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TRANSFORMING CONSTRUCTION NETWORK PLUS

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Maurizio Sibilla

Buildings-as-Energy-Service

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Preface
"Transforming Construction Network Plus"[1]

Innovating can be pretty difficult, can't it?

It's no surprise, then, that when we take a moment to really think about the full breadth of systemic innovation needed to transform our cities into the smart, zero carbon living places we know they could be, it can be rather overwhelming. Numerous scholars have tackled this subject, and there's no easy fix. Innovating takes time, deep thinking, and a willingness to change – at the very least.

But it is possible to make headway on the wicked, complex challenges that are holding us back. The Transforming Construction Network Plus is supporting 13 small projects spanning digital, construction, manufacturing and energy research. These research projects are at the forefront of today's thinking, and it is a privilege to see these catalytic endeavours come to fruition – setting the standard and defining the shape of future academic research and industry practice.

In this booklet, Dr Maurizio Sibilla takes us on a journey into a new world where buildings become an energy service. He believes that a distributed, renewable, interactive energy system is possible and within our grasp. Dr Sibilla has worked with colleagues in the Active Building Centre to create a vison where a shared language and approach leads to high performing buildings and cities. Only through such careful and scholarly research can we start to bring together the knowledge and the technology we need to be able to innovate – and ultimately, transform.

Jacqueline Glass

1. Professor Jacqueline Glass is Professor in Construction Management at The Bartlett School of Construction and Project Management and Vice Dean Research for The Bartlett Faculty of the Built Environment University College London.

The Research Project

This project developed a Tool Kit, called *BasES*, for knowledge integration to envisage buildings as components of future distributed renewable and interactive energy systems (DRIs). The project was designed with the understanding that this is a high risk and high gain revolutionising plan for reconfiguring energy infrastructure and the construction industry by delivering a new generation of buildings. It deals with the ambitious objective of exploring and analysing DRIs' emergent properties at local level, developing, testing and implementing the Tool Kit proposed. The specific objective concerns the use of the Tool Kit in the organisation of a *Technology Support Net* (TSN) for *Buildings-as-Energy-Service (i.e. BasES)*.

Zeleny (2012) states that when systems evolve from one form of organisation to another, the first step is the definition of a new TSN. A TSN is composed of a multitude of actors, who often have different perspectives and scopes, but they are called to work collaboratively in order to establish work rules, requisite skills, work contents, standards, and culture and organisational patterns with regard to the emergent systems. *Buildings-as-Energy-Service* is a completely new topic and thus, an appropriate TSN is needed urgently.

This Tool Kit is a ground-breaking cognitive apparatus for involving academic and non-academic stakeholders in knowledge transfer and integration processes. This is considered as an essential condition to promote a new TSN. Therefore, this project can be considered as exploratory research which poses the following questions:

"What are the main barriers and opportunities to organise a Technology Support Net (TSN) to achieve the vision of Buildings-as-Energy-Service at local level?"

This project adopts a holistic and scholarly approach, and it is based on a ground-breaking application of *Constructive Grounded Theory* (Charmaz, 2014), *Diverse Case Method* (Seawright & Gerring, 2008), *Cognitive Mapping Technique* (Novak, 2011) and *Meaningful Learning Activities (MLAs)* (Jonassen & Strobel, 2006). Our approach is appropriate in order to create an inter-disciplinary environment, which is important because creativity comes about when collaboration is nurtured in such environments that engage the user in the knowledge process (Florida, 2003). Therefore, our approach can increase the quality of the integrated knowledge paths by working through concepts and connections drawn from individual and collective previous knowledge. Concepts and connections can be visualised, manipulated, organised, focused, contextualised and discussed (i.e. *MLAs*) using cognitive maps in a cutting-edge computer environment dedicated to DRIs. This approach was adopted to:

- ***Provide a pre-ordinate cognitive structure***, (i.e., the content of *BasES*), which is useful to activate the Users' prior knowledge;
- ***Adapt this structure***, engaging different target groups in knowledge integration and transfer activities in order to develop a TSN *in situ*;
- ***Offer a scalable tool***, to promote transformative design, construction and operation of buildings as components of the future energy grid.

This booklet represents an instructional guide which firstly, allows readers to understand what the Tool Kit is and why it is need. Secondly, it informs the reader about the development of its content and functionalities. Thirdly, it points out who the Tool Kit is aimed at. Finally, due to the Tool Kit being disseminated as an Open Educational Resource, instructions as to where to find and access it, are also included. In addition, this booklet includes a glossary, introducing the definition of key concepts. For further information, readers will be called to explore the Tool Kit.

WHAT
a Tool Kit for
BUILDINGS-AS-ENERGY-SERVICE
Is

BasES is a Tool Kit for re-thinking about a new generation of buildings as components of a future energy infrastructure. It is a cognitive apparatus, which helps to form a set of theoretical reflections and practical recommendations used in promoting the underexploited potential of driving *Buildings-as-Energy-Service*. This potential can be synthesised in the following three points:

Improvements in the innovation capacity and in the integration of new knowledge.

The open-source nature of *BasES* is designed to foster continuing research and implementation of *Buildings-as-Energy-Service* approach. *BasES* serves as a ready-to-use knowledge base within *Buildings-as-Energy-Service* for the creation of new *Technology Support Networks*. This facilitates and encourages further research, as general interest in this new topic is high, and that both its understanding and its *Technology Support Networks* are considered inadequate.

Strengthening the role of Intermediaries for a Low Carbon Transition.

BasES focuses on Intermediaries, (i.e. single professionals and/or institutions), which play a key role in organising *Technology Support Networks* at the local level. It confronts the challenge by allowing measurements of local capacity to build up *Technology Support Network* impacts and providing stakeholders with specific information on benefits resulting from *Buildings-as-Energy-Service* vision by creating multiple prospects for the widespread diffusion of DRIs.

A comprehensive approach to academic and non-academic engagement and collaboration.

BasES includes both a tool to engage people and organisations in an interdisciplinary environment and a procedure to establish how this engagement is sustained. Therefore, our approach is based on a continuous training process, which is adaptable to and implementable with regards to both contexts of application and participants involved. This type of tool helps to explore products and services for *Buildings-as-Energy-Service* which come from different sectors.

WHAT
a Tool Kit for
BUILDINGS-AS-ENERGY-SERVICE
Is

BasES is expected to configure a multi-stakeholder co-designed roadmap on socio-technical innovation in DRIs transition. It will map *Buildings-as-Energy-Service* best practices in the field of innovative collaborative socio-technical modes, creating a learning environment in which developing and discussing tailor-made recommendations for different stakeholders. The procedure adopted to elaborate the Tool Kit was built upon my previous works, coming to propose a rigorous method to elaborate and manipulate the content of the Tool Kit. In detail, the Tool Kit was created combined the following methods:

Constructive Grounded Theory.

It allows a rigours management of the content of the Tool Kit, elaborating a conceptual framework, which evolves through a sequence of saturation phases. These phases vary in relation to the users' perspective.

Diverse Case Method.

It permits the selection of appropriate case studies. This approach requires the selection of a set of cases intended to represent the full range of values characterising X (e.g., x = Building Use), Y (e.g., y = type of digital integration; type of renewable resource), or some particular X/Y relationships.

Cognitive Mapping Technique.

It facilitates the prioritising of information, visualising potential interdisciplinary interconnections, and stimulating users' point of view in a continuous process of adaptation.

Meaningful Learning Activities.

They enhance the integration of interdisciplinary perspectives, looking for new directions of innovation.

The combination proposed is useful in elaborating new interdisciplinary nodes of knowledge, which are essential to organise a Technology Support Network.

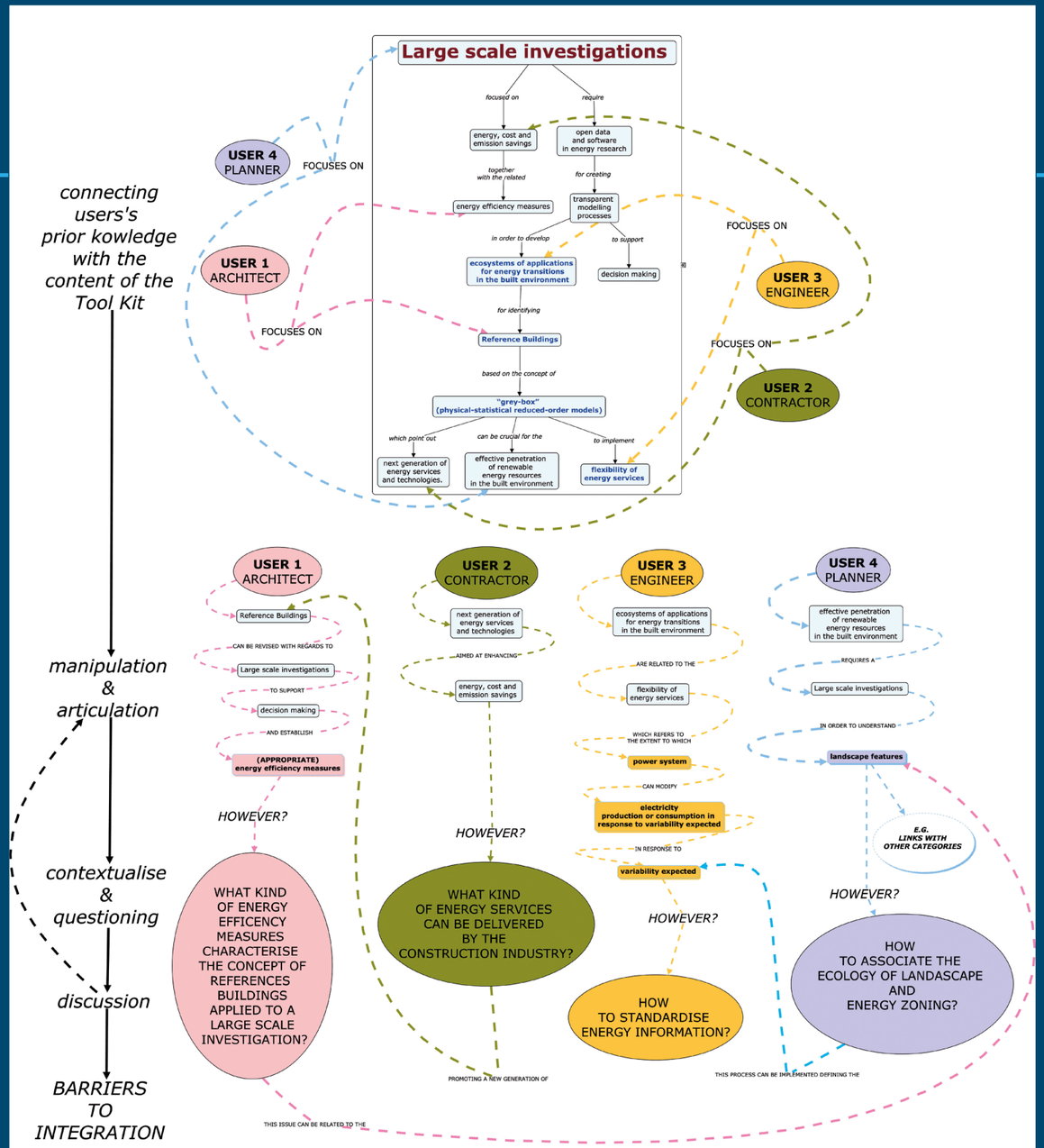

Figure 4. The figure shows a simulation of the process of adaptation of the Tool Kit applying the Meaningful Learning Activities (i.e. Manipulation, articulation, contextualise, questioning, and discussion). The simulation takes into account only one domain of knowledge (i.e. Large scale investigation) in order to make the explanation as simple as possible. It involves four users (i.e. an architect, a contractor, an engineer and a planner) who are engaged in the activity to produce a meaningful discourse concerning: How can/could the use of buildings as components of a future energy network impact on your practice or field of expertise? The first part of the image represents how users connect their prior knowledge with the content of the Tool Kit, selecting specific concepts. Then in the second part of the image), users extract these concepts, redefining their connections. In doing so, they can introduce new concepts (or for instance, they can use concepts, which belong to other domains) in order to contextualise the field of explorations, and pose specific questions, which emphasizes their perspective. Finally, they can try to point out barriers, which impede the integrations of their perspective. Using the Tool Kit, they can be involved in a continuous process of adaptation, visualising both the ideas promoted by other users, who are using and working together within the same knowledge framework.

WHO the Tool Kit Is For

This Tool Kit is for both academics and non-academics. The former mainly refers to professionals engaged in the organisation and development of innovative training programmes. The latter, refers to the actors engaged in innovation in industry, governance, and agencies, which act as intermediaries.

Academics. Academic actors interested in introducing new courses/programmes/modules based on energy transition in urban environment. Specifically, Built Environment disciplines, among which:

Architects who are interested in the form of the buildings, and how buildings can be integrated within the renewable energy system. They could be interested in exploring what characterises a new generation of buildings, which are interconnected with each other and how the form of the building links with the technology support network (TSN).

Planners and Urban designers. Similar to architects, they could be interested in what characterises a new generation of master plans, taking into account the hierarchical organisation of the urban energy system components (i.e. buildings).

Economists (e.g., Energy Manager). They could be engaged with the new vision because they can design the market aspect of the energy system. They can be involved in defining the new rules of the energy market, under which, economic conditions are needed to ensure that energy micro-grids are effective. Here, legal aspects also emerge in order to develop a new business model to support introduction of smart local energy grids.

Engineers (Energy Systems, Renewable Energy, Smart Grid). Several types of engineers, interested in technical systems, act as software developers. Software defines the functionality of the local smart grid, studying the efficiency of the renewable plant systems, as well as, its user-friendly platforms to allow the public to manage the energy grid.

Non-Academics who are interested in introducing a niche of innovations based on Energy Transition in the urban environment. Specifically, Built Environment actors (i.e., public, non-profit, and private), among which:

Decision makers and policymakers (e.g. local and/or regional level). To understand how the energy system works and defines the new legislative apparatus. This apparatus allows local communities to establish duties and responsibilities, as well as, incentives to make the energy system feasible.

Intermediaries (Innovators and Start Up Companies) in SMEs. This category mainly refers to new players into electricity industry decision making. Industry can be inspired by the emergent properties of distributed, renewable and interactive energy systems to re-think a new set of services that can be offered.

Intermediaries in Society are promoters of social innovations in a decentralised energy system e.g., Member of Energy Communities, Self-organized Energy Communities, and Local Energy Associations. They increase the local resilience, improving engagement of local communities within the energy infrastructure. They also clarify benefits associated with new technology through reduction in costs to end users, reduction in the carbon footprint, and improved sustainability profiles for buildings. They promote technology literacy to allow members of the local community to be a part of a Technology Support Net.

Member of Energy companies, utilities, or NGOs who seeks to explore the interaction between the role of the energy company into the self-organised energy community.

Member construction industry (Smart Buildings). A new typology of buildings, new elements of digitisation, new methods of management and products for DRIs (e.g. industry 4.0, Architectural on Demand).

As a first step, users need to download Cmap-Tools software[7]. The Tool Kit has been uploaded on IHMC Public Cmaps, which is a public server managed by the University affiliated Research Institute for Human and Machine Cognition. By doing so, the Tool Kit can be searched for, downloaded, edited and re-used by any Cmap user as an Open Educational Resource. After installing Cmap-Tools software, users can have access to the platform through steps showed in figure 6.

Once users have access to the folder of *BasES*, they can open the file[8]. Users are not permitted to modify the Tool Kit within this folder. Therefore, it is suggested to copy the entire content into the "Cmaps in My Computer". However, they can use it and save the file with a new name. If the modifications proposed will be considered relevant, they will be integrated into the Tool Kit by the administrator. Anyway, only when the file is uploaded on a public server, it will be possible to activate a synchronous collaboration. Synchronous collaboration allows concurrent editing of the Tool Kit by multiple users, where they can see the changes others make in real-time.

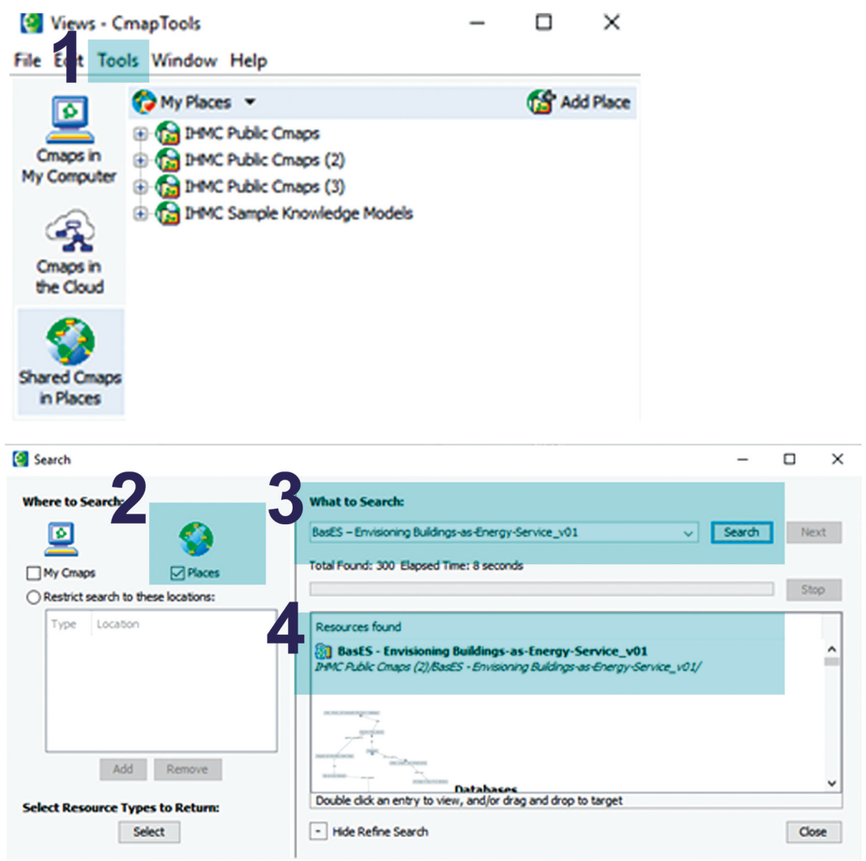

Figure 5. BasES – Envisioning Buildings-as-Energy-Service_v01

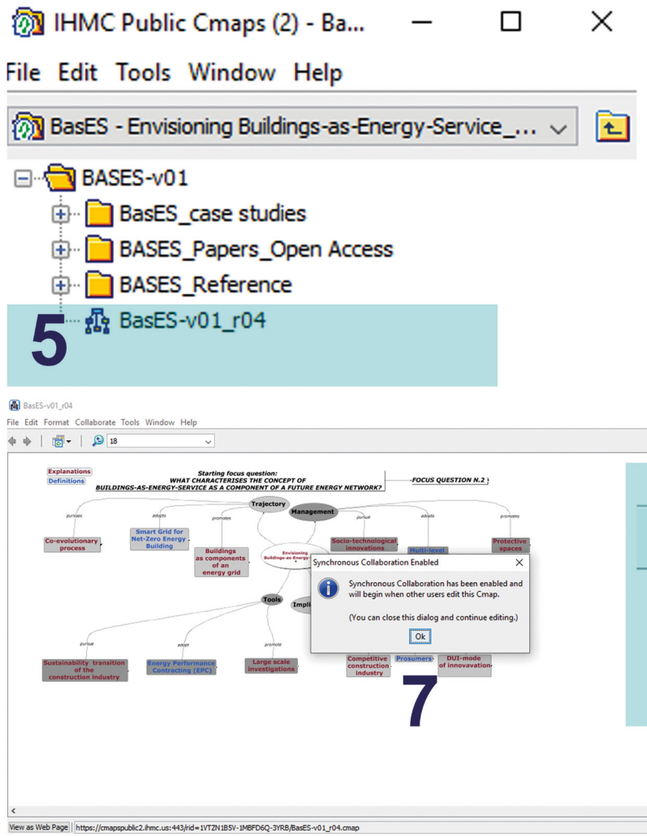

Figure 6. Synchronous collaboration can be activated clicking on the bottom "6". A message alerts the user that the synchronous collaboration has been enabled and will begin when other users edit the Tool Kit[9].

7. https://cmap.ihmc.us/

8. The Tool Kit is under a continuos update. Therefore its version may differ from that showed in the figure 6.

9, Further instructions on synchronous collaboration are available at http://cmap.upb.edu.co/rid=1ND6YF687-W5PWYC-C37/CmapTools%20-%20Synchronous%20Collaboration.cmap