Service-based business models for circular economy in the solar power sector

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CREATING CIRCULAR BUSINESS MODELS IN THE SOLAR POWER INDUSTRY

Solar photovoltaics (PVs) and electric vehicles (EVs) have been two key engines powering the energy transition. As the numbers of PVs and EVs on the market rise, and more efficient models become available replacing earlier versions, resource efficiency is becoming an increasingly critical factor for the long-term success of these sectors. Circular economy and renewable, clean energy need to go hand in hand, to safeguard a truly sustainable transition towards a low-carbon future.

CIRCUSOL (www.circusol.eu) is a Research and Innovation Action project funded by **the Horizon 2020 Programme of the European Commission**. CIRCUSOL wants to unleash the full potential of circular business models, Product-Service Systems (PSS), in simultaneously delivering real environmental, economic and user benefits. By that, CIRCUSOL aims to establish solar power as a spearhead sector in demonstrating a path driven by service-based businesses towards a circular economy in Europe.

BY 2030

8 million TONS OF PV WILL BE DISCARDED AS WASTE	**2 million** OLD BATTERIES WILL BE REMOVED FROM EV	**13 GW** SOLAR POWER FOR EU CAN BE PROVIDED BY SECOND-LIFE PV	**25 GWh** STORAGE CAPACITY FOR RENEWABLE ENERGY CAN BE PROVIDED BY SECOND-LIFE BATTERIES

HOW WILL CIRCUSOL TACKLE THIS?

CIRCUSOL will develop and demonstrate Product-Service System (PSS) business models[1] for the solar power sector. What does this mean and how is this different from what happens today?

Today by default, a supplier sells new solar panels and batteries to a user. The user then manages the solar power generation and storage. When their use life at the site reaches the end, the PVs/batteries enter the waste stream and get recycled or disposed.

In a PSS model envisioned by CIRCUSOL, a supplier provides solar power generation and storage to a user as a service. The PV and batteries are installed at the user's site, but the supplier remains as the owner and is responsible for their optimal functioning. When their use life at the site reaches the end, the supplier takes them back and decides whether they can get a second life[2] and be installed somewhere else or should be sent for recycling.

WHY WOULD THIS BE BETTER? A PSS MODEL CAN BE A TRIPLE-WIN!

For the environment, a PSS model could reduce waste by enabling longer product life with e.g. proper maintenance, and by encouraging market adoption of second-life products, since their performance, lifetime and safety will be assured by the supplier.

For the user, a PSS model could significantly reduce initial investment, ensure optimal performance of the installed system, and minimize hassles throughout the whole process and increase the level of service and warrantees.

For the supplier, a PSS model could provide diversified, recurring revenue and long-term relationship with the customers.

CIRCUSOL WILL WORK ON THREE KEY SUCCESS FACTORS:

- **Environmental benefits**, by paving way for high-quality supply and market adoption of second-life PV modules and batteries.
- **Market competitiveness,** by co-creating value propositions which answer to real user needs.
- **Financial health**, by reducing costs with new operational processes and digital technologies; and by creating new revenue streams and financing mechanisms.

CIRCUSOL WILL DELIVER:

- **Circular PSS business models** with real environmental benefits and economic feasibility, validated in five real-life commercial demonstrators, and suitable for replication.
- Second-life PV modules and second-life batteries **labelling and certification protocols**;
- **Business case** for circular product designs in the PV supply chain.
- **Validated systemic circular business model innovation methodologies and tool**s for broader use in business and academia.
- **Policy recommendations.**
- **New ICT platform for data generation, storage, analysis and sharin**g throughout the value chain.

1 PRODUCT-SERVICE SYSTEMS (PSS)

A product–service system (PSS) can be defined as consisting of "tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs". The term covers a wide range of business models from product-oriented (such as maintenance contracts), to use-oriented (such as leasing and sharing), to result-oriented (such as pay-per-use, or Philips Pay per Lux). (Tukker, 2004)

PSS models, the 'result-oriented' PSS, have the potential to align environmental and economic incentives. In theory, it would be in the interest of both producer and consumer to extend product lifetime and minimize life-cycle costs.

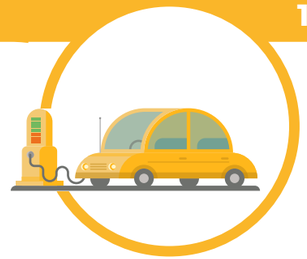
2 SECOND LIFE

The term "second-life" refers to re-use, refurbish or remanufacture. In second-life circular paths, the product remains as a product or components. It is different from recycling, in which the product is disintegrated and recovered as raw materials.

FIVE DEMONSTRATORS IN THREE COUNTRIES

A central activity of CIRCUSOL is to validate circular solar service models in **five large-scale demonstrators**. The demonstrators are selected to represent different market segments (residential, commercial and utility), different European countries (France, Belgium and Switzerland), and different scale (from single sites to entire region). **Together they will demonstrate three key success factors of circular service business models.**

1. CLOVERLEAF HEUSDEN-ZOLDER, BELGIUM, DEMO LEAD FUTECH



This demonstrator site is at an existing EV charging facility in Belgium. The facility already has a MW PV installation, provided by Futech under Power Purchase Agreement. Futech will add second-life batteries to the site as a service. The objective is to demonstrate the economic and technical feasibility of a storage-as-a-service model using second-life batteries for a commercial end-user.

2. MICRO E-MOBILITY CHARGING HUBS

BERLIN, GERMANY, DEMO LEAD SUNCRAFTER

The demo site will demonstrate that second life solar can also be a business case in an urban environment. There is a growing electricity demand in cities due to the increased presence of light electric vehicles like eBikes and eScooters. Charing these vehicles is still a big issue and electricity access in a city can be very difficult because of complex regulations. With our off-grid solution, it is way easier to provide charging infrastructure.

3. WAASLAND CO-HOUSING SINT-NIKLAAS, BELGIUM, DEMO LEAD DAIDALOS

The Waasland co-housing complex has 22 households, with a large proportion of shared space and facilities. This demo installs a second-life PV system (potentially with batteries) at the co-housing complex, and will test new service propositions co-created with the residents, such as energy consumption feedback and optimization. This demo aims to demonstrate solar PSS value propositions for the residential market, as well as evaluate technical feasibility and market potential of second-life PV (and batteries) for residential applications.

4. SCALING PSS WOHLEN BEI BERN & LAGOULE, SWITZERLAND, DEMO LEAD BKW

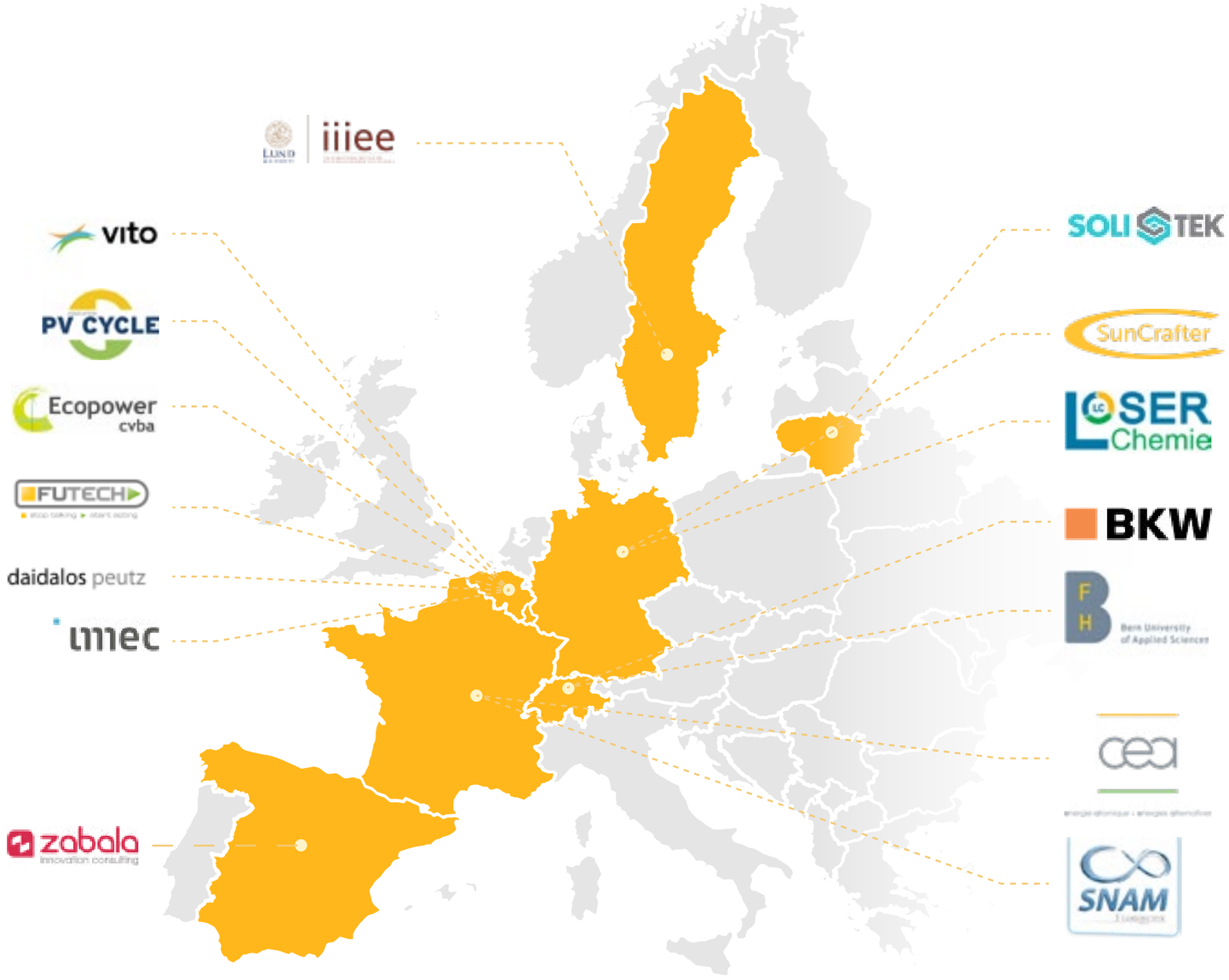
This demo will roll out solar power services in steps at different geographic scales in Switzerland, from neighborhood (~30 homes), to village (~1,000 homes), and eventually to region (~30,000 homes). The operational path to scale up in the residential segment is complex and challenging, since each home owner has individual preferences and investment possibilities. This demo aims to establish an economical geographical scaling path of solar PSS models in the residential segment, enabled by cost-efficient operational processes with innovative planning and coordination software.

5. RESCOOP PV FLANDERS, BELGIUM, DEMO LEAD ECOPOWER

In this demo, Ecopower will launch the solar PSS offer to its member base of 50,000 Flemish citizens. The PSS will then be implemented in the households signed up for the offer. This demonstrator is a large-scale market replication experiment for 1) residential market acceptance of solar PSS value propositions; 2) operational process for scaling up solar PSS in individual households at regional level.

15 PARTNERS TO ACHIEVE THE GOAL IN EUROPE

CIRCUSOL brings together **15 partners** from 7 different countries. The consortium consists of **5 research centers** and universities, 9 industrial players from the PV and battery value chains, and 1 consultancy firm. The consortium is coordinated by VITO (Flemish Institute for Technological Research).



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