



High Value Skills for a Net-Zero Economy: A Skills Assessment for the Ports, Supply Chain, and Maritime Sector

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The PIER is Canada’s first living lab dedicated to enabling collaborative problem solving between tech companies, local and global supply chain partners, researchers, SMEs, and startups to support innovation and uncover new commercial opportunities within the transportation, supply chain and logistics industries. The PIER provides a landing space for developing companies with expertise in maritime and landside transportation and logistics who want to create solutions alongside global industrial leaders.

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Executive Summary

The Ports, Supply Chain, and Maritime Sector is experiencing a talent shortage and is anticipating more significant paucity of high demand skills as the industry advances to more sustainable practices. This phenomenon is not unique to the sector and as skilled workforce pools shrink, we continue to see an accelerated race for talent. Net-zero strategies across the industry are highlighting gaps in the skillsets that are already and will continue to be high value as these strategies are enacted. Reactivity in recruitment and upskilling often lead to reliance on conventional job descriptions and engagement strategies. In short, many employers keep hiring from conventional cohorts who possess traditional skillsets and expect their workers to not only thrive in an ever-shifting industry, but to lead the way in navigating a green shift toward a net-zero economy. This report proposes an informed and thoughtful approach to building and curating workforce and contends that there is urgency to do so.

Many of the systems for building skills and capacity are not yet in place. According to interviewees for this study, high-value socio-cognitive skills such as divergent thinking, problem and data interrogation, adaptability, and management of complexity are under-developed via conventional education and training curricula. Similarly, industry members reported that new graduates are entering the workforce lacking the technical skills, including trades and technician capabilities, engineering, and digital skills needed to support a shift to more sustainable practice. But the sector is also in need of a broader slate of skills to interpret, undergo and sustain such transformative and essential change. Skills in environmental law, regulatory and compliance, planning and logistics, safety and security, and resource and route optimization will come into play in unprecedented ways.

For the purposes of this report, the term *sustainability* is defined as **the balance of economics, community integration, and the environment**. It is important to acknowledge that net zero in the ports, supply chain, and maritime sector is part of a broader sustainability ambition that integrates strategies and measures of progress for economic, environmental, social, and cultural well-being and regeneration. Advancement towards more sustainable practice in the sector requires not just evolving skillsets, but also expansive mindsets. The term *green skills* has become the vernacular adopted by the Federal government and industry to refer to skills that support industry advancement toward net zero goals, and thus are perceived as high value and high demand. This study provides insights to help shape a definition of *green skills* in the Ports, Supply Chain, and Maritime Sector.

This study revealed that there is awareness among industry member of the need for transition pathways from jobs in both thriving and vulnerable sectors to leverage the high demand skills and experience that are readily transferrable. Unfortunately, there are few well-developed approaches to do so. This is partly due to uncertainty about who is responsible for taking the lead on training and upskilling (i.e. industry/employer led vs government led vs personal development). Furthermore, the race for talent dulls an already lackluster interest in collaboration and knowledge sharing for the purposes of training or retraining across the industry.

Green skills for a net-zero economy include the skills, competencies, attitudes, behaviours, knowledge-holding, technical skills, and work experience that relate to sustainable industry practice and to advancing economic, environmental, social, and cultural wellbeing through those practices.

This study has shown that many of the high value *green skills* are common across industries, while others are unique to the Ports, Supply Chain, and Maritime sector, especially those involved in engineering, skilled trades, and economics roles.

Interviewees reported some technical skills that are distinctly *green*, such as skills related to production, transportation, bunkering, and safe handling of green hydrogen, while others are green insofar as they facilitate changing practices and technologies in pursuit of net zero goals. An additional, though not surprising finding of this study is that most of the high value *green skills* cited by interviewees are also highly transferrable and are subsequently in extraordinary demand across related industries. This drives the race for talent in a net zero economy.

It is encouraging to note that at the time of this study, new Federal, provincial, and industry initiatives are being launched to better understand and develop the *green skills* that will support the nation's ambitions of a net-zero economy.



High Value Skills for a Net Zero Economy

The ports, supply chain, and maritime sector is highly energy intensive. The current reliance on fossil fuels as the primary energy source means that the industry is also carbon intensive, the primary contributors being diesel usage on port and with intermodal transporters (i.e., truck and rail), and vessel fuels. Together these are responsible for roughly three percent of global emissions, which exceeds that of the entire aviation industry (Maritime Magazine, 2023).

Key priorities of the industry's decarbonization strategy include advancing the efficiency and optimization of port resources and infrastructure, as well as transitioning from fossil fuel to reliable

alternate or renewable energy sources. As port authorities direct investment into alternative energy infrastructure and supplies, there is optimism that the economic benefits of more sustainable practice will emerge alongside gains in ecological, social, and community well-being. The broader transportation industry is experiencing concurrent market and workforce shifts as it launches net-zero strategies. According to Powell (Green Collar Jobs: The skills revolution Canada needs to reach net-zero, 2022) **nearly 40% of new jobs in trades, transport, and equipment operations will need an enhanced skill set to keep up with the industry's growth and evolution towards more sustainable practices.**




Industry Overview and Objectives for Net-Zero

Canada's ports, supply chain, and maritime sector has ambitious and laudable net zero and sustainability goals where the current primary focus is on reducing carbon emissions via asset optimization and a switch to alternative fuel sources. These are lofty - though attainable goals - but not without a skilled workforce. The pursuit of net zero strategies has crossed paths with a decline in workforce numbers, and the impact has been staggering. Not only has the talent pool shrunk, but the skills needed to swim in that pool have changed and are continuing to do so.

Industry participants for this study shared insights into the skills that will be, or already are, of high value across the sector, as net zero strategies are enacted. The high value - or *green skills* in the vernacular of the Federal Government - identified in this study fall into buckets of technical (i.e., profession or sector specific), digital/technology, and socio-cognitive (i.e., similar to those cited in popular industry literature as *future skills*).

There is not a clear or common understanding of what comprises these so-called *net-zero* jobs and the unique *green skills* that define them. This presents a difficulty for employers to assess the capabilities and readiness of their current workforce and new recruits. It is equally puzzling for workplace mentors and work integrated learning (WIL) providers to identify key experiences and knowledge transfer priorities that will equip young talent with soon-to-be high demand net-zero skills. This highlights the important role post-secondary institutions (PSIs) can play in evaluating their current curricula to ensure they are cultivating talent with the necessary current and future *green skills*.

This study focused on identifying the high demand and high value skills and competencies needed to support the transition towards net-zero in the Ports, Supply Chain, and Maritime Sector (the industry), which includes marine and terrestrial transportation, and related supply chain and logistics industries. This study also explored how *green skills* emerged as high priority and most acute within the industry, and which foundational *green skills* are common across industries.



For the purposes of this report, the term *sustainability* is defined as *the balance of economics, community integration, and the environment.*

In Profile: The Halifax Port Authority

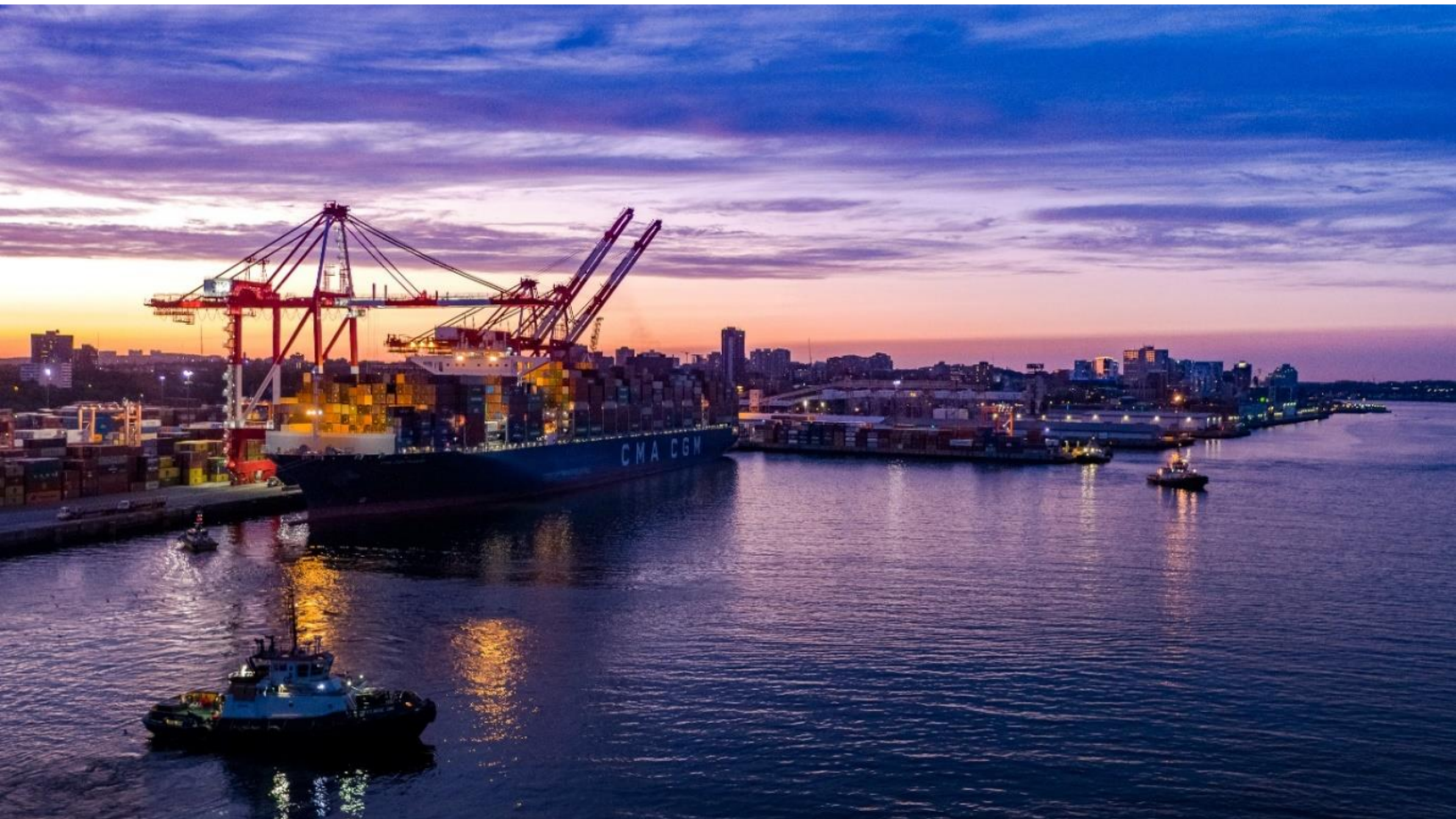
Defining Sustainability.

Sustainability at the Halifax Port Authority is the *balance of economics, community integration, and the environment*. This definition includes consideration of social justice, diversity, accessibility, inclusion, and regenerative community. The commitment to sustainability is demonstrated at the HPA by conducting business in a way that meets the needs of the present while contributing to the well-being of the future. HPA's Sustainability Strategy identifies specific goals and targets that advance progress towards a net-zero economy. HPA's net-zero strategy" is one element of our greater Sustainability Strategy

The phrase *net zero economy* has become a colloquial way to convey a future where industry and low carbon activities have formed a happy

union. Informally, it is also used to convey the intention that economic prosperity not be at the expense of social well-being or environmental impact.

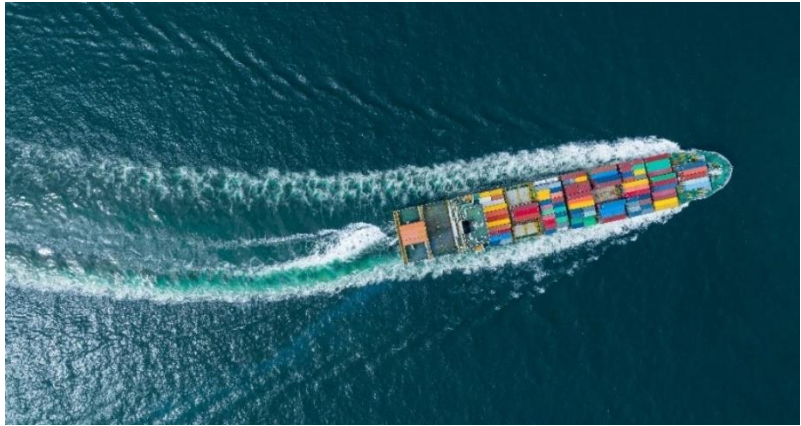
The net-zero strategy being implemented at the Port of Halifax considers several measures of sustainability that include integrated and interrelated ecological, economic, social, and cultural metrics that signal impact, progress, improvement, and well-being. All measures are integral to implementing a successful strategy where interests, benefits, and activities are in support of one another. For the purposes of this study and to give context to findings and recommendations, the definition above in italics will be the operational definition for sustainability and will guide considerations of '*green skills* for a net-zero economy.'



In Profile: The Halifax Port Authority (HPA)

Environmental sustainability

Decarbonization is a key objective for port sustainability at HPA. Across the marine transportation industry, environmental sustainability efforts also include efforts to remediate ecosystem damage, manage waste (including human waste, food, recyclables, garbage, and grey water) from cruise ships and other commercial vessels in port, integration of renewable energy sources and related infrastructure for onshore and on-water port operations, and any other activities aimed at mitigating other pollutants or environmental impacts.



Where technology can play a role in advancing progress to Net-Zero in Ports, Supply Chain, and Maritime Sector

- Smart grids
- EV batteries and storage
- Offshore wind
- Hydrogen and ammonia production and other renewable energy sources
- EV and dual-fuel vessels and heavy equipment
- Shoreside recharging and refueling
- Asset and infrastructure retrofitting and design
- Materials engineering (including drag-reduction and anti-bio-fouling surfacings/coatings)
- AI, digital twinning, and other digital technologies that support optimization of

routes and container storage as well as port equipment and assets

- Carbon sequestration
- Autonomous systems



This encouraging range of innovation endeavors highlights the importance of understanding the corresponding broad range of high demand and emerging workforce needs.



The ocean technology sector is considered by the Federal Government as a high growth economy, driven in part by sustainability-focused activities related to decarbonization of the port, supply chain, and maritime sector. Across Canada 97.9%¹ of employer businesses are small to medium sized (SME) where Workforce challenges can be pronounced, as they lack inhouse expertise and capacity for building a future proof workforce or lack the resources to pay for highly coveted talent.

Interviewees for this study identified a common gap in understanding how to recruit, shape, build, and retain their workforce to match the sector's ambitions for a net zero economy.

Organizations large and small in the ports, supply chain and maritime sector will benefit from an emerging workforce that possess the high value technical and knowledge-based expertise and experience needed to advance toward net zero goals.

Objectives and Project Scope

- Identify the key skills that will be needed across the ports, supply chain, and maritime sector to support progress towards net-zero goals.
- Inform the recruitment, training, upskilling, reskilling, mentoring, and work integrated learning (WIL) activities of organizations operating across the marine transportation industry.
- Support PSIs as they develop evidence-based revisions or additions to curricula.
- Provide information and recommendations to apprenticeship and other professional credentialing agencies as they evolve their criteria for competency or mastery of relevant *green skills*.

It is not the objective of this study to develop an exhaustive list of *green skills* and jobs, but it does summarize some industry-related high value *green skills* that exist today or are reasonably envisioned to emerge over the short to medium term. Given the shared pressures and common triggers, it is highly likely that the findings from this study will also have relevance across other industries.

Data Summary: Common Themes and Insights from this Study¹

This study found that many of the high value skills are cross-industry, though the challenges with enacting more sustainable practices may be uniquely complex because the maritime industry is comprised of marine and terrestrial transportation partners, including rail and trucking freight operators. These intermodal partners have their own infrastructure, assets, regulations, and workforces and their net zero goals and challenges don't overlap entirely. The loftier goal of achieving global industry net zero via 'green corridors' relies on green practices and commitments across entire supply chains which imposes a scope creep beyond that which individual sector players can directly control or influence. This also has implications for integrating social, cultural, and economic sustainability goals as they pertain to workforce. An example of this from a social justice perspective is that care will be needed to ensure protection of seafarers' rights. Global South countries² which supply the much of the world's seafarers may need additional support to make the transition, including the establishment of national skills bodies. Developing countries will need fair access to opportunities created by decarbonization, like zero-carbon fuel sources. The inherently global nature of shipping sets it apart from other industries, so this is where the greatest challenges will be (Henriksen, 2023).

Common Themes

1. *Green skills* include some novel competencies but primarily relate to application of traditional skills and knowledge to projects and practices for advancing sustainability. This means that there are minimal uniquely green skills – rather, industry is seeing traditional skills applied within an evolving context of sustainable practice.
2. Technical *green skills* will require a combination of formal (PSI) and informal (industry provided or on-the-job) training. This will involve upskilling for existing workers and those in transition from other industries, and new or augmented skills training in existing training curricula for new workers. For example, engineers working in areas of renewable energy for shipping and ports will need skills for working with hydrogen production or EV power and storage, systems and infrastructure design, and fuel transport and bunkering. Heavy automotive mechanics will need to extend their skills for maintenance and service on dual fuel equipment and vehicles.
3. Popular media paints visions of future net zero economies with wind turbines and electric lifters, hydrogen-powered heavy equipment and flora wrapped infrastructure. With these expectations comes the assumption that workforces building these futures will be drawn from traditional STEM (science, technology, engineering, and math) pathways. This study has found that high demand green skills will be contributed from all disciplines. *Green skills* will be distributed across technical and operational and support roles including but not limited to

¹ In putting together this report we reviewed existing academic studies, industry reports, applied research publications, and traditional media. We compared insights from this literature with qualitative data collected through 40+ interviews with industry and ecosystem members.

² A term which refers to less industrialized and developed nations which tend to be southerly of more developed, colonizing, "Global North" countries.

- finance and economics (e.g. green credits, port funding incentives), HR (mapping *green skills* and competencies with role descriptions, recruiting for *green skills*), communications and marketing (communicating green strategies to community, government, industry or other stakeholders), real estate and space planning (e.g. vehicular and pedestrian traffic, renewable energy infrastructure), and planning and monitoring departments (optimizing container flow and resource utilization).
4. New or evolving consultancy or in-house experts will play essential roles in advising on policy, safety, security, and regulatory requirements, compliance, operating standards, incentives programs, and the economic, social, environmental, and reputational benefits (or risks) of sustainable practice, and the viability of innovative technology adoption.
 5. Green skills will range from novel to adapting to traditional. Some jobs will be net new, be broadly changed, or may see minimal changes in skills requirements. Unicorn jobs, never-before imagined, will appear, such as helicopter pilots who transport acrobatic service technicians to offshore wind turbines. There will be new and growing roles in safe handling of renewable fuels (such as hydrogen) for commercial use. Logistics roles and crane operator roles will require greater digital competency as new technologies bring about digital interfaces, algorithmic planning, automated tasks, and AI for operations monitoring and other tasks. Other jobs, such as automotive technicians, will remain largely unchanged with the shift from diesel to EV powered vehicles. Apart from engine maintenance and oil changes and diagnostic functions which will require new skills, traditional skills for servicing and repairs of other parts of vehicles will be largely the same.
 6. Digital skills will integrate more with socio-cognitive skills, with less emphasis on coding and programming, and more on using technology to filter, interrogate, and interpret data for knowledge sharing, collaborative problem solving, and navigating complex and integrated systems.
 7. Interviewees consistently highlighted socio-cognitive skills such as critical thinking, problem solving, adaptability, and resilience. Those most consistently identified by all interviewees include skills in systems integrative thinking and managing complexity. Those working in a net zero economy will need to be more flexible in their skills and abilities and be receptive to big-picture thinking and capacity for change.

There are some uniquely *green skills* – but industry is primarily seeing traditional skills applied within an evolving context of sustainable practice.

Commonly Identified Socio-Cognitive Skills and Competencies

Systems Thinking. A style of problem-solving and analysis that works through seeing the interrelation of complex systems.

Integrative Thinking. A cognitive process where opposites are held together to form a synthesis. This requires being comfortable with complexity and not eliminating variables or alternate views for the sake of simplicity.

Openness to learning. The capacity to be flexible and learn to use new technologies and techniques.

Adaptability and resilience. Ability to adjust to new conditions and purposes and recover and learn from difficulties.

Communication. Ability to exchange ideas and information with others, effectively. This works in combination with openness to new knowledge.

Problem Solving. Involves deconstructing and defining a problem and understanding the systems they belong to and the relevant variables, and then creatively generating solutions. Skills include recognizing that problem solving is an iterative process.

Critical Thinking. Use of objective analysis of multiple variables or sides of an issue to form a judgement or decision.

Making use of expert sources. Interrogation and probing of digital information.

Creativity. Ability to think about a task or problem in new or different ways and generate multiple unique ideas or take inspiration from existing ideas.

8. Finding talent with deep expertise will continue to be an ongoing challenge as expertise is a factor of skill + experience. Both of these factors take time – and both are continuously adjusting to a rapidly evolving net zero economy with fluid targets and intensifying environmental, economic, social pressures, and employee expectations.

9. Infrastructure for shipping decarbonization will be mostly land-based, but mariners and equipment operators will need to learn how to use physical assets that are powered by different fuel sources. High demand socio-cognitive skills will include problem solving, critical thinking, self-management, adaptability, and resilience, and may require workers to possess a broader range of skills than current position descriptions outline. These skills are important because in the transition to net-zero we are going to need an adaptable, resilient workforce. This requires individuals to be more flexible in their skills and abilities. What connects the commonly mentioned cognitive skills is the big-picture thinking and openness that create capacity for change.



10. Some of the most significant green skills adoptions will be seen in skilled trade, technician, and technologist roles. Sectors that are already seeing significant demand for green skills include construction, transportation, the renewable energy sector, and carbon capture and storage, all of which have corresponding workforce needs. High value electrician and electronics skills will be needed for EV vehicles and vessels and other marine, transportation, and sensing technologies. Welders will need to be trained to a different standard as physical asset design and materials evolve, which in turn can increase the complexity of vehicle/vessel/equipment production and maintenance. Early decarbonization efforts in ports and shipping will likely be concentrated on land-based infrastructure but mariners and equipment operators will need to learn how to

use physical assets that are powered by different fuel sources. There will be an increased demand for upgraded skills, like electricians with high voltage training to work on solar panels and electric heating and vehicles (Powell, 2022). Electrical skills in general are already in high demand and that demand will only grow. Welders also are already in short supply, and they will need to be trained to a different standard as physical asset design and materials evolve. Special skills are needed to join multiple metals together such as aluminum, a favourite metal for EVs due to its lightness. These changes will add to the complexity of making the vehicles. Currently, industry is not supportive of micro-credentialing for skilled trades so there will be call for accredited curricula to meet these training needs.



High Demand Green Skills in the Ports, Supply Chain, and Maritime Sector



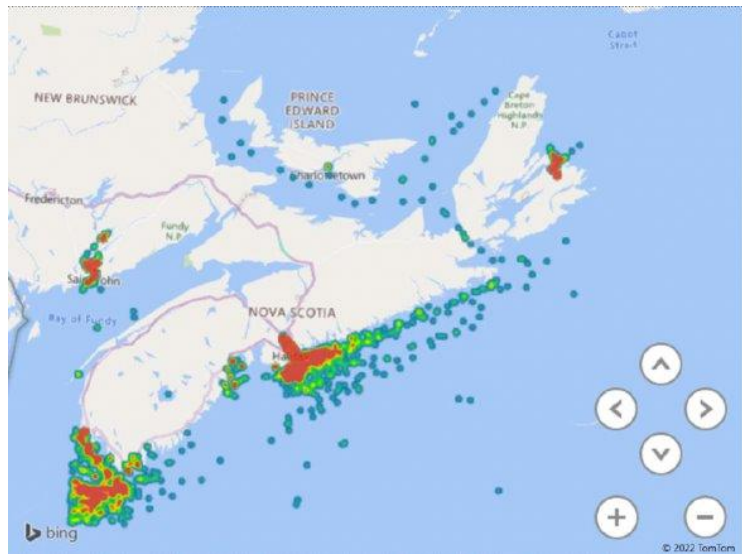
The labour market is changing rapidly; 40% of new jobs in trades, transport, and equipment operations will need an enhanced skill set (Powell, 2022)

Interviews indicated that among knowledge workers there is a distinct shortage of, and need for, particular technical skills: applied mathematics, especially statistics, use of AI and computer modeling, and above all, data analysis, applied economics and environmental finance and accounting. Effective application of technical skills relies on cognitive skills like problem solving, communication, and interdisciplinary thinking.

We will likely see more government and/or industry regulation and monitoring, and consequently there will be an increase in demand for inhouse and external consultants who offer ESG (environmental, social, and governance), and policy and compliance expertise, and competency in risk assessment. These roles will require skills and knowledge in new regional, federal and international requirements for reporting data on emissions, human rights risk in the supply chain, and other sustainability metrics. There is currently no formal credential for skills in ESG in the ports, supply chain, and maritime sector, but perhaps there should be.

Interviewees expressed concern with PSI and industry readiness to train for these evolving and emerging skills. For example, while the fundamentals of engineering programs will continue to be distinct, there will likely be more overlap between electrical, computer, robotics, and mechanical engineering³ in applied settings as industry leverages IoT capabilities and integrated systems. Industrial and civil engineers will be looking more at optimizing systems with sustainability and economic metrics in mind.

Table 1 is not an exhaustive list of roles but provides an example of many high value skills that are highly transferrable across many industries in a net-zero economy. The table also summarizes some of the emerging digital, technical, and trades skills that are critical to transition.



Ship tracking Visualization technology. Image courtesy of DeepSense.

³ ‘Mechatronics’ is a term referring to the growing interdisciplinary field where electrical and mechanical engineering overlap with robotics and computer science to create unified design solutions.

Table 1: Essential skills and Related Roles for Net-Zero Ports, Supply Chain, and Maritime Sector

Role	Transferrable and High Value Skills
Engineering: Mechanical, electrical, electronics, electrotechnical, chemical, environmental, mechatronics, civil, industrial	Technical knowledge, mathematical skills, analytical and systems thinking, problem solving; Incorporation of robotics and AI, comfortability with higher power capacities, interdisciplinary collaboration; greater skill overlaps for electrotechnical engineers and technologists; energy system modeling; Ensuring safety and sustainability, data analytics; Computer modeling and visualization; (design, test and maintain automated, unmanned equipment); sustainable design
Planning/supply chain engineer	Interdisciplinary communication and collaboration, strategic thinking, research, and analysis, applied mathematics and science; Adherence to emerging regulations, balancing environmental and economic sustainability, fulfilling new regulatory requirements
Safety	Current skills will transfer and there will be a need for significant upskilling related to communication, analysis, risk assessment, safe handling, bunkering, and transport of alternative fuels, safe operation of EV or hydrogen powered vehicles and heavy equipment; skills for responding to leaks, fires, or explosions of alternative fuels; conduct and protocols for refueling and recharging, attention to new regulatory and safety standards, For example, there are currently no formal qualifications related to handling hydrogen and ammonia, but they will certainly emerge.
HVAC technician	All skills are highly relevant and valuable for the future. Current skills of oil furnace technicians are transferrable into HVAC careers; adaptation of traditional skills to an emerging field
Terminal operator	Logistics, marine safety; Digital skills, multitasking, use of remote operating systems will transfer and require upskilling to support technology adoption.
Electrician And Electrical Technician	All skills transfer. Growing demand for digital skills, computer diagnostics, high voltage expertise for working with EV with higher power levels
Construction	All current skills will transfer. Emerging skill will relate to retrofitting existing structures for upgrades; energy efficient building techniques, clean construction materials,
Heavy equipment mechanic	All current skills will be needed for some time while adapting to cleaner fuel technologies and new equipment operating on dual or fully-renewable fuels
Controls technician	Manage controls of automated equipment. Digital and technical skills; trouble shooting and problem solving; This is a relatively new role that is extremely valuable especially for vehicle/vessel optimization and avoidance of disruptions



There will be demand for evolving or emerging *green skills* among trades and technician/technologist roles as they apply to net-zero activities. Many of these roles will require skills in interpreting and applying data driven requirements and diagnostic skills, as most equipment will eventually be sensor enabled. Some roles will see the need for dual skillsets as industry transitions to assets powered by renewable energy. For example, we will

see a need for dual-fuel engineers and technicians who can design, service, and retrofit old assets for dual-fuel. Some of this training can be done inhouse for sector specific equipment (e.g. Gantry cranes), however foundational skills will be common across industries and should be credentialed. The greening of 'antique' infrastructure will drive early demand for **construction skills**, and demand will continue as new requirements are set for sustainable structures.

High demand socio-cognitive skills will include problem solving, critical thinking, self-management, adaptability, and resilience, and may require workers to possess a broader range of skills than current position descriptions outline. These skills are important because in the transition to net-zero we are going to need an adaptable, resilient workforce.

Mariner and Longshore(wo)man Roles in a Net-Zero Ports, Supply Chain, and Maritime Sector

The increasing adoption of technologies like AI, digital port management systems, and sensor and remote controls to move and catalogue cargo, will lead to the gradual phasing out of some manual tasks. Digital technology will play a central role in the net zero port, supply chain, and maritime sector, and mariners will need continuous digital upskilling. Adoption of new fuel sources and the switch to EV will require additional skills related to vessel operations, port-side and intermodal operations (such as electric rail and trucking, and working electric rubber tire Gantry cranes), and marine maintenance and service.

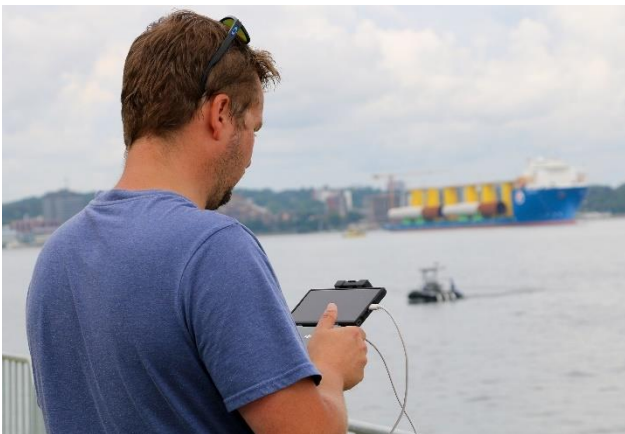
High-Value Digital Skills for a Net-Zero Economy

Interviewees communicated that digital skills are essential for progress towards net-zero Ports, Supply Chain, and Maritime Sector. Examples of specific digital skills include:

- Data visualization and digital modeling (including digital twinning, mixed reality, augmented display overlay with real world).
- Digital logistics planning for vessel and terminal optimization including predictive analytics.
- Use of diagnostic tools that will replace some human problem solving.
- Strong foundations in scientific data handling, AI, data analytics, and skills related to handling big data sets.
- Skills related to IoT (Internet of Things) such as sensors, processors, software, and other technologies that connect and exchange data with other devices and systems. This includes coding and programming skills. In some cases, the IoT devices and data are so industry specific that additional in-house and bespoke skills training is required.
- Interactive interface software (e.g. apps which indicate to users how much hydrogen is left when switching from hydrogen to dual fuel).
- Skills related to data reporting systems that help to optimize routes and vessel speed for fuel efficiency



Shipping Logistics. Prediction. Image courtesy of DeepSense



and to ensure that batteries don't fail at inopportune moments.

- Skills in additive manufacturing to allow for in situ production and replacement of critical parts that have high fail rates and where fails cause costly disruptions to operations. This includes skills in designing original manufacture equipment with the intention of eventual 3D printing, as well as skills in printing, and skills in servicing and replacing those parts.

A common theme across responses from interviewees was the need for strong disciplinary foundations coupled with interdisciplinary breadth in order to understand how the work of one interacts with the work of others in complex systems.

Green Skills in a Port Context

Automotive Service Technician Mechanic and Heavy Equipment

Positions like automotive service technician are changing quickly because of the rapid shift to EV. New requirements have already been added to the NSAA automotive service technician apprenticeship program. Even as vehicles change, workers will still need to have the traditional skillset to work on the remaining gasoline engines. Most vehicles already have motherboards and some degree of computerization, so existing digital skills for EVs will be essential and must continuously evolve with each new generation of vehicle and equipment. Alongside the continuing development of digital skills and computerization, conventional skills will still be in demand as existing assets live out their lifespans and continue to need maintenance and servicing until they are retired and upgraded with alternative-fuel powered replacements.



Data Analysts

With the push for sustainability there is growing demand for people skilled in data analytics. Skills relating to data collection and analysis, including presentation of coherent data, will be essential to integrated net-zero operations strategies. Interviewees reported that these skills are in high demand but in low supply in the labour market.

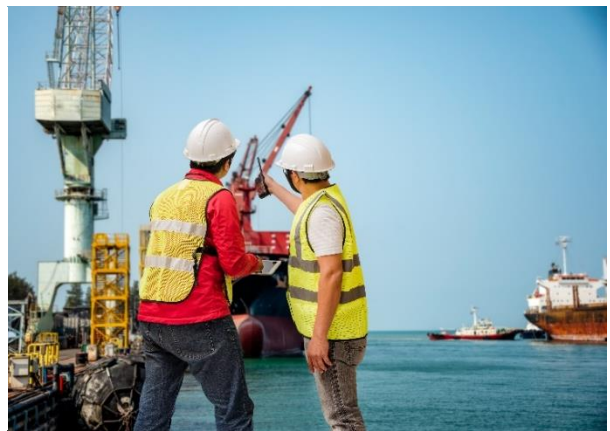


Engineers, Asset Managers, and Harbour Masters

An integral part of the industry's net-zero strategy includes the switch to alternative fuels including EV. This will involve the integration and management of infrastructure to transport and bunker fuel, and to provide refueling or recharging stations for port and shore side vehicles/equipment and vessels.

Port Operators

A primary challenge for greening port operations is the need to optimize terminal operations. This makes changing operations and switching technologies risky. With the increasing use of technology there will be a concurrent need for people with flexible technical, digital, and socio-cognitive skillsets.



Logistics Planner

Logistics planners will play a key role in resource optimization to support decarbonization of port and shipping operations. Essential skills will include the use of logistics softwares to enable synchromodality for smart utilization of available resources and synchronization of transport flows. This ultimately reduces costs, emissions, and delivery times while maintaining the quality of supply chain service.

Developing a Workforce with *Green Skills* Across the Industry and Related Sectors

While this study has shown that many of the high value skills are cross-industry, there will continue to be challenges with achieving net-zero across the entire industry in a single timeline. Intermodal and supply chain partners have their own infrastructure, assets, regulations, workforces and net-zero goals and challenges – and associated skills needs - that don't overlap entirely. The loftier goal of achieving global industry net-zero via 'green corridors' relies on green practices and commitments across entire supply chains which imposes a scope creep beyond that which can be directly controlled or influenced by single players. In the global environmental sustainability effort, social and economic sustainability must also be ensured. An example of this is already being demonstrated in the implementation of requirements around reporting human rights risk in the supply chain. The global nature of port, supply chain and maritime industry compounds the challenge of building economic, social, and cultural sustainability into the whole system. At the same time, it also unites global leaders in addressing this challenge.

Recommendations

1. Focus on preparing for changes to industry and the skills will become apparent.
 - This will include detailed summaries of current skills and their assessment of skill-gaps that are likely to arise as newer net-zero-oriented technologies and processes emerge.
 - But also, be agile and ready to adapt education/training for unanticipated but emerging high value skills. Trying to predict and revise **entire** curricula based on predictions can be unproductive use of time. Foundational skills should continue to be developed via accredited programs. Space may be needed in formal programs for fluid curricula to counter disruption that changes more immediate and high demand skill needs.
 - Provide more work integrated learning opportunities (WIL) so that young talent is entering the workforce with experience in applying their skills in net zero industry context.
2. Build awareness, motivation, and urgency. This will include prioritizing skills for immediate benefit.
 - Socialize industry-specific *green skills* as well as those that cross-industries.
 - Review net-zero strategies and anticipate high value skills which correspond.
 - Work with PSIs to update training to meet the evolving needs of industry in training. Commit to more joint (public/private) responsibility for upskilling/retraining.
 - Cultivate a mindset where sustainability isn't an add-on or separate consideration in strategy building and decision making. Progressive industry cultures will default to integrate sustainability alongside other critical factors and KPIs.
 - Draw talent from mature, vulnerable, or declining sectors where workforce possesses highly transferable skills.
 - Identify talent with key but untapped skill areas such as project management for energy conversion, or consultancy and advisement on sustainable shifts.
 - Commit to training workers in transition to broaden talent pool to those who may not possess a 100% skills match.

3. Develop a more diversified workforce.
 - Build inclusive capacity. Help people to enter the industry via untraditional pathways. This allows new entrants with diverse skills and perspectives, and from diverse communities, to participate in the industry, while also expanding the talent pool. Additionally, new talent is looking for employers who are proactively building more inclusive workforces, where equity is a priority and a guiding principle. The competition for talent means that employers need to better meet the expectations of jobseekers.
 - Diversity also relates to skills and experience. There is a tendency to default to traditional skillsets (and job descriptions) when hiring. Develop competency grids to recognize evolving and comparable capabilities and skills.
 - Update job descriptions and change hiring/interview processes and protocols. This will include training recruiters to recognize equivalent experience and cognitive profiles.
4. Adopt digital and automated technology where appropriate to replace dull, dirty, dangerous, or inefficient tasks, and those related to more sustainable operations. Digitization is not a popular notion in the sector but is a reality that needs to be acknowledged in any globally competitive industry.
 - Commit to training existing workforce for the skills needed to engage effectively with the technology, and to keep pace with the evolution of the industry. Technology adoption can also provide more accessible pathways for non-traditional workers, particularly those for whom physical accessibility has presented a barrier to participation.
 - Consider continuous digital upskilling as required professional development.
5. Engage in knowledge sharing across regions and nations.
 - There are several global examples of quickly developed programming such as 'Fit for Offshore', an energy transition program from the University of Aberdeen. Cultivating more partnerships internationally can facilitate swifter knowledge transfer, capacity building, and technology adoption.
6. Develop more micro-credentialing curricula to support swift capacity building.
 - Micro-credentialing can accelerate the speed to readiness of new or transitioning talent and can help keep workforces current and agile and engaged. It can also help with overall competitiveness and relevance of industry players.
 - Formal micro-credentialing would need rigor in assessment for quality assurance of the program. Industry employers are signaling more willingness to recognize skills developed from informal, uncredentialed – but credible - programs. This means that organizations or sector councils can develop bespoke training/micro-credentialing without the requirement for rigorous review and approval by an accredited training provider. The current workforce and skills gap has prompted new willingness and more resource allocation to bespoke training. Industry can validate this approach by looking to the successes of other agile industry leaders like the Construction Association of Nova Scotia.

Final Thoughts and Questions to Ponder

2050 may seem far off, but the climate crisis has increased the urgency of reaching milestones for net-zero. Integral to this is building workforce skill, competency, and capacity quickly, which leaves us with some questions to ponder:

- What is the digital future of the port, supply chain, and maritime sector?
- Where do we focus our training and development resources in the short term?
- Why are we not sharing best practices around training and upskilling nationally and across industry if this knowledge sharing is vital to meeting national net-zero goals?
- Is there a possibility for national curricula for common, high value green skills that translate across several priority industries to yield more consistency in foundation skills and knowledge?
- Is there a possibility for national curricula for micro-credentials to support rapid upskilling transition from industries that are highly impacted by the shift to a net-zero economy?
- How can government and industry share the heavy lifting of developing and delivering bespoke industry-specific green skills programs to prevent a growing skills gap and support competitiveness in a net zero economy?



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