R&D Vision

(Revised with Long Term plan in-addition to Short & Medium Term Plan)

(1)	**Introduction:** National Institute of Wind Energy (NIWE) has been established by Ministry of New and Renewable Energy (MNRE), Government of India as an autonomous R&D institution in Chennai in the year 1998. It serves as technical focal point for wind power development in India. In the last two decades, NIWE as a knowledge based institution provided technical services to Indian Wind Energy Stakeholders starting from Wind resource assessment (onshore & offshore), Wind Farm design (micro siting), Type Certification, Type Testing, Wind Turbine Inspection services and etc., NIWE has a Wind Turbine Test Station (WTTS) at Kayathar for Type testing of wind turbines.
(2)	**Vision:** To act as a technical focal point and provide total solutions in the area of wind energy technologies to all stake-holders in the wind sector.
(3)	**Mission:** NIWE, a knowledge based institution of high quality and dedication, offer services and seeks to find total solutions for the major stakeholders across the entire spectrum of the wind energy sector. It will support the wind turbine industry in achieving and sustaining quality such that products of the highest quality and the reliability are installed, harnessing maximum energy available in wind. NIWE will strongly support the wind energy industry in developing the know-how and know-why and promoting export of products and services.
(4)	**Objectives:** a) To serve as the technical focal point for wind power development in India; for promoting and accelerating the pace of utilization of wind energy; and, support the growing wind power sector in the country. b) To develop and strengthen the facilities and capabilities, evolve strategies, promote, conduct, co-ordinate and support research and development programs to achieve and maintain reliable and cost effective technology in wind power systems. c) To analyze and assess wind resources based on the data available from various sources and prepare wind energy density maps/wind atlas/reference wind data. d) To prepare and establish standards including guidelines, procedures, protocols for design, testing and certification of wind power systems, sub-systems and components, taking into consideration the Indian conditions, and in line with internationally recommended practices and standards, and update the same based on the feedback. e) To establish world class facilities, conduct and/or co-ordinate testing of complete wind power systems, sub-systems and components according to internationally accepted test procedures and criteria, whereby the total performance such as the power performance, power quality, noise level, dynamics, operation and safety systems are tested according to agreed protocols. To accord type approval/type certification which verifies conformity with safety related requirements as per standards, guidelines and other rules for design, operation and maintenance, as well as adequate documentation of quality issues such as power performance, noise, life expectancy and reliability. f) To monitor the field performance of wind power systems, sub-systems and components; effectively utilize this feedback for fulfillment of the above objectives and review of certification; establish and update the data bank on a continuous basis and serve as information Centre for selective dissemination. g) To undertake Human Resource Development programs for the personnel working in the wind energy sector in collaboration / tie-up with other academic institutions, Universities as a Centre of Excellence in India or abroad. Also, to conduct short term / long term courses in the field of Renewable Energy in collaboration / tie-up with other renewable energy related academic institutions, Universities as a Centre of Excellence.

	h) To promote commercial exploitation of know-how, know-why results, and offer various consultancy services to the customers. i) To promote the development and commercialization of any other wind energy systems, including stand-alone systems, hybrid systems or combination of Wind-Solar-Bio-mass and Hybrids.
(5)	**Research & Development Thrust Areas:** India ranks fourth globally in wind power installation and achieved significant success in the Onshore wind power development with about 45 GW of installed wind energy capacity. Growth in wind energy has been spurred by policy supports in different locations around the world. However, as global installations have grown, innovation driven by technology scaling has led to a corresponding drop in the levelized cost of energy (LCOE). The main drivers for LCOE reduction have been technology scaling to larger wind turbines coupled with innovation in several areas of wind turbine and plant design, operations, and reliability. Over three decades' modern wind power development is characterised by huge advancements in turbine scaling, drivetrain technology, switching rotor fixed-speed to variable-speed operation, advanced load-control and grid integration. Larger rotors per megawatt aims at much lower cost of energy (CoE) and achieving accelerated cost parity with conventional power plants. Based on the recent advancements in technology, it is identified that research in following thrust areas would provide impetus to further development of wind energy in the country including offshore, large scale hybrid systems:

Wind Resource Characterization (Onshore & Offshore)	• Resource Assessment including remote sensing • Offshore Resource Assessment using floating LIDAR • RSD Calibration • Wind Flow Modeling (Micro siting) • Site Suitability analysis (Turbulence, Wind shear, extreme wind conditions)
Wind Turbine Design	• Rotor design (including Airfoil & Wind turbine aerodynamics) • Aero elastic load simulations • Type Certification (Design Assessment) • Type Testing (Power Performance, Loads) • Acoustic Noise Measurements • Drivetrain Technology innovation • Support Structure design (Onshore & Offshore)
Wind Energy Systems	• Distributed energy systems including hybrid system • Hybrid Power Plant design and operation • Wind Power Forecasting
Wind Turbine Materials & Components	• Structural design and full scale Testing (Blades) • Composites Analysis, manufacturing and Testing
Market & Policy	• Standards, guidelines, schemes preparation on above areas • Repowering • Life Time extension • Wind Farm economics including LCOE studies

Above Thrust areas align with existing RD&D focus of MNRE:

- Renewable Energy Resource Survey, Assessment and Mapping
- Technology Benchmarking
- Technology validation for scaling up/ demonstration/ commercialization
- Capacity building
- Technology development and demonstration, testing, and standardisation including through international collaboration
- Policy recommendations
- Feedback to manufacturers for upgrades
- Technology innovation
- Cost reduction of new and renewable energy products and service

(6) **R&D Vision:**

As a central hub for research, innovation, and technical excellence, NIWE's R&D Vision is firmly aligned with the Government of India's Renewable Energy targets, including the commitment to achieve 500 GW of non-fossil fuel capacity by 2030, and supports the broader goals of Atmanirbhar Bharat in clean energy technology. In parallel, it is strategically harmonized with the United Nations Sustainable Development Goals (UN SDGs)—notably SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 13 (Climate Action), and other interconnected goals related to responsible consumption, biodiversity conservation, and sustainable urban development. This R&D Vision outlines a comprehensive roadmap with short-term (up to 2 years), medium-term (up to 5 years), and long-term (up to 10 years) milestones. These span a wide range of focus areas including wind resource assessment, offshore and floating wind systems, advanced turbine technologies, digitalization and AI-driven forecasting, grid integration, decarbonization strategies, and social and environmental research. By promoting indigenous innovation, facilitating cross-sectoral and global collaborations, and leveraging cutting-edge science and technology, NIWE aims to catalyze India's transition toward a resilient, inclusive, and low-carbon energy future.

<table>
<tr><th>Short Term
(Up to 2 years)</th><th>Medium Term
(Up to 5 years)</th></tr>
<tr><td>Lifetime Extension Assessment studies</td><td rowspan="10">• Test Station Development for Offshore Wind Turbines at Dhanuskodi: Establish India's first offshore wind turbine test station to accelerate indigenous offshore turbine certification and performance validation.
• Blade Test Facility for Large Wind Turbines: Develop a full-scale blade testing infrastructure to support next-generation multi-megawatt turbine prototypes (10–20 MW class), aiding India's push for global wind competitiveness.
• Wind Energy Data Repository: Compilation, standardization, and integration of data generated by various onshore, offshore, and distributed wind power systems across the country. This will support advanced analytics, machine learning models, and national-scale forecasting improvements.
•</td></tr>
<tr><td>Met ocean Studies</td></tr>
<tr><td>Mesoscale data validation using one year measurements</td></tr>
<tr><td>Research in wind resource assessment - urban, rural, complex regions - hills & Mountains. Analysis of Wind Resource for Wind Power potential assessment using AI techniques.</td></tr>
<tr><td>Forecasting techniques for Wind Data and Wind Power generation an related research</td></tr>
<tr><td>Offshore Resource Assessment using floating LIDAR</td></tr>
<tr><td>Inter decade variability in wind resources (to determine AEP uncertainty)</td></tr>
<tr><td>Acoustic Noise Measurements in different terrain conditions</td></tr>
<tr><td>Validation of Turbulence Normalization with measured data</td></tr>
<tr><td>Condition Monitoring using Artificial Intelligence</td></tr>
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Long Term (Up to 10 years)

1. Wind Characteristics Research Needs:

Aligned with SDGs: SDG 7 (Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 13 (Climate Action), SDG 11 (Sustainable Cities)

1.1. Resource Assessment and Siting

- ***Wind Atlas:*** Develop publicly accessible database of land-based and offshore wind resources and conditions; improve the accuracy of wind resource estimates; Development of indigenous numerical down-scaling model; Correction of Global Wind Models; Validation and bias correction for wind potential maps; Prediction of Spatial wind variation
- ***Icing Conditions:*** Consistent method(s) for characterisation of icing conditions during resource assessment
- ***Remote Sensing Techniques:*** High spatial resolution sensing technology and techniques for use in high-fidelity experiments, both in the laboratory and in the field (e.g. LIDAR/SODAR development); Standardization of remote sensing devices
- ***Siting Optimisation:*** Planning methodologies for siting and development of wind plants, including the development of better developer tools based on state-of-the-art models and the standardisation of micro-siting methodologies. Refine and set standards for wind resource modelling techniques.
- ***Built Environment Resource Assessment:*** Improve siting tools and methodologies for building-integrated small wind turbines.
- ***Atmospheric Complex Flow Modelling and Experimentation:*** Develop integrated, fully coupled models linking all relevant temporal and spatial scales of the wind flow life-cycle: large-scale climatology, meso-scale meteorological processes, micro-scale terrain, and wind power plant flows. Validate these models through extensive testing and long-term data collection in offshore, coastal, inland, and complex terrain conditions.
- ***Resource Forecasting for medium term and long term and big data analytics:*** Develop integrated, fully coupled models linking all relevant temporal and spatial scales for forecasting medium term and long term wind profile. Validate these models through extensive testing, atmospheric information and big data analytics in offshore, coastal, inland, and complex terrain conditions.

1.2. Design Conditions:

- ***Wind Power Plant Complex Flow Modelling and Experimentation:*** Develop integrated, fully coupled models linking all relevant temporal and spatial scales of wind plant aerodynamics: inflow conditions, wake creation and ingestion, blade aerodynamics, blade tip compressibility, and other intra-plant flows. Extensive experimentation is required to validate these models, including laboratory-scale tests, wind tunnel tests, full-scale multi-MW wind turbine tests, and operational wind plant tests. Experiments must include multiple terrain types, both on- and off-shore.
- ***Marine Environment Design Conditions (Offshore)***: Measurement, modelling, characterisation and design case development for the complex interactions among wind, waves, turbulence and current. This includes handling of extreme conditions such as typhoons and icing.
- ***Forecasting and Power Production Forecasts:*** Accurate power forecasts for use in power system operation, with consideration of storm and icing forecasts; Wind Hind-casting
- ***AI-Driven Wind Power Forecasting Platforms***: Launch national-scale forecasting projects using AI and atmospheric modeling to support RLDCs/SLDCs and improve wind scheduling, curtailment reduction, and grid reliability.
- **Localized Small Wind Systems for Decentralized Applications**: Develop and field-test rooftop-compatible and building-integrated small/micro wind turbines for urban and peri-urban applications in states with low wind zones.

2. Wind Power Technology Research Needs

Aligned with SDGs: SDG 7 (Clean Energy), SDG 9 (Industry, Innovation & Infrastructure), SDG 12 (Sustainable Production), SDG 13 (Climate Action)

2.1. System Design

- ***Systems Engineering:*** Systems engineering provides an integrated approach to optimising the design of wind power plants from both a performance and cost optimisation perspective.
- ***Wind Turbine Scaling:*** Improve understanding of design requirements for turbines in the 10-20 MW range, and develop offshore reference designs.
- ***Wind Turbine Design Tools:*** Improve full computational fluid dynamics (CFD)-structure interaction tools, aerodynamic engineering methods, hydrodynamic linking capabilities, and overall model accuracy and performance of land-based and offshore wind turbines and their components. Include integrated numerical design tools system dynamics models for offshore wind plants in deep water.
- ***Distributed Wind Systems:*** Optimise system designs for community scale projects such as wind-diesel systems and the built-environment. Develop procedures and design tools for building integrated small wind turbines with improved performance and reliability.
- ***Wind Turbines in Diverse Operating Conditions:*** Improve system designs for diverse environments such as cold climates, tropical cyclones, and low wind conditions.
- ***Floating Offshore Wind Plants:*** Examine diverse system architectures and novel designs that may result in cost effective deployment of floating offshore wind plants in deep waters; studies should include industrialisation analysis and standardised load analyses.
- ***Innovative Turbines and Components:*** Examine diverse system architectures and novel designs including exploration of radical design options.

2.2. Advanced Rotors

- ***Novel Rotor Architectures:*** Explore large, flexible rotors and unique design concepts by comparing engineering codes and advanced aerodynamic models.
- ***Noise Reduction Technology:*** Explore novel devices, blade design and control techniques that may allow for reduced blade noise and/or increased tip speed at existing noise levels.
- ***Active Blade Elements:*** Develop load reducing technologies such as control surfaces and flexible blade technology that can facilitate active flow control systems and improve rotor control dynamics.
- ***Advanced Blade Materials:*** Investigate advanced materials such as carbon fibre and “smart” materials that will facilitate cost effective lighter, stiffer blades.

2.3. Advanced Drivetrains and Power Electronics

- ***Novel Drivetrain Designs and Topologies:*** Direct-drive other advanced designs (concerning weight, size, encapsulation and reliability); magnetic materials, and alternatives to rare earth magnets.
- ***Advanced Power Electronics:*** Develop indigenous cost-effective, high efficiency power electronics and high performance power electronics materials. Innovations must also allow for improved grid support services.
- ***Generator Design:*** Design and develop medium-speed, superconducting, and other advanced generator designs.

2.4. Support Structure Design

- ***Design Optimisation and Analysis:*** Explore stronger, lighter structural materials, and identify potential steel replacements for towers.

- ***Advanced Offshore Support Structures:*** Develop next generation concepts including floating structures, alternative bottom fixed foundation types for use in water depths up to 50 m.

2.5. Advanced Controls

- ***Wind Turbine Controls:*** Continue develop of indigenous load reducing advanced controls that incorporate advanced algorithms, lidar/sodar wind measurements, and blade/rotor based sensors and technologies. Integration of these controls with active control devices must also be considered.
- ***Wind Power Plant Control Methods:*** Develop novel wind power plant control methods for reducing aerodynamic losses, accounting for wakes and wake dynamics, optimising performance, and improving reliability through reduced turbine loads. Optimise the balance between performance, loading and lifetime.

2.6. Manufacturing and Installation

- ***Offshore Installation and Logistics:*** Develop cost-effective installation technologies and techniques; make available sufficient purpose-designed vessels; improve installation strategies to minimise work at sea; and make available sufficient and suitably equipped large harbour space.
- ***Small Wind Turbine Manufacturing:*** Improve largescale manufacturing process for small wind turbines in order to enhance economies of scale and cost reduction.
- ***Advanced Manufacturing Methods:*** Investigate manufacturing cost optimisation, automation of blade manufacturing, anti-fatigue manufacturing technology of key structural components, carbon fibre blade manufacturing and possibilities of blade elements/segmented blades, localised, large-scale manufacturing for economies of scale, and the use of recyclable components.

2.7. Reliability and Testing

- ***Testing of Wind Turbines:*** Establish testing procedures for building integrated small wind turbines and facilitate the creation of testing facilities capable of serving the small wind turbine market.
- ***Operational Data Management:*** Develop standardised and automated wind plant financial and technical data management processes and transparent and internationally accepted data collection best practices. Include reliability characteristics such as failure rates and repair times in the data bases.
- ***O&M and Diagnostic Methods:*** Optimise O&M strategies. Improve diagnostic methods for generators, converters, bearings and mechanical components, and develop predictive maintenance tools and advanced condition monitoring techniques. Analysing life-time consumption, failure mode analysis, modelling of growth of damage on cracks. Improved repairing techniques especially offshore.
- ***Testing Facilities and Methods:*** Design and construct new state-of-the-art component and system testing facilities. Develop advanced methods for testing large components in the lab by simulation of the most relevant physical environmental conditions and using hardware in the loop principles.
- ***High Reliability System Development:*** Develop components with increased lifetimes and that function under failure conditions. It is also important to improve reliability for electrical components (e.g. less temperature cycling) and minimise O&M for remote locations (e.g. far offshore).

3. Wind Integration Research Needs

Aligned with SDGs: SDG 7 (Clean Energy), SDG 9 (Industry & Infrastructure), SDG 11 (Sustainable Cities), SDG 13 (Climate Action)

3.1. Transmission Planning and Development

- ***Transmission Planning:*** Develop interconnection-wide transmission infrastructure plans in conjunction with power plant deployment plans. Develop and implement plans for continental-scale transmission overlays to link regional power markets under high wind penetration scenarios. Also investigate the potential for high voltage direct current (HVDC) transmission.
- ***Offshore Transmission Planning:*** Progress and implement plans for offshore grids, linking offshore wind resources and bordering power markets. Develop tools for offshore electric design, transnational offshore grid design, and offshore wind plant power management.

3.2. Power System Operation

- ***Electricity Markets:*** Advance strategies for high-penetration levels of wind; improve operational methods and electricity market rules; accelerate development of larger-scale, faster and deeper trading of electricity through evolved power markets; and enable wind power plants bidding for ancillary services.
- ***Grid Codes and Support Capabilities:*** Harmonise grid code requirements, improve compliance testing, and conduct code testing (e.g. via voltage source convertor).
- ***Power System Studies:*** Conduct power system studies for scenarios involving high penetration of wind and other variable renewables, both in larger footprints and in smaller systems. Include studies addressing electric vehicle integration, demand side flexibility, enhanced flexibility from conventional generation units, and storage. Incentivise timely development of additional flexible reserves, innovative demand-side response and storage integration.
- ***Distributed Wind on the Grid:*** Investigate micro generation in urban and inhabited areas, low cost and reliable SCADA's for small wind turbine smart grid integration, and the impacts of integrating small wind systems onto the grid.
- ***Grid Operational Tools:*** Develop new computing architecture for real-time information from increasing amounts of renewable generators and advance probabilistic planning tools and information and communication technology (ICT). Study system operation when reaching non-synchronous system, close to 100% from asynchronous generation.
- ***Smart Grid Architecture:*** Research smart grid architectures for renewable and distributed power generation, transmission and distribution. Also conduct modelling, implementation and experimental testing of virtual wind power plants.

3.3. Wind Power Plant Internal Grid

- ***Wind Power Plant Grid Control:*** Improve voltage control and frequency control systems that can monitor and predict of voltage dips
- ***Design Tools for Offshore Wind Power Plant Electrical Design:*** Develop tools for offshore grid and wind power plant electric design; optimise grid design within offshore wind power plants; and examine direct current grids for offshore plants.

4. Wind Social and Environmental Research Needs

Aligned with SDGs: SDG 7 (Clean Energy), SDG 11 (Sustainable Cities & Communities), SDG 12 (Responsible Consumption), SDG 13 (Climate Action), SDG 14 (Life Below Water), SDG 15 (Life on Land)

4.1. Social Acceptance

- ***Spatial Planning Methods and Tools:*** Develop methods and tools for spatial planning to meet economic, social and environmental objectives, all with the objective of ensuring social acceptance.
- ***Cost Drivers of Wind Energy:*** Develop accepted methods to calculate the cost of wind energy and identify the cost driving components for research investments.
- ***Human Use Effects and Mitigation:*** Generate insight into human-use conflicts (e.g., radar, view shed, noise, property values) that will allow decision-makers and communities to site projects in such a way as to maximise socioeconomic benefit and minimise conflicts with other users.

4.2. Environmental Impacts

- ***Recycling and End of Life Planning:*** Conduct policy studies and develop strategies for wind turbine end of life and recycling procedures and best practices.
- ***Environmental Strategies and Planning:*** Institute a coordinated strategy to gather, analyse, and publicly disseminate environmental data, modelling tools, and related technologies. This will allow the industry to better understand and mitigate potential environmental impacts of land-based and offshore wind power development
- ***Issue Mitigation for Marine Environments:*** Assess impacts of offshore project installation and operation, validate models that can be used to predict the impact of future projects, and develop a suite of instrumentation and techniques that can be used by future projects to measure and mitigate, where necessary, environmental impacts.

5. AI-Driven Wind Energy Systems

Aligned with SDGs: SDG 7 (Clean Energy), SDG 9 (Industry, Innovation & Infrastructure), SDG 13 (Climate Action), SDG 12 (Responsible Consumption and Production)

As wind energy systems become increasingly complex and data-intensive, Artificial Intelligence (AI) and Machine Learning (ML) have emerged as critical enablers across the wind energy value chain. NIWE envisions an integrated thrust area that harnesses the power of AI to optimize performance, enhance reliability, reduce costs, and accelerate decision-making in both onshore and offshore wind ecosystems.

Key Focus Areas:

1. AI-Based Resource Forecasting
    - Develop high-resolution, AI-powered forecasting models for short-term, medium-term, and long-term wind profiles.
    - Use deep learning, recurrent neural networks, and probabilistic models to improve wind and power generation forecasts under variable climatic and terrain conditions.
2. AI-Enabled Turbine Performance Monitoring & Diagnostics
    - Implement AI-driven condition monitoring systems (CMS) using SCADA, vibration, acoustic, and thermal data to predict faults, extend component life, and reduce downtime.
    - Utilize digital twin models trained on real-time operational data to simulate turbine behavior and optimize operational efficiency.
3. Predictive Maintenance & Fault Detection
    - Deploy machine learning algorithms for early fault detection in critical turbine components like gearboxes, bearings, and blades.
    - Integrate AI with IoT sensor networks for remote diagnostics, especially for offshore wind assets where accessibility is limited.
4. Smart Controls & Adaptive Turbine Operations
    - Develop AI-integrated control systems for wind turbines that adjust dynamically to changes in wind flow, load conditions, or grid signals.
    - Utilize reinforcement learning algorithms for adaptive pitch, yaw, and rotor speed optimization.
5. AI for Micro-Siting and Layout Optimization
    - Enhance wind farm planning using AI models for wake prediction, turbulence modeling, and terrain-aware micro-siting.
    - Incorporate GIS, LIDAR/SODAR data, and land-use constraints into intelligent site selection tools.
6. AI in Grid Integration & Demand Response
    - Create AI platforms for real-time grid response, load forecasting, and optimizing energy dispatch from wind farms.

- Develop virtual wind power plants using AI to aggregate distributed wind assets and improve participation in ancillary service markets.

7. AI for End-of-Life Management & Recycling
    - Use AI tools to track component degradation, assess recyclability, and plan for circular economy interventions.
    - Predict optimal repowering or replacement timelines based on operational history and material fatigue models.
8. AI-Powered Decision Support Systems (DSS)
    - Build interactive DSS platforms for policy makers, investors, and utilities, integrating multi-layered data analytics for R&D prioritization, project risk assessment, and performance benchmarking.

6. Decarbonization:

Aligned with SDGs: SDG 7 (Clean Energy), SDG 9 (Industry & Innovation), SDG 13 (Climate Action), SDG 12 (Responsible Consumption)

NIWE Focus:

- **Decarbonization Policy**: Strategic alignment with India's net-zero pathway by integrating wind energy in national and corporate decarbonization roadmaps.
- **Scenario Modeling**: Expanded simulations on the role of offshore wind energy in reducing national GHG emissions.
- **Carbon Reduction Tech**: Developing technologies that reduce wind energy-related carbon emissions by **45% by 2030**, achieving **net-zero by 2050**.
- **New Materials Research**: Advanced, **engineered materials** with improved durability for long-term high-performance turbine components.
- **Waste Minimization & Circularity**: Emphasis on **product reuse, recycling, and circular design** to manage end-of-life wind turbine components.
- **Green Hydrogen-Wind Coupling Research**: Begin R&D and pilot collaborations on wind-powered green hydrogen production systems, focusing on efficiency, intermittency management, and integration with hydrogen valleys or hubs.

7. Biodiversity

Aligned with SDGs: SDG 14 (Life Below Water), SDG 15 (Life on Land), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action)

NIWE Focus:

- **Impact Mitigation Targets**: Research aimed at reducing biodiversity impacts from wind projects by **80% by 2030**, achieving **zero net biodiversity loss by 2050**.
- **Circular Design for Biodiversity**: Promote **recycling and reuse** of wind turbine components to **minimize material extraction**, reduce environmental footprint, and lower pressure on natural ecosystems.
- **Foresight Studies**: Conduct **techno-ecological studies** on materials currently used in turbine systems and **forecast availability** of key raw materials under different energy transition scenarios.

8. Offshore Wind

Aligned with SDGs: SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 13 (Climate Action)

NIWE Focus:

- **Foundation Modelling & Economics**: Study the impact of various **foundation types** (monopile, jacket, floating) on the **lifecycle cost and structural stability** of offshore wind turbines.
- **Floating Wind Feasibility**: Technical and economic **feasibility studies for floating wind turbines** in deep waters such as the **Gulf of Mannar**, expanding India’s offshore wind frontier.

	• **Atomistic Stress Analysis**: Use **material science and nano-mechanical modeling** to identify **microscopic weaknesses** and stress concentration zones in offshore structural systems. • **Policy-Driven Investment Mobilization**: Advocate for policy incentives, **green finance**, and **blended contract models** to mobilize investments in offshore wind development.

Note:

Upon approval by the R&D Council, the Vision Document will be published on the NIWE website to invite research proposals in the identified thrust areas from academic institutions, R&D organizations, and the wind energy industry. NIWE aims to foster strong linkages between academic researchers and the wind power industry to promote collaborative innovation and translational research. Proposals featuring multi-institutional collaboration, both in terms of technical expertise and financial contributions, will be encouraged and considered, subject to the approval of the R&D Council.

All proposals received will undergo a preliminary screening and technical evaluation by NIWE's Internal R&D Committee. Where necessary, feedback will be provided to strengthen and improve submissions. Proposals recommended by the committee will be placed before the R&D Council for final approval and funding concurrence. For effective implementation and monitoring, a Project Monitoring Committee (PMC) will be constituted for each sanctioned project to provide technical guidance and ensure timely progress.

To facilitate knowledge exchange and broader engagement, NIWE will organize periodic Wind Energy Symposiums, Workshops, and Conferences to disseminate outcomes of NIWE-funded R&D projects. These events will serve as platforms for interaction among industry stakeholders, academia, policymakers, and young researchers, thereby nurturing the next generation of scientific and technical manpower in the country.