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National Introduction of No Net Land Take

A comparative study of five pioneering countries seeking to limit their land consumption

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Abstract

The ambitious European objective of achieving no net land take (NNLT) by 2050 calls for a radical change in the strategies and instruments of national planning policies. Based on a comparative case study of five pioneering countries, this paper analyses the different approaches taken to implement the NNLT goal, drawing on policy cycle theory. It demonstrates that the transfer of the NNLT target is a top-down process that conflicts with land use plans and planning practices at the local level. This study shows that the support and involvement of the local planning level is crucial to limiting land consumption effectively.

Keywords

Land use, no net land take, European policy, land consumption, planning policy

Introduction

Land consumption, or 'land take' as it has been coined in the European context, is a primary type of land use change at the expense of natural and agricultural land. Land take is defined by the European Environment Agency (EEA) as the increase of artificial surfaces, including areas sealed by construction and urban infrastructure but also urban green areas, sport and leisure facilities (EEA, 2019).

While Europe experienced limited population growth between 1975 and 2015 (+10%), its settlement area doubled (Pesaresi et al., 2016). On average, the settlement areas cover 5% of the EU-27 surface (EEA, 2019), but the national rates vary widely from 1% in Finland to 30% in Malta. According to the European data, land take continues in the EU at an estimated annual net rate of 440 km²/year (2012–2018) or 0,8 m²/year per capita (EEA, 2020). Approximately 50% of this overall surface is considered to be sealed, with

substantial variations between the different territories and cities (Decoville and Feltgen, 2023). The conversion of land into artificial areas comes with far-reaching environmental consequences, such as land degradation and climate change (Prokop and Salata, 2017).

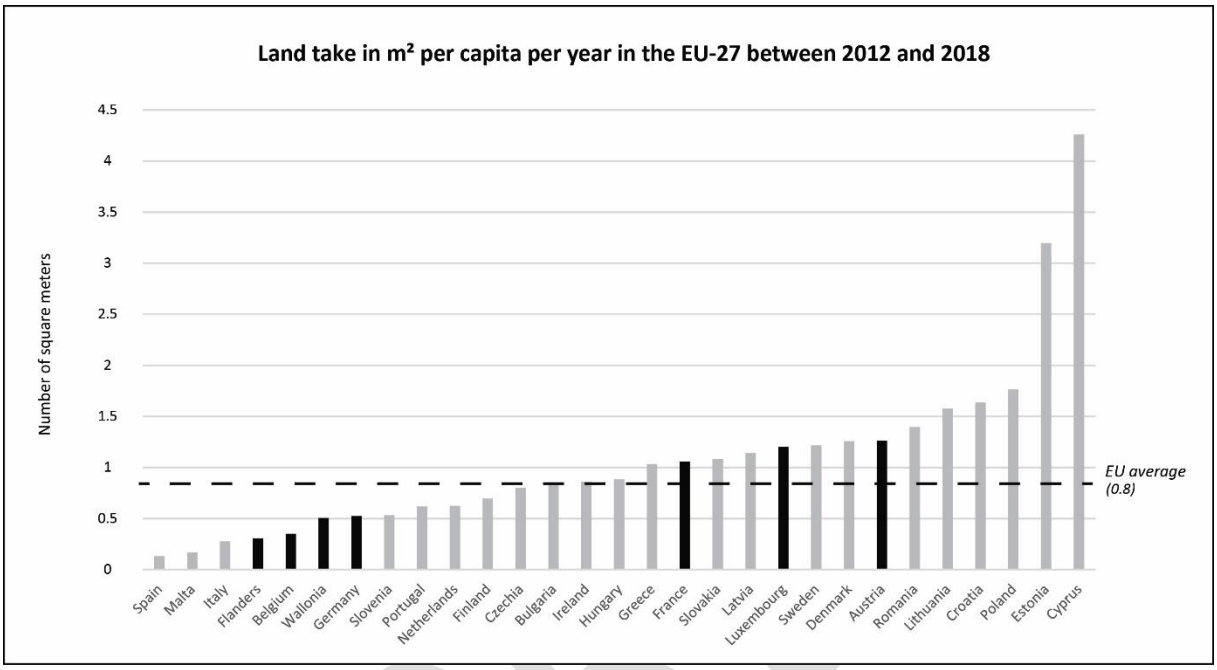

Figure 1: Land take per capita EU-27 (m²/capita/year, source CLC 2012-2018 and Eurostat 2018)

To address the degradation of the land system, the European Commission has called for 'No Net Land Take' by 2050 (EC, 2011 & 2023). This No Net Land Take (NNLT) objective implies that land take needs to be avoided, minimised, and compensated by land reconversion to non-artificial land categories (EC, 2021). However, the land take rate was more than tenfold the reconversion rate between 2012 and 2018 (EEA, 2019). The Commission outlined a non-binding soil policy in its Roadmap to a Resource Efficient Europe (EC, 2011), Soil Strategy (EC, 2021), and its proposal for a Soil Directive[1] (EC, 2023). It is unlikely that the target of zero net land take will be met by 2050 if member states do not integrate the common European goal into their national planning policy (Bovet and Marquard, 2022).

The common European goal of NNLT sets quantitative limits to the overall urban expansion but does not put an end to development as such. Within a NNLT framework, existing settlement areas need to be densified (Hartmann et al., 2023), and new development will have to use land sparingly and be compensated with land reconversion (Leroy and Bigard, 2020). The integration and application of the mitigation hierarchy 'reuse-reduce-compensate' in the planning practice is thus of key importance to the NNLT policy (Von Long et al., 2014).

Nevertheless, in the traditional planning discourse, spatial growth is still dominant (Grant, 2018). "*So far, greenfield development has allowed planners to postpone the moment when they would have to tackle the management of scarcity*" argue Gerber et al. (2018: 348). In most European countries the orientation of spatial planning is indeed strongly development-oriented (Nadin et al., 2018), but the planning discourse is shifting towards variations such as *sustainable development, smart growth,* and *growth management* (Hersperger et al., 2020). However, setting *final* 'limits to growth' is a true paradigm shift for planning and can be considered a first milestone towards

[1] The latest proposal for a Directive on Soil Monitoring and Resilience was put forward by the EC in 2023. This new proposal for a Soil Directive suggests a different definition for land take (Art. 3, 17°) that rather resembles soil sealing. Since this new proposal has no status (yet) and the EU approach to land take lacks continuity, the initial definition (EC, 2011 and EEA, 2019) remains the basis of our research.

post-growth planning or *degrowth planning* (Savini et al., 2022). The adoption of a national NNLT target is thus a 'game changer' for many national policies and practices.

Some European countries have been pioneering this objective in recent years and are gaining initial experiences that are relevant for countries adopting an NNLT objective in the future. Research on land take and its reduction mainly focuses on the definition of the concept (e.g. Marquard et al., 2020), the measurement (e.g. Decoville and Schneider 2016), the drivers (e.g. Colsaet et al., 2018) and the national context of land take (e.g. Davy, 2009). A comparative study of the status, similarities, and differences of national NNLT policies that are under development has not yet been conducted. This paper aims to bridge the knowledge gap between planning research and the fast-evolving NNLT policy and practice of (some) EU member states. Identifying the success factors and obstacles encountered during this transition is highly relevant for other states and regions considering embarking on an NNLT pathway or a similar reduction pathway.

Methodology

The European goal of NNLT implies a transfer to the national level of the member states. Urban and spatial planning in the European Union is based on the subsidiarity principle, and although European sectoral policy has a significant effect on the urban development of the individual states, all planning decisions are finally made by the national and regional governments. A European survey of 23 countries shows that hardly any initiative was taken by the member states until 2020 (EEA, 2020). Yet, the number of member states endorsing the European target and adopting a national NNLT target has been increasing in recent years: Germany (2017), the Belgian regions of Flanders and Wallonia (2018 & 2019), France (2021), Luxembourg (2023), and Austria (2023).

This policy research is a comparative approach of these five national cases. The case study method is an appropriate research method to gain concrete, contextual, and in-depth knowledge (Gagnon, 2010). In order to collect all relevant documents and analyse and interpret them correctly (in the original language), a national expert for each pioneer country was involved in this comparative research. The national experts selected either contributed academically to the debate and research of the new NNLT policy in their country or contributed to the policy preparation for their national or regional government. Separate case studies were conducted for Belgium as the regions of Flanders and Wallonia have autonomous spatial policies.

Both qualitative and quantitative comparative methods were applied. National data on land take and land use were collected and recalculated and the national reduction trajectories were also recalculated on a comparable basis (per capita). After all, previous research has shown that the European CLC data underestimates the actual settlement area and land take (Lacoere and Leinfelder, 2023). By compiling the same selection of land use categories in the national datasets, a more accurate measurement was obtained. These national measurements systematically show more settlement area (see Technical Annex), and the land take data deviate even more; the differences with the European CLC data range from twofold (Luxembourg: 1.4 versus 2.8 m^2/cap/year) to sevenfold land take (Flanders: 0.4 versus 2.8 m^2/cap/year). This result demonstrates the importance of accurate national (or regional) measurements when setting up an NNLT policy. The corresponding section begins with the basic data on land take and land consumption ratio for each country.

For the *qualitative* comparison of the case studies, the research draws on policy theory. The policy trajectory and status of national or regional NNLT policies were analysed and compared according to the theoretical model of the policy cycle (Howlett & Giest, 2015). Several researchers already adopted this governance model to describe similar land targets (e.g. Verburg et al., 2022). Although the cycle model assumes ideal policy conditions that are rarely met, the model provides a simple and clear model of policymaking. New policy can be described and structured following the connected phases of problem setting, agenda setting, policy formulation, legitimation, monitoring, and adjustment-set (Cairney, 2020).

According to this framework of policymaking, the transfer of the European NNLT target starts with a strong national awareness of the importance of preserving land resources (*problem setting*). Once the NNLT

target is adopted nationally (*agenda setting*), the national planning authority will initially have to decide over which period it wants to spread the reduction of land take and whether intermediate milestones will be adopted, e.g. by 2030 (*policy formulation*). Once the NNLT target is defined, the next step is to work out a strategy for the gradual reduction of land take (*implementation*). Both measures that maximize the reuse of buildings and land (*pull* measures), as well as measures that increase the protection of agricultural land and nature (*push* measures), are needed. Existing instruments will have to be reviewed, strengthened, or rather abolished if they are counterproductive. New, more protective instruments may also need to be introduced to implement the reduction strategy. However, the transfer of policy does not stop at the national level; many European countries have a multi-layered planning system and have decentralised their planning competencies to lower levels of government (Nadin et al., 2018). As none of the member states has yet fully implemented its NNLT policy, this investigation mainly focuses on the first phases of the policy cycle. The status of the NNLT policies was analysed in detail using the main official documents and strategic plans from the national or regional authorities (an overview of these national references can be found at the end of the paper). The policy phases were merged and a fixed list of research questions was used for each stage to conduct the comparative study for every country:

Problem setting & Agenda setting	*Emergence of the policy topic:* What is the current rate of land take and land use change, where does land consumption occur?, what are its main trends and drivers? Why and how did the problem of land take emerge in the policymaking process?
Policy formulation & Legitimation	*Setting the objective, the process of policymaking:* How is the NNLT policy defined? How was it approved? Is it a binding or a non binding target? What reduction trajectory has been laid out?
Implementation	*Implementation of the objective, first actions in planning*: Which actual and new measures are in place to reduce and limit land take? What kind of obstacles, legal barriers, and capacity problems occur?

The status and evolution in each country is explained according to this order in the corresponding chapter. The outcome of this case study is of course a first snapshot of NNLT policies; both in the member states and at the European level, the NNLT goal remains under continuous development and is intensively debated. Our comparative study has therefore a clear end date (15 May 2024), subsequent sources and legislative changes in member states and regions were not taken into account. The development of the new land policy for Germany, the Belgian regions, France, Luxembourg and Austria are examined in chronological order of approval of the NNLT target. The comparative findings and the main conclusions based on the five country cases are discussed in the final sections.

Germany: *Reduzierung des Flächenverbrauchs*

*14.5 % settlement area (2020) * 2.4 m²/cap/ year land take ratio (2020) * NNLT by 2050*

Problem and agenda setting. According to the Federal Statistical Office, the German settlement area has expanded from about 11 per cent of the country's territory in 1992 to 14.5 at present, predominantly at the expense of agricultural land (*Flächenverbrauch*). The German monitoring of land take is based on local cadastral data, which are annually compiled, evaluated, and published by the Federal Statistical Office, and displayed in hectares per day (as a four-year rolling average). Currently, land take in Germany continues at 52 hectares per day (2022) which sums up to 19,000 ha/year. Land take was already identified as a problem in Germany in the 1990s (Köck et al., 2007). At that time, the land-take ratio was about 120 hectares per day. A non-binding land take target in the context of environmental policy was first set within the fundamental environmental program of the German Environment Ministry in 1998. Following the advice

of the Enquete-Commission of the German parliament, the target to reduce land take to 30 hectares per day until the year 2020 entered the political discussion.
Policy formulation and legitimation. In 2002 the target to reduce land take to 30 hectares per day by the year 2020 (*Das 30 ha Ziel*) was politically implemented as a non-binding target within the national sustainability strategy of the German Government.
Despite the reduction of land take, the initial 30 hectares target was not achieved by 2020. In 2017 the German Government revised the sustainability strategy with an updated target, still non-binding. The perspective for NNLT by 2050 was included (following a first entry in Germany's Climate Protection Plan of 2016). The intermediate milestone is now 'less than 30 hectares per day' by 2030 on the pathway to NNLT in 2050. The federal government only sets the policy framework in terms of guiding principles and legal basis. Federal planning adopts national requirements to the specific spatial conditions in the 16 federal states (or *länder*), while land use planning takes place at the local level of about 11,000 municipalities. Some federal states have set their own political targets on land take in local coalition agreements or local sustainability strategies. However, these agreements are not legally binding either. There have also been a series of changes to German planning and building legislation. For example, there is a legal requirement to justify land take based on the availability of inner-city development potential.

Integration and implementation in planning. After the target was in place, numerous national and regional initiatives related to land take reduction arose, such as the creation of public stakeholder working groups, the diffusion of land management guidelines, and specific research programs on the drivers of land take and identifying tools for its reduction. Furthermore, several amendments to the national building and planning legislation towards land take reduction were implemented, and the topic became more aware among all relevant stakeholder groups including the public. This certainly contributed to a significant reduction of land take. Land policy conflicts become visible predominantly at the municipal level. The financing of municipalities in Germany for example is determined to a great extent by the number of inhabitants as well as by locally collected company and property taxes. Similar conflicts appear in regions that must undergo a structural change after the collapse of industry sectors since new jobs must be created while the development of new land in peripheral areas is faster and a lot cheaper than revitalizing old industrial sites. However, conflicts emerge also in growing cities as the housing market comes under pressure and additional housing space has to be provided, especially in the low-price segment of greenfield locations.

However, the main deficit of the German NNLT policy remains the lack of a binding target with sufficient impact on the local authorities. Therefore, the German Environment Agency is currently exploring options to implement binding land take targets in legislation. One option is the implementation of land take targets into existing spatial planning laws of the federal government and/or the federal states. Another option would be the implementation of tradable land planning certificates (Grimski, 2019). This tool has been successful in a countrywide model project. The idea is to grant municipalities or planning regions with a limited number of certificates for the development of greenfield land outside urban boundaries. A tool to calculate specific targets for municipalities, counties, planning regions or federal states based on the population is available online (Umweltbundesamt, 2023). To achieve NNLT by 2050 Germany will start to develop a detailed circular land management strategy.

Belgium-Flanders region: *Bouwshift*

*32.4 % settlement area (2022) * 2.8 m²/cap/ year land take ratio (2022) * NNLT by 2040*

Problem and agenda setting. The spatial disorder and land consumption in the Flemish region bring serious spatial conflicts, poor natural and environmental performance, and high social costs (Vermeiren et al., 2022). One-third of the regional territory is taken by settlement. Not only the vast amount of built-up area is impressive, but also the nature of the land take is specific; half of it is accompanied by soil sealing and a significant part of it is scattered settlement or ribbon development in rural areas. Since 2013, the government agency VITO has been monitoring land take in Flanders every three years according to the EEA definition (Land Use Map). This regional measurement shows a tenfold of land take compared to the CLC data. While the land take rate fell in the late 1990s, the ratio has now reached about 3.8 ha/day or 1,390 ha/year between 2019 and 2022. The regional data indicate that half of all land take occurs in designated agricultural areas. Due to loose derogation rules since 2004, there seems to be no control over the degradation of the rural

areas. Consequently, public pressure to turn the tide has increased sharply in recent years, pushing the reduction of land take to the political agenda.

Policy formulation and legitimation. In a new Strategic Plan (*Strategische Visie BRV*), the regional government laid down the NNLT target in 2018 (Departement Omgeving, 2018). Initially framed by the media as a *Betonstop*, (literally *concrete stop*), the regional government renamed the target as *Bouwshift* (literally *construction shift*), which suits the construction sector more but weakens the initial focus of land protection. In line with the EU target, the government first set 2050 as the endpoint, but after public criticism and the 2019 climate marches, the ambition was raised to achieve the net target as early as 2040 and an intermediate milestone of 3 ha/day by 2025. Since its introduction, there has been a lively debate about the implementation and actual aim of the *Bouwshift*. The regional government, in its discourse of absolute legal certainty (Lacoere and Leinfelder, 2023), decided to link the NNLT target to increased financial compensation for aggrieved landowners (Decree *Instrumentendecreet*). GIS research shows that at least 30,000 ha of zoned land should be downzoned, of which 11,000 ha need urgent protection because of climate and nature objectives (Lacoere et al., 2021). However, by unilaterally increasing the compensation costs to billions of euros, the regional government risks undermining the local will to rezone.

Integration and implementation in planning. The public debate on the NNLT target became dominated by the financial consequences and social (in)justice of compensation. To get out of this impasse, a taskforce of experts was appointed to develop a strategy and action plan for the *Bouwshift* (Taskforce Bouwshift, 2021). This expert group proposed an action plan to protect land in addition to the necessary downzoning. Despite the expert report, the regional government has gone ahead with its plans to increase the cost of downzoning. The regional level expects the municipalities to implement the rezonings, while the municipalities expect more initiative and guidance from the regional level. Currently, only the 'freezing' of reserve construction areas and the downzoning of flood-prone building areas are carried out by the Flemish regional government (2023). However, aside from these limited initiatives, the Flemish level does not coordinate and distribute the reduction trajectory across provinces and municipalities. Consequently, the five provinces have developed their spatial policy plans autonomously, ensuring that they do not impose a reduction trajectory on themselves or their municipalities.

As the Taskforce report has shown, the NNLT objective is achievable by applying or adapting existing instruments. Several new instruments were investigated and eventually politically discarded, such as a TDR system and a value capture scheme that could help cover the costs of downzoning elsewhere. The expert report led to the introduction of a new instrument in a decree: the zoning compensation of new buildable zones with equal downzoning. This instrument existed already for some time in Wallonia and could, at least in the first stage of the NNLT reduction trajectory, halt the further increase of zoned land.

Belgium-Walloon region: *Optimisation spatiale*

*15.9 % settlement area (2020) * 3.0 m²/cap/ year land take ratio (2020) * NNLT by 2050*

Problem and agenda setting. In the Walloon region, and generally in Belgium, urban sprawl is very extensive due to the oversizing of the residential zones (Halleux et al., 2012). In Wallonia, land use data based on cadastral information is used to monitor land take. According to the official data, the settlement area in Wallonia is about 16% of the territory (IWEPS, 2022). Land consumption has been declining in recent decades: it was around 4.3 ha/day between 2000 and 2009 and fell to 2.9 ha/day or an average of 1,200 ha/year between 2010 and 2021. However, the land take ratio is still higher than the population growth ratio. In 2019, the Walloon Region started to develop its own 'stop béton' in response to the Flemish 'betonstop' from 2018. The official term for the NNLT policy in Wallonia is now '*Optimisation spatiale'*, which is less explicit than 'le stop béton'.

Policy formulation and legitimation. The NNLT target was set on the political agenda in the context of the development of the strategic plan for Wallonia, the *Schéma de développement du territoire* (SDT or Territorial Development Perspective). In 2019, a SDT proposal was approved by the regional government. However, the government has never set a date yet for its official entry into force and the document was finally withdrawn in 2022. The 2019 SDT contained the ambition to follow the European NNLT strategy by

halving the land consumption to 6 km²/year by 2030, and moving towards net zero by 2050. Besides the objective to limit land take, the 2019 SDT includes the complementary objective to limit the spatial dispersion of new residential developments: new dwellings should be for at least 50% within 'urban and rural centralities' by 2030 and that number should rise to 75% by 2050. By putting forward the objective to limit the dispersion and to concentrate most residential developments in the 'centralities', the regional authority intends to avoid more urban sprawl that further degrades the Walloon landscape.

Implementation and integration in planning. The Walloon regional government has approved a new version of the SDT (April 2024). At the time of writing, this version is not yet public, but in the draft version (Wallonie Territoire – SPW, 2023), the objectives related to the NNLT strategy are similar to those in the 2019 version, both on the limitation of land take and urban dispersion. However, the interim milestone of reduction no longer appears in the new strategy. For the limitation of land consumption, a distribution model is planned at the scale of seven subareas, the so-called 'basin of spatial optimisation'. These geographical 'basins' do not correspond to functional urban regions but meet the spatial organisation of the Walloon planning administrations.

Despite its official approval by the regional government, there are still many uncertainties about the implementation of the NNLT strategy. In particular, it is unclear how the target of 'spatial optimisation' will be implemented locally, as the recent public inquiry on the SDT draft version has shown that most suburban and rural mayors are still opposed to modifying their development model that is based on the single-family house on a large plot of land. The regional authority has decided to provide the local authorities with a six-year window to prepare strategic municipal plans aiming to implement the strategy, including the very sensitive delimitation of the 'centralities'. The main obstacles to achieving NNLT objectives are similar in Wallonia and Flanders. The most significant one relates to the oversupply of building land for residential developments defined by binding subregional land use plans. For Wallonia, this amounts to 107,000 ha of zoned land, including 55,000 ha of unused residential land (IWEPS, 2022*)*. This oversupply is due to landowners' right to compensation. Several decades after the land use plans came into force, the right to compensation remains.

Legally, rezoning without compensation could be justified by the lack of technical equipment (e.g. road, water infrastructure, etc.) or by a constructability issue. For the whole of Wallonia, this potential for downzoning is estimated at 23,000 hectares or 42% of the current unused residential land. Another instrument, with some potential of controlling land take, is the planning compensation scheme. According to this scheme, any additional zoning should be compensated by the same amount of downzoning or by an alternative type of compensation. A more strict application of the principle of planning compensation could have potential in an NNLT framework and limit the amount of zoned land. In operational terms, new measures to reduce and limit land take have not yet been installed since the NNLT ambition was proposed in the 2019 SDT.

France: *Zéro Artificialisation Nette* (*ZAN*)

*9,1 % settlement area (2020) * 3,3 m²/cap/ year land take ratio (2020) * NNLT by 2050*

Problem and agenda setting. According to European data, France has an average settlement area of 6%, but national data indicate a figure of 9%. Since 2011, land take has initially decreased at the national level, from 33,012 ha/year in 2011 to 22,384 ha/year in 2015. However, it has not fallen below 22,000 ha/year since 2016. Over the course of a decade, this land consumption has reached the size of Luxembourg or half of an average department in France (Colsaet, 2019). Most of the land take is used for residential development (68%), followed by economic development (26%; Cerema, 2020). France has a long tradition of legislation addressing land take. As soon as the 1970s began, the 1976 law on nature protection introduced the obligation to 'avoid, mitigate, and compensate' damages to the environment. Coined as the 'ERC sequence' in France (*éviter-réduire-compenser*), this policy was first in place for major urban projects before it was progressively extended to include smaller ones. Concerns about urban sprawl led the parliament to pass two laws protecting mountains (1985) and coastlines (1986), effectively limiting urban zoning capacities for thousands of municipalities. More recently, urban planning laws in 2000 (law n°2000-1208), 2010 (law

n°2010-788) and 2014 (law n°2014-366) have addressed land take, most notably by stating municipalities should justify their land consumption.

Policy formulation and legitimation. The first official document advocating for an explicit NNLT objective was the 2018 report on biodiversity driven by former French Minister of Ecological Transition, Nicolas Hulot, a well-known figure of Green political movements. In France, the NNLT policy was introduced by the government after it had been advocated through a non-governmental and participatory procedure, The Citizens' Convention for Climate (composed of 150 participants chosen by lot), a procedure proposed by the 'Gilets jaunes' (a social protest movement against an ecological tax on gasoline) and then taken up by the government.

The proposals issued by this participatory process were nevertheless submitted to technical-political filters. Parliamentary debates highlighted conflicting views among political parties (conservative parties being more reluctant to support NNLT objectives) and also between the two chambers of Parliament. Eventually, the adopted law (2021) remained broadly in line with the proposal of the Citizens' Convention, as binding and quantified objectives were endorsed: a 50% reduction of land consumption in the next decade and zero land take (*Zéro Artificialisation Nette*, or *ZAN*) by 2050. This new *ZAN* policy is in line with successive legislative reforms adopted in the 2010s to reduce urban sprawl. In particular, the 2010 Law on Agriculture (Law Nr. 2010-874) established '*committees on farmland consumption*' which edict non-binding recommendations on land-use plans concerning urbanization in agricultural spaces. Following the 2021 Law on Climate and Resilience, a decree by the Council of State (*Decree Nr. 2022-763, completed by Decree Nr. 2023-1096*) clarified a legal definition of land take (*artificialisation*). This definition is in line with EU standards and includes not only areas sealed by urbanization but also urban green areas.

After NNLT was made into law in 2021, the legislation sparked criticism over fears that it would reduce the planning sovereignty of the municipalities. The association of French mayors appealed against the 2022 implementation decrees, and right-wing senators introduced a new law, eventually voted by the Parliament in 2023 (*law n°630-230*), and followed by new implementation decrees (*decrees Nr. 2023-1096 and 1097*). This new legal frame has extended the delays for NNLT implementation and granted slightly more flexibility to municipalities.

Implementation and integration in planning. *ZAN* implementation is a top-down process: objectives have been set up at the national level, they will then be differentiated for the regions by a distribution model and finally, municipalities will need to comply with them. Local zoning plans which fail to meet the objective may be rejected by prefectures. Through a process called 'territorialisation', municipalities may hand out their building rights to one another as long as the regional objective of a 50% reduction is met. However, a ministerial circular issued at the start of 2024 edicted that land-use plans could remain within a 20 % margin of the 50 % reduction goal, a new flexibility challenged in court by an environmental organization. A second NLLT law in 2023 stipulated that every municipality with a local land-use plan should receive at least one hectare of building rights to prevent this process from depriving municipalities of any building rights. This law also created a 12,500-hectare "national fund", which should be strictly used for "major projects of general interest." As of the writing of the present article, a ministerial decree determining each region's contribution to this fund as well as the list of those major urban projects was still undergoing consultation, giving rise to intense discussions with regional councils.

Numerous obstacles hinder the development of the new NNLT policy. Municipalities are funded by local taxes, which rely on urbanization, and the implementation of NNLT could potentially jeopardize their financial model. Although municipalities might be granted the right to compensate if they exceed land take thresholds, this spatial compensation could prove costly. Current local zoning plans were decided before the NNLT target became law, and most of these plans allow far greater land take than the 50% reduction expected for 2030. Downzoning will occur in many municipalities, and this process could stir up tensions between landowners and local authorities. This is especially an obstacle because these local land-use plans are expected to be compatible with NNLT by 2027. In the meantime, municipalities are free to allow developers to implement housing and economic projects. This delay in application may jeopardize the short-term goal of 2031. These various legal changes, among them the vote on a law that significantly amends the initial NNLT proposal, illustrate how intense the political debate on NNLT is in France currently.

Luxembourg: *Réduction de l'artificialisation du sol*

*12.5 % settlement area (2018) * 2.8 m²/cap/ year land take ratio (2018) * NNLT by 2050*

Problem and agenda setting. The small member state of Luxembourg experiences a high relative population growth, driven by a fast-developing economy that generates a huge demand for new constructions. Although the dynamics of land take in Luxembourg may seem modest in absolute figures, with 0.46 ha/day or 168 ha/year, it should be considered to the country's small surface and population (2,586 km² for 645,000 inhabitants). Land take monitoring is carried out by the Department of Spatial Planning of the Ministry of Energy and Spatial Planning, using high-resolution aerial images processed by a private company. The phenomenon of land take concerns the whole territory and has led to massive developments over the last 30 years. The collectively shared impression of a construction 'rush' that has a high impact on the fragmentation of ecosystems has influenced the political debate and pushed the government to respond for the first time in 2010.

Policy formulation and legitimation. In its *Plan National de développement durable* (2010), the Luxembourg government formulated for the first time a non-binding target to reduce land take to 1 hectare per day and reduce it by half by 2020. However, improvements in monitoring tools have allowed to show that the rhythm of land take was much lower than it appeared before, at approximately 0.5 hectares per day. The consequence has been a reformulation of the objective in 2020 with a target of 0.25 ha per day until 2035, before aligning with the NNLT objective by 2050. This shows the importance of accurate monitoring tools for defining policy objectives (Decoville and Schneider, 2016). This strategy is incorporated into the new national spatial planning program, which was approved by the government on June 21, 2023 (Ministère de l'Energie et de l'Aménagement du Territoire, 2023).

Implementation and integration in planning. Despite the lack of a legally binding mechanism, the ministerial authorities have developed and communicated a distribution model of municipal thresholds to 102 municipalities to increase their awareness, and with the aim of achieving the NNLT objective by 2050 and the intermediate objectives by 2035 (2023). The lack of a binding mechanism is linked to the strong autonomy of municipalities in terms of land use planning, and if some local policymakers are aware of the necessity to decrease land take, others are more inclined to favor a development that will increase local resources. Indeed, the subsidies granted by the State are calculated based on the evolution of the municipal population, among others. The approach can therefore be considered top-down and focused on raising awareness rather than legally binding goals. The maximum thresholds for land consumption have been calculated according to the principle of a quota of areas that can be taken annually per municipality until 2035. Reaching the NNLT objective by 2050 involves a gradual reduction of land take of 7 ha/year at the national scale.

The first criterion used in the distribution model to define the local thresholds is the current demographic weight of the municipalities and the number of job places they host. The second one refers to the type of commune as defined in the national spatial planning strategy (rural, suburban, urban) Finally, building density criteria are assigned to each municipality to avoid overly dense constructions in rural areas that would affect their architectural and urbanistic aspects. The capacity of the urban fabric to 'absorb' new developments has not been considered directly in the calculation of these thresholds, but the objective in itself is a strong incentive for urban densification. Until now, the question of the support given by the State to the communes has not been tackled. Pilot projects aimed at improving density in urban areas are carried out, but without specific mention of the land take reduction strategy.

One of the most challenging issues for Luxembourg is balancing the NNLT environmental objective with the social concern of providing sufficient housing to accommodate newcomers at an affordable price. An anti-land speculation law has been recently put in place to increase the response to housing needs by forcing landowners to build the plots that have been designated as buildable in the municipal planning documents. This might lead to a lack of coherence between the different sectoral policies (housing, mobility, and landscape economic development versus spatial policy) and a strong opposition against the no net land take objective, especially from landowners and developers. Another problem is the oversupply of zoned land inherited from the local urban development plans that are still in force. A recent study shows that the

available land is over 5,000 ha, while the land take reduction policy is supposed to limit to a maximum of 2,340 ha that could be taken until 2050 (Ministère du Logement, 2021). The question of how, when, and at what financial compensation land could be rezoned into unbuildable land has not yet been answered.

Austria: *Österreichische Bodenstrategie*

*6.9 % settlement area (2020) * 4.7 m²/cap/ year land take ratio (2020) * NNLT by 2050*

Problem and agenda setting. Austria's total land take rate is high compared to other Member States. In the period 2019-2021, land take amounted to 41 km²/year, which corresponds to a consumption of 11.3 ha/day. New settlement, economic development, and transport infrastructure are considered the main driving forces. A variety of policies and measures such as the mobilization of building land, the reduction of additional zoning, and time-limited zoning contributed to the reduction of land take by half in the last decade. However, hardly any further reduction has been recorded in recent years, showing that the existing framework of policies and instruments is not delivering further reductions.

The *Umweltbundesamt* (Environment Agency Austria) is commissioned by the Ministry to monitor land take annually. The cadastre land register served as the sole, but not the most suitable source of data. Therefore, the monitoring method was updated in 2022 in response to the requirements of the Soil Strategy draft. Due to its topography and mountainous regions, the proportion of usable land is very limited in Austria. Securing Austria's agricultural land and food security has therefore become a public concern. Under pressure from public opinion, media, commercial stakeholders, and environmental movements, *Flächenfraß* has appeared on the political agenda in recent years.

Policy formulation and legitimation. Quantitative targets on land take reduction were already part of the Austrian Strategy for Sustainable Development, adopted in 2002. It was intended to reduce the soil-sealing rate to a maximum of one-tenth by 2010. By analogy, the same reduction target for land take was defined, resulting in a net land take rate of 2.5 ha/day net by 2010. However, the target of reducing land take was not met in 2010. The federal government included the target again in the government program 2020-2024, namely to limit additional land take to 2.5 ha/day net by 2030. The Austrian Conference on Spatial Planning (ÖROK) was commissioned to elaborate a *Bodenstrategie* (ÖREK, 2021).

This resulted in a draft of Soil Strategy (2023) that envisages the ultimate goal of achieving NNLT by 2050. Land take reduction is meant to be achieved through the protection of land, the prevention of urban sprawl, the support of efficient inner development, and the raising of public awareness. At the time of writing, the final strategy is still under discussion due to different political views. In particular, binding quantitative reduction targets for 2030 are rejected by the federal states. Moreover, it has become uncertain whether a final version of the Strategy will be adopted with elections looming.

Implementation and integration in planning. In Austria, land use planning is the competence of the municipalities, while federal states are in charge of regional strategic planning. The national government has no planning competences but coordinates the planning levels and is responsible for related sectoral policies such as infrastructure, forestry, and water supply. The Action plan of the Soil Strategy draft outlines clear objectives, milestones, and responsibilities for each action. Examples of such objectives are the establishment of agricultural priority zones, the reduction of oversupply of zoned land, conducting an active land policy, restrictions on land-intensive building uses, compensation for land use, and the adjustment of financial instruments.

A major challenge is to deal with the zoned but undeveloped land, which accounts for about 21% (67,142ha) of the total zoned area (ÖROK-Atlas). Efforts to downzone face great resistance; downzoning without financial compensation is legally difficult to implement and could turn out costly for the municipalities. However, other techniques and instruments are already in place in the Austrian planning system to reduce land consumption. For instance, municipalities can impose a development moratorium for a limited time and refuse permit applications. Another instrument is time limited-zoning (*befristete Widmung*), which is

mainly used in Austria for new zoning plans. Municipalities, though, still hold the constitutional right to allocate additional zones until today.

Based on the newly developed method for measuring land take, the federal government's target of 2.5 ha/day will be assessed with a feasibility check. Furthermore, regionalised reduction targets should be developed, states the Strategy's action plan, and a three-year progress report should complete the policy cycle of Austria's Soil Strategy. Based on these reports, it is intended to adjust or specify the measures if necessary. In summary, the success of the Austrian NNLT policy will greatly depend on the extent to which the reduction measures are anchored at the level of the federal states and reductive instruments are implemented at the local level (Getzner and Kadi, 2020).

Comparative findings

In the five member states investigated, land consumption has fallen significantly over the past 20 years but has not continued to fall in recent years. It is difficult to demonstrate a causal relationship between the introduction of official objectives to limit land take and its decline followed by a steady consumption rate. Some countries already had land take reduction policies in place (Germany, France, Austria) even before the European policy was formulated in 2011. In these countries, the ultimate NNLT goal is rather a long-term 'extension' of existing spatial policies which can be built in the future. For other countries, the reduction of land take is a completely new approach that has appeared on the political agenda due to increasing fragmentation and damage to the landscape and nature, and due to the way public opinion, the media and environmental movements have exerted pressure (Austria, Belgium).

With the different names given to the NNLT policy nationally, member states seem to prefer a particular angle that fits the wider political context. The names *Reduzierung des Flächenverbrauchs, Réduction de l'artificialisation and ZAN* highlight the restrictive aspect of the NNLT. The Austrian *Bodenstrategie* emphasises the link with integrated soil policy more. The Belgian regions chose to highlight the shift in construction production with names such as *Bouwshift* and *Optimisation spatiale*, rather than the more restrictive 'beton stop' or 'stop béton' coined by the media and better known by the public.

Besides accurately determining the *starting* point of current land consumption, the political choice of the *end* point of the reduction pathway is also important. Because of its excessive settlement area, only the Flanders region has adopted a target that is more ambitious (2040) than the European one (2050). The resulting national trajectories are best compared in relative terms, e.g. as land take rate (m^2/cap/year). Germany, France, Luxembourg, and Wallonia appear to project a very similar trajectory until 2050 (Figure 2). Striking is Austria's high land consumption per capita and the steep reduction that the national government wants to achieve by 2030 to less than one-fifth of it. Except for Wallonia, the five countries approved an intermediate step (2025 and 2030).

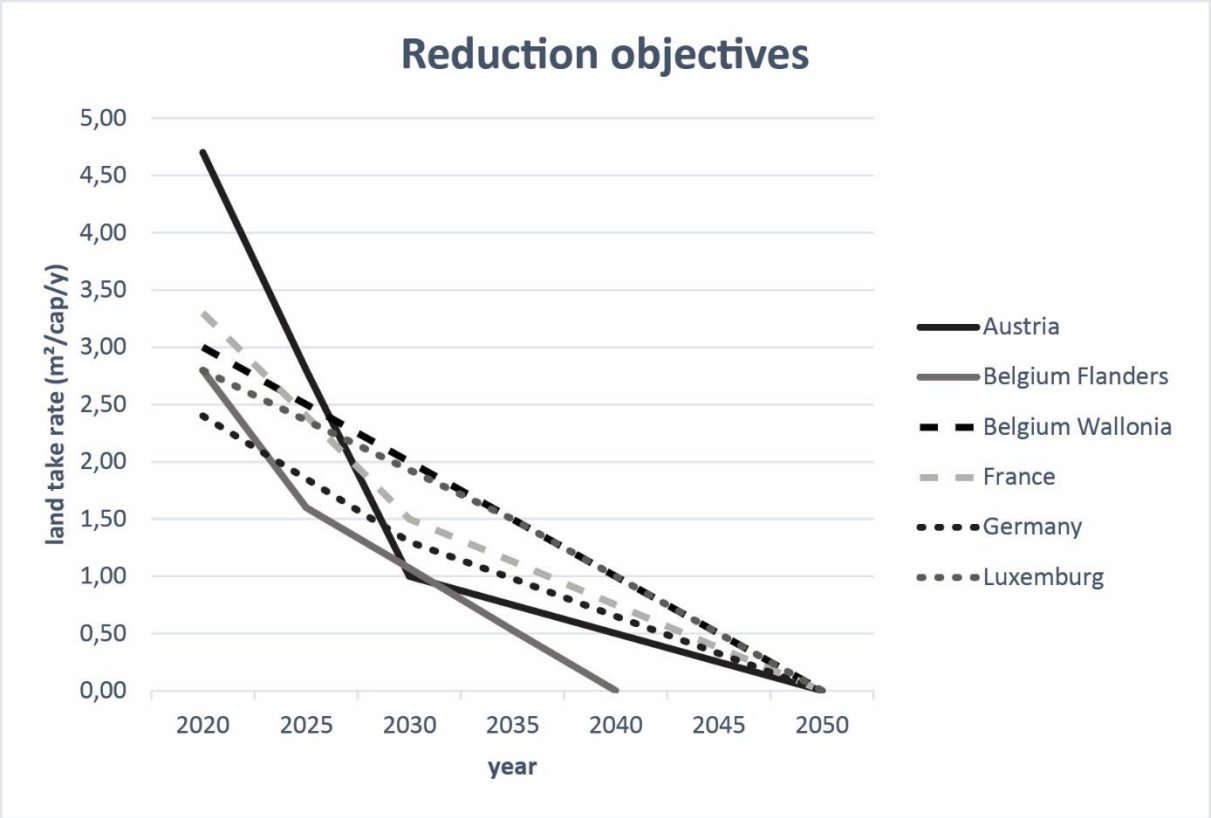

Figure 2: Relative NNLT reduction trajectory of the five EU member states (m²/cap/y)

Also, the degree of policy progress varies. Austria, Germany, and Luxembourg started early on reduction policies and are gradually refining these but are now finding that additional measures are needed. The two Belgian regions approved the NNLT objective, but implementation through concrete actions has been very slow. In contrast, France started later (2021) and already approved three implementing decrees a year after the binding decision. Only France has given the NNLT target a binding status, as part of its comprehensive Climate Law.

In contrast, a non-binding target makes the national policy entirely dependent on the willingness of provinces, regions, and municipalities to cooperate. France, Austria, and Wallonia are preparing a distribution model where quotas of maximum land take are distributed among regions or provinces. Germany has developed an online distribution model as a tool, but the underlying distribution is not fixed in national and local policy. Luxembourg has already developed such a distribution for its 102 municipalities.

Among the member states studied, a wide variety of land policy instruments are found, both instruments that already support a reduction of land take and new instruments that are still under examination or have recently been introduced. A general observation is the frequent oversupply of buildable land in local land use plans which can be many times larger than the limit of a NNLT reduction trajectory allows, such as in Austria, Luxembourg, and Belgium (data is missing for France and Germany). Downzoning and a periodic review of local plans will therefore be crucial to ensure that binding local plans are aligned with the NNLT objectives. Additionally, the increase in net buildable areas can be halted by a zoning compensation scheme, as demonstrated by the Belgian regions. The French ERC sequence is an inspiring example of how the basic principle of land take hierarchy can be integrated into the planning and building permit systems.

Conclusion

This policy research investigates the agenda setting, policy formulation, and initial implementation of NNLT by five pioneering countries. As the NNLT policies in Germany, Belgium, France, Luxembourg, and Austria are still under development, this comparative case study is merely a first snapshot. In a next step, when the

NNLT policies are in full implementation, more comparative research will be possible on the side effects that the NNLT strategies might induce, for instance, on land prices and the capacity of households to afford decent housing.
The European NNLT target is defined generically, but the circumstances of the five member states are diverse in terms of territorial area, demographic evolution, spatial condition, and performance of the planning system, and so will the national NNLT policies. The policy transition from the general EU objective to a specific, national planning system will inevitably run into obstacles that are similar in the different member states or rather unique to a particular country. France and Luxembourg still expect strong demographic growth, which these member states will have to reconcile with sparse land take. The Belgian regions will have to overcome the rigidity of their old land use plans to control additional land take in the future. Germany, and especially Austria, will have to take more decisive actions to relaunch the stalled reduction in land consumption.

NNLT policy is a top-down process in which the reduction objective becomes more specific and concrete in cascade, per policy level. Of course, setting purely quantitative targets is no guarantee of success, and other countries might implement containment policies that can be as effective as or even more effective than those adopted in the set of countries under scrutiny in this paper. Especially if it remains a non binding target at the national level, the implementation of NNLT at lower planning levels risks becoming optional. For example, twenty years of reduction policies in Germany and Austria have produced results, but the reductions are lower than intended. In several member states, the subsidiarity principle is coming under pressure from the top-down NNLT policy. Excessive decentralisation of spatial planning is being questioned in light of new land policies and environmental challenges (Austria). More restrictive policies such as those on net land take are at odds with the continued growth sought by municipalities. Municipalities insist on their autonomy, and in some member states their self-government is legally entrenched (Germany). Member states are therefore trying to encourage the lower governmental levels to act similarly, namely through a distribution model that is a breakdown of the reduction trajectory (Luxembourg). Also, larger member states need to diversify their NNLT policy as they include regions both in growth and decline (France). Either way, in both a binding and a non-binding context, the success of an NNLT policy depends on local governments since legally binding decisions towards landowners are made at that level. The actual 'battlefield' of land conservation is thus at the municipal level. Will municipalities act and carry out the policy alignment, and are they prepared for this task? Could top-down financial incentives stimulate local authorities to preserve land, rather than aiming for more bottom-up tax revenues? Would NNLT policies raise tensions between urban and rural areas as the rural territories could be seen as mere 'reservoirs' of compensation for urban expansion? Especially the small municipalities will need support and possibly a budget from the higher boards to implement the necessary reallocations. National and regional governments have instruments at their disposal to coordinate the process and negotiate a fair and viable arrangement for the local level. All levels of government will therefore be called upon to deploy their instruments and capabilities within a national or regional NNLT policy. Cooperation and coordination across the different levels of government will be crucial for a successful implementation of NNLT policies.

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National references

AUSTRIA. ÖREK (2021), *Austrian Spatial Development Concept. ÖREK 2030 in brief. Need For Transformation*.

AUSTRIA. ÖROK (2023), *Bodenstrategie für Österreich (Entwurf). Strategie zur Reduktion der weiteren Flächeninanspruchnahme und Bodenversiegelung bis 2030*, https://www.oerok.gv.at/fileadmin/user_upload/Bilder/2.Reiter-

Raum_u._Region/6._OEREK_Umsetzungspakte/Bodenstrategie/OEROK_Bodenstrategie_fuer_Oesterreich_ENTWURF.pdf (accessed 15 May 2024).AUSTRIA. ÖROK-Atlas: Zoned, but undeveloped land; https://www.oerok-atlas.at/#incicator/70 (accessed 15 May 2024).

BELGIUM-FLANDERS. DEPARTEMENT OMGEVING (2018), *Strategische Visie Beleidsplan Ruimte Vlaanderen*, https://publicaties.vlaanderen.be/view-file/28360 (accessed 15 May 2024).

BELGIUM-WALLONIA. WALLONIE TERRITOIRE - SPW (2023), Schéma de Développement du Territoire. Vers une optimisation spatiale, PROJET 30 mars 2023, https://lampspw.wallonie.be/dgo4/tinymvc/apps/amenagement/views/documents/amenagement/regional/sdt/sdt-2023/sdt-projet-30-mars-2023.pdf (accessed 15 May 2024).

FRANCE. *Assemblée Nationale, (2021), Loi portant lutte contre le dérèglement climatique et renforcement de la résilience face à ses effets 2021-1104* [online], 22nd of August 2023, https ://www.legifrance.gouv.fr/jorf/id/JORFTEXT000043956924/(accessed 15 May 2024).

FRANCE. *Assemblée Nationale, (2023), Loi visant à faciliter la mise en œuvre des objectifs de lutte contre l'artificialisation des sols et à renforcer l'accompagnement des élus locaux 2023-630* [online], 20th of July 2023, https ://www.legifrance.gouv.fr/jorf/id/JORFTEXT000047866733/(accessed 15 May 2024).

GERMANY. *The Federal Government, German Sustainable Development Strategy* (2021), https://www.bundesregierung.de/resource/blob/975274/1873516/9d73d857a3f7f0f8df5ac1b4c349fa07/2021-03-10-dns-2021-finale-langfassung-barrierefrei-data.pdf?download=1, page 270f

GERMANY. UMWELTBUNDESAMT (2023), *Kommunaler Flächenrechner*, https://gis.uba.de/maps/resources/apps/flaechenrechner/index.html?lang=de (accessed 15 May 2024).

LUXEMBOURG. MINISTERE DU LOGEMENT (2021), *La détention du foncier constructible pour l'habitat au Luxembourg en 2020/2021 : distribution et typologie de propriétaires*. https://logement.public.lu/dam-assets/documents/publications/observatoire/note-29.pdf (accessed 15 May 2024).

LUXEMBOURG. MINISTERE DE L'ENERGIE ET DE L'AMENAGEMENT DU TERRITOIRE (2023), *Programme Directeur d'aménagement du territoire (PDAT 2023),* https://amenagement-territoire.public.lu/content/dam/amenagement_territoire/pdat-programme-directeur-damnagement-du-territoire-4072023.pdf (accessed 15 May 2024).

References

BOVET, J. and MARQUARD, E. (2022), Quantitative Targets, Tradable Planning Permits and Infrastructure Cost Calculators: Examples of Instruments Addressing Land Take in Europe, in: Ginzky et al. (eds.), *International Yearbook of Soil Law and Policy* 2020/2021, 77-96.

CAIRNEY, P. (2020), Understanding public policy, London: Macmillan Education.

CEREMA (2020), Les déterminantes de la consommation d'espaces. Période 2009-2019.

COLSAET, A., LAURANS, Y. and LEVREL, H. (2018), What drives land take and urban land expansion? A systematic review. *Land Use Policy* 79:339–349.

COLSAET, A. (2019), Land take in France: what political progress, for what results? ISSUE Brief 2.

DAVY, B. (2009), Land thrift as sustainable development. The case of Germany's 30 hectares goal, in A. van der Valk and T. van Dijk (eds), Regional Planning for Open Space, London, Routledge, 279–300.

DECOVILLE, A. and SCHNEIDER, M. (2016), Can the 2050 zero land take objective of the EU be reliably monitored? A comparative study, *Journal of Land Use Science*, 11:3, 331-349.

DECOVILLE, A. and FELTGEN, V. (2023), Clarifying the EU objective of no net land take: A necessity to avoid the cure being worse than the disease. *Land Use Policy*, *131*, 106722.EC (2011), *Roadmap to a Resource Efficient Europe*. COM (2011) 571.

EC (2011), *Roadmap to a Resource Efficient Europe*. COM(2011) 571.

EC (2021), *EU Soil Strategy for 2030 Reaping the benefits of healthy soils for people, food, nature and climate*. COM(2021) 699.

EC (2023), *Proposal for a Directive on Soil Monitoring and Resilience.* COM(2023) 416.

EEA (2019), *Land take and net land take*, https://www.eea.europa.eu/data-and-maps/dashboards/land-take-statistics#tab-based-on-data (accessed 15 May 2024).

EEA (2020), Results of the Land Take Questionnaire. Copenhagen: 23 p.

GAGNON, Y-C. (2010), *The Case Study as Research Method*. Presses de l'Universite du Quebec.

GERBER, J-D., HARTMANN, T. and HENGSTERMANN, A. (2018), *Instruments of land policy. Dealing with scarcity of land*. Routledge, Abingdon, Oxfordshire.

GETZNER, M. and KADI, J. (2020), Determinants of land consumption in Austria and the effects of spatial planning regulations, *European Planning Studies*, 28:6, 1095-1117.

GRANT, J. (2018), Growth management theory. From the Garden City to Smart Growth. In: Gunder, M., Madapipour, A. & Watson, V. (Eds.) *The Routledge Handbook of Planning Theory*, 41-52 & 69- 80.

GRIMSKI, D. (2019), Tradable Land Planning Certificates to Reduce Land Take: Results of a Simulation Game with Communities in Germany. In: GINZKY et al. (eds.) *International Yearbook of Soil Law and Policy 2018, International Yearbook of Soil Law and Policy*, 131-147.

HALLEUX, J.-M., MARCINCZAK, S. and VAN DER KRABBEN, E. (2012), The adaptive efficiency of land use planning measured by the control of urban sprawl. The cases of the Netherlands, Belgium and Poland, *Land Use Policy*, 29(4), 887-898.

HARTMANN, T. et al. (2023), Land for densification: how land policy and property matter. *Town Planning Review*, 94(5), 465–473.

HERSPERGER, A.; GRADINARU, S. and SIEDENTOP, S. (2020), Towards a better understanding of land conversion at the urban-rural interface: planning intentions and the effectiveness of growth management*, Journal of Land Use Science 15*(5), 644-651.

HOWLETT, M and GIEST, S. (2015), The policy-making process. In: E. Araral, S. Fritzen, M. Howlett, M. Ramesh & X. Wu. (eds), Routledge Handbook of Public Policy, London: Routledge, 17-29.

IWEPS (2022), *Les chiffres-clés de la Wallonie*, Namur: 238 p.

KÖCK, W. et al. (2007), Activating Spatial Planning Law: Options for the Reduction of Land Consumption. *Journal for European Environmental & Planning Law* (JEEPL) 01, 2-16.

LACOERE, P. and LEINFELDER, H. (2023), No net land take for Flanders. Towards a roadmap for the implementation of Europe's land target, *Raumforschung und Raumordnung | Spatial Research and Planning*.

LE BIVIC, C. and MELOT, R. (2020), Scheduling Urbanization in Rural Municipalities: Local Practices in Land-Use Planning on the Fringes of the Paris Region. *Land Use Policy* 99, 105040.

LEROY, M. and BIGARD, C. (2020), Appréhender la séquence Éviter-Réduire-Compenser dès la planification de l'aménagement : du changement d'échelle à sa mise en oeuvre dans les territoires. Sciences Eaux & Territoires, INRAE, 2020, 31, 12-17.

MARQUARD, E. et al. (2020), Land Consumption and Land Take: Enhancing Conceptual Clarity for Evaluating Spatial Governance in the EU Context, *Sustainability* 2020, 12, 8269.

NADIN, V. et al. (2018), *COMPASS - Comparative Analysis of Territorial Governance and Spatial Planning Systems in Europe*, Luxembourg.

PESARESI, M. et al. (2016), *Atlas of the Human Planet 2016*. Mapping Human Presence on Earth with the Global Human Settlement Layer; EC JRC.

PROKOP, G. and SALATA, S. (2017), The European approach: Limitation, mitigation and compensation. In: *Urban Expansion, Land Cover and Soil Ecosystem Services*. Routledge, 265-275.

SAVINI, F., FERREIRA, A. and SCHÖNFELD, K. (2022), Post-Growth Planning, New York, Routledge.

TASKFORCE BOUWSHIFT (2021), https://www.hogent.be/sites/hogent/assets/File/Taskforce%20Bouwshift%20einddocument%202021-11-30.pdf (accessed 15 May 2024).

VERBURG, P. et al. (2022), *The Contribution of Integrated Land Use Planning and Integrated Landscape Management to Implementing Land Degradation Neutrality: Entry Points and Support Tools.* UNCCD, Bonn.

VERMEIREN, K. et al. (2022), Modelling urban sprawl and assessing its costs in the planning process: A case study in Flanders, Belgium, *Land Use Policy* 113, 105902.

VON LONG et al. (2014). *Study supporting potential land and soil targets under the 2015 Land Communication*, Report prepared for the European Commission.