Renewable Energy Transitions: Risk and Opportunities

ILP-MIT Joint Program Webinar: Climate-Related Physical and Transition Risks

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Connecting technologies, economic sectors, and continents to catalyze the transition to the 21st century energy economy.

Founding Partners:

- NREL
- Colorado School of Mines
- Colorado State University
- Massachusetts Institute of Technology
- Stanford University
- University of Colorado Boulder

www.jisea.org
To reduce emissions, the energy supply is transitioning fast

In 2019, renewable energy generated 18% of the total U.S. electricity (~7% wind, 7% hydropower, 2% solar, 1.5% biomass, 0.5% geothermal)

Natural gas power is ~38% (“bridge fuel?”)

COVID Update: January-August 2020, renewable electricity = 21% (wind 8%, solar 3.4%) with natural gas = 40% and coal = 18%
Scenarios of future electricity indicate on-going transition... and will affect regions differently

Example: Mid Case Scenario

Electrification growth may greatly increase demand and grid stress... with new industries in electric transportation, building efficiency, etc.

All Figures from NREL's Electrification Futures Study: www.nrel.gov/efs
U.S. jobs increasing in natural gas, renewables, efficiency... with national benefit but localized impact

**NATURAL GAS**
- Industry employs: 636,042
  - Up 1.7 percent.

**PETROLEUM**
- Industry employs: 824,290
  - Up 3.1 percent.

**NUCLEAR**
- Industry employs: 70,323
  - Down 2.5 percent.

**ELECTRIC POWER**
- Generation and fuels directly employed over 2 million
  - Up 42,584 (a 2.1 percent).

**TRADITIONAL FOSSIL FUEL SECTORS**
- In 2019, 62 percent, or 1.2 million,
  - 1.2 million of these employees worked in traditional coal, oil, and natural gas.

**COAL**
- The coal industry employs: 185,689
  - Down 5.9 percent.

**ENERGY EFFICIENCY**
- Energy Efficiency employed 2.38 million

**ZERO EMISSIONS**
- 509,697 worked in zero emissions' generation technologies, including solar, wind, hydro, geothermal, and nuclear.

**LOW EMISSIONS**
- 227,096 worked in low-carbon emissions technologies, including biofuels, CHP, and advanced/low emissions gas.

Supply chain of energy-related materials is changing... but still global and extractive

**Sustainable Mining Industry**

- **Raw Materials**
  - Mining and Separation, Concentration and Primary Refining
  - Cobalt ores and concentrates
  - Cobalt Intermediates

- **Processed Materials**
  - Metal Refinery: Cobalt Product for Li-ion batteries (cobalt sulfate and cobalt oxide cathode powders)
  - Chemical Refinery

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**Global Trade and Supply Risks**

- **PV**
- **Wind turbines**
- **Batteries**
- **Refrigerants**
- **Etc.**

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**Circular Economy Tech, Costs, Policy**

- Design for Disassembly or Recycling
- Raw Material Extraction
- End of life
- Infrastructure to extract value through reuse, remanufacturing, or recycling

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Source: JISEA/CEMAC, [https://www.jisea.org/](https://www.jisea.org/)
Ideas about the risks & opportunities of energy transition

• **Complexity and Resilience:** Distributed multi-input, multioutput energy systems are more complex, but may be more resilient than centralized large grid model
  – Solution may be mix of variable/non-variable low-emission energy sources plus diverse temporal storage and automated demand management
  – Cost for the transition but potentially lower marginal costs and lower externalities

• **Electrification:** Increased electrification resulting in lower emissions but higher demand for power
  – May be more difficult to meet emissions targets due to slower transition of overall energy mix
  – Increased innovation and jobs in energy efficiency, electrified equipment, transportation

• **Jobs & Local Economies:** Domestic energy jobs may grow/transition to cleaner higher-tech positions
  – May have localized impacts, especially on rural economies

• **Trade & Geopolitics:** Global supply chain dynamics shift from petroleum to metals & minerals for manufacturing

• **Environment:** Unknown effects on environment from very high deployment of renewables
  – Lower emissions and water use, but unknown changes in land use, localized temperatures, chemical use and release, landfill use and composition, viewsheds, wildlife impacts, etc.
  – All energy transitions had positive and negative effects, key is to anticipate them and mitigate the negative
Thank you! Questions?

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