

# BDC

Università degli Studi di Napoli Federico II

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### **Renewable Energy Communities: Urban Research and Land Use Planning**

**Guest editors:**

Roberto Gerundo

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# BDC

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## Renewable Energy Communities: Urban Research and Land Use Planning



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### Territorial acupuncture: benefits and limits of energy community networks

*Agopuntura territoriale: benefici e limiti dei network di comunità energetiche*

Federica Leone<sup>a,\*</sup>, Fausto Carmelo Nigrelli<sup>a</sup>, Francesco Nocera<sup>a</sup>, Vincenzo Costanzo<sup>a</sup>

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#### ABSTRACT AND KEYWORDS

##### Territorial Acupuncture

Territorial Acupuncture is an approach that proposes a micro-invasive solution for the adaptation of densely populated areas through punctual interventions on a district scale. The aim of this study is to analyse the potential and limitations of this new application in order to understand whether and how to implement Territorial Acupuncture to make it as efficient and effective as possible. By first introducing the basic idea and a brief explanation of how this new approach works, it will then proceed to an analysis and research phase to identify the benefits and limitations of this new approach. Finally, solutions for its improvement will be proposed. While the application of Territorial Acupuncture might be difficult due to the large number of actors to be involved, with small variations and theoretical additions (mostly social and environmental), it would allow energy, socio-economic and environmental dynamics to be changed quickly and optimally. In conclusion, Territorial Acupuncture, with the modifications proposed in this study, would be able to respond to the problems of contemporary urban poles without returning completely different territories even more efficiently and effectively.

**Keywords:** territorial acupuncture, biourbanism, energy community, territorial resilience, positive energy district

##### Agopuntura territoriale

L'agopuntura territoriale è un approccio che propone una soluzione micro-invasiva per l'adattamento di aree densamente popolate attraverso interventi puntuali su scala distrettuale. Lo scopo di questo studio è quello di analizzare le potenzialità e i limiti di questa nuova applicazione, così da comprendere se e come implementare l'Agopuntura Territoriale per renderla più efficiente ed efficace possibile. Introducendo prima l'idea alla base e una breve spiegazione sul funzionamento di questa nuova teoria, si passerà, poi, a una fase di analisi e ricerca per identificare benefici e limiti di questo approccio. Infine, verranno proposte delle soluzioni per il suo miglioramento. Se l'applicazione dell'Agopuntura Territoriale potrebbe risultare di difficile applicazione a causa dell'elevato numero di attori da coinvolgere, dall'altro lato, con piccole variazioni e aggiunte tematiche (perlopiù sociali e ambientali) permetterebbe di modificare le dinamiche energetiche, socio-economiche e ambientali in maniera rapida e ottimale. In conclusione, l'Agopuntura Territoriale, con le modifiche proposte in questo studio, riuscirebbe a rispondere ai problemi dei poli urbani contemporanei senza restituire territori completamente diversi in maniera ancora più efficiente ed efficace.

**Parole chiave:** agopuntura territoriale, biourbanistica, comunità energetiche, resilienza, distretti ad energia positiva

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## 1. Introduction

This study stems from the intention to contribute to the refinement of territorial acupuncture. In fact, after developing this approach in a previous study, the authors of this research set out to analyse the benefits and potential limitations of applying this innovative approach to the transition to carbon neutrality in its current state. In this way, it will be possible to understand what solutions can be proposed to increase its effectiveness and efficiency. Consequently, a multidisciplinary study (typical of territorial analyses) will be carried out, so as to examine every aspect and every discipline involved in the dynamics activated by Territorial Acupuncture.

### 1.1 Territorial Acupuncture

In the coming decades our territories will have to face unprecedented consequences related to pollution and the climate crisis (Pierrehumbert 2019). These consequences have already begun to appear with the outbreak of new epidemics/pandemics (Perkins et al. 2021), food crisis (Hanjra and Qureshi 2010), energy crisis (Zacà et al. 2015) and extreme weather conditions (von Homeyer, Oberthür & Jordan 2021). Therefore, a profound change in urban and spatial planning is needed to ensure a good quality of life for the population without distorting the previous asset (Khan & Zaman 2018, Saaty & Sagir 2015, Glazebrook & Newman 2018).

A solution that helps in the transition to new realities could be territorial acupuncture. Proposed as an evolution of energy districts, Territorial Acupuncture (Leone et al., 2023) may constitute a new approach aimed at integrating the solution to the problem of energy supply from renewable sources, with other environmental issues (from zero soil consumption to the preservation of agricultural areas to the enhancement of the landscape) and with actions to reduce territorial inequalities with reference to the endowment of services to citizens and businesses (Leone et al., 2023).

Proposed as an evolution of energy districts, Territorial Acupuncture is a new theory that allows the energy and social dynamics of territories to be modified without excessively altering the pre-existing urban fabric (Leone et al., 2023). This approach stems from the combination of a reinterpretation of Urban Acupuncture and Energy District design. The first is a principle derived from the therapeutic practice of acupuncture (in traditional Chinese medicine) and popularised by Marco Casagrande, who sees the application of punctual artistic/architectural interventions to the city organism as a way to bring social and sometimes even environmental improvements (Casagrande 2014, 2019). Instead, energy districts are defined as portions of territory with defined boundaries that help meet their own energy needs through the production of energy from renewable sources (Bossi, Gollner & Theierling 2020, Hedman et al. 2021).

The reinterpretation of the acupuncture tool to move from the urban to the territorial dimension is not only a change of scale, but constitutes an attempt to move it within the territorialist theory and practices, based on the seminal reflections of Alberto Magnaghi and subsequently developed and shared by the experts who founded the territorialist school (Magnaghi, 2011). This school bases its action on an in-depth knowledge of the physical and cultural specificities of places (morphotypological and identity), on their interpretation and representation and on their recognition as territorial heritage (Magnaghi, 2011).

In this way, the transformation of the territory and the activation of non-extractive integrated socio-economic models also activate the communities whose participation is fundamental to the achievement of the objectives (Gisotti & Rossi, 2018; Lombardini et al., 2019).

The transfer of the metaphor of territorial acupuncture from the biourbanism approach to the territorialist approach is possible because for the Magnaghi school, territory is the outcome of a long-term co-evolutionary relationship between human settlement and the environment (Cellamare & Scandurra, 2016; Magnaghi, 2011; Poli, 2018), and it is precisely this that constitutes the patrimonial basis for the project (Ciervo, 2022).

The substantial difference between the biourbanism and territorialist approaches can be found in the different evaluation of the territory (Caperna et al., 2010; Magnaghi, 2011). For the former – which deals more with the city than with the territory – the human settlement is considered as an organism whose complexity it reproduces and, consequently, it methodologically confronts the ‘life sciences’ (Tracada, 2013; Tracada & Caperna, 2012). In this context, the city is regarded as ‘the living environment of the human species’ of which one could recognise an optimal form that would guarantee ‘the optimum in terms of systemic efficiency and quality of life of the inhabitants’ (Serafini, 2013).

In the wake of Christopher Alexander, the biophilic approach to urban and spatial planning and its relation to neuroscience gives central importance to the question of form and emphasizes the search for well-being, particularly psychophysical well-being, through that of balance.

In this position, as Luisa Bonesio (2015) has noted, the role of communities and citizens at the centre of reflection and practices of change in the bio sense” in the territorialist paradigm is not identified as a crucial element of project and lifestyle change.

Within this theoretical framework and its operational potential, the goal of replacing fossil energy sources with sustainable ones can play a central role (IEA, 2019). In fact, the international objectives of energy production from renewable sources by 2050 (Paris Agreement, 2015) require the construction of an enormous extension of photovoltaic fields that could constitute a further element capable of increasing territorial and social inequalities, the destruction of agricultural areas, and the disruption of landscapes (Güneralp et al., 2017; IEA, 2021b, 2021a).

This is why it is appropriate to develop hypotheses that lead to the achievement of objectives, bearing in mind, from the outset, the need not to produce negative side effects, such as those mentioned above.

Positive Energy Districts can be useful tools to compose the different objectives (JPI Urban Europe, 2020; Albert-Seifried et al., 2022; Alpagut et al., 2019).

A Positive Energy District is defined as a portion of territory with defined boundaries whose domestic production of energy from renewable sources exceeds internal demand (Lindholm, Rehman & Reda 2021; Brozovsky et al., 2021).

In our hypothesis, the definition of the perimeter of the PED must also respond to zero soil consumption, to equity in access to energy sources by the communities within it and must be a driver of welfare development processes to reduce territorial inequalities between inner areas and metropolitan systems or, within the latter, between suburbs and centralities (Leone et al., 2023; Petersen et al., 2020).

The punctual insertion of energy districts in specific areas of the organism-territory, according to this new methodology, would modify energy, social, economic and environmental dynamics (Leone et al., 2023). These must see communities as protagonists in the process from the conception phase to the implementation and, finally, management, and not as actors to be involved in simple consultation activities by institutional or economic actors intervening from outside (Leone et al., 2023).

A parallelism is thus created between acupuncture, urban acupuncture and territorial

acupuncture (Leone et al., 2023). Table 1 shows the similarities and differences between these three practices.

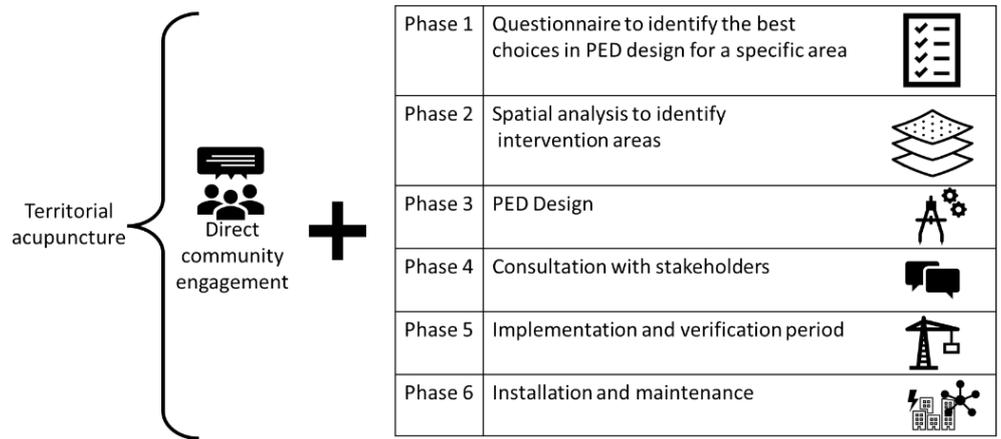
**Table 1. Summary diagram of the differences in acupuncture, Urban Acupuncture and Territorial Acupuncture**

|                            | <b>Acupuncture</b>                | <b>Urban Acupuncture</b>                 | <b>Territorial Acupuncture</b> |
|----------------------------|-----------------------------------|--|--------------------------------|
| <b>Intervention scale</b>  | Human Body                        | City                                     | Land (regional)                |
| <b>Ambition</b>            | Well-being of the human organism  | Social and artistic                      | Social and environmental       |
| <b>Acupuncture needles</b> | Needles                           | Artistic and Architectural installations | Positive Energy District (PED) |
| <b>Acupoint</b>            | Specific points of the human body | Portion of squares and streets           | Districts                      |

By applying Territorial Acupuncture, a micro-invasive method for modifying the settlement patterns of predominantly extra-metropolitan territories is proposed to facilitate the transition to renewable energy sources and to change the dynamics between inner areas and large urban centres (Di Cristofaro & Panunzi 2018). A reorganisation, therefore, of the entire territory that enhances areas that are underused or progressively abandoned, transforming them into attractors of cultural, energy and social wealth (Leone et al., 2023).

As shown in Figure 1, to apply this theory it is necessary to conduct a study in stages, carrying out territorial, urban, economic, social and energy analyses. Right from this initial stage, the protagonism of the communities is needed (Nigrelli, 2021), as they are the only ones who know their territorial heritage and can facilitate the implementation of choices that are not sectoral and are not pure commodification of the territory as is the case with compensatory and mitigation policies (Magnaghi, 2020). The results obtained will then be analysed and compared in order to identify the best areas in which to place Positive Energy Districts (Leone et al., 2023). Once the application points have been identified, a questionnaire will be filled out to understand which type of PED (Autonomous, Dynamic or Virtual) best suits the acupoint and which technologies are best to use (Lindholm, Rehman & Reda 2021; Clerici Maestosi, 2021; Good et al., 2017). Starting from the results obtained, the individual PEDs will be designed, involving the population once again in the choices, so as to allow a process of territorial appropriation by the citizens (Moreno et al. 2021). Verification analyses will be carried out and finally PEDs will be implemented. This approach ensures that the new shape that is added to the land is not, as has too often been the case in the recent past, the result of an extractive approach that sees the land as an undifferentiated and neutral space, but is placed within a strategy of care as proposed by territorialists (Gisotti & Rossi, 2018, Nigrelli 2022).

**Figure 1. Summary of work steps required for the application of Territorial Acupuncture**



*1.2 Urban bioregion*

The urban bioregion can be considered the evolution of the idea of the city as an ecosystem, a concept that territorialists (Vernetti, 1998) extend from the natural to the anthropic sphere. If the bioregion is “an interpretative and planning tool at the level of the ‘minimum units of territorial and landscape planning’ of a region’s vast area determined with holistic criteria, integrating the government of housing (Colavitti & Serra, 2022), economic-productive, infrastructural, landscape, environmental, identity functions” (Magnaghi, 2019), the addition of the adjective “urban” and its co-option within the territorialist paradigm determines a new definition that is set by Magnaghi himself:

“An urban bioregion is a local territorial system characterised within it:

- by the presence of a plurality of urban and rural centres, organised in networked and non-hierarchical systems of cities, each connected in a synergetic, distinctive and multifunctional way with its rural territory. Systems interrelated by housing, service and production (specialised and complementary) relations.
- by the presence of complex and differentiated hydrogeomorphological and environmental systems, related in co-evolutionary and synergetic forms with the urban settlement and agroforestry system”.

In the territorialist approach, the energy system of an urban bioregion should strive for ‘energy sovereignty’, meaning its autonomy should be based on community-controlled forms of production, thus eliminating environmental conflicts generated by heterodirected actions (Budoni et al., 2018).

*1.3 Energy community*

Energy communities are defined as those territorial measures that involve the population to be promoters of an energy transition towards Renewable Energy Sources (RES). These communities, through their actions and planning choices, promote the development and implementation of new green technologies (JPI Urban Europe/SET Plan Action 3.2, 2020; Moreno et al., 2021). The main purpose of energy communities, therefore, is to contribute to the transition towards Carbon Neutrality (Ahlers et al., 2020). Based on a technological system, the first proposals for energy efficiency in this sense were at the building scale with realities such as: Zero Energy Building (ZEB), net Zero Energy Building (nZEB), Near Zero Energy

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Building (NZEB), Retrofit Energy Building (REB) and Positive Energy Building (PEB) (Gouveia et al., 2021; Panagiotidou & Fuller, 2013; Aminoroayaei & Shahedi, 2018). Later, with the promotion and development of these realities and related technologies, the focus shifted to designing energy neighbourhoods and districts such as: Zero Energy District (ZED), Net Zero Energy District (NZED), Smart Energy District (SED), Retrofit Energy District (RED) and Positive Energy District (PED). Positive Energy Districts PEDs are the most advanced experience currently (Leone et al., 2022; Ala-Juusela et al., 2016;).

For the proper planning of these areas, it is necessary to take into account not only energy production (where energy always means electricity and heat), but also storage, distribution and mobility (electric and hydrogen) (Leone et al., 2022; Laitinen et al., 2021).

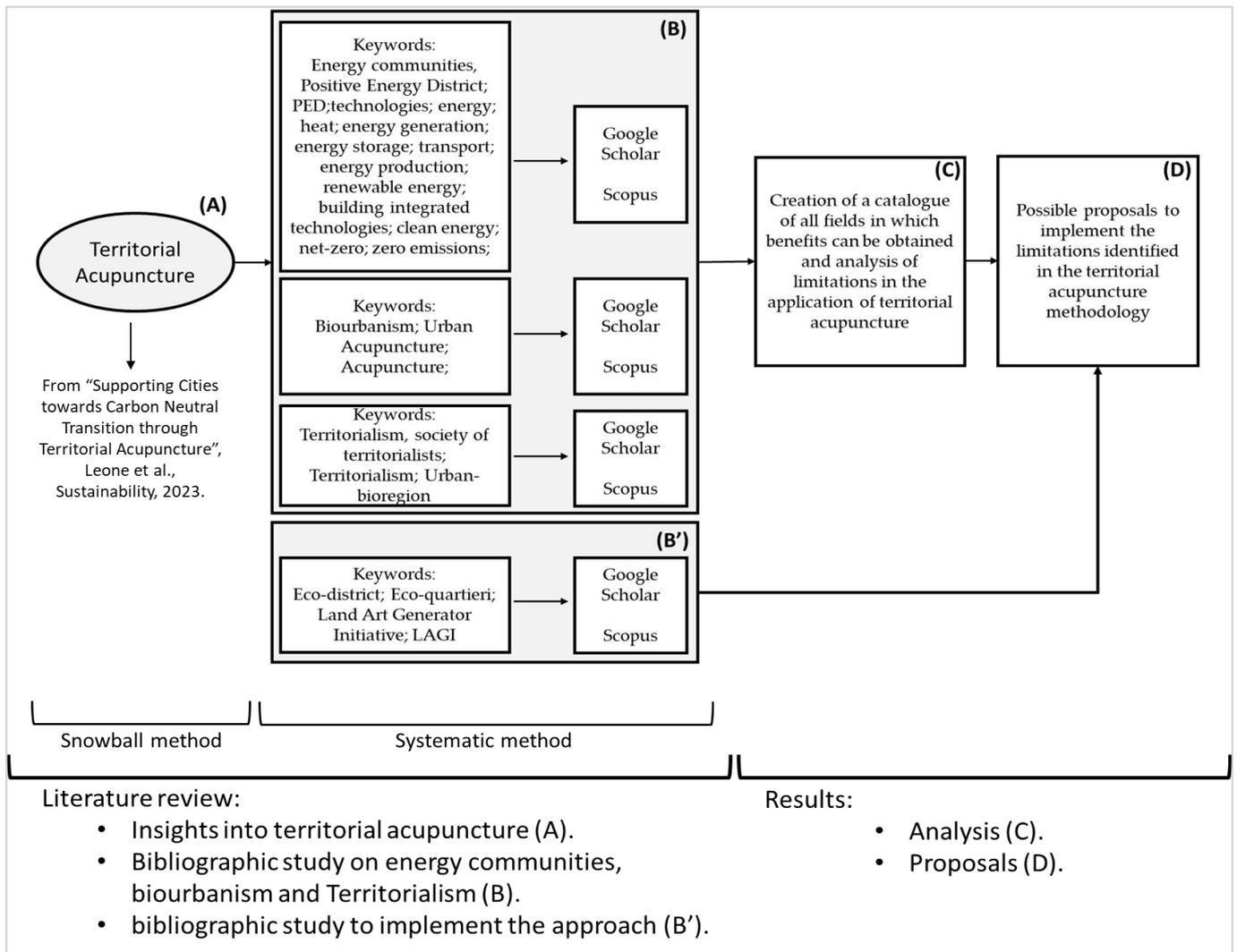
## 2. Material and Methods

With the aim of defining the limits and benefits of territorial acupuncture, it was required to carry out a step-by-step study in order to conduct this research. It is first necessary to specify that in this case the methodology presented is valid both for the advancement of the research and for the organisation of the work within the paper. The first action carried out was the organisation of the literature review. Topics on territorial acupuncture (developed by the authors of this study) and the theories and practices behind them (bio-urbanism and energy communities) were taken up. Related topics with innovative approaches were also addressed. One example is the proposals put forward by the Land Art Generated Initiative group. At this stage, literature reviews were carried out with different approaches. The first step was a snowball literature review approach from the text Supporting Cities towards Carbon Neutral Transition through Territorial Acupuncture (Leone et al., 2023). This made it possible to analyse in detail the main document dealing with this topic and the references linked to it. This made it possible to analyse in detail the main document dealing with this topic and the references linked to it. Then, the next step was to analyse the other topics of the literature review with a systematic methodology. In this way, it was possible to delve more deeply into the subject of territorial acupuncture. The combination of these two approaches made it possible to gain an overview of both the topic addressed and its context. With the literature review study, it was possible to define the necessary data and information base on which to base subsequent analyses. At the end of this phase, the process of organising the work and the methodology with which to approach the research was defined. Figure 2 shows this organisation.

The organisation of the data and information obtained during the literature review was used to pursue two different themes. It can be stated that the results obtained can be divided into two sub-categories: identification of pros and cons of territorial acupuncture and proposals for its implementation. Thus, in the first sub-phase, it was possible to create a catalogue of all fields in which the application of territorial acupuncture could bring benefits and one on the application limitations were identified. In the second sub-phase, on the other hand, proposals were made for the implementation of the theory, so that it could be improved.

This research, therefore, through the methodology just presented, made it possible to serve its intended purpose.

**Figure 2. Graphical presentation of the methodology pursued to carry out the research presented in this paper**



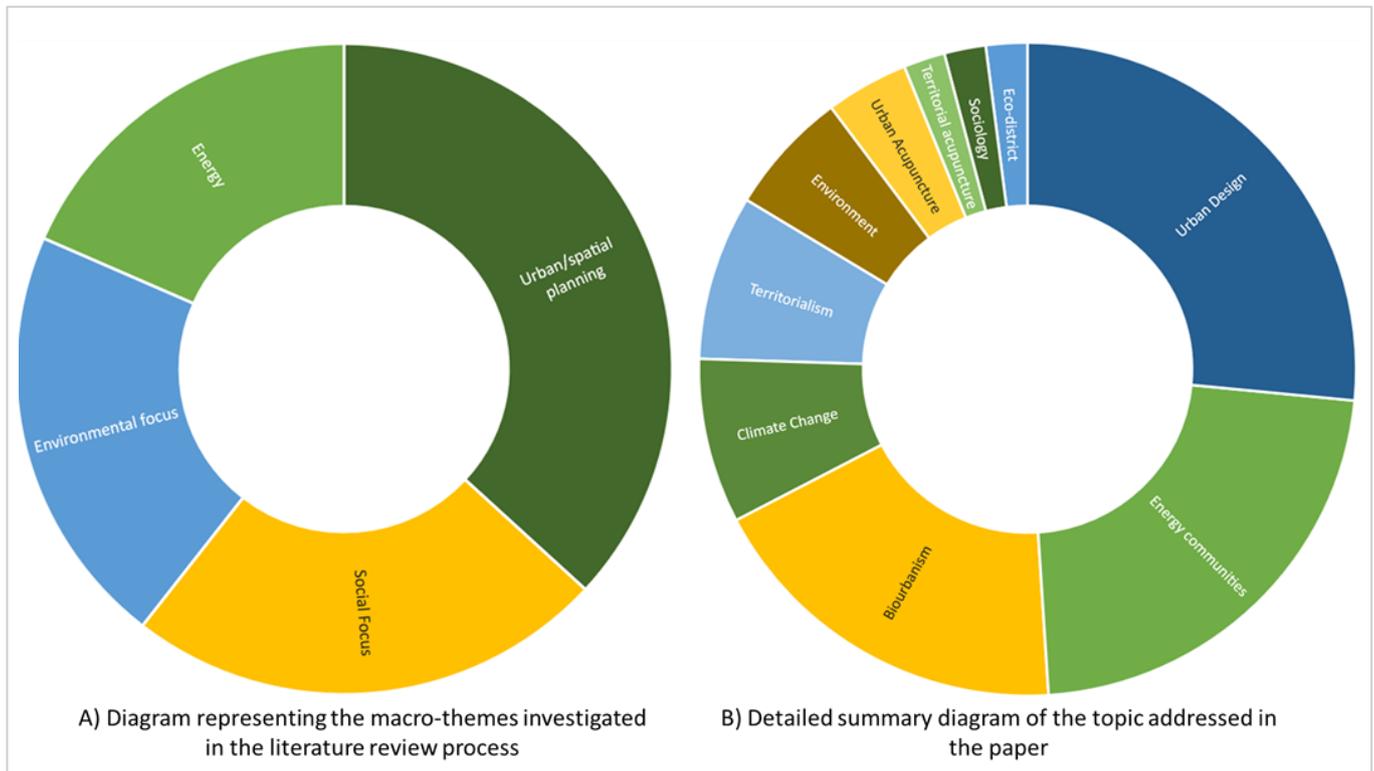
*2.1 Evaluation of the literature review process*

As mentioned above, a literature review process with a hybrid approach was applied to carry out this study: snowball and systematic. With the first method, the study presenting territorial acupuncture and the papers in its bibliography were investigated, while with the second method, related topics were examined. In this way, different topics related to urban and territorial planning were analysed, among which were: urban and territorial acupuncture, the climate crisis and related policies, urban sociology, health urbanism, energy communities, new methods of energy production, storage and distribution, the problem of inland areas, urban and territorial planning, bio-urbanism, territorialism, eco-neighbourhoods and Land art Generator. In total, around 300 papers were analysed, which were published between 1962 and 2023. All these topics and this extensive research ensured a broad view of the issues that territorial acupuncture aims to address, so as to properly define what the benefits and limitations might be in applying this methodology.

As for the references used in this text, the multidisciplinary approach also emerged. References dealing with energy communities, energy management and climate crisis, urban and territorial acupuncture, urban sociology and urban and territorial

planning were used. Figure 3 shows the analysis of the thematic macro-areas analysed and the topics covered in the references.

**Figure 3. Analysis of the topics addressed in the literature review process**



## 2.2 Materials – Eco-district

As part of those urban regeneration processes aimed at modifying the fabric of our cities to make them resilient and meet the high quality of life and sustainability needs of our times, the concept of ‘eco-neighbourhoods’ takes its cue from the 2005 Bristol Accord (Mantini, 2013). This defines the principles of sustainable communities. A sustainable community is defined as an active, inclusive, safe, well-managed, well-connected, well-serviced, environmentally sensitive, prosperous and equitable city (Mantini, 2013).

By eco-district is meant a green district in which a high quality of life for the population coexists with design choices that guarantee the conditions for a reduction in the ecological impact of human activities (Boutaud, 2009).

In order to be considered an eco-district, it must respect some main axioms. This must:

- Pursue energy-saving goals and encourage the use of technologies from renewable energy sources.
- Use sustainable materials for the construction of buildings and public areas.
- Reduce land consumption and enhance green areas.
- Reduce water consumption and focus on water management (e.g. with rainwater recovery and reuse systems).
- Promote sustainable and soft mobility.
- Improve waste management.
- Reduce pollutant emissions.

- Increase people’s quality of life and focus on social issues.
- Therefore, this district form normally has within its boundaries:
- Acoustic islands, which are public areas where no cars can pass to avoid noise pollution.
  - Cycle paths and a mobility system that is integrated with the city’s public transport network.
  - Public green spaces with parks and tree-lined avenues.
  - Spaces serving the community and free of architectural barriers.
  - District heating systems integrated with solar panels.
  - Rainwater reuse systems for irrigating gardens or for the house drainage network.
  - Lighting systems powered by renewable energy sources.
  - Low-energy buildings constructed with environmentally friendly building materials.

Many examples of eco-districts have sprung up around the world to date. As a side effect, improving outdoor comfort through increased greenery would help mitigate the effect of urban heat islands (UHI) (Leone & Nigrelli, 2021).

### *2.2 Materials – Land Art Generator Initiative*

The project known as the Land Art Generator Initiative (LAGI) is being developed with the aim of actively contributing to the transition towards carbon neutrality (Ferry & Monoian, 2012). Through its work and research, LAGI shows how a multidisciplinary collaboration that merges widely differing disciplines (such as artistic practices and technologies for the production and storage of energy from renewable sources) can bring multilevel benefits (Ozgun et al., 2015). The idea behind LAGI is that technologies for the production and storage of energy (mainly electricity but also heat) from RES have reached such a level of development that they can be modelled and remoulded to create real art installations. In this way, these technologies lose the appearance of mere urban installations and also acquire a whole new range of possibilities. It will thus be possible to conceive of them as street furniture, landscape enhancers (and no longer detractors as they have been until now) or parts of building furnishings (Ferry & Monoian, 2012). With the inclusion of artistic ambitions in the energy transition process, a whole series of new perspectives are opened up, enabling these plants to also have a faster implementation on a larger scale. A greater and more rapid development of these technologies would in fact be fostered by the inclusion of artistic ambitions, as it would promote the process of acceptance by the population (Ozgun et al., 2015). Thanks to the promotion of various events and competitions by LAGI, many different solutions have already been identified. Thus, photovoltaic panels or wind turbines can be used as art installations, urban decorations, pavilions, landmarks in the landscape, etc. (Ferry & Monoian, 2012) Technologies, therefore, that have taken unexpected forms and become integral parts of the urban and natural landscapes in which they are embedded.

## **3. Results**

One of the first analyses carried out was a search by macro-areas of investigation. It was studied how detailed each topic had gone. Starting from the bibliography study of the paper “Supporting Cities towards Carbon Neutral Transition through Territorial Acupuncture” and the resulting snowball analysis carried out on related



it more efficient and effective in every aspect. Macro-categories whose possible implementations represented a novelty were focused on: the social and the environmental. Therefore, once they were grouped and systematised, proposals for implementation were found. In both categories, solutions were identified that fulfil several limits at the same time. This is because the proposed solutions affect the different issues simultaneously at different levels. Figure 5 shows the proposed solutions to the identified problems.

**Table 2. Systematisation of the solutions already adopted in Territorial Acupuncture and suggestions for possible future improvements**

| Topics covered      | Solutions   | Could be implemented? | How to improve – further investigation   | Update or novelty in the concept |
|---------------------|---|-----------------------|--|----------------------------------|
| Energy              | Production, storage and distribution of electricity and heat from renewable energy sources. Energy infrastructure | Yes                   | Follow and apply advances in research on these topics  | Update                           |
| Services            | Health, security, administrative, cultural and entertainment services   | Yes                   | Follow and apply advances in research on these topics  | Update                           |
| Comfort indoor      | Attention to indoor microclimate, air quality, lighting and acoustic conditions                                   | Yes                   | Follow and apply advances in research on these topics  | Update                           |
| Mobility            | Electric and hydrogen vehicles for public and private mobility  | Yes                   | Follow and apply advances in research on these topics  | Update                           |
| Social focus        | Participatory design consultations. Changing social dynamics between inland and metropolitan areas.               | Yes                   | Redevelopment/prevention of degraded areas, attention and promotion of aesthetic and artistic aspects                    | Novelty                          |
| Environmental focus | Reducing Pollutant Emissions and contributing to mitigating the Climate Crisis                                    | Yes                   | Protecting biodiversity, increasing the green plot, reforestation, environmental preservation and landscape conservation | Novelty                          |

**Table 3. Pros and cons identified in the application of territorial acupuncture at the current stage of development of the approach in the paper Supporting Cities towards Carbon Neutral Transition through Territorial Acupuncture. (Leone et al., 2023)**

| Pros   | Cons   |
|--|--|
| Alters the economic, social, energy and environmental dynamics of the territory. | Careful multidisciplinary and multi-scalar study required, hence risk of ineffectiveness of theory if not applied as required. |
| Improves conditions in metropolitan areas.                                       | Does not take into account the green plot.   |

|  |   |
|--|---|
| Improves conditions in inland areas.                                     | Does not take into account the inclusion of nature.   |
| Contributes to the large-scale development of energy communities.        | Risk of greenery being conceived as mere urban embellishment.                                     |
| Change the territory without having a totally different one in response. | No attention to outdoor comfort.  |
| Redistributes services on a territorial scale.                           | No focus on redevelopment/prevention of degraded areas.   |
| Reduces pollutant emissions into the atmosphere.                         | No attention/promotion of aesthetic and artistic aspects.   |
| Helping to mitigate the energy crisis                                    | No in-depth study on how to promote the process of land appropriation by the population involved. |
| Rapid energy emancipation of entire territories                          |   |
| Lower intervention costs than redevelopment of entire territories        |   |
| Helping to mitigate the climate crisis                                   |   |

**Figure 5. Implementation proposals for territorial acupuncture.**

|  | Issues identified  | Proposed solutions   |
|--|--|--|
| Social<br>        | attention and promotion of aesthetic and artistic aspects.   | <ul style="list-style-type: none"> <li>• Increase neighbourhood workshops and participatory planning.</li> <li>• Incorporate the principles of eco-neighbourhoods.</li> <li>• Specify the need to pursue artistic ambitions.</li> <li>• Promote and foster collaborations with LAGI and similar initiatives.</li> </ul>                                  |
|  | No focus on redevelopment/prevention of degraded areas   |  |
|  | No attention/promotion of aesthetic and artistic aspects   |  |
|  | No in-depth study on how to promote the process of land appropriation by the population involved in district changes |  |
| Environmental<br> | Protecting biodiversity, reforestation and landscape conservation.   | <ul style="list-style-type: none"> <li>• Planting of greenery in the districts/greening of the districts.</li> <li>• Attention to outdoor comfort.</li> <li>• Plan shading through greenery.</li> <li>• Insert green roofs and green wal (where it is not possible to insert energy plants and there are no historical-cultural constraints).</li> </ul> |
|  | Does not take into account the green plot  |  |
|  | Does not take into account the inclusion of nature   |  |
|  | Risk of greenery being conceived as mere urban embellishment   |  |
|  | No attention to outdoor comfort  |  |

**4. Discussion**

Territorial Acupuncture with its punctual but connected interventions offers a quick, effective solution to achieve a territory with different energy, socio-economic and environmental dynamics without altering the pre-existing territorial asset and urban fabric.

Analysing the results obtained, an initial reflection could be made on the macro-

themes analysed. As previously highlighted, themes such as energy, service management or mobility have already been sufficiently covered to meet the objectives set by the territorial acupuncture. Indoor comfort satisfies these objectives sufficiently, as it is the result of the correct planning of the buildings forming part of the districts (Lindholm et al., 2021). As far as the social and environmental focus is concerned, however, these should be further investigated. In fact, in the first design phase of this new approach, only the main core themes for its proper functioning were taken into account (Leone et al., 2023), such as:

- The participatory process by the population in the various planning stages of the new territories and districts.
- The changing dynamics between metropolitan and inland areas.
- The mitigation of the climate crisis.
- The reduction of air pollutant emissions.

This focus only on the main social and environmental aspects is due to the multidisciplinary nature of the approach, which requires coordination of several subjects simultaneously (Leone et al., 2023). Having already broadly defined how this new approach works, it was then possible to go on to analyse in more detail what the advantages and limitations of territorial acupuncture are.

The application of this theory has several benefits:

- It would contribute to the mitigation of pollutant gas emissions into the atmosphere, thus helping to ameliorate the consequences related to the climate crisis (Ahlers et al., 2020).
- It would be a quick and relatively fast option to mitigate the energy crisis (Leone et al., 2023).
- The development of different energy solutions for the production, storage and distribution of electricity and heat integrated in buildings, either on a district or virtual scale, would lead to the rapid energy emancipation of entire territories or at least contribute to a significant step forward in this regard (Lindholm et al., 2021; Moreno Gabaldón et al., 2021).
- The intervention costs are low compared to those for modifying the entire territory (Ciervo, 2022; Leone et al., 2023).
- Once built and interconnected, the PEDs would become attractors for both the population and companies, and this would affect the current economic and social trends in the areas of intervention (Casagrande, 2019; Nigrelli 2021).
- By redeveloping abandoned areas and small towns and villages that were becoming depopulated and by interconnecting the various energy districts, a solution would be proposed for the issue of inland areas (Nigrelli, 2022).

While there are many benefits, as it is still at an early stage of development, there are issues that have not yet been discussed in detail. These include:

- In order to be applied in different territories while guaranteeing its effectiveness, variables such as the different availability of renewable sources in different territories, different climates, the previous availability of urban infrastructures, historical, cultural or landscape constraints, and the different reception of these changes by populations with different feelings must be taken into account (Pellow & Nyseth Brehm 2013). For this reason, a prior in-depth study of the area in which the intervention is to take place is necessary, as well as the development of multidisciplinary teams to be able to analyse the various aspects required for the theory to work properly (Leone et al., 2023).
- Often the planning of PEDs does not take into account the green plot and the inclusion of nature within them (JPI Urban Europe, 2020). In these cases, if used at all, greenery is conceived as mere urban embellishment, without paying

attention to the environmental and outdoor comfort benefits that conscious planning can provide (Alers, et al., 2020; JPI Urban Europe, 2020). This is also reflected in territorial acupuncture.

- In the current situation, territorial acupuncture does not have the explicit objective of preventing/rehabilitating deprived neighbourhoods within metropolitan areas (Leone et al., 2023). Moreover, it does not pay attention, except indirectly, to aesthetic and artistic aspects (Leone et al., 2023).

It could be stated that with the exception of the problem based on the need to address multi-scalar and multi-disciplinary analyses, the challenges identified would fall into two sub-categories: social and environmental (Leone et al., 2023).

However, it must be specified that although possible limitations in the application of territorial acupuncture have been identified, the benefits that would be gained in its application are far greater than the limitations detected. Therefore, even at the current stage, without the implementation changes proposed in this study, it would be beneficial to apply this approach. Without the implementations being proposed, it simply would not have the same impact in all fields and would, therefore, be less efficient and effective with respect to the totality of the dynamics confounding a territory.

The existence of this study stems precisely from the attempt to identify as many of the current limitations of territorial acupuncture as possible so as to propose solutions to be implemented and make this approach as effective and efficient as possible.

Starting from the two sub-categories of identified problems (social and environmental), proposals for integration were made. For the social issues, solutions were proposed to increase the participative process of the communities living within the districts not only during the planning stages but also afterwards (Casagrande, 2014, 2019; Cellamare & Scandurra, 2016). This proposal would lead to a greater sense of appropriation of places, thereby discouraging neglect and degradation of public areas (Nigrelli, 2021, 2022; Perkins et al.; 2021). For this reason, it would be desirable to start integrating art within the districts. A solution would be to place artistic and architectural installations in the public areas of the districts in which action is taken (Casagrande, 2014, 2019). This would, however, be a simple addition of elements. At the same time, technologies for the production and storage of energy have reached such a level of advancement that it would be possible to design and shape them in such a way that they themselves become real installations or elements of public furniture (Ferry & Monoian, 2012). One example is the proposals put forward by the society LAGI. Seeing energy solutions as technologies with artistic ambitions, it would be possible to act on multiple layers and bring multi-level benefits to the district in which these solutions are inserted (Casagrande, 2014; Nigrelli, 2021, 2022; Ferry & Monoian, 2012). This is why, according to the authors of this study, it would be plausible to think about encouraging close collaboration with LAGI or similar initiatives. In this way, the energy districts distributed across the land would act on a cultural level, helping to further change social and economic dynamics as they would attract domestic and international tourism (Ferry & Monoian, 2012).

On the other hand, from the environmental point of view, it would be appropriate in the design phase of the individual districts to pay more attention to the design of green areas by including rows of trees, green walls and green roofs (in those surfaces not suitable for energy installations), equipped green areas, etc (Boutaud, 2009). Particular attention should be paid to outdoor comfort, studying the ventilation of common areas, planning shaded areas and inserting solutions to mitigate the heat island phenomenon if it is present (a phenomenon that is prevalent in the districts of

metropolitan areas) (Boutaud, 2009; Leone & Nigrelli, 2020). In general, it is the authors' opinion that pursuing the typical principles of eco-districts would be a way to effectively implement most of the identified solutions.

Thus, according to this study, it would be desirable to hybridise territorial acupuncture with additional theories and principles to increase its efficiency and effectiveness. It would no longer be about connecting only urban acupuncture, territorialism and energy communities (Leone, 2023), but also paying attention to eco-neighbourhoods (Boutaud, 2009) and fostering a collaboration with artistic currents that make technological installations into true art installations (while maintaining their efficiency) (Ferry & Monoian, 2012).

In conclusion, with the application of Territorial Acupuncture it would be possible to achieve energy, economic and social benefits including an alleviation of the energy crisis, an aid in the fight against the climate crisis, an alternative to reverse the problem of inland areas and a way to strengthen the sense of belonging of the various communities (Leone et al., 2023; Nigrelli, 2021). In addition, if the focus was also placed on greenery in the planning phase of individual PEDs, it would be possible to reforest and increase the green plot of the territory following the PED network, thus giving further impetus to the previously mentioned benefits. And if, in addition, attention were also paid to art and social aspects, this would intervene in all aspects essential for the smooth functioning of the territories, not only in the implementation phase, but also in the long term. However, in order to achieve a satisfactory result, it will be necessary to take into account all the variables and create a work team with various professional figures (sociologists, urban planners, architects, engineers, etc.) to strictly follow all the work phases and allow for an effective result that corresponds to what was envisaged during planning (Leone et al., 2023). Territorial Acupuncture is, therefore, an innovative theory that, through punctual interventions, improves the conditions of the entire territory without, however, returning it totally altered (Leone et al., 2023). Although it presents some criticalities linked to its complexity of implementation, it would currently appear to be a rapid and effective solution for applying the solutions identified in the planning of energy districts to the territorial scale.

## 5. Conclusion

The study presented in this paper represents a novelty insofar as it proposes new themes to be integrated into the practice of territorial acupuncture, so as to have a total overview. This will allow a territorial management that is attentive to all aspects, even the most innovative ones. Indeed, the aim of this study is to make improvements to the territorial acupuncture approach. For this purpose, analyses were carried out to define the benefits and limitations of this approach in its current state. It was found that the application of territorial acupuncture aids in the transition to carbon neutrality of entire territories in many respects, such as, for example, by reducing atmospheric pollutant emissions or by favouring the large-scale development and implementation of RES-based technologies). It also helps to change the social, economic, energy and environmental dynamics between inland and metropolitan areas, without delivering a completely altered territory in return. However, some possible criticalities were also highlighted, such as the need to strictly follow all the phases and involve all the actors specified in this approach (otherwise the effectiveness of the application would be reduced) and a lack of attention to nature and aesthetic/artistic aspects. The results obtained showed that even at the current stage, the benefits in the application of territorial acupuncture are

considerable. In addition, the only limitations identified are not constraints for the development of the area or have negative implications during the planning stages that must be taken into account. Rather, they represent topics that were not yet addressed in their entirety and that could improve the general conditions of the territories in which this approach is applied. Thus, it was decided to pursue the research by putting forward proposals to be implemented within the territorial acupuncture. From the environmental point of view, it was chosen to recommend that attention be paid to the inclusion of the green plot within the districts.

Among the solutions identified is an abundant increase of the green plot in the common areas of the energy districts examined. The development of an upstream reforestation plan in the spatial planning phase (phase two of territorial acupuncture) would promote the development of a green plot along the energy district network (PED). Another suggested solution is to focus on outdoor comfort by including solutions to mitigate the urban heat island phenomenon (if present), such as the inclusion of reflective surfaces, green roofs and green walls, and a study on the shading of public spaces. With regard to artistic and social aspects, on the other hand, it was proposed to insert artistic and architectural installations in the common areas of the districts and to collaborate with artistic realities, LAGI or similar, to modify the technologies for energy production and storage so that they themselves become artistic installations. Generally speaking, the ambitions and goals pursued by the eco-districts were to be integrated into territorial acupuncture, so as to make this network of districts even more effective. An approach that would now bring together urban acupuncture (and bio-urbanism in general), territorialism theory, energy community design and eco-districts. In this way, it would be possible to achieve a new form of bio-region in a short time.

The actors involved in this process, therefore, would be multidisciplinary teams that address issues tout-court at both the territorial and district scales and stakeholders. By stakeholders is meant various figures such as: government and policymakers, nonprofit and nongovernmental organisations, local communities, industry peers, associations, suppliers, investors, financial communities and research partners. These, in accordance with the theory of territorial acupuncture already presented in other studies, will be involved between the stage of energy needles design and implementation. The only exceptions will be the local communities with whom there will be constant dialogue at all stages of the project. The purpose of this involvement is to achieve a participatory process, dialogue and redefinition of the project.

It is the authors' opinion that the proposals put forward in this study provide a viable solution for the improvement of territorial acupuncture and, in this way, foster the resilience of territories. Therefore, the proposals and analyses presented in this paper represent an upgrade on the previously presented version of territorial acupuncture, posing as a novelty with respect to the previous study. However, since territorial acupuncture aims to involve all the dynamics affecting the territory analysed, it is not only possible, but also foreseeable, that this study will be subject to further future additions and implementations.

Thus, it can be said that this study managed not only to fulfil its purpose by outlining the (current) limits and benefits of territorial acupuncture. Moreover, it has also provided impulses and insights to make it even more efficient and effective.

#### **Author Contributions**

Collaboration Group Member, Federica Leone (F.L.), Fausto Carmelo Nigrelli (F.C.N.), Francesco Nocera (F.N.), Vincenzo Costanzo (V.C.); Conceptualisation, F.L., F.C.N., V.C and F.N.; methodology, F.L., F.C.N. and V.C.; formal analysis, F.L., F.C.N. ; investigation,

F.L., F.C.N.; re-sources, F.L., F.C.N.; data curation, F.L., F.C.N.; writing—original draft preparation, F.L., F.C.N.; writing—review and editing, F.L., F.C.N., F.N. and V.C.; visualisation, F.L., F.C.N., F.N. and V.C.; supervision F.C.N., F.N. and V.C.. All authors have read and agreed to the published version of the manuscript.

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The authors declare no conflict of interest.

### Originality

The authors declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere, in the present of any other language. The manuscript has been read and approved by all named authors and there are no other persons who satisfied the criteria for authorship but are not listed. The authors also declare to have obtained the permission to reproduce in this manuscript any text, illustrations, charts, tables, photographs, or other material from previously published sources (journals, books, websites, etc).

### References

- Ahlers, D., Alpagut, B., Cerna, V., Cimini, V., Haxhija, S., Hukkalainen, M., Kuzmic, M., Livik, K., Padilla, M., Poel, M., Montalvillo, C. S., Schouten, S., Myrstad, T., van Wees, M., Williams, K., Wyckmans, A., Gabaldon, A., Fernandez Perez, N., Kantola, S. H., ... Smok, A. (2020). *Positive Energy Districts Solution booklet*.
- Ala-Juusela, M., Crosbie, T., & Hukkalainen, M. (2016). Defining and operationalising the concept of an energy positive neighbourhood. *Energy Conversion and Management*, 125, 133–140. <https://doi.org/10.1016/j.enconman.2016.05.052>
- Albert-Seifried, V., Murauskaite, L., Massa, G., Aelenei, L., Baer, D., Krangsås, S. G., Alpagut, B., Mutule, A., Pokorny, N., & Vandevyvere, H. (2022). Definitions of Positive Energy Districts: A Review of the Status Quo and Challenges. *Smart Innovation, Systems and Technologies*, 263. [https://doi.org/10.1007/978-981-16-6269-0\\_41](https://doi.org/10.1007/978-981-16-6269-0_41)
- Alpagut, B., Akyürek, Ö., & Mitre, E. M. (2019). Positive Energy Districts Methodology and Its Replication Potential. *Proceedings*, 20(1). <https://doi.org/10.3390/proceedings2019020008>
- Aminoroayaei, N., & Shahedi, B. (2018). Study of effective factors in the design of zero energy buildings in arid climate (case of Isfahan City). *Ukrainian Journal of Ecology*, 8(1), 211–221. [https://doi.org/10.15421/2018\\_205](https://doi.org/10.15421/2018_205)
- Caperna, A., Cerqua, A., Giuliani, A., Salingaros, N., & Serafini, S. (2010). *La Biourbanistica*. International Society of Biourbanism. <https://biourbanistica.com/la-biourbanistica/>
- Barberani S. e Bonesio L. (2015). Introduzione al Tema: immaginario “bio”. *Im@go. Rivista di Studi Sociali sull’immaginario - Anno IV, numero 5*, 5-10. ISSN 2281-8138
- Bossi S., Gollner C., & Theierling S. 2020. “Towards 100 Positive Energy Districts in Europe: Preliminary
- Boutaud, B. (2009). Quartier durable ou éco-quartier? *Cybergeog: European Journal of Geography*, 0–11. <http://journals.openedition.org/cybergeog/22583>
- Brozovsky, J., Gustavsen, A., & Gaitani, N. (2021). Zero emission neighbourhoods and positive energy districts – A state-of-the-art review. *Sustainable Cities and Society*, 72. <https://doi.org/10.1016/j.scs.2021.103013>
- Budoni, A., Martone, M., & Zerunian, S. (2018). *La Bioregione Pontina: esperienze, problemi, linee di ricerca per scenari di futuro a*.
- Casagrande M. 2014. “Paracity: Urban Acupuncture.” International Conference: Public Spaces Bratislava (November).
- Casagrande M. 2019. “From Urban Acupuncture to the Third Generation City-Alternative Studio Narratives.” In *Teaching Landscape: The Studio Experience*.
- Cellamare, C., & Scandurra, E. (a cura di). (2016). *Pratiche insorgenti e riappropriazione della città*. <https://iris.uniroma1.it/handle/11573/854091#.WTUPChOGPdQ>
- Ciervo, M. (2022). *La Strategia di bioeconomia è sostenibile? Territori, impatti, scenari*. SdT Edizioni.
- Clerici Maestosi, P. (2021). Smart Cities and Positive Energy Districts: Urban Perspectives in 2020. *Energies*, 14(9). <https://doi.org/10.3390/en14092351>
- Colavitti, A. M., & Serra, S. (2022). *Building the Urban Bioregion Governance scenarios for urban and territorial planning*. SdT Edizioni.
- Di Cristofaro M., & Panunzi S. 2018. “Aree Interne”. Prometeo.
- Gisotti, M. R., & Rossi, M. (2018). *Territori e comunità Le sfide dell’autogoverno comunitario*. SdT Edizioni.
- Glazebrook G., & Newman P. 2018. “The City of the Future.” *Urban Planning* 3(2).
- Good, N., Martínez Ceseña, E. A., Mancarella, P., Monti, A., Pesch, D., & Ellis, K. A. (2017). Barriers, Challenges, and Recommendations Related to Development of Energy Positive Neighborhoods and Smart Energy Districts. In *Energy*

- Positive Neighborhoods and Smart Energy Districts: Methods, Tools, and Experiences from the Field. <https://doi.org/10.1016/B978-0-12-809951-3.00008-9>
- Gouveia, J. P., Seixas, J., Palma, P., Duarte, H., Luz, H., & Cavadini, G. B. (2021). Positive Energy District: A Model for Historic Districts to Address Energy Poverty. *Frontiers in Sustainable Cities*, 3. <https://doi.org/10.3389/frsc.2021.648473>
- Güneralp, B., Zhou, Y., Üрге-Vorsatz, D., Gupta, M., Yu, S., Patel, P. L., Fragkias, M., Li, X., & Seto, K. C. (2017). Global scenarios of urban density and its impacts on building energy use through 2050. *Proceedings of the National Academy of Sciences of the United States of America*, 114(34). <https://doi.org/10.1073/pnas.1606035114>
- Hanjra, Munir A., & Ejaz Qureshi M. 2010. “Global Water Crisis and Future Food Security in an Era of Climate Change.” *Food Policy* 35(5).
- Hedman, Åsa et al. 2021. “IEA EBC Annex83 Positive Energy Districts.” *Buildings* 11(3).
- von Homeyer I., Oberthür S., & Jordan A. J. 2021. “EU Climate and Energy Governance in Times of Crisis: Towards a New Agenda.” *Journal of European Public Policy* 28(7).
- IEA. (2019). Renewables 2019 – Analysis - IEA. *International Energy Agency*.
- IEA. (2021a). *International Energy Agency: Data and statistics*. Global Energy Database.
- IEA. (2021b). Renewables 2021. *International Energy Agency (IEA) Publications International.*, 167.
- JPI Urban Europe. (2020). Europe Towards Positive Energy Districts. *PED Booklet, February*.
- JPI Urban Europe / SET Plan Action 3.2. (2020). Europe Towards Positive Energy Districts. *PED Booklet, February*.
- Khan, Shahed, & Atiq Uz Zaman. 2018. “Future Cities: Conceptualizing the Future Based on a Critical Examination of Existing Notions of Cities.” *Cities* 72.
- Laitinen, A., Lindholm, O., Hasan, A., Reda, F., & Hedman, Å. (2021). A techno-economic analysis of an optimal self-sufficient district. *Energy Conversion and Management*, 236. <https://doi.org/10.1016/j.enconman.2021.11404>
- Leone, F., Hasan, A., Reda, F., Rehman, H. ur, Nigrelli, F. C., Nocera, F., & Costanzo, V. (2023). Supporting Cities towards Carbon Neutral Transition through Territorial Acupuncture. *Sustainability*, 15(5), 4046. <https://doi.org/10.3390/su15054046>
- Leone, F., Nigrelli, F. C., (2021), Urban Changes to Control and Mitigate the Urban Heat Islands (UHI): Analysis in the Catania’s Territory. *Innovation in Urban and Regional Planning*, 146. DOI: 10.1007/978-3-030-68824-0\_48
- Leone, F., Reda, F., Hasan, A., Rehman, H. ur, Nigrelli, F. C., Nocera, F., & Costanzo, V. (2022). Lessons Learned from Positive Energy District (PED) Projects: Cataloguing and Analysing Technology Solutions in Different Geographical Areas in Europe. *Energies*, 16(1), 356. <https://doi.org/10.3390/en16010356>
- Lindholm O., Ur Rehman H., & Reda F. 2021. “Positioning Positive Energy Districts in European Cities.” *Buildings* 11(1).
- Lombardini, G., Rossi, M., & Butelli, E. (2019). *Dai territori della resistenza alle comunità di patrimonio: percorsi di autorganizzazione e autogoverno per le aree fragili*. 1–349.
- Magnaghi, A. (2011). *Bozza di manifesto per la società dei territorialisti / e Premessa Il contesto*. 1–8.
- Magnaghi, A. (2019). La bioregione urbana nell’approccio territorialista. *Contesti. Città, Territori, Progetti*, (1), 26-51. <https://doi.org/10.13128/contest-10629>
- Magnaghi A. (2020). *Il principio territoriale*. Torino, Bollati Boringhieri. ISBN 9788833934884
- Mantini, P. (2013). Rigenerazione Urbana, Resilienza, Re/Evolution. *Profili Giuridici. XXVIII Congresso Dell’Istituto Nazionale di Urbanistica*, 1–26. [http://www.inu.it/wp-content/uploads/Mantini\\_RIGENERAZIONE\\_URBANA\\_RESILIENZA\\_REEVOLUTION.pdf](http://www.inu.it/wp-content/uploads/Mantini_RIGENERAZIONE_URBANA_RESILIENZA_REEVOLUTION.pdf)
- Moreno Gabaldón A. et al. 2021. “How to Achieve Positive Energy Districts for Sustainable Cities: A Proposed Calculation Methodology.” *Sustainability (Switzerland)* 13(2).
- Nigrelli F. C. (2021). Oltre il feticcio della competitività. Costruire territori desiderabili per la ripresa postpandemica. BDC Bollettino del Centro Calza Bini, Special Issue “Aree Interne e marginalizzate: geografie e alleanze per una nuova politica di coesione”, Napoli, Unina, 487-504. print ISSN 1121-2918, electronic ISSN 2284-4732 1
- Nigrelli F. C. (2022). Paesaggi scartati e innovazione. Una visione concreta, in G. Bonini e R. Pazzagli (a cura di), *Il paesaggio delle aree interne*, atti della Summer School Emilio Sereni, Storia del paesaggio agrario italiano XIII Edizione, 24 - 28 agosto 2021, Gattatico. Edizioni Istituto Alcide Cervi, 83-98. ISBN 978 - 88 - 944733 - 7 - 7
- Ozgun, K., Weir, I., & Cushing, D. (2015). Optimal electricity distribution framework for public space: Assessing renewable energy proposals for Freshkills Park, New York City. *Sustainability (Switzerland)*, 7(4), 3753–3773. <https://doi.org/10.3390/su7043753>
- Panagiotidou, M., & Fuller, R. J. (2013). Progress in ZEBs-A review of definitions, policies and construction activity. *Energy Policy*, 62, 196–206. <https://doi.org/10.1016/j.enpol.2013.06.099>
- Perkins K. M. et al. 2021. “COVID-19 Pandemic Lessons to Facilitate Future Engagement in the Global Climate Crisis.” *Journal of Cleaner Production* 290.
- Petersen, S. A., Petersen, I., & Ahcin, P. (2020). Smiling Earth—Raising Awareness among Citizens for Behaviour Change to Reduce Carbon Footprint. *Energies*, 13(22). <https://doi.org/10.3390/en13225932>
- Pierrehumbert R. 2019. “There Is No Plan B for Dealing with the Climate Crisis.” *Bulletin of the Atomic Scientists* 75(5).
- Poli, D. (2018). *Territori rurali in transizione: Strategie e opportunità per il Biodistretto del Montalbano*.
- Robert Ferry & Elizabeth Monoian. (2012). A field guide to renewable energy technologies. *Febbraio 2012*, 71. <http://landartgenerator.org/LAGI-FieldGuideRenewableEnergy-ed1.pdf>
- Saaty T. L., & Mujgan Sagir. 2015. “Choosing the Best City of the Future.” *Journal of Urban Management* 4(1).
- Serafini S. (2013). Definizione di biourbanistica. <https://biourbanistica.com/blog/2013/11/30/definizione-di-biourbanistica/>

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- Tracada, E. (2013). The fractal urban coherence in biourbanism: The factual elements of urban fabric. *International Journal of Architectonic, Spatial, and Environmental Design*, 7(1). <https://doi.org/10.18848/2325-1662/CGP/v07i01/38355>
- Tracada, E., & Caperna, A. (2012). Biourbanism for a healthy city: biophilia and sustainable urban theories and practices. *International Convention, September*.
- Vernetti G. (1998). La città come ecosistema territoriale. Magnaghi A. (a cura di), *Il territorio dell'abitare. Lo sviluppo locale come alternativa strategica*. Milano, Franco Angeli, 304-331. ISBN 8820466031
- Zacà I., D'Agostino D, Congedo P. M., & Baglivo C. 2015. "Assessment of Cost-Optimality and Technical Solutions in High Performance Multi-Residential Buildings in the Mediterranean Area." *Energy and Buildings* 102: 250–65. <http://dx.doi.org/10.1016/j.enbuild.2015.04.038>.





