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Supporting SMEs in designing Product-Service Systems applied to Distributed Renewable Energy: Design Framework and Cards

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ABSTRACT

About 1.4 billion people living at the Bottom of the Pyramid currently lack modern energy services and Distributed Renewable Energy (DRE) appears as a promising approach to provide small-scale and locally produced clean electricity in rural areas and urban slums. In these contexts, Product-Service Systems (PSS) are considered suitable types of business models to provide sustainable solutions for lower-income customers.

This research aims at investigating the application of PSS to DRE systems in Bottom of the Pyramid contexts and at providing strategic design tools to support Small and Medium Enterprises (SMEs) and practitioners in designing sustainable energy solutions. In this paper we present a Design Framework that visualises necessary elements to consider for designing successful energy solutions. The framework is combined with a set of guidelines, best practices and successful examples that have been collected from literature and case study analysis and that are organised in the form of cards.

The PSS+DRE Design Framework & Cards have been practically applied and evaluated through testing activities with companies and practitioners in South Africa and Kenya.

Key Words: Product-Service Systems, Distributed Renewable Energy, design tool, business model

1. Introduction

The lack of modern energy services represents a fundamental barrier to development for about 1.4 billion people who are currently living at the Bottom of the Pyramid (BoP). The importance of energy access for people living in these contexts is addressed in the 2030 Sustainable Development Goals (Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all) (UN 2014). BoP customers present very specific characteristics in terms of energy needs and habits, ability and willingness to pay and it has been predicted that the grid expansion is not going to be able to tackle these issues in the short-medium term (Zerriffi, 2011; Myers, 2013).

In these contexts, customers usually have low energy demand and spend about 30% of their income for cooking, heating and lighting using diverse types of dangerous and polluting fuels such as kerosene, LPG or car batteries (IFC and WRI, 2007).

Distributed Generation, defined as “*electric power generation within distribution network or on the customer’s side of the network*” (Ackerman et al. 2001), appears as a promising approach to provide energy solutions in Bottom of the Pyramid contexts (Zerriffi, 2011). In particular, by using renewable energy sources we refer to **Distributed Renewable Energy (DRE)** systems as appropriate models that can allow communities self-sufficiency, imply lower transmission costs for dispersed areas, present greater flexibility and economic resilience and show reduced environmental impact (Friebe et al. 2013; Terrado et al. 2008; Zerriffi 2011).

Although promising, DRE systems present some barriers of implementation not only in terms of technological constraints (such as limited capacity, low voltage and transmission), but mostly in relation to policy frameworks (Beck and Martinot 2004; Terrado et al. 2008) and economic hindrances. DRE systems require high capital financing for providers and these solutions must be also affordable for customers who have a very limited purchasing power. Another issue is related to the need for local maintenance and expertise in order to avoid systems failure (Schäfer et al. 2011; Terrado et al. 2008).

In these contexts, the model of **Product-Service System (PSS)** appears to be appropriate. PSSs are defined as “*a mix of tangible products and intangible services designed and combined so that they are jointly capable of fulfilling final customer needs*” (Tukker and Tischner 2006) and imply a shift from a traditional ownership-based model to offering a satisfaction-based solution (e.g. from selling lighting systems to providing an agreed amount of lux). PSSs present several benefits in terms of environmental sustainability: PSSs can decouple economic value from consumption of materials and energy (White et al., 1999; Stahel, 2000; Heiskanen and Jalas, 2000; Wong, 2001; Zaring et al. 2001; UNEP, 2002). In other words, PSS providers are economically motivated to reduce energy and material resources since their profits are linked to unit of performance delivered instead of unit of product sold.

Many authors have explored the applications of PSS in low-income and Bottom of the Pyramid contexts (Castillo et al. 2012; Jagtap and Larsson, 2013; Shafer et al., 2011; Moe and Boks, 2010) arguing that PSSs can tackle challenges where traditional business models fail in reaching customers (Shäfer et al., 2011) by offering integrated solutions instead of traditional product-focused approaches (Jagtap and Larsson, 2013).

In particular, several benefits emerge in the application of PSS models in low-income and developing markets: PSSs allow low-income customers to access products without paying upfront for their whole value (Tukker et al. 2006); these models can facilitate socio and economic development by overcoming the stages of individual consumption and ownership (Tukker and Tischner, 2004); PSS can tackle some critical BoP issues such as resource use and waste (Schafer et al., 2011).

In conclusion, the application of PSS models appears not only suitable for low-income markets but also appropriate to be combined with DRE systems in tackling the issue of energy access. Combining PSS and DRE models can in fact present several advantages: environmental ones (reduced environmental impact, increased reliability and efficiency), economic advantages (lower costs of transmission, reduced investment costs, flexibility) and socio-ethical benefits (increased energy independence, strengthening of local economies and increase of employment, customisation to users’ needs) (Vezzoli et al., 2015).

In our previous work we explored the applications of PSS to DRE, with the aim of providing supporting tools for SMEs and practitioners to design energy services for the BoP.

The first part of this research provided a new classification system and archetypal models of PSS and DRE (Emili et al., 2016(a)) and presented a new tool for mapping PSS+DRE models, exploring new opportunities and generating business concepts (Emili et al., 2016(b)).

In this paper we present the second output of this investigation: a Design Framework combined with Cards that aim at supporting the design of PSS applied to DRE. The paper is structured as follows: first we discuss the methodology adopted for this research; then the Design Framework and Cards development is presented, followed by the description of the testing activities in South Africa and Kenya. We then introduce a revised version of the Design Framework and Cards, concluding with further research activities.

2. Methodology

The methodology adopted in this research can be summarised in the following phases: 1- development of the Framework and Cards from literature review and case studies using a theory-building approach²², 2- testing activities with companies and practitioners, 3- refinement and redesign of the tool. More in details, these phases are divided in (see Fig. 1):

1. Development

- **Step 1.1:** A first review of the literature was carried out to explore PSS and DRE models and dimensions characterising these models (Emili et al., 2016 (a)). Secondly, case studies of PSS applied to DRE have been collected in order to cover, as much as possible, all variables of the identified dimensions (e.g. types of energy systems, types of providers) following the maximum variation strategy (Miles and Huberman, 1994). The common characteristic is that all cases and examples collected are applied in low-income and developing contexts, mostly in rural areas or informal urban settlements. Information used in the case studies' collection are constituted from secondary sources (e.g. scientific papers, reports, articles, companies' websites) and data have been verified using the triangulation of methods (Yin, 1994).
- **Step 1.2:** Once the PSS+DRE models have been identified and their characterising dimensions determined, the literature review focused more in detail on collecting key factors, best practices and success or failure elements of PSS applied to DRE. These have been translated in guidelines and organised in topics (e.g. "training services") that could support companies and practitioners in the design process.
- **Step 1.3:** The framework has been built considering the building blocks of a PSS applied to DRE offer.
- **Step 1.4:** All collected critical factors have been organised in the form of cards, grouped according to the design dimension (e.g. customer).

2. Testing

- **Step 2.1:** The testing activities involved companies and practitioners from South Africa and Kenya. The first testing took place during a course organised in February 2016 in collaboration with TU Delft University, Brunel University London and Cape Peninsula University of Technology, as part of the LeNSes project (Learning Network on Sustainable energy systems). The course, structured in five days of activities, aimed at applying PSS and DRE models for designing sustainable business models for energy access in low-income and developing contexts. Twelve participants from local companies and consultancies working with renewable energy, financing and business models were divided in four groups of similar interests. After having been introduced to the concept of PSS applied to DRE, the groups worked on a design brief of their choice with the aim of designing a detailed business offer and presenting it at the end of the course. Participants used the Design Framework & Cards for detailing their selected business concept and completed the session within 6 hours. They were then asked to provide feedbacks and evaluate the tool through questionnaires at the end of the course.

The second testing, which followed a similar structure, took place in Nairobi in April 2016 as part of the LeNSes project and it was organised by Brunel University London and the University of Nairobi. Ten participants from local companies and consultancies were involved in a four-day long course about designing sustainable business models for energy access in low-income contexts. Participants worked in groups choosing their own design briefs and used the Design Framework & Cards with the aim of detailing their concept of business model. The session started with an introduction on PSS and DRE, followed by a first idea generation of PSS+DRE concepts. Once the final concept has been selected, groups used the Design Framework and Cards for 5 hours-long session of concept detailing. Feedbacks and comments have been collected through questionnaires.

3. Refinement

- **Step 3.1:** Reflecting on the considerations emerged from the testing activities, a new version of the Design Framework and Cards has been developed with changes concerning format, layout and minor content changes.

²² In particular, an "analytical conceptual research" approach (Meredith, 1993; Wacker, 1998). This approach focuses on building new insights through logically developing relationships between defined concepts (in this particular case the PSS and the DRE concepts). Basically, it involves integrating research, often from a diverse background of literatures, and suggesting relationships between variables based on these existing findings.

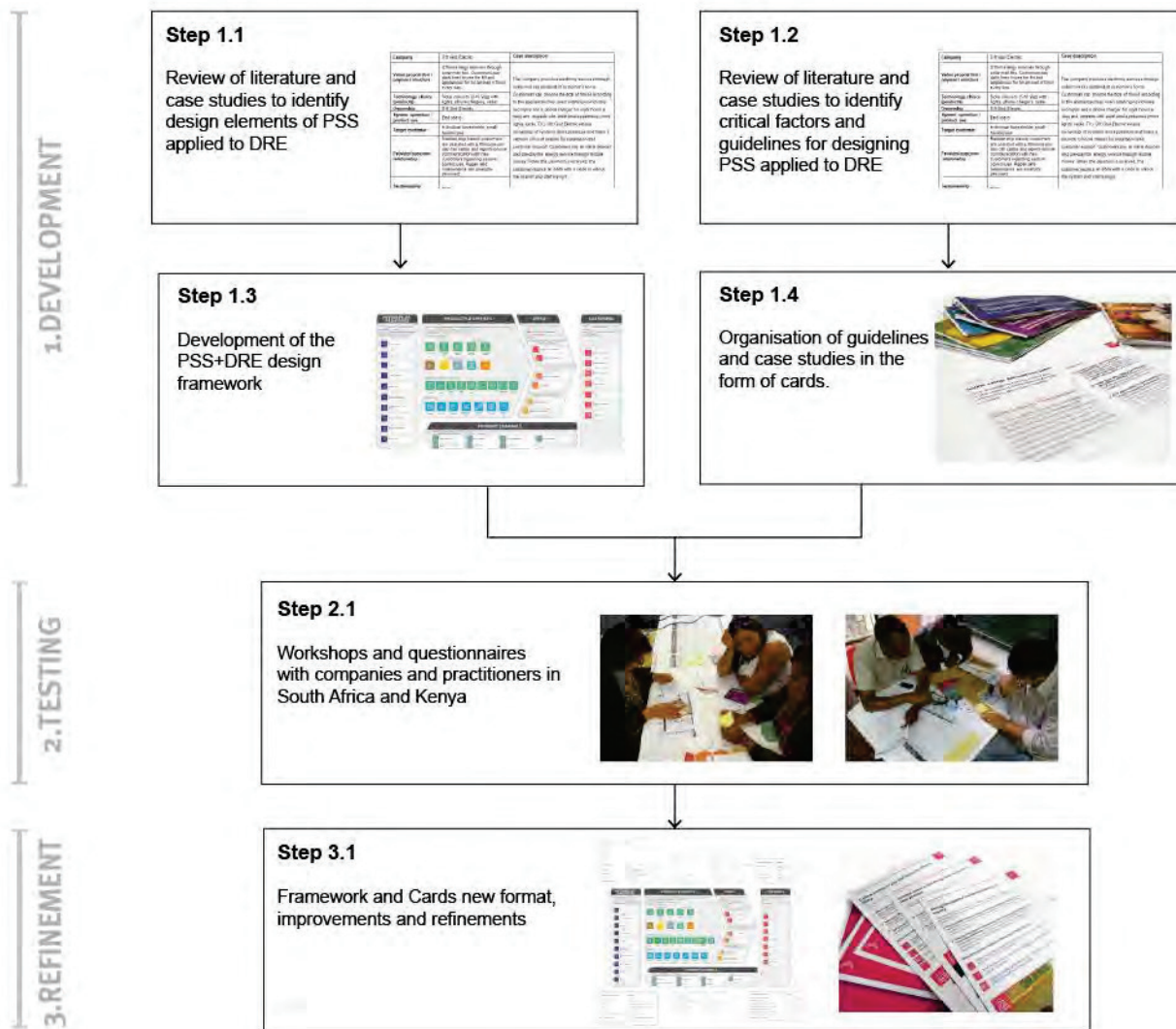


Figure 1 - Schematic of the methodology adopted in this research

3. Development of the PSS+DRE Design Framework and Cards

3.1 Development of the Design Framework

The Design Framework has been built drawing from the literature review on PSS and DRE models. As mentioned in Section 1, the first part of this research identified dimensions of PSS and DRE models with the purpose of classifying them (Emili et al., 2016 (a)). These dimensions are: *target customer, energy system, value proposition/payment structure, ownership of energy system, energy system operation, provider/customer relationship and environmental sustainability potential* (see Table 1).

Table 1 - Dimensions characterising PSS applied to DRE models

PSS+DRE Dimension	Description	Details
Energy system	Defines the connection type (stand-alone, grid-based systems) and renewable source involved (solar, wind, biomass etc.)	<u>Stand-alone system</u> : mini grid, individual energy system, charging station <u>Grid-based system</u> : isolated mini grid, connected mini grid <u>Energy sources</u> : solar, hydro, biomass, wind, human power
Value proposition / payment structure	Represents the value offered to the customer, i.e. the combination of product and services for which the customer is willing to pay.	<u>Product-oriented PSS</u> : - Pay-to-purchase with advice, training and consultancy services

		- Pay-to-purchase with additional services <u>Use-oriented PSS:</u> - Pay-to-lease - Pay-to-share/rent/pool <u>Result-oriented PSS:</u> - Pay-per-energy consumed - Pay-per-unit of satisfaction
Energy system ownership	Refers to who owns the energy system and products involved in the offer, i.e. the provider, the end user or a number of users.	Customer or provider
Energy system operation	Defines who operates the energy system.	Customer or provider
Target customer	Indicates the type of end-user (e.g. household, community, public building etc.)	Individual or community
Provider / customer relationship	Refers to the nature and intensity of interaction between the two actors and varies from transaction-based (product-oriented PSSs) to relationship-based (result-oriented PSSs) according to the responsibilities and activities performed on the product.	Transaction-based or relationship-based
Environmental sustainability potential	Refers to the PSS environmental impact, which can potentially be lower than traditional product-based business models. It generally goes from high sustainability potential in result-oriented PSSs, to low sustainability potential in product-oriented PSSs.	Low, medium or high environmental sustainability potential

Starting from the identified dimensions and following a similar structure as Osterwalder and Pigneur’s business model canvas (Osterwalder and Pigneur, 2010), the Design Framework has been organised in a series of elements or “building blocks” (Fig. 2).

Each design element includes variables that can be applied in PSS+DRE models and they are described below:

- *Network of providers.* It refers to the actors involved in providing the energy solutions and it includes private enterprise, technology manufacturer, community, local entrepreneur, Non-Governmental Organisation (NGO), Cooperative, Micro-Finance Institution (MFI), public and governmental entity, national grid supplier.
- *Products and services.* It refers to the combination of products (energy systems and energy-using products) and services offered. Energy systems include stand-alone systems (mini kit, individual energy system, charging station) and grid-based systems (isolated and connected mini-grid). In this section are also included the types of renewable energy sources used for DRE: solar, hydropower, biomass, wind or hybrid sources (i.e. combination of different renewables). In the product category are listed the appliances that can be included in the offer in combination with the energy systems (i.e. generator). This includes: lantern, lights and bulbs, battery, phone charger, radio, TV, fan, IT and computer devices.
The service category includes consultancy services (training, financing) and services provided during or at the end of the product life-cycle (installation, maintenance and repair, product upgrade, end-of-life services).
For both energy-using products and services an icon indicating “other” appears on the Design Framework. This indicates that other products or service may be added in the PSS idea generation.
- *Offer.* This element refers to the different types of PSS offer that can be applied to DRE models. Their classification is divided into: product-oriented (pay-to-purchase with training, advice and consultancy services; pay-to-purchase with additional services), use-oriented (pay-to-lease; pay-to-rent/share/pool), and result-oriented PSSs (pay-per-energy consumed; pay-per-unit of satisfaction).
- *Customer.* It refers to the type of target customers addressed in the PSS solution and includes: individual household, productive activity, local entrepreneur, public buildings, community, public and governmental entity, mix of target customers.

- *Payment channels.* This element refers to the different ways customers pay for the energy solution. It includes: cash, credit, mobile payments, scratch cards and energy credit codes, in-kind contribution, fee collection and meter reading as an activity supporting payment.

With the purpose of helping users in understanding the characteristics of each element, the Framework is provided with a series of questions that should guide the user in the design process. For example, the network of providers refers to: “Who are the actors involved in the provision of the energy solution? What are their roles and responsibilities? What partnerships can be established?” (See Fig. 3).

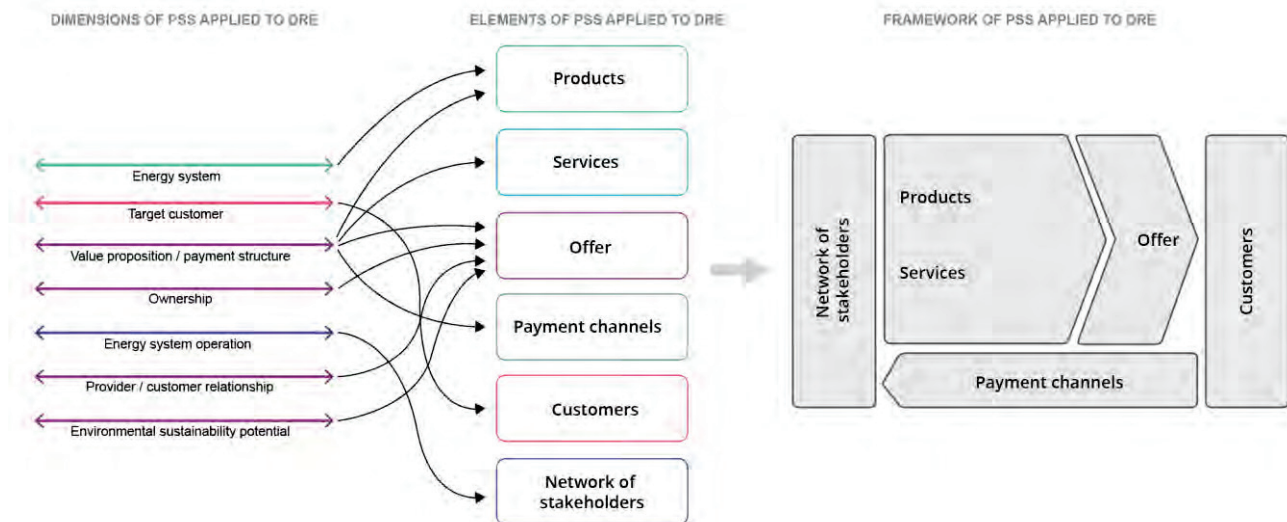


Figure 2 - Development of the Design Framework starting from PSS+DRE dimensions

3.2 Development of the Cards

The Cards have been developed with the aim of providing support to companies and practitioners in designing the PSSs applied to DRE. In particular, they aim at filling the knowledge gap about best practices, critical factors and successful examples of PSS+DRE and their practical applications in low-income and developing contexts. The process of developing these guidelines has been carried out simultaneously to the design of the Framework, by reviewing literature for each dimension characterising PSS and DRE models and extracting its critical factors, i.e. those considerations on best practices, key variables or conditions that have impact on the success or failure of PSS and DRE projects. These have been then grouped in thematic clusters. For example, as illustrated in Table 2, the review of literature led to the collection of several critical factors that have been collected under the “services” dimension and later grouped under the specific cluster “training services”.

In a second moment, these factors have been translated in the form of suggestions or tips for the design process, structured in questions. Along with the collection of critical factors, case studies have been selected to best provide an applied example of the guidelines.

The purpose of the guidelines and case studies is to facilitate the idea generation process of designing a PSS applied to DRE. For these reasons, the information collected have been organised in cards so that they could be applied in workshops and brainstorming sessions. Fig. 4 shows an example of the “Services” group of cards and their structure: the group contains 10 cards, organised according to the type of service offered and each of them is characterised by the colour indicating the group of cards (e.g. light blue), title, subtitle explaining the relevance of the card, a set of guidelines in the form of questions and explanations, a case study with a photo providing an applied example.

A total of 88 Cards have been developed and grouped according to the six design element of the Framework: network of providers, products, services, offer, customers, and payment channels (Fig. 5).

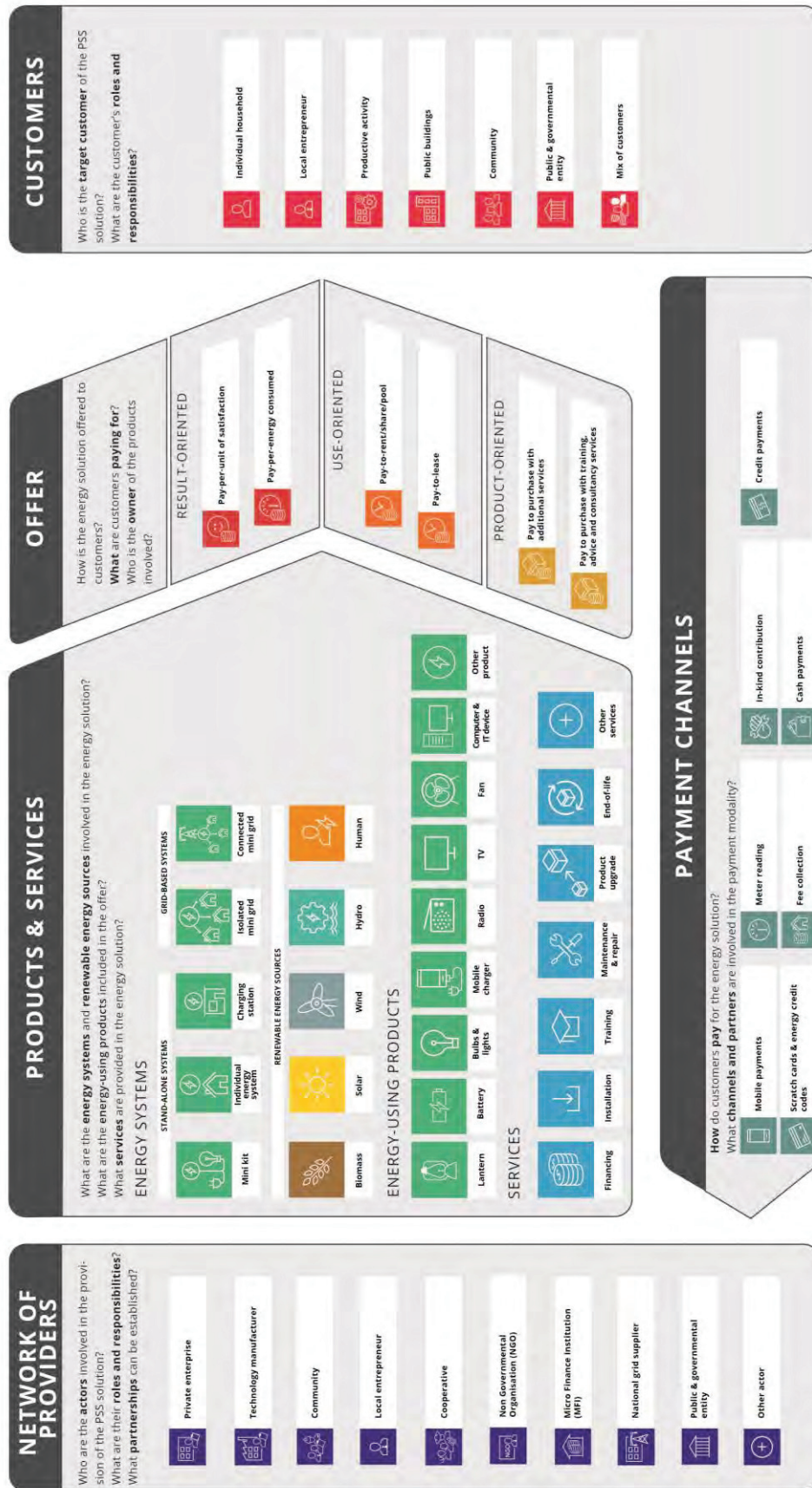


Figure 3 - First version of the Design Framework

Table 2 - Example of development of guidelines: Offer training services to end users

Dimension: services	Critical factor	Reference	Guideline	Case study/example
Training services				
Offer training to end users	It is important that customers learn capabilities and limitations of systems. User training also creates a lasting relationship between provider and customer.	Gunaratne (2002)	Providing information on optimal use and limitations of the system is essential to build an enduring provider/customer relationship and educate end-users on sustainable behaviour.	SELCO sells energy home systems and products with an inclusive service package. In order to prevent users from misuse or damage the solar systems, the company provides user training during installation of systems. Technicians, qualified by in-house training programs, explain clearly what the user should expect from the system and how to use it. A manual is provided
	Training for technicians and users through manuals and guide books should be provided in their language and should be adapted to users' and technicians' prior belief structures and knowledge	Tillmans and Schweizer-Ries (2011)	Are you communicating in the right way? Training through manuals and guide books should be provided in the users' language and should be adapted to their prior knowledge and background. Use illustrations.	
	It is important that customers learn capabilities and limitations of systems. The technical education of consumers to help them to make the best out of their systems and to ensure the project sustainability is fundamental	Gunaratne (2002); Rolland and Glania (2011)	Can you educate or provide tools to end-users to enable them in reducing energy consumption? Wise consumption can prevent system blackouts and help end-users to save money.	
	Technical problems tend to be linked to overuse of systems and this happens because of a lack of understanding of the limits of the system. Regular visits of technicians would facilitate the learning process	Lemaire (2009)	Why not coupling installation with training services? You can provide end-user training about product use, limitations and care during the installation of the system. If a maintenance service is provided, technicians can also train end users during regular visits.	



Service	Card number and title	Case study / example
TRAINING	1- Offer training to end-users	SELCO, India Sri Lanka Vietnam
	2- Offer training to local entrepreneurs	Mobisol, Kenya and Tanzania
	3- Offer training to local technicians	Grameen Shakti, Bangladesh
	4- Offer training to local communities	Practical Action, Peru
FINANCING	5- Offer microcredit to end-users and entrepreneurs	SEWA and SELCO, India
INSTALLATION	6- Offer installation services	The Sun Shines For All, Brasil
MAINTENANCE & REPAIR	7- Offer maintenance and repair services	DESI Power, India
PRODUCT UPGRADE	8- Offer product upgrades	Azuri Technologies, Kenya
END-OF-LIFE	9, 10- Offer end-of-life services	Steama, Remba Island Kenya Sunlabob, Laos

card

Front

Back

A Case study / example
B Card group
C Card icon
D Title
E Subtitle / explanation
F Guidelines

Figure 4 - Services' list of cards and an example of card's structure



Figure 5 – Groups of Cards for each design element and corresponding list of content

3.3 Applications of the PSS+DRE Design Framework and Cards

The Design Framework and Cards aim at supporting the design process of PSS+DRE and they have been developed to be used by SMEs and practitioners as a reference when detailing their own business model. The Framework and Cards are thought to be used in combination with an “empty” framework canvas to be filled during idea generation sessions (Fig. 6). The tool (Framework+cards+canvas) can be used in several ways, according to the needs and

knowledge of its users. For example, a company can start with a previously developed a business concept and then use the tool to detail its concept. Another application emerges when a company only wants to focus on one specific aspect of the energy provision (e.g. payment channel) and therefore can search for inspiration among the selected group of cards and generate ideas on one design element. Applications of the tool are discussed more in details in the following section.

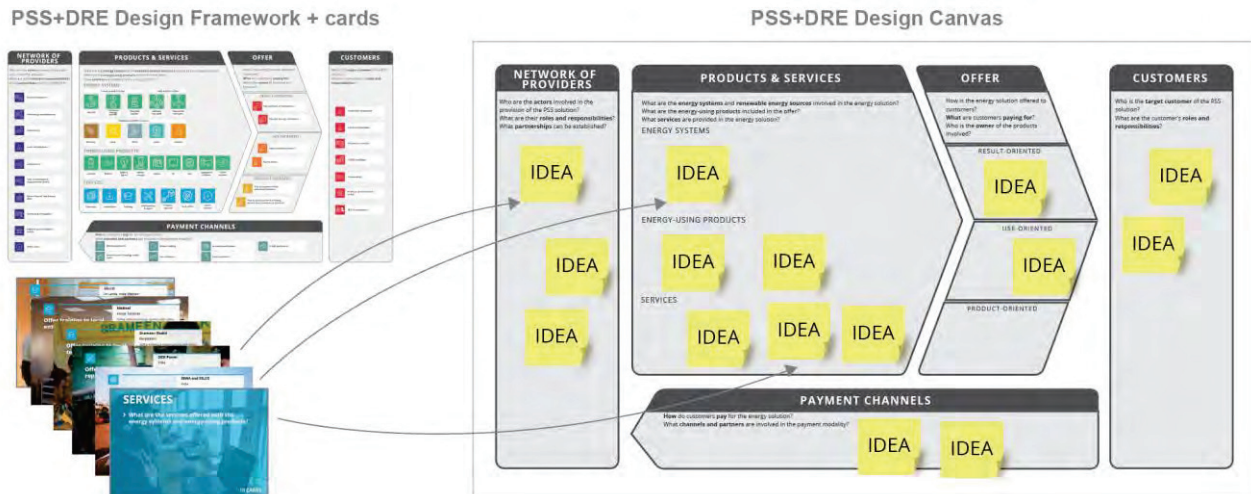


Figure 6 - Design Framework and Cards combined with the canvas for positioning ideas

4. Testing activities

The aim of the testing activities was to evaluate the application of the Design Framework and Cards as a tool for supporting the design of PSS applied to DRE.

As anticipated in the methodology section, participants (listed in Table 3) were divided in groups and used the Design Framework and Cards to generate ideas for their own chosen business offer and for detailing all aspects of the energy solution. The session aimed at testing the applications of the tool and at evaluating its usability and usefulness in the design process.

4.1 Testing the ease of use

A first aspect to be tested was the usability and ease of use of the Design Framework and Cards, i.e. that the tool can be clearly understood and that the combination of cards and framework is easy to apply.

Participants were asked to rate the clearness of the Design Framework and the content of the Cards, meaning that the elements of the framework and their relations are clear and the guidelines and case studies are easy to be understood. Most participants from both testing activities found the framework and the design questions for each element to be clear (average score 4.3 and 4.4 out of 5) and the content of cards easy to be understood (average score 4.5).

Another aspect to evaluate was related to the appropriateness of the layout and format of the cards in relation to its content. Participants were asked to give rating to the process of browsing cards and looking for information and to provide comments about their layout. Most participants rated the layout appropriate for its content (64% rated 5=very good, 36% rated 4=good) and the process of looking for information and browsing cards easy to be carried out (average rating 4.5). Some participants highlighted the need of more time to getting familiar with the cards (*“Very clear but takes time to fully understand”*), considering the high amount of information provided and suggested a larger format for the cards to reduce their volume (*“too bulky to go through at an inspectional rate”*; *“use a booklet or big foldable sheet”*).

4.2 Testing the usefulness

Visualising all elements of PSS applied to DRE. The first purpose of the Design Framework is to visualise all elements needed in the design of a PSS applied to DRE. Each group participating in the workshops completed the

idea generation by covering all elements of the framework (an example from Fig. 7). Participants have commended the use of the framework as a tool that “works very well” and “it is a good condensed business tool”.

Table 3- List of participants in the testing sessions

Testing activities in Cape Town	
Firm type and main business	Number of participants and position
Consultancy – energy	1, energy management engineer
Consultancy – business models, circular economy	1, founder and CEO
Consultancy – business models	1, consultant
Consultancy – business models, recruitment	1, director
Consultancy – energy	1, quality manager
Consultancy – energy and financing	3 -
Academic – engineering	1, lecturer and researcher
Consultancy – engineering, biomass energy	1, consultant
Company – Energy management and solar appliances	2: technical engineer, manager
Testing activities in Nairobi	
Firm type and main business	Number of participants and position
Consultancy – energy access	1, consultant
Consultancy – energy, business models	1, CEO
Consultancy - energy	1, consultant
Company – solar systems	1, HSE advisor
Company - cookstoves	1, director
Company – energy	1, managing partner
Company - energy	1, chief engineer quality
Company – energy, cookstoves	1, business unit director
Company – training, cookstoves	1, managing director
Company – solar systems	1, technical manager

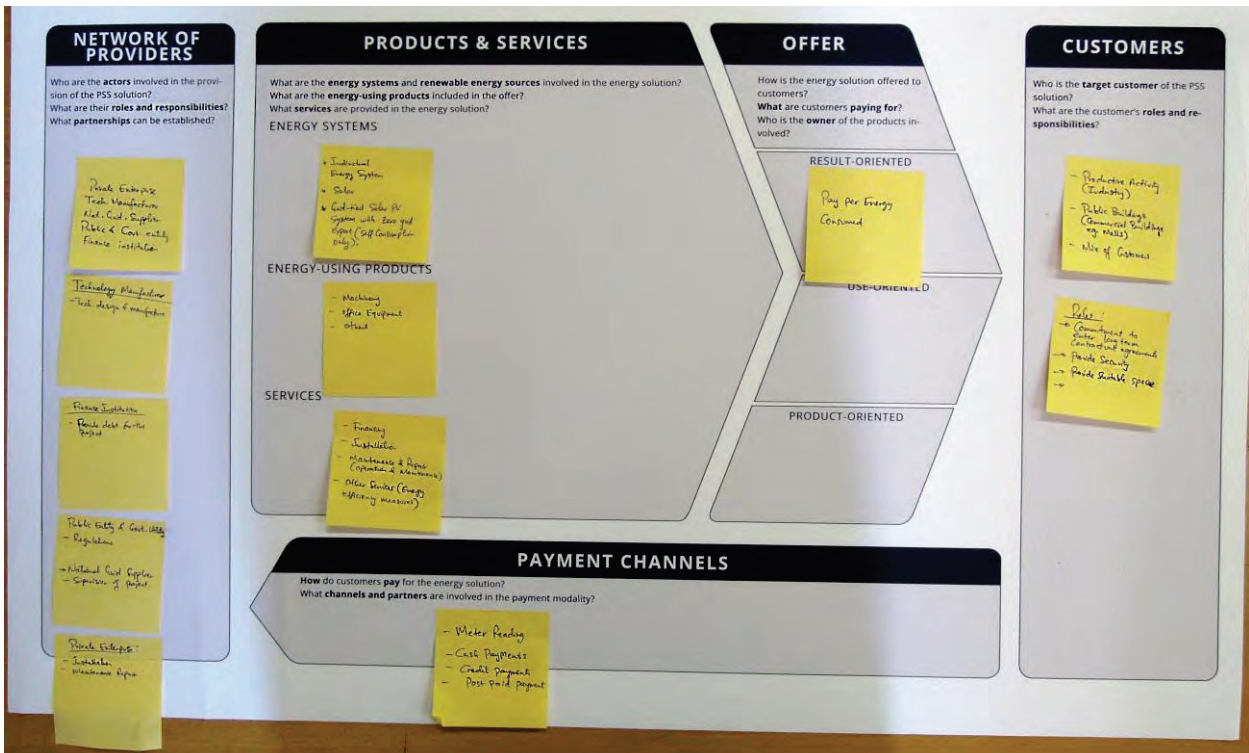


Figure 7- Result of the workshop: the Design Framework completed with the idea generation

Support the generation of ideas. The guidelines on the Cards and the case studies are intended to be used as inspiration and support for the idea generation of PSS+DRE. Participants highly commended this application of the tool and some stated that “*the cards were impressive, well-researched and well-summarised. The pictures on the cards also helped in visualisation of the case studies*”, “*the cards help jog one’s mind and thus help generate ideas*”, “*cards content was great*” and “*guidelines are useful*”. In particular, participants highly rated the usefulness of guidelines to support the generation of ideas (45% rated 4 and 55% rated 5), and the majority of them (62%) affirmed that the case studies were useful to gather inspiration for their business model.

Table 4 - Results from the questionnaires

<u>DESIGN FRAMEWORK</u>						
Testing the ease of use						
Question	1=very poor	2=poor	3=sufficient	4=good	5=very good	Avg.
1. To what extent is the framework clear (i.e. the various elements of the framework, and their relations, are clear)?	-	-	3 (14%)	9 (41%)	10 (45%)	4.3
2. To what extent are the design questions (for each design element of the framework) clear?	-	-	1 (5%)	10 (45%)	11(50%)	4.4
<u>CARDS</u>						
Testing the ease of use						
Question	1=very poor	2=poor	3=sufficient	4=good	5=very good	Avg.
1. To what extent is the content of the cards clear, i.e. the guidelines and case studies are easy to understand?	-	-	1 (5%)	7 (32%)	14 (63%)	4.5
2. To what extents are the cards easy to be used (e.g. looking for information, browsing cards)?	-	-	1 (5%)	8 (36%)	13 (59%)	4.5
3. To what extent is the layout of the cards appropriate to its content?	-	-	-	8 (36%)	14 (64%)	4.6
Testing the usefulness						
4. The guidelines on the cards are intended to be used to support the generation of ideas. To what extent are the guidelines contributing to the achievement of this objective?	-	-	-	10 (45%)	12 (55%)	4.5
5. The case studies in the cards are intended to be used as inspiration for generating ideas. To what extent are the case studies contributing to the achievement of this objective?	-	-	-	8 (38%)	13 (62%)	4.5



Figure 8 - Companies using the Design Framework and Guidelines in Nairobi (left) and Cape Town (right)

5. New version of the PSS+DRE Design Framework and Cards

The testing activities with companies and practitioners led to consider some improvements and adjustments in the tool. In details the following changes have been made considering suggestions and comments made by companies and practitioners:

Design Framework:

- Addition of hybrid systems in the product category;
- Specification of “meter reading” as “activity supporting payment” among payment channels;
- Inclusion of list of guidelines on the Framework itself.

Cards:

- New format: A5 portrait orientation, multiple cards from same category collected in foldable sheets;
- New layout: combination of guidelines and case study in the same page;
- Inclusion of geographic area of case studies (i.e. South America, South Asia, South East Asia, Africa).

The new version of the Design Framework and Cards is illustrated in Fig 10 and 11.

6. Conclusions and further research activities

The PSS+DRE Design Framework and Cards is presented as a strategic tool for supporting the design process of PSS applied to DRE. The Design Framework visualises all elements of a PSS+DRE offer and it is combined with cards collecting guidelines, critical factors and case studies that aim at supporting the idea generation session. The tool has been tested and evaluated with companies and practitioners in South Africa and Kenya and the testing activities led to its refined version. Further research activities will aim at evaluating the format and layout from a design perspective and at testing the tool’s completeness and usefulness from a content point of view involving energy and PSS academics and experts.

7. Acknowledgements

This research is framed within the LeNSes project (Learning Network for Sustainable energy systems). The authors are grateful to the University of Nairobi, Cape Peninsula University of Technology and TU Delft University for the support in organising and delivering the courses during which the testing activities took place.



SERVICES - Training

Offer training to end users

Providing information on optimal use and limitations of the system is essential to build a enduring provider/customer relationship and educate end-users on sustainable behaviour.

- Why not coupling installation with training services? You can provide end-user training about product use, limitations and care during the installation of the system. If a maintenance service is provided, technicians can also train end users during regular visits.
- Are you communicating in the right way? Training through manuals and guide books should be provided in the users' language and should be adapted to their prior knowledge and background. Use illustrations.
- Can you educate or provide tools to end-users to enable them in reducing energy consumption? Wise consumption can prevent system blockouts and help end users to save money.

CASE STUDY
South East Asia

SELCO
Sri Lanka, India, Vietnam

Selling individual energy systems with advice and training services.

SELCO sells energy home systems and products with an inclusive service package. In order to prevent users from misuse or damage the solar systems, the company provides user training during installation of systems. Technicians, qualified by in-house training programs, explain clearly what the user should expect from the system and how to use it. A manual is provided.

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SERVICES - Training

Offer training to local entrepreneurs

Establish a network of trained technicians with our provider network and help services to local customers.

- Can you train local companies to commercial energy products? Companies in the area can be trained to provide services to local customers. This can be done through a training program.
- Can you offer energy equipment and services to local entrepreneurs? Local entrepreneurs can be trained to provide services to local customers. This can be done through a training program.

CASE STUDY
South East Asia

Wahid
Nepal, Timor

Offering individual energy systems and services to local customers.

The company will offer home systems and services to local customers. This can be done through a training program. The company will offer home systems and services to local customers. This can be done through a training program.

SERVICES - Training

Offer training to local technicians

Establish a network of trained technicians with our provider network and help services to local customers.

- Can you identify the most recurring technical problems challenge? Identify the most common technical problems and offer training to local technicians.
- Can you differentiate your training program? Local technicians can be trained to provide services to local customers. This can be done through a training program.

CASE STUDY
South East Asia

Government District
Singapore

Offering individual energy systems and services to local customers.

The company will offer home systems and services to local customers. This can be done through a training program. The company will offer home systems and services to local customers. This can be done through a training program.

SERVICES - Training

Offer training to local communities

Establish a network of trained technicians with our provider network and help services to local customers.

- Can you identify the most recurring technical problems challenge? Identify the most common technical problems and offer training to local technicians.
- Can you differentiate your training program? Local technicians can be trained to provide services to local customers. This can be done through a training program.

CASE STUDY
South East Asia

Practical Action
New

Offering individual energy systems and services to local customers.

The company will offer home systems and services to local customers. This can be done through a training program. The company will offer home systems and services to local customers. This can be done through a training program.

Figure 10 - The new cards' layout and an example of folding card (training services)

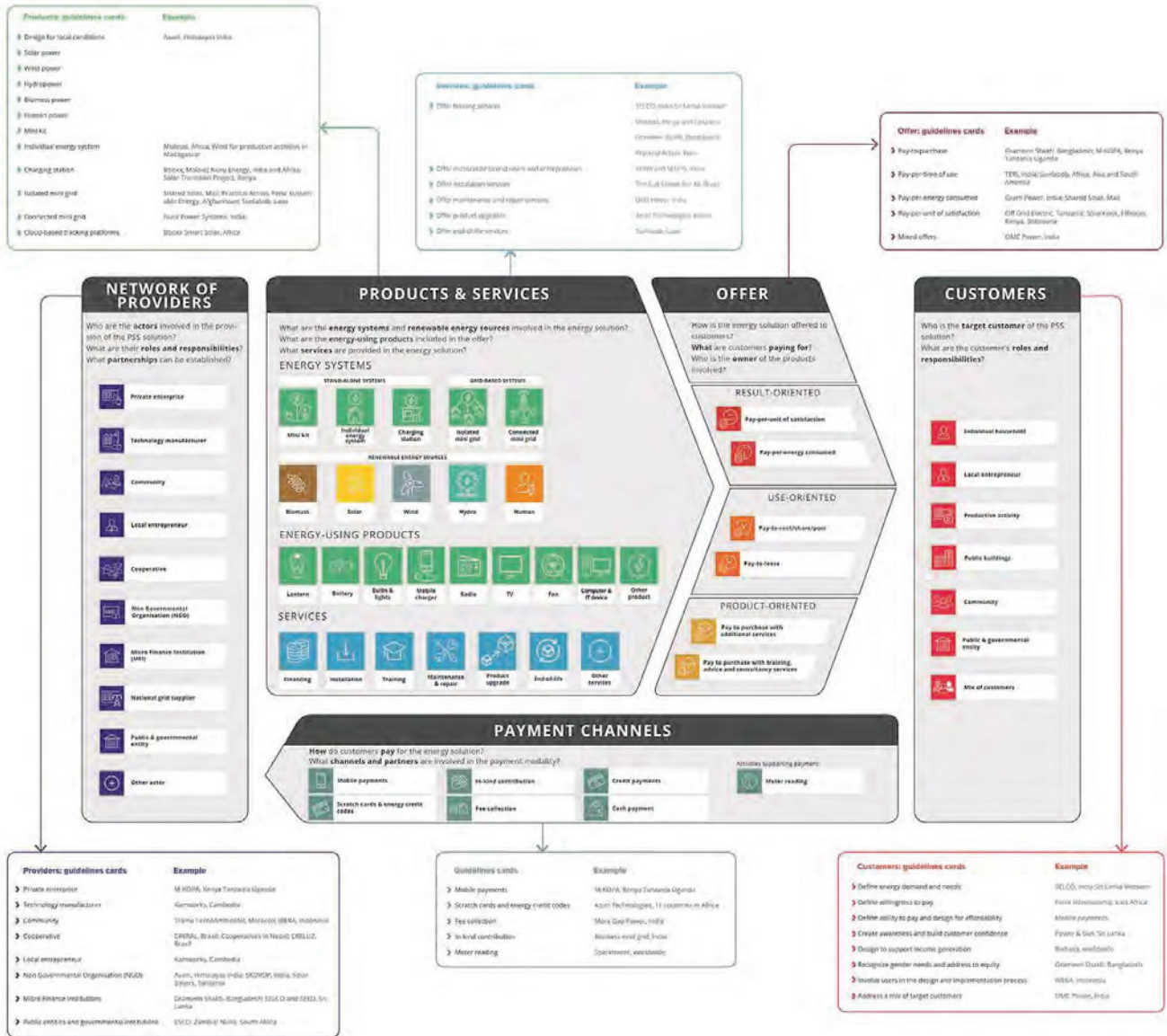


Figure 11 - The new Design Framework with the integrated list of guidelines for each design elements

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