Horizon 2020 Programme

LEAP-RE

Research and Innovation Action (RIA)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 963530

Start date : 2020-10-01 Duration : 63 Months
http://www.leap-re.eu/

Knowledge sharing and clustering strategy

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LEAP-RE - Contract Number: 963530

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Document title	Knowledge sharing and clustering strategy
Author(s)	Mrs. Melissa PLATH
Number of pages	31
Document type	Deliverable
Work Package	WP4
Document number	D4.1
Issued by	UHEL
Date of completion	2021-07-12 09:33:41
Dissemination level	Public

Summary

The Long-Term Europe-Africa Partnership on Renewable Energy (LEAP-RE) is a five-year programme funded by the European Commission under Horizon 2020, aiming to develop a long-term partnership between Africa and Europe on Research and Innovation (R&I) in renewable energy. LEAP-RE represents a major contribution to the implementation of the AU-EU Research and Innovation Partnership on Climate Change and Sustainable energy (CCSE) and its Roadmap for a Jointly funded AU-EU Research & Innovation Partnership on Climate Change and Sustainable Energy in itself, but also via the projects to be undertaken in Pillars 1 and 2 of the programme. This document details a strategy for the clustering and knowledge sharing of the Pillars 1 and 2 projects to better enable mutual learning, cooperation, and the meaningful contribution of the projects and the LEAP-RE programme to the long-term objectives of the CCSE Partnership and its Roadmap. It outlines the aims and approach to clustering and describes the LEAP-RE strategic approach to implementing clustering activities. A simple system for knowledge management, responding to the needs of the LEAP-RE projects and clusters, is also be described. This strategy is a living document, intended to create a strategic framework under which clustering activities take place. It recognizes that the context for implementing these activities ? the implementation of the LEAP-RE programme ? is an evolving one. Therefore, this strategy is flexible and can and should be adapted according to changes in the context or needs of the LEAP-RE programme and its projects.

Approval

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LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

Research & Innovation Action

May 2021

D4.1 Knowledge Sharing and Clustering Strategy

Version N°1

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This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

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Document information

Grant Agreement	963530
Project Title	Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy
Project Acronym	LEAP-RE
Project Coordinator	Vincent Chauvet (Vincent.chauvet@lgi-consulting.com) – LGI
Project Duration	1st October 2020 – 31st December 2025 (63 Months)
Related Work Package	WP4
Related Task(s)	4.1
Lead Organisation	University of Helsinki
Contributing Partner(s)	AESG, POLIMI, SU, MESRS, ANR
Due Date	31.5.2021
Submission Date	30.06.2021
Dissemination level	Public

History

Date	Version	Submitted by	Reviewed by	Comments
17.5.2021	1	Melissa Plath	EC, SH, LL, NB	
24.6.2021	2	Melissa Plath		
30.6.2021	3	Melissa Plath	MS, LL, EC	The document will be uploaded on due date but will be updated by the end of 2021

This project has received funding from the European Union’s Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

Table of contents

1. Introduction and Purpose 8
1.1 LEAP-RE 8
1.2 Purpose 8
2. The 6 LEAP-RE Multi-Annual Roadmaps 9
3. Clustering 11
3.1 Strategic Approaches 11
3.2 Implementation 13
3.3 LEAP-RE Approach to Clustering 14
3.3.1 LEAP-RE Taxonomy for Clustering 14
3.3.2 Cluster Formation 15
3.3.3 Cluster Activities 15
4. Knowledge Sharing 16
4.1 Strategic Approaches 16
4.2 Implementation 17
4.3 LEAP-RE Approach to Knowledge Sharing 18
5. Conclusion 19
Annex 1: The 6 Multi-Annual Roadmaps 20
MAR #1: Mapping joint research and innovation actions for next-step development of RES and integration of RES in sustainable energy scenarios 20
MAR #2: End-of-life and second-life management and environmental impact of RE components 21
MAR #3: Smart stand-alone systems 23
MAR #4: Smart grid (different scales) for off grid application 24
MAR #5: Processes and appliances for productive uses (agriculture and industry) 26
MAR #6: Innovative solutions for priority domestic uses (clean cooking and cold chain) ...28
Annex 2: LEAP-RE Clustering Matrix 31

List of figures

Figure 1 Schematic representation of the PRE-LEAP-RE multidisciplinary framework for an R&I agenda 10

This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

List of tables

Table 1 Key Beneficiaries of Clustering Approaches 13
Table 2 Taxonomy for Clustering 14
Table 3 Examples of Clustering Activities 16

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Abbreviations and Acronyms

Acronym	Description
WP	Work Package
LEAP-RE	Long-Term Europe-Africa Partnership on Renewable Energy
R&I	Research and innovation
CCSE	Climate Change and Sustainable energy
PRE-LEAP-RE	Preparing for a Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy
MARs	Multi-Annual Roadmaps
RE	Renewable Energy
RES	Renewable Energy Source
SAS	Smart stand-alone systems
PRODUSE	Processes and appliances for productive uses
MEL	Monitoring, Evaluation and Learning
HLPD	AU-EU High Level Policy Dialogue on Science, Technology, and Innovation

Summary

The Long-Term Europe-Africa Partnership on Renewable Energy (LEAP-RE) is a five-year programme funded by the European Commission under Horizon 2020, aiming to develop a long-term partnership between Africa and Europe on Research and Innovation (R&I) in renewable energy. LEAP-RE represents a major contribution to the implementation of the AU-EU Research and Innovation Partnership on Climate Change and Sustainable energy (CCSE) and its *Roadmap for a Jointly funded AU-EU Research & Innovation Partnership on Climate Change and Sustainable Energy* in itself, but also via the projects to be undertaken in Pillars 1 and 2 of the programme.

This document details a strategy for the clustering and knowledge sharing of the Pillars 1 and 2 projects to better enable mutual learning, cooperation, and the meaningful

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contribution of the projects and the LEAP-RE programme to the long-term objectives of the CCSE Partnership and its Roadmap. It outlines the aims and approach to clustering and describes the LEAP-RE strategic approach to implementing clustering activities. A simple system for knowledge management, responding to the needs of the LEAP-RE projects and clusters, is also be described.

This strategy is a living document, intended to create a strategic framework under which clustering activities take place. It recognizes that the context for implementing these activities – the implementation of the LEAP-RE programme – is an evolving one. Therefore, this strategy is flexible and can and should be adapted according to changes in the context or needs of the LEAP-RE programme and its projects.

Keywords

project clustering, knowledge sharing, strategic implementation

1. Introduction and Purpose

1.1 LEAP-RE

The Long-Term Europe-Africa Partnership on Renewable Energy (LEAP-RE) is a five-year programme funded by the European Commission under Horizon 2020, aiming to develop a long-term partnership between Africa and Europe on Research and Innovation (R&I) in renewable energy.

The programme is implemented in three pillars:

- Pillar 1: transnational open call(s) for proposals for research, innovation, and capacity building activities, funded by national or regional funding agencies and by the European Commission;
- Pillar 2: individual R&I and capacity building projects undertaken by members of the LEAP-RE consortium; and
- Pillar 3: management and coordination of the programme.

LEAP-RE represents a major contribution to the implementation of the AU-EU Research and Innovation Partnership on Climate Change and Sustainable energy (CCSE) and its *Roadmap for a Jointly funded AU-EU Research & Innovation Partnership on Climate Change and Sustainable Energy*[1] in itself, but also via the projects to be undertaken in Pillars 1 and 2 of the programme.

Alone, the Pillar 1 and 2 projects will produce new knowledge, innovation, technology, products, and/or services that can accelerate the inclusive transition to reliable and affordable energy. However, to fully catalyse the contribution of these projects to the CCSE Partnership and its Roadmap, dedicated efforts must be made to support knowledge sharing and clustering of projects.

1.2 Purpose

The purpose of this document is to set-out a strategy for the clustering and knowledge sharing of the Pillars 1 and 2 projects to better enable mutual learning, cooperation, and the meaningful contribution of the projects and the LEAP-RE programme to the long-term objectives of the CCSE Partnership and its Roadmap. It will outline the aims and approach to clustering and describe the LEAP-RE strategic approach to implementing clustering activities. A simple system for knowledge management, responding to the needs of the LEAP-RE projects and clusters, will also be described.

This strategy is a living document, intended to create a strategic framework under which clustering activities take place. It recognizes that the context for implementing these activities – the implementation of the LEAP-RE programme – is an evolving one. While Pillar 2 projects are operative at M8, Pillar 1 projects will be selected and launched in M12 or M13, which presupposes updating this document at this date. Therefore, this strategy is flexible and can and should be adapted according to changes in the context or needs of the LEAP-RE programme and its projects.

[1] https://ec.europa.eu/info/files/ccse-roadmap_en

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2. The 6 LEAP-RE Multi-Annual Roadmaps

The Horizon 2020 project, Preparing for a Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy (PRE-LEAP-RE), undertook an ecosystem analysis to highlight the gaps, trends, challenges, and potential opportunities for bi-regional collaboration in the renewable energy sector[2].

The analysis was based on information provided by PRE-LEAP-RE consortium members and relevant international literature and studies. An *Initiatives & Network Matrix* was built with 89 selected initiatives, which allowed for analysis resulting in the recommendation of a multidisciplinary framework for an R&I agenda, with the following three key components.

1. **Technological development** needs to be deepened at all points along the energy supply chain, including conversion technologies and end use devices. Resource assessment is still crucial for some sources, while distribution is an important area for research and innovation when dealing with integration of renewables via smart hybrid mini grid, either in their off-grid configuration, or when considering their long-term integration within the national grid. This is one of the most attractive areas of research, where leapfrogging can be done by leveraging innovation with the digital revolution that is currently taking place in regions of Africa and allowing integration of sources and additional storage opportunities.

2. Technological development cannot stand alone. A **comprehensive methodological approach** is needed, able to address the different phases of the energy supply chain by taking into account societal needs, market evaluation, business models for long-term sustainability, and solution deployment as well as the long-term impact on society. As underlined by the CCSE Roadmap, such an approach is essential for guaranteeing the long-term social, economic, and environmental sustainability of technology.

3. Renewed attention to **energy scenarios and policy** is vital for understanding the contexts in which technologies and energy solutions will be developed, helping to minimize unforeseeable consequences. there is a clear need for supporting further research and capacity building on energy scenario analysis, including modelling approaches and tools that support policy and decision makers to build a long-term plan at national and regional levels.

[2] Towards a Joint AU-EU funding in Renewable Energies Technologies: An Ecosystem Analysis, http://pre.leap-re.eu/wp-content/uploads/2019/12/1-Background-Paper-Roadmaps-Ecosystem-2.pdf

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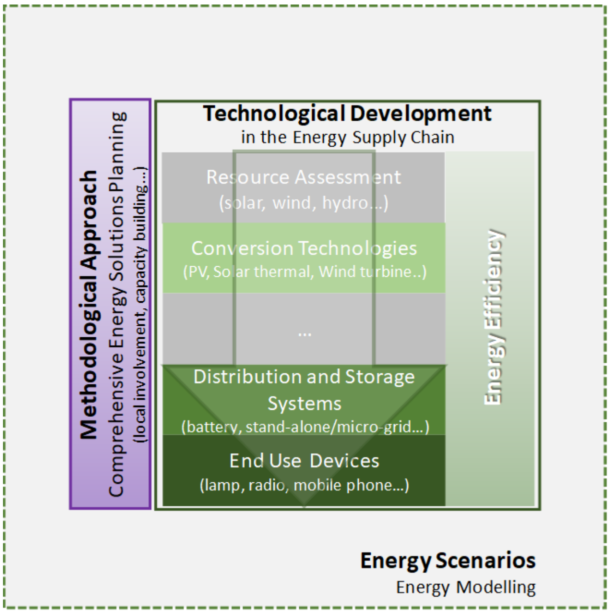

Figure 1 Schematic representation of the PRE-LEAP-RE multidisciplinary framework for an R&I agenda

Such a multidisciplinary approach encourages the development of scenarios that are appropriate to logical contexts and can be further utilized to support policy makers. Moreover, this approach requires the development of capacity building activities to increase local empowerment and ownership.

With this basis, and in consultation with stakeholders, PRE-LEAP-RE developed a set of 6 Multi-Annual Roadmaps (MARs) for research and innovation, representing the main topics related to renewable energies development and described in terms of social challenges, research scope, and expected output, outcome, and impact. These six MARs serve as the basis for the LEAP-RE Joint Call 2021 and for the 8 projects undertaken in Pillar 2.

The MARs are included in full in Annex 1: The 6 Multi-Annual Roadmaps, a summary of which is included here and constitutes an important aspect for knowledge sharing and clustering in the LEAP-RE programme.

#	Multiannual Roadmaps (MARs)
1	**Mapping joint research and innovation actions and resources for future RES development** – Consolidation of detailed map of R&I initiatives, sources in Europe and Africa per technology, application etc. type with the aim to support the RE industry to prioritize and contextualize target areas of RES deployment
2	**End-of-life and second-life management and environmental impact of RE components** - Map the component value chain, identification of key stakeholders & successful business models promote replicability scenarios of operational models and standard operating procedures in concerned regions
3	**Smart stand-alone systems (SAS)** - Promote the development of RE-SAS demonstrator(s) considering the diversity of potential local RE sources and the local effective environment
4	**Smart grid (different scale) for off- grid application** - Development of new tools for optimizing capacity in planning/ and dispatching strategies based on

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	people's needs with the aim to reduce the energy dependence on fossil fuel and increasing the share of RES use
5	**Processes and appliances for productive uses (PRODUSE)** – Improvement and Promotion of wider us of PRODUSE appliances for Cold chain and thermal tools and equipment's (healthcare and agriculture - livestock, fisheries and farming)
6	**Innovative solutions for priority domestic uses (clean cooking and cold chain)** - Improving, managing and maintaining solar photovoltaic systems, cookstoves and cold chain components for food cooking and food storage. Supporting interactions with policymaking to foster fast market uptake considering the macro socio-economic and gender impacts

3. Clustering

Project clustering is a tool that can support the delivery of strategic goals, encourage mutual sharing and learning, and support excellence and impact. It is both an input – into the achievement of strategic aims – and an outcome. In simple terms, project clustering involves the formation of groups of projects by forming networks with various scales that share specific attributes for a common goal.

Clustering can be beneficial for projects and project partners themselves but can also bring added value for research funders, policy makers, and in prioritisation phases of funding programmes. Clustering also can provide inputs into long-term objectives by supporting Monitoring, Evaluation and Learning (MEL) processes and supporting the building of dynamic networks of scientists. Clustering is an incremental approach that will evolve throughout the project, depending on the progress made by the Pillar 1 and Pillar 2 projects, and by the expansion of the LEAP RE community. The overall knowledge sharing and clustering strategy will be reviewed if necessary during PMB meetings.

For projects and project partners, clustering supports mutual and cross learning and the potential to utilise and benefit from research outcomes occurring in different projects. Clustering also serves as a basis for networking and better understanding the shared context in which project activities are taking place.

For LEAP-RE, project clustering serves multiple purposes. It can support the strategic delivery of the MARs, while also ensuring better use of resources by supporting mutual learning and greater impact by increasing collaboration between projects.

For policy makers, and particularly those addressing the AU-EU High Level Policy Dialogue on Science, Technology, and Innovation (HLPD) and its Research and Innovation Partnership on Climate Change and Sustainable Energy (CCSE), project clustering can offer a snapshot of the actions taken toward the implementation of the Partnership's Roadmap and can help show where further actions and investments should be made. Clustering can support monitoring and evaluation of the CCSE Partnership by showing the projects' (and LEAP-RE's) contributions to the larger goals of the Partnership.

3.1 Strategic Approaches

A diversity of approaches could be used for project clustering and implementation, depending on the intended outcome and for whom the clustering is being undertaken. Listed below are some strategic approaches that may be useful for strategic clustering of

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the LEAP-RE projects, the implementation of which is described in more detail in section 3.2 Implementation.

MAR(s) addressed

Project clustering around the MARs addressed is a straightforward approach, which can also bring substantial benefits. Clustering on this basis increases the strategic delivery of the MARs by supporting coordination, synergy building, knowledge sharing, technological development, and exploitation of results. A strength of this approach is its possibility to also support the future development of the MARs, including the foreseen updating process, ensuring the relevance of the LEAP-RE programme.

Projects and partners serve to gain a better understanding of the other actions undertaken in support of the MAR, and the chance to identify potential areas of cooperation or knowledge sharing. For LEAP-RE, clustering around the MARs serves to increase their potential impact and outcomes.

Methodological or technological approaches

While the LEAP-RE projects will use a diversity of methodological and technological approaches, project clustering around similar approaches may prove useful. Knowledge sharing and identification of good practices on methodologies used or technological aspects can encourage interdisciplinary exchange and insights. Policy makers, programme owners, and funding agencies may find benefit in clustering on this basis as it can also support processes leading to innovation and the identification of areas of particular interest for further development.

Geographical

The formation of project clusters related to geographical distribution of either project activities, partners, or some combination may also be meaningful. Such clusters can support networking, information sharing, and the broadening and deepening of stakeholder and end user engagement. Clustering on a geographical basis also provides important information and insight on the depth and breadth of programme activity, including gaps. This kind of information may be useful for shaping future funding orientations or focal points.

Activity

Cluster formation around activities of a similar nature can encourage coordination, pooling of scientific equipment, infrastructures, mutual learning and peer support, and identification of good practices. This can provide real benefits for projects and support the implementation and success of projects.

Outcome Pathways

Clustering on the basis of outcome pathways identified in the LEAP-RE Monitoring and Evaluation framework can also be useful, supporting the MEL process itself while simultaneously encouraging interdisciplinary learning and cooperation.

Capacity Building

The LEAP-RE projects will undertake capacity building activities either formally in the project, or informally as part of scientific capacity building. Cluster formation around capacity building can support more strategic inputs into capacity building and the achievement of strategic goals, mutual learning and peers support, and identification of good practices.

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Table 1 Key Beneficiaries of Clustering Approaches

Clustering Approach	Projects and partners	LEAP-RE	Policy and decision makers
MARs Addressed	✓	✓	✓
Methodological or technical	✓	✓	
Geographical	✓	✓	✓
Activity	✓		
Outcome pathways	✓	✓	
Capacity building	✓	✓	✓

The clustering approaches described above represent the most relevant and realistic basis for project clustering within the LEAP-RE programme. However, other approaches may prove useful, and could be taken up within the scope of the LEAP-RE programme.

3.2 Implementation

The implementation project clustering could be both 'virtual' or 'real'. Virtual clustering is suitable for better understanding the current or future situation and does not necessarily require informing the projects of the clustering effort. Real clustering, on the other hand, is suitable for exchanging information and experiences and can result in joint activities or other kinds of 'real' action. A combination of these is also possible.

Ultimately, the most suitable approach is dependent on the perspective and interest of the actor(s) doing the clustering. The first action to undertake is the identification of the needs of the community constituting the future clusters. This work will be conducted with WP5. For example, LEAP-RE may undertake a virtual clustering of projects to better understand future funding needs, whereas the projects themselves may benefit from a real clustering to engage in mutual learning. These approaches and methods should not be seen as fixed, but adaptive to needs, perspectives, and resources.

To support the implementation of LEAP-RE clustering formation and development, three workshops will be organized alongside the LEAP-RE General Workshops. These clustering workshops will facilitate the formation of clusters by bringing together projects; encouraging dialogue between clusters; and supporting the definition of needs, synergies, and, potentially, activities. In addition, the workshops will serve as the principal forum for dialogue between the project clusters and LEAP-RE, creating space for multiple interactions.

Additional support for clustering will be offered by the platform chosen for the online community management. While the tool is not yet selected, it is expected to allow for spontaneous and flexible engagement, similar to the design of social media platforms. The tool should allow for user-driven communication and interaction within clusters and between clusters, while also maintaining functionality for network management.

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3.3 LEAP-RE Approach to Clustering

The LEAP-RE approach to clustering aims to support the implementation of the MARs, bring value to projects and programme, encourage strategic cooperation, and contribute to the development of a long-term perspective. These aims act as the main drivers for the actions to be taken toward project clustering.

The LEAP-RE community will be comprised of a diverse set of projects and stakeholders. Clustering will primarily bring together pillar 1 and 2 projects, but relevant stakeholders may also be including the clustering. Pillar 1 and 2 leaders, and LEAP-RE Work Package 5 are also undertaking activities relevant for clustering, and their actions are an included as part of the overall LEAP-RE approach.

3.3.1 LEAP-RE Taxonomy for Clustering

To support the initiation and development of a framework for project clustering, a draft taxonomy of project attributes has been developed. This taxonomy suggests key features of the projects that may be a useful basis for clustering, reflecting the multi-disciplinary framework described in Figure 1. It Is important to note that this suggested taxonomy is not static, but a dynamic and flexible one that can evolve based on the needs of the beneficiaries.

Table 2 Taxonomy for Clustering

Attribute Name	Description
Coordinating Country	Country of the organization coordinating the project
Partner Countries	Countries of the partners involved in the project
Geographical Focus	Region(s) in which the primary actions are taking place: • North Africa • Central Africa • West Africa • East Africa • Southern Africa • Europe
MARs Addressed	The primary MAR(s) the project responds to
RE Source	The primary renewable energy sources addressed in the project
Technologies	The primary technologies developed or studied in the project
Methodological approach	The primary methodological approach(es) utilized in the project
Capacity Building	The primary level at which the project undertakes capacity building activities: • Individual • Institutional • System
Activities	The primary kind of activities undertaken by the project: • Research • Prototyping • Testing • Innovation • End-user consultation • Networking or events

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This proposed taxonomy for clustering will be discussed and validated with the LEAP-RE projects to ensure its appropriateness and usefulness. Critically, it should not be considered indicative of a top-down approach to clustering, but rather as a tool for supporting cluster formation and activities.

From this, a matrix has been developed to easily identify projects with similar attributes. The matrix will be completed for the Pillars 1 and 2 projects, utilizing information collected in interviews conducted by WP3 leaders, and will act as a reference point for developing LEAP-RE clustering activities. The draft matrix is included in Annex 2: LEAP-RE Clustering Matrix.

3.3.2 Cluster Formation

LEAP-RE-led clustering

Using the taxonomy and matrix as a basis, LEAP-RE will create virtual clusters to support the overall implementation of the LEAP-RE programme, the delivery of its strategic aims, and the expected contribution to the CCSE Partnership. Virtual clusters will also serve to provide insights that can better direct LEAP-RE activities and MEL. Virtual project clustering will take place based on programme needs, e.g. geographical focus, MARs addressed, and activities. The formation of virtual clusters around other attributes is possible and will be based on emerging needs. As described in section 3.2 Implementation, the formation of virtual clusters does not require any additional effort from the projects clustered, and thus does not pose additional or unwanted burden on the projects.

Beyond virtual clustering, Pillar 2 supports the building of synergies between projects, identifying points at which the projects meet, intersect, or might have mutual interest. These activities respond to the clustering strategy and may include activities such as those listed in Table 3 Examples of Clustering Activities.

Project-led clustering

LEAP-RE will also facilitate the formation of clusters, defined and driven by the projects themselves. Voluntary, need- and interest-based cluster formation will support the core principle of adding value to the projects and reduces the potential of fatigue from project coordinators and partners. The process of forming 'real' clusters and defining activities to be included in the clustering will begin at the clustering session organized as part of the first LEAP-RE General Workshop and followed-up in the following two LEAP-RE General Workshops.

It is recognized that the projects may have limited capacity to undertake aspects of the clustering processes. Therefore, LEAP-RE can assist the formation and development of clusters as needed and requested.

3.3.3 Cluster Activities

As with the formation of 'real' clusters, the identification of activities to be undertaken by the clusters must be defined and driven by the projects and clusters themselves. LEAP-RE will act as a facilitator in this process, ensuring a strategic perspective and creating the framework for clustering activities.

To assist project clusters in identifying potential activities, the table below provides examples of strategic activities that could be undertaken.

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Table 3 Examples of Clustering Activities

Activity	Aims(s) Addressed	Implementation Approach	Expected Outcomes
Coordination of project activities	• Support implementation of MARs • Add value • Strategic cooperation	• Real • Virtual	• Joint learning • Strategic actions to implement the MARs
Joint participation in project events and other activities	• Support implementation of MARs • Add value • Strategic cooperation	• Real	• Joint learning • Strategic actions to implement the MARs
Cluster workshops	• Add value	• Real	• Improved reporting and implementation of MEL activities • Strategic actions to implement the MARs • Networking • Patenting
Joint communication activities	• Add Value	• Real • Virtual	• More effective dissemination of results / outputs

4. Knowledge Sharing

Knowledge sharing is an important driver behind clustering and can add real value for individual projects while also supporting LEAP-RE project aims and the CCSE Partnership more broadly. However, mechanisms for knowledge sharing and cooperation are needed to encourage consistent and meaningful knowledge sharing, including in the long-term.

4.1 Strategic Approaches

Knowledge sharing between projects (clustering)

Learning and knowledge sharing between projects is an important means for improving the implementation, results, and outcomes of projects, creating conditions for building synergies, leapfrogging and transforming research into innovations. Projects clustering and knowledge sharing must be considered in two complementary ways: between projects selected under Pillar 1 and Pillar 2 projects, but also between all these projects and other initiatives funded by the EU, AU and other international donors on renewable energies research and innovation.

Knowledge sharing for MEL

MEL of the LEAP-RE projects is based on a framework that identifies a theory of change and impact pathways. Knowledge sharing around specific questions relevant for the MEL, or at important moments in the MEL process can assist in identifying results and consolidating findings.

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Knowledge sharing for the CCSE Partnership

LEAP-RE aims to create conditions for long-term partnership in renewable energy and to contribute to the CCSE Partnership and its Roadmap. To fulfil these ambitions, learning from the projects and from the MEL process is critical. Formal pathways for knowledge capture are important for supporting learning at the level of the Partnership, which can ultimately improve the framework for bi-regional partnership in renewable energy.

Knowledge sharing for systems improvement

Fostering conditions for systems-level improvement -- e.g. related to innovation systems, capacity building, research uptake -- requires knowledge sharing beyond the LEAP-RE projects. For example, sharing and learning with innovation actors, private sector, relevant networks and stakeholders, other research actors, and policy makers can lead to insights and lessons applicable throughout a system.

4.2 Implementation

Similar to project clustering, knowledge sharing can be facilitated in a multitude of ways. For a programme like LEAP-RE, there are three main mechanisms that can support knowledge sharing, described in general terms below. The LEAP-RE strategic approach to knowledge sharing is described further in section 4.3 LEAP-RE Approach to Knowledge Sharing.

Dialogues

Physical and virtual meetings of actors for discussion, exchange, and peer support. For dialogues to be effective, they should be well facilitated, utilizing both guided methods for discussion and allowing space for freely bringing forward topics of interest.

Reporting

Formal and informal reporting. Formal reporting channels include project reporting and deliverables, MEL activities, and other formal means such as via the CCSE Working Group. Informal reporting includes discussions, the LEAP-RE online community, and other informal means.

Dissemination

Dissemination activities are specifically intended for sharing information with the science community, stakeholders, and the general public. This includes, for example, publishing scientific publications, project reports or other documents, creating videos or other communications materials, and giving presentations at relevant occasions. Dissemination activities are primarily unidirectional, making them less effective as a means for sharing and mutual learning. It also involves promoting the project at real and physical events, public speaking at industry events, etc.

Capitalisation

Specific attention will be paid to other existing programmes and initiatives related to cooperation in the field of renewable energies between African and European countries and

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partners, exploiting the existing *Mapping of Energy Initiatives and Programs in Africa*[3], and all other initiatives related to the AU-EU High Level Policy Dialogue (HLPD) on Science, Technology and Innovation.

4.3 LEAP-RE Approach to Knowledge Sharing

The LEAP-RE approach to knowledge sharing aims to create meaningful opportunities for knowledge sharing and learning and mechanisms for knowledge capture, supporting the CCSE Partnership, the LEAP-RE strategic aims, and project clustering.

Project Reporting and Dialogues (clustering)

Regular opportunities for dialogues between projects and stakeholders (including policy makers), both formal and informal, will be organized. As part of the clustering workshops to be organized at the LEAP-RE General Workshops, space will be given for both facilitated and unstructured knowledge sharing. Beyond the workshops, other opportunities for meeting will be identified and virtual meetings may be organized to further develop themes or topics identified in the dialogues, based on the interest of LEAP-RE projects and stakeholders.

Opportunities for informal reporting and sharing will be organized through the online community management platform established by LEAP-RE. This will offer additional space for project-driven knowledge sharing activities, responding to needs identified by the projects themselves.

MEL processes

LEAP-RE monitoring, evaluation, and learning will serve as an opportunity for routine, formal knowledge sharing and reporting. A theoretical framework and accompanying MEL plan will be developed, including approaches and mechanisms for learning and knowledge capture. This serves the dual role of collecting lessons and good practices, but also creates the mechanism for assuring feedback.

Stakeholder dialogues

LEAP-RE will organize regular dialogues with policy makers and other stakeholders, where dialogues for knowledge sharing can be facilitated. These also serve as a means for engaging in activities that can improve the CCSE Partnership and the R&I systems more broadly.

Communicating and disseminating outcomes

Communicating and disseminating results and outcomes of both the LEAP-RE projects and the programme itself are a key component of the overall approach for knowledge sharing. These activities will be undertaken in line with the Scientific Dissemination Guidelines and the Communications and Awareness Raising Strategy and can serve as a way of formalizing knowledge.

Channels for Knowledge Sharing

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[3] https://africa-eu-energy-partnership.org/wp-content/uploads/2020/04/01_mapping_of_initiatives_final_report_may_2016.pdf

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Knowledge sharing will be facilitated and supported by the platform chosen for the online community management. The tool is expected to support user-led engagement, ideally creating dynamic and interactive exchanges. Moreover, the tool should support interaction beyond the lifetime of the LEAP-RE programme. This will offer opportunities for continuing interactions and development into the future and can support future cooperation and activities.

5. Conclusion

The Knowledge Sharing and Clustering Strategy outlines an approach for the LEAP-RE programme to ensure the strategic implementation of its activities related to clustering and knowledge sharing. The strategy also aims to build the basis for cooperation and interaction between the LEAP-RE projects and its stakeholders, including with the aim of building long-term, sustainable cooperation.

The LEAP-RE approach aims to support the achievement of the MARs, bring value to projects and the programme, and encourage strategic cooperation. These aims act as the main drivers for the actions to be taken and necessitates an approach that is user-led and driven.

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Annex 1: The 6 Multi-Annual Roadmaps

MAR #1: Mapping joint research and innovation actions for next-step development of RES and integration of RES in sustainable energy scenarios

Specific Challenges

Energy is a key driver of national development and energy access is crucial to the delivery of fundamental services such as healthcare and education. African countries need energy to improve the quality of life and income levels of their citizens. Within the energy transition, African countries need to adopt low carbon energy sources to meet their international commitments. This is feasible since the continent has a lot of renewable energy potential which can serve different development needs. This transition will also require research and innovation actions to support the rethinking of energy infrastructure, energy access and energy uses, taking into consideration different political, cultural, and social contexts on the continent. Deployments of renewable energy systems (RES) in Africa have been achieved for centralized and grid connected systems as in high income countries, but recent development of renewable energy systems demonstrate they can also be used in decentralized and off grid contexts.

Technological development must be included in a more general framework directly related to the capacity of policymakers understanding and related to energy scenarios at the local, country, and global levels. Medium and long-term sustainability of energy scenarios, as well as the assessment of needs and potential resources at country or regional levels is also needed in order to be able to understand the potential implication of technology or energy solutions for local conditions (economic, environmental and even cultural). There is a strong need for supporting further research and capacity building on Energy Scenario Analysis, which include all modelling approaches and tools aimed to support policy and decision makers to build a long-term plan for energy systems development at the national level.

Mapping research and innovation actions will aim at developing a common data base from which lesson and direction can be taken for driving R&I for RES. The potential pathways for the next steps in the development of RES in Africa will benefit from LEAP-RE projects and the evidence emerging from the scientific community. This process will provide a detailed map of updated research and innovation initiatives in Europe and Africa by technology and application with the aim of assisting the RE industry and policymakers to prioritize and contextualize target areas of RES deployment.

This mapping exercise should be designed to meet the following criteria alongside the desirable outputs, outcomes and impacts of the LEAP-RE program: (i) compliance with national policies for RE development; (ii) essential compliance with the needs of local population; (iii) focus on efficiency and reliability; (iv) compliance with decarbonization and a replacement of conventional energy solutions; and (v) a focus on achieving universal access for all.

Expected outputs, outcomes, and impacts:

The mapping exercise and modelling approaches in this MAR will allow:

Outputs

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- The establishment of a global reference point for the huge amount of scientific literature and collaborative projects related to R&I on RES in Africa that have been undertaken in the last decade.
- KPIs, Categorizations and prioritization of reviewed publications and initiatives will be set in a consistent way with the literature (scientific and grey) in order to align our work to that of the international community.
- A better integration of RES' contribution to medium- and long-term sustainable energy scenarios at different levels (national, regional, continental).
- A precise map of RES components and systems to be developed, localised, and deployed in the EU and AU.
- Identification of key R&I actors and stakeholders for future joint Europe/Africa future initiatives.
- Identification of key parameters for feasibility of RE projects and the mapping of RE resources.
- Identification of areas of profitability in specific context according to RE availability.

Outcomes

- Updated knowledge and base data on the scenario and progress of EU-AU R&I cooperation on RES.
- Increased awareness of existing networks in RE in AU-EU by researchers on both continents.
- Robust and confident scenarios developed supporting energy public policies in countries.

Impact

- Closer long-term oriented collaboration between African and European funders of R&I and H&ICB.
- Closer collaboration between researchers, innovators, and funders of innovations.

MAR #2: End-of-life and second-life management and environmental impact of RE components

Specific Challenges

End-of-life (EoL) components (batteries from electric cars, solar panels from large PV plants, etc.) used in renewable energy (RE) production or storage present a new environmental challenge, but also an unprecedented opportunity to create value and pursue new economic avenues. More energy systems will get decommissioned at the end of life, or when out of specification (OoS) for their initial purpose as RE technology is mainstreamed. To contextualize this, the volume of decommissioned solar PV panels will increase as the global solar PV market increases thus large amounts of EoL PV components are anticipated. The International Renewable Energy Agency (IRENA) estimates that there will be a surge in solar panel disposal in the early 2030s, and that by 2050, there will be 60 to 78 million cumulative tons of photovoltaic panel waste globally. The rise of electric vehicles and the increase in adoption of storage systems will also lead to a large amount of EoL/OoS batteries. There will also be a yearly increase in decommissioned wind turbine blades. In some cases, these components may still have enough performances to be used in 'second life' applications. Accordingly, new energy paradigms are emerging in both Africa and Europe where 'second life' components are presented as appropriate solutions or, for example the substitution of lead-acid batteries by second-life Li-ion batteries. In this regard, RE EoL/OoS components and their supply chains require research, development, innovation, and capacity support. Materials that enable RE should be recycled or reused to prevent a scenario where the envisaged clean energy future becomes anything but clean. In Africa, off-grid solar products are revolutionizing the quality of life. Current EoL component volumes from this sector are small in proportion to the quantity and environmental impact of the total e-waste stream. However, due to rapid sector growth,

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there is a need to develop the end-of-life management of off-grid solar and storage products without delay.

In Africa, and in most developing countries, collection of EoL components is done very effectively by informal collectors who purchase the components from consumers. Informal collectors then re-sell components to other informal sector players such as local repair shops. Informal sector EoL component streams do not usually incur the costs associated with proper treatment and disposal of hazardous e-waste due to their use of rudimentary methods. These rudimentary methods however tend to be unsafe and environmentally unfriendly. There is need to regularize this sector, ensuring that the informal collection and re-purposing of EoL RE components becomes part of formal, regulated systems (including waste collection, disposal, reuse and recycling process such as extraction of reusable materials), whilst paying attention to the needs of the informal workers whose livelihoods will be lost.

Moreover, where there are new products developed then innovation needs to take questions of lifecycle analysis into account right from the start.

Capacity Building Focus

Across all the areas of second life components, and for their successful uptake, further technical and managerial competences and capacities need to be developed.

At individual level (academic and business):

Researchers and engineers need technical competences to successfully support additional value creation from RE end-of-life components. These should include market knowledge, business savviness (including business models). Researchers and engineers should participate in the definition of, and fully integrate in their research and development performing activities, management schemes for waste from RE components to be adapted to the unique conditions of each country or region. Additionally, they should be capable to design metrics for environmental impact categories. Innovations for reuse, business models, testing procedures that are compatible with industrial standards should be developed and shared among business actors.

At institutional level:

Research institutions should promote international standards and rigorous testing protocols. To achieve this, collaborative capacity building activities involving European and African research institutions are highly recommended. Within this transcontinental perspective, collaboration is also needed for research institutions to provide input to policymakers for them to create the international enabling regulatory framework for sustainable end-of-life management policies for RE components. This will naturally create awareness and capacity at the system level.

Expected outputs, outcomes, and impacts:

The research and capacity building activities within this multi-annual roadmap will allow:

Output

- Map of the EoL/OoS component value chain, identification of key stakeholders & business models.
- Creation of categories of components found in EoL/OoS components and proposed safe methods of handling.

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- Development of comprehensive models and standard operating procedures including actual appliances/prototypes/demos for EoL/OoS component management.
- Proposal of methods for EoL/OoS component recycling which address local environmental impact through effective management.
- Identification of second life components with a benefit for African countries: lower cost; higher reliability, less environmental impact.
- Dissemination of acquired knowledge among the African and European community to extend support for sustainable EoL/OoS component management.

Outcome

- Promotion of environmental and ecological sustainability of renewable energy systems.
- Increase in innovation around the use and reuse of EoL/OoS components before disposal, limit dumping wastes.
- Increased awareness among researchers on the importance of accounting for EoL/OoS components in RE research work.

Impact

- Creation of jobs through use and reuse of EoL/OoS components management e.g. creation of jobs through repair of systems and proper collection of EoL/OoS components.
- Creation of policy incentives towards RE production, including handling and disposal at EoL/OoS component stage e.g. financial incentives to encourage manufacturing of easily repairable systems.
- Reduced materials used for new products and thus cost and environmental impact reduction.

MAR #3: Smart stand-alone systems

Specific Challenges

Integrating renewable energies into the global energy mix through versatile, stand-alone systems can help to address the energy needs of off-grid areas in Africa. Despite the fact that urban population is growing rapidly, over 45% of the African population live in isolated rural communities, which could benefit from the introduction of RE technologies fitting their unique environment and availability of RE sources. In addition, in the vast landscape of the Sahel, steppes and open areas, population rarely have access to electricity. Severe climate disasters and conflicts have resulted in increased migration and 'climate refugees' in many African regions. RE and technology can provide a unique opportunity to equip communities with new facilities without interfering with their way of life and preventing their being left behind. The utilization of renewable energies can also be a good opportunity to fight climate changes, such as desertification and dryness in the Sahel, and keep communities alive by encouraging young people to stay on their traditional lands.

Access to energy, especially electricity, is thus a fundamental component to address rural or isolated communities and support economic and social development. Specific needs include clean cooking (e.g. electric cooking), clothes washing, studying, walking safely (by night), connecting fridges and fans, phones charging, refrigeration (store food and medication), lighting, communications, and water pumping. RE stand-alone systems (RE-SAS) are mandatory to ease access to energy in all its forms (electricity for lighting, domestic appliances and pumping, heat for cooking, potable water, etc.) from local renewable sources and for local use of population and economy. Research and innovation is expected not only on SAS itself but also on energy use equipment.

Capacity Building Focus

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Across all these areas to be further researched, technical and managerial competences and capacities need to be developed.

At individual level (academic and business):

Researchers and innovative engineers should be involved in improving the technology of standalone components and usability of the whole systems.

Knowledge transfer should be ensured regarding the final purpose of different devices and established standards for increasing the compatibility of systems and components. Capacity building activities shall also aim at the training of local electrical technicians regarding research outputs and the experimentation of innovative solutions through local initiatives in order to link new technologies and new uses of existing technologies to the needs of the local communities promoting the behavioural changes needed to achieve a more reliable, efficient and safe energy access.

At institutional level:

Concerning infrastructures, activities and programmes shall be organised to establish and provide accreditation for public or private laboratories to test stand-alone systems and provide programs to inform policy makers about the potential of the RE-SAS systems in specific social and geographic contexts.

Expected outputs, outcomes, and impacts:

The research and capacity building activities within this multi-annual roadmap will allow:

Output

- To provide avenues for the development of RE-SAS technologies and testing new products in real-life contexts e.g. running trials of new battery designs with existing SHS or mini-grid companies, considering the diversity of potential local RE sources and the local effective environment.
- To develop tools for RE-SAS design.

Outcome

- The development of reliable stand-alone system architecture that can be easily and widely deployed in off-grid African rural and remote areas.
- Sharing acquired knowledge to develop a sustainable RE-SAS systems deployment.
- Validation of business models for SAS deployment.
- To increase the share of renewables responding to energy needs and reliability of systems.
- To promote environmental sustainability of renewable energy systems.

Impact

- The creation of jobs in RE production and uses through RE-SAS systems installation, management and maintenance.
- To give access to affordable energies to the largest number of beneficiaries and to maximise the socio-economic impact.
- To promote income generating activities in different socio-economic context through demonstrators' results References to results of existing research and innovation projects in this field will be positively valued in the selection process.

MAR #4: Smart grid (different scales) for off grid application

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Specific Challenges

Currently, more than 600 Million people in Africa do not have access to electricity, 80% of which live in rural areas. In addition to small stand-alone systems for individual households and extensions of the national grid, there is a growing need for small- to medium-scale Distributed Generation (DG) solutions capable of integrating a diverse mix of Renewable Energy Sources (RES) for supply to small- and medium sized communities. Increasing the attention of governments to regulated penetration of REs into the national grid will help overcome the dichotomy between centralized and decentralized electrification. Moreover, using hybrid solutions coupling different RES with conventional sources combines a bottom-up and top-down approach. Such solutions may contribute to an increase in the reliability of the power supply and reduced dependence on storage and fossil backup systems, thus also mitigating energy poverty. Hybrid and Smart RES Grids have a role in addressing the many technological challenges that may arise from the integration of different RE technologies, distribution, and storage systems.

Different energy storage systems options should be developed taking into account the analysis done by World Bank's Energy Storage Partnership (such as batteries, Hydrogen, thermal storage…). These systems must be optimized and integrated to be able to respond to rapidly evolving energy needs. They can play a role addressing environmental challenges since they contribute to reducing local air pollution and GHGs emissions. If properly designed, they can also decrease energy-water- food competition by reducing reliance on traditional biomass and contributing to wise water management.

Furthermore, Smart and Hybrid Grids can respond to local socio-economic challenges. They can be scaled-up to meet growing demand, tailored to match productive uses in either agriculture or rural industries, collective cooking at the community level and support community service delivery in education and health. With the deployment of appropriate business models, improved energy affordability may be achieved for local people and job opportunities may be created associated with manufacturing, installation, and maintenance.

Capacity Building Focus

Across all these areas to be further researched, technical and managerial competences and capacities need to be developed.

<u>At individual level (academic and business)</u>:

Researchers and engineers should be involved in improving smart grid components, connections and management and all activities should be programmed to ensure knowledge transfer and established standards for the smart grid system and components. Capacity building activities should also aim at training of local electrical technicians taking into account existing interventions of this type within the industry itself such as those implemented by companies or associations involved in mini-grid development: these trainings should be updated according to research and innovation outputs so technicians' competences address the needs of the communities with respect to the new technologies and uses provided by research and innovative solutions. Likewise, capacity building activities should also target the triggering of behavioural changes in technology design and utilization in order to have energy access with reliable systems.

<u>At institutional level:</u>

Concerning infrastructures, activities and programs should be organized to establish and provide accreditation for public or private laboratories to test smart grid systems. Demonstration projects should also enhance the administrative capacity of rural electrification policies designed and implemented at national governments and local

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authority level (legislation for electrification through public-private concessions, pricing of the electricity produced, involvement of local communities in the governance of mini-grids…).

Expected outputs, outcomes, and impacts:

The research and capacity building activities within this multi-annual roadmap will allow:

Output

- Development of new technologies, systems and optimization tools based on people's needs.
- Reduction of energy dependence on fossil fuels and increase in the share of RES.
- New open-source code access for researchers worldwide.
- New business models will be experimented with and validated.

Outcome

- Researcher capacity will be strengthened with holistic and multidisciplinary thinking and needed technical competences through capacity building. Increased awareness of people's needs will support longer-term behaviour change.
- New business models will uptake rural electrification sustainable solutions with easier access to finance.
- Research and related capacity building will be valorised as instrumental to the creation of local innovation and behavioural change.
- Technologies design will be increasingly people-driven, increasing efficiency.
- Local people and civil society will feel more engaged in the research-innovation process.

Impact

- Increased energy access in rural areas and use of REs.
- Improved living conditions and socially inclusive growth in the local context.
- Improved economic development and job creation in the local context.
- Behavioural change in relation to energy usages.

MAR #5: Processes and appliances for productive uses (agriculture and industry)

Specific Challenges

According to a 2017 State of Food and Agriculture report by the UN's Food and Agriculture Organisation, the key to achieving the Sustainable Development Goals in Africa is transforming rural communities and promoting agriculture. This is because approximately 60% of Africans derive their income from agriculture and agricultural processes. It is therefore important to prioritize boosting small-scale farmers' productivity and incomes in the agricultural production stage and creating off- farm employment in expanding segments of the food supply and value chains. Food supply and value chain segments involve processes such as harvesting, grain milling, drying, cooking, cooling, transportation, and retail. These processes require variations of cold chain technologies, and electrical power. The demand is met differently by different industries and countries in Africa. An example of such is industries where thermal power demand is met through biomass while cold chain energy needs are met through grid supply supplemented by diesel generators in cases of blackouts. Changing eating and food retail processes in Africa should also be noted. Across urban Africa there has been a significant transformation in how people consume food incorporating a growing trend towards commercial pre-cooking of foods which are then retailed to consumers either as hot food or food which can be quickly finished (e.g. part-cooked beans) or re-heated, thereby reducing the energy expended in

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the household. There is a considerable opportunity to develop food processing, part, and full cooking. Clean cooking beyond domestic context as productive use of energy should also be considered strongly.

Technologies like combined heat and power systems (cogeneration) can help improve fuel use efficiency while improving pollution control. In order to transform rural communities, access to lighting systems alone is not enough for economic empowerment.

Craft and small industrial activities at local level should also be addressed in programs supporting local economic development such as sewing workshops, welding works and craft manufacturing. The facilitation of productive use activities will increase the demand for energy from off-grid suppliers amongst poorer communities and in so doing contribute to a more commercially viable electric loading charge demand curve regarding solar electricity production, avoiding too expensive storage options and optimizing RE investments.

To do this, it is important to support technological innovations and solutions such as productive use (PRODUSE) appliances in agriculture and other activities as a way of improving rural livelihoods. These appliances can be used to increase productivity and/or efficiency in agriculture and other Income Generating Activities (IGAs), such as rural industrial processes, and to improve healthcare systems delivery. PRODUSE appliances are relatively new to bottom of the pyramid markets, which are mostly found in rural communities since system costs are as sensitive as the need for the appliances. The uptake and utilization of emerging RE can easily be slowed or curtailed by quality assurance concerns, energy efficiency gaps, lack of consumer financing and policy interventions. To avoid this, the following challenges should be addressed as part of innovation efforts in this area: the cost of energy should be low for bottom of the pyramid consumers; the power provided should be reliable to prevent loss of trust in technology; technologies used should account for cultural interactions; utilized appliances should be of good quality; system operation and maintenance capacity should exist locally.

Capacity Building Focus

Across all these areas to be further researched, technical and managerial competences and capacities need to be developed.

At individual level (academic and business):

Researchers and engineers shall be involved in improving the adaptability of existing PRODUSE systems in order to match the identified needs and development of in-depth training on productive systems that can use renewable energy sources. Capacity building activities shall also aim at the training of local technicians to develop competences and skills to install or maintain PRODUSE equipment/system in order to address the needs of the communities introducing the new technologies and use cases provided by research and innovation.

At institutional level:

Concerning infrastructures, activities and programs should be organized in such a way that the results generated by the research and innovation are integrated effectively into outreach to policy makers and donors.

Expected outputs, outcomes, and impacts:

The research and capacity building activities within this multi-annual roadmap will allow:

Output

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- Understanding of the categories of IGAs performed by off grid communities, existing PRODUSE appliances supporting these IGAs and IGA categories and the existing gaps that RE PRODUSE appliances can fill.
- Existing PRODUSE appliances in small- and large-scale agriculture (livestock, fisheries and farming) and in local industrial processes to be adapted to decentralized RE equipment that can be improved or developed.
- Cold chain and thermal PRODUSE appliances in different sectors such as healthcare, agriculture, cooking.
- PRODUSE appliances used by industries, alternative appliances that can be used and energy efficiency measures that can be taken to improve the energy consumption of existing ones.
- PRODUSE appliances available to on-grid consumers vs off grid consumers to assist with assessment of levels of service expected from RE PRODUSE appliances by off grid consumers.
- Existing business models used to sell PRODUSE appliances and quality issues related to PRODUSE appliances in on grid and off grid markets.

Outcome

- Understanding of opportunities for PRODUSE appliances to address IGA related challenges by researchers and innovators.
- Reduction of post-harvest losses in the agricultural sector.
- Adoption of energy efficiency measures by industries.
- Improved partnerships and joint research opportunities between European and African researchers and engineers.

Impact

- Increase in productivity of the informal sector such rural industries.
- Improved socio-economic development of off-grid communities due to support of their IGAs.
- Creation of jobs and improved energy access through support of IGAs in off grid communities.
- Reduced GHGs, local pollution and deforestation due to improvement in energy efficiency in Industries.

MAR #6: Innovative solutions for priority domestic uses (clean cooking and cold chain)

Specific challenges

Today, there are 4 billion people worldwide who lack access to modern energy cooking services (SDG 7 definition)– more than half of the world’s population. Fifty percent of these people are living in developing countries. In Africa alone, 700 million people lack access to clean cooking. Currently, traditional devices used are typically fuelled with firewood, or with charcoal, and have very low efficiency.

The utilization of traditional biomass poses numerous environmental challenges:

- Traditional biomass utilization is a recognized contributor to deforestation & land degradation.
- Biomass burning in traditional cook-stoves has been found to be responsible for about 20% of global black carbon emissions.
- Indoor cooking with traditional devices causes respiratory illness, which contribute to the premature death of millions of people from associated diseases. In addition, the utilization of traditional biomass also poses social challenges, including:
    - The time spent by women and children in gathering fuel; and

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  - Absenteeism from school caused by Illness due to respiratory infections, common in some countries of sub-Saharan Africa.

Actions necessary to overcome the challenges associated with the use of traditional cooking systems represent technological challenges:

- Improving the design of existing stoves has been attempted for the past twenty to thirty years and has made few in-roads into the total numbers lacking access to modern cooking or effectively addressing the health and environmental impacts of cooking with biomass. The LEAP-RE programme focuses on innovations that relate to the grasping of opportunities for the substantial deployment of highly efficient cooking appliances (e.g. the rapidly emerging potential for electric cooking), new or improved approaches to LPG retail, and delivery such as PAYG, new larger-scale approaches to biogas via municipal scale developments or the development of other innovative new fuels such as ethanol.

Complementary to clean cooking is food and drug preservation, a second common issue at the domestic and community levels in Africa. In sub-Saharan Africa nearly 40% of food perishes before it reaches the consumer, while the lack of effective refrigeration limits the possibilities for vaccine distribution in rural, and in remote areas: a factor taking on greater significance in the current COVID era. Here the cold chain can play a crucial role in reducing food waste, improving public health, and enabling African communities, especially in rural areas, to participate in national and international trade as producers and consumers. The technological challenges are mainly based on the energy vector, with the use of heat in place of electricity to generate low temperatures in domestic and community systems, or the use of static and compact technologies with higher reliability compared to traditional systems, and the coupling of refrigeration units with off-grid electric power systems. The development of movable autonomous systems is another important element. Finally, the need for compact and fully reliable systems that avoid breaking the cold chain for medicine, and for food preservation with reasonable costs represents a significant socio-economic challenge.

Capacity Building Focus

Across all these areas to be further researched, technical and managerial competences and capacities need to be developed:

<u>At the individual level</u>:

Researchers and engineers need to be involved in improving, managing and maintaining solar photovoltaic systems, cooking appliances and cold chain components. They also need to be capacitated to be involved in establishing the standards for renewable energy components and supply chain, and very importantly in knowledge transfer with local communities and value chain stakeholders. Additionally, capacity needs to be improved for researchers to interact with policymaking to foster an appropriate, supporting, long-term and stable policy environment to ensure market and fast community uptake. Specialized technicians need to be trained in the specific technologies and their different usages and applications and updated regularly according to research results. Likewise, capacity building activities shall trigger behavioural changes to have energy access with reliable systems relying on robust supply chains and maintenance to ensure longevity for appliances.

<u>At institutional level</u>:

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For what concerns infrastructures, activities and programs shall be organized to establish and provide accreditation for laboratories to test photovoltaics, cooking appliances and cold chain systems.

Expected outputs, outcomes, and impacts:

The research and capacity building activities within this multi-annual roadmap will allow:

Outputs

- Innovative cooking device.
- New and appropriate modern cooking systems.
- Localized and low-cost materials and appliances used for efficient cooking appliances construction.
- Technical improvements in fuel processing or fuel production technologies, and the technical and managerial capacities related to these improved processes and production technologies.
- Improvements to existing technologies, and new technologies for cold chains, including refrigeration units based on solar or biomass resources, as well as long-term sustainability and management capacities.

Outcomes

- Researchers provided with capabilities for lab and field testing of cooking appliances.
- Use of modern fuels and appliances promoted and its required skills.
- Sustainable fuel supply chains promoted.
- Effective and low-cost food preservation promoted.
- Efficient air conditioning promoted.
- Greenhouse gas (GHG) emissions due to lower power consumption from the grid or diesel generators reduced.

Impacts

- GHGs, local pollution, land degradation and deforestation reduced.
- Medicines and vaccines in remote areas better preserved.
- Social conditions of local stakeholders as well as job creation improved.
- Drudgery for girls and women reduced and their social power and health conditions (female empowerment) improved.
- Food and nutrition security strengthened.
- Individual health, and public healthcare improved.

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Annex 2: LEAP-RE Clustering Matrix

Name of Project	Coordinating Country	Partner Countries	Geographical Focus	MAR(s) Addressed	RE Source	Technologies	Methodological Approach	Capacity Building	Activities

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