2**	**Feedback 3**	**Average feedback**	**Weight criteria**
2	High	Criterio 1	7	6,5	7	6,83	8
3	High	Criterio2	6,5	7	7	6,83	8
4	High	Criterio3	7	7	7	7,00	8
5	Medium	Criterio4	6	6,5	7	6,50	5
6	Medium	Criterio5	6,5	6,5	8	7,00	5
7	Low	Criterio6	7	6	5,5	6,17	3
8	Low	Criterio7	6	6,5	6,5	6,33	3
9							
10							
11						**Weighted average**	6,76
12							

If at the end of validation process it emerges that one or more tools do not reach the sufficiency threshold, the tools in question will not be validated.

[2]Formula referred to the example shown, cell references may change in real calculation

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- **Checks**

Some of the selected internal criteria will be judge through a check- list by the leader of WP3.
With the same periodicity used by "scores" method described above, the leader of WP3 will undertake to assess the internal criteria by means of "check" corresponding to the test criterion. The criteria that will not receive the "Check" will be investigated and the leader of WP3 with the developers of the tools will evaluate the possible solutions and reapply the tool.

To pass to the final validation phase, these criteria must obtain a percentage of "check" defined according to the priority:

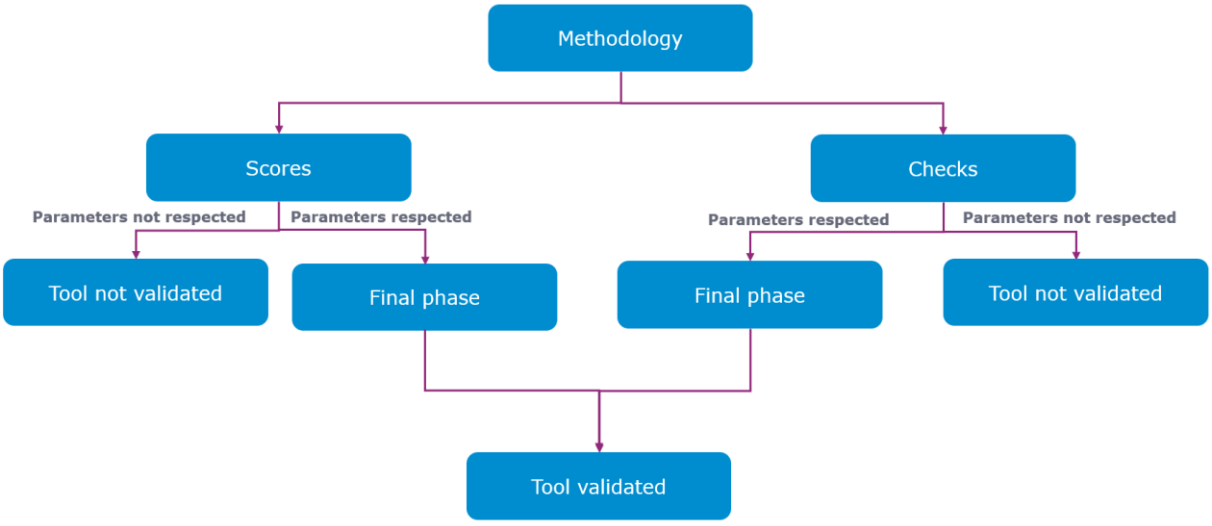
Table 5: Validation limit tool – "checks" method

Criteria priority	Sufficiency for the validation
High	3/3
Medium	2/3
Low	1/3

- **Final validation**

In order to validate the tools, internal and external criteria must meet the parameters set out above. The single tool will be validated when the "scores" method and the "checks" method will both return positive results (sufficient level respected). If one of the two method failed to meet the set parameters, the tool would not be validated.

Figure 3: Calculation methodology (Final validation)



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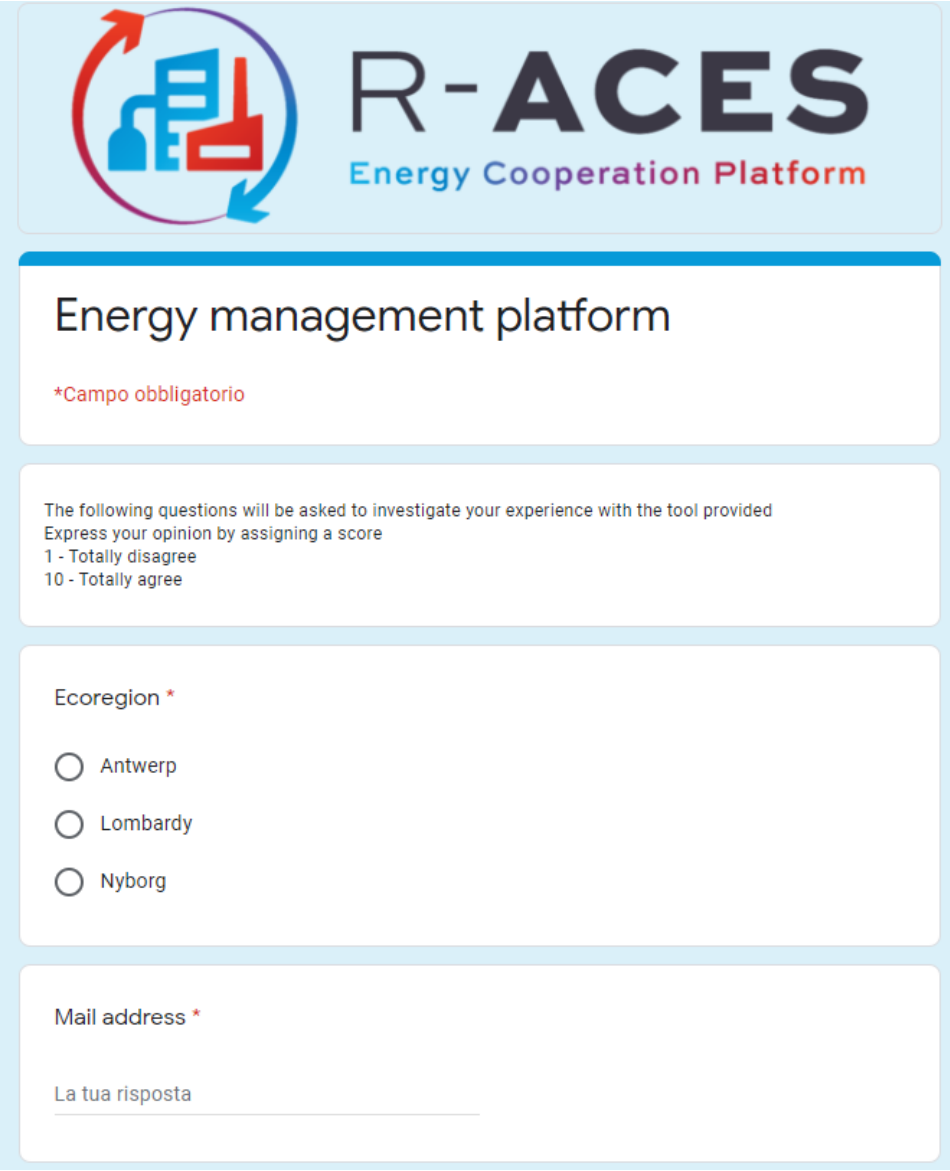
2.2 Analysis of end user satisfaction

- **External criteria**

Once the criteria, timing, and calculation methodology for validation have been defined, the second phase will focus on their application. Once the tools have been distributed to the users selected within the ecoregions, surveys will be created periodically (as defined above) and interviews conducted on the functioning of the tools.

The surveys, in this phase of investigation, will be useful to identify any problems with the tools.
The users/facilitators will have to express their opinion on a scale from **1 to 10** (1: Highest degree of dissatisfaction; 10: Highest degree of satisfaction) on a Google Forms form regarding the use of the tools. The questions asked will be divided per tool and will reflect the criteria identified above. To make the data processing easier, each tool have its own Google forms with its own criteria previously presented.
In order to be able to investigate any problems with the use of the tools, the users who fill the forms will be asked for an e-mail contact in order to be contacted
The google forms will be attached (Annex 04).

Figure 4: Example of survey question



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Depending on the results (averages obtained for each validation criterion), we will be able to identify the criteria that do not reach the required level of sufficiency. The managers of the ecoregions already involved in the project will then proceed to investigate the reasons for this through targeted interviews with users. The reasons why users do not consider the criterion(s) to be fully satisfied will be investigated and, once the critical points have been identified, they will be asked to propose the solutions they consider most appropriate in order to validate the tool in question.
The leader of WP 3 will examine all proposals and proceed to contact the developers of the tools from WP 2. We will discuss with them and study the changes necessary to see that the tool(s) works properly. Once the appropriate changes have been identified and applied, the affected tool(s) will be redistributed to the users and feedback will be requested again one month after the new application. Surveys in Google Forms will not take more than 5 minutes, each tool will have its own form, in order to facilitate data processing.
To facilitate the sending of Google Forms will be asked to the heads of the pilot Ecoregions to identify the beta-users and provide the contacts of these. An excel file for contacts (Annex 03) will be provided. The contact of the facilitator/user who will be subject to interview will be asked.

- **Internal criteria**

As for the external criteria used for evaluation of the tools, also for the internal ones we will proceed to provide feedback with the same timing. The leader of WP3will be directly involved in the evaluation of these criteria, will express its opinion on the tools by assigning a score to the criteria ("Scores" method) or using a check-list. Timing and evaluation cycle remain the same as those used by external criteria.

2.3 Final Report

At the end of the validation phase **(M22)**, 3 final reports will be drafted showing for each tool the process undertaken for the validation and the suggestions/improvements to be undertaken:

- **D3.2 Validation report EMP;**
- **D3.3 Validation report self-assessment tool;**
- **D3.4 Validation report legal decision support tool.**

Throughout the validation phase, the leader of WP3will keep a record of all the results obtained from the different surveys and any changes that will be made to the different tools.
For each tool the final report will be able to summarize all the results obtained from the different feedbacks requested from the users and the eventual modifications that will be made during the testing phase.
The final reports will also be useful when it is decided that the tools can be applied outside the R-ACES project, once it is finished.

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3 Conclusion

On the basis of the information obtained to date on the development of the tools, a methodology has been described here with which the tools can be validated.
This deliverable (**D3.1**) will be of fundamental importance for the R-ACES project as it represents the key to all the work done. If one or more tools at the beginning of month 24 should not be validated, the project may be considered not entirely successful.

The methodology outlined here will certainly allow the appropriate changes to be made to the tools in time for the project to be fully successful. The key to this methodology will be the cooperation between the R-ACES project partners.

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4 Annexes

4.1 Annex 01 – R-ACES definitions

Project Glossary

Definition of Key Concepts in the R-ACES project

Business park: An area of land in which many office buildings are grouped together with a common infrastructure (Wikipedia). Business parks, like industrial sites, often have similarities in heating and cooling demand. Certain businesses may even have residual energy streams, for example data centers. As such, business parks may also organize as an ecosystem or eco business park (EBP) and become an important stakeholder within an ecoregion.

Eco Business Park: *"An eco-industrial park is a community of businesses located on a common property in which businesses seek to achieve enhanced environmental, economic and social performance through collaboration in managing environmental and resource issues. This is known as industrial symbiosis, which is a means by which companies can gain a competitive advantage through the physical exchange of materials, energy, water and by-products, thereby fostering inclusive and sustainable development."* (United Nations Industrial Development Organization)

Communicate: professional and public coverage of the project results and achievements, benefits and potential deployment. This will be realised via the adoption of a large variety of distribution channels, including already existing platforms focusing on energy cooperation in industrial sites and business parks and energy exchange/cooperation at large.

Disseminate: exploitation of the project results to relevant stakeholders in the regions. It intends to ensure a low threshold in accessibility, usage of R-ACES tools and methods. This includes access to the tools, to the use case libraries and to the training and capacity building material and related self-explanatory instruction manuals.

DHC: Abbreviation of District Heating and Cooling. A system for distributing heating/cooling generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements such as space heating/cooling and water heating/cooling.

> 4th generation DHCs: *"4GDH systems provide the heat supply of low-energy buildings with low grid losses in a way in which the use of low-temperature heat sources is integrated with the operation of smart thermal grids. Smart thermal grids consist of a network of pipes connecting the buildings in a neighbourhood, town centre or whole city, so that they can be served from centralised plants as well as from a number of distributed heating and cooling producing units (or decentralised units) including individual contributions from the connected buildings. The concept of smart thermal grids can be regarded as being parallel to smart electricity grids. Both concepts focus on the integration and efficient use of potential future renewable energy sources as well as the operation of a grid structure allowing for distributed generation which may involve interaction with consumers."* (adapted from Lund et al, Energy 68; 2014, p1-11).
>
> 5th generation DHCs: *"5GDHC is a highly optimized, demand-driven, self-regulating, energy management system for urban areas. Its key features are: 1) ultra-low temperature grid with decentralized energy plants; 2) closed thermal energy loops ensuring hot and cold exchange within and among buildings; 3) integration of thermal and electricity grids."* (D2grids, Interreg NWE)

Ecoregion: An ecoregion within the R-ACES project is a geographic area where energy and information exchanges occur between stakeholders of various types to reduce energy consumption. Geographical size does not matter (the size of an ecoregion can be as small as a business park or as large as a city). Important is that an ecoregion relies on an anchor organization responsible for

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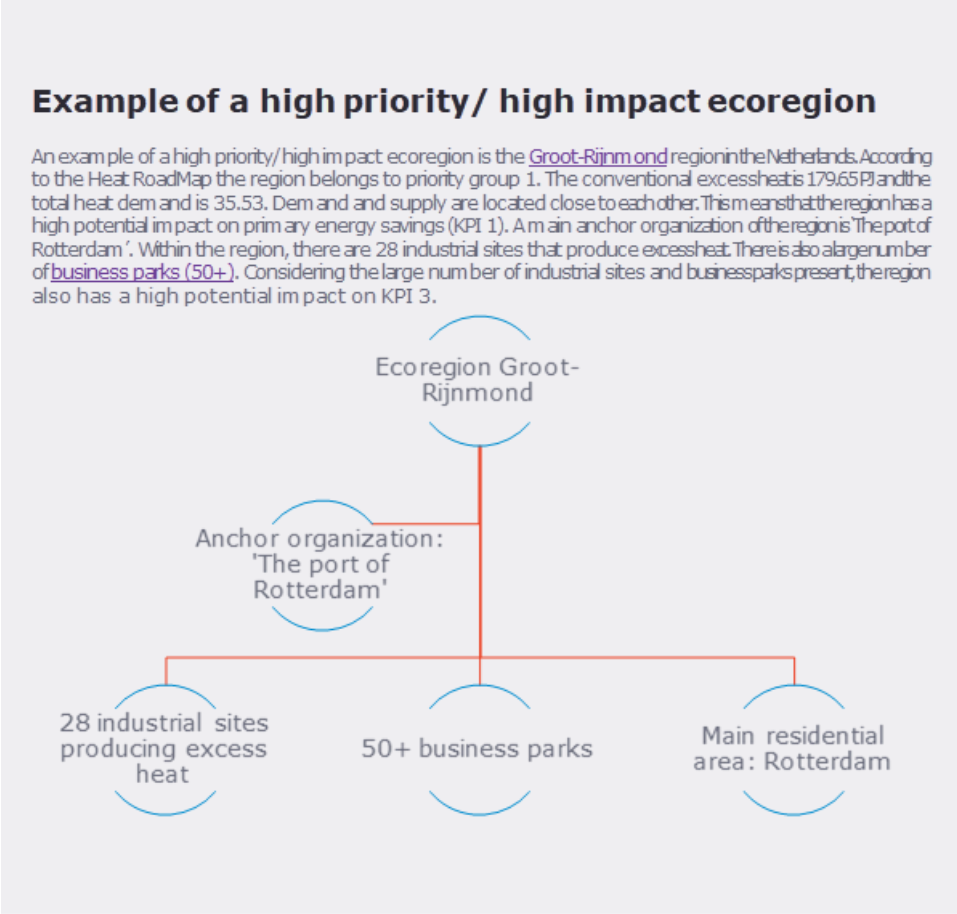
managing the area (for example park management). Another aspect is the proximity of stakeholders to ensure interconnected energy flows (continuity of supply, quality of supply, quantity). Within an ecoregion, a wide range of assets could be involved: office parks, data centers, multimodal centers, technological centers, agro-centers, science parks, brain parks, lighthouse parks, chemical parks, eco-industrial parks, and cluster/business parks. For the demand of heat, also residential areas could be considered. As such, the term ecoregion functions as an 'umbrella term'.



High priority region: A high priority region is an Ecoregion, as defined above, that has balanced potential match of heating/cooling supply and heating/cooling demand in both quantitative (amount of heating/cooling) and qualitative (temperature, form of heat) terms. The region should be identified by heat roadmap studies (for example, the Heat RoadMap Europe or Stratego) or other research activities. In addition, the regions should have networking possibilities. The regions can include industrial sites, business parks and residential areas.

The table below gives an indication of the priorities. R-ACES will focus on priority group 1 +2.

Table 2.19. Excess heat ($E_{heat,o}$) and heat demand (Q_{tot}) characteristics for the definition of priority groups to identify heat synergy regions

	Characteristics			
Priority group	**Excess heat[a] [PJ/a]**	**Heat demand[b] [PJ/a]**	**Priority status**	**Comment**
1	$\Sigma E_{heat,o} > 10$	$Q_{tot} > 10$	Very high	High levels of both $E_{heat,o}$ and Q_{tot}
2	$1 < \Sigma E_{heat,o} < 10$	$Q_{tot} > 10$	High	Moderate levels of $E_{heat,o}$ and high Q_{tot}
3	$\Sigma E_{heat,o} > 10$	$1 < Q_{tot} < 10$	Moderate	High $E_{heat,o}$ and moderate levels of Q_{tot}
4	$1 < \Sigma E_{heat,o} < 10$	$1 < Q_{tot} < 10$	Low	Both $E_{heat,o}$ and Q_{tot} at moderate levels
0	$\Sigma E_{heat,o,max} < 2.5$	$Q_{tot,max} < 25$	No priority	Both $E_{heat,o}$ and Q_{tot} at low levels

[a] Maximal theoretical levels of annually available excess heat.
[b] Space heating and domestic hot water preparation in residential and service sectors.

High potential region: Within the project proposal, sometimes the term high potential ecoregion is mentioned. From now on, this term will not be used within the scope of the R-ACES project.

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High impact (in R-ACES terms): Regions that have a high potential impact on the R-ACES KPIs. More specifically, regions are meant that have a high potential impact on KPI 1: Primary energy savings, and KPI 3: Number of plant sites and number of industrial parks where businesses commit to energy cooperation.

Energy cooperation: Energy cooperation activities between industries, which include physical clustering (e.g., of buildings and processes, energy exchange, collective production) and/ or service clustering (e.g., joint contracting). Both can deliver a more stable cumulative demand, economy of scale for larger installations with higher efficiencies and smaller spatial footprint and an optimized demand response. Within R-ACES, the focus is mainly on energy cooperation through the exchange of heating and cooling.

Energy management Platform: The platform is an ICT-tool that makes energy flows transparent; allows energy consumption and production to be allocated to specific installations, stakeholders and nodes; and identifies anomalies and opportunities. A key feature is that it is very easy to use for a wide range of stakeholders. In this way, it is possible to deploy it in a cluster and give access to the different company and cluster managers – each at their level of detail and with the information they should have access to. On the ecoregion level, there will be a dashboard that shows different energy flows.

ESCO: Abbreviation for Energy Service Company. An ESCO is a business that provides a broad range of energy solutions including designs and implementation of energy savings projects, retrofitting, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management.

Facilitator: someone who helps to bring about an outcome (such as learning, productivity, or communication) by providing indirect or unobtrusive assistance, guidance, or supervision. This task does not include technical expert know-how, instead facilitators are trained to facilitate interaction between multiple actors.

Industrial cluster: Within the project proposal, sometimes the term Industrial cluster is used. From now on, this term will not be used within the scope of the R-ACES project.

Industrial park: Within the project proposal, sometimes the term Industrial park is used. From now on, this term will not be used within the scope of the R-ACES project.

Industrial region: Within the project proposal, sometimes the term Industrial region is used. From now on, this term will not be used within the scope of the R-ACES project.

Industrial site: An area zoned and planned for the purpose of industrial development. An industrial site can be thought of as a more "heavyweight" version of a business park or office park, which has offices and light industry, rather than heavy industry. They may contain oil refineries, ports, warehouses, distribution centres, factories, and companies that provide manufacturing, transportation, and storage facilities, such as chemical plants, airports, and beverage manufacturers (Wikipedia).

(R-ACES) Learning community: Local group of stakeholders that are (a) directly involved with the energy collaboration on a site; and (b) engaging in both organised and informal exchange of knowledge and best practices over the course of the project period. These groups are the first beneficiaries of instruments like serious gaming. Learning communities from different sites in this project will eventually be brought into contact with each other to further stimulate the exchange of best practices.

Learning network: *"Allow for enduring relationships built on trust to develop among companies within an industrial site. In turn these relationships encourage information sharing, creative solutions, long term planning and governance among stakeholders. Social aspects increase interactions among stakeholders and strengthen collaborations and partnerships including industrial ones"* (Scaler, 2018). To establish such learning networks, the R-ACES project will use learning communities.

(R-ACES) Legal tool: A tool that supports practitioners by giving the legal decision support for joint contracts. A low threshold for usage is a critical requirement. The tool is self-explanatory, application oriented, using well-defined and clear terminology. The tool should be able to deal with a high

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diversity of local situations. For practical reasons, the name of the legal tool might change during the R-ACES process. In this case, the consortium will be informed.

LESTS framework: Abbreviation for Legal, Economic, Spatial, Technical and Social/Managerial. LESTS is a framework that is used in the project to categorize barriers and drivers in ecoregions. The different categories include: Legal, e.g. liabilities, regulatory requirements, third party contracts, service agreements, rules; Economic, e.g. cost savings, waste/ resource recovery value, funding mechanism, taxes & environmental considerations; Spatial, including geographical proximity, planning rules and environmental considerations; Technical, e.g. sharing and cascading resources, system stability, facilities; Social/Managerial, e.g. with regard to workers, consumers, local communities employment, community engagement, and capacity building.

Lock-in: Exchange of by-products will lead to long term reliance on an outside company, which will restrict flexibility of the involved companies and possibility for innovation, or possibility to relocate the site.

Longlist (for example longlist of regions): Exists of lists of items (rows), for example regions, that have been selected on the basis of loose selection criteria (columns). The long list is a first step in creating a short list. The long list should cover all potential subjects that might be of interest to the short list. Example:

Region	Region	Country	Source	# DHCS	# Industrial sites	# Business parks	Contact person	Contact details
1	Maasvlakt	Nederland	...					
2	Chemelot	Nederland	...					
3	Terneuzen	Nederland	...					

Long-term: Long-term impact of R-ACES is gained after the end of the R-ACES project (in KPI terms).

Peer2peer: A network of peers (R-ACES stakeholders) that perceive each other as equal. The peers interact with each other to learn from each other. The peer2peer learning context is a formal or informal setting, in small groups or online. Pear learning manifests aspects of self-organization. By this is meant, that there is no hierarchical structure within a peer2peer network (Wikipedia).

(R-ACES) Self-assessment tool: A tool that helps ecoregions to determine the next steps they have to take in the energy cooperation process. The tool exists of several questions practitioners have to answer. Based on the answers, the practitioners will get a score and some practical considerations they should take into consideration.

Serious gaming: A method for learning-through-experience that presents participants with a case study in which they have to play pre-assigned roles to each reach a pre-defined objective as quickly as possible. The interactive & competitive gaming element increases the attractiveness and the learning outcome of the case study. Serious gaming addresses cooperation elements among a large variety of practitioners and focus at creating acceptance and awareness, where the learning communities focus at sharing experiences between peers.

Shortlist (for example shortlist of regions): List of items, for example regions, that have been selected from a long list on the basis of (strict) selection criteria. Hereby, the advantages and disadvantages of each item are considered (OpenLearn). The shortlist contains items that have a high potential and likelihood to contribute to the R-ACES goal.

Short-term: Short-term impact of R-ACES is gained during the R-ACES project.

Use case: A written description of the sequence of steps performed by an ecoregion to come to fruitful energy cooperation.

Use case library: A library that contains multiple use cases.

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4.2Annex 02 – Criteria

These tables show the validation criteria, divided according to the validation method used

- **External criteria ("scores" method)**

Self-Assessment tool

Priority	Validation Criteria
High Priority	Ease of use by users / stakeholders - Replicability level of the tool
	Support managers to set up the next steps of energy cooperation
Medium Priority	Adaptable to local conditions
	Monitor user satisfaction indicator
	Amount of human effort
	Provide guidance on best practices
	Cover all themes: technical, economic, legal, market, social acceptance
Low Priority	Evaluation and comparison of the expected results
	Time to execute

Legal Decision Support tool

Priority	Validation Criteria
High Priority	Ease of use by users / stakeholders - Replicability level of the tool
Medium Priority	Monitor user satisfaction indicator
	Amount of human effort
	Understandable language
Low Priority	Evaluation and comparison of the expected results
	Adaptable to users' company policies
	Support to get better contracts (e.g. lower costs / find buyers)

Energy Management platform

Priority	Validation Criteria
High Priority	Ease of use by users / stakeholders - Replicability level of the tool
	Estimated energy saving[3]
Medium Priority	Monitor user satisfaction indicator
	Amount of human effort
Low Priority	Evaluation and comparison of the expected results
	Provide simple allocation of energy consumption and parameters

[3] Rated after 6 months from the first application of the tool

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- **Internal criteria ("scores" method)**

Self-Assessment tool

High Priority	Number of users by region
	Flexibility in software development to speed up the updates
	Ability to engage the users over long period of time
	Security
Medium Priority	Adaptable to local conditions

Legal Decision-Support tool

High Priority	Number of users by region
	Ability to engage the users over long period of time
	Security
Medium Priority	Adaptable to local conditions
	Amount of human effort
	Understandable language

Energy Management platform

High Priority	Number of users by region
	Flexibility in software development to speed up the updates
	Ability to engage the users over long period of time
	Security
	Users accessibility
	Transparent flows
Medium Priority	Adaptable to local conditions / legislation

- **Internal criteria ("checks" method)**

Self-Assessment tool

Medium Priority	Available also at the end of the R-ACES project
	Relationship with R-ACES project KPIs
	Provide a checklist to explore energy needs reduction and other aspects that may influence energy cooperation
Low Priority	Ensure interoperability between tools

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Legal Framework tool

Medium Priority	Available also at the end of the R-ACES project
	Relationship with R-ACES project KPIs
	Monitor user satisfaction indicator
Low Priority	Ensure interoperability between tools

Energy Management platform

High Priority	Applicable in different countries (language, legislation, etc)
Medium Priority	Available also at the end of the R-ACES project
	Relationship with R-ACES project KPIs
Low Priority	Ensure interoperability between tools
	Overall efficiency gains of plants producing waste heat

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4.3 Annex 03 – Table for contact

This table was prepared by leader deliverable for the partners to fill in the contacts with the local beta-users.

	A	B	C	D	E	F	G	H	I	J	K
1	Region name (choose from drop down list)	Nace Code of Company	Name of Company	Name of contact	Name of contact using tool	Role	Contact information for Google Forms (e-mail address)	Notes	Date of First Self-Assessment tool application	Date of First Legal Framework tool application	Date of First EMP application
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

The leaders of the pilot Ecoregions will have to report here the data of beta-users who will be involved in the testing of the tools. You are asked to enter:

- Ecoregion to which they belong;
- Nace code of the company involved;
- The name of the company;
- The contact person (email);
- The name of who will apply the tool (in agreement with the developers of the tools, the tools can be applied by facilitators, not only by a member of the company);
- The role of the person who applies the tool (external facilitator or internal staff);
- An email address to send google forms for the evaluation of tools;
- Date of the first application of the tools.

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4.4 Annex 04 – Google Forms

Here the links to access google forms.

- **Self-Assessment tool:** https://docs.google.com/forms/d/e/1FAIpQLSdVM4mqvkEFB5iTPkJUjlxpXl49YHnr8dFOIJ-_zOEnkPBqkA/viewform
- **Legal decision support tool:** https://docs.google.com/forms/d/e/1FAIpQLSeH7RvHrzGiwb_yZ-Ifn7pZ4iInvlNjLhKu-HUcqlaR7Y2ehA/viewform
- **Energy management platform:** https://docs.google.com/forms/d/e/1FAIpQLSeSe7oWEHj5zXiqFSiv24ONioKz4pPsYbqhMJ3kchc01RQdAw/viewform

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