COST Action CA23138

Port City Territories in Action: A collaborative Laboratory for Inclusive Energy Transition (PACT)

Deliverable D4.1:

Working papers on understanding, reframing and envisioning



Working Group 4: Pilots

Funded by the European Union

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Introduction

COST Action PACT

The COST Action Port City Territories in Action: A Collaborative Laboratory for Inclusive Energy Transition (PACT) began in October 2024 and is now entering its second year of collaborative work across Europe. This Action brings together researchers, practitioners, policymakers, and local communities working on the urgent challenge of achieving sustainable and inclusive energy transitions in complex port city territories (PCTs) - the unique spaces where ports, cities, and surrounding regions interconnect across the boundary between sea and land.

The challenge that PACT addresses is substantial. While ports are critical hubs for the energy transition - both as sites of energy infrastructure and as essential nodes in Europe's quest to decarbonize - port, city, and regional authorities currently pursue energy transition efforts in isolation, guided by sectoral interests rather than integrated strategies. This fragmentation is compounded by limited involvement of local communities and marginalized groups in decision-making, the absence of shared frameworks and terminology across disciplines and stakeholder groups, and the lack of tailored, place-based tools and methodologies that can facilitate meaningful collaboration. Individual port cities have developed innovative initiatives - such as Le Havre's collaborative approach to energy transition - but these remain largely undisseminated and untested across other European contexts.

PACT aims to overcome these barriers by catalysing knowledge exchange and promoting networking to develop a holistic understanding of the spatial and socio-cultural implications of energy transition in port city territories, with the goal of tailoring findings to other localities so they can be tested and replicated across Europe. The Action pursues this vision through a multidisciplinary, multi-stakeholder approach organized around five Working Groups, each addressing distinct research questions and phases of collaborative work. Working Group 2 focuses on collaborative governance frameworks; Working Group 3 on spatial data mapping and analysis; Working Group 4 (the focus of this document) on common taxonomy and glossary development and pilots; Working Group 5 on dissemination and transmission of knowledge; and supporting groups on communications and coordination.

Working Group 4: Pilots

Working Group 4 is distinguished by its role as the testing ground and integrative laboratory for the PACT Framework. Rather than working solely on conceptual development, WG4 translates the theoretical, methodological, and collaborative advances developed by other working groups into lived practice in real port city territories. WG4's core responsibility is to examine how knowledge creation, collaborative planning, and inclusive energy transition unfold in pilot port city territories which were selected for their diverse contexts, innovations and opportunities to engage researchers, practitioners and other stakeholders in discussions, events and creative and scientific work in understanding port city transitions. Le Havre, Rotterdam, and Livorno were selected as pilots during the initial phase of the COST Action, while three more - Lisbon, Limassol, and Dubrovnik – have been designated as pilots due to the interest of PACT participants with close networks of ties and professional interest in these port city territories to contribute their work to the Action and host on-site events.

WG4 produces two principal deliverables, each spanning different phases and timeframes of the Action:

- **D4.1 - Understanding, Reframing, and Envisioning** (M15, Quarters 1–5 of the Action): Working papers documenting the early exploratory phase of pilot work, where the Action examines, analyses, and visioning challenges and opportunities specific to each pilot territory before proposing solutions.
- **D4.2 - Mapping, Co-Creating, and Structuring** (M33, Quarters 6–13): Working papers from the action-oriented phase, where insights and methods developed in D4.1 are operationalized through concrete collaborative practices, spatial analyses, participatory design processes, and implementable governance frameworks.

During its first year, PACT has catalysed rich engagement across its pilot territories. Two events have anchored this work during the first grant period running from October 2024 to October 2025:

Blue Limassol Forum (May 2025)

PACT's participation in the Blue Limassol Forum provided a remarkable opportunity to explore the Limassol port city territory in depth, engaging a wide and diverse spectrum of stakeholders including port authorities, municipal governments, environmental organizations, tourism bodies, and community groups. This forum was particularly significant in addressing a core challenge facing coastal port cities: balancing rapid urban development and economic growth with environmental sustainability and climate resilience, while ensuring that transformations genuinely benefit all citizens. The forum foregrounded inclusive and participatory approaches to coastal transformation, emphasizing that sustainable energy transitions in port city territories depend fundamentally on active participation by local communities in decision-making processes that affect their lives, territories, and futures. The Limassol experience exemplified PACT's commitment to understanding the intricate interactions between policy domains, sustainability goals, economic development, and social inclusion that characterize contemporary port cities.

PACT Conference and Workshop in Le Havre (September 2025)

The inaugural PACT Conference and Workshop in Le Havre marked a defining moment for the network, bringing together researchers, practitioners, and local stakeholders to critically examine port city territories in action. On the first day of the three-day event, the conference gathered submissions accepted following an open call to which PACT participants were invited to contribute. Three sessions were held: Theoretical Perspectives on port city energy transitions; Technical Applications of energy technologies and infrastructure; and grounded Case Studies documenting real-world initiatives. The submissions presented here were selected from a broader conference programme and form the foundation of this deliverable on D4.1.

The second day brought Le Havre stakeholders, including representatives from the port authority, city planners, NGO representatives, and community members, into direct dialogue with conference participants. This session emphasized spatial planning for decarbonization, infrastructure innovations for sustainable energy, and the complex economic and social connections between port and city operations. Participants benefited from learning how transitions unfold in practice, beyond academic framing.

A site visit to the Port of Le Havre allowed participants to see firsthand the material realities of port infrastructure, industrial operations, spatial

constraints, and opportunities for intervention, and catalysed discussions anchored in place-based understanding of the port's relationship with global and national markets, stakeholders and flows.

A particularly innovative contribution to the Le Havre conference was the piloting of a counter-cartography initiative. This creative submission category invited participants from diverse backgrounds - residents, workers, artists, activists - to rethink how port city territories are visually represented and understood. Counter-cartography challenges the standardized, top-down representations of space produced by government and economic stakeholders, instead inviting people to map their own experiences, perceptions, and visions of port territories. The open call invited contributions reflecting on how participants experience port city territories - spaces they explore or avoid, places where they feel welcome or marginalized, and how they themselves would represent these territories from their unique perspectives. Over seven port city territories across three continents, participants submitted counter-maps offering cultural, environmental, and deeply personal perspectives on port spaces. The initiative demonstrated that creative, artistic, and grassroots contributions are vital ways of seeing and reimagining port city territories, offering insights that conventional planning and academic methods often overlook. This innovation has been recognized by COST for advancing inclusive outreach strategies and will continue as a category of contributions in future PACT events.

Operationalising deliverables

The terms "understanding," "reframing," and "envisioning", introduced in the Action's proposal and Memorandum of Understanding, serve as organizing concepts for D4.1, helping structure how WG4 gathers, evaluates, and packages contributions from pilots and related activities. WG4 operationalised these terms to ensure that calls for future conferences, training schools, and collaborative activities yield submissions, discussions, and outputs that meaningfully contribute to WG4's objectives within the broader PACT framework.

By clearly defining what each term means - and by offering concrete examples of the types of work that exemplify it - PACT can provide guidance to potential contributors about what kinds of research, projects, and practices strengthen WG4's work and the Action as a whole. It will enable the Working Group to communicate outreach calls that explicitly welcome

diverse forms of knowledge and expression, as well as structure and assess submissions consistently across pilots and events. Ultimately, it will contribute to building coherent deliverables that collectively address the distinct but interconnected phases of pilot work.

It is important to emphasize that not all contributions need to be traditional academic papers. The PACT Journal and this working paper series deliberately embrace diverse formats. Shorter contributions documenting case studies from practitioners and community members, who often lack time and institutional support for lengthy academic writing, are actively welcomed. Creative and artistic projects are equally valued contributions. The counter-mapping challenge piloted at Le Havre exemplified this openness: it generated rich, provocative ways of seeing and discussing port territories from manifold perspectives, stimulating discussion and revealing dimensions of lived experience that conventional academic discourse can overlook. Similar innovative formats - such as speculative design projects, artistic interventions, multimedia works, policy briefs, and reflective pieces - are encouraged as ways of advancing knowledge about port city energy transitions.

Understanding

Understanding refers to the diagnostic, contextualizing, foundational work of making sense of energy transition challenges and opportunities in each pilot port city territory. It involves:

- Mapping existing conditions and systems: Documenting current energy infrastructure, governance structures, stakeholder ecosystems, spatial configurations, cultural-historical contexts, and institutional arrangements that shape how energy transitions unfold
- Identifying local challenges and opportunities: Recognizing what makes each pilot unique - its assets, vulnerabilities, path dependencies, and possibilities - and comparing patterns across pilots to develop typologies and insights applicable elsewhere
- Centering diverse perspectives: Ensuring that understanding incorporates voices not typically heard in planning discourse - residents, workers, marginalized communities, local knowledge holders - whose experiences and concerns are essential to grasping PCT realities

Contributions that exemplify *understanding* include: case study descriptions of specific pilot port city energy systems and transitions; stakeholder analyses documenting who is involved, who is excluded, and what power dynamics shape decision-making; historical analyses of port-city relationships and the path-dependent trajectories created by past industrial policies and infrastructure investments; baseline assessments of current energy transition initiatives; documentation of governance fragmentation and institutional challenges; qualitative and ethnographic studies of how local communities experience and perceive energy transitions; and comparative analyses across pilots identifying patterns, typologies, and distinctive features.

Reframing

Reframing involves the critical analytical work of challenging dominant narratives and revealing dimensions of energy transition that conventional approaches overlook or suppress. It asks: What assumptions underlie current energy transition plans? What perspectives and values are centered, and which are marginalized? What contradictions or blind spots become visible when we shift our analytical lens?

Reframing moves beyond accepting energy transition as primarily a technical challenge (deployment of renewable technologies, grid modernization, infrastructure upgrade). Instead, it foregrounds socio-cultural, spatial, and justice dimensions, which can get sidelined when techno-optimistic or "smart port" narratives predominate. It reveals how energy transitions are shaped by and reshape values, power relations, cultural identities, environmental vulnerabilities, and distributions of benefits and burdens across different social groups. Reframing work might integrate outputs from other WGs - applying the common taxonomy and glossary developed by WG4 to pilot contexts, or drawing on stakeholder analyses from WG2 to understand whose interests drive or are harmed by particular transition pathways.

Contributions exemplifying *reframing* include: critical analyses of existing energy transition plans and their blind spots or contradictions; papers applying environmental justice frameworks that foreground fair treatment and meaningful participation of affected communities in decision-making; conceptual papers that reconceptualize port city relationships, seeing ports not merely as economic/energy infrastructure but as socio-spatial-cultural systems embedded in territorial contexts; studies revealing tensions

between stated sustainability goals and actual development trajectories (e.g., port expansion conflicting with emission reduction targets); inter- and transdisciplinary papers examining the imaginaries, narratives, and values that shape energy transitions, often unexamined in technical discourse; and investigations of cultural and symbolic dimensions of waterfront futures - heritage, memory, identity, sense of place - that energy transitions inevitably touch and sometimes threaten.

Envisioning

Envisioning is the forward-looking, imaginative work of asking: What could and should energy transitions in port city territories look like? What futures are possible or desirable? How might we move from current conditions toward more sustainable, just, and equitable arrangements?

Envisioning draws on understanding and reframing, but is fundamentally oriented toward possibility and transformation. It involves co-creating with stakeholders images of desirable futures, experimenting with scenarios, and sketching preliminary transition pathways. Importantly, envisioning is not speculative fantasy divorced from reality; it is grounded visioning - rooted in understanding of local contexts and constraints, informed by reframing of current problems, and tested through dialogue with diverse stakeholders who would inhabit and shape these futures.

Contributions which exemplify *envisioning* include: scenario studies and foresight exercises exploring how energy transitions might unfold under different assumptions and policy choices; workshop reports documenting visioning processes where stakeholders collectively imagine desired futures; design-based research and speculative design projects that visualize alternative spatial arrangements, infrastructure configurations, or governance models; policy reflections proposing alternative governance structures or institutional arrangements; papers outlining transition pathways - step-by-step strategies for moving from current state to desired futures; and artistic, graphic, or narrative interventions that frame and communicate transition imaginaries in compelling, accessible ways.

This document packages selected contributions from the PACT network that exemplify D4.1: *Understanding, Reframing, and Envisioning*. Subsequent sections present these working papers, each contributing distinct insights and methodologies to deepen comprehension of energy transitions in port

city territories, challenge conventional framings, and open imaginative possibilities for more inclusive and sustainable futures.

2. Working papers on Understanding, Reframing and Envisioning

Reactivating Sea and Ocean Cultures in Support of Inclusive Sustainable Transitions in Port Cities An Impact Framework

Maëlle Salzinger [1] and Carola Hein [1]
[1] Delft University of Technology

Understanding ***Reframing*** ***Envisioning***

Port-cities are striving for energy transitions and a renewed social contract between citizens and ports. However, they often underestimate the potential of cultural and aesthetic interventions to reactive maritime heritage and relationships with the seas and oceans, in support of inclusive sustainable transitions. A major obstacle to the deployment of creative cultural solutions is the lack of impact frameworks and tools for longterm planning, assessment and learning.

An analytical impact framework was developed in the European project Bauhaus of the Sea Sails to help fill this gap. The project tested creative cultural solutions that promoted climate action and sustainable transitions in 8 locations (in Italy, Portugal, Germany, Sweden, Belgium and the Netherlands) that are shaped by a history of port and maritime trade. As such, the project aimed to reconnect human communities with the sea, marine life and maritime heritage through innovative approaches resulting from the collaboration of art, design, architecture, science, food and social sectors, as well as municipalities and port authorities (e.g. future tidal architectures, nature-based wellbeing reefs, inclusive digital storytelling).

The analytical impact framework helped translate high-level EU ambitions, rooted in the New European Bauhaus (NEB) Compass and its core values of aesthetics, sustainability, and inclusion, into locally aligned impact tools and indicators. The article will focus on three main elements of the impact analysis framework: the process of aligning with local projects, comparative analysis and long-term orientation. The author(s) will reflect on the processes and tools used, their strengths and shortcomings, and share learnings for project replication, impact assessment and policymaking.

The article will finish with a discussion on value-driven transformations, taking the example of the NEB project Bauhaus of the Seas and its four

core values: aesthetics, sustainability, inclusion and locally grounded. Can values guide the way we plan for and assess the impact of local projects? Do values provide a strong guiding framework for inclusive, sustainable transitions in port cities? And how can this framework continue to evolve by learning from more port-city contexts and partners?

Capacity-Pressure Mismatches in Urban Energy Transitions: Institutional Lock-ins and Democratic Legitimacy in European Port Cities

Lars Marcus [1], Carl Mossfeldt [2], Ulf Petrusson [1], and Alan Plattus [2]

[1] Chalmers University of Technology

[2] Yale University

Understanding ***Reframing***

Urban energy transitions are increasingly constrained not just by technical or financial barriers, but by the mismatch between the spatial scale and temporal urgency of infrastructural pressures and the institutional capacities available to municipal governments to respond. When these pressures exceed local capacity, political and institutional lock-ins tend to emerge and slow transitions. As this leads economic risks to accumulate - which disproportionately tend to burden vulnerable communities - democratic legitimacy may be undermined. This capacity-pressure mismatch reflects a more general structural problem: municipalities must navigate global climate transitions using governance arrangements designed for dfferent historical eras, while inherited built infrastructure creates spatial constraints that reinforce institutional limitations.

A decade of longitudinal action-research on the energy transition in Gothenburg has allowed us to show how these dynamics unfold in practice. Post-war Swedish industrial policy deliberately integrated municipal port and energy infrastructure with state-owned assets to support national development. The city now finds itself embedded in global commodity and production networks, which means the transition requires negotiations with private actors operating at scales and in domains where city officials struggle to engage. The resulting mis-match between infrastructural pressures and municipal capacity in the city, furthermore, does not seem to spur institutional renewal but rather generate political lock-in. The dynamics observed in Gothenburg reflect

broader patterns in European port cities where state-led industrial development created infrastructural and institutional arrangements that threaten to became vulnerabilities as globalization has transformed operating environments.

Understanding these historical trajectories and the lock-ins they generate is essential to understanding what holds energy transitions back and what can be done about it. We propose a framework which focuses on the dynamic interplay between infrastructural pressures and available public capacities and thus makes "institutional learning" the central variable. It points to the need for governments constantly to monitor "lock-in danger" and react when pressures outpace municipal capacities, either by accelerating capacity development through partnerships or redistributing responsibilities to match institutional capacities with infrastructural demands. Stakeholder engagement across governance domains thus becomes essential infrastructure for effective and legitimate transitions which also involve reconstructing municipal responsibilities and identity. It is a process that requires attention not only to spatial and institutional arrangements, but also to how industrial heritage and cultural identity shape how communities respond to global change pressures.
We suggests that such a framework could be constructed using "structured social orders" (materially embedded institutional arrangements) and "strategic action fields" (contested decision-making arenas) as analytical building blocks. This allows infrastructural analysis to integrate with legal, institutional, social, and cultural analysis and help explain how built environments both enable and constrain institutional adaptation. Developing the framework would require systematic comparison across port cities with different historical trajectories with varying path dependencies and institutional configurations. The relevance would extend beyond port cities, but would likely have particular significance for them, given the tension in port cities between infrastructural pressures "from the sea" and governance developments emerging in interaction with national capitals and hinterlands. As such, port cities can serve as crucial testing grounds for the broader ambition.

Rethinking Maritime Spatial Planning in the Context of Energy Transition and the Evolving Role of EU Ports

Charalampos Platias [1] and Petros Pallis [2]

[1] Panteion University of Athens
[2] University of the Aegean

Reframing ***Envisioning***

A new energy landscape is emerging in Europe, with ports assuming increasingly diverse and strategic roles. Beyond their traditional functions, ports are evolving into energy nodes, providing energy services not only to their usual customers but also entering new markets. They are actively involved in multiple transitions, including phasing out fossil fuels, electrifying port activities and transport systems, providing onshore power supply for ships at berth, facilitating the use of alternative fuels, integrating offshore wind infrastructure, supporting energy system integration, enabling circular economy practices, and contributing to decarbonization and sustainable development.

These expanding roles will require ports to access more energy and more space. As they pursue ambitious projects, ports will need new infrastructures, regulatory frameworks, and spatial arrangements to accommodate both traditional and emerging activities. This transformation is likely to reshape port–city relations, potentially creating new tensions while also presenting opportunities for integrated planning.

Maritime Spatial Planning (MSP) is a key tool for anticipating and shaping this transition. From a governance perspective, this paper examines the parameters that MSPs must consider, the planning processes that should be adopted, and the roles and interactions of relevant stakeholders. It advocates for an MSP approach grounded in sustainability and democratic planning, capable of yielding high-quality outcomes for ports and their surrounding urban areas.

Despite the strategic importance of ports for both economy and society, they have so far attracted limited attention within MSP discourse, particularly in relation to the energy transition. This conceptual paper aims to address that gap by mapping key challenges and research needs, with the goal of stimulating further academic inquiry. At the same time, it highlights practical implications, as decisions made today will have lasting effects on both ports and the cities that host them.

Based on a review of existing literature, which combines different research streams including Maritime Spatial Planning, port–city relations, and port governance, alongside policy reports and insights from expert discussions, the findings suggest that ports remain underrepresented in MSP frameworks, with largely proceeding along a business-as-usual path. This poses significant risks, not only in terms of missed opportunities but also in failing to prevent emerging conflicts. While MSP still holds great potential, the need for timely and coordinated action is urgent.

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Geopolitical Lenses for Understanding the Spatial Dimension and Governance Needs of Energy Transition

Athanasios A. Pallis [1], Gordon Wilmsmeier [2] and Andreas Hadjikofinas [1]

[1] University of Piraeus

[2] Kühne Logistics University

Understanding ***Reframing***

This contribution examines the perspectives on studying the spatial dimension and governance of the energy transition in ports, cities, and territories through a geopolitical lens. Ports stand at the forefront of the energy transition, as critical hubs for energy transportation and transformation. Meanwhile, within an ever-evolving global landscape, ports and the related cities and territories are places where local and foreign environmental, economic, and social interests intersect. Sustainable transitions require a multilevel collaboration between port authorities, private actors, and local communities. Yet, varied governance structures, divergent priorities, lack of shared visions and/or policies, along with the complex interactions between foreign and local actors, pose substantial challenges. The evolving spatial dimension of the energy transition and its governance are two of these challenges.

The study unpacks the worthiness of developing a comprehensive understanding of how the energy transition in port cities and their governance is (will be) influenced by the involvement of global private multinational companies and state-owned enterprises (SOEs) with limited embeddedness in existing institutional settings and economic trajectories, and strategies and practices are directed by interests that extend well beyond local communities.

In particular, the study discusses and suggests research on the interaction of influences and dynamics, highlighting the gap between global ambitions and local realities, as well as the frameworks for addressing this gap. It advocates for a research framework that identifies who might be influenced by the (im) balance, priorities, capacities, and dynamics between the actors involved. and set up a framework on how vertical and horizontal coordination of the actors involved can make the global energy transition appealing for local contexts.

Energy transition is associated with the presence of multinationals, state-owned and private non-local enterprises in ports. The presence of state-owned enterprises acts as an extension of state power, as they commonly function in a dual capacity, with a broader purpose of fulfilling national strategic objectives and interests. Private non-local enterprises are typically market-driven, seeking to match investment expectations and pursue competitive advantages. Both actors, influenced by geopolitical factors, play distinct roles in shaping the energy transition in port cities, where their economic, political, social, and broader perspectives significantly influence the outcomes for the countries and cities hosting the investments.

While research on the complexities of ports and port cities, as well as the actors involved, has long been documented, integrated approaches to the geopolitical perspectives shaping the energy transition in these territories remain underdeveloped. By (re)thinking the energy transition in port cities as a multi-level dynamic process, directly influenced and affected by geopolitical perspectives, this contribution will offer a new lens, expanding the various perspectives through which the topic has already been explored.

Techno-Anthropological Technology Assessment of Power-to-X in Ports

Kristian Holst Kristiansen [1], Tom Børsen [1], Jorge Contreras [2], Mette Marie Karsten [2],
and Sidse Ansbjerg Bordal [2]

[1] Aalborg University
[2] Danish Institute of Fire and Security Technology

Understanding ***Reframing***

Ports are vital infrastructures in the green transition. A case in point is the role of ports for the installation and servicing of offshore wind farms. Recently, ports have also increasingly turned their attention towards the emerging Power-to-X (PtX) industry. PtX refers to the production of green hydrogen and hydrogenderived fuels and feedstock based on the electrolysis of water using renewable energy sources. PtX has become a central technology in the EU and beyond, poised as a so-called sector-coupling technology, seeking to strengthen energy security by storing surplus electricity as molecules and decarbonising hardto- abate sectors,

such as maritime shipping, by producing hydrogen-derived fuels. PtX fuels such as green methanol (made from green hydrogen and CO2) and green ammonia (from green hydrogen and nitrogen), are expected to replace fossil-based fuels in vessels that are not feasibly electrifiable. In this context, ports serve as relevant infrastructures for the storage, bunkering, and utilization of these novel green fuels for the maritime industry. However, such a transformation raises critical concerns regarding the novel risks associated with the storage and handling of these fuels.

While many ports have substantial experience in handling and storing fossil-based fuels, and likewise in mitigating their hazards and accidents, the same cannot be said of hydrogen-based fuels. This introduces risks for residents and communities in port city territories, which are likely to raise potential fears and concerns over these technologies. Using the Port of Rønne, located on the Danish island of Bornholm in the Baltic Sea, as a case study, we introduce Techno-Anthropological Technology Assessment and discuss how it can be applied to questions of technological risks associated with the storage of PtX fuels. Techno-Anthropological Technology Assessment bridges the tradition of social scientific and humanistic Technology Assessment (TA) with fieldwork-driven traditions within the social study of science and technology (STS).

This methodological approach enables an ethnographically driven study of the cultural embedding of the socio-technical assemblage under assessment, while also reflexively accounting for the analyst's embedding and positionality, i.e., the TA-analyst-cum-ethnographer. We draw on the Constructive, Ethical, and Participatory traditions of TA, thus seeking to involve diverse stakeholders, including citizens, technical experts, and port actors and authorities, in assessing and shaping technological development. We focus our attention on facilitating the upstream articulation of ethical concerns related to risks associated with PtX in the Port of Rønne. Paramount to this approach is the inclusion of the perspectives of citizens and local communities, whose voices might typically be excluded due to their perceived unscientific, emotional or irrational nature by technical decision-makers. However, such inclusion can serve both instrumental and democratic ends, such as addressing epistemic blind spots illuminated by local knowledge and ensuring a more accountable and transparent decision-making process.

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Sustainable Collaborative Laboratory for Inclusive Energy Transition for Port City Ohrid: Preserving a UNESCO Heritage Site located at Europe's Oldest Lake

Viktorija Mangaroska [1]

[1] International Balkan University

Understanding ***Reframing***

Port City Ohrid, situated on the southwestern shores of Lake Ohrid, the oldest and deepest lake in Europe, represents a unique convergence of natural biodiversity, cultural heritage, and vibrant urban life. Recognised as a UNESCO World Heritage Site for its exceptional cultural landscape, archaeological sites, and biodiverse aquatic ecosystems, Ohrid is facing increasing pressures from climate change, mass tourism, and outdated energy infrastructure. These challenges threaten both the ecological integrity of Lake Ohrid, which harbours over 200 endemic species, and the historic urban fabric that defines the city's identity. This research and innovation initiative proposes a collaborative, interdisciplinary framework for an inclusive energy transition in Port City Ohrid, aiming to align sustainable energy development with ecological preservation and cultural continuity.

The project acknowledges that energy systems are not neutral but deeply embedded within local social, cultural, and environmental contexts, requiring adaptive strategies that respond to Ohrid's unique heritage and natural sensitivity. The objectives of the research are aim to develop energy transition models that integrate renewable technologies with the preservation of lake ecosystems and cultural assets, to foster inclusive governance by engaging a broad spectrum of stakeholders: municipal authorities, heritage institutions, local communities, tourism actors, and youth organizations, to explore how energy infrastructures can be designed to support climate resilience, reduce carbon emissions, and improve socialequity without compromising Ohrid's UNESCO values. to create a participatory platform for co-creating innovative solutions, knowledge exchange, and capacity building, leveraging international collaboration and cross-sector partnerships.

The methodology of the collaborative laboratory research is to employ initiative for interdisciplinary and participatory approach, combining spatial and energy system mapping to identify areas of ecological and infrastructural vulnerability, environmental monitoring to assess energy impacts on the lake's water quality and biodiversity, social research involving interviews, focus groups, and workshops to understand local

perceptions, needs, co-creation participatory laboratory including solar-powered transport on the lake, energy-efficient retrofitting of heritage buildings, and community-based microgrid systems, collaborative governance frameworks to coordinate action across multiple levels and sectors.

The results from the study provide an impact by positioning Ohrid as a living laboratory for sustainable energy innovation within a heritage-sensitive ecological context. The research aims to generate scalable strategies that balance environmental stewardship, cultural preservation, and social inclusion. The initiative contributes to achieving local climate goals and fulfilling international commitments under the UNESCO World Heritage Convention, the European Green Deal, and the Sustainable Development Goals (SDGs). The project aims to transform Ohrid into a model UNESCO port city, where energy transition is co-created by communities and institutions, demonstrating how heritage cities can lead the global movement toward a greener, more equitable, and culturally enriched future.

The Energy Transition as an Engine for Spatial Transformations: Reconfiguring the Energy Hubs and Port Cities of Gela and Ravenna, Italy

Leonardo Ramondetti [1], Angelo Sampieri [1] and Sara Giudice [1]

[1] Polytechnic University of Turin

Understanding ***Reframing***

Over the last decade, port territories have become a privileged target for European investment in the energy transition. However, the restructuring of these sites to enhance infrastructure and industrial sustainability has proven more complex than originally expected. Key questions have emerged regarding how to govern energy-related spatial transformations, including challenges in territorial policies (Carter & Drouaud, 2024), temporal alignments (Elsner et al., 2019), and institutional coordination across multiple scales (Mat et al., 2016). Above

all, the urban implications of reconfiguring long-established socio-physical spaces into novel energy landscapes (Hein, 2021) have brought renewed attention to the need to transcend the perception of these sites as mere 'technical lands' (Nesbit & Waldheim, 2023). This shift involves reimagining their social and ecological roles to foster more inclusive relationships with both inland and maritime environments (Couling & Hein, 2020). This paper contributes to this growing debate within the fields of spatial planning and urban design by examining ongoing transformations in the Italian port cities of Gela and Ravenna, Italy. Both were founded by the energy company ENI in the 1960s: Gela, on the southern coast of Sicily, to exploit local petroleum reservoirs; and Ravenna, on the northern Adriatic coast, as a hub for offshore gas extraction. These ports were established alongside vast chemical plants that had a profound urban impact. Between the 1960s and the early 2000s, both cities experienced economic and demographic growth, although persistent environmental issues accompanied this growth.

Today, the structural crisis in the European chemical industry, combined with the imperatives of national and EU green energy policies, is profoundly transforming these sites. After a period of downturn, the Gela industrial complex is downsizing into a smaller biorefinery, shifting from fossil fuel-based production to renewable sources. Conversely, Ravenna is experiencing a resurgence of industrial activity. Not only is the local chemical industry expanding its operations, but the entire territory is also undergoing a reconfiguration to become the main energy hub in Italy, hosting the largest Carbon Capture and Storage facility in the Mediterranean, extensive solar farms, and offshore wind infrastructure. These divergent trajectories carry significant urban implications. In Gela, local communities and institutions express concerns over the potential full closure of the city's largest employer, the chemical plant, and the unresolved issue of reclamation of contaminated land. In Ravenna, the proliferation of energy projects is producing a fragmented and heterogeneous landscape that combines new industrial and port facilities with existing urban areas. Through fieldwork conducted since 2023 – including interviews with public authorities and local stakeholders, as well as the collection of visual materials – such as photographs and critical cartographies, this paper reflects on two issues: 1) the territorial and spatial implications of reconfiguring energy metabolism in port cities (Gandy, 2025); 2) the inherent uncertainties of these ongoing transformations (Monstadt et al., 2024; Wiig & Silver, 2019), which must navigate complex regulatory frameworks, potential funding shortages, and volatile external conditions. Examining these issues is useful for proposing alternative, more inclusive spatial arrangements and measures to mitigate and govern existing tensions.

Inclusive Energy Transition in a Complex PCT: The Case of Varna-Beloslav-Devnya Agglomeration in Bulgaria

Iliyan Kotsev [1]
[1] Bulgarian Academy of Sciences

Understanding ***Envisioning***

The Varna–Beloslav–Devnya port agglomeration (contiguous to the homonymous cities) forms a key node in Bulgaria's maritime transport, logistics and energy infrastructure. As the country's busiest port complex (comprising Varna-East and Varna-West, Varna Thermal Power Plant terminal, Beloslav and Devnya harbor cargo facilities, etc.) it links maritime transport with road, rail, and inland waterway networks, fostering a dynamic industrial corridor, where Devnya-Beloslav's chemical and power-generation cluster has been established since the Socialist Period.

Despite the strategic location on the crossroad from Odessa and Constan#a towards Istanbul, also lying on the Black Sea-Danube River transport node, the area faces multiple overlapping challenges nowadays, namely: (a) Dense industrial activities requiring energy and environmental optimization—particularly at Devnya Industrial Complex (chemical factories) and near Beloslav (Varna thermal power plant) that creates high energy demand, tied to imported fossil fuels; (b) Outdated, mostly Socialist Period-inherited port facilities, including shallow berth drafts (~11 m) restricting larger vessels from entering, which increases reliance on road transport and associated GHG emissions; (c) High energy consumption of the associated old port facilities, infrastructure and industrial plants, which requires urgent improvements; (d) Rather close proximity to Varna's urban core (Varna East extends approximately 1 km from downtown Varna) - resulting in air and noise pollution, traffic congestion and strained urban conditions overall.

Major modernisation efforts have been undertaken to decrease GHG emissions and transport-related congestion. The Oliva JSC Grain Terminal at Beloslav is deepening its quays to 13.5 m, adding advanced grain storage and handling facilities, and improving rail/road links. This enables road-to-sea modal shifts, reducing GHG and diverting heavy cargo handling away from the urban areas. Meanwhile, Varna West is already the most modern terminal in North Bulgaria, handling containers, bulk and project cargoes, with full rail and road integration.

The Varna–Beloslav–Devnya PCT is steering toward decarbonization and energy resilience through multiple pathways: (a) Infrastructure modernisation - expansion of deeper-water terminals and new LPG/LNG facilities in Beloslav, which will improve energy logistics and support "greener" options; (b) Modal shift & digitalisation - ongoing rail integration and digital single-window systems, thus promoting efficiency and GHG reduction from hinterland transport; (c). Industrial energy transition - decarbonization strategies at Devnya (e.g. Solvay Cement Plant, Solvay-Sodi sodium salt plant, etc.) and Beloslav (Varna Thermal Power Plant) through fuel transition, efficiency, and integration with renewable energy and grid modernisation; (d). Socio-environmental integration - relocating heavy port operations away from urban zones (e.g., from downtown Varna to Beloslav-Devnya shift) and compensatory greening initiatives that demonstrate commitment to sustainable urban development and spatial planning at the regional level. Varna–Beloslav–Devnya forms part of an R&D zone, leveraging academic, scientific, and industrial synergies.

The Varna–Beloslav–Devnya PCT is at a crucial stage in its energy transition. With major shifts underway in spatial planning, port infrastructure renovation, modal operations, and digitization, an integrated decarbonization strategy for the energy-intensive industrial cluster and port logistics is indeed essential for the near future.

Water-Designed Territories – Thresholds and Interfaces

Sofia Morgado [1]

[1] University of Lisbon

Understanding ***Reframing***

Examining the role of water in metropolitan territories from its origins raises several questions that can be approached from different angles. One such approach is to consider water as fundamental in the design of threshold areas and the interface between land and river-maritime territories. The materials and methods employed include a literature review and spatial analysis. The research is based on documentation from various sources, including urban planning and design, legislation, statistics, administration, published documentation, cartography, and iconography. The historical periodisation follows the industrial cycles of the Contemporary Age, which are more relevant to metropolitan areas

Changes in industrial cycles are mainly due to technological innovation and the introduction of new forms of energy, communication and urban occupation, such as water power (first mechanical, then steam), fossil fuels (coal and petroleum derivatives) and electricity production from various sources (from the aforementioned to photovoltaic and wind power). Throughout the first half of the 20th century, the Port of Lisbon's territory expanded through the artificial reclamation of area from the water and the blocking of the mouths of rivers. As in most industrialised port cities, the oil crisis led to the abandonment of areas, which were then offered for redevelopment (still under port authority jurisdiction).

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Conversely, the 21st century has seen these areas progressively handed over to municipalities for more integrated rehabilitation with other urban areas. The current moment and its as-yet-poorly understood implications of digitisation and AI usage raise doubts. While the energy sources seem

cleaner, they also constrain 1/2landscape values (e.g. photovoltaic plants spread over water bodies) and are far from sufficient to meet current needs. Public, leisure and cultural spaces are being made available to the population. Ecological and environmental issues, particularly in the context of climate change, are crucial in architectural and urban design approaches (e.g. emergency routes in the event of a tsunami and ground shaping, as seen at the Champalimaud Centre). As it is not possible to cover the entire area that was once under the jurisdiction of the Port of Lisbon — one of the few natural deep-water ports which was home to an extensive overseas territory — we have selected the municipality of Oeiras. This is due to its strategic location at the mouth of the Tagus estuary, meaning it still has the largest number of significant heritage-listed fortifications from the Modern Age, which are rarely seen in their territorial and functional context. There are other heritage elements to consider.

Bordering Lisbon, the impulses arising from its innovations and transformations are also felt here. Innovation in urban planning and design are marked by the passage of industrial cycles, especially in threshold areas. Taking into account economic, energy, and urban aspects, and in the context of SSH, the study will focus on the green-blue axis (EVA) and the rehabilitation of the Pedrouços dock, as these are exceptions due to their inter-municipal character.

Can the Existing Port Governance Model Support the Energy Transition? Setting the UK Green Port Governance Framework

Stavros Karamberidis [1]
[1] University of Plymouth

Understanding ***Reframing*** ***Envisioning***

Ports are vital nodes in global trade networks as they support maritime transport through facilitating 80% of global trade. However, maritime transport is responsible for three per cent of global greenhouse gas (GHG) emissions. The need to reduce GHG emissions is imminent, as the 1.5 °C threshold was exceeded in 2024, and if it is not addressed soon, global warming will have catastrophic consequences. Ports need to reduce their environmental footprint and supply alternative fuels to the maritime transport sector. Therefore, ports need to change their traditional operational model (solely trade), to a new operational model

which combines trade and energy. The combination of trade and energy will imminently transform ports to trade and energy hubs.

Ports operate under port governance models, which refer to the rules, processes, and structures that guide their management, operation, and development. The objectives of the current port governance model are to facilitate trade; therefore, the energy part is clearly missing. In the UK, the current port governance models were established in the late 1970s. While the UK government is actively working on streamlining regulations and encouraging private investment in green technologies, which in several cases is supported by the UK government (e.g., the Clean Maritime Demonstration Competition with a total budget of £206 million), an effective clean port governance framework is lacking. A truly effective framework requires a more collaborative and strategically focused approach. Considering that the UK ports are having a unique port governance model, namely: private, trust and local authorities, the aim of the research is: to examine if the UK port governance model is still fit for purpose, considering the immense change in ports operation due to the introduction of new sustainability initiatives and establish a framework that could help ports to embrace sustainability initiatives.

To achieve the aim, a structured literature review will be conducted at the first stage. The second stage will analyse the findings using a thematic analysis. In contrast, the final stage will involve conducting several interviews with key stakeholders (e.g., ports, government, shipping companies, cargo owners, logistics companies, and fuel suppliers) to confirm the findings. The anticipated outcomes will provide information on how global maritime transportation could become appealing to local contexts but also will help the EU to understand how its third biggest trade partner (UK) is reacting to sustainability measures. This will align with several EU green initiatives that are part of the Green Deal, for example, the EU ETS and the Corporate Sustainability Reporting Directive.