The future of energy : Leading the change

A research program analyzing how to implement a successful energy transition

Call for projects 2014

Topic 3 - Energy autonomy of urban areas

Small technical systems: new infrastructure of daily life?

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Barcelone, le centre de traitement des déchets est intégré. Au-delà d'un simple habillage, il s'agit ici de s'appuyer sur les infrastructures existantes pour en optimiser les rendements, en assumant une proximité qui permet de rapprocher les lieux de production des lieux de consommation.

Summary of the project

It's a comparative analysis on 13 european projects that relocate (at different scales) some services loop (water, heat, cooling, biomass, electricity). This research showed that the infrastructural transition drives, through a new service management, a new territorial and urban organization. We examined the spatial implications of this relocation. The reorganization of these urban services favors a new hierarchy of the technical systems and the governance. Network operators (historic or emergent) innovate. In close collaboration with the persons in charge of the energy and urban planning, they appear as key actors of the physical renewal of territories. This change of scale associated with eco-systematic restructuring raises the question of the development of new networks-spaces and modifies the entire chain process, from the production, to traditional systems of governance and management.

Corpus of study, methodology and sources.

The results of this study are stem from the study of 13 european sites that implement self-sufficiency at different scales. The selection of sites where new network configurations are invented, are as followed: The headquarters of SMA (Niestetal, 2011), the community Eva Lanxmer (Culemborg, 1994), Björkhagen, (Stockhölm,1999) and Bedzed (Beddington, 2001), the boroughs of Hammarby Sjöstad, (Stockholm, 1995), Wilhelmsburg (Hambourg, 2013), Kronsberg (Hannover 2000) and 22@ (Barcelona, 2015), the city of Woking (UK, 1990); for the regional scale : the Nord Pas de Calais, (Picardie, 2013) and the euroregion Copenhagen-Malmö. For each project, on-site visits were organized. The principal project stakeholders : architects, urbanists, network operators and local authorities were interviewed.

Synthetic document
Project objectives, methodology and results

Each energy transition raises the question of technologic choices, and of the evolution or mutation of the socio-technic organization of existing infrastructures. The modern services network (transportation, communication, energy and resources) did not stop expanding and structuring since the end of the 19th century, bringing undeniable improvements in terms of comfort and salubrity for populations. A theoretical frame came along to question this technical development. Notions as "mégamachine", "système technicien", "large technical systems" or "macro-système technique" were theorized by Lewis Mumford, Jacques Ellul, Thomas Parke Hughes, Bernward Joerges, and Alain Gras[1]. These authors established the specificity, the diversity and the complexity of this historical technical model on a large scale (large technical system) that influences the entireness of the social field.
The environmental and energy crisis of the 20th century, that follows the international Stockholm conference on environment in 1972 and the oil crisis of 1973, has for echo the rising awareness concerning the limits of our resources, especially fossil, and the emerging doubts on the "tout nucléaire". This awareness cracks one of the biggest technological scheme of modernity. This network crisis[2], challenges the evidence of the macro grid as the dominating model and tends to favour a new interest in researches dealing with alternatives and infrastructural diversity. Without questioning the capacity of coherence and cohesion of the network as a technical equipment for urban and territorial solidarity, how can the network system reinvent itself facing the reorganization of energy territories?
Progressively, the relocation of certain productions appears, with renewable energies, as a new chapter in energy history. Experimented since the end on the 1960, alternative systems to the traditional macro grid model are multiplying in Europe. Notions of infrastructures at a local scale, intermediary, alternative, decentralized, dispersed, autonomous, disconnected[3], out grid or post-grid [4], come to shake up the hundred year old energy order.

The *small technical systems* disrupt and sometimes substitute themselves to the *large technical systems*. These small-technical systems can operate independently from the large existing services networks. The relocation of energy (from the use of local resources to the distribution) is one of their most important specificity. This change of scale, alongside the emergence of new ecosystemic relationships, raise the question of the planning for new networks-spaces and modifies the entire production scheme, including the governance systems and traditional managements.

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1 Bernward Joerges, « Large Technical Systems: Concepts and Issues », in Thomas P. Hugues, Renate Mayntz, *The Development of Large Technical Systems* (Frankfurt : Campus Verlag 1988). Alain Gras, *Grandeur et dépendance, sociologie des macro-systèmes techniques* (Paris : Puf, 1993).
2 Olivier Coutard and Jonathan Rutherford, "Vers l'essor de Villes « post-réseaux » : infrastructures, changement sociotechnique et transition urbaine en Europe" in Forest, J. et Hamdouch, A. *L'innovation face aux défis environnementaux de la ville contemporaine* (Lausane : Presses Polytechniques Universitaires Romandes, 2015), pp. 98-117.
3 Fanny Lopez, *Le rêve d'une déconnexion, de la maison autonome à la cité auto-énergétique* (Paris : La Villette, 2014). Book drawn from a thesis presented in July 2011, Université Paris I Panthéon-Sorbonne under the direction of Dominique Rouillard.
4 Coutard and Rutherford, *op.cit*.

Problematic and research hypothesis

In Europe, numerous forms of energy autonomy or small-technical systems exist, are promoted or debated, with the objective to reduce the dependency to the large inherited networks services, to improve energy efficiency and carbon neutrality. How to define small-technical systems and what are their characteristics?

While the energy and environmental crisis speed up the mutation of our modern infrastructures, what are the spatial effects of this relocation? Is a typology of these emerging forms from this infrastructural transition possible?

This reorganization of urban services favours a new hierarchy of technical and governance systems. Network operators (historical or emerging) innovate : in close collaboration with the ones in charge of the energy and the urban planning, they appear as indispensable stakeholders for the physical renewal of territories. This change of scale, associated with the emerging of new ecosystemic relationships raise the question of the planning of new network-spaces and modifies the entire chain process, from production, to governance and traditional managements systems [5]. Original partnerships bloom, inside which emerging network operators (as Thermo Bello in Netherlands or Hofor in Copenhagen) play a central role in connection with the energy strategy of territories and concerned consumers. In Germany, we assist at the return of energy cooperatives (Feldheim, Niestetal, Hambourg) that play a central role in the transition economy. At the European scale, we see a true rise of local heating districts. CHP powerplants and the development of methanization as primary and relocated source face an industrial success.

Technically more difficult to optimize, the electrical autonomy is deploying. Beyond the solitary building (Abalone or SMA), mutualization at the scale of the block, the neighborhood or the municipality proved its efficiency, as shows the example of Woking in the UK. Polemical when it is secessionist or too radical, the notion of autonomy [6] is nonetheless an efficient stimulator to think the energy « deepening »[7] of a territory. It offers a relevant awareness of the relationship and the limits between : supply /demand / consumption / stock for a given territory[8].

Networks are not a juxtaposition of technical elements, it's a complex assembly that raises the question of materiality, visibility, and efficiency of these systems in connection with the inhabited urban fabrics. The energy productive matrix comes back at the center of the territorial and urban project, questioning the limits between architecture and infrastructure. Our hypothesis is that this change of networks' form and scale modifies the urban and architectural project in its process of conception itself (new actors, new datas),

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5 Van Vliet Bas, Heather Chappells and Elizabeth Shove, *Infrastructures of Consumption: environmental innovation in the utility industries,* London: Earthscan, 2005.

6 Autonomy is one of the most problematic axe of the energy transition : it stipulates that the energy used in a given perimeter is produced by the buildings and / or micro-infrastructures of this perimeter (the house, the building, the borough, the town, the region…).

7 "Le siécle n'est plus à l'extension des villes mais `*a l*'approfondissement des territoires" (p. 131)

8 As demonstrated Paola Vigano, Sabine Barles or Raphael Ménard for the Greater Paris, the energy autonomy supposes equality between the supply and the demand, that is a drastic drop of primary energy consumption.

but also on a spatial point of view. A new network architecture is appearing: aboveground, visible, proud of its carbon footprint and its energy efficiency. It's also a redefinition of the relationship between architecture and infrastructure, a rapprochement is happening, and can be a vector of urbanity. The energy power plant reinvents itself according to the 21st century paradigms, as an iconic object, accessible and comprehensible, in articulation with the debates on industrial symbiosis and the use of local and renewable energies. It is possible to go eat and dance on the Bunker Energy terrace at the heart of Wilhelmsburg borough in Hambourg, soon to go ski on the power plant Amager in Copenhagen, or to walk around the Energy Forum at the extreme north-east of Barcelona Port. These productive sites, in activity, offer at the heart of the functioning infrastructure, public spaces and activities. Far from being anecdotal, these new uses question the symbolic mutation and the future of these energy sites. The power plant in service is no longer a closed and monofunctional infrastructure, it is one of the totems of an ongoing energy transition. We can however wonder if the visibility of the infrastructure favours, beyond reconciliation, the comprehension of the systems. According to the case studies, we note a difference between the aesthetization of the network through the retrofitting / layout of the powerplant, which architecture seems too obsolete, and the affirmation of an ecosystemic idea linked to the industrial symbiosis.

We already published an article on this research

http://www.revue-urbanites.fr/6-les-micro-systemes-techniques-de-la-transition-energetique/