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‘The Energy of Freedom’? Solar energy, modern slavery and the Just Transition

Findings based on research by Prof. James Cockayne, Dr Edgar Rodríguez Huerta and Dr Oana Burcu, March 2022[i]

The global solar energy industry must act urgently to address concerns about modern slavery in its supply chain. The rapid increase in demand for solar energy risks fuelling demand for slave-made products, including polysilicon used in solar panels and cobalt used in lithium-ion batteries. The industry needs a roadmap to transform the solar energy production system so that it is truly just and equitable, promoting not only the freedom of consumers from fossil fuel dependence but also the freedom of workers and producers.

Key findings

- Around 40-45% of the polysilicon now used in solar panels comes from Xinjiang, where forced labour appears to be state policy.
- Solar energy is stored in lithium-ion batteries that use cobalt cathodes. 15-30% of global cobalt supply is mined in DRC in conditions in which forced and child labour is common.
- With solar energy generation projected to grow 450% by 2030, there is a risk that increased solar energy demand will drive an increase in forced labour and modern slavery.
- Equally, poorly designed modern slavery risk management responses could slow the roll-out of solar energy, the replacement of expiring capacity, and slow overall decarbonization.
- Policy responses around the world are shifting from a focus on labour rights and supply-chain reform to industrial policy aimed at securing control of solar energy value-chains.
- There are signs of a bifurcated supply-chain emerging, with ‘slavery-free’ supply-chains serving markets that exclude goods made with forced labour, and ‘slave-made’ supply-chains supplying the rest. This may increase costs and reduce innovation, without necessarily addressing underlying modern slavery risks.
- Stakeholders along the value-chain need to work together to better identify and manage these risks.
- Effective due diligence is made difficult by active state resistance in China, including criminalization of cooperation with due diligence efforts. Complementary risk estimation approaches are needed.
- This study offers a new approach to estimating forced labour risk per kWh and per USD LCOE, which may facilitate improved risk management at the enterprise, project and system level.
- The market is looking for greater clarity on expectations around: due diligence, leverage to address risks, withdrawal and remedy.
- Stakeholders including governments, manufacturers and investors should engage in collective action to provide this clarity and develop a roadmap to transition the industry to a slavery-free footing.

Why is this important?

Demand for renewables is rising as governments move to reduce their reliance on fossil fuels, a trend accelerated by the crisis in Ukraine.

The presence of modern slavery in solar energy production systems complicates the ‘justice’ of the transition away from fossil fuels to renewable power. Increased enslavement risks becoming the unintended cost of decarbonisation.

Finding a way to address modern slavery risks without undermining solar energy uptake is critical to achieving a Just Transition. Actors with an interest in answering these question include those involved in:

Solar and battery manufacturing policy and finance, including US Congressional debates over the Build Back Better agenda, the Republican-backed *Keep China Out of Solar Energy Act*, the Democrat-backed *Reclaiming the Solar Supply Chain Act*, and the EU Battery Regulation;

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Purchasers of solar power for industrial, commercial or residential use, or as part of emissions abatement or broader ESG programmes;

Supply-chain due diligence and disclosure debate participants, including the current debate over the European Commission's proposed Directive on Corporate Sustainability Due Diligence, G7 Leaders' Carbis Bay Communiqué commitment to address forced labour in supply-chains, or ongoing OECD work on the cobalt supply-chain; and

Forced labour product ban proponents and subjects, including the bans instituted in the US under the *Uyghur Forced Labor Prevention Act* and the related *Tariff Act 1930* section 307, and those being considered by authorities in Australia, the EU and UK.

Finally, how we manage these risks may tell us a lot about the **deeper transitions afoot in the global order**. Modern slavery risks and how to manage them have emerged as a flashpoint in a broader contestation of global energy governance. Different policy framings propose different solutions, allocating different roles to governments, manufacturers, industry associations, investors, civil society – and those vulnerable to or harmed by modern slavery. Each perspective rests on different conceptions of the purpose of the energy governance regime, and how the relationship between states, markets and affected communities should be justly ordered. Studying these debates thus helps us understand the nature and dynamics of larger transitions under way in the global economic and political order.

Recommendations to solar energy value-chain stakeholders

- **Recommendation 1: Develop a roadmap to transition the sector to a 'slavery-free' footing**

This should be based on the UN Guiding Principles on Business and Human Rights and the OECD Guidelines for Multinational Enterprises. It should be developed through consultation with all relevant stakeholders, *including* vulnerable and affected workers and production communities.

- **Recommendation 2: Clarify due diligence expectations**

Clarify expectations on the roles of different solar energy value-chain stakeholders in enabling and providing due diligence. Beyond transparency and tracing protocols, this needs to address how to conduct effective human rights due diligence where states or other groups actively resist it.

- **Recommendation 3: Build and use collective leverage to address modern slavery risks**

Businesses may have limited leverage to address some modern slavery risks in the global value-chain, because they are the product of state policy and action. A collective action approach will be needed to address drivers of risk throughout the life-cycle. Stakeholders should avoid a compliance-only approach. A shared strategy for engaging Chinese manufacturers is especially needed. Our research suggests there may be openings available through reframing some of the current disuptes in terms that are amenable to resolution through the global free trade architecture.

- **Recommendation 4: Clarify expectations on withdrawal and bifurcation**

Stakeholders should work together to agree milestones for withdrawing from supply-chains that do not mitigate modern slavery risks below agreed risk threshholds by agreed dates. Governments, buyers, developers and and investors also need to clarify expectations on engagement with suppliers who offer both 'slavery-free' and slave-made products.

- **Recommendation 5: Develop coordinated industrial policies to scale up slavery-free supply**

Governments need to coordinate procurement, investment, trade, tax, transport and energy policies to create clear incentives for the market to invest in new, slavery-free production capacity. The financial sector has an important stewardship role to play here.

- **Recommendation 6: Remedy modern slavery harms connected to the solar energy industry**

The industry should develop plans to provide and enable remedy to those harmed by modern slavery in solar energy production. Creative solutions may be needed where affected populations are hard to identify or reach. Such solutions might include funding community organizations, supporting those displaced by modern slavery, or supporting broader accountability initiatives.

- **Recommendation 7: Develop an accepted approach to estimating modern slavery risk**

Given the difficulties involved in conducting due diligence, complementary risk estimation methods are needed. An accepted approach to estimating modern slavery risks would facilitate comparison at the enterprise, project and investment level, improving planning and risk management. We show a method to estimate forced labour risk per kWh or per USD LCOE.

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Research overview

Background

Solar energy generation is projected to grow 450% by 2030 and may account for as much as 76% of global electricity supply by 2050.[ii] Since 2017, 91% of new polysilicon production capacity worldwide has been developed in China.[iii] Around 40-45% of the polysilicon now used in solar panels comes from Xinjiang Uyghur Autonomous Region (XUAR) in China, where forced labour appears to be state policy.[iv] The practices that raise human rights concerns include coercion of Uyghurs and other XUAR minority populations to move from traditional lifestyles into industrialised employment. This can include a period of detention ('internment') in government run 'education' or 'vocational training' facilities, and subsidized employment in private industry, including in other provinces through a 'labour transfer' scheme. Together these policies appear to violate the right to free choice of employment under Article 23 of the Universal Declaration on Human Rights and various commitments that China has made under International Labour Organization-backed Conventions.[v] Research and first-hand testimony have documented physical and sexual assault, forced sterilisation, enforced disappearance, torture, and violations of rights to privacy, family life and religious freedom, connected to these state policies.[vi] Some actors, including the independent Uyghur Tribunal, US State Department and UK and Canadian Parliaments, have concluded that these policies constitute crimes against humanity and genocide.[vii]

The batteries in which solar-generated electricity is stored are also a source of modern slavery risk. Lithium-ion (Li-ion) batteries depend on cobalt. Electric vehicle batteries use up to 20 kg of cobalt in a 100-kWh pack. The World Bank estimates that cobalt production needs to grow by 460% by 2050 to meet energy storage requirements to keep global warming to 2 degrees celsius.[viii] Between 15% to 30% of global cobalt supply is thought to come from informal 'artisanal' or ASM mines in eastern Democratic Republic of the Congo (DRC), where forced and child labour is prevalent.[ix] This often involves trespassers scavenging, using hand-tools on land owned by industrial mines. Mineshafts are poorly constructed and offer extremely hazardous working conditions including exposure to fine dust and particulates that cause DNA-level damage, high risks of death from tunnel collapse, and significant risks of injury from equipment and falls. Between 100,000 and 200,000 people are thought to work in ASM cobalt extraction in DRC, and many more depend on those livelihoods.[x] Estimates of the numbers of children affected vary from 35,000 to several times that.

Responses

Last year the US Department of Labor added polysilicon to a list of goods produced by forced labour, on which many market actors rely in assessing forced labour risks.[xi] US Customs and Border Protection (CBP) issued a Withhold Release Order (WRO) denying entry to the US market for goods made with silica and polysilicon produced by companies connected to the XUAR photovoltaic (PV) industry, along with those in other sectors including cotton and tomatoes. A related action added some solar energy value-chain entities to the US Department of Commerce 'Entities List', limiting their ability to access certain US-sourced commodities, software, and technology subject to the Export Administration Regulations.

In late 2021 US Congress passed the Uyghur Forced Labour Prevention Act (UFLPA), which will exclude all goods made in XUAR from the US market unless the importer can prove they are not made with forced labour. A number of other jurisdictions – including Australia, Canada, the EU, France, Germany, Japan, Netherlands, Norway and the UK – are considering adopting, or have already adopted, measures aimed at strengthening due diligence and screening arrangements to exclude goods made with forced and child labour, with a particular focus on XUAR.[xii] At the G7 in Cornwall in June 2021, leaders committed to take action on forced labour in the solar supply-chain.[xiii]

In August 2021, Roth Capital Partners, an influential source of sector analysis, warned that 2.1GW of solar projects representing a total investment of about USD 2.2 billion on a payroll of 3,000 construction workers was at risk from import bans.[xiv] In September 2021, SEIA president and CEO Abigail Ross Hopper warned that the WROs, together with price increases and other supply-chain disruptions, could "significantly exacerbate supply chain constraints and increase solar system prices".[xv] One analyst predicted that if both the US and EU adopted their proposed forced labour bans, "polysilicon shortages will immediately occur", disrupting the global PV market – in part because the large capital expenditure required to build new, slavery-free PV manufacturing capacity means that capacity will not come online for at least two years.[xvi]

Meanwhile moves have begun to develop 'slavery-free' production capacity outside of China, including in Viet Nam, to supply to North American and European markets. This raises difficult policy questions around value-chain bifurcation, not least because it may enable some manufacturing players to become dominant in both 'slavery-free' and 'slave-made' value-chains. The same firms may sell both types of products to different buyers.

With regard to cobalt, several large automotive and electronics brands such as BMW, Ford and IBM have launched responsible sourcing and tracing pilot projects to drive transparency and address child labour risks. But concerns about the effectiveness of these strategies lingers. Analysts have begun to recognise that solar energy storage technologies, including Li-ion batteries, may yet be subject to exclusion from the US market under section 307 of the US Tariff Act of 1930.[xvii]

In December 2019, a class action lawsuit was filed on behalf of 14 Congolese families claiming that their children were killed or maimed while mining cobalt. The lawsuit claimed that defendants Apple, Dell, Google, Microsoft and Tesla "knew that DRC's cobalt mining sector is dependent on child labour which included hazardous work such as tunnel digging in primitive cobalt mines".[xviii] The lawsuit was dismissed on the grounds that plaintiffs had not demonstrated sufficient evidence of a causal connection, but it helped spur a wave of industry initiatives to strengthen governance of supply-chains.

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Policy process tracing

This research analyses debates on modern slavery risks in the solar energy value-chain in ten different policy arenas: US, UK, EU, G7, Australia, United Nations fora, China, international solar energy industry initiatives, global financial circles, and multistakeholder initiatives relating to the global cobalt supply-chain. Each provides a case study for policy process tracing. For each, we reviewed open-source documents and other written evidence. We also consulted the small existing body of relevant academic literature. In some cases, twe had direct written or spoken engagement with insider stakeholders to confirm or develop analysis of the policy currents identified. Four main policy currents emerged:

The **Rights** current frames modern slavery in the solar energy value-chain as a serious, large-scale violation of human, labour and child rights. It foregrounds the individuals and communities victimised by these rights violations, including Uyghur and other minority victims and survivors of state-perpetrated human rights violations in XUAR, and artisanal mining communities extracting cobalt in DRC. Victims are platformed not only as witnesses to the facts on the ground – for example providing testimony to parliamentary and other investigative processes – but also as rights-bearers. Given the right institutional setting, these rights-bearers may be able to achieve remedy for these rights violations.

The **Supply-Chains** current shifts the focus of policy action from rights to risk and from victims to business. It focuses on the risks posed by forced labour to both individual businesses and to the efficient and reliable operation of the supply-chain. The Supply-Chains current looks to business to address modern slavery risks through improved tracing, due diligence and supply chain remediation. Government is expected to set the incentives and parameters to which the market then responds. This current is the focus of many regulatory efforts, and championed by many industry associations.

The **Autarky** current focuses less on the risks posed to business and more on the risks posed to the political community and political economy by dependence on foreign producers. It suggests a need to 're-shore' value-chains and establish sovereign control through increased domestic production capacity and/or market access standards. It is the focus of emerging policy proposals in the US and EU.

The **Collective Action** current frames reduction of modern slavery risks and carbon emissions not as a tension between competing policy objectives, but as mutually reinforcing goals. This builds on a growing body of evidence suggesting that modern slavery risks often overlap with environmentally destructive production systems and business models.[xix] This is also true in solar energy production, where forced labour risks seem to coincide with lax environmental controls and high carbon emissions. The Collective Action current suggests that the goal should not be narrowly to reduce modern slavery risks in established supply-chains, but rather collective action to transform the solar energy production system so that it is truly just and equitable, promoting not only the freedom of consumers from fossil fuel dependence but also the freedom of workers and producers.

Estimating modern slavery risk

Effective supply-chain due diligence in the solar energy value-chain is made more difficult by weak state capacity in DRC and state resistance in China. This can make it difficult to identify and measure forced labour risk at the worksite, project, enterprise and investment instrument level. Therefore, the sector needs to develop new, complementary approaches to estimating modern slavery risk in the value-chain.

This research develops and demonstrates a new estimation technique for forced labour risk per kWh (FLR/kWh) and per USD Levelized Cost of Electricity (FLR/USD LCOE) in the production of photovoltaic (PV), on-grid energy at the national energy production system level. This involves combining supply-chain inventory, LCOE, export-import and social impact datasets from multiple sources. This method provides detailed insights into the nature, size and source of forced labour risks in country-level PV, on-grid production systems. With the right input data, it could be adapted to firm-level inventories, allowing inter-firm and project-level comparison, which may prove useful for developers and investors.

This method also allows tracing of how changes in the forced labour risk associated with specific inputs, such as polysilicon, cascade through the value-chain to different production systems. An interactive suite of country profiles for the top 30 PV producing countries in the world is available at https://tabsoft.co/3K80caK.

Solutions – a 'Just Transition' roadmap

A roadmap with clearly announced expectations and milestones could help transition the solar energy value-chain to a slavery-free footing. The aim should be to transition solar energy production towards a more responsible business model that accounts for and addresses the system-level effects of policies in energy production and storage and in related, high-use industries such as transportation.

Such an approach would create greater certainty for developers, investors and consumers, and help create efficiency by allocating costs to those that are the highest sources of modern slavery risk in the system. The current approach, which relies on non-uniform, unscalable and organic risk identification processes is less efficient, less predictable, and spreads risk mitigation costs across all actors, rather than allocating them to those that are, in fact, the greatest source of risk.

Whether solar energy will prove to be 'the energy of freedom' for energy consumers alone, or also for workers and producer communities, has not yet been decided. A roadmap will be critical to ensuring the solar industry is regarded in the future not as a source of modern slavery risk, but as 'the energy of freedom'. The policy choices we make around these questions in the months and years ahead may reveal much about the emerging political economy of the global Just Transition – and the freedoms that the emerging global order will offer or deny.

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[ii] Dmitrii Bogdanov et al. (2021). 'Low-cost renewable electricity as the key driver of the global energy transition towards sustainability', *Energy,* Volume 227, article number 120467.

[iii] Joan Fitzgerald (2021). 'The Case for Taking Back Solar', *The American Prospect*, 24 March 2021, available at https://prospect.org/environment/climate-of-opportunity/case-for-taking-back-solar/.

[iv] Laura Murphy and Nyrola Elimä (2021). *In Broad Daylight: Uyghur Forced Labour and Global Solar Supply Chains*, Sheffield, UK: Sheffield Hallam University Helena Kennedy Centre for International Justice, available at https://www.shu.ac.uk/helena-kennedy-centre-international-justice/research-and-projects/all-projects/in-broad-daylight.

[v] ILO (2022). *2022 Report on the application of international labour standards.* Report of the Committee of Experts on the Application of Conventions and Recommendations, International Labour Conference, 110th Session (Geneva: International Labour Conference) Available at https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---relconf/documents/meetingdocument/wcms_836653.pdf.

[vi] Murphy and Elimä, 2021; Darren Byler (2021). *In the Camps: China's High-Tech Penal Colony*. New York, NY: Columbia Global Reports; Uyghur Tribunal (2021). *Judgment*. London, 9 December 2021. Available at https://uyghurtribunal.com/wp-content/uploads/2022/01/Uyghur-Tribunal-Judgment-9th-Dec-21.pdf; James Milward and Dahlia Peterson (2020). 'China's system of oppression in Xinjiang: How it developed and how to curb it', *Brookings Institute,* September 2020, available at https://www.brookings.edu/wp-content/uploads/2020/09/FP_20200914_china_oppression_xinjiang_millward_peterson.pdf; Adrian Zenz (2020a). Sterilizations, IUDs, and mandatory birth control: The CCP's campaign to suppress Uyghur birthrates in Xinjiang. Working Paper, 21 July. Washington, DC: The Jamestown Foundation. Available from: http://www.jamestown.org/wp-content/uploads/2020/06/Zenz-Internment-Sterilizations-and-IUDs-UPDATED-July-21-Rev2.pdf?x58715; Adrian Zenz (2020b). Coercive Labor in Xinjiang: Labor Transfer and the Mobilization of Ethnic Minorities to Pick Cotton. New Lines Institute for Strategy and Policy, December 2020. Available at https://newlinesinstitute.org/wp-content/uploads/20201214-PB-China-Cotton-NISAP-2.pdf; and Jo Smith Finley (2019). Uyghur Islam and Religious "De-Extremification": On China's Discourse of "Thought Liberation" in Xinjiang", in Oxford Islamic Studies Online, OUP, 2019, available at http://www.oxfordislamicstudies.com/Public/focus.html.

[vii] Uyghur Tribunal, 2021; Edward Wong and Chris Buckley (2021). 'U.S. Says Chinese Repression of Uighurs is 'Genocide"', *New York Times*, 27 July 2021.

[viii] World Economic Forum (2019). *'*A Vision for a Sustainable Battery Value Chain in 2030: Unlocking the Full Potential to Power Sustainable Development and Climate Change Mitigation'*, Global Battery Alliance,* September 2019, available at https://www.globalbattery.org/media/publications/WEF_A_Vision_for_a_Sustainable_Battery_Value_Chain_in_2030_Report.pdf.

[ix] World Economic Forum (2020). 'Making Mining Safe and Fair: Artisanal cobalt extraction in the Democratic Republic of the Congo', *White Paper*, 15 September 2020, available at https://www.weforum.org/whitepapers/making-mining-safe-and-fair-artisanal-cobalt-extraction-in-the-democratic-republic-of-the-congo; Dionne Searcey, and Eric Lipton (2021). 'Hunt for the 'Blood Diamond of Batteries' Impedes Green Energy Push', *New York Times*, 29 November 2021, available at https://www.nytimes.com/2021/11/29/world/congo-cobalt-albert-yuma-mulimbi.html.

[x] WEF, 2020; Amnesty International (2016). '"This is what we die for": Human rights abuses in the Democratic Republic of the Congo power the Global Trade in Cobalt'. Amnesty International*,* AFR 62/3183/2016, 19 January 2016, available at https://www.amnesty.org/en/documents/afr62/3183/2016/en/; Chris N. Bayer. and Anthony Cooper (2019). 'Worst Forms of Child Labour in the Democratic Republic of the Congo: Cobalt Refiner Due Diligence Reporting Development International', *Development International,* 31 July 2019, available at https://www.academia.edu/43763413/Cobalt_Refiner_Due_Diligence_Reporting; Anna Triponel, Susannah McLaren and Tom Fairlie (2021). **'**Call to Action: Putting People at the Heart of the Decarbonization of Transportation**'**, *Cobalt Institute*, 28 October 2021, available at https://www.cobaltinstitute.org/news/call-to-action-putting-people-at-the-heart-of-the-decarbonization-of-transportation/.

[xi] ILAB (2020a). 'List of Goods Produced by Child Labor or Forced Labor', *Bureau of International Labor Affairs*, 2020, available at https://www.dol.gov/agencies/ilab/reports/child-labor/list-of-goods

[xii] James Cockayne (2021b). *Overview Policy Brief*, www.xinjiangsanctions.info.

[xiii] G7 (2021a). Carbis Bay G7 Summit Communiqué, Cornwall, 13 June 2021, available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1001128/Carbis_Bay_G7_Summit_Communique__PDF__430KB__25_pages_.pdf

[xiv] David Wagman (2021a). 'Customs enforcement is jeopardizing 2.1 GW of solar projects', *PV Magazine*, 20 August 2021, available at https://www.pv-magazine.com/2021/08/20/us-customs-enforcement-is-jeopardizing-2-1-gw-of-solar-projects/.

[xv] David Wagman (2021e). 'Price increases hit solar as trade uncertainties with China cloud growth goals', *PV Magazine*, 14 September 2021, available at https://pv-magazine-usa.com/2021/09/14/price-increases-hit-solar-as-trade-uncertainties-cloud-aggressive-growth-goals/.

[xvi] Corinne Lin (2021). 'Polysilicon amid international trade disputes', *PV Magazine*, 14 September 2021, available at https://www.pv-magazine.com/2021/09/14/polysilicon-amid-international-trade-disputes/.

[xvii] David Wagman (2021d). 'What energy storage can learn from solar import's woes', *PV Magazine*, 13 October 2021, available at https://pv-magazine-usa.com/2021/10/13/what-energy-storage-can-learn-from-solars-import-woes/

[xviii] *Doe 1 et al v. Apple Inc. et al*, (2019) No. 1:19-cv-03737 D.D.C., available at http://iradvocates.org/sites/iradvocates.org/files/stamped%20-Complaint.pdf

[xix] Kevin Bales (2016). *Blood and Earth: Modern Slavery, Ecocide, Climate Change* (Random House); Kevin Bales and Benjamin K. Sovacool (2021). 'From forests to factories: How modern slavery deepens the crisis of climate change', *Energy Research & Social Science*, vol. 77, July 2021, 102096; Bethany Jackson, Jessica L. Decker-Sparks, Chloe Brown and Doreen S. Boyd (2020). 'Understanding the co-occurrence of tree loss and modern slavery to improve efficacy of conservation actions and policies', *Conservation Science and Practice*, 2020;2:e183.