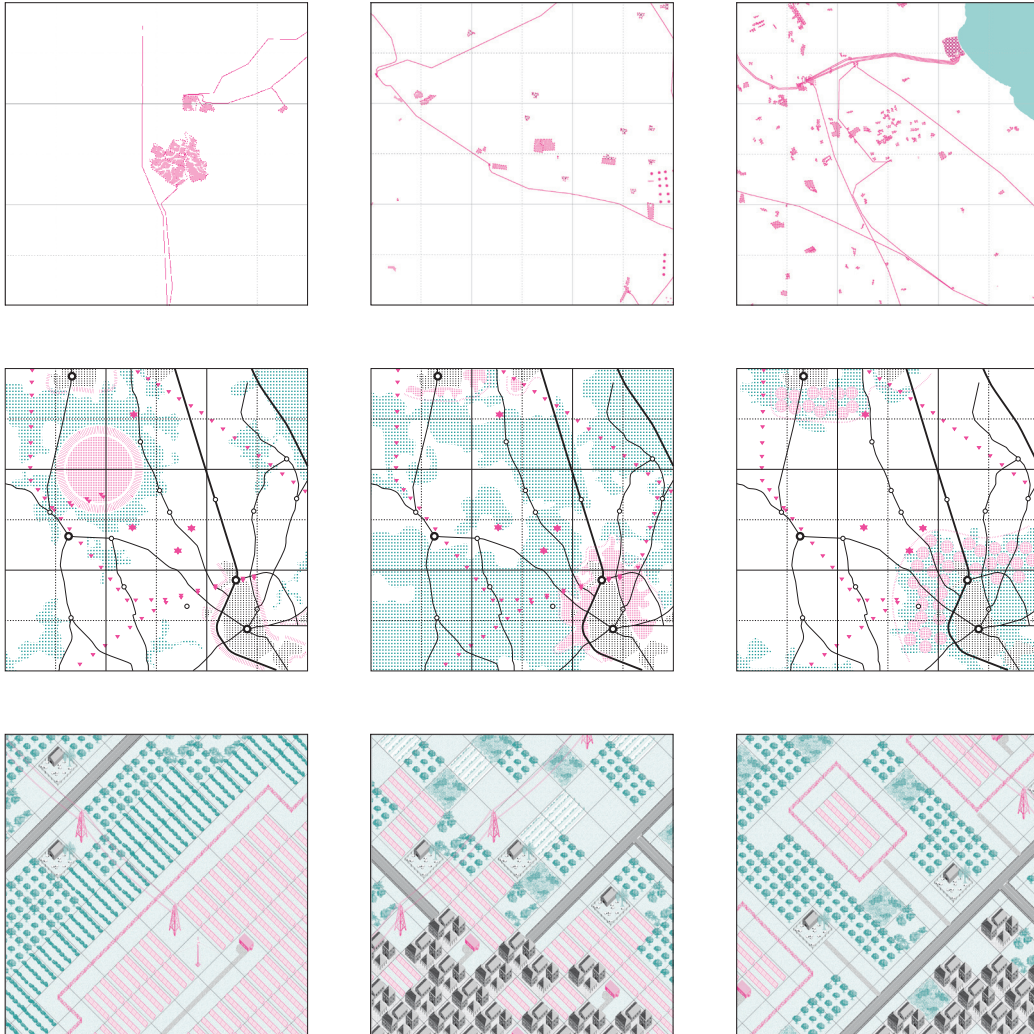


Politecnico di Torino
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The Form of Energy

Solar Landscapes in Europe as an Architectural Issue



Riccardo Ronzani

Supervisors | Prof. Elena Vigliocco, Prof. Matteo Robiglio



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Doctoral Dissertation
Architecture, History and Project
(37th Cycle)

The Form of Energy

Solar Landscapes in Europe as an Architectural Issue

Riccardo Ronzani

* * *

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Declaration

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I hereby declare that, the contents and organisation of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Riccardo Ronzani
July 2025

This dissertation is presented in partial fulfillment of the requirements for Ph.D. degree in the Graduate School of Politecnico di Torino (ScuDo).

Executive summary

The thesis demonstrates that by applying strategies and methods that belong to the design of renewable energy production spaces, the architectural design can play a key role in the current challenges of the energy transition.

At the beginning of the thesis, the relevant contribution of architecture in the design of energy plants and landscapes becomes evident through the study of best practices.

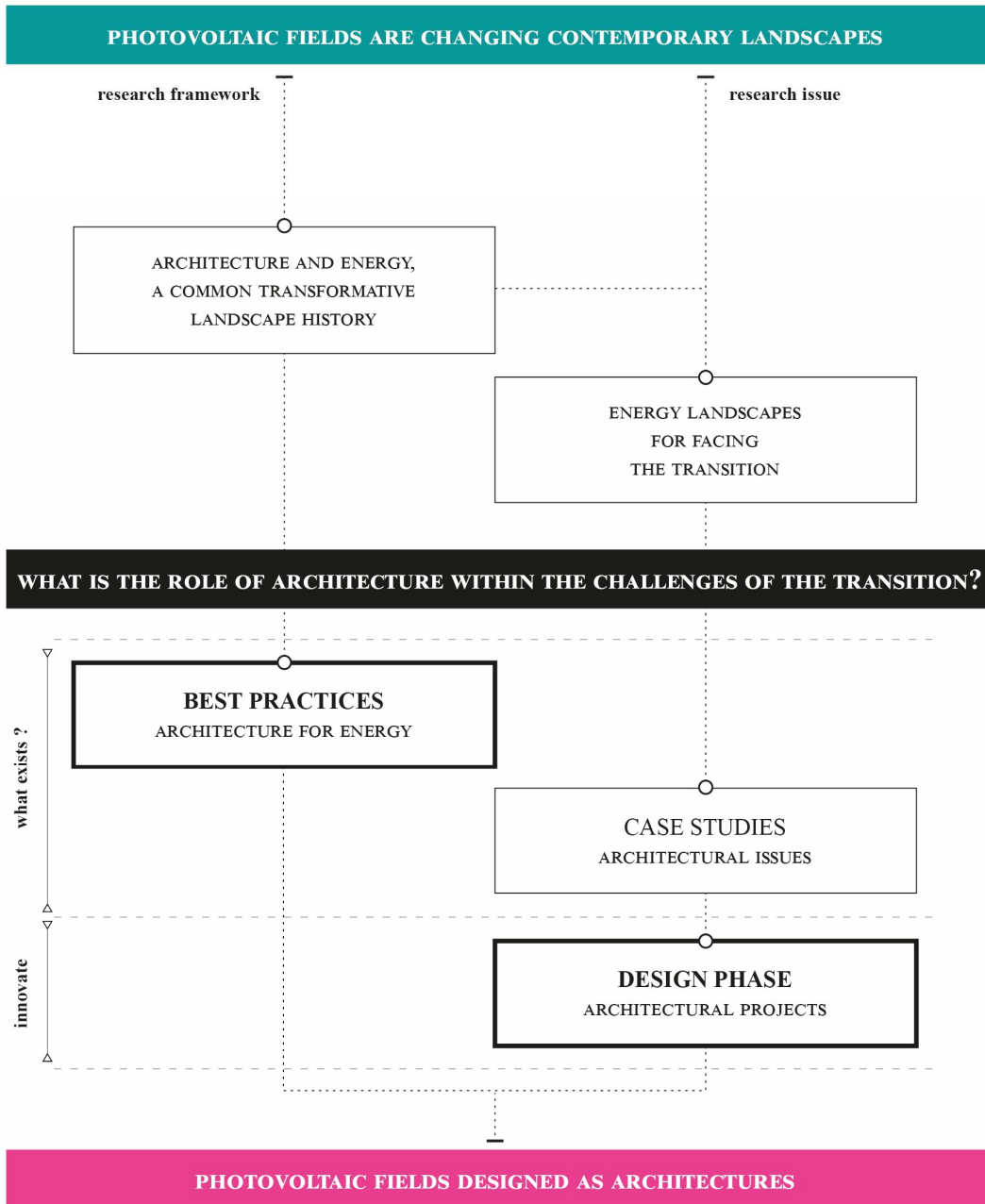
Through drawings and morphological analysis, the research investigates the architectural forms that solar plants have determined in contemporary landscapes (case study analysis), determining recurrences and differences.

Finally, the thesis tests three design experimentations on a specific case. The comparative evaluation of the experimentations states that designing solar energy plants is an opportunity to explore the potential connected to designing new landscapes.

Summary diagram of the structure and main sections of the thesis.

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Source: elaboration by the author, December 2024.



III

RESEARCH TOPIC

The research deals with the architectural design applied to the landscape as a medium for enhancing the landscape quality on one side and reinventing new shapes for energy infrastructures in the territories during the transition era.

The research overlaps with the main goals of the ONU Agenda 2030 and the European Green Deal 2050, and includes the instances and the debates promoted both by associations and organizations for landscape quality preservation – e.g., Council of Europe Landscape Convention, Europa Nostra, etc. – and the environmentalist activists and associations.

From a scientific point of view, the research investigates a topic rarely studied in Italy that can be linked to other research in the international academic context.

Energy production responds to fundamental human needs; therefore, since ancient times, buildings and facilities aimed at producing energy have drawn new shapes on the territories and infrastructure landscapes. These paradigms of energy landscapes constructed through history have been defined by specific balances between the presence of nature, the consistency and shape of energy facilities, their proximity to humans, and the needs – but also values and ambitions – of the societies.

The fossil fuels era has changed and transformed previous situations, defining a new paradigm (a productive, economic, political, and social paradigm), which today proves to be unsustainable. Nowadays, because of the climate change challenges and the consequent spread of renewable energies – whose link with the Earth's resources is strong and evident – energy production seems to become an impactful activity on the landscape increasingly.

This impact – usually negatively evaluated – often causes a conflict between those who consider the preservation of the natural landscapes as a priority and those who turn the gaze more on the ecological and environmental emergency.

Within this complex and multifaced scenario, the primary key issues of the research are:

_ What is a sustainable energy landscape, which opportunities does it offer, and what are the current challenges?

_ Designing new solar energy landscapes, what room for manoeuvre does the architecture project applied to the landscape have?

_ How can the shape of solar energy facilities re-design contemporary landscapes?

One of the main aims of the research is to identify scalable design strategies for the project of new large-scale renewable energy plants in order to overcome the current “landscaping practice”, as Bertrand Folléa defines it.

The research ambition is to impact contemporary attitudes in energy plant design activity, proposing new landscape typologies whose cultural values could be acknowledged, shared and enjoyed.

RESEARCH METHODS

From a methodological point of view, the research combines an analytical approach and a research-by-design method.

The analytical research is based primarily on a critical literature review and a multi-layer historical research; later, the case study analysis constitutes a critical reading of the current state of the art.

Research-by-design aims to solve complex and multi-variables problems, such as landscape projects.

This combination allows for both a more descriptive/critical analysis and an experimental design phase.

MAIN EVIDENCES

The research shows that embedding the design of photovoltaic fields within the domain of architecture is an opportunity to implement the transition.

Suppose it is true that the challenge of the contemporary transition cannot be exclusively a transition in the quality and efficiency of the produced or stored energy. In that case, it is also true that the field of technological design is necessary but not sufficient. The thesis demonstrates the importance of a broader approach, within which architecture can contribute.

The analysis of a selection of case studies, firstly, and then the design experimentation, show that photovoltaic fields can no longer be considered as temporary elements, but instead as architectural elements that shape the landscape with their forms.

It is precisely the forms of energy installations that are the experimental field of this research, and the main outcomes of the research are also morphological.

EXPECTED IMPACTS

The main results of the research aim to engage in a dialogue with:

- architects and planners, engaged in research or not, to question the disciplinary boundaries of Architecture and explore opportunities;
- scholars, researchers, and academics interested in the topic of landscapes designed by the presence of energy structures and infrastructures;
- policy makers who imagine and regulate ways for the urgent energy transition to be implemented in a sustainable manner;
- local administrators and planners who directly address the issue of the construction of energy facilities on the territory and their impact on the landscape;
- planners and companies involved in the construction of new photovoltaic installations, who are looking for viable ways to increase the acceptance of these facilities and their integration into the landscape;

- local communities, which, in experiencing first-hand the adversities of the NIMBY effect (Not In My Back Yard), seek possible ways for the convergence of energy and landscape demands.

The research aims to impact on the urgent challenges dictated by the transition; the objective is not only to make the building process of photovoltaic fields less conflictual but even to create new opportunities for the design of new landscapes.

The research also interrogates the discipline of architecture, inviting the extension of its methods and field of interest to those forms of territory that energy infrastructures design.

Therefore, the goal is that this research can:

- dialogue with aligned research projects that have been developed in recent years in Europe and around the world;
- initiate new reflections in the relationship between architecture and energy landscapes, and invite the development of other morphological and design studies on this topic;
- have a direct impact on the planning practices first and then the design of photovoltaic installations;
- propose a new narrative of the development of energy landscapes in history, which inscribes the current energy transition within an ancient and consolidated transitional history.

Thesis structure

The structure of the research is summarized here.

The statement inscribes the research topic within the discipline of architecture and the field architectural design application.

The Introduction frames the research topic and defines the central questions; the objectives and the ambitions are also outlined within this section. The introduction also describes and supports the methodological approaches selected for the research process.

After the Introduction, the core of the thesis is organized into five chapters.

Chapter 1 defines the research position within the scientific context. Main concepts (firstly, landscape and energy) are described and supported by a wide bibliography. The literature review reveals connections between energy production and landscape design and perception. Finally, the concept of energy landscape is introduced and defined.

Chapter 2 is about the history of energy landscapes from ancient times until the current context. So, it outlines the complex and stratified relationship between the energy production sites and the landscape construction and perception. Throughout history, energy landscapes have been constituted by different paradigms that should find new balances after the fossil fuel era.

Chapter 3 is oriented to selecting of the specific scope of the research; since the contemporary energy scenario is composed of several possibilities and technologies, the research must focus on a specific field of study. The analysis and representation of an inventory of energy systems allow us to investigate design possibilities and opportunities within the landscape architecture practice. The study of the main trends highlights the photovoltaic energy system's relevance in the energy transition and its significant impact on the landscape.

Chapter 4 is dedicated to the selection, analysis, and comparison of case studies. Case studies are selected in three different regions of Europe (Salento, in Puglia,

Italy; the province of Midden-Groningen, Netherlands, in the Northern European context; the landscape around the municipality of Usagre, in the Extremadura Region, Spain. The comparison leads to constructing a morphological matrix of solar energy landscapes. Then, two case studies are selected (the Municipality of San Pietro Vernotico in Salento and the Municipality of Hoogezand in Groningen) and studied in-depth; these deep analyses and comparisons reveal the main directions that a project of a solar field can follow. The result is a handbook of possible design actions, which opens the next chapter.

Chapter 5 finally contains project simulations for constructing new and innovative solar energy landscapes. Three design hypotheses are tested within the same context (the Municipality of San Pietro Vernotico in Salento) to try to solve the unplanned situation that nowadays characterized this landscape. In the end, the design hypotheses are critically compared to understand the design strategies that can drive the project in this context and many others.

At the end of the thesis, a final section outlines the main conclusions of the research and evaluates the research's impact on the contemporary scenario. Lastly, some future perspectives for further research developments are drawn; main applications are summarized, and possible implications are outlined.

A complete bibliography is found at the end of the document.

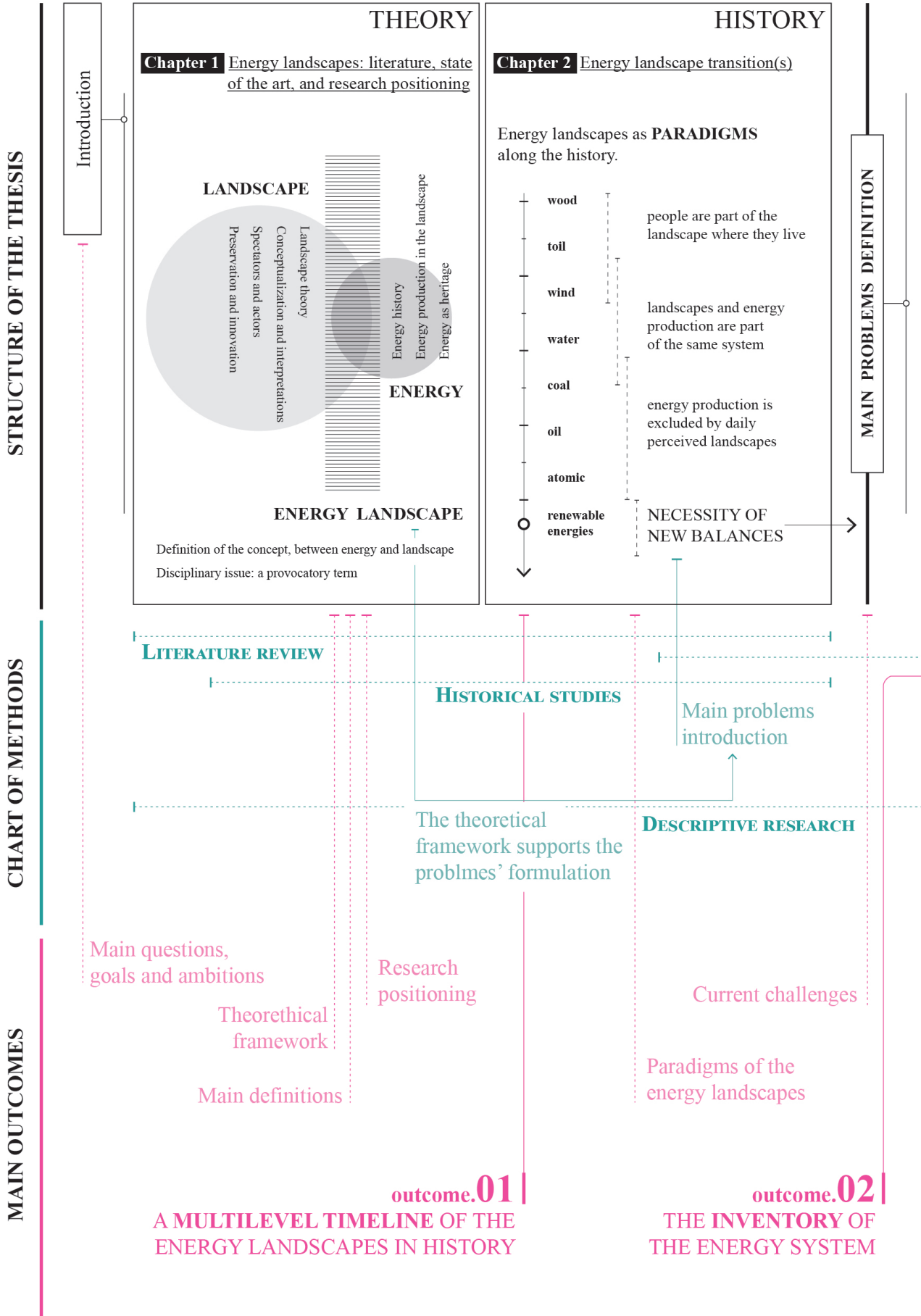
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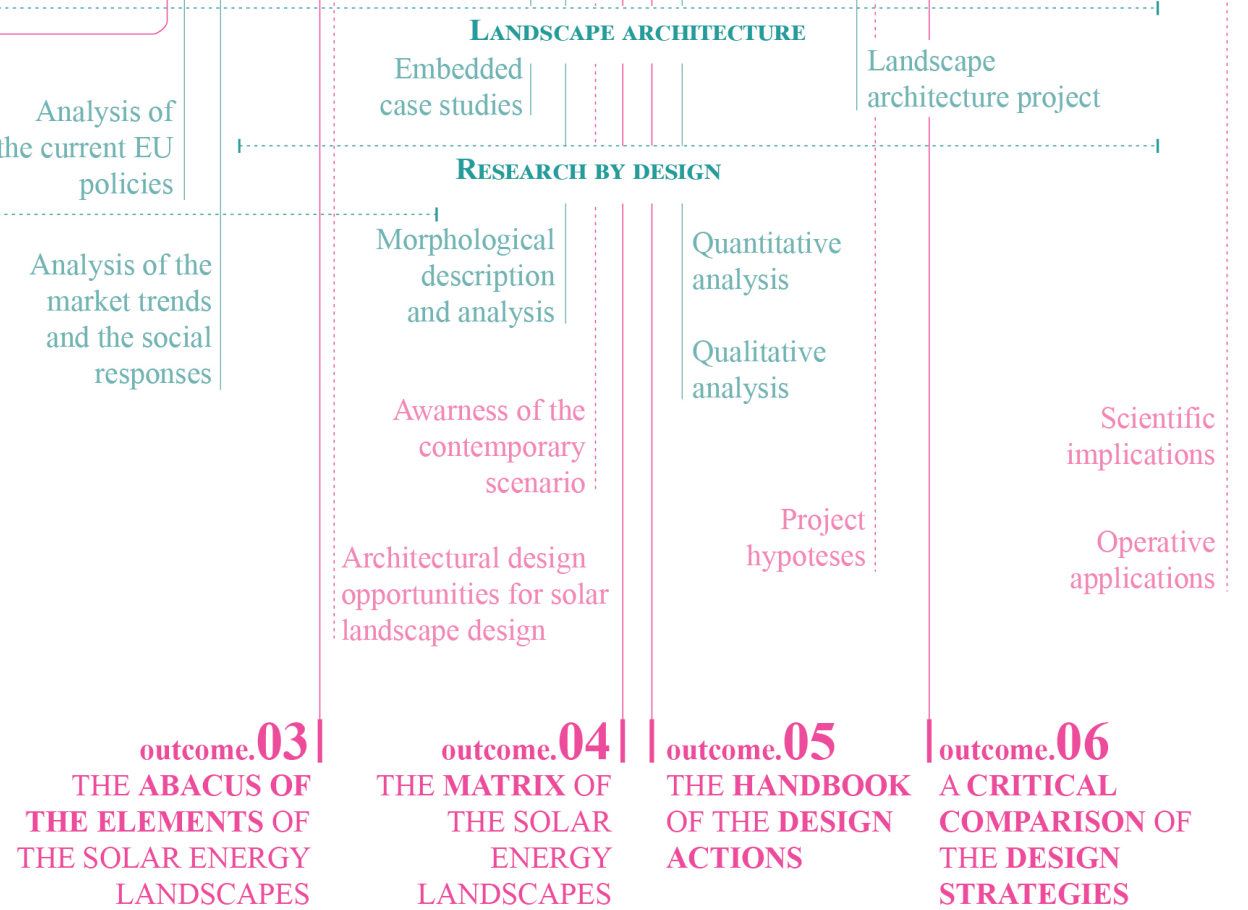
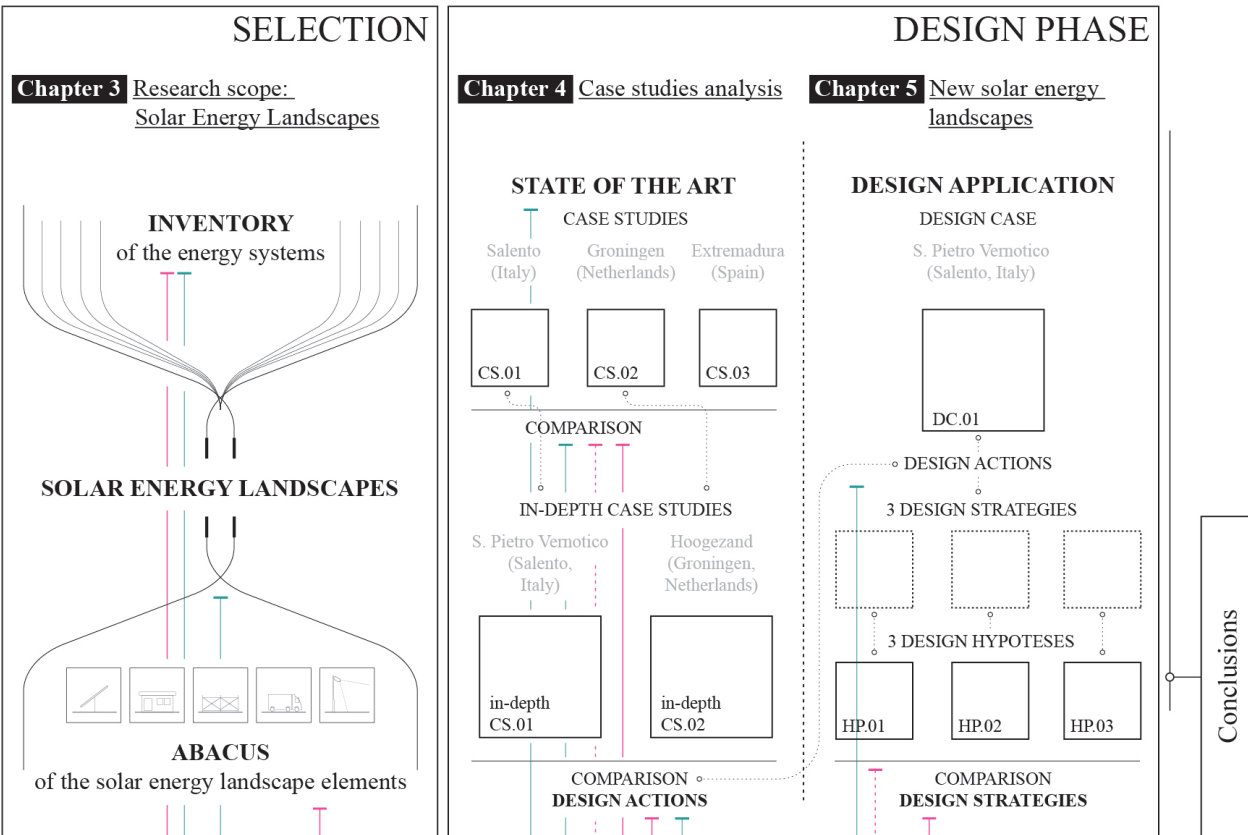
Structure of the thesis, in relation to the methods and the outcomes.

The chart shows the five chapters of the thesis (listed on the left) and a synthesis of the contents of each chapter. The necessity of each chapter for the following ones (or for answering at the previous questions) is represented in the second column, in terms of methods. Finally, the main expected outcomes are listed in the final column.

—

Source: elaboration by the author, September 2023.





outcome.03
THE ABACUS OF THE ELEMENTS OF THE SOLAR ENERGY LANDSCAPES

outcome.04
THE MATRIX OF THE SOLAR ENERGY LANDSCAPES

outcome.05
THE HANDBOOK OF THE DESIGN ACTIONS

outcome.06
A CRITICAL COMPARISON OF THE DESIGN STRATEGIES

Acknowledges

I want to express my gratitude to everyone who helped me along the way, to acknowledge that this research was made possible from support and dialogue.

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Aerial view of Montalto di Castro's photovoltaic landscape.
The photovoltaic fields are scattered throughout the territory, and they follow only partially the shapes of the agricultural pattern.

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Source: picture by Fabio Modesti (www.fabiomodesti.it).

La métamorphose profonde et urgente qu'est la Transition (...) ne se fera pas sans transition paysagère (...).

La démarche paysagère, bien comprise et bien pratiquée, s'offre comme un mode de pensée et d'action particulièrement innovant et pertinent pour l'aménagement contemporain. Elle se révèle intéressante, fédératrice, humaine, sensible, opératoire, réparatrice, économe, créative, efficace à toutes les échelles.

(B. Folléa, *L'archipel des métamorphoses. La transition par le paysage*, Editions Parenthèses, Marseille, 2019, pp. 27-30)