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Energy efficiency rating of districts, case Finland

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HIGHLIGHTS

- We have created a tool for assessing energy efficiency of detailed city plans.
- The energy source is the most important factor for efficiency of districts in Finland.
- Five case districts in Finland were analyzed.
- In this paper one residential district has in-depth sensitivity analyses done.

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ABSTRACT

There is an increasing political pressure on the city planning to create more energy efficient city plans. Not only do the city plans have to enable and promote energy efficient solutions, but it also needs to be clearly assessed how energy efficient the plans are. City planners often have no or poor know how about energy efficiency and building technologies which makes it difficult for them to answer to this need without new guidelines and tools. An easy to use tool for the assessment of the energy efficiency of detailed city plans was developed. The aim of the tool is for city planners to easily be able to assess the energy efficiency of the proposed detailed city plan and to be able to compare the impacts of changes in the plan. The tool is designed to be used with no in-depth knowledge about energy or building technology. With a wide use of the tool many missed opportunities for improving energy efficiency can be avoided. It will provide better opportunities for sustainable solutions leading to less harmful environmental impact and reduced emissions.

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1. Introduction

The buildings sector has been recognized as a key sector of the economy in improving sustainability. The United Nations panel on climate change IPCC has estimated that the greatest greenhouse gas reduction potentials are available in buildings (IPCC, 2007). Concerning Finland, it has been estimated that a few percent higher investment in energy efficient construction and renovation can decrease total primary energy consumption of the country 4–5% by 2020 and 5–7% by 2050 (Tuominen et al., 2013).

Various environmental assessment tools have been developed for the building sector to improve sustainability and support decision making during the past few decades. Recently the focus of assessing energy efficiency and sustainability of built environment has expanded from single building level into neighbourhoods, district and even city level assessments (Haapio, 2012). There are already lots of different assessment tools for evaluating energy efficiency and sustainability, such as internationally well

known LEED for Neighbourhood Development (LEED, 2011), BREEAM Communities (BREEAM, 2012) as well as CASBEE for Urban Development (CASBEE, 2007) and CASBEE for Cities (CASBEE, 2011). In addition, national assessment tools and frameworks for sustainable built environment are developed in specific projects in Finland. Lahti et al. (2010) developed a tool for evaluating eco efficiency of areas in the city of Helsinki.

Energy efficiency is one of the key targets for city planning, but at least among Finnish city planners, there is a lack of tools for evaluating the energy efficiency of districts. Especially support is needed when estimating the effects of different decisions and actions within a district. Feedback from city planners has shown that the existing tools are rather complicated to use and take too much time. A need for an easy and fast tool was expressed in the feedback. To fulfil this need, a tool for rating energy efficiency of Finnish districts was developed in Ekootajama project between 2010 and 2012.

The target was to provide a quick and easy-to-use tool for evaluating energy efficiency of districts for city planners, focusing on aspects that can be influenced on a detailed city planning level. Energy efficiency rating is based on primary energy use, in order to take into account both the energy demand and the energy source.

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It is possible to evaluate different areas, for example with centralised energy production systems, such as district heating, but also distributed energy production and separate energy production systems of buildings. Energy demand is being assessed mainly through the energy classification rating system taking the heating and electricity demand of buildings into account.

The decision to use primary energy as the indicator was done because of many reasons. The tool was to indicate energy efficiency, not low emissions. The use of primary energy supports the energy efficiency rating taking the whole energy chain into account. If emissions were to be used, it should be assessed which emissions to take into account and with what weighting factor. The common way to use only CO₂ eqv as indicator was dismissed because of many other emissions also having an important role. One example is particle emissions. In rural areas small scaled wood heating is common and can create lots of particle emissions which can have negative impacts on the local air quality. The tool was based on the energy classification rating systems which are based on primary energy demand; this was another reason for choosing primary energy and using the same primary energy conversion factors as in the energy classification rating system. The energy classification rating was in turn chosen because it enables city planners to easily evaluate the energy demand of the buildings without having building physics knowhow.

1.1. Finnish city planning processes

To better understand the use of the tool, a short description of the city planning process in Finland is given below.

The Land use- and Construction Law (LCL), that contains rules for both land use planning and instructions for constructing, was founded for the purpose of creating a healthy, safe and comfortable living environment where the needs of different population groups are taken into account. The purpose of the law is to:

- organize land use and constructing objectives to provide for good living environment,
- promote development in terms of ecological-, economical-, social- and cultural sustainability, and
- secure the possibility of individuals to take part in preparation of matters, quality of planning and interactivity, versatility of expertise and open publicity (Ministry of the Environment, 2012b).

Fig. 1 illustrates the hierarchy chain of urban planning in Finland. The Finnish Ministry of the Environment elaborates the Nationwide Objectives for Land Use (NOLU) based on the Land use- and Construction Law, international agreements and EU directives. The NOLU is for balancing the development of regions and therefore also dictating all of urban planning in the country. It contains strategic decisions on higher level such as those concerning nationwide road- or rail networks and harbours. Based on the NOLU regional councils prepare their regional plans which are to be approved by the Ministry of the Environment (FINLEX, 1999).

Each regional council prepares a land use plan for their own region which usually involves several municipalities. The regional plans in turn serve as a frame for urban planning in the municipalities. Urban planning on a municipal level is about bringing forth a master plan, a town- or detailed plan and in some municipalities also a shore plan.

The master plan is made to direct the development and land use for the municipality as a whole, while a detailed plan is more specific and concerns certain areas of the municipality. The master plan forms in that sense a bigger picture that detail plans must fit into. The shore plan on the other hand dictates the use of shoreland (often for vacation settlement) (FINLEX, 1999).

An important issue is that all municipalities do not have equal resources allocated to urban planning. Larger municipalities or cities have in general more resources than smaller municipalities, usually

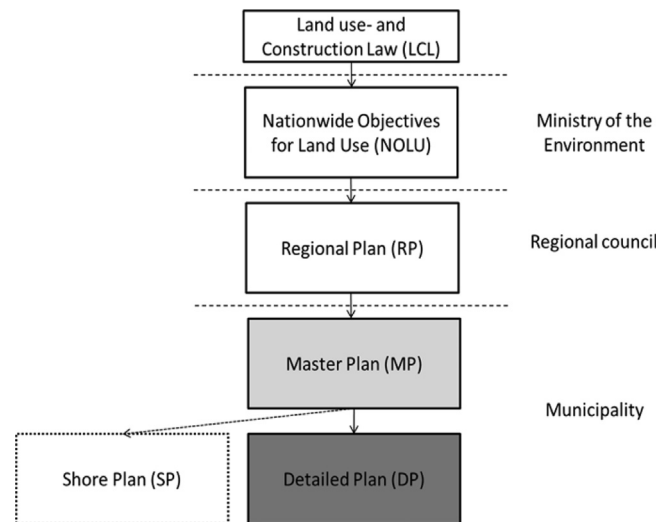


Fig. 1. The hierarchy chain of urban planning in Finland (FINLEX, 1999).

they have an own city- or urban planning department for developing both the master- and detailed plans. Urban planning departments mainly consist of architects and might often include land surveyors as well. Smaller municipalities may not have a department for urban planning and might therefore outsource some of the tasks to companies or consultants. Also, the responsibility of urban planning belongs to the head of urban planning department in larger municipalities, while in smaller municipalities it might be appointed as one of the tasks of a head engineer or technical manager. This further underlines the unequal prerequisites for urban planning between municipalities in Finland (Löytönen, 2011; Simons, 2011; Tommila, 2011).

The master plan is as earlier mentioned a general plan for directing the societal structure and land use of a municipality in its entirety. Existing social structures, economic- and ecological sustainability and natural values are to be paid attention to when a master plan is being developed. It also has to secure the inhabitants accessibility to social infrastructure and services such as water supply and sewage, energy- and waste management and roads.

A master plan could also be made for only a part of a municipality (partial-master plan) or jointly made by several municipalities (jointly drafted plan) (Ministry of the Environment, 2012b). The objectives and restrictions of a master plan are to be considered for the preparing of detailed plans. The detailed plan in turn defines the land use and construction of certain areas by taking into account local circumstances, city and scenery picture, and good construction methods (FINLEX, 1999).

A detailed plan includes a map where borders are declared for the planned areas. The map also contains information about what purposes different areas are going to be used for, the level of construction and principles regarding the localization and size of the building and also the method of construction when needed. Both the master and detailed plan are approved by the municipal council. According to the land-use and construction law, those people who are affected by the plans are also given the right to influence them (FINLEX, 1999).

Once a detailed plan is approved, it is the task of the building inspector to follow up on its implementation. The building inspector is responsible for ensuring that all construction is following plans and regulations, and that the built environment is safe and sustainable. They also grant building rights, offer counselling when needed, and decide in the end when a building can be brought into service (Ministry of the Environment, 2012b).

In the development of this energy efficiency rating tool, detailed city planning areas are considered as districts. One detailed city plan being one district. In the development project, Ekotaajama, five

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