SAND2011-6249C

DOE Reference Models

Rich Jepsen, SNL
September 5, 2011
EWTEC

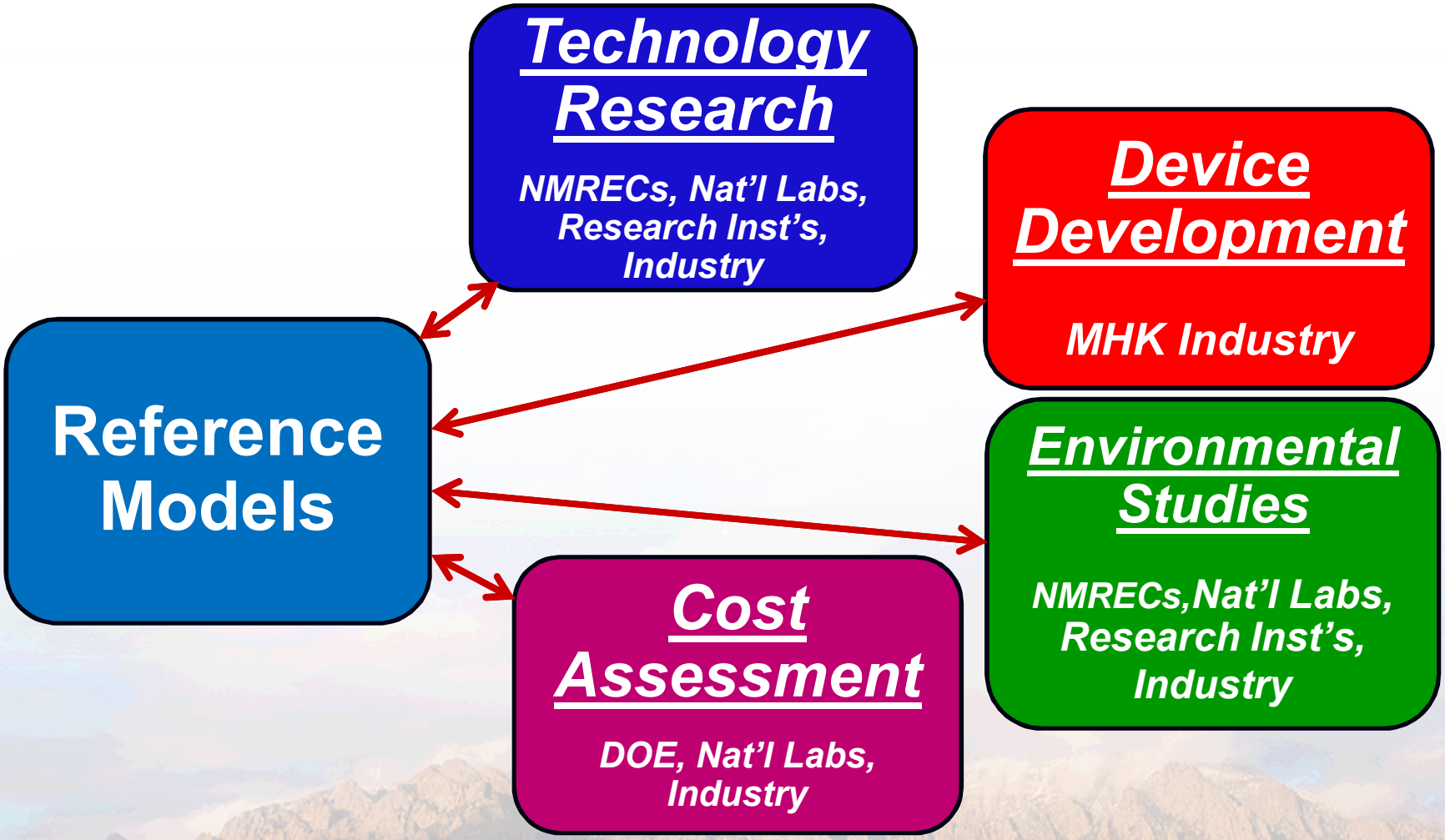
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Overall Goal and Motivation

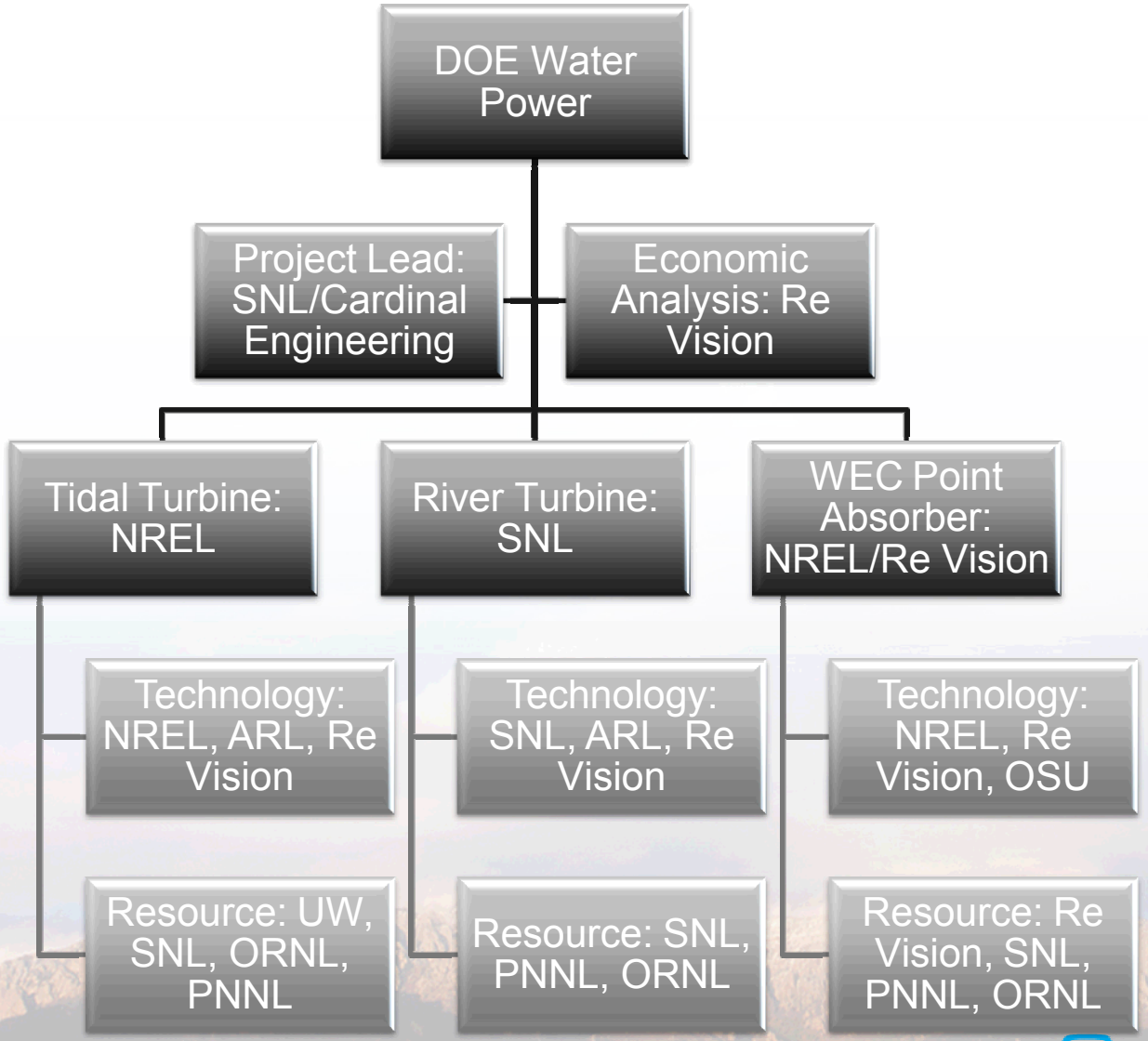
- **Goal:** Develop a representative set of Reference Models (RM) for the MHK industry to develop baseline cost of energy (COE) and evaluate key cost component/system reduction pathways.

- **Motivation:** Industry needs for COE targets with regard to technology type, and identify future innovation opportunities to prioritize research and cost reduction pathways
  - Promote and assist a vibrant and cost effective MHK industry
  - Develop and disseminate system design tools and/or MHK models for the development of advanced MHK designs (*DOE Goal – 10 platforms*)

Reference Models Integrate Program



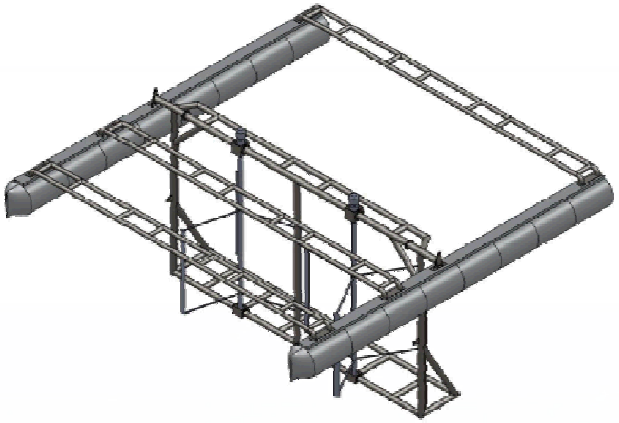
Project Team and Organization

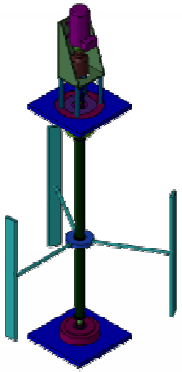


Making Measurable Progress

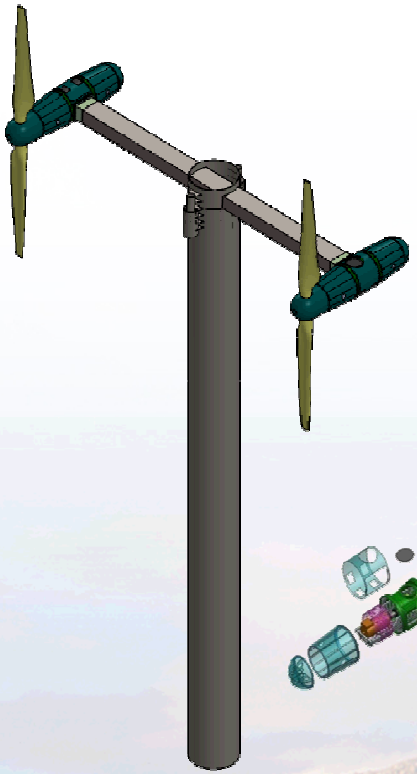
- **Although just begun in May 2010:**
  - Performance and cost results for 1st three models
  - Have demonstrated that a techno-enviro-economic model makes sense and can:
    - Provide a synergistic purpose
    - Suggest focal points for cost reduction
    - Create an ability to compare and contrast radically different devices
  - Design methods have been implemented and improved
    - NREL led workshops on modeling/analysis and test instrumentation
  - Generated interest among US developers, both to validate and improve performance and to act as a credential for investors
    - DOE-funded development leverages new data from device design and demonstration
  - Final reports for 1st three models scheduled for November 2011

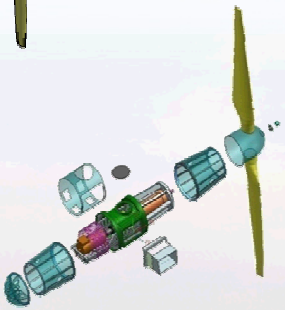
First Three Reference Models



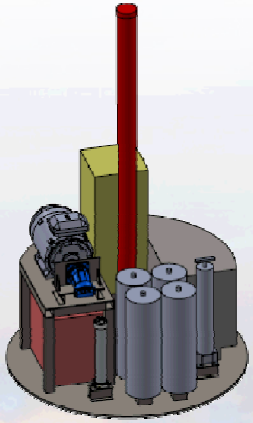


RM#2 River Turbine





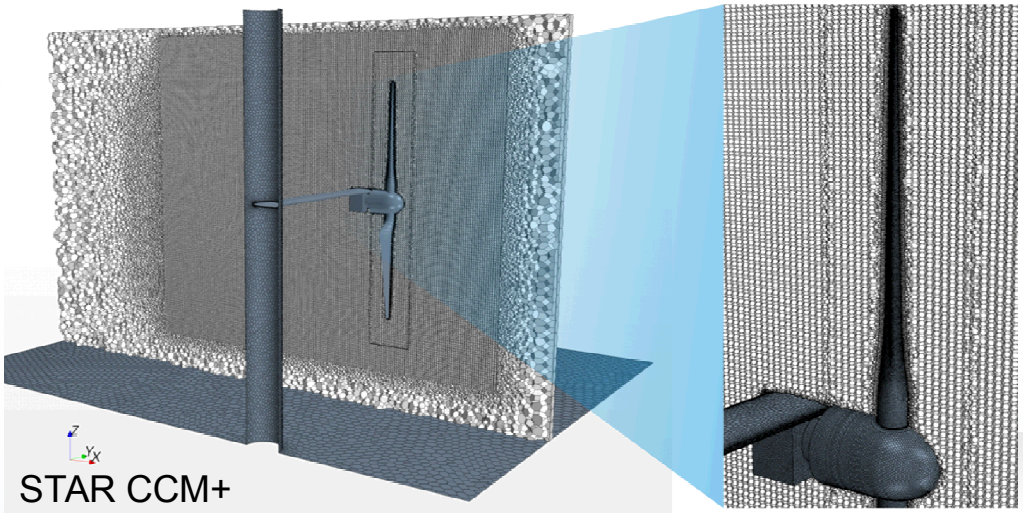
RM#1 Tidal Turbine

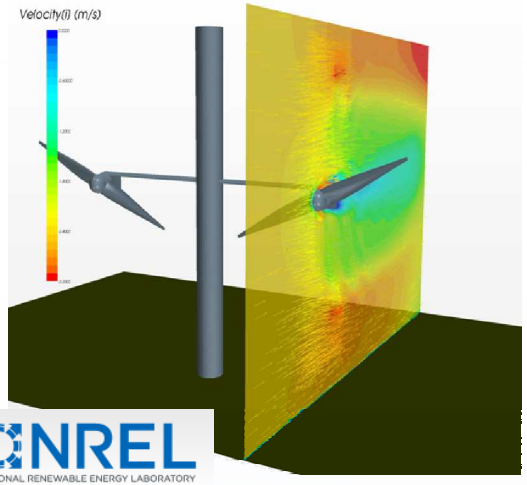


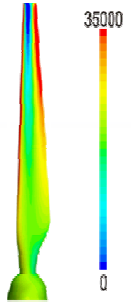
RM#3 WEC Point Absorber

Sandia National Laboratories

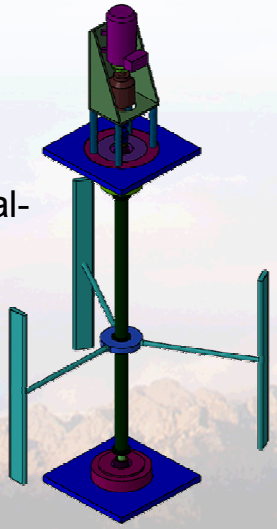
Development and Application of Analysis Tools



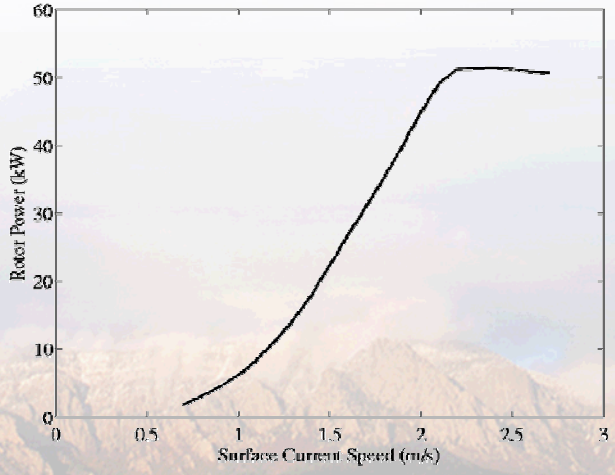




CACTUS (Code for the Analysis of Cross and axial-flow TUrbine Simulation)



Sandia National Laboratories

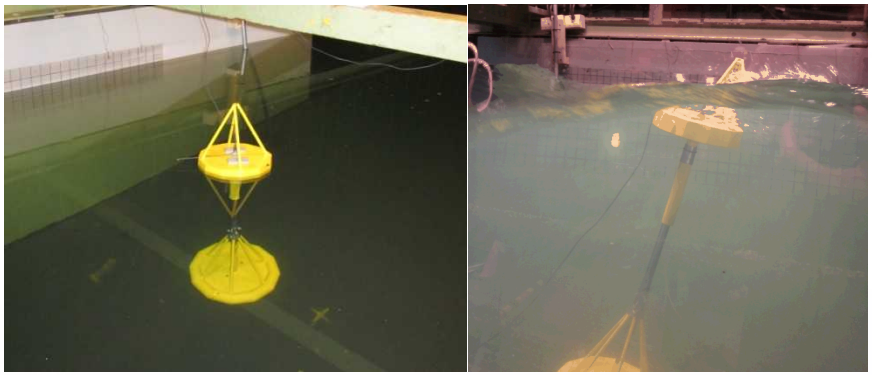


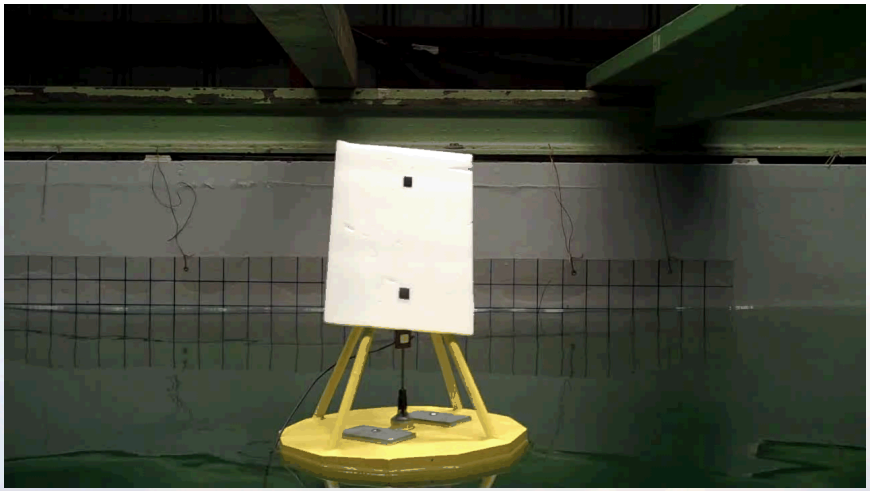
Sandia National Laboratories

Point Absorber Survivability: Tank Test & Analysis

UC Berkeley Wave Tank Test

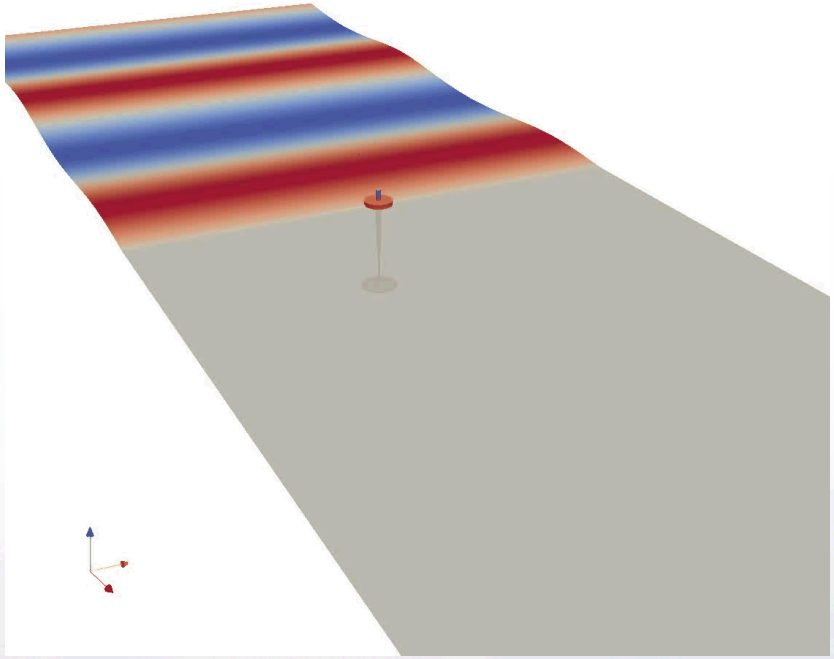
(H=2m to H=20m)





Wave height H=6 m & wave period
T=10sec (full scale)

CFD simulation – *NREL*- STAR CCM

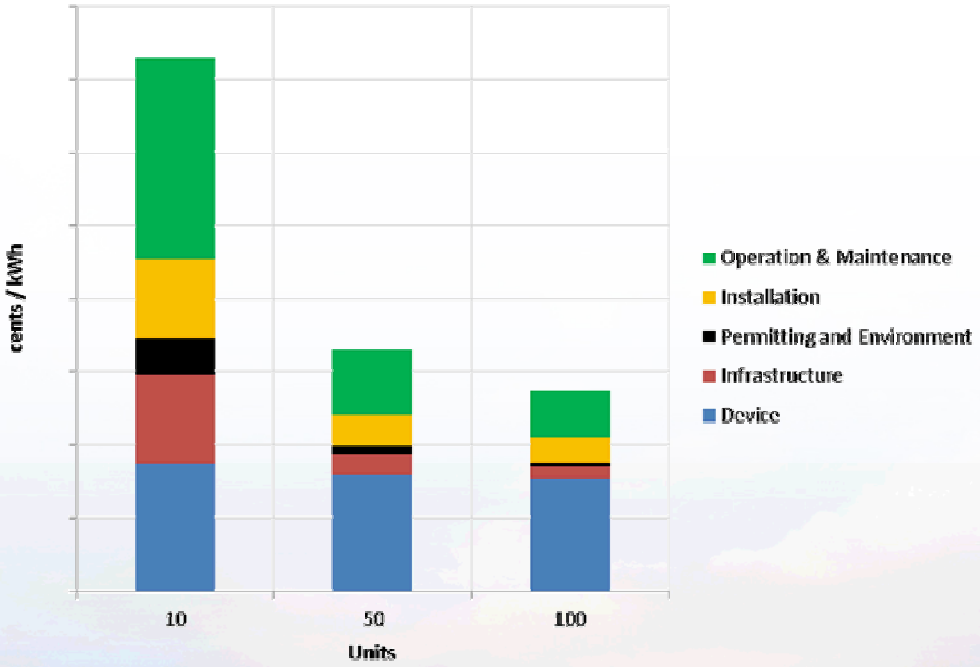


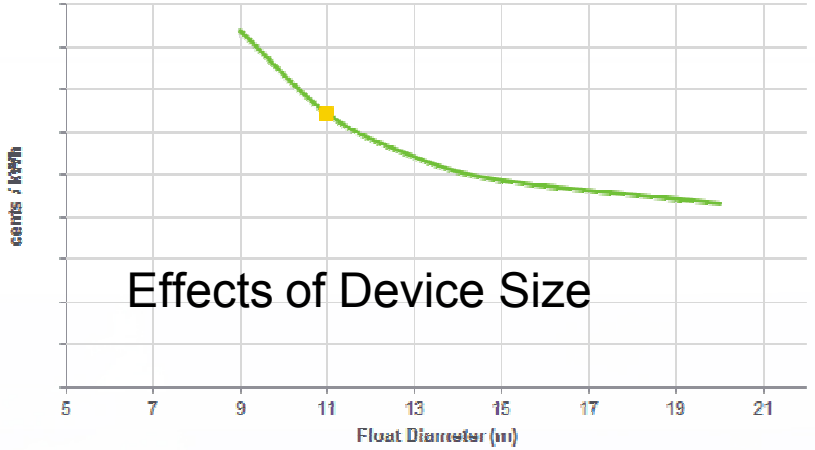
- 5th-order Stokes waves
- wave height H=4 m; wave period T=10sec)

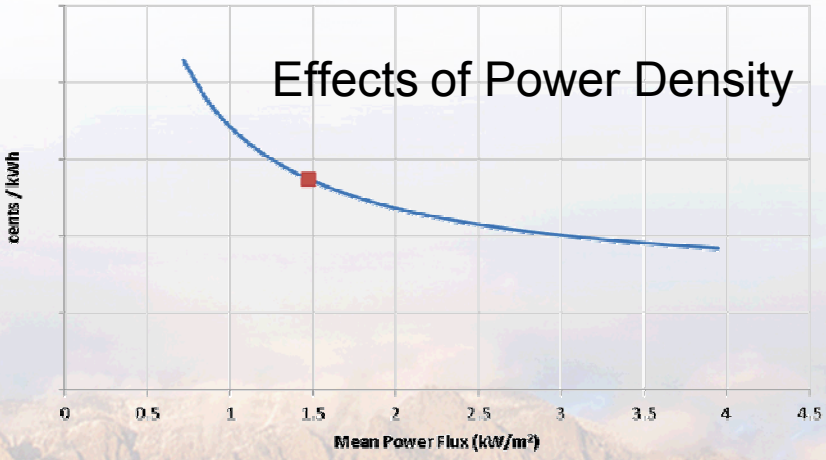
Sandia National Laboratories

Impact on COE

Cost Drivers







Sandia National Laboratories

- **Accomplishments**
  - Validation testing for WEC model
  - Preliminary report on first three models
    - Includes performance and COE estimates
    - Already demonstrating areas for future improvements/investments
- **Upcoming Milestones and Products**
  - Final Report for Version 1 of first three models (Sept. 2011)
  - Initiated designs and concepts for next three models (2 WECs and 1 Turbine) due at end of FY12