



**NATIONAL
OFFSHORE WIND**
RESEARCH & DEVELOPMENT CONSORTIUM

CPUC Strategic Goals Workshop

Kori Groenveld

Senior Program Manager at the National Offshore
Wind R&D Consortium

NOWRDC's Mission

NOWRDC is a nationally-focused, not-for-profit organization collaborating with industry to fund prioritized R&D activities to:

- Accelerate the deployment of offshore wind energy in the U.S.
- Address challenges and obstacles facing the offshore wind industry and maximize economic and social benefits.
- Reduce the levelized cost of energy (LCOE) of offshore wind in the U.S.



Our Core Activities



Fund innovation directly responsive to the technical and supply chain barriers faced by offshore wind project developers in the U.S.



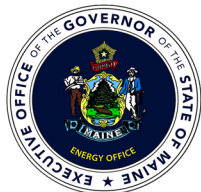
Convene strong networks (and solicit input from) connecting technology innovators, research institutions, project developers, supply chain companies, utilities, and state and federal government agencies



Increase U.S. content and job opportunities

NOWRDC Members and Board

Government & Utilities



NY Power Authority



Offshore Wind Developers



equinor



TotalEnergies

bp



Orsted

VINEYARD OFFSHORE



RWE



hexicon

Independent Offshore Wind Industry Members



R&D Projects Funded to Date

Project Distribution by Quantity

Wind Resource & Site Characterization

7.7%

Supply & Logistics

9.6%

O&M & Safety

15.4%

Floating Structure Engineering

21.2%

Transmission and Grid Stability

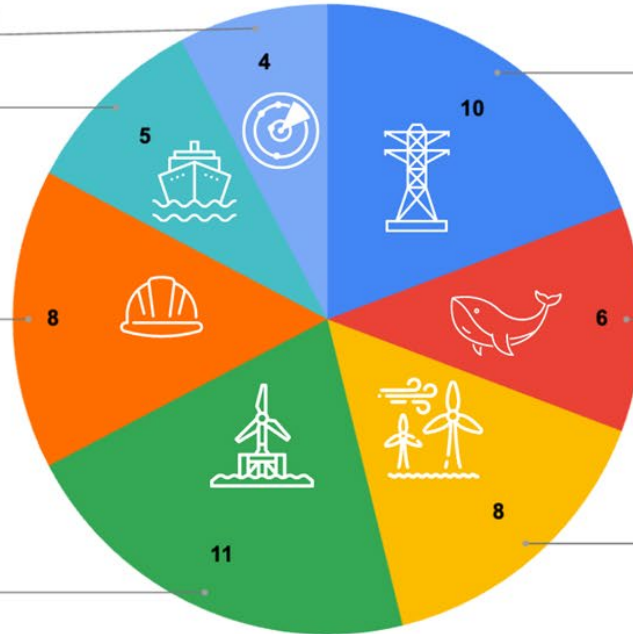
19.2%

Environmental and Conflicting Use

11.5%

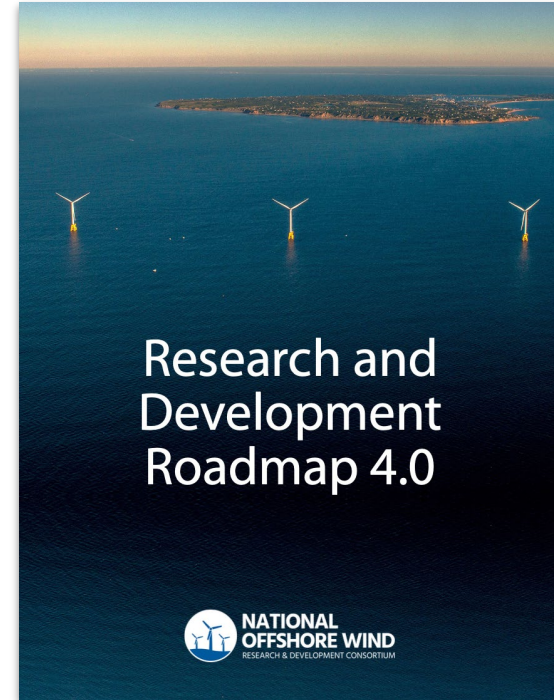
Fixed Structure Engineering

15.4%



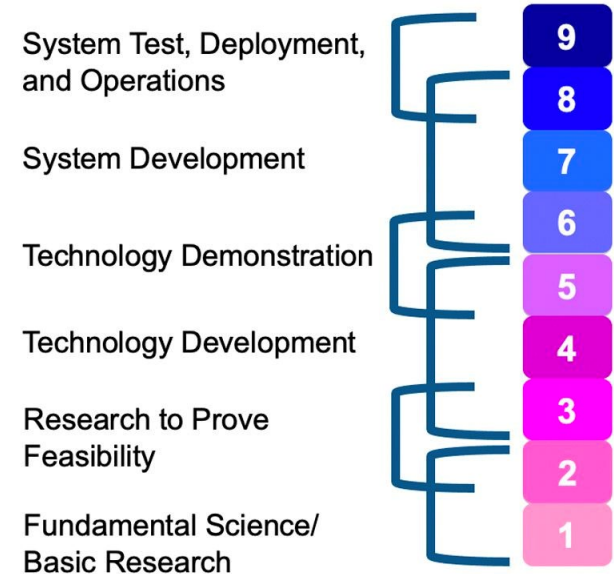
Research and Development Roadmap 4.0

- NOWRDC's R&D Roadmap serves as our overarching technical guidance document
- Specifically focused on technology advancement in 3 pillars:
 - Pillar 1: Offshore Wind Farm Technology Advancement
 - Pillar 2: Offshore Wind Power Resource and Physical Site Characterization
 - Pillar 3: Installation, Operations and Maintenance, and Supply Chain
- The Roadmap is updated approximately every 2 years
- Version 4.0 was released in April 2023



What role should R&D play in filling gaps in technology needs?

- R&D advances technoeconomic solutions to specific engineering, environmental, and policy challenges
- Solutions arise from fundamental science and basic research, then progress onto feasibility analysis, demonstration, and deployment
- Continual design feedback and refinement along the way
- For floating offshore wind, R&D has the potential to advance solutions that are safer, higher performing, lower cost, and have the potential to accelerate project development timelines
- Since floating offshore wind is a new technology in the U.S. and globally, R&D has potential to have near term impacts
- For example, R&D can accelerate down selection from current wide ranging technology offerings, resulting in standardization of manufacturing and development practices that yield cost savings inherent in economies of scale



NOWRDC projects use the Technology Readiness Level scale above, developed by NASA

Floating OSW R&D Needs - Main Categories

Lowering the LCOE of OSW in CA will be driven by increasing turbine size, technology innovation, competition within the supply chain, and industry-wide learning as project development experience is gained and economies of scale are realized.

Floating offshore wind turbines, platform, & mooring system - developing cost effective technology for deeper waters



Surrounding infrastructure & supply chain: ports, vessels, and electric grid/transmission

Technology to ensure environmental stability and ocean co-use

Floating OSW - Key R&D Needs:

- Transitioning technologies from oil and gas
 - Floating offshore wind loads are dynamic due to the turbine, whereas floating oil platforms have mostly static loads.
 - Offshore oil concentrates production in a single unit, so design can be conservative and redundant. For offshore wind, power is produced across dozens of units, so design must be more efficient to be cost effective.

→ **A need to design, develop, and test floating platforms, mooring systems, and array layout configurations that are fit for purpose**

- Design R&D should also:
 - Comply with International Electrotechnical Commission (IEC) design standards (e.g., IEC 61400-3-2)
 - Be coupled with technoeconomic modeling to ensure design improves overall cost profile
 - Aim to minimize conflicts with existing offshore ecosystems and stakeholders

Floating OSW - Key R&D Needs:

Specific examples of floating offshore wind turbine system R&D needs include:

- Design and cost studies of proven floating offshore prototype substructures that adapt prototype assembly methods to serial production through value engineering approaches, demonstrating highly increased production volume and lower cost
- Integrated mooring and dynamic cable array designs for water depths between 600 and 3,000 meters
- Design solutions that mitigate extreme earthquake loads in floating systems
- Comprehensive studies that assess floating operations and maintenance costs and cost trade-offs for a range of substructure types
- Working with designers to improve methods to lower the uncertainty of material fatigue properties in floating systems from load estimations using engineering system tools,
- Working with marine operations specialists on strategies to lower installation and assembly costs for floating offshore wind substructures integrated with large-scale turbines

Floating OSW R&D Needs



Floating offshore wind turbines, platform, & mooring system - developing cost effective technology for deeper waters

Surrounding infrastructure & supply chain: ports, vessels, and electric grid/transmission

Technology to ensure environmental stability and ocean co-use

ENERGY earthshots U.S. DEPARTMENT OF ENERGY Floating Offshore Wind™

Environmental Stability & Ocean Co-Use - Key R&D Needs

- Technical solutions can improve FOW development and operations practices' impacts on the offshore environment and other ocean users
- Some specific examples of R&D needs in this topic include:
 - Autonomous environmental monitoring technologies
 - Mooring line sensors to detect primary and secondary entanglements
 - Concepts that reduce deepwater mooring system footprints and mooring line lengths
 - Mooring line and electric array cable configurations that can minimize impact on fishing activities and other existing ocean use activities
 - Advanced methods to automate or expedite anchor and mooring line installation

Floating OSW R&D Needs

Floating offshore wind turbines, platform, & mooring system - developing cost effective technology for deeper waters



Surrounding infrastructure & supply chain: ports, vessels, and electric grid/transmission

Technology to ensure environmental stability and ocean co-use

Surrounding Infrastructure & Supply Chain

Much of this topic requires traditional infrastructure investment, however R&D has the potential to provide alternative infrastructure upgrade designs that are higher performing, more cost effective, and better built for floating OSW needs than current market offerings.

Specific R&D examples include:

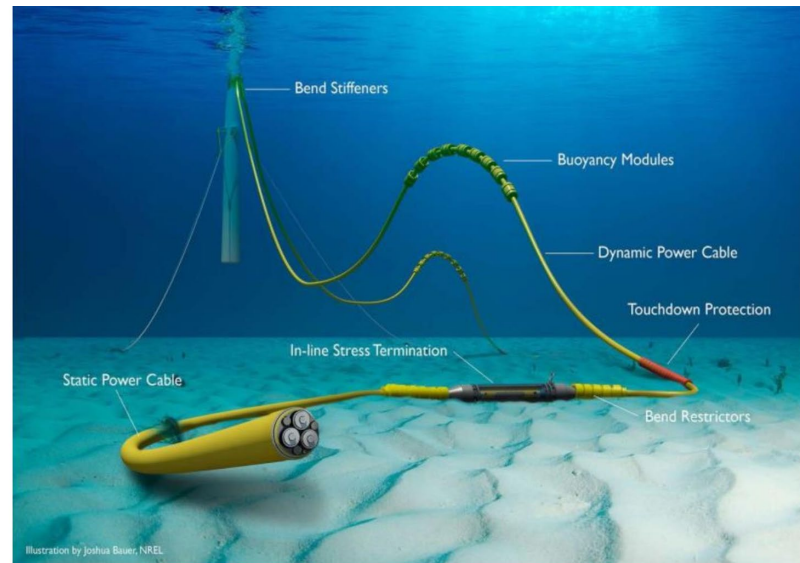
- Innovative floating installation vessel concepts that are Jones Act Compliant and address key issues with platform stability during assembly and tow out, anchor installations, mooring system connect/disconnect, or large component repairs
- Projects that adapt domestic supply chain infrastructure or manufacturing facilities to address floating system components for mass production and rapid deployment
- Designs to adapt new offshore wind port facilities to minimize upgrade costs, minimize other port user conflicts, and streamline floating OSW construction, assembly, and service operations

Transmission for Floating OSW:

Technical solutions have the potential to provide higher performing, lower cost profiles than what is currently available on the market:

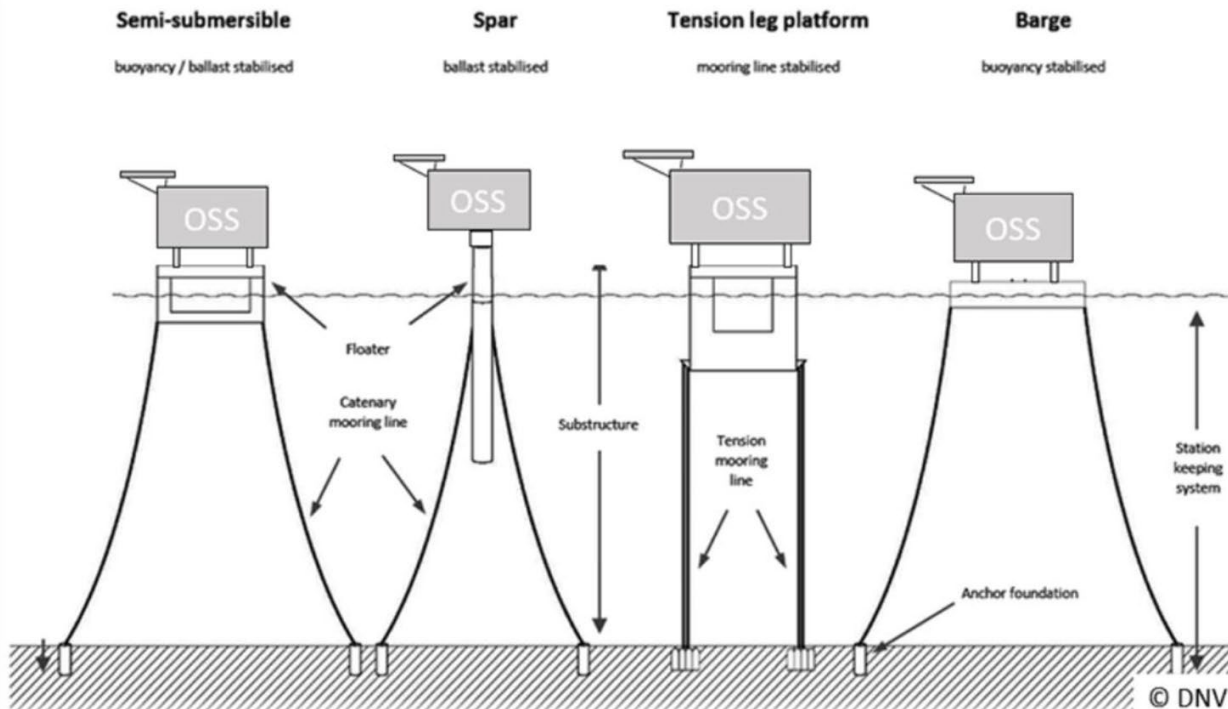
- Design and qualification of higher capacity dynamic power cables for floating wind turbines
- Detailed design solutions for floating substations resulting in cost-efficient floating substations that address station keeping challenges
- Innovative solutions for quick disconnect of dynamic array cables and mooring lines for installation and service
- Technologies for converter stations that facilitate mesh networks and improve grid flexibility

Illustration of a dynamic power cable:



Source: NREL

Floating Substation Platform Concepts



Source: DNV



Thank you

*NOWRDC's full project database is available here:
<https://nationaloffshorewind.org/project-database/>*



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Appendix I: NOWRDC Projects by Technical Challenge Area

NOWRDC Projects: Transmission and Grid Stability

Contractor	Project Title
NREL	Development of Advanced Methods for Evaluating Grid Stability Impacts
PNNL	An Offshore Wind Energy Development Strategy to Maximize Electrical System Benefits in Southern Oregon and Northern California
GE Research	DC Collection and Transmission for Offshore Wind Farms
Tufts University	Transmission Expansion Planning Models for Offshore Wind Energy
Offshore Wind Consultants	Shared Landfall and Onshore Cable Infrastructure for Cable Colocation Feasibility Study
ThayerMahan	Transmission and Export Cable Fault Detection and Prevention Using Synthetic Aperture Sonar
University of Michigan	Robust Stabilization of Subsea Power Cables using Nonlinear Energy Sinks
Clarkson University	Atlantic seaboard offshore stability risk evaluation & service
Rutgers University	AIRU-WRF: AI-powered Physics-based Tool for OSW Forecasting and Grid Integration

NOWRDC Projects: Environmental & Conflicting Use

Contractor	Project Title
CODAR Ocean Sensors LTD	Oceanographic HF Radar Data Preservation in Wind Turbine Interference Mitigation
Advisian	Technology Development Priorities for Scientifically Robust and Operationally Compatible Wildlife Monitoring and Adaptive Management
Cornell University	Right Wind: Resolving Protected Species Space-Use Conflicts in Wind Energy Areas
Northeastern University	Long-Term Availability and Bankability of Offshore Wind Through Hurricane Risk Assessment and Mitigation
Saildrone	Renewable Powered, Uncrewed Mobile Assets to Monitor Protected Marine Mammals
NREL	Co-Design Solutions for U.S. Floating Offshore Wind and Fishing Compatibility

NOWRDC Projects: Fixed Structure Engineering

Contractor	Project Title
ESTEYCO SL	Self-Installing Concrete Gravity-Base Substructure Sizing for 15MW Turbine
Texas A&M	Vibratory-Installed Bucket Foundation for Fixed Foundation Offshore Wind Towers
Keystone Tower Systems	Tapered Spiral Welding for US Offshore Wind Turbine Towers
DEME Offshore US LLC	Tri-Suction Pile Caisson Foundation Concept
RCAM Technologies	A Low-Cost Modular Concrete Support Structure and Heavy Lift Vessel Alternative
Stony Brook University	Computational Control Co-design Approach for Offshore Wind Farm Optimization
NREL	Wind Farm Control and Layout Optimization for U.S. Offshore Wind Farms

NOWRDC Projects: O&M and Safety

Contractor	Project Title
ULC Robotics	UAS to Transform Offshore Wind
GE Renewable Energy	Self-Positioning Single Blade Installation Tool
GE Research	Autonomous Vessel-Based Multi-Sensing System for Inspection and Monitoring
UMass Lowell	A Novel Structural Health Monitoring System for Offshore Wind Turbine
Anduril Industries Inc.	Fully Autonomous Subsea Asset Inspection by a Shore-Launched AUV
Tagup Inc.	Survival Modeling for Offshore Wind Prognostics
GE Research	Enabling Condition Based Maintenance for Offshore Wind
GE Research	Radar Based Wake Optimization of Offshore Wind Farms
Tufts University	Physics Based Digital Twins for Optimal Asset Management

NOWRDC Projects: Supply and Logistics

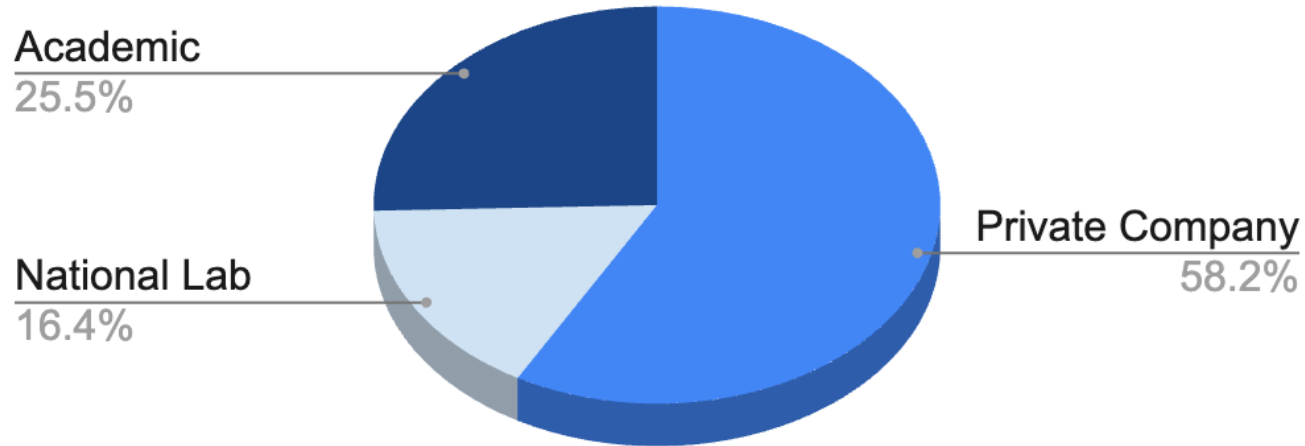
Contractor	Project Title
NREL and BNOW	30GW by 2030: Supply Chain Roadmap for Offshore Wind in the US
Crowley	Technical Validation of Existing U.S. Flagged Barges as a “Feeder” Solution for the U.S. Offshore Wind Industry
Exmar Offshore Company	Feasibility of a Jones Act Compliant WTIV Conversion
MARIN USA	Comparative Operability of Floating Feeder Solutions
GE Renewable Energy	Weld Assembly of Large Castings
EPRI	Verifying OSW Turbine Blade Integrity During Manufacture

NOWRDC Projects: Wind Resource and Site Characterization

Contractor	Project Title
NREL	A Validated National Offshore Wind Resource Dataset with Uncertainty Quantification
GE Research	Impact of Low Level Jets on Atlantic Coast Offshore Wind Farm Performance
Cornell University	Reducing LCoE from Offshore Wind by Multiscale Wake Modeling
WHOI	Development of a Metocean Reference Site near the MA & RI Wind Energy Areas

R&D Projects Funded to Date

Awardee Distribution



Appendix II: NOWRDC Board Members and Staff

NOWRDC Board Members



**Janice Fuller – President,
Mid-Atlantic at Anbaric**



**Jan Matthiesen – Director
at the Carbon Trust**



**Scot Hewitt-Gudgin,
Senior Director, U.S.
Offshore Business Project
Services at Avangrid
Renewables**



**Stuart Nachmias – President
and CEO at conEdison**



**Sam Aronson – Director
emeritus, Brookhaven
National Lab**



**Antoine Cognard – Senior
Director, Offshore
Implementation at EDF
Renewables**

NOWRDC Board Members



ELECTRIC POWER
RESEARCH INSTITUTE

**Ron Schoff – Director -
Renewable Energy and Fleet
Enabling Technologies at EPRI**



**Adrienne Downey –
Principal Engineer &
Country Manager: US &
Canada at Hexicon**



equinor

**Scott Lundin – Head of US
Permitting and Environmental
Affairs at Equinor Wind**

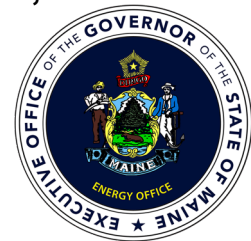


Hitachi Energy

**John Haysbert – Vice
President & Head of
Government and
Institutional Relations
U.S., Hitachi Energy**



**Christy Guthman – General
Manager of Sales &
Commercial Operations, North
America, GE Offshore Wind**



**Celina Cunningham – Deputy
Director, Governor's Energy
Office, State of Maine**

NOWRDC Board Members



Maryland
Energy
Administration

**Eric Coffman – Director of
MEA**



**MASSACHUSETTS
CLEAN ENERGY
CENTER**

**Nils Bolgen – Program
Director- Offshore Wind at
the MassCEC**

nationalgrid

**John Bruckner – Former
President at National Grid**



**Robert (Bob) Brabston –
Executive Director at New
Jersey Board of Public
Utilities**



**NEW YORK
STATE OF
OPPORTUNITY.** | **NY Power
Authority**

**Paul Tartaglia – Senior Vice
President, Chief Technology and
Innovation Officer at NYPA**



**NEW YORK
STATE OF
OPPORTUNITY.** | **NYSERDA**

**Doreen Harris – President
and CEO of NYSERDA**

NOWRDC Board Members



**Michael Brown – Country
Manager US at Ocean
Winds**



**Wojciech Wiechowski –
Senior Business
Development Manager
USA at RWE Renewables**



**Kevin Hansen, Head of Government
Affairs & Policy, New York, at
Ørsted**



**Ruth Perry, Head of
Regulatory Affairs,
Offshore Power Americas,
at Shell**



Currently Vacant



**Stony Brook
University**

**Bob Catell – Chairman of the Board of
the Advanced Energy Research and
Technology Center (AERTC) at Stony
Brook University**

NOWRDC Board Members



TotalEnergies

**Nick Prokopuk – Offshore
Wind Business Developer
at TotalEnergies**



**VINEYARD
WIND**

**Jordan Shoesmith –
Project Manager at
Vineyard Wind**



**Al Christopher – Director
of the Department of
Energy at Commonwealth
of Virginia**



**Jan Klaasen – Business
Unit Director**



**Yasser Bangash –
Business Unit Director**



**Cameron Willard – Director
of Commerical Management**

NOWRDC Board Members



**Jonah Steinbuck – Director of
Research & Development Division,
California Energy Commission**

**Kevin Knobloch – President of
Knobloch Energy**

NOWRDC Core Staff



**Lyndie Hice-
Dunton**
Executive Director



Christine Sloan
Deputy Executive
Director



Kori Groenveld
Senior Program
Manager



Melanie Schultz
Program
Manager



Julian Fraize
Program
Manager