

Renewable Technology for the Future

Jill Engel-Cox, Ph.D.,

Director, Joint Institute for Strategic Energy Analysis
U.S. National Renewable Energy Laboratory

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Session 2: Opportunities and Economics in
Non-Biomass Renewables

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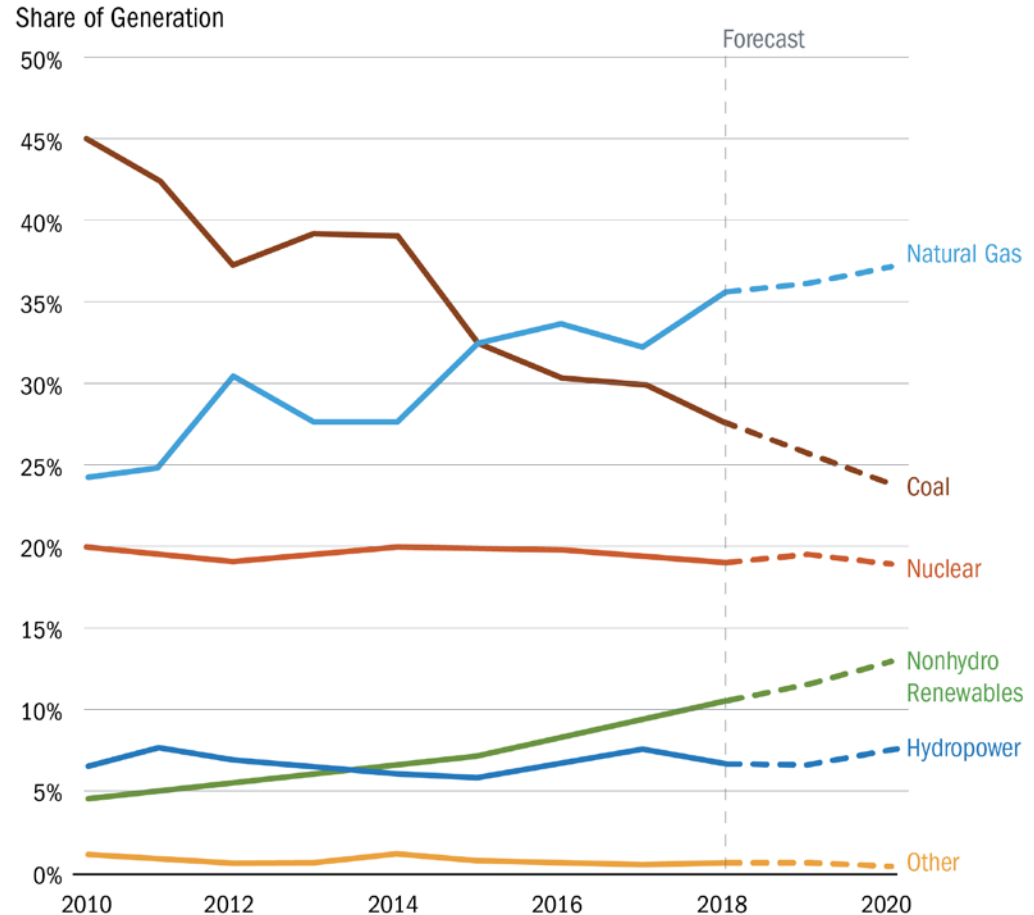
Energy Supply is Shifting

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%.

U.S. Electricity Generation by Energy Source (2010-2020)



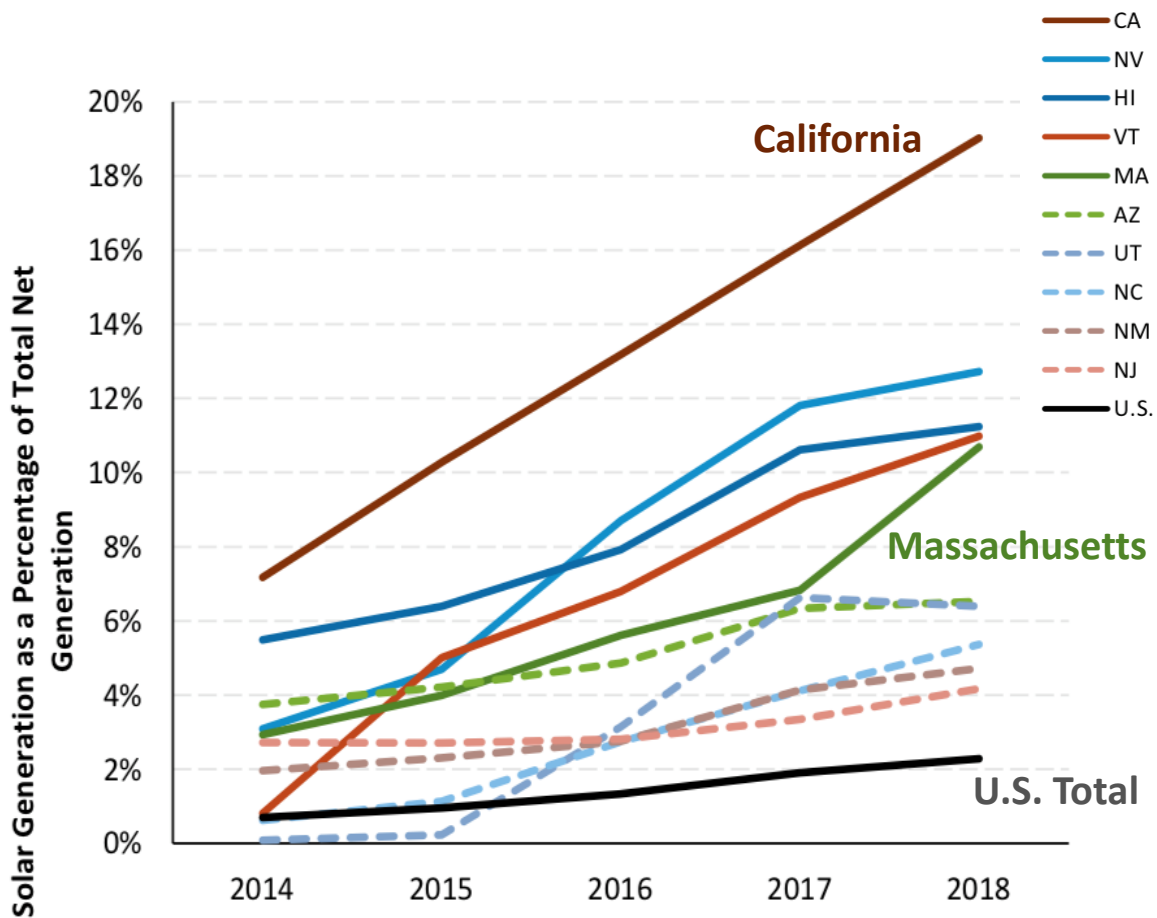
Source: United States Energy Information Agency, *Today in Energy*, 18 January 2019

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

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

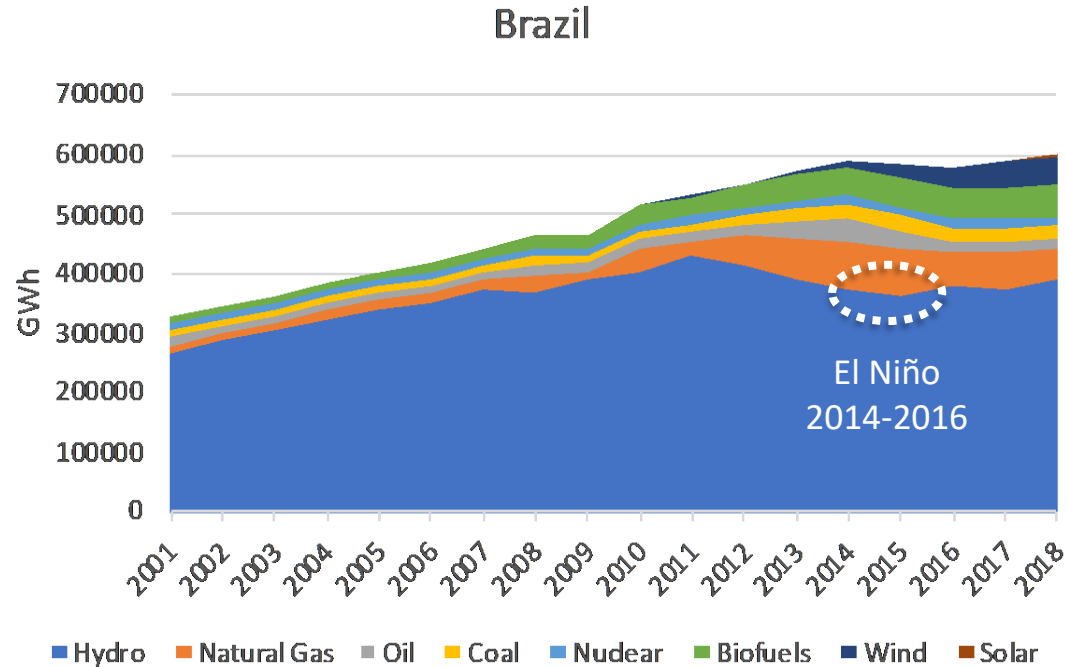
Five U.S. states generated over 20% from wind power.

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



All renewable energy technologies have a role

WIND
Onshore



Offshore



GEOHERMAL



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



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

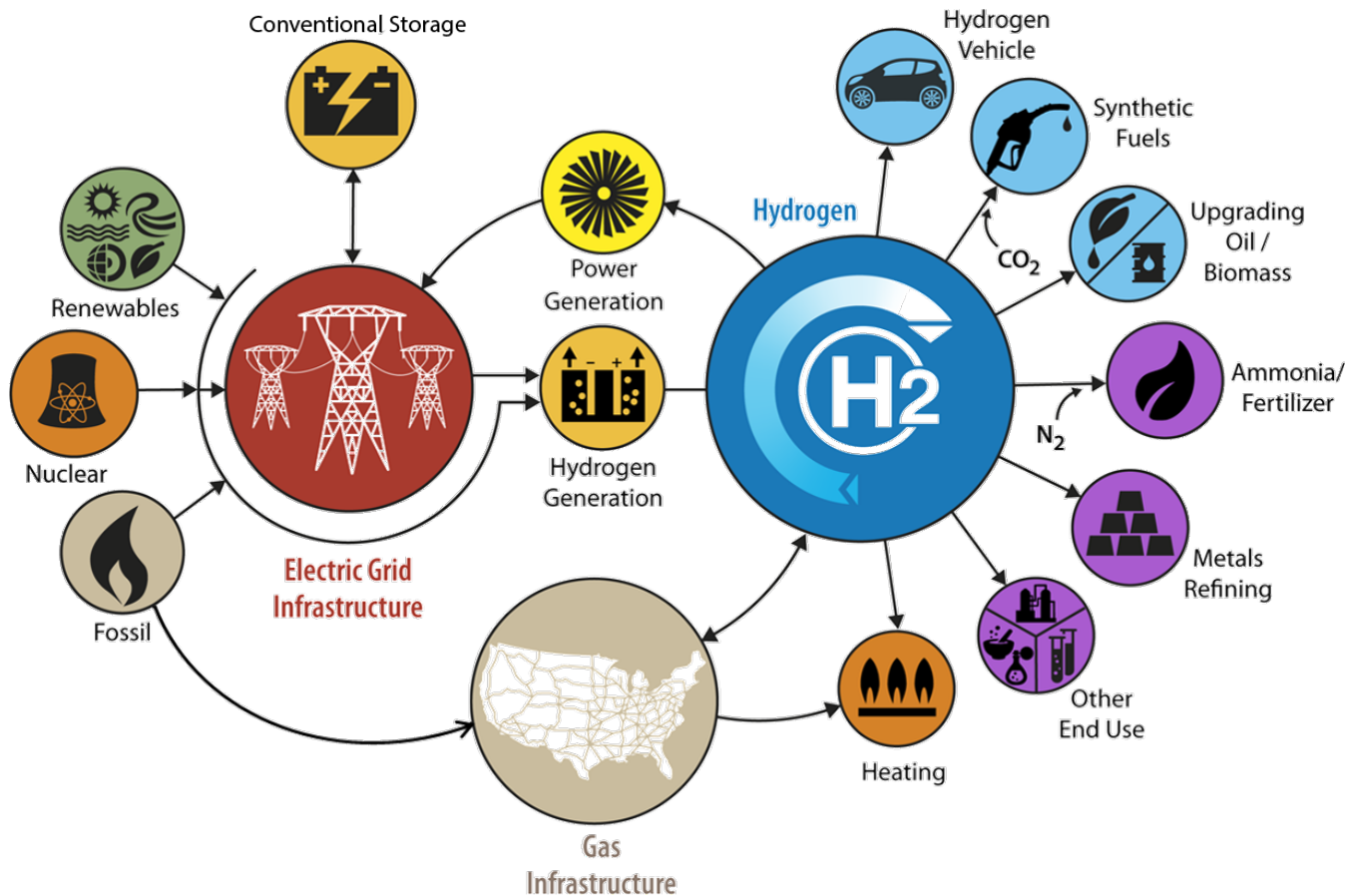
Multi-scale simulations of electric drive vehicle battery systems to create cutting-edge battery simulation tools



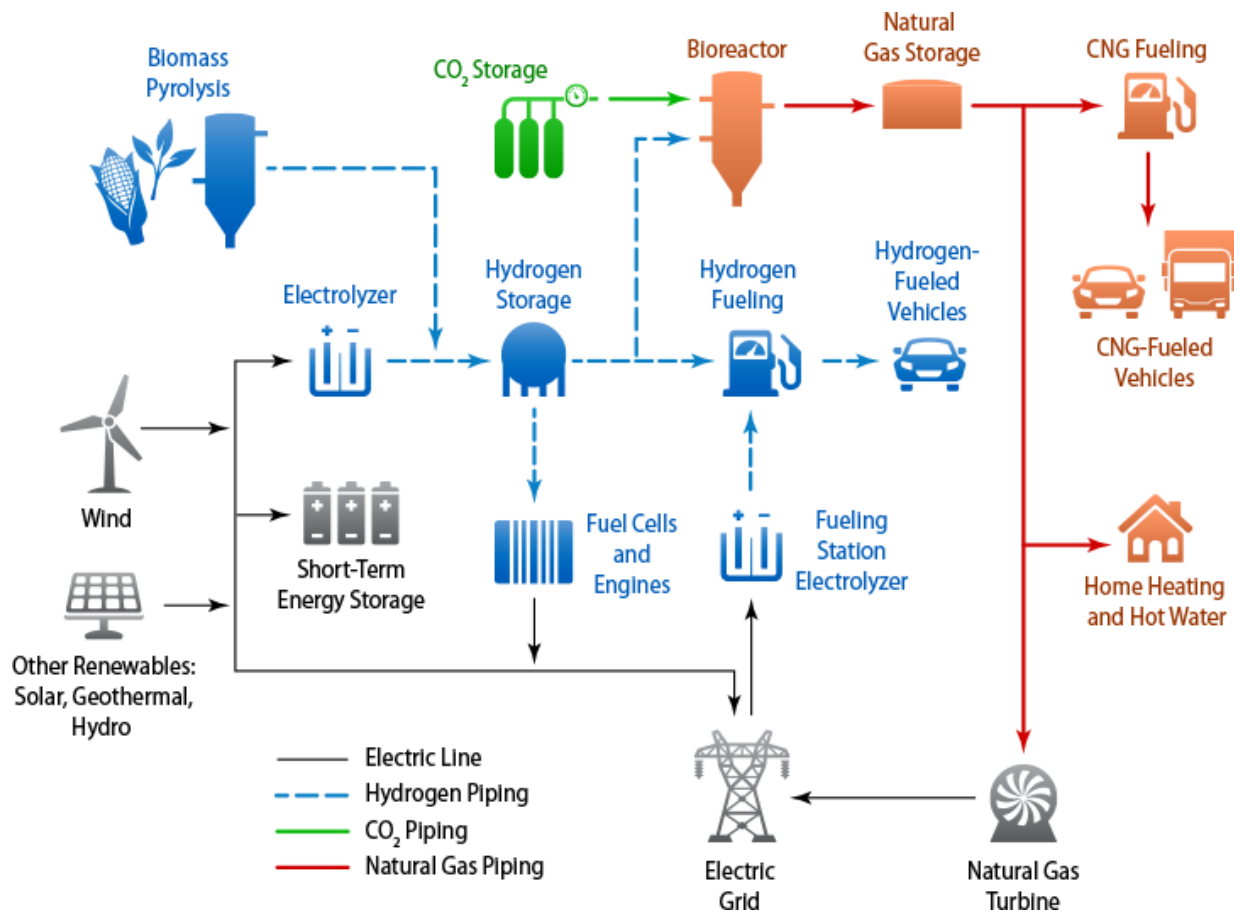
Energy system integration

Modeling interconnects at native spatial scales under different renewable penetration scenarios

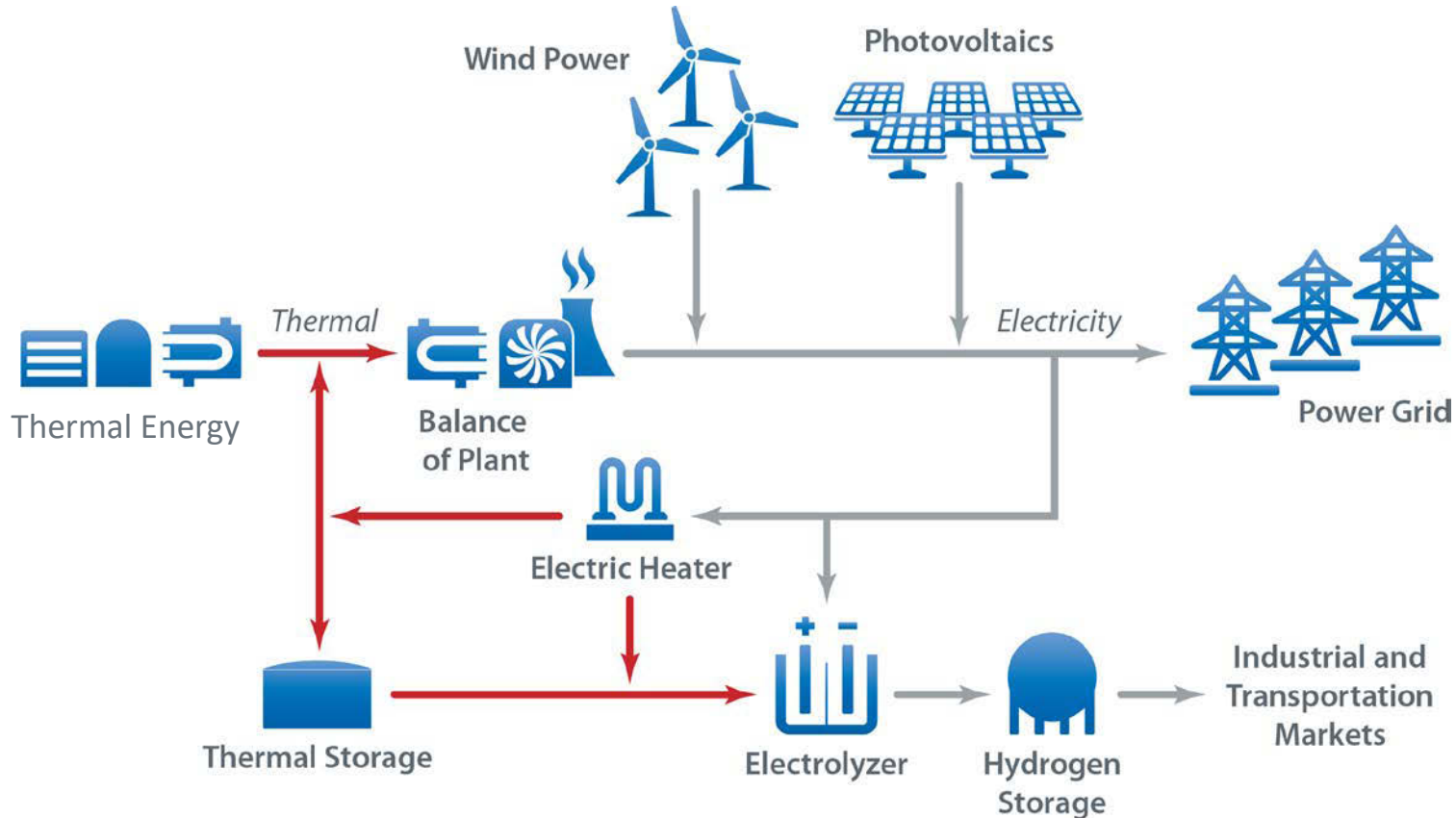
Use of Hydrogen @Scale for storage and fuel



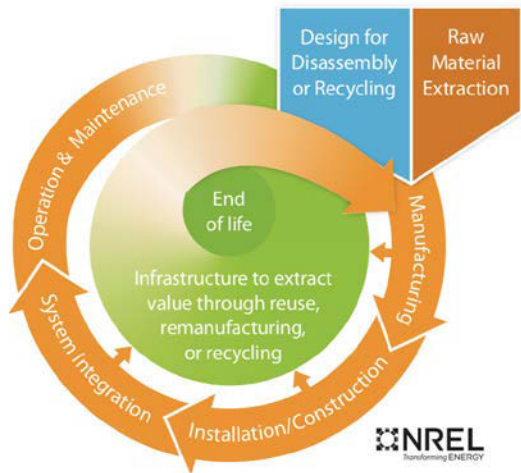
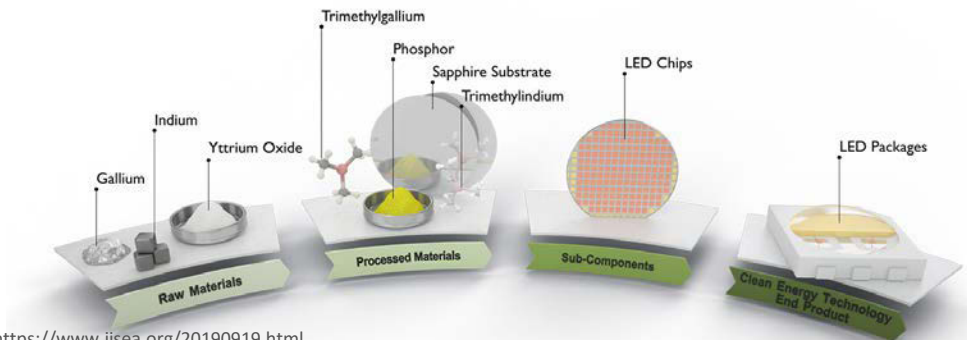
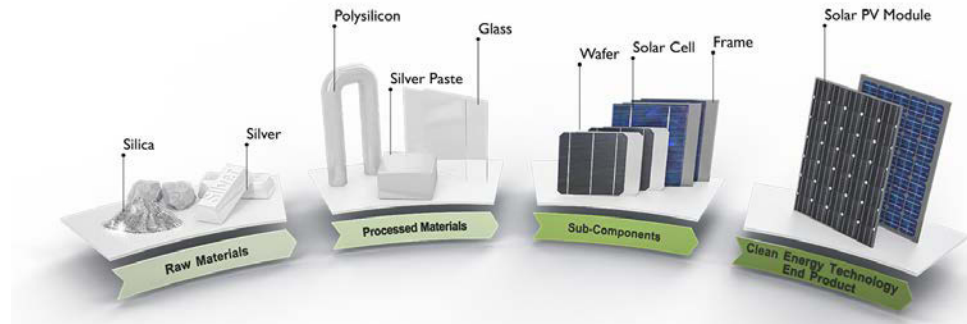
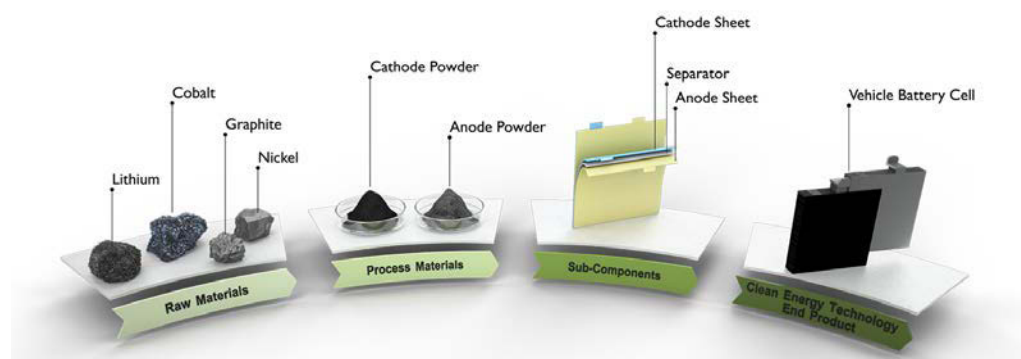
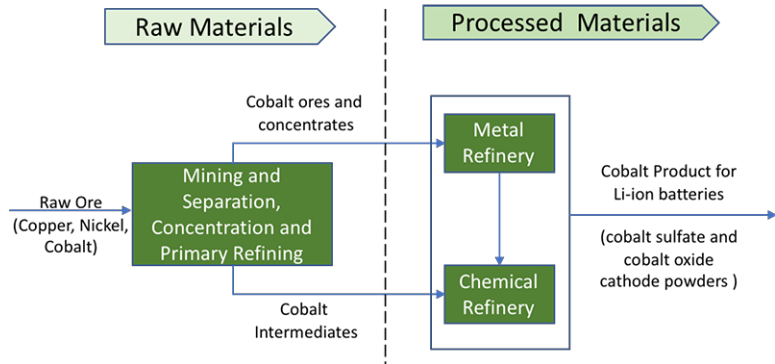
Integration of Renewable & Carbon Capture Systems



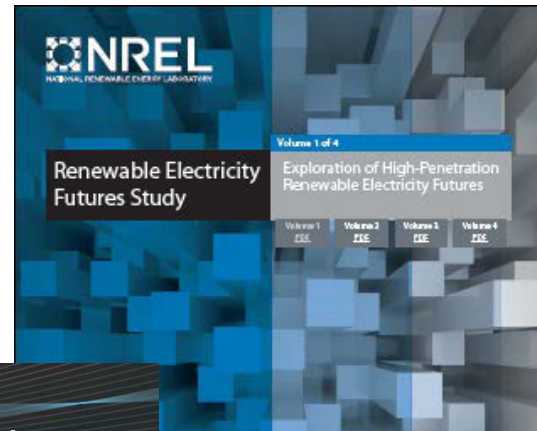
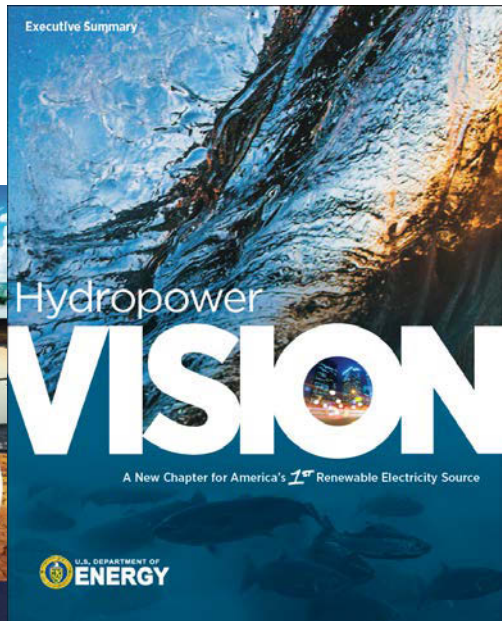
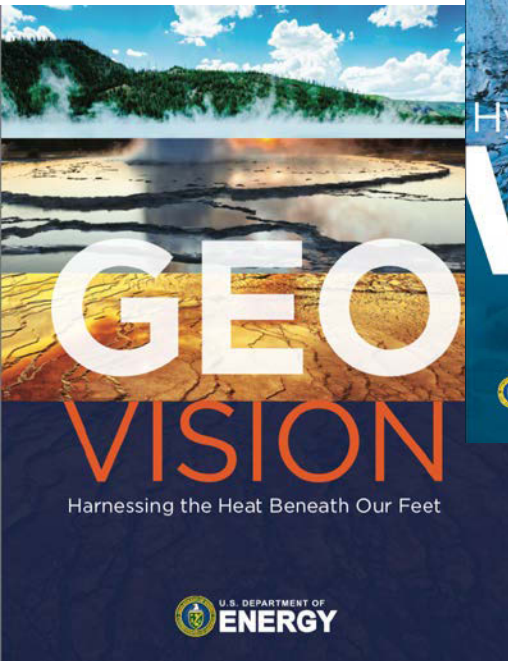
Thermal-Renewable Hybrid Energy Systems



Raw materials and supply chains



For more information: Technology vision studies



Questions?



Thank you!

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