



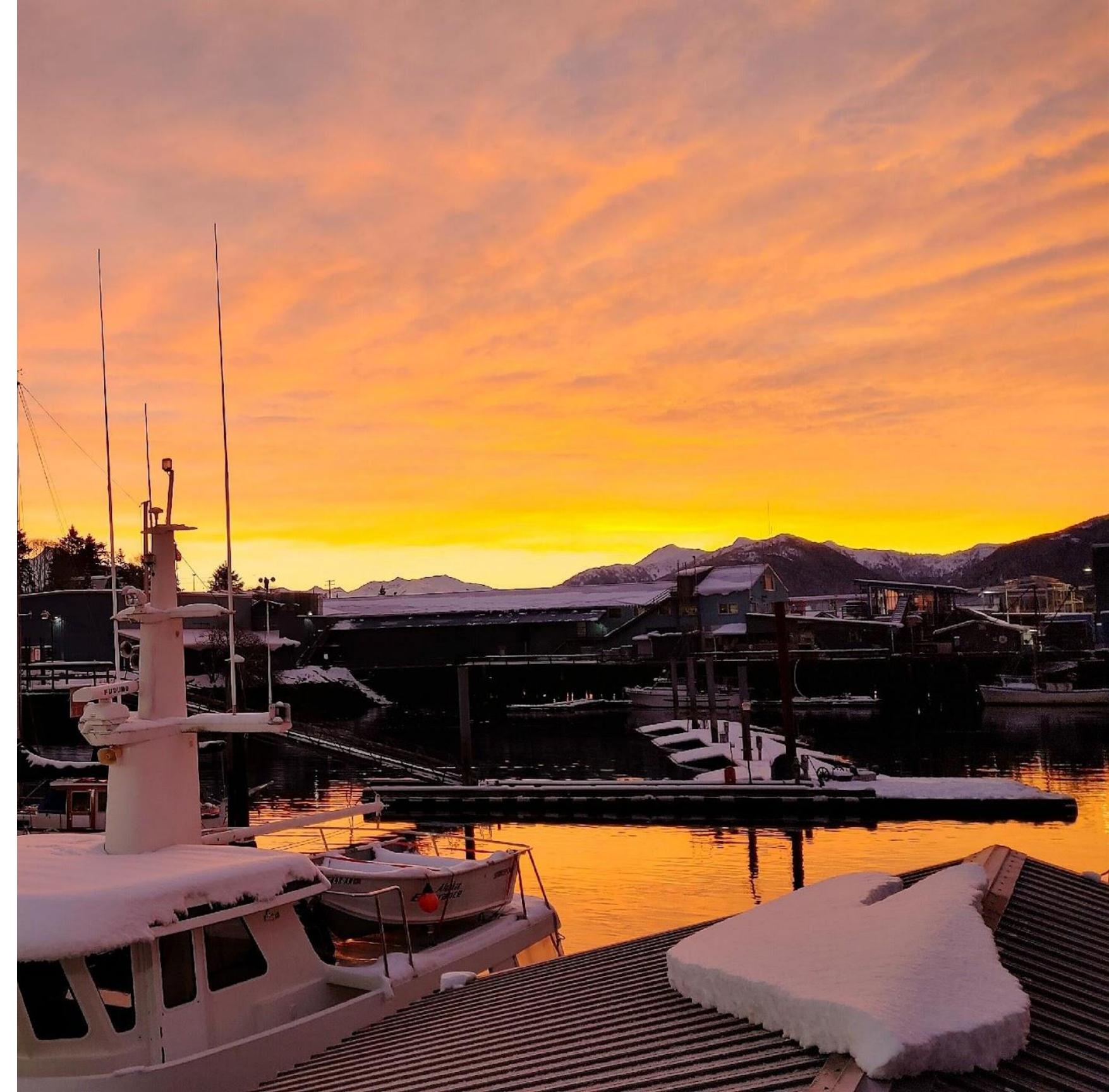
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A Responsive Research Agenda to inform community decision making in wave energy

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Post Doctorate Research Associate



PNNL is operated by Battelle for the U.S. Department of Energy



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In what ways does wave energy research support community decision making, and where does it fall short?

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What do communities
make decisions about?

Technical Decision Areas

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What are the important factors guiding communities' decisions?

Technical Decision Areas

Community Preferences

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Are there different *types* of research that provide different types of support?

Technical Decision Areas

Community Preferences

Pyramid of Support

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Technical Decision Areas

Community Preferences

Pyramid of Support

Literature Review and Crafting a Research Agenda



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		Technical Decision Areas		
		Site Selection	WEC Design and Selection	Systems and Operations
Community Preferences	High			
	Medium			
	Low			



		Technical Decision Areas		
		Site Selection	WEC Design and Selection	Systems and Operations
Community Preferences	Cost and Value of Energy			
	Social and Community Impacts			
	Environmental Impacts and Spatial Use			

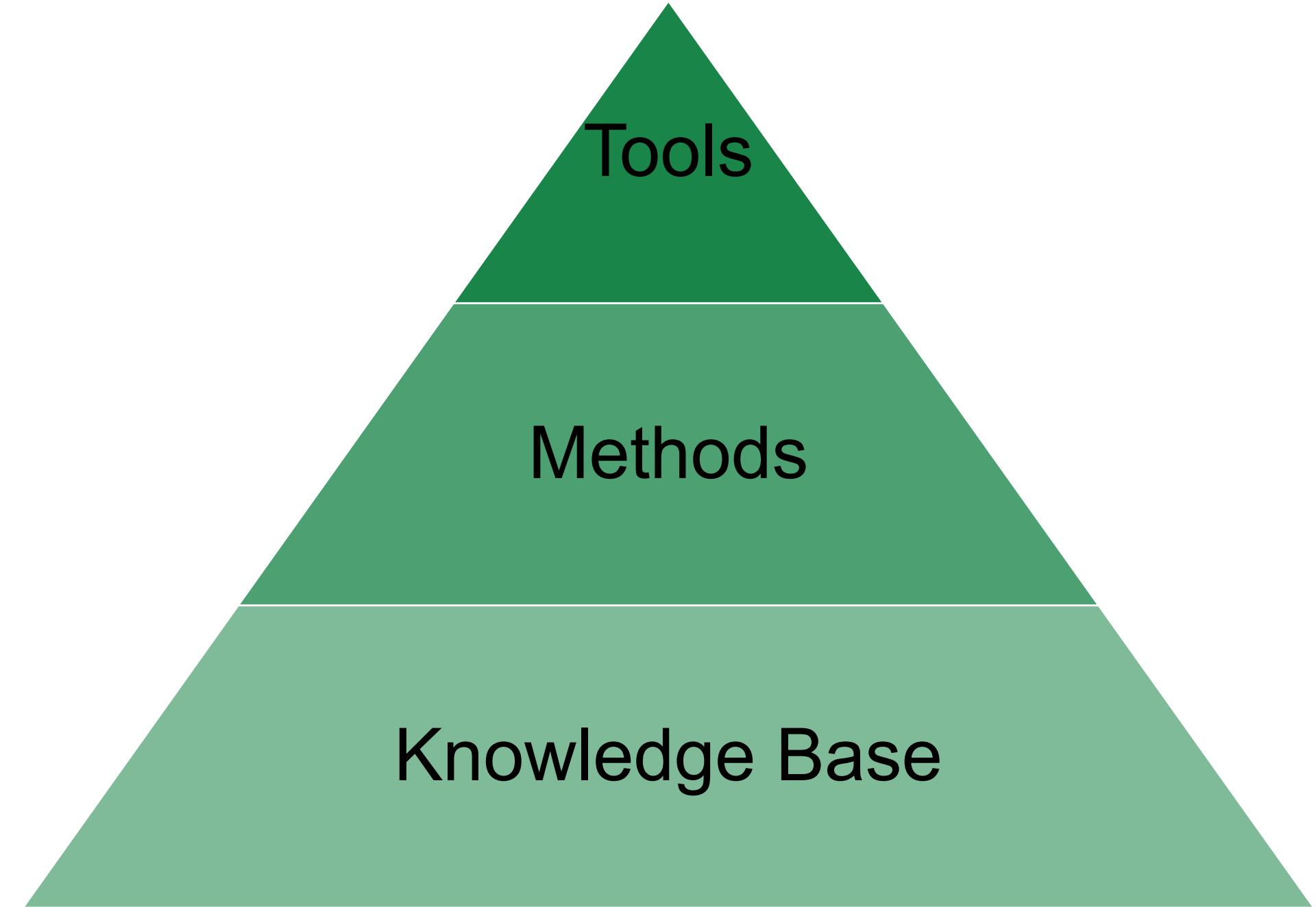
		Technical Decision Areas		
		Site Selection	WEC Design and Selection	Systems and Operations
Community Preferences	Cost and Value of Energy	<p>How does site selection impact costs?</p> <p>How does site selection impact energy production?</p>	<p>What WEC provides the most valuable power for a given location?</p> <p>Does it cost more to optimize some WECs for variable or extreme sea states than it costs others?</p>	<p>How does the changing the number vs. size of devices impact the value of power?</p> <p>What are the costs associated with localizing maintenance strategies?</p>
	Social and Community Impacts	<p>How does site selection impact existing industries?</p> <p>How does site selection relate to social preferences?</p>	<p>What device characteristics improve safety and reliability?</p> <p>How is the selection and optimization of a WEC consequential with respect to social and community impacts?</p>	<p>How does the layout of a WEC farm impact safety, reliability, and maintainability?</p> <p>How might choices to leverage existing infrastructure support community social preferences?</p>
	Environmental Impacts and Spatial Use	<p>How do environmental impacts differ across types of sites (i.e. sand bottom vs. rocky bottom)?</p> <p>How does site selection impact other ocean spatial uses?</p>	<p>How do environmental impacts differ across WECs?</p> <p>How do impacts on fisheries differ across WECs?</p>	<p>How do fisheries impacts scale with farm footprint?</p> <p>How do energy storage and infrastructure decisions impact the environmental consequences of a wave energy project?</p>



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Are there different *types* of research that provide different types of support?

Pyramid of Support



Knowledge Base

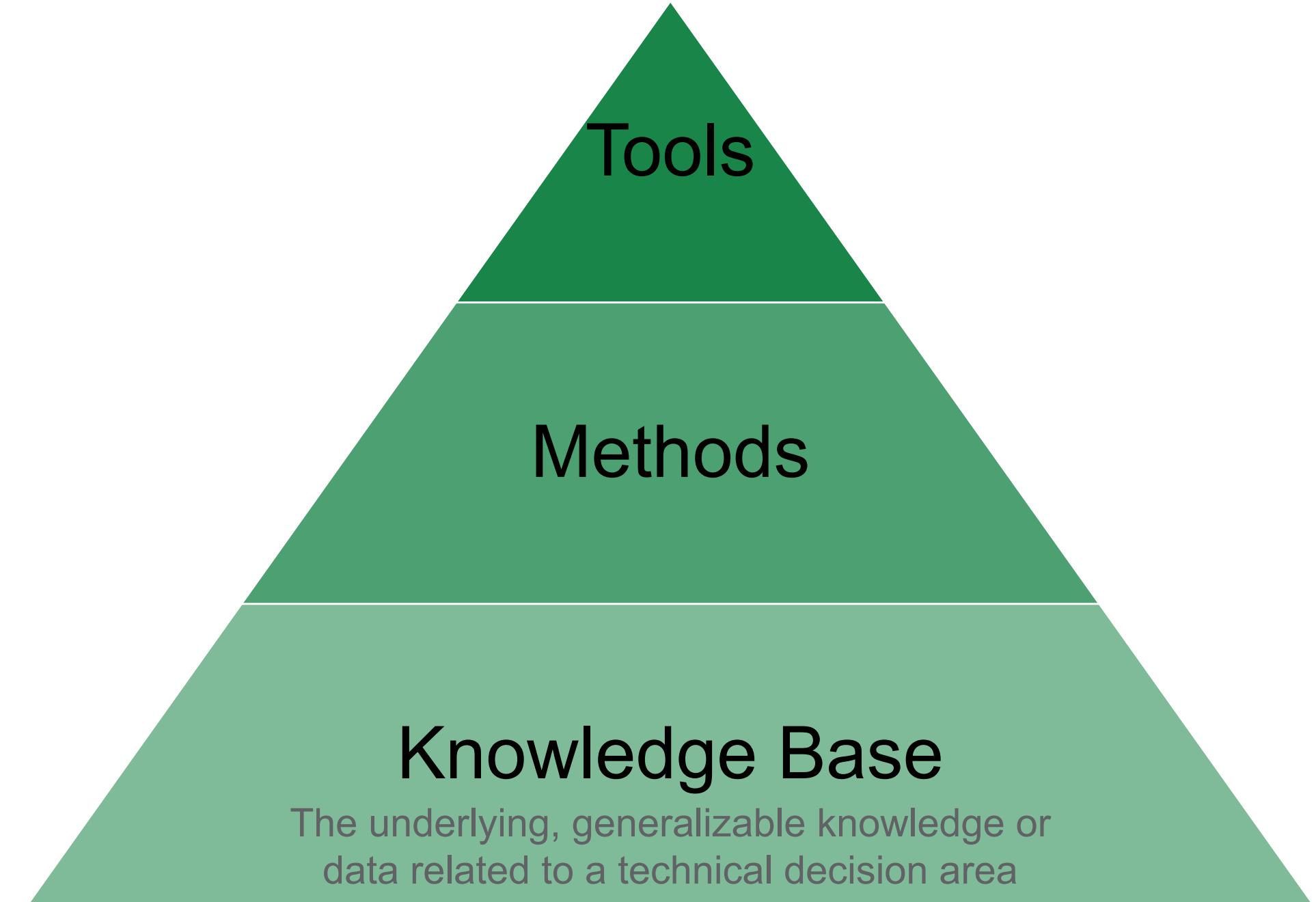
Methods

Tools



Are there different *types* of research that provide different types of support?

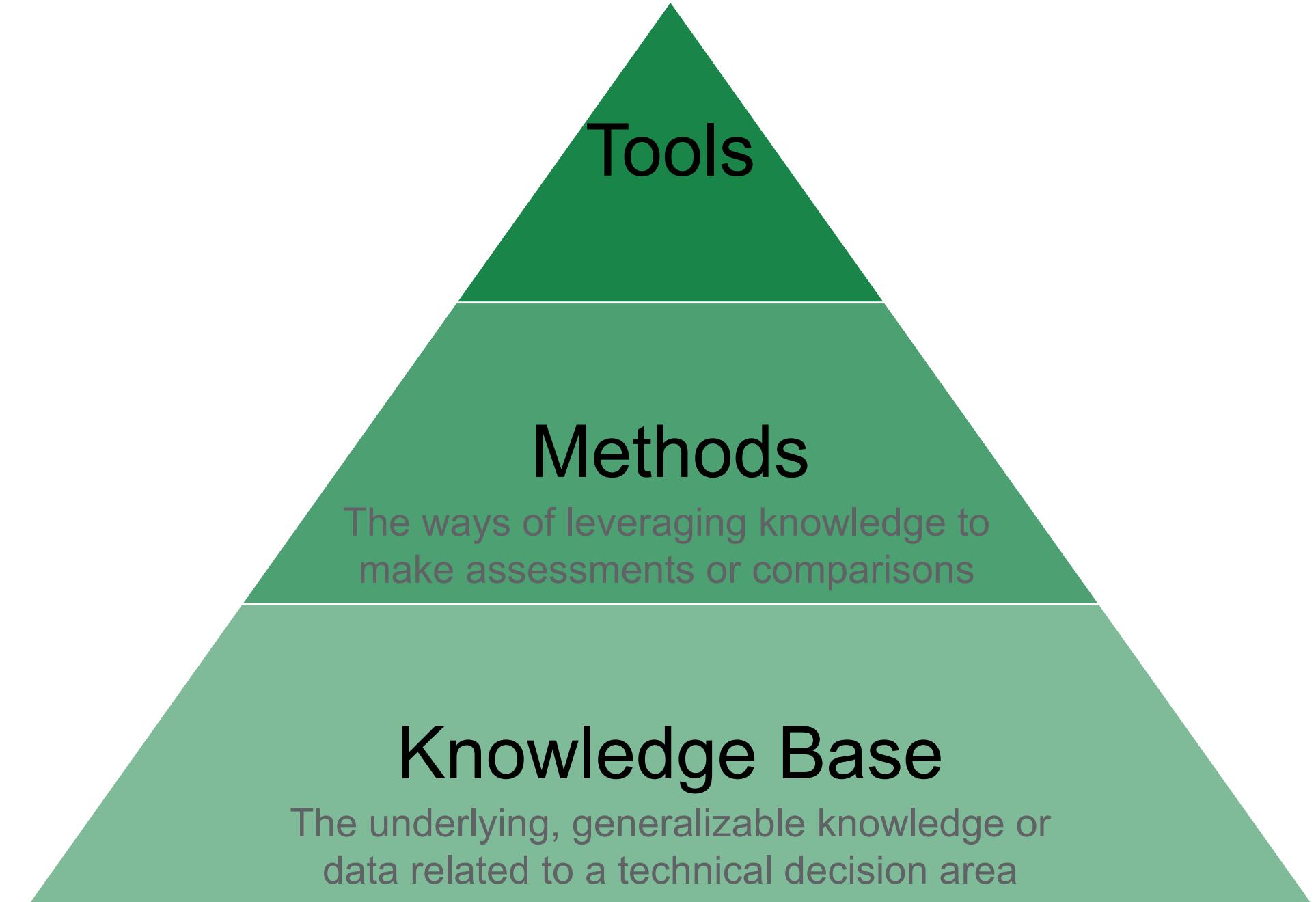
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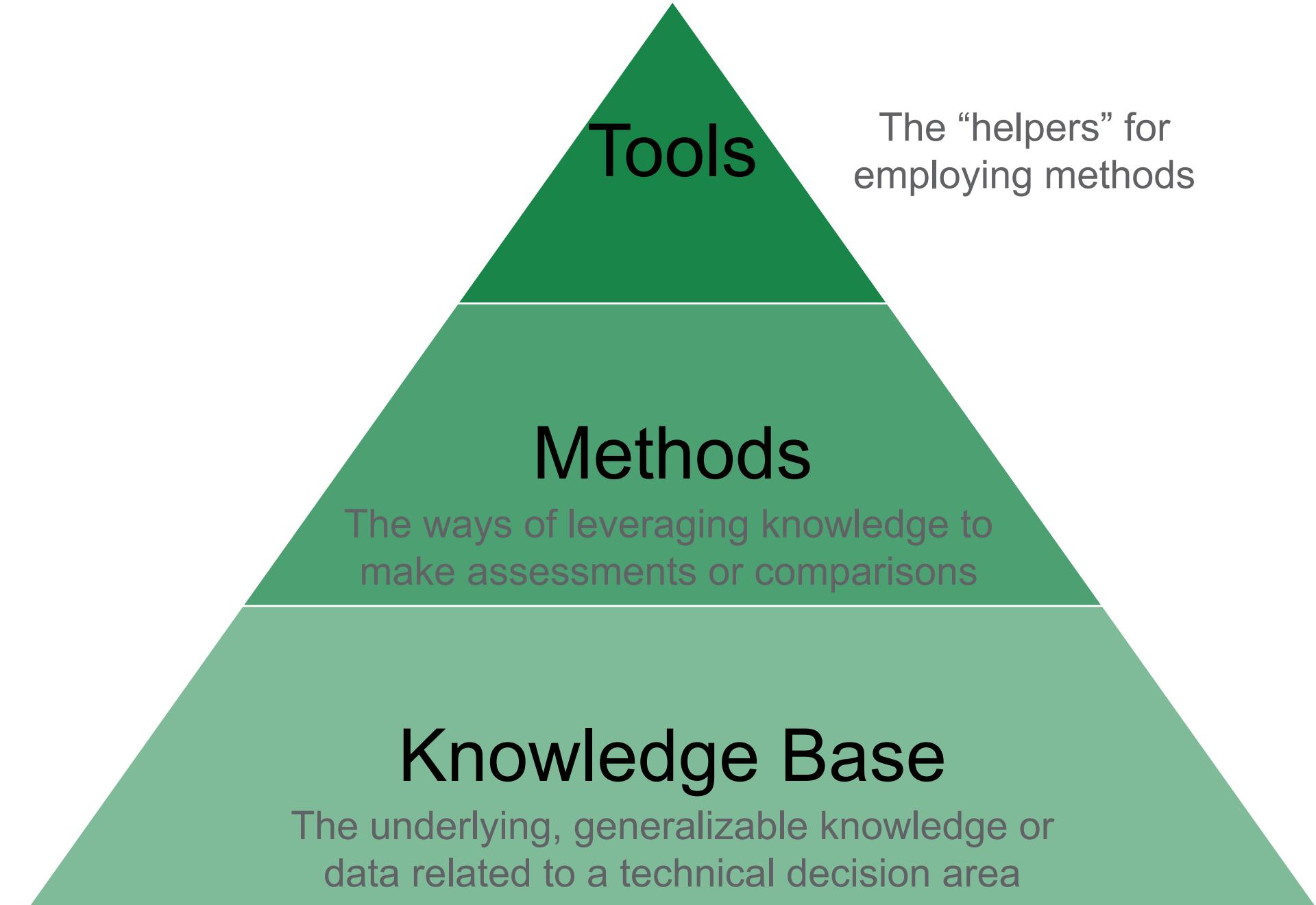
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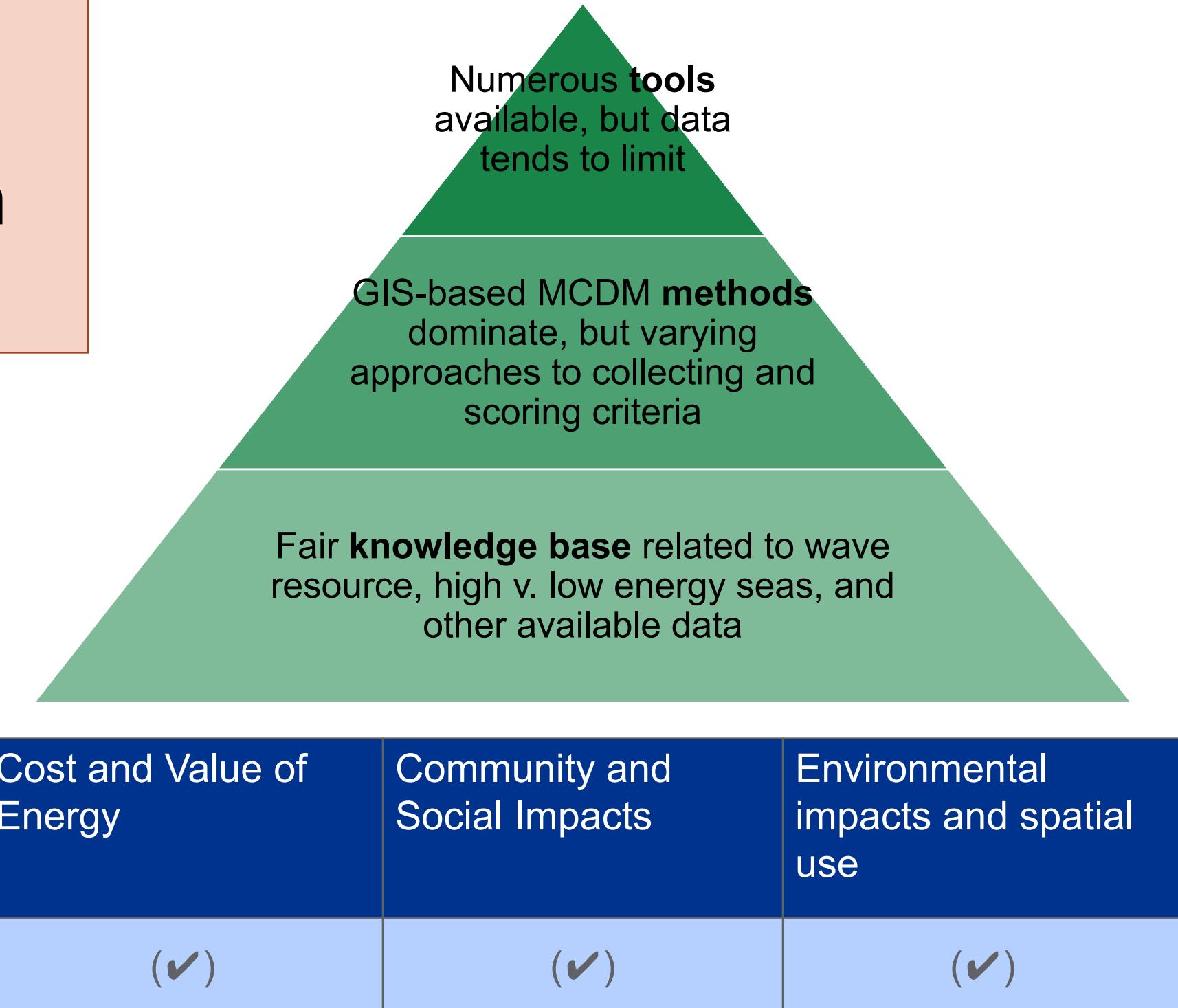
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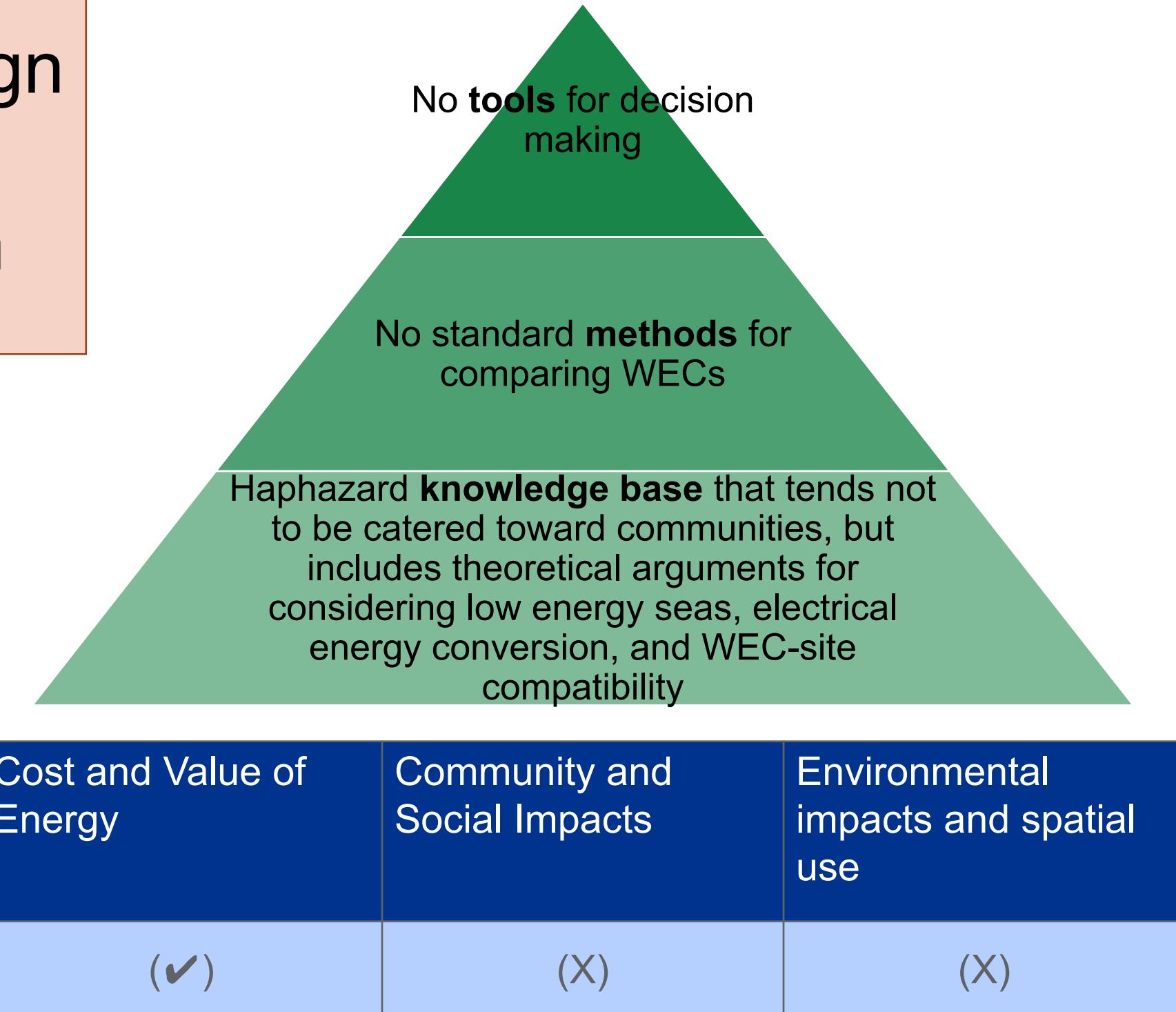




Site Selection

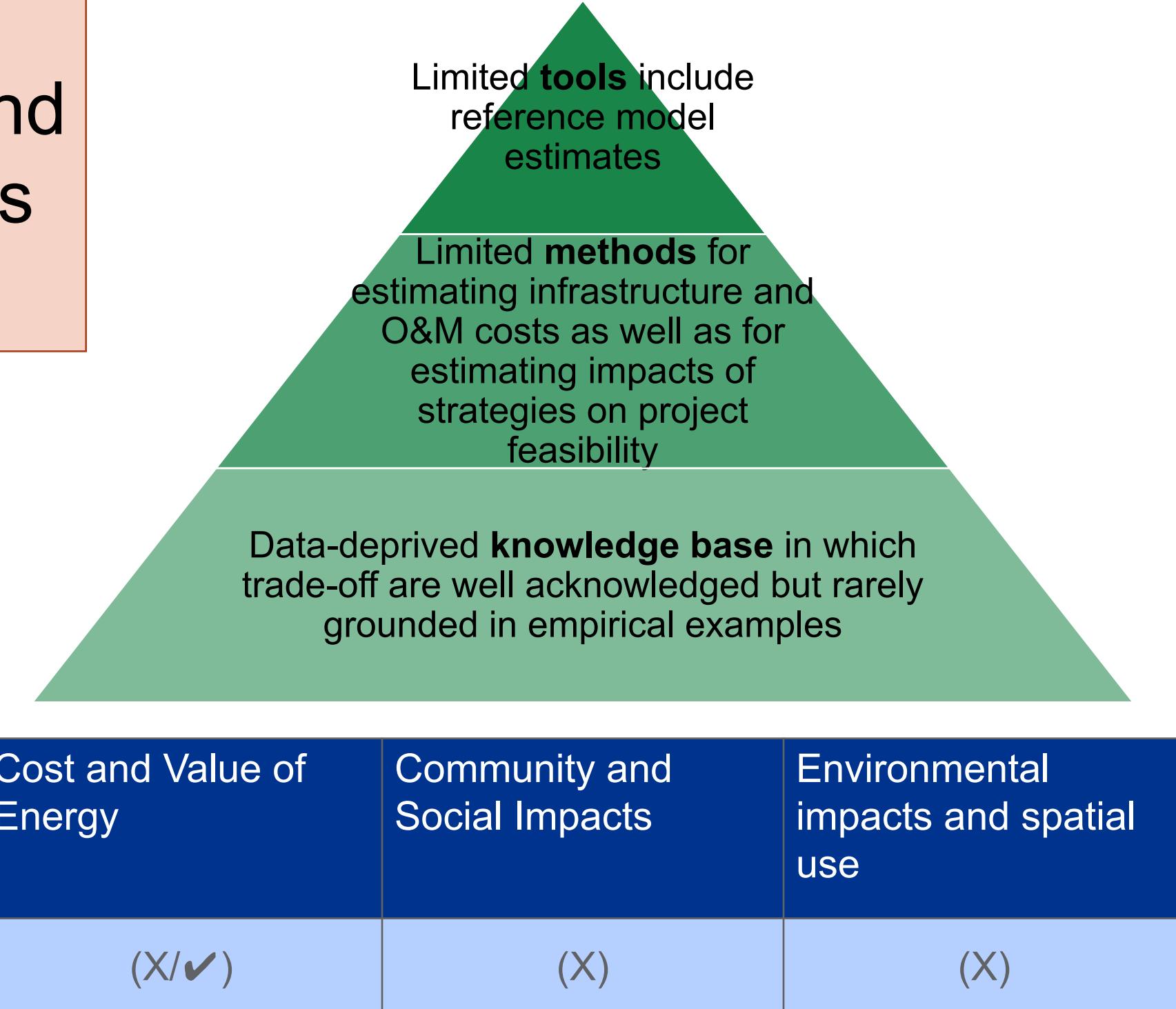


WEC Design and Selection





Systems and Operations



A responsive research agenda to inform community decision making in wave energy



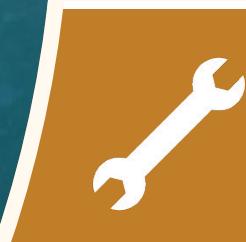
Community Perspectives as Guide



Interactions Between Local and Technical Characteristics



Comparative Studies



Operations and Maintenance in Early Deployments



Multi-disciplinary and Co-produced Research



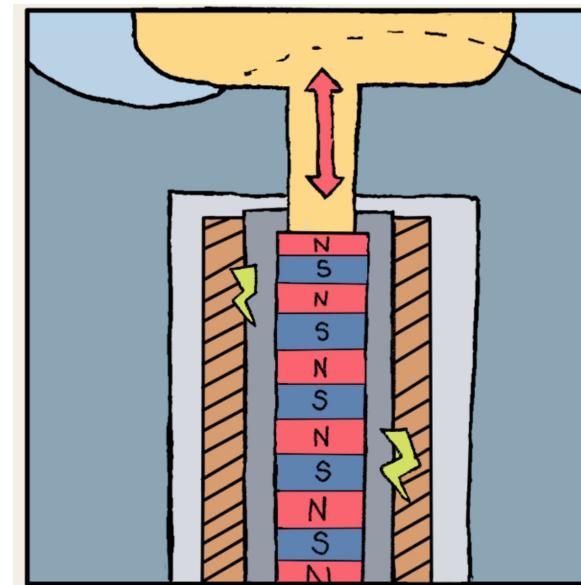
Interactions Between Local and Technical Characteristics

- Investigate how the intra- and inter- relationships between technical decision areas and community preferences depend on the deployment site

How do a WEC's optimal PTO parameters change with wave characteristics? Generation constraints?



Methods and tools for community-developer collaboration

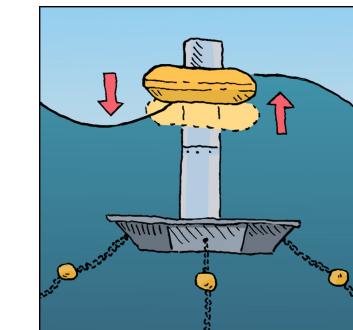
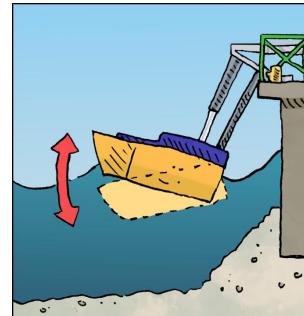




Comparative Studies

- Compare WEC types and other technical decisions in terms of social, community, and environmental impacts
- Establish more consistent methods of modeling and optimizing WECs when making comparisons related to cost of energy

How do WEC archetypes differ
in term of environmental
impact? Fisheries impact?

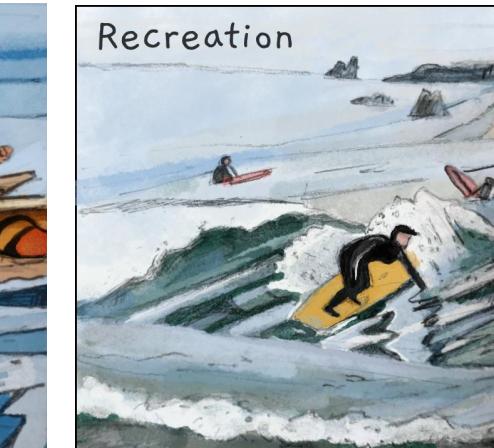
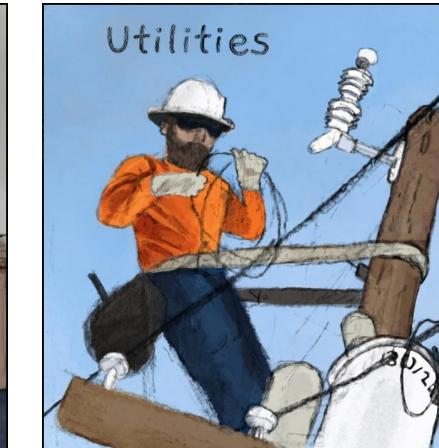




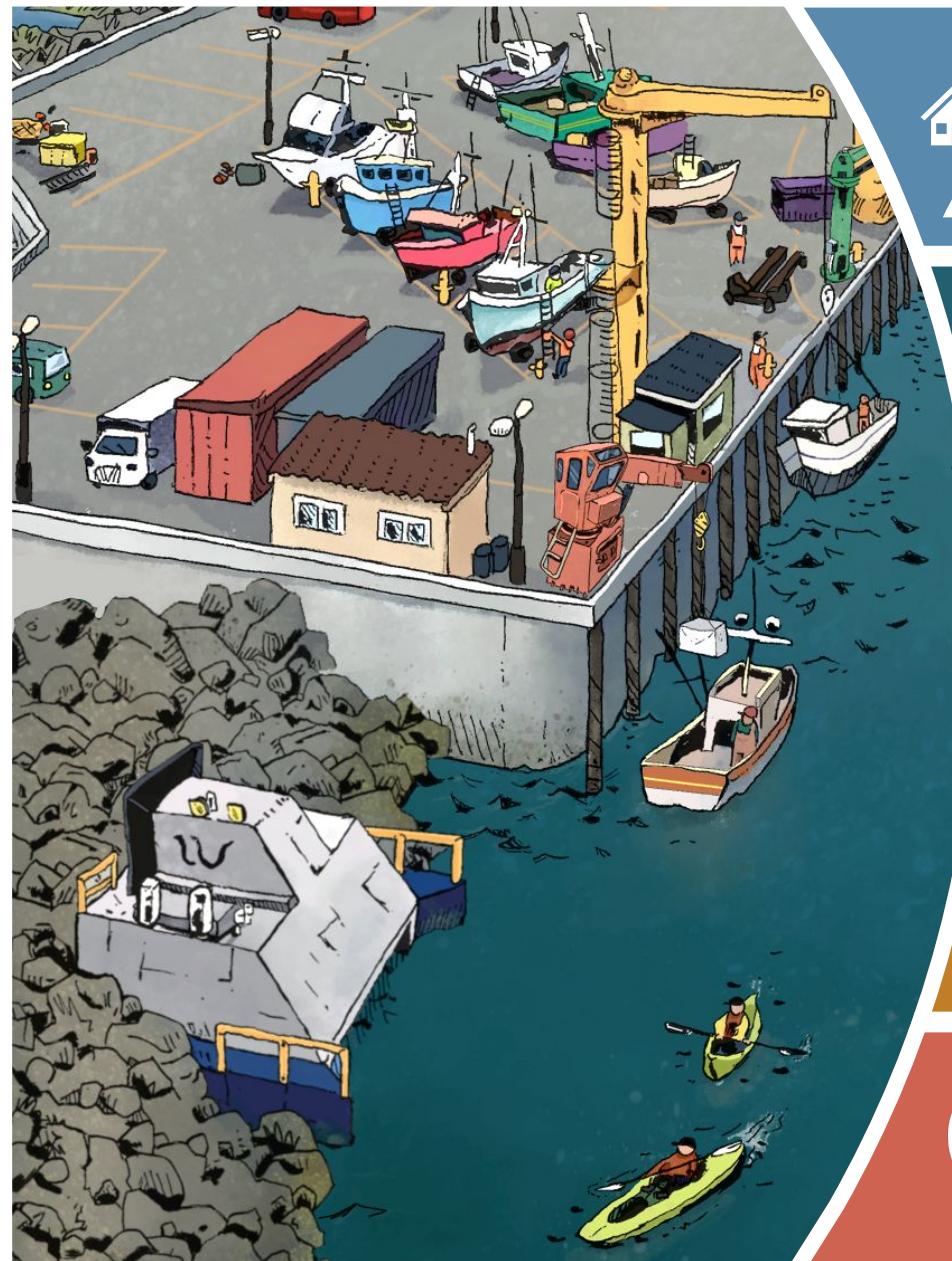
Multi-disciplinary and Co-produced Research

- Bring together disparate knowledge from locals and researchers to support all agenda items

What are feasible access limits for WECs? And how do they depend on community operations capacity?



A responsive research agenda to inform community decision making in wave energy



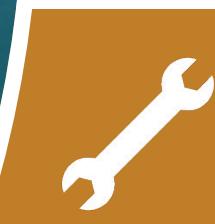
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Interactions Between Local and Technical Characteristics



Comparative Studies



Operations and Maintenance



Multi-disciplinary and Co-produced Research



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Look out for the final product!

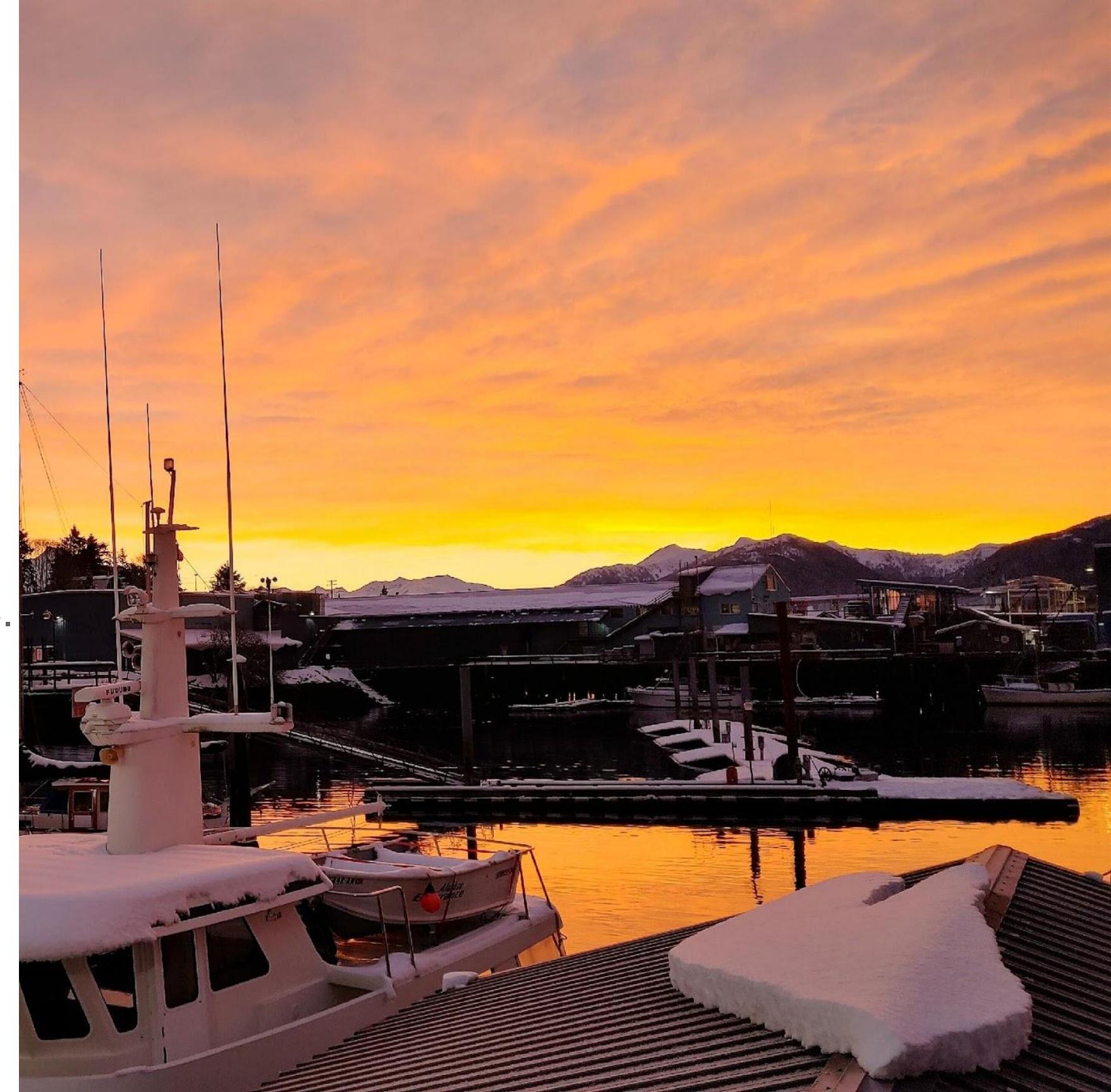
Under internal review for submission to Renewable and Sustainable Energy Reviews

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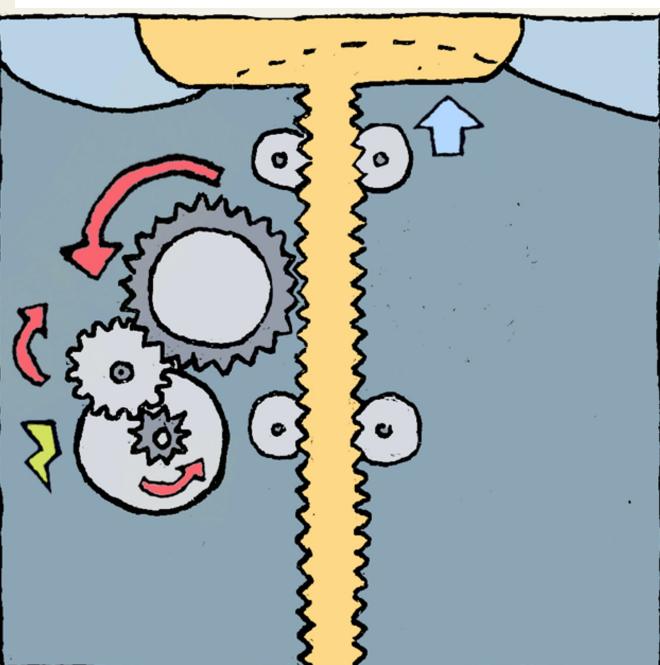
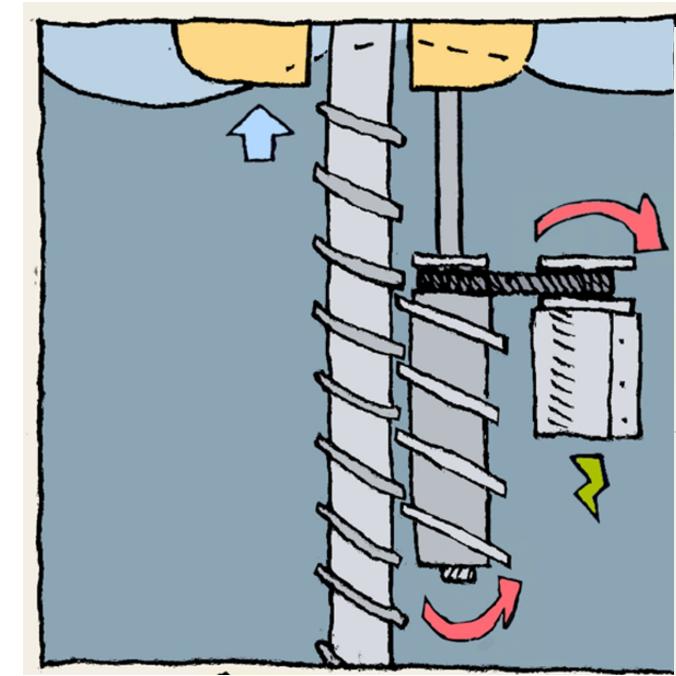
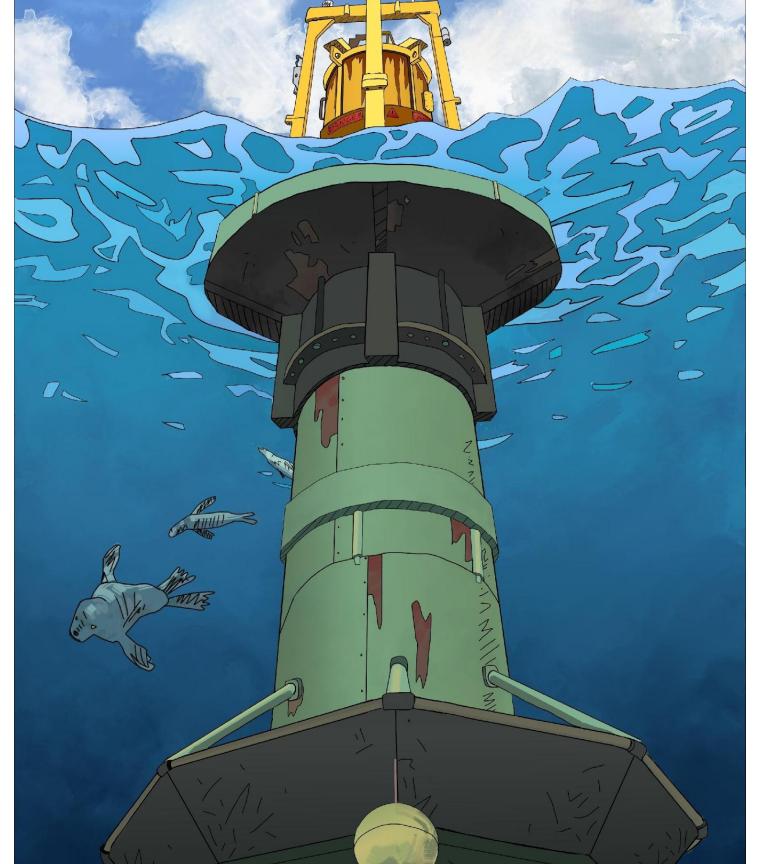
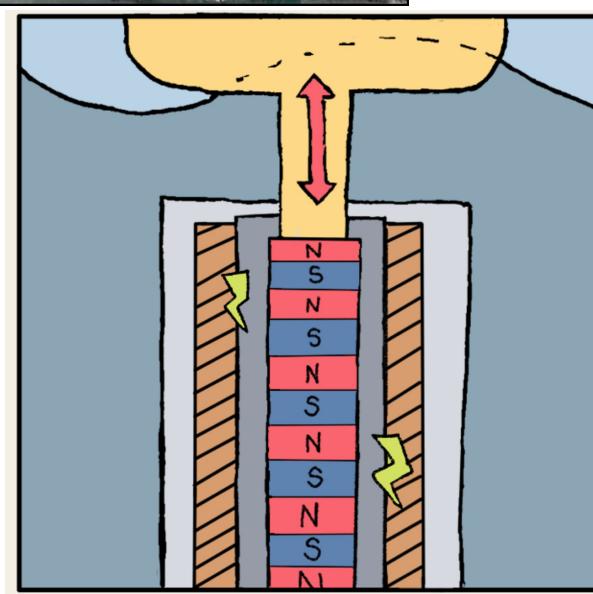
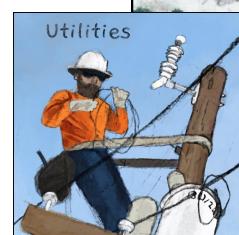
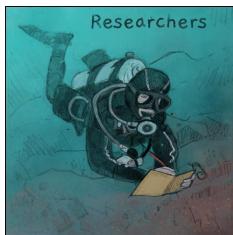
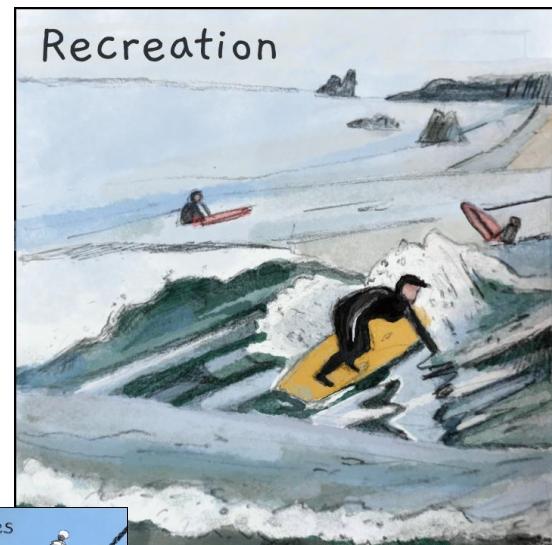
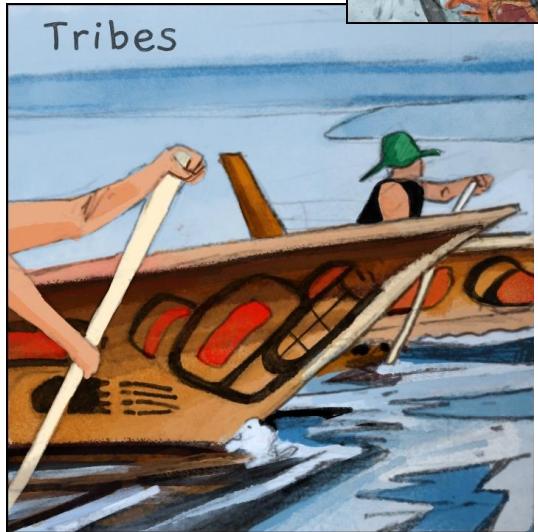
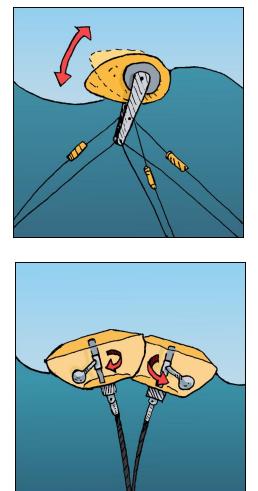


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Community Perspectives as Guide





Operations and Maintenance



Summary of observations

Site Selection	WEC Design and Selection	Infrastructure and Operations
Fair knowledge base that has been applied in a dominant GIS-based MCDM method, with numerous tools published and publicly available	Haphazard knowledge base that is not catered to communities, no standard method of comparison, no tools	Data-deprived knowledge base with limited methods and tools
Site selection criteria from literature, but more recent work integrates community surveys and interviews	WEC comparisons are done mostly in terms of energy metrics, sometimes cost	Suggestions of trade-offs appear in literature but lack data or numerical examples
Limited research on effectiveness or acceptability of methods, as data tends to drive tool limitations	Worthwhile to consider smaller seas, that different WECs are suitable for different locations, and performance depends strongly on mechanical to electrical conversion	Focus on broad potential costs and impacts for the industry, but lacks support for early actions



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