NOVA SCOTIA
OFFSHORE WIND
R&D FORUM

Shaping the Future of Offshore Wind in Nova Scotia

SUMMARY REPORT

NOVEMBER 18, 2024

NOVA SCOTIA

net-zero atlantic

Contact Information

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Funding Acknowledgement

We extend our sincere thanks to our sponsors for supporting the 2024 Nova Scotia Offshore Wind R&D Forum. Your commitment to advancing offshore wind research and development is instrumental in shaping the future of this industry in Nova Scotia.

Land Acknowledgement

The 2024 Nova Scotia Offshore Wind R&D Forum took place at the Halifax Marriott Harbourfront Hotel based in Mi'kma'ki. This ancestral and unceded territory of the Mi'kmaq is covered by the Treaties of Peace and Friendship, which the Mi'kmaq and Wolastoqiyik people first signed with the British Crown in 1725, and which are based on relationships. We honour and respect those treaties and encourage reflection on the meaning of having an agreement based on relationships.

Our collective work takes place in many traditional territories of Indigenous Peoples, including those of the Mi'kmaq, Beothuk, Innu, Inuit, Wolastoqiyik, and Passamaquoddy. In our shared work, we acknowledge the historical partnership between the land and Indigenous Peoples and our joint commitment to its protection. We show our gratitude and appreciation of past and ongoing contributions from our Indigenous partners by the mentioning of this historical relationship. We are committed to an inclusive transition to a net-zero future.

Forward: CEO's Message

Alisdair McLean
Chief Executive Officer
Net Zero Atlantic

Net Zero Atlantic is pleased to present the summary report for the 2024 Nova Scotia Offshore Wind R&D Forum. The 2024 Forum was the first opportunity for researchers, stakeholders, and rightsholders in Nova Scotia to share what we know, what we must learn, and to deepen our shared understanding of the work being done locally, regionally, and internationally to advance sustainable and inclusive offshore wind sector development.

With the completion of the Final Report of the Regional Assessment for Offshore Wind Development, this summary report provides a key opportunity to reflect on the importance of a collaborative R&D effort. The 2024 Forum was an important milestone to measure our collective impact, where 263 participants assembled to discuss research findings, identify gaps in R&D, and fill these areas with knowledge. The research contained in this summary report, alongside findings from the Regional Assessment, provides the foundation to align R&D efforts with the pressing needs of industry, government, and communities. We recognize the critical role of strategic, focused, and applied R&D to meet these needs.

As we look ahead to the anticipated Provincial call for bids for the issuance of offshore wind licenses, and to the Nova Scotia Offshore Wind R&D Forum in September 2025, Net Zero Atlantic is prepared to keep pace and be ready to recognize, plan, and action the R&D opportunities as the sector steadily progresses.

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Introduction

Net Zero Atlantic, the Nova Scotia Department of Energy, and proudly hosted the first edition of the Nova Scotia Offshore Wind R&D Forum on November 18, 2024, at the Halifax Marriott Harbourfront Hotel in Halifax, Nova Scotia. This event brought together 263 participants—15% of whom were from international jurisdictions—to explore R&D topics required to advance the development of a sustainable and inclusive offshore wind sector in Nova Scotia.

Background

Centered on the theme "Shaping the Future of Offshore Wind in Nova Scotia," the Forum was a platform for researchers and technical experts to share their insights regarding the development of the offshore wind sector. The Forum offered a blend of panel sessions, interactive Q&A sessions, poster presentations, and networking, providing insights into the research, strategies, and networks aiming to advance the development and sustainability of the offshore wind sector regionally and internationally.

Program Considerations

We ensured the program for the 2024 Forum included representation from Indigenous and rural communities, youth, fishers, and key groups involved in shaping the future of offshore wind development in Nova Scotia. We sincerely thank all participants for taking the time to offer their insights and perspectives.

Purpose of the Report

This report provides an overview of the Forum presentations, identifies gaps in research and development, and outlines key takeaways and next steps to address those gaps. Its purpose is to align a shared understanding of the complex dynamics shaping Nova Scotia's offshore environment, and to support more coordinated, purposeful research that advances the sustainable and inclusive development of the offshore wind sector. Grounded in Nova Scotia's expertise and informed by national and international perspectives, this report aims to foster stronger collaboration across sectors and related research disciplines.

Conference Overview

The full-day Forum featured an array of sessions that tackled topics from grid interconnection and innovative technologies to environmental effects and socioeconomics. The Forum participants included cross-sector representation from government, private sector, academia, Indigenous organizations and communities, and Nova Scotia communities.

Sessions Included:

2 Keynote Sessions, including:

- ***"Hubs and Spokes as a Next Step in European Collaboration to Integrate Offshore Wind"*** explored research from the North Sea investigating the use of a hubs-and-spokes system for offshore wind development.
- ***"Regional Assessment Committee – The Offshore Wind Option for Nova Scotia"*** approached the local context for offshore wind development, focusing on the key results and recommendations from the recently completed Regional Assessment for Offshore Wind Development in Nova Scotia.

11 Concurrent Sessions featuring **38 presenters**, including:

- 4 Technical Sessions focused on grid integration, metocean data use and collection, the role of geoscience, and floating offshore wind.
- 4 Environmental Sessions focused on effects on marine life, effects on bird and bat populations, marine spatial planning, and interactions with invertebrates, mammals, and turtles.
- 3 Policy & Regulatory Sessions focused on fisheries sector considerations, best practices in education and social acceptance, and enabling measures and strategies for future development.

19 Poster Presentations focused on a wide range of technical, environmental, and policy and regulatory-related topics.

Keynote Sessions

Keynote 1 | **Hubs and Spokes as a Next Step in European Collaboration to Integrate Offshore Wind**
Anders Grønbech Jørgensen | Bedford Institute of Oceanography
Link to presentation

The first keynote of the Forum explored research from the North Sea Wind Power Hub Programme, highlighting that a hubs-and-spokes system, which integrates energy production, cross-border transmission, and hydrogen conversion, could offer significant efficiency, capacity, and cost advantages over traditional radial designs.

Anders Grønbech Jørgensen from Energinet began the keynote session by highlighting the European Union's pursuit of 300 GW of offshore wind capacity by 2050, a key step in reaching targets defined in the Paris Agreement. The North Sea Wind Power Hub Programme has investigated the development and integration of vast amounts of offshore wind energy and concluded that it is possible to do so using hubs-and-spokes systems. The hubs would collect the electricity generated, connect production and consumption across national borders, and convert electricity to hydrogen. Offshore wind sites would be linked across large demographic distances with a goal of increasing energy efficiency and decreasing costs.

Offshore wind sites in Europe currently use a radial transportation system, in which electricity from offshore

wind is collected and sent directly to shore. However, beyond 80–100 km offshore, the electricity must be converted from alternating current (AC) to direct current (DC) to prevent losses, requiring additional equipment and larger platforms. In contrast, converting some of this electricity to hydrogen offshore using separate platforms with more space could simplify the collection, conversion, and cross-border transmission of electricity. This makes the hubs-and-spokes method more efficient than the standard radial approach.

Using connected platforms in a hubs-and-spokes system, an additional 39 GW of energy can be generated at the same cost as the radial system. While the most efficient offshore wind sites currently operate at full capacity only 50% of the time, the hubs-and-spokes model could increase this to 70%. Furthermore, the hubs-and-spokes approach requires 24% less infrastructure than the radial method. Accordingly, a long-term vision is in place to implement the hubs-and-spokes system by 2050.

Next Steps

Jørgensen stressed the importance of near future decisions to be made regarding the development and design of the hubs-and-spokes systems, which requires international collaboration across the European Union.

- **Strong international collaboration is needed** and should be focused on developing a clear mandate to advance the hubs-and-spokes approach.
- **Supporting offshore infrastructure development and design is required** in the near future, including integrated designs for electricity generation and hydrogen infrastructure. These design decisions for post-2030 development should be made in the immediate future.
- **A stable investment framework must be established to** ensure forward momentum. In particular, tender designs should be aligned internationally and provide long-term certainty regarding offshore wind's role as a central component of the region's long-term decarbonization strategy. Further highlighted was the implementation of offshore wind bidding zones in support of the hubs-and-spokes system and large-scale offshore wind deployment.

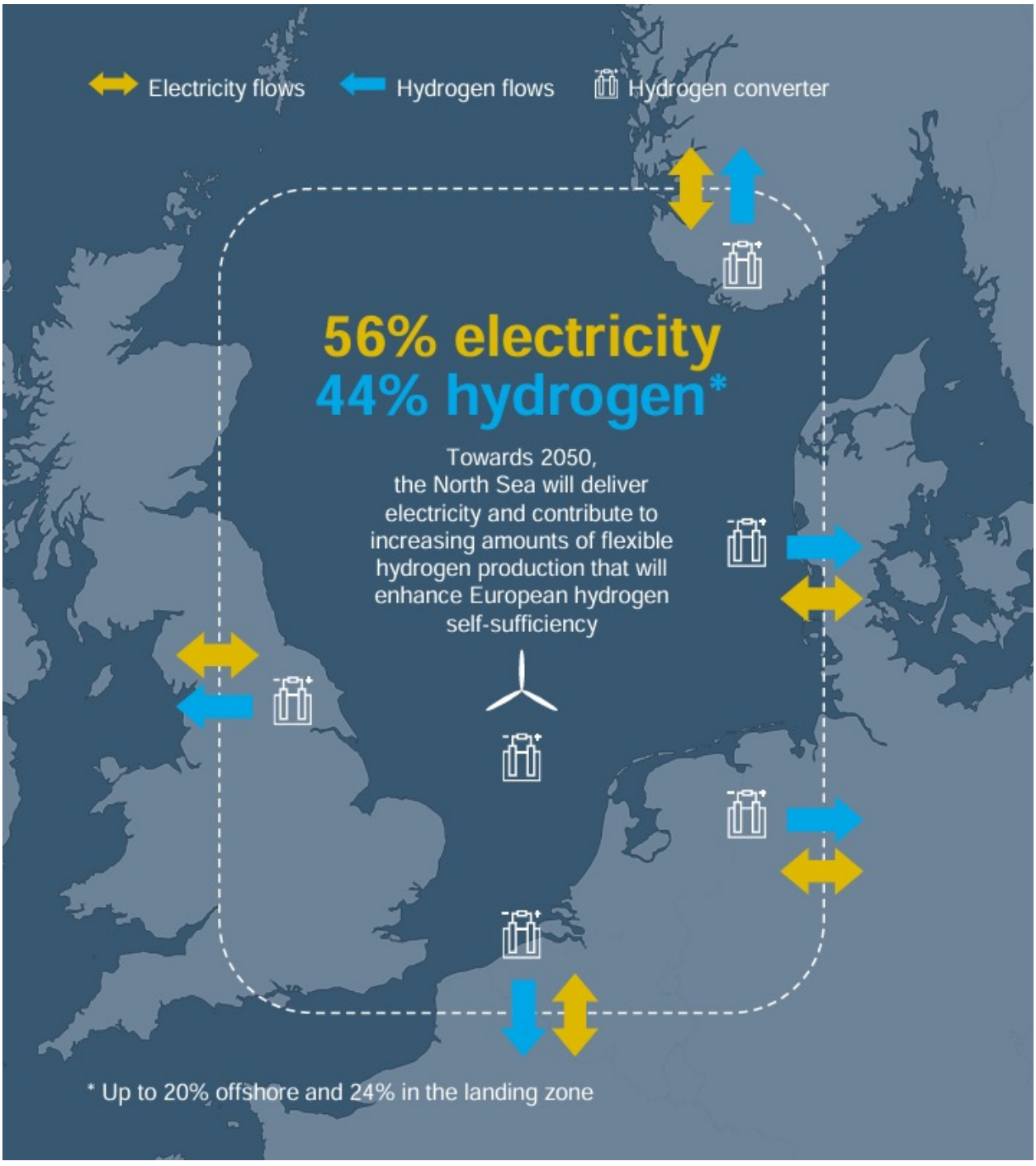

Figure 1. *Slide reference #14 from Anders Grønbech Jørgensen's presentation.*

Keynote 2 | **Regional Assessment Committee – The Offshore Wind Option for Nova Scotia**
Graham Daborn | Acadia University
Link to presentation

The second keynote of the Forum approached the local context for offshore wind development in Nova Scotia, focusing on the key results and recommendations from the Regional Assessment for Offshore Wind Development in Nova Scotia.

Graham Daborn from Acadia University began the keynote address by highlighting Nova Scotia's opportunity to capitalize on a world-class offshore wind energy resource. In April 2023, a five-member independent committee, well supported by a seven-member Secretariat, began to examine the feasibility and acceptability of large-scale capture of wind energy in offshore regions of Nova Scotia. The committee was tasked with providing information, knowledge, and analysis regarding future offshore wind development and its potential effects in the study area (the Scotian Shelf). The purpose of this Regional Assessment is to inform and improve future planning, licencing, and impact assessment processes for offshore wind activities in a manner that will protect the environment, human health, social and economic conditions, and creates opportunities for sustainable development.

The Scotian Shelf study area is a highly complex, unique, and biologically diverse coastal habitat with ecological linkages that span from the Arctic to the South Atlantic, and from the Americas to Europe. Daborn noted that while offshore wind project development in other jurisdictions provide valuable insight about potential environmental effects, local conditions on the Scotian Shelf are unique and must be further investigated. Furthermore, research into the potential effects of offshore wind must include financial, environmental, social, and cultural considerations, including implications for commercial fisheries, coastal livelihoods, and First Nation communities.

After extensive engagement with the public, Indigenous communities and organizations, government agencies, fishers, academic, and industry experts, the committee identified eight potential development areas: five 'Tier 1' and three 'Tier 2' wind energy areas. These areas could accommodate offshore wind development and provide the least conflict with other important activities in the study area, such as commercial fishing and shipping conservation area designations. The committee further recommended a 25 km buffer zone between offshore wind sites and the coast due to high shipping traffic.

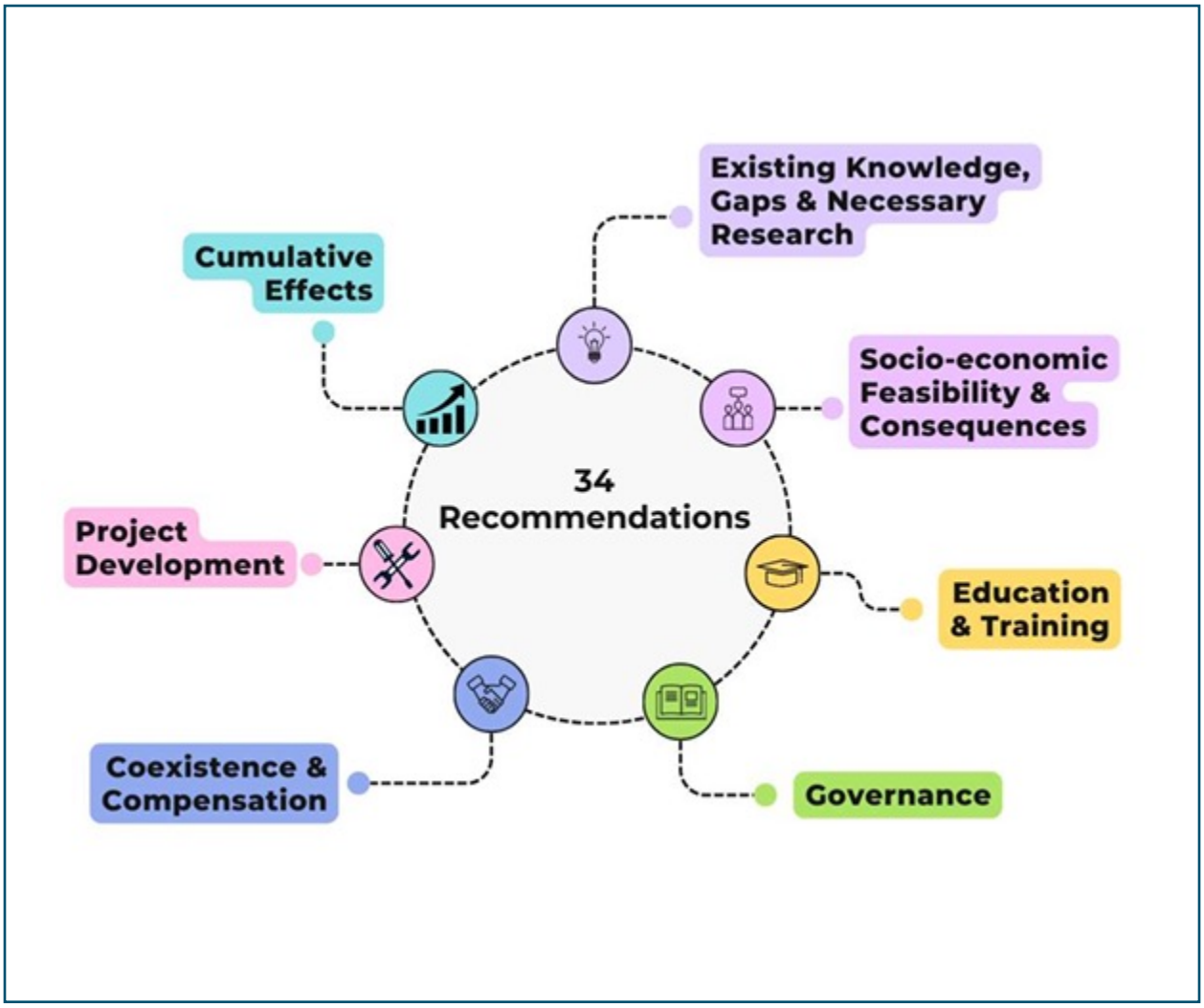

Figure 2. *The Regional Assessment Committee provided 34 recommendations across seven broad subject areas that are directly relevant to offshore wind development in Nova Scotia. Slide reference #12 from Graham Daborn's presentation.*

Next Steps

The Regional Assessment Committee produced 34 key recommendations across seven broad subject areas relevant to offshore wind development in Nova Scotia. Daborn emphasized the importance of addressing key knowledge gaps and the need for national and international collaboration to advance the sector. This included:

- Project costs vary significantly based on factors such as project scale, supply chain maturity, and grid connection complexity. **A more comprehensive understanding of the financial dimensions** of offshore wind development is essential to support effective planning and investment strategies.
- **Critical data gaps remain in spatial mapping and modelling**, particularly regarding commercial fisheries activity. Comprehensive mapping of fishing areas is currently limited; however, equipping commercial vessels with GPS trackers could help generate the necessary data for integrated marine spatial planning.
- **Workforce training and education programs must be established** to support the industry. Early investment in skills development is essential to build sector-specific expertise and enhance existing knowledge-sharing mechanisms.
- **Further research is needed on environmental and socioeconomic impacts**, including the effects of offshore wind on pelagic and benthic ecosystems, the structure and demands of the supply chain, and the infrastructure required to support a growing offshore wind workforce—such as housing, healthcare, and community services.

Technical Sessions

Metocean Data: Collection and Use

Speakers

Thomas Levy | NRCan (Moderator)
William Perrie | Bedford Institute of Oceanography
Link to presentation
Lukas Swan | Dalhousie University
Link to abstract

This session examined Nova Scotia's offshore wind energy potential through the lenses of atmospheric science, satellite data, and power system integration.

William Perrie of the Bedford Institute of Oceanography presented a methodology for assessing offshore wind potential using high-resolution Synthetic Aperture Radar (SAR) data combined with various wind datasets. Perrie argued that SAR, thanks to its all-weather and day-night sensing capability, is particularly well-suited to estimating wind characteristics in offshore environments. The approach is valuable for understanding both the average wind resource and storm-related wind extremes—two critical factors in siting and designing offshore wind projects.

Lukas Swan of Dalhousie University presented research that connects offshore wind resource data with the performance characteristics of Nova Scotia's electricity system. By analyzing wind shear and seasonal generation patterns, Swan identified the spatial and temporal potential of offshore wind to support both local demand and broader system needs. Swan also stressed the mismatch between the scale of offshore wind potential and Nova Scotia's small grid, highlighting the need for export strategies and better data.

This session highlighted the critical need for improved data and modelling at regional scales, especially as the province evaluates offshore wind development areas. The speakers emphasized that while Nova Scotia has promising wind resources, refined tools and more robust measurements are necessary to reduce uncertainty, evaluate project viability, and prepare for integration into the Atlantic Canadian grid.

Knowledge Gaps

- **Wind Measurement & Validation:** There is an urgent need for more meteorological and SAR observations, particularly at turbine hub heights, to confirm model accuracy.
- **Climate Impact Modeling:** More research is needed to model how extreme wind events will change under future climate scenarios and what that means for infrastructure survivability.
- **High-Resolution Simulations:** Finer spatial and temporal resolution is essential for both wind estimation and system integration modeling.
- **Wind Direction & Variability:** Better understanding of directional patterns and seasonal variability will improve turbine layout and system planning.
- **Icing Effects:** No current local data exists on the impact of icing on offshore wind turbines—this is a key operational and safety concern.
- **System Integration & Export Strategy:** There must be a clearer understanding of how much offshore wind energy will be exported versus used locally, and what grid infrastructure is needed in support.
- **Definition of Extreme Events:** Offshore wind will require Nova Scotia to adopt new criteria for extreme weather events and develop contingency strategies accordingly.

Next Steps

- Expand data collection efforts, including deployment of offshore measurement platforms and expanded use of satellite SAR archives.
- Conduct geographically diverse validation studies to calibrate models.
- Advance high-resolution modeling using locally appropriate boundary layer and atmospheric assumptions.
- Begin grid integration studies that simulate the impact of various offshore wind scenarios on system reliability, capacity value, and export capability.
- Establish collaborative research initiatives to address icing, extreme wind events, and other Nova Scotia-specific operational conditions.

Offshore Wind: Grid Integration

Speakers

Tim Bachiu | Net Zero Atlantic (Moderator)
Matteo Niccoli | Canada-Nova Scotia Offshore Energy Regulator (CNSOER)
Link to presentation
Jordan Eamer | Geological Survey of Canada
Link to presentation
Grant Wach | Dalhousie University
Link to abstract

This session primarily focused on the current state of knowledge about seabed morphology and geological composition of offshore areas of Nova Scotia where offshore wind development is anticipated but also delved into subsurface energy storage options that could be used to balance the intermittency of offshore wind energy generation.

Matteo Niccoli of the newly renamed and mandated Canada-Nova Scotia Offshore Energy Regulator (CNSOER) highlighted that the CNSOER has historically collected geophysical and geotechnical datasets in support of the offshore oil and gas industry in Nova Scotia that are relevant to offshore wind development. This includes curated seismic data available through the 'Data Management Centre' that can be used to map important seabed features (e.g., near-surface faults, canyons, channels). Niccoli also identified the importance of understanding sediment composition (i.e., grain size distribution by fraction) to offshore wind development and indicated that the seabed of proposed wind energy areas is largely comprised of sand, gravel, and mud in varying proportions.

Jordan Eamer of the Geological Survey of Canada identified the importance of understanding seabed morphology and geology of the seabed where offshore wind development is planned, and indicated that the Geological Survey of Canada commenced new data collection efforts in 2023 on the Eastern Scotian Shelf to fill in knowledge gaps. Eamer revealed that seabed mapping and shallow subsurface data in nearshore and bank-edge environments indicate the preservation of relict coastal or terrestrial landforms, while new data across the northern half of Middle Bank reveals a potential longer-term flux of sediment off the bank edges and complex textural patterns across the seabed.

Grant Wach of Dalhousie University discussed the need for energy storage solutions such as hydrogen and compressed air to support Canada's energy transition. He also addressed the importance of storage options for balancing the intermittent nature of offshore wind energy and noted the substantial subsurface storage capacity available in Atlantic Canada. Additionally, Wach pointed out various regulatory challenges related to gaps and barriers within existing regulations concerning offshore energy storage, emphasizing the need to address economic, social, and environmental issues to facilitate the energy transition.

Overall, this session identified the need for additional data and improved models to enhance understanding of sediment dynamics and suitability for offshore wind development, and identified regulatory challenges with respect to offshore energy storage.

Knowledge Gaps

- **Seabed mapping:** Additional data collection in proposed wind energy areas is needed to support offshore wind development, including identifying areas suitable for subsea energy storage.
- **Improved modelling:** Enhanced approaches are required to understand sediment dynamics in offshore wind development areas.
- **Geological characterization:** Sector growth requires improved knowledge of sediment thickness under banks, locations of drowned/preserved coastal landscapes, engineering properties of offshore sediments and bedrock, risk of mobile sediments in shallow regions, and sediment flux and loss rate along bank edges.
- **Regulatory clarity:** Gaps and barriers within regulations as they relate to offshore wind, and uncertainty about where responsibility lies for providing oversight for offshore wind development (provincial or federal jurisdiction).

Next Steps

- Continue efforts for works already underway (e.g., geological surveys, geomorphic analyses, sediment classification and seabed characterization).
- Identify specific regulatory issues that exist and clarify roles and responsibilities for federal and provincial government agencies with respect to offshore wind development.

Offshore Wind: Grid Integration

Speakers

John Dalton | Power Advisory (Moderator)
Tershara Matthews | WSP
Link to presentation
Cornelis A. Plet | DNV Energy Systems
Link to presentation
Mahmoud Kiasari | Dalhousie University
Link to presentation

This session focused on how to optimize offshore wind energy delivery, covering physical transmission infrastructure, strategic planning of lease areas, and digital technologies for grid optimization. It explored technical, environmental, and regulatory considerations, as well as innovation opportunities in transmission and grid management. Key themes included starting transmission planning early, using HVDC for efficiency and scale, and integrating artificial intelligence (AI) and machine learning (ML) for reliability and predictive control.

Tershara Matthews of WSP emphasized the primacy of transmission logistics in the siting of offshore wind farms. The core thesis: "Where are the cables going to go?" must be the first question, not an afterthought. This framing shifts project sequencing to transmission-led planning, aligning lease area decisions with offtake feasibility and existing infrastructure. Ecological impact and permitting considerations tied to transmission corridors were also noted as critical early inputs.

Cornelis A. Plet of DNV Energy Systems presented a technically detailed case for high-voltage direct current (HVDC) as a strategic enabler of large-scale offshore wind transmission. He argued that 2 GW ±525 kV HVDC bipoles are optimal for Nova Scotia's remote offshore wind sites. However, realizing this requires lease areas with sufficient capacity and regulatory upgrades to accommodate the Most Severe Single Contingency (MSSC) implications.

Mahmoud Kiasari of Dalhousie University focused on how AI and machine learning can address renewable integration challenges, from forecasting to operational optimization. Variability and intermittency are primary barriers, but real-time analytics and predictive models offer emerging solutions to enhance market access and reduce costs for renewable developers.

This session underscored the need for transmission-first planning frameworks to guide wind energy area development. Grid infrastructure limitations, especially MSSC constraints, must be addressed for HVDC integration. Lastly, the speakers identified coordination challenges with government and regulators around transmission rights, lease sizing, and contingency planning that must be addressed to advance the industry.

Knowledge Gaps

- **Environmental research:** Potential effects of submarine cable installation on benthic and coastal habitats and protected marine areas must be further investigated.
- **Transmission architecture:** Comparative analysis of radial, intraregional, interregional, and backbone networks remains limited.
- **Digital solutions:** Uncertainty remains around commercial feasibility and stakeholder acceptance of AI-based tools for grid management.
- **Market education:** Demonstrating AI/ML value to developers, utilities, and policymakers is critical.

Next Steps

- Develop integrated offshore wind-transmission planning processes with government agencies.
- Fund environmental impact studies for submarine cable routes and coastal landings.
- Pilot HVDC systems with storage/flexibility contingencies to raise MSSC readiness.
- Scale and test AI/ML models in live grid environments with industry partners.

Floating Offshore Wind: The New Frontier in Renewable Energy

Speakers

Anne-Marie Belliveau | Projectable Consulting (Moderator)
Saverio Ventrelli | Siemens Energy
Link to presentation
Jean-Robert Fournier | SBM Offshore
Link to presentation
Mohammad Mahdi Azimnia | Condition Monitoring Center, Sharif University of Technology
Link to presentation

This session highlighted significant advancements and challenges for floating offshore wind, and explored the intersections of technology, operations, and strategy in project development.

Saverio Ventrelli of Siemens Energy focused on how battery energy storage solutions (BESS) are transforming the renewable energy landscape – particularly for floating offshore wind – by enhancing frequency regulation, voltage control, and overall grid integration. Ventrelli highlighted how BESS enables energy independence, supports decarbonization goals, and offers scalable, modular configurations suited for both grid-connected and remote, off-grid applications.

Jean-Robert Fournier of SBM Offshore identified the need for significant upgrades to port infrastructure, logistics, and resource management to support offshore wind growth in Atlantic Canada. Key focus areas include modular turbine assembly, risk management, and workforce planning to support this emerging industry well into the future.

Mohammad Mahdi Azimnia of Condition Monitoring Center, Sharif University of Technology discussed how predictive digital twin models – using data analytics, fuzzy logic, and machine learning – are being developed to assist with the maintenance of turbine blades by anticipating failures and optimizing upkeep. The application of digital twins, especially through vibration monitoring of critical components like bearings and gears, helps prevent breakdowns, reduces expenses, and enhances operational efficiency for offshore wind turbines (Figure 2).

Speakers in this session emphasized the importance of battery storage to enhance grid stability and asset performance, the prioritization or port infrastructure for efficient project delivery, and the role of digital twin technologies in enabling predictive maintenance and reliability for wind turbines. Collectively, these innovations point toward a future where modular systems, integrated digital solutions, and upgraded logistics are pivotal for the efficient, sustainable, and scalable development of offshore wind energy in Nova Scotia.

Knowledge Gaps

- **Scalable logistics infrastructure:** Strategic planning and readiness of port facilities, material sourcing, and construction logistics are needed.
- **Comprehensive risk management strategies:** There is uncertainty in operational risks stemming from weather downtime, O&M labour supply, and long-term sustainability of assets.
- **Holistic integration & optimization of advanced storage solutions:** There is an incomplete understanding of how BESS can be fully integrated with floating offshore wind projects at scale.
- **Standardization in digital monitoring & predictive maintenance:** Effective large-scale implementation of digital twins remains a challenge, and there is insufficient knowledge about the standardization of digital twin models, data management protocols, and real-world integration with diverse turbine technologies and offshore environments.

Next Steps

- Develop detailed methodologies for forecasting demand, scaling up port infrastructure and logistics capacity, and managing supply chains efficiently as the industry grows.
- Research is needed to develop robust risk mitigation strategies, workforce planning models, and adaptive operations frameworks tailored to floating offshore wind.
- Determine optimal strategies for cost-effectiveness, long-term reliability and seamless grid integration of advanced energy storage solutions for offshore wind.
- Explore opportunities for the use of predictive digital twin models in the Atlantic Canadia context.

Environmental Sessions

Offshore Wind: Effects on Marine Life

Speakers

Anna Redden | Acadia University (Moderator)
Kaus Raghukumar | Integral Corp
Link to presentation
Benjamin Williamson | University of Highlands & Islands
Link to abstract
Caitlin McGarigal | New Jersey Department of Environmental Protection
Link to presentation
Andrew Gill | Center for Environment Fisheries and Aquaculture Science (CEFAS)
Link to presentation

This session explored the multifaceted environmental impacts of offshore wind energy development, highlighting advances in sound source verification, ecosystem-level assessments, regional monitoring initiatives, and ecological considerations for fisheries.

Kaus Raghukumar of Integral Corp discussed the application of modelling approaches and advanced tools like directional acoustic sensors to improve the accuracy of sound source verification during offshore wind construction and operations to more precisely assess environmental impacts. These methods help with the development of targeted rules for various activities that streamline permitting and support responsible offshore wind development.

Benjamin Williamson of the University of Highlands & Islands outlined the PELAgIO project's goal to assess the cumulative effects of offshore wind on marine ecosystems, with a focus on offshore wind impacts on ocean mixing, food chains, and fish populations. Through the application of interdisciplinary fieldwork and advanced modelling, this effort seeks to understand the broader ecological consequences of offshore wind development – information essential for shaping objective marine policy and management strategies.

Caitlin McGarigal of the New Jersey Department of Environmental Protection provided an overview of an environmental monitoring initiative in New Jersey that collects oceanographic and biological data to support both ecosystem assessments and fisheries management, ensuring sustainable offshore wind development while protecting marine habitats.

Andrew Gill of the Center for Environment Fisheries and Aquaculture Science (CEFAS) emphasized the importance of ecosystem-focused planning during offshore wind project development, and consideration of factors such as project scale, species-specific impacts, and fluctuating populations. Key concerns include effects on fish behavior, fisheries displacement, and the introduction of floating wind farm technologies.

Overall, speakers emphasized the importance of accurate modeling, interdisciplinary collaboration, and robust data collection to ensure that offshore wind projects are both environmentally responsible and beneficial to marine ecosystems. The session underscored the ongoing need for comprehensive monitoring, adaptive management, and continued research to address data gaps and support sustainable offshore wind development.

Knowledge Gaps

- **Limited in-situ data collection:** A lack of comprehensive monitoring data collected directly within, and around operational offshore wind sites hinders the accuracy of models and the ability to assess impacts.
- **Cumulative effects:** Improved understanding of the broader ecological and ecosystem-level effects of multiple offshore wind sites rather than focusing on single turbines or isolated projects.
- **Species-specific responses & ecosystem dynamics:** Gaps in knowledge about how different species respond to offshore wind projects across various life stages and ecological contexts coupled with the complexity and variability of natural populations presents challenges for clear cause-effect relationships.
- **Temporal variability:** The absence of longitudinal studies for oceanographic conditions and biological communities that track changes over time limits the ability to predict long-term consequences and to distinguish between natural fluctuations and offshore wind induced changes.
- **Fisheries data collection within offshore wind sites:** The absence of fisheries data collection from within offshore wind site boundaries makes it difficult to assess real-time and long-term impacts on commercially important species
- **Socio-economic effects:** Detailed, localized data on how offshore wind sites displace fishing vessels, alter fishing patterns, and impact the well-being of local fishing communities is lacking.

Next Steps

- Enhance the development of regional-scale monitoring and assessment tools and approaches to better understand cumulative effects.
- Improve temporal data coverage by implementing baseline data collection efforts well in advance of offshore wind installation, and monitoring across all phases of development (pre-construction, construction, operation, and decommissioning).
- Develop frameworks for the integration of multidisciplinary data that unifies physical, biological and socio-economic data to achieve a holistic understanding of offshore wind effects and guide objective policymaking.

Offshore Wind: Interactions with Invertebrates, Mammals and Turtles

Speakers

Sarah Thomas | DP Energy (Moderator)
Robert Lennox | Ocean Tracking Network, Dalhousie University
Link to presentation
Hilary Moors-Murphy | Fisheries & Oceans Canada (DFO)
Link to presentation
Daphne Monroe | Rutgers University
Link to presentation

This session focused on interactions between marine animals and offshore wind development and discussed how tracking marine animals using acoustic telemetry networks can help understand impacts and migration patterns, the importance of long-term acoustic monitoring for providing information about whales on the Scotian Shelf, and the economic effects of offshore wind on invertebrate fisheries.

Robert Lennox of the Ocean Tracking Network, Dalhousie University, discussed the value of tracking technologies (acoustic telemetry and gliders) to monitor marine animal movement and habitat use, including around offshore wind developments, and the importance of collaborations through regional networks and shared infrastructure to better inform marine spatial planning and conservation efforts.

Hilary Moors-Murphy of Fisheries & Oceans Canada (DFO) highlighted how long-term acoustic monitoring efforts for cetaceans on the Scotian Shelf being implemented by DFO are leveraging complementary data sets (e.g., sighting data) to map species distributions and identify crucial areas for these marine mammals.

Daphne Monroe of Rutgers University explored the interaction between a commercial shellfish fishery and offshore wind development in New Jersey, focusing on potential economic impacts, survey methods, and mitigation strategies. Monroe highlighted that offshore wind could displace fishing efforts, increasing costs and reducing revenues for local fishers, but also identified the potential for financial and non-financial mitigation (e.g., surfclam seeding) to offset losses.

This session emphasized the importance of coordinated monitoring efforts, long-term data collection, and regional collaboration to effectively assess the ecological and economic impacts of offshore wind development.

Knowledge Gaps

- **Incomplete coverage:** Current research frequently covers only certain geographic regions or portions of offshore wind areas, leaving large swaths understudied and thereby restricting comprehensive understanding of broader ecosystem impacts.
- **Longitudinal studies:** There is a need for consistent data collection over extended temporal periods to capture changing patterns and delineate between natural variability and effects of offshore wind.
- **Direct and indirect impacts of offshore wind:** Interactions between marine animals and offshore wind infrastructure (e.g., collision risk, displacement) are not fully understood, especially regarding cascading or long-term effects across multiple species.
- **Identification of critical habitats:** Additional research is needed to identify important habitats, migration corridors, and key behavioural patterns for fish and marine mammals.
- **Economic & mitigation uncertainty:** In the context of fisheries, there are unresolved issues about the economic effects of offshore wind on coastal communities and the effectiveness of financial and non-financial mitigation strategies.

Next Steps

- Optimize tracking tools, improve survey methods and enhanced data sharing frameworks to support robust marine monitoring and management.
- Develop collaborative frameworks to conduct more broad and integrated studies to address persistent data and knowledge gaps – essential steps toward sustainable offshore wind development.

From Collision Avoidance to Habitat Impact: Assessing the Potential Effects of Offshore Wind on Bird and Bat Populations

Speakers

Phil Taylor | Acadia University (Moderator)
Stephanie Avery-Gomm | Environment and Climate Change Canada (ECCC)
Link to presentation
Paul Knaga | Environment and Climate Change Canada (ECCC), Canadian Wildlife Service (CWS)
Link to presentation
Kate Williams | Centre for Research on Offshore Wind and the Environment (CROWE), Biodiversity Research Institute (BRI)

This session explored the challenges and approaches to understanding and mitigating the impacts of offshore wind development on birds and bats in Atlantic Canada.

Stephanie Avery-Gomm and **Paul Knaga** each overviewed efforts by Environment and Climate Change Canada (ECCC) and partners to develop a flexible, species-focused framework to assess cumulative impacts of offshore wind on aerofauna in Atlantic Canada. The approach integrates data on species movement, density and habitat use, information from regional assessments, and best practices from Europe and North America to predict high-risk areas and inform regional management decisions. This work will ultimately guide mitigation and monitoring efforts for sustainable offshore wind development.

Kate Williams of the Centre for Research on Offshore Wind and the Environment (CROWE) and Biodiversity Research Institute (BRI) highlighted the urgent need for better data and more rigorous testing of mitigation strategies to protect aerofauna from the impact of offshore wind development. While avoidance is the most effective mitigation approach, comprehensive and transparent studies that assess a variety of species concurrently are essential to ensure that mitigation strategies and reliable and ecologically sound.

Speakers in this session highlighted the development of assessment frameworks and vulnerability models that integrate detailed species data and movement patterns, supporting regional decision-making and mitigation planning.

Knowledge Gaps

- **Limited data offshore:** More comprehensive movement and distribution data (i.e., tagging, tracking and monitoring) is required from the offshore to accurately assess impacts of offshore wind; particularly for vulnerable species.
- **Mitigation strategies:** The effectiveness of mitigation strategies is unclear due to the absence of rigorous testing, and there is a need for more robust and transparent research to guide offshore wind practices to protect aerofauna.
- **Data integration:** Flexible and integrated data systems are required for effective cumulative effects assessment and decision making.
- **Data deficiencies:** There is a lack of detailed data for certain groups (e.g., shorebirds, coastal birds, marine birds and bats) and important behaviors (e.g., migration paths, altitudinal movement, offshore foraging) that are needed to evaluate risks and develop targeted mitigation strategies.
- **Research transparency and accessibility:** Greater transparency and public sharing of research results with respect to the effectiveness of mitigation strategies and species responses to offshore wind development.

Next Steps

- Support ongoing data collection efforts to map key habitats, understand risk factors, track migratory paths and understand offshore movement patterns for vulnerable species.
- Support collaboration across regions to ensure protection of vulnerable aerofauna as offshore wind energy expands.
- Ensure data sets are robust and accessible to inform regional assessment and support sustainable offshore wind development.

Marine Spatial Planning: Minimizing Impacts with Other Ocean Users

Speakers

Kiera Walsh | Net Zero Atlantic (Moderator)
Karl Hanke | Baird & Associates
Link to presentation

Ian Stewart & **Christopher Milley** | University of King's College & NEXUS Coastal Resource Management
Link to presentation

Elizabeth Nagel | Fisheries & Oceans Canada (DFO)
Link to presentation

This session focused on key efforts underway to advance offshore wind development in Nova Scotia, including the use of advanced risk modelling tools to assist navigation safety around offshore wind installations, the evolving regulatory and impact assessment processes essential for balancing ecological, economic, and social interests, and the development of robust marine spatial planning supported by data-driven decision tools.

Karl Hanke of Baird & Associates described advanced modelling tools to assess and quantify the risks of vessel collisions (i.e., a vessel striking another moving vessel) and allisions (i.e., a vessel striking a stationary object) associated with offshore wind projects; by simulating vessel movements and interactions with turbines using real traffic and environmental data, these models provide vital insights for marine spatial planning.

Ian Stewart of the University of King's College and Christopher Milley of NEXUS Coastal Resource Management focused on due diligence and impact assessments surrounding Nova Scotia's approach to offshore wind development and the balance between environmental protection and the need to advance clean energy solutions. By evaluating current and future ecosystem impacts and considering both potential risks and long-term benefits (e.g., energy security, climate change mitigation), Nova Scotia aims to ensure that planning and decision-making processes are informed, precautionary, and adaptive.

Elizabeth Nagel of Fisheries & Oceans Canada (DFO) discussed how marine spatial planning is being used to guide the responsible development of offshore wind by balancing the ecological, economic, and social interests in the ocean space. Using decision-support tools and spatial analysis software, DFO is identifying suitable areas for offshore wind development while minimizing conflicts and protecting important marine features.

Collectively, speakers in this session identified important and comprehensive approaches for sustainable offshore wind development that address safety considerations, environmental protection, and coexistence with other marine activities.

Knowledge Gaps

- **Data quality and availability:** High-quality and comprehensive datasets – whether related to vessel traffic, ecological features, or human activities – are needed for accurate modelling, spatial analysis, and risk assessment.
- **Understanding impacts:** There is uncertainty about the effects of offshore wind on existing marine activities (e.g., commercial fishing) that requires additional research to forecast changes and develop effective mitigation strategies.
- **Modelling behavioural responses:** Gaps exist in understanding how fishers, vessels and other marine users will adjust their behaviour in response to offshore wind installations, including changes in navigation patterns and spatial use.
- **Balance scope and specificity in assessment tools:** Impact assessment and decision-support processes must be broad enough to capture cumulative and long-term effects, yet focused enough to address immediate risks and knowledge gaps; determining the right scope for these tools remains an ongoing challenge.
- **Dynamic and evolving regulatory needs:** Regulatory frameworks are being adapted to address the rapid growth of offshore wind, and there is a need for streamlined, robust processes that can respond to emerging science and changing conditions.

Next Steps

- Support ongoing efforts to improve data collection and refine planning tools to ensure informed, sustainable decisions for Canada's marine ecosystems.
- Continue to engage with real-world users (i.e., fishers, local communities and other stakeholders) to refine models and impact assessments to reflect lived experience and diverse knowledge systems.
- Develop adaptive, participatory planning and assessment tools to guide responsible offshore wind development.

Policy & Regulatory Sessions

Sustaining the Seascape: Considerations for the Fisheries Sector

Speakers

Kevin Stokesbury | University of Massachusetts, Dartmouth (Moderator)
Link to presentation

Kris Vascotto | Nova Scotia Fisheries Alliance for Energy Engagement (NSFAEE)
Link to presentation

Melissa Nevin | Atlantic Policy Congress of First Nations Chiefs (APC)
Link to presentation

Russell Dmytriw | Atlantis Watershed Consultants, Ltd.
Link to presentation

This session focused on policy and regulatory concerns surrounding offshore wind development with respect to commercial fisheries and First Nations communities.

Kevin Stokesbury of the University of Massachusetts, Dartmouth provided an overview of recent research on the impacts of offshore wind development on the Northeastern US continental shelf that integrates historical data with new observations to predict substrate changes and establishes a baseline for environmental monitoring. Key findings show the economic value of offshore wind sites and the ecological impact, including habitat creation and potential disruptions to marine ecosystems.

Kris Vascotto of the Nova Scotia Fisheries Alliance for Energy Engagement (NSFAEE) identified the importance of sustainable co-existence between the fishing industry and offshore wind development on the Scotian Shelf, and emphasized the need for good spatial planning, robust assessments, and mitigation efforts to ensure that commercial fishing practices and economic returns are maintained as offshore wind development proceeds.

Melissa Nevin of the Atlantic Policy Congress of First Nations Chiefs (APC) emphasized the need to consider Indigenous knowledge and practices when developing offshore wind farms, which impact both treaty and rights-based fisheries – including those that focus on culturally relevant species and those that provide important income to communities.

Russell Dmytriw of Atlantis Watershed Consultants highlighted mitigation strategies that are being explored for the potential impacts of offshore wind development on Indigenous communities and commercial fisheries in Nova Scotia. The approach involves identifying mitigation measures, examining international models for compensation, and ensuring transparent fund administration and adaptive management to minimize conflicts and support sustainable livelihoods.

Speakers highlighted the need for comprehensive baseline data and monitoring, the economic and cultural significance of fisheries, the importance of meaningful inclusion of Indigenous knowledge, and strategies for mitigating and compensating for potential conflicts and environmental impacts.

Knowledge Gaps

- **Environmental impacts:** The long-term effects of offshore wind development on marine ecosystems – including fish and fisheries – are not well understood, but are important for predicting implications for commercial harvests and livelihoods.
- **Mitigation and compensation:** Strategies for mitigating the negative effects of offshore wind development on fisheries and the establishment of appropriate compensation programs are not fully developed.
- **Indigenous knowledge:** There is an insufficient understanding of how offshore wind development will impact Indigenous communities and their fishing practices, and how to meaningfully include Indigenous knowledge and practices in the planning and development process.
- **Monitoring mechanisms:** Effective mechanisms for monitoring and assessing the impacts of offshore wind sites on ecosystems and fisheries are lacking, including tracking changes over time and adapting management strategies accordingly.

Next Steps

- Define how Indigenous knowledge and practices will be meaningfully included in the offshore wind development process.
- Develop clear strategies for mitigation of potential negative effects of offshore wind development and develop appropriate fisheries compensation programs.

Emerging Best Practices in Education and Social Acceptance

Speakers

Scott Skinner | Clean Foundation (Moderator)
Jennifer MacNeil | Cape Breton Partnership
Link to presentation
Kelsey White & **Zach Sabean** | The Confederacy of Mainland Mi'kmaq (CMM)
Link to presentation
Kat Mataya | Centre for Ocean Ventures and Entrepreneurship (COVE)
Link to presentation
John Colton | Acadia University
Link to presentation

This session highlighted the importance of community engagement during offshore wind development and emphasized the need for inclusive and sustainable practices, educational initiatives for youth, and continuous dialogue with communities to build trust and capacity.

Jennifer MacNeil of the Cape Breton Partnership described community engagement efforts throughout Unama'ki-Cape Breton about offshore wind development, emphasizing two-way knowledge sharing, the importance of flexibility, empathy, addressing misinformation, and leveraging local expertise to establish meaningful dialogue in communities.

Kelsey White and **Zach Sabean** of the Confederacy of Mainland Mi'kmaq (CMM) discussed the partnership between the CMM and Net Zero Atlantic aimed to enhance Mi'kmaq capacity and foster meaningful participation in offshore wind development. Key community engagement practices include hands-on approaches, conflict resolution strategies, and continuous community contact; ongoing research and community engagement remain central to inclusive and sustainable offshore wind development.

Kat Mataya of the Centre for Ocean Ventures and Entrepreneurship (COVE) focused on recent efforts at COVE to increase diversity in the marine sector, including key initiatives around offshore wind through hand-on learning experiences that engaged students and families (e.g., Offshore Wind for Kids, the Floating Wind Challenge). Mataya highlighted future efforts to expand outreach throughout the Maritime Provinces, including First Nations communities, and provide multilingual resources.

John Colton of Acadia University identified the significance of continuous and respectful community engagement in the development of offshore wind, and highlighted lessons from past projects that underscore the need for deliberate and inclusive practices to build trust and social acceptance. This included the importance of starting early, being transparent, and including diverse voices in the conversation, especially youth.

Several insights emerged from this session, including the significance of respecting local expertise, addressing environmental and economic concerns, and fostering social acceptance through meaningful benefits and partnerships.

Knowledge Gaps

- **Inclusivity and participation:** There is a need for inclusive and meaningful participation in offshore wind development, particularly for Indigenous communities, including community empowerment through fostering a sense of identity, sovereignty, and community pride in offshore wind development.
- **Socioeconomic benefits:** There is a lack of clear and specific information about local job creation, economic impacts, and community benefits related to offshore wind initiatives (e.g., benefit agreements for Indigenous communities).
- **Regulatory framework:** There is a lack of accessible and specific information about the regulatory processes governing offshore wind projects and what they entail.

Next Steps

- Continue community engagement efforts that include regular updates about proposed technologies, regulatory processes, and efforts to address environmental effects become clearer. A clear focus on relationship building and continuity in outreach should be emphasized for Indigenous and rural community engagement.
- Conduct a comprehensive socioeconomic assessment of Indigenous and key communities across Nova Scotia to gather specific data on local job creation, economic benefits, and community impacts associated with offshore wind development.
- Establish a framework around effective strategies for conflict resolution for commercial fisheries and offshore wind development.
- Build on existing engagement and education efforts for youth to enhance knowledge of wind energy and awareness of potential careers in offshore wind.

Enabling Measures and Strategies for Future Development

Speakers

Mohammad Ali Raza, Cox & Palmer (Moderator)
Martin Thomsen | Municipality of the County of Richmond & Town of Port Hawkesbury
Link to presentation
Courtney Wall & **Katy Macdonald** | Stantec
Link to presentation
Blair MacDougall | Waterford Energy Services Inc.
Link to abstract

This session outlined enabling measures for offshore wind development in Nova Scotia, including a review of federal and provincial policies supporting sector growth and a feasibility assessment for establishing a centre of excellence that would serve as a resource for engagement and research.

Martin Thomsen outlined a joint effort between The Municipality of the County of Richmond and the Town of Port Hawkesbury and AECOM to assess the feasibility of establishing an Offshore Wind Centre of Excellence in Nova Scotia that would unite experts, researchers, government and industry to advance offshore wind technology, and provide an important resource for public engagement.

Courtney Wall and **Katy Macdonald** of Stantec assessed the policy landscape for offshore wind development in Atlantic Canada, and reviewed various federal and provincial policies focusing on greenhouse gas emissions, renewable energy, and hydrogen development. Although challenges exist (e.g., political uncertainty, regional collaboration barriers), opportunities include interprovincial consistency, alignment on sector drivers, sustained government funding, and workforce development.

Blair MacDougall of Waterford Energy Services Inc. outlined a conceptual study for a 700 MW fixed bottom offshore wind farm in Nova Scotia that highlighted transferable skills from offshore oil and gas, favorable ports, and infrastructure, but also identified challenges posed by market supply-demand uncertainties, regulatory framework developments, and environmental considerations.

Speakers in this session emphasized the importance of collaboration and strategic partnerships, with a focus on regulatory frameworks, environmental stewardship, and market potential.

Knowledge Gaps

- **Regional collaboration:** The absence of a regional approach and collaboration among Atlantic provinces poses challenges in aligning policies, strategies, and priorities.
- **Technical & infrastructure requirements:** There are gaps in knowledge about the specific technological advances needed and the infrastructure upgrades required to integrate large-scale offshore wind into the regional grids.
- **Market demand and commercial viability:** There is uncertainty in future market supply-demand for Power-to-X products (e.g., green hydrogen) and the commercial risks associated with these products.
- **Environmental impact:** More detailed environmental surveying is required to understand the effects of offshore wind development on marine ecosystems and commercial fisheries in advance of industry growth.
- **Regulatory framework:** There is a need for a streamlined environmental impact assessment, comprehensive regulation harmonization, and clarity in leasing terms for offshore wind projects.

Next Steps

- Develop a regional collaboration framework in Atlantic Canada to support offshore wind development.
- Define the infrastructure requirements and technical upgrades to electric grids required to deliver offshore wind energy to domestic and export markets.
- Explore commercial viability of Power-to-X products from offshore wind development in Nova Scotia.

Poster Presentations

Poster presentations delivered at the Forum focused on local and international offshore wind research focused on a diverse range of technical, environmental, and policy and regulatory factors.

Quantifying the possible contribution from offshore floating PV to the electricity supply of Atlantic Canada

Presenter(s): **A. Ayyad**[1] & **S. Mirbagheri-Golroodbari**[2]

[1]Independent researcher, Metro Vancouver BC, Canada
[2]Copernicus Institute for Sustainable Development/Utrecht University, Utrecht, the Netherlands

Link to abstract

Thesis: This work outlines two scenarios for quantifying the potential penetration levels of offshore floating solar photovoltaic (oFPV) energy generation alongside offshore wind turbines in Atlantic Canada.

Key takeaway: Both scenarios require mapping of the offshore wind resource (i.e., average hourly wind speed) in regions where commercial offshore wind development is anticipated; however, the first scenario considers offshore wind development alone, whereas the second scenario considers oFPV development alongside offshore wind.

Glider based ocean sampling in Atlantic Canada

Presenter(s): **A. Comeau**[1] & **R. Davis**[2]

[1]Ocean Tracking Network, Halifax NS, Canada
[2]Dalhousie University, Oceanography Department, Halifax NS, Canada

Link to abstract

Thesis: The Coastal Environmental Observation Technology and Research (CEOTR) group at Dalhousie University operates a series of semi-autonomous vehicles (SLOCUM and Wave gliders) that have collected a suite of environmental data from the marine waters around Atlantic Canada for over 12 years.

Key takeaway: These semi-autonomous vehicles can be equipped with a variety of instruments to provide near real-time monitoring for marine animal detection and tracking studies, to support collection of physical environmental data (e.g., pH, ocean currents), and are an effective tool for long term offshore environmental monitoring.

Feasibility study of offshore wind installation in Nova Scotia with emphasis on Cape Breton Island

Presenter(s): **P. Chukwudum**[1] & **A. Miadonye**[1]

[1]School of Science and Technology, Cape Breton University, Sydney NS, Canada

Link to abstract

Thesis: This work investigates the economic feasibility of establishing an offshore wind facility and marshalling yard in Cape Breton using cost estimation, cost of energy, and profitability metrics.

Key takeaway: A variety of factors related to the economic feasibility of offshore wind energy development (e.g., sector maturity, technology development, investor confidence) are required to determine the most suitable investment strategy, and must be considered in economic models for evaluating the feasibility and risk of establishing an offshore wind facility and marshalling yard in Cape Breton.

Mitigating impacts to birds and bats from offshore wind development: Available evidence and data gaps

Presenter(s): **K.A. Williams[1], J. Gulka[1], S. Knapp[1], L. LaMartina[1], A. Soccorsi[1], P. Knaga[2]** & **S. Avery-Gomm[3]**

[1]Biodiversity Research Institute, Portland, ME, USA
[2]Canadian Wildlife Service, Environment and Climate Change Canada, Dartmouth NS, Canada
[3]Wildlife and Landscape Science Directorate, Environment and Climate Change Canada, Ottawa ON, Canada

Link to abstract

Thesis: The effectiveness of mitigation measures for counterbalancing the potential effects of offshore wind turbines on aerofauna (birds and bats) are difficult to assess in situ and may lead to i) false assurance that effects are being mitigated, or ii) resources invested in ineffective mitigation measures.

Key takeaway: A literature review of offshore mitigation measures for aerofauna revealed that few approaches have been adequately tested to assess their efficacy at offshore wind facilities (partly due to extensive data requirements). This is supplemented by the identification of mitigation approaches that i) could be universally applied to offshore wind facilities based on available evidence, ii) require additional data to assess efficacy, and iii) should not be considered in the future.

Geological suitability of eastern Canada's offshore for marine renewable infrastructure

Presenter(s): **G. Philibert[1], J.B.R. Eamer[1], E.L. King[1]** & **M.Z. Li[1]**

[1]Geological Survey of Canada – Atlantic, Dartmouth NS, Canada

Link to abstract

Thesis: The Geological Survey of Canada provides crucial data about surficial geology to ensure the environmentally responsible development, safety, reliability and longevity of offshore development projects; this study focused on identifying geologically suitable regions of the continental shelf that can support offshore wind development.

Key takeaway: A regional scale suitability model for a portion of the continental shelf of Atlantic Canada was built using multiple input layers (e.g., water depth, slope, surficial geology etc.) to identify areas that were suitable to support offshore wind development using monopiles, gravity bases and suction caissons.

Nova Scotia's hourly and climate wind data, energy storage, hydrogen, and approaching 100% renewable energy using wind-water-solar with EnergyPLAN

Presenter(s): **J. Thompson**[1] & **M. Tango**[2]

[1]Wiwasolvet/Nova Scotia Energy Map, Halifax NS, Canada
[2]School of Engineering, Acadia University, Wolfville NS, Canada

Link to abstract

Thesis: With a focus on grid integration and pathways to market and met-ocean data conditions and data collection, this study assessed Nova Scotia's offshore and onshore hourly wind data coinciding with Nova Scotia Power Incorporated's (NSP) hourly electricity grid load balance to help unlock production ready "Emerging Technologies."

Key takeaway: While there are profitable energy storage and green transportation opportunities in Atlantic Canada, NSP's plans to build 150 MW at 600 MWh of grid capacity over the next few years coupled with curtailment of 2.8 TWh of electricity annually (i.e., 800-1,0000 MW at 32-40% capacity factor of wind power being ineffectively offline) essentially constitutes 'supply waiting for demand'.

Recent geological data collection and preliminary interpretations in support of offshore wind energy decision making on the Scotian Shelf

Presenter(s): **J.B.R. Eamer**[1], **A. Normandeau**[1], **P-A., Desiage**[1], **G. Philibert**[1], **D.C. Campbell**[1], **L. Broom**[1], **C. Greaves**[1,2], **E. King**[1]

[1]Geological Survey of Canada – Atlantic, Dartmouth NS, Canada
[2]Department of Earth and Environmental Sciences, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: The Geological Survey of Canada began collecting geological data on the Eastern Scotian Shelf in 2023 to begin addressing knowledge gaps around seabed composition, potential mobility of seabed sediments, geohazards (e.g., shallow gas or fluids), thickness of sediment above bedrock suitable for infrastructure burial, and the geotechnical characteristics of those sediments.

Key takeaway: Seabed mapping in nearshore and bank-edges revealed the presence of relict and terrestrial landforms, whereas new data from Middle Bank indicates a potential longer-term flux of sediment off bank edges and complex textural patterns across the seafloor comprised of coarse sand and gravel that require further investigation to understand erosion, transport, net flux and periodicity of sediment dynamics.

Developing an energy management system based on machine learning forecasting of renewable energy systems

Presenter(s): **K. Melchior**[1] & **H. Aly**[1]

[1]Department of Electrical and Computer Engineering, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: Hybrid energy systems that rely on multiple forms of energy production (e.g., renewables, storage, traditional fossil fuels) require an energy management system that can ensure reliable operation when using energy sources with high levels of variability/uncertainty.

Key takeaway: This study aims to develop an energy management system using individual and hybrid forecasting techniques (e.g., long-short term memory, support vector machine, and adaptive neuro fuzzy inference systems) to forecast load demand and expected power generated from renewables. The system employs optimization and decision-making techniques to create different operational scenarios for energy management, uses hierarchical control layers to manage the hybrid energy system over different time steps, and machine learning to choose an operational state based on forecasted power generation and load, current state of energy storage systems and access to reliable power sources. System performance was evaluated for operational savings and capacity to increase integration of renewables with minimal increase to storage.

Optimizing power system integration of double-fed induction generator wind turbines and HFCs: A multi-objective framework

Presenter(s):
M. Masoumiasl[1], **A. Babazadeh**[2] & **E. Batmanghelich**[2]

[1]Iran's University of Science of Technology, Tehran, Iran
[2]Sharif University of Technology, Tehran, Iran

Link to abstract

Thesis: Transmission network expansion management and reactive power management are critical for ensuring the efficient and reliable integration of renewable energy into existing grid infrastructure.

Key takeaway: This work presents a novel optimization framework that incorporates the integration of variable speed wind turbines and the advanced control capabilities of hybrid flow controllers. The optimization framework enhances flexibility and efficiency while ensuring a balance between economic, technical and environmental objective, addresses interconnection issues of modern power systems, and provides valuable insights in transitioning towards a more sustainable and resilient power grid.

Modelling the impact of Long-Duration Energy Storage for Nova Scotia's wind energy transition

Presenter(s): **N. Legge[1], L. Swan[1]** & **C. Wade[2]**

[1]Renewable Energy Storage Laboratory, Dalhousie University, Halifax NS, Canada
[2]Subtura Research, 2095 Bauer St., Halifax NS, Canada

Link to abstract

Thesis: Long-Duration Energy Storage (LDES) is an important part of the energy transition in Nova Scotia; it enables the integration of renewable energy sources, addresses multi-day and seasonal variability in power generation, and can mitigate curtailment and bridge generation gaps.

Key takeaway: This study used an advanced energy system optimization model (i.e., optimizes investment and operational decisions to minimize system costs while adhering to reliability and policy constraints) to assess the impact of six LDES technologies (e.g., pumped storage, lithium-ion batteries) on Nova Scotia's electricity system through to 2050; this work is ongoing.

Is the surface sediment composition a threat for the development of offshore wind energy on the Scotian Shelf: Preliminary results and future projects

Presenter(s): **P-A. Desiage[1], J.B.R. Eamer[1], J-C. Montero Serrano[2], G. Philibert[1], M.Z. Li[1], D.C. Campbell[1], L. Broom[1], A. Normandeau[1]**

[1]Geological Survey of Canada – Atlantic, Dartmouth NS, Canada
[2]Institut des Sciences de la Mer-UQAR, Rimouski QC, Canada

Link to abstract

Thesis: The Geological Survey of Canada began collecting new surface and subsurface sediment data on the Eastern Scotian Shelf in 2023 to complement an existing dataset (GSC-Atlantic legacy collection) and to inform decision making about future seabed use, including offshore wind energy development.

Key takeaway: Early interpretation of surface sediment from the central part of Middle Bank did not show evidence of glauconite sand that can transform into a non-penetrable clay-like substance under pressure during pile driving and can impede monopile depth during installation. However, the presence of glauconite in other areas of the Scotian Shelf cannot be summarily dismissed, as it has been identified in the shallow waters around Sable Island.

Enhancing renewable energy integration through multi-objective optimization

Presenter(s): **S. Talebi**[1] & **H. Aly**[1]

[1]Department of Electrical and Computer Engineering, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: This work examines the integration of offshore wind energy alongside solar power and battery energy storage systems (BESS) to address inherent intermittency of wind and solar energy and the challenges of overproduction that can disrupt grid stability.
Key takeaway: Unpredictable wind and varying solar outputs require solutions to maintain a consistent and reliable energy supply, including the integration and optimization of BESS to balance supply and demand by storing excess energy and releasing it during peak demand or periods of low generation. Offshore wind offers a substantial contribution to renewable energy portfolios in Nova Scotia, but requires sophisticated management strategies to maximize its reliability and economic viability.

Monitoring offshore ocean currents using high-frequency radar

Presenter(s): **R. Davis**[1] & **T. Wilson**[1]

[1]Dalhousie University, Oceanography Department, Halifax NS, Canada

Link to abstract

Thesis: Coastal Ocean Dynamics Applications Radar (CODAR) stations established in Nova Scotia can be used to estimate ocean current velocities up to 200 km offshore and can provide estimates of surface currents over most of the Scotian Shelf in near real-time.

Key takeaway: Comparison of data from CODAR with model predictions and measurements from Acoustic Doppler Current Profile (ADCP) deployments on ocean currents are generally congruent and within 10 cm/s. This highlights the value of CODAR networks for collecting ocean current baseline data, monitoring effects of offshore wind, and tracking changes in surface currents in a dynamic marine environment.

Student Poster Competition

Weighing opportunities and risks: Creating a comprehensive evaluation framework for Nova Scotia's offshore wind sector

Presenter: **A.M. Atiq**[1]

[1]School for Resource and Environmental Studies, Dalhousie University, Halifax, NS, Canada

Link to abstract

Thesis: This study outlines the development of a methodology (i.e., scoring mechanism) to evaluate offshore wind projects in Nova Scotia, with the goal of ensuring equitable, transparent and sustainable development.

Key takeaway: The study will examine how key considerations (i.e., economic, social, and environmental criterion) are assessed in other jurisdictions to establish a series of metrics that decision makers can use to evaluate non-price criteria to ensure that Nova Scotia maximizes the potential benefits of future offshore wind energy projects.

Navigating the social seas: Using mental models to understand stakeholder perceptions of offshore wind development in the Gulf of Maine

Presenter: **E. Batchelder**[1]

[1]School of Environmental Studies, University of Victoria, Victoria, BC, Canada

Link to abstract

Thesis: This study uses a mental modelling approach to assess what stressors and opportunities are the most impactful in contributing to the coexistence of offshore wind and commercial fisheries in Maine, and creating a fair future for harvesters. Additionally, comparisons between fishers and fisheries managers were conducted to determine alignment of regional management decisions with the experience of commercial fishers.

Key takeaway: Generally, both commercial fishers and fisheries managers view offshore wind development as negatively impacting a fair future for fisheries, with commercial fishers perceiving a stronger negative impact. However, threats to fisheries and coastal livelihoods in Maine are multifaceted (e.g., effects of climate change on species distributions, increased cost of living, gear restrictions) but are often studied separately. This highlights that future offshore wind policy and research needs to jointly consider the cumulative social impacts of management, environmental, and community changes.

WINNER: Best Research Presentation

Advancing underwater communication: Introducing the filtering augmented with adaptive iterations model

Presenter: **M. Ahmadi**[1] & **H. Aly**[1]

[1]Department of Electrical Engineering, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: This work introduces the Filtering Augmented with Adaptive Iterations (FAAI) model that enhances underwater communication by iteratively refining signal clarity and minimizing noise interference by employing a dynamic, multi-iteration Kalman filtering technique that continuously adapts to changing environmental conditions.

Key takeaway: The ability of the FAAI model to dynamically adjust the noise filtering process and adapt to the changing acoustic conditions of the marine environment is a key innovation for underwater communication; simulations and real-word tests have revealed the superior ability of FAAI to reduce noise while preserving the integrity of the underlying signal.

Enhancing coexistence between offshore wind energy and fishing: A regulatory and policy challenge

Presenter: **F. Marsit**[1]

[1]University of West Britanny, Brest, France

Link to abstract

Thesis: Coexistence between commercial fisheries and offshore wind energy development is a crucial challenge facing sector growth, and regulatory shifts in some jurisdictions that promote fishing within the boundaries of offshore wind farms is increasing social acceptability of offshore renewable energy projects.

Key takeaway: Adapting national maritime and coastal laws to integrate coexistence principles, reduce impacts on fisheries, or compensate fishers as necessary is required, and may draw analogy from "prevent, reduce, control" principles of marine pollution in the Law of the Sea to address these conflicts.

Minimizing the voltage regulation to enhance the microgrid stability using hybrid optimization approaches for offshore wind integration

Presenter: **M. Ghaffari**[1] & **H. Aly**[1]

[1]Department of Electrical and Computer Engineering, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: Microgrids provide important solutions for managing the distribution of energy and ensuring energy system stability, but the fluctuating and intermittent energy source of renewables can result in voltage deviation that needs to be addressed.

Key takeaway: Demand response strategies and hybrid optimization techniques can improve the voltage profile and can balance renewable energy variability and enhance grid stability, particularly for microgrids.

The investigation of wind turbine implication in decarbonizing remote communities in Canada: An optimization framework with economic, environmental and social objectives

Presenter(s): **M.M Sani[1], H. Afshari[1], A. Saif[1]**

[1]Department of Industrial Engineering, Dalhousie University, Halifax NS, Canada

Link to abstract

Thesis: Although hydrogen has been proposed as a cost-effective and eco-friendly long-term storage solution to complement the intermittent nature of solar and wind energy in isolated communities, it remains uncertain whether hydrogen storage can significantly contribute to a 100% renewable energy system (100 RES). This study introduced and utilized a multi-period optimization model that balances economic, environmental and social objectives to determine the optimal configuration of a 100RES for isolated communities and to evaluate hydrogen as a long-term energy storage solution to seasonal energy fluctuations.

Key takeaway: The study demonstrated that hydrogen could serve as a long-term energy storage option to address energy shortages during winter in isolated communities. The optimization model indicates that by transitioning away from diesel power generation to hydrogen storage, isolated communities in northern territories accrue 62% in cost savings and incur a 49.5% reduction in their environmental impact.

Conclusion

The first edition of the Nova Scotia Offshore Wind R&D Forum delivered critical insights and practical takeaways for policymakers, researchers, industry leaders, and key stakeholders working in offshore wind development. This Forum highlighted a continued need for collaboration as the sector continues to advance, with sessions throughout emphasizing interregional and cross-sector partnerships are necessary for the effective implementation of R&D.

Both keynote speakers addressed the importance of collaborative research efforts: on the local level, findings from the Regional Assessment brought forth by Graham Daborn emphasized the need to strategically advance comprehensive research into Nova Scotia's offshore environments and communities through a collaborative research initiative, while the international perspective presented by Anders Grønbech Jørgensen stressed the importance of a strong forum of stakeholders and that clear mandates to advance offshore wind strategies depend on international collaboration.

It is clear that shaping the future of offshore wind in Nova Scotia will require a collaborative and purposeful approach to applied research for the sustainable and inclusive development of the offshore wind sector. The participants in the 2024 Forum presented a significant body of research aimed to meaningfully advance the necessary R&D for the sector. To this end, Net Zero Atlantic has compiled 12 insights and action items gleaned from the collective efforts of the participants who presented at the 2024 Forum.

Insights and Action Items

1. **Improve Offshore Data Quality and Coverage:** Conduct accurate and geographically diverse data collection, analysis, and modelling to enhance confidence in resource assessments. Establishing collaborative research initiatives ensures that data quality and coverage is robust.
2. **Good Modelling is Critical:** Implement the use of high-quality models, which are critical for the development of offshore wind resources, (e.g., for the analysis of the climate impacts on resource quality and availability).
3. **Investigate Energy Storage Solutions to Accommodate Peak Demands:** Design modular and customized approaches to energy storage, enabling offshore wind grid integration and ensuring that peak demand is being met at all times.
4. **Strengthen Grid Integration and Interregional Collaboration:** Advance interjurisdictional and strategic electricity grid planning to address transmission constraints and ensure the efficient integration of offshore wind into the energy system.

5. **Monitor Ecosystem Impacts:** Conduct early and ongoing monitoring of offshore wind sites' impacts on marine life and ensure data sharing to enhance research. Consider how broader factors, like climate change, and cumulative effects could influence changes to ecosystems.
6. **Further Aerofauna Research:** Focus on species that are vulnerable to collisions to assess what mitigation measures could be beneficial. Also, conduct a localized study of the cumulative effects of offshore wind development to better protect bird and bat populations.
7. **Formulate Risk Mitigation Strategies:** Analyze potential changes in ocean traffic patterns due to offshore wind sites, set and enforce frameworks that balance environmental protection with industry growth, and encourage cross-sector collaboration in mitigation efforts. Advance impact assessment and decision-support processes to address broad cumulative and long-term effects alongside immediate risks and pressing knowledge gaps.
8. **Marine Fauna Data Gaps:** Develop frameworks for assessing invertebrate, mammal, and turtle population densities, focusing on under-studied areas like the Scotian Shelf. Explore alternatives to financial fishing compensation to address community impacts.
9. **Fishing Industry Impacts:** Establish long-term monitoring and account for drifting fishing gear in assessments to support with mitigating environmental impacts. Recognize the vital cultural and social significance of species such as Atlantic Salmon and American Eel to Indigenous communities, and prioritize sustainable practices that respect these connections.
10. **Meaningful Inclusion of Indigenous Knowledge:** Define with Indigenous organizations and communities how Indigenous knowledge and practices will be meaningfully included in the offshore wind development process.
11. **Expand Community Engagement:** Facilitate open, two-way discussions and engage youth early in offshore wind education. Provide clear, tangible materials, such as site maps, to enhance understanding. Ensure engagement is equitable, accessible, consistent, and sustained to build trust and nurture meaningful, long-term relationships with communities.
12. **Centralize Offshore Wind Activity Coordination:** Unify Atlantic Canada's efforts in offshore wind, further connect academia with industry, and maintain a resource hub. The coordination should leverage regional expertise while addressing challenges, like grid limitations and small domestic markets.

By actively implementing these insights, researchers, stakeholders, and rightsholders can work towards collaborative and purposeful research for the sustainable and inclusive development of the offshore wind sector in Nova Scotia.

Net Zero Atlantic will continue to work with collaborators to advance a purposeful and strategic R&D approach for the development of the offshore wind sector. Our recent work in this space includes the first Nova Scotia Offshore Wind R&D Roundtable hosted on June 9, 2025, which convened researchers and key stakeholders to define research priorities identified through the Regional Assessment process and the 2024 Forum. This Roundtable played a critical role in setting the stage for the development of a strategic R&D plan that defines and prioritizes key research topics necessary to efficiently and effectively advance the sector.

The next edition of the Nova Scotia Offshore Wind R&D Forum on September 24, 2025, will aim to move from ambition into action, aligning offshore wind R&D with real-world outcomes. The 2025 Forum will provide an opportunity for researchers, innovators, Indigenous and community leaders, policymakers, and industry professionals to take stock of the progress we have made so far, refine research priorities, and define our next steps to move the sector forward. Please visit our webpage for the 2025 Nova Scotia Offshore Wind R&D Forum for more details on how to register.

Stay tuned with Net Zero Atlantic for more information on our research supporting the energy system transition in Atlantic Canada. We lead offshore wind research covering a range of environmental, technical, economic, and socioeconomic topics.