JISEA Joint Institute for Strategic Energy Analysis

Renewable Energy Transitions: Risk and Opportunities

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

17 November 2020

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NREL Transforming ENERGY · Colorado School of Mines Earth • Energy • Environment · Colorado State University · Massachusetts Institute of Technology · Stanford University · University of Colorado Boulder

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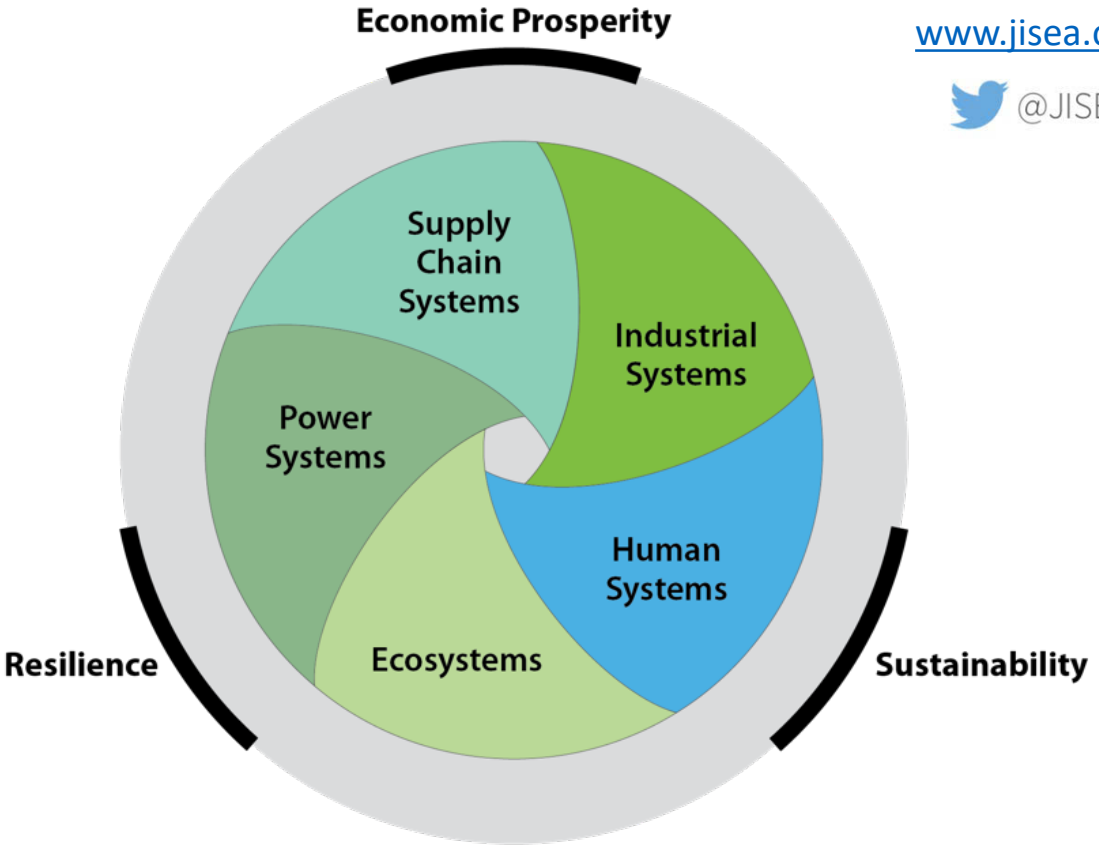
Joint Institute for Strategic Energy Analysis

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



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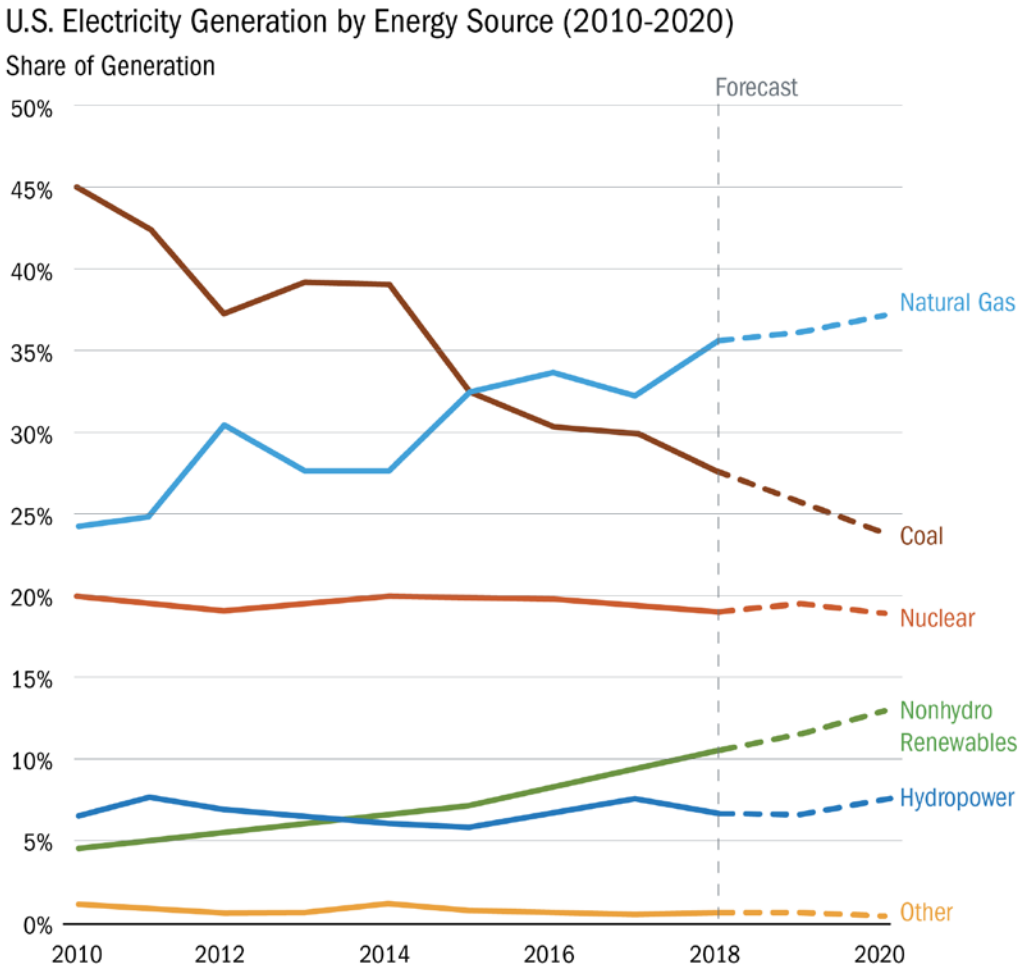
To reduce emissions, the energy supply is transitioning fast

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%

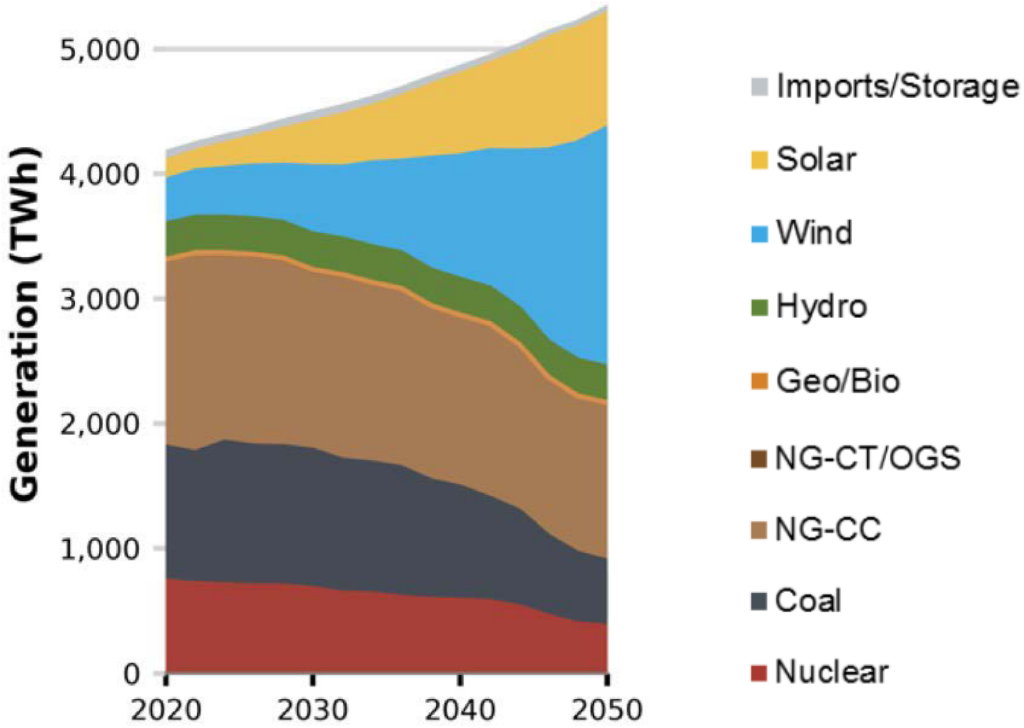
Source: United States Energy Information Agency, *https://www.eia.gov/electricity/data.php, 26 October 2020*



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

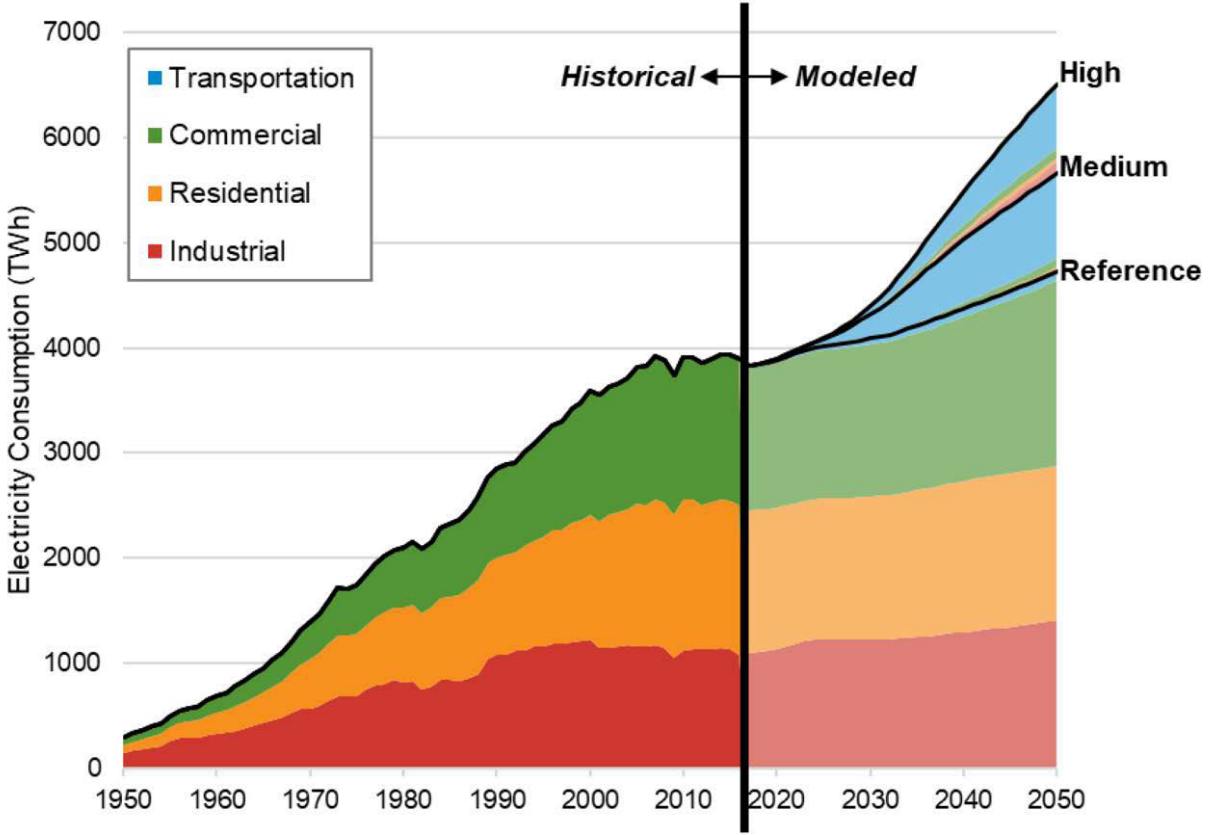
Scenarios of future electricity indicate on-going transition… and will affect regions differently

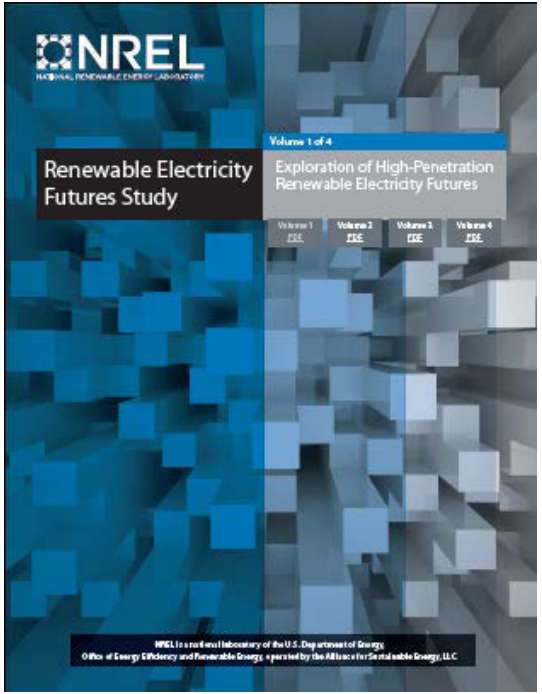
Example: Mid Case Scenario



Generation projections across 36 scenarios: NREL 2019 Standard Scenarios Report: A U.S. Electricity Sector Outlook, https://www.nrel.gov/analysis/standard-scenarios.html

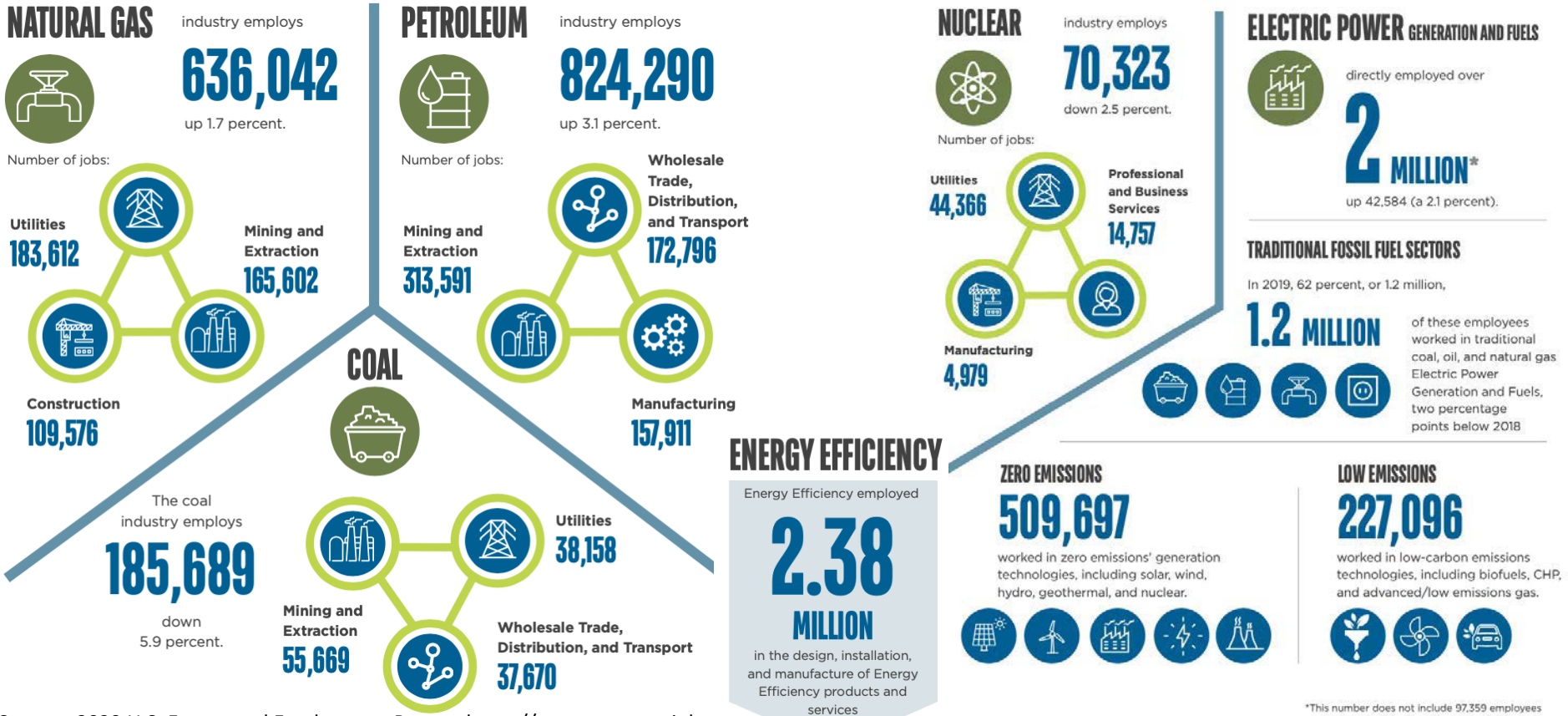
Electrification growth may greatly increase demand and grid stress… with new industries in electric transportation, building efficiency, etc.





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

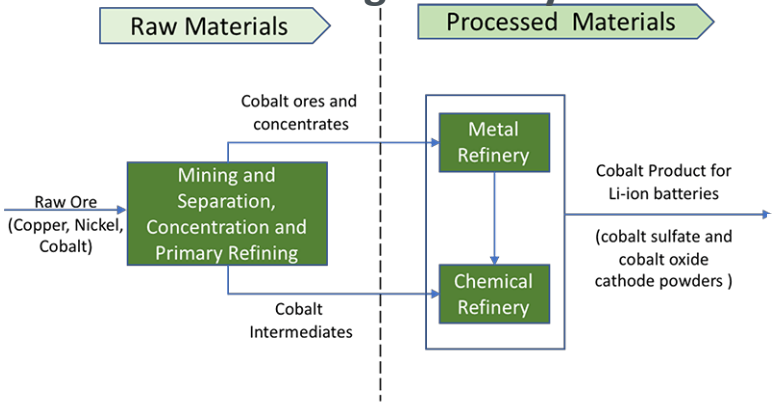
U.S. jobs increasing in natural gas, renewables, efficiency… with national benefit but localized impact

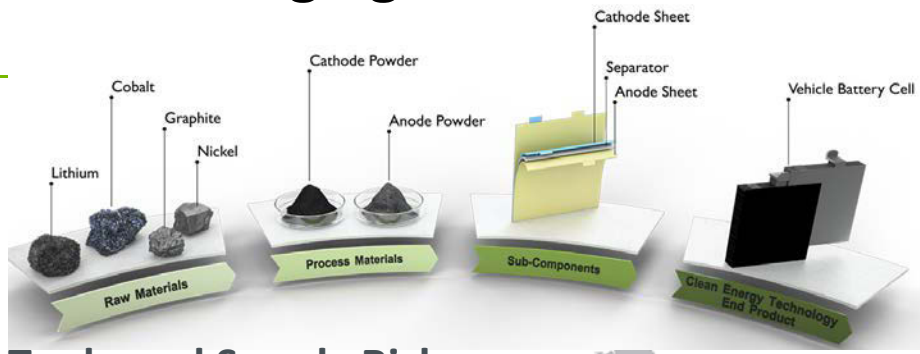


Source: 2020 U.S. Energy and Employment Report, https://www.usenergyjobs.org

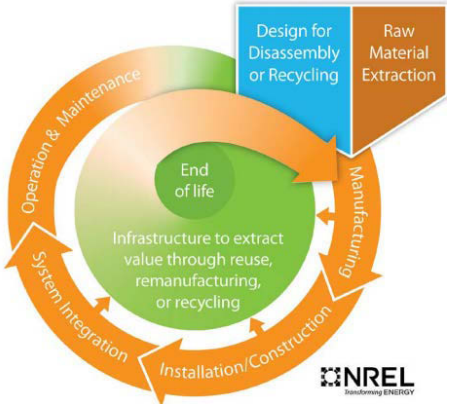
Supply chain of energy-related materials is changing… but still global and extractive

Sustainable Mining Industry





Circular Economy Tech, Costs, Policy



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

Source: JISEA/CEMAC, https://www.jisea.org/

Global Trade and Supply Risks

In 2017, 32 countries accounted for all global production of key NMC materials

- **60 million tons aluminum (smelters):** 54% China, 6% Russia, 5% Canada
- **16 million tons manganese:** 33% South Africa, 16% China, 14% Australia
- **2.1 million tons nickel:** 11% Philippines, 10% Canada, 9% Russia, 9% Australia
- **1.2 million tons natural graphite :** 67% China, 13% India, 8% Brazil
- **110,000 tons cobalt:** 59% Democratic Republic of Congo, 5% Russia, 5% Australia
- **43,000 tons lithium:** 44% Australia, 34% Chile, 13% Argentina

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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