NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Ports generating energy or serving as a utility

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AAPA Environmental Committee Meeting

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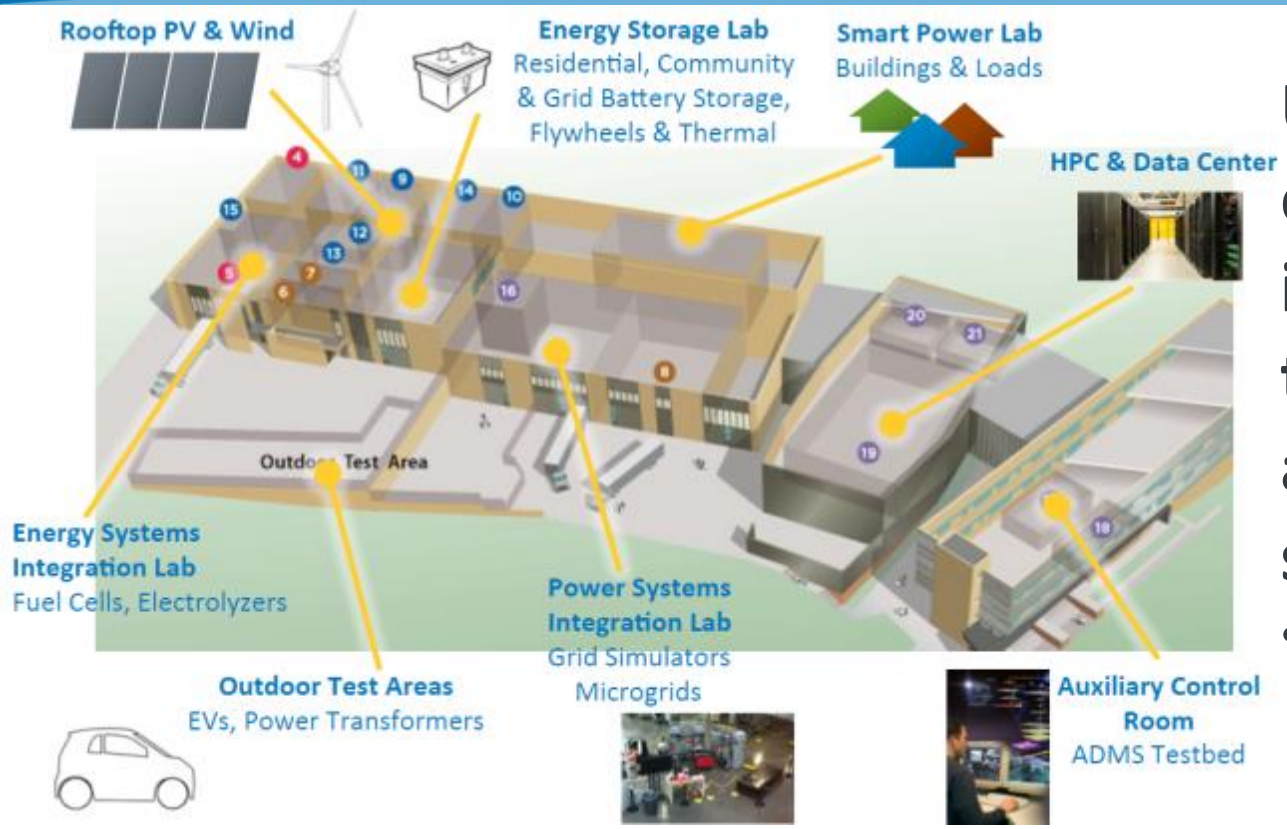
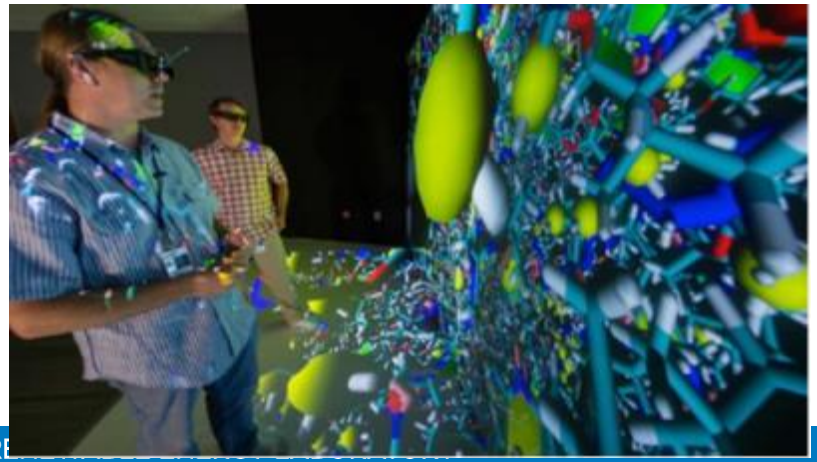
NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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)

NREL Capabilities





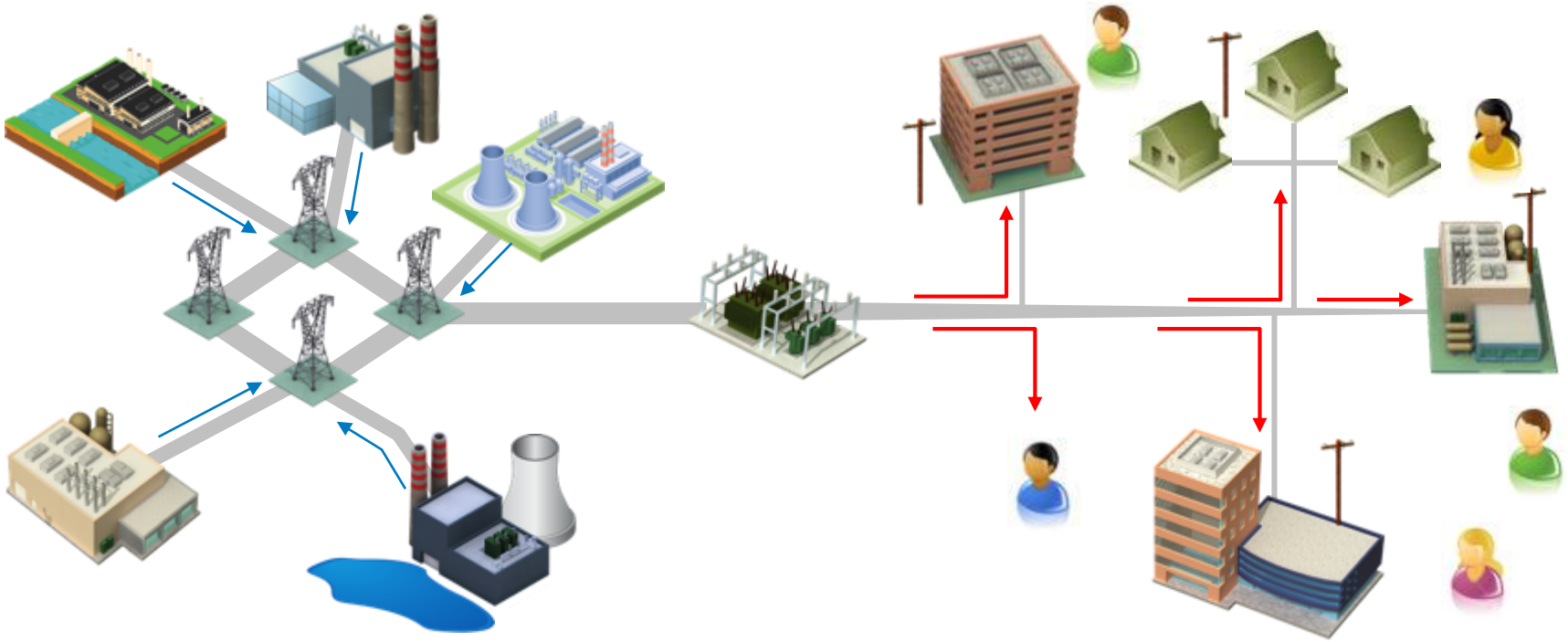
Unique assets for energy system integration R&D, testing, and analysis at various scales

- MW scale Power Hardware in the Loop testing
- Penta-scale HPC
- Virtual utility operations center and visualization center

THE GRID OF THE PAST

The existing U.S. power system has served us well…

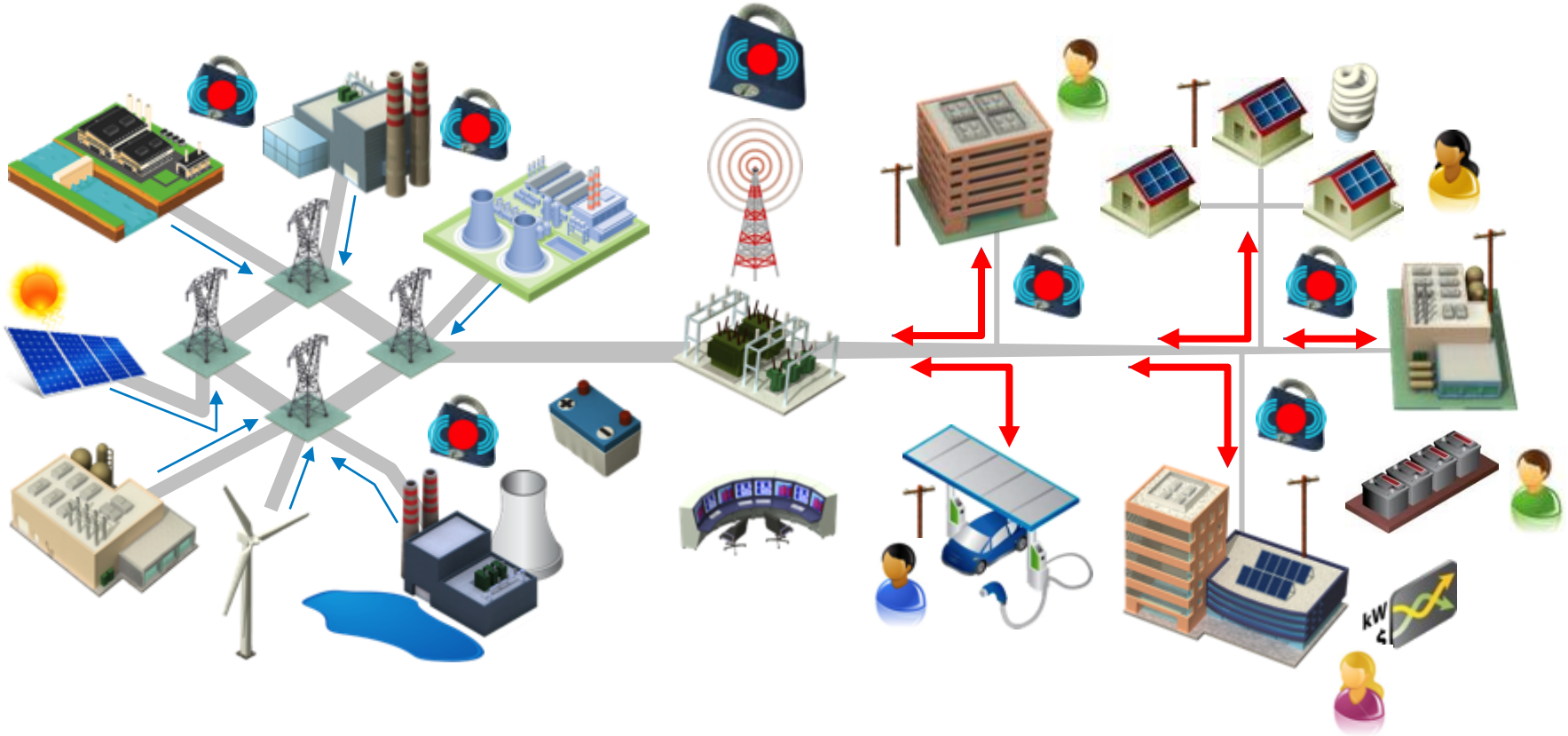
but our 21st Century economy needs a 21st Century grid.



Generation **Delivery** **Customer**

Source: EPRI, 2009

THE GRID OF THE FUTURE



Source: EPRI, 2009

Navy Experience

Nationally recognized energy advisor to US Navy

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

Screening → **Feasibility** → **Procurement** → **Commissioning**

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

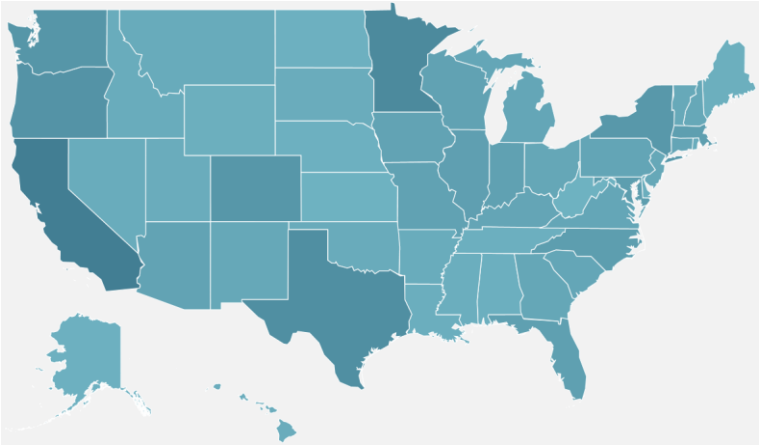
Physical Security

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)



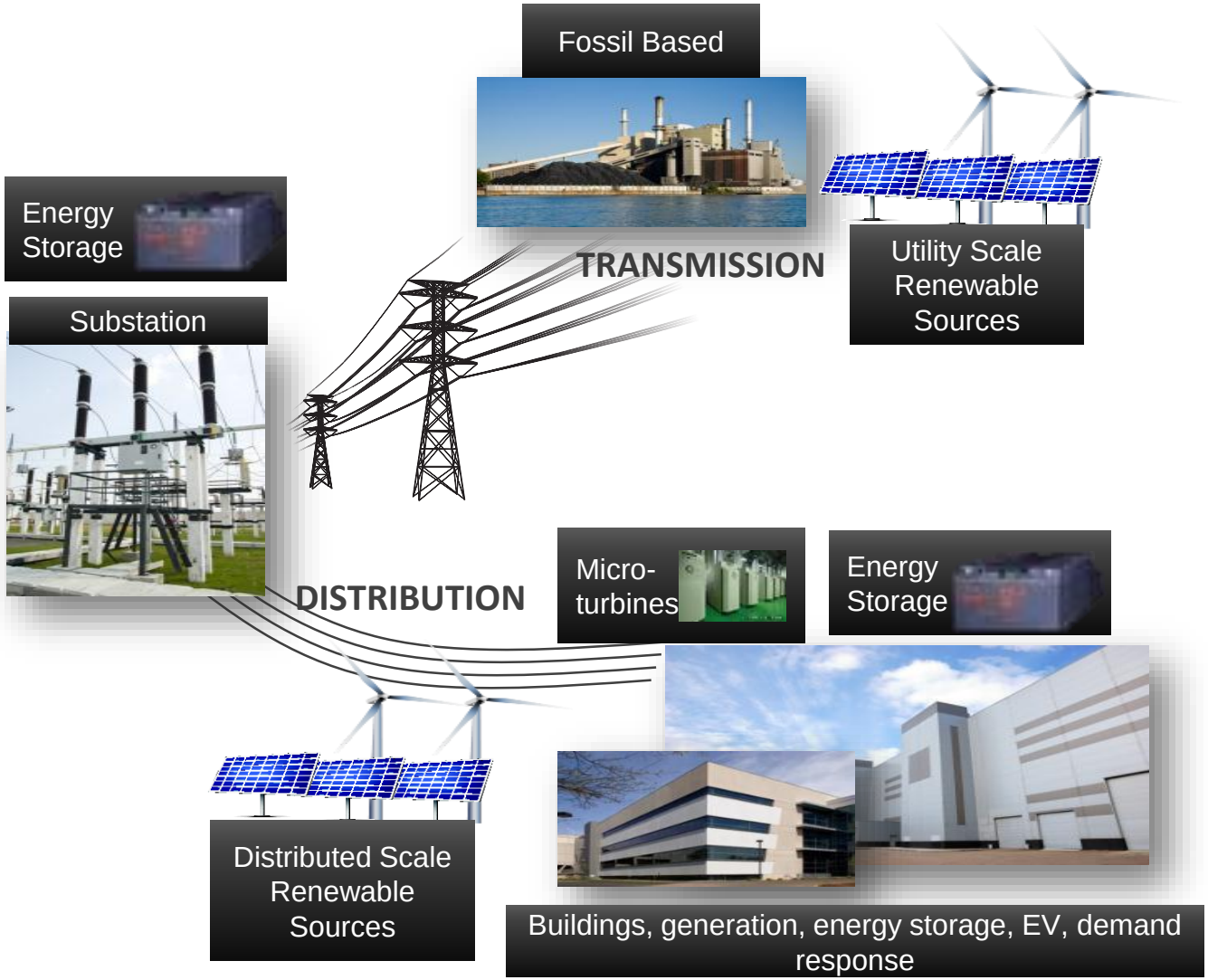
Growing state/city air or clean energy requirements

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

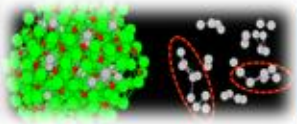


Microgrids - Miramar

- 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

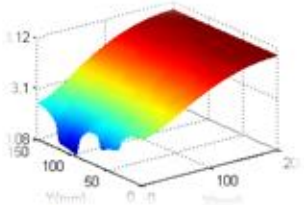
Energy Storage

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

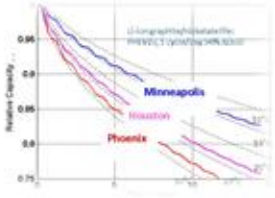


Battery Materials Synthesis and Processing
(Higher energy density and stability)

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

Energy – Transportation Nexus

100% Electric truck

- BMW/Terberg
- 62 mile range

Nikola One

- NG – Electric Hybrid
- 800 – 1,200 mile range

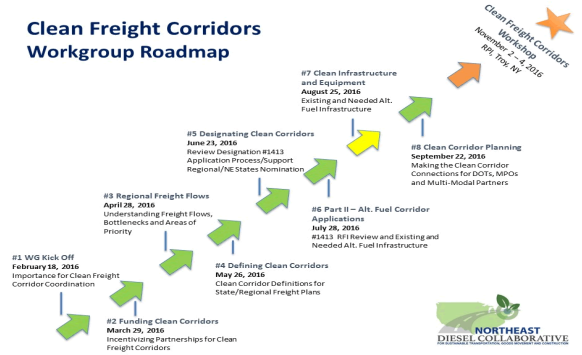
Diesel-Electric trains

- GE Evolution Tier 4 emissions
- NextFuel NG retrofit capability

Other Opportunities

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

Questions?

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