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Metrics of readiness to support community-driven marine energy

Ocean Renewable Energy Conference
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Katie Arkema
Senior Earth Scientist

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Island and remote coastal communities

- Challenging environment for building, operating, and maintaining energy infrastructure.
- High costs for electricity, fuels, and other essential energy sources.
- Sea-level rise & storms → increasing risk from natural hazards and need for energy resilience.
- Lack of local employment opportunities; attrition of working age community members to larger population centers

Island and remote coastal communities

- Envisioning energy solutions that will support the triple bottom line goals of the blue economy:

  social equity, environmental sustainability, economic prosperity,

- But island and remote communities have limited resources and capacity to tackle complex energy and coastal resilience issues.

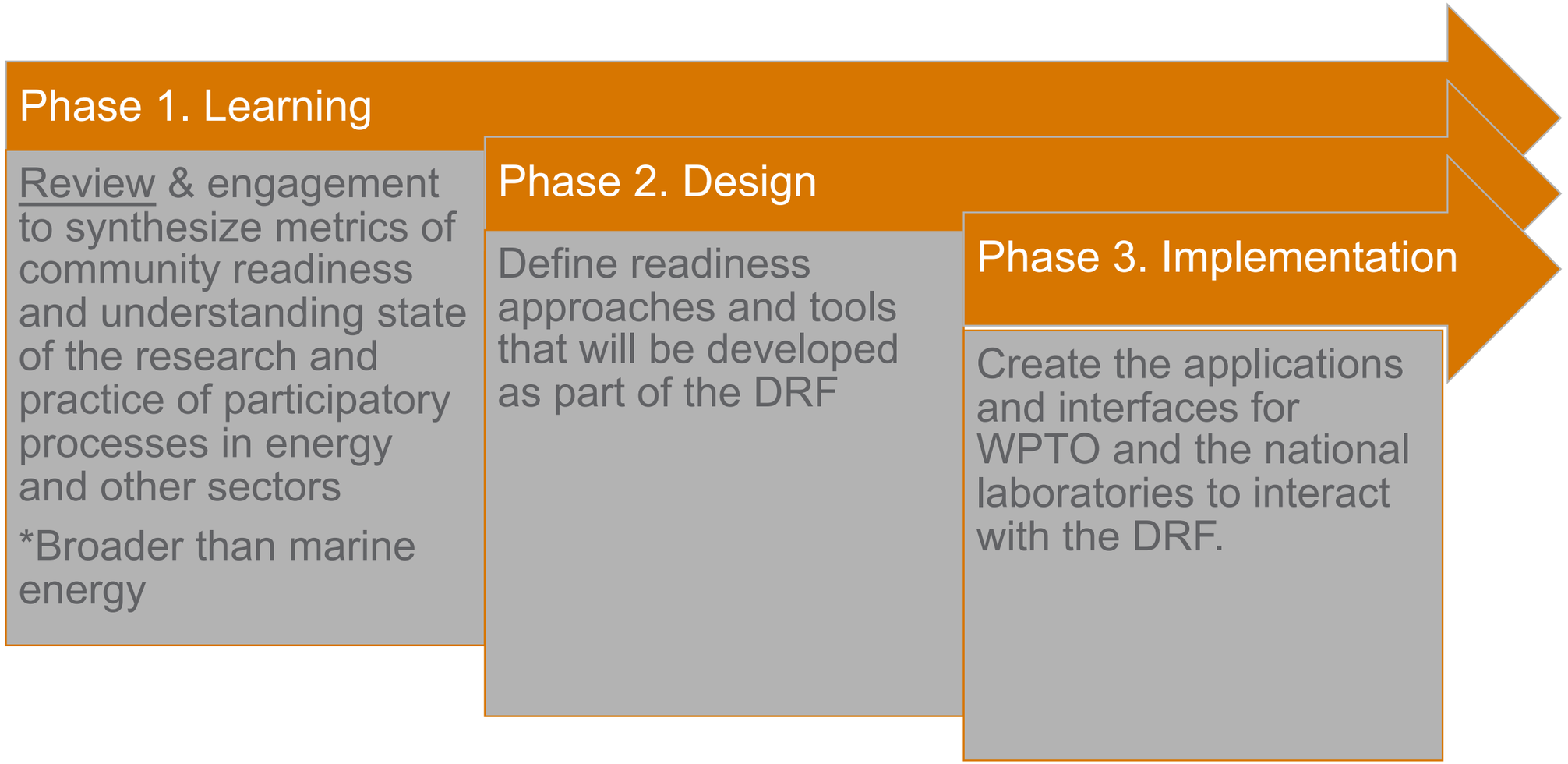
Deployment readiness framework (DRF)

- Overarching goal - support community-driven energy transitions in island and remote communities, and to better understand relationships between energy, community, and ecosystem resilience

- Objective of this work - co-produce and test practical tools and approaches that will help WPTO and the national laboratories better understand the readiness of coastal communities for marine energy demonstration, deployment, and operation; not meant to evaluate communities

- The DRF aims to build on and support the Energy Transitions Initiative Partnership Program (ETIPP) and other community-oriented energy transition programs.

Three phases of developing the framework



Outline of presentation

- Introduce definitions
- Research questions for Phase 1 Subtask 1 - review
- Approach to review
- Results from review
- Recommendations for DRF

Definitions

- **Energy transition** - a sustainability transition that transforms an existing energy system towards a resilient and self-sufficient one. *Future energy transitions will not necessarily be quick, orderly, or uniform and any framework we propose must be adaptable to the many forms that a transition can take.*

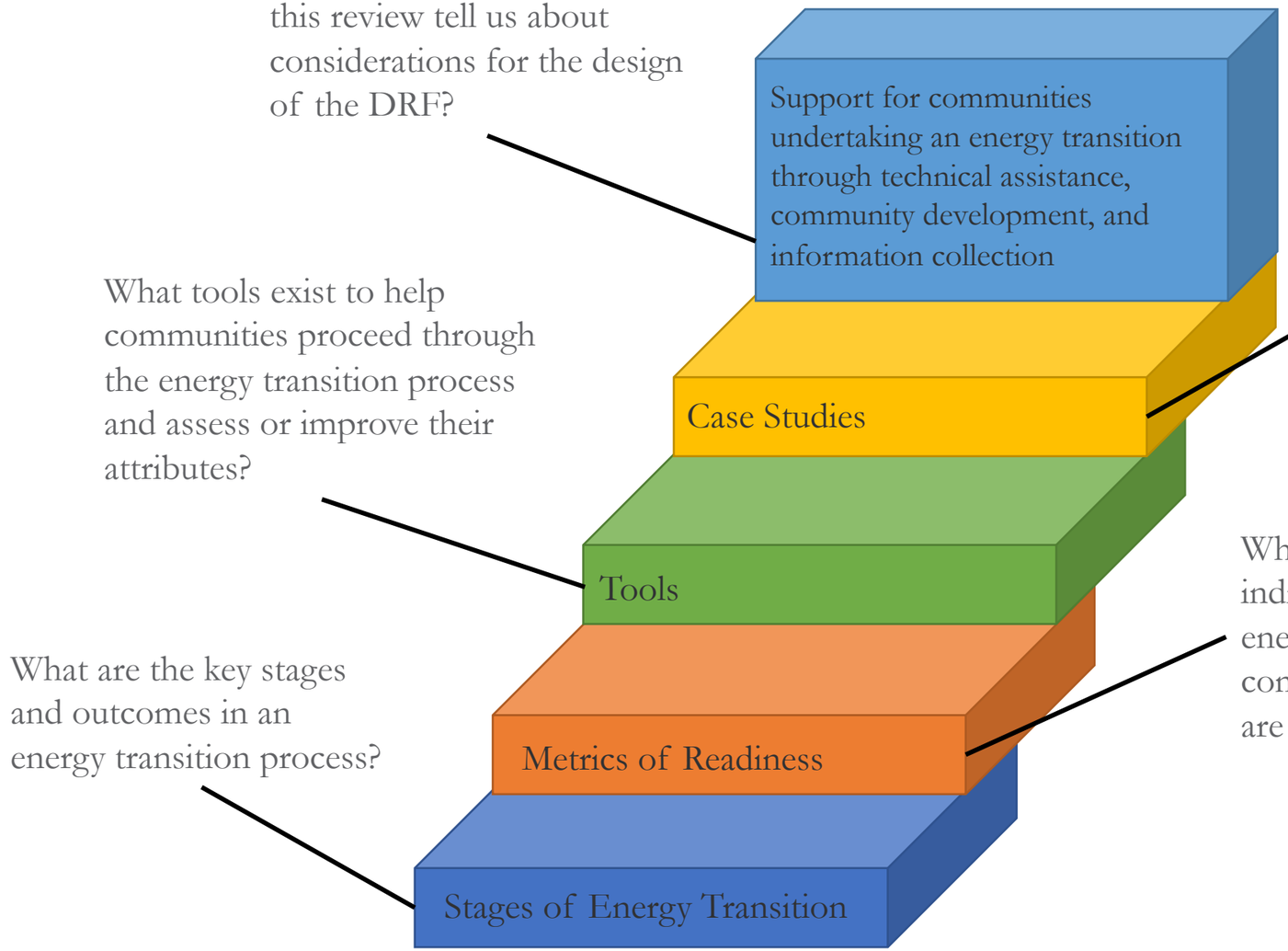
- **Community** - the people living in one area or the people who are considered as a unit because of their common interests, social group, or nationality

- **Resilience** - the ability to anticipate, prepare for, and adapt to changing conditions, and to withstand, respond to, and recover rapidly from disruptive events. This definition includes energy resilience, as well as other forms of resilience such as climate, natural disaster, social, economic, and/or ecological resilience.

- **Science-policy process** - a process by which policy- and decision-making are informed by science.

Research questions – Review

What do the key results from this review tell us about considerations for the design of the DRF?



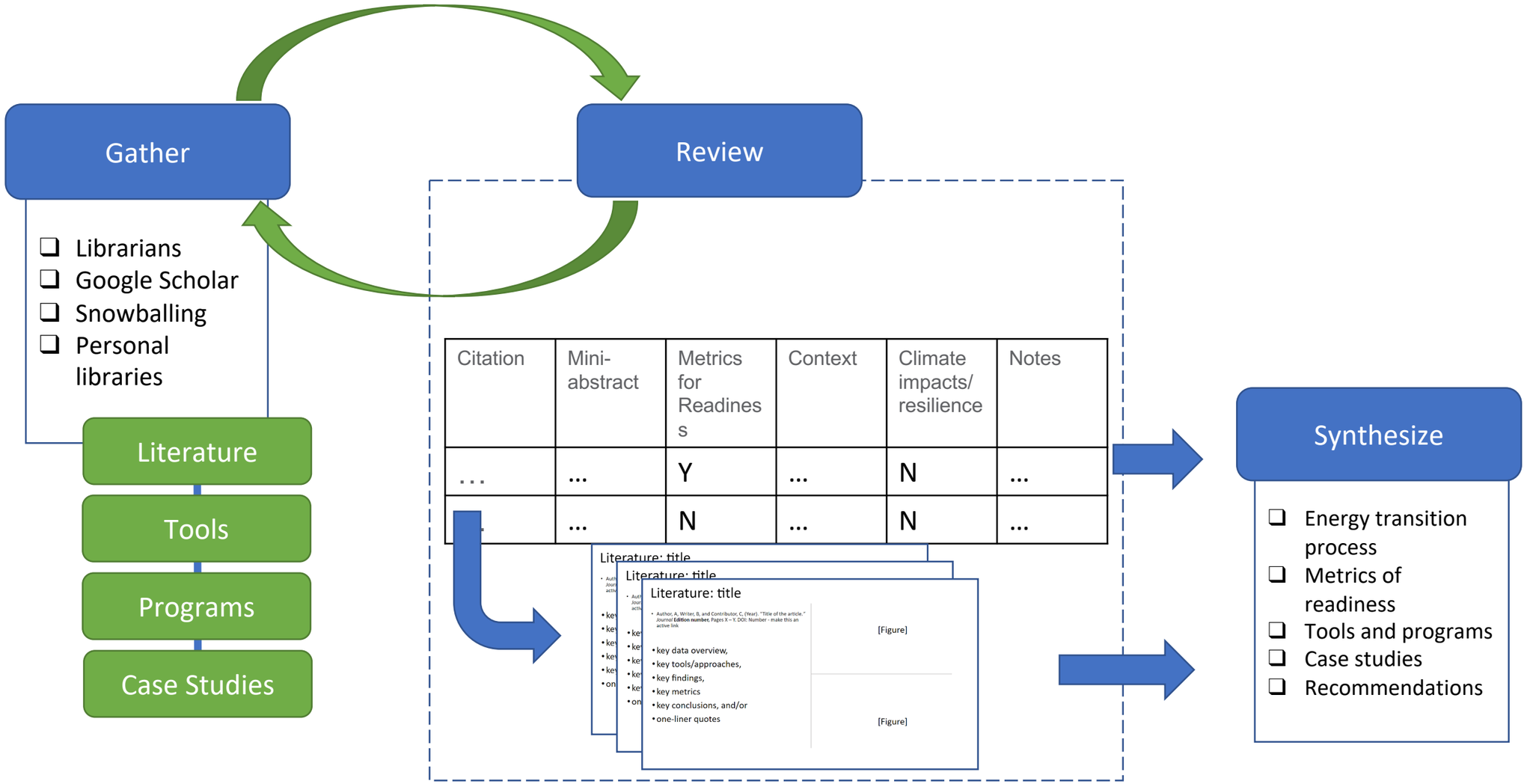
How have these metrics, tools, and other methodologies been applied?

What tools exist to help communities proceed through the energy transition process and assess or improve their attributes?

What attributes can we use as indicators of the stage of the energy transition in which a community is and whether they are ready for the next?

What are the key stages and outcomes in an energy transition process?

Approach


Gather
Review
❑ Librarians
❑ Google Scholar
❑ Snowballing
❑ Personal libraries
Literature
Tools
Programs
Case Studies
Citation
Mini-abstract
Metrics for Readiness
Context
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• key data overview,
• key tools/approaches,
• key findings,
• key metrics
• key conclusions, and/or
• one-liner quotes
[Figure]
[Figure]
Synthesize
❑ Energy transition process
❑ Metrics of readiness
❑ Tools and programs
❑ Case studies
❑ Recommendations

Results

- Commonalities in key steps in effective science-policy processes for renewable energy projects and other sectors

- Narrow focus on energy resources and technology that ignores broader community goals and lacks consistent attention to sustained community engagement, building human capacity, financing mechanisms, and consulting with regulatory entities early in project development.

- Diversity of metrics for understanding community readiness, including technical, financial, governance, social, economic, environmental, and strategic factors. These metrics point to the importance of gathering and assessing a wide breadth of information to inform the energy transition.

Snapshot of literature we reviewed

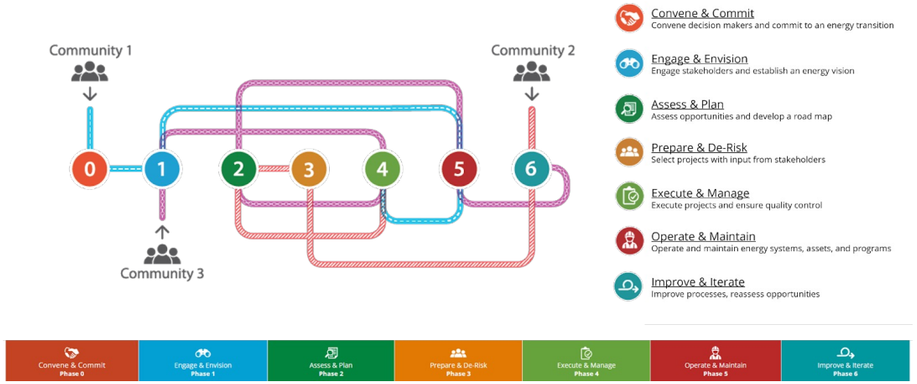
- 126 papers, 34 tools, 6 case studies

Papers	Topics
27	explicitly addressed climate impacts or resilience in conjunction with energy transitions
68	explored relationships between renewable energy and other sectors or community development goals other than energy
22	included mention of frameworks for energy transitions, project assessment, or community readiness, of which 6 were reviewed in-depth for application to energy transition processes.
35	specific to the US, while the rest were international examples or not specific to a particular location
19	focused on marine energy, likely due to the nascent status of the industry

Key steps in energy transition frameworks

1) scoping and convening
2) data collection and baseline assessment
3) development of alternative pathways/scenarios of the future
4) analysis of alternatives
5) identification of financing mechanisms
6) communication and sharing strategic plan
7) implementation of the plan and associated projects
8) monitoring and evaluation

Example 1. Energy Transitions Initiative Playbook



Example 2. DOE Office of Indian Energy Strategic Energy Planning Process and Project Development Strategy

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Metrics of readiness

Category	Subcategory	Attributes (e.g.,)
Technical	Resource	Assessment, Quantity, Timing, Selection
	Existing capacity	Grid, Energy sources, TRL, infrastructure, workforce, equipment, access, load, emissions, utilities, data knowledge, universities
	Needs	Quantity, storage, reliability, efficiency, maintenance, system upgrades, safety, optimization
Financial	Funding	External, community, risk allocation
	Cost	Total costs, initial capital costs, distribution,
	Ownership	Infrastructure, location, community participation
Governance	Legal	Framework, mandates
	Policy	Programs, process, political will
	Regulatory	Framework
	Characteristics	History of engagement, stability, responsibility
Economic	Utility	Operations, debt burden, fuel, electricity costs
	Community	Credit rating, markets
	Financial impacts	Rates of return, jobs, taxes, landowners, cost, willing to pay
Social	Demographics assessed	Diversity, vulnerability, poverty, education, health, living standards, gender, population
	Core values	Risk appetite, innovation, flexibility, motivation, commitment, receptivity, interpersonal and social trust, perceptions of climate change, views on the future, visual, sense of place
	Culture	History of success, agency, indigenous assessment, cultural land use, cultural practices, social movements, peer networks, partnerships external integration, messaging, information
Environmental	Permitting	Requirement, species, habitats, ecosystems, siting, monitoring, mitigation
	Ecosystem services	Quantification of benefits & costs, available data, natural resource uses
	Resilience	Understanding of benefits & costs, integrating planning
Strategic	Planning	Development plan, links to regional plan, synergistic opportunities, leadership team, installation/decommissioning
	Goal setting	Specific goals, vision, purpose, scale, priorities
	Outreach	Roadmap, community champion, customer experience, transparency, responsiveness, co-creation
	Capacity	Building, assessment
	Evaluation	Equity and energy justice, benefits assessment, sustainability, outcomes

Recommendations for Deployment Readiness Framework

- Support sustained, consistent, and iterative collaboration among communities, laboratories, and DOE.
- Help DOE and the national laboratories contribute more broadly to capacity building.
- Foster a more integrated approach to renewable energy development to ensure marine energy meets the triple bottom line of the blue economy: social equity, environmental sustainability, economic prosperity.
- Support communities, laboratories, and DOE in considering permitting and funding mechanisms earlier in energy planning and community-driven energy transitions.
- Help national laboratories and DOE better understand a community's stage in its energy transition and how to "meet a community where it is" with the appropriate technical assistance, capacity building, and other support.

Next steps

- External communication of the “Report on Subtask 1.1 Deployment Readiness Framework Literature Review”. katie.arkema@pnnl.gov
- Utilize key findings from the report to inform surveys, interviews, and engagement with technical leads, regional partners, and community members.
- Synthesize and draw on results from the review and engagement to understand gaps in available tools and approaches for supporting community-driven energy transitions, especially around understanding readiness.
- Use this information to inform the design and application of the deployment readiness framework.

Acknowledgements

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- ETIPP – regional partners, technical teams, remote, island, and islanded communities

- Support from WPTO

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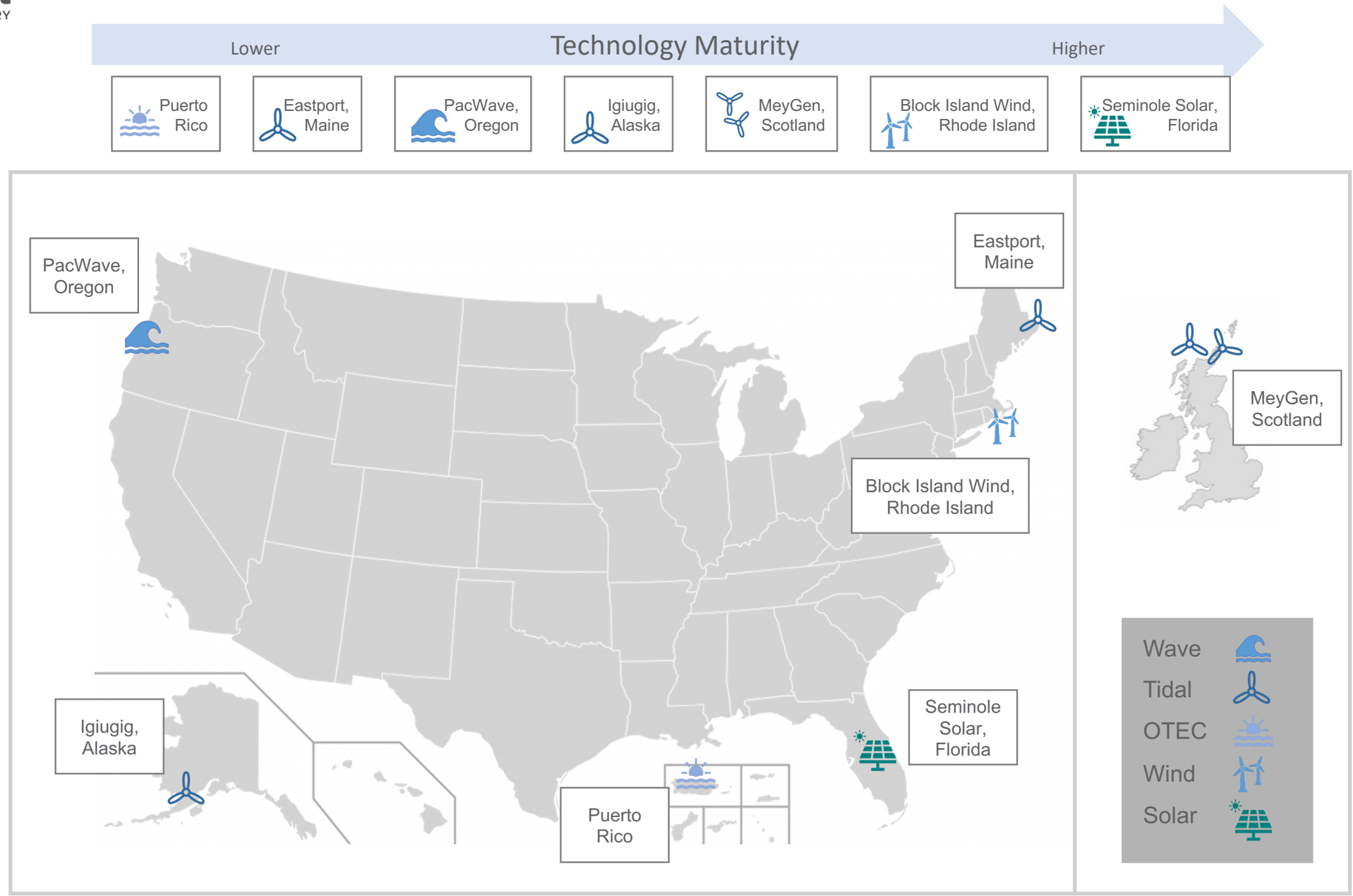
Extra slides

Tools

Tools collected in literature review. Tools are categorized by energy transition stage (green) and data type according to the categories of metrics of readiness (purple).

Tool	1	2	3	4	5	6	7	8	Metrics Addressed
AEDG Community Metric Explorer	☐	☑	☐	☐	☐	☐	☐	☐	technical, economic, strategic
Climate Adaptation Knowledge Exchange	☐	☑	☑	☑	☐	☐	☐	☐	social, environmental
Community Toolbox	☑	☑	☑	☑	☑	☑	☑	☑	financial, strategic
Critical Habitat Mapper	☐	☑	☐	☐	☐	☐	☐	☐	environmental
EJScreen	☐	☑	☐	☑	☐	☐	☐	☑	
Energy Justice Workbook	☑	☑	☑	☑	☑	☑	☑	☑	governance, strategic
Energy Resilience in the Public Sector	☐	☐	☑	☑	☑	☐	☑	☐	
HOMER	☐	☐	☑	☑	☐	☐	☐	☐	
InVEST	☐	☐	☑	☑	☐	☐	☐	☐	
IRENA Global Atlas	☐	☑	☑	☐	☐	☐	☐	☐	technical, economic, environmental, strategic
Marine Cadastre	☐	☑	☐	☐	☐	☐	☐	☐	technical, governance, economic, social, environmental
Marine Energy Atlas	☐	☐	☑	☑	☐	☐	☐	☐	
Marine Energy Toolkit	☐	☐	☐	☑	☐	☐	☐	☐	
Marine Mapping Tool	☐	☑	☐	☐	☐	☐	☐	☐	environmental
MRE Spatial Decision Support Tool	☐	☑	☐	☐	☐	☐	☐	☐	technical, social, environmental
NOAA Fisheries Social Indicators	☐	☑	☐	☐	☐	☐	☐	☐	social, environmental
ORECCA	☐	☑	☐	☐	☐	☐	☐	☐	technical
Oregon Offshore Wind Mapping Tool (OROWindMap)	☐	☑	☐	☐	☐	☐	☐	☐	technical, social, environmental
RADE: Resilience Assessment & Data Explorer	☐	☐	☑	☑	☐	☐	☐	☐	
Renewable EnerGIS	☐	☑	☑	☑	☐	☐	☐	☐	environmental
Renewable Energy Data Explorer	☐	☐	☑	☑	☐	☐	☐	☐	
Renewable Energy Permitting Wizard	☐	☑	☐	☐	☐	☐	☑	☐	strategic
REopt	☐	☐	☑	☑	☐	☐	☐	☐	
Resilience Gaps Guide	☑	☑	☑	☐	☐	☐	☐	☐	technical, strategic
Resilience Roadmap	☑	☐	☐	☐	☐	☐	☐	☐	
Resilience Solution Prioritization	☐	☐	☑	☑	☐	☐	☐	☐	
RETScreen	☐	☐	☐	☑	☐	☐	☐	☐	
Selkie MRE Technoeconomic GIS	☐	☑	☑	☑	☐	☐	☐	☐	technical
State and Local Planning for Energy (SLOPE)	☐	☑	☑	☐	☐	☐	☐	☐	technical, financial, economic, social
State Energy Resilience	☑	☐	☐	☐	☐	☐	☐	☐	
Tidal GIS tool	☐	☑	☐	☐	☐	☐	☐	☐	technical
Tribal Energy Atlas	☐	☑	☑	☐	☐	☐	☐	☐	technical, environmental
Tribal Energy Projects Database	☑	☐	☐	☐	☐	☐	☑	☑	
WEC-ERA	☐	☐	☐	☑	☐	☐	☐	☐	
Xcel Energy Renewable Energy Toolkit	☑	☑	☐	☐	☑	☑	☐	☑	technical, governance, financial, economic, social

Case studies