



The Energy Revolution and Earth Science Applications

Panel on “The Next Decade in Earth Science and Applications”

57th Annual Robert H. Goddard Memorial Symposium

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Mission: NREL advances the science and engineering of energy efficiency, sustainable transportation, and renewable power technologies and provides the knowledge to integrate and optimize energy systems.

Example Technology Areas:



- 1800 employees, plus 400 postdoctoral researchers, interns, visiting professionals
- 327-acre campus in Golden & 305-acre National Wind Technology Center 13 miles north
- 61 R&D 100 awards. More than 1000 scientific and technical materials published annually

www.nrel.gov/about

Clean Energy Is Diverse

WIND

Onshore



Offshore



GEOTHERMAL



Images from <https://images.nrel.gov/>

SOLAR PV

Distributed & Micro Grids



Utility Grid Connected



CONCENTRATING SOLAR



HYDROPOWER

Large & Small



Wave & Tidal



BATTERIES & STORAGE



BIOMASS & WASTE



HYDROGEN & GAS

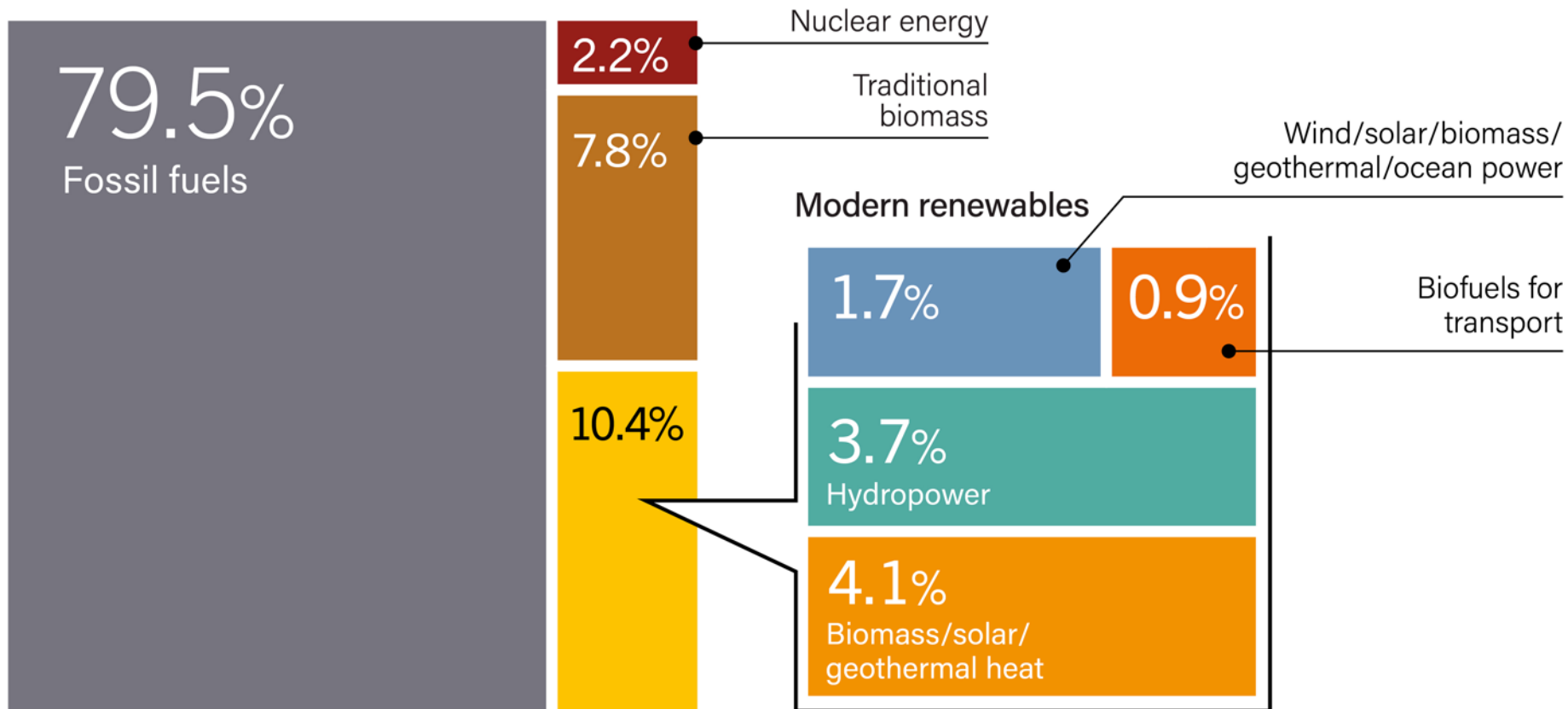


EFFICIENCY & HEAT USE



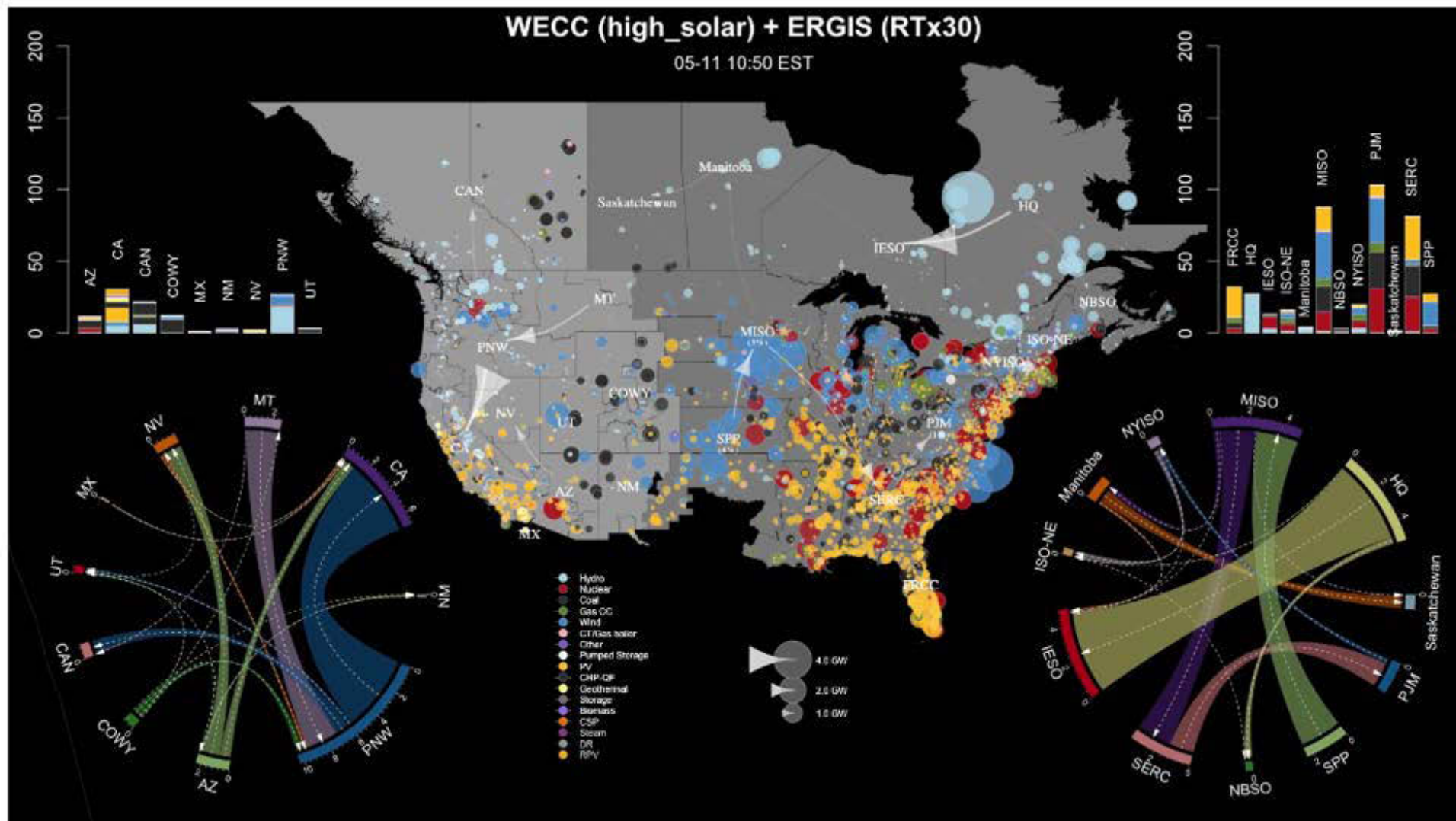
Global growth of renewables in all sectors

Estimated Renewable Share of Total Final Energy Consumption, 2016

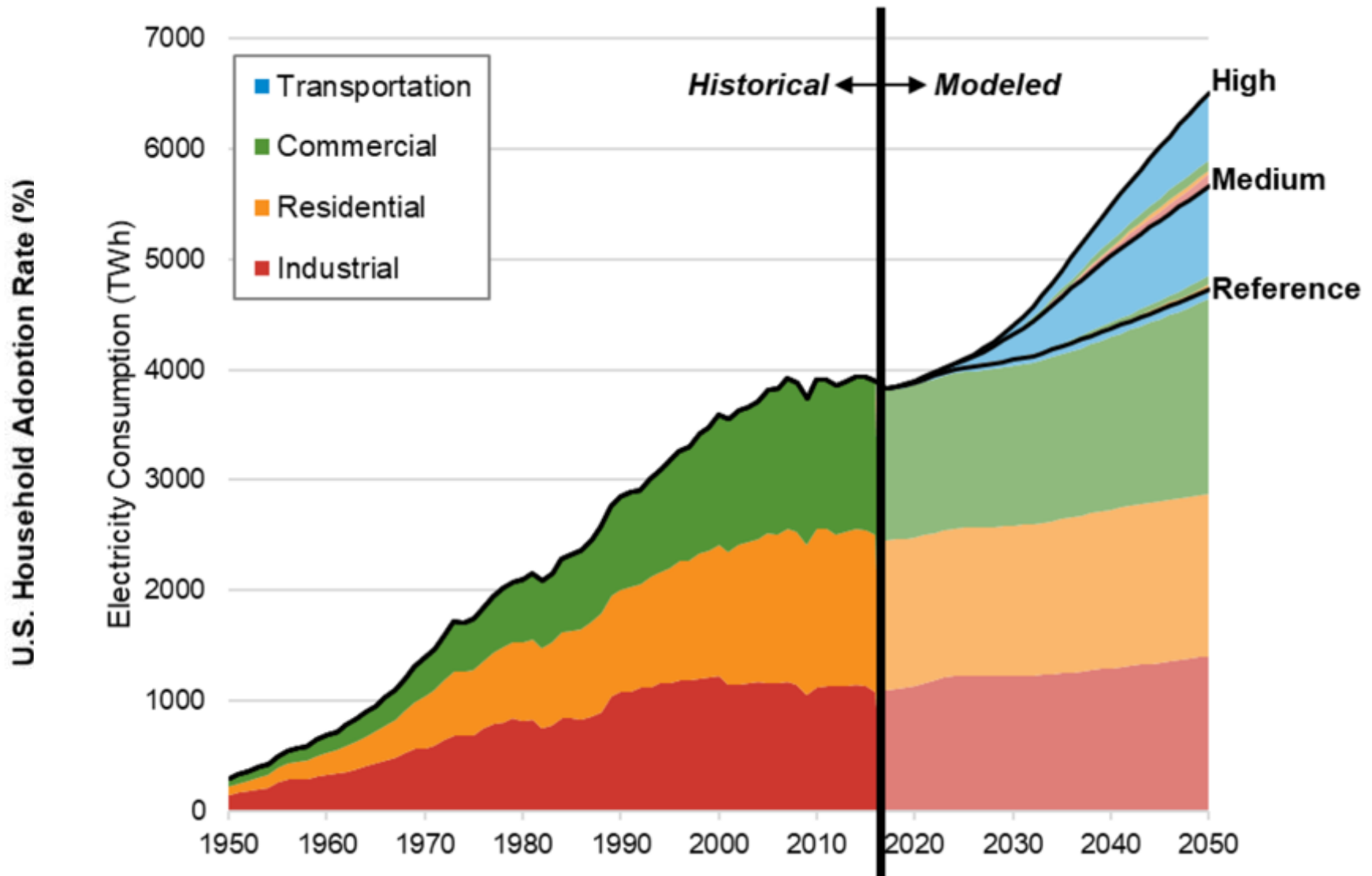


Detailed grid modeling to evaluate scenario feasibility

Interconnection Study, <https://youtu.be/YcgvGe2sN8Y>



Electrification Futures Study

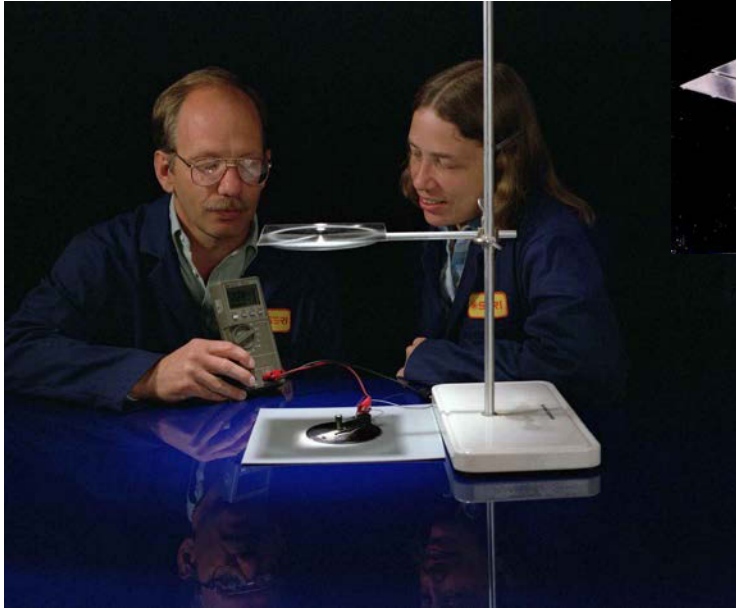


All Figures from NREL's Electrification Futures Study: www.nrel.gov/efs

Energy-Water-Food Nexus



NASA has long history of collaboration with NREL for advanced energy technology development



Current work to develop better and safer batteries



Early work to develop high-efficiency thin film solar cells for satellites and space missions

NREL, NASA, and UCL Team Up to Make Lithium-Ion Batteries Safer on Earth and in Space

April 25, 2017

NREL's [energy storage](#) team has teamed up with the National Aeronautics and Space Administration (NASA) and University College London (UCL) for a cutting-edge study on lithium-ion (Li-ion) battery failure right down to the cell level, using the lab's newly patented, R&D Award-winning Battery [Internal Short Circuit \(ISC\) Device](#). A clear, in-depth understanding of what causes destructive, internal short circuits will set the stage for improved manufacturing processes to make these popular batteries safer in all applications.

Because Li-ion batteries are lightweight and have a high storage capacity, they are ideal for use in everything from home electronics, including cell phones and laptops, to electric drive vehicles (EDVs), to technology used by NASA for space travel. However, safety risks can be posed by their potential to overheat and go into thermal runaway, which can result in fire, and in rare cases, explosions. Although catastrophic failure is extremely rare, recent high-profile cases, including the recall of Samsung's Galaxy Note 7 smartphone line and the grounding of an aircraft fleet, highlight why it's important to understand battery failure.

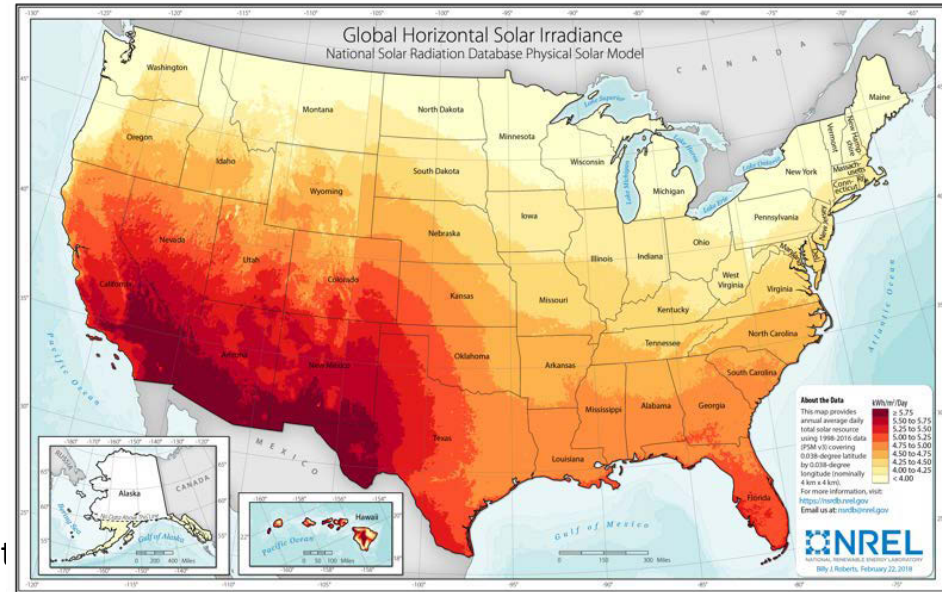


Space explorers' very lives depend on the reliability of Li-ion batteries used to power everything from communications systems to lights and breathing apparatus. NREL joined forces with NASA in finding new, more precise ways to trigger internal short circuits, predict reactions, and establish safeguards in the design of battery cells and packs.
Photo courtesy of NASA

NASA Earth Science supports renewable energy resources.. and we could do more!

NASA systems and models can (already) help with:

- Identification quantity of resources
- Siting generation facilities
- Planning and optimizing production
- Provide data on:
 - Solar radiation and angle
 - Meteorology data, e.g., wind speed, cloud cover, aerosols, rainfall
 - Surface properties, e.g., vegetation, soil type, surface temps, soil moist
 - Reservoir height and water availability



New ideas for Earth science applications to energy:

- Linking global climate scenarios and regional energy production models
- City-rural scale infrastructure planning scenarios
- Small-scale predictions of multi-sector disasters that affect energy-water-food
- Others to discuss!



Questions and Discussion

Thank you!

Disclaimer

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