Renewable Technology for the Future

Jill Engel-Cox, Ph.D.,
Director, Joint Institute for Strategic Energy Analysis
U.S. National Renewable Energy Laboratory

G20 Workshop on Global Circular Carbon Economy
Session 2: Opportunities and Economics in Non-Biomass Renewables
Riyadh, Saudi Arabia
5 March 2020
Energy Supply is Shifting

In U.S., renewable energy—not including hydropower—currently produces 10% of the total electricity generation. Within the next two years, this is expected to grow to 13%.

With hydropower, renewable energy is 17%.

With nuclear (19%), U.S. low-carbon electricity is 36%.

Energy Supply is Shifting.... with some places faster than others

California now generates 19% of its total electricity generation from solar photovoltaics.

Five U.S. states generated over 20% from wind power.

Many countries have similar high renewable power generation rates.
Changing climate and energy mix requires resilience

- Countries that traditionally rely heavily on large hydropower face increasing risk and reliability concerns during El Niño and La Niña hydrological phases.
- Rainfall and snowmelt patterns are changing, making hydropower resources more unpredictable, variable.
- Aging infrastructure susceptible to a variety of hazards.

Source: JISEA, [https://www.nrel.gov/docs/fy20osti/75467.pdf](https://www.nrel.gov/docs/fy20osti/75467.pdf)
All renewable energy technologies have a role

- Wind: Onshore, Offshore
- Solar PV: Distributed & Micro Grids, Utility Grid Connected
- Hydropower: Large & Small, Wave & Tidal
- Biomass & Waste
- Hydrogen & Gas
- Geothermal
- Concentrating Solar
- Batteries & Storage
- Efficiency & Heat

Images from https://images.nrel.gov/
Renewable technologies continue to advance

- **Biomass pyrolysis**: Simulations guiding optimization of reactions and catalysts to reduce cost of fuel production.
- **Perovskite PV materials**: Computations drive search for new perovskite-like materials, thin film, low cost, more stable, do not contain lead, tandem with Si.
- **Geothermal Energy**: Modeling subsurface to enable geothermal anywhere through development of Enhanced Geothermal Energy technology.
- **Wind energy**: Model wake fields in wind plants with realistic terrain to reduce cost; design larger turbines to access resource; advanced manufacturing.
- **Electric vehicles**: Multi-scale simulations of electric drive vehicle battery systems to create cutting-edge battery simulation tools.
- **Energy system integration**: Modeling interconnects at native spatial scales under different renewable penetration scenarios.
Use of Hydrogen @Scale for storage and fuel
Thermal-Renewable Hybrid Energy Systems

Raw materials and supply chains

Questions?
Thank you!

www.nrel.gov

NREL/PR-6A50- 76198

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the Joint Institute for Strategic Energy Analysis (JISEA). The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.