SUSTAINABLE ENERGY FOR ALL BY DESIGN

Edited by Emanuela Delfino and Carlo Vezzoli

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Campus: "lab" and "window" for Distributed Renewable Energy applied as Sustainable Product-Service System

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ABSTRACT

This paper intends to promote the hypothesis to consider the University Campus as win-win locus for the design, implementation and dissemination of Distributed Renewable Energy, seen as a key leverage for a sustainable development. In particular, by applying to them a Sustainable Product-Service System offer model, a promising solution applicable even to low and middle-income contexts.
A presentation, description and justification of the following new research knowledge achievements (within the LeNS project), it is given at the beginning: the design and implementation of Sustainable Product-Service System applied to Distributed Renewable Energy is a win-win strategy to diffuse Sustainable Energy for All. This is the main knowledge outcomes of the LeNSes Learning Network on Sustainable energy system EU funded project (Edulink programme II).
Secondly, it is described and proposed the Research Hypothesis of making University Campus as community "lab" and "window" to design, implement and promote radical innovation for sustainability, in particular for Distributed Renewable Energy systems, seen as a paradigm shift form centralised and fossil fuel-based energy plants and a key leverage for the transition towards a sustainable for all society.
In fact, the paper proposes that (design) Higher Education Institution may have a challenging role to play in a transition towards a Sustainable Energy for All society, by going further the diffusion of System Design for Sustainable Energy for All knowledge-base and know-how (in fact the aim of the LeNses project), towards a new role/research hypothesis of university campuses as optimum "lab" for socio-technical innovations test as well as "windows", i.e. show-cases for the design, testing and dissemination of sustainable energy for all solutions.
The paper does encourage further action by suggesting the reinforcement and amplification of the existing LeNS network, in the sense of real design, prototyping and testing of sustainable energy for all concepts, i.e. the implementation of DRE&S.PSS-based pilot projects within the university's campus.

Key Words: Sustainable Product-Service System, Distributed Renewable Energies, Socio-technical experiments, Sustainable Campus.

1. INTRODUCTION

The Learning Network on Sustainable energy systems (LeNSes) an African-European multi-polar network for curriculum development on Design for Sustainability (DfS) focused Sustainable Product-Service Systems (S.PSS) applied to Distributed Renewable Energy (DRE), i.e. focused on System Design for Sustainable Energy for All (SD4SEA). The project has been funded by the European Union (EU) 2013-2016, Edulink Programme and involves four African and three European universities offering design-specific programs of study.

The research hypothesis presented in this paper is to move form university as key actors for the building and diffusion of knowledge-base and know-how for a new generation of designer (LeNSes project main aim), to a new challenging potential commitment of university campuses as elected location to speed up the process of DRE diffusion, by the design and implementation of innovative energy supply of the same university campuses. Campuses so fort as lab and windows for DRE design, implementation and diffusion, capable so forth to effectively contribute to the transition towards a DRE energy for all based society.

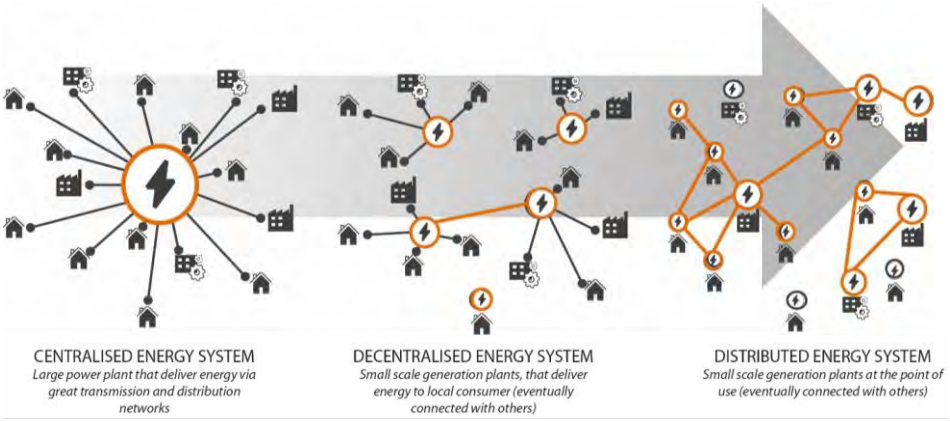
2. SUSTAINABLE ENERGY FOR ALL FOR SUSTAINABLE DEVELOPMENT

In the recent period it has become a shared understanding that sustainable development is not possible without sustainable energy for all".
In fact, energy is the world's largest industrial sector whose output is an essential input to almost every good and service provided in the current economy. Energy services have a profound effect on productivity, health, education, food and water security, and communication services. Therefore, that access to energy can contribute to reduce inequality and poverty.
The United Nations has promoted 2012 as the International year of sustainable energy for all" as well in the UN summit rio+20 one of the statement was that "Sustainable development is not possible without sustainable energy".
Some numbers related to energy access (World Energy Outlook 2015, International Energy Agency): 1.2 billion People worldwide lack access to electricity and 1 further billion do not have reliable access to electricity.
Who are those living without electricity? More than 95% are in the sub-Saharan Africa and developing Asia countries. Furthermore, 80% of the world total are in rural areas.
What about in particular the access to modern fuels/energy for cooking?
We know that (World Energy Outlook 2015, International Energy Agency) 2.7 billion People access energy through traditional biomass, and because of that .4.000 premature deaths everyday are due to biomass fumes (this means 1, 5 million a year).

Distributed Renewable Energy is seen by many authors as a key leverage for sutainable energy for all, so forthj for sustainability.sustainability.
Distributed Renewable Energy (DRE) generation could be defined as follows (Vezzoli et al., 2015).

> *Small-scale generation plants harnessing renewable energy resources (such as sun, wind, water, biomass and geothermal energy), at or near the point of use, where the users are the producers – whether individuals, small businesses and/or a local community. If the small-scale generation plants are also connected with each other (for example, to share the energy surplus), they become a Renewable Local Energy Network, which may in turn be connected with nearby similar networks.*

Distributed Renewable Energy generation is a paradigm shift alternative to traditional one, characterised by huge plants that generate energy in one location to distribute it to many users. Using mainly fossil fuels, the one schematized (Figure 1) on the left hand side to a distributed generation system in which the energy is generated in the same place of its use, by very small generator and eventually exchanged among nearby users. In between those two system, we have the so-called decentralized energy generation and distribution system, in the middle part of the figure, where we have medium size generator that distribute the energy locally.



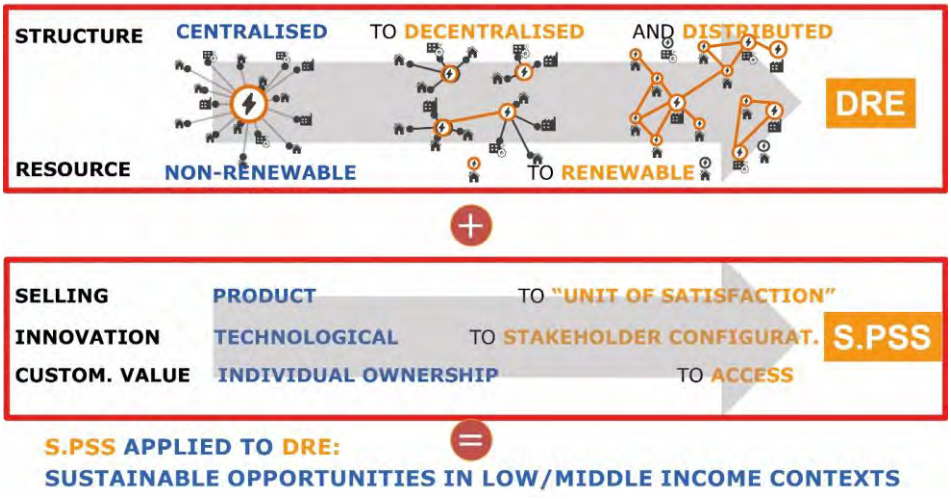
[Figure 1] Paradigm shift from centralised fossil fuel based to distributed renewable energy systems

As we said before, fossil fuels as, oil and coke (all centralised system) are environmentally un-sustainable. Most of CO2 emissions are far responsible of global warming and for other pollution problem during extraction, with high-energy transmission losses. On the contrary, renewable resources (within an appropriate use) are non-exhaustible: they progressively may reduce greenhouse effect through lower environmental cost for extraction, transformation and distribution.
Centralised system are un-sustainable even in socio-ethic terms, because for the same composition of oil and coke they are very complex to be extracted, produced, distributed. They require very expensive and big centralised structures, which reduce the possibilities of direct access. Micro plants for energy production are manageable by small economic entity, where the user can become a producer and micro plants could be connected in energetic micro network, connected with global network. This would increase the self-sufficiency of local communities and of single individuals leading towards a resources democratisation, and so forth to an iniquity reduction, enhancing local employment and dissemination of competences.

3. S.PSS APPLIED TO DRE IS SUSTAINABLE OPPORTUNITIES IN LOW AND MIDDLE-INCOME (ALL) CONTEXTS

The most recent definition of Sustainable Product-Service System is 'an offer model providing an integrated mix of products and services that are together able to fulfil a particular customer demand (to deliver a 'unit of satisfaction'), based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the economic and competitive interest of the providers continuously seeks both environmentally and socio-ethically beneficial new solutions (Vezzoli et al., 2014).

Said this we introduce here the research hypothesis that has been studied, verified and refined within the LeNSes project (see Figure 2.):
"A S.PSS applied to DRE is a promising approach to diffuse sustainable energy in low/middle-income contexts (for all), because it reduces/cuts both the initial (capital) cost of DRE system purchasing and the running cost for maintenance, repair, upgrade, etc., while increasing local employment, related skills and entrepreneurship, resulting in a key leverage for a sustainable development process aiming at democratizing the access to resources, goods and services."



[Figure 2] S.PSS applied to DRE a sustainable opportunities for all

4. SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL (SD4SEA)

A design research hypothesis (LeNSes): system design for sustainable energy for all a new challenging design role defined as follow (LeNSes proposal, EU Edulink project, 2013-2016):
"the design of a Distributed Renewable Energy system of products and services, able to fulfil the demand of sustainable energy of low and middle-income people (all) - possibly including the supply of the Energy Using Products/Equipment system - based on the design of the innovative interactions of the stakeholders, where the economic and competitive interest of the providers, continuously seeks after both socio-ethically and environmentally beneficial new solutions".

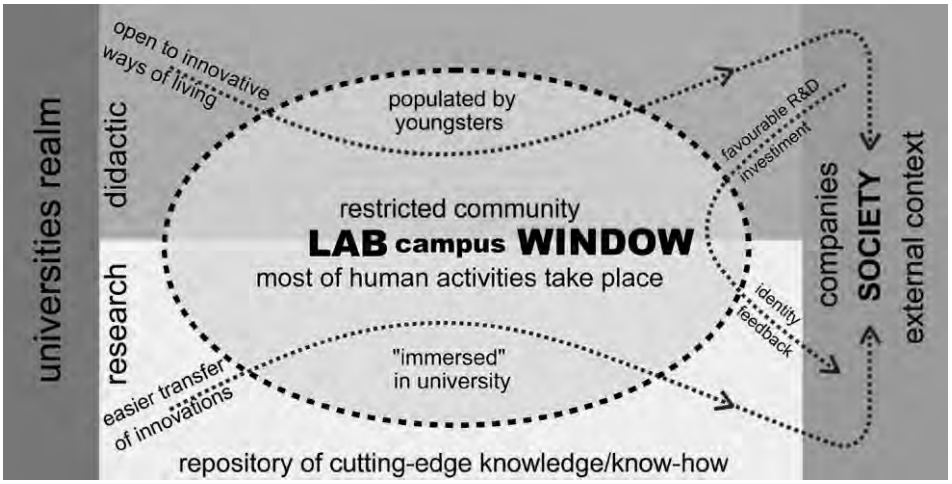
Assuming the above definition the following new approaches and skills could be highlighted for System design for sustainable energy for all:
A. "satisfaction-system" approach:
Design the energy access - possibly including the satisfaction of a particular demand (satisfaction unit) - and all its related products and services
B. "stakeholder configuration" approach:
Design the interactions of the stakeholder of the energy access system - possibly including those related to a particular "satisfaction unit"
C. "system sustainability&energy4all" approach:
Design such a stakeholder interactions (offer model) that for economic and competitive reasons continuously seek after both socio-ethical and environmentally beneficial new solution, while providing sustainable energy for all.

5. Campus: a community "lab" and "window" to design, implement and help diffuse DRE based on S.PSS model

As already anticipated, a new research hypothesis is the use of the University campuses as peculiar communities, i.e. "laboratories" and "windows" for DRE applied to S.PSS sustainable innovation.
In other words, it proposes the consideration of the university campus as a peculiar community for which it is effective to design, introduce and test advanced S.PSS as pilot projects: a community-lab to design, implement and promote sustainable solutions.
Moreover, university campuses could represent an optimum community-window because of its potential to show and disseminate the sustainable innovations and ideas to wider communities.

A university campus is a restricted community within which most of human activities take place: to study and to research, but not only, other aspects of everyday life are also present there: to sleep, to eat, and to practice sports, to relax and so on.
In this sense, we can consider them as suitable communities where sustainable innovations can be designed and tested.

Let us see now why this should be a successful context for such innovations (see Figure 3).



[Figure 3]: Scheme of forces that configure the campus as lab and window as a successful context to design and promote sustainable innovation

Every university is (or should be) a repository of society's cutting-edge knowledge production. It is a scientific community, an aggregation of articulated departments and unities dedicated to research activities (and high level education), devoted to the generation and development of knowledge, know-how and innovation whether in technological, humanistic, economic or biological areas. And this is true also for sustainability studies. That means a university campus is a community very close to research and innovation; hence, this restricted community character could make it work as a "community-laboratory" where it should be easier to transfer innovations studies and results into practice (sustainable innovations), i.e. DRE applied to S.PSS.

Furthermore, a campus is a place in great part populated by youngsters, and where often they have their first autonomous living experience. They represent a significant part of the new generation that, in principle would be more open to innovative ways of living. Hence, it should be easier to successfully introduce even innovations of a socio-cultural nature (coherent with sustainability).

In addition, university campuses could be favourable contexts in which and for which companies could decide to invest in innovation aiming at reinforcing their corporate identity, with respect to sustainability. Companies would be interested in contributing to support the implementation of innovative pilot projects, as an opportunity to invest on and profit from the development of applied research.
Because of all the above reasons a campus can be at the same time an optimum window-shop to demonstrate sustainable innovations and to disseminate the new successful ones, to be later spread to society at large.

6. Conclusion: the LeNS network framework

LeNS, the Learning Network on Sustainability is an international network aiming at the promotion of a new generation of designers (and design educators) capable to effectively contribute to the transition towards a sustainable society for all. LeNS aims at Design for Sustainability (DfS), focused on Sustainable Product-Service Systems (S.PSS) and Distributed Economies (DE) – considering both as promising models to couple environmental protection with social equity, cohesion and economic prosperity – applied in different contexts around the world.
LeNS connects a multi-polar network of Higher Education Institutions adopting and promoting a learning-by-sharing knowledge generation and dissemination, with an open and copyleft ethos. This is wahy it could be a fertile ground to discuss the possibility to futher refine and the introduce such a project.

It is here proposed to investigate within the LeNS international network the possibility and the feasibility of effectively to "using" universities campuses as "labs" to design new S.PSS applied to DRE systems.

In this perspective an experimental didactic design exercise could be proposed and then carried out (within the LeNS network). This is a multi-lateral and multi-cultural process of exchange between students and docents in design, aiming at producing knowledge transfer and a set of DRE and S.PSS ideas for the world (for a sustainable world).

In a second stage it could be designed the moving from designing and disseminating sustainable Product-Service Systems concepts, to real prototyping and testing i.e. the implementation of S.PSS&DRE pilot projects within the university's campus. In this sense, further achievable results would be the creation of sustainable ideas collection (database); a series of executive sustainable PSS projects (adaptable and replicable); some sustainable PSS prototypes in the university campus (pilot projects tested and showed).

The proposed approach assumes that Universities have to rethink themselves not only as places for advanced education but even promoters of experimental laboratories linked with new research issues for the production of new sustainable ideas and cutting-edge implementation.

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