



SOLutions for Low Energy Neighbourhoods



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SOLE.N : SOLutions for Low Energy Neighbourhoods



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Articles dans des revues scientifiques avec peer reviewing

Marique, A.-F., & Reiter, S. (2014). A simplified framework to assess the feasibility of zero-energy at the neighbourhood / community scale. *Energy and Buildings*, 82, 114-122.

Zero-energy buildings (ZEBs) are attracting increasing interest internationally in policies aiming at a more sustainably built environment, the scientific literature and practical applications. Although “zero energy” can be considered at different scales (e.g., community, city), the most common approach adopts only the perspective of the individual building. Moreover, the feasibility of this objective is not really addressed, especially as far as the retrofitting of the existing building stock is concerned. Therefore, this paper aims first to investigate the opportunity to extend the “zero-energy building” concept to the neighbourhood scale by taking into account two main challenges: (1) the impact of urban form on energy needs and the on-site production of renewable energy and (2) the impact of location on transportation energy consumption. It proposes a simplified framework and a calculation method that is then applied to two representative case studies (one urban neighbourhood and one rural neighbourhood) to investigate the feasibility of zero-energy in existing neighbourhoods. The main parameters that act upon the energy balance are identified. The potential of “energy mutualisation” at the neighbourhood scale is highlighted. This paper thereby shows the potentialities of an integrated approach linking transportation and building energy consumptions.

Marique, A.-F., de Meester, T., De Herde, A., & Reiter, S. (2014). An online interactive tool to assess energy consumption in residential buildings and for daily mobility. *Energy and Buildings*, 78C, 50-58.

Improving energy efficiency in the building and transportation sectors is a viable approach to mitigate the effects of climate change and has become an important policy target. As a result, in addition to scientific research and public policies addressing energy efficiency, raising public awareness of the impact of the behaviour of citizens to energy efficiency is crucial and could quickly lead to significant reductions in the total energy consumption of a territory. In this context, this paper presents a new online interactive tool that enables not only citizens but also local authorities and private developers to (1) assess the sources of energy consumption related to housing and to daily mobility at both the individual and neighbourhood scales, (2) compare these sources and (3) determine relevant and personalised suggestions to reduce energy consumption. Numerous methods and tools, including



a typological classification of buildings, thermal dynamic simulations, life-cycle assessments and statistical treatments of national censuses, were used to produce the two large databases used in this interactive tool. This report represents the primary results of a three-year long scientific research project dedicated to the study of energy efficiency in buildings and for daily mobility that is accessible to a large non-specialised audience.

Marique, A.-F., Dujardin, S., Teller, J., & Reiter, S. (2013). Urban sprawl, commuting and travel energy consumption. Proceedings of the Institution of Civil Engineers. *Energy*, 166(1), 29-41.

Commuting to and from dense urban centres is often believed to be more energy efficient than commuting from more suburban areas. However, quantitative evidence is lacking. In this context, this paper investigates the interactions between the spatial structure of the territory and transport energy consumption for commuting. Based on empirical surveys carried out every 10 years in Belgium, a quantitative method was developed and applied to assess energy efficiency of home-to-work and home-to-school travels. Our main findings highlight that urban structure acts upon travel energy consumption for commuting and that major cities present low energy consumption. However, a local-scale approach is useful for refining these observations, and this approach highlights the existence of secondary suburban and rural cores that also are characterized by low transport energy consumption. In this respect, the distance from home to a destination is paramount, whereas the mode of transport used has a lower impact. The method is parameterised and reproducible in other territories.

Marique, A.-F., Dujardin, S., Teller, J., & Reiter, S. (2013). School commuting: the relationship between energy consumption and urban form. *Journal of Transport Geography*, 26, 1-11.

A large amount of research in the past has focused on the relationships between the energy consumption for home-to-work travels and land-use patterns. However, little is known about children's mobility. This paper analyses the energy consumption, travel distances and mode choices for school commuting based on two decennial surveys in Belgium. The results highlight the following: (1) Mobility behaviours have evolved drastically over the past decades for school commuting, an evolution that cannot be entirely related to land-use variables. (2) The energy consumption for school commuting is strongly dependent upon the school level. (3) The links between land-use patterns and energy consumption for school commuting are different than those highlighted within the literature between urban forms and home-to-work commutes. The concentration of secondary schools and tertiary institutions



in urban centres induces higher energy consumption rates, whereas the decentralisation of nursery and primary schools across the entire territory leads to very low local energy consumption and increased walking and cycling. These results provide a better understanding of school commuting within the European context and could guide future policies focused on transport energy consumption at the local scale.

de Meester, T., Marique, A.-F., De Herde, A., & Reiter, S. (2013). Impacts of occupant behaviours on residential heating consumption for detached houses in a temperate climate of the northern part of Europe. *Energy & Buildings*, 57, 313-323.

The occupants' behaviour has a great influence on the energy demand, management and consumption of a building. This paper investigates the influence of three parameters related to human behaviour through their modes of occupations (based on family size, management of the heating system and management of the heated area) on the housing heating loads of a standard dwelling in Belgium. Seven levels of insulation were tested: no insulation, two intermediate levels corresponding to 3 and 6 cm of insulation, the current standard for new buildings in Belgium, the low energy standard, the very low energy standard and the passive house standard. Multi-zone simulations were performed with a dynamic thermal simulation software. The impact of occupants' lifestyle and the interactions between occupation modes and insulation levels are highlighted. These results prove that the more the building is insulated, the more the lifestyle proportionally influences the heating loads. One important strategy for reducing heating consumption during the whole life cycle of the building is adapting the size of the house and its occupation modes to the evolution of family size. However, insulation is paramount, and increasing the insulation of the house provides generally better results than merely adapting the occupation mode.

Marique, A.-F., & Reiter, S. (2012). A method for evaluating transport energy consumption in suburban areas. *Environmental Impact Assessment Review*, 33, 1-6.

Urban sprawl is a major issue for sustainable development. It represents a significant contribution to energy consumption of a territory especially due to transportation requirements. However, transport energy consumption is rarely taken into account when the sustainability of suburban structures is studied. In this context, the paper presents a method to estimate transport energy consumption in residential suburban areas. The study aimed, on this basis, at highlighting the most efficient strategies needed to promote awareness and to give practical hints on how to reduce transport energy consumption linked to urban sprawl in existing





and future suburban neighborhoods. The method uses data collected by using empirical surveys and GIS. An application of this method is presented concerning the comparison of four suburban districts located in Belgium to demonstrate the advantages of the approach. The influence of several parameters, such as distance to work places and services, use of public transport and performance of the vehicles, are then discussed to allow a range of different development situations to be explored. The results of the case studies highlight that travelled distances, and thus a good mix between activities at the living area scale, are of primordial importance for the energy performance, whereas means of transport used is only of little impact. Improving the performance of the vehicles and favoring home-work give also significant energy savings. The method can be used when planning new areas or retrofitting existing ones, as well as promoting more sustainable life styles regarding transport habits.

Marique, A.-F., & Reiter, S. (2012). A Method to Evaluate the Energy Consumption of Suburban Neighbourhoods. HVAC&R Research, 18(1-2), 88-99.

Energy use in buildings, transportation systems and lighting networks represents a significant contribution to the overall energy consumption in urban and suburban areas. This paper presents a method to evaluate the energy consumption of suburban neighborhoods from these three points of view, aiming to highlight the most relevant variables linking urban form and neighborhoods energy consumptions. The method includes three parts: 1) a computational approach combining dynamic simulation tools and a database of building typologies to determine the energy consumed in heating; 2) an empirical approach to assess the energy consumed by transportation systems (four purposes of travel are taking into account: work, school, leisure and shopping); and 3) a simplified approach to calculate the energy consumed by public lighting. Results from the application of the method to three characteristic suburban neighborhoods in Belgium are presented along with a life cycle energy assessment of buildings. A sensitivity analysis was conducted to determine the effects of building and neighborhood characteristics and of building inhabitant behavior on calculated energy consumption. Results from the analysis show that building insulation, building distribution, heating system management and neighborhood location are critically important factors in the energy efficiency of suburban residential areas.

Reiter, S., & Marique, A.-F. (2012). Toward low energy cities : A case study of the urban area of Liège. Journal of Industrial Ecology, 16(6), 829-838.





Within the framework of sustainable development, it is important to take into account environmental aspects of urban areas related to their energy use. In this article, a methodology is proposed for assessing residential energy uses for buildings and transport at the city scale. This method is based on the use of GIS tools combined with a statistical treatment of urban and transport criteria. The methodology allows to model buildings and transport energy use at the city scale, as well as to consider the possible evolution of the city energy consumption and to simulate the effects of some strategies of urban renewal. An application is given to study different energy management strategies for the urban area of Liège. Buildings and transport energy consumption are compared at the city scale and their possible evolution in the future is highlighted. Forecast scenarios on future energy policies for Liège's building stock show that the European Directive on the Energy Performance of Buildings and even more selective energy policies applied only on new buildings are not sufficient to widely decrease buildings energy consumptions at the city scale. The renovation of the existing building stock has a much larger positive impact on city energy consumption reductions. The methodology developed in this article can be adapted and/or reproduced on many other urban regions in Belgium but also in Europe or even further.

Rossi, B., Marique, A.-F., & Reiter, S. (2012). Life-cycle assessment of residential buildings in three different European locations, case study. *Building & Environment*, 51, 402-407.

The paper presents the comparative results of the life-cycle assessment (LCA) of one residential building with two constructive systems in Brussels and one steel frame house located in three different European towns: Brussels (Belgium), Coimbra (Portugal) and Luleå (Sweden). In a recent study, a modular building was studied in Coimbra and Luleå. It was shown that in terms of CO2 emissions, the Use Stage was the most harmful stage during the building life-cycle for Coimbra climate. Contrarily, in Luleå, it was the Product Stage, despite energy consumption being higher than Coimbra, due to the way electricity and heat are generated. In the present study, two structural systems are first compared for the Belgian house: steel frame and traditional masonry. A different life-cycle scenario is taken into account for the steel frame house for the three different locations, in which the monthly temperatures, energy mix, heating and cooling systems are defined. The LCA is carried out using the basic tool described in the companion paper. It is worth recalling that the results obtained with the basic tool were verified against Pleiades+Comfie and Equer software, enabling to carry out a complete LCA, for Brussels. Our results confirm that for all the three climates, the Use Stage (Operational energy) is the most harmful period during the building life-cycle and that the energy mix of the country strongly influences the equivalent CO2 emissions related to the Use Stage (Operational carbon) and may entirely reverse the conclusions about the life-cycle carbon footprint of the building.





Rossi, B., Marique, A.-F., Glaumann, M., & Reiter, S. (2012). Life-cycle assessment of residential buildings in three different European locations, basic tool. *Building & Environment*, 51, 395-401.

The paper deals with the development of a tool used for the life cycle assessment of residential buildings located in three different European towns: Brussels (Belgium), Coimbra (Portugal) and Luleå (Sweden). The basic tool focuses on the structure and the materials of the buildings and permits the evaluation of the Embodied energy, Embodied carbon and yearly energy consumption. For that purpose, a different set of original data is taken into account for each location, in which the monthly temperatures, energy mix, heating and cooling systems are defined. The energy consumption, being for heating space or water, for cooling or for lighting is transformed into CO2 emissions to deduce the Operational carbon as well. The influence of the energy mix can therefore be assessed in the basic tool. As a matter of fact, the heating and cooling systems habitually used in the three countries are also of great importance. The District Heating system, is, for instance, incorporated in the basic tool. The presence of solar water heater or photovoltaic panels is also strongly influencing the operational carbon. After a short literature review on building LCA and the description of the basic tool, the software Pleiades+Comfie combined with Equer is used to achieve the complete LCA for one building using two different load bearing frames. The results of the calculations for Brussels climate are verified against these software results. The dependence of the results to parameters such as climate, energy mix and habits is then discussed in the companion paper.

Articles dans des revues scientifiques sans peer reviewing

Marique, A.-F., de Meester, T., De Herde, A., Winant, J., & Reiter, S. (2012). Des territoires au projet : le projet de recherches SAFE. *Cahiers Nouveaux (Les)*, 82, 81-85.

Cet article présente les principaux résultats du projet de recherches SAFE (Suburban Areas Favoring Energy efficiency) qui traitait de l'évaluation énergétique des quartiers périurbains wallons (bâtiment + transport).





Ouvrages et chapitres d'ouvrages

Reiter, S., & Marique, A.-F. (2013). Toward a Sustainable Energy transition in the Built Environment. In S., Reiter (Ed.), Energy Consumption : Impacts of Human Activity, Current and Future Challenges, Environmental and Socio-economic Effects (pp. 35-52). New York: Nova Science Publishers.

The world is undergoing the largest wave of urban growth in history. In the actual context of growing interests in environmental issues, urban areas are known to present high potentialities in terms of energy reduction. However, existing models and regulation often adopt the perspective of the individual building as an autonomous entity, and neglect the importance of phenomena linked to larger scales, while decisions made at the neighbourhood and the city scales have important consequences on the performance of individual buildings, on the transport habits of the inhabitants and on the potential mutualisation of renewable energy production. This chapter examines strategies toward a sustainable energy transition in the built environment. The chapter summarizes and put into perspectives findings from numerous studies that have investigated parameters influencing energy consumption of the built environment including location, urban form, density, mix use, mobility patterns, buildings insulation, energy mix and inhabitants' behaviours. This chapter contributes to the important area of understanding how to facilitate a sustainable transition in the built environment through urban and suburban renewal.

Conférences scientifiques dans des universités et centres de recherche

Marique, A.-F. (2014). Sustainability and the built environment: urban form and location matter. Guest lecture at ICIS, Maastricht, The Netherlands.

Marique, A.-F. (2014). Efficacité énergétique et forme urbaine. Guest lecture at EIVP, Paris, France.



Colloques et congrès scientifiques

Sur invitation

Marique, A.-F. (2013). Renewal of Walloon suburban neighbourhoods. Paper presented at Workshop «Single family housing estates of the post-war era», Aachen, Germany.

This paper addresses the challenges, transformations and conditions of a sustainable suburban transition in Wallonia (Belgium). Two powerful levers are used: (1) urban form, which is considered in addition to the individual building scale, and (2) mobility, because sprawl spatially separates activities, resulting in an increase in travel distances and energy used in transportation. Three scenarios focused on the evolution of the existing building stock are modelled and assessed (the retrofitting of existing neighbourhoods, an increase in the built density and demolition / reconstruction) to answer two main questions: «how to intervene in suburban areas?» and «where to intervene?».

Marique, A.-F., & Reiter, S. (2013). Solar buildings and the urban environment. Paper presented at The 3rd New Energy Forum-2013. From Green Dream to Reality, Xian, China.

Marique, A.-F., & Reiter, S. (2013). Models and prospects for a sustainable suburban transition. Paper presented at Re-engineering the city 2020-2050: Modelling Sustainable Urban Transition Dynamics, Cardiff, UK.

This paper addresses the challenges, transformations and conditions of a sustainable suburban transition. Two powerful levers are used: (1) urban form, which is considered in addition to the individual building scale, and (2) mobility, because sprawl spatially separates activities, resulting in an increase in travel distances and energy used in transportation. Two main indicators (the heating needs of different types of suburban forms and a commute performance index) are developed and discussed. Three scenarios focused on the evolution of the existing building stock are modelled and assessed (the retrofitting of existing neighbourhoods, an



increase in the built density and demolition / reconstruction) to answer two main questions: «how to intervene in suburban areas?» and «where to intervene?».

These main results focused on energy efficiency are then studied in a larger framework to highlight the opportunities, limitations, constraints and feasibility of each strategy. Concrete prospects and guidelines for policy makers are finally proposed to operationalize a «sustainable suburban renewal». These findings show that, beyond the traditional polarization of the debates on energy efficiency of our built environment between the “compact city” and the “sprawled city”, a new pragmatic paradigm, focused on the transition of suburban areas by densification, can make suburban areas evolve towards more sustainability.

Rossi, B., Marique, A.-F., & Reiter, S. (2011). Life-cycle carbon footprint of a residential steel framed building in different climates. World Sustainable Building Conference: SB11, Helsinki 18-21 October 2011 (pp. 118-119).

Sur proposition personnelle

Marique, A.-F., Cuvellier, S., & Reiter, S. (2014). Energy Efficiency and the City: An Integrated Urban Tool Dedicated to Local Stakeholders and Citizens. Paper presented at Symposium “Toward Integrated Modelling of Urban Systems”, Lyon, France.

Marique, A.-F., Penders, M., & Reiter, S. (2013). From zero-energy building to zero-energy neighbourhood : urban form and mobility matter. Proceedings PLEA 2013.

Zero-Energy” Building (ZEB) is arousing more and more interest internationally, both in policies aiming at a more sustainable built environment (such as the European Directive PEB that will require, for example, all new buildings to be “nearly Zero-Energy” Buildings (nZEB) by 2020) and in the scientific literature. Although Zero-Energy can be considered at different scales, this approach only adopts the perspective of the individual building and neglects phenomena linked to larger scales. Therefore, this paper aims at investigating the “Zero-Energy Neighbourhood” concept. It proposes a calculation method that takes into account three main topics: the energy consumption of buildings, the impact of the location on the energy consumption for daily mobility and the use of renewable energies. An application of this calculation method to two representative case studies (one urban neighbourhood and one suburban neighbourhood) is proposed. Main parameters that act upon the energy balance are highlighted





and combined to propose concrete results to improve our built environment and move towards more sustainability. Hourly and monthly balances, the potential of “energy mutualisation” and smart grids are keys challenges that are of crucial importance in the scope of a Zero-Energy objective at the neighbourhood scale.

Marique, A.-F., & Reiter, S. (2013). Perspectives pour une transition durable des territoires périurbains. Journées Aperau : Aménager les métropoles.

L'article traite de la transition durable des territoires périurbains. Deux leviers d'action sont mobilisés à cette fin: (1) la forme urbaine et (2) la mobilité. Trois types de scénarios centrés sur une évolution du stock bâti existant sont modélisés et évalués (la rénovation énergétique, la densification et la démolition/reconstruction) de façon à répondre à deux questions : « comment intervenir dans les quartiers périurbains existants? » et « où intervenir? ». Ces simulations montrent que le renouvellement périurbain par densification des quartiers les mieux localisés permet de dépasser le clivage traditionnel entre les modèles de la « ville compacte » et de la « ville diffuse », en offrant de véritables opportunités pour la transition durable des territoires périurbains existants. Ces résultats théoriques, et appréhendés du seul point de vue énergétique, sont ensuite recadrés dans un contexte plus large pour mettre en évidence les opportunités, les limitations, les contraintes et la faisabilité de ces scénarios.

Marique, A.-F., & Reiter, S. (2013). La transition des territoires périurbains vers un modèle plus durable : perspectives pour le renouvellement périurbain. In J.-P., Van Ypersele & M., Hudon (Eds.), 1er Congrès interdisciplinaire du Développement Durable : Quelle transition pour nos sociétés ? Thème 3 : Logement et Aménagement du territoire. Recueil (pp. 59-80).

L'article aborde la question du recyclage des quartiers périurbains existants sous l'angle énergétique. Deux leviers d'actions sont mobilisés à cet effet : la forme urbaine, qui est étudiée en complémentarité de l'échelle du bâtiment individuel, et la mobilité, car l'étalement urbain est entretenu et favorisé, en grande partie par la dépendance à la voiture individuelle. Deux indicateurs principaux (les besoins de chauffage de différents types de formes périurbaines et un indice de performance des déplacements) sont développés et discutés pour mettre en évidence les scénarios de renouvellement les plus adaptés et répondre à deux questions : « comment intervenir dans les quartiers périurbains existants ? » et « où intervenir ? ». Des pistes concrètes visant à l'opérationnalisation d'un « renouvellement périurbain » plus durable sont ensuite proposées.



Marique, A.-F., de Meester, T., & Reiter, S. (2012). An online interactive tool for the energy assessment of residential buildings and transportation. Proceedings of PLEA 2012.

In the current context of increasing environmental awareness, energy efficiency is presented as a viable approach to the mitigation of climate change. In addition to public policies dealing with energy efficiency, heightening public awareness on the impact of citizens' lifestyles and behaviours is crucial and could quickly lead to significant reductions in the total energy consumption of a territory. This paper presents a new online interactive tool which enables citizens, local authorities and private developers (1) to assess energy consumption in the building and transportation sectors, at the individual and at the neighbourhood scales; (2) to compare them and (3) to find relevant and personalized hints to reduce their energy consumptions. Numerous methods and tools including a typological classification of buildings, thermal dynamic simulations, life-cycle assessments, statistical treatments of national censuses, etc. were used and combined to build the database used in the online interactive tool. This tool makes the main results of a scientific research accessible to a large non-specialized audience which is crucial in the scope of the sustainable development.

Marique, A.-F., Petel, M., Hamdi, A., & Reiter, S. (2012). Combining Territorial Data With Thermal Simulations to Improve Energy Management of Suburban Areas. Proceedings of GEOProcessing 2012.

Urban sprawl has been identified as a major issue for sustainable development. Energy consumption in suburban buildings, in particular, is a widespread issue because detached types of houses require significantly more energy to be heated than more compact urban forms. Energy efficiency is often presented as a viable approach to the mitigation of climate change, but research and studies mainly contend with individual buildings and do not address this issue at larger territorial scales or for a whole building stock. In this respect, this paper first presents a morphological definition of urban sprawl. This definition uses territorial and cadastral data available for the Walloon region of Belgium. Using this definition, a suburban type classification adapted to thermal studies is drawn up. A representative block of each type is selected to model energy use and to determine the total energy consumption of the whole suburban building stock. An application is then presented concerning a comparison of potential energy savings associated with several renovation strategies. The results of this exercise are presented and highlight the benefits of combining Geographic Information Systems (GIS) tools, territorial data and thermal simulations for the efficient energy management of suburban areas at the scale of the whole building stock.



Marique, A.-F., & Reiter, S. (2011). Improving energy efficiency of existing suburban areas through district energy planning. Proceedings of ISHVAC 2011.

Urban sprawl represents a significant contribution to the overall energy consumption of a territory for energy needs in buildings and for transport. It is a huge concern in Belgium where public authorities face the following question: “what to do with existing low-density districts that require a lot of resources?” while households still continue to favour this kind of dwellings. In this context, the paper draws up a typological classification of reference Walloon suburban blocks. Then, energy savings relating to several types of renewal strategy are evaluated. These strategies deal with the measures to reduce heat demand in buildings, to increase the built density and to reduce energy consumption in the transport sector. Results from this analysis show that a strong potential exists to improve energy efficiency in existing suburban districts. Building insulation and travel distances are critically important factors. Solar gains on the roofs are huge even if the built density is increased.

Marique, A.-F., De Meester, T., & Reiter, S. (2011). Energy requirements and solar availability in suburban areas: the influence of built density in an existing district. Proceedings of the International Conference CISBAT 2011 - Clean Tech for sustainable buildings - From Nano to urban scale (2011) (pp. 925-30).

Although the environmental impacts of urban sprawl and their associated energy consumptions are now well documented, it remains a concern in many regions. In the current context of growing interest in environmental issues, local authorities become aware of this concern and are now trying to limit the development of new low-density suburban districts while households still continue to promote dispersed individual housing types located outside city centres.

In this context, the paper proposes to investigate the influence of an increase in built density, in existing suburban neighbourhoods. The idea is to favour a higher built density in existing neighbourhoods instead of building new low-density neighbourhoods on unbuilt areas. The impacts of four renewal strategies dealing with the density are assessed, at the neighbourhood scale, for three indicators: (1) the potential energy savings for heating houses, (2) the solar energy received by the facades and roofs, as dispersed individual housing types are known to be those that receive most solar gains and (3) the potential area of land savings.

Marique, A.-F., Dujardin, S., Teller, J., & Reiter, S. (2011). Urban Sprawl and Travel Energy Consumption: the Case of the Walloon Region of Belgium. Irish Transport Research Network Conference, Energy & Transport, Programme and Proceedings.





In the actual context of growing interests in environmental issues, reducing energy consumption in the transport sector, which represents 27% of final energy in the Walloon region of Belgium, appears as an important policy target. Although it is often argued that more compact urban forms would significantly reduce transport energy consumption, urban sprawl is a concern in a large part of the regional territory. Moreover, assessment tools dedicated to transport energy consumption are lacking.

In this context, the paper first presents a quantitative method developed to assess the transport system in the Walloon region of Belgium. Statistical data available at the neighbourhood scale and characteristics of cars and public vehicles are used to predict transport needs and assess energy consumption as far as home-to-work and home-to-school travels are concerned. Three index are presented and mapped (the energy performance index, the modal share and the mean distance travelled) to investigate the interdependences between spatial planning, urban sprawl and travel energy consumption in the Walloon region of Belgium. Three complementary scales are used: the “municipality” scale allows to highlight the general structure of the territory whereas the “former municipality” and the “census block” scales (the smallest geographical unit in which data are available in Belgium) highlight more detailed phenomenon. The evolution of the performance index between 1991 and 2001 and the difference in energy performance between home-to-work and home-to-school travels are also presented.

Our main findings are presented and highlight that urban planning acts upon travel energy consumption. We show particularly that main cities present low energy consumption. However, a local scale approach is useful to highlight the existence of secondary suburban and rural cores presenting low transport energy consumption. In this respect, distance from home to destination is paramount while the mode of transport used has a lower impact.

Marique, A.-F., & Reiter, S. (2011). Towards more sustainable neighbourhoods: are good practices reproducible and extensible? In B. M., Evrard Arnaud (Ed.), Proceedings of International Conference PLEA 2011 : Architecture & Sustainable Development (pp. 27-32). Presses Universitaires de Louvain.

Several urban neighbourhoods built or retrofitted from the 1990s have become renowned for their sustainability and are often presented as good practices, as far as sustainable development and low energy architecture are concerned. Although these “sustainable neighbourhoods” receive a great deal of media coverage, they seem to stay “single” experiments and are rarely repeated in other territories or at larger scales. This paper first discusses the European context, which fostered the development of these pilot experiments. It then proposes a rereading of eight famous sustainable neighbourhoods in an analytic way that is more than descriptive to highlight good practices to repeat and weaknesses to avoid and question the reproducibility of these experiments. The settings grid, which describes the achievement conditions and some common characteristics of these urban



projects, highlighted through this analysis, is compared with a Belgian dwelling project, and this comparison allows us to explain why it can be difficult to extend these concepts more widely. Finally, the paper proposes several guidelines to promote energy efficiency and sustainability at the urban scale in order to support the planning of more sustainable urban projects.

Wallemacq, V., Marique, A.-F., & Reiter, S. (2011). Development of an urban typology to assess residential environmental performance at the city scale. In B. M., Evrard Arnaud (Ed.), Proceedings of International Conference PLEA 2011 : Architecture & Sustainable Development (pp. 119-125). Presses Universitaires de Louvain.

In this research, a typology of urban blocks is drawn up for the urban area of Liege. This typology of urban blocks is organized into a set of themes according to various environmental parameters. This paper presents the energy part of this typology on the residential building stock of Liege, which includes four topics: residential buildings energy consumption; transport energy consumption of residents; development potentialities of public transport and development potentialities of energy networks. The proposed typology was elaborated

through the use of GIS tools combined with a statistical treatment of several specific criteria at the urban block scale. For each class of this typology, a representative block is selected for further energy simulations in order to model residential energy use related to buildings, transport and energy networks at the city scale. The methodology developed in this paper is adapted to urban, suburban and rural zones. It can thus be adapted and/or reproduced on many other territories in Belgium but also in Europe or even further.

de Meester, T., Marique, A.-F., & Reiter, S. (2011). The influence of occupation modes on building heating loads: the case of a detached house located in a suburban area. In B. M., Evrard Arnaud (Ed.), PLEA 2011 Architecture & Sustainable Development, Proceedings (pp. 450-456). Belgique: Presses Universitaires de Louvain.

Occupants' behaviour is known to have a great influence on energetic demand, management and consumptions of a building. However, parameters related to inhabitants' lifestyle are often neglected in energetic studies and researches that often focus on insulation, ventilation or climate. In this context, the aim of the paper is to investigate the influence of three parameters related to human behaviour (the family size and the modes of occupations, the management of the heating system and the management



of the heated area) on the housing heating loads of a standard dwelling. The case study chosen for this analysis is a detached house located in a suburban area. Five levels of insulation are tested (no insulation, an intermediate level corresponding to 3 cm of insulation, the current standard for new buildings in the Walloon region of Belgium, the low energy standard and the passive house standard) in order to highlight the impact and the interactions between occupation modes and insulation levels. The relevance of the adaptation of the living area of the house according to the evolution of the family size is finally discussed.

Marique, A.-F., & Reiter, S. (2010). A method to assess global energy requirements of suburban areas at the neighbourhood scale. Proceedings of the 7th International Conference on Indoor Air Quality, Ventilation and Energy Conservation in buildings.

This article presents the method developed to assess existing suburban neighbourhoods in order to improve their energy efficiency. It combines the use of dynamic simulation tools to evaluate energy requirements for heating and lighting residential buildings, a statistical approach to assess the transport system and a simplified calculation to take also into account public lighting. The method is completed by a life-cycle analysis of buildings. An application is presented concerning the comparison of three typical suburban structures in the Walloon region of Belgium. The influence of parameters which are often underestimated, like distribution of buildings or location, on the global energy performances of suburban fabrics is tested. The results of this exercise are presented and its limits are discussed.

Marique, A.-F., & Reiter, S. (2010). A method to assess transport consumptions in suburban areas. Paper presented at Managing the Urban Rural Interface. Strategies and tools for Urban Development and Sustainable Peri-Urban Land Use Relationships (PLUREL), Copenhagen, Denmark.

Posters





Ruelle, C., Marique, A.-F., Reiter, S., & Teller, J. (2013). Les projets SUN et SOLEN : Soutenir la régénération durable des quartiers. Poster session presented at HERA Awards 2013, Bruxelles.

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