POCACITO

european post-carbon cities of tomorrow

# D2.4 PAPER ON TYPOLOGIES

## LEADING MID-SIZED EU CITIES IN POST-CARBON TRANSITIONS: TOWARDS A PRELIMINARY TYPOLOGY

IRS, ECOLOGIC INSTITUTE, CEPS, ENERGY CITIES

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# INTRODUCTION

The article entitled, “Leading mid-sized EU cities in post-carbon transitions: towards a preliminary typology” was developed within the scope of WP2. D2.4 compiles the following cover letter and article, which will be submitted to the open access journal, *Sustainability,* on behalf of the POCACITO project.

**COVER LETTER:**

**"Leading mid-sized EU cities in post-carbon transitions: towards a preliminary typology"**

Ross Beveridge, Monica Ridgway, Kristine Kern, Cristian Stroia, Noriko Fujiwara, Stéphane Dupas, and Till Sterzel

Dear Editors,

To summarize, the paper's main contributions are that it:

1. Provides sustainability profiles of five mid-sized European city types, building upon the economic-focused State of European Cities Report.
2. Develops a preliminary typology of mid-sized cities; a simple analytical structure that can be used to assess and compare across urban contexts.
3. Offers preliminary insights on the interrelationships between context, action and performance in the five city types.

This paper aims to advance knowledge on how leading mid-sized cities are undergoing sustainability transitions in the EU. At present, there is a deficit in the literature regarding the diversity of urban transitions, particularly how contextual factors (e.g. regarding the economic state, population size, and climate) shape actions and performance within cities. The paper addresses this gap by identifying indicative examples of urban sustainability transitions per mid-sized city type and developing a preliminary non-comprehensive typology. Five cities are preselected on the basis of being recognized leaders in urban sustainability (indicator: finalists and winners of the European Green Capital Award) and to provide a reasonable geographic coverage within the EU: (1) Malmö (Sweden); (2) Bristol (UK); (3) Freiburg (Germany); (4) Vitoria-Gasteiz (Spain); and (5) Ljubljana (Slovenia). Mid-sized cities (population: 100,000-500,000) have been chosen because this is where the majority of the EU population lives and because there is a great diversity of (economic, political, environmental) types of mid-sized cities. They are thus both central to sustainability transitions and presumably varied in terms of their transition pathways due to the contextual differences between them.

The approach is explorative and qualitative, in large part because of the challenge of acquiring comparable data on cities' environmental performance. Within this context, the paper profiles the five cities in terms of their contexts of action, basic strategy and main achievements. From this, the purpose of the typology is to provide a basic structure for analyzing urban sustainability transitions: to help identify commonalities and differences across urban contexts. The paper discusses the different city types presented, developing future research questions on the interrelationships between context, action and performance.

The research leading to these results has received funding from the European Union FP7 SSH.2013.7.1-1: Post-carbon cities in Europe: A long-term outlook under the grant agreement n°613286. We confirm that neither the manuscript nor any parts of its content are currently under consideration or published in another journal.

Yours sincerely,

The authors

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*Article*

# Leading mid-sized EU cities in post-carbon transitions: towards a preliminary typology

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**Abstract:**

Adopting an explorative approach, this article seeks to advance understanding of how leading mid-sized cities are undergoing transitions towards post-carbon futures in the EU. The paper develops a preliminary typology of mid-sized cities in post-carbon transitions, profiling five exemplary city types according to a combination of their sustainability characteristics. The profiled cities have been pre-selected to provide reasonable geographic distribution within the EU, and show the influence of different contextual factors: population size, local political autonomy and economic wealth: (1) Malmö (Sweden); (2) Bristol (UK); (3) Freiburg (Germany); (4) Vitoria-Gasteiz (Spain); and Ljubljana

(Slovenia). Conceptually, transitions are viewed as the outcome of the specificities of a place and broader (regional, national, transnational) dynamics in a range of dimensions (climate, economic, political-discursive) over a period of time. The progress of these cities in transition is evaluated qualitatively in environmental, social and economic terms. It is hoped that developing knowledge on generic urban types may aid in establishing which mid-sized cities are peers for the transfer of successful mitigation practices. This is especially important for disseminating and scaling up effective practices across European cities under different contextual conditions and with limited funding.

**Keywords:** urban sustainability; energy transitions; post-carbon city; Malmö; Bristol; Freiburg; Vitoria-Gasteiz; Ljubljana

## 1. Introduction: Low-carbon transitions, contextual factors and mid-sized cities

Adopting a largely qualitative and explorative approach, this paper seeks to advance understanding of how leading mid-sized cities are undergoing transitions towards post-carbon futures in the EU. Information on practices and actual performance is combined with data on contextual factors to characterize profiles of five exemplary city types and develop a preliminary typology which helps identify commonalities and differences. The profiled leading cities have been pre-selected to provide reasonable geographic distribution within the EU and show how different contextual factors, such as socio-economic, developmental and biophysical factors, will influence performances of mid-sized cities. To meet these objectives, we have chosen mid-sized (100,000 – 500,000) European Green Capital Award finalists from the following cities: (1) Malmö (Sweden); (2) Bristol (UK); (3) Freiburg (Germany); (4) Vitoria-Gasteiz (Spain); and (5) Ljubljana (Slovenia).

Cities are vital to dealing with climate change both generally, in the sense that transformation, particularly decarbonization, must be achieved in urban areas[1], and in specific cases, in terms of certain cities developing innovative responses[2] and certain types of other cities being able to learn from them. The paper reports on ongoing results from the EU-Funded research project *POCACITO* (Post Carbon Cities of Tomorrow). Within the POCACITO project, the concept of "post-carbon cities" is used to signify "a rupture in the carbon-dependent urban system, which has led to high levels of anthropogenic greenhouse gases, and the establishment of new types of cities that are low carbon as well as environmentally, socially and economically sustainable. The term "post-carbon" emphasizes the process of transformation, a shift in paradigm, which is necessary to respond to the multiple challenges of climate change, ecosystem degradation, social equity and economic pressures" [3] (8). By developing a preliminary typology to structure the analysis across similar types of cities, this paper aims to help address a deficit in the literature regarding knowledge and indicative examples of urban sustainability transitions per city type.

[1] Since the perceived failure of nation states to deal with climate change, e.g. at the 2009 United Nations Climate Change Conference in Copenhagen, there is a sense that change is more practicable at the urban level [1].
[2] In fact, many cities have adopted measures in advance of and of a more ambitious nature than the national level – and as such they influence national and even EU policy e.g. London, Rotterdam, Munich, and Stockholm [2].

Recent research on urban climate governance has devoted much attention to the importance of transnational and internal networks for learning and the transfer of expertise, policy and best practices [4-6]. Networks are an integral feature of urban sustainability [7], be they internal or external, local, regional, national or transnational in form. However, despite this proliferation of learning opportunities, overall achievements in low-carbon transitions and urban sustainability remain unclear [8] (p. 150).

This can be explained in a number of ways. First, it should never be forgotten – as it sometimes is in the literature – that transitions are contingent, political as well as technological and economic [9]. They are thus unpredictable. Second, transitions are fundamentally complex, defined by constraints and limitations, as well as opportunities and obligations. Urban climate governance is shaped by multiple and overlapping processes, by a range of actors, organizations and scales [5]. Cities can only do so much autonomously. Achieving urban post-carbon transitions requires dealing with a varying combination of constraints, as well as opportunities.

Many constraints are generic, even if the particular ways in which they are combined vary from city to city. In a literature review and study of 38 cities' involvement in climate action worldwide, Martins and Ferriera [10] (46) conclude that the following general categories of constraints on action at the urban level are apparent: resources and capacity, knowledge and information, institutions and governance. Constraints are not always endogenous to a city, even if they are always locally observable. A lack of financial revenue at the urban level may result in part from the national context in which cities are embedded, e.g. wider national taxation frameworks in the UK, which result in a concentration of tax revenue at the center. Understanding transitions to post-carbon cities requires an analysis of the relationships between urban contexts themselves, internal dynamics, such as the actions undertaken and the overall performance of cities in moving to a post-carbon system, and the external dynamics from the EU to the national and the sub-national levels, e.g. EU-agreed and binding emission reduction goals (40% below the 1990 level by 2030).

To better identify the importance of contextual factors in influencing cities' performance in post-carbon transitions, this paper will focus on mid-sized cities which amount to between 100,000 and 500,000 cities across the world. Many existing studies focus on iconic cities or capitals above 500,000 inhabitants such as London, Paris, Stockholm, Copenhagen, Amsterdam, Hamburg, Berlin or Zürich. However, there are far more cities which have less than 500,000 inhabitants, and even in centrally-organized countries like France or Sweden, the majority of people still live in cities of less than 500,000 inhabitants. There is also more variety among cities between 100, 000 and 500,000 inhabitants. Further, although the vast majority of cities and towns have less than 100,000 inhabitants, only a very low percentage of these small cities (such as Växjö in Sweden) have become known as sustainability pioneers. Thus, a focus on mid-sized cities with more than 100,000 inhabitants is highly relevant to understanding the low-carbon transition in Europe, and developing a typology is important to capture the diversity of mid-sized cities (in terms of population size, wealth and economic structure, for instance).

A recent UN [11] (53) report also argues that the preponderance of mid-sized cities globally provides perhaps the best opportunity to make cities more sustainable; the implication being that change is more achievable financially, socially and materially at this urban scale of urban form than at that of smaller and larger cities. Within this context, means of improving 'matchmaking' between mid-

sized cities, helping them find practices and general approaches attuned to their particular contexts of action is of paramount importance. Ultimately, cities have unique histories, but at the same time they share systemic and contextual features. Hence, very different cities can share very particular characteristics. For this reason, it could be "valuable to discern the particular drivers and mechanisms that contribute towards shifting evolutionary trajectories towards more sustainable ends" [12] (313). It is hoped that developing knowledge on generic urban types may aid in establishing which mid-sized cities are peers for the transfer of successful mitigation practices. Hence, the paper develops a preliminary non-comprehensive typology of mid-sized cities in post-carbon transitions, profiling five exemplary city types according to a combination of their sustainability (social, environmental and economic) characteristics. This may be especially important for disseminating and scaling up effective practices across European cities under different contextual conditions and with limited funding.

The paper has the following structure. Section two provides an overview of urban and sustainability typologies. Section three profiles and discusses the five types of mid-sized leading cities, outlining selection criteria, an introductory conceptual approach to urban post-carbon transitions and the preliminary typology. Section four reflects critically on the typology and offers ways forward for future research.

## 2. Urban and sustainability typologies

The term "typology" is still rather ambiguous and used in various ways. According Lang [13], typologies are the categorization of different types, or "construct[s] of a product or a process that serve as generic model[s] of way of thinking." Due to the diversity of European mid-sized cities, it is clear that many different types of cities and performance profiles are present. A typology, or categorization, of various city types can help identify commonalities and differences across urban contexts and lead to more meaningful benchmarking (see also Zoeteman, Zande, and Smeets [14]). The following therefore briefly summarizes the state of the art in international and European urban sustainability benchmarking and typologies that can serve as a baseline for further elaborating on the context, activities, and post-carbon performance of mid-sized EU cities.

In the field of urban sustainability, the benchmarking, or ranking[3], of cities according to various aspects (i.e., sustainability, liveability, innovativeness, etc.) has gained much popularity in Europe and worldwide. Some of the most notable rankings for European cities include the European Energy Award, European Green Capital Award, European Green City Index, European Soot-free City Ranking, RES Champions League, and the Urban Ecosystem Europe, all of which have their own methodological characteristics and limitations [16]. Although benchmarking is a potentially useful instrument to identify (and start a public debate about) a city's strengths, weaknesses, and strategies for future development, much attention has focused entirely on the ranks themselves rather than interpreting what they mean for urban policy [15]. Moreover, the methods and indicators used by city rankings often do not control for the diverse contextual conditions and are frequently non-transparent,

[3] According to Giffinger and Gudrun [15], city rankings comprise at least two cities, are structured in a hierarchical, ascending/descending order, which is based on a combination of at least two indicators.

which undermines the fairness and meaningfulness of comparisons. In fact, Venkatesh (2014) [17] notes that it may be necessary to tailor the indicators collected according to the city type.

The adequacy, normalization, aggregation, and weighting of indicators used by different benchmarks are, furthermore, subjects of much debate [16, 17]. Benchmarks also overlook the interrelatedness of indicators, meaning that an improvement/decline in one area could be offset or reinforced by an improvement/decline in another area, which is not immediately apparent after aggregation despite being highly relevant for policymaking [16, 17]. Although it is difficult to address all the methodological issues of benchmarking, using typologies to structure an analysis across similar types of cities would improve the usefulness of the instrument [14, 16, 17]. Nevertheless, none of the European city rankings mentioned above apply a city typology to benchmark performance [16]. Doing so would minimize differences within group comparisons and make it easier to identify structural (dis)similarities in sustainable city transitions [14, 16, 17] and thereby facilitate more targeted policy design and transferability of good practices [18-20].[4]

Although not yet included in prominent EU ranking methodologies, much research has focused on creating a typology of EU cities, which could aid in the analysis of post-carbon transitions across varying urban contexts. Of the assortment of European urban typologies reviewed, the typology developed in the State of European Cities Report is, as of yet, the most suitable in terms of providing a baseline categorization of a large selection of cities to assess the different types of post-carbon transitions. Many of the EU city typologies are based on limited factors, such as land cover,[5] population density,[6] and functional areas [24], which make them less relevant for benchmarking the sustainability of EU cities as they do not consider important socio-economic and environmental baseline conditions. A series of typologies established under the ESPON 2013 program are slightly more descriptive, including a typology of the sectoral structure of European cities (percentage share of agriculture, manufacturing, industry and energy, construction, trade and transport, finance and business services, and other services) as well as common types of metropolitan macroregions[7] based on demography, economic structure and labor market data [25, 26]. In order to provide a more balanced assessment of sustainability, Zoeteman, Zande, and Smeets [14] very recently published a preliminary typology of cities based on 87 indicators. However, these city types are based on 58 European Green Capital Award applicants and therefore not representative of EU cities as a whole. Recognizing the complexity of comparing diverse cities, the EEA's European Topic Centre on Urban, Land and Soil Systems is currently developing a new European city typology according to city socio-economic, environmental and geographic characteristics with the objective to improve the analysis of urban sustainability [27]. Information about these typologies, however, is not yet available.

Using data from the Urban Audit (2001 and 2004 datasets, respectively), the typologies developed for the First and Second State of European Cities Reports [28, 29] employ a broad set of indicators to

[4] See also Giffinger, Haindlmaier, and Strohmayer [21], who develop a typology of European small and middle-sized cities to benchmark their performance according to "smart" city indicators

[5] For example, the Urban Morphological Zones (UMZ) developed by the EEA [22]

[6] Degree of urbanisation (DEGURBA) developed by Eurostat[23]

[7] These types include: 1) Monocentric service centres surrounded by regional hinterland with labour market problems, 2) Central service centres surrounded by industrialised regional hinterlands, 3) Small service centres surrounded by mountain areas, 4) Polycentric metropolis in polycentric regions, 5) National growth poles surrounded by industrialised areas, 6) Restructuring cities in problem areas, 7) National growth poles surrounded by traditional rural areas, 8) Smaller cities in peripheral areas, 9) Other macroregions – capital cities, 10) Other macroregions – non-capital cities

cluster EU cities into different, mutually exclusive "city types." The first report develops thirteen city groupings based on 15 indicators, which cover aspects such as size, economic structure, economic performance and competitiveness. However, the categorization is mainly based on measures of economic criteria, thereby limiting the amount of context it could provide for analyzing post-carbon transitions. With a sample size of 329 cities (EU, Swiss and Norwegian), the subsequent State of European Cities Report [29] uses a set of 21 indicators to group EU cities into four basic "city types" and nine sub-types (see Table 1). The revised typology leads to a greater distinction between the core urban areas of the European economy and the outlying cities of Western Europe as well as the non-capital cities of Central Europe [29]. Due to the inclusion of demographic, economic, social, as well as environmental aspects, this appears to be the most relevant typology of EU cities for the purposes of this paper.[8]

In the following, we use the city types developed by the State of European Cities Report as well as publicly available data to provide context for a qualitative profiling of the selected mid-sized cities. Through this approach, we aim to reflect on the usefulness of the city types, further inform city benchmarking, and propose a structure for comparatively analyzing cities in post-carbon transitions on which future research could expand. Following RWI et al. [29] the five types of mid-sized cities with populations between 100,000 and 500,000 are "Regional Service Centre"; "Regional Innovation Centre"; "Regional Centre with Growing Population"; "National Capital and Metropolis"; "Leading European Capital and Metropolis" (see Table 1).

[8] Nevertheless, significant limitations remain - the authors note that there is a considerable degree of simplification that comes with categorising the cities and therefore advocate caution when applying the city types. Furthermore, labels could be misleading for "borderline cases," which do not adhere to the group average values across all variables.

**Table 1.** EU City Types and selected mid-sized cities.

| EU CITY TYPE | DESCRIPTION OF EU CITY TYPE | LIST OF CITIES WITH SELECTED HIGH PERFORMING CITY IN BOLD |
|---|---|---|
| **"Regional Service Centre"** | • 76 ities providing highly specialised services, particularly from the financial and business service sector, public administration, health and education<br>• Research centres for hi-tech industries and hubs of IT services<br>• Overall economic output (GDP) per inhabitant, patent intensity and entrepreneurial activity are lower than in the highest-ranking urban centres, yet still above national averages | Aalborg , Aix-en-Provence, Amiens, Arnhem, Belfast, Bergen, Besançon, Birmingham, Bonn, Bordeaux, Bradford, Breda, Brescia, Caen, Cardiff, Charleroi, Clermont-Ferrand, Cork, Coventry, Dijon, Eindhoven, Enschede, Exeter, Funchal, Galway, Gent, Gravesham, Grenoble, Göteborg, Irakleio, Kingston-upon-Hull, Lausanne, Le Havre, Leeuwarden, Leicester, Lens - Liévin, Lille, Limerick, Limoges, Lincoln, Liverpool, Liège, **Malmö**, Manchester, Marseille, Metz, Montpellier, Nancy, Nantes, Napoli, Newcastle upon Tyne, Nice, Nottingham, Oporto, Orléans, Palermo, Poitiers, Portsmouth, Reims, Rennes, Rotterdam, Rouen, Saint-Etienne, Sheffield, Stevenage, Stoke-on-trent, Strasbourg, Tilburg, Toulon, Toulouse, Tours, Utrecht, Wirral, Wolverhampton, Worcester, s' Gravenhage |
| **"Leading European Capital and Metropolis"** | • 24 metropolises that represent the highest urban concentration of GDP per head<br>• Account for the largest number of (national) patent applications per population and the largest share of new businesses<br>• Centres of specialised service industries aimed at national or international markets<br>• Ports of entry for international migrants | Amsterdam, Bremen, **Bristol**, Bruxelles/Brussel, Dublin, Düsseldorf, Edinburgh, Frankfurt am Main, Glasgow, Hamburg, Hannover, Helsinki, Köln, København, London, Luxembourg, Milano, München, Nürnberg, Oslo, Paris, Stockholm, Stuttgart, Wien |
| **"Regional Innovation Centre"** | • 51 cities, mainly from Germany and Italy, which are characterised by a particularly dynamic entrepreneurial and research activity<br>• Ageing resident population<br>• Overall economic output (GDP) per inhabitant, patent intensity and entrepreneurial activity are lower than in the highest-ranking urban centres, yet still above national averages | Aberdeen, Ancona, Augsburg, Bari, Bielefeld, Bochum, Bologna, Brugge, Cagliari, Cambridge, Cremona, Darmstadt, Dortmund, Erfurt, Firenze, **Freiburg im Breisgau**, Genova, Genève, Graz, Göttingen, Halle an der Saale, Heerlen, Karlsruhe, Kiel, Koblenz, Leipzig, Magdeburg, Mainz, Modena, Moers, Mönchengladbach, Mülheim a.d.Ruhr, Oulu, Padova, Pescara, Plzen, Regensburg, Saarbrücken, Schwerin, Torino, Trento, Trier, Trieste, Turku, Venezia, Verona, Vigo, Volos, Wiesbaden, Wuppertal, Zürich |
| **"Regional Centre with Growing Population"** | • 24 cities from Western (Austria, Germany, the Netherlands) and Southern Europe (Greece and Spain)<br>• Among the Regional Centres, this is the most dynamic group in terms of city growth, particularly due to in-migration, but also because of birth surpluses.<br>• Employment in public services, health and education combined accounts for a relatively high share (33% compared to 28% in all cities) of the total labour force<br>• Overall economic output (GDP) per inhabitant, patent intensity and entrepreneurial activity are lower than in the highest-ranking urban centres, yet still above national averages | Alicante/Alacant, Bilbao, Dresden, Gijón, Groningen, Innsbruck, L'Hospitalet de Llobregat, Las Palmas, Linz, Logroño, Málaga, Nijmegen, Oviedo, Palma di Mallorca, Pamplona/Iruña, Potsdam, Salzburg, Santa Cruz de Tenerife, Santander, Sevilla, Thessaloniki, Valencia, Valladolid**, Vitoria/Gasteiz** |
| **"National Capital and Metropolis"** | • 28 cities, which are large economic centres of national importance and/or capital cities<br>• Account for the largest number of (national) patent applications per population and the largest share of new businesses<br>• Centres of specialised service industries aimed at national or international markets<br>• Ports of entry for international migrants | Antwerpen, Athina, Barcelona, Berlin, Bern, Bratislava, Bucuresti, Budapest, Essen, Gdańsk, Kraków, Leeds, Lefkosia, Lisboa, **Ljubljana**, Lyon, Łódz, Madrid, Poznan, Praha, Riga, Roma, Sofia, Tallinn, Valletta, Vilnius,Warszawa, Wrocław |

Source: Adapted from RWI et al. (2010)

## 3. Profiling major types of mid-sized cities in post-carbon transitions

### *3.1. Criteria for selection*

The selection of mid-sized cities was based on the following criteria: The selected cities should (1) provide a geographic coverage of Europe and allow for preliminary insights on the importance of different city types and contextual factors generally; (2) be recognized as high performers, with particular reference to the European Green Capital Award; (3) have readily available and accessible data.

The leading green cities analyzed in this study represent different regions in Europe: Nordic countries, Britain and Ireland, Continental Europe, Southern Europe and Central and Eastern Europe. (1) Malmö: in the Nordic countries, the density of high performing cities is very high (see, for example, European Green City Index developed by Siemens); (2) Bristol: cities in the UK (and Ireland) where smaller and mid-sized cities, such as Leicester, have long been engaged sustainability initiatives despite the centralized political system; (3) Freiburg: cities in Continental Europe where the most prominent high performing green cities are located, from Nantes to Amsterdam, Freiburg, Zürich and Graz; (4) Vitoria-Gasteiz: in Southern Europe, cities started sustainability initiatives later than cities in the Nordic countries and in the UK (e.g. LA21 initiatives), although a few larger cities, such as Barcelona, have developed into European leaders; and (5) Ljubljana: cities in Central and Eastern Europe where high performing green cities are still an exception.

The selection of cities is based primarily on data from the European Green Capital Award, particularly the data on the award finalists. Since its introduction (2010), 20 cities have become finalists. Copenhagen and Oslo have been among the finalists twice and Bristol even three times. Among the 20 finalists for the award, six cities are located in Northern Europe (three Swedish, one Danish, one Norwegian, and one Icelandic city); two cities in the UK; nine cities in Continental Europe (six German, one French, one Dutch, and one Belgium city); two cities in Southern Europe (both located in Spain); and one city in Central and Eastern Europe (located in Slovenia). This means that 85% of the finalists can be found in Northwestern and Continental Europe, while only a few finalists are located in Southern Europe (Spain) (10%) or in Central and Eastern Europe (5%). All of the finalists are university cities, 60% are harbor cities, and 35% are capital cities (except Ljubljana all these capital cities are Nordic or Benelux cities).

15% of the finalists are cities with above 1,000,000 million inhabitants (Brussels, Hamburg, Barcelona), 25% have between 500,000 and 1,000,000 inhabitants (Copenhagen, Oslo, Stockholm, Glasgow, and Amsterdam), and 60% between 100,000 and 500,000 inhabitants (Malmö, Bristol, Nantes, Freiburg, Münster, Nuremberg, Frankfurt, Essen, Vitoria-Gasteiz, Ljublana, Reykjavik, Nijmegen, and Umeå). It can be concluded that the majority of cities which applied for the award and made it to the final round are mid-sized cities below 500,000 inhabitants. On this basis, we assessed the following five cities: (1) Malmö (Sweden); (2) Bristol (UK); (3) Freiburg (Germany); (4) Vitoria-Gasteiz (Spain); and (5) Ljubljana (Slovenia).

*3.1. Malmö: from deindustrializing to knowledge-based sustainable city*

**Context:** Malmö, a low-lying coastal city in Southwest Sweden, is, with around 302,000 inhabitants, Sweden's third largest city. Around 615, 000 people live in the metro region of Greater Malmö, and the Öresund region is one of the most innovative regions in Europe. Malmö has become an important city for business because around 30 companies moved their headquarters to the city and generated around 2,300 jobs. With 31% of its inhabitants born abroad and an average age of 36 years, Malmö is also a very international and young Swedish city. The city has a considerable degree of autonomy due to the highly decentralized political system (see, for example, the Swedish Local Government Act), the financial capacities of Swedish municipalities [30] and other contextual factors, such as the percentage of homes owned by Swedish cities (in Malmö 37%).

**Strategy:** Historically, Malmö identifies itself as an industrial city, home to Kockum's Shipyard. After the collapse of the industry, Malmö lost 27,000 jobs and the unemployment rate increased to 25%. The city underwent drastic transitions in the late 1980s and early 1990s and started to reinvent itself based on the new vision of a knowledge and sustainable city. This transition included major infrastructure projects, in particular, the transformation of the Western Harbour area, the establishment of Malmö University (with around 12,000 students) in 1998, and the Öresund Bridge in 2000. Today, the dominant sectors in Malmö are business services, commerce, health care and social services, and education. Malmö introduced its first Environmental Plan in 1990, followed by the Project 'Malmö 2000' and the 'Vision Malmö 2015' (1995). The new Masterplan (2012) is a long-term approach with the vision to develop Malmö into a sustainable and attractive city. Malmö aims for a 40% reduction in $CO_2$ emissions by 2020 using 1990 as baseline year. In contrast to other comparable cities, Malmö addresses the challenges of climate change and sustainability simultaneously, i.e. Malmö's climate change policy is embedded in its sustainability strategy. This approach acknowledges social sustainability as an equal priority and also includes a communication strategy. This combination of climate change and sustainability seems to be one of the key factors for Malmö's development and relative success.

**Main achievements:** Malmö has become internationally renowned for its pilot project in the Western Harbour, which was transformed from a largely industrial shipyard into an area for sustainable living. Policy-makers, led by Malmö's ambitious mayor Ilmar Reepalu (1994-2013), opted for an ecological approach to planning and environmental sustainability, supported by many actors including the newly established Malmö University. Malmö has won several awards, such as the European Commission's 2012 RegioStars Award for integrated sustainable development strategies, Idébanken's 2011 prize for long-term efforts to become a sustainable city, and WWF's 2011 Earth Hour Capital Award [31]. In 2012/13, Malmö became a finalist for the European Green Capital Award. The city has been active in urban transportation (expanding bike paths and increasing the number of people cycling in the city) and undertaken sustainable housing projects in disadvantaged districts (e.g. Augustenborg).

| | Country: Sweden | | City: Malmo | |
|---|---|---|---|---|
| | Population (2012)[9] | 9,482,855 | Population (2011)[10] | 302,835*(cities and greater cities)<br>615,721(larger urban zone) |
| | GDP €/capita (2011)[11] | 40,800 | GDP €/capita (2011)[13] | 35,100 (NUTS 3 region) |
| | GDP per capita in PPS[12] (2013) | 127 | | |
| | Region | Nordic Countries | | |
| City's physical geography | Location | ✓ A port town situated in the Skane Region in South West Sweden and the wider Oresund Region incorporating southern Sweden and Eastern Denmark. | | |
| | Climate[14] | ✓ Oceanic climate, with 4.7 hours of sunshine per day<br>✓ Average temperate: warmest month is 18.2°C; coldest month is -1.7°C<br>✓ Annual rainfall: 697 litre/m² | | |
| Political Autonomy[15] | | ✓ Decentralised unitary state with three recognised levels of governance: central, county and municipal.<br>✓ Municipalities have mandatory administrative powers in the fields of:<br>✓ Transport, Social Welfare, Economic Development, Education, Planning and Building, Health Protection, Environment (environmental protection, water and sewage, refuse and waste management)<br>✓ Voluntary responsibilities include: Energy and Housing | | |
| $CO_2$ Reduction Targets | | ✓ 40% reduction $CO_2$ emissions by 2020 using 1990 as baseline year[16]<br>✓ GHG reduction of 92% in the Transport sector and 8% for Local Electricity by 2020[17] | | |

**Table 2.** Malmö Profile.

### *3.3. Bristol (UK): policy entrepreneurialism, local activism and green business*

**Context:** Bristol was winner of the European Green Capital Award 2015, commended by the jury for its transport and energy investment plans in particular. Bristol is a growing city with a population of 430,300 and is the major city of South West England. It has experienced general economic prosperity in recent years, despite the economic and financial crisis. Its economic strengths are in advanced manufacturing, aerospace and, increasingly, in knowledge sectors and the green economy [39]. Bristol has recently gained political formal autonomy by way of an elected City Mayor (supported through public referendum in 2012) and the combining of local authorities. Although this has not resulted in a substantial decentralization of formal powers within the highly centralized UK political system, it has provided opportunities to stimulate the local economy and heighten focus on urban sustainability. The elected mayor can access a new economic fund supported by the local

[9] Eurostat [32]
[10] Eurostat [33]
[11] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[12] GDP in PPS: EU28 = 100; Eurostat [34]
[13] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[14] Figures for 2008, Eurostat [35]
[15] See European Union Committee of the Regions [36]
[16] Covenant of Mayors [37]
[17] Covenant of Mayors [38]

retention of business tax rates to fund, for example, transport improvements. Nonetheless, capacity to instigate change is low in comparison to Swedish cities and, in particular, German cities.

**Strategy:** The first elected mayor, George Ferguson (2012- ), has acted as a "policy entrepreneur" [40] promoting sustainability and the city's potential in the field, emphasizing the economic and social benefits of urban sustainability, such as addressing energy poverty [41]. However, this can be seen as a continuation of the city council's proactive approach to environmental issues. Although Bristol has no statutory responsibility for controlling the energy mix of the city, it is attempting to increase renewable energy generation under its Sustainable Energy Action Plan (SEAP) (2012) through the construction of wind turbines in the Avonmouth area [42]. There is a strong sense of localism and the city is also home to many green organizations (Soil Association and Sustrans) and a growing green economy. There is, then, a bottom-up dimension to transition as well, with civil society and market actors promoting change.

**Main achievements**: The main foci have been on the areas of transport (especially promoting cycling), energy and the green economy. Bristol is a signatory to the Covenant of Mayors and has set ambitious targets to reduce energy use by 30% and $CO_2$ emissions by 40% by 2020 (from 2005 baseline). The city has undertaken a wide range of strategic initiatives, chief among them being the Bristol Climate Protection and Sustainable Energy Strategy, the Local Transport Plan to 2026 and initiatives centered on liveability and health, which have been recognized by the 2014 International Making Cities Liveable Lewis Mumford Award. At the center of the city's financial commitment to sustainability is transport and energy. Bristol has committed €500m for transport improvements up to 2015 and €300m for energy efficiency and renewable energy up to 2020. In Bristol, domestic energy use has been reduced by 16% (2005 to 2010), and the energy efficiency of housing has been improved by 25 % (2000/2001 to 2011). The green and knowledge economy has been another major focus with plans to create 17,000 new jobs through the new Bristol Quarter Enterprise Zone in the areas of low carbon, creative and digital industries by 2030 [42]. Following in the footsteps of the original Transition Town, Totnes, in 2012 Bristol created the UK's first city-wide local currency, the Bristol Pound, which promotes local sustainability as money generated from interest rates are reinvested in city initiatives.

| | Country: United Kingdom | | City: Bristol | |
|---|---|---|---|---|
| | Population (2012)[18] | 63,495,303 | Population (2012)[19] | 430,300 (cities and greater cities)<br>898,800 (larger urban zone) |
| | GDP €/capita (2011)[20] | 28,200 | GDP €/capita (2011)[22] | 29, 400 (NUTS 3 region) |
| | GDP per capita in PPS[21] (2013) | 109 | | |
| | Region | United Kingdom and Ireland | | |
| City's physical geography | Location | ✓ A port town situated on the river Avon and Severn Estuary in south-west England. | | |
| | Climate[23] | ✓ Oceanic climate, with 4 hours of sunshine per day (2004)<br>✓ Average temperate: warmest month is 17°C; coldest month is 4°C<br>✓ Annual rainfall: 852.60 litre/m² | | |
| Political Autonomy[24] | | ✓ The UK is a unitary state with devolved powers to Scotland, Wales and Northern Ireland and relatively centralised local government financing system in England.<br>✓ There are two local levels of government in England: County Council and District Council.<br>✓ County Councils are responsible for providing schools, social services, and public transport services<br>✓ District Councils are responsible for local services, including council housing, gyms and leisure facilities, local planning, recycling and refuse collection. | | |
| $CO_2$ Reduction Targets | | ✓ 29% reduction $CO_2$ emissions by 2020 using 1992 as baseline year[25]<br>✓ GHG reduction of 100% in the Transport sector[26] | | |

**Table 3.** Bristol Profile.

### *3.4. Freiburg (Continental Europe): from anti-nuclear roots to high-tech solar energy*

**Context:** Freiburg has a population of 229,144 inhabitants and lies in the southwest corner of Germany, in the Black Forest region, near the borders with France (towards the West) and Switzerland (in the South). The city is an urban district ("Kreisfreie"), enjoying relative political autonomy at the intermediate level between the state ("Länder") and municipal ("Gemeinden") levels in the federal political of Germany. The elected Lord Mayor was the first mayor from the Green Party to be elected in a city larger than 100,000 inhabitants. Freiburg was one of the first cities in Germany to establish an Environmental Protection Office. The city was a European Green Capital Award Finalist in 2009 and named German Federal Capital for Climate Protection in 2010.

**Strategy:** Often called the solar capital of Germany because of its engaged solar policy, the city of Freiburg is also highly active in transport initiatives, sustainable housing districts (in particular the Vauban and Rieselfeld districts) and shows a comprehensive approach to sustainability. In 2014, the Municipal Council resolved to reduce $CO_2$ emissions by 29% by 2020 and at least 50% by 2030 (1992

[18] Eurostat [32]
[19] Eurostat [33]
[20] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[21] GDP in PPS: EU28 = 100; Eurostat [34]
[22] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[23] Figures for 2008, Eurostat [35]
[24] See European Union Committee of the Regions [36]
[25] Covenant of Mayors [37]
[26] Covenant of Mayors [38]

baseline) and to set itself the long-term goal of climate neutrality by 2050. The city has also long been involved in transnational networks (e.g. Energy Cities, ICLEI, Climate Alliance). The story of sustainable policies in Freiburg starts in the mid-1970s [43]. At the time, there were plans to set up a new nuclear power station near Freiburg, in Whyl. This project was confronted with widespread resistance from the population including farmers, wine growers and students [44]. Protests prevented the nuclear power plant from being built and are seen as instrumental to the development of environmental politics and the strength of the Green Party in Germany [45]. Shortly after the nuclear power plant debate the institute of solar energy systems was set up in Freiburg. Today, the Fraunhofer-Institut for Solar Energy Systems (ISE) is one of the largest institutes of this kind. Dieter Salomon [46], the current mayor of Freiburg, states that the city was involved in local sustainable energy strategy much earlier than many other cities, with energy saving and renewable energy issues being prominent in the 1970s and laying the basis for the broader engagement with climate change which emerged in the decades afterwards. Overall, the transition can be seen as being bottom-up with a broad coalition of societal actors promoting environmental issues and the city government responding with ambitious policy measures centered on energy saving, new technology, and renewable energy sources [47].

**Main achievements**: Freiburg is an internationally recognized leader in post-carbon transitions. It became a member of the Covenant of Mayors as early as 2007 and has an approved and monitored Sustainable Energy Action Plan (SEAP). The city receives annually around 25,000 "business visitors" from around 45 nations on account of the environmental policy approach [48]. According to the city administration, the green economy and environment research sectors employ around 12,000 people in 2,000 business units and generates €650 million added value to the city. The solar economy provides 2,000 jobs in 100 business units (around 3-4 times as much as in the rest of Germany) [48]. Over 50% of the city's electricity is generated from combined heat and power plants. The $CO_2$ balance from 2012, monitored by the Institute for Energy and Environmental Research (IFEU), showed a global $CO_2$ reduction of 25.1 % between 1992 and 2012 [49]. In the transport and mobility sector, there has been an increase in the share of low-carbon transportation modes. The share of biking in the total volume of inner-city traffic rose from 15% to 27% between 1982 and 1999, while, in the same period the share of public transport rose from 11% to 18%, and the percentage of trips made by car fell from 38% to 32%. Freiburg currently has a low density of cars, with only 428 vehicles per 1,000 residents [48]. City-led campaigns targeting local stakeholders and citizens have been conducted in order to raise awareness of post-carbon opportunities and possibilities e.g. "Freiburg's $CO_2$ Diet", "200 Families Climate Project" and the "Climate Club" [48].

| | Country: Germany | | City: Freiburg | |
|---|---|---|---|---|
| | Population (2012)[27] | 81,843,743 | Population (2012)[28] | 229,144 (cities and greater cities)<br>640,226 (larger urban zone) |
| | GDP €/capita (2011)[29] | 31,900 | GDP €/capita (2011)[31] | 31, 300 (NUTS 3 region) |
| | GDP per capita in PPS[30] (2013) | 122 | | |
| | Region | Continental Europe | | |
| City's physical geography | Location | ✓ A University town in the south west of Germany, within the Black Forest region, close to the borders with France and Switzerland. | | |
| | Climate[32] | ✓ 4.68 hours of sunshine per day<br>✓ Average temperate: warmest month is 19.6°C; coldest month is 1.8°C<br>✓ Annual rainfall: 847 litre/m² | | |
| Political Autonomy[33] | | ✓ Germany is a federal state, with power relatively decentralized across the federal, state (Land), intermediary (cities with over 100,000 population) (Kreis) and municipality levels.<br>✓ Intermediary level mandatory responsibilities include: district spatial planning, nature and landscape protection, social welfare, household waste collection and disposal.<br>✓ Municipalities mandatory responsibilities include: town planning, construction affairs, green areas, urban development and regeneration. | | |
| $CO_2$ Reduction Targets | | ✓ 29% reduction $CO_2$ emissions by 2020 using 1992 as baseline year[34]<br>✓ GHG reduction of 100% in the Transport sector[35] | | |

**Table 4.** Freiburg Profile.

### *3.5. Vitoria-Gasteiz (Southern Europe): environmentally-sensitive spatial planning, citizen involvement and green growth*

**Context:** The city of Vitoria-Gasteiz, located in the north of Spain and capital of the Autonomous Community of the Basque Country, was the first medium-sized and Southern European city awarded the European Green Capital Award for its long-established commitment to promoting sustainability. Since 2003, the city has seen a population increase of 8.4%, with the total population of the urban area reaching 242,223 in 2012 [33]. Although still negatively affected by the economic downturn, the city's unemployment rate is much less than the national average. In Spain, a large amount of power resides with the Autonomous Communities, who determine the responsibilities of municipalities [36]Relative to their EU counterparts, local authorities in Spain have a high degree of fiscal autonomy, yet the Autonomous Communities are responsible for the majority of expenditures. Larger municipalities (>50,000 inhabitants), as in the case of Vitoria-Gasteiz, are responsible for environmental protection and public transport [50].

[27] Eurostat [32]
[28] Eurostat [33]
[29] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[30] GDP in PPS: EU28 = 100; Eurostat [34]
[31] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[32] Figures for 2008, Eurostat [35]
[33] See European Union Committee of the Regions [36]
[34] Covenant of Mayors [37]
[35] Covenant of Mayors [38]

**Strategy:** As the first Spanish city to sign the Aalborg Charter and design a local Agenda 21 [51], Vitoria-Gasteiz is renowned for its long-term commitment to the environment and well-planned growth, which has become part of its cultural identity [52]. Already in the 1980s, Mayor José Ángel Cuerda – together with the support of all political parties – established the Environmental Studies Center (CEA), an interdisciplinary public organization that helped lay the groundwork for sustainable initiatives in Vitoria-Gasteiz [51]. By involving civic organizations (schools, community and professional associations), citizens, and the industry in initiatives, the city also supports a bottom-up approach to environmental protection, which has led to a high level of public commitment to sustainability. Furthermore, with the aim to foster a sense of 'belonging' in a green community, Vitoria-Gasteiz takes a citizen-centric approach to its post-carbon transition.

The flagship project of the city is the Green Belt, which is a semi-natural area surrounding the city that evolved over the last 20 years with considerable effort to reclaim and partially recover degraded areas (gravel pits, drained wetlands and burnt ground) and transform them into green and blue areas. As set out in its long term vision, "Climate Change Prevention Strategy 2006-2012," Vitoria-Gasteiz aims to become a carbon neutral emission zone. The city signed the "Covenant of Mayors" in 2009, committing to a 25.7% reduction in total $CO_2$ equivalent emissions by 2020 (56% of emissions associated with the activity of the City Council) and a 90% reduction by 2050 using 2006 as the baseline year [53] (33). The $CO_2$ emissions reduction strategy is primarily based on energy efficiency (buildings, mobility and municipal services) and renewable energy. In 2010, GHG emissions were equivalent to 3.26 t $CO_2$eq/inhabitant, a 10.4% decrease from 2008 [54].

**Main achievements:** Despite this growth and an expansion of the urban territory, planners have increased the density of the built environment, successfully minimizing spread in the environmentally sensitive areas to the south of the city. Some 81% of the population live within 1,500m of the city center, and 95% have access to basic services such as education, health and cultural facilities within 500 m, everything thus being within easy reach [53]. The abundance of green space and the compact city model has helped walking being the most used choice of transportation (53.6% in 2011) and a steady increase in other sustainable modes [55]. Shops revenues have increased over the years, owing to the 25% of the streets reserved for pedestrian use [56]. Although still the second most used mode of transportation (28.3%), private vehicle usage decreased considerably (29.3%) from 2006-2011 [57]. Furthermore, Vitoria-Gasteiz has successfully involved the business sector in the drive towards a sustainable environment, which enabled the city to remain prosperous in the crisis-torn economic situation. With an unemployment of 10.9% (2011) – half the national average – the high standard of living and the reputation as a green city has attracted big business and residents alike. Firms occupy more than 9.5 million $m^2$ of the municipality, and the Jundiz business park is one of the largest industrial areas in the north of Spain [53] (15). It is also a major innovation center, attracting a wide range of companies to its technology park and research centers, some of which focus on alternative energy research and electric vehicle development [53] (19-20).

| | Country: Spain | | City: Vitoria-Gasteiz |
|---|---|---|---|
| | Population (2012)[36] | 2,055,496 | Population (2012)[37] 242,223 (cities and greater cities)<br>268,950 (larger urban zone) |
| | GDP €/capita (2011)[38] | 22,700 | GDP €/capita (2011)[40] 35,200 (NUTS 3 region) |
| | GDP per capita in PPS[39] (2013) | 94 | |
| | Region | Southern Europe | |
| City's physical geography | Location | ✓ Located in the north of Spain and is the capital of the Autonomous Community of the Basque Country | |
| | Climate[41] | ✓ The urban territory lies in a region that encounters intense climate variations due to its placement in a transition zone between the Atlantic and Mediterranean climates[42]<br>✓ 5.21 hours of sunshine per day<br>✓ Average temperate: warmest month is 18.9°C; coldest month is 4.6°C<br>✓ Annual rainfall: 885.5 litre/m² | |
| Political Autonomy[43] | | ✓ In Spain, local powers largely depend on State or autonomic law and may differ largely across Autonomous Communities.<br>✓ Local authorities also have a high degree of fiscal autonomy. Autonomous Communities, however, are responsible for the majority of expenditures<br>✓ Responsibilities devolved to municipalities include: public safety, traffic management, management of parks and garden, urban policies, cultural heritage, protection of public health, social services, promotion of social reinsertion, cultural activities, participation in the design of education programs and facilities.<br>✓ Municipalities >50.000 inhabitants are also responsible for: environmental protection, urban public transport, markets and public parks, waste treatment, civil protection, social service allowances. | |
| $CO_2$ Reduction Targets | | ✓ 25.7% reduction in total $CO_2$ equivalent emissions by 2020 using 2006 as baseline year (90% by 2050)[44]<br>✓ Strategy primarily based on energy efficiency (buildings, mobility and municipal services) and renewable energy | |

**Table 5.** Vitoria-Gasteiz Profile.

### *3.6. Ljubljana (Central and Eastern Europe): city center renewal, sustainable transportation and living standards*

**Context:** Named the capital of Slovenia in 1991, Ljubljana is the country's most important economic, political, administrative, and cultural center. The 280,607 inhabitants (in 2012) make up 13.7 % of the country's population. Economically speaking, it is by far the most developed region in the country with a GDP per capita of 24,660 € [58] (9), 42.3% higher than the Slovenian average (in 2009). The economic and urban restructuring that occurred in the 1990's helped Ljubljana become one

[36] Eurostat [32]
[37] Eurostat [33]
[38] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[39] GDP in PPS: EU28 = 100; Eurostat[34]
[40] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[41] Figures for 2008, Eurostat [35]
[42] European Green Capital 2012 Report, p. 16 European Green Capital 2012 Report, p. 16
[43] See European Union Committee of the Regions [36]
[44] Covenant of Mayors [37]

of the most competitive urban areas in Central Europe [59]. Municipalities in Slovenia have a moderate level of fiscal autonomy controlling only 14% of total local tax revenues and are dependent on revenues from personal income tax redistributed by the central government [60].

**Strategy:** Over the last 15 years, Ljubljana has taken measures towards a post-carbon transformation, particularly in areas such as public transport and the pedestrianization of the city center [61]. The basis for the city's development is the Vision 2025, adopted in 2007, through which eco-innovation and sustainable development is ensured and ambitious goals are put forth by the city authorities. Between 2007 and 2013, more than 650 projects were implemented to improve the quality of life in the city [62] (13). As a signatory of the Covenant of Mayors, Ljubljana commits to achieving an overall $CO_2$ emissions reduction target of 21% using 2008 as the baseline year, an equivalent of 1.9 tonnes $CO_2$/capita. This translates into an estimated emission reduction of 24% in the transport sector, 65% for local heating/cooling and 4% for local electricity by 2020 [58]. The long-term targets are more ambitious, reaching for a 50-80% reduction of emissions by 2050 compared to 2008.

The most important sustainable-oriented strategic projects in Ljubljana are the Urban Master Plan, Environmental Protection Program, Sustainable Mobility Plan, Sustainable Energy Action Plan (SEAP) and the Electromobility Strategy. 83% of all city development is directed towards renewal of existing developed areas and brownfields, which helps increase city density. Furthermore, in cooperation with the state, Ljubljana plans to invest 50 million euro to increase flood safety [63].

**Main achievements:** Ljubljana has undertaken ambitious steps to support the transition away from heavy car traffic to pedestrian and cycling networks, which is one of the biggest problems in the city and surrounding region due to the gap between the distribution of jobs and places of residence [58](13). These include closing a section of the main transport artery – the Slovenska Street – and renovating the city center as well as encouraging public participation in initiatives, such as the Civitas Elan project, which aim to reduce car use and make public transport, walking, and cycling more attractive [64]. An analysis of traffic patterns between 1994 and 2013 showed a reduction of private car usage in favor of pedestrian and bicycle usage.

Ljubljana also created an extensive urban ecological zone – almost three quarters of Ljubljana's surface area now consists of green spaces, with 16.5% designated as Natura 2000 areas. Between 2008 and 2012, the city created 40 ha of new parks on formerly degraded areas. The city has also made progress in decreasing waste and increasing its share of renewable energy sources. Although still higher than the national average, municipal waste generated (domestic and commercial) has decreased by 8.9% (a total of 115,737,000t) since 2010. Moreover, the total power from renewable sources, particularly solar power plants, increased by more than 50% each year from 2008-2012 – the share of renewable energy in the final energy consumption amounted to 13.5% in 2012 [62] (35).

| | Country: Slovenia | | City: Ljubljana | |
|---|---|---|---|---|
| | Population (2012)[45] | 2,055,496 | Population (2012)[46] | 280,607 (cities and greater cities)<br>536,484 (larger urban zone) |
| | GDP €/capita (2011)[47] | 17,600 | GDP €/capita (2011)[49] | 24,600 (NUTS 3 region) |
| | GDP per capita in PPS[48] (2013) | 82 | | |
| | Region | Central & Eastern Europe | | |
| City's physical geography | Location | ✓ Situated on a natural crossroad from Central Europe to the Mediterranean, to the Balkan Peninsula, and to the Pannonian Basin [50] | | |
| | Climate[51] | ✓ Central continental climate<br>✓ 5 hours of sunshine per day<br>✓ Average temperate: warmest month is 21.4°C; coldest month is 2,5°C<br>✓ Annual rainfall: 1,490 litre/m² | | |
| Political Autonomy[52] | | ✓ State authorities supervise the legality of the work of local community authorities<br>✓ Local authorities have a moderate level of fiscal autonomy controlling only 14% of total local tax revenues and are dependent on transfers from the central government.<br>✓ Responsibilities devolved to municipalities include: education, primary health care, family and youth assistance, social welfare, housing, urban planning, spatial planning, water and sewage, environmental protection, culture (libraries), sport and leisure, promotion of agriculture, economic development of the municipality.<br>✓ In some cases, urban municipalities have additional responsibilities of urban transport and urban development | | |
| $CO_2$ Reduction Targets | | ✓ 21% reduction $CO_2$ emissions by 2020 using 2008 as baseline year (50-80% by 2050)[53]<br>✓ GHG reduction of 24% in the Transport sector, 65% for Local Heating/Cooling and 4% for Local Electricity by 2020[54] | | |

**Table 6.** Ljubljana Profile.

### *3.7. Discussion: constraints and resources in city types*

This section reflects on the city types, tracing out what is distinctive about their post-carbon transitions and what similarities are apparent between the cities. In doing so, the section asks what the profiles tell us about the emerging types of post-carbon cities, and the constraints and opportunities shaping them. In particular, we return to the insights of Martins and Ferriera [10] who conclude that the main constraints on action at the urban level are: resources and capacity, knowledge and information, institutions and governance. The city types are roughly considered in relation to these categories. Given the preliminary nature of our profiles, the discussion is exploratory and preliminary, intended to provide inspiration for future research in the area. In the case of each city, the section

[45] Eurostat [32]
[46] Eurostat [33]
[47] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[48] GDP in PPS: EU28 = 100; Eurostat[34]
[49] GDP at current market prices by NUTS 3 regions; Eurostat [34]
[50] City of Ljubljana – - Profile, Development Projects and Investments Office, 2011, p. 6
[51] Figures for 2008, Eurostat [35]
[52] See European Union Committee of the Regions [36]
[53] Covenant of Mayors [37]
[54] Municipality of Ljubljana [65]

considers what is distinctive about each of these cities, why they might be of interest to other cities and which types of city in particular.

**Malmö**: A 'Regional Service Centre', Malmö has transformed its economy from industry to service and knowledge sectors. The key question that arises when we consider Malmö is how did the city embark on such an ambitious and high profile move to sustainability in the context of economic crisis, social problems and deindustrialization? The city is not what might be termed a typical Nordic sustainability leader – it has neither the economic wealth nor the long tradition of environmental activity of Copenhagen, for instance. Hence, it is overcoming deficits in resources and capacity, as well as knowledge and information. In very general terms, it is achieving this through developments in the sphere of governance. Within the Swedish national context, Malmö has benefited greatly from national sustainability and regeneration funding programs. Thus, the national context has been pivotal in the city's attempts to reinvent itself, assisting it in overcoming its own economic constraints. It might also be added that the regional context (the economically strong Öresund region) and the proximity to the economic and environmental leader, Copenhagen, has also been beneficial. Within the city, the leadership role played by the municipality has been also been crucial in making sustainability a central component of socio-economic restructuring towards the knowledge society. Furthermore, the city has successfully presented itself internationally as an urban sustainability leader, embedding itself in regional, national and international networks. This is why Malmö is (already) of interest to a wide range of city types, e.g. other deindustrializing cities in other parts of Europe/ the World.

**Bristol**: A 'Leading European Capital and Metropolis', Bristol has a strong economic base, a growing population and a broad coalition of actors promoting sustainability. In general terms, the city is not constrained by resources and capacity, knowledge and information. Rather, it is a strong example of how cities can be entrepreneurial in sustainability despite the restricted autonomy afforded by the UK political system. The relative alignment of "green" business and citizen groups and the city's administration appears crucial to the transition. The city's transition is instructive to other cities in centralized political contexts and in terms of its city administration reacting to and incorporating societal pressure for increased action on sustainability. As in Freiburg, the city administration has responded to societal actors pressing for more sustainability, with a distinctive emphasis on localness. The ongoing transition has been accompanied by general economic growth and a particular growth in the so-called green economy. Bristol does not have a long-established record in sustainability like Freiburg nor quite the level of performance, but like the other cities assessed here, it combines high level of city administration activity/ intervention and strenuous publicity work to place sustainability on the urban agenda and city on the European sustainability agenda.

**Freiburg**: A 'Regional Innovation Centre', the city is something of an archetype of a prosperous, 'green' high performing mid-sized Continental European city. Freiburg has long been seen as an example of how economic development can be combined with environmental ambitions. The city might be considered to enjoy a very favorable context of action in that it is a relatively wealthy city in a relatively wealthy nation. Hence, it has resources and capacity. It also has relative knowledge and information, given the strength of the high-tech knowledge economy. The institutional and governance context is also comparatively favorable in that Freiburg enjoys a fair degree of political autonomy. Perhaps a difference between Freiburg and other, wealthy, but less environmentally-concerned cities is the broad coalition of actors involved in the post-carbon transition – from green activists, (even)

conservative politicians and high-tech businesses. While undeniably being a model for other wealthy mid-sized cities (and cities of other sizes generally), its inherent wealth casts doubt on the usefulness of poorer cities seeing it as a *Leitbild* in terms of its overall transition narrative. It is a city defined by an unusually 'green' political constellation, not found in many other parts of the world. Nevertheless, its harnessing of solar energy makes it of interest to southern European countries.

**Vitoria-Gasteiz:** A 'Regional Centre with Growing Population', Vitoria-Gasteiz is a good example of how cities are attempting to align social, environmental, and economic objectives to enhance their regional standing despite having less financial resources at the national and local level compared to its counterparts in wealthier countries. As the first Spanish city to sign the Aalborg Charter and design a local Agenda 21[51], Vitoria-Gasteiz demonstrates the importance of strong political leadership. By emphasizing a high amount of public participation in initiatives (including education programs for children), the city is able to mold a cultural identity based on sustainability, which further supports its post-carbon transition. This is complemented by the relatively high municipal fiscal autonomy and capacity in areas such as spatial planning, environmental protection, and urban transport. By curtailing unsustainable sprawl and increasing density, the city is able to protect the natural environment, encourage the use of sustainable modes of transport (demonstrated by the majority of trips now being undertaken by foot), and increase street revenues and therefore the local economy. The population density also allows the city to provide citizens better access to amenities in a relatively more efficient manner, which also increases quality of life and attracts new residents and companies. Vitoria-Gasteiz capitalizes on its strong history of mechanical and metallurgy industries (still the city's main industries) [66], and is now attracting green innovation to its technology park and research centers; which help build a more diverse economy. This enabled the city to be more economically resilient compared to other Spanish cities during the economic crisis.

**Ljubljana:** A 'National Capital and Metropolis', Ljubljana is an example of a capital that has yet to become a 'Leading European Capital and Metropolis' in terms of economic influence, but has nevertheless made recent strides to improve its sustainability. With the lowest national and local GDP per capita out of the selected high performing cities, Ljubljana provides an example of a city that has embarked on a post-carbon transition despite significant economic and structural constraints (e.g., aging infrastructure and population) as well as a moderate level of fiscal autonomy. As in several other Central and Eastern European cities in this category of city type (Berlin, Bratislava, Bucharest, Budapest, Kraków, Gdańsk, Łódz, Poznan, Prague, Riga, Sofia, Tallinn, Vilnius, Warsaw, Wrocław), Ljubljana underwent significant economic and urban restructuring in the 1990's [59] and only began tackling issues of sustainability within the last 15 years. Although the city does not have a deep-seated history of sustainability as in the case of many of the other high performing cities, substantial progress has been made over a short period of time to pedestrianize the city center, provide convenient and accessible public transportation, and revitalize deteriorated brownfields into useful public and private spaces. These initiatives encourage the use of more sustainable modes of transport, support the quality of life for elderly inhabitants, attract younger residents to the city center, and revitalize the economy of underdeveloped areas. Moreover, faced with high levels of annual rainfall, the city also demonstrates resilience in terms of flood management. Ljubljana can therefore serve as an example as to how to include social and environmental goals in economic restructuring plans as well as innovative measures in terms of climate adaptation.

Cities may be constrained in some categories, but the leading types outlined above have utilized or developed strengths in the other areas to overcome them. Malmö has taken advantage of economic funding opportunities in Sweden, a country with generally strong economic performance, to overcome its own economic weaknesses and political decentralization to re-define itself. Bristol is attempting to overcome a lack of political autonomy through the city administration building on economic strengths and societal coalition engaged in sustainability. Through political leadership and the involvement of the public, Vitoria-Gasteiz has created a cultural identity of being "green", which supports its transformation despite economic constraints and attracts new residents and business. After a decade of economic restructuring, Ljubljana is rapidly transforming and revitalizing its spaces to be more sustainable, inclusive, and accessible, as well as economically prosperous. Freiburg is, in a sense, an exception as it appears not to be overtly constrained in the categories identified as crucial by Martins and Ferriera [10]: resources and capacity, knowledge and information, institutions and governance. Of course, this is not to say that the city is not constrained in these areas. Rather, Freiburg appears to have relatively large capacity for action in sustainability due to generally favorable contextual factors.

## 4. Conclusions

The aim of this article was to profile five leading mid-sized cities in different EU regions. By providing a basic structure for assessing sustainability in cities, this preliminary research is intended to be used to compare other mid-sized cities of similar types (i.e. with similar contextual characteristics). The analysis has been based on readily available data sources, and hence the analytical structure adopted here could be utilized to conduct research on other examples or other city types in the EU. Given the explorative approach and preliminary results in this article, much work remains. Researchers may want to develop and test the approach adopted here by comparing data and transition narratives within the same EU city type, as identified in Table 1, e.g. comparing Malmö with Newcastle upon Tyne, or Vitoria-Gasteiz with Potsdam. The aim in doing so would be to further develop and refine city profiles as well as trace out commonalities and differences between city types.

Going further, research may seek to focus on the geographical patterns within the groups and their explanatory significance for transitions, transfer and learning. A quick glance over these economic types reveals a number of puzzles in sustainability terms. For instance, within the "Leading European capital & Metropolis" group we find most of the acknowledged sustainability leaders and most of these are in Northern and Western Europe (Bristol, Copenhagen, Stockholm, Amsterdam). But what of cities such as Milan – can it be seen as an exception or a potential leader in its own geographic context? And what of the cluster of Italian cities (Triest, Firenze, Torino, Trento) in the 'Regional Innovation Center' group – what links can be drawn between them and those cities in other parts of Europe (Freiburg, Graz, Turku, Heerlen)? Similarly, there is a cluster of Spanish cities in the group 'Regional Center with Growing Population' (Victoria-Gasteiz, Alicante, Bilbao, Las Palmas, Valencia, Malaga), which might suggest that Victoria-Gasteiz may provide some kind of solid basis for further comparison. There may be very few grounds for comparing Ljubljana with some of the other 'National Capital & Metropolises', such Berlin and Rome, but comparison to other central and Eastern cities in the group

may be fruitful (e.g. Bratislava, Warschawa, Talinn, Krakow, Gdansk). Finally, researchers might probe the similarities and difference between high performing 'Regional Service Centers' in different geographical areas, such as and Nantes.

Ultimately, the article has attempted to advance knowledge of how post-carbon transitions are occurring in mid-sized cities. It has evaluated indicative examples of five particular types of high performing city. The justification for this has been that a more nuanced, context-concerned approach is needed when assessing transitions, and that a typology or grouping of cities with similar attributes is one way in which this can be better achieved. Ultimately, comparisons are fairer within, and not across, city types due to great variation in contextual factors, such as wealth, climate, and population size. Hence, future research in the field should seek to account for contextual factors as a first step. Research on post-carbon transitions could focus on the progress or maturity of transitions within city types. This would also give insight into whether the city types chosen are useful or if further modification is necessary (as factors are dynamic and cities will move from different city types as they develop).

The aim here has not been to develop a comprehensive typology, though this study provides pointers as to how this might be done. For instance, in order to be more representative, the approach taken by Zoeteman, Zande, and Smeets [14] should be expanded to include a larger set of cities in the EU and not just applicants to the European Green Capital Award. As Zoeteman, Zande, and Smeets' [14] preliminary typology focuses on sustainability, it might be interesting to compare the groupings of cities with the city types developed by the Second State of European Cities Report. An analysis of this manner could shed light on key factors that influence the sustainability of a city as well as how typologies can change over time. In general, to achieve this comparable data, particularly on performance (e.g. on GHG emissions) in sustainability would be needed, more detailed research on the conditions of transitions in individual cities would have to be conducted, perhaps in the form of case studies, which might better delineate how transitions have (or have not) emerged in particular cities, what is driving and constraining them and what similar types of cities might learn from them. The following questions might guide the development of typologies: What types of urban context exist? What do cities do to achieve the post-carbon transition? What kind of strategies in what types of cities? What combination of context variables promote or constrain actions and performance in these types? Which sets of actions in which contexts are the most effective? By addressing such questions, researchers will ensure that the typology elucidates the complex inter-relationships between context, action and performance, which shape urban post-carbon transitions.

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## Author Contributions

Ross Beveridge conceived jointly of the structure and design of the paper, wrote the abstract and introduction (section 1), contributed to section 3 (Bristol profile, general editing of profiles, tables and discussion) and the conclusion.

Monica Ridgway conceived jointly of the structure and design of the paper, wrote section 2, contributed to section 3 (editing the Vitoria-Gasteiz (3.5) and Ljubljana (3.6) profiles, tables and discussion) and the conclusion.

Kristine Kern conceived jointly of the structure and design of the paper, wrote section 3.1. and 3.2 Malmö profile.

Cristian Stroia and Noriko Fujiwara drafted the Vitoria-Gasteiz (3.5) and Ljubljana (3.6) profiles and provided general inputs.

Stéphane Dupas drafted the Freiburg profile and general inputs (3.4).

Till Sterzel provided city data for section 3 and general inputs.

## Conflicts of Interest

"The authors declare no conflict of interest".

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