



Project acronym: POTENT-X

Project title: Ports as Energy Transition Hubs



Proceedings of the second POTENT-X annual conference

Held at WMU on 6 May/ 2026

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List of Abbreviations	
AEI	Agencia Estatal de Investigación
CETP	Clean Energy Transition Partnership
CBS	Copenhagen Business School
CTH	Chalmers University of Technology
DTU	Technical University of Denmark
PoA	Port of Aalborg
PoT	Port of Trelleborg
SWEA	Swedish Energy Agency
USEV	University of Seville
WMU	World Maritime University



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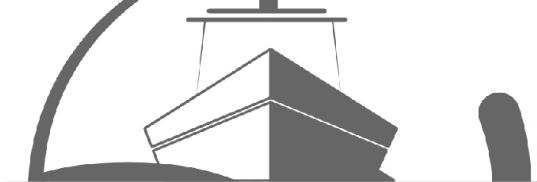


Executive Summary

The second annual POTENT-X conference was held on 6 May at the World Maritime University (WMU) in Malmö in the afternoon prior to the “Decarbonizing Together” Global MTCC Network Workshop on Inclusive Maritime Decarbonization.

The POTENT-X conference highlighted the importance of collaboration between academia, industry, ports, and international organizations in supporting maritime decarbonization and sustainable port energy transitions. The conference brought together experts from leading institutions, universities, ports, and the International Maritime Organization (IMO) to discuss policy, digitalization, financing, stakeholder engagement, and practical implementation strategies for transforming ports into energy transition hubs.

The event promoted interaction between students, researchers, industry professionals, and international organizations, strengthening institutional collaboration and supporting long term capacity development in maritime energy management and decarbonization.

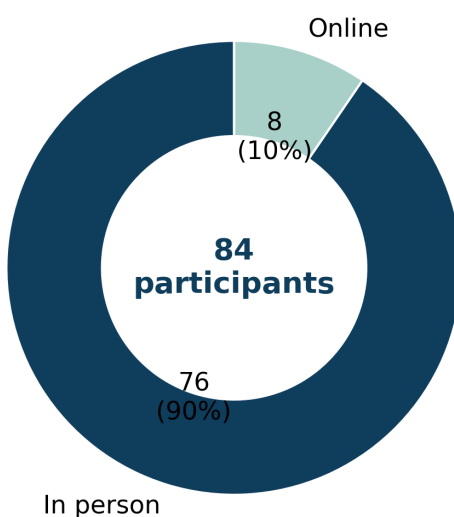


1. POTENT-X Workshop: Participant Statistics

Overview

The workshop brought together 84 participants from 26 organisations across academia, international bodies, government, industry, and NGOs. Of these, 76 attended in person in Malmö and 8 joined online. Online participants registered without organisational details, so they are counted in the overall attendance but not in the breakdowns below.

Workshop Participation

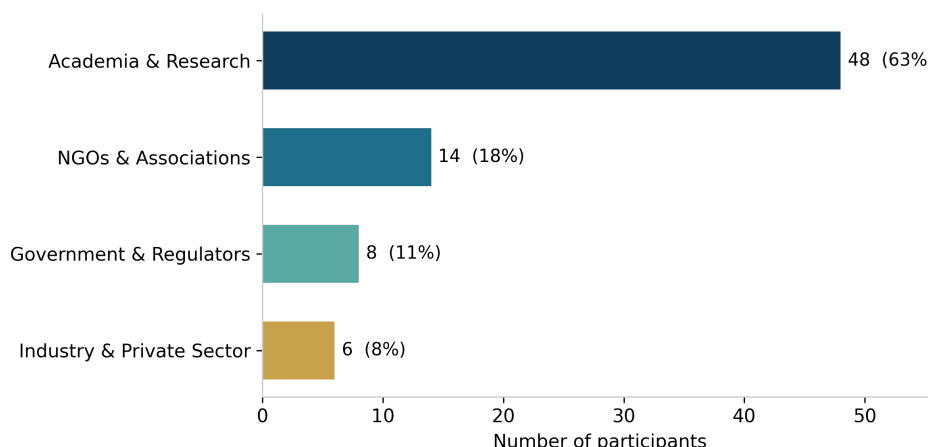


Sectors

Academia & Research formed the core of the audience with 48 participants (63%), followed by NGOs & Associations with 14 (18%), led by the IMO and the four regional Maritime Technology Cooperation Centres. Government & Regulators contributed 8 participants (11%) and Industry & Private Sector 6 (8%), giving the workshop a strong academic base complemented by policy, regulatory, and industry voices.



Participants by Sector

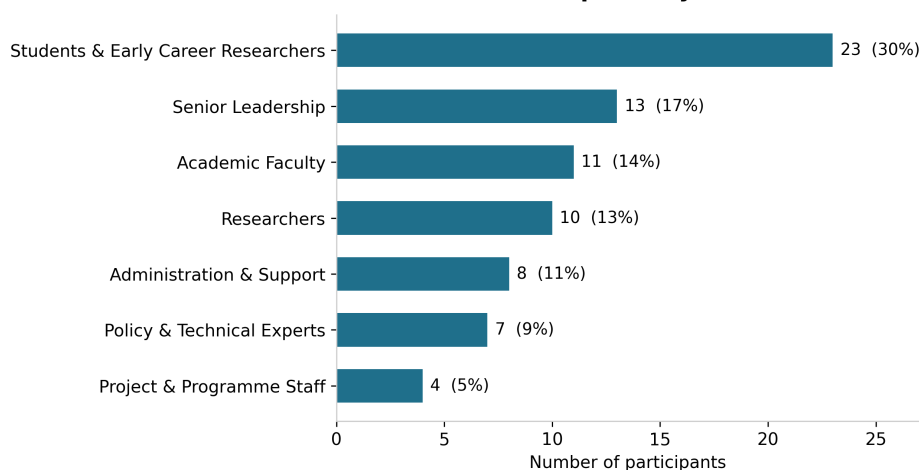


n = 76 participants with registered details; a further 8 joined online (details not recorded). Total participation: 84.

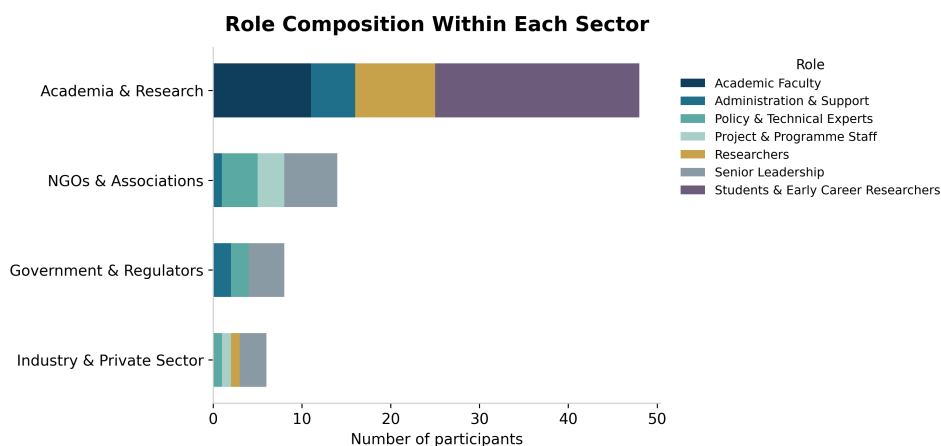
Roles

Students and early career researchers were the largest group (23 participants, 30%), followed by senior leadership (13, 17%), academic faculty (11, 14%), and researchers (10, 13%). Within sectors, the academic contingent paired established faculty with a large early career cohort, while the NGO, government, and industry delegations were weighted towards senior leadership and technical experts, bringing decision makers and specialists from practice alongside the research community.

Participants by Role



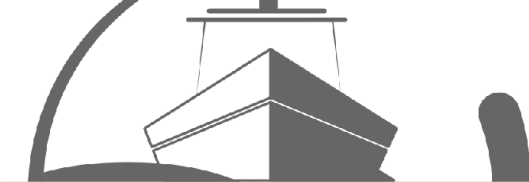
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Organisations

World Maritime University, as host, provided the largest delegation (36 participants), most of them mid-career professionals from different countries who hold leading positions in maritime administrations, port authorities, shipping lines, regulatory bodies, fisheries, navies, and other maritime sectors. The University was followed by the IMO (5), Copenhagen Business School (4), and Chalmers University of Technology and MTCC Asia (3 each). The remaining organisations each sent one or two participants, giving the event broad institutional reach across Europe, Africa, Asia, Latin America, and the Caribbean.



2. Introduction

The second annual POTENT-X conference, held on 6 May at the World Maritime University (WMU) in Malmö, was moderated by Associate Professor Fabio Ballini (WMU) and Professor Sonia Yeh (CTH). They introduced the various speakers of the conference, as well as the consortium's partners: Professor Aykut Ölcer (WMU), who introduced the Potent-X project, Assistant Professor Christopher Dirzka (CBS), who focused on the Policy Analysis, Research Associate Anas Alamoush (WMU), who spoke about the stakeholder interests, needs, dependencies and interactions in Port Energy Transition, Professor Charlampos Orfanidis (DTU), who explained the baseline technical requirements for smart port digital infrastructure and system-of-systems architecture, Researcher and Scientific Coordinator Bénédicte Madon (USEV) who emphasized the connection between energy transition and ecological consideration in ports, and living labs as tool to make this integration real, Project Director in Port of Aalborg's new Research & Development department Lars Jøker, who illustrated the living lab example of port of Aalborg, WMU Adjunct Fellow and Advisor Mark Clintworth, who stressed the financial aspect of projects, especially pilot ones, and Director & GHG Advisor, Maritime Technology Cooperation Centre Caribbean Stephan Nanan, who explained the role and peculiarities of the Caribbean ports.

2.1 The moderators

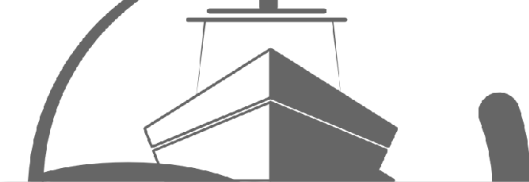
2.1.1 Sonia Yeh, Professor, Physical Resource Theory, Department of Space, Earth and Environment, Chalmers University of Technology

Professor Dr. Sonia YEH is Professor of Transport and Energy Systems at the Division of Physical Resource Theory, Department of Space, Earth and Environment, Chalmers University of Technology (Sweden). Her research focuses on sustainable transportation, energy systems modelling, alternative and low-carbon fuels, and the policies and consumer behaviours that shape the transition to low-carbon mobility. She is internationally recognised for her expertise in energy economics and in the systems modelling of transport, including pioneering analysis that has informed the design of low-carbon fuel standards. Prior to joining Chalmers, she was a research scientist at the Institute of Transportation Studies at the University of California, Davis (USA), and she has held affiliations with a number of international energy and climate policy research networks. In 2018 she was named by Cell Press among its "50 Scientists that Inspire," and her work continues to be widely cited across the transport, energy and climate research communities.



2.1.2 Fabio Ballini, Associate Professor, Maritime Energy Management, WMU

Dr. Fabio BALLINI is Associate Professor in the Maritime Energy Management (MEM) specialization at the World Maritime University (WMU) in Malmö, Sweden. He holds a European Ph.D. in Electrical Engineering from the University of Genova (Italy), where he also completed his BSc and MSc in Maritime Economics and Transport. His research addresses smart ports, the circular economy and the clean energy transition, port energy management, gaseous emissions from ships in harbours, the external costs of transport, and energy audit systems in ports, with a growing focus on renewable energy and alternative marine fuels. Prior to joining WMU, he served as Adjunct and Assistant Professor at the Faculty of Maritime Economy in Genova. He has been extensively involved in EU and internationally funded research, including Horizon 2020 and Horizon Europe projects, and his work appears in leading peer-reviewed journals such as Transportation Research Part D, Transport Policy and Marine Pollution Bulletin.



3. Key Speakers and Notes

3.1. Aykut Ölcer, Professor, Nippon Foundation Chair, Director of Maritime Research, Head of Maritime Energy Management, WMU

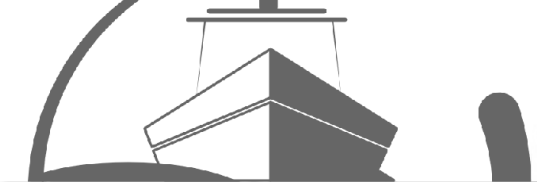
Professor Dr. Aykut I. ÖLÇER is a naval architect and marine engineer holding the Nippon Foundation Professorial Chair in “Marine Technology and Innovation” at the World Maritime University (WMU). He is currently the Director of Research of WMU as well as the Head of Maritime Energy Management Specialization (MSc program). He served as the Editor-in-Chief of WMU Journal of Maritime Affairs (JOMA) and Book Series between February’17 and February’19. Prior to joining WMU, he worked at Newcastle University (England), University of Strathclyde (Scotland) and Istanbul Technical University (Türkiye) within the fields of Naval Architecture and Marine Engineering. He played an important role in Newcastle University’s first international branch in Singapore to help the University achieve its objectives in teaching/learning and research activities in the UG and PG programs of Marine Technology. In 2025, he was ranked #2 worldwide in Naval Engineering by ScholarGPS. His consistent impact on the field is further recognized by his inclusion in Stanford University’s list of the top 2% of scientists globally for three consecutive years (2023–2025)

3.1.1. Notes

Professor Ölcer spoke on the establishment of WMU by the IMO 43 years ago to build capacity. He goes on to indicate that PotentX has the ambitious task of transforming European Ports to Energy Hubs using a living labs network. He states that the Living labs networks are quite interesting as they live in the real world, constantly being tested. Changing to MTCCs, he iterates that they demonstrate that capacity can be built; they have shaped the IMO GHG strategy for their own unique circumstances. Potent X and GMN conference is where the regional lens meets the global lens and this means to Energy Transition that no communities are left behind. There can be an exchange of views and building of cooperation, ending, he calls on the audience to make the most of the opportunity.

3.2. Christopher Dirzka, Assistant Professor, CBS

Christopher Dirzka is an Assistant Professor in the Department of Economics at Copenhagen Business School. His work examines climate action, competition law, liner shipping, market-based measures, performance, regulation, and strategy, with a particular focus on liner shipping networks. In this presentation, he shared policy analysis from the POTENT-X project on maritime decarbonization, including FuelEU Maritime, hydrogen-based fuels, port energy resilience, and regulatory alignment across Europe.

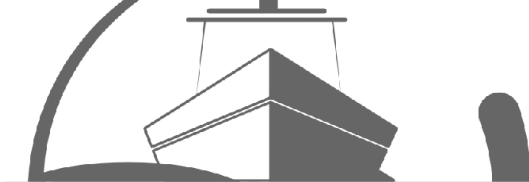


3.2.1. Notes

Professor Dirzka's presentation focused on Policy Analysis and he walked through the process and the results of said analysis. He shared that the EU policy landscape is changing and that ports are recognised to have a more and more important role in energy transition and can be seen in Fuel EU. The report focused on the misalignment with EU regulation and national regulation, and followed policy documents analysis, benchmark policy assessment and stakeholder consultations. He continued to emphasise that Fuel EU focuses on well to wake emissions and was adopted in 2023, it notably does not mandate a specific fuel however it tightens the limits on fuel emissions, which up to 2035 are moderate then significantly intensifies. It also incentivises early users, promotes onshore power, has financial penalties and strives to enhance maritime compliance. Importantly noted is that there is no regulation that guides a cross-sectional approach. Professor Dirzka then presented analyses of specific regions, the North Sea he said was suitable for renewable Hydrogen and hydroelectric energy, while Germany may be better at handling Hydrogen, Denmark's operations are most advance, Sweden's east coast has potential production opportunities and the carbon intensive electric mix in Poland is a constraint. Overall there is a Nordic advantage and eastern asymmetry. He concludes his presentation highlighting that Hydrogen and supply chain gaps exist, and while larger ports have OPS connections, smaller ports struggle to make this financially viable. There is also regional asymmetry with diverging compliance costs, but a major bottleneck is Grid infrastructure. He rounded out by recommending alignment between Fuel EU and a certification framework, accelerate investments, issue EU level guidance, designate a single monitoring authority and support regional cooperation.

3.3. Anas Alamoush, Research Associate, WMU

Dr. Anas Alamoush works as post-doctoral research associate at the WMU. Anas embarked on his academic journey after serving as a ship captain in Jordan Navy. He has a Master of Science degree in Shipping Management and Logistics, and PhD in maritime affairs from WMU. He focused on developing sustainability frameworks for the Port of Aqaba in Jordan. He actively participated in high-level projects, collaborating with industry professionals, such as EU Bonus Baltimari, which focuses on enhancing maritime safety, and the WMU/ITF Future of Work project, which explored the integration of cutting-edge technologies in the shipping industry. Currently, Anas also works at WMU on IMO impact assessment of the GHG medium term measures. Beyond academia, Anas has engaged with diverse nations, fostering international partnerships and contributing to the development of comprehensive transport strategies. Anas's accomplishments have not gone unnoticed, as he has been honored with prestigious accolades, including the Queen of Denmark Maregerate Second Medal for his outstanding service in the realm of international affairs.



3.3.1. Notes

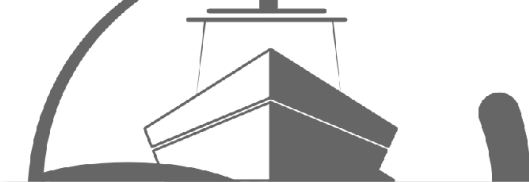
Dr. Alamoush opened with a question to the audience “who can be a stakeholder?” He then answered breaking it down to anyone who had interest, rights, ownership, knowledge, impact/influence or contribution to a project. He continued on stating that there is a slow uptake of energy transition, due to the fact that most ET (Energy Transition) projects are expansion projects and project failure is costly, this is why Stakeholder management in ports is crucial, early inclusion of stakeholders creates strategic value. There are many examples where port stakeholders had significant impact on projects, stopping or delaying them, Hamburg, Le Havre, Rotterdam and Dubai are a few. The 5 step Circle framework was used, Identify, Prioritize, Visualize, Engage and Monitor. Though this method 22 stakeholder groups were identified and through Potent X workshops it was reduced to 17 groups. These were examined to understand their Interests, dependency, capacity and conflicts. The key takeaways were identified some of which are, multistakeholder cooperation is a must, government and industry are entangled, there are issues of environment vs economic, capacity gaps are universal and civil society must be brought in early. Dr. Alamoush ended on a note of caution, that the groups of 17 stakeholders are not exhaustive, stakeholders are dynamic and recommends identifying them using the lifecycle tool referenced in his paper.

3.4. Charlampos Orfanidis, DTU

Professor Charlampos Orfanidis works in Embedded Systems Engineering Section at the Technical University of Denmark. Before, he was at KTH Royal Institute of Technology where he received his PhD in Technology and Health. He also spent some time in Uppsala University as PhD student before moving to KTH. His research interests span around Low-Power Wide Area Networks, IoT and Wearables for Sports and Health.

3.4.1. Notes

The professor opened with a question, What are the baseline requirements to digitalise ports in Europe? He goes on to explain that European ports are not one entity, there are multiple stakeholders and operate without a single actor having full control. They also face energy complexity, fragmented governance, and rising cyber exposure. A baseline was established using a 5 step system, reference scenario, elicitation, practitioner grounding, synthesis and component mapping. During the practitioner grounding 95 questionnaires were sent out and only 5 returned so the data was not usable statistically. He gave an overview of the synthesis after explaining the reference scenario which was not a real port but modeled after smaller ports in Europe, larger ports were excluded because their issues are different. Each energy asset at the scenario port created a specific digital integration obligation, this is an architectural constraint and the port authority does not own the data flow. The synthesis



showed 30 requirements across 8 technical domains, Interoperability Middleware & Protocols, Edge Computing & Field IoT, Data Platform & Data Fabric, Digital Twin, Energy Integration, Operational Monitoring & Optimisation, Cybersecurity & IT/OT Convergence and Governance & trust. Professor Orfanidis continued on to state that the biggest problem in Interoperability is not the availability of data but incompatible formats, project specific integrations that cannot transfer across ports. Then looking at edge computing there is poor connectivity across legacy devices or different protocols. He goes on to state that time should be a common standard that is used (IEEE), and that they would be working on a digital twin next. Cyber security is what closed the loop, stakeholders should not be forced to surrender sovereignty over commercially sensitive data but should be enforced technically. He ended by summarising the key takeaways, a baseline has been established, port governance is a constraint and the EU has made this mandatory. The next steps are to work on a digital twin, build a formal system architecture and define key performance indicators.

3.5. Bénédicte Madon, Researcher and Scientific Coordinator, USEV

She is a marine ecologist and statistician working on how ports and coastal infrastructures influence marine biodiversity. Her research combines eDNA-based monitoring with close collaboration with engineers to develop innovative tools for assessing biodiversity in operational port environments. She also works on port environmental governance, contributing to emerging approaches that position ports as active areas for scalable biodiversity monitoring and improved biodiversity management

3.5.1. Notes

Professor Madon opened by highlighting her area of study as Biodiversity in ports then continued to speak about collaborative port governance and its role in enabling green transition in European Ports. She states that Governance matters because actors will pull in different directions. While there are different types of ports, traditional models are struggling with green transition; they have a top-down structure and cannot keep pace with the demands of decarbonization, digitalization, and stakeholder inclusion. Collaborative governance relies on co-creation, shared decision-making, and mutual accountability, and as part of the Potent X deliverable through living labs, it's a real-world experiment where stakeholders collaborate to co-create, test, and refine solutions in real-life conditions. She goes on to say that there are two pathways to a green transition: environmental and technological. For a sustainable port future, there needs to be synergy between these pathways. Furthermore, she states that there is no successful energy transition without ecological consideration. Research shows that ports are hotspots for biodiversity, and for a truly green transition in ports, energy and ecology are



two sides of the same coin, and living labs have given us a tool to make that integration real, practical, and future-proof.

3.6. Lars Jøker, Potent-X Project Director, Port of Aalborg

Lars Jøker, Project Director in Port of Aalborg's new Research & Development department, has been appointed the new Chairman of ErhvervsNetværk 9220 (Business Network 9220). He takes over from Port of Aalborg's Chief Technical & Sustainability Officer, Mette Schmidt, who continues as Vice Chairman of the business network with a specific focus on Aalborg East. Lars Jøker is Project Director in Port of Aalborg's new Research & Development department, which builds on the work started in the maritime research center Center for Logistik og Samarbejde (Center for Logistics and Collaboration). Jøker has years of experience from the Danish Ministry of Foreign Affairs and Danish Technological Institute. Now, he is looking forward to another exciting role in ErhvervsNetværk 9220

3.6.1. Notes

Mr. Jøker presented the results thus far on the living lab at the port of Aalborg, he continued to give context on the Port of Aalborg which is located in northern Denmark and is an inland port, 20 km from the sea. It is also an industrial port and owned by the municipality, however the operations are run by a limited liability company employing over 110 employees and have a board. They defined 3 main pillars in their strategy, freight and logistics, business park and green transition. The onboarding for the living labs was in May 2025 and initially it wasn't easily understood by the port, however there has been a lot of technical assistance given by the European network including workshops where they formulated the framework of a living lab. Following this there was also a governance model workshop which contributed to the collaborative governance framework. The port is constantly changing, new staff are coming onboard hence there needs to be constant alignment with the living lab concept, ENOLL has been providing this technical support. Mr. Jøker continued on that they have 4 pillars in implementing the living labs concept, test and demo, energy communities, electrification and carbon capture and storage. They also conducted a feasibility study for electrification and found that there is a big consumption of electricity and it's growing, which poses a bottleneck along with grid development. There has also been efforts in stakeholder engagement and plans for solar PV development which is intended to be a collaboration with the companies at the port. The regulatory framework changing is key to progress and this will occur in 2026. He ended by stating that there is still a long way to go but they are committed, however having something tangible would help the stakeholders along.

3.7. Mark Clintworth, WMU Adjunct Fellow and Advisor, European Investment Bank



Mark is a researcher specialising in shipping company financial risk through the application of machine learning tools. He is an Adjunct Fellow at the World Maritime University lecturing in Port Finance and financial derivatives in shipping. His research interest focuses on mathematical modelling/computational finance. He served as the Head of Shipping for the European Investment Bank (EIB) in Luxembourg, until 2019. He is a speaker and panellist at global maritime industry events as well as a visiting lecturer for a number of Universities. The focus of these varied representations is maritime finance and environmental issues. He holds a PhD in the application of machine learning to shipping company financial risk management. He also has an MSc in Naval Architecture and Marine Engineering from the University of Newcastle and BSc (Hons) in Computer Science (Hons) from the University of Liverpool, UK. He is a member of the British Computer Society (MBCS) and a Chartered Engineer with the UK Engineering Council. He is also an associate member of the Royal Institution of Naval Architects (RINA).

3.7.1. Notes

Professor Clintworth opened strongly asking the audience, “Where’s the money?” He then goes on to deliver a presentation of the importance of including finance at the beginning of projects, especially pilot projects. The reason being that if a project is not deemed bankable it would not be successful. Finance should be included at the start of a project, Multilateral Development Banks (MDB) role is misunderstood, they are not only for loans but have a crucial role as ‘de-riskers’. This is also a service they provide and when they are involved at the start it sends a message to the private world that there is less risk. Professor Clintworth reiterates that there are renewable energy solutions, governments involved in PotentX, living labs, clean energy in real port environments, adopted carbon strategies, recognised ports as strategic nodes, but still missing to this point are bankable projects. He then highlights 3 main conditions that need to be met in making a project bankable, regulatory certainty, revenue predictability and a governance framework that allocates risk clearly. Keeping this in mind, research in living labs will make financing possible if MDBs are present when the governance is being designed.

3.8. Stephan Nanan, Director & GHG Advisor, Maritime Technology Cooperation Centre Caribbean

Mr. Stephan Nanan is a Senior Instructor and Discipline Leader in Marine Engineering at the University of Trinidad and Tobago with over 21 years of teaching and research experience at UTT and The University of the West Indies. He holds a BSc in Physics and an MSc in Environmental Science and Management and is currently pursuing a PhD in Process Engineering focused on Maritime Decarbonisation. He serves as Director and GHG Advisor for



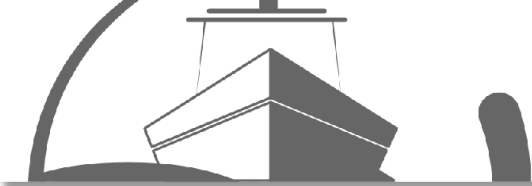
MTCC Caribbean and is certified by the UNFCCC Secretariat and the Greenhouse Gas Management Institute in the application of IPCC Guidelines. His work includes leading maritime port GHG inventories in Trinidad and Tobago and contributing to regional research on ship energy efficiency. He also represents Trinidad and Tobago and Caribbean member states at the IMO's MEPC Working Group on Air Pollution and Energy Efficiency.

3.8.1. Notes

Mr. Nanan presented ports in the Caribbean, and stated that they are important transport hubs for the region. He stresses that everything in the Caribbean arrives via ports. Referring to the previous presentation by Professor Clintworth, he reflected as a cautionary tale that they did not involve finance at the beginning of their projects and now are seeking funding for project implementation. The MTCC Caribbean project focused on 3 case studies, port of Point Lisas, port of Bridgeton and Galeota marine terminal. While these ports are some of the larger ones in the region, consideration needs to be given to the smaller ports in the region that form a hub and spoke relationship. These dependencies are crucial as they provide a livelihood for the populations of these areas. In the initial phase Mr. Nanan said they focused on building port inventories for the past 2 years and have now certified these ports as EcoPorts, the IMO port Toolkit was used in developing the methodology. From these case studies it can be seen that ocean going vessels are responsible for a significant portion of the total emissions, and to have an impact on port emissions reduction this needs to be addressed. Trinidad and Tobago is a petrochemical producing island and the grid is powered by LNG. The next steps are a phased reduction in the emissions from the vessels and shore power, taking into consideration the grid would give an overall CO₂ reduction between 1-5%. With future projects in the development stage for green energy, New Gen Low Carbon Hydrogen Project, wind turbine installation and geothermal energy exploration could facilitate greater emissions reductions using shore power. He closes on the barriers that the region faces, limited grid capacity, high capital costs, technical and infrastructure constraints, and regional collaboration, international funding mechanisms and technical cooperation programs remain crucial in enabling Caribbean ports to achieve meaningful GHG reduction.

3.9. Panel Discussion

The panel discussion was interactive, and the audience asked several questions to the speakers. The first question was about the Potent-X project's geographical implementation, suggesting a collaboration between the African and Caribbean contexts, since it is focused only on European ports. The speakers highlighted that the Potent-X project is mainly focused on European, and more precisely, on Baltic ports. However, the results could be implemented in other contexts. Related to this, the audience asked for more explanation of how findings from archetypal European mid-sized or large ports generalize to broader world ports. The speakers



explained that it depends on various factors, such as the port governance framework and national and regional regulations. The discussion continued with a reflection on the transition to clean energy systems and, in particular, where the Potent-X project stands in the net-zero framework. It was underlined that the project aligns with the European Union target; however, it presents several challenges to face. Another aspect that was addressed was the barriers in implementing sustainability policies, in particular, asking what the major barrier is. It was mentioned that while ports are in different countries, vessels need the same services and resources, such as the same fuels; financial instruments are insufficient sometimes, especially for smaller ports, such as those in the Caribbean. However, another important barrier is conflict between stakeholders. The audience continued the debate with a reflection on the collaborative governance framework, which is a theoretical good practice; however, it is challenging, particularly when it involves large-scale collaboration, political interference and community involvement. The speakers answer that, first of all, collaborative governance starts with an open discussion with the stakeholders involved, especially the civil society