SIREVIVAL

(01.03.2022 – 28.02.2025)

LEAP-RE

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

Pillar-1 project

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

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Consortium

***Project coordinator**:*

- *Université catholique de Louvain - UCLouvain (**Belgium**)*

Project partners:

*- Centre de Recherche en Technologie des Semi-conducteurs pour l'Energétique - CRTSE (**Algeria**),*

*- Université catholique de Louvain - UCLouvain (**Belgium**),*

*- CNRS, Institut d'Electronique, de Microélectronique et de Nanotechnologie - IEMN (**France**),*

*- École nationale supérieure d'ingénieurs de Tunis - ENSIT, and Centre de Recherche et des Technologies de l'Energie - CRTEn (**Tunisia**).*

Aim of the project

SIREVIVAL aims at the reduction of the environmental impact of spent photovoltaic (PV) modules. The effort is focused on the use of recycled materials, like Si, to build all solid-state supercapacitors and to integrate them with modern photovoltaic cells, in order to meet instantaneous power generation and delivery.

Relevance vs MARs

SIREVIVAL relies on interlinked chemistry, physics and engineering activities and is relevant for two multi-annual roadmaps: end-of-life and second-life management and environmental impacts of renewable energy components (MAR 2) and smart stand-alone systems to ease the access to energy in all its forms (MAR 3).

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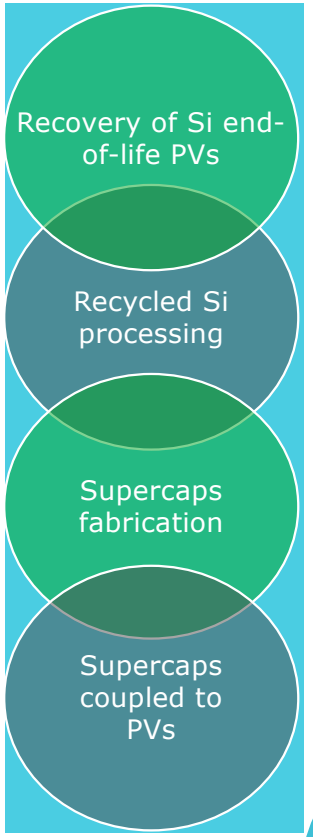
Presentation of scientific and technical objectives as defined in the initial proposal submitted to the LEAP-RE program

1. *Material recovery from end-of-life PV panels with >85% overall efficiency*
2. *Ionogels with a large temperature and electrochemical operational window*
3. *Solid-state micro-supercapacitors based on recycled materials*
4. *Engineering of new systems for energy production and storage*



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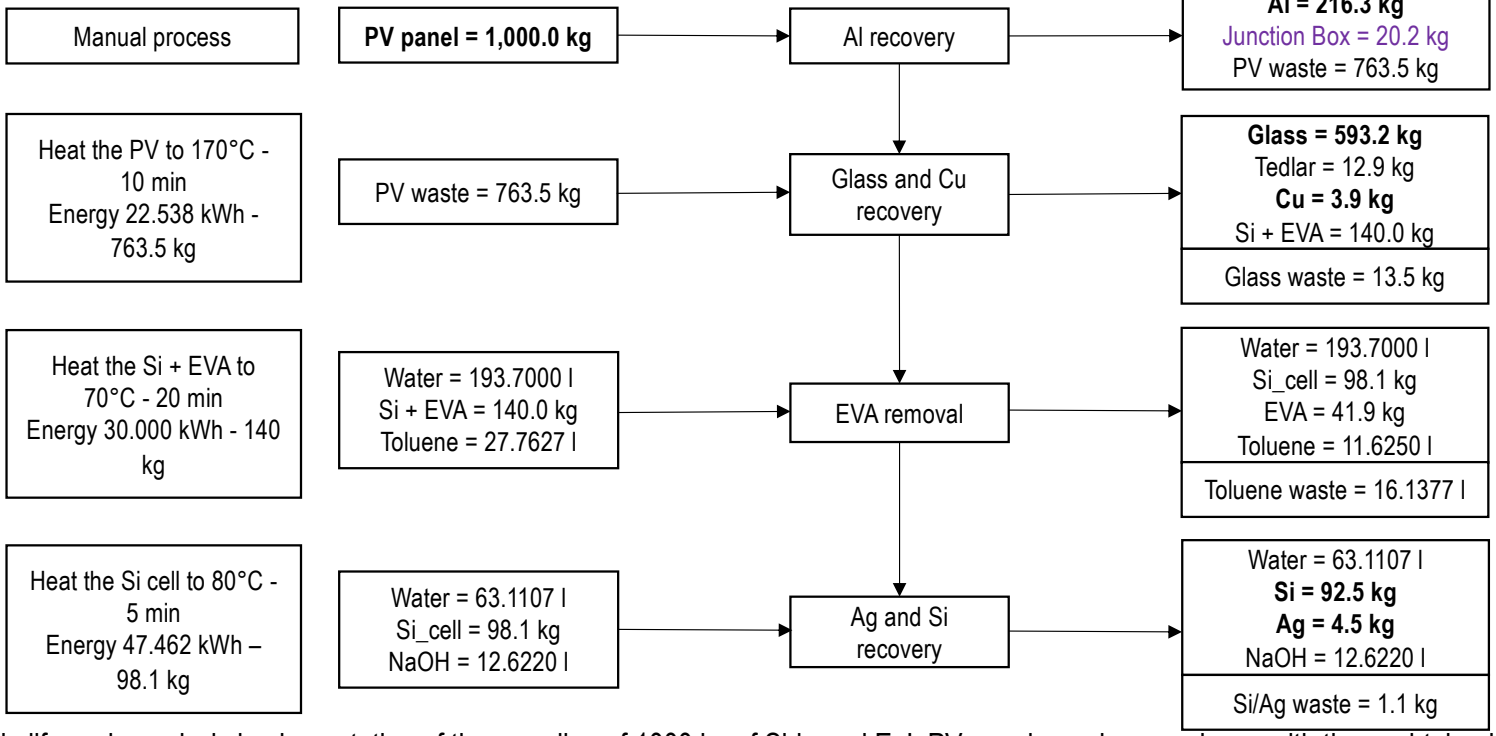
Results achieved: Highlights. I. Recovery efficiency > 90%



The results obtained in life cycle analysis implementation of the recycling of 1000 kg of Si-based EoL PV panels are in accordance with those obtained in the work of Latunussa *et al.*, in which a similar process is evaluated for the recycling of 1000 kg of EoL PV panels with a similar method - SimaPro software and the Ecoinvent 3 database. [C. Latunussa *et al., Sol. Energy Mater. Sol. Cells*, **2016**, *156*, 101]

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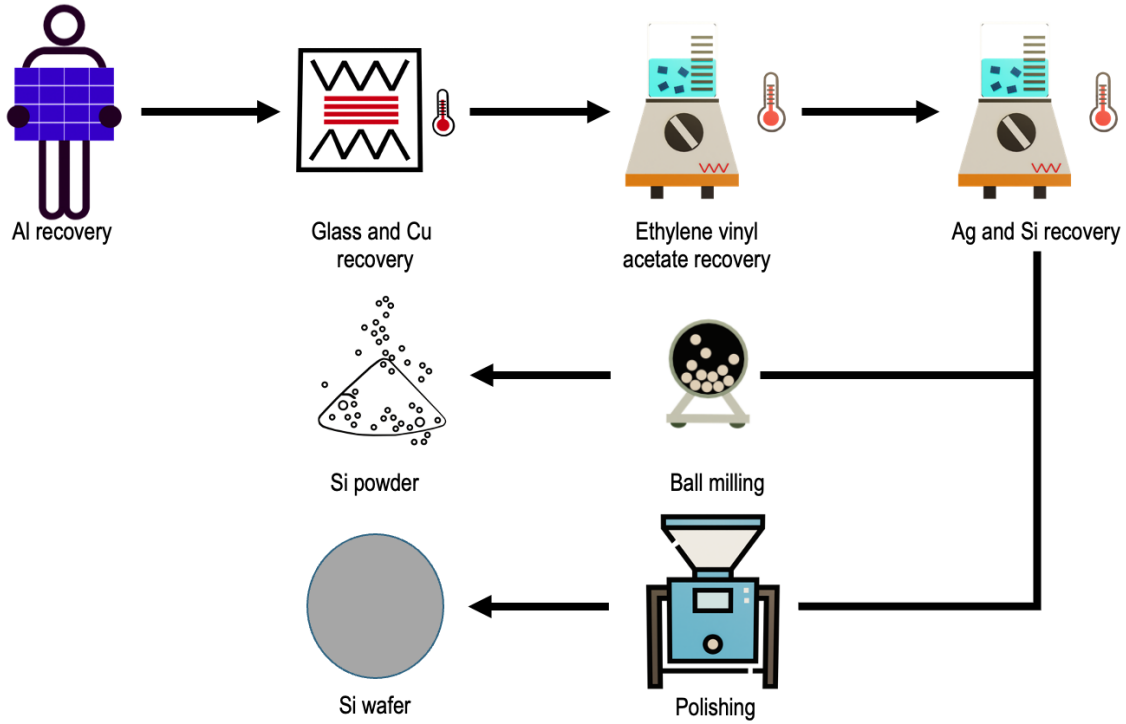
Progress compared with the state of the art. I

Recycled products: Si powder and Si wafers



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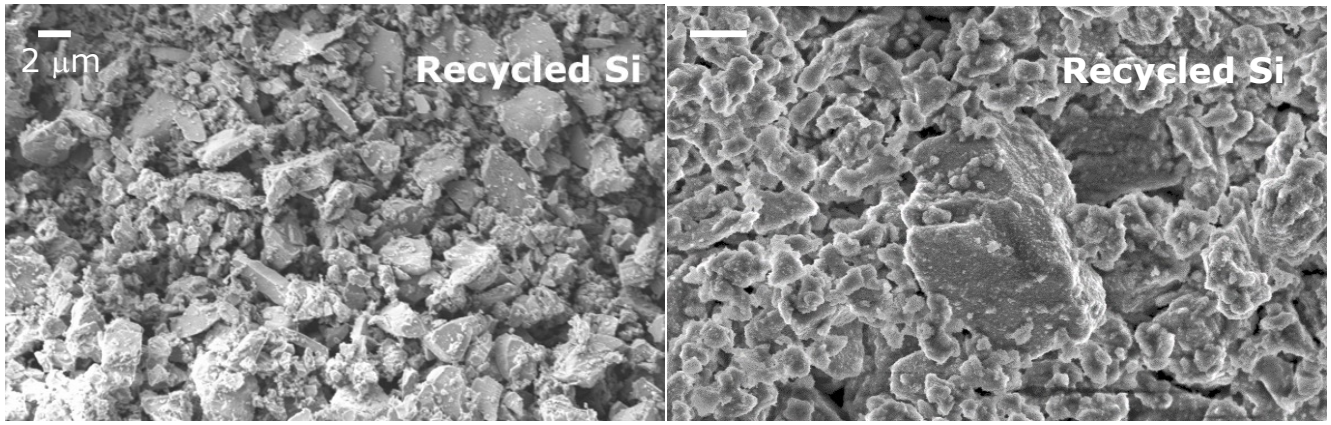
Progress compared with the state of the art. II

SIREVIVAL vs ReSiTec [https://www.resitec.no/]



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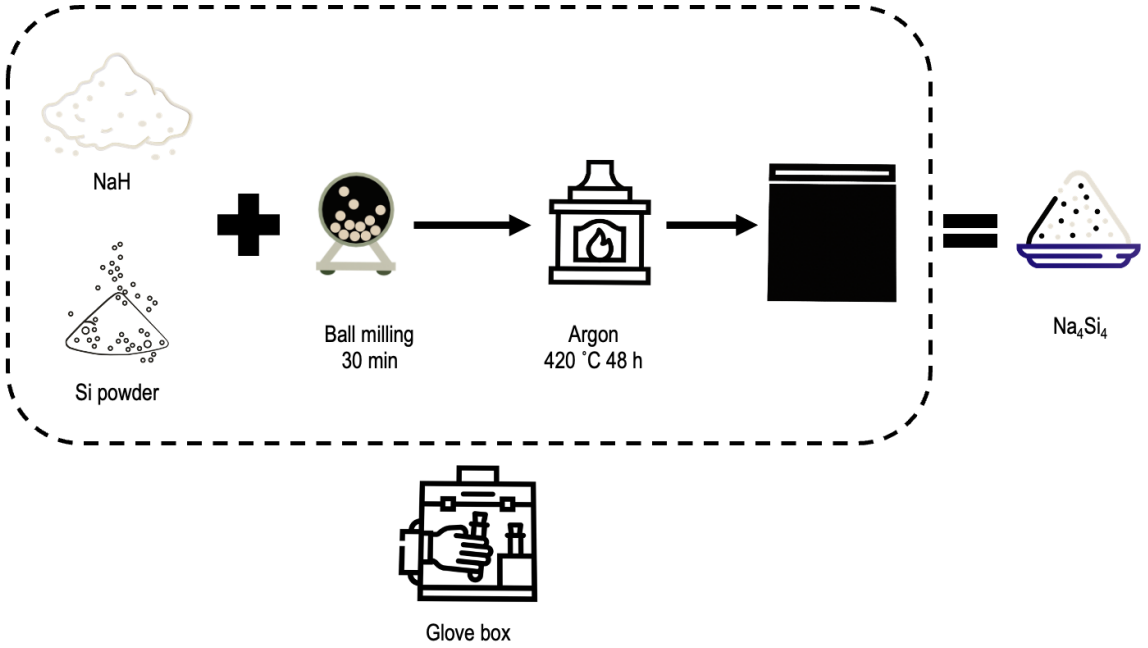
Progress compared with the state of the art. III

Upcycled products from Si powder: CNTs-Si [1] and Na_4Si_4 [2]



[1. C. Martin *et al., Adv. Funct. Mater.*, **2011**, *21*, 3524]
[2. A. Dopilka *et al., J. Electrochem. Soc.*, **2021**, *168*, 020516]

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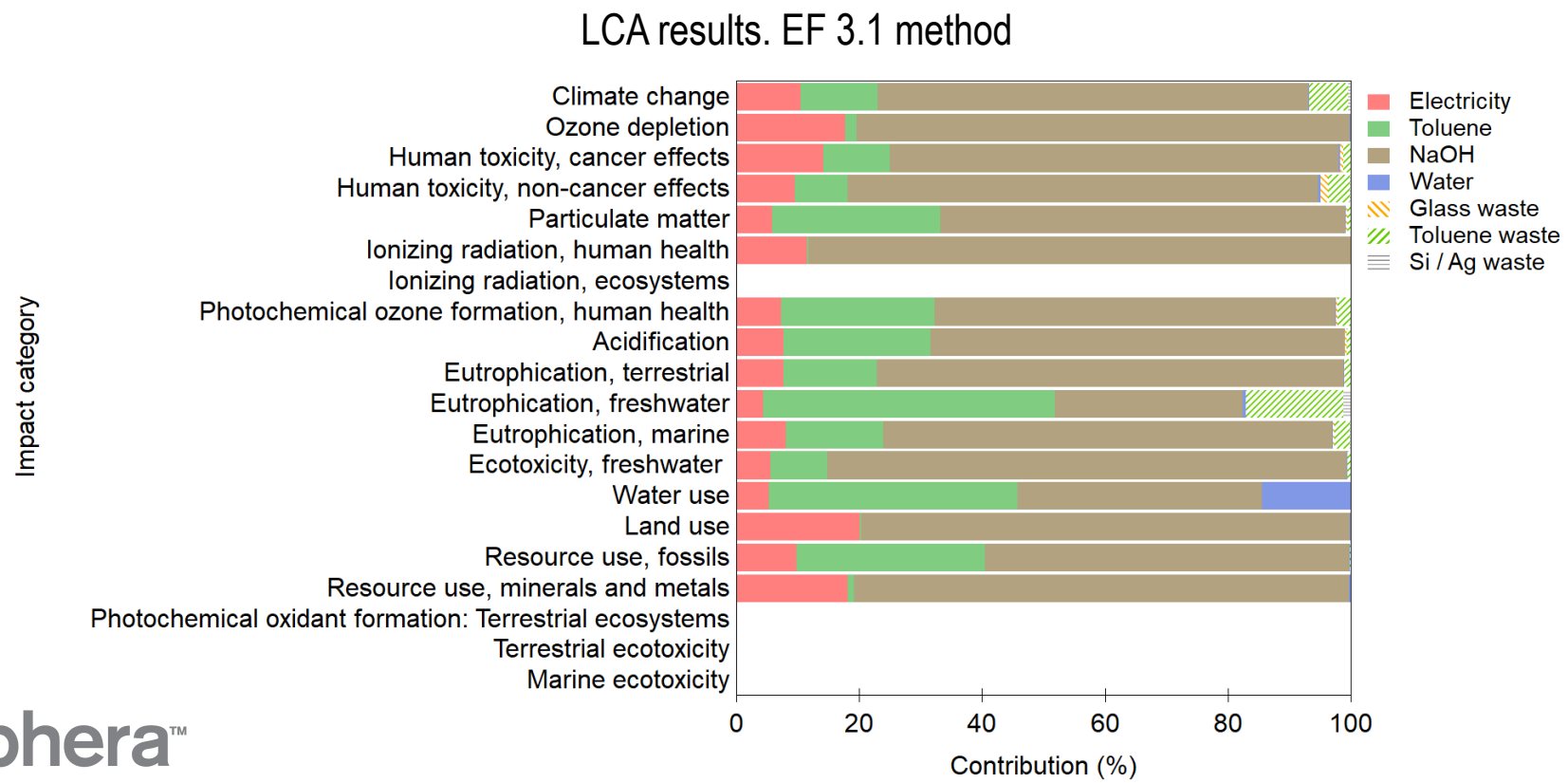
Progress compared with the state of the art. IV. EoL solar panels



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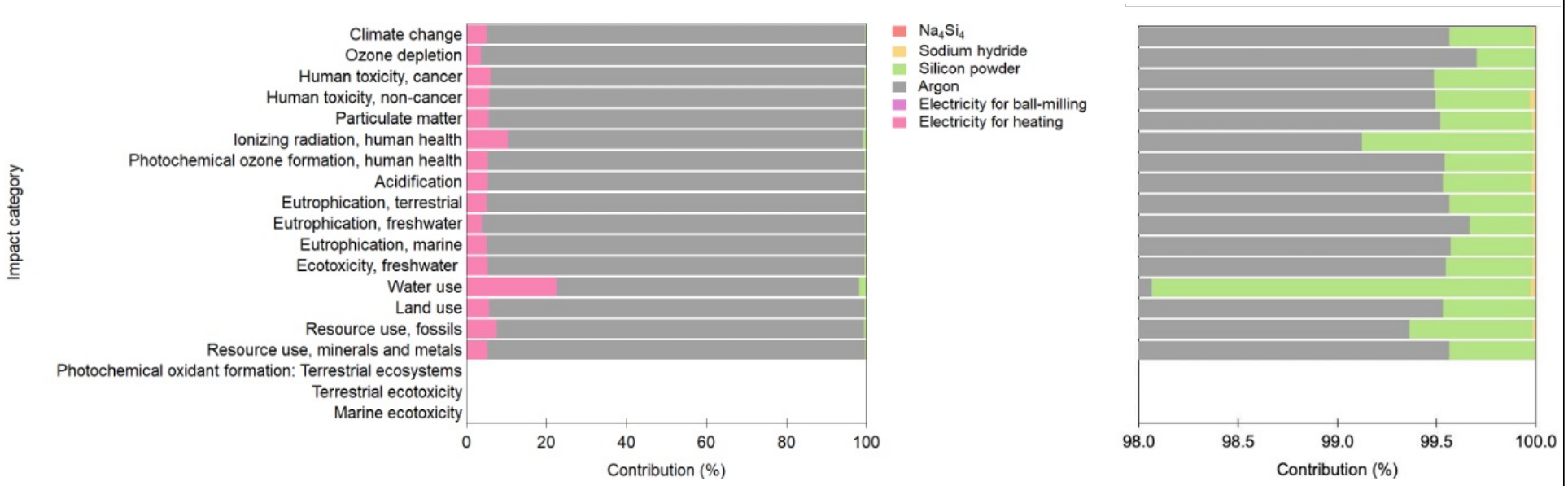
Progress compared with the state of the art. V. Upcycling Na_4Si_4

LCA results. EF 3.1 method



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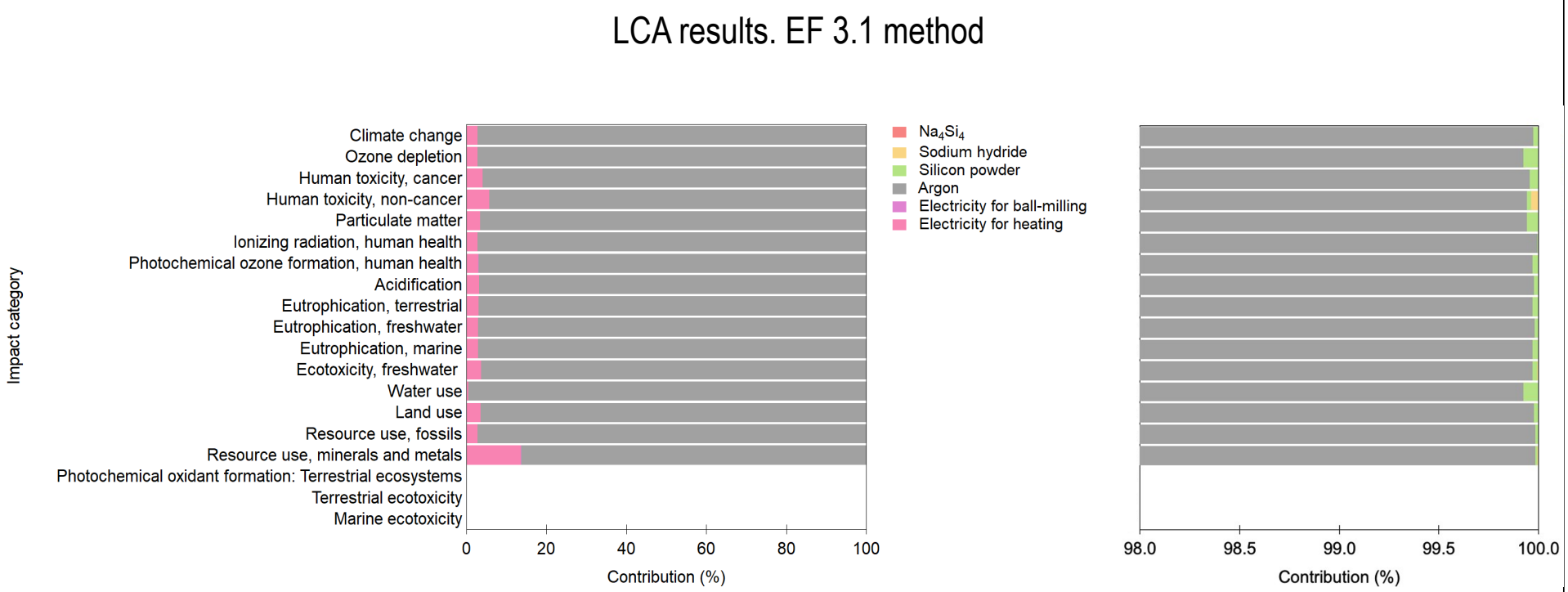
Progress compared with the state of the art. VI. Upcycling Na_4Si_4



SimaPro

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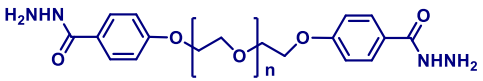
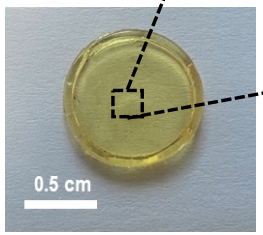
Results achieved: Highlights. II. Ionogels

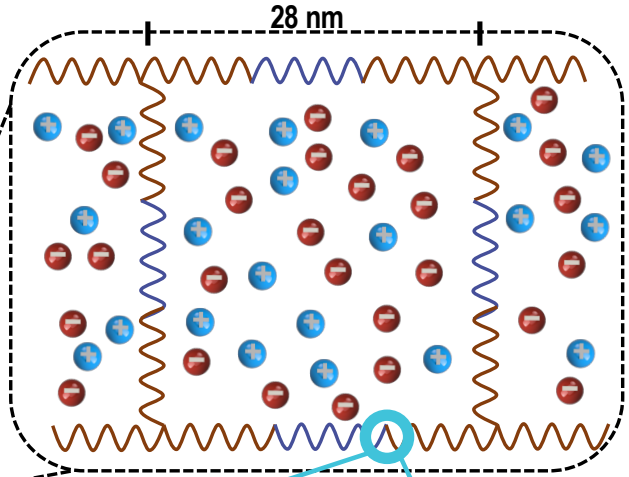
3-ArmPEG-CHO
M = 1312 g/mol

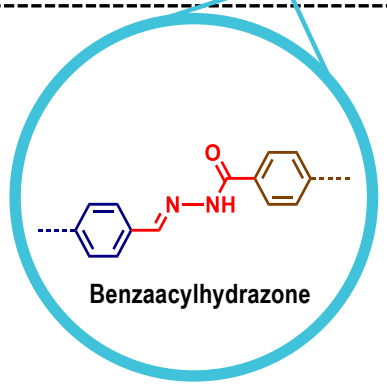


PEG-$(NHNH_2)_2$
M = 1782 g/mol

Ionic Liquid







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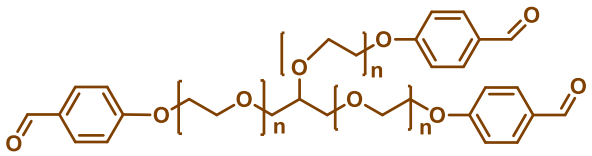
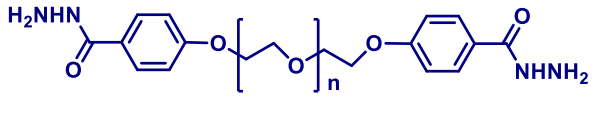
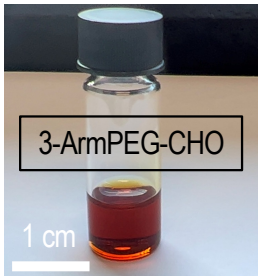
Progress compared with the state of the art. VII

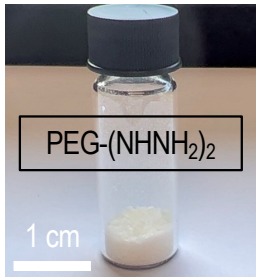


3-ArmPEG-CHO
M = 1312 g/mol



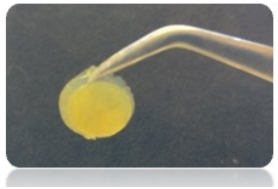
$PEG\text{-}(NHNH_2)_2$
M = 1782 g/mol





Ionic liquid
$PEG\text{-}(NHNH_2)_2$
3-ArmPEG-CHO
Dry DCM

→ Vortex 1 min → Evaporation of solvent at R.T. → Dry at 70°C under vacuum for 24 h



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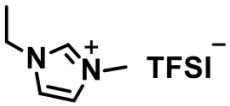
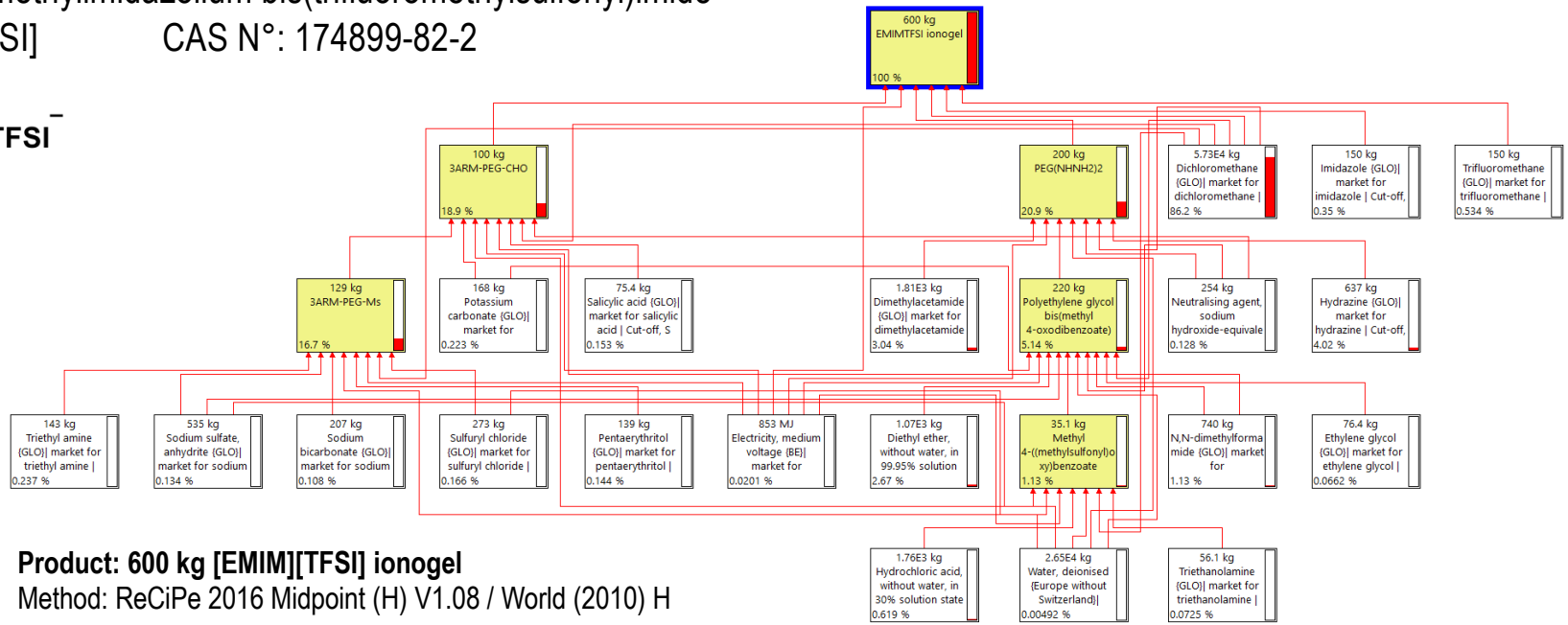
Progress compared with the state of the art. VIII

Ionic liquid:

1-Ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide
[EMIM][TFSI] CAS N°: 174899-82-2





Product: 600 kg [EMIM][TFSI] ionogel
Method: ReCiPe 2016 Midpoint (H) V1.08 / World (2010) H

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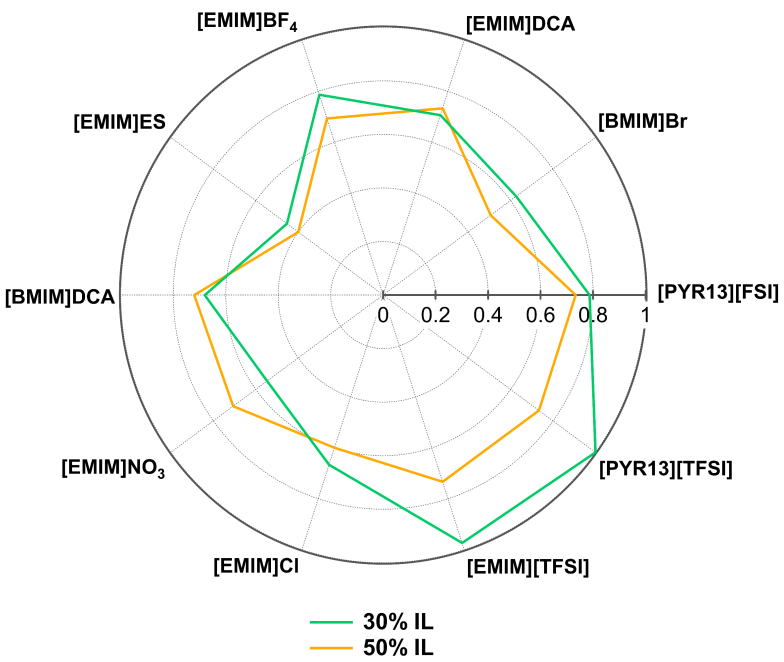
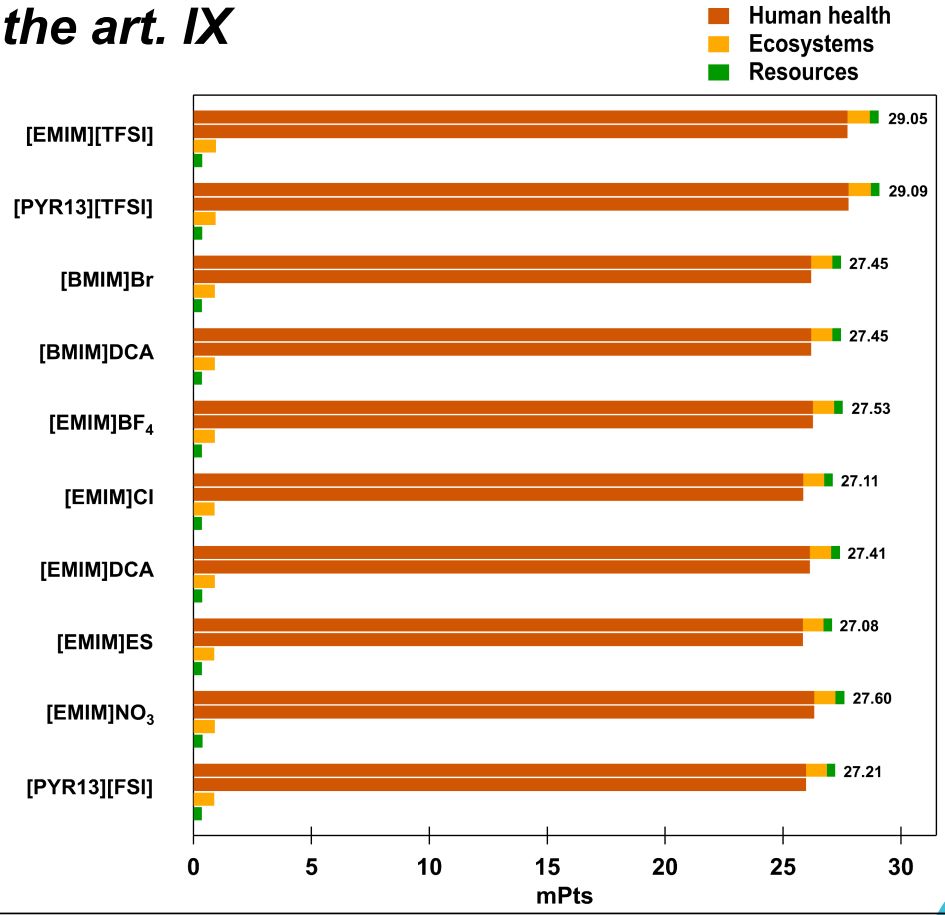
Progress compared with the state of the art. IX



Electrochemical stability window



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New products or developments. I. New instruments

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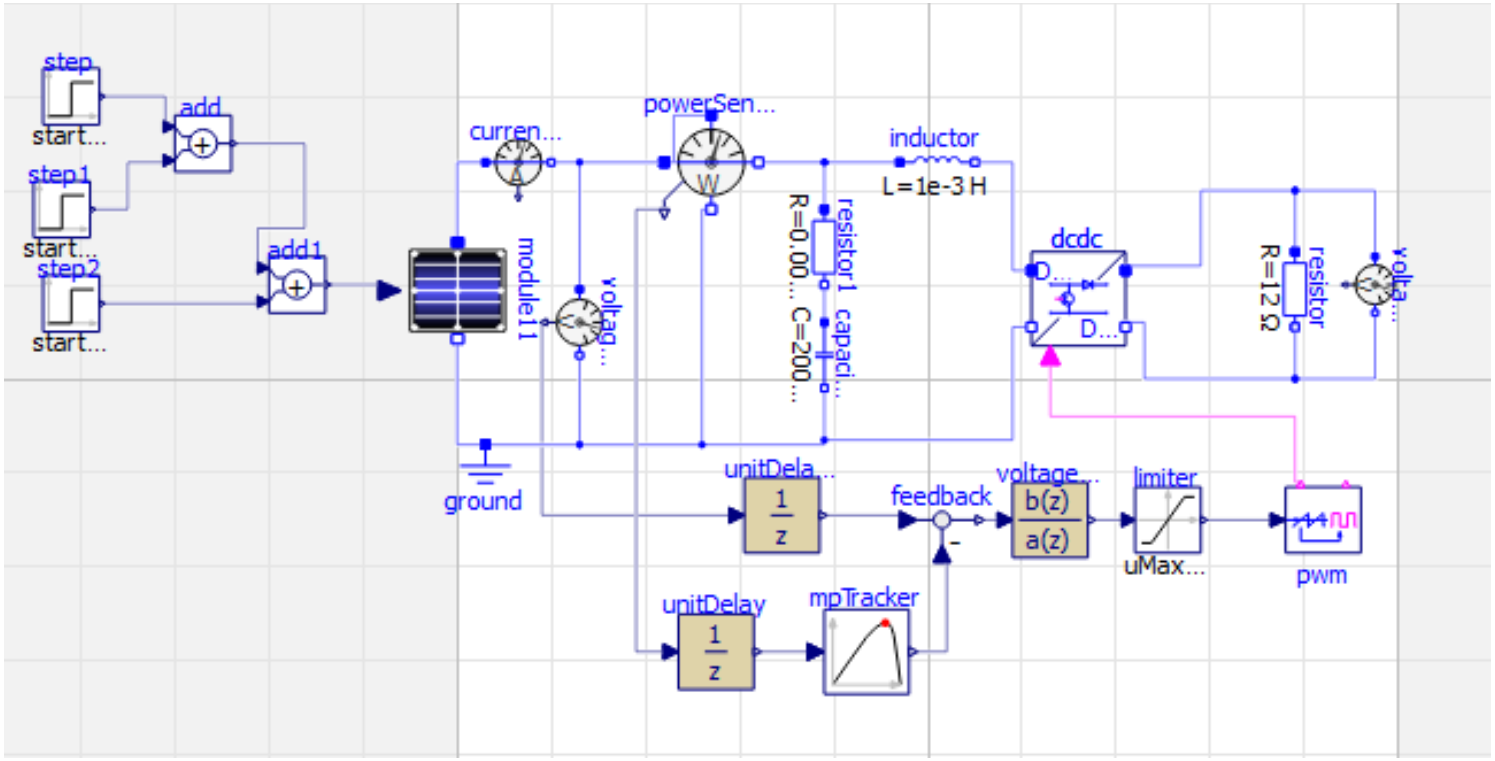
New products or developments. II. Software (Open Modelica)



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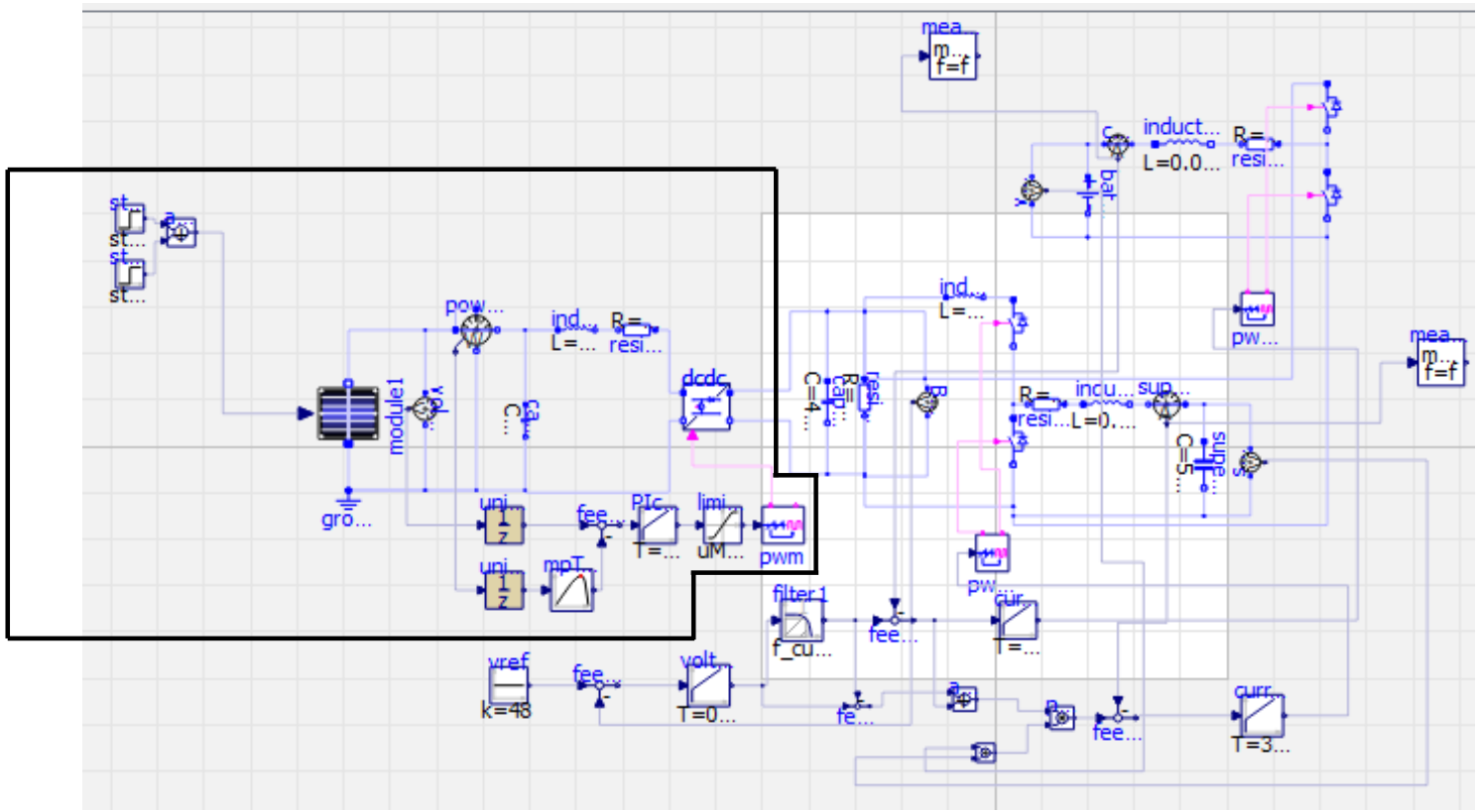
New products or developments. III. Software (Open Modelica)



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Problems encountered during the project

Budget was limited and not flexible for almost all partners.

Consortium did not achieved critical mass to move technologies beyond TRL 4.

Some tasks were more difficult to implement as expected (e.g. collecting of solar panels in Algeria at the beginning of the project).

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How the project contribute to a gender equal societal development ?

Number and share of people engaged in activities and scientific dissemination, categorized by age group (20-30, 30-40, over 40): ***6 young researchers, 6 senior researchers/technicians, 6 promoters***

Share of overall publications in international peer-reviewed journals that include at least one author under the age of 40 among the authors: ***85%***

Share of overall publications in international peer-reviewed journals that include at least one woman among the authors: ***100%***

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Planned follow up work

Work on LCA to up-scale recycling scenarios (integration with teams participating in MSCA "SusMatEner")

Work on product traceability (integration with teams developing digital technologies)

Work on supercapacitors with recycled materials

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Become of the consortium set up on this project

On-going efforts to secure funding for future activities, including those linked to SIREVIVAL objectives

Management structure for future initiatives to be established in AU

On-going efforts to link to industry partners

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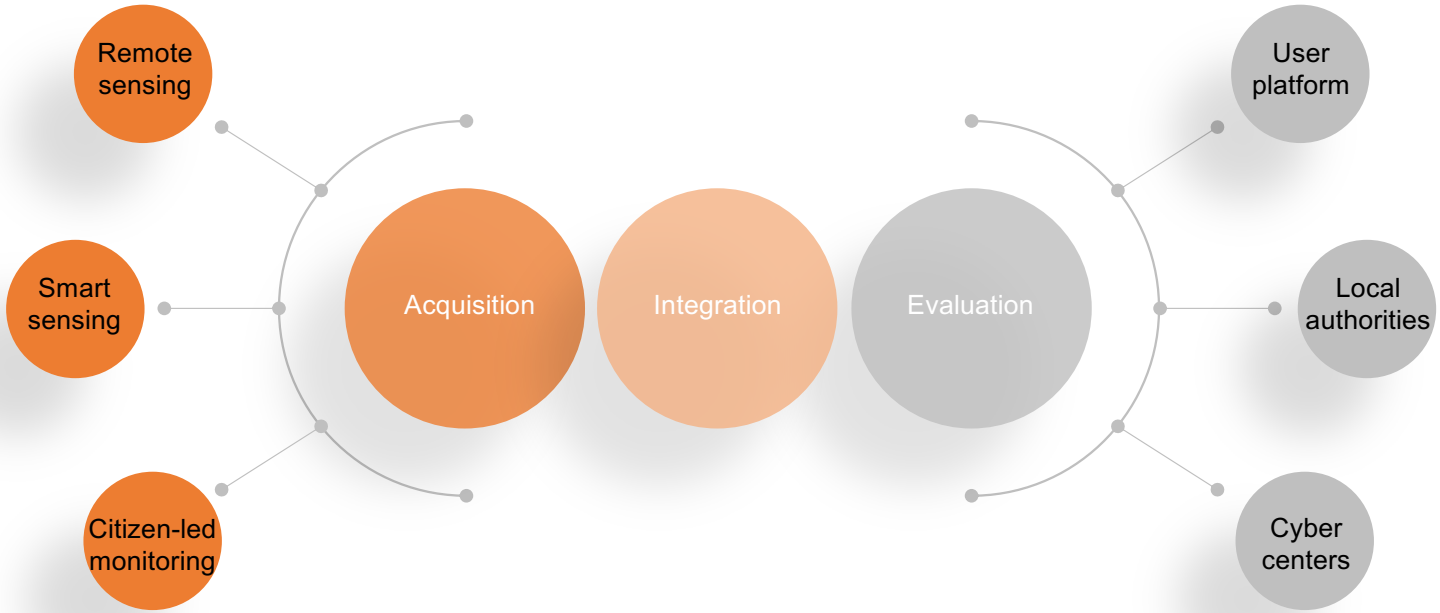
New collaborations planned for the future: *Energy modeling at local and regional scale based on AI-based methods for demand estimation and real-time anomaly detection for input data*



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New collaborations initiated thanks to the results of the project (following publications, conference presentations, etc.)

Collaborations with AU: On-going efforts with Strathmore University (Kenya) and University of the Witwatersrand (South Africa)

Collaborations with EU: On-going efforts with Fraunhofer-Institut für Energiewirtschaft und Energiesystemtechnik IEE (Germany)

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Expected outcomes in case of success of the project (2030)

1. *Traceability of the PV panels across the full value chain (e.g. blockchain technology), beyond life cycle assessment*

2. *Smart methods to inspect PV panels (e.g. drones) to maximize productivity and collection of end-of-life PV panels (e.g. free of charge removal or relocation)*

3. *Automated, ultrafast processes of recycling*

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Contribution of the project to AU – EU R&D partnership	***Interest of Consortium members in participating in LEAP-RE clustering activities***
Reinforcement of scientific and innovation cooperation in the renewable energy sector between Algeria, Belgium, France and Tunisia through several scientific visits and workshops	*Aggregated datasets (recycling technologies)*
Capacity building of the participating teams in the area of circular economy	*Life cycle analysis (digital technologies)*

THANK YOU

CONTACT US FOR MORE INFORMATION

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