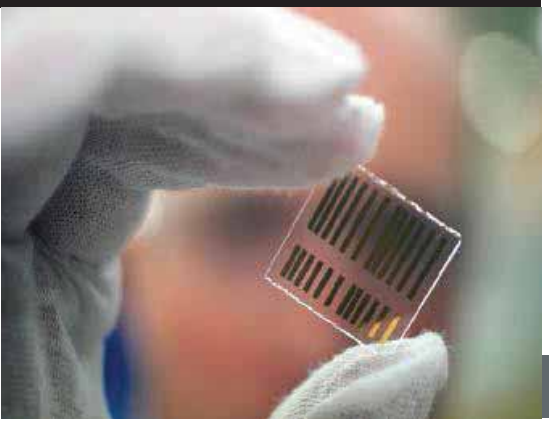
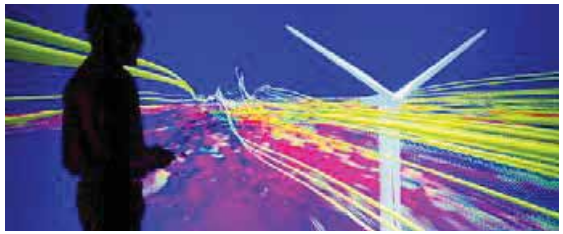
NREL
NATIONAL RENEWABLE ENERGY LABORATORY





Leading the Way to a Clean Energy Future

Michael Callahan

May 24, 2016

Hawaii Clean Energy Study Tour

Laboratory Snapshot

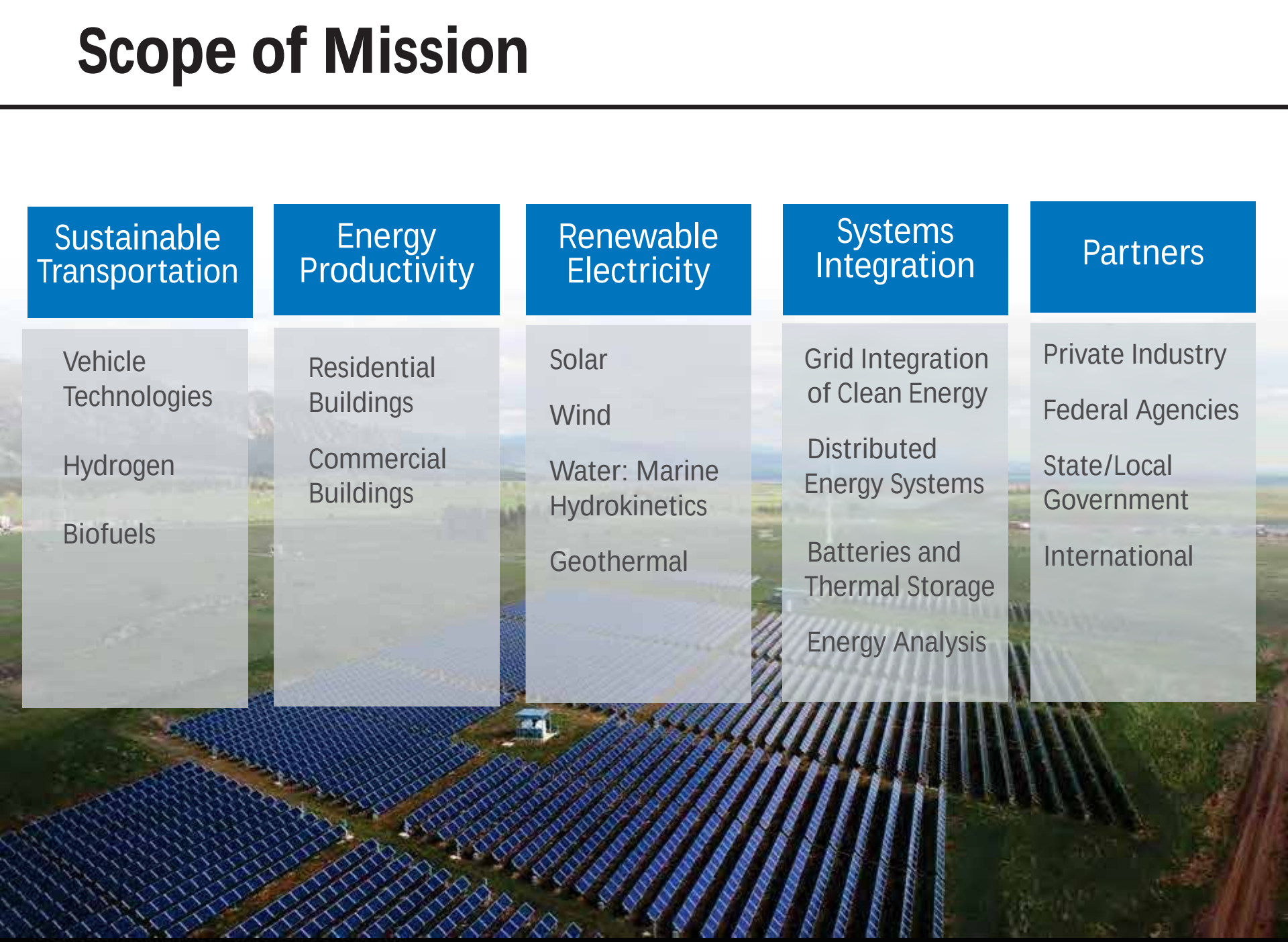
Only National Laboratory Dedicated Solely to Energy Efficiency and Renewable Energy

- Leading clean-energy innovation
- 37 years
- 1,763 employees with world-class facilities
- Campus is a living model of sustainable energy
- Owned by the Department of Energy
- Operated by the Alliance for Sustainable Energy

NREL's Energy Vision

A clean, resilient and reliable energy system that contributes to economic prosperity, national security, and environmental quality.

Scope of Mission

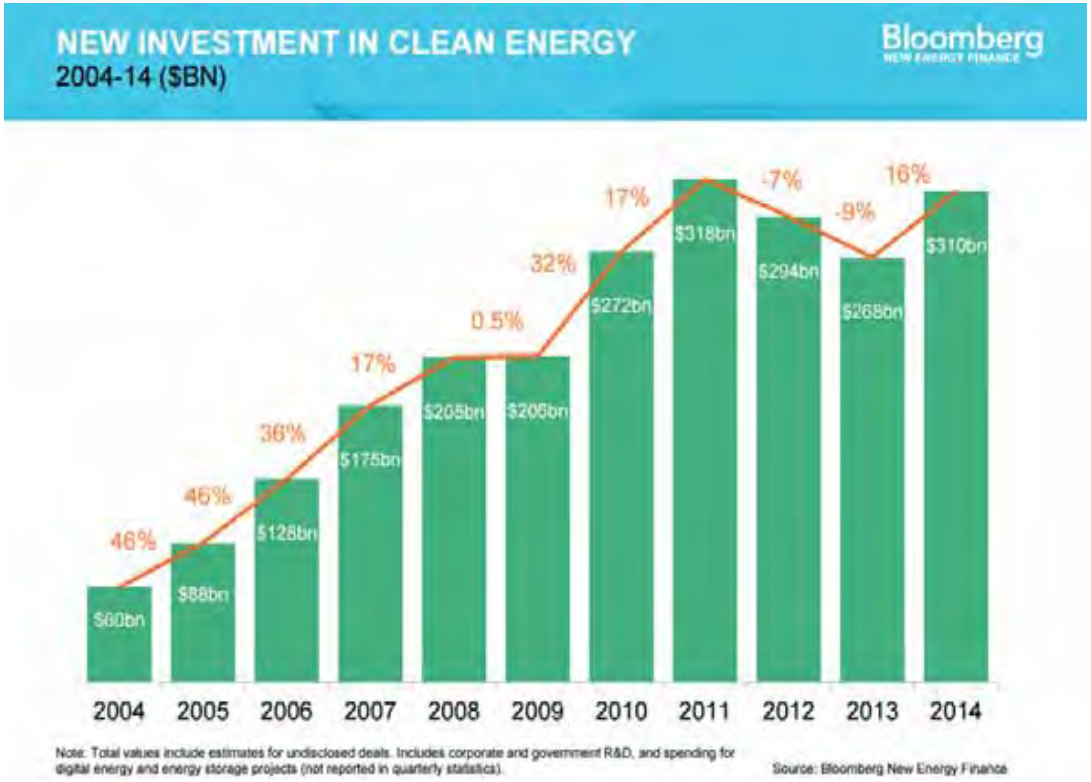


Sustainable Transportation	Energy Productivity	Renewable Electricity	Systems Integration	Partners
Vehicle Technologies	Residential Buildings	Solar	Grid Integration of Clean Energy	Private Industry
Hydrogen	Commercial Buildings	Wind	Distributed Energy Systems	Federal Agencies
Biofuels		Water: Marine Hydrokinetics	Batteries and Thermal Storage	State/Local Government
		Geothermal	Energy Analysis	International

Challenges to Success

Energy Market Barriers

- Inconsistent public policy
- Outdated infrastructure
- Lack of knowledge
- Limited private investment
- Global renewable industry investment increased from 2013 to 2014



NREL's Solutions Role

Reducing Investment Risk

- Integrating technology at scale
- Enabling basic and applied clean energy technology innovation
- Accelerating technology market introduction and adoption
- Encouraging collaboration in unique research and testing partnering facilities
- Providing analysis and expertise to inform decisions and catalyze market adoption

Commercial Partnerships

Updated: May 2015

Energy Systems Integration Facility

- NREL's Energy Systems Integration Facility (ESIF) integrates electric, thermal, and fuel systems with high-performance modeling and simulation capabilities
- The ESIF's world-class laboratories offer megawatt-scale hardware-in-the-loop testing with actual or simulated electrical devices, a supervisory control and data acquisition system, and unique analysis and visualization tools
- Energy systems integration brings together the wide range of energy carriers—electricity, thermal sources, and fuels—with other infrastructures, such as water and transportation, to work together optimally

Analyses, Models, and Tools

- NREL analyzed high penetrations of renewable energy in the eastern and western U.S. power grids for benefits, impacts, and mitigation strategies
- For solar photovoltaic manufacturing, NREL modeling tools identify cost improvements and assess competitive advantages
- The OpenEI website links and shares energy data worldwide
- NREL's System Advisor Model determines the economic value of proposed solar, wind, and geothermal projects

Innovation for the Future

Integrating/Upgrading Energy Systems

- Grid modernization through integration of energy systems at all scales
- Innovation today for the smart homes of tomorrow

Advancing DOE's SunShot Solar Initiative

- Reduce the cost of solar energy systems to 6 cents per kWh by 2020
- Cost competitive without subsidies to enable large-scale adoption across the US

Achieving Scientific Breakthroughs

- Improving Efficiency in Bio-based Hydrocarbon Fuels – NREL scientists discover effect of catalyst structure for producing significant amounts of hydrocarbon fuels
- Water Power Software Makes a Splash – Open-source software provides essential modeling and simulation for water power research and development
- Semiautomated Truck Platooning – NREL study finds platooning of long-haul trucks reduces fuel consumption at all tested highway speeds

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For more than 37 years, NREL has delivered innovation impact enabling the emergence of the U.S. clean energy industry.

For more information please visit our website at
www.nrel.gov.