Contribution of cadastral information to climate change policy in the Netherlands

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Key words: climate change, greenhouse gas emission, reduction energy consumption, built environment, cadastral data.

SUMMARY

In the challenge to cope with climate change, the importance of urban areas is increasingly acknowledged. This article provides an outline of the use of cadastral information, combined with other spatial datasets in support of climate change policy within the context of the Netherlands. The examples of the municipalities of Bussum and Apeldoorn are used to explain and discuss the use of cadastral data to support governments in their climate policies. The paper concludes exploring and discussing the possibilities of implementing this strategy outside the Netherlands and to combine data, experiences and ideas internationally.

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1. INTRODUCTION

Data comprised in land information systems are useful to facilitate governments in both their adaptive and mitigative climate policy. In order to do this, land registers and cadastres have to extend their function beyond the conventional use (Van der Molen, 2009).

This paper aims to demonstrate the potential use of cadastral information in support to urban climate change policy in the Netherlands. First the general role of urban areas in climate change policy is given in paragraph 2. Then an introduction to climate change policy and the emission of greenhouse gasses in the Netherlands is given in paragraphs 3 and 4. The next two paragraphs describe the possibilities of the use of cadastral core data as an information base for policy makers as well as several tailor-made energy characteristics. Two practical use cases of these characteristics are given in paragraph 7. The paper concludes with the possibilities of implementing this strategy outside the Netherlands and by discussing the exploration of chances in combining data and ideas internationally.

2. URBAN AREAS AND CLIMATE CHANGE

In the global challenge to cope with climate change, the importance of urban areas is increasingly acknowledged. The renowned 1987 Brundtland report made the role of cities central in most current environmental policies (Schubert and Láng, 2005). In the Brundtland report it was argued that as the majority of the future population would live in cities, they should have a major focus of attention to climate change policy. Their prediction has proven to be correct as today more than 50% of the global population lives in cities. This makes urban areas the prior areas for greenhouse gas emissions (Grimm et al., 2008) and the development of sustainable cities as a central goal on the climate agenda. The role of cities in the reduction of greenhouse gas emissions is not only important because of their relatively high energy consumption and production of waste. Also, cities have proven to be prepared and capable to work on sustainable development issues (Bulkeley and Betsill, 2005). Moreover, climate change effects the urban environment directly; urban temperatures are regularly higher than temperatures in their rural surroundings, known in literature as the urban heat island effect (i.e. Kleerekoper et al., 2011). Urban municipalities thus stand for the extreme challenge to develop their urban areas into sustainable cities and to decrease the amount of greenhouse gasses that are emitted within their municipality. When developing climate policy at municipal scale, detailed climate information can be very supportive. It may even be argued that 'high quality energy information' is essential to develop a good climate change policy.

3. CLIMATE CHANGE POLICY IN THE NETHERLANDS

There is a natural sense of urgency for climate change policy in the Netherlands as 26% of the land surface is situated below sea level and another 29% of the land is susceptible for flooding. Thus 55% of the land surface in the Netherlands is extra vulnerable for the effects of climate change. As a result, the Netherlands was in the nineties one of the first countries to develop a national climate change policy (Gupta et al., 2007). Today, the Netherlands have, in accordance with EU directives, set their climate change targets for 2020. They consist of a 20% reduction of CO_2 emissions, a 20% reduction in energy consumption, and an energy production of 14% non-fossil renewable energy sources. National and local authorities are challenged to achieve these targets and are developing and implementing climate change policies. The aims should be reached by the increased use of renewable energy sources combined with energy saving measures. In order to develop effective strategies and to monitor the results of these policies basic information on a fine-grained level is needed.

4. CO2 EMISSION IN THE BUILT ENVIRONMENT

In the Netherlands, agriculture, transport & traffic, industry & energy and the built environment are the main four sectors that cause CO_2 emissions. The built environment is accountable for 25% of the CO_2 emissions and 40% of the energy consumption. Moreover, 70% of the emissions caused by the built environment come from dwellings. Hence, in obtaining the national targets, special attention is given to the residential built environment by municipal governments.

Most municipalities have limited budgets to reach the climate targets and therefore depend on real estate owners to invest in their properties to make them 'climate proof'. In this context it is important for municipal policymakers to distinguish between private and rental houses, as both target groups require a different approach. Rental houses in the Netherlands are mainly owned by housing corporations and can therefore be approached centrally via the corporation. Yet, private house owners are a more diffuse group to reach and form a major challenge for Dutch municipalities.

Another important distinction that municipalities need to make is based upon the year of construction of the dwellings. As Dutch building regulations have been tightened, construction techniques have been improved in the last fifty years (AgentschapNL, 2011). The energy performances of dwellings have therefore generally improved over time (figure 1). Fifty percent of the emissions from residential buildings are accountable to dwellings that were built before 1976.

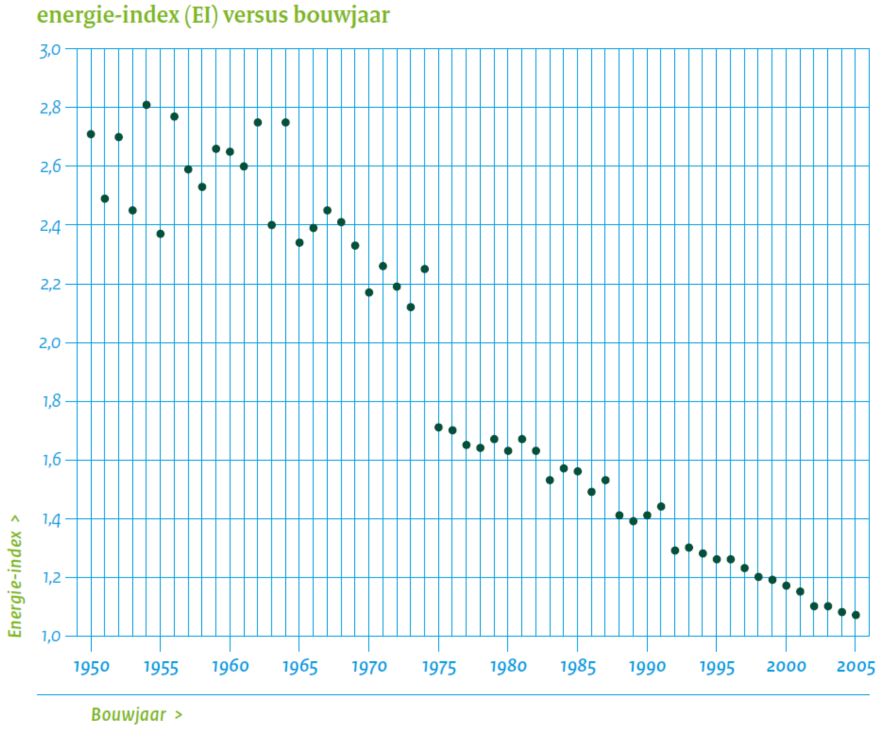

Figure 1: Average energy-index of Dutch dwellings per year of construction (source: Agentschap NL, 2011)

Municipalities search for effective measures to reach private house owners. Currently, communication campaigns in local areas are regularly applied. However, these campaigns often have low success rates. Municipalities are thus still searching for effective means to reach private house owners that are willing to invest in measures to improve the energy efficiency of their properties.

5. CADASTRAL DATA AS AN INFORMATION BASE FOR POLICY MAKERS

The Netherland's Cadastre, Land Registry and Mapping Agency, known as Kadaster, registers and administers several data that can be used in support of climate change policy. Basically the registers are grouped around the Cadastral Key Register; the cadastral map and the cadastral registration. The cadastral registration consists of a broad variety of data on the legal and factual status of immovable property. For example all property rights of parcels and buildings can be found in the cadastral registration. The Netherland's Cadastre has integrated these core data within the Cadastral Key Register and they are linked with the addresses and building Key Register. The Netherland's Cadastre does not bear the final responsibility for the addresses and building Key Register but controls it under operational governance. Moreover, the Netherland's Cadastre has many other national registers under operational governance, for example the energy labels of buildings in the Netherlands.

The registration of energy labels of buildings is a result of the implementation of the Energy Performance Building Directive (EPBD). In this directive the European Union has implemented the obligation to make an energy performance certificate for residential and utility buildings available for the prospective owner. This obligation was implemented with the direct aim of promoting the energy performance of buildings and is effective for all member states of the European Union (Brounen and Kok, 2011). In the Netherlands this legislation has been implemented since January 2008. An energy label is now required during sale, letting or construction transactions of real estate. The energy labels are registered in the registers of the Dutch Cadastre and as such publicly available.

Starting with the core data, cadastral parcels, buildings and ownership rights it is possible to attach relevant information attributes and design these into coherent and tailor-made information packages. These information packages can be used in the context of the policy issues as for climate change policies and energy policies.

6. ENERGY CHARACTERISTICS FOR THE BUILT ENVIRONMENT

In order to support policy makers in obtaining and monitoring their targets in the built environment, a pilot study in the municipality of Apeldoorn was conducted. In this study several information packages were developed to be used as energy characteristics for any municipality in the Netherlands. These information packages were designed with the challenges and demands of policy makers in mind. Within the pilot study, prototypes of the information packages were discussed with policy makers and fine-tuned to their specific needs. During the discussions we learned that Apeldoorn was interested in the combination of information on the energy performance of buildings and information on the social characteristics of their inhabitants.

Cadastral data provide both insights in characteristics of the property itself and in the legal owner of the property. Table 1 gives an overview of the main information that is relevant in the context of climate change policy and that is available via the Netherland's Cadastre.

Table 1: Dwelling and owner information

Dwelling & owner information	**Data source**	**Variables/unit**
Dwelling type	Cadastral Key Register	Separate, semi-detached, detached, detached-corner, flat
Year of construction	Addresses and building Key Register	Year
Type of ownership	Cadastral Key Register	private or rental
Age of private owner(s)	Cadastral Key Register	Date of birth
Guarantee or maximum mortgage	Cadastral Key Register	Euro's
Registered energy label	Energy Label Register	A++, A+, A, B, C, D, E, F, G.
Geographical location of house	Cadastral Key Register	Geographic coordinates/ cadastral map

In order to support municipalities during the development of their climate change policies, the cadastral data were combined and enriched with other available national and statistical databases on energy consumption (gas and electricity) and social-economic characteristics of neighborhoods. Two methods to link the datasets were explored. In the first method, cadastral data and databases could be combined using the address of individual houses as linking key. In the second method the datasets were linked using geographical coordinates. Both methods successfully resulted in a dataset in which cadastral parcels were linked to the address, housing type, building year, energy label (when available), neighbourhood and type of property right.

Benchmark data on estimated energy label, energy efficiency improvement measures, potential energy label improvement, potential reduction on energy and CO_2 emission, and potential costs of label improvement are used to translate the above-mentioned dataset into energy performance data. The cadastral data and benchmark data could be combined with the 'year of construction' and 'dwelling type' as linking key.

Abovementioned data are available on different scales, but all have a minimum geographical scale of neighborhood level. For reasons of privacy and to be able to compare the data, the combined results were aggregated on the scale of neighborhoods. This aggregation was possible by combining address data with the geographical boundaries of neighborhoods.

The data combinations are designed to result in tailor-made information packages and are called Energy Characteristics for the Built Environment. These packages were used in several occasions by policy makers as is described in the use cases further on in this paper. These energy characteristics are mostly plotted as a geographical map on the scale of city neighborhoods. Examples of these energy characteristics are

- mean energy label, registered or estimated
- mean energy consumption
- mean CO_2 emission
- potential reduction of energy consumption and potential reduction of CO_2 emission when efficiency measures are taken
- mean costs and mean payback time of efficiency measures
- age distribution of owners of dwellings
- indication of purchasing power of owners

An example of the characteristic on the potential of CO_2 emission reduction is given in figure 1.

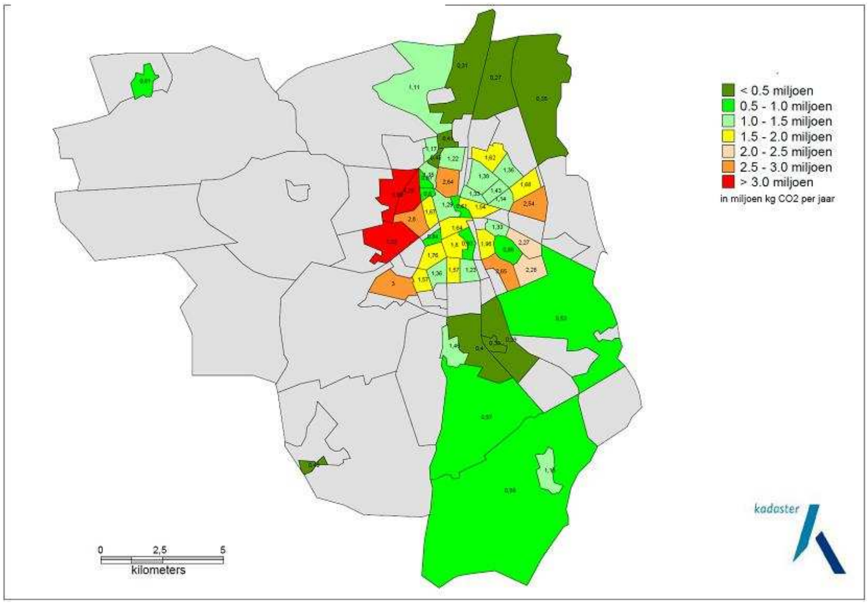

Figure 1: Potential of CO2 emission reduction (million kg /year) for privately owned dwellings when energy efficiency measures are taken.

Different energy characteristics can be combined with 'neighborhood' as linking key. By quantifying several energy characteristics in a multi-criteria analysis it is possible to make a geographical visualization of the neighborhoods where the highest reduction in energy consumption and reduction in CO2 emissions are possible. With this information a municipal policymaker can focus on the low-hanging fruit.

7. USE CASES IN THE NETHERLANDS

7.1 Bussum

The municipality of Bussum, with more than 32.000 inhabitants, is fine-tuning its climate change policy on dwellings. In order to convince the owners in taking energy efficiency measures, the municipality has started a communication campaign. Part of this campaign is to show the citizens the appearance and type of energy label on the scale of individual buildings. Furthermore the citizens are informed about the energy efficiency of private dwellings by means of an estimated mean energy label per neighborhood. This information is published by the municipality of Bussum on a public web based GIS.

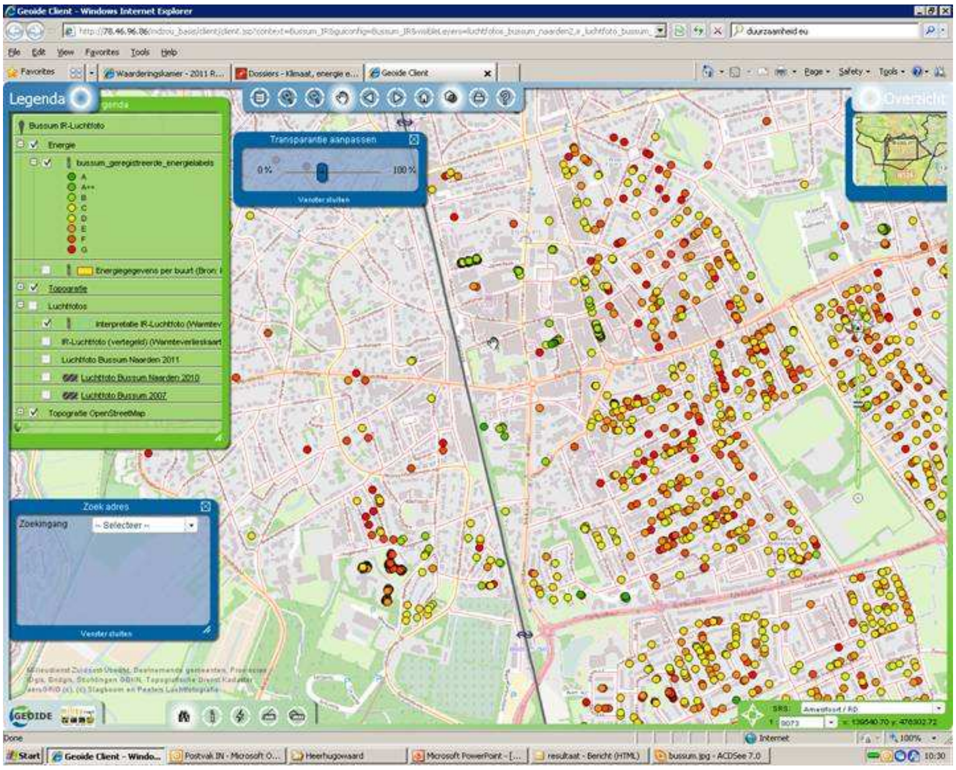

Figure 2: Appearance and type of registered individual energy labels in the municipality of Bussum. The appearance of the mean energy label for each neighborhood is blanked for reasons of readability. (available on: http://www.bussum.nl/ruimtelijke-plannen/geoloket)

The Dutch Cadastre has provided the geo-referenced energy labels and has analyzed the privately owned dwellings to estimate the mean energy label for each neighborhood. With this information the municipality of Bussum was able to make an underpinned focus for the most successful areas for implementing their climate change policy.

7.2 Apeldoorn

The municipality of Apeldoorn, having more than 156.000 inhabitants, is amongst many other municipalities, searching for effective means to indicate the areas where private owners of dwellings are most willing to take energy efficiency measures. Apeldoorn has indicated that physical as well as social- economic aspects are important indicators.

In cooperation with Ecofys, a leading international consultancy in energy and climate policy, a set of indicators was developed and discussed with Apeldoorn. Indicators were analyzed and calculated on the scale of neighborhoods. The following indicators where chosen:

- Energy index of privately owned dwellings. If present, the registered energy labels where used. The registered energy labels are combined with neighborhoods with 'address' as linking key. However, the vast majority of these buildings have no energy label registered yet. In those cases the energy index was estimated based on the type of

dwelling and year of construction. The estimated energy labels are combined with neighborhoods with ‘address’ as linking key.
- Homogeneity of residential buildings. Apeldoorn wanted to investigate the possibilities of a bulk approach for taking energy efficiency measures in dwellings. Neighborhoods with many comparable buildings are more eligible for bulk approach. This indicator was calculated based on the combination of the type and construction year of the dwelling. These data are combined with neighborhoods with ‘address’ as linking key.
- Appearance of monuments. State, provincial and municipal monuments are strongly protected by law. In many cases it is forbidden to alter the construction and appearance of these buildings and this interferes with the taking of energy efficiency measures. Some neighborhoods of Apeldoorn are known to have many residential buildings with a monument status. As the Netherland’s Cadastre registers part of the monument-related constraints of a building, it was possible to determine this indicator for each neighborhood. The appearance of monuments is combined with neighborhoods with ‘address’ as linking key.
- Estimated Income. The Netherland’s Cadastre registers the maximum mortgage (guarantee) for each transaction, it does not register the income of the owner. However a relative indication on the income can be made as the height of mortgages are calculated by banks based on the income of the owner. By analyzing all mortgages it was possible to determine an income indicator. The estimated income is combined with neighborhoods using ‘address’ as linking key.

Abovementioned indicators were combined and a final score was calculated for each neighborhood of Apeldoorn. The final score predicts the chance that private owners will take energy-efficiency measures resulting in a relatively high reduction of CO2 emissions. A map was made to show the geographical distribution of these chances. With this map the municipality of Apeldoorn was supported with the implementation of their climate change policy.

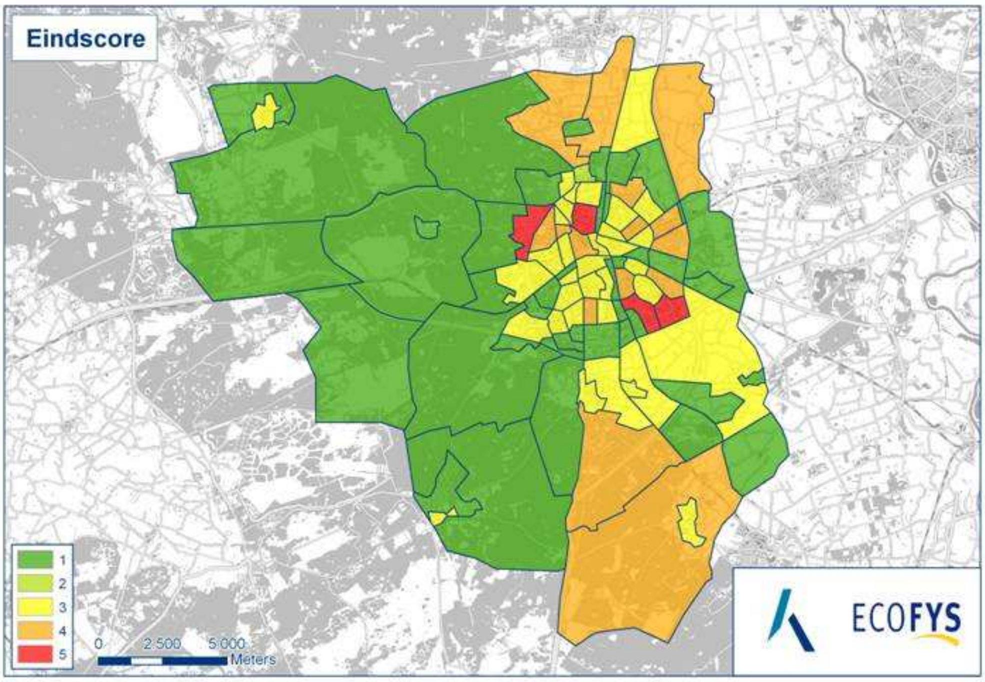

Figure 3: Chances of reduction of energy consumption and CO2 emissions by taking energy efficiency measures by owners of privately owned dwellings. Red: highest chance Green: lowest chance

8. CONCLUSION AND DISCUSSION

As shown in the abovementioned cases of Bussum and Apeldoorn, the combination of cadastral core data with other data sets is well equipped as a base for information packages on the theme of climate change. If analyzed and designed from the perspective and demands of policy makers, tailor-made information and maps can directly be used in support to climate change policy. The tools and information packages used in the example of Bussum and Apeldoorn are one amongst many other possibilities in the use of cadastral data. Some already have been recognized but still need further research and analysis.

Colleagues from cadastral organizations are invited to explore the possibilities of their core data in relation to climate change. The Dutch approach might be inspirational and helpful in developing this within different contexts. Special attention should be given to explore the broad possibilities of joint data of many cadastral organizations to address international and global climate change challenges and policies.

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BIOGRAPHICAL NOTES

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