What Does Building Green Mean in Port Cities?

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Publication date
2022

Document Version
Final published version

Published in
PORTUSplus

PORTUSplus_the Journal of RETE
N. 14 - 2022, Year XII
Issue *"Research Themes"*
RETE Publisher, Venice, ISSN: 2039-6422

ABSTRACT

This article explores the concept of 'green' in architecture and urban design through the lens of port cities. Due to global pressures such as climate change, energy transition and soil consumption the planning of port cities requires new scenarios for achieving equilibrium between nature and water systems. Despite the fact that the concept of green is widely shared in both academic and professional fields –who could possibly oppose green?– it can be argued that the concept is also widely misused and misunderstood. This article uses the "Building Green" TU Delft Architecture master's elective course (academic year 2021/2022) designed and coordinated by Carola Hein as a starting point for a larger discussion of whether the term green is helpful for achieving sustainability in port cities and at what scale. The course analyzes the concept of sustainability through time, arguing that people built green "by necessity" before the industrial revolution and it explores contemporary attempts at building "green by desire". Finally, it asks for approaches of building "green by design". The course argues that these diverse approaches to building green and the contemporary needs of sustainability are highly relevant for port cities. It challenges students to analyze a port city in light of its sustainability practices and to develop scenarios for sustainability.

What Does Building Green Mean in Port Cities?

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KEYWORDS
Green; Design; Education; History; Sustainability; Scenarios

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Introduction

Globally, ports create multiple economic opportunities for their nearby cities and surrounding regions. Ports also bring challenges and threats to people in cities and landscapes. At the top of these are ecological hazards, conflicting uses, reduced safety, and other socio-cultural costs. The relationship between cities, landscapes and their ports is often a troubled one, marked by competing interests. To fulfill their economic goals, ports need room to thrive and grow, including through the development of infrastructures or the construction of dry ports. City governments aim to create space for economic growth and livability that at times compete with the interests of ports[1]. Although the future seems uncertain, this article argues that planning for the future also provides opportunities for designers and decision makers to rethink the nature of ports in close connection with the city and territory and to look for opportunities for collaboration specifically in terms of the shared desire to create more circular "green" practices and spaces.

The article uses the "Building Green" TU Delft Architecture master's elective course (academic year 2021/2022) as a starting point to understand how a broad analysis of the concept of sustainability through time can inspire new approaches to the design of sustainable practices in port city territories. It argues that the concept of sustainability, understood as economic, environmental and social practice, has long accompanied the formation and development of port cities[2]. In many historic port cities such as Naples, Genoa, Marseille and Rotterdam, ports have been the main reason for the economic and urban development of the nearby city; this relationship meant that it was necessary to find ways of providing housing and infrastructure for port workers who needed to be able to access the port. This was the case in many parts of the world until the 18th century and remained true throughout the early years of the 19th century[3].In Mediterranean cities such as Beirut, Alexandria and many others, the expansion of the ports and the regulation of movement of goods and people had a direct impact on economic prosperity and the improvement of education and public health in the host cities. The relationship between port and city has contributed to creating a vibrant and diverse socio-cultural environment[4]. With the rapid expansion of industrialization and shipping activities, this relationship was interrupted. As port authorities focused on economic growth, the historic link to the city disappeared[5].

Sustainability is a goal that many port, city and territorial authorities hope to achieve in the near future. Its pursuit requires new approaches as seen in European policies and projects on smart and green ports and sustainable mobility[6]. Although the global pressures to achieve this goal are immense, and despite the need to introduce new policies to respond to those pressures, it can be argued that most port and city authorities have yet to take any serious steps toward more sustainable models of growth that put the fundamental relationship between ports and their host

[1] Luigi Fusco Girard, 'Sustainability, Creativity, Resilience: Toward New Development Strategies of Port Areas through Evaluation Processes', *International Journal of Sustainable Development* 13, no. 1–2 (2010): 161–84.
[2] Carola Hein and Dirk Schubert, 'Resilience and Path Dependence: A Comparative Study of the Port Cities of London, Hamburg, and Philadelphia', *Journal of Urban History* 47, no. 2 (2021): 389–419.
[3] Carola Hein. "Port cities and urban waterfronts: how localized planning ignores water as a connector." *WIREs Water* 3 (2016): 419–438.
[4] Toufoul Abou-Hodeib, 'Quarantine and Trade: The Case of Beirut, 1831–1840', *International Journal of Maritime History* 19, no. 2 (2007): 223–44.
[5] Marica Castigliano et al., 'Reinventing Wastescapes in Port Cities. A Resilient and Regenerative Approach to Plan Naples at the Time of Logistics', *BDC. Bollettino Del Centro Calza Bini* 20, no. 2 (2020): 261–76.
[6] European Commission. 2020. Sustainable and Smart Mobility Strategy – putting European transport on track for the future. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789. Last access 15.12.2022.

cities at the center[7]. As a result, multiple scholarly voices are calling for a reconsideration of the paradoxical relation between ports and cities and have proposed a new path, in which ports and cities are seen to complement each other, with a common aim of developing sustainable practices for both port and city that actually support each other[8]. European port cities such as Hamburg, Antwerp and Rotterdam have been producing studies that make a strong argument for the urgency of reversing the strongly negative environmental impacts of ports. The most discussed topics include the development of ecological transport chains, the protection of nature, reduction of CO2 emissions, the shift toward a circular economy and the improvement of business ethics[9]. The recent explosion at the Port of Beirut in August 2020 –for example– shows that such a reverse can no longer be a luxury, nor can it be limited to academic discourse only. The storage of a huge amount of explosive material within the port in complete absence of safety measures led to a catastrophe with serious consequences for health and the economy and heritage of the city[10].

The following sections use the main elements of the Building Green course syllabus to start discussion on three key topics. The first one is about the role of urban and architectural history and perspectives for understanding the relation between spatial transformations and practices and various historical concepts of sustainability. The second theme looks at the more recent history of modernist architecture and planning and explores the ways in which designers altered the concept of sustainability focusing on industrial, energy-intensive models that are also at the heart of the relationship between ports and cities, creating significant impacts on the environment and social wellbeing. The third theme tackles the present moment by looking at energy transition in port cities. It is within this system of moments of change that designers, architects and historians among others have to situate themselves and take positions. In Building Green, students were invited first to understand the various historical continuities and path dependencies of sustainable thinking in planning. Then, building on such knowledge, they were asked to look at current challenges to identify possible opportunities for building new sustainable scenarios in port cities.

Taking Historical Practices Seriously

In line with the work done in the course Building Green, this section explores the history of the concept of sustainability, first in general terms and then in port cities in particular. Sustainability is a concept that has a very long history and that there are multiple lessons that can be learned from this history for addressing today's challenges in port cities.

Traditionally, human development has been limited by the capacity to live with nature. The long history of industrial and pre-industrial development offers examples of cities and towns which succeeded (or not) at developing a good relationship with their hinterlands and surroundings. This took different shapes and forms, ranging from maximizing use of resources to improving and strengthening circularity. Through engineering and the development of complex systems, many ancient cities in Iraq, Egypt and Palestine developed systems that maximized the use of water resources without heavily degrading them. This was particularly visible in water and coastal cities, where the opportunities afforded by the contact between land and water attracted various human groups to settle and work. Ports as places of transshipment have long been built as an extension

[7] Libera Amenta and Paolo De Martino, 'Wastescapes in Port Cities. Naples and Rotterdam: A Spatial and Institutional Comparison on the Role of Ports as Promoters of Circular Economy', BDC. Bollettino Del Centro Calza Bini 18, no. 2 (2018): 159–80; AIVP. (2018). AIVP Agenda 2030. Retrieved from https://www.aivp.org/en/acting-sustainably/agenda-2030/; AIVP. (2021). Preparing Ports and Port Cities for Climate Change: Mitigation and Adaptation. Retrieved from https://www.aivp.org/en/newsroom/preparing-ports-and-port-cities-for-climate-change-mitigation-and-adaptation/.

[8] Ying Zheng, Jingzhu Zhao, and Guofan Shao, 'Port City Sustainability: A Review of Its Research Trends', *Sustainability* 12, no. 20 (2020): 8355.

[9] Natalia Wagner, 'Sustainability in Port Cities–a Bibliometric Approach', *Transportation Research Procedia* 39 (2019): 587–96.

[10] John Hanna, 'Virtual Roundtable "Beirut Urban Declaration: Which Future for Beirut Port?', *PortCityFutures* (blog) (Port City Futures, 2021), https://www.portcityfutures.nl/news/virtual-roundtable-beirut-urban-declaration-which-future-for-beirut-port.

of the city toward the sea, the marketplace and the large urban square on water[11]. This close contact with water was in multiple cases a driving force for developing ecological thinking and fostering a reciprocal relationship with nature to mitigate threats and increase the livability of nearby cities.

Ancient cities developed a carefully balanced relationship of local needs and global transport and paid careful attention to water management, often addressing the particular challenges of life at the edge of sea and land. Archaeobotanical examinations carried out by American and Jordanian archaeologists in Aqaba around the historical Red Sea port city of Aila, for example, found botanical evidence of local cultivation and evidence that only select goods were transported to port cities. This counters the earlier assumption that the city depended on imported food and strengthens the probability that local oasis agriculture existed within the city[12]. It also provides evidence of the attention given in port cities to local water management, which was key to making life even possible in many port cities. Around the Mediterranean, the economic prosperity of the port town of Jaffa benefited from local agriculture in its hinterland[13]. In Alexandria, a complex water management system led to maximizing the use of rainwater and limiting the deterioration of limited natural resources[14]. In Edo-period Japan, recycling and resource-circularity were driving systems of the port town of Edo (present-day Tokyo)[15], effectively limiting the size of the city.

All these examples show how sustainable thinking went hand in hand with the development of many ports and their nearby cities and territories. Driven by need, an essential degree of integration between ancient port cities, the environment and their surroundings led historical political actors and societies to try to achieve economic and social prosperity by maximizing use of natural resources without over-stressing them.

Understanding Port Cities Through the Lens of Modern Planning

To bring about a change in contemporary (port) cities, it is important to question the planning visions and concepts of the past. By the second half of the 19th century, industrialization and mechanization introduced many new opportunities and challenges. Zoning and functional segregation appeared as solutions to safeguard people's health. Architects and planners developed visions and technical solutions to facilitate the industrial productivity of urban communities[16]. Yet, while adapting this paradigm, many of the early pioneers linked their proposals to their own concepts of sustainable development, building for people and with nature. Today, we see a situation in which sustainability, driven by need in antiquity, has become selective and driven by desire in modernism.

In many port cities, unregulated population density, lack of green and open spaces, and the deteriorating living conditions of workers and city inhabitants were understood to have a negative impact on the livability and functionality of these industrial communities. In Liverpool, Industrial

[11] Michelangelo Russo, 'Harbourscape: Between Specialization and Public Space', in *The Fluid City Paradigm* (Springer, 2016), 31–44.

[12] Jennifer H Ramsay and S Thomas Parker, 'A Diachronic Look at the Agricultural Economy at the Red Sea Port of Aila: An Archaeobotanical Case for Hinterland Production in Arid Environments', *Bulletin of the American Schools of Oriental Research* 376, no. 1 (2016): 101–20.

[13] Komal Potdar and Els Verbakel, 'Eidetic Mapping: An Exploration for Sustainability and Resilience of Historic Urban Landscapes', vol. 1 (The Twelfth International Convention of Asia Scholars (ICAS 12), Amsterdam University Press, 2022), 547–59.

[14] S Spanoudi, A Golfinopoulos, and I Kalavrouziotis, 'Water Management in Ancient Alexandria, Egypt. Comparison with Constantinople Hydraulic System', *Water Supply* 21, no. 7 (2021): 3427–36.

[15] Herbert Girardet, *Cities People Planet* (Wiley, 2008); Kosuke Sakura, 'The Relationship between Urban Structure and Waterways in Edo, Old Tokyo', *Irrigation, Society and Landscape. Tribute to Tom F. Glick*, 2015, 924–34; Morris Low, 'Eco-Cities in Japan: Past and Future', *Journal of Urban Technology* 20, no. 1 (2013): 7–22.

[16] Elisa Iturbe, 'Architecture and the Death of Carbon Modernity', *Log*, no. 47 (2019): 10–23.

entrepreneur William Lever commissioned William Owen in 1888 to overview the development of a new town on the banks of the Mersey River, just to the south of the port of Liverpool. The development was driven by Lever's interest in providing his community of workers with green spaces and improved health conditions, part of his efforts to improve the brand of his company[17]. Attempting to redefine a connection between industry and nature at the turn of the 20th century, Ebenezer Howard critiqued the development of London as an industrial city. He proposed instead *Garden Cities of Tomorrow*, promoting social and urban sustainability, focusing on railways. His writings challenged the binary thinking about town and country and proposed a healthy combination between the two. He argued this would increase quality of life by reconnecting people to nature[18].

In 1913 in Rotterdam, the Rotterdamsche Droogdok Maatschappij NV (RDM) shipbuilding and repair company commissioned Amsterdam-based architect H. A. J. Baanders to plan a housing village for its employees. Inspired by concepts of garden villages and their English examples, Baanders developed a plan for Heijplaat on the southern side of the Maas River, which aimed to contribute to the improvement of the health and housing conditions of the workers of the company[19].
These projects were commissioned by industrial entrepreneurs to engineer and regulate working communities with the ultimate goal of improving their brands and enhancing worker productivity, however, they remain significant because they took into account many factors contributing to sustainability[20].

Figure 1. Heijplaat. (Photo by John Hanna, 2022).

Port cities, as hubs of industrial development, also held a key place in the theories of modernist planners. Le Corbusier's 1933 *Athens Charter*, which was based on observations made by participants at the fourth Congrès internationaux d'architecture moderne (CIAM), showed a clear understanding of the housing crisis and made a case for zoning as a way to solve the ills of the city.[21] These ideas found application in the work of Cornelis van Eesteren, Dutch planner and chairman of CIAM, whose General Expansion Plan for Amsterdam (AUP) in 1934 introduced massive new green spaces to the second-largest Dutch port city, connecting it with the surrounding nature[22]. Indeed, one can argue that the separation of functions –a common and favorable pattern of urban planning during that period– had a number of negative implications,

[17] Amanda Rees, 'Nineteenth-Century Planned Industrial Communities and the Role of Aesthetics in Spatial Practices: The Visual Ideologies of Pullman and Port Sunlight', *Journal of Cultural Geography* 29, no. 2 (2012): 185–214.
[18] Ebenezer Howard, Garden Cities of Tomorrow (Faber London, 1946).
[19] Jean-Philippe Zwaluw, *Heijplaat in Verzet: Oorlogsgetuigenissen Uit Het Gebied Rond de Rotterdamse Waalhaven* (Uitgeverij Verloren, 2010).
[20] Rees, 'Nineteenth-Century Planned Industrial Communities and the Role of Aesthetics in Spatial Practices'.
[21] Le Corbusier and Anthony Eardley, *The Athens Charter* (Grossman Publishers New York, 1973).
[22] John I Gilderbloom, Matthew J Hanka, and Carrie Beth Lasley, 'Amsterdam: Planning and Policy for the Ideal City?', *Local Environment* 14, no. 6 (2009): 473–93.

particularly in regard to the connection between the city and the port[23]. Nevertheless, the plan offers a social and ecological solution to challenges of density and overcrowding[24].

Critiques of the modern industrial city and its living conditions led other authors, such as Frank Lloyd Wright, to call for integrating nature and architecture. This integration was not to be driven only by notions of a better outer aesthetic, but to create the complete circumstances for a better way of life, where the inhabitants of these houses would feel in harmony with the surrounding nature. In this work, Wright stressed the economical sustainability of using natural material[25]. Here again, it becomes clear that sustainable thinking (seen through a broad lens and understood within its historical context) has developed side by side with architecture and urban planning, even during times when the discipline embraced new technologies and practices. History shows various incidences where modernist architects and planners succeeded at improving health, living conditions, and building strong connections with surrounding nature, driven by a conscious awareness of the scarcity of resources and the necessity of economic and environmental sustainability.

The pioneers of modernism were not blind to the need for sustainable planning and the challenges of achieving this. They understood them and related to them. They tried to address these challenges by fostering stronger connections with nature and by improving the residential space. However, while aiming for forms of sustainable and nature-integrated practices, these modernist planners, often assuming an abundant and never-ending supply of energy[26], set the stage for energy-intensive, spread-out cities for cars, with functional separation and skyscrapers, paving the way for the modernist separation of port and city, and the creation of large monofunctional areas for oil, containers and giant ships. Architects and planners facilitated the petroleum revolution, while trying to promote their own vision of sustainable development. They served as multipliers, raising the question of how architects and planners today can facilitate sustainable practices without effectively promoting a continuation of the energy intensive practices they helped establish. Thinking about sustainability has been taking on different shapes and has been driven by different forces over time. This paper and the Building Green course therefore argue that it is important to explore and understand the multiple dimensions of sustainability and develop comprehensive perspectives for more sustainable futures, notably in port cities that have been hubs of industry and energy-intensive development.

Planning Beyond Oil

Today, sustainable thinking in future-planning for port cities has become even more urgent. One of the main issues to address is the fossil fuel infrastructure. Port cities and their territories are home to numerous functions of the oil industry, a major challenge to sustainability. Planning for a sustainable future requires a reimagination of port cities, especially those that are dependent on the oil industry. This section considers how oil has shaped the port city spaces and cultures we experience today. Oil has shaped landscapes and cities around the world in different ways. Industrial facilities such as oil refineries, oil tanks, oil company headquarters, gas stations and road infrastructures are the tangible result of petroleum power. In various publications, Carola Hein has introduced the concept of the petroleumscape to analyze the complex interconnection of

[23] Han Meyer, 'Ex-Ports: The Laboratory Role of the London Docklands In Which the Author Looks at the Historical Development of Docklands From', in *London's Turning,* by Michael J. Rustin (Routledge, 2016), 25–32.
[24] Edwin Brierley, 'A Comparison of the Berlage and van Eesteren Plans for the Extension of Amsterdam', in *The Urban Experience*, by F.E. Brown, S.J. Neary, and M.S. Symes (Routledge, 2003), 488–97.
[25] Frank Lloyd Wright, *The Natural House* (Bramhall House, 1954).
[26] Barnabas Calder and GA Bremner, 'Buildings and Energy: Architectural History in the Climate Emergency', *The Journal of Architecture* 26, no. 2 (2021): 79–115.

tangible and intangible aspects of oil in relation to space and culture[27]. The concept can be used as an interpretative tool to understand and re-interpret the complex relationship between oil flows, infrastructure, and human life.

Indeed it is because of the oil industry and the development of ports, refineries and the larger petroleum infrastructure spread across our territories that cities function today in the way we know it. Most of the clothes we wear contain petroleum, as do all the objects that surround us, from smartphones to computers to cosmetics. Food also contains oil, if we think of the logistics chain that transports it or the packaging that wraps it[28]. Oil has produced prosperity and increased well-being, allowing people to move smoothly around the world. At the same time, oil has produced inequality and enormous waste and has altered the landscape. There are many examples that can be used as background to the story of petroleum: Naples, Dunkirk, Antwerp, Le Havre and Rotterdam are just a few from Europe. There are many others around the world. Dealing with the often unacknowledged petroleumscape requires an urgent rethinking of both spaces and cultures; port cities have a key role in that rethinking.

Imagining a scenario without oil requires designers and policy makers to think not only about technical solutions, but also to question lifestyles and cultural beliefs. Addressing an urban and spatial problem is also an opportunity for a radical transformation of society and dominant cultural constructs. The territories left behind by petroleum need to be recovered and redesigned to make room for new energy forms, for people and for nature. All of this raises questions: How will these places work in the future? How much space will the energy transition take? What role can culture play in rethinking the port cities of the future? Post-oil scenarios require rethinking the urban palimpsest together with the material and immaterial flows that are part of it. A scenario beyond oil can help reformulate the relationship between cities, infrastructure, heritage, landscape, water and economy. We need to adapt heritage to host new functions that are more compatible with contemporary needs. This is particularly important in oil-intensive port cities. The design perspective can allow ports to establish new forms of integration with the city, enriching the urban form and function and its memories.

Planning Beyond Technology. (Re)imagining Brownfields to Re-connect Land and Water

Ports are areas in transition and fragile spaces that today are experiencing radical spatial and institutional changes. Their location at the edge of sea and land makes them particularly vulnerable to climate change[29]. Ports have progressively lost their dual nature of landscape and urban space to become places of logistics and large-scale infrastructure, detached from cities and from the collective imagination. While academics and professionals are paying considerable attention to sustainability and whether ports can be developed differently to achieve circularity, few ports or cities have taken significant steps toward new circular models of growth. Ports are still expanding, and they still generate large amounts of waste, while also leaving networks of left-

[27] Carola Hein, 'Between Oil and Water. The Logistical Petroleumscape', *The Petropolis of Tomorrow*, 2013, 228–37; Carola Hein and Mohamad Sedighi, 'Iran's Global Petroleumscape: The Role of Oil in Shaping Khuzestan and Tehran', *Architectural Theory Review* 21, no. 3 (2016): 349–74; Carola Hein, Michelangelo Russo, and Paolo De Martino, 'Planning the Post-Petroleumscape: Overcoming the Territorial Impact of Oil on the Urban Landscape of Naples' (Conferenza XX Nazionale SIU: La responsabilità della proposta, Planum Publishers, 2017), 1153–63; Carola Hein, 'Oil Spaces: The Global Petroleumscape in the Rotterdam/The Hague Area', *Journal of Urban History* 44, no. 5 (2018): 887–929.

[28] Carola Hein, Michelangelo Russo, and Paolo De Martino, 'Planning the Post-Petroleumscape: Overcoming the Territorial Impact of Oil on the Urban Landscape of Naples' (Conferenza XX Nazionale SIU: La responsabilità della proposta, Planum Publishers, 2017), 1153–63.

[29] Braudel Fernand, Il Mediterraneo. *Lo Spazio La Storia Gli Uomini Le Tradizioni* (Milano: Bompiani, 2008).

over territories that exist in states of wastefulness: port-city wastescapes[30]. These are complex territories dominated by uncertain planning regimes that require new strategies. Much more attention should be paid to the contact areas between land and water as porous spaces where the flows of logistics and global distribution connect land and sea[31].

Planning for the Future

The open and experimental setting of architectural academic education can activate new modes of thinking, making it possible to reimagine port cities, notably their entanglement with the oil industry, in a way that responds to the current climate crisis. At Delft University of Technology, the Chair of History of Architecture and Urban Planning for the past few years has been offering a master's of architecture elective with the title "Building Green: Past, Present, Future". In the course, students are asked to carefully assess the theoretical and practical foundations of projects for sustainability in existing cities. The students are encouraged to use port cities, especially Rotterdam, as case studies of possible future green transformations.

This section attempts to answer these questions by analyzing scenarios. Scenarios are a particular form of prevision. They propose to look at the future through *"what if"* questions allowing for a different narrative. More specifically, they permit different stories to coexist and they help to create a new vision[32].

Figure 2. Dwelling or Offices | Impressions. (Source: AR2HA011 Building Green: Past, Present, Future - Ásta María Þorsteinsdóttir, Cedric Hietbrink, Manasse Heijkoop, Kristen Delis).

[30] Marica Castigliano et al., 'Reinventing Wastescapes in Port Cities. A Resilient and Regenerative Approach to Plan Naples at the Time of Logistics'; Libera Amenta and Arjan Van Timmeren, 'Beyond Wastescapes: Towards Circular Landscapes. Addressing the Spatial Dimension of Circularity through the Regeneration of Wastescapes', *Sustainability* 10, no. 12 (2018): 4740.

[31] Carola Hein, 'Planning for Porosity: Exploring Port City Development through the Lens of Boundaries and Flows', *Urban Planning* 6 (2021).

[32] Paola Viganò, I Territori Dell'urbanistica: Il Progetto Come Produttore Di Conoscenza (Officina, 2010).

One group of students (Fig. 2)—also inspired by European examples such as the Gasometers in Wien which were transformed into housing units by Jean Nouvel, Coop Himmelblau, Wilhelm Holzbauer and Manfred Wehdorn at the beginning of the 21th century—looked at oil tanks around the port of Rotterdam as a form of city heritage. They argued that dismantling them would involve a loss of cultural and architectural heritage. They believed in the potential of recycling. As a result, they proposed a handbook to help future designers to transform oil tanks. They came up with four different categories: conditions, urban, pollution and space & structure. For each category, they identified and analyzed problems and provided some solutions for different contexts.

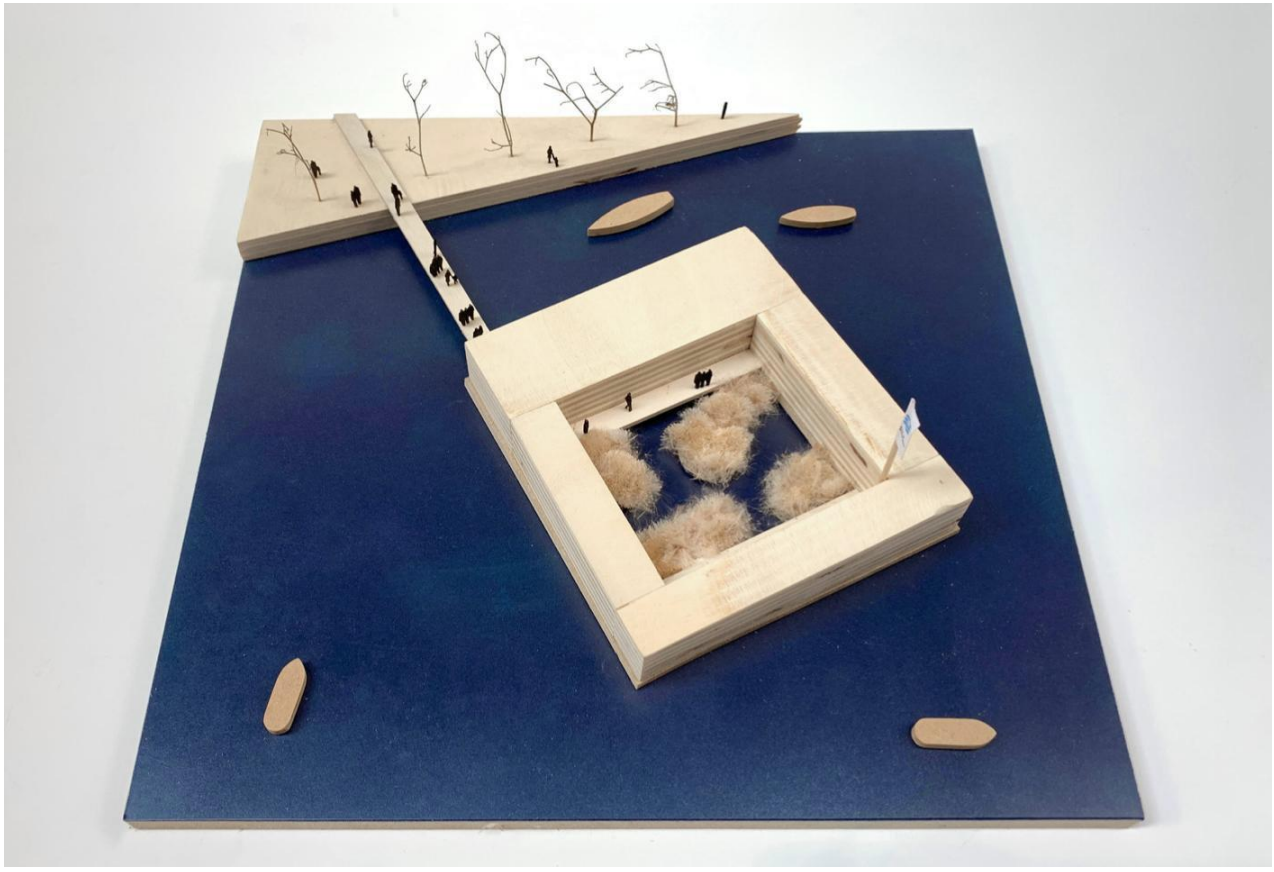

Figure 3. Model of Futurama 2050 Pavillon. (Source: AR2HA011 Building Green: Past, Present, Future - Khalil Amrani, Emily Manche, Marianna Moskal, Bartosz Teodorczyk).

Another group (Fig. 3) found their inspiration in the Futurama Pavilion designed by Geddes in 1939 for the New York World's Fair. Their proposal, Futurama 2050, speculated about what the future of Rotterdam would look like in thirty years. More than a reflection on space itself, the project aims to create awareness of the social dimension of sustainability. The pavilion would be placed on water and built as a new public space and it will benefit the community by creating inclusion, diversity, social cohesion, social capital, participation and security. The pavilion will give nature a voice inside the center of the pavilion by creating a wetland. This wetland will provide a habitat for several species and benefit water quality. Industrial spaces like the port of Rotterdam often have poor water quality and wetlands like this could be a solution by providing nutrient removal, nutrient processing and metabolism, reduction of the effects of eutrophication, heavy metal sequestration, carbon sequestration into plant biomass, improved water clarity, food, structure, and refuge for fish and nekton. Habitat will also be provided for birds, insects and other biotas. The project is a provocation that asks for new forms of coexistence in the future between infrastructure, the built environment, industry and nature as captured in a poster promoting their Futurama event (Fig. 4).

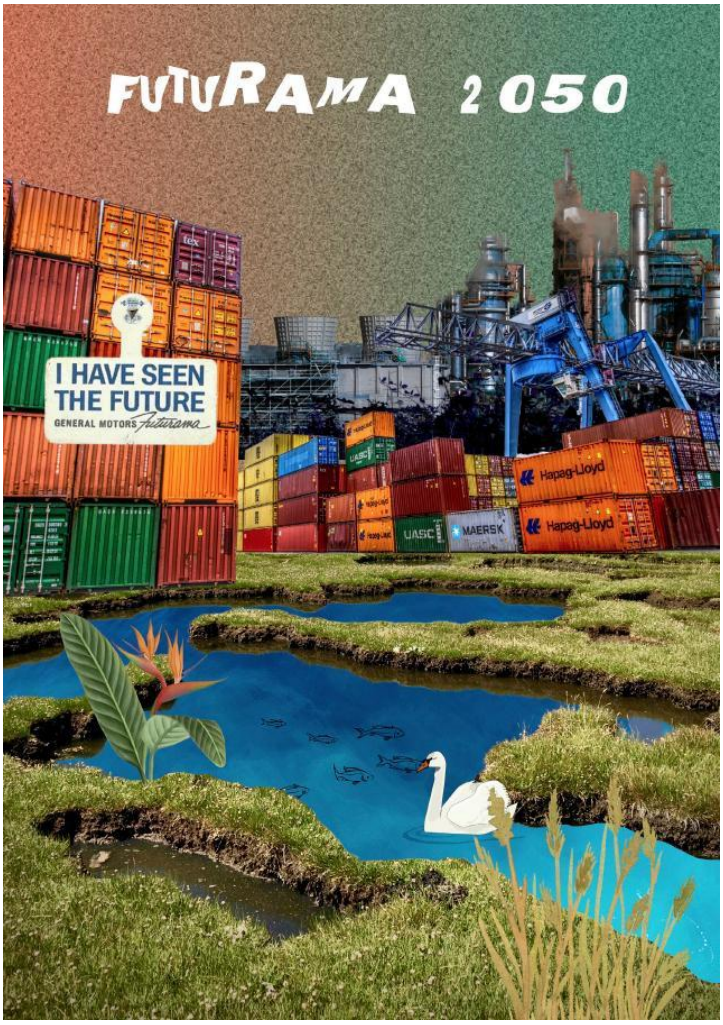

Figure 4. Futurama 2050, poster promoting a new vision of future. (Source: AR2HA011 Building Green: Past, Present, Future - Khalil Amrani, Emily Manche, Marianna Moskal, Bartosz Teodorczyk).

Various initiatives at the European level, including ideas and regulations, have been proposed to make people realize that they must live more sustainably with the planet[33]. However, path dependencies seem to work against cultural, economic and environmental transitions. If sustainability is framed as a cultural construct, one group of students argued that we need to build awareness both of what a port is and its impact on the territory. They presented a game with the ambition of building more sustainable scenarios (Fig. 5). They argued that to reduce the large amount of CO_2, emitted by the Port of Rotterdam- carbon emissions of 13.7 million tons annually[34],- it is important to make people more aware of their impact on the environment[35]. The game took the game Monopoly as a point of departure since it responds to the materialistic and capitalistic culture to which our society belongs. The Monopoly model helps make the game more tangible, so that people can better imagine the transitions that take place while playing the game. The player can buy assets. These assets make revenues, from which taxes are deducted depending on emissions. These emissions are deducted from the player's account on a yearly basis, or in case of inspections, a fine can be issued if the values are above average. It is the player's intention to find a balance between sustainable investment and economic growth.

[33] EC. (2019). Delivering the European Green Deal. Retrieved from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en/.

[34] Transport and Environment. URL: https://www.transportenvironment.org/discover/rotterdam-tops-ranking-of-port-polluters-doing-little-to-support-green-fuels/#:~:text=T%26E's%20ranking%20of%20Europe's%20ports,shipping%20while%20industry%20profits%20soar. Last access 11 July 2022/.

[35] Hilde Sennema et al., 'The Maritime Mindset: A Conceptual and Practical Exploration of Mapping Port Cities', European Journal of Creative Practices in Cities and Landscapes 4, no. 2 (2021): 152–63.

Figure 5. The game "Building Green". (Source: Marc van Zantvliet, Gili Hofland, Justus Bos, Adriaan D. R. I. Bon).

Conclusions

This article has explored changing approaches to sustainability in relation to port cities. It argues that path dependencies need to be recognized to gain an understanding of obstacles and opportunities. This awareness is essential for planning for the future. Ancient and historical examples point to an appreciation of circularity and an awareness of resource scarcity in port cities. The modern history of sustainability has been about improving housing and shelter and connecting with nature, but to achieve such practices, planners recommended functional separation and zoning, effectively promoting unsustainable traffic and energy-intensive practices. Modernity and the idea of progress attached to it have in fact led to a separation of ports and cities—which entails not only a separation of spaces, but also of cultures and economies. Contemporary challenges call for an urgent positioning in relation to this long and often-contested history of planning. Answering them requires a rethinking of the practices that have established ports and cities planned as separated entities. Education can play a key role in preparing future designers to generate a better future. The students' designs that have been discussed in this article exemplify the capacity of critical thinking and imagination that can help create scenarios for sustainable development.

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DE MARTINO, Paolo, HANNA, John and Carola HEIN. 2022. What Does Building Green Mean in Port Cities?. *PORTUSplus* 14 (December). https://portusplus.org/index.php/pp/article/view/268