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**Integrating Clean Energy in Mining Operations: Opportunities, Challenges, and Enabling Approaches.**

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Access full report through:  
<https://www.nrel.gov/docs/fy20osti/76156.pdf>



## Intern and Postdoc experience at JISEA

Started at JISEA as Intern in summer of 2018 (while at MINES) – converted to Postdoc (May 2019) and – later Researcher (May 2020). Key projects:

1. Track supply chain of lithium used in EV batteries
2. Developing a sustainable energy and food systems project – collaboration with CSU
3. Developing renewable integration in mining project – collaboration with Mines and Missouri University
4. Manufacturing industry decarbonization roadmap – multi-lab effort with industry participation.
5. Manufacturing of anodized aluminum frames for solar module – extrusion and anodizing U.S capacity

Value of being intern/postdoc at JISEA

- Diversity of projects
- Access to academic (theoretical) and industry (practical) research
- Career decisions - evaluate whether I want to go to back to academia and kind of projects I want to do

# How much mining spends on energy?

- What proportion of total mining operating expenses go to **energy costs**?
  - a) 5 - 15%
  - b) 15 - 40%
  - c) More than 40%



# Introduction

- Energy expenses comprise **15 – 40 %** of total mining operating costs, on average
- Mining activities consume about **11% of total global energy**
- Before the pandemic, energy demand in the mining industry was anticipated to grow by as much as **36% by 2035**
- Most of this energy is from **fossil fuels – negative impacts to the environment** - without significant adoption of renewable energy technologies, most of this new demand will be met by fossil fuels.

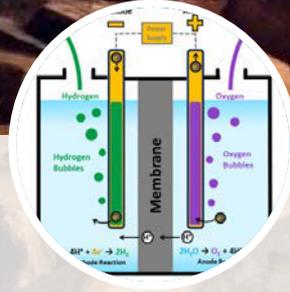
# RE Applications in Mining



Supplying onsite electric loads



Replacement of diesel-fired loads



H<sub>2</sub> production and storage

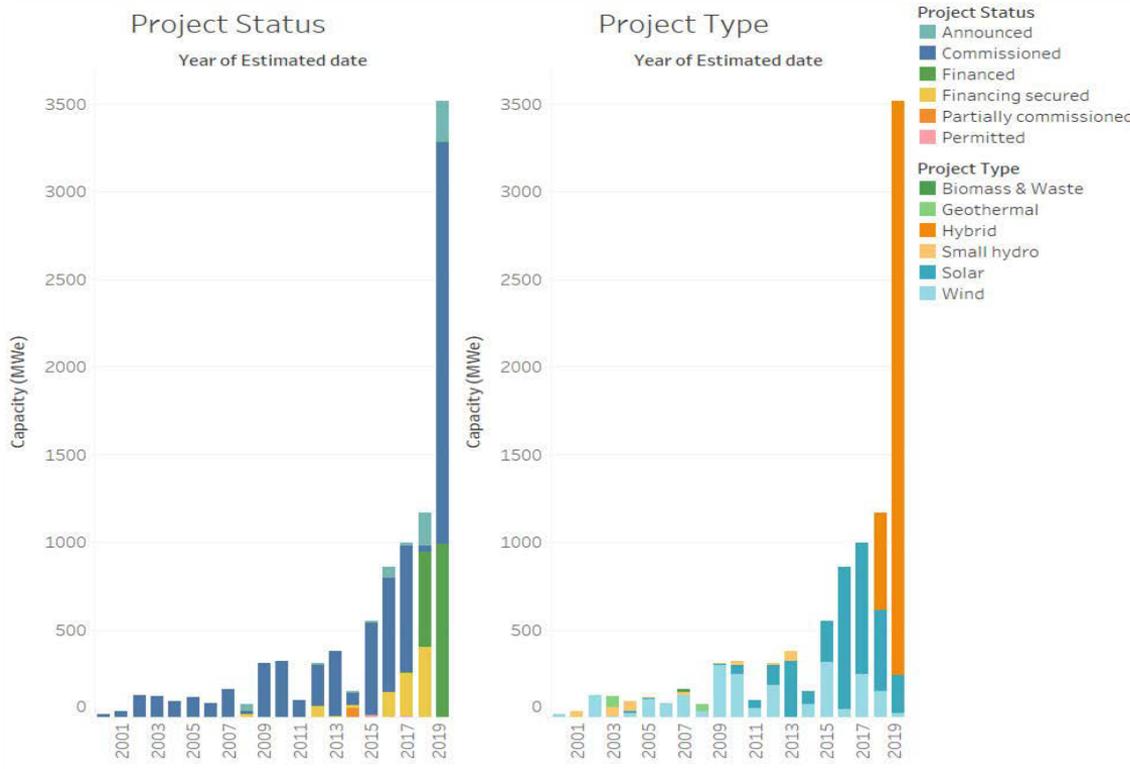


Process heating



Feedstock substitution

# Renewable use in Mining



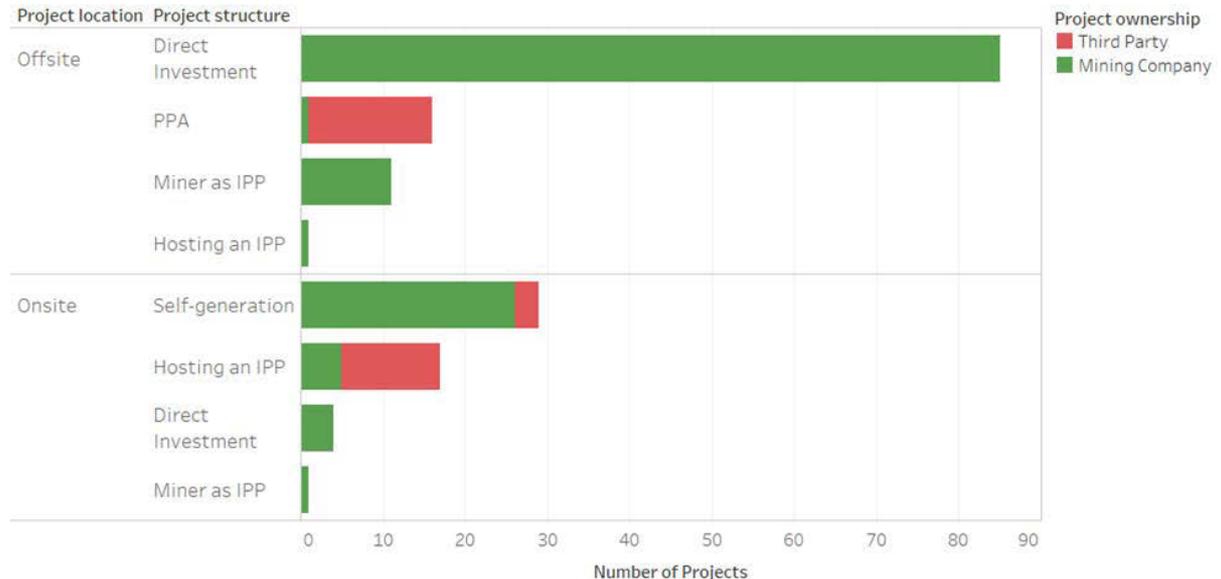
## Global Renewable Energy Projects Serving Mining Operations

Source: BNEF 2019

- There are significant efforts to scale renewables by mining companies to meet their GHG targets.
- In 2015 there were about **600 MW** of renewable energy projects serving mine sites
- In 2020, over **5 GW** cumulative of renewable energy projects serving mining operations have either been installed or are planned.
- This current renewable capacity is a fraction of total energy demand by mining industry. E.g. In Sub Saharan Africa alone, the mining industry is projected to consume about 23 GW of energy in 2020 (Banerjee et al., 2014).
- **Why is renewable use in mining developing slower to meet the industry's growing energy demand?**

# Barriers to renewables integration

- Conflicting business models between mine operators and RE developers
- Variability of RE generation
- RE expertise in the mining industry
- Land constraints
- Technology readiness and R&D gaps (e.g. heat demand and energy storage)
- For more information on opportunities : Please read our full report at <https://www.nrel.gov/docs/fy20osti/76156.pdf>



Renewable project business model

Data source: BNEF 2019

# Thank you!

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