

Chapter 2

Methodology

Abstract The chapter presents the methodology implemented for reaching the objectives of the “Symbiotic Neighbourhoods” research project. Taking lifestyles as a starting point, the research explores three different scenarios (technological, behavioural and symbiotic) for the future development of a neighbourhood for 2035. An energy flow analysis is then achieved, in order to establish an estimated global balance, allowing the assessment and comparison of the energy performance of each scenario. Three quantitative indicators are calculated: total primary energy, non-renewable primary energy and global warming potential. Energy supply, which is defined on the basis of local resources, varies from one scenario to the other. They provide a more complete evaluation of each scenario. In parallel, an urban form adapted to the proposed lifestyle is designed, in order to evaluate how architectural and urban design is likely to foster the necessary behaviour changes towards a society consistent with objectives to reduce energy consumption.

Keywords Sustainable neighbourhood • 2000-Watt society • Energy consumption • Industrial ecology • Urban agriculture • Energy mapping • Flow analyses

2.1 Energy Mapping

The research focuses on four distinct phases.

First of all, in order to estimate available local resources, the first stage consists in establishing a regional energy map. In the first Instance, on the basis of an earlier report (Weinmann Energies 2010) and using information obtained from the Energy Department of Yverdon-les-Bains (SEY), the list of the different renewable energy production installations present in 2013 and located within the perimeter of the Yverdon-les-Bains conurbation was established. Energy supply projects for the municipality of Yverdon-les-Bains planned by the SEY up until 2035 were also assessed.

These projects are essentially based on local resources potential. i.e. biomass, the multiple types of waste that can be recycled either using a process of biomethanisation, or to produce heat through combustion, but also the local rate of sunshine for solar power, as well as geothermal energy and wind power. This information enabled researchers to draw up a mapped inventory of the various local resources available.

During the final stage of establishing this energy registry, the different potentially promising zones for heat recovery from waste heat were mapped. The global overview of these results is presented in Chapter 4.1 “Local resources”.






2.2 Scenarios

On the basis of this inventory and using the Localised Master Plan (LMP) as the frame of reference, three scenarios for the neighbourhood development with 2035 as the horizon were imagined, fuelled by prospective thinking on the evolution of western lifestyles (Emelianoff et al. 2012). Each scenario deliberately corresponds to a distinct vision of how to reach sustainability objectives and thus, in a way, embodies a different intellectual point of view:

- The *technological scenario* calls on cutting-edge technologies to reduce energy consumption and emission of greenhouse gas. No substantial user-behavioural change is expected and the current trend continues. Globally, environmental impacts are lessening thanks to improved efficiency of control mechanisms, but this effect is counterbalanced by the general increase in consumption.
- The *behavioural scenario*, on the other hand, is quite the opposite of the technological scenario, relying mainly on a meaningful evolution in users’ behaviour: lower consumption, voluntary simplicity, lower consumerism and a ‘return to favour’ of slowness. In this scenario the driving force behind energy transition thus depends essentially on a reduction in the final demand thanks to a change in certain current social practices.
- The *symbiotic scenario* gives even higher value to the possibilities of urban and industrial symbiosis to reduce the neighbourhood’s impact on the environment. It aims in particular to transform lost waste (particularly unavoidable heat production) into resources. The approach implies maximising the use of exchange networks for material and energy, at all levels (buildings, groups of buildings, neighbourhood, between the neighbourhood and its surrounding perimeter). With respect to the behavioural dimension, this scenario is mid-way between the previous two, as the users will act according to the logics of networks and partnerships.

Table 2.1 provides a synthetic overview of the hypotheses made for the technological, behavioural and symbiotic scenarios according to five energy consumption sectors.

Table 2.1 Overview of the hypotheses made for the technological, behavioural and symbiotic scenarios according to five energy consumption sectors (buildings, mobility, infrastructures, food, goods and services)

| |  BUILDINGS |  MOBILITY |  INFRASTRUCTURES |  FOOD |  GOODS + SERVICES |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Technological scenario | <div>Minergie A standard</div> <div>Massive construction</div> <div>Smart buildings</div> <div>Integration of renewable energies</div> <div>60 m²/person</div> | <div>Increase in air transport</div> <div>Hydrogen cars</div> <div>Electric cars</div> | <div>Functional public spaces</div> <div>Low-energy public lighting</div> <div>Mineral urban public spaces</div> | <div>Imported (by plane)</div> <div>Transformed, processed foods</div> <div>Intensive agriculture</div> <div>Crops grown in heated greenhouses</div> | <div>High-tech products</div> <div>Global increase in consumption</div> <div>Improvement in energy performance</div> |
| Behavioural scenario | <div>Minergie standard</div> <div>Light local wood construction</div> <div>Pooling of common spaces and equipment</div> <div>Lower room temperatures</div> <div>40 m²/person</div> | <div>Soft mobility</div> <div>Car-sharing and car-pooling</div> <div>European flights replaced by train</div> <div>Animal-drawn vehicles</div> | <div>Community spaces devoted to urban agriculture</div> <div>Economical organisation of public spaces</div> | <div>Vegetarian</div> <div>Local, seasonal, organic products</div> <div>Abandon of luxury products</div> <div>Waste reduction</div> <div>Minimisation of food packaging</div> | <div>Self-production of furniture and clothes</div> <div>Recovery and diversion</div> |
| Symbiotic scenario | <div>Minergie P standard</div> <div>Recycled materials</div> <div>Reuse of thermal waste</div> <div>Industry and craft</div> <div>50 m²/person</div> | <div>Biodiesel vehicles</div> <div>Lighter cars</div> <div>Development of public transport</div> <div>Leisure-based European flights replaced by train</div> | <div>Large, convivial public spaces</div> <div>Public spaces set out as permeable areas</div> | <div>Reduction of meat consumption</div> <div>Local production (vertical farming)</div> <div>Seasonal products</div> | <div>Repairable products</div> <div>Recyclable products</div> <div>Eco- or regenerative designs</div> |

2.3 Flow Analyses

For each scenario, several hypotheses are then formulated bearing in mind the energy issues relating to the fields of buildings, mobility, infrastructures, food and consumption of goods and services. The energy consumption of each of these scenarios is calculated on the basis of these hypotheses, using analysis of energy flow. Three quantitative indicators have been retained: total primary energy, non-renewable primary energy and global warming potential (emissions of CO₂ equivalent).

An initial calculation bears in mind the current situation, representative of the status of the neighbourhood if it were inhabited to full capacity. This current status is a point of reference which has subsequently enabled adaptation of data depending on the hypotheses developed for each scenario. These calculations are made in detail for each area and every category of energy consumption. The hypotheses used to build up the scenarios are summed up in Table 1.1. They are addressed in more depth in the annexes to this report.

The first area analysed is *Buildings*. It includes the residential and office categories which each comprise sub-categories on Construction, Heating, Domestic Hot Water (DHW), Ventilation and Lighting, and Appliances. This section considers the building’s grey energy as well as the electricity and heat used during its operational

period. Calculation is based on the different standards of Minergie control (Minergie, Minergie A and Minergie P). These reference values, per square meter, are then applied to the residential and office surface areas, per inhabitant, in the scenario considered.

The *Mobility* section includes the following categories: Car, Plane, Train and other Public Transport. This data comes from the listings used by the Swiss Federal Statistical Office (SFSO). Only passenger transport is included here, goods transport is allocated to 'goods'.

Systematically, the *Infrastructures'* final energy consumption is estimated in accordance with a pro rata principle of the populations concerned. The first category comprises Equipment, i.e. both the neighbourhood facilities (whose total consumption is allocated to the inhabitants of the Gare-Lac sector), communal facilities, such as swimming pool, ice-rink, etc. (of which the neighbourhood residents pay only 14 %, i.e. the ratio between the neighbourhood and the town of Yverdon-les-Bains) and finally regional facilities provided for the whole conurbation of Yverdon-les-Bains (St-Roch, CFF workshop), of which only 7 % are borne by residents of the neighbourhood. The Remaining Infrastructures category comprises the grey energy of these facilities (its estimation would deserve a complete analysis although it remains constant from scenario to scenario) as well as the grey energy linked to infrastructures servicing the residents (roads and refuse department, small-scale installations) which do not vary according to the scenarios. The final category External Installations corresponds to the higher pace consumption represented by the large domestic producers/transmitters, i.e. infrastructures releasing over 15,000 tonnes of CO₂ eq/per year (Bébié et al. 2010). This national data is shared across the whole of the Swiss population to obtain an average figure per inhabitant.

The fourth area bears in mind energy and greenhouse gas emissions related to *Food*. It includes agriculture, processing, packaging and distribution. Estimations are based on recent surveys which evaluate the primary energy consumption at approx. 750 W per inhabitant (Jungbluth and Itten 2012). Categories with the most interesting potential for reducing energy consumption are then identified which enables researchers to vary results from one scenario to another.

The last area accounts for *Goods and Services*-related energy used by households, which does not feature in any other area's calculations. Products with a short lifespan (clothes, furniture, etc.) and non-standard activities (concerts, hotel stays, etc.) are the highest grey energy consumers (Novatlantis 2011). Currently, the electrical power linked with goods and services consumption is evaluated at approx. 750 W per person. Just as for the area of *Food*, each scenario adapts this estimation of the current status of *Goods and Services*-related energy consumption according to the hypotheses made.

Once the three indicators are calculated for the different areas, the values are summed up in order to estimate the overall assessment of each scenario. To check the relevance of the reflection, these results are then compared with objectives set out in the framework of a 2000-Watt society for 2035.

2.4 Urban Form

In parallel, an urban form proposal adapted to the lifestyle described in the scenario is modelled. This spatial installation allows researchers to determine the neighbourhood's hosting capacity. Indeed, each lifestyle implies distinct usages corresponding to specific needs in terms of spatial, functional and sensitive qualities (Thomas 2011).

This foresight exercise in translating conceptual hypotheses into a built-up form also enables us to evaluate the extent to which the architectural and urban quality is likely to support—even encourage—the behavioural changes required for the transition towards a society compatible with the reduced energy consumption goals.

The development scenarios use the Localised Master Plan (LMP) prepared for the Gare-Lac sector of Yverdon-les-Bains (Bauart et al. 2013) as their reference framework. The specific identity of the future neighbourhood and its closeness to the historical town centre, the railway station and the lake all contribute to making it a rare site in the urban environment. The aim is to make the most of these advantages not by densifying at all costs, but rather by introducing mixed-use planning and a balance between the built and non-built spaces. Established by the Localised Master Plan (LMP), human density (the number of inhabitants and jobs per hectare) remains identical for all the scenarios. On the other hand, the built density (gross floor area) and the urban form vary from one scenario to another, depending on the function of the area per inhabitant and the type of activities focused on in the different scenarios. Based on different sustainable development visions, the scenarios aim to tangibly explore various forms of urban development and siting of buildings.

2.5 Optimisation

Finally, the last phase involves optimizing the scenarios' performances by developing a scenario incorporating the three visions. The hypotheses retained for this hybrid scenario thus reflect a less radical and more pragmatic and realist vision of sustainable development. At this stage, the flow analysis results are compared once again with the goals of the 2000-Watt society.

Figure 2.1 presents a diagram of research progress. In spite of the apparent linearity of the process, numerous iterations are made between the different stages in research.

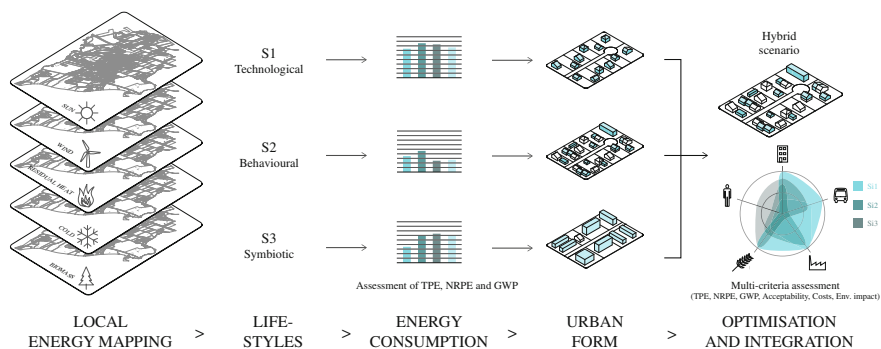


Fig. 2.1 Methodological diagram describing the different stages in the symbiotic neighbourhoods research project process

References

- Bauart et al (2013) Plan Directeur Localisé Gare-Lac. Commune d'Yverdon-les-Bains, Yverdon-les-Bains
- Bébié B, Hartmann C, Lenel S et al (2010) Les cités de l'énergie, les villes, les communes et les régions sur la voie de la société à 2000 watts. Cossonay
- Emelianoff C, Mor E, Dobre M et al (2012) Modes de vie et empreinte carbone. Prospective des modes de vie en France et empreinte carbone, Paris
- Jungbluth N, Itten R (2012) Umweltbelastungen des Konsums in der Schweiz und in der Stadt Zürich: Grundlagendaten und Reduktionspotenziale. Zurich
- Novatlantis (2011) Vivre plus légèrement. Vers un avenir énergétique durable: l'exemple de la société à 2000 watts. Villigen
- Thomas M-P (2011) En quête d'habitat : choix résidentiels et différenciation des modes de vie familiaux en Suisse. EPFL
- Weinmann Energies (2010) Parc scientifique et technique d'Yverdon-les-Bains (Y-Parc). Etude pour l'évaluation des rejets thermiques et des besoins en chaleur du site. Echallens

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