Ports generating energy or serving as a utility

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WHO IS NREL?

National Renewable Energy Laboratory (NREL)

• World-class facilities
• Nearly 1,700 employees, 500+ contingent staff
• Campus is a model of sustainable energy
• ~650 active partnerships with industry, academia, and government
• Operated for DOE by the Alliance for Sustainable Energy LLC (owned by Battelle and MRIGlobal)
Unique assets for energy system integration R&D, testing, and analysis at various scales

- MW scale Power Hardware in the Loop testing
- Penta-scale HPC
- Virtual utility operations center and visualization center
The existing U.S. power system has served us well...

*but our 21st Century economy needs a 21st Century grid.*

Source: EPRI, 2009
THE GRID OF THE FUTURE

Generation

Delivery

Prosumer

Source: EPRI, 2009
Navy Experience

- Procurement of 1GW of Renewable Energy; Energy Security
- Evaluation of 70 installations worldwide

Nationally recognized energy advisor to US Navy
PORTS – Strategic Focus

Leverage US Navy knowledge base

- Bring experience to Ports due to similarities
  - Efficient movement
  - Energy security, resiliency
  - Energy intensive

- Want to utilize Port findings for further advancement of Navy efforts
Threats

Physical Security

Cyber Security

Extreme Events

Many considerations for Port energy needs
- Current/future load
- Asset management plan
- Reliability
- Emissions
- Infrastructure
- Resiliency
- Integration/Control
- Informational
Locational Demands/Requirements

Numerous Ports are located within Nonattainment Zones (exceeding Air Quality Standards)

Growing state/city air or clean energy requirements

DOE’s Clean Cities program advances the nation's economic, environmental, and energy security by supporting local actions to cut petroleum use in transportation
On-Site Generation

Advantages

• Lower energy cost vs utility
• Improved resiliency
• Greater control of energy mix
Microgrids - Miramar

- Primarily flight training and operations
  - Site: 14 MW peak, 5 MW min
  - Critical: 6 MW peak, 2.5 MW min
- SD & Miramar experienced an eight hour utility power outage in September 2011
  - Critical facilities lost power (backup generators failed to start, UPS batteries ran out, loss of communications, etc.)
  - Flights were grounded
  - Justification for a critical facilities microgrid became apparent
Energy Storage

Supporting DOE and industry to achieve energy storage targets for various applications

- **Battery Materials Synthesis and Processing**
  *(Higher energy density and stability)*

- **Component Testing and Characterization**
  *(Evaluate performance, life, and safety)*

- **Multi-physics Battery Modeling**
  *(Improve performance, life, and safety)*

- **Battery Management and Control**
  *(Improve utilization and life)*

- **Battery System Evaluation**
  *(Finding cost-effective pathways)*
Growth in loads

Shore Power
• Ship size, associated loads growing

Electrification
• Cranes, hostlers, etc

Growth in imports
• US containerized imports forecasted to grow 5.3% in 2016
100% Electric truck
• BMW/Terberg
• 62 mile range

Nikola One
• NG – Electric Hybrid
• 800 – 1,200 mile range

Diesel-Electric trains
• GE Evolution Tier 4 emissions
• NextFuel NG retrofit capability
City/Regional Collaboration
• Lower Air Emissions, Clean Energy, or Fresh water supply

State/Regional intermodal coordination
• CA (Fast lane), GA (Network Georgia), Northeast

Water Production
• Utilizing off-peak, excess renewable energy or as a DSM load