

## Depth-averaged tidal current speed at southern tip of Cape May, NJ

Source: Xu, T., Haas, K. Evaluation of Tidal Energy for U.S. Coast Guard Station, Cape May, New Jersey – Draft Report, November 2016

DOD MHK Deployment Opportunity  
Identification

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February 2017

## **DOD MHK Deployment Opportunity Identification:**

- Investigation of the potential of emerging MHK technologies' to meet renewable energy goals while increasing energy security at U.S. Department of Defense (DOD) bases.
- Original approach and methodology was developed in an marine and hydrokinetics (MHK) report for U.S. Navy and Marine bases in FY14-15. Navy/Marine reviews and comments led to improvements screening criteria and evaluation/scoring mechanisms for subsequent DOD work.

## **The Challenge:**

Developing accurate understanding of current and near future technology development stage; potential impacts to mission

## **Partners:**

- U.S. Coast Guard—Interested in investigating MHK resources and developing an MHK research center
- US Army—Interested to better understand deployment potential at bases
- US Air Force—Interested to better understand deployment potential at bases
- Georgia Tech—Site-specific tidal bathymetric analyses

## Technology Maturity

- Test and demonstrate prototypes
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- Conduct R&D for Innovative MHK components
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

## Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- Support research focused on retiring or mitigating environmental risks and reducing costs
- **Build awareness of MHK technologies**
- **Ensure MHK interests are considered in coastal and marine planning processes**
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

## Market Development

- **Support project demonstrations to reduce risk and build investor confidence**
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

## Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- Exchange of data information and expertise

## Deployment Barriers:

- Build awareness of MHK technologies and current state of development with DOD energy managers;
- Ensure MHK interests are considered in coastal and marine planning processes.

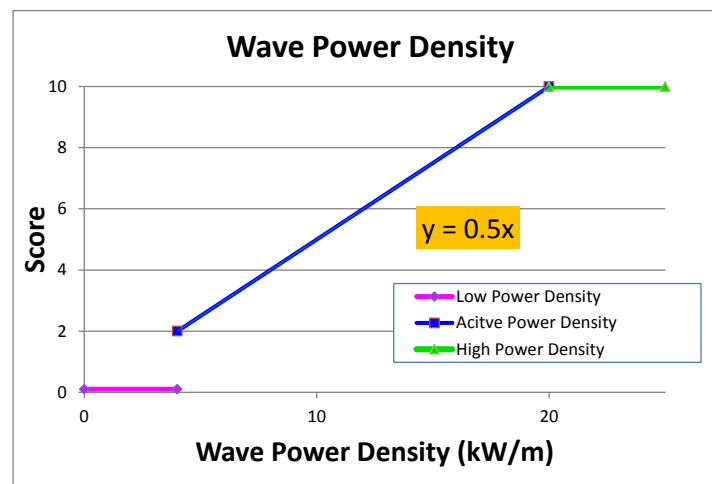
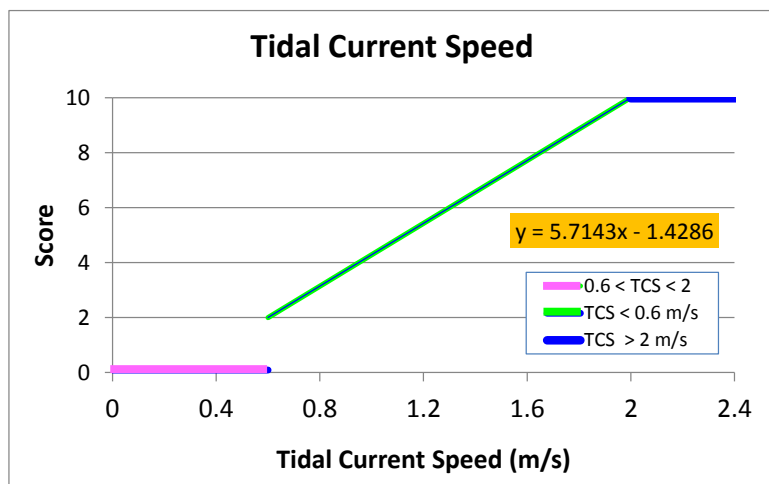
## Market Development:

- Wave test facilities at Marine Corps Base Hawaii–Kaneohe and at Camp Rilea in Oregon are examples of DOD actively supporting technology testing.
- Through increased MHK technology development awareness, build DOD interest to support eventual technology demonstration and pilot deployment projects.

## Scoring and Weighting Mechanism for Project Factors:

Developed a scoring mechanism and weighting system that is transparent and adjustable—as project cost factors or distance limitations become better quantified, adjustments can be made to better reflect the differences in mission or operations. It can serve as template for future DOD MHK evaluation.

- Wave power density
- Tidal current speed
- Total area with resource
- Distance to viable resource
- Facility energy load
- Substation voltage
- Number of environmental exclusions



Graphical representation of equations used for scoring two project factors within scoring metric

## Resource Screening and Ranking:

- Screened for a range of factors and evaluated based on scoring equations
- Ranked tidal and wave energy potential for Coast Guard (USCG), Army, and Air Force coastal bases based on scoring

Base Name	State	Distance to Area w/ TCS >0.6 m/s to 150m	Maximum TCS	Area with TCS >0.6 m/s to 150m Depth	Total Exclusions	Sub-station Distance	Sub-station Voltage	Electricity Cost
		(m)	(m/s)	(m <sup>2</sup> )	(#)	(mi)	(kVA)	(¢ / kWh)
NSWC Det Cape Canaveral	FL	495	0.61	200,492	8	0.0	115	8.41
AFRC Daytona Beach	FL	125	0.63	204,275	5	0.8	115	8.41
Whittier Anchorage Pipeline	AK	247	1.01	3,223,792	1	0.1	138	14.45
NG Lightner Building/City Hall	FL	793	0.67	307,174	5	0.4	115	8.41
Sp Forces Site Key West	FL	847	0.82	542,605	7	0.5	69	8.41
MTA Camp Edwards	MA	102	0.82	412,346	2	0.7	115	13.32
Haines Terminal	AK	1,143	0.62	195,146	1	0.1	115	14.45
Ivy Green Site 4	WA	886	0.9	323,791	1	0.5	0	4.55
NG Portsmouth Readiness Center	NH	1,085	1.48	470,504	1	0.5	115	12.55
NAS Key West	FL	0	0.88	1,073,125	11	2.3	69	8.41
NG Dillingham Armory	AK	543	1.22	1,688,999	1	0.0	115	14.45
NSY Portsmouth	ME	3	1.73	1,305,555	1	0.0	115	8.64
NAS Portsmouth NCTS Cutler VLF Area	ME	0	0.58	17,944,589	3	0.0	0	8.64

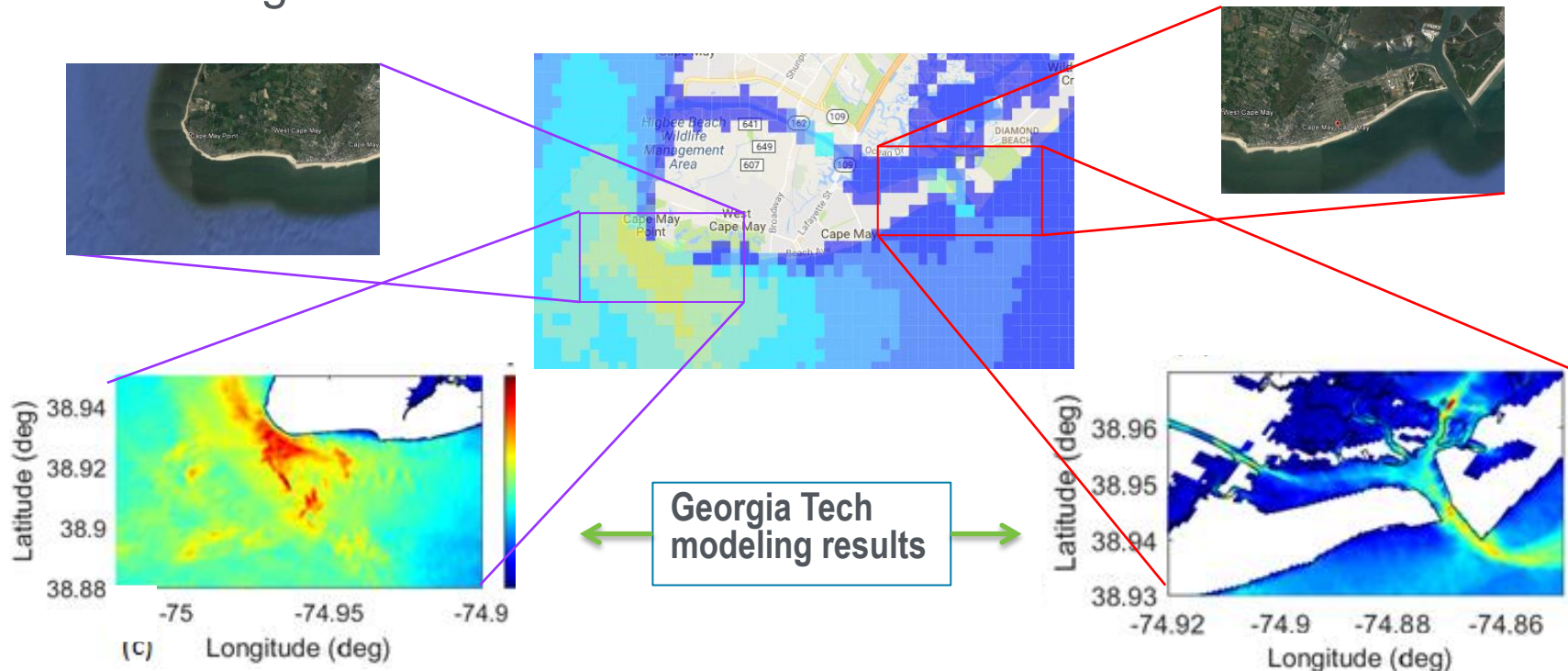
## Results of Resource Screening and Ranking:

- Ranked top ten based on resource and siting factor scores
- Asked DOD for load data and feasibility assessment of top sites
- Iteratively collaborated with DOD renewable energy (RE) leads to down-select to 2 bases
- Contracted with Georgia Tech to enhance resource assessment at two sites (Camp Edwards MA, Cape May NJ).



## Assessment Mechanisms:

- The database underlying National Renewable Energy Laboratory's (NREL's) MHK Atlas was used for high level resource assessment
- Georgia Tech's site-specific bathymetric tidal analyses drilled down to better explain the difference micro-siting will make for these technologies



## **Development of Assessment Mechanisms:**

Developed a scoring mechanism and weighting system that is transparent and adjustable. As project cost factors or distance limitations become better quantified, adjustments can be made to better reflect the differences in mission or operations. It can serve as template for future DOD MHK evaluation.

Results include:

- Conducted resource assessment for tidal and wave energy potential within five miles of DOD bases
- Developed transparent, weighted scoring metric for range of resource and siting factors
- Ranked DOD bases by branch based on resource and siting factors
- Completed and delivered summary table of scoring factors and results
- Solicited load data and general feasibility assessment from each DOD branch for the top MHK resource sites and then re-ranked the sites

## Development of Assessment Mechanisms (cont.):

- In conjunction with the DOD RE leads, two sites were down-selected for site specific bathymetric analyses and site visits
- One bathymetric analysis is complete, the second in its final stages
- DOD branches are more aware and better informed on the difference between tidal and wave resources and general thresholds required for deployability
- DOD branches are more aware and better informed on current state of MHK technology development and the differences within tidal and wave technologies
- DOD will use knowledge gained from the site visits and the final report to enhance energy security and resiliency planning at coastal bases
- DOD is more aware of MHK potential for powering remote island bases

## Assessment Results:

- In collaboration with DOD RE Leads, reviewed operational details of top-scoring bases to down-selected to one USCG and one Army base for site visit and bathymetric analyses:
  - Cape May, NJ (USCG)
  - Camp Edwards, MA (Army)
- Georgia Tech has completed one site-specific bathymetric analysis and will complete the second before the site visit
- Identified need for educating DOD on technology readiness and potential mission benefits and impact

- **FY14:**
  - Auxiliary research for Navy MHK Report identified DOD MHK resources
  - Resulted in planning for subsequent DOD MHK investigation
  
- **FY 15:**
  - Completed tidal and wave database resource screening:
    - Developed scoring equations
    - Identified DOD RE leads, explained project objectives and goals
    - Delivered scoring summary
  
- **FY 16:**
  - Requested DOD assistance in load estimates at bases, narrow to site selection. Very slow response delayed subsequent actions significantly
  - Revised scoring and weighting, delivered visual report with scoring to aid site selection process
  - Contracted bathymetric analyses by Georgia Tech
  - USCG and Army sites have been down-selected
  - Site visits scheduled for week of January 9, 2017

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$0	\$0	\$176K	\$0	\$0	\$0

- 80% of funding has been costed to date
- **FY14:** As part of Navy MHK study, DOD MHK resources were identified for future study and analyses
- **FY15:** NREL GIS data analyses, DOD RE leads identification and project explanation, scoring mechanism development, initial findings summary, request DOD assistance with energy loads at bases, down-selecting sites (\$48k)
- **FY16:** Scoring equations and weighting revisions, findings revision, Georgia Tech subcontract, final site selection with DOD (\$82k)

## **Partners, Subcontractors, and Collaborators:**

Georgia Tech subcontracted to conduct site-specific bathymetric analyses identifying areas of stronger tidal flow. This type of analysis work provides training for Georgia Tech graduate students in the MHK field in state of the art numerical modeling techniques for tidal flow rates determination and resultant energy content.

## **Communications and Technology Transfer:**

- Delivered to DOD bases and RE leads branch-specific MHK resource investigation findings, site-specific analyses based on MHK Atlas data
- Site visits will help frame future site planning for bringing MHK power to shore and electrical system upgrades
- Final Report will provide DOD:
  - Update to current technology knowledge
  - Greater understanding of technology development stages
  - Awareness to include MHK in future base planning

## Impacts of MHK Investigation:

DOD had not been aware of current level of technology readiness, active research and development in resource assessment and technology development, or industry players.

DOD now sees potential for future benefits from MHK with USCG having a strong interest in developing a tidal or wave test facility.

- Energy security/resiliency are major thrusts in current energy planning – MHK may play a roll as technology develops
- Better understanding of benefits of considering MHK deployment areas/substations in long-term base operations planning
- Interested to better understand the potential cost savings and energy security aspects of MHK at remote island bases such as, Diego Garcia or the Marshall Islands as potential locations for MHK farms
- Site visit and final report informs DOD energy and facility planners and helps to set realistic frameworks for technology adoption in coming decades



## **FY17/Current Research:**

- Planning for site visits – conduct site visits in Jan FY17
- Complete the final report
- Review results with DOD RE leads
- Deliver report to Coast Guard, Army, and Air Force