Envisioning tomorrow: nuclear energy production sites as future legacies

How to preserve (or not) what we have inherited is a critical contemporary issue that significantly influences the shaping of a sustainable and desirable future. In a world grappling with the challenge of conserving our cultural heritage for the years to come, the boundaries defining what constitutes heritage have grown increasingly nuanced.
This booklet delves into the ongoing international discourse surrounding the preservation (or not) of the built legacy. By examining how even unacknowledged aspects of our inheritance play an integral role in the broader conversation, this publication offers insights into the evolving perspectives shaping the potential futures of our built legacy.

Politecnico di Torino
Future *Urban Legacy* Lab

FULL

Designing the future of the past

A survey across the contemporary international debate

Quaderni Future *Urban Legacy* Lab

The contributions, spanning critical heritage, architecture of reuse, future literature studies, post-preservation, and counter-preservation, outline the dual nature of the built legacy of the past—both a positive and negative commons influenced by social, cultural, economic, and environmental contexts.
By providing a comprehensive overview of leading international theories, the book aims to foster interdisciplinary dialogue on the adaptation of urban legacy, heritage, and landscape.
This publication takes inspiration from the 2022 Intensive Seminar 'Designing the Future of The Past' and the concurrent PhD Excellence Course 2022-2023 at Politecnico di Torino. The records from the seminar guest lecturers point out diverse ways of approaching the Future of the Past, while PhD students' works devloped in the course assess the topic in the framework of their ongoing PhD research. In the end, the Q & A section addresses a few questions that have emerged from the seminar discussion.

Designing the future of the past

A survey across the contemporary international debate

Quaderni Future *Urban Legacy* Lab

Collezione Quaderni Future *Urban Legacy* Lab,
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This volume collects the outcomes of the International Seminar "Designing the Future of the Past," held on 17-18th February 2022 in Turin. The event was conducted in collaboration with the Doctoral programs in "Architecture: History and Project" and featured the participation of the PhD program in "Architectural and Landscape Heritage" at Politecnico di Torino. This intensive seminar served as an integral component of the DASP PhD Course titled "Designing the Future of the Past" for the academic year 2022-2023.

Quaderni Future *Urban Legacy* Lab

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PhD Students' Papers

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PhD Research Title: Transformative Energy Morphologies

ENVISIONING TOMORROW: NUCLEAR ENERGY PRODUCTION SITES AS FUTURE LEGACIES

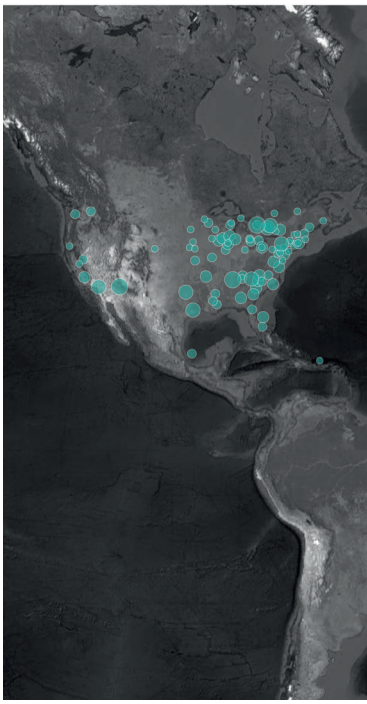
Abstract

Nuclear power plants are often poorly considered objects from an architectural and landscape perspective. The extreme functionalism that determines their shapes and sizes, the socially controversial debate that characterizes this form of energy, the fear of radioactivity and unhealthiness of the places... are all characteristics that lead to the lack of a vision for these places after their shut down.

The following paper aims to investigate the possible futures of these places. In fact, decommissioned nuclear power plants today are characterized by dismantling plans in order to return the site to greenfield status. However, the long time required, and the high costs involved invite reflection on the nature of such an operation. We could imagine if, with similar timing and costs, one could not envisage a reuse of these places, to preserve their memory on the one hand, and to take advantage of a building capital already invested on the other.

The paper investigates the current situation starting from the analysis of some case studies, and then reflects on the nature of a reuse project for these places. In this case, the relationship between past and future would be distributed over many decades, and this opens interesting considerations on the objectives that should guide the design intention.

Nuclear Plants as heritage



The inclusion of nuclear energy in the EU taxonomy for sustainable activities has increased public interest and media attention on this controversial subject.[1] Regardless of the debate about the legitimacy of this form of energy, its relevant role in the current global energy landscape must be recognized.

The multitude of nuclear power plants in thirty countries around the world (of which sixteen in Europe alone)[2] constitute an architectural and landscape heritage that is not recognized as having a positive quality value, but which, to quote Holtorf and Högberg, will constitute "part of the human legacy of the 20th and 21st centuries" for the world of tomorrow. These landscapes of energy production – energy as "the oxygen of economic life on the planet" (Colombo, 2000) – are in most cases destined for complete dismantling through a process that may exceed a century.

This paper proposes a reflection on the possible futures for nuclear production sites. The decommissioning commonly envisaged for these sites could be replaced by unexplored opportunities to conceive of nuclear power plants as a legacy to be transmitted and transformed. Through the comparison between two European power plants in the process of decommissioning, we propose to investigate the possible paths to follow for the recovery of these productive places, to make them a legacy to be handed over to the future.

The landscape in which these places are stratified becomes the testimony of an important part of human history, the history of energy in the contemporary world[3], which is a history that perhaps we should learn to know, to avoid, taking up the words of Adriano Prosperi, «to consign it to oblivion of future memory» (Prosperi, 2021).

[1] European Commission – press release, EU Taxonomy: Commission begins expert consultations on Complementary Delegated Act covering certain nuclear and gas activities, Brussels, January 1, 2022

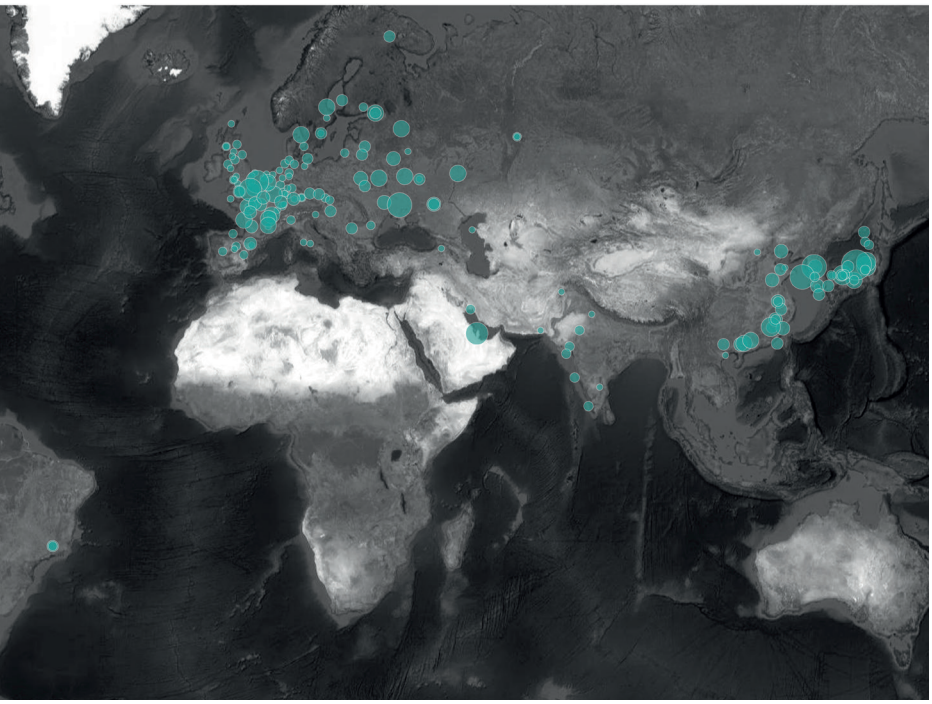
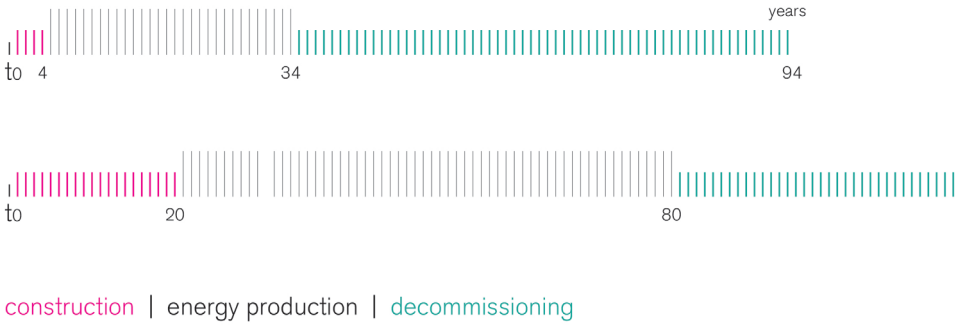


Figure 1) *Diffusion of nuclear power plants all over the world, reported by power output, author: Riccardo Ronzani, March 2022, Turin / source: www.carbonbrief.org*

Landscapes and production over time

«Every society produces its own space, a necessary theatre of economic production, social hierarchies, power, knowledge, and rituals: this is why the space of an industrial civilization is so radically different from that of a peasant culture» (Settis, 2010).[4] In this way, Salvatore Settis relates the landscape to the society that inhabits it: the dynamics that generate the landscape are not only social but also political and economic. Nuclear power plants design industrial landscapes, which in different ways remain productive throughout the life cycle of the plant. In 95%

[2] World Nuclear Association, World Nuclear Power Reactors & Uranium Requirements, datasheet, February 2022



of cases, a nuclear power plant is built in a time range of four to twenty years[5]. From the moment of entry into operation, a plant remains active for about forty years[6] (many studies propose the extension of the operation of these places up to sixty years[7]), after which it is necessarily closed for economic unsustainability and safety reasons. At this point, given the radioactivity of the now unproductive sites, the decommissioning phase begins, which involves the sanitization and remediation of materials and finally the demolition of the various buildings and infrastructure, until the land returns to greenfield status. This process of decommissioning lasts at least sixty years, and in some cases can exceed a century[8]. Two considerations follow: the first is that, unlike a normal non-operative industry, which ceases to have any function at the moment of the shutdown, nuclear power plants maintain constant functions throughout the entire cycle of closure and compulsory decommissioning. They remain workplaces from the beginning of the construction site, until the end of their decommissioning (the workers employed in the decommissioning of the four former Italian nuclear power plants are 322).[9]

[3] Vaclav Smil, Energy in World History, Routledge – Taylor and Francis Group, New York, October 19, 2000 (copyright 1994)
[4] Translation by the author - Original text: « Ogni società produce il proprio spazio, teatro necessario della produzione economica, delle gerarchie sociali, del potere, del sapere e dei riti: perciò lo spazio di una civiltà industriale è così radicalmente diverso da quello di una cultura contadina»

Figure 2) *representation of the shortes and longest possible life cycle of a nuclear power plant, author: Riccardo Ronzani, March 2022, Turin / source: AEN NEA 2006 - report*

A second consideration concerns the disproportion, in terms of years, costs and invested resources, between the energy production period and the time required for the complete decommissioning of the plant. This second issue brings out several questions about the possibility of rethinking these places today to make a heritage that will be usable again in the future.

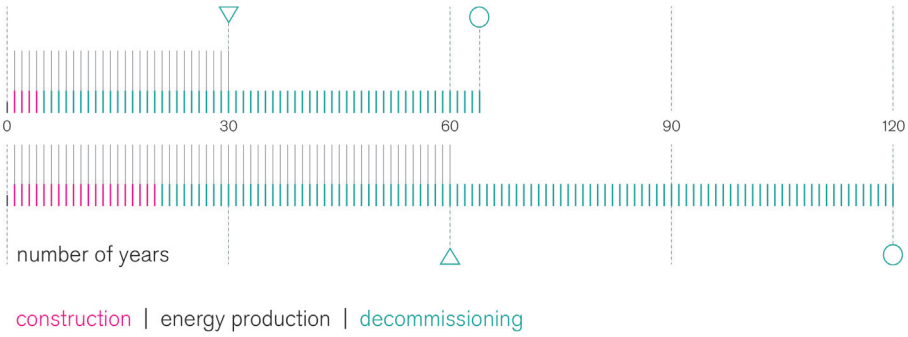
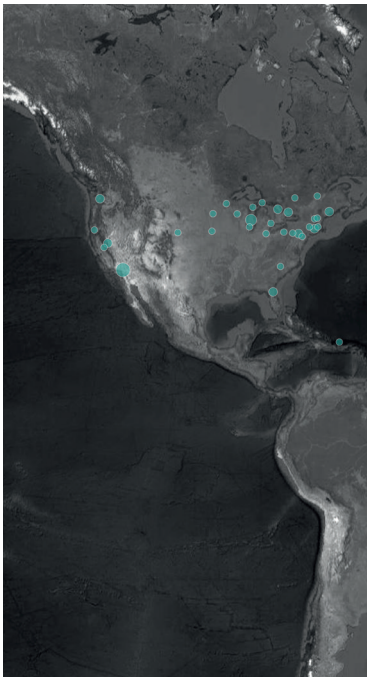


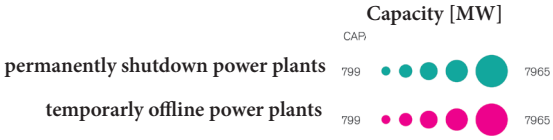
Figure 3) *comparison of the productive and unproductive period in the shortest and longest possible life cycle - the production period is about half of those of construction and demolition; author: Riccardo Ronzani, March 2022, Turin / source: AEN NEA 2006 - report*

[5] Carajilescov Pedro, M. L. Moreira João, Costruction time of PWRs, 2011
[6] AEN NEA, Nuclear Power Plant Life Management and Longer-term Operation, report 2006
[7] Eric English, Jeffrey Donovan, IAEA Data Animation: Nuclear Power Plant Life Extensions Enable Clean Energy Transition - IAEA agency – 2020
See also:
Paul Voosen, How Long can a nuclear reactor last?, Scientific America – 20 novembre 2009
[8] Nuclear Energy Institute, Decommissioning of Nuclear Power Plants, Factsheet, Agosto 2016

About decommissioning

Nuclear energy is active in thirty countries around the world, where four hundred and thirty-seven active power plants are currently deployed, and while the construction of fifty-eight new reactors is proceeding, ninety-six more are being planned.[10] At the same time, in the next decade it is foreseen the shutdown of about one hundred power plants[11], which will be added to the one hundred and ninety-nine already closed in past decades[12]. In this scenario, knowledge of these places and a strategic vision for their future is more urgent than ever.





Decommissioned power plants, in fact, continue to draw landscapes for periods that can even exceed a hundred years, especially when the necessary technical timing is compounded by a confusing lack of future planning.

This is the case of the Brennilis Power Plant in France, which began operating in 1965 as an "industrial prototype" destined to soon come to terms with more efficient technologies. Its definitive closure in 1985 triggered a political, economic and social debate that has repeatedly and cyclically opened and closed the possibility of its complete dismantling, until a last enquête publique organized between November 2021 and

[10] World Nuclear Association, World Nuclear Power Reactors & Uranium Requirements, datasheet, February 2022
[11] Giorgia Marino, Agenzia internazionale per l'energia atomica: così il decomissioning nucleare diventa circolare, in the online magazine Materia Rinnovabile, March 11, 2021
[12] IAEA-PRIS (Power Reactor Information System), Permanent Shutdown Reactors, datasheet, March 2022

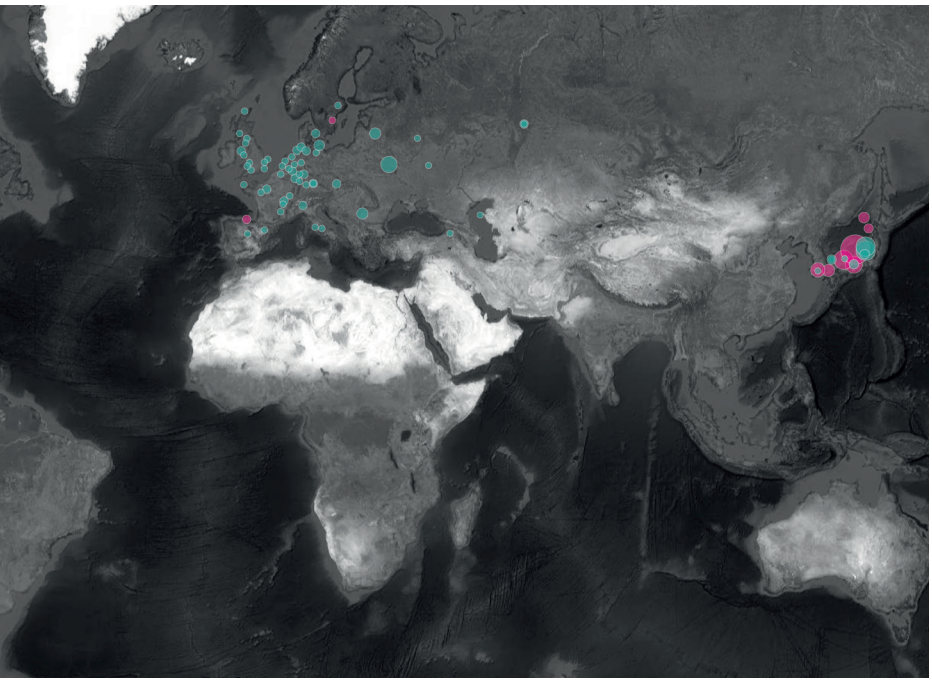


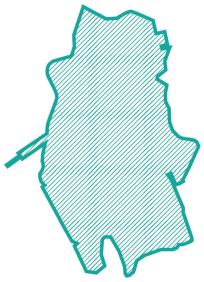
Figure 4) *Diffusion of the offline nuclear power plants all over the world, reported by power output, author: Riccardo Ronzani, March 2022, Turin / source: www.carbonbrief.org*

January 2022[13]. The future of Brennilis Power Plant has been suspended for almost forty years, and the deconstruction phase – «une étape normale dans la vie d'une centrale nucléaire»[14] – appears today as a socially and politically controversial topic, as well as economically more and more disadvantageous (the costs are increased by twenty times compared to what was originally planned[15]).

Despite the positive energy balance, the inconvenience of this operation in logistical and economic terms is a key point. The case study of the Sellafield Nuclear Power Plant (overlooking the Irish Sea in Cumbria, Great Britain) is particularly

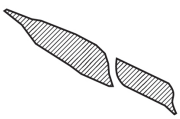
[13] Public inquiry 2021-2022
[14] EDF, Dossier de presse 2020 - centrale nucléaire en démantelèment de Brennilis, May 2020
Translation by the author: «a normal step in the life of a nuclear power plant»
[15] Christian Gouerou, Finistère. Combien va réellement coûter le démantèllement de la centrale nucléaire de Brennilis?, in Ouest-France, December 12, 2021

significant in addressing this issue.
This plant, whose reactor was shut down in 2003, occupies a territory of two hundred and seventy-six hectares[16], has more than one thousand buildings[17] and currently more than ten thousand employees[18], making it one of the largest repositories of radioactive materials in the world. The NDA (Nuclear Decommissioning Authority) has predicted a time needed for dismantling of 120 years: more than double the time of activity[19]. This is the reason why University of Manchester's Dalton Nuclear Institute has considered the possibility of proposing possible alternative scenarios for this site. Back in 2007, the NDA commissioned a renowned engineering firm to conduct a feasibility study[20] to transform the Sellafield site into an industrial tourism attraction in about a hundred years. The study also included the possibility of configuring the site as one of the first attractors of a real nuclear energy tourism. What is evident in the case of the Sellafield power plant is that such a strongly anthropized territory has the potential to generate development possibilities other than simple

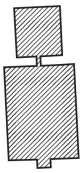


Sellafield

San Pietro



Ile de la Cité e Ile Saint-Louis



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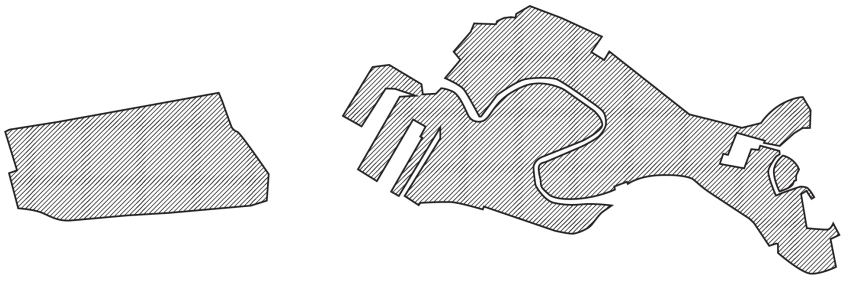
[16] Government commission, SDP factsheet Sellafield – GOV
[17] Sellafield Ltd, annual report 2017-2018, retrieved Sept 2019
[18] Sellafield nuclear decommissioning work 'significantly' delayed and nearly £1bn over budget, report reveals, in The Independent, December 15, 2019
[19] National Audit Office, The Nuclear Decommissioning Authority: taking forward decommissioning, London, January 2008
[20] NDA (Nuclear Decommissioning Authority), Calder Hall Nuclear Power Station Feasibility Study, 2007

dismantling. Abandoned industrial sites have generated and are generating very different solutions in contemporary times: from adaptive reuse hypothesis, with minimal interventions to ensure new functions and the satisfaction of new requirements[21], to the exaltation of post-industrial landscape and Industriekultur (industrial heritage) as, for example, the Landschaftspark in Duisburg, Germany[22]. Despite this, the sites of energy production (especially nuclear) are often destined only to be dismantled, even when their presence, their morphology, and their consistency, could on the contrary open up a series of potential future scenarios of reuse.

«Patterns of intention»[23]

Nuclear sites, although characterized by buildings with iconic and futuristic shapes (from spherical reactor buildings to hyperbolic cooling towers), are designed and defined for essentially functional purposes. To borrow a concept well



Hyde Park *Venezia*

Figure 5) *Shape and size of the Sellafield nuclear site, compared with some famous orographic or architectural-urban features, author: Riccardo Ronzani, March 2022, Turin*

[21] Matteo Robiglio, RE-USA. 20 american stories of adaptive reuse. A toolkit for post-industrial cities, Jovis Verlag GmbH, Berlino, 2017 / Page 169
[22] Caitlin DeSilvey, Curated Decay. Heritage beyond saving, University of Minnesota Press, 2017 / Pages 99 and onwards

expressed in the past by Michael Baxandall, the shape of these places derives little from intention, while it derives much from what he calls «binding causes», those causes that define the program (Baxandall, 1987). These same buildings inherently possess transformative potential for future uses; possible scenarios range from ruin preservation to full adaptive reuse.
However, one consideration must be made. Places designed today, at the beginning of the decommissioning process, will see the light of day at the end of the process, which takes at least fifty if not a hundred or more years. It means, ultimately, designing with an intention, as Baxandall would call it, but for a future context that will have potentially entirely different "binding causes." The need is to be designer-futurologists, in a way, by designing in the present an object for the future world. It is true that every architectural project looks at the future as a time horizon, but this case is different: it is no longer a matter of designing a place that from today will live until tomorrow, modified by the action of the people who will inhabit it (as Heidegger understands the term inhabit[24]), but instead it means designing today a building that in tens if not hundreds of years will be delivered into the hands of future generations. It means designing a place that the designers themselves will probably never see completed.
As described by the diagram, the lens constitutes the moment when «past and future are preceived based on certain assumptions about pasts and futures» (Holtorf and Högberg, 2021). All of us obviously stand at that midpoint, and with that lens we look at the past and imagine the future.
Ours is, in most cases, an interpretive attitude. The design intention, in the case of nuclear power plants, would mean transforming the present moment from a lens for observing into a set of telescopes for projecting towards all possible futures and envisaging development scenarios. That is, from the stasis of

[23] Michael Baxandall, Patterns of Intention: on the historical explanation of pictures, Yale University Press, London, 1987
[24] Martin Heidegger, Costruire, abitare e pensare, in Gianni Vattimo (curated by), Saggi e Discorsi, Edizioni Mursia, Milano, 1976

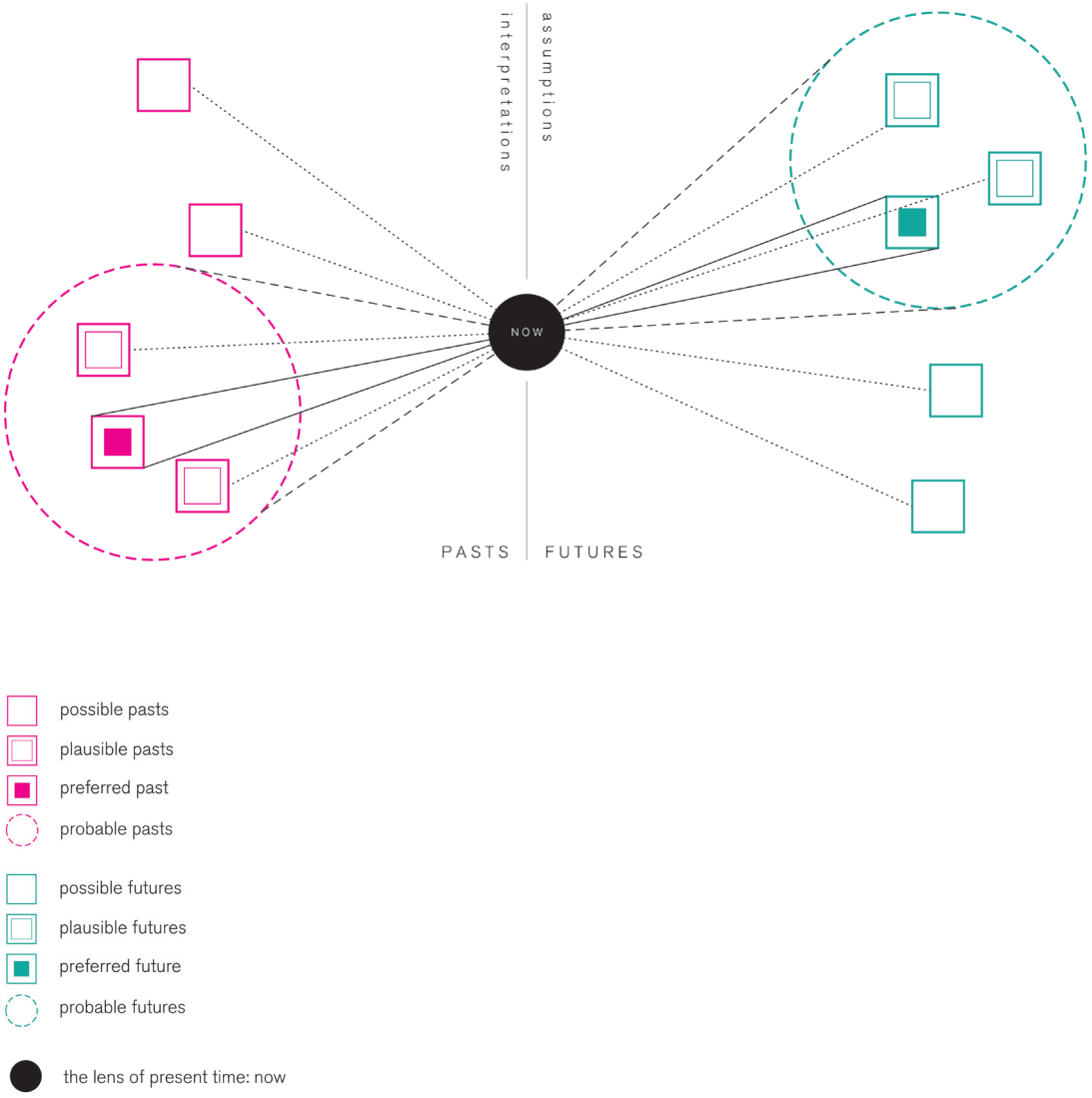


Figure 6) *Schematization of "how the lens of the present affects the narrative of the past" and assumptions about the future, author: Riccardo Ronzani, March 2022, Turin (based on original graphics by Stephan Magnus)*

observation it is necessary to come alive with the will to move, to leave the present and try to oscillate between past moments and expected futures. In this action of understanding the futures that may occur, the project should be configured as a flexible platform, open to all possible futures and moving away from the idea that there are necessarily probable ones. Otherwise, the risk would be that of proposing projects in dialogue with futures that, in the end, might never come true. From a more operational point of view, perhaps it would be interesting to revisit the concept of Adaptive Reuse. It would not only be a matter of adapting a place, with the minimum of possible interventions, to the needs of a new present, but rather of adapting a building in the present to make it in turn adaptive to a series of possible future requirements. From this point of view, the ability to conceive adaptable, modifiable, flexible solutions acquires even greater importance than the current situation.

Conclusion

At the end of this brief writing, we would like to emphasize the need to imagine possible futures for shutdown nuclear power plants, capable of preserving the evidence that these places represent on the one hand, while on the other hand capable of offering a response to future needs and requirements. Such projects, developed in the present, capable of mobilizing substantial capital, are aimed at the future, and will be usable for generations to come. «The question is not how to create a long-term strategy based on our-own perspectives and perceptions of the challenges. Instead, we need [...] to create a long-term strategy that appreciates what will happen in the future nows» (Holtorf and Högberg, 2021). The objective of those who are called upon to rethink these places is to recognize the legacy to be handed over to the future, preserving and enhancing it,

opening up the possibility for the future itself to recognize a potential use for the needs of the future. We will therefore speak of flexible, adaptable, long-term projects, open in some way to novelty and change. It would be dangerously inconclusive to turn the lens of the present into a viewfinder, focused on a specific future direction, especially for projects so projected in time. As Holtorf and Högberg remind us: «planning for the future thus requires a new approach» that avoids the unsuccessful will to forecast and instead proposes an attempt to become part of a world whose essential characteristic is continuous change.

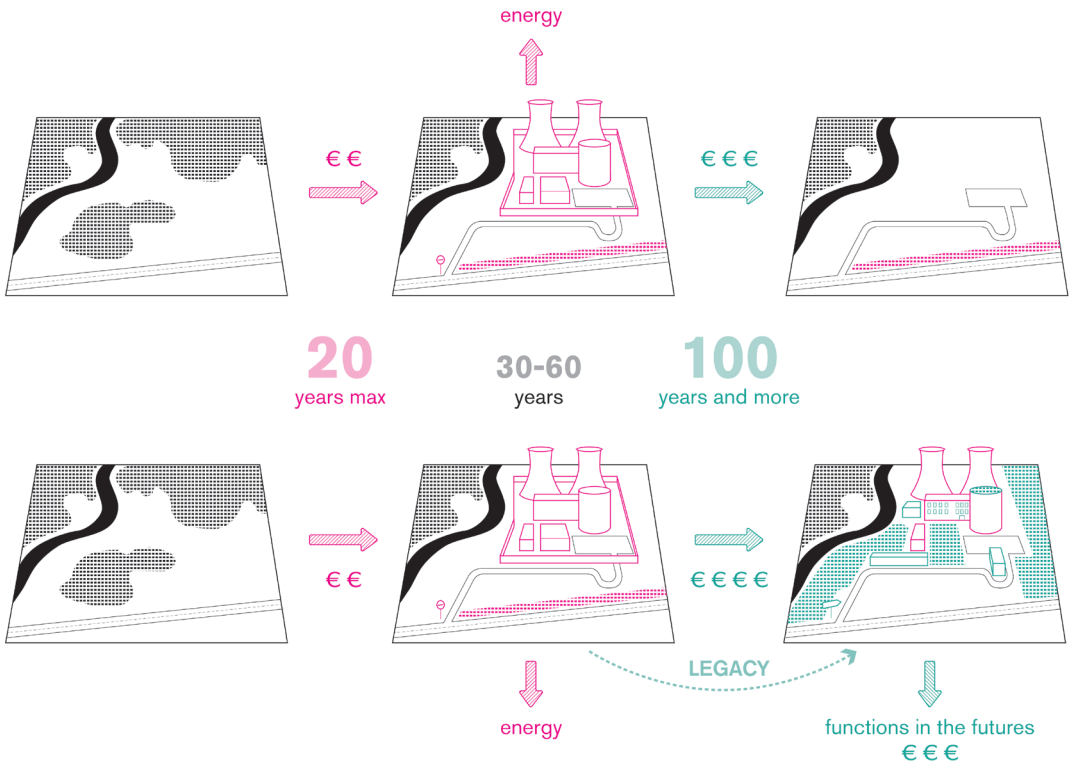


Figure 7) *Representative diagram of the life cycle of nuclear power plants: state of the art and potential, author: Riccardo Ronzani, March 2022, Turin*

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