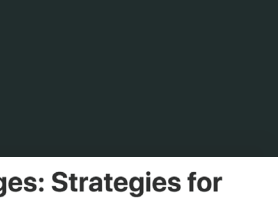


Green is not enough.

University of Alberta

Christopher Chan | Kayvon Miller | Kabir Nadkarni | Kia Valdez Bettcher

Under the terms of the 2015 Paris Agreement, participating parties are seeking to limit global average temperatures. Achieving this goal will require countries to drastically and immediately reduce greenhouse gas emissions. This global transition is estimated to put immense pressure on the development of new renewable energy projects and electric vehicles.



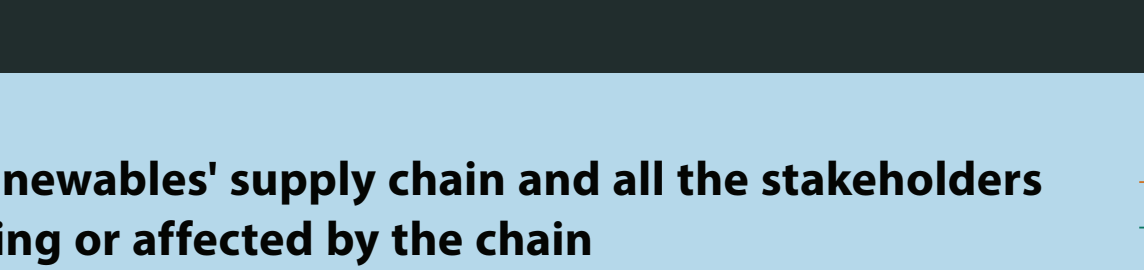
Despite common beliefs, the renewable energy sector causes numerous social and environmental problems...

Chinese Solar Companies Tied to Use of Forced Labor

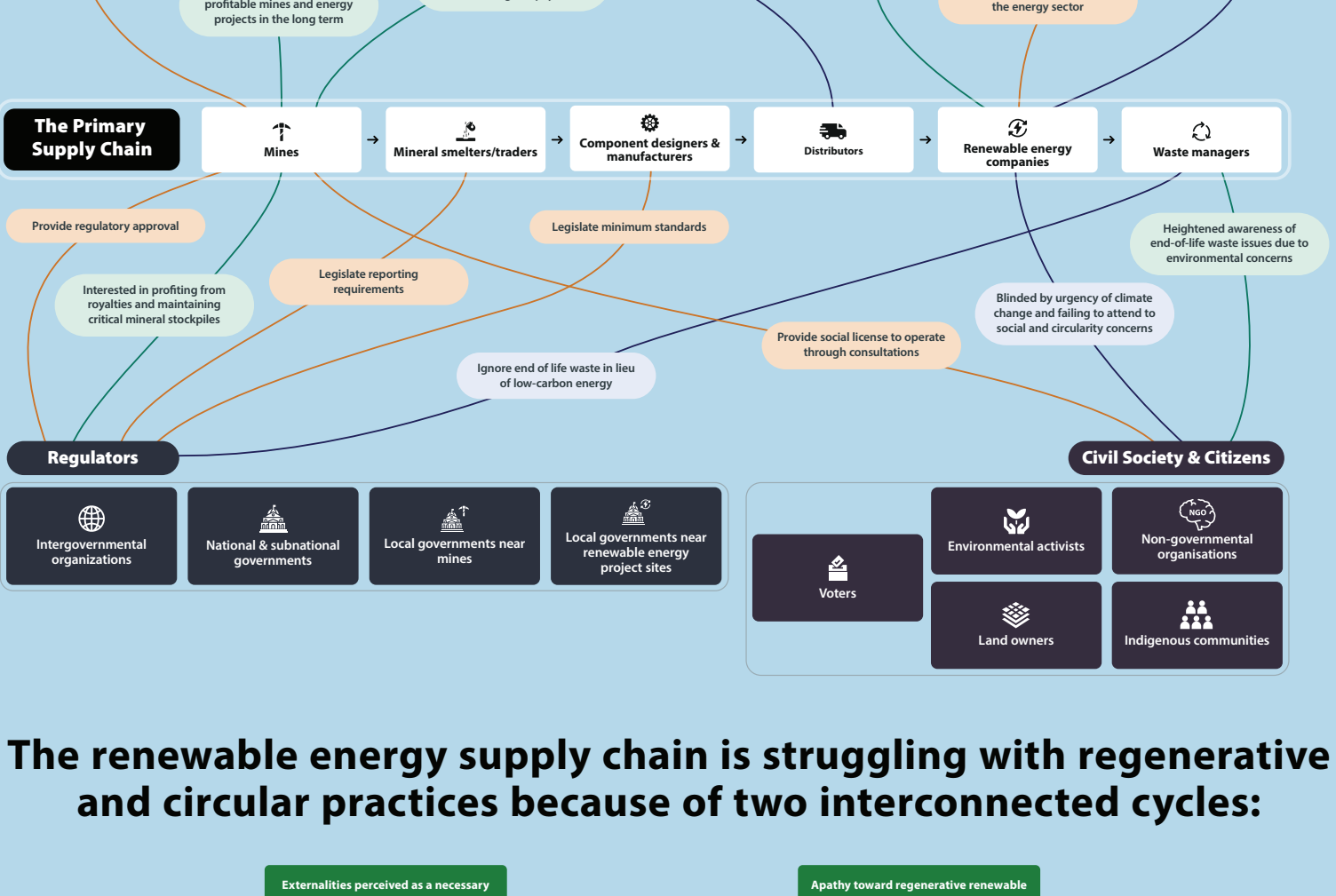
DRC: Alarming research shows long lasting harm from cobalt mine abuses

Fighting labor shortages: Strategies for recruiting, training and retaining in the solar industry

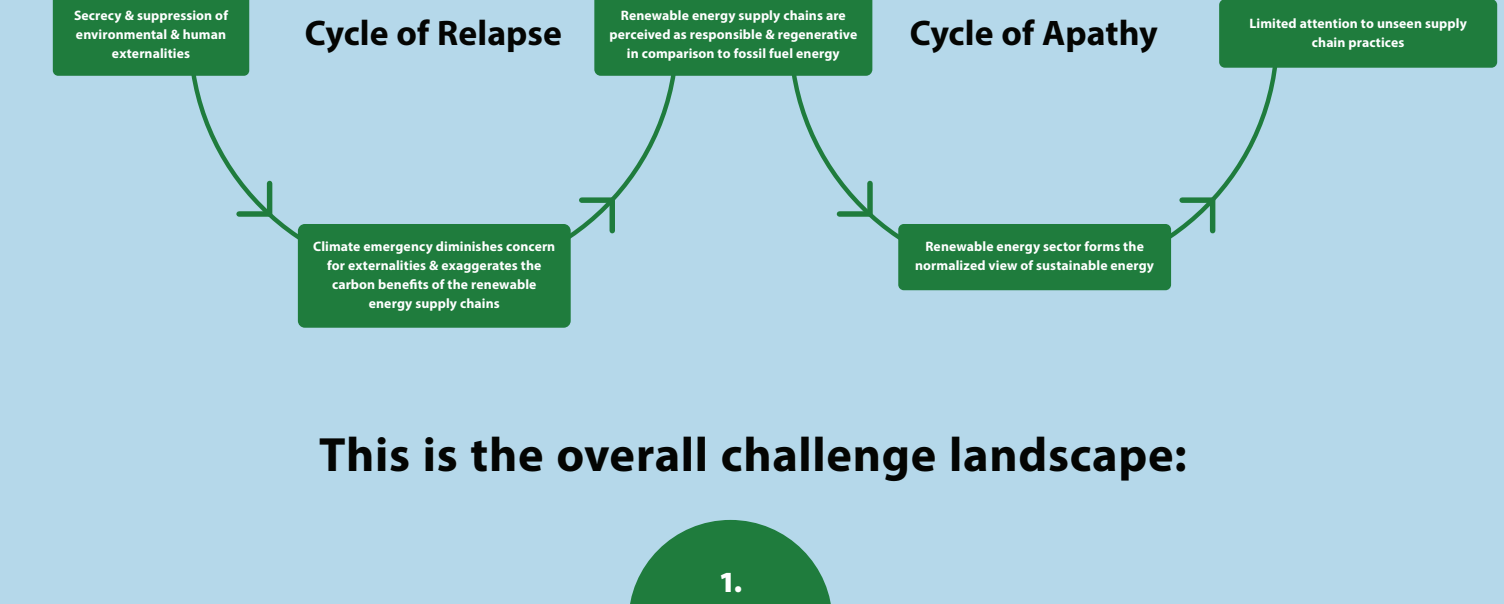
The definition of sustainability has changed over time. **Regenerative sustainability** is the new model we need for the sector.



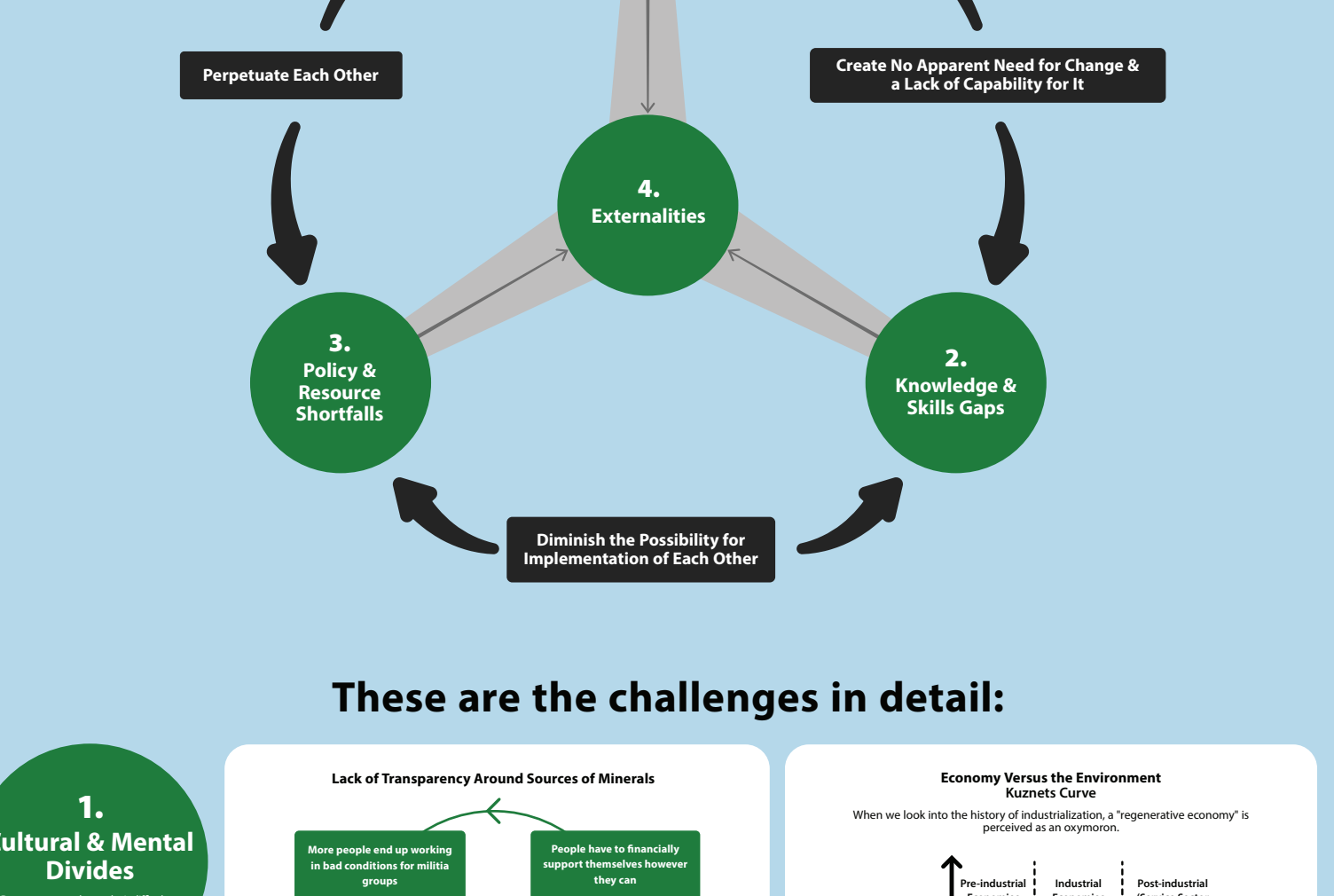
Why can't the emerging renewable energy sector implement regenerative practices throughout its global supply chain?



The renewable energy supply chain is struggling with regenerative and circular practices because of two interconnected cycles:



This is the overall challenge landscape:



These are the challenges in detail:

1. Cultural & Mental Divides

Lack of Transparency Around Sources of Minerals

- Many people end up working in bad conditions for militia groups
- People have to essentially support themselves however they can
- More illegal mining emerges
- State ministers & successors to rule by non-state actors & militias

2. Policy & Resource Shortfalls

Capital Requirements

- Technology Development:** Impact: Medium; Relatively mature tech; Capital Availability: High; Venture Capital
- Manufacturing:** Impact: Very Low; Supply waiting for projects; Capital Availability: High; China Development Bank
- Project Development:** Impact: High; Advancement bottleneck; Capital Availability: Very Low; Small, complicated investments
- Construction:** Impact: Very Low; Ample supply, low margins; Capital Availability: High; Commercial banks
- Operation:** Impact: Low; Cash flow assets; Capital Availability: High; Sovereign, PE, Pension, Vg

3. Knowledge & Skill Gaps

Geopolitics of Critical Minerals

Energy-related demand for critical minerals tempts global geopolitics

Tons of Rare Earth Metals Production vs Time

Uncoordinated International Policies

- Unwillingness of countries to cooperate on seemingly less important issues
- No one wants to be the first actor because of high costs of early stage innovation
- Vested interests of countries to want to promote their own resources internationally

4. Externalities

Knowledge Gaps

- Design stage:** Lack of research & development for more efficient & less resource-intensive technologies
- Fabrication stage:** Lack of technologies for reducing indirect & hidden materials during metal refining & parts manufacturing
- Use stage:** Not enough adequately trained professionals
- End of life stage:** Not enough tools and processes to be able to reduce, reuse, recycle & appropriately dispose of waste

Skills Gap

Entrants into the energy sector have... Established actors in the energy system have...

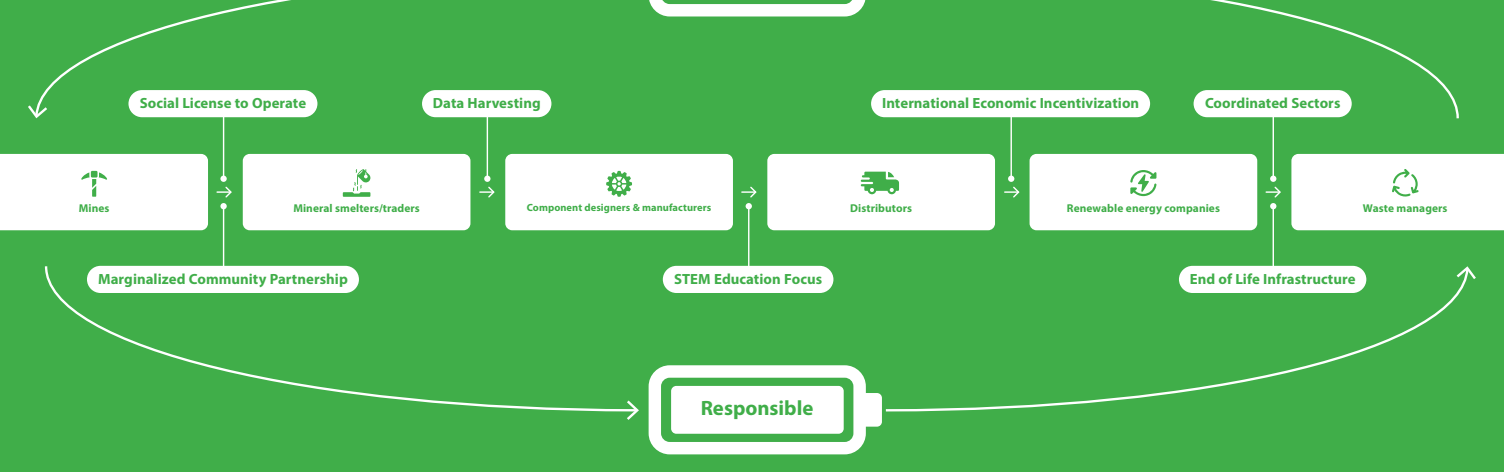
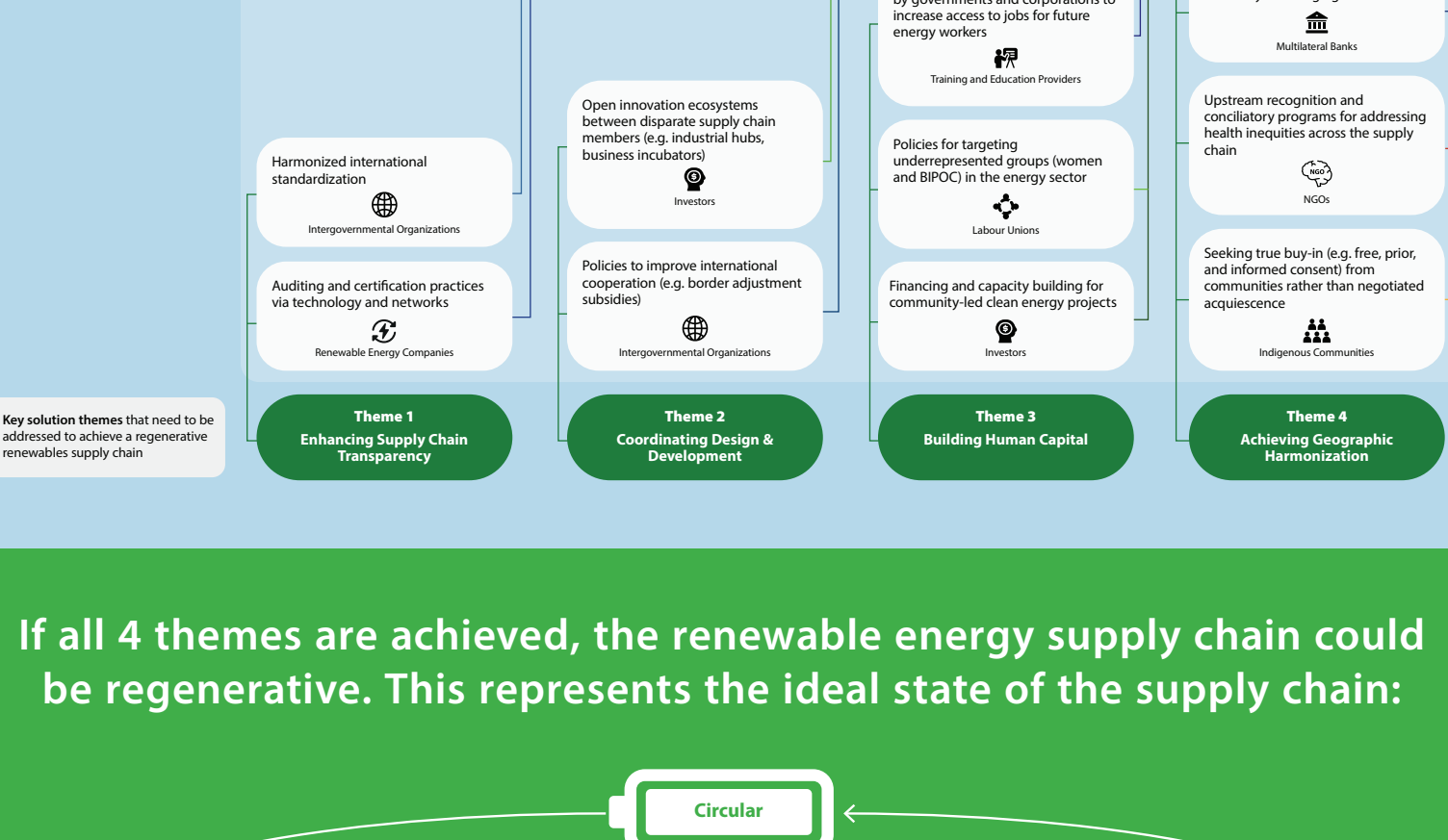
- No employment from established professionals
- Lack of energy education
- No opportunities to build skills
- No venues to unite with each other
- No understanding of the value of energy
- No resources devoted to youth energy leaders

Leading to a persistent divide between change agents and opportunities for skill development in the clean energy sector

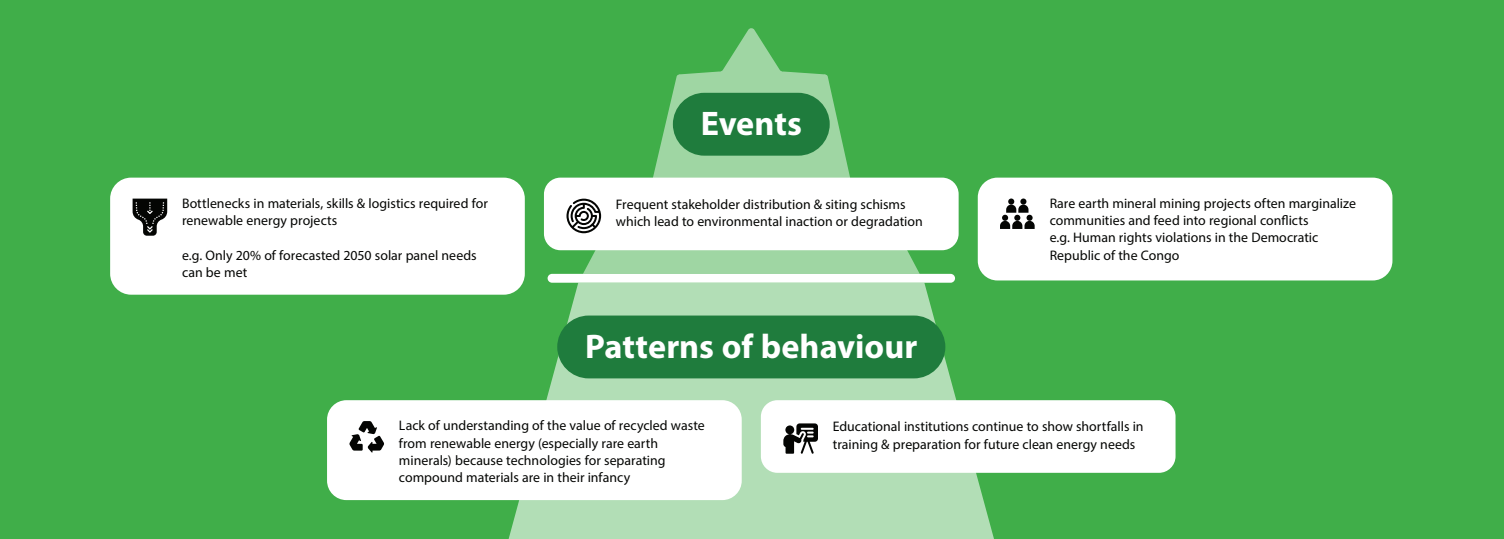
Data Gaps for Auditing & Verification

- Use legislated standards to guide responsible sourcing of minerals but turn a blind eye to implementation
- Trust a smelter when they claim minerals procurement adheres to ethical standards
- Verify that smelter is adhering to standards through an in-person auditor program
- Create ongoing relationships between auditors, mining companies and communities to encourage improved standards

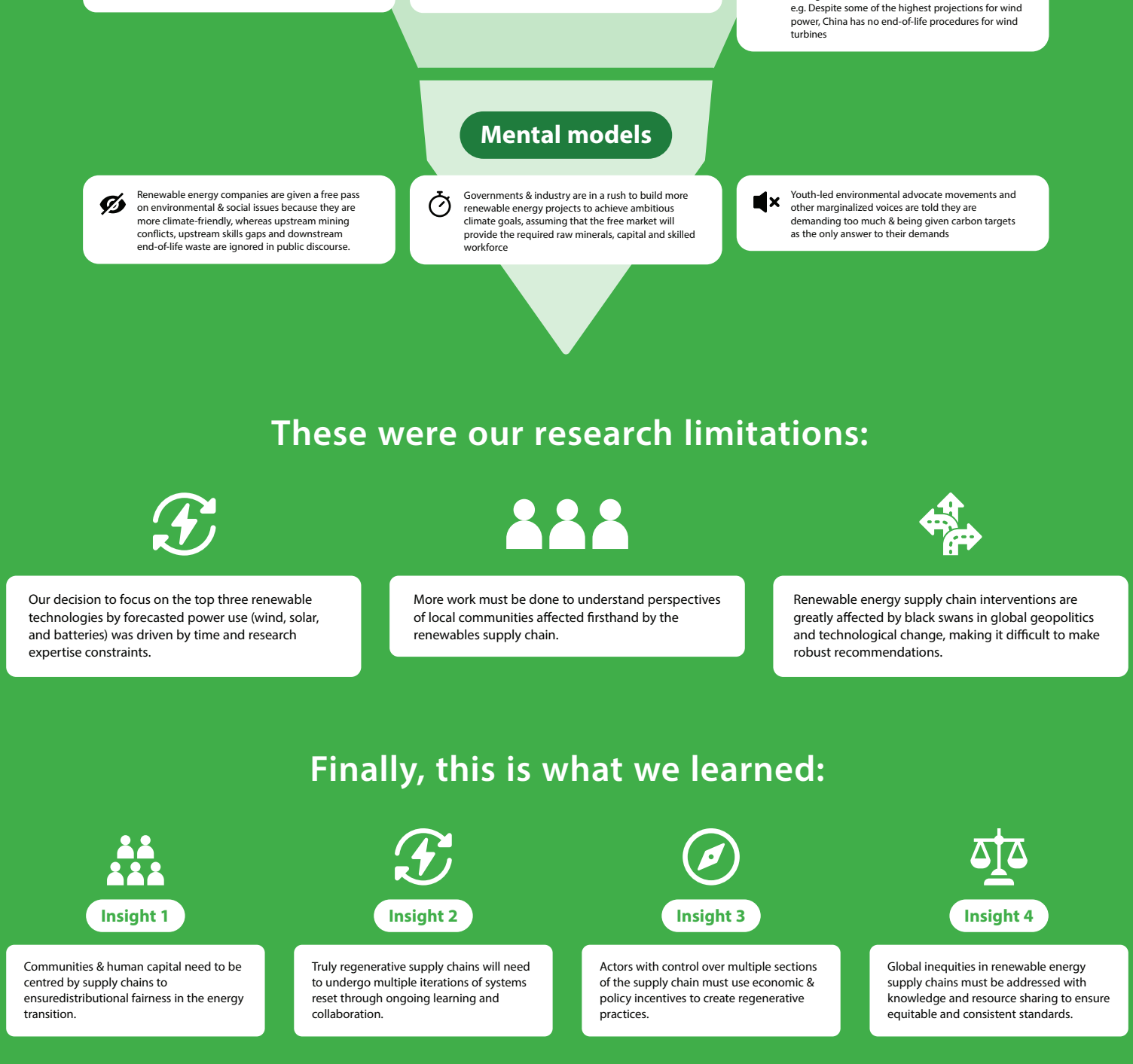
Easy but ineffective ← → Difficult but effective



If all 4 themes are achieved, the renewable energy supply chain could be regenerative. This represents the ideal state of the supply chain:



To summarize, we started by looking at the challenges of the supply chain as well as why those challenges are entrenched:



These were our research limitations:

- Our decision to focus on the top three renewable technologies by forecasted power use (wind, solar, and batteries) was driven by time and research expertise constraints.
- More work must be done to understand perspectives of local communities affected first-hand by the renewables supply chain.
- Renewable energy supply chain interventions are greatly affected by black swans in global geopolitics and technological change, making it difficult to make robust recommendations.

Finally, this is what we learned:

- Insight 1:** Communities & human capital need to be centered by supply chains to ensure distributional fairness in the energy transition.
- Insight 2:** Truly regenerative supply chains will need to undergo multiple iterations of systems reset through ongoing learning and collaboration.
- Insight 3:** Actors with control over multiple sections of the supply chain must use economic & policy incentives to create regenerative practices.
- Insight 4:** Global inequities in renewable energy supply chains must be addressed with knowledge and resource sharing to ensure equitable and consistent standards.

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