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Spread Is Better: Suitability for Climate Neutrality of Italian Urban Systems

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Abstract: In light of the challenges required by the European Green Deal policies concerning the achievement of climate neutrality by 2050, this paper analyses the suitability of different Italian urban systems for energy consumption and CO_2 emission reduction. In anthropised territories, there are strong relationships between energy consumption, climate-changing emissions and settlement patterns. Lands considered low could increase their rating because they have far greater environmental, energy and land resources than more pivotal ones. After an Italian-scale overview of the ecosystem capacities, this paper develops a detailed study of three exemplary areas: the northeast, the northwest, and the central-west coast. The analysis uses Burkhard's matrix for ecosystem values and the energy consumption 2021 report of the National Energy Authority. The first finding is that the northeast region, characterised by spread and rarefied urbanisation, has a peculiar suitability for climate neutrality. In the results, spread territories perform much better than centralised ones. The coexistence of little urban cores, space for vegetation and a widespread water network promotes synergies for enhancing an ecosystem approach to land design.

Keywords: urban design; ecosystem capacity measurement; climate change

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1. Introduction

This paper aims to define the suitability of Italian territorial settlement models based on the challenges required by the European Green Deal to achieve climate neutrality by 2050. The research has three motivations. The first is to recognise which territorial settlements are best suited to achieve climate neutrality. The second is to identify whether there is a need to convert spread cities towards more centrality. The third is to provide a framework for differentiating tailor-made local actions for neutrality.

The European Green Deal is a programme developed by the European Commission to fight climate change, bringing Europe to climate neutrality. The main goals of this programme are to have no more greenhouse gas emissions generated by 2050, economic growth dissociated from resource use and no person and place neglected [1–3].

Addressing the problem of the suitability of the Italian territorial settlement models means, first and foremost, understanding how to recognise the level of preparedness of the Italian system, which is quite complex with highly dissimilar settlement, economic and service models. This system is characterised by a mix of more peripheral areas, often in the medium or high mountains, and more central and strategic zones, mainly located on the coast or in the open plain. In recent decades, a growth in economic and demographic flows from the peripheries of this territory towards its centres is evident.

The tendency is to represent the aggregation compactly as more sustainable and functional in mitigating climate change. This article questions this assumption. A careful analysis of the territorial settlement could testify to a relevant capacity in the neutrality of areas with medium polarisation and high sprawl, considered unattractive. Large centres depend entirely on energy, food, water and risk in less densely urbanised areas, and analysis of the adequacy for neutrality cannot consider these aspects. The spread areas testify to the great proximity of ecosystem services to the inhabited areas and the significant redundancy in infrastructure and manufacturing locations. The spread urban system composed of medium-sized cities and axial ramifications between them is strategic on a European scale and widely described in the literature [4]. Although growth in economic and demographic flows from the peripheries of peripheric territory towards its centres is evident, a careful analysis of the state and sustainability prospects of the settlements will help in recognising a fundamental character that is often underestimated in the development of a project for sustainability [5]: the relevance of the dependence in terms of energy, food, water and risk of the centres in the less urbanised areas, much less polarised in the spread territories [6].

The construction market cycle we are currently experiencing is the first in which transforming the built environment is the most relevant way to develop new urban areas. Urban development is one of the major causes of the production of fossil emissions in Europe and among the hardest to abate. Urban development will have to wisely select which types of settlement schemes to favour because the preferred scheme will significantly affect the future capacity for neutrality. Transforming the settlement scheme to achieve neutrality will cause significant fossil emissions. Therefore, it is essential to choose the paths to neutrality correctly.

Questioning the preferred development model for European objectives and abandoning the narrative of the inevitable failure of the land of sprawl and extensive consumption [7–9] means understanding this dependency link and fostering a shift from a polyperiphery geography to a nonhierarchical, networked one [10]. The analysis outcomes can provide critical reflections on spatial and urban development perspectives at the European level, suggesting a change in mindset for all design and planning processes of the significant spatial transformations underway for climate change adaptation and mitigation [11,12]. To date, real estate and census values predominantly drive spatial developments, concentrating transformations towards the centres with the highest financial availability and the soils where the value is highest. The indicators of consumption and climate-changing emissions illustrated in the following lines prompt reflection on the potential value chains that median territories have [13,14] when observing the environmental challenges of the near future [15–18].

The application context of this research is Italian territory. Deepening the state condition and the process profile necessary for neutrality in Italy is particularly relevant to the Euro-Mediterranean system. Italy has different urbanisation conditions: spread, as in the northeast; polycentric networked, as in Emilia-Romagna and on the Adriatic coast; and monocentric, as in the northwest and the centre-south. These conditions correspond to different settlement schemes and economic and service management patterns. Understanding which ones are most efficient in terms of achieving the neutrality objectives proposed by the European Green Deal is particularly significant because it will not only help the development of sustainability in Italy but also allow the entire Euro-Mediterranean region to orient its urban development.

Italy not only presents several scenarios to analyse in a homogeneous environment, reducing the complexity of comparison, but also has a deep tradition of research and projects in sustainability and neutrality. Applied research and projects vary in many fields, from transport networks to energy networks, disaster risk to adaptation of built systems and circular economy to waste management.

For an in-depth look at the general Italian situation in terms of sustainability issues, the most known references are the works of Musco [19–21], De Gregorio [22] and Lanzani [23–25]; however, the literature in this field is vast [26–31]. Aside from the general studies, some research presents a systematic review of the regeneration of minor fabric in Italy, which is fundamental to the research described here [29,32,33].

There are several studies on the relationship between the territorial context, the infrastructural capacity of public mobility, the availability and safety of soft mobility infrastructures and the impacts of private motorised transport [34,35].

There are many works [36–40] on the topics of risk and adaptation due to the high risk of Italian territories concerning climate (landslides, floods, avalanches, drought, heat, intense precipitation, combined climate-geological risks, sea storms, erosion).

Several valuable experiments have been carried out in the last decade in Italy on the topics of circular economy and waste management concerning domestic waste, industrial waste, integration between agro-food production and waste disposal and the conversion of waste into energy [41–46].

2. Materials and Methods

This research selected three areas capable of portraying the main recognisable models to investigate the condition of the Italian territorial fabric regarding neutrality. The areas have homogeneous characteristics regarding the number of inhabitants and strategic and economic value on an Italian and European scale. These areas are the northeast (understood as the Veneto Region, Friuli-Venezia Giulia Region, Province of Trento, Province of Bolzano), the Region of Lombardy and the Region of Lazio. The Region of Lombardy is representative of the northwest area. The Region of Lazio is representative of the central area. While the northeast has several residents and an economic system that necessitated consideration of the entire area, the other two regions represent a large part of the residents and economy of the reference areas. Considering the whole northwestern and central areas would be misleading for the metrics mixing urban and nonurban areas' average energy consumption and emission values.

The three areas have very different settlement patterns, economic models, extensions and densities. The northeast is predominantly a spread territory, with small centres and great sprawl, the economy being predominantly manufacturing-industrial, organised into hundreds of small centres. Lombardy has a monocentric structure with a production-industrial economy intensely concentrated around the Milan-Bergamo metropolitan system [47]. Lazio has a monocentric system with a predominantly service-based economy, with more than 75 per cent of the regional GDP of tertiary origin strongly centralised in Rome. Table 1 shows the data comparing the territorial systems considered.

Table 1. Comparison between the Italian territorial systems considered for this research [1].

Territory	Extension	Inhabitants	GDP	Density
Northeast	39,865 Km^2	7,193,000	USD 219,210 mil	180
Lombardy	23,864 Km^2	10,060,000	USD 333,475 mil	422
Lazio	17,242 Km^2	5,879,000	USD 169,349 mil	341
Italy	302,073 Km^2	58,815,463	USD 2,090,448 mil	195

[1] Data from Istat 2023 [48].

This research exclusively uses certificated open data released by regional and state administrative bodies and official bodies for environmental protection and research (ISPRA, ARPAV, ARPA FVG, APPA, DPC, TERNA) as described in the final note. This study also used statistical data certified by ISTAT and risk data produced internationally by EU-ESPON and IPCC [49–59]. The data processing, developed in a GIS environment, amalgamated the data while paying attention to the scale of the reference data to avoid statistical simplifications or unsound projections.

The survey selected four key indicators to conduct the analysis: average energy consumption (A); exergy capture (I_2); global climate regulation (I_3); and energy-biomass (I_4). All energy and environmental values were calculated based on the land use of the northeast as expressed by Corine Land Cover 2018 (CLC).

(A) The first environmental indicator is derived from Terna's energy consumption inventory and describes for each CLC item the average value per hectare of the two anthropogenic impacts.

The subsequent indicators are derived from Burkhard's matrix [50–53]. The matrix provides a qualitative picture of the ecosystem services in the territory concerned. The indicators describe these services in terms of extension. Extents per region (S) are expressed as a percentage of land. Burkhard's matrix is a tool for assessing ecosystem services first defined by Benjamin Burkhard in 2009 and applied in many studies from different fields. The matrix, refined in subsequent publications, determines the levels of ecosystem services of each land cover type (based on Corine Land Cover legend) on qualitative scales for 30 different services organised into 3 categories: regulating services, provisioning services and cultural services.

(I_2) Exergy capture measures the fraction of energy that can be transformed into mechanical work. In ecosystems, captured exergy is used to build biomass (e.g., through primary production) and structures. Its representation is a picture of the extent to which ecosystems cannot transform the energy received into usable energy; by extension, it is also a measure of a specific ecosystem's metabolic cost and efficiency. Exergy is conserved in reversible processes and diminished in irreversible processes; it is used in thermo-economics to assess the economic value of an energy flow.

(I_3) The Global Climate Regulation is an integrated indicator that measures potential sinks or sources of CO_2, methane and water vapour in 5 classes. Ecosystems play an essential role in climate, both in the absorption and emission of greenhouse gases. The Global Climate Regulation indicator in this research has a structure of three classes: the territories that can capture more CO_2 than they emit and have indices between +1 and +5; the second shows the territories that are sources of climate-altering gases, which emit more CO_2 than they can absorb, with indices between −1 and −5; the third shows the neutral territories, whose balance between potentially produced and absorbed climate-altering substances is zero and which have a slight surplus and deficit, with indices between −1 and +1.

(I_4) Energy-biomass measures, on the one hand, are a function of the presence of trees or plants that can potentially be used as an energy source and, on the other hand, of the potential demand for energy concerning the activities of a given land use. This energy indicator is structured into 5 value classes from the measurement of woody or plant biomass/ha, kJ/ha or energy demand. The biomass energy indicator has a structure of three classes: the first aggregates energy-credit territories, i.e., territories that produce more energy than they consume and have indices between +1 and +5; the second aggregates debit territories, which consume more than they can produce, with indices between −1 and −5; the third aggregates neutral territories, whose balance between potentially produced and consumed energy is zero and which have a slight surplus and deficit, with indices between −1 and +1.

Energy consumption indicators (I_1) are expressed in GwH. The average energy consumption value (A) of each region is expressed in GwH/Km^2. Exergy capture indicators (I_2), global climate regulation (I_3), and energy-biomass (I_4) are expressed in the value of ecosystem service per percentage of regional territory with that specific land use according to Formula (1)

$$I_n = B_n \times S \tag{1}$$

B_n represents the value attributed by the Buckhard matrix to a given land use for an ecosystem service n (exergy capture; global climate regulation; energy-biomass).

The overall ecosystem value of the area is a weighted sum of the I_n values for each of the three indicators considered. According to the procedure Burkhard [50–52] indicated and repeatedly applied in the literature in the territorial evaluation of ecosystem services, the overall ecosystem value will allow a comparison between the ecosystem capacity of the three regions.

From the comparison of these four indicators will emerge an assessment of the current state of sustainability, expressed by current energy consumption, and of potential sustainability concerning the settlement pattern present in the different territories. Once this research established these relationships, the article proceeds by cartographically comparing the distribution of ecosystem services, mapping the distribution of the most suitable tissues to achieve climate neutrality according to the indications of the European Green Deal. The research concludes by comparing the findings of the geo-statistical survey and the cartographic survey.

3. Results

From the application of the method described, we recognise a significant contradiction between the current state of energy consumption, often understood as a significant indicator of a territory's capacity for sustainability even in the future, and the territorial ecosystem capacity in the application of the Burkhard matrix.

In Table 2, we report the energy consumption of the northeast and, for comparison, of Lombardy and Lazio. Although the areas differ in extension, the indicators are expressed by the percentage of soil type and energy consumed and, therefore, are comparable. We report only the most significant entries by topic and for the territories considered.

Table 2. Percentage of energy consumption by land use type (clc-2018) in the northeast, Lombardy and Lazio areas [54]. Energy consumption data from Terna 2021 [56].

Land Use	S N-E (%Km^2)	I_1 N-E (GwH)	S Lo (%Km^2)	I_1 Lo (GwH)	S La (%Km^2)	I_1 La (GwH)
Continuous urban fabric	0.06	4343.9	1.27	5790.3	0.44	3300.7
Discontinuous urban fabric	4.74	17,380.3	6.53	23,148.1	2.71	13,204.9
Industrial or commercial units	1.26	16,066.1	4.20	23,492.6	0.69	2255.8
Road and rail networks	0.06	2295.2	0.89	3358.9	0.05	321.3
Port areas	0.08	2295.2	0.01	3358.9	0.02	321.3
Airports	0.06	2295.2	0.11	3358.9	0.11	321.3
Mineral extraction sites	0.12	58.0	0.22	99.4	0.13	46.8
Dump sites	0.00	58.0	0.02	99.4	0.02	46.8
Construction sites	0.03	647.5	0.11	397.5	0.02	238.3
Green urban areas	0.03	806.9	0.98	1033.5	0.06	442.6
Sport and leisure facilities	0.12	806.9	0.60	1033.5	0.13	442.6
Agriculture	38.19	1261.1	41.47	1079.9	42.17	336.2
Totals	39,865 Km^2	48,319	65,183 Km^2	66,251.1	25,268 Km^2	21,281
Average consumption GwH/Km^2	Northeast	1.21	Lombardy	1.02	Lazio	0.84

The table shows a sizeable average energy consumption (A) in the northeast and a relatively low consumption in Lazio, with an intermediate value for Lombardy. The compact city proves to be advantageous to date because it contains logistical spoils. Thus, in a scenario of energy production from imported fossil fuels, it consumes less. The limited energy consumption is generally considered indicative of greater sustainability, but is this true? Energy consumption does not provide information about the mitigation capacity of emissions.

Table 3 shows the values for the three indicators for the northeast and, for comparison, for Lombardy and Lazio. The table shows the most significant items by topic and the territories considered. The value of sea and ocean is considered on an equal minimum territorial component for all sea-facing territories to avoid it weighing too heavily on the total, distorting the overall result.

Table 3. Value of ecosystem services in the three study areas.

Land Use	Northeast			Lombardy			Lazio		
	I_2	I_3	I_4	I_2	I_3	I_4	I_2	I_3	I_4
Continuous urban fabric	0.00	−0.18	−0.24	0.00	−3.81	−5.08	0.00	−1.32	−1.76
Discontinuous urban fabric	4.74	−14.22	−14.22	6.53	−19.59	−19.59	2.71	−8.12	−8.12
Industrial or commercial units	0.00	−6.30	−5.04	0.00	−21.00	−16.80	0.00	−3.43	−2.74
Road and rail networks	0.00	−0.24	−0.24	0.00	−3.56	−3.56	0.00	−0.18	−0.18
Nonirrigated arable land	106.10	−21.22	0.00	−29.78	0.00	106.10	89.48	0.00	−22.37
Principally occupied by agriculture	11.13	0.00	0.00	19.85	15.88	3.97	20.55	0.00	0.00
Mixed forest	40.40	32.32	8.08	19.85	15.88	3.97	1.90	1.52	0.38
Water bodies	2.72	0.68	0.00	10.68	2.67	0.00	3.71	0.93	0.00
Coastal lagoons	7.65	0.00	1.53	0.00	0.00	0.00	0.00	0.00	0.00
Sea and ocean	0.09	0.15	0.09	0.00	0.00	0.00	0.09	0.15	0.09
Totals	3.92	1.02	0.10	3.87	0.15	−0.26	1.18	−0.10	−0.35

Observe the difference in values between the three territories, especially for the total values of I_2, I_3 and I_4. The territory with the best performance is the northeast, especially regarding Global Climate Regulation and energy-biomass values. The graph below in Figure 1 compares the four general indicators. The values have been normalised on a 0–1 scale to be comparable. The value of average energy consumption is shown here in the form of 1-A (A′) to be more comparable at a glance.

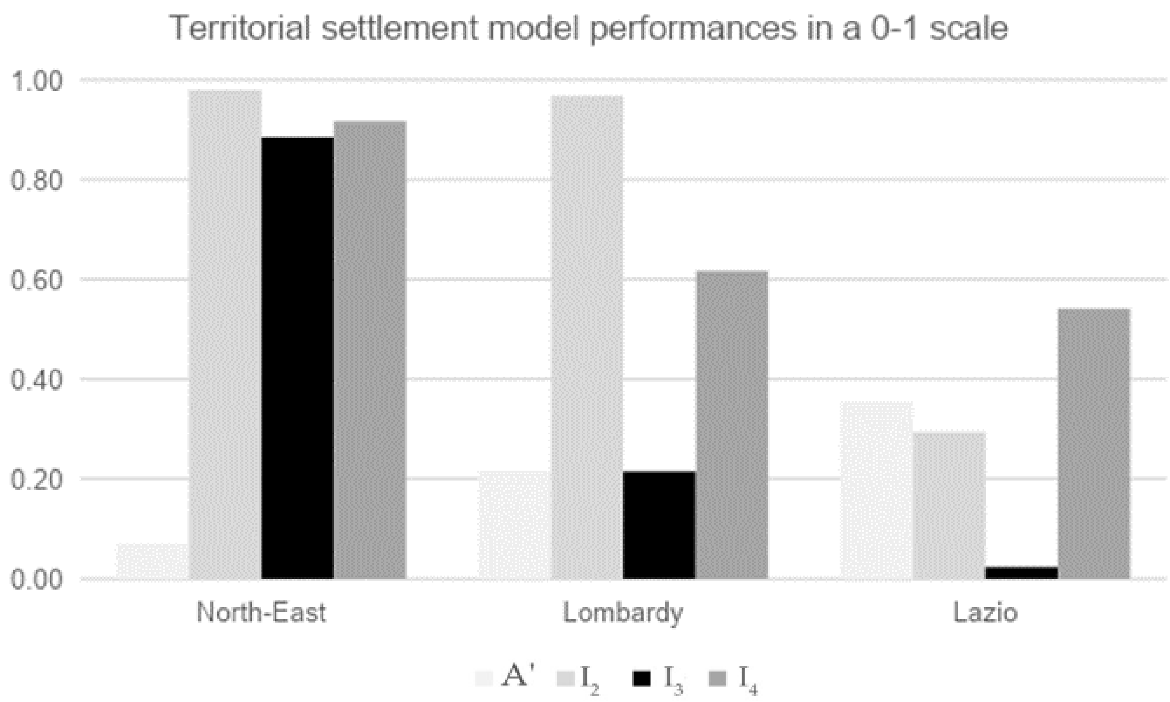

Figure 1. Confrontation of ecological performances of the territorial settlement model for the three cases considered.

The values depicted show a potential radical reversal of the sustainability rating of settlement models when considered in terms of the ability to produce biomass energy autonomously on site, containing fuel transport, and the ability to eliminate climate-altering gases (I_3) directly.

Next, the research produces a cartographic comparison between Northeast, Northwest and Central Italy. Below are the three figures representing the spatial distribution of the Buckhard matrix results for the I_3 indicator. The decision to publish the maps related to this indicator has two reasons. Firstly, there is a significant similarity between these maps and the energy-biomass maps, and thus, through these maps, we also offer pretty approximate information on the geographical distribution of local energy production capacity. Secondly, the climate-changing gas abatement was more valuable between these two indicators because it is the first operational factor towards climate neutrality among ecosystem services. The maps represent the territories most capable of climate neutrality in black. Figure 2 shows the map of the northeast territories. As described above, the northeast has the settlement structure of a spreading city, densifying into a few main centres of not considerable size and ramifying along axes, continuously interspersing vegetation and water systems. Neutrality-functional ecosystem services are close to neighbourhood-scale settlements. This continuity offers a basis for designing the territory of neutrality without radical upheavals in urban forms. Mobility systems and infrastructures must become a capillary network in the diffuse grid, but a significant relocation of settlements is unnecessary.

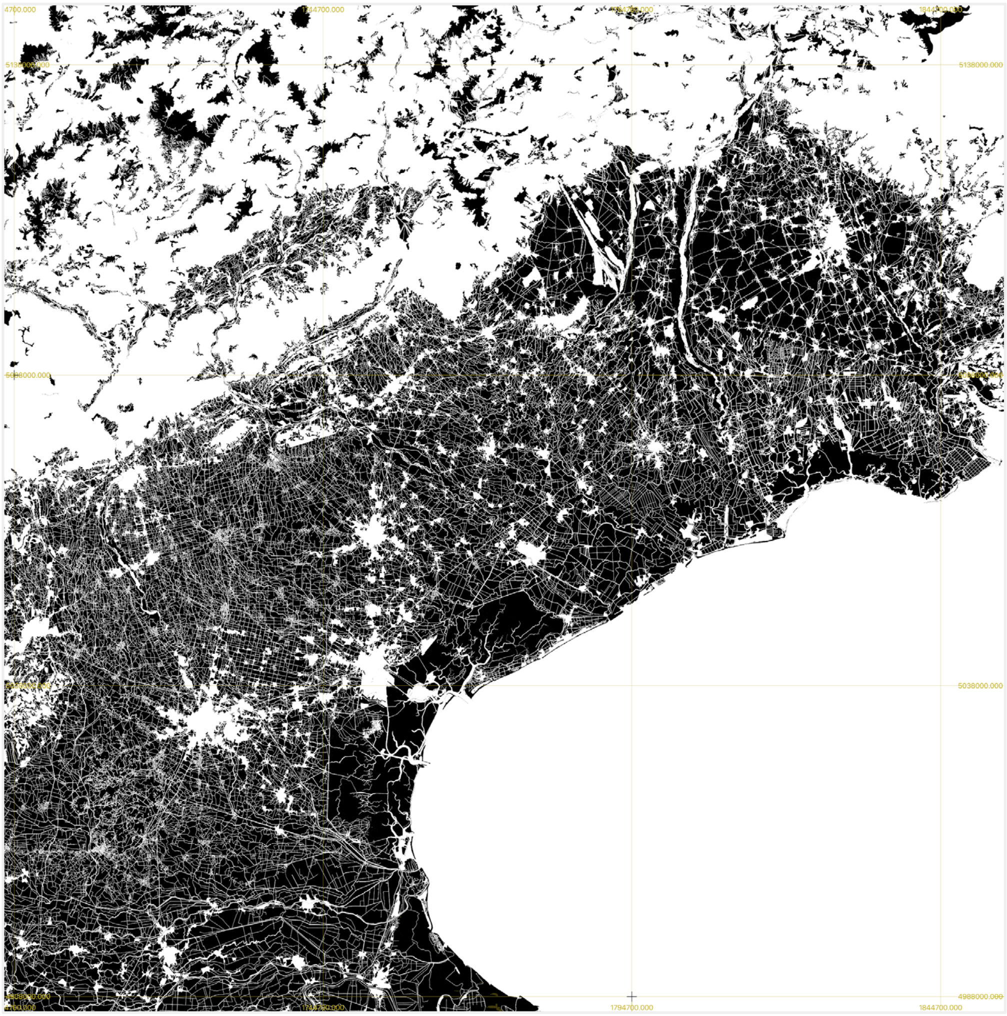

Figure 2. A geographical analysis of the neutrality in climate change mitigation in the northeast region. Black represents the areas that are already neutral, and white represents the areas that are far from neutral. There is no strong separation between the two categories. Most anthropised land is in direct contact with areas capable of sound neutrality.

The map geographically corroborates the capabilities that emerged in the statistical survey and reaffirms the potential relevance of this territory. From what emerged in the geo-statistical and geographical investigation, we can state that the northeast territories have, at the same time, relevant energy consumption but equally significant capacities in fixing climate-altering gases and opportunities for energy production from renewables. Therefore, this is a vast territory in-between, which, if correctly oriented, presents an outstanding possibility to achieve the climate neutrality expected from European policies. In the following Figure 3, we will see the potential neutrality in the northwest.

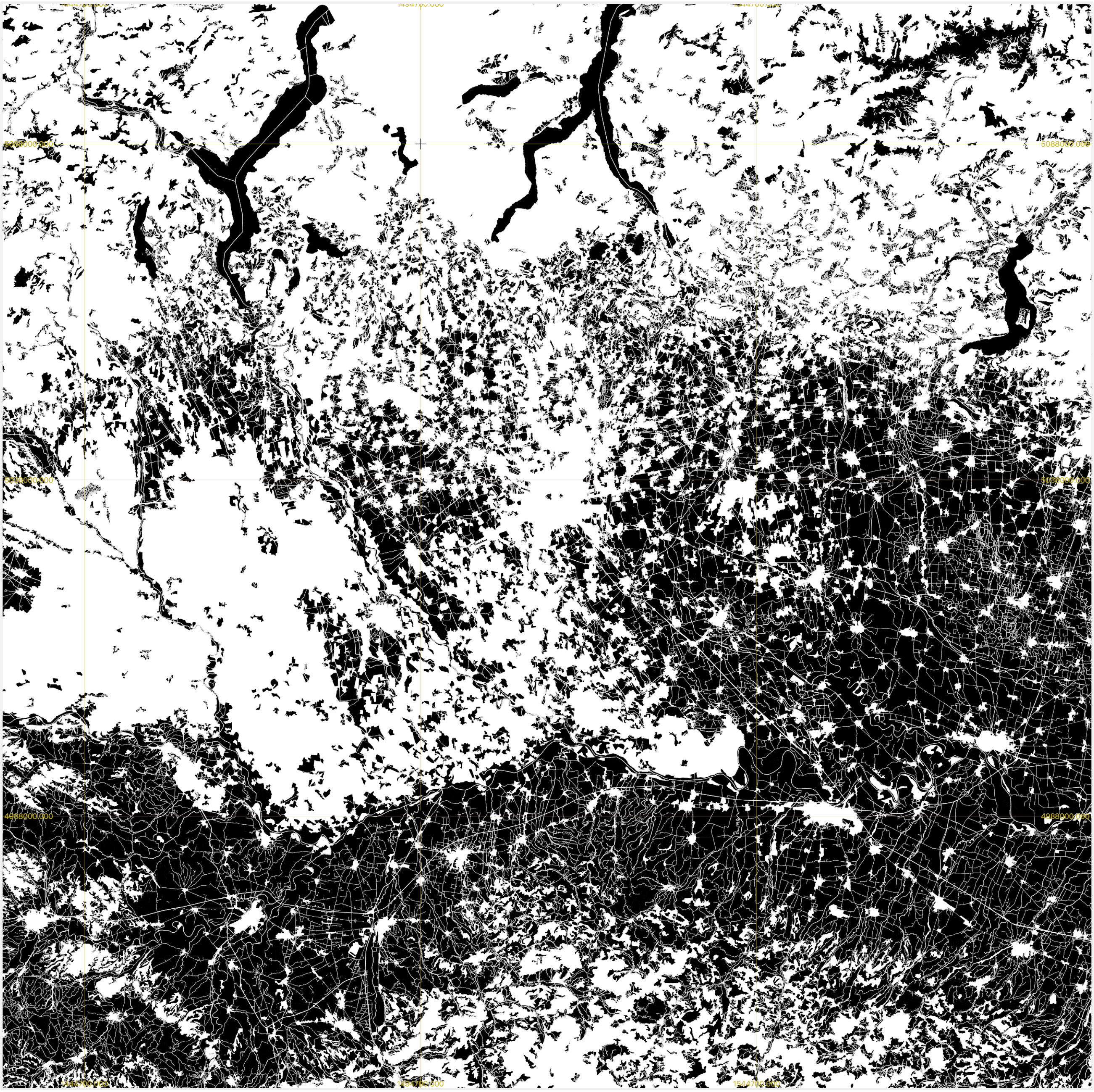

Figure 3. A geographical analysis of the neutrality in climate change mitigation in northwest region. The white and black areas are dense and exclusive patterns without significant overlapping.

In the northwest, the territories of energy and climate neutrality are limited. They are located just to the south of the extensive metropolitan system. Investments in greening in Milan have been significant in recent years and have brought results. However, looking at this map, we can see how these investments are severely limited in their systemic effectiveness and how the present settlement patterns contain the prospect of radical transformation towards neutrality. The Lombardy metropolis has a density and compactness that does not allow for the penetration of ecosystem services in abundance. In the following Figure 4, we see the potential neutrality in the centre.

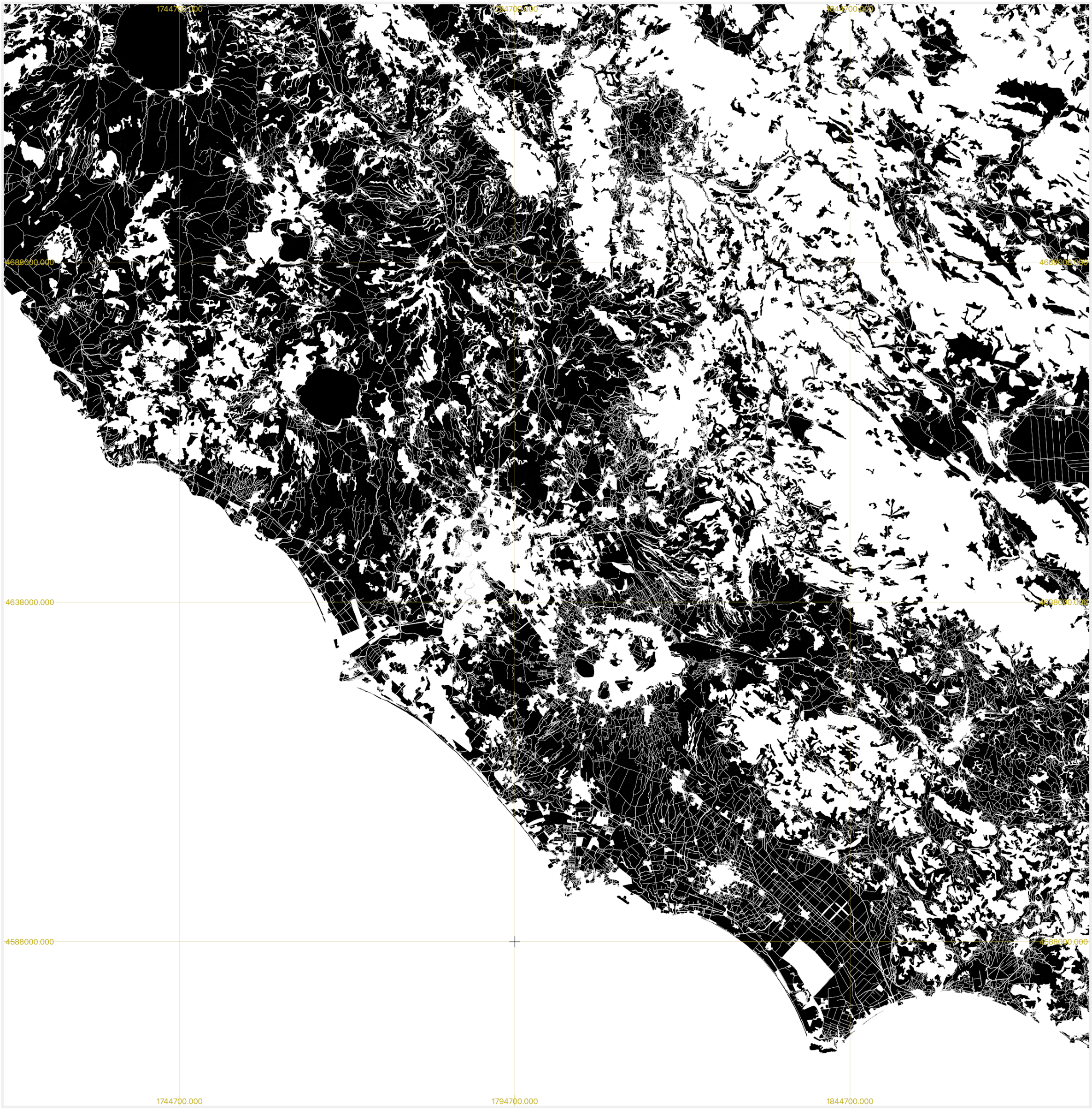

Figure 4. Geographical analysis of the neutrality in climate change mitigation in central region. The white and black areas are dense and exclusive patterns without significant overlapping.

For the centre, too, we can see a considerable white centralisation, corresponding to the inhabited city, surrounded by an intense and extensive black area. The city of anthropic services and the city of ecosystem services are separated, requiring significant logistical investments for the exchange between the two, especially for food and electricity production and the abatement of climate-changing gases. Again, the settlement patterns do not make a profound transformation to acephalous grid-to-grid models easy.

The territories of climate neutrality are much more identifiable in the northeast, as emerged in the statistical survey. Therefore, the spread cities and medium-sized centres have characteristics favourable for climate neutrality. Summarising what has emerged from the geo-statistical and geographical survey, we can state that the territories of the northeast have great energy consumption concerning their extension but equally significant capacities for fixing climate-altering gases and opportunities for energy production from renewables. We are, therefore, faced with a vast territory in between, which, if correctly oriented, presents excellent resilience and is naturally ready for the neutrality expected from European policies. The situation is different in the northwest and Lazio, where the climate neutrality territories are strongly polarised, exogenous and located south of the extensive metropolitan system described above.

4. Discussion

The research was limited in terms of territorial extent and the indicators included to avoid contaminating the results with too much complexity. The assumption underlying the research was radical. Denying a direct connection between the compact city and sustainability merits cautious evaluation. The application of the research method led to three primary outcomes. In the future, it will be possible to repeat the investigation on a larger scale and with more complexity to investigate the most effective ways to achieve climate neutrality.

1. The general indicators of ecosystem services per region depicted in Figure 1 are very different, suggesting a correlation between settlement schemes and the availability of services, primarily in the abatement of climate-altering gases and biomass production. Furthermore, the maps (Figures 2–4) show the different distribution of ecosystem services in the different regions, describing different degrees of availability of ecosystem services according to settlement patterns. The first result of the research is the confirmation of a significant dependency between settlement patterns and the ability to achieve climate neutrality.

2. The regions with a strong polarisation between the centre and peripheries are usually considered more efficient in sustainability. Nevertheless, ecological performance is weak in Lombardy and Lazio, independent of economic and social aspects. On the contrary, the northeast's spread structure shows higher performance in indicators. Therefore, spread structures may exert less effort to achieve neutrality for spread settlement patterns than a pattern with relevant separation between inhabited and ecological zones.

3. The territory of neutrality in the spread settlement schemes is not distributed outside the urbanised areas. It represents a background and support for land development. First, it is an ecological support: it is a generator for the production of biomass, a system for the absorption of climate-altering gases, and an infrastructure for the mitigation of hydraulic and heat risks. It is also social support because many practices related to leisure time and slow mobility of the diffused city occur. Finally, it is geographical support because the grain and density of its partitions of ditches, hedges and unpaved roads define the palimpsest that ground the landscapes characterising their regions [34–37]. It, therefore, seems helpful to encourage more proximity between inhabited areas and ecosystem services.

The research findings state that the northeast has a vast territory quite effortlessly ready for improving the climate neutrality expected in the Green Deal agenda [1,2]. The neutral territory of the northeast crosses small and medium-sized cities and diffuses urbanisation systems [9,49]. It is a cultivated and weakly urbanised space that forms the backdrop to the scaffold of infrastructures, diffuses urbanisation and small towns that describe the entire Veneto-Friuli metropolitan system, extending around half of the Po Valley megalopolis [50]. It is a territory contained between the significant biomass reserves of the Alps and the Apennines, crossed by that dense network of rivers, ditches and canals, wetlands and marshes, which, over time, man's work has made habitable [51]. It is a potential reserve of food and energy, suspended between scarcity and excess of water, which climate change has made increasingly fragile [52–54].

Northeastern Italy is on the edge of a transition of its settlement scheme based on a nonecosystemic and spatialised reading of energy consumption and climate-changing gas emission data. What has emerged here, however, suggests a decidedly reverse process, i.e., a transition of an ad hoc territorial project, which must not be distorted in its distribution and in which the territory of climate neutrality may play a decisive role.

What emerges from the research allows for further reflection on proximity. Very often, the assessment of the risk status of territory for climate [60–64] disregards the conditions of resource availability [65]. The maps produced by ESPON [7,66] represent the metropolitan areas of London, Paris and Berlin as being at shallow risk. ESPON map derives its considerations in the correspondence from the location of the expected extreme events [67]. However, the cascading effects of the event, such as the interruption of the production of energy, food, timber or other natural goods, are not considered. These metropolises, which correspond on a larger scale to the centre of Lombardy, have no such production. How safe are they, therefore, in light of what emerges from identifying ecosystem services? New research can question the effective resilience of large metropolitan systems testified by ESPON to assess whether the spatial design horizons are predefined to date, i.e., concentration.

Given that climate neutrality is a long-term goal, the research results could take unexpected directions at present for potential shifts in energy technologies, socioeconomic trends or climate impacts. The suitability of the identified territorial models could become obsolete if the directions hypothesised at present are not confirmed. For example, a large availability of house-by-house energy production could reduce the need for biomass and proximity to water or wind sources, favouring centralised urban systems. On the other hand, a significant economic collapse or difficult access to food distribution might reinforce the need for sprawl. Unexpected climate impacts, connected, for example, to the global average temperature exceeding 4 degrees, could lead to the total nonhabitability of settlement schemes considered to date. However, these scenarios are currently not included in the accepted models or are very remote and will have to be considered in subsequent confirmatory studies to verify the suitability of the development models undertakens.

In conclusion, the spread settlement model, which is a territory that merges countryside and city in a third type of articulation, has a relevant strategic potential if duly infrastructured for sustainable mobility and grid-to-grid energy production. This observation must become a planning horizon for rethinking land value determinations and reorienting development plans.

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Data Availability Statement: The research considers only certificated open data released by regional and state administrative bodies and official bodies for environmental protection and research: ISPRA-isprambiente.gov.it/it, ARPAV-arpa. Veneto.it, ARPA FVG-arpa.fvg.it, APPA-appa.provincia.tn.it, DPC-protezionecivile.gov.it/it/, TERNA-terna.it/it.

Conflicts of Interest: The authors declare no conflict of interest.

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