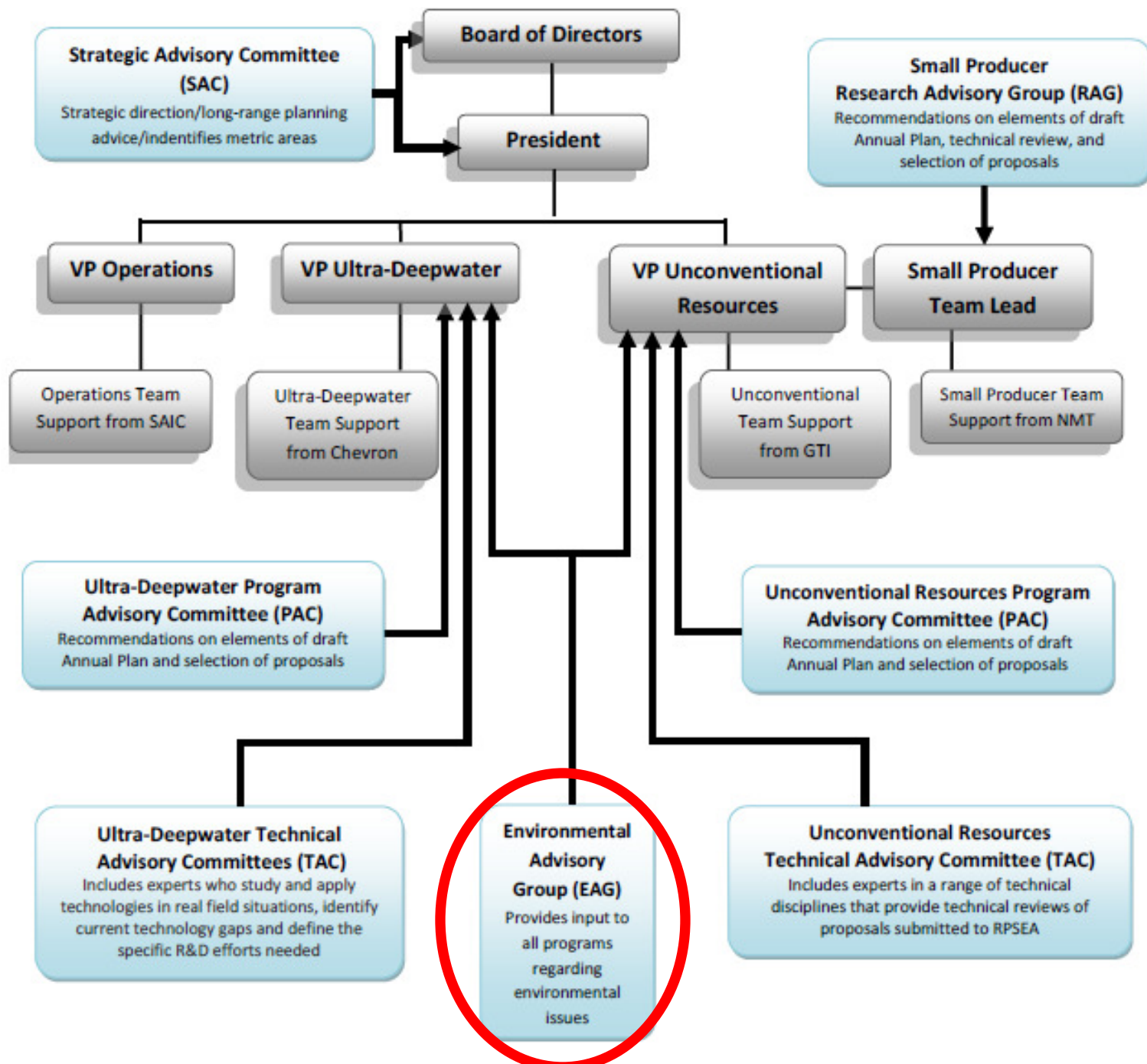


- -
 -
 -
 -
 -
 -
- Research
Partnership to
Secure Energy
for America**

Environmental Advisory Group





Environmental Advisory Group (EAG)

Environmental stewardship is at the core of all RPSEA activities.

The EAG is designed to provide input to the Program regarding environmental issues.

- ***Organizes and brings together key experts and policy leaders from academia, regulatory entities, nongovernmental organizations, and industry for road mapping exercises to identify key regulatory barriers/issues.***
- ***As requested, the EAG reviews programs, projects, and plans to ensure that environmental issues are appropriately addressed.***
- ***Serves in a liaison capacity with various environmental programs and organizations.***

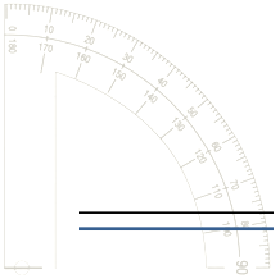




Environmental Issues are Imbedded in the RPSEA Activities

(examples)

- **RPSEA Member Forums**
 - **Technology for Mitigation of Environmental Impact of Rocky Mountain Unconventional O&G Operations Forum (5/12/08)**
 - **Low Impact O&G Operations in Environmentally Sensitive Areas Forum (5/30/08)**
 - **Long-Term Environmental Vision for Ultra-Deepwater Exploration and Production (11/20/08)**
- **Industry Functions**
 - **Barnett Shale Produced Water Conference 2007**
 - **Center for International Energy and Environmental Policy 2009**
 - **Clean Technology Conference and Expo 2009**
 - **Energy and Environment Subcommittee Meeting 2008**
 - **Interstate Oil and Gas Compact Commission Annual Meetings and Mid-Year Summits 2007, 2008, 2009**



-
-
- **Research**
- **Partnership to**
- **Secure Energy**
- **for America**
-

Review of Complementary Environmental Research



Environmental Protection Agency (EPA)

- Strategic multi-year planning process to guide the direction of its research over five or more years.
- Enables EPA's Office of Research and Development (ORD) to focus on the highest priority needs for science and promotes coordination of research across its laboratories and centers to achieve research goals.
- ORD's research program is planned in collaboration with EPA's program and regional offices, and is described in Multi-Year Plans (MYPs).
- Programs include *Clean Air, Drinking Water, Ecosystem Services, Endocrine Disruptors, Global Change, Land, and Water Quality.*



Department of Defense (DoD)

- DoD's Strategic Environmental Research and Develop Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) are designed to help the DoD fulfill its mission in an environmentally sound manner.
- Combine a more research focused arm (SERDP) with a technology development arm (ESTCP).
- Example funding areas include:
 - *Remediation of Contaminated Groundwater*
 - *In Situ Management of Contaminated Sediments*
 - Characterization, Control, and Treatment of Range Contamination
 - Military Munitions Detection, Discrimination, and Remediation
 - Energy Efficiency and Renewable Energy for DoD Installations.



Department of Interior

- Many different programs going on across the country that could assist RPSEA funded researchers in understanding how the environment may be impacted by the technology that they are developing.
- Research areas include *aquatic ecology, ecosystem modeling* and *landscape ecology*.
- The *Environmental Applications and Research Group* conduct impact assessment studies associated with Reclamation's and other Federal agencies' compliance requirements under the National Environmental Policy Act, Endangered Species Act, Clean Water Act, and other legislation.
- The *Riparian and Wetland research program* located at Reclamation's Technical Service Center in Denver, CO, combines numerous scientific and engineering disciplines to help understand and manage natural riparian and wetland ecosystems.



Minerals Management Service (MMS)

Department of Interior

- MMS has a substantial amount of funded research that RPSEA funded deepwater researchers should be made aware of.
- A specific goal of the MMS Environmental Program is to develop workable solutions for those industry activities that could adversely affect environmental resources.
- Environmental science research, funded by the MMS, *provides technical information to elucidate complex environmental processes and provides analyses for NEPA (National Environmental Policy Act) and OCSLA (Outer Continental Shelf Lands Act) reports, and proposed legislation and regulations that may affect OCS activities.*



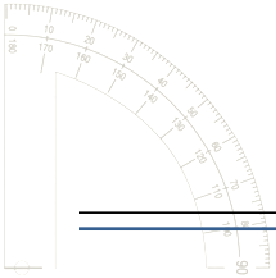
Research Funded by Foundations, Others

- *Gordon and Betty Moore Foundation* awarded a two-year, \$1.97 million grant to a collaboration of *Stanford University's Woods Institute for the Environment*, *The Nature Conservancy* and the *World Wildlife Fund* to develop a software program for **mapping and evaluating the economic benefits provided by temperate marine ecosystems**.
 - Proposed software will give policy makers and other stakeholders a means to calculate the services that people derive from ocean ecosystems and to incorporate those values into planning processes.
- In 2005, the *World Wildlife Fund – Canada and Environment Canada* helped to fund research projects concerning the sage grouse.
- Other research has been funded by Ultra, Wyoming Game and Fish, the Bureau of Land Management (BLM), Shell and EnCana.
- Other wildlife research in Wyoming's Upper Green River Valley has also been funded by industry, Wyoming state government and Federal agencies.



Research Funded by Texas Environmental Research Consortium (TERC)

- TERC (www.tercairquality.org) receives funding from Federal, state and private sources to *improve ozone science and air quality modeling*.
- Manages a program to develop and verify technologies that reduce nitrogen oxide (NOx) emissions from diesel engines.
- Manages programs related to emissions inventories, monitoring, atmospheric chemistry, meteorology, complex air quality modeling, human exposure and policy analysis.



RPSEA Program

- -
 -
 -
 -
 -
 -
- Research
Partnership to
Secure Energy
for America**



RPSEA 2010 DAP

Longer Term (UDW)

- **Objective 5: Environmental and Safety Technology Development and Deployment**
 - The UDW will assess the environmental and safety impact of UDW-funded projects.
 - This effort may take the form of individual solicitations or elements of more extensive project-based solicitations.



UDW Program

Need 6: HS&E Concerns (Safety and Environmental)

- **Initiative 1: Metocean Needs That Impact Operations and Facility Design**
 - **Effect of Global Warming on Hurricane Activity (2007)**
National Center for Atmospheric Research (NCAR)
 - The primary objective is to assess the threat that global warming will substantially increase GOM hurricane activity (intensity and/or frequency).
 - Assessment is to be based on simulations using a high resolution climate model capable of generating hurricanes without data assimilation.
 - **Gulf Three Dimensional Operational Current Model Pilot (2008)**
 - Overarching goal of this pilot is to improve the ability of numerical models to forecast the loop current and its associated eddies.
 - Vision of success at the end of the pilot is that there will be a well-validated operational model (or perhaps ensembles from multiple models) in place that produces timely, accurate forecasts, which are summarized by web-based products that provide substantial benefits to knowledgeable users.



2009 UDW

Initiative 2: HS&E Concerns with Emerging New Technologies

- **Subsea Processing and Seabed Discharge of Produced Water**
 - Proposals addressing review and evaluation of existing regulations, standards and HS&E requirements that may govern deepwater surface and/or seabed direct discharge of produced water, define relative seabed conditions, environment, and marine toxicology will be of interest.
 - Cost/benefit/impact assessments and conceptual design(s) of subsea processing systems(s) that incorporate discharge of solids and produced water at the seafloor and proposals on other related topics will also be requested.



2010 UDW

Need 6: Associated Safety and Environmental Concerns

- Tremendous amount of environmental research funded by the federal and state governments as well as private foundations.
- RPSEA will reach out to the environmental researchers and safety professionals, enabling them to understand the importance of their efforts with respect to U.S. domestic energy production.
- RPSEA's focus is on technology development and, as such, RPSEA will be focusing efforts to ensure new technology developed within the program takes environmental impact and safety considerations into account.
- RPSEA will be seeking to leverage ongoing research efforts, and collaborate within existing forums and venues, and where possible integrate with ongoing UDW projects.
- Areas of study may include:
 - Discharge of produced water subsea – technology and regulatory aspects
 - Environmental impacts associated with technologies addressed under other UDW needs



Unconventional Environmental Focus

- **Develop advanced drilling, completion and/or stimulation methods that allow a greater volume of reservoir to be accessed from a single surface location**
- **Develop advanced drilling approaches that minimize the surface impact of well construction associated with the targeted unconventional gas resource**
- **Develop advanced completion, stimulation and/or reservoir management approaches that minimize the environmental impact associated with the development of the targeted resource**
- **Develop methods for planning and site selection that minimize the surface footprint and the impact of drilling and production operations**
- **Develop surface mitigation methods applicable to all environments**
- **Develop technologies to recycle water**
- **Develop technologies for detection and capture of emissions from unconventional oil and gas operations**



Environmentally Friendly Drilling Program

For 20 years, we have worked to reduce our environmental footprint. Remarkable progress has been made.

The program has shown we can **reduce the footprint more than 90%** with a further reduction in the impact on the environment if low impact technologies are combined in a system.

From the past...
(multiple well sites)



...to the present drill site pad
6 times smaller and able
to access multiple wells
from **ONE** location



System includes:

- Modular small footprint rigs with reduced emissions.
- Pad drilling of multiple wells from one site.
- New downhole logging and steering tools.
- Closed loop drilling fluid systems.



Managed by the Houston Advanced Research Center (HARC), Texas A & M University, San Houston State University and TerraPlatforms LLC. www.earthplatforms.com

The project was co-funded by the DOE National Energy Technology Laboratory, Research Partnership to Secure Energy for America (RPSEA), industry and environmental organizations.

SPONSORS



ENVIRONMENTAL ORGANIZATIONS



MANAGEMENT TEAM



Deepsea Hybrid Power Systems

Houston Advanced Research Center
Lawrence Livermore National Laboratory
Naval Facilities Engineering Service Center
Yardney Technical Products
Curtiss-Wright Corporation

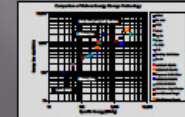


Shell
Chevron
GE

EVALUATE ALTERNATIVE METHODS FOR LOCALLY GENERATING SIGNIFICANT ELECTRICAL POWER ON THE SEAFLOOR

- Document the performance and functional requirements expected for subsea hybrid power systems. (Basis of Design Document)
- Using the existing knowledge base of high-performance energy conversion and storage systems, appropriate for underwater applications, and as the basis for several conceptual designs, systematically screen and develop a data base for the best hybrid power system.
- Select the two most promising generation-storage combination(s), and prepare detailed sub-scale conceptual prototype design(s), and perform initial qualification testing for the purpose of concept demonstration.
- Perform a formal Risk Assessment of the two conceptual prototype system(s) and document their respective Technology Readiness Levels (TRLs). Further, estimate the environmental impact (carbon footprint) of such systems were they deployed and then compared to conventional gas turbine power generation.

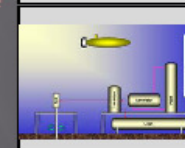
Power	Output	Approximate % Seafloor Power	Comments
Small Power	Less than 100 kW (potentially DC)	Proton 100% backup or fuel storage	<ul style="list-style-type: none"> May be able to create control modules for a cluster of wells (1-3 times that size of a typical electrical hydraulic line) May be able to handle small chemical injection pumps Multi-channel flow meter would need 80 to 100 wells Cost of most of each channel
Mid Power	1 to 10 MW (AC)	Proton 100% backup or fuel storage	<ul style="list-style-type: none"> Small scale multiphase pumps (up to 3 MW each) Small gas compressor (approx. 3 MW) Direct electrical heating of flowlines and pumps (approx. 10 MW) Reservoir HP (high pressure) station (1 MW for each pump, 8-10 wells)
Large Power	10 to 100 MW (AC)	Proton 100% backup or fuel storage	<ul style="list-style-type: none"> Integrated system (large 100 MW total, 10 MW for each component) Currently require 8-10 MW (future requirements could be 12-15 MW or higher) Proton larger compressor (20 MW each) to be modular in concept (parallel units connected in parallel)
Very Large Power	10 to 1000 MW (AC)	Proton 100% backup or fuel storage	<ul style="list-style-type: none"> Proton 100% backup or fuel storage Greater than 20 year life Could serve as a subsea utility hub As a stretch target, would consider a drilling vessel operating on location under the sea (power then, could transfer into subsea power plant for drilling operations. A drilling vessel could require a maximum of 100 MW, including: <ul style="list-style-type: none"> • 4-6 MW for deckburn • Approx. 5 MW for blow works (4-6 MW) • Approx. 7 MW for mud pumps (4-6 MW) • Two parallel electric cranes and two electric hydraulic hoist cranes Proton to be modular in concept (parallel units connected in parallel)



Energy density and specific energy for various energy conversion storage systems.



Second scenario with energy produced at point of use with proton exchange membrane (PEM) fuel cell, with hydrogen fuel and oxidant ferried from surface.

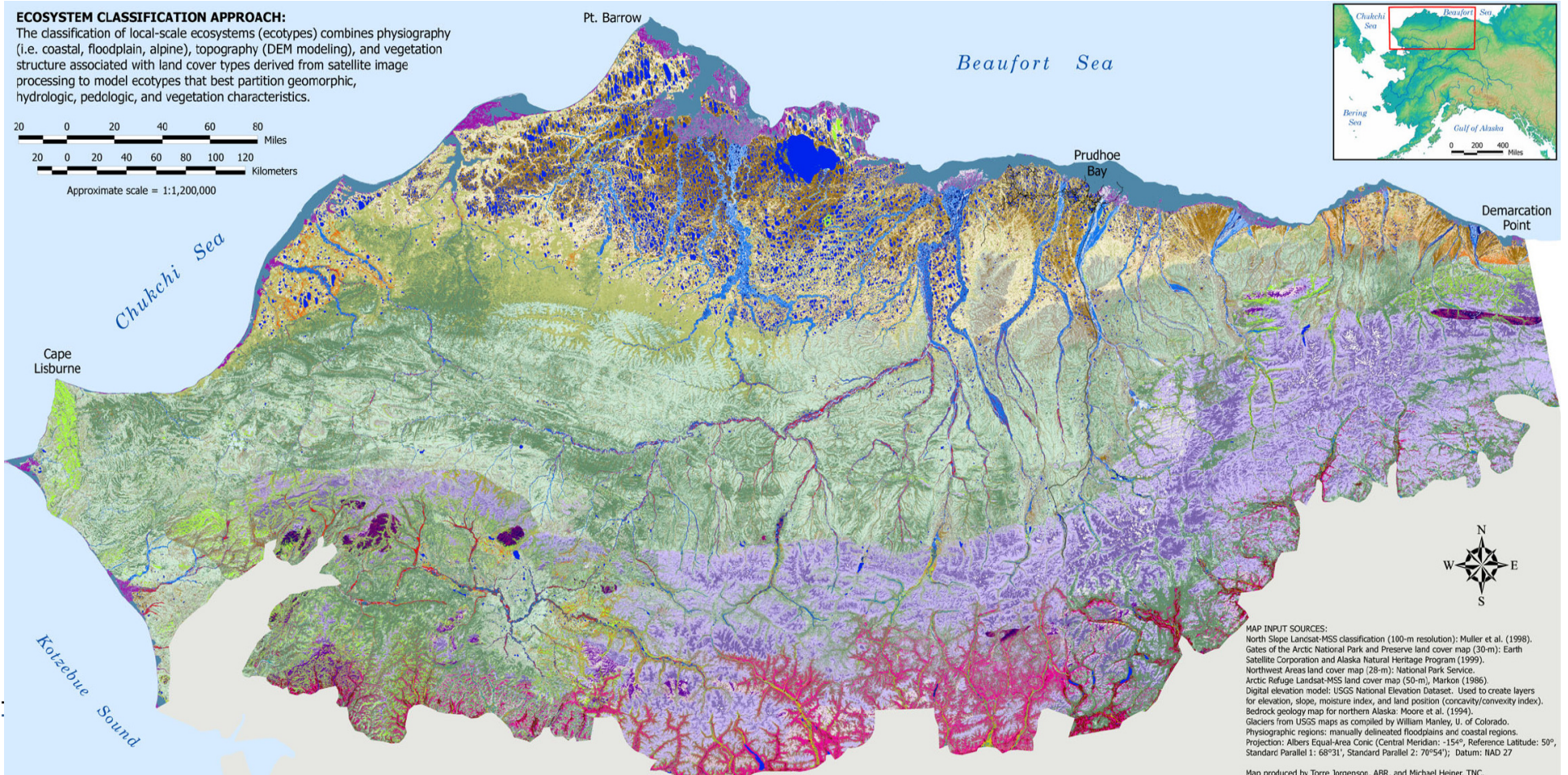


Third scenario with energy produced at point of use with small commercial PWR, with bank of lithium ion batteries used for energy storage.



Ecosystem and Biodiversity Measurement and Assessment

Develop tools for adaptive ecosystem management to assist integrated management of land, water and living resources that promotes conservation and sustainable use.

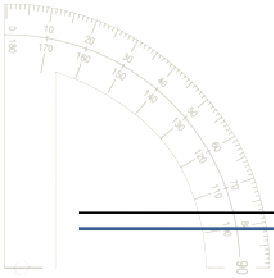


2020 Vision

Network of Self-Sustaining Regional Centers

- Remote sensing
- Modeling
- Risk management assistance





- -
 -
 -
 -
 -
 -
- Research
Partnership to
Secure Energy
for America**

Environmental Advisory Group Thoughts and Recommendations



RPSEA's Focus – Technology Development

- Researchers funded by RPSEA need to ensure that they understand environmental issues in order to determine how the technology that they are developing can affect the environment.
- There are tremendous opportunities for RPSEA to *leverage ongoing environmental research efforts*.
- RPSEA's program may be complemented by environmental research funded by others.
- Technology developers and environmental scientists need opportunities to interact and challenge one another.
 - In this way, multidisciplinary teams may form and environmentally focused technology development projects may arise.



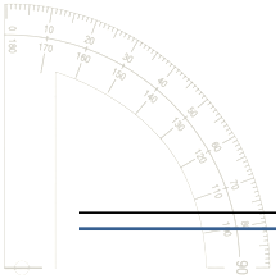
EAG Recommendations

- **RPSEA should be *pro-active in fostering interactions between RPSEA-funded technology development and environmental research funded by others.***
 - **Have RPSEA-funded UDW researchers attend and participate in the MMS Information Transfer Meetings (ITM's) that are held on a two-year cycle (odd years).**
 - RPSEA could hold a specific session of the ITM wherein RPSEA-funded research is presented.
 - Enables RPSEA-funded research to be reviewed by environmental scientists.
 - **Organize a Deepwater Information Transfer Meeting that is held on a two-year cycle (even years).**
 - Environmental scientists that typically attend the MMS ITM's should be invited to participate.
 - Having a yearly exchange will enable RPSEA researchers to network with environmental scientists and could lead to multidisciplinary research teams.
 - **Organize an Onshore Information Transfer Meeting that is held on a two-year cycle (odd years).**
 - Environmental scientists funded by state and Federal agencies as well as foundations and other sources should be invited to participate. Having such an exchange will enable RPSEA researchers and environmental scientists to network and could lead to multidisciplinary research teams.
 - Objective of the meeting would be to present ongoing research in order to identify environmental issues.



EAG Recommendations *(continued)*

- ***RPSEA proposal review/selection process*** and should attend project selection meetings.
- **Consider weighting factors** for multidisciplinary teams for review criteria.
- **After the Information Transfer Meetings** have been established and progress is made towards forming multidisciplinary teams, ***RPSEA should hold an Environmental Forum to solicit program ideas*** related to RPSEA's mandate.



Questions?



Richard C. Haut
Houston Advanced Research Center
rhaut@harc.edu
281-364-6093