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The 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems

Editorial

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In an ever-changing world, the roles of product development, business innovation, advanced manufacturing, service delivery and end-of-life management become increasingly important to enhance the competitiveness of industrial companies. The boundaries between disciplines soften and it is increasingly apparent that the scope for innovation and market disruption is to be found in the careful integration of numerous life cycle activities as the object of design.

Industrial Product/Service-Systems (IPSS) are one answer to this development, offering solutions towards the conceptualisation, design, planning and deployment of new solutions and value propositions in fundamentally different ways than before. Implicit in the philosophy behind IPSS is to create customer-oriented solutions that function for longer and thus increase resource productivity, minimise resource consumption and enhance the ultimate value-add to the end user. In this context, PSS solutions have a great potential to enable the transition to a Circular Economy, where the goal is to think in circular product- and system life cycles, rather than our current linear “take-make-waste” paradigm.

This Procedia CIRP Special Issue collects manuscripts from the 9th CIRP IPSS Conference, IPSS2017, which focused its theme on “Circular Perspectives on Product/Service-Systems”. With this theme, the conference, and therefore these manuscripts, have explored how the transition to a Circular Economy can be supported by PSS, in terms of life cycle, sustainability, optimisation, design and user satisfaction. The Special Issue is organised in five complementary and synergic tracks, offering a holistic and systemic view on the circular perspectives of PSS. The five tracks are as follows:

- **PSS as enablers for Circular Economy in a Sustainability Context:** In this track, opportunities and challenges experienced or envisaged, when transitioning to Circular Economy through PSS are discussed, with a reflection about the role of PSS in achieving sustainability.
- **Organisational capabilities for PSS implementation:** business model innovation, servitisation processes, key business activities and changing work systems are discussed in the context of PSS implementation in companies.
- **Engineering design approaches and methods for PSS:** explores the development and implementation of PSS design methods, tools and approaches, with focus on simulation and Design for X, including Design for Value and Service Design.
- **PSS and the digital transformation:** augmented production systems and the Industry 4.0 concept are discussed in a PSS context, bringing applications for the management of PSS during its life cycle and operation.
- **PSS cases and success stories:** presents a set of success stories and case studies on PSS implementation in industry, highlighting barriers and success factors for its effective implementation.

We hope that you will find the proceeding an interesting source of information and inspiration in your endeavours related to PSS. We would like to express our deep gratitude to the organising committee, to the international programme committee, to the authors and to all participants for making the CIRP IPSS2017conference a lively platform for the exchange of ideas, knowledge and new perspectives.

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A design approach with method and tools to support SMEs in designing and implementing Distributed Renewable Energy (DRE) solutions based on Sustainable Product-Service System (S.PSS).

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Abstract

Nowadays, around 1.2 billion people lack access to electricity. This condition hampers the provision of basic services such as health care and education. In this challenging scenario, Distributed Renewable Energy (DRE), meaning locally-based and small-scale energy systems based on renewable resources (e.g. sunlight and wind), is perceived as a possible solution towards sustainable energy access for All.

Some authors agree that the diffusion and implementation of DRE solutions can be facilitated if Sustainable Product-Service Systems (S.PSSs) are applied to them, as S.PSSs offer models able to move the focus from product ownership (e.g. solar panel) to the satisfaction of a specific demand (e.g. energy access). In fact, *"S.PSSs applied to DRE are able to cut/reduce both the initial investment (e.g. solar panel purchase) and life-cycle costs (e.g. maintenance, repair of solar panel) democratizing the access to energy and energy-related services."* (LeNSes project – EU funded, Edulink II program, 2013-2016).

However, designing and implementing S.PSS-applied-to-DRE solutions is still a complex process. The paper describes the design approach, method and tools used to support local SMEs (as well as NGOs, students, designers, researchers) in the design and implementation of S.PSS-applied-to-DRE solutions, the design process itself and the results achieved. The current generation of local entrepreneurs and designers worldwide need a broad knowledge base and know-how, as well as effective design approaches, methods and tools, in order to play an active role in promoting, designing and implementing S.PSS-applied-to-DRE solutions, and thus foster sustainable energy access for All.

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Keywords: Offer models; Design strategies; Distributed Renewable Energies.

1. Sustainable energy for All and the role of Distributed Renewable Energy (DRE)

Nowadays, energy access for All is considered one of the main challenges of our era. [1][2]. Around 1.2 billion people in low and middle-income contexts, lack access to electricity for basic life services such as health care and education. Another 2.7 billion people access energy through traditional biomass and this causes 4000 premature deaths everyday due to biomass fumes [3].

These conditions, especially in low and middle-income contexts, are reinforced by the lack of grid connection, often not available due to infrastructure limitations and unsuitable policies [4]. Furthermore, the limited purchasing power of customers in low and middle-income contexts, further reduces future opportunities of grid extension.

For the above reasons, Distributed Renewable Energy (DRE) solutions, which are locally-based and small-scale energy systems based on renewable resources such as sunlight and wind, are considered as a promising model to access

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sustainable energy for All, especially in low and middle-income contexts [5][6][7].

DRE solutions are characterized as follows:

- They are based on inexhaustible resources, thus reducing greenhouse gas emissions and avoiding environmental impact for extraction and transformation of resources;
- They are set up as small-scale generation plants requiring a reduced economic investment due to the small size of the system and local consumption of energy;
- They are easy to install, maintain and manage, thus fostering local management of plants, increasing local employment and developing skills.

However, DRE are still facing barriers to their diffusion. Gaps in technology and local operation & maintenance are two of the reasons, but the limited purchasing power of local customers represents the main barrier to accessing energy, since even DRE requires initial investment. Consequently, an appropriate offer model is needed. [8]

The paper aims to contribute to the discussion by proposing the offer model of S.PSS applied to DRE as a promising strategy to design and implement sustainable DRE solutions. In particular, the main objective of the paper is to present a dedicated design approach, method, tools, and resulting design process, to support the design and implementation of such a model, and foster its adoption by local SMEs as well as NGOs, students, designers, researchers.

2. Sustainable Product-Service System (S.PSS) applied to Distributed Renewable Energy (DRE): a promising offer model

Some authors agree that a Sustainable Product-Service System (S.PSS) that is able to move the focus from product ownership (e.g. washing machine) to the satisfaction of a specific demand (e.g. having clean clothes) [9] could be a promising offer model when used to support Distributed Renewable Energy (DRE) solutions.

The LeNSes project (EU funded, Edulink II program, 2013-2016) has proposed the following definition: *"The Sustainable Product-Service System (S.PSS) offer model applied to Distributed Renewable Energy (DRE) is a win-win approach to diffuse (DRE) solutions in low and middle-income (all) contexts, because it reduces/cuts both the initial investment cost of hardware purchasing and the life-cycle costs of maintenance, repair, upgrade, etc. while improving local skills and increasing local employment, resulting in key leverage for a sustainable development process that aims to democratize access to resources, goods and services."*[7]

OFF-GRID Electric is an example of a Sustainable Product-Service System applied to Distributed Renewable Energy (S.PSS-applied-to-DRE) solution. *It offers rural people in Tanzania Solar Home Systems (SHS) which include the hardware to generate energy (Solar panel + Storage + Wires) and related Energy Using Products (EUP - two lights + phone charger). Customers pay a daily pay-per-period fee. OFF-GRID Electric retains the ownership of the SHSs and the EUPs including operation & maintenance services. OFF-GRID Electric organizes training in installation and customer support for local dealers, and has recently opened the first OFF-GRID Academy for technical training.*

To clarify, the following characteristics highlight why S.PSS-applied-to-DRE solutions are considered opportunities, especially in low and middle-income contexts:

- focus on access rather than DRE hardware ownership: this reduces/avoids initial investment costs (too high) for hardware purchase;
- sell the "unit of satisfaction" (e.g. energy access) rather than the hardware (e.g. solar panel): so this avoids (unexpected) costs for operation & maintenance on the product that may lead to product use interruption;
- focus on a specific context of use: this leads to (competent) local stakeholder involvement (and thus empowerment), rising (local) employment and the diffusion of skills.

According to the above, S.PSS-applied-to-DRE would seem to be an important strategy to speed up diffusion, and guarantee the long-term use of DRE solutions in low and middle-income contexts. This is especially true since it cuts both the initial investment cost of access to energy and the unexpected operation & maintenance costs of (DRE) products (e.g. repair), avoiding or reducing the risk of use drop off. [8]

3. S.PSS-applied-to-DRE design approach, method, tools

3.1 Research methodology

Firstly, a desk research on existing design approaches, methods and tools from the S.PSS area was conducted [10][11][12][13][14][15][16][17] to verify and extract the main characteristics to integrate with the new S.PSS-applied-to-DRE ones. Specific DRE tools were found in energy research fields; however, S.PSS-applied-to-DRE tools were missing, so these were designed by the author and experts from the LeNSes network (see Table 1). Secondly, a (draft) version of the design approach, with method and tools, was designed and implemented during internal workshops at the Design and system Innovation for Sustainability (DIS) Research Group of Politecnico di Milano, Design Dept. Thirdly, two on field implementations were made during two vocational training modules for local Small and Mediumi-sized Enterprises (SMEs) in Botswana and Uganda in 2016. Between the two modules, the design approach, methods and tools were updated according to participants' feedback. Finally, the draft version was refined after feedback from design experts in the LeNSes network, arriving at the current version presented below in sub-sections 3.2 and 3.3.

3.2 Design approach

The focus of the proposed design approach, based on the S.PSS offer model, moves from the appropriate technologies

approach, often applied in Bottom of the Pyramid (BoP) [1] interventions, to appropriate interactions among actors (system-perspective). In fact, the design approach proposed includes stakeholders and their interactions throughout the entire life-cycle of the S.PSS as key elements towards a stable innovation.

The design approach is essentially a combination of the following three approaches:

- *Satisfaction-system:* this approach entails the design of demand satisfaction ("satisfaction unit"), meaning, in this case, to achieve access to energy and related products and services, thus moving the focus from mere product selling to a complex system;
- *Stakeholder configuration:* this approach entails designing stakeholder interaction in relation to the particular "satisfaction unit". In this case, this means that all stakeholders in the life-cycle of a product-service need to be considered and involved in the design process;
- *System sustainability:* this approach entails designing the sustainability of stakeholder' interactions, on the basis of mutual economic, socio-ethical and environmental benefits, as a way of achieving sustainable DRE solutions.

On the one hand, the combination of the above approaches shows the complexity of S.PSS-applied-to-DRE solutions; on the other hand, it reveals opportunities for stakeholder involvement (e.g. in co-designing activities, and in a human-centered approach).

3.3 Method and tools

The proposed method focuses on the offer model of S.PSS applied to DRE and seeks to foster the design and implementation of such a model, as a promising way towards achieving Sustainable energy access for All.

Apart from methodology gleaned from the desk research conducted, the proposed Method for S.PSS-applied-to-DRE is based mainly on the Method for System Design for Sustainability (MSDS) developed during EU funded research projects [2], and seeks to support and orient the entire development of system innovations towards sustainability [11].

The five phases of the proposed method came directly from MSDS, also recalling the structure of other methods for S.PSS development [14]. Coherently with the five phases, the aims and processes of the proposed method are also based on MSDS, even though they now focus on the design and implementation of S.PSS-applied-to-DRE solutions. In particular, specific processes were added/adapted in the various phases to analyze, design and implement S.PSS-applied-to-DRE solutions; these processes are marked with an asterisk * in Table 1. Other processes, not specific to DRE, were added to analyze and communicate outcomes from the design activities.

The method, is organized in five modular phases (details on aims, processes and tools in Table 1):

- *Strategic Analysis (SA)* aims to collect background information to facilitate the generation of S.PSS-applied-to-DRE ideas. It analyzes project proposers, analyzes context of reference and trends and sets the priorities for the design intervention;
- *Exploring Opportunities* aims to generate promising strategies for S.PSS-applied-to-DRE solutions e.g. to generate a set of promising ideas for S.PSS-applied-to-DRE and/or a sustainability design-orienting scenario;
- *Design System Concept* aims to design one or more system concepts oriented towards S.PSS-applied-to-DRE solutions i.e. cluster promising ideas for S.PSS-applied-to-DRE, design, assess, evaluate and narrate the system concept of S.PSS-applied-to-DRE;
- *Design (and engineering) the System* aims to develop the most promising system concept of S.PSS-applied-to-DRE into the detailed version ready for implementation, i.e. to detail, evaluate, refine and narrate the system concept itself;
- *Communication* aims to present (internally/externally) the general and (above all) sustainable characteristics of the system designed, for example by narrating through an Animatic tool the whole S.PSS-applied-to-DRE solution in order to involve existing and new stakeholders.

Due to its modular structure, the method can be adapted to respond to the specific needs of designers/companies:

- method phases/processes can be used in sequence or separately according to designer/customer needs. For instance, a company with an S.PSS-applied-to-DRE solution concept, could go directly to the "Design (and engineer) system details" phase;
- method and tools (many of them elaborated within EU funded research projects) can be included/or not during the design process and used within different phases (with an increasing level of detail) according to the needs and skills of the designer/customer;
- three dimensions of sustainability (environmental, socio-ethical and economic) are included in the method; according to project aims, it is possible to operate on one or more of them.

Tools related to S.PSS applied to DRE were not available, due to only partial exploration of the topic; consequently, a series of tools were designed, prototyped, refined and integrated in the method. Furthermore, other energy-related tools were found in other fields and adopted in the method. To facilitate sharing and reuse of tools, most of them are provided as digital elements, but a printable version is also usually available in case digital support is not effective (more about in section 4).

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[1] Bottom of the Pyramid (BoP) is the four billion people who live on less than say $3,000 per year (Shah, Anup. 2016).

[2] MSDS has been elaborated within the MEPSS project (EU 5th FP Growth), the HiCS project (EU 5th FP Growth) and refined within the LeNS project (EU Asia-Link), particularly by DIS unit, Politecnico di Milano (coordinator).

Below, Table 1 illustrates the proposed Method for S.PSS applied to DRE with *phases*, *aims*, *processes* and related *tools*. Energy-related processes and tools are recognizable through *.

Table 1. Method and tools for S.PSS-applied-to-DRE solutions.

Strategic Analysis (SA) Phase		
Aims	*Processes*	*Tools*
To obtain information to facilitate the generation of S.PSS-applied-to-DRE ideas	Analyse project proposers and reference context	- S.PSS&DRE Innovation Diagram* - System Map for Energy* - Strategic Analysis (SA) template* -S.PSS&DRE Innovation Map* - MiniDOC - SWOT matrix
	Analyse General macro-trends	- Strategic Analysis (SA) template*
	Analyse sustainability of existing system and set priorities for the design intervention	- Strategic Analysis (SA) template* -S.PSS&DRE Innovation Map* - Sustainability Design Orienting (SDO) toolkit
	Analyse access to energy in the context of reference*	- Strategic Analysis (SA) template* - Resources assessment software* - Sustainability Design Orienting (SDO) toolkit
	Collect and Analyse best practices	- S.PSS&DRE concept description form* - System Map for Energy* - Strategic Analysis (SA) template* - S.PSS&DRE case study format* - Sustainability Design Orienting (SDO) toolkit - MiniDOC - Interaction table
Exploring Opportunities Phase		
Aims	*Processes*	*Tools*
To make a 'catalogue' of promising strategies towards S.PSS-applied-to-DRE e.g. a sustainability design-orienting scenario and/or a set of sustainably promising ideas	Generate sustainability-oriented ideas at system/stakeholder level	- Offering Diagram - Sustainability Design Orienting (SDO) toolkit - Satisfaction System Map
	Generate DRE oriented ideas at system/stakeholder level*	- Sustainability Design Orienting Scenario for S.PSS&DRE* - Strategic Analysis (SA) template* - Sustainable Energy for All Idea Tables* - Sustainability Design Orienting (SDO) toolkit
	Outline a Sustainable Design-Orienting Scenario	- Sustainability Design Orienting Scenario* -S.PSS&DRE Innovation Map* - Polarity diagram - Offering diagram - System concept Audiovisual - Interaction storyboard
Design System Concepts Phase		
Aims	*Processes*	*Tools*
To determine one or more system concepts oriented towards S.PSS-applied-to-DRE solutions	Select clusters and single ideas (environmental, socio-ethical, DRE oriented)*	- S.PSS&DRE Innovation Diagram*
	Develop system concept/s	- S.PSS&DRE Innovation Diagram* - System Map for Energy* -S.PSS&DRE Innovation Map* (with cards) - Sustainability Stakeholder's Motivation Matrix - Offering diagram - Interaction table - Interaction storyboard - System concept Audiovisual
	Design DRE system*	- Estimator of DRE (E.DRE) *
	Make environmental, socio-ethical, and economic assessment of system concept/s	- Sustainability Design Orienting (SDO) toolkit - Sustainability interaction story-spot
	Evaluate the system concept/s developed e.g. outline the emerged Sustainable Design-Orienting Scenario/s	- System concept Audiovisual
Design (and Engineer) System Details Phase		
Aims	*Processes*	*Tools*
To develop the most promising system concept into the detailed version ready for implementation	Detail the system concept	- System Map for Energy* - S.PSS&DRE concept description form* - Offering diagram - Interaction storyboard - Sustainability Stakeholder's Motivation Matrix - Solution element brief - Interaction table
	Define development plan for the system	- Interaction storyboard - Business plan
	Make environmental, socio-ethical, and economic assessment of DRE system*	- Sustainability Design Orienting (SDO) toolkit - Sustainability interaction story-spot
	Detail and evaluate the DRE system*	- Estimator of DRE (E.DRE) *
	Present/discuss the system developed e.g. outline main activities characteristics, actors	- S.PSS&DRE Design framework and cards* - Animatic
Communication Phase		
Aims	*Processes*	*Tools*
To communicate (internally/externally) the general and (above all) sustainable characteristics of the system designed	Draw up the documentation for (internal) communication	- Sustainability Design Orienting (SDO) toolkit - MiniDOC
	Draw up the documentation for (external) communication	-Animatic - System Map for Energy* - Offering diagram - Interaction story-spot - Sustainability Design Orienting (SDO) toolkit

4. Vocational training modules with 15 SMEs from Africa

The proposed design approach, together with method and tools, was adopted in two vocational training modules for local SMEs dealing with energy, in Botswana and Uganda in 2016[3]. This gave the opportunity to implement them in a real context, providing feedback for further improvements as well as introducing S.PSS-applied-to-DRE knowledge and know-how to a new generation of local entrepreneurs. The two modules are discussed below, to show a practical application of what is presented in the above sections.

4.1 Aims and objectives of the modules

Both modules aimed to present S.PSS applied to DRE to local SMEs from Botswana and Uganda as a promising way to shift their existing businesses towards S.PSS-applied-to-DRE solutions, as well as giving them a first trial of the design approach, method and tools to design and implement such a model. Accordingly, the overall objective was to explore the proposed design approach, method and tools, within design simulations with local SMEs, while (on the design side) verifying them in terms of benefits and limits of application.

4.2 Vocational training modules

Both modules were based on theoretical lectures, aiming to provide basic knowledge on the offer model of S.PSS and S.PSS-applied-to-DRE, and on a design simulation where acquired notions were put into practice. The latter sought firstly to increase participants' self-confidence with the offer model and support method and tools, and secondly, to show them a promising way to shift existing businesses towards more Sustainable (and profitable) DRE solutions.

The first module *Designing Sustainable Product-Service System (S.PSS) offer models for Distributed Renewable Energy (DRE) systems* was held by the University of Botswana in collaboration with the Politecnico di Milano from 2 to 6 of May 2016. Five local SMEs and one Research Centre from Botswana were involved. Participants, organized into groups, designed two concepts of S.PSS-applied-to-DRE starting from their businesses. The design process started with the *Strategic Analysis phase*, analysing the participants' current businesses, then it moved on to the *Exploring Opportunities phase*, to the generation of promising ideas for S.PSS-applied-to-DRE solutions. Subsequently, ideas from the *Design System Concept phase* were clustered to define a system-concept, then refined through the adoption of a series of tools. *Communication phase* sustainable characteristics of each S.PSS-applied-to-DRE concept were presented in a final plenary session.

The second module, *Designing Sustainable Product-Service System (S.PSS) offer models for Distributed Renewable Energy (DRE) systems*, was held by the Makerere University (Uganda) from 19 to 22 of July 2016, as a collaboration between the university's Centre for Research in Energy and Energy Conservation (CREEC) and the DIS Research Group from the Politecnico di Milano. It involved nine local SMEs from Uganda. Participants, in groups, were asked to innovate their existing businesses through the design of S.PSS-applied-to-DRE solutions. In this second module attention was mainly addressed to defining system-concepts - *Design System Concept phase*, and to properly communicating them to external audiences through the use of dedicated tools - *Communication phase*, e.g. involving new stakeholders, or requesting permission from local administrations with the support of narrative tools.

During both modules, the phases, processes and tools were explored through design simulations; according to the specific focuses of each module, certain processes and tools were selected or avoided. On an operational level, the tools were presented in their digital version and this created initial uncertainty among participants. Support from facilitators was therefore central in the initial phases, becoming less important as participants became more confident with the digital interface. The design approach, method and tools, were evaluated by the participants through a questionnaire aimed to provide in-process insights concerning possible design, technical and conceptual improvements.

All resources from the modules are available open source and copy-left on www.lenses.polimi.it section courses.

5. Lesson learned

The proposed *Design approach*, based on a system-perspective where unit of satisfaction, stakeholder involvement and sustainability are key elements, is considered a promising approach to achieve stable (DRE) innovations. In fact, its comprehensiveness (stakeholders and activities from the whole life-cycle were included in the design process) leads to (DRE) solutions where risks are reduced and shared among stakeholders, while benefits in sustainable (economic, environmental, socio-ethic) terms proportionally increase. Also, its focus on unit of satisfaction instead of a single product, opens a wider range of design opportunities for S.PSS-applied-to-DRE solutions, as well as stimulating collaborations among stakeholders. In fact, they will have economic incentives both to set up (S.PSS-applied-to-DRE) solutions with an extended product lifetime, postponing both the disposal costs and the costs of manufacturing new products, and to provide high quality (DRE) products/solutions with low life-cycle costs to reduce costs (e.g. repair) while obtaining higher margins [9]. On the other hand, such a design approach, based on a system-perspective, is both theoretically and practically highly complex, and requires skilled management. However, twelve out of the fifteen local SMEs involved stated that they would adopt the proposed design approach for their future business

[3] The mentioned vocational training modules, together with other two modules developed in South Africa and Kenya, were developed as activities of the LeNSes project (EU funded, Edulink II program 2013-16). All resources from the modules are freely available at www.lenses.polimi.it

opportunities, so the profitability of collaborating with other stakeholders to achieve stable, sustainable (DRE) solutions was clearly recognized.

Regarding the proposed *Method*, its modularity and flexibility make it relatively easy to set up the design process to satisfy specific needs, avoiding redundant phases, processes, and tools. It will be possible to invite local SMEs to work on specific issues – such as designing the system sustainability of a DRE system – focusing only on a specific phase, process, or tool in the method. The Centre for Research in Energy and Energy Conservation (CREEC) of the Makerere University (Uganda), coordinator and host of the second module, has planned collaborations with local SMEs to support their design processes based on the above design approach and working on specific tasks according to their needs.

The *Tools* came partially from consolidated S.PSS methods or alternative research fields, while some were specifically designed for S.PSS-applied-to-DRE solutions. Other tools could also be integrated into the method according to the specific needs of the design activity. S.PSS-applied-to-DRE tools designed within the LeNSes project are considered as a first step in building specific know-how to design and implement S.PSS-applied-to-DRE solutions. Around 70% of the modules' participants declared themselves to be “very satisfied” with the proposed S.PSS-applied-to-DRE tools, both in terms of usability and the impact of the process; the remaining 30% were “moderately satisfied” and their feedback indicated new room for improvement. Particular interest was shown in tools to communicate the S.PSS-applied-to-DRE innovation both internally and externally. For example, the System Map for Energy was supportive in describing stakeholder roles and interactions, and the Sustainability Stakeholders’ Motivation Matrix was important to make the potential benefits of an offer clear.

The above discussion seems to indicate that a design intervention in the creation and implementation of sustainable DRE solutions is able to: I) offer (energy) access rather than (DRE) system ownership, avoiding initial investment costs, so that all can access renewable energy more easily; II) cover the unit of satisfaction with (energy) services rather than the (DRE) system, reducing/avoiding unexpected costs to the customer for life-cycle services (e.g. maintenance, repair, …) for (DRE) products, which may lead to the interruption of use; III) favor/involve local rather than global stakeholders, thus fostering local production and employment, as well as local skills and competences.

6. Conclusions

The first steps taken met with encouraging feedback and further field implementations of both method and tools are in place or planned. However, the design knowledge and know-how proposed through the design approach, method and tools presented are only an initial support for S.PSS-applied-to-DRE know-how, and are far from being commonly adopted.

Up to now applications of S.PSSs to DRE have mainly been implemented in the so called emerging countries. However, this research intends to extend the meaning of “for All”, to include all low and middle-income contexts, which are defined as contexts where economic difficulties limit access to sustainable energy, and which can be found both in emerging and industrialized countries, e.g. the Milanese context of “"case popolari" *(the Italian equivalent of "council housing")* where basic energy related services are not guaranteed every day. This consideration becomes important since it enlarges the field of research where S.PSS-applied-to-DRE solutions can be studied and applied. Furthermore, this calls for new roles for System Design towards sustainable energy for All.

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