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Exploring the feasibility of future housing development within existing cities: science-for-policy in the face of complexity and politicisation

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Abstract
In cities around the world, housing demand is increasing rapidly. Since housing supply is inelastic, house prices are rising as well, which causes affordability problems. Although there is consensus about the need to raise production, there is debate about its location: within the existing city, on underused or derelict buildings and sites, or on greenfield land outside existing city boundaries? The question we address is how researchers on the science–policy interface can support these debates and facilitate evidence-based decision-making. We address two major problems while doing this: (1) the complexity of the object at hand, that is, of the development of urban systems and (2) the politicised nature of science-for-policy. The contribution of this paper is that it links complexity theory to the literature about science-for-policy, two usually unconnected literatures. An additional contribution is that it shows how the role of the scientist as 'honest broker', as developed by Roger Pielke, can be operationalised and applied to existing policy debates. We do that for the Dutch debate about housing development in existing urban areas.

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Introduction

There is a revival and even a 'triumph' of the city (Glaeser, 2011), or at least of cities with human capital that allows them to benefit from world-wide technological advancement (Moretti, 2012), such as London, New York, San Francisco, Boston, Paris, Munich, Amsterdam, and so on. Such cities attract people and businesses seeking to enjoy the opportunities offered, both as production and consumption magnets. Housing demand in these cities is large and rising, raising prices to such an extent that even the 'squeezed' middle classes have started to suffer affordability problems (e.g. Florida, 2016). The answer, many agree, is straightforward: increased housing production.

The question is: where? Within the existing city, on underused or derelict sites and buildings, or outside existing city boundaries, on greenfield land? This question is raised particularly in countries with strong traditions of protecting green areas around cities, such as the UK with its Green Belts and the Netherlands with its Green Heart (e.g. Faludi and Van der Valk, 1994; Hall, 1973). It leads to politicised debates in which different parties tend to take rather absolute and immovable positions (see 'To build-in or build-out: The Dutch debate' section). The debate covers multiple elements including the desirability, financial feasibility and 'physical' feasibility of housing development within the existing urban fabric. In this paper, we deal with the latter, i.e. the feasibility of housing development given the physical space 'available' on 'un(der)occupied' (vacant, derelict) sites and buildings in the city.

As researchers working on the science–policy interface, we want to address this issue for the Dutch case. In doing so, we face two major problems: one is the complexity of the object, that is, of urban systems and urban development, and two is the politicised nature of the debate around building inside or outside the city limits. In trying to shed light on the issue, we link two bodies of literature. The first is the growing body of literature that connects planning and complexity, with its focus on non-linear relations, uncertainty, self-organisation, the problems of predictability and the need for adaptive planning (e.g. Abbott, 2005; Batty, 2005; Moroni, 2015; Portugali, 2006; Portugali et al., 2012; Rauws, 2017). The second body relates to role of science in politics and policymaking (e.g. Hajer, 2009; Jasanoff, 1990; Pielke, 2007; Turnhout et al., 2013). While in the planning literature the focus is often on the role of the planner, more specifically within deliberative planning processes (e.g. Forrester, 1989; Healey, 1997), research(ers) for policy gets less attention. Particularly Pielke's (2007) *The Honest Broker* enables us to navigate through different roles and challenges at the science–policy interface. The scientist as an 'honest broker' between policy alternatives allows the value plurality in policy debates and the complexity and the uncertainty of the policy object to be taken into account. The contribution of this paper to the literature is twofold: one, it links two bodies of literature (i.e. complexity theory and theories about science-for-policy), and two, we operationalise and apply the role of the scientist as 'honest broker' to a modelling exercise we did to inform the Dutch policy debate about housing development in cities.

The paper is structured as follows. In the first part of the article ('Urban future research in the face of complexity and mediatised politics' section), we elaborate on the theoretical notions of complexity and uncertainty as conditions under which planning for urban futures

takes place ('Cities as complex urban systems' section). We then discuss the fraught relationship between science and policy, and the possible interface roles to deal with uncertainty and complexity ('Science-for-policy in a politicised context' section). We argue that the role of the honest broker is best suited for independent researchers in a politicised context. Subsequently, we operationalise this role as one to uncover limitations in the debate in order to broaden the scope for policy choice, instead of narrowing it down, and one in which research choices and their implications are pointed out. In the second part of the article ('To build-in or build-out: The Dutch debate' and 'Exploring the Dutch possibilities for future housing development within current city boundaries' sections), we apply this role to the Dutch case: to what extent can housing demand be accommodated within the existing urban fabric and how can we as 'brokers' support the debate on this issue and facilitate evidence-based decision-making? We first disentangle the scope of the building-in versus building-out debate in the Netherlands and identify five limitations ('To build-in or build-out: The Dutch debate' section). In 'Exploring the Dutch possibilities for future housing development within current city boundaries' section, we address these limitations to broaden the scope for decision-making by drawing attention to overlooked policy aspects such as regional differences and uncertainty and by showing the impact of different policy decisions for the feasibility of building inside existing cities. We do so by laying out a scenario approach and apply land-use modelling in which we identify the important variables, the assumptions regarding the values of those variables and the sensitivity of the outcomes to those assumptions. In being explicit and transparent (i.e. 'honest'), we contribute to well-informed policymaking. In the final section, we reflect on the lessons learned in performing our role as 'honest broker', and its implications for policy and decision-making.

Urban future research in the face of complexity and mediatised politics

Cities as complex urban systems

Planning involves understanding and managing uncertainty about urban and spatial development (Abbott, 2005; Christensen, 1985). This is not new. It has been a key topic in planning theory since the 1960s (e.g. Faludi, 1973; Friend and Jessop, 1969). Related to uncertainty is the issue of complexity. In recent years, there has been increasing attention for the (increasingly) complex nature of cities and the transitions that they face (e.g. Abbott, 2005; Batty, 2005; De Roo et al., 2012; Moroni, 2015; Portugali, 2006; Portugali et al., 2012; Rauws, 2017). In this context, some have pointed to the presence of 'deep uncertainties' and 'wicked problems' (e.g. Rauws, 2017: 32). Complexity is not a mere platitude – surely, that society is complex will not surprise many – but it has important consequences for our understanding of cities and for policy intervention. A *complex* system can be defined as: 'composed of a large number of components whose interaction is iterative and recursive (i.e. non-linear), with many direct and indirect feedback loops; it presents unintentionally emergent forms of order; it is self-organising; it is markedly dynamic and adaptive' (Moroni, 2015: 250).

Complexity is not solely the result of individual components and the frequency of their occurrence, but of the *interactions* between them. It is the same with cities: it is impossible to retrospectively derive its end result from all individual events (whether demographic, geological, economic, technological, cultural or otherwise) that occurred over time (e.g. Portugali, 2006; Rauws, 2017: 33). This is not merely the result of practical problems,

such as data availability, but rather it is the result of the very nature of cities and the limits of our brain's capacity to comprehend this complexity (Moroni, 2015).

This, of course, also poses challenges to 'prediction' and forecasting, and is therefore of value to researchers and planners operating at the science–policy interface, particularly those concerned with future research. Although complex systems show patterns, there are limits to the extent to which these patterns can be predicted. According to Moroni (2015: 251–252), *specific* predictions about the dynamics of complex systems are intrinsically impossible. So, we cannot say that on location X in 10 years' time, 141 apartments can and *will* be built within the price range of 161,451 and 347,547 euros. The maximum we can hope and strive for are *qualitative* predictions. These are predictions not of particular events but of 'classes of events'. Such predictions may, for instance, be based on Alonso's (1964) bid-rent theory. It could read as follows: with a decrease of distance to the economic centre of the city, land prices will increase as well as urban density, because of a substitution of land for capital.

These limits to prediction are crucial for research into the future. In addressing our central case-study question about the extent to which housing demand can be accommodated within the existing urban fabric, we take these lessons from complexity theory into consideration. First and foremost, we have to be aware of the presence of *uncertainty*, which is the result of the *future* component of the study but also of the nature of complex systems, such as cities, with the interaction of many variables and the positive and negative feedback loops between them. Second, there are *limits to prediction*, in the sense that specific predictions about urban development, and its feasibility, are inherently impossible. Third, this requires modesty on behalf of the researcher about what he or she does and knows it requires transparency and honesty:

> The modest answer of academic research to face this cruel reality is to be explicit about the assumptions of the lenses, to make the steps of research traceable in this way, and to be aware that the findings of research cannot exceed the limits of this selective scope. (Salet, 2018: 89)

Science-for-policy in a politicised context

Traditionally, science and policymaking/planning are seen as more or less sequential events. Sir Patrick Geddes (1915), with his concept of 'survey-before-plan', and later the rational-comprehensive planning theorists (such as Faludi, 1973), thought of science as the systematic surveying activity that precedes and fuels rational policy. During the course of the development of planning theory and practice, the political nature of policy and the value plurality in society have been emphasised repeatedly (e.g. Davidoff, 1965; Forrester, 1989; Healey, 1997). It appears that this has become even more prominent and pressing in recent times.

As a result of the development and proliferation of traditional and modern social media, we now live in an era of 'mediatised politics' (Hajer, 2009). This has contributed to challenging taken-for-granted institutions, such as science, and to the public polarisation in opinion over many issues, such as over climate change, housing affordability, traffic management (e.g. congestion charging) or vaccination. Science is becoming increasingly politicised (Jasanoff, 1990: 249).

This politicisation of science challenges the role of science. How do researchers at the science–policy interface position themselves? How to deal with the great value plurality around us and the ways in which that is expressed? There is not just one role a scientist

can play, but rather there are multiple roles. Important choices need to be made. In *The Honest Broker*, Roger Pielke Jr (2007) distinguishes between four different (idealised) roles a scientist may fulfil within a policy and political context. The first role is that of the 'pure scientist' who has little interest in the decision-making process and what happens with the knowledge they share. Their main interest is producing fundamental knowledge. The second role is the 'science arbiter', who serves the knowledge demands that a decision-maker may have. The science arbiter therefore functions as a resource to the decision-maker. The former does not tell the latter what he or she ought to think and decide. This is different from the 'issue advocate' (i.e. the third role), who seeks to limit the choice for decision-makers by simply advocating one policy alternative. In planning theory, this has become known as 'advocacy planning' (Davidoff, 1965), while the first two roles seem to fit more with a rational-comprehensive approach (e.g. Faludi, 1973). The fourth and last role is that of the 'honest broker between policy alternatives'. In that role, the scientist does not reduce but increases the scope for choice by also emphasising blind spots and limitations and by showing the challenges and trade-offs that lie ahead of the decision-maker. Or as Pielke (2007) expresses it: 'The defining characteristic . . . is an effort to expand (or at least clarify) the scope of choice for decision-making in ways that allows for the decision-maker to reduce choice based on his or her own preferences' (2–3). In our view, the honest broker role comes to terms with value *plurality* best. The pure scientist and the science arbiter are not concerned with values (although they are often implicitly present or explicitly attributed by adversaries) and the issue advocate is concerned with only one value (i.e. the one he or she advocates).

The honest broker in practice

The honest broker must try to expand the 'scope of choice' for decision-makers (see Pielke, 2007). But what does that mean, expanding the scope? And how can it be done? We consider the scope of decision-making to be the *range of policy options* known and available to the decision-maker. The honest broker seeks to maximize this range or at least tries to make it explicit and visible to decision-makers.

First, it means tracing the scope of the existing debate. What is the discourse? Who is involved and who is not? Where lies the emphasis? What is lacking in the discussion or what are the limitations? In 'To build-in or build-out: The Dutch debate' section we deal with these questions in relation to the housing development debate in the Netherlands.

Second, it implies coming to terms with urban complexity (see 'Cities as complex urban systems' section). What is known, what can be known and what not? It means taking account of the heterogeneity of the research object and the uncertainty regarding its future. In other words, avoiding oversimplification. In practice, this often implies broadening the scope of research and policy. The 'Exploring the Dutch possibilities for future housing development within current city boundaries' section will take account of the uncertainty around housing demand, by using different scenarios, and the regional heterogeneity of demand and (re)development opportunities.

Third, a wide(r) scope means taking into account value plurality ('Science-for-policy in a politicised context' section). Science-for-policy is not value-free. Different values lead to different research choices and different policy alternatives. This needs to be made explicit. In the 'Exploring the Dutch possibilities for future housing development within current city boundaries' section, we make the choices with regard to development opportunities explicit. In addition, we use sensitivity/robustness analyses to show what the implication of alternative choices would be.

To build-in or build-out: The Dutch debate

In our quest to identify the scope of the debate and of the decision-making process, we have explored the debate in the popular professional media (blogs, reports, magazine articles, columns, etc.) in the period 2015–2016. The aim is not a discourse analysis as we know it from the discursive literature (such as Hajer, 1995; Van den Brink, 2009). The exploration is a quick scan (Van Duinen et al., 2016: chapter 3) that is only instrumental in tracing the crude narratives and the scope of the debate, so as to be able to relate to it. In the debate on future housing locations in the Netherlands, roughly two main narratives can be distinguished: to build-in versus to build-out.[1]

Build-out

Actors endorsing the 'build-out' narrative call for new building areas to be prepared outside existing cities (amongst others Cobouw, 2016; De Zeeuw, 2015; Dynamis, 2016; Feijtel, 2015; Fokkema, 2015). It can be heard amongst some of the larger property developers, investors and builders, including organisations such as the Dutch Association for Real Estate Developers (NEPROM), the Association of Institutional Property Investors in the Netherlands (IVBN), several individual large property developers and real estate agents. In this narrative, the possibilities for building within the existing city are insufficient to accommodate all future housing demand. This holds, in particular, for urban areas with high pressure on the housing market. There is simply not enough land available within cities, and often the vacant real estate is not located in the required living environments, for example, near highways. Moreover, already urbanised land becomes available slowly and the production of urban redevelopment projects is time-consuming. This will inflate house prices even further. The production of new homes outside – but near – the existing cities is also needed from the perspective of market demands. In the Netherlands, it is argued, there is a continuous need for suburban living, in spacious homes with a garden (see, for instance, De Zeeuw, 2015). Only by supplying good-quality housing in living environments that are in high demand, and by doing that rapidly, can the Dutch economic competitive position remain strong. The overall argument is not to overestimate the possibilities for (re)developing land within the city boundaries: future housing demand is simply too high to be accommodated within existing urban areas.

Build-in

On the other hand, there are organisations arguing for accommodating housing demand within existing cities, i.e. through the transformation of obsolete or vacant real estate and derelict areas. Actors advocating this (e.g. the Cultural Heritage Agency of the Netherlands RCE, the Central Government Architect Floris Alkemade, the national Transformation Team and most provincial government agencies) focus on the importance of sustainable urban development and the protection of green space (amongst others, Alkemade, 2016; H-team 2016; Pen, 2015; Van Dijk, 2015; Vereniging Deltametropool & College van Rijksadviseurs CRA, 2014). The central argument is that there is (more than) enough space within the existing urban fabric to accommodate virtually all housing demand. In their view, the redevelopment of vacant and derelict urban land offers many advantages to society as a whole, such as agglomeration advantages, maintenance of open space, support for amenities and the rendering of previous infrastructure investments. On top of that, living in redeveloped real estate is currently in high demand by consumers, due to the often-characteristic nature of the buildings such as former schools or manufacturing factories.

The housing demands in society are changing, with a need of other forms of housing than traditional suburban living. There is sufficient space within the existing built-up area to accommodate this future housing demand, in both a quantitative and qualitative sense. Only in the long run additional locations outside this built-up area may be needed.

Five limitations

Reviewing the debate on future housing locations in the Netherlands, it is clear that none of the participants denies the potential and value of adding houses to the existing city. However, actors do have different opinions about the extent to which current cities can accommodate growing housing demand (limited versus substantial). Characteristic of the debate and the two dominant narratives is that they are inspired and fuelled by beliefs and interests and are rather absolutist and immovable. We identify a number of limitations on both sides of the debate.

First, the debate is often held in a rather dichotomous fashion: to build-in *or* build-out. However, these positions rest on assumptions and (implicit) choices, and must not be seen as claims to (absolute) truth. We consider it the role of an honest broker (Pielke, 2007) to point that out and to show the implications of various normative decisions.

A second limitation is the underestimation of uncertainty, an important element of complex systems. Housing demand until 2040 is often considered as a fixed figure ('1,000,000 extra homes in 2040').[2] There is little acknowledgment of the bandwidth between multiple scenarios and of uncertainties in housing demand forecasts. By using single projections instead of a bandwidth of two or more scenarios, a precision is suggested that future projections cannot provide.

A third issue, which is also related to urban and regional complexity, is the importance of regional differentiation. There is little attention for regional variation, not only in terms of housing demand (i.e. the '1,000,000 extra homes in 2040' as a number for the whole country), but also regarding available building sites and the number and size of vacant buildings. As housing markets are regional, discussions about the accommodation of housing demand need to be regional as well.

A fourth limitation in the debate is that definitions and assumptions behind statements often remain implicit. The numbers (e.g. again the '1,000,000 figure') are often discussed as being absolute and unconditional. In fact, they *are* conditional. For instance, assumptions about density and the suitability of sites for development are crucial for answering the main question. Again, being transparent is a logical consequence of the complexity of the system and the required humility of the researcher ('Urban future research in the face of complexity and mediatised politics' section).

Finally, a more practical observation. The emphasis in the debate seems to be on the redevelopment of vacant buildings,[3] and much less on the redevelopment of obsolete, derelict sites.

Exploring the Dutch possibilities for future housing development within current city boundaries[4]

Having articulated these five 'limitations' in the debate, the next challenge is to address them in our quest to increase the scope of decision-making. We do so by identifying the space for housing development in the city in relation to overall housing demand. As indicated, we use a scenario approach to this end, in which future housing demand in two scenarios is confronted with physical possibilities for housing development within the city margins.

We address the five limitations by deriving our findings from explicit assumptions and observations and by taking uncertainty and regional differences into account.

Methodology: Two scenarios for future housing demand

The main driving forces behind housing demand are highly uncertain. To account for this, we use a scenario approach. As a starting point, we make use of two scenarios about the growth of Dutch housing demand[5] until 2050: a 'low' and a 'high' growth scenario. They are derived from scenarios that have been developed by two independent research institutes and form the basis for many cost–benefit analyses in the Netherlands. The underlying data and methodology process are documented extensively in CPB & PBL (2015).

The low and the high scenarios assume low and high economic growth: 1% per year versus 2% per year. Higher economic growth, it is assumed, leads to more household formation and, consequently, smaller household sizes. The two scenarios also vary in the assumptions behind low and high population growth, i.e. about fertility rates, immigration numbers and life expectancy. In the low scenario, the total number of households of 7.7 million in 2012 is assumed to have grown by 2% in 2050, while in the high scenario this is as much as 13% (in 2050). The two scenarios assume varying regional distributions of housing demand. The high scenario assumes a greater concentration of future housing demand in cities than the low scenario.[6] A limitation of these scenarios is that they focus on quantitative rather than qualitative demand. This is done for practical reasons as household preferences are dynamic, endogenous and therefore hard to project.

To account for regional differences, demand is projected per NUTS 3 region,[7] which corresponds roughly to the spatial scale of housing markets. As Figure 1 shows, the additional housing demand (more specifically, demand in addition to the use of the current housing stock) derived from this differs substantially between regions and scenarios. In the high scenario there is extra demand in virtually every region and most notably in the western part of the country, known as the Randstad area (with cities such as Amsterdam, The Hague, Rotterdam and Utrecht). In the low scenario, the urban regions in the Randstad area still show extra demand, albeit much lower than in the high scenario. The number of regions with no or a negative extra demand is much larger now.

(Im)possible development areas within city boundaries

The next challenge is to assess the possibilities to accommodate the projected housing demand within existing city boundaries. For this purpose, we apply a 'sieve analysis' and a 'potential analysis', two common planning methods for simple and fast explorations (Voogd, 1995: 118). In sieve analyses, criteria are made spatially explicit to determine sites to be rejected as an opportunity for, in our case, residential development. In a potential analysis, criteria are made explicit to score the degree of suitability of the remaining sites. The criteria are applied to a 100 metre $\times$ 100 metre grid resolution and combined as map layers in GIS. The final result: a detailed, countrywide map of the (im)possibilities for residential development within city boundaries (more details on the methodology can be found in Van Duinen et al., 2016: 27–30).

Sieve analysis

Given our focus on building opportunities, it is important that we are only left with clearly underdeveloped sites within existing urban areas. Therefore, we first excluded all

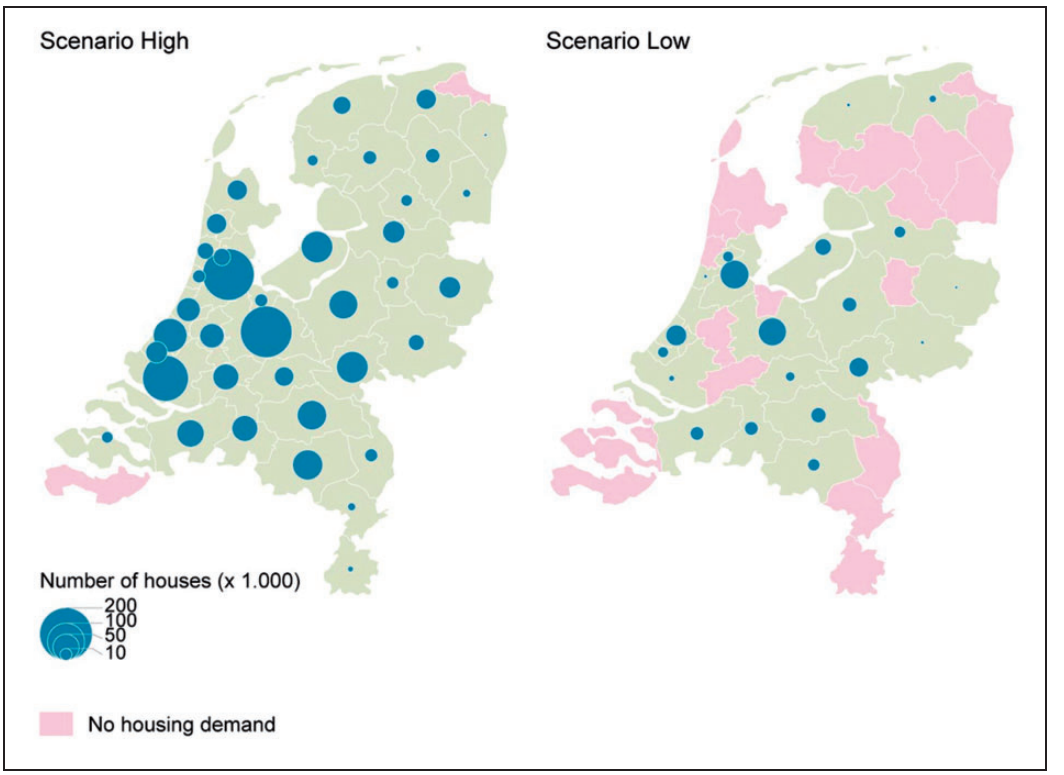

Figure 1. Projected Dutch housing demand in a high (left) and low (right) scenario, per NUTS 3 region, 2012–2050.

areas outside the existing urban fabric, which are demarcated by the so-called BBG-boundaries.[8]

Second, we excluded areas in which it is prohibited to build as determined by national ordinances, provincial spatial ordinances and provincial environmental ordinances (Van Duinen et al., 2016: 56). We distinguish between 'hard', unconditional restrictions and softer, conditional restrictions. Initially, we included both types of restrictions, while in a sensitivity analysis (end of this section) the softer ones were excluded. Additional local-government restrictions were not considered as they commonly 'record' the current (spatial) state of affairs but can easily be changed in response to developers' requests. They are therefore less restrictive and stable (Buitelaar and Sorel, 2010).

Third, the analysis also sieves areas for which there are (clear) short-term or long-term plans for business estates. This is done on the basis of the *Nieuwe Kaart van Nederland* (Nirov, 2009), a large data set that took[9] stock of all pipeline plans in the Netherlands.

Potential analysis

In the potential analysis, we selected the buildings and sites most suitable for redevelopment and accommodating housing. As for the former, we only selected structurally vacant commercial property[10,11] within the vicinity (less than 300 metres) of existing residential areas.

As for the sites, we only selected *un*occupied and *under*occupied ones. Unoccupied sites are those sites labelled by Statistics Netherlands (CBS, 2012) as a building site or derelict site. A site is qualified as underoccupied if (1) it is within the city boundary (BBG) and labelled as 'agricultural' or as 'grassland', or (2) its current use is for businesses but transformation to housing is planned. Those sites, like the vacant buildings, had to be within no more than 300 metres from existing residential areas.

The importance of density

To attribute houses to the buildings and sites that come out of the sieve and potential analysis, the housing density must be determined. The assumption is that the density of new developments will be similar to densities in the vicinity. We looked at both densities in the immediate vicinity and the entire region. The former get priority over the latter, unless the latter is higher. This might be the case when the immediate surrounding of an area is a park or also an area waiting to be transformed (more details can be found in Van Duinen et al., 2016: 29–30).[12]

Synthesis: Development opportunities in the context of demand

When we confront the housing demand per scenario from Figure 1 with the residential development possibilities (given the locally/regionally appropriate densities), the image as

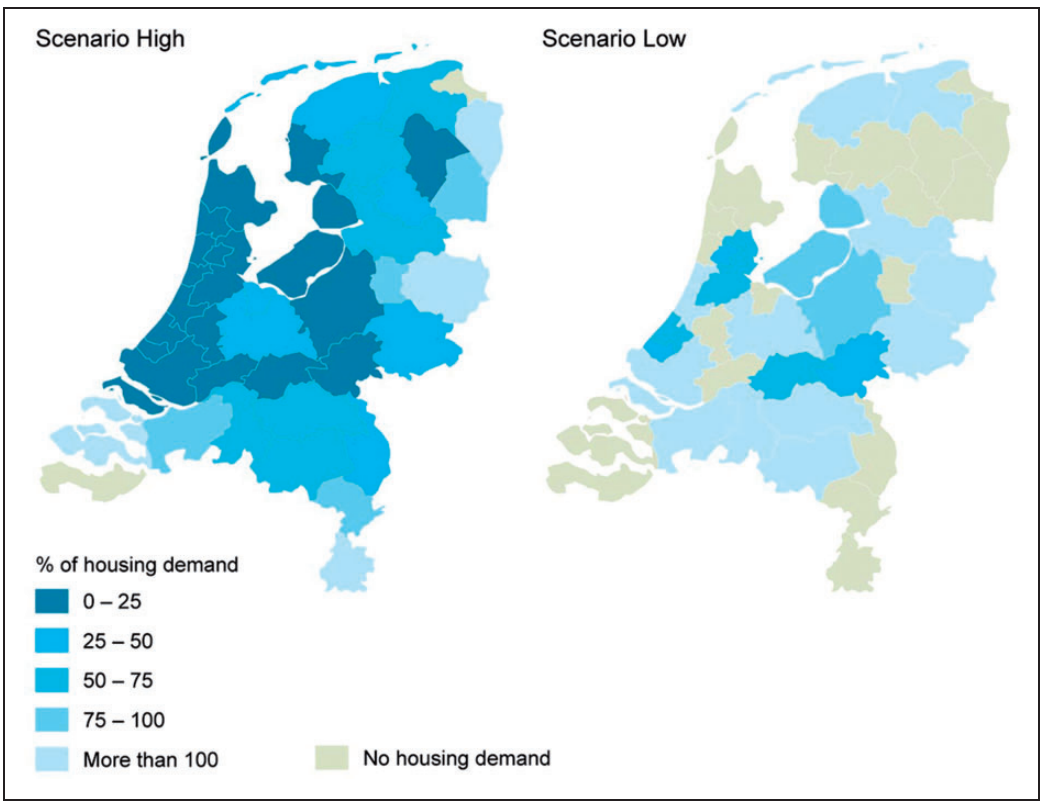

Figure 2. Share of Dutch housing demand that could be accommodated within current city boundaries in a high (left) and low (right) scenario, per NUTS 3 region, 2012–2050.

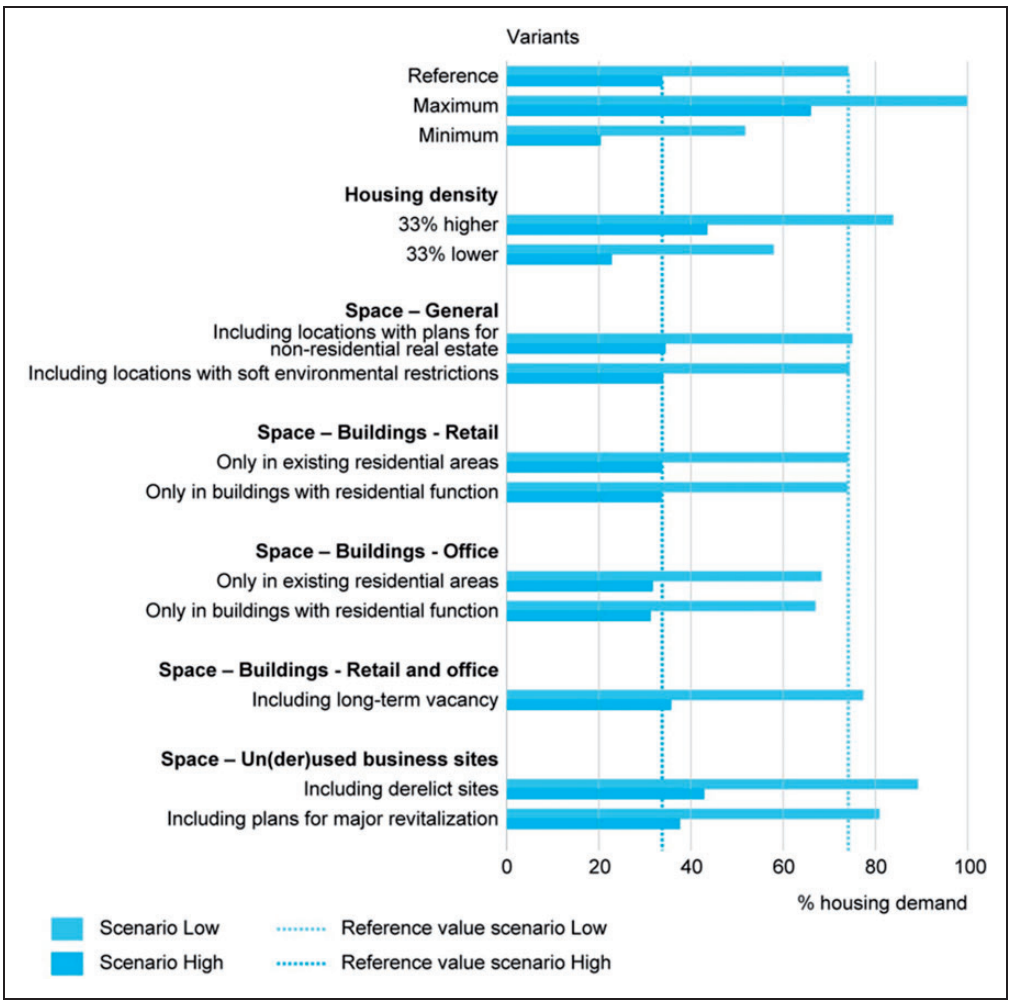

Figure 3. Share of Dutch housing demand that could be accommodated within current city boundaries according to variations in the assumptions about local building opportunities.

represented in Figure 2 arises. It shows that, in the low-growth scenario, the share of demand that can be realised within the city is greater than 100% in almost every region. In the high-growth scenario, this full capacity of the existing built-up areas only applies to a few peripheral regions. Together, 75% (low) or 35% (high) of regional housing demand could be accommodated (at least physically) within current city boundaries and under the conditions (such as current densities) that we explained before.

Sensitivity analysis

The results in Figure 2 are based on a large number of premises, all of which are, by definition, debatable. To make our assumptions and their impact explicit, we have employed a comprehensive sensitivity analysis showing how the results change according to variations of these assumptions. Figure 3 shows the results per variant.

The first variation in a premise of the reference scenarios is of the density, i.e. the effect if we raise or reduce housing density by one-third. It leads to a bandwidth of between just over 20% (33% lower density in the high household scenario) and just over 80% (33% higher density in the low household scenario). Under the heading 'Space – general' in Figure 3, we evaluated two variants, one in which the excluded short-term or long-term plans for business estates were included, and one in which the area with 'soft' environmental regulations was not sieved but included. It only leads to marginally more accommodation of housing demand, in comparison to the reference variant. We also did some variations with retail and office buildings, some more accommodating (i.e. also including long-term vacancy, not only structural, as potentially transformable[13]) and others more restrictive (i.e. only retail and office objects with also housing in the building, and only retail and offices in residential areas). Again, there is little impact on the results. In the last sensitivity check, we tried two more accommodating variants regarding business site transformation. Rather than only including areas (reference variant) that have plans to transform the site to housing, we also included business sites that are considered derelict/obsolete and sites with revitalisation plans (according to data source IBIS (2011)). These turn out to lead to a significantly higher accommodation of housing demand than the reference.

As a synthesis, we also calculated a minimum and a maximum variant capturing the opportunities when all assumptions are tuned to either extremes (i.e. restrictive versus accommodating) for each housing demand scenario. Understandably, the bandwidth becomes very large: between 20% (the minimum variant of the high household scenario) and (over) 100% (the maximum variant of the low household scenario). This underlines once more the (great) sensitivity of urbanisation processes to the collective decisions that we may or may not take. The results are particularly sensitive to housing density.

Through this, we have tried to demonstrate the scope for policy choice. In the debate, on the other hand, the space for housing development is often presented in absolute terms, as an inevitability. But there are choices to be made, often in the context of continuous and often unpredictable change. Including any type of assumption creates (even) larger sensitivity problems.

Conclusion and discussion

Although the general outcome of the scenario and land-modelling study shows that there are ample housing possibilities within existing cities, it also shows that the possibilities vary depending on the assumptions that have been made (e.g. on the intended density of the new housing locations). Moreover, if we bear in mind that we have not considered qualitative housing demand, financial feasibility or the demand for other land uses, the outcome may vary even more. Under the conditions chosen, it is only under the low housing demand scenario, and only when we tune all variables to the maximum, that we reach a 100% accommodation. When we do the same tuning to the high-demand scenario, the share remains under 70% (Figure 3). The implication is that only building within the existing urban fabric will arguably not suffice to meet future housing demand.

What is relevant to an international audience is not so much these specific modelling outcomes, but the modelling *approach* and the thinking about the role of a researcher who is active somewhere in between science and policy. These outcomes illustrate how the role of 'honest broker' in a public debate might take shape. It means revealing the scope of the existing debate ('To build-in or build-out: The Dutch debate' section) and enlarging it by taking complexity, uncertainty and value plurality into account.

Rather than making specific predictions, the role of the 'honest broker' is to make explicit what the policy choices are and what the impact of making them might be. Those who have higher expectations of the policy scientist – in other words, expect precise and unambiguous policy recommendations and no or smaller bandwidths – may find this unsatisfactory. However, the complexity of the matter – the earlier mentioned concept of 'cities as complex systems' – and the value plurality in society and politics, make it impossible to draw definite and absolute conclusions on what to do, which policy-makers could then readily turn into policy and action. This is not a shortcoming of science-for-policy; it is perhaps exactly how it *should* be. Or as Moroni (2015) puts it: 'the real usefulness of models of this kind is, in many cases, that they clarify what we *cannot* know or what we *cannot* do' (255 – italics in the original).

Honest brokering in planning practice

Taking complexity and uncertainty seriously has important implications for planning in practice. It is fairly common in many countries to make population projections and eventually translate these into land-use claims. It is part of governments' quest for control (Scott, 1998; Van Gunsteren, 1976). But perhaps more fundamentally, it touches upon the omnipresent view of the city as an organisation, as a made order, a *taxis*, rather than what it actually is and should be: a *cosmos*, an emergent, adaptive and spontaneously evolving order (Hayek, 1982; Ikeda, 2017; Jacobs, 1961; Moroni, 2010). The former can be known and controlled, while in the case of the latter, it is a contradiction in terms. Rather than making projections, making scenarios and assuming a relatively large bandwidth between them, to account for the unknown, is the maximum we can and must do in the context of future research.

What does that mean for planning? It means anticipating and preparing for the best and the worst. In the case of housing development, plans should make spatial reservations for the highest scenario. If population and household growth is high, as well as economic growth, the same can be expected of housing demand and therefore of the residential space needed. And plans must anticipate this situation. As we have seen in the previous section, density assumptions are crucial for determining the total amount of space needed. These assumptions are not exogenous and given but are the result of political decisions.

These limits to knowing and controlling complex and evolving urban systems should also have implication for specific planning rules. Detailed land-use planning and zoning rules are usually made with a desired urban end-state (i.e. a *taxis* rather than a *cosmos*) in mind. Instead, 'framework-rules' that are more general regulate *classes* of situations (and locations) and *prohibit* a number of things that ought not to take place rather than *prescribe* what should take place. Such more general and simple rules come to terms with the complexity and the evolving nature of urban systems (Zywicki, 1998).

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Notes

1. More details can be found in Van Duinen et al. (2016).
2. A simple Google search on '1 miljoen nieuwe woningen', or a similar search, shows immediately that this number is treated in absolute terms with no/little room for variation.
3. For instance, together with local governments and stakeholders from the industry, national government designed a programme to deal with vacant retail buildings (*Retailagenda*, 2015) and one for vacant office buildings (*Convenant Aanpak Leegstaande Kantoren*, 2012).
4. This section is largely based on Van Duinen et al. (2016).
5. This is not 'demand' as commonly defined in economics, as a consumer's desire to purchase a good or service at a certain price. Here we express it as the number additional units of houses needed given particular assumptions about economic growth, demography, etc.
6. Housing demand is calculated by multiplying household growth by historical data on the households–homes ratio.
7. NUTS stands for Nomenclature of Territorial Units for Statistics. There is a hierarchy of territorial subdivisions for EU countries ranging from the largest, NUTS 1, to the smallest, NUTS 4. The NUTS 3 level divides the Netherlands into 40 regions.
8. This is a boundary for urban areas as defined by the Ministry for Spatial Planning (abbreviated as VROM at the time) in the year 2003.
9. This data set has not been updated since.
10. Property that has been unoccupied for three years or more is considered structurally vacant (Buitelaar et al., 2013).
11. As we have microdata available for offices (Bak, 2014) and retail (Locatus, 2014), those have been included, consequently leaving out industrial property, property with social purposes and others.
12. The potential housing density per grid cell is based on the maximum of the average on three different scales: (1) weighted, distance decay (weight: 1/radius) within a maximum radius of 1250 metres, (2) the housing market region (as defined by NVM) and (3) the bigger housing market region (as defined in the Socrates model by ABF).
13. Long-term vacancy means one to three years unoccupied.

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