



# Suburban climate adaptation governance: assumptions and imaginaries affecting peripheral municipalities

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## ABSTRACT

The world is rapidly suburbanising and, as recognised in numerous academic and policy documents, suburbs are not only environmentally unsustainable but also particularly vulnerable to climate change. This same literature and policy discourse suggests the solution to making suburbs more sustainable and adaptable is densification and investing in infrastructural green growth. Meanwhile, alternative approaches in critical suburban literature suggest that densification might create negative externalities, and instead propose the transformation of infrastructures' management and ownership to support an innovative and autochthonous path for suburbs' climate adaptation. Yet limited empirical knowledge exists on what adaptation strategies are being implemented across peripheral municipalities where suburbs are more prevalent. A comparative analysis is presented of three peripheral municipalities in Santiago de Compostela, Spain, on their adaptation strategies for water and sanitation. This shows how mainstream assumptions about suburbs and imaginaries of adaptation influence their strategies, as well as how the specific characteristics in the peripheral municipalities allow or hamper more innovative approaches. Three factors emerge as more important in allowing innovation and autochthonous solutions: the level of suburbanisation, the management model for municipal infrastructures, and their political context (including proximity of local government with higher-tier bodies and government composition).

## PRACTICE RELEVANCE

Peripheral municipalities around the world, with a predominant suburban character, are considered the most unsustainable form of urbanisation and the areas in cities that are most at risk to climate change. This research demonstrates the importance of policymakers' imaginaries for advancing less formal and *de facto* (as well as formal) innovative adaptation strategies in peripheral municipalities. While the production of formal adaptation strategies by capital cities' governments is growing, less formal, more intuitive and *de facto* strategies dominate any adaptation efforts in peripheral municipalities, where suburbs are prevalent. Opportunities for innovation in adaptation strategies and challenging existing assumptions reside in influencing the underlying policy assumptions and imaginaries that peripheral municipalities' policymakers currently hold.

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AS	adaptive strategies
CM	central municipalities
CSS	critical suburban studies
LIF	lifestyles
PM	peripheral municipalities
SA	suburban adaptation
SAS	suburban adaptation strategies
SdC	Santiago de Compostela
SOT	sociotechnical
SPA	spatial form

## 1. INTRODUCTION

The world is rapidly (sub)urbanising, with 60% of the world's population expected to be living in cities by 2050, and up to 83.7% in Europe (UN 2014). However, most will not live in consolidated, high-density, compact city centres but rather in the urban periphery (Keil 2017). Meanwhile, cities continue to be responsible for climate change, as well as being the areas where climate change will be most brutal (IEA 2008). Nevertheless, according to the 2022 Intergovernmental Panel on Climate Change (IPCC), certain parts of the city such as the urban periphery (peri-urban areas) will be impacted more severely (p. 910) given either their lack of infrastructure or their poor planning (Addie 2016; Filion & Keil 2017). Despite the challenge, climate adaptation plans in peripheral municipalities (hereafter PMs), where suburbs are the prevalent form of urbanisation – typically smaller and less resourced than central municipalities (hereafter CMs) – are scarce. In the absence of a plan, the extension of and investment in infrastructure continues, which ultimately represents a less formal, more intuitive and *de facto* approach to climate change adaptation. This form of climate adaptation is referred to here as ‘weak’ climate adaptation planning and forms the focus of this paper.

Almost a decade ago, climate adaptation planning scholarship called attention to the urgency of focusing on cities’ and localities’ needs and experiences as these would be particularly vulnerable to climate change (IPCC 2014). Since then, most research has focused on the analysis of large cities’ and urban settings’ formal plans, assessing their outcomes and their effectiveness. More recently, scholarship has brought to the fore the unintended consequences of such plans and/or initiatives (such as increasing inequality and negative environmental externalities), while identifying the causes of maladaptation. However, three key aspects remain overlooked. First, although in the 2022 IPCC report the urban periphery and/or suburbs were identified as the most vulnerable places within cities, limited research has investigated the particularities of climate adaptation in them (and their variability). Second, the prevalence of large cities and urban setting cases in adaptation scholarship has resulted in a bias of assuming formal ways of climate adaptation planning, as opposed to less formal, more intuitive, and *de facto* mechanisms used by smaller and peripheral municipalities. Third, how adaptation processes are governed (influenced by assumptions and imaginaries) and how more structural factors impact the capacity of PMs to develop more innovative and autochthonous strategies – remains unexplored.

Two opposing, dominant narratives about how suburbs must adapt to climate change are considered. One is a narrative that sees the physical transformation of suburbs (mainly through densification) as the main solution to tackling suburbs’ unsustainable performance, as well as infrastructural ‘green growth’ (the extension and upgrade of large and centralised infrastructures) to secure universal and safe access to basic services. The other is an emerging narrative that presents the suburbs in their current spatial form as distinctive spaces and as places of opportunity

for advancing an agenda of environmental sustainability and progressive forms of governance. This second narrative tackles suburbs' unsustainability not through the transformation and/or densification of suburbs' morphology but instead through the transformation of their sociotechnical underpinning. Scholars in this group suggest doing so by advancing more progressive forms of infrastructure management and ownership in the form of communal and/or individual models. This could not only reduce environmental externalities but also resist the commodification of basic services and advance more democratic processes (Cerrada Morato 2024a). These two narratives have been described as normative – stating how adaptation should be – as opposed to critical – questioning why and how more or less progressive forms of suburban adaptation are materialising. This paper draws on scholarship that has critically studied both suburbs' densification and infrastructure transformation in order to propose a framework that unpacks these two questions.

It is argued here that suburbs constitute a specific form of urban settlement that calls for specific and autochthonous forms of adaptation to climate change, away from the cognitive dependency of the urban paradigm. So what is preventing the adoption of these more innovative forms? Although PMs (where suburbs are most prevalent) tend to lack formal climate adaptation plans, their infrastructural investment plans and strategies act as *de facto* adaptation plans. And these less formal, more intuitive and *de facto* adaptation strategies (ASs) are strongly influenced by policymakers' assumptions and imaginaries. Therefore, it is suggested here that:

- in order for PMs to develop more innovative suburban adaptation strategies (hereafter SASs), assumptions on what suburbs are now (spatial, sociotechnical, social) need to be unpacked and new imaginaries need to be developed in order to influence decision makers and/or policy
- different types of PM (degree spatial suburbanity, sociotechnical underpinning, suburban lifestyles) exist and each type has its own opportunities and challenges.

The paper is structured as follows. The next section reviews the two dominant narratives on suburban adaptation by bringing to the fore their spatial and socio-material approach for adapting suburbs and examining the assumptions and imaginaries underpinning each. Then the heterogeneity of suburbs is explored and translated into a PM typology to develop a more nuanced understanding of the opportunities and challenges. After outlining the conceptual framework, the relationship between key factors is explored: the local government degree of innovation in their adaptation strategy, the imaginaries and assumptions underpinning each, and their peripheral municipality type. This is done using a comparative assessment of the water and sanitation adaptation strategies of three specific PMs in the metropolitan area of a medium-sized city in Spain.

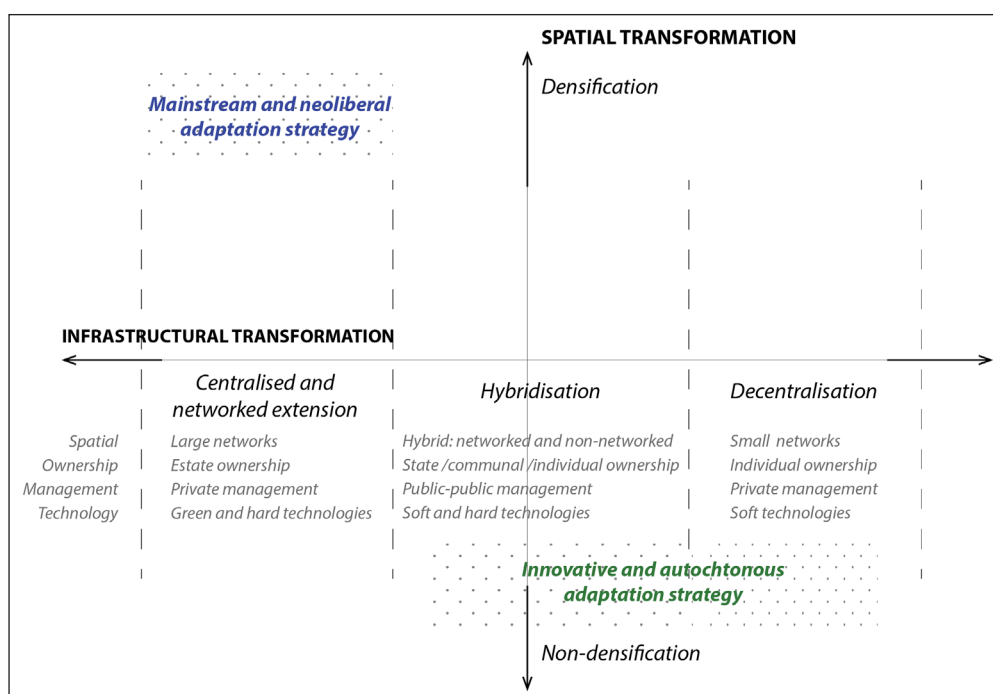
## 2. SUBURBAN ADAPTATION: A CONCEPTUAL FRAMEWORK

Climate adaptation literature has recently explored the effectiveness of climate adaptation plans and their unequal impact across places and communities (Magnan *et al.* 2016). While scholarship has identified a lack of embeddedness of climate adaptation plans as the main root for maladaptation (Olazabal *et al.* 2021), the transference of practices and more important imaginaries of good adaptation remain to be explored (Olazabal & Castán Broto 2023). Furthermore, as pointed out by Lioubimtseva and da Cunha (2020), the adaptation literature has engaged with large global north and global south cities but has failed to target small- and medium-sized cities, as well as suburban areas. The latter is particularly concerning given the exacerbated vulnerability of suburbs and suburban dwellers to climate change (IPCC 2022: 910). This section reviews the suburban adaptation literature to present the two dominant narratives in scholarship: a mainstream and neoliberal strategy and a more innovative approach. Then suburban critical studies are used as a basis for advancing a PM framework that incorporates spatial, socio-material infrastructure and social issues.

## 2.1. SUBURBAN ADAPTATION: A CONCEPTUAL FRAMEWORK TO IDENTIFY ILL-SUITED APPROACHES

The suburban adaptation literature is extensive in the Anglo-Saxon context (the USA, Canada and Australia), where suburbs (and suburbanisation) have been the predominant form of urbanisation (Dunham-Jones & Williamson 2011; Dunham-Jones 2005; Talen 2011). There is a wealth of propositions under the banners of new urbanism or smart growth in North America and sustainable cities in Europe (Urban Task Force 1999), around the ‘battle against urban sprawl’ and the need to a) increase the density of cities to make them more resilient and sustainable (Logan & Molotch 2007; Béal *et al.* 2011; Charmes & Keil 2015) and to b) invest in infrastructural ‘green growth’ to reduce emissions and to adapt to climate change (Altobelli *et al.* 2020; Torralba *et al.* 2022). An opposing and more innovative narrative to the one above, which has emerged both in Anglo-Saxon countries but more strongly in Europe, argues that suburbs’ physical characteristics offer opportunities for their transformation into environmentally sustainable and more democratic and progressive places (Sieverts & Larup 2012; Alexander & Gleeson 2019). Therefore, from a morphological perspective, they argue that densification might create negative outcomes (Artmann *et al.* 2019), and instead focus on the ‘radical’ transformation of infrastructures, overcoming the ‘green growth’ narrative. The ‘radical’ transformation incorporates spatial and technological transformation, as well as issues of ownership and management. On the former, this scholarship suggests that the implementation of physically decentralised (off-grid and non-networked solutions), low-carbon and soft technologies across suburbs might be the most appropriate strategy to adapt to climate change as it will increase circularity at the smallest scale possible, reducing externalities (Sieverts & Larup 2012; Alexander & Gleeson 2019). On the latter, a more innovative and progressive infrastructural transition for suburban adaptation needs to incorporate issues of ownership beyond the public versus private dichotomy, as well as management arrangements that incorporate public-public partnerships to not only advance participation but also resist services’ commodification (Cerrada Morato 2024a).

Based on the two dominant narratives of suburban adaptation, a new framework is proposed (Figure 1). The framework maps ASs on two dimensions: physical densification (y-axis) and sociotechnical transformation (x-axis) – from ‘green growth’ to ‘radical decentralisation’ (and ‘hybridisation’ in between). Each of the latter categories is deconstructed according to spatial, technological, ownership and management dimensions. This framework allows the two antagonistic approaches to be mapped, as well as to deconstruct them and to identify potential (or existing) diverse combinations.



**Figure 1:** Suburban adaptation framework.

Source: Author

The two opposing narratives dominating urban studies have a normative view about how suburban adaptation should be, but have failed to critically investigate:

(Q1) how these narratives have been constructed – what imaginaries and assumptions underpin them;

(Q2) how adaptation processes are governed, and what are the opportunities and challenges for adopting innovative strategies.

To respond to these questions, critical suburban studies (CSS) provides a useful approach (Phelps 2018; Keil 2017; Phelps, Maginn & Keil 2023). The first question is important because, as hypothesised before, in less formal, more intuitive and *de facto* ASs (the dominant form of adaptation in PMs where suburbs are prevalent), imaginaries and assumptions have a more decisive role on what strategies are adopted. On this question, this scholarship has analysed the above suburban adaptation narratives, bringing to the fore and challenging what each narrative understands for suburbs today. This paper considers assumptions in terms of suburbs’ spatial form (SPA) (Wandl *et al.* 2014), sociotechnical underpinning (SOT) (Cerrada Morato 2024b) and lifestyles (LIF) (Keil 2013). It also considers what suburbs should become (social imaginaries) not only as a (sub)urban category but also as an economic, environmental and sociotechnical agenda. Table 1 synthesises the assumptions and imaginaries on each adaptation narrative.

	IMAGINARIES	ASSUMPTIONS
<b>SAS 1</b>	<p><b>Suburbs as a fixed category between urban and rural</b></p> <ul style="list-style-type: none"> <li>• Neoliberal ‘same old growth’ solution</li> <li>• Dense urban form more sustainable</li> <li>• Networked ideal: networked and state-led infrastructures</li> </ul>	<p>SPA – Suburbs are homogenous (low-density, monofunctional etc.)</p> <p>SOT – Networked and top-down forms of provision recognised. Other forms informalised.</p> <p>LIF – Combining urban and rural lifestyles. Aspirational to meet urban characteristics.</p>
<b>SAS 2</b>	<p><b>Suburbs as a dynamic category where new forms of life emerge beyond the urban–rural dichotomy</b></p> <ul style="list-style-type: none"> <li>• Degrowth as an agenda to be pursued</li> <li>• Porous and low-density allows for sustainable solutions</li> <li>• Alternative forms of infrastructural provision more progressive</li> </ul>	<p>SPA – Suburbs are heterogenous</p> <p>SOT – Hybrid including networked and top-down but also alternative forms of provision.</p> <p>LIF – Diverse lifestyles that are NOT a combination of urban–rural.</p>

**Table 1:** Imaginaries and assumptions in suburban adaptation strategies (SAS)  
Note: LIF = lifestyles; SAS = suburban adaptation strategies; SOT = sociotechnical; SPA = spatial form.  
Source: Author’s synthesis of literature.

As synthesised in Table 1, SAS 1 is driven by an imaginary of what the ‘ideal urban form’ is, equating dense urban forms with sustainability performance (Charmes & Keil 2015). This SAS is also imagined through a neoliberal understanding of urban planning and the role of city planners, who ‘should promote growth and densification to improve sustainability through concentration and the promotion of green growth’ (The Economist 2012). Furthermore, it is assumed that the provision of ‘urban’ infrastructures in low-density areas is inefficient and, in parallel to densification to achieve economies of scale, the solution lies in investing in green technologies and in expanding networks. This sociotechnical imaginary is supported by the ‘networked ideal’ (Coutard & Rutherford 2011), which assumes that top-down and networked forms of provision are the best approach to provide safe and universal access (Graham & Marvin 2001). Ultimately, this strategy is articulated via a dichotomic understanding of suburbs as something in between urban and rural, and in which the (sub)urbanisation process grows concentric to the urban core, advancing ‘urban characteristics’ into the city’s periphery (EEA 2006). Furthermore, a critical review of this literature suggests it is built on the assumption that (SPA) suburbs are socio-spatially homogenous, with prevalent low-density, car-dependent, and homogenous land-use composition, that (SOT) more affluent residents and formal suburbs are connected to networked infrastructures and alternative forms of

provision put residents in a disadvantaged position and are therefore either presented as informal and/or ignored; and finally that (LIF) suburban lifestyles are the result of the combination of rural and urban forms of living, but are predominately aspirational to meet an ‘urban’ status.

Alternatively, SAS 2 is driven by a critical view on growth as a desirable agenda and instead proposes an economic path that respects the planetary limits. This approach advances more democratic and participatory political and social structures that secure the livelihoods of suburban residents while resisting commodification of basic resources (Xue 2022; Alexander & Gleeson 2019). In the context of suburbs, this means that densification should not be pursued and non-built areas should be protected and enhanced, and that infrastructural provisions should be transformed to reduce environmental externalities (Coutard & Rutherford 2016) and democratised through the promotion of alternative forms ownership and management to also resist the commodification of basic services (Cerrada Morato 2024a). The sociotechnical imaginary is articulated through a vision of infrastructural heterogeneity and hybridity (see for water and sanitation Monstadt & Schramm 2015; Jaglin 2008; Lemanski 2023) of different spatial, technological, ownership and management models that respond to the heterogenous spatial character of suburbs. Ultimately, this strategy is built on the assumption that suburbs do not fit in the classic ‘urban–rural’ typologies and ‘cannot be understood as simply places of intensification of urban functions in the rural environment’ (Wandl, et al. 2014: 50). Rather, they have specific spatial and programmatic features where new lifestyles emerge (Viganò 2001). Finally, although more complex than in SAS 1, some of the assumptions underpinning this literature are that (SPA) cities’ peripheries are spatially heterogenous (Phelps et al. 2006; Keil 2017), that (SOT) the sociotechnical underpinning is hybrid and results from the historical thickening of infrastructures built via both institutional and bottom-up initiatives (Viganò 2009; Cerrada Morato 2022), and (LIF) that there are a variety of lifestyles that do not conform to either rural and/or urban ones (Wandl et al. 2014).

CATEGORIES	DIMENSIONS	SCORE
<b>Spatiality (SPA)</b> <i>Degree of homogeneity</i>	SPA 1: Degree of suburban homogeneity and percentage of urban ‘type’ SPA 2: Size of municipality and population	High/Medium/Low
<b>Sociotechnical (SOT)</b> <i>Degree of sociotechnical hybridity</i>	SOT 1: Degree of centralised network extension SOT 2: Management model for municipal network	High/Medium/Low
<b>(Sub)urbanity (SUB)</b> <i>Degree of (sub)urbanity</i>	SUB 1: GDP municipality SUB 2: Percentage of rural/urban land cover	High/Medium/Low
<b>Governance (GOV)</b> <i>Degree of alignment</i>	GOV1: External alignment with upper-tier institutions GOV 2: Internal alignment	High/Medium/Low

**Table 2:** Framework for a peripheral municipalities typology  
 Source: Author.

To address the second question – how adaptation processes are governed and what the opportunities and challenges are for adopting innovative strategies – CSS offers a better understanding by advancing the multi-actor and multiscalar composition of decision-making structures, as well as of the presence of formal and informal governance mechanisms in the (re) production of suburbs worldwide (see Hamel & Keil 2015), and also by analysing the suburban governance of infrastructure (see Filion & Pulver 2019). However, as pointed out by Filion and Pulver (2019), this scholarship has yet failed to explore how institutional arrangements might influence the provision of suburban infrastructures (p. 375). If the premise of this article is accepted (*i.e.* that in suburban settings formal adaptation plans are rare and in their absence the extension and investment in infrastructures, which ultimately represent a less formal, more intuitive, and *de facto* approach to climate change adaptation, continue), then it is evident that CSS has failed to explore how institutional arrangements influence the form suburban adaptation takes. Two important notes and/or gaps must be highlighted: first, that informality in this paper is understood not as processes external to institutions but as constructed through institutional decisions

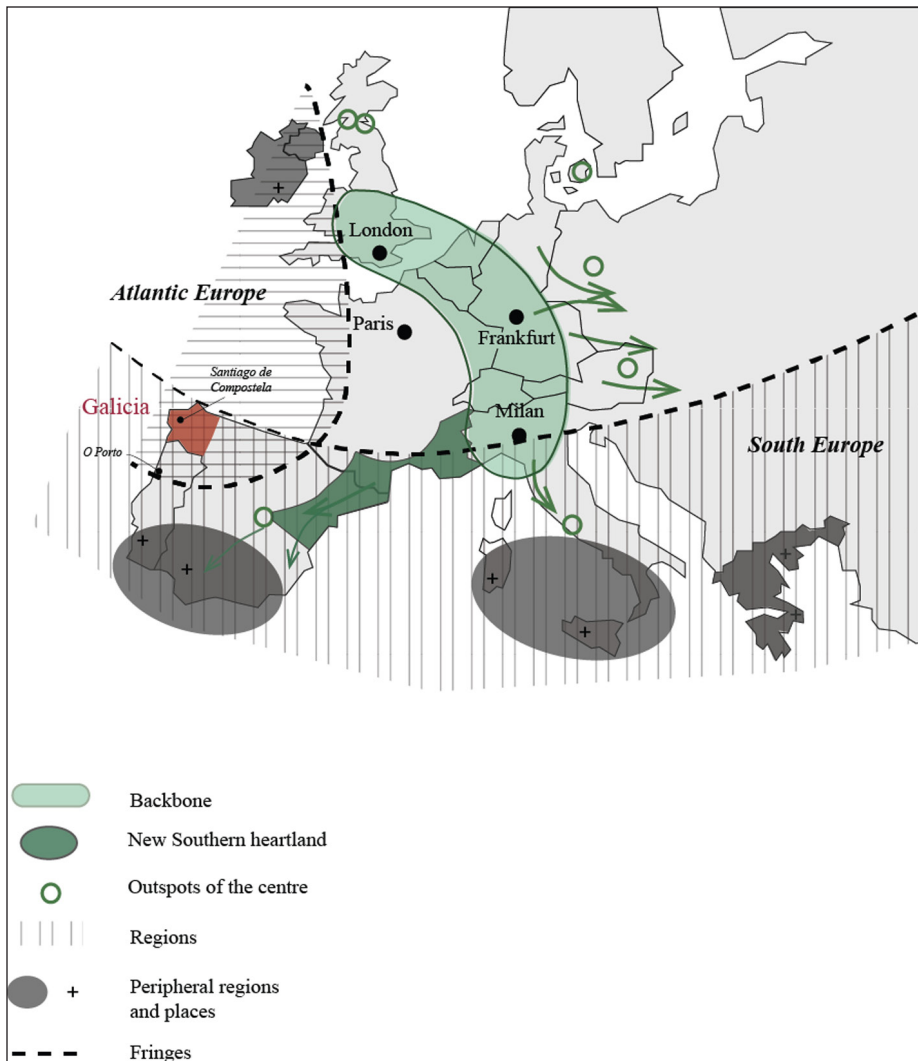
(Caldeira 2017; Roy 2005) and, second, that an analysis of CSS shows that, within this multitier institutional structure, the fundamental role of PMs has been overlooked and/or underplayed, and, when explored, it rarely reflects their variability. Table 2 presents a framework of PMs that incorporates issues of spatial heterogeneity, sociotechnical hybridity, and lifestyle variability, for a more nuanced analysis in this article.

### 3. METHODS: A COMPARATIVE PERIPHERAL MUNICIPALITIES STUDY

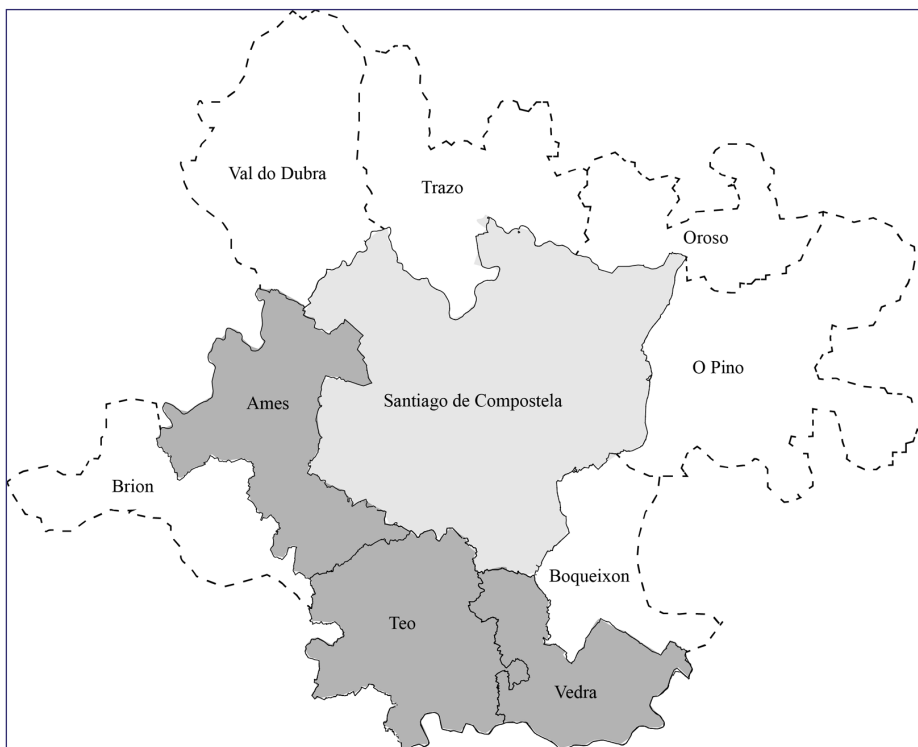
The development of innovative and autochthonous SASs (*i.e.* strategies that are adapted to the specific form of suburbs as distinctive human settlements and that shift away from the cognitive dependency of the urban paradigm) has the potential to reduce suburbs' environmental problems while securing a more democratic and progressive future. But how are PMs governing and planning adaptation and what is preventing some of them from advancing more innovative and autochthonous solutions? To assess a) whether PMs' ASs adopt innovative approaches, b) what the assumptions and imaginaries underpinning these strategies are and c) what the PMs' characteristics that might prevent more innovative approaches are, evidence is drawn from water and sanitation infrastructural ASs across three PMs in the metropolitan area of a medium-sized city in Spain. By analysing these infrastructures – the most expensive for municipalities across Europe (Lambotte *et al.* 2008) – the focus is on the services that will be more strongly impacted by climate change due to global warming (resulting in droughts) and intense rain (resulting in flooding and infrastructure collapse). The comparative analysis shows that the three municipalities are on very different paths to adapt to climate change. Their strategies differ regarding their approach to how, on the one hand, the physical transformation of their territories might contribute to their capacity to adapt and how, on the other, the transformation of water and sanitation infrastructures (spatial form, technology, ownership, management) might advance more innovative and autochthonous forms of suburban climate adaptation.

The selection of the Santiago de Compostela (SdC) metropolitan area is important given the existing knowledge gap on adaptation issues in cities of less than one million inhabitants (IPCC 2022: 910), which are generally less skilled and less advanced in the implementation of adaptation plans (Lioubimtseva & da Cunha 2020). Furthermore, the Southern European region (Figure 2) has been overlooked in the dominant global north and global south narrative. Nevertheless, this peripheral European region represents a paradigmatic and distinctive case important to analyse as it is a) suffering the more extreme impacts of climate change (droughts and intense rains will intensify in this region); b) financially very dependent on EU funding and still under austerity measures, which raises questions about its autonomy and sovereignty to adopt the most appropriate adaptation strategy; c) politically bipartisan on climate issues, which challenges long-term approaches to tackle and adapt to climate change; and finally d) working within very specific governance limitations given the important role of regional governments (with great autonomy and financial independence) and the weakness and underfunding of local governments. The latter is particularly problematic given the almost total absence of metropolitan governments in Spain (Tomàs 2023).

The methodological approach of comparatively analysing three PMs in the same metropolitan area also responds to gaps both in climate adaptation and suburban climate adaptation literature. In the former, studies have generally focused on longitudinal case studies across different cities (Bulkeley 2010; Reckien *et al.* 2018); in the latter, the dominant unit of analysis remains focused on either the household or building level (Gabriel & Watson 2013) and/or at the scale of the neighbourhood (Dunham-Jones & Williamson 2011). There is therefore a lack of understanding about how suburban ASs are shaped and governed at the municipal level (exception Williams *et al.* 2013). That said, CSS has challenged the homogenous depiction of suburbs in mainstream literature – advancing concepts and typological classifications (Wandl *et al.* 2014) – it has yet failed to articulate the same level of nuanced understanding at the municipal scale. Therefore, as this article seeks to reflect the variability of adaptation approaches among PMs, a comparative analysis of PMs' strategies emerges as the most appropriate methodology.



**Figure 2:** Santiago de Compostela regional context.  
Source: adapted from Brunet (1989).



**Figure 3:** Santiago de Compostela metropolitan area.  
Source: Author.



	(CASE 1) AMES	(CASE 2) TEO	(CASE 3) VEDRA
<b>Suburban homogeneity</b>	Medium	High	Low
<b>SPA 1: Population</b>	32,095	18,918	5,005
<b>SPA 2: Municipality area (km<sup>2</sup>)</b>	80	79	52
<b>SOT 1: Networked reach (%)</b>	81	60	30
<b>SOT 2: Municipal management model</b>	Private	Municipal	Hybrid
<b>SUB 1: Municipal GDP (€)</b>	27,853	30,367	24,541
<b>SUB 2: Percentage of rural coverage (%)</b>	52	45	73
<b>GOV 1: External governance alignment</b>	Medium	Low	High
<b>GOV 2: Internal governance alignment</b>	Medium	Medium	High

**Table 3:** Peripheral municipalities' characteristics  
Source: Author.

The three studied PMs are in the metropolitan area of SdC, a medium-sized city in the north-west of Spain and the capital of the Galicia region. The SdC metropolitan area is made of 10 municipalities (see Figure 3): SdC itself is the CM and the rest are PMs. The total population of the metropolitan areas is 200,000, with half living in the CM. The PM selection has been designed to overcome the homogeneity that literature generally presents when talking about the peripheral condition. Table 3 synthesises the main characteristics of the three PMs in this case: Ames, Teo and Vedra. All of these are located in the south-east side, where urban growth has been greater (see Ferrás Sexto & Lois González 1993).

Finally, as has been argued before, to examine ASs in PMs, it is appropriate to look beyond the formal instruments (as those are rare in PMs). In the absence of formal instruments, PMs continue to expand and invest in infrastructures, as well as adopt statutory planning documents such as local plans. Therefore, the methods used to map their *de facto* ASs consist of the analysis of secondary sources (Table 4) and interviews with policymakers to triangulate the information in policy documents but also unpack their assumptions and imaginaries.

	AMES	TEO	VEDRA
<b>Adaptation plan</b>	Yes (2020)	No	No
<b>Local plan</b>	Yes (2002)	Yes (2010)	Yes (2007)
<b>Infrastructure investment programme</b>	Yes	Yes	Yes
<b>Infrastructure audit</b>	No	Yes (2015)	No
<b>Interviews</b>	5 policymakers	4 policymakers and 1 service manager	3 policymakers

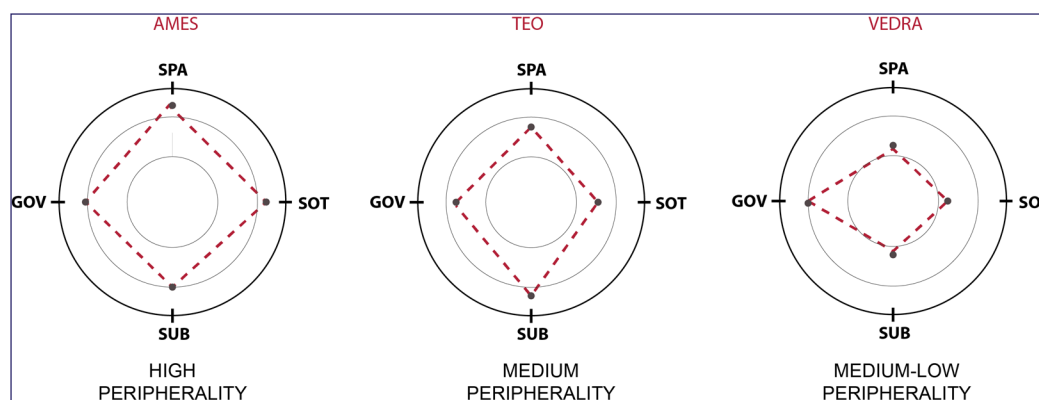
**Table 4:** Sources  
Source: Author.

## 4. THREE DISTINCTIVE PATHS TO ADAPTATION

The comparative analysis of PMs in the SdC metropolitan area reveal three degrees of peripherality (Figure 4) as well as three distinctive paths to climate adaptation (see Figure 5). While Ames scores medium-high in all dimensions and Teo medium in all, Vedra scores low on the spatial dimensions (which places it in a medium-peripherality category).

### 4.1. AMES: A DENSIFICATION AND GREEN GROWTH INFRASTRUCTURE PATH

An analysis of sources indicates that the overall adaptation strategy for adapting the municipality is to a) grow and densify certain parts of the municipality and b) at the same time investing in the 'green growth' of the municipal networked infrastructure for water supply and sanitation. The adaptation plan (AP) (2020) primarily focuses on reducing carbon emissions, and interventions on water and sanitation infrastructures represent a minimal proportion of the document. Although the AP states that water consumption levels should drop, it solely focuses on demand policies



**Figure 4:** Degree of peripherality across municipalities.

Source: Author.

through campaigns to reduce domestic consumption and the installation of rainwater collection infrastructure to irrigate open spaces and roads. The document also suggests investment in green infrastructures (such as solar panels) to reduce the energy demand of running such a large network. The infrastructure investment programme on water and sanitation infrastructures further shows the municipality’s approach to the network: almost eight million euros will be invested in extending the network (disconnecting non-networked forms) and upgrading treatment plants. The policymaker overlooking infrastructure argued:

Our strategy is to provide municipal water and sanitation from a centralised network to all residents. Dwells and community networks will be replaced and only kept in ‘Lens’, a very rural area. This is our commitment, to provide a modern infrastructure that is safe and monitored to all residents no matter where they live. We are investing 8 million. We will incorporate green energy to the plants.

(Interview 8)

When queried about the long-term cost of maintaining such large network, policymakers suggest that population growth and more clients will be necessary to make it financially viable.

All policymakers interviewed for this project defended the same argument, except for a policymaker from another party (the left-wing party Podemos) in the government coalition. The imaginaries underpinning the discourse of most policymakers showed that, first, their understanding of the territory in Ames is divided between two big urban centres (Milladoiro and Bertamirans) and the rest, which was referred to as rural. Through these lenses, they argued that urban areas (and urban residents) need access to ‘urban’ infrastructures (which are networked and municipally owned), and only alternative solutions such as communal and individual infrastructure were acceptable in rural places. The networked bias was therefore very strong, as well as the assumption around residents’ lifestyles and their aspirations. In terms of their economic imaginaries, their adaptation strategy mirrors the growth discourse synthesised before, where the future of the municipality depends on its further urbanisation and infrastructural growth.

Another important agenda pursued by the municipal government was the partial re-municipalisation of the management of municipal water and sanitation services. The management was externalised to a private company more than 12 years ago, and policymakers thought that bringing the service inhouse could provide them with more resources to further invest in upgrading the municipal network.

#### **4.2. TEO: ADAPTING TO CLIMATE CHANGE THROUGH DECOMMODIFICATION AND CO-OWNERSHIP**

The analysis suggests that Teo’s AS has a) a non-densification planning approach that is partially influenced by environmental and quality-of-life reasons and by an estimation of limited demographic growth and b) an infrastructure investment plan that prioritises the decommodification of the service. The latter sought the re-municipalisation of water and sanitation services but also alternative forms of service provision. This entailed communal and

individual forms of ownership and management beyond the public versus private dichotomy. In practice, this meant non-investment in extending the municipal network and the incorporation of low-carbon infrastructures and technologies to make the existing network more efficient.

In contrast with Ames, policymakers in Teo demonstrated a willingness to develop an AS that was neither urban nor rural but autochthonous, responding to their own needs and characteristics. This shows that their imaginary of their territory was not along the urban–rural spectrum but of a different type of territory – referred to as ‘the garden city’ by Interviewee 8. Through these lenses, its built form has a great value that needs to be protected. Furthermore, policymakers articulated a discourse that showed their concern around the high levels of water consumption (and waste disposal) and the limits of the ecosystem to support certain types of activities and/or lifestyles. In this line, policymakers pointed to the numerous problems that a large, networked infrastructure – typical in urban and dense contexts – poses in PMs, which have a much broader type of urban patterns and densities, in terms of significant damage caused by tree roots, challenges of maintaining the network, and finding and repairing leakages. According to interviewees, all of these factors result in the loss of water (almost 20%) and infiltrations into the sanitation network:

The networked infrastructures that have been built here are not for a context like ours, this is an urban infrastructure transferred to a setting that has very different characteristics. We cannot continue extending this network – we are causing ourselves more problems in the future. [...] And we need to also control what water is used for what purpose – we cannot be filling [swimming] pools with ‘potable’ water or watering gardens.

(Interview 6)

What the policymaker argues here is evidenced via the water and sanitation audit report previously mentioned. This is important because it shows that one of the main political decisions when gaining the municipal government was to audit the service to propose its re-municipalisation and that the knowledge of technical aspects was only gained through an interest in the direct management of the service.

Therefore, the imaginary of Teo’s policymakers is to seek an alternative infrastructure model to the existing one (which was perceived as having been pursued/promoted by other institutions and actors). In this alternative model, policymakers focused on advancing the decommodification and participation in decision-making (through public–public partnerships and diversified services to individual solutions), while exploring the future production model of the municipal economy and debating whether and how livelihoods of suburban dwellers could be reconciled within planetary limits.

### **4.3. VEDRA: SUBURBAN PRAGMATISM FOR CLIMATE CHANGE ADAPTATION**

The analysis of the various sources indicates that Vedra’s AS is a) non-growth and/or densification – primarily given the projected limited demand – and b) the strategic extension of the water network and the support of alternative models of sanitation. Their plan is designed to mitigate the impacts of climate change. As policymakers anticipate difficulties for alternative water infrastructures in periods of drought they plan to evenly extend the municipal network across the territory to allow residents (when scarcity impacts alternative forms) to obtain supply from the municipal network. Alternatively, the approach to sanitation is to promote alternative solutions and/or non-networked municipal options as their cost is lower and it is not expected that these will be negatively impacted by climate change. As a policymaker remarked:

We have limited resources, and we need to invest intelligently to make sure we can provide these services not only now but in 25 years’ time when weather will be hotter and droughts more recurrent. In that regard water supply is under greater threat and there is where we are investing.

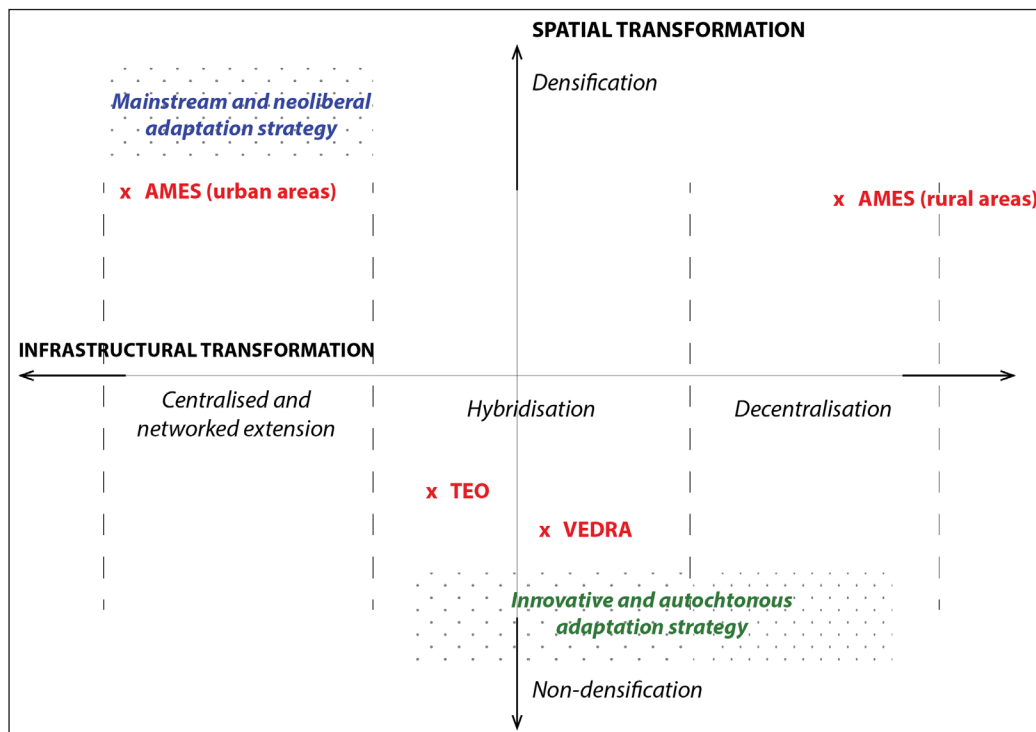
(Interview 3)

Vedra’s AS is therefore driven by a pragmatic approach on environmental grounds, with no ambition for a more democratic and participatory sociotechnical future. Similarly, the mixed approach to service management (private for sanitation and public for water supply) is presented on pragmatic terms, linked to economic efficiency.

Despite its different agenda from Teo’s, Vedra’s approach is also underpinned by an autochthonous strategy that does not see its territory as rural versus urban but as holding a morphology and character that brings different lifestyles’ needs and opportunities. Furthermore, the limits to growth imaginary are slightly different from Teo’s, as it is not a political/economic project but an externality of the urbanisation patters (lack of demand). Finally, alternative solutions with different ownership and management arrangements are not valued as opportunities for the further decommodification of basic services or for a more radical agenda for a democratised service but solely as a technical fix for climate change adaptation.

## 5. DISCUSSION

The above exploration points to three different AS approaches across PMs. While Ames’s can be considered the paradigmatic example of the dominant and more neoliberal model, Teo’s and Vedra’s represent more innovative and autochthonous approaches. In the case of Ames, there is a dual strategy, physical densification of the built environment and an infrastructure networked extension in ‘urban areas’ and non-densification and promotion of alternative forms of provision only in ‘remote and rural areas’. In the case of Teo and Ames, their policies support a non-densification strategy and the hybridisation of infrastructure models. However, a closer look shows that, while Vedra seeks a path that primarily targets low-carbon infrastructure technologies and non-networked spatial forms to achieve environmental outcomes, Teo’s strategy also pursues the democratisation and decommodification of both services. Although a high-level analysis suggests that the more awareness of the impacts of climate change on water availability, the less likely PMs are to embrace densification and infrastructure growth, policymakers’ assumptions and imaginaries of suburbs are also fundamental to advance more progressive ASs. The relationship of these is explored in Section 5.1 with the four main PMs’ characteristics to establish the extent to which each influences its capacity to challenge mainstream approaches.



**Figure 5:** Three paradigmatic cases of suburban adaptation in Santiago de Compostela periphery.  
 Source: Author.

## 5.1. DEGREE OF (SUB)URBANITY AND MUNICIPALITIES SIZE

The degree of (sub)urbanity and heterogeneity of suburban types (*i.e.* the mix of different types of suburbs including urban morphology and lifestyles) influences the degree of innovation in each PM's AS. First, interviewees suggested that the larger the PM's area, with denser and more urban fabric, the greater the tendency to have a more 'urban' and mainstream approach to adaptation. This is not only because of the path dependencies created by the centralised network extension but it is also influenced by municipalities' self-perception, which determines politico-cultural approaches to adaptation. For example, Ames has two big urban centres (where more than 65% of the population live), which creates a vision of an urban municipality. The remainder of the territory and its urbanisation patterns are perceived by policymakers to be in opposition to these two centres. As such, policymakers demonstrate an understanding of the territory according to a strong rural versus urban dichotomy. This in part justifies their approach to expanding the centralised and networked model, rendering other forms of spatial and technical solutions (*e.g.* off-grid and low-carbon; ownership and management; communal and/or individual) as marginal and 'rural'. In the other two municipalities, the interpretation of the type of territory is more heterogeneous – not only spatially but with a greater hybridity of infrastructure systems and more types of suburban lifestyles. This provides more nuanced lenses through which to interpret the variety of infrastructure models and their potential contribution to adapt to climate change.

Another important factor reported in the case of the SdC metropolitan area is the PMs' size: population and area. However, this is in inverse relation to what has been suggested in the literature, *i.e.* the larger the municipality, the more capacity from a technical and human perspective to devise innovative plans (Reckien *et al.* 2018) and that having formal adaptation plans secures more appropriate and innovative strategies (de Gregorio Hurtado *et al.* 2014). This suggests that a municipality having a large size might prevent more innovative approaches to climate adaptation. Although Vedra is the smallest, it is the municipality with the most innovative approach. Conversely, Ames is the only one of the three municipalities with a formal adaptation plan and a dedicated staff member for water and sanitation service. Ames is the one with the more mainstream approach. An analysis of interviewees suggests that this is primarily caused by the pressure in larger PMs to have their service management privatised – resulting in having their knowledge 'kidnapped' (Interviewee 2) by private companies who pursue a more mainstream approach to large networked infrastructures growth (and green growth). A small municipality and a non-privatised management means that municipal governments are more permeable to subaltern forms of knowledge that can boost local adaptation (as described by Olazabal *et al.* 2021).

## 5.2. CENTRALISED INFRASTRUCTURE ROLL-OUT AND SERVICE MANAGEMENT MODEL

According to interviewees, one of the key characteristics that determines the degree of innovation in an AS is the extension of the networked and municipally owned network. The more extended this is, the greater the path dependencies that limit the scope of municipal governments to think about other forms of provisions that might be more appropriate/innovative for climate change. According to participants, there are important material considerations and path dependencies that require municipal governments to pursue further investment in centralised and hard technological solutions. Consequently, when this occurs, PMs revert to discourses of densification to meet the economies of scale that would financially sustain the maintenance cost of such large networks. This supports the existing literature, which suggests that the less rolled-out the network, the more opportunities for innovation. According to this argument, PMs are generally in a privileged position to devise more innovative strategies given their more limited progress in rolling out centralised networks. However, the analysis of historical infrastructure plans in the case of Ames and Teo suggests that path dependency is not as decisive as policymakers argue. Ten years ago, the two PMs had the same sanitation and water networked infrastructure extension (limited to the urban centres). At that point, their strategies started to diverge, reaching a very different scenario today.

When this was brought up, policymakers suggested that the expectations of population growth but also the ambition to attract more residents from the CM justified large investments to extend the centralised network in Ames.

The second dimension of the sociotechnical characterisation of PMs is the management model of the municipal network. Most interviewees argued that the commodification of the water and sanitation service through its privatised management is the most influential factor limiting the capacity of PMs to adopt more innovative ASs. It does so in two different ways. First, it influences PMs' levels of understanding and access to information about each infrastructural model. Second, it reduces their capacity to operate infrastructure in a particular way (and transform and adapt them). Interviewees within the three PMs clearly indicated that policymakers in Teo and Vedra – with total or partial municipalised services – have a better understanding of the complexities and challenges of each infrastructure model and are therefore able to challenge mainstream and ill-suited adaptation approaches. As a policymaker in Teo explained:

They [water service workers] have their offices in our building, if there is any issue I know immediately. It provides me [in the Mayor's office] with a direct and timely picture of the difficulties: breakages, leaks, etc. Before I was on the dark.

(Interview 11)

In the case of Ames, policymakers do not receive information to the same degree and are therefore more limited in their capacity to apprehend the limitations of the large, networked infrastructure. In places where the municipality operates the service, the interviewed civil servants and policymakers stated they had the scope to operate different pieces of the infrastructure to not only prioritise different aspects of sustainability but also to modify the technology, so the system consumes less energy or reduces other outputs.

### 5.3. LIFESTYLES AND POLITICAL CONTEXT

To what extent does the socio-economic composition of PM's residents influence their AS? This case suggests that there is no clear correlation between residents' socio-economic level and policymakers' socially preferable ideas for climate adaptation. Instead, it seems that policymakers' imaginaries are influenced by their own interpretation of residents' status and questions of desirability, rights and legitimacy. First, policymakers' assumptions around socially preferable and/or acceptable models of supply have guided political discourse and thus the decision-making process on infrastructural investment. For example, in Ames, rural areas (and users) are assumed to be 'less modern', hence more open to accepting alternative forms of infrastructure provision, while more urban areas (and users) are believed to be more demanding of 'cleaner' and safer infrastructures (centralised and networked). However, in Teo, with a higher rent per capita ratio, policymakers are trying to challenge that narrative, proposing alternative options as valid for all residents, which ultimately affect their capacity to innovate in their AS. Likewise, policymakers are influenced by the demand of certain groups and not others to their 'right to the suburbs' through access to certain services and resources (such as swimming pools and garden irrigation). In the case of Teo, a small number of very vocal residents have swimming pools and/or gardens that consume large amounts of water and they oppose the municipalities' proposal to limit how much municipal water is used during the summer. While some policymakers are more open to compromising their AS with uses that seem very demanding on water resources, others challenge the right of residents to access/retain those uses in the context of climate change. Finally, although set in local plans through land classification, policymakers' imaginaries of what uses are more desirable and appropriate for the future of PMs influence their ASs. While in PMs such as Vedra, where the local plan (with a larger percentage of land allocated for rural uses) and policymakers (who believe agricultural and cattle-raising activities are more appropriate/desirable than others) are aligned, this aspect is less relevant. In Ames, where these two conflict, policymakers' imaginaries of desirability are fundamental. Policymakers' ambition to become an urban municipality means that large agricultural and/or cattle-raising activities are generally not seen as legitimate. These uses are seen as in direct conflict with more leisure-type of activities, resulting in their lack of strategic support and the investment in 'urban'-type infrastructures in the AS.

Finally, a factor that has proven decisive in influencing PMs' ASs is governments' political composition and wider alliances. The comparative analysis highlights PMs' relationship with higher government tiers, and the municipal governments' configurations influence their capacity to innovate in their ASs. First, a closer relationship with higher government tiers provides better access to funding and technical support, a structural limitation of PMs as discussed earlier. While the interviewees in Vedra talked about collaboration and support from the regional government, Teo and Ames experienced a very different and challenging relationship given their different political affiliation. Finally, in Teo and Ames, the government is formed by two different left-wing political parties – PSOE and Podemos – which according to interviewees results in the lack of a unified vision, preventing a more ambitious and bolder adaptation strategy approach. According to interviewees, this is further exacerbated by the lack of experience of coalition governments in Spain. Finally, interviewees also suggested that new parties with closer relationships with environmental and civil society groups might be changing the approach to infrastructures in PMs. They do so by providing different lenses on the role of alternative models based on a different understanding of the roles of civil society and environmental protection in the everyday (re)production of infrastructures.

## 6. CONCLUSIONS

Suburbs across the world are trapped in a twofold crisis: they have been identified as the most unsustainable form of urbanisation and they are the victims of the worst impacts of climate change. While densification and green infrastructural growth are the mainstream approach to suburban adaptation, alternative and more innovative strategies that challenge densification and advocate for diversification of infrastructural provision (including communal and individual types) have emerged. This article has explored what strategies are being implemented in a sample of peripheral municipalities (where suburbs are the prevalent form of urbanisation) and why. Although many large cities and urban municipalities produce formal adaptation strategies (in the form of plans, projects etc.), less formal, more intuitive and *de facto* strategies dominate any adaptation efforts in peripheral municipalities. Within these more informal forms of planning, imaginaries and actors' perceptions gain increasing relevance.

This article has shown how the formality of adaptation plans does not equate to more autochthonous and/or innovative approaches (as suggested by the literature). Instead, a weak adaptation planning offers opportunities for non-mainstream approaches for infrastructural provision to emerge. This seems to replicate some arguments around informality as a mechanism 'of resistance to modern, commodified, market-led and consumerist models' (Cerrada Morato 2024a). However, further research should explore how vulnerable these less formal, more intuitive and *de facto* approaches to climate adaptation are to changes on policymakers' sensibility to climate change and know-how, as well as how more innovative approaches can be protected in the transition from these to formal ASs.

Policymakers' assumptions about the spatial, socio-material and social heterogeneity underpinning the municipality influences PMs' capacity to innovate. The lack of empirical data on the socio-material infrastructural underpinning, and the socio-economic demographic composition across, PMs results in policymakers' adoption of more mainstream (non-autochthonous) strategies. If opportunities for innovation in adaptation strategies are to be realised, then challenging assumptions through empirical studies should be an important research agenda for suburban adaptation studies.

This research has demonstrated how important policymakers' imaginaries are to advancing less formal and *de facto* (as well as formal) innovative ASs. Primarily, this has looked at policymakers' imaginaries around what suburbs are as a distinctive place, beyond the rural versus urban dichotomy. This suggests that more work needs to be done in not only challenging assumptions but also developing theories, bringing to the fore projects and best-practice examples in suburbs that inspire the imaginations of an alternative and progressive future for PMs beyond densification and infrastructure growth. This case has shown a positive correlation between non-growth agendas and the pursuit of different forms of infrastructure management and ownership.

The analysis of three PMs shows that there are important differences across their ASs, and a more granular understanding of how different characteristics influence their capacity to innovate is important. While some municipalities are adopting strategies that are innovative and disruptive through issues of ownership, management and technology, others plan their adaptation plans without challenging more radical issues of growth and de commodification. While material questions such as PMs' size and networked infrastructure roll-out influence the pursuit of more innovative approaches, three factors have emerged as more important in allowing innovation and autochthonous solutions: the level of suburbanisation, the management model under which their municipal infrastructure is provided, and finally their political context (including the proximity of local government with higher-tier bodies and government composition).

There is a structural factor that all PMs share: their dependence on other governmental tiers to fully fund and govern their ASs (which as discussed before is a structural deficit in Southern European countries). Further work should explore how upscaled forms of governance can support PMs to achieve innovative and autochthonous strategies, further addressing sovereignty issues as well as financing aspects.

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The author has no competing interests to declare.

## DATA AVAILABILITY

The data that support the findings of this study are available from the author upon reasonable request.

## ETHICAL CONSENT

The research this paper draws upon received ethical consent by the UCL Research Ethics Committee (Ethics Application 9119/001).

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