Energy Landscapes in Transition.
The Port of Ravenna

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Abstract

This article investigates how the current energy transition is driving a radical reconfiguration of the Port of Ravenna. Once a powerhouse of gas extraction and processing in the Adriatic Sea, this site is set to become the largest sustainability hub in the Mediterranean. However, this green transformation has major implications for its surroundings and environment. The result will be a novel ecosystem which fuses land and sea into a landscape for energy production and exploitation. However, the controversies this process sparks call for a reflection on the expertise required to engage with large-scale spatial transformations brought about by the energy transition, as well as alternative approaches to the current debate on energy and infrastructure landscapes.

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Received:
18 October 2023

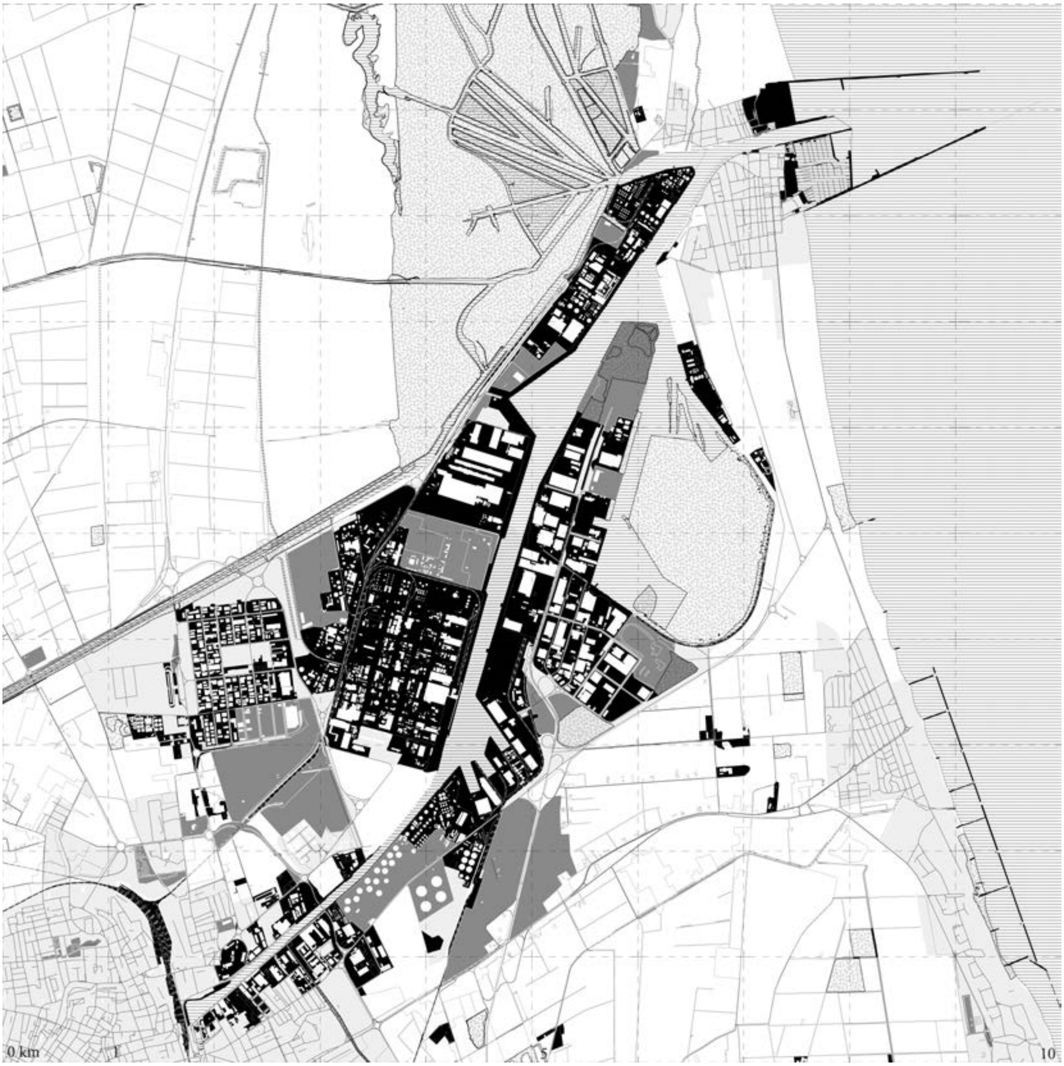
Accepted:
20 April 2024

DOI:
10.17454/ARDETH13.05

ARDETH #13

Fig. 1 - The Port of Ravenna. Map by the author.

The Adriatic powerhouse going through the energy transition
Standing at the window of her office, Elena, a representative of the Ravenna Port Authority, points out the terminus of the canal. "Down there is where the port begins", she says. However, it looks nothing like a port. In front of us, there is a deserted 50-meter-wide waterway with no ships, no cranes, not even a single stevedore. Just a monotonous flatland bisected by a line of still water. I must look surprised since she invites me on a boat trip. Setting out from the city of Ravenna, after passing under a drawbridge, the scenery along the banks changes suddenly. An expanse of brownfields appears. "This used to be Sarom," she says, "one of the largest refineries in Italy in the 1950s, and closed down in the mid-1980s." The set of Antonioni's *Red Desert* is gone, and so too are the anxieties of the modern industrial society he portrayed. All that remains is two



massive cooling towers surrounded by debris and rusted storage tanks. "This doesn't look great, but it will soon be covered with solar panels: the green transition is on the way, and Ravenna will be a protagonist." The canal then widens into a basin, and countless chimneys, barely visible from the city, now tower over us. For the next 7 kilometres, the scene is a succession of massive factories, warehouses, mounds of aggregates, and silos for cereals. But mostly huge power stations and ancillary activities, with their intricate networks of pipes, tubes, and turbines. "This was one of the largest oil refining and chemical clusters in Italy, and it will rise again as one of the most important green energy hubs in Europe," she declares with pride.

Elena's sentiment is justified. The Port of Ravenna is a massive facility covering 2,080 hectares, with tanks storing one million cubic metres of liquid bulks (Figure 1). Its 10.5 kilometres of docks host 26 private terminals, some of which belong to major industries such as Saipem, Marcegaglia, and Buzzi Unicem. These quays are connected by a 35-kilometre rail network that serves both sides of the main canal. At present, 14% of the outbound freight is moved by rail, that is, about four million tons per year on approximately 8,500 trains. Large-scale industries and good connections make Ravenna the biggest Italian port for general cargo traffic: 27.3 million tons in 2022. Incoming goods account for 85% of this traffic, in particular, metallurgical products for Marcegaglia factories (6.4 million tons), cereals and fertilizers for the agribusinesses in the lower Padania plain (5.7 million tons), and raw materials for the ceramics cluster in Sassuolo (5.6 million tons) (Assoporti-Autorità di Sistema Portuale, 2022). Thanks to this inflow, about 15,000 people currently work in the Port, including satellite activities and on-site manufactures. Belying its industrial semblance, the Port of Ravenna is not solely for producing and sorting goods. It was founded by Enrico Mattei to support the rapidly growing national industrial powerhouses during the Italian economic miracle, and it has been the centre of offshore gas extraction in the Adriatic Sea. Major energy companies such as Eni, Sarom, and Siom built facilities along this waterway to benefit from the offshore gas fields (Menzani, Tagliaverga, 2017). Over the years, this hub underwent many transformations as a result of the changing fortunes of the industrial sector and management turnover. Above all, it suffered badly during the energy crisis in the late 1970s, and underwent partial deindustrialisation in the 1980s. In 2020, a massive development plan was funded under the European Green Deal, the Next Generation EU, and complementary national programmes. Investment increased to 1.5 billion euros, and then doubled in 2023 to address the energy crisis owing to the Russia-Ukraine War. To date, 4.1 billion euros has been invested by public authorities and local stakeholders: 2.3 billion euros is for 11 green energy transition projects, while 1.8 billion euros is for 38 intermodal and integrated logistics developments (AdSP MACS, 2023). The sum of these initiatives aims to turn Elena's prophecy into reality, that is, to transform Ravenna

into the largest energy production and storage hub in Northern Italy, in turn, encouraging the establishment of new businesses in the logistics and manufacturing sectors.
This paper examines the spaces and landscapes being generated by these projects to increase green energy production and improve resource management and exploitation. While the aim is to create a sustainable infrastructure integrated with the pre-existing configuration, the result is a novel anthropic ecosystem which affects the environment, economy, and society. This emerging energy landscape is here investigated and discussed by means of first-hand observations, pictures, and critical cartographies, in the tradition of landscape research and recent studies on infrastructural spaces (Belanger, 2016; Duncan, Duncan, 2009; Lyster, 2013; Waldheim, Berger, 2008). The data presented in the paper have been gathered through empirical work conducted in 2023, when the Author visited port terminals, logistics sites, manufacturers, energy industries, and urban areas of Ravenna, to understand their functioning and monitor their development. In parallel, interviews have been conducted with representatives of public organisations, private stakeholders, and practitioners involved in infrastructure design and management. This information has been collated with secondary sources such as planning and policy documents, consultancy reports, and official statistics – for further details on the methodological aspects of the research see Ramondetti (2024a, 2024b). Without the presumption of providing an exhaustive view on the ongoing transformations and their implications, this paper aims to provide an insight into the emerging energy landscape in Ravenna, its composition and interactions with the environment. This understanding solicits a reflection on the role of planning and design in developing novel approaches for infrastructural spaces, especially to address the challenges arising from the changing energy scenarios.
This paper is structured as follows: the next two sections present the on-land and offshore transformations in Ravenna, their environmental effects, and the ecosystem generated; thereafter, drawing upon this case study, the conclusions set out some preliminary considerations with respect to the current approaches to the design of infrastructure and energy landscapes.

Reclaiming the land
From the outset, the Port of Ravenna was destined to be one of the largest energy clusters in Northern Italy. This energy park is now the base for the Petrolifera Italo-Rumena (PIR), Enel, and Eni facilities, where gas arrives from the many Adriatic offshore platforms and LPG conversion plants. Together, these power stations form the largest energy cluster in Italy, with a total capacity of 1,722 MWe. Under the current energy transition, the public and private stakeholders are upgrading the hub in three ways: the expansion of the energy storage facilities, the ramp-up of renewable energy production, and the reclamation of contaminated areas for energy-related usages. The expansion of the energy storage

facilities and the optimisation of the energy supply chain has become a national priority to replace the gas previously supplied by Russia. In October 2022, PIR, Edison, and Enagas opened a 180-million-euro facility for the storage and distribution of 20,000 cubic metres of LPG, enough for about 12,000 trucks and 50 ferries each year, reducing CO2 emissions by 6 million tons a year (Gruppo PIR, 2018). In parallel with the upgrade in power infrastructures, abandoned industrial sites and brownfields are being reclaimed for energy production. Eni has recovered 45 hectares of contaminated land for a solar farm, a soil reclamation processing site, and a multi-functional platform for waste-treatment (Eni Rewind, 2017). Another 50 hectares, the former Sarom refinery, will be the site of a hydrogen solar farm. In conjunction with these projects, work is progressing on increasing the energy efficiency of the new port logistics structures by installing a 16-MWe solar system. All these initiatives are inextricably linked with landscape transformations. Not only are the existing docks undergoing major improvement for cold ironing (i.e., the use of shore side electricity), but also new logistics platforms are to be built to develop operations in a sustainable fashion (Figure 2). For instance, given the abundance of energy resources, there are plans to build an 85-hectare agrifood hub centred on an energy-intensive cold-storage terminal for the conservation of fresh produce.

Fig. 2 - Logistics area under construction. Photograph by the author.

These on-land works have, however, some controversial effects, exacerbated by the time constraints imposed by infrastructural programmes such as the Next Generation EU. For instance, redevelopment of contaminated sites, such as the conversion of the former Sarom refinery into a solar farm, involves only a partial reclamation. This solution has been adopted because the soil has tested safe in the first two meters, and the foundations of solar panels are less than one meter deep. Thus, green energy production will increase sustainability, but at the expense of a thorough soil decontamination. In parallel, issues arise concerning the new built-up areas. The logistics sites are being constructed on the former Port silt storage facility; however, the new plant for soil treatment has not yet been built, and its plan underwent radical modifications in early 2023. Even so, work is underway to dredge the canal to -13.50 meters, extracting 4.7 million cubic meters of material: raising questions about how and where this material will be reclaimed. Nevertheless, dredging cannot stop. Investments for electric cranes, cold ironing, and new rail facilities have already been made. To remain economically viable in the long term, cargo operators need to increase shipping traffic, especially containers. Thus, a new 40-hectare platform is under construction, while the former area is to be converted into a car terminal.

Reclaiming the sea

The ongoing on-land projects go together with offshore developments. Over the years, the growth of the Port has been driven by gas exploitation. At present, there are 346 wells extracting gas over 1,204 square kilometres of sea, and the Ravenna Offshore Contractors Association is one of the most important groups worldwide in the offshore platforms and facilities sector (Ravenna Offshore Contractors Association, 2023). The Association has recently embraced the green transition paradigms, and started developing sustainable solutions for offshore energy production. However, this transition has been slowed by the gas crisis, with a surge in the number of drilling licences for extracting gas over a new 570-square-kilometre area (MASE, 2023). In addition, in early 2023, the national government allocated one billion euros for a new offshore LPG conversion plant.

This is a floating platform where a regasification ship can receive LPG at a temperature of -160°C from LPG carriers, and then convert it to gas to be fed into the national grid. The plant, by Snam, is scheduled to start up in 2024, and will fill 8% of the national demand, or five billion cubic metres of gas (AdSP MACS, 2023). Together with the expansion of the energy storage facility, projects are underway to increase renewable energy production. Plans have been made to institute the Port Renewable Energy Community: an association of public and private actors involved in the production and management of energy from renewable sources (Figure 3). Within this framework, the Agnes company plans an offshore energy facility composed of two wind farms and a solar farm with a total

Fig. 3 - Eni Teodora Powerhouse. Photograph by the author.

capacity of 166 MWe, as well as a storage facility for 50MWe (Agnes srl, 2019). The project is a one-billion-euro investment and will be the largest green energy platform in the Mediterranean. In parallel, other experimental projects are also underway, such as the Inertial Sea Wave Energy Converter, a floating platform producing electricity from wave power. Furthermore, Eni plans a one-billion-euro investment to install a Carbon Capture and Storage (CCS) facility for the transportation of CO2 to exhausted gas fields off the coast of Ravenna (The CCUS Hub, 2021). This infrastructure will be realised in two construction phases: the first aims to offset the emissions from the Casal Borsetti power station and the Versalis chemical cluster; the second will involve other local energy-intensive industries, which will be able to take advantage of this facility to reduce their carbon footprint. As for the on-land projects, also the offshore green developments present some controversial aspects. A perfect example is Eni's CCS project, which environmental associations such as Legambiente and Greenpeace have strongly opposed. Indeed, the injection of CO2 into gas reservoirs that are near exhaustion is a way to maintain high pressure. As a result, the companies can continue pumping fuel, causing damage to the environment. But side-effects are also arising from the Agnes project. The development will occupy 8,500 hectares of sea with 75 wind turbines, creating an underwater forest of foundations and cables. This will generate a new marine ecosystem, with a strong impact on the local fishing sector: restrictions on trawling will be compensated by the growth in mussel farming. This is expected to increase thanks to the oxygen released into the sea as a by-product of the green hydrogen processing, as the lack of oxygen is seriously damaging the marine environment of the Adriatic Sea. However, the construction of green hydrogen plants is only the final step of the project, and it has not yet been scheduled. Indeed, these facilities are to be installed on the decommissioned offshore platforms for gas extraction, which however will continue to operate thanks to the CCS. These controversial effects call for better coordination among the stakeholders in order to mitigate the long-term impacts of the ongoing developments.

Planning for the reconfiguration of energy landscapes
The many on-land and offshore projects in the Port of Ravenna require a reflection on how energy transition is impacting major infrastructural hubs and their surroundings (Figure 4). The transformations in Ravenna are strictly interrelated with the economy, society, and space: the reconfiguration of the Port is thus a unique opportunity to plan an energy landscape integrated with the territory. However, the rushed green transition, owing to the relatively short time to complete complex projects, is producing an uncoordinated development, with negative effects and environmental consequences. This is partially the result of weak governance. For instance, the Port Authority, which should mediate between the many interests at stake, is relegated to a secondary role. Similarly, the local administrations concern themselves solely with the economic role of the Port, giving scant attention to the impact of this energy landscape on the urban and maritime environments. Furthermore, a common framework for coordinating the many stakeholders is currently missing. Not only is this a policy issue, but it also concerns the instruments and tools currently available to arrange the spatial layout and organisation of the new developments. For instance, the Port Authority is entrusted to plan land-uses and interventions within the Port area. These could eventually occur in coordination with the local administrations responsible for the urban and maritime planning, but not necessarily. Consequently, the many actors pursue their own interests with little coordination. This condition, common to most of Italian ports (Ramondetti, 2023), is further exacerbated in Ravenna, where the Port Authority owns only the 10-metre-wide quays along the canals, and leasing the docks to companies other than those located in the back area is almost impossible. This makes it difficult to negotiate with port operators a shared vision for a comprehensive and coordinated development of the landscape infrastructure. As a result, the plans for the port are merely the sum of the many technical operations necessary to keep the harbour working, with little attention to landscape issues and infrastructure externalities. In sum, weak govern-

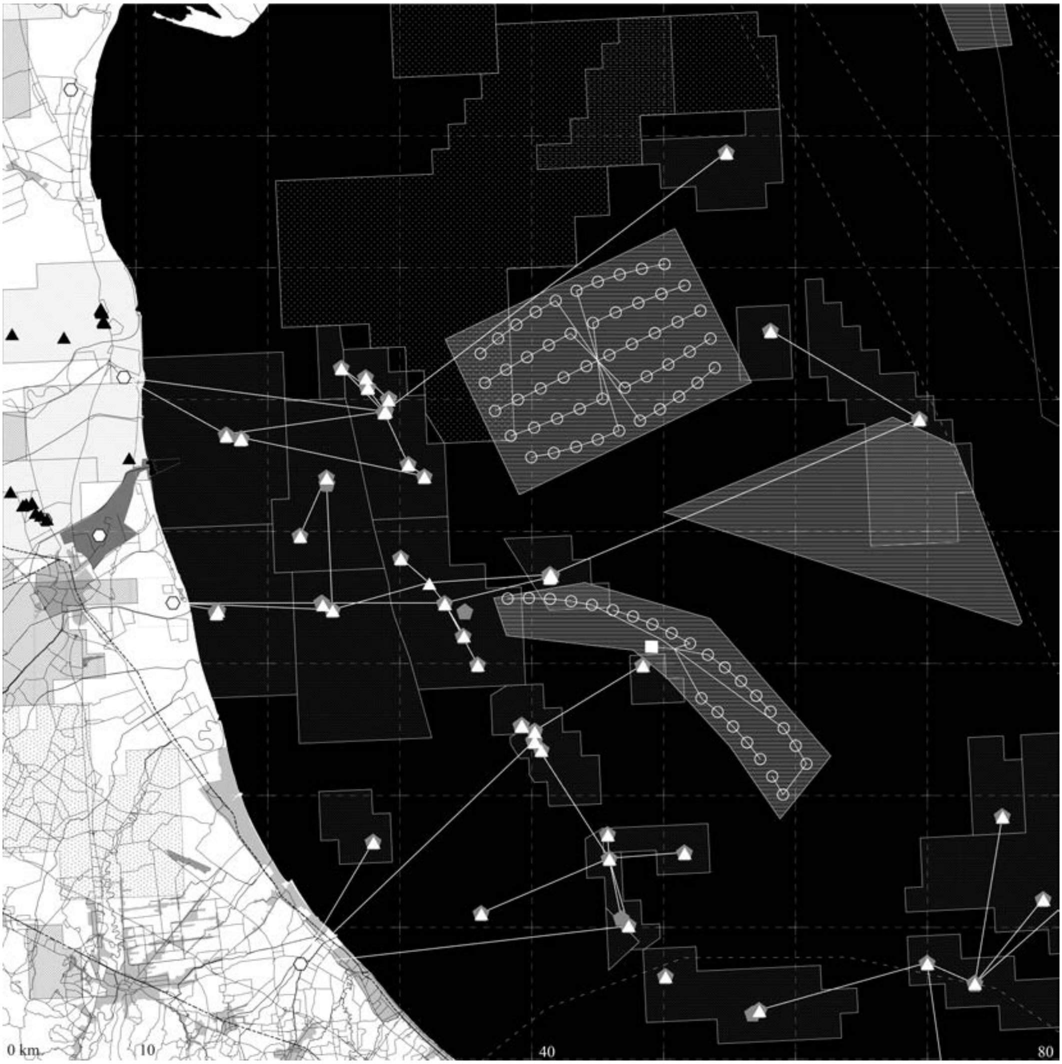


Fig. 4 - The extended energy landscape of the Port of Ravenna. Map by the author.

ance and inadequate tools preclude the involvement of urban and planning expertise to produce large-scale, territorial visions; thus, a systemic approach to integrate harmoniously energy facilities with the urban and natural spaces is completely absent.
However, Ravenna is not unusual in this respect, as documented in literature on port-cities and energy developments (Couling, Hein, 2020; Hein, 2021). Despite being at the core of contemporary urban studies (Castán Broto, Robin, 2023), energy landscapes are still rarely debated within applied science. Not only is this due to the complexity of contemporary infrastructural realms, which require the engagement of multiple disciplines and fields of expertise, but also to some conventional approaches to dealing with infrastructure landscapes, and the transformations brought about by energy transition (Audet, 2016).

In one case, energy landscapes are regarded as a technical support for the economy; hence, their efficient function is essential (Nesbit, Waldheim, 2023). Expanses of solar panels, offshore wind farms, dams, water reservoirs, and port facilities are part of operational landscapes, that is, "specialised regions of production, extraction and circulation where land, energy and labour are invested in the exploration, harvesting and operationalisation of all physical and material substances that sustain contemporary urbanisation" (Katsikis, 2018: 43). Such an economic reading tends to downplay the agency of landscape (Belanger, 2016), since spaces appear to be completely bowed to the capitalist regime (Arboleda, 2020). Within this framework, urbanists and architects have little room for manoeuvre since infrastructural landscapes are purely an engineering domain: each network is assessed per se by technical experts, whose objectives are to optimise resources and improve efficiency. BIG's plan for the *Aqaba Container Terminal* (2022) illustrates this. The project is to develop a decarbonised port; however, the plan assigns the logistics and energy optimisation exclusively to engineering solutions and technical elements, such as the electrification of the machinery and the construction of a huge canopy of solar panels. Little consideration has been given to the features of the landscape; for instance, the project envisions a thriving forest in the desert, which seems more a token gesture than part of an overall strategy for reducing the environmental impact. Similarly, the *eThekwini Regional Hydrogen Strategy* by Arup (2019) envisions a process of decarbonisation at a regional scale – including the largest port in the Southern hemisphere – mainly based on technical solutions for the conversion of the energy facilities and infrastructural networks. Even though projects such as these are important attempts to accelerate the energy transition and to test engineering advancements, they illustrate the challenges in addressing the construction of energy landscapes as comprehensive systems which have regard for the relationships between technical objects and their surroundings.

While this approach gives precedence to technical aspects, another addresses the ongoing transformations from an ecological, grassroot perspective. Energy landscapes are regarded as precarious socio-technical achievements since "service delivery is a process always in the making, one that extends well beyond the time when a connection is provided and the good delivered" (Baptista, 2019: 515). This approach, while helpful in framing infrastructural spaces as a constantly changing realm (Addie, Glass, Neilles, 2024), risks overreliance on problem-solving solutions, and romanticising remedial operations (Jaglin, 2015). Great importance is given to the agency of local institutions, people, and participatory tactics to drive small-scale interventions, raise awareness of environmental issues, and inspire virtuous cultural behaviours (Lemansk, Massey, 2023; Simone, 2004). Such incremental tactics have been applied in urban projects for reducing energy consumption, for instance *Soft City* by KVA MATx (2009), which has developed an adaptable textile system for heat-regulation in buildings while producing energy. Amongst the most emblematic of these grassroot projects is the DIY urbanism fostered by MVRDV for Almere Oosterwold. Based on collective

participation, *Freeland* envisions a self-regulating community that is also a "productive landscape for energy, water reception and purification, and food" (MVRDV, 2011). Although projects like this have seldom been adopted in major logistics and energy-intensive sites, an attempt to stimulate a self-organisation can be found in initiatives such as the Port Energy Community, that is, an ensemble of companies which self-improves the facilities for sharing and producing energy. These kinds of projects, while pursuing flexibility and adaptation, risk being partial: in promoting a step-by-step modification of the environment, they lack a holistic vision. Furthermore, while helping to smooth energy transition, some of the initiatives are embedded in a deeply conservative narrative: no risk must be taken with respect to the current moral ethic, and modifications in networks must occur in harmony with human and non-human beings (Castán Broto, 2019).
The emerging energy landscape in Ravenna helps clarify the limits of such approaches. The ongoing projects implement the on-land and off-shore transformations by adopting technical solutions which seldom take into consideration their side-effects, and mostly regard each network independently (e.g., the construction of wind farms, CCS hubs, and LNG terminals). The role of energy infrastructure in shaping complex ecologies and urbanities is mostly overlooked, so problematic externalities and controversies emerge when examining the current transformations from an environmental perspective. In any case, there are no viable alternatives other than abandoning current development and conserving the existing ecosystem as it is – as proposed by environmental activists. However, this means halting green energy projects, with consequences far beyond their local impacts. To overcome this impasse, a radical change in the approach to large-scale energy landscapes, such as the Port of Ravenna, is necessary. In this respect, it would be desirable to conceive energy as part of an irreducible whole which also includes the terrestrial and maritime ecosystems, as well as the social and economic realms, not to mention the inhabitants' needs (Lopez, 2019). Similar to that proposed by Couling and Hein, the new landscape can be viewed as a "sea-land continuum" (2020: 6), that is, a highly urbanised space where infrastructures fuse sea and land, creating a new environment and ecology. Based on this premise, it is possible to develop novel spatial planning, integrate technical networks and environmental features, and rethink the emergence of new ecosystems. A similar concept can be found in "Urban Metabolism: Sustainable Development in Rotterdam" by James Corner Field Operations and FABRIC (2014). Based on an understanding of the flows that characterise the port and the city of Rotterdam (energy, food, goods, and people), the project proposed a strategy to optimise resources by improving the relations between flows, as well as increasing the efficiency of the production-consumption chains. These examples show how, by avoiding considering energy landscapes as technical spaces, or as grounds for remedial interventions, it is possible to build alternative scenarios. This could be the first step in challenging consolidated norms, questioning contemporary energy production and consumption models, and ultimately envisioning new ecosystems and strategies for energy transition.

Acknowledgments
This article is part of the Marie Skłodowska-Curie Research Integrating Energy and Logistics Hubs: Sustainable Infrastructure Development in Second-tier Mediterranean Ports financed by Fondazione Compagnia di San Paolo. This study also benefits greatly from the workshop "Governing heterogeneous urban energy landscapes: Global North and South perspectives" (20-23 June 2023) at the Utrecht University, funded by the Netherlands Organisation for Scientific Research; and a 6-month visiting period at the Laboratoire Techniques, Territoires et Sociétés (March-July 2023), funded by the Université Gustave Eiffel.

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