Faculty of Design

2013

System design for sustainable energy systems in emerging an low-income contexts

Vezzoli, Carlo

Relating Systems Thinking & Design 2013
Emerging Contexts for Systemic Design
AHO – Oslo School of Architecture & Design Oslo, Norway
9th-11th October 2013

SYSTEM DESIGN FOR SUSTAINABLE ENERGY FOR ALL
The Learning Network on Sustainable energy systems EU funded project

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Learning Network on Sustainabile energy system

CONTENTS

CONTENTS

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1. DISTRIBUTED RENEWABLE ENERGY: KEY LEVERAGE FOR A SUSTAINABLE DEVELOPMENT

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source: http://www.un.org/en/events/sustainableenergyforall/index.shtml

energy is the world's largest industrial sector whose output is an essential input to almost every good and service

energy services have a profound effect on productivity, health, education, food and water security, and communication services

access to energy can contribute to reduce inequality and poverty

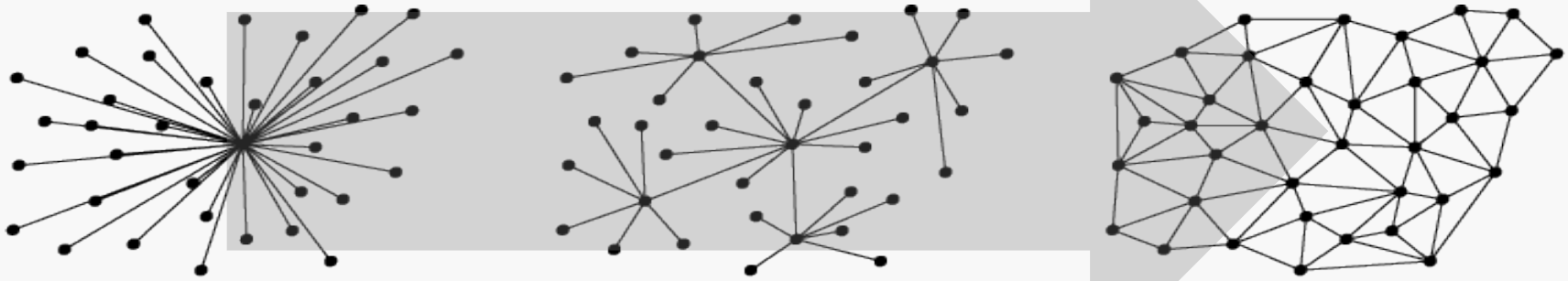
UNITED NATIONS:
"2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL"

UNITED NATIONS:
"Rio+20", 2012 SUMMIT ON SUSTAINABLE DEVELOPMENT
"SUSTAINABLE DEVELOPMENT IS NOT POSSIBLE WITHOUT SUSTAINABLE ENERGY"

DISTRIBUTED RENEWABLE ENERGY: A PROMISING MODEL FOR SUSTAINABLE DEVELOPMENT

aiming at sustainable energy for all…
… a paradigm shift is needed to lead to a new era, alternative to traditional non-renewable and centralised (e.g. fossil fuels)

non-renewable RESOURCES renewable



centralized decentralised distributed

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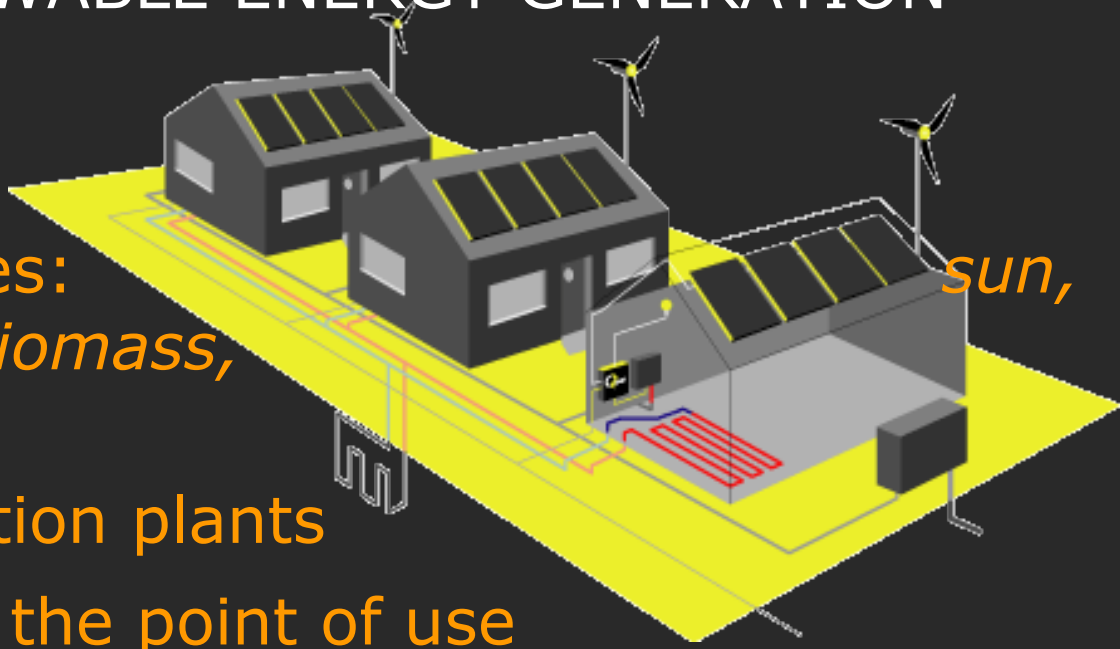
DISTRIBUTED RENEWABLE ENERGY GENERATION



. renewable resources: *sun, wind, water, biomass, geothermal energy*

. small-scale generation plants

. generation at/near the point of use

. users is the producer: individuals, small businesses and/or communities

. if connected with each other > Renewable Local Energy Network (connected with similar Network)

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SUSTAINABILITY OF DRE

environmental benefits: non-exhaustable, global warmimg reduction, lower environmental impact reduction for extraction, transformation, distribution

socioethical benefits: direct access to energy > increased participation and power to individuals and local communities > democratisation of access to energy, poverty and inequality reduction

economic benefits: potentials for reduced cost of energy, increased reliability, increased employment

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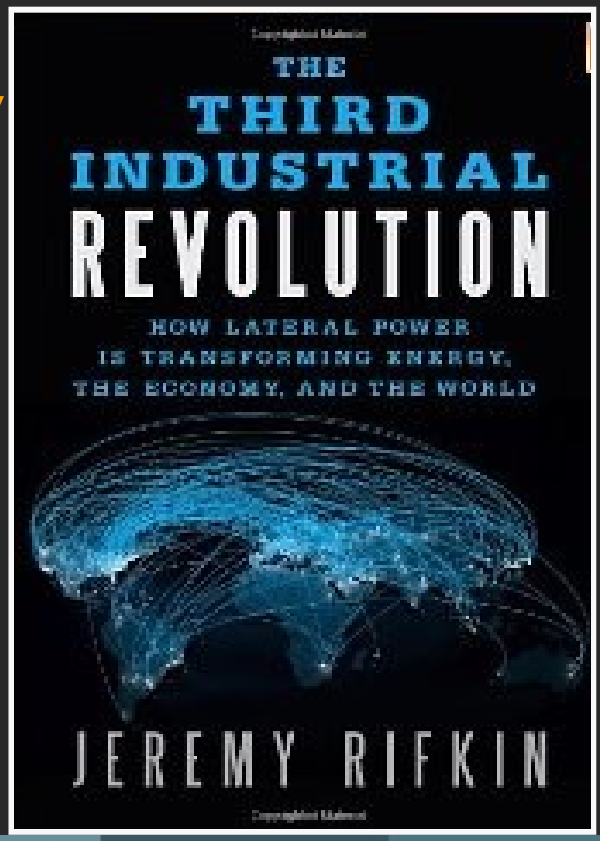
UNITED NATIONS
SUSTAINABLE ENERGY FOR ALL (SE4ALL)

aims at :
. ensuring universal access to modern energy services
. doubling the rate of improvement in energy efficiency
. DOUBLING THE SHARE OF RENEWABLE ENERGY IN THE GLOBAL ENERGY MIX BY 2030

THE THIRD INDUSTRIAL REVOLUTION

"the creation of a renewable energy regime, loaded by buildings, partially stored in the form of hydrogen, distributed via an energy internet—a smart intergrid—and connected to plug in zero emission transport, opens the door to a Third Industrial Revolution."

[Rifkin, 2011]



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2. PRODUCT-SERVICE SYSTEMS (PSS): A PROMISING MODEL FOR SUSTAINABLE DEVELOPMENT

A KEY CONTEMPORARY QUERRY:

WITHIN THE ENVIRONMENTAL AND ECONOMICAL CRISIS WHICH ARE THE OPPORTUNITIES?

DO WE KNOW ANY OFFER/BUSINESS MODELS CAPABLE OF CREATING (NEW) VALUE DECOUPLING IT FROM THE MATERIALS AND ENERGY CONSUMPTION?

> significantly reducing the environmental impact of traditional production/consumption systems?

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ECO-EFFICIENT PRODUCT-SERVICE SYSTEMS (PSS) IN INDUSTRIALIZED CONTEXTS:

AN EXAMPLE

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RICOH: PAY PER PAGE GREEN

photocopiers > COPIED PAPER

Ricoh offers a package deal and installs, maintains and collects at the end-of-life the printers and photocopiers (not owned by the customer); the customer pays for the number of delivered pages and copies.

the innovative interaction between the company and the client, make the company economic interest to provide (and design) long lasting, reusable and recyclable photocopiers, i.e. environmentally sust.

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… in terms of (social-ethical) sustainability a question has been (UNEP, 2002):

IS A PSS APPROACH APPLICABLE TO LOW/MIDDLE-INCOME CONTEXTS TOO?

IF SO, COULD IT ALSO FACILITATE (TOGHETHER WITH ECO-EFFICENCY) SOCIO-ETHICAL ENHANCEMENT IN THESE CONTEXTS?

SUSTAINABLE PRODUCT-SERVICE SYSTEMS (PSS) IN MIDDLE/LOW INCOME CONTETXS:

AN EXAMPLE

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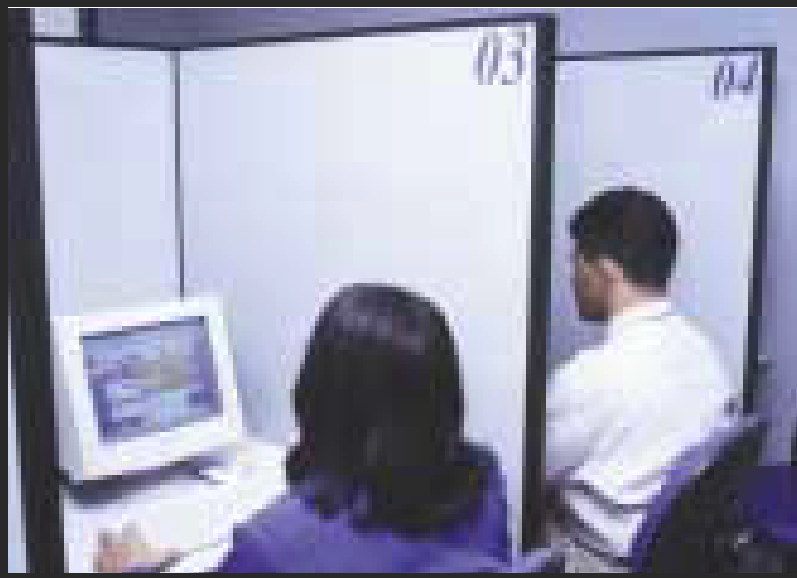
VIRTUAL STATION (OFFICES)
Fortaleza, Brasil

supply a full range of products, infrastructure (owned by virtual station) and services for a complete office. clients only pay for the periods of use; spaces are equipped with computers, printers, scanners, access to internet, TV, copiers etc; reception, personalised phone answer, answering and remittance of fax reception/transmiss.



it is environmentally sustainable because infrastructure/equipment are shared (less needed) and most efficient are used + it is socio-economically sustainable because of no need for initial investiment facilitate the set-up of small company.

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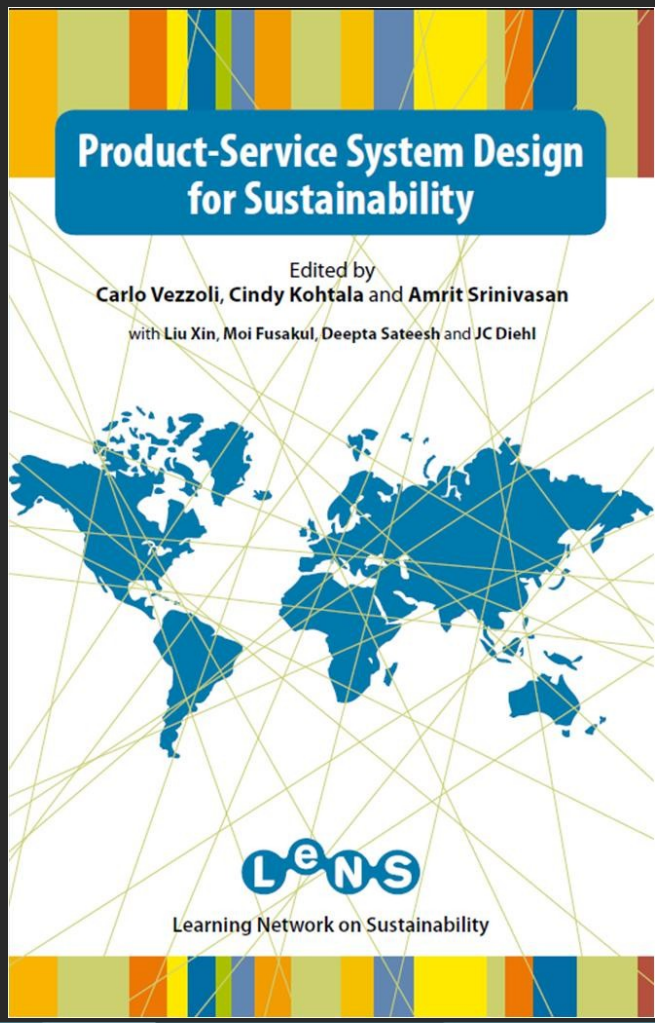
SUSTAINABLE PRODUCT-SERVICE SYSTEM: A DEFINITION

"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, where the economic and competitive interest of the providers continuously seeks environmentally and socioethically beneficial new solutions"

[to be published in 2013, by Greenleaf
english, chinese, thailandese,
pdf free of charge and in copy left www.lens.polimi.it]



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PSS: MAIN CHARACTERISTICS

ROOTED IN A SATISFACTION-BASED ECONOMIC MODEL

each offer is developed/designed and delivered in relation to a particular customer "satisfaction" (unit of satisfaction)

STAKEHOLDER INTERACTIONS-BASED INNOVATION

radical innovations, not so much as technological ones, as new interactions/partnerships between the stakeholders of a particular value (satisfaction) production system

INTRINSIC SUSTAINABILITY POTENTIAL

innovation in which is the company/companies' economic and competitive interest that may leads to environmental or socioethic benefits

3. PRODUCT-SERVICE SYSTEM DESIGN FOR SUSTAINABILITY: AN EMERGING ROLE

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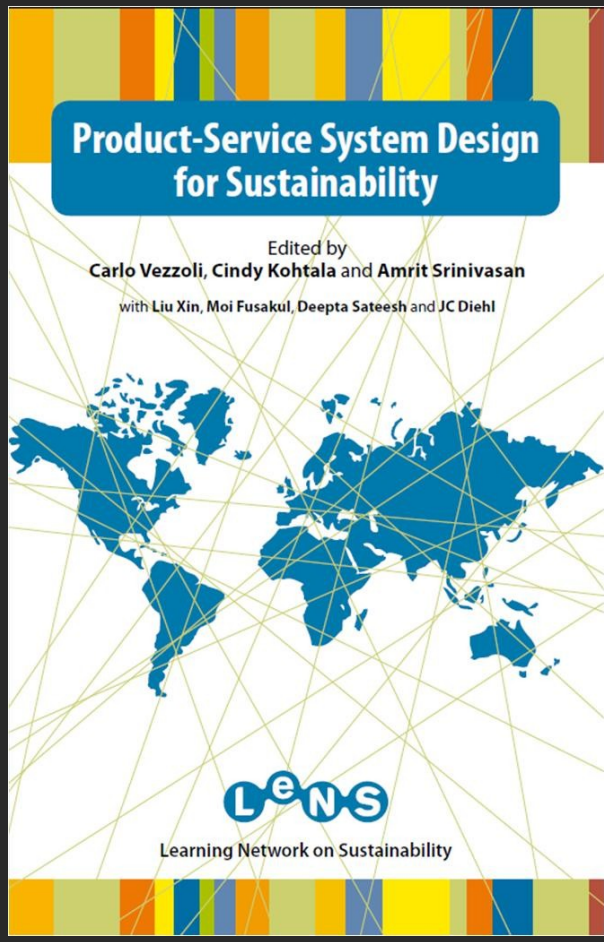
PRODUCT-SERVICE SYSTEM DESIGN FOR SUSTAINABILITY: EMERGING DEFINITION

"the design of the system of products and services that are together able to fulfil a particular customer demand (deliver a "unit of satisfaction"), based on the design of innovative interactions of the stakeholders (linked to that "satisfaction" system), where the economic and competitive interest of the providers continuously seeks environmentally and socio-ethically beneficial new solutions"

[to be published in 2013, by Greenleaf
english, chinese, thailandese,
pdf free of charge and in copy left www.lens.polimi.it]



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PSS DESIGN FOR SUSTAINABILITY: EMERGING APPROACHES AND SKILLS

A. "SATISFACTION-SYSTEM" APPROACH

design the satisfaction of a particular demand (satisfaction unit) and, thereafter, all its related products and services

B. "STAKEHOLDER CONFIGURATION" APPROACH

design the interactions of the stakeholders of a particular satisfaction-system

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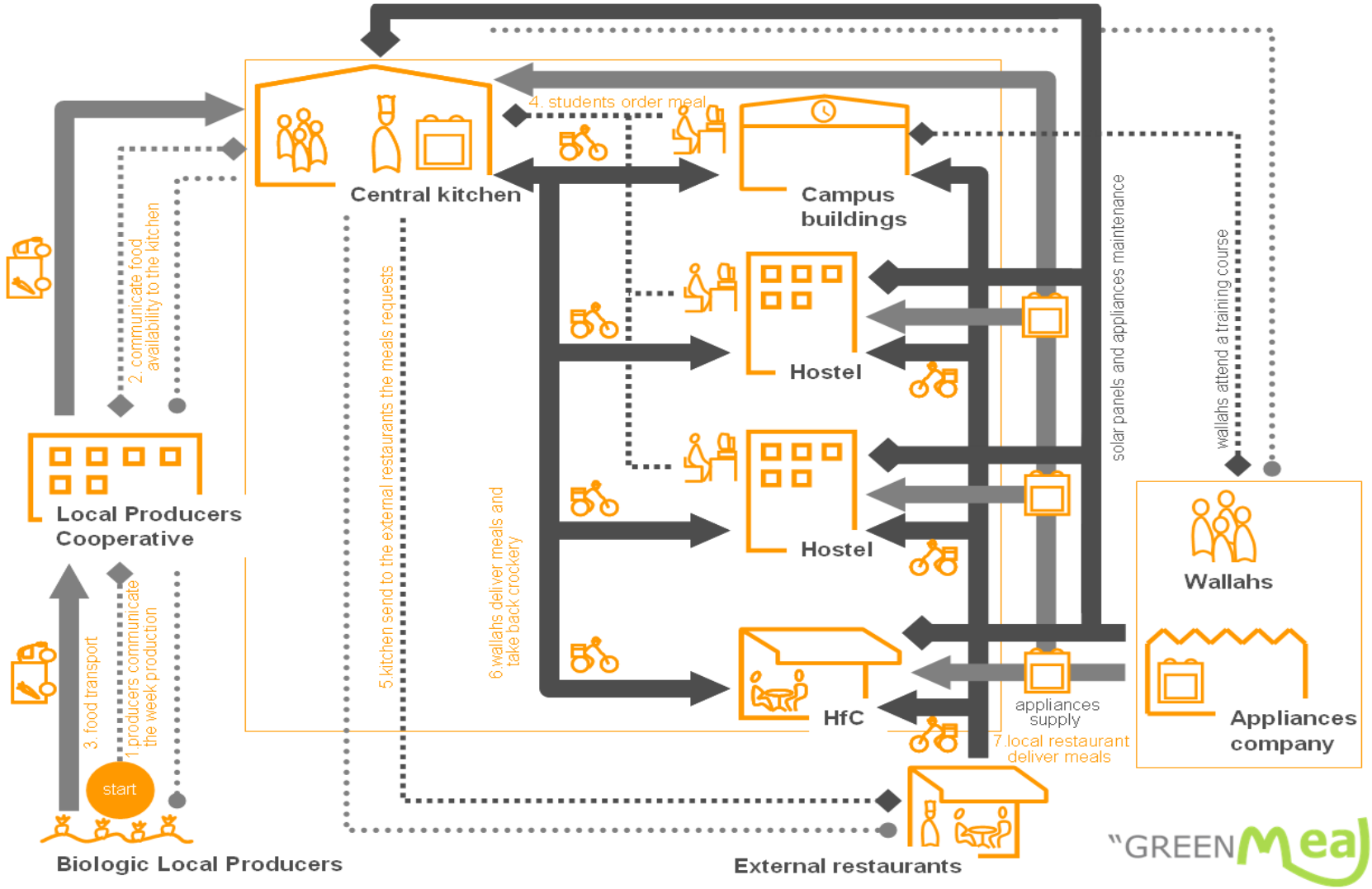
STAKEHOLDERS SYSTEM MAP

(SYSTEM DESIGN TOOL)



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PSS DESIGN FOR SUSTAINABILITY: EMERGING APPROACHES AND SKILLS

A. "SATISFACTION-SYSTEM" APPROACH

design the satisfaction of a particular demand (satisfaction unit) and, thereafter, all its related products and services

B. "STAKEHOLDER CONFIGURATION" APPROACH

design the interactions of the stakeholder of a particular satisfaction-system

C. "SYSTEM SUSTAINABILITY" APPROACH

design such a stakeholder interactions (offer model) that for economic reasons continuously seek after environmentally and socio-ethical new beneficial solutions

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NOT ALL PSS ARE ENVIRONMENTALLY AND/OR SOCIOETHICALLY SUSTAINABLE!

> CRITERIA AND GUIDELINES ARE NEEDED …

> METHODS AND TOOLS ARE NEEDED …

… to orientate design towards *such* stakeholder interactions *(offer model) that continuously seek after environmentally and/or socioethically new beneficial solutions*

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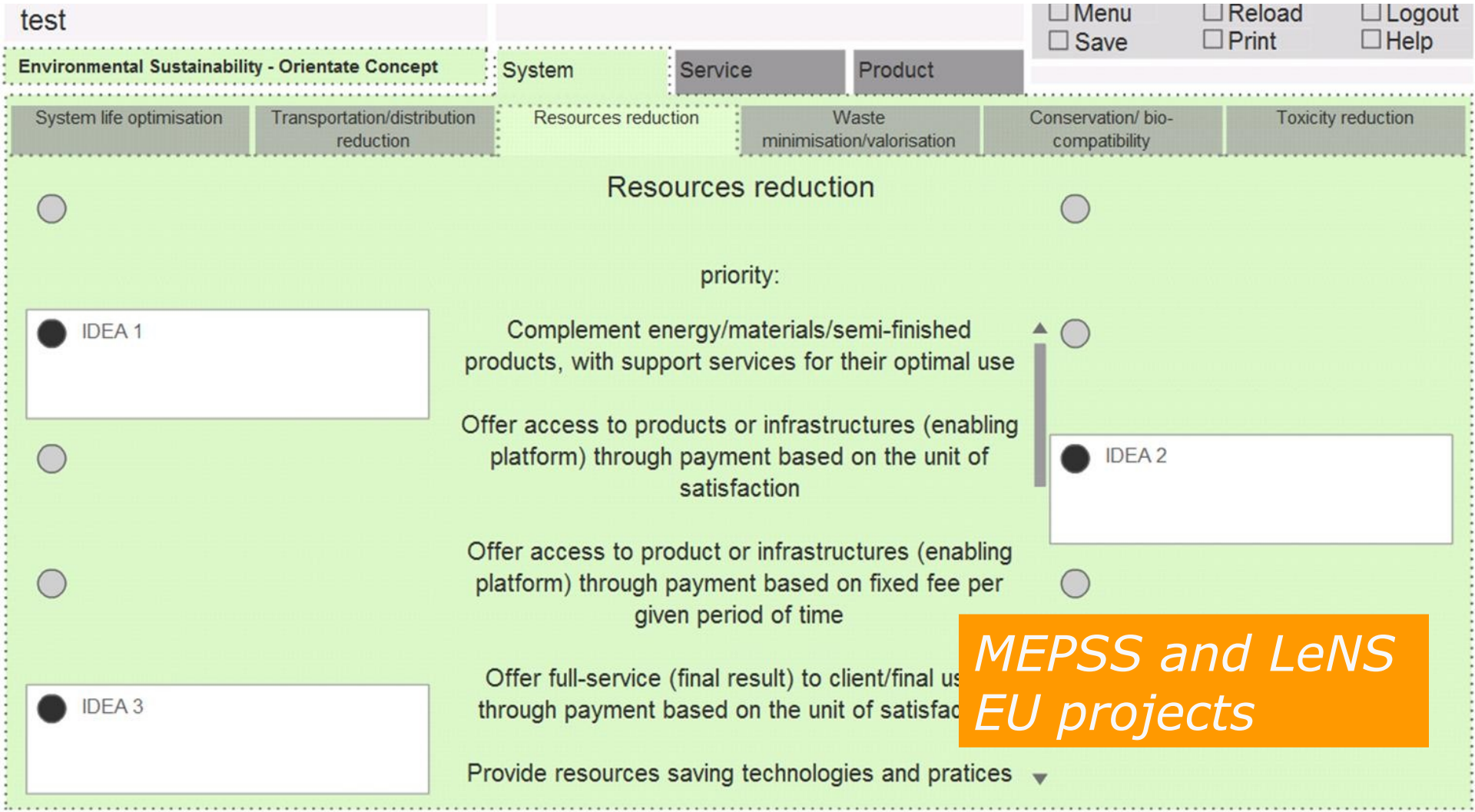
SDO SUSTAINABILITY DESIGN-ORIENTING TOOLKIT

ENVIRONMENTAL DIMENSION /
6 CRITERIA / (6) IDEA GENERATION TABLES WITH GUIDELINES (SYSTEM LEVELS)



MEPSS and LeNS EU projects

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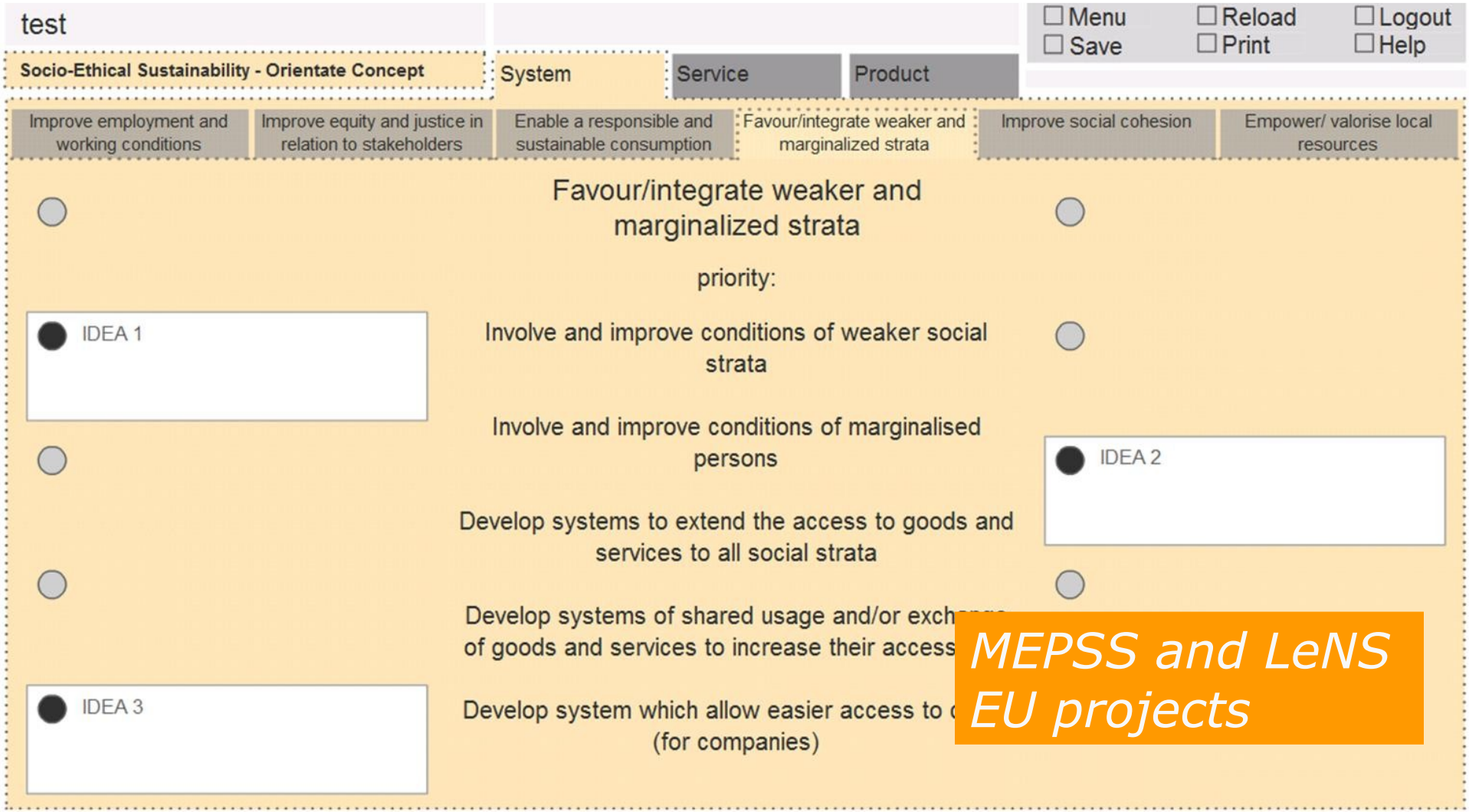
SDO SUSTAINABILITY DESIGN-ORIENTING TOOLKIT

SOCIOETHICAL DIMENSION /
6 CRITERIA / (6) IDEA GENERATION TABLES WITH GUIDELINES (SYSTEM LEVEL)



MEPSS and LeNS EU projects

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METHODS/TOOLS

some methods/tools developed to support Product-Service System design for sustainability

HiCS, Highly Customerised Solutions

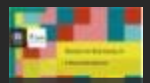
[see Manzini et al. 2004]

MEPSS, MEthodology for Product Service System development

[see van Halen et al. 2005]

SusProNet, Network on sustainable PSS development

[see Tukker &Tischner, 2006]



Design4Sustainability Step by step approach

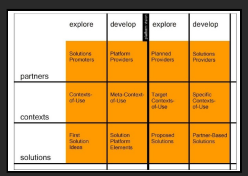
[see Tischner & Vezzoli, 2009]

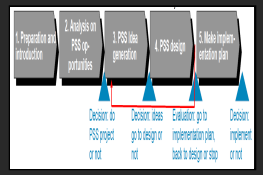
Product-Service System Design for Sustainability

[see Vezzoli et al., tbp 2013]

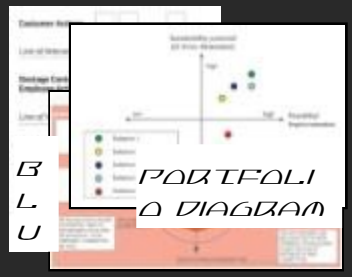
DESIGN

METHODS





TOOLS



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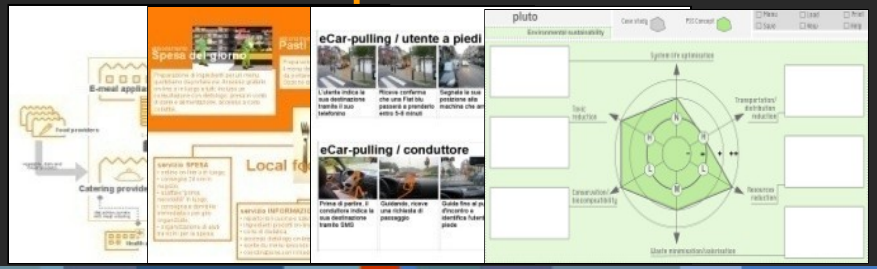
MSDS: Method for System Design for Sustainability

EU funded project, Asia-link programme

SCOPE: support design processes for the development of sustainable PSS, modular and adaptable to specific design requirements and usable in existing design processes

USERS: designer, design office, designer within a company

TOOLS: free to download at www.lens.polimi.it



. . .

MSDS PHASES/PROCESSES

STRATEGIC ANALYSIS
- ANALYSIS OF THE PROJECT PROMOTERS
- ANALYSIS OF THE REFERENCE CONTEXT
- ANALYSIS OF THE REFERENCE STRUCTURE
- ANALYSIS OF BEST PRACTICES
- DEFINITION OF SUSTAINABILITY DESIGN PRIORITIES

EXPLORING OPPORTUNITIES
- IDEAS GENERATION ORIENTED TO SUSTAINABILITY
- DEVELEPMENT OF THE SUSTAINABILITY DESIGN ORIENTING SCENARIO - VISIONS/CLUSTERS/IDEAS

SYSTEM CONCEPT DESIGN
- VISIONS, CLUSTERS AND IDEAS SELECTION
- SYSTEM CONCEPT DEVELOPMENT
- ENV., SOC. & ECON. CHECK

SYSTEM DESIGN (AND ENGIN.)
- SYSTEM DEVELOPMENT (EXECUTIVE LEVEL)
- ENV., SOC. & ECON. CHECK

COMMUNICATION
- DOCUMENTS EDITING

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MSDS MAIN TOOLS:

. Sustainability Design-Orienting toolkit (SDO)
. sustainability interaction story-spot

. *system map*
. *interaction table / story-board*
. *satisfaction offering diagram*
. *stakeholder motivation matrix*
. *solution element brief*

LEGENDA
sustainability-orienting system design tools
(other) system design tools

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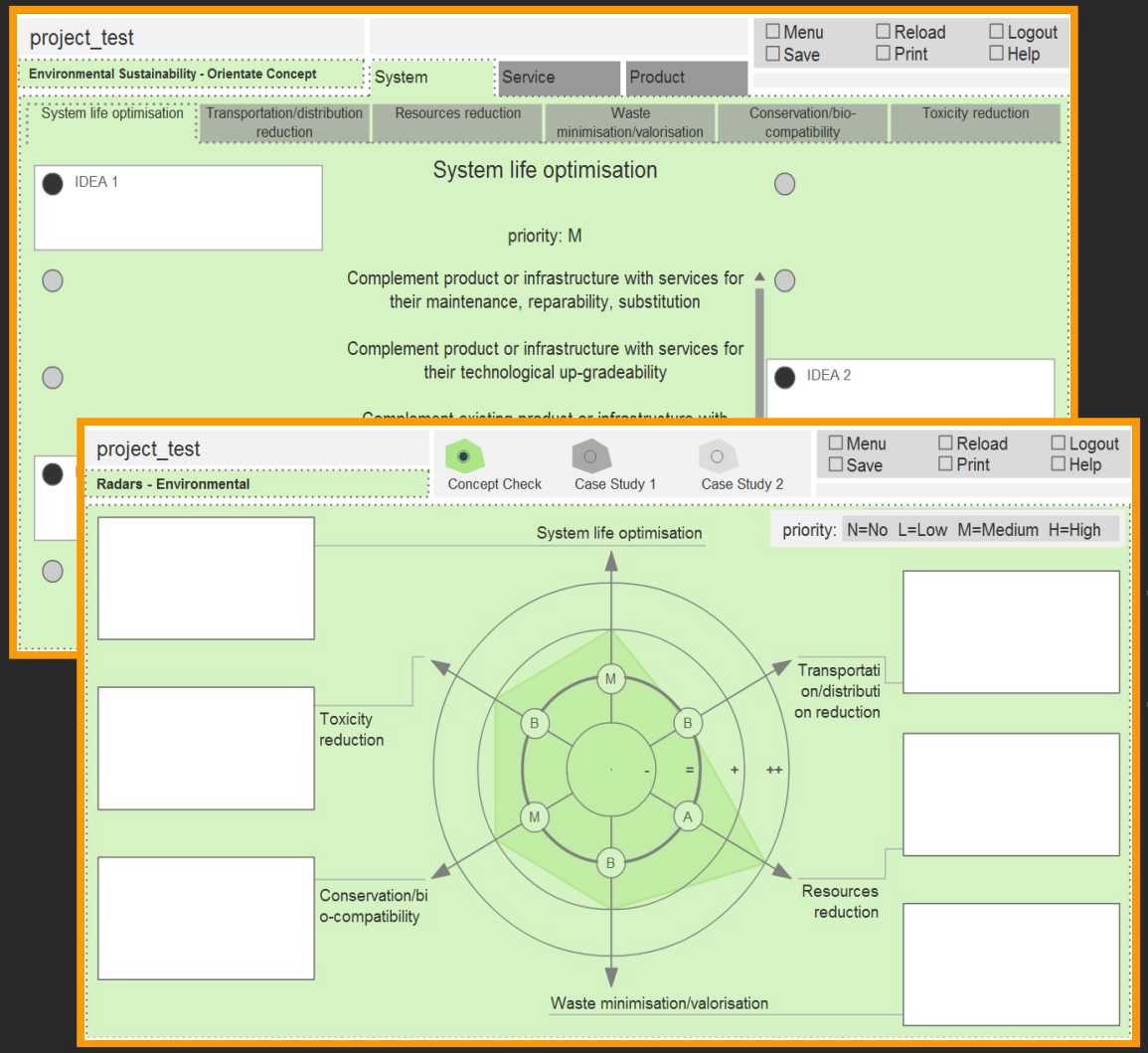
. SUSTAINABILITY DESIGN-ORIENTING (SDO)



to orientate system design process towards sustainable solutions (environmental, socio-ethical, economic)

www.lens-sdo.polimi.it

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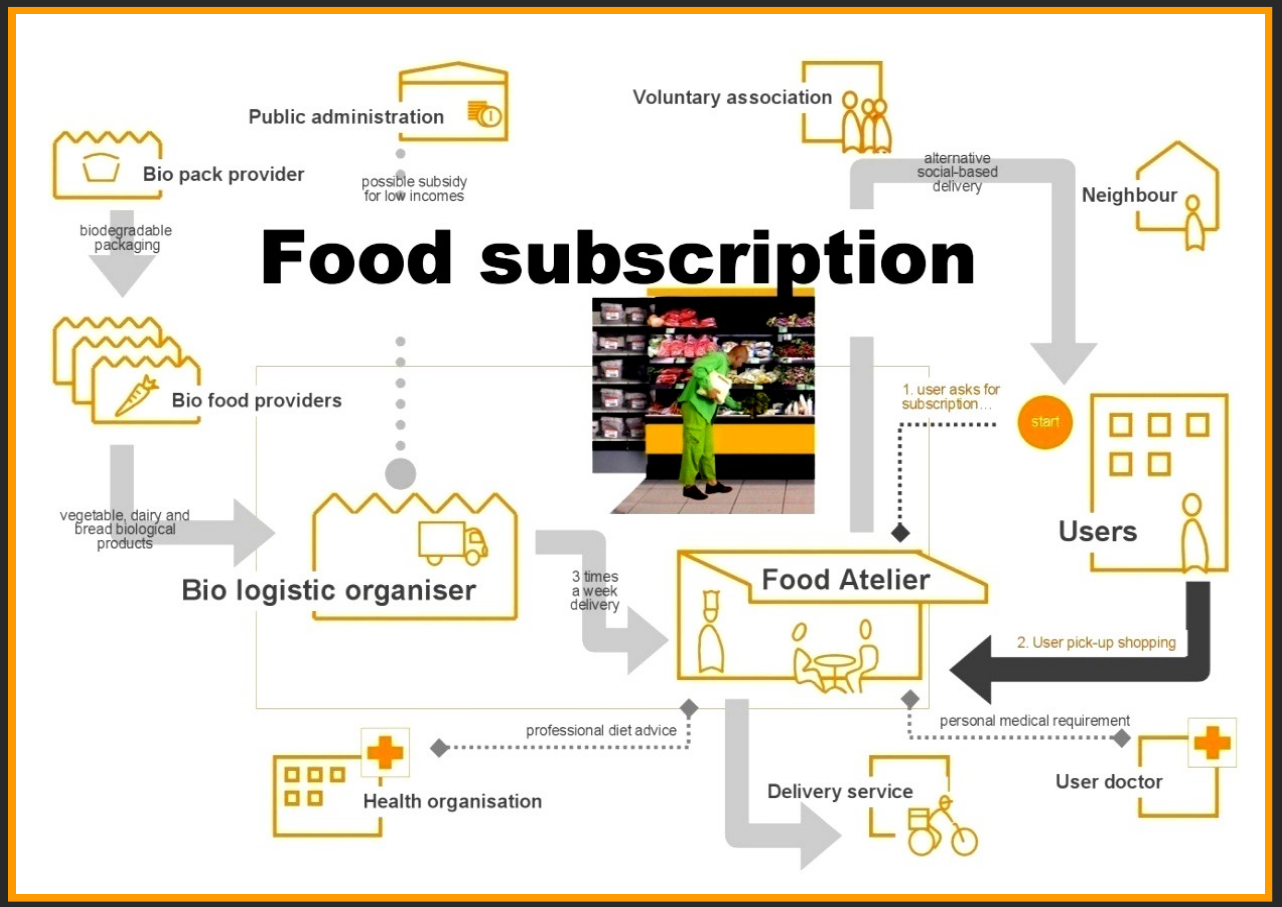
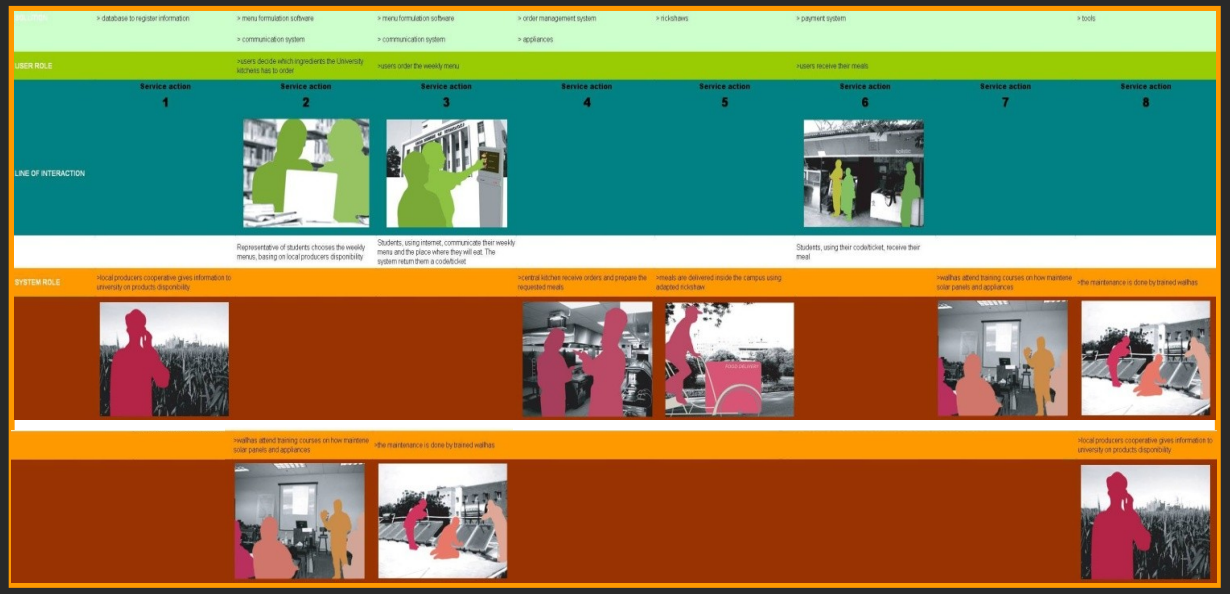
. SYSTEM MAP
(could be animated)



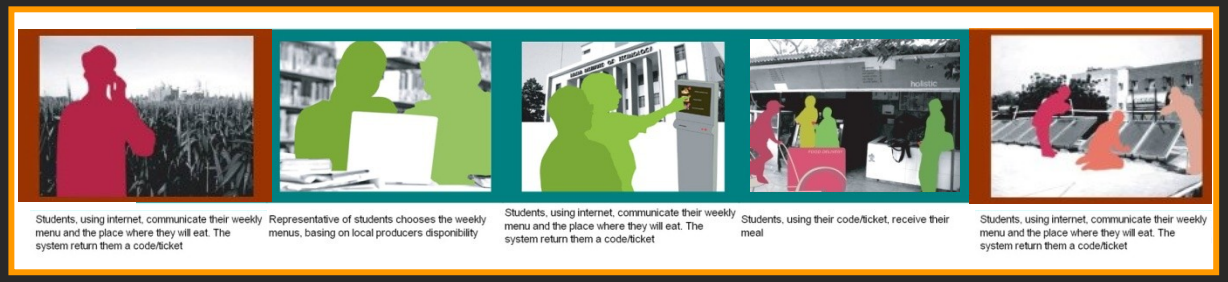
to visualise (design and co-design) the configuration of the system, describing actors involved and their interactions

. INTERACTION TABLE and STORY-BOARD (could be animated)

INTERACTION TABLE



INTERACTION STORY-BOARD



to visualise (design and co-design) the functioning of the system in time: the narratives (stories) of the front-desk (with the clients) and back-stage interactions (between other stakeholders)

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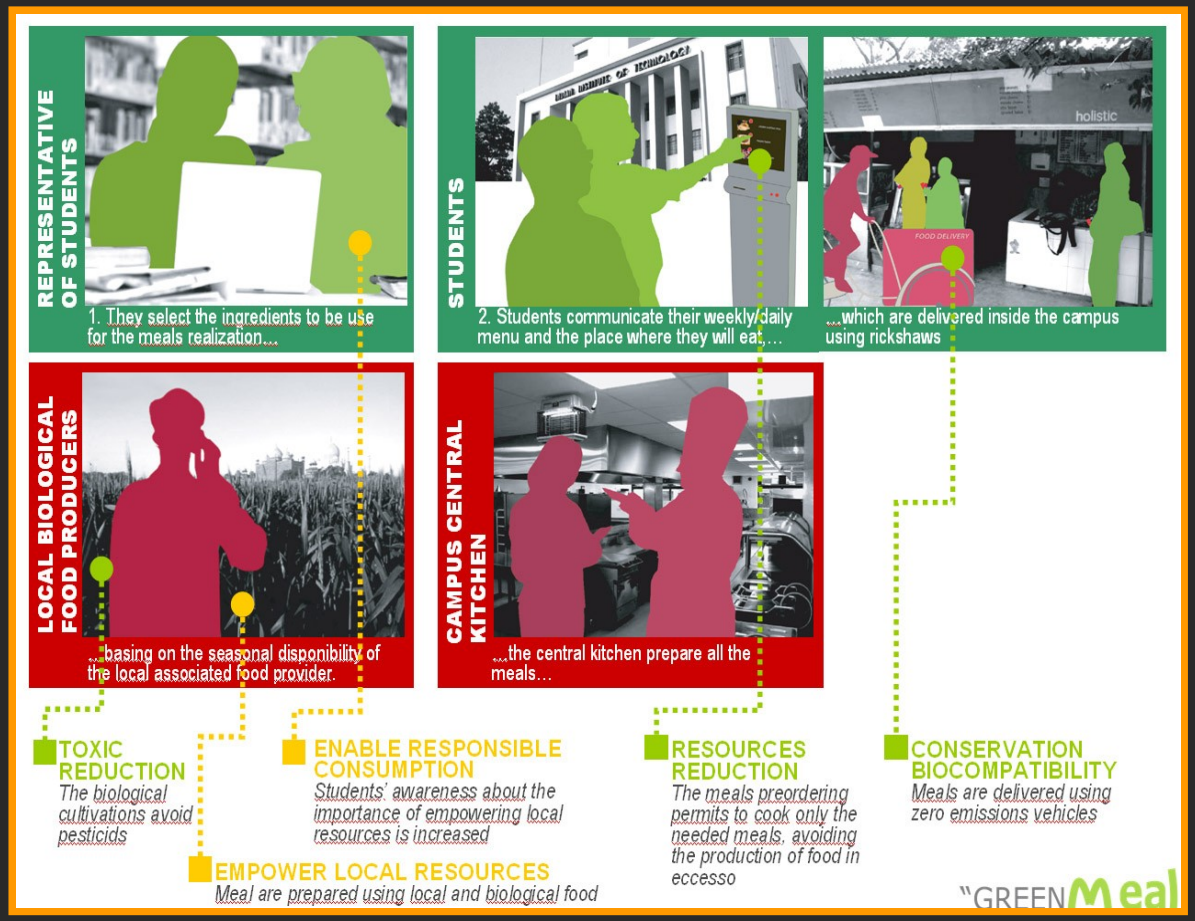
. SUSTAINABILITY INTERACTION STORY-SPOT (could be animated)



to visualise (only) key stakeholder interaction in relation to criteria of sustainability (environmental, socio-ethical, economic)

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. SATISFACTION OFFERING DIAGRAM

to visualise (design and co-design) the satisfaction offered by the system, and how this is delivered to the user/customer

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PSS DESIGN FOR SUSTAINABILITY AND MSDS IN PRACTICE

(BY DIS-POLIMI)

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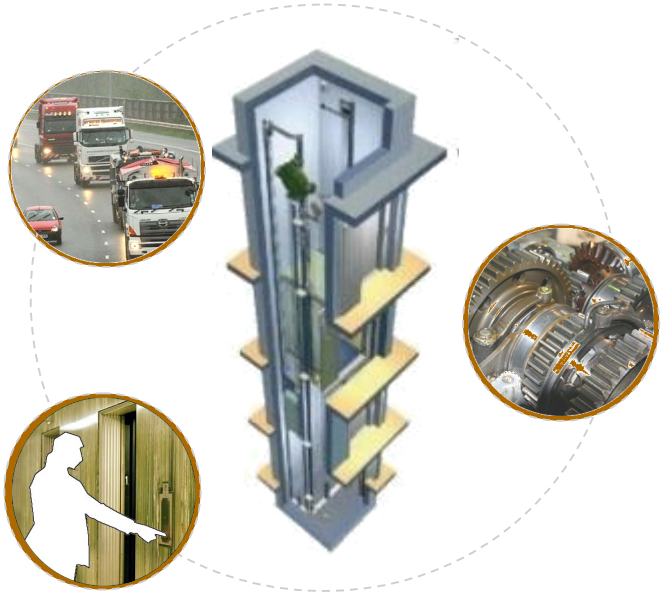


DESIGN OF ECO-EFFICIENT PSS DESIGN-ORIENTING SCENARIOS

ECO-EFFICIENT PSS CONCEPT

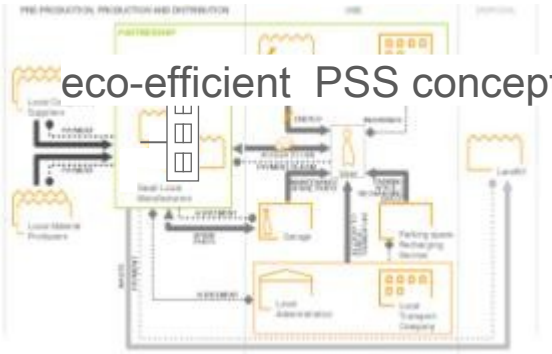
POLITECNICO DI MILANO

DIPARTIMENTO INDACO

UNITA' DI RICERCA DIS
Design e Innovazione di sistema per la Sostenibilità

commissioned by: KONE

eco-efficient design orienting scenarios elaboration



eco-efficient PSS concept design

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DESIGN OF ECO-EFFICIENT PSS SCENARIO
DESIGN OF ECO-EFFICIENT PSS CONCEPT
DESIGN OF IMPLEMENTATION STRATEGY

POLITECNICO DI MILANO

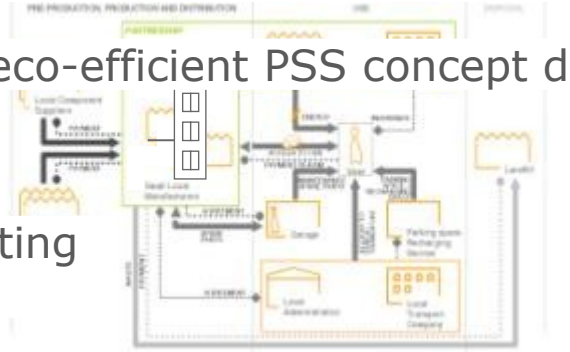
DIPARTIMENTO INDACO

UNITA' DI RICERCA DIS
Design e Innovazione di sistema per la Sostenibilità

commissioned by:

TETRA PAK

eco-efficient design orienting scenarios elaboration



eco-efficient PSS concept design

design of transition and diffusion path

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TANGO EU funded project (culture programme)

Towards A New interGenerational Openness

partners: Aalto University, Finland; Nantes A. School, France; Politecnico di Milano, Italy

Re-Made In Barona
video: off-line on-line
(3:30 sustainability)

ShareRadio (ex)change your time
video: off-line on-line
(4:00 sustainability)

CaseVerdi.net
video: off-line on-line
(3:38 sustainability)

Sun Light
video: off-line on-line
(2:53 sustainability)

Tango in Milan: proposals for sustainable Product-Service Systems promoting social inclusion and integenerational dialogue in Milan

free to view and download at www.designtango.eu

Culture Programme

Education and Culture DG

Culture

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1. *Distributed Renewable Energy (DRE): key leverage for a sustainable development*

2. *Product-Service System (PSS): promising model for a sustainable development*

4. SUSTAINABLE PRODUCT-SERVICE SYSTEM (S.PSS): A PROMISING MODEL FOR DISTRIBUTED RENEWABLE ENERGY (DRE)

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S.PSS FOR DRE IN LOW/MIDDLE INCOME CONTEXTS:
AN EXAMPLE

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SOLAR HOME KITS
electricity + lamps > light

TSSFA company offers to Brasilian rural people a solar home kits that include the hardware to generate solar energy + the installation service + products that use the electricity, e.g. lighting and electrical outlets. Customers sign a three-year service contract (all of the tangible inputs are owned by the provider).

it is environmentally sustainable because it uses the solar energy + it is socioethically sustainable because give to poor people access to useful services + it is economically sustainable because is a business for TSSFA company.

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A RESEARCH WORKING HYPOTHESIS

S.PSS APPLIED TO DRE:
SUSTAINABLE OPPORTUNITIES IN LOW/MIDDLE INCOME (ALL) CONTEXTS:

"A S.PSS approach may act as a business opportunity to facilitate the diffusion of DRE-based value production system (satisfaction system) in low and middle-income (all) contexts, as a key leverage for a sustainable development process aiming at democratizing access to resources, goods and services."

[LeNSes, EU edulink funded project, 2013-2016]

3. Product-Service System (PSS) design for Sustainability: an emerging role, the LeNS approaches

4. *Sustainable Product-Service System (S.PSS): a promising model for Distributed Renewable Energy (DRE)*

5. SYSTEM DESIGN FOR SUSTAINABLE ENERGY (FOR ALL): A DESIGN RESEARCH WORKING HYPOTHESIS OF THE LeNSes EU BIREGIONAL PROJECT

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Lerning Network on Sustainable energy system.

Multipolar and open network for curricula and lifelong learning capacity development focused on Sustainable Energy Systems Design & Engineering (SES.DE)

EU funded project 10.10.2013-9.10.2016

Brunel
Brunel University,
School of Engineering & Design,
nited Kingdom

TU Delft
Delft University of Technology, the Netherlands

Polimi
Politecnico di Milano, DESIGN Department, Italy
(coordinator)

MAK
Makerere University, Uganda
+ Local company (associate)

UONBI
University of Nairobi, Kenya
+ Local company (associate)

UOB
University of Botswana
+ Local company (associate)

CPUT
Cape Peninsula University of Technology, South Africa
+ Local company (associate)

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LeNSes OBJECTIVES

to contribute to curriculum and lifelong learning capacity development in Sustainable Energy Systems Design & Engineering (SES.DE), to favour the building up a new generation of practitioners capable of extending the access to locally-based, secure and cleaner energy services, based on the promising models of Sustainable Product-Service Systems (PSS) and Distributed Renewable Energy (DRE), and addressing equity and gender issues.

Product-Service System design for Sustainability
LeNS approach, method, tools

Distributed Renewable Energy (DRE) design and engineering

.....

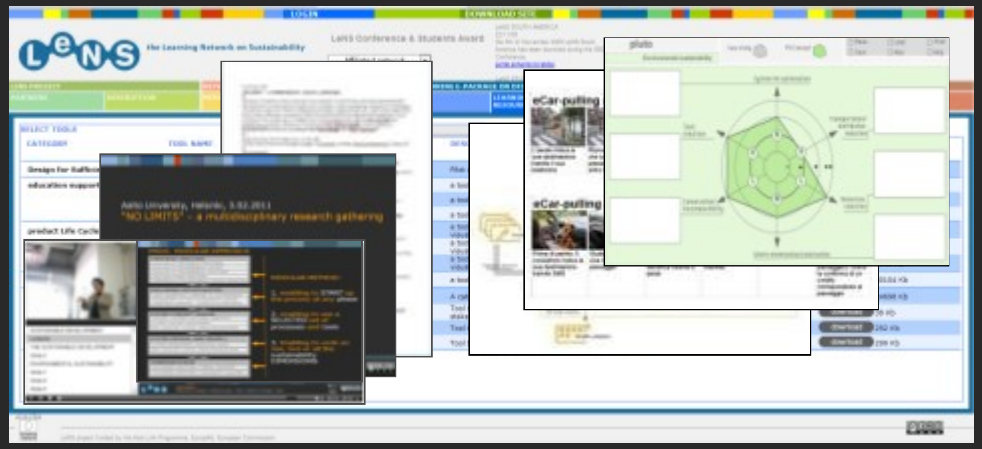
SYSTEM DESIGN FOR SUSTAINABLE ENERGY (FOR ALL)
(knowledge-base and know-how)

DISSEMINATION IN HEIS: LEARNING-BY-SHARING WITH OPEN AND COPY LEFT ETHOS

LeNSes MAIN OUTPUT:
Open Learning E-Package (OLEP) on Sustainable Energy System Design for Sustainability (SES.DE)

a web platform allowing interested teachers to freely download open source and copyleft LEARNING RESOURCES (slideshows, texts, audio-videos, etc.) and TOOLS that could be modified/remixed and reused.

LEARNING RESOURCES



TOOLS

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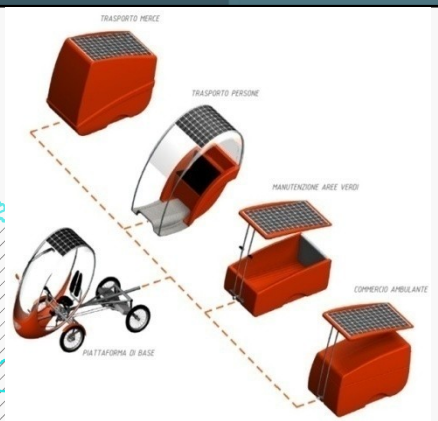
MULO SYSTEM
OPEN PROJECT



(by fabrizio ceschin)

socio-technical experiment

incubation

S.PSS detailed design

Brunell University

Politecnico di Milano

Burkina Faso

Basanti - India

Rio de Janeiro

Zambia

Cape Town

MULO is an open system project aiming at promoting sustainable mobility Product-Service System in low and middle income contexts based on the use of vehicles powered by solar, electric and human power

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SYSTEM AND PILOT PROJECT DESIGN AND IMPLEMENTATION OF A SUSTAINABLE MOBILITY SYSTEM FOR THE TRANSPORTATION OF DISABLED PEOPLE IN CAPE TOWN SUBURBS, SOUTH AFRICA

BASED ON MULO SUSTAINABLE MOBILITY OPEN PROJECT

PARTNERS

Politecnico di Milano

Cape Peninsula University of Technology

Shonaquip

Benbikes

Philiza Abafazi Bethu

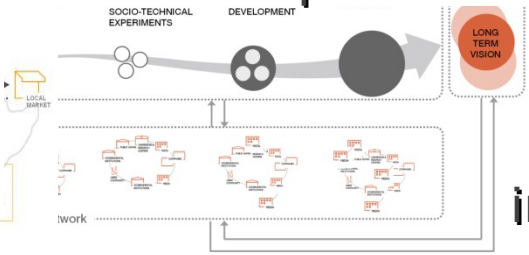
first pilot launch, Cape Town:
12 October 2011

http://muloafrica.wordpress.com

detailed product design

detailed design of service and stakaholder inetractions

design of transition path and of socio-technical experiment



pilot project implementation

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FINAL REMARKS

AN EMERGING SYSTEM DESIGN ROLE FOR SUSTAINABILITY

form
"APPROPRAITE TECHNOLOGIES" DESIGN
to
"APPROPRIATE STAKEHOLER CONFIGURATION" DESIGN, ADDRESSED TO S.PSS AND DRE

SUSTAINABILITYMAKER

PROJECT WEBSITE

funded by the European Life Programme (2013-2015)

OBJECTIVE/RESULTS

TO PROVIDE SUSTAINABLE SOLUTIONS, THROUGH AN OPEN INNOVATION, CROWD-SOURCING, CROWD-VOTING, CROWD-FUNDING ONLINE INNONATIVES PLATFORM AND MARKETPLACE.

SUSTAINABILITY MAKER CONVENTION 2013

the launch conference of the Sustainability Maker project, its Open Innovation for Sustainability platform innonatives.com and the first open challnges.
OCTOBER 15°, COLOGNE, GERMANY

www.sustainabilitymaker.org
www.innonatives.com

PARTNERS

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