IN BROAD DAYLIGHT

Uyghur Forced Labour and Global Solar Supply Chains

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Sheffield Hallam University | Helena Kennedy Centre for International Justice

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MAY 2021

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THE HELENA KENNEDY CENTRE FOR INTERNATIONAL JUSTICE AT SHEFFIELD HALLAM UNIVERSITY is a leading centre for social justice and human rights research, practice, and pedagogy. It provides a vibrant environment at the cutting edge of legal and criminal justice practice which prepares students for excellence in their chosen professional careers.

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EXECUTIVE SUMMARY

The People's Republic of China (PRC) has placed millions of indigenous Uyghur and Kazakh citizens from the Xinjiang Uyghur Autonomous Region (XUAR or Uyghur Region) into what the government calls "surplus labour" (富余劳动力) and "labour transfer" (劳动力转移) programmes. An official PRC government report published in November 2020 documents the "placement" of 2.6 million minoritised citizens in jobs in farms and factories within the Uyghur Region and across the country through these state-sponsored "surplus labour" and "labour transfer" initiatives. The government claims that these programmes are in accordance with PRC law and that workers are engaged voluntarily, in a concerted government-supported effort to alleviate poverty. However, significant evidence – largely drawn from government and corporate sources – reveals that labour transfers are deployed in the Uyghur Region within an environment of unprecedented coercion, undergirded by the constant threat of re-education and internment. Many indigenous workers are unable to refuse or walk away from these jobs, and thus the programmes are tantamount to forcible transfer of populations and enslavement.

It is critical that we examine the particular goods that are being produced as a result of this forced labour regime. This paper focuses on just one of those industries – the solar energy industry – and reveals the ways forced labour in the Uyghur Region can pervade an entire supply chain and reach deep into international markets. We concluded that the solar industry is particularly vulnerable to forced labour in the Uyghur Region because:

- 95% of solar modules rely on one primary material – solar-grade polysilicon.
- Polysilicon manufacturers in the Uyghur Region account for approximately 45% of the world's solar-grade polysilicon supply.
- Hoshine Silicon Industry, the metallurgical-grade silicon producer in the region with the highest production capacity, has participated in labour transfer programmes and has significant exposure to forced labour through its quartz supplier.
- All four of XUAR's polysilicon manufacturers – Daqo, TBEA (and subsidiary Xinte), Xinjiang GCL, and East Hope – have reported their participation in labour transfer or labour placement programmes and/or are supplied by raw materials companies that have.
- Daqo alone is a supplier to the four largest solar module manufacturers in the world – JinkoSolar, Trina Solar, LONGi Green Energy, and JA Solar.
- In 2020, China produced an additional 30% of the world's polysilicon on top of that produced in the Uyghur Region, a significant proportion of which may be affected by forced labour in the Uyghur Region as well.

In the course of this research, we identified

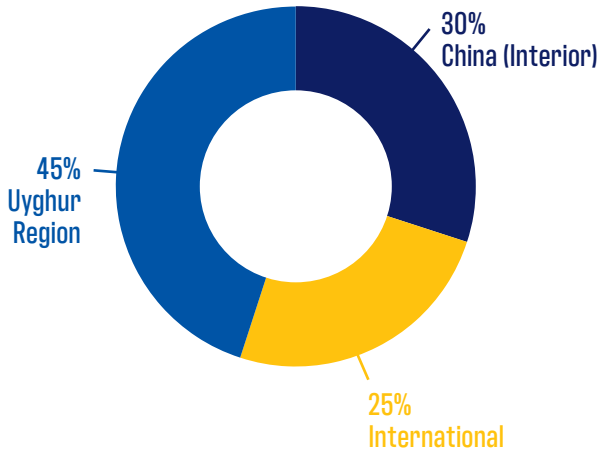
- 11 companies engaged in forced labour transfers
- 4 additional companies located within industrial parks that have accepted labour transfers
- 90 Chinese and international companies whose supply chains are affected

This report seeks to increase the knowledge base upon which the solar industry determines its exposures to forced labour in the Uyghur Region. We investigated the entire solar module supply chain from quartz to panel to better understand the extent to which forced labour in the Uyghur region affects international value chains. The examples of engagement in these programs are meant to provide stakeholders with the evidence base upon which to judge risk of exposure to forced labour in the solar supply chain.

While Xinjiang accounts for 45% of the world's solar-grade polysilicon supply, 35% more of it comes from other regions of China, and 20% from outside of China. Experts agree that this is enough to supply the United States and Europe's needs for solar modules. However, this does not account for the companies in the interior of China and internationally whose supply chains are likely affected by manufacturing in the Uyghur Region. The extent to which Xinjiang metallurgical-grade silicon and polysilicon pervades the market means that module manufacturers that want to avoid producing goods that are potentially tainted by forced labour in Xinjiang will have to scrutinise their supply chains thoroughly, all the way to the raw quartz materials, to determine if they are produced with forced labour or blended with affected materials. They will have to demand that the polysilicon that goes into the manufacture of their wafers is not sourced from companies engaged in forced labour transfers. This effectively leaves only a few Chinese alternatives with no confirmed exposure to forced labour in the Uyghur Region.

The solar supply chain is relatively easy to map, and identifying forced labour exposure in Xinjiang is less of a challenge than in industries such as textiles or agriculture. And doing so is critical, as it would not only address the forced labour issue in Xinjiang but would also substantially reduce the carbon emissions of the solar industry. From a human rights and climate perspective, the alternative of basing our green energy future on coal's high carbon emissions and on the forced labour of oppressed communities is a higher and longer-term price to pay.

2020 Polysilicon Market Share



A Note on Sources

Wherever possible, we provide official corporate documentation as evidence of the claims made in this paper. In some instances, we have had to rely on other publicly available sources, including state media, corporate publicity, and social media (including Weixin). These reports tend to reflect the interests of the companies investigated in our research, and so may at times exaggerate successes and/or the facts. However, we take company representatives and company websites and advertisements at their word regarding their participation in surplus labour and state-sponsored labour transfer programmes in the Xinjiang Uyghur Autonomous Region.

I. INTRODUCTION

Forced Labour in the Uyghur Region

In the spring of 2018, significant evidence began to emerge that the People's Republic of China (PRC) government understood its system of detention centres and internment camps as merely one part of a massive transformation of the Xinjiang Uyghur Autonomous Region (XUAR or Uyghur Region) into a docile and lucrative economic hub.[1] While continuing to hold indigenous citizens of the region in internment camps without trial, regional and local governments shifted their focus to the creation of an enormous forced labour regime. This system had the explicit goal of employing practically every adult citizen and was accompanied by the justification that the programme would increase both the economic productivity and the "stability" of the region.

To those ostensible ends, the Chinese Communist Party (CCP) has placed millions of indigenous Uyghur and Kazakh citizens from the XUAR into what the government calls "surplus labour" (富余劳动力) and "labour transfer" (劳动力转移) programmes. An official PRC government report published in November 2020 documents the "placement" of 2.6 million minoritised citizens in jobs in farms and factories within the Uyghur Region and across the country through state-sponsored "surplus labour" initiatives.[2] By the CCP's own calculations, this represents a 46.1% year-on-year increase in the number of XUAR citizens "transferred" for work. If the government's figures are correct, this indicates that approximately a fifth of the Uyghur and Kazakh population of XUAR is engaged in labour relocation programmes.

Workers manually crush silicon in Jingang Circular Economy Industrial Park, Ili Prefecture, Xinjiang. Source: Kokodala News via Weixin.

The government claims that these programmes are in accordance with PRC law and that workers are engaged voluntarily, in a concerted government-supported effort to alleviate poverty. However, this expansive labour transfer system as it is practiced in the Uyghur Region represents something more complex and coercive than the government might suggest. Employing government documents and state media reports, researchers have clearly identified that, as they are practiced in the XUAR, these so-called "surplus labour" and "labour transfer" initiatives are in fact mechanisms of a massive programme of compulsory labour.[3] Evidence reveals that labour transfers are deployed in the Uyghur Region within an environment of unprecedented coercion, undergirded by the constant threat of re-education and internment. Many indigenous workers are unable to refuse or walk away from these jobs, and thus the programmes are tantamount to forcible transfer of populations and enslavement.

The first evidence that people held in the camps were being forced to work in factories was revealed by PRC state media, which celebrated the transformation of the internment camp victims into model citizens through labour in factories located on the premises of the camps.[4] First-person testimony of people who have been held in the camps, worked as security guards or teachers within the camps, or have relatives in the camps confirms that Uyghur, Kazakh, and other minoritised citizens held in internment camps have been compelled to work as part of their daily schedules.[5]

People who are purportedly "released" or "graduated" from the internment camp system are often required as part of their release to work in factories near the camps in which they were once interned.[6] Journalists, scholars, and independent researchers who exposed this situation relied on public information – including government speeches and directives – to make their claims. For instance, Shohrat Zakir, Chairman of the XUAR, stated in October 2018 that "trainees" who completed their terms in the internment camps (called "vocational skills training education centres" by government sources)[7] would be placed in jobs with "settled enterprises" through a "seamless link between learning in school and employment in society."[8] Reporters have identified at least 135 camps that are co-located with or are proximate to factories.[9] In April of 2018, Kashgar regional government alone reported that they had plans to transfer 100,000 people from "vocational training" to employment, providing significant subsidies to the companies that took on these forced labourers.[10] First-person testimony of survivors of the camps and stories relayed through family members of released detainees who have been forced to work has indicated that participation in the programmes is not voluntary for camp detainees and is coerced through threats of further imprisonment.[11]

> Labour transfers are deployed within an environment of unprecedented coercion, undergirded by the constant threat of re-education and internment.

In addition to compelling internment camp victims to work, the CCP has designated as "surplus labour" those citizens living outside the camps who lack jobs, are seasonally employed, work as small-scale farmers, or are retired. Government-sponsored surplus labour transfer programmes have long existed in the XUAR, but the efforts have expanded and intensified in recent years. In 2018, the XUAR government announced a programme to "transfer" 100,000 workers to jobs within and outside the region within three years.[12] Local governments are required to identify all "surplus labourers" and induce them to take jobs in factories either close to home or further afield. As one 2018 county-level government directive indicated, in some regions, government agents or labour recruiters go household to household and assign each Uyghur or Kazakh person a point value and one of three categorisations – "controlled," "general," or "assured." These categories determine how far a person's work placement will be from home: those who need to be controlled are sent for "training;" all others are sent to work, either close to home or across the country. No one is exempt: "All surplus labour force in the jurisdiction shall be managed by a quantitative points system, so as to ensure that all the surplus labourers in the jurisdiction who should be trained are trained, and all who should be employed are employed." It continues: "If, during organization, publicity campaigns, and mobilization efforts of all villages and townships, there are people who are discovered to be able to participate in training but are unwilling to participate in training, or who are able to go elsewhere for employment but are not active in seeking employment, or have outdated concepts or stubborn thinking, the corresponding points should be deducted."[13]

The recruitment strategies deployed by government agencies on behalf of corporations suggest significant

coercion. Interviews with a government cadre and a former detainee revealed that people with family members in the internment camps were coerced into working in factories when government officials promised that their labour would improve their detained family members' scores and hasten their release. The former detainee said "I learned that if one family [member] was in a camp you have to work so father or husband can get out quickly."[14] State media and government-funded reports provide evidence that government and private labour agencies repeatedly intervene in the lives of rural villagers until they relent to being transferred – often first through language and ideological training and surveillance, and then through repeated attempts to "encourage" them to leave their villages for industrial labour in spite of any personal or financial investments they may have in land, homes, family, or communities.[15] State media reported the story of an elderly farmer who was pressured to adopt sheep by workers stationed with the Xinjiang Production and Construction Corps. Even though he repeatedly resisted because he knew nothing about raising sheep and in the end was compelled to spend significant money to buy the unwanted sheep when the government subsidy was not enough to cover the full cost of the ten sheep, he was nonetheless compelled to purchase and raise the sheep. It was only through repeated visits and insistence that the farmer participated in the state-sponsored labour programme.[16] A Chinese media (CCTV) broadcast told another story of several young women who were distraught at the thought of leaving their families and lives behind to go work thousands of miles away, but government officials and labour agents harassed the women for days, promising them the ability to return home at any time and great wealth in order to convince them to go, which they only did reluctantly.[17] In order to "relieve migrant labourers of their worries," the government has created nurseries and elder care facilities to manage the families who are left behind by transferred labourers.[18] The government also transfers land into its own possession (for a small rental fee), purportedly to free farmers to move away from their hometowns.[19]

Lop County #4 Re-Education Camp.
Source: Xinjiang Justice Department via Weixin

State reports and directives regarding these labour transfer programmes promote the idea that the indigenous people of the region are lazy and unproductive and committed to their own poverty. The reports state that labour transfers are meant to discipline minoritised people and train them to be productive citizens, even if they are otherwise uninterested in these personal changes. In the local government labour transfer directive mentioned above, labour agencies were directed to "have organizational discipline in place and implement militarised management to make people with employment difficulties get rid of selfish distractions, to change their long-cultivated lazy, idle, slow, and inconstant behaviours of personal freedom, to abide by corporate rules and regulations and work discipline, and to devote themselves fully to daily production. The government should use iron discipline to ensure that worker cooperation results in a 1+1>2 result."[20] A PRC government-funded study conducted by Nankai University concluded that one of the impediments to the success of the surplus labour transfer strategy was that, "fettered by traditional concepts, there are still some labourers who are unwilling to move far away from home and have serious homesickness," despite "the government's serious guiding efforts over the past several years," indicating that these programmes are not voluntarily chosen by all who are employed by them.[21]

Though state-sponsored labour transfers and so-called "poverty alleviation" (扶贫) strategies (and indeed forced labour) have long existed in the Uyghur Region[22] and also operate in other parts of the PRC, they

are now operating in the XUAR against a backdrop of mass internment and extra-judicial imprisonment, which make refusal to participate a non-option. While there may be some people who would choose to be deployed to a factory through a labour transfer, in the XUAR, it is impossible for a citizen to refuse these supposed opportunities for "poverty alleviation" because if they do, there are dire consequences. In a lengthy justification of the labour transfer programmes released in September 2020, the CCP claimed that "terrorists, separatists, and religious extremists" incite the region's indigenous citizens to "refuse to improve their vocational skills, economic conditions, and the ability to better their own lives" as a justification for requiring local governments to implement these labour transfers at a mass scale.[23] Thus, the programmes are grounded in the logic of labour as a strategy of anti-terrorism. For Uyghur people to resist state-sponsored programmes purportedly designed to encourage vocational skills and "poverty alleviation" would be to align themselves with the above named "three evils," which are the rationale for the CCP's crackdown and criminalization in the Uyghur region, including the camp system.[24] Han "relatives," who are assigned to visit and even live in Uyghur homes to educate them in appropriate behavior and monitor them carefully for signs of deviation from party ideology, are required to report anyone who resists "poverty alleviation" programmes such as the labour transfers.[25] These practices of surveillance support the logic of anti-terrorism that undergirds the labour transfer system. Together, they ensure that minoritized citizens do not have a legitimate opportunity for choice when asked to participate in state-sponsored labour transfer programmes.

As further evidence that these are not voluntary programmes that are designed to lift people out of poverty, there is the fact that many of the people who work in the camps are trained professionals and business people (e.g. university graduates, film makers, dentists, nurses, medical professionals, restauranteurs, business owners, engineers, marketing professionals, or retirees) who are not under-employed and who would not otherwise work in factories.[26] Nonetheless, they are forced to work in what the CCP calls "labour-intensive" industries. Others are forced to be complicit in the work of the camps, assigned to work as teachers (a leaked government list names several camp graduates recruited as teachers) or security guards in the camps, despite sometimes having been victims of the camps themselves.[27] Again the Nankai report is helpful in contextualizing why this might be the case – the report indicates that the labour transfer regime "not only reduces the Uyghur population density in Xinjiang but is also an important method to influence, integrate, and assimilate Uyghur minorities," (感化，融化，同化)[28] thus poverty alleviation is not the sole or even likely the primary motivating factor for the programme.

> These programmes deny citizens the human right to free choice of employment afforded by Article 23 of the U.N. Declaration of Human Rights.

Many of the factories employing supposedly free XUAR citizens are surrounded by razor-wire fences, iron gates, and security cameras, and are monitored by police or additional security, while Han workers' mobility is unrestricted in the workplace and in the ability to return home.[29] In many cases, Uyghur and Kazakh workers are not allowed to leave the factories voluntarily.[30] First-person reports indicate that people working in the camps are either unpaid, paid far less than the minimum wage, or have their salaries reduced with the explanation that they owe a debt to their employers for food or transport to work.[31] Reports suggest that local police hold workers' identification cards, controlling their movement.[32] The restriction of the rights to free movement and to walk away from employment are indicators of forcible transfer and human trafficking. Some who have escaped this

forced labour regime have explicitly described it as "slavery."[33]

The evidence regarding labour transfers for the indigenous people of the XUAR points to clear indicators of human trafficking and compulsory labour as defined by international conventions regarding labour rights. Indeed, these programmes deny citizens the human right to free choice of employment afforded by Article 23 of the U.N. Declaration of Human Rights.[34] The United Nations' Palermo Protocol prohibits "the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability, or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation."[35] These labour transfer strategies clearly suggest the indicators of forced labour identified by the ILO, including (at a minimum): abuse of vulnerability, deception, restriction of movement, isolation, intimidation and threats, retention of identify documents, withholding of wages, and potentially debt bondage.[36] The International Labour Organization's (ILO) Forced Labour Convention of 1930 defines forced or compulsory labour as: "all work or service which is exacted from any person under the threat of a penalty and for which the person has not offered himself or herself voluntarily,"[37] and in 1957 they further prohibited member states from employing compulsory labour

- (a) as a means of *political coercion or education* or as a *punishment for holding or expressing political views* or *views ideologically opposed* to the established political, social or economic system;
- (b) as a method of mobilising and using labour for purposes of *economic development*;
- (c) as a means of *labour discipline*;
- (d) as a punishment for having participated in strikes;
- (e) as a means of *racial, social, national or religious discrimination*.

It is clear from the evidence presented above that the CCP's labour transfer programme in the Uyghur Region is used to punish people with oppositional ideological views, to create a regime of economic development built on compulsory labour, and to discipline the masses whom they deem to be inherently deficient because of their race and religion. While the PRC government justifies these programmes as "poverty alleviation" strategies, the spectre of internment camps looms, creating a situation in which no Uyghur or other minoritised citizen could refuse participation in these government-run programmes without risk of being sent to the camps. This clearly contravenes the ILO convention, to which the PRC is subject because all member states must comply with the four fundamental principles of the ILO, which includes the abolition of slavery.[38]

Because the Chinese government has invested vast resources in this unprecedented system of compulsory labour and because that system so clearly contravenes the conventions that govern labour rights internationally, it is critical that we examine the particular goods that are being produced as a result. This paper focuses on just one of those industries – the solar energy industry – and reveals the ways forced labour in the Uyghur Region can pervade an entire supply chain and reach deep into international markets.

Xinjiang Production and Construction Corps

The Xinjiang Production and Construction Corps (also called the XPCC or bingtuan) is a state-operated paramilitary corporate conglomerate that had a gross production value of nearly CNY 275 billion in 2019.[39] It might be most easily understood as a prefectural government; it governs 2.43 million people across 10 distinct cities and 37 towns, dispersed across the vast Xinjiang Uyghur Autonomous Region like an archipelago. In addition to operating local governments, the XPCC also owns and operates a corporate empire that includes 14 publicly listed companies and (by one estimate) as many as 862,600 direct and indirect holdings.[40] One metric of its importance in the Chinese economy is the fact that the XPCC grows 30% of the PRC's cotton.[41]

The XPCC has come under increased scrutiny in recent years because it is also involved in operating and supporting some of the internment camps where minoritised citizens are being held for re-education in the Uyghur Region, and it facilitates forced labour transfers.[42] As a result of its deployment of re-education, internment, and forced labour, the XPCC has been subject to a U.S. government Withhold Release Order that bans the importation of all cotton products produced in whole or in part by the state conglomerate.

While the XPCC does not directly own or operate any metallurgical-grade silicon or solar-grade polysilicon facilities, they do operate many of the industrial parks within which the manufacturers are located. The XPCC promises significant benefits to companies that locate in their industrial parks, with the motto of "You build the project; we will handle the formalities."[43] Those formalities can include anything from reduced rents and utilities for manufacturing sites to providing logistics, warehousing, and transport of finished goods. We have included corporate engagement with the XPCC in this report to illustrate the ways the XPCC may have affected the solar supply chain.

The Making of a Solar Panel

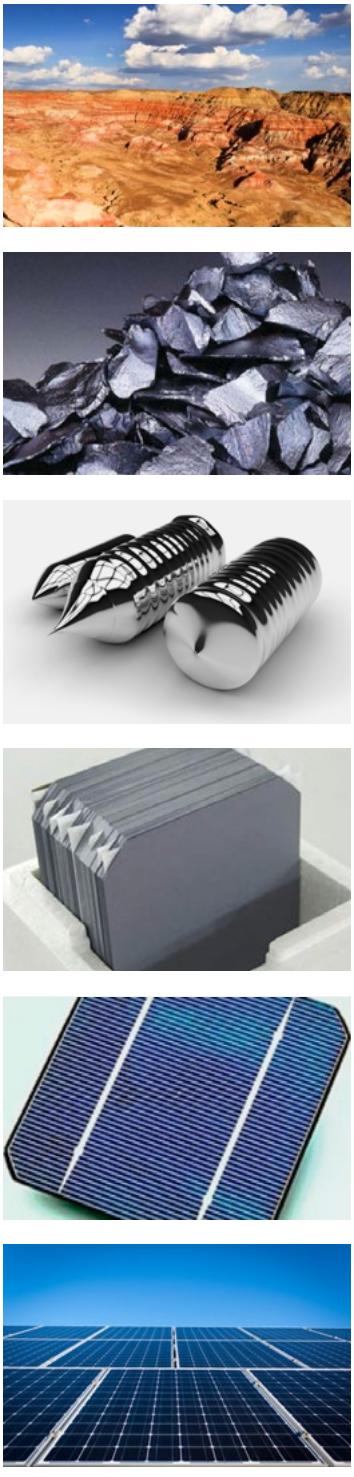


Image credits: raw materials: Zhundong Economic and Technological Development Zone promotional video (still); polysilicon: Daqo New Energy; ingots: Peter Soboley via 123rf; wafers: DS New Energy; cells: U.S. Department of Energy; modules: DSM Functional Coatings (PR001) via Flickr.

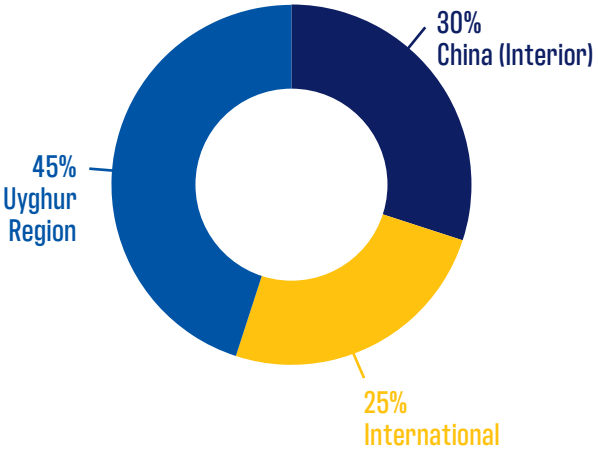
Incentivizing Solar in the Uyghur Region

Around 95% of solar modules rely on one primary material – solar-grade polysilicon.[44] Until 2005, seven companies headquartered in the United States, Germany, and Japan made practically all of the polysilicon needed to manufacture solar modules for the world; the People's Republic of China had almost no presence in the polysilicon market. One Chinese company, Emei Semiconductor, produced a very small amount of polysilicon, not even enough to begin to address China's own domestic requirements, where solar energy generation plants were increasingly under development.

After only fifteen years in the industry, the PRC now dominates the global solar energy supply chain.[45] In 2020, China produced nearly 75% of the world's polysilicon (including solar-grade and electronic-grade). The four largest producers in Xinjiang alone account for around 45% of the world's solar-grade polysilicon supply. The journey to this extraordinary market share only took 15 years, and it saw rapid acceleration in the last five. As polysilicon expert Johannes Bernreuter put it, the top six producers of polysilicon alone "reached a production capacity of 470,000 MT in 2020 – almost as much as all polysilicon manufacturers had in total worldwide at the end of 2015."[46] Five of those companies are in China; four of them have facilities in the Uyghur Region.

The first major polysilicon company to emerge in China, GCL-Poly Energy Holdings, started manufacturing in 2007 in Xuzhou and was the world's leading supplier of polysilicon by 2013. Other companies soon followed suit. Tongwei Solar Company's subsidiary Sichuan Yongxiang broke into the polysilicon competition in 2008 and has since risen to become the polysilicon producer with the highest production capacity in the world. Daqo New Energy began operations the next year and quickly became a significant supplier of polysilicon for a wide range of downstream manufacturers. Tebian Electric Apparatus Stock Company's (TBEA) subsidiary Xinte New Energy Company began producing polysilicon in 2009. The Chinese polysilicon industry began significantly expanding capacity after 2013, when the PRC government imposed duties on U.S. polysilicon imports, which currently remain in effect.[47] With those duties in place, Tongwei, Daqo, and Xinte all significantly expanded their polysilicon production capacity to meet domestic need.

2020 Polysilicon Market Share



TBEA was the first of the solar industry manufacturers to recognise that the abundant natural resources in the Uyghur Region was a benefit to business and would lower prices far below that of international manufacturers. TBEA headquartered its subsidiary TBEA Silicon Industry Company (renamed Xinte Energy in 2012) on the distant outskirts of the XUAR's capital Urumqi in 2008, and it built a coal-fired power plant in the Zhundong Economic and Technological Development Zone in 2009 to take advantage of the Uyghur Region's resources. The company simultaneously invested in a massive industrial park and logistics centre that would become a hub for the transport of the new energy materials being manufactured in the region. Daqo relocated all of its polysilicon production from Chongqing to Shihezi, XUAR in 2011/2012, to be closer to the raw materials used in the manufacturing process.

In the fall of 2016, the Xinjiang Party Committee and People's Government began promoting the expansion of several industries (including silicon and polysilicon) in Xinjiang as part of the "Made in China 2025" strategy.[48] In the "13th five-year plan on national economic and social development of the Xinjiang Uyghur Auton-

omous Region," the regional government encouraged companies to take advantage of the Uyghur Region's rich resources to become internationally competitive in industrial production, with a special emphasis placed on the development of the non-ferrous metals, polysilicon, and mono- and polycrystalline wafers that are essential components of solar module production. The five-year plan cited explicit concerns about the "fragility" of the ecological environment, the "lack of water resources," and the economic, social, and educational inadequacies of the workers to be "transferred" to the industries that would move into the region.[49] One significant solution to these challenges outlined within the five-year plan was to provide companies with subsidies that would allow them to better "absorb employees" through training programmes and insurance subsidies. Companies were directed to "give full play to the enterprise's principal role in promoting employment."[50] In 2017, the Xinjiang government declared that two main regions to be the only two sites for new development of silicon industry projects – the Turpan Shanshan Industrial Park for raw materials and the Zhundong Economic and Technological Development Zone for polysilicon manufacturing. Corporate development in these sites promised significant tax incentives and additional "added value" from the government.[51]

These programmes and incentives initiated a rush to build in the Uyghur Region. By 2018, the Uyghur Region had seen a significant expansion of the polysilicon industry. GCL-Poly built facilities within and on the outskirts of the massive Zhundong Zone, in a joint venture with Zhonghuan Semiconductor (the world's second largest producer of solar wafers). Polysilicon newcomer East Hope New Energy built an industrial park for a new production facility, which also began operation in the Zhundong coalfield in 2018. The company also established a metallurgical-grade silicon manufacturing subsidiary in the same park, locating all of the production steps in one small area, deliberately keeping down transportation and fuel costs. Xinte Energy expanded their manufacturing in the XUAR as well, locating its Crystalline Silicon Co. manufacturing site only a few miles outside Zhundong in 2018. Add to that the fact that JinkoSolar, the world's second largest solar module manufacturer, completed the final phases of the construction of its Xinjiang ingot production facility in 2018, and it is clear that Xinjiang was indeed effectively transformed into a significant centre for solar energy manufacturing as predicted.

Polysilicon Capacity 2020

RANK	COMPANY	CAPACITY (IN TONS)
1	Tongwei	96,000
2	GCL-Poly	90,000
3	Wacker	84,000
4	Daqo New Energy	80,000
5	Xinte Energy	80,000
6	East Hope	40,000

From Dernreuter Research

By 2020, smelting and processing of non-ferrous metals (which includes metallurgical-grade silicon and polysilicon) accounted for more than 5% of Xinjiang's gross industrial output, and the generation of electricity (which many of these companies also engage in) accounted for 20% – all of this due in part to the expansion of the polysilicon industry into the region.[52] It was the capitalization on cheap energy prices that were unavailable to international competitors (at least in part because energy costs multiple times more in other countries) that allowed China's polysilicon manufacturers to grow so quickly and to rank as five of the top six highest-capacity producers in the industry by the end of 2020. Two Korean companies, OCI and Hanwha Solutions, had been riding a similar upward trajectory in the 2010s, but they could not compete with China's cheap production costs. In February of 2020, both companies declared that they would shutter their polysilicon production facilities in Korea (though OCI still runs a polysilicon plant in Malaysia), leaving the PRC in a position to dominate the industry almost entirely.[53]

It is perhaps not a coincidence that the period between 2016 and 2018 saw a significant expansion of the polysilicon industry in the Uyghur Region. Low energy prices were indeed a draw for many companies. In

fact, a wide variety of industries were expanding into the XUAR at that time, in part in response to cheaper production costs in the region. However, it was not cheap coal alone that lowered the costs and increased the incentives of doing business in the Uyghur Region.

The Competitive Advantage of Forced Labour

The solar industry is not alone in its rapid expansion into the XUAR. The CCP has set ambitious targets for the growth of its industries, and they have determined that the Uyghur Region will be a strategic centre for development of their exports to the West, as well as for their national security, stability, and "unity of the motherland."[54] In an effort to facilitate the expansion of industry in the Uyghur Region, XUAR prefectural governments have provided significant financial and tax incentives to corporations that move to or build facilities in Xinjiang. Starting as early as 2010, governments exempted companies that moved into the "difficult regions of Xinjiang" from all corporate income tax from their first to second year and it was reduced to 50% from their third to fifth year.[55] Local prefectures added to the incentives. In Ili Prefecture (where JinkoSolar's Xinjiang factory is located), for instance, new companies that made at least 50% of their sales from products for export, and existing companies that made at least 70% of their sales from products for export, were granted exemptions for local corporate income tax, property tax, and urban land use tax for five years.[56] In addition to similar exemptions, some companies located in the Xinjiang Production and Construction Corps' (XPCC) Shihezi Industrial Park (where metallurgical-grade silicon producer Hoshine Silicon and polysilicon manufacturer Daqo New Energy both operate facilities) receive free office space, chairs, desks, computers, and internet and they qualify for annual monetary rewards.[57] These government incentives encouraged many companies to build plants or launch subsidiaries in the Uyghur Region, despite the significant bias against Uyghur labourers that dominates Chinese corporate culture, as a researcher from Peking University documented.[58]

> In the Uyghur region, companies create green energy by consuming cheap, carbon-emitting coal. They aim to improve climate conditions but sacrifice humane labour conditions in the bargain.

The compulsory labour transfers described above went hand-in-hand with this expansion. In 2015, the government introduced "rewards for towns, villages and other basic-level organizations, public employment service agencies, labour dispatch agencies, labour brokers, and other institutions and individuals that have successfully implemented the organised transfer and employment of rural surplus labour" to these new and expanding enterprises.[59] After 2016, by which time the camp system had begun to emerge, companies that "absorbed" "surplus labourers" to work in their facilities received significant incentives, including subsidies for the cost of building new factories, transport of the products made there to the coast, training for the new labour recruits (including Chinese language training), transport of new workers, and salaries of workers. Companies were "encouraged and guided" to hire these surplus labourers and to act as arbiters of ethnic unity in order to assist the government in its ambition of achieving 2.2. million "transfers for employment" of rural surplus labour per year on average from 2016 to 2020.[60] In Turpan (where another of Hoshine Silicon's facilities is located), for instance, the government provides subsidies for each worker that a company "absorbs" and trains as well as "tax reductions and exemptions" for those companies that "undertake social training tasks and provide practical training and internships" for "personnel participating in vocational training."[61]

What made the period between 2016 to 2018 a particularly lucrative time for solar and other industries to expand into the XUAR, then, was the new government-sponsored corporate incentives programmes that were introduced at the national, provincial, and local levels, including the incentives to employ "surplus labour transfers," which were enthusiastically embraced by many of the raw material and polysilicon manufacturers in the region, as this report will show. While BloombergNEF researcher Jenny Chase argued recently that labour costs only account for "a small component" of the cost of producing polysilicon and therefore using "unskilled and unhappy" forced labourers represents a negligible incentive for companies, that does not mean that companies are not benefiting from the exploitation of indigenous workers.[62] As discussed above, the Xinjiang government introduced a suite of corporate incentives in an explicit effort to attract polysilicon and other "labour-intensive industries" (劳动力密集产业) to move into the region and simultaneously directed corporations to understand the absorption of surplus labour as a social responsibility. Because they are associated with high-priority government efforts, these compulsory labour programmes are almost as difficult to avoid for companies as they are for the workers who are compelled to work within them. The corporate subsidies and other incentives thus serve to facilitate the implementation of the government's expansive labour transfer strategy. While companies may not see a significant and directly attributable decrease in their production costs due to the labour transfers, the extensive package of subsidies affiliated with operating in the Uyghur Region, where the government has instituted this ethnically-discriminatory forced labour regime, do indeed add up to a significant financial benefit.

The Purpose of This Report

The PRC's development of this vast, intertwined system of mass internment and forced labour has only occurred in the last several years. The solar industry seemed to first take notice of the potential implications of its significant investment in the XUAR in 2020,[63] and companies have since been trying to determine the extent to which they are exposed to the forced labour regime in operation there. The U.S.-based Solar Energy Industries Association (SEIA) released a call to action to manufacturers through which 245 companies have committed to "helping ensure that the solar supply chain is free of forced labour."[64] The SEIA has encouraged signatories of the pledge be divested from Xinjiang by June 2021 and has also committed to "industry-led solar supply chain traceability protocol as a tool for identifying the source of primary raw materials and inputs and tracking their incorporation into finished products, including solar modules."[65] Nonetheless, Mark Widnar, chief executive at U.S. manufacturer First Solar has indicated that it is "going to be tough" for panel manufacturers that source polysilicon products from the PRC to "really understand where [their] exposure is."[66]

This report seeks to increase the knowledge base upon which the solar industry determines its exposures to forced labour in the Uyghur Region. We investigated the entire solar module supply chain from quartz to panel to better understand the extent to which forced labour in the Uyghur region affects international value chains. To understand the context of the issue, we conducted a rapid assessment of experts in the field of forced labour, supply chains, the history of the Uyghur Region, and PRC policy, as well as with members of the affected community. We consulted with experts in the field of solar energy to shape our portrait of the process by which and conditions within which modules are manufactured. Our team of forced labour and supply chain experts fluent in Chinese, Uyghur, and English then examined hundreds of publicly available corporate disclosures, government directives, state media campaigns, social media posts, and industry reports. In the end, we investigated over 30 companies involved in the Chinese solar energy supply chain to determine any potential exposures each may have to the compulsory labour programmes instituted by the PRC government in Xinjiang.

Based on our determination that engagement in state-sponsored labour transfers is indeed a form of forced labour that contravenes international conventions on labour rights, our investigation determined that many of the major Chinese producers of raw ma-

terials, solar-grade polysilicon, ingots and wafers integral to solar module manufacturing are operating facilities in the Uyghur Region that have employed forced labour transfers of the indigenous people of the region and that many of these manufacturers have beneficial relationships with the Xinjiang Production and Construction Corps. These manufacturers' adoption of compulsory labour has a significant impact on downstream producers of solar modules and for the governments, developers, and consumers who buy them. The examples of engagement in these programs are meant to provide those stakeholders with the evidence base upon which to judge risk of exposure to forced labour in the solar supply chain.

The global demand for solar energy has encouraged PRC companies to go to great lengths to make our climate responsibility as inexpensive as possible, but it comes at great cost to the workers who labour at the origin of the supply chain. In the Uyghur Region, companies create green energy by consuming cheap, carbon-emitting coal. They aim to improve climate conditions but sacrifice humane labour conditions in the bargain.

2. RAW MATERIALS

The primary raw material used to produce photovoltaic cells is quartz, which is found in the vast deserts of the Uyghur Region. Indeed, one industry estimate indicates that Xinjiang holds 10% of the PRC's reserves of vein quartz used in the manufacture of metallurgical-grade silicon.[67] To create polysilicon, quartz is mined and then crushed, and then heated to remove the oxygen, leaving metallurgical-grade silicon (sometimes referred to as "silicon metal" or "industrial silicon" in China). The last ten years has seen the rapid expansion of the metallurgical-grade silicon manufacturing sector in the Uyghur Region, with one company – Xinjiang Hoshine Silicon Industry Co. – dominating all of the others. Hoshine (also known as Hesheng) and many of its competitors in the Uyghur Region engage in state-sponsored labour transfer programmes, affecting the entire solar module supply chain.

Xinjiang Hoshine

Xinjiang Hoshine Silicon Industry Co., Ltd (新疆西部合盛硅业有限公司)is a wholly-owned subsidiary of Zhejiang's Hoshine Silicon Industry Co. Xinjiang Hoshine is the world's largest metallurgical-grade silicon producer and perhaps the world's largest producer of siloxanes.[68] Xinjiang Western Hoshine operates from Shihezi, Xinjiang. The company established its Xinjiang Eastern Hoshine Co. in Piqan (Chinese: Shanshan 鄯善) outside of Turpan in 2016. There, Hoshine built the "Silicon-based New Material Circular Economy Industrial Park of Hoshine Silicon Industry" as its mining and manufacturing base within the Shanshan Stone Industrial Park. According to a description of the park, "experts" announced "China's stone material depends on Xinjiang, and Xinjiang stone material depends on Shanshan."[69]

Participation in Labour Transfers: There is evidence that Hoshine has actively recruited and employed "transferred surplus labour" from rural villages around Turpan to its Shanshan facility.[70] The company's labour recruitment process promises "transformation of surplus rural labour into industrial workers and urban dwellers, making them become fresh combat troops for industrialization, urbanization, and agricultural modernization."[71] A Hoshine recruitment fair in 2017 included a visit to the County National Unity Education Hall nearby, where the recruits "unanimously agreed that Xinjiang has always been an inalienable part of the motherland, and that people of all ethnicities have staunchly resisted the incursions of foreigners for over one hundred years."[72] Political indoctrination is an integral aspect of the ideological transformation imposed on rural farmers who are subject to labour transfer.[73]

> Their labour recruitment process promises "transformation of surplus rural labour into industrial workers and urban dwellers, making them become fresh combat troops for industrialization, urbanization, and agricultural modernization."

Xinjiang Hoshine relies on government programmes that place rural labourers deemed to be "surplus" in factory work. In its 2019-2021 voca-

tional skills implementation plan, the Turpan government explicitly names Hoshine as a "key enterprise" in the "vocational skills training platform."[74] One effort early in Hoshine's development in the Uyghur Region suggests the potential scale of that collaboration. In 2017, the Turpan Bureau of Human Resources assured the media that the agency had adjusted its training of 9,800 surplus rural labourers to provide them with skills required by Hoshine and would be able to "fully meet [Hoshine's] employment needs" for 5,000 trained labourers.[75] Hoshine further received subsidies from the XPCC to provide its own surplus labour vocational skills training, as a part of an extensive Turpan government multi-agency effort to employ indigenous workers in labour-intensive industries.[76] Guidance from the Turpan government referred to in the Xinjiang Hoshine annual report in relation to labour transfer subsidies indicates that the payments are meant to provide vocational training for "rural surplus labourers" who will be "transferred" to companies in need of workers.[77]

State-sponsored recruitment efforts on Xinjiang Hoshine's behalf depend on coercive strategies that suggest non-voluntary labour. For instance, one media report depicts a married couple from rural Dikan Township who were targeted for "poverty alleviation." They were provided a government-determined "income-increasing package," which began with the assignment of a cadre who instructed them in Chinese language skills "to pave the way for them to leave their hometown to work." The regional work team then assigned the couple to vocational skills training to learn to be welders in the farming off-season. The couple followed the directives of the cadre, while the regional work team still provided "encouragement and help" for them to do "pre-employment training for the surplus rural labour force," after which they were transferred to work at Xinjiang Hoshine. Though the couple owned seven acres of grape fields that would need tending, the government "relieved the two of their worries," by transferring their land use rights (流转) to the state. The couple was transferred to Xinjiang Hoshine, more than 50 kilometers away from home, to work as a mechanic and a product inspector in the Shanshan County Hoshine Silicon Industry factory, leaving behind their children and ill parents. Though the report indicates that the couple have a bright and spacious house in their village, the photos accompanying the story suggest that the couple now lives in a bunk house with other employees at Xinjiang Hoshine and only rarely return home.[78]

Couple recruited through labour transfer program in a bunk room at Hoshine Silicon Industry facility.Source: Weixin

Hoshine's "surplus labour" recruitment programme explicitly strives to "change the employment concept of residents" and for the "transformation of the poor labour force's thinking" to "strengthen the endogenous motivation of poverty alleviation."[79] This implies that their inherent beliefs are opposed to poverty alleviation and that they are in need of correction that labour can provide. Hoshine's recruitment practices thus present labour transfers as a necessary ideological disciplining process.

These recruitment efforts appear to have been successful in transferring workers to Hoshine.[80] In 2020, Hoshine's parent company won an award as a "social support and caring enterprise," for its efforts to "fight against poverty, enable local people to increase employment and income, and promote local industrial upgrading" in Shanshan County, Xinjiang.[81]

Open worker recruitment advertisements from Hoshine suggest other discriminatory hiring practices. "Minority" workers must be able to speak Chinese and

have "no bad political records." Manual laborers are paid a piece rate of CNY 42 per ton to manually crush silicon, whereas other jobs get paid a salary.[82]

Supplier Exposures: The Shanshan Stone Industrial Park, in which Xinjiang Hoshine is operating, is separated into two sections, the north and the south, which are six miles apart. Xinjiang Hoshine's facilities all appear to be located in the north section of the park, which Google Earth satellite imagery shows was barren desert as of 2015 but has been built up by Hoshine since and appears to house the industrial aspects of its operations.[83]

The southern part of the Stone Industrial Park[84] was a stone processing site as early as 2005, more than a decade before Hoshine's facilities were built six miles to the north. The southern section of the Shanshan Stone Industrial Park is a site for the mining and processing of quartz stone; 98% of Shanshan's stone processing companies are located in this park.[85] Hoshine Silicon Industry (Shanshan) Co, Ltd.'s Environmental Impact report notes that the company "purchases stone from Shanshan and carries out intensive processing in the park to smelt quartz stone,"[86] creating the metallurgical-grade silicon that the company sells downstream to polysilicon manufacturers. Furthermore, in a response to an online investor query, Hoshine indicated that it outsources for the quartz stone they use for manufacturing metallurgical-grade silicon.[87] This information suggests that when the company does not mine and process the quartz itself, it is almost certainly coming from the park that processes 98% of stone in the region. Google Earth imagery further confirms that the coordinates provided in Hoshine's corporate document regarding sourcing of stone align with the southern Shanshan Stone Industrial Park.

If Hoshine is indeed sourcing its raw materials from the southern Shanshan Stone Industrial Park (as is likely the case), this fact is significant because the park engages in labour transfers and because two internment camps identified by the Australian Strategic Policy Institute (ASPI) are located within the bounds of that park.

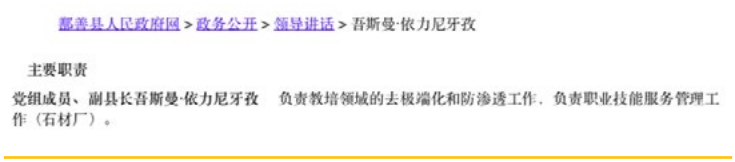
Media reports confirm that there are coercive strategies being used to recruit labourers to the Shanshan Stone Industrial Park. In 2018, five cadres were assigned to nearby villages and had "mobilized the surplus labour in the region, especially the residents who were unwilling to go out to work and guided them to change their minds." One of the people who was mobilized was a 28-year-old man whose home had been demolished by the government. He was visited by all five team members in turn, who each performed "ideological work" on him so that he eventually "abandoned his fear of enduring hardship" in manual labour. Among the companies he could have been employed by was Hoshine Silicon Industry. The team of labour recruiters reported "transferring" 59 "surplus labourers" in all.[88]

The southern Shanshan Stone Industrial Park is the site of two internment camps. Satellite imagery reveals that the northeastern site identified by ASPI (see map) as a "Tier 1 Re-education Facility" appeared to be the site of factories alone until 2018.[89] In 2018, however, a building that may be a dorm was built on the northern perimeter of the site, and a double layer of significant exterior walls and interior fencing was erected. By 2019 additional interior fencing was added near the dorm-like facilities. By 2021, much of the fencing was removed, but the facility still seems to be in operation. While it is unknown whether detainees are (or were) deployed to work in the park, the addition of high-security fencing on the inside of exterior walls suggests potential detention of people within the facility. Additional due diligence would be necessary to determine the relationship of this high-security facility to the stone processing facilities both within and outside the facility's walls. Given that there is evidence of other internment camps providing labour for co-located companies (see introduction), this co-location raises the risk of additional forced labour in Hoshine's supply chain.

Southern Shanshan Stone Materials Industrial Park. Source: Google Earth Pro

Satellite imagery of the ASPI-identified internment camp/ factory co-location in the northeastern corner of southern Shanshan Stone Industrial Park. Source: Google Earth Pro

The camp in the southwestern corner of the southern Shanshan Stone Industrial Park was first identified by researcher Shawn Zhang, who located the resume of a local government official that indicated that as part of his job, he was "responsible for de-radicalization (去极端化) and anti-infiltration (防渗透) work in the field of education and training" and "responsible for vocational skills service management (stone factory)."[90] This suggests that the re-education camps are likely supplying laborers for the stone industry in the Shanshan Stone Industrial Park.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主要职责

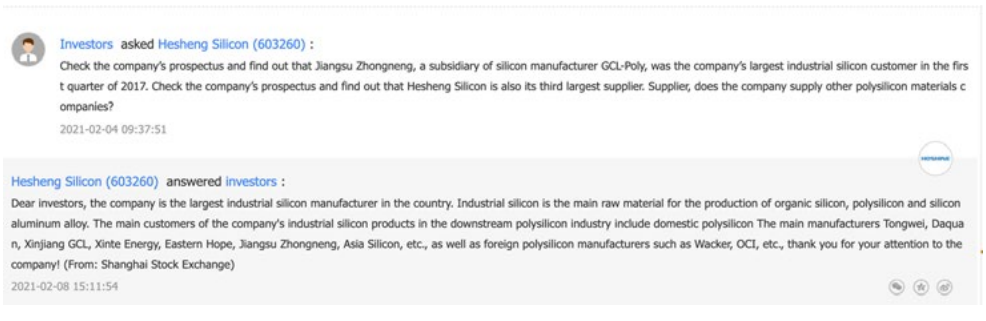
党组成员、副县长吾斯曼·依力尼牙孜　负责教培领域的去极端化和防渗透工作，负责职业技能服务管理工作（石材厂）。

In addition to the Shanshan supplier exposures, Xinjiang Hoshine is exposed to labour transfers through its chemicals supplier Xinjiang Tianye Co., Ltd. Xinjiang Tianye is a state-owned enterprise of the 8th Division of the XPCC.[91] Xinjiang Tianye's 2018 annual report indicates participation in a wide array of so-called poverty alleviation programmes, including labour transfers and vocational training programmes. The company reports that it has "absorbed" (吸纳) 100 local workers, which typically is a euphemism for labour transfers.[92] Furthermore, a state media report in 2020 provides evidence that the company has been the recipient of "poverty alleviation" surplus labour transfers as a "paired poverty alleviation work unit" (对口帮扶单位).[93] It may be that Tianye primarily supplies Hoshine's downstream sealant projects and not their metallurgical-grade silicon projects;[94] nonetheless, this again raises the likelihood of labour transfers in Hoshine's supply chain.

Relationship with the XPCC: Xinjiang Hoshine is a private company, but it benefits significantly from its relationship with the Xinjiang Production and Construction Corps. Hoshine's Xinjiang headquarters is in the XPCC's 8th Division city of Shihezi, in the XPCC-operated Shihezi Economic and Technological Development Zone, where its customer Daqo is also located. Hoshine has invested more than CNY 4 billion recently in the expansion of their facilities in this Shihezi Park.[95] Xinjiang Hoshine's latest expansion of its sealant and metallurgical-grade silicon production facilities was touted recently as the largest investment attraction project of the XPCC in 2019-2020.[96] Xinjiang Hoshine's website once boasted that the company's significance is evidenced by the fact that "it can make use of Xinjiang's rich mining resources to fill the gaps in XPCC's industrial products."[97]

Xinjiang Hoshine receives significant subsidies and support from the XPCC. In its 2019 annual report, Hoshine indicated receipt of financial incentives/investments from the XPCC in the amount of CNY 40,140,411, and it listed an additional on-going special subsidy from the XPCC that originated in 2012 for the amount of CNY 26,855,298.[98]

Potentially Affected Supply Chain: Hoshine supplies more than 33% of Daqo New Energy Corporation's raw materials, according to Daqo's 2021 corporate filings.[99] Daqo in turn supplies polysilicon to the solar module manufacturers with the world's largest market share (as discussed in the next section). Official corporate documents indicate that Hoshine's other major customers include some of the industry's major players, Jiangsu Zhongneng (a subsidiary of GCL-Poly),[100] Asia Silicon,[101] and Wacker Chemie AG.[102] Hoshine also indicated in an online investor forum in February 2021 that its customers include Tongwei, Xinte, East Hope, and Korea's OCI (though these companies do not appear in Hoshine's annual reports as primary customers).[103]


Investors asked Hesheng Silicon (603260) :

Check the company's prospectus and find out that Jiangsu Zhongneng, a subsidiary of silicon manufacturer GCL-Poly, was the company's largest industrial silicon customer in the first quarter of 2017. Check the company's prospectus and find out that Hesheng Silicon is also its third largest supplier. Supplier, does the company supply other polysilicon materials companies?

2021-02-04 09:37:51

Hesheng Silicon (603260) answered investors :

Dear investors, the company is the largest industrial silicon manufacturer in the country. Industrial silicon is the main raw material for the production of organic silicon, polysilicon and silicon aluminum alloy. The main customers of the company's industrial silicon products in the downstream polysilicon industry include domestic polysilicon The main manufacturers Tongwei, Daquan, Xinjiang GCL, Xinte Energy, Eastern Hope, Jiangsu Zhongneng, Asia Silicon, etc., as well as foreign polysilicon manufacturers such as Wacker, OCI, etc., thank you for your attention to the company! (From: Shanghai Stock Exchange)

2021-02-08 15:11:54

Other Raw Materials Suppliers

Xinjiang Sokesi New Materials Company (aka Sokos, 新疆索科斯新材料有限公司) supplies 47% of Daqo's raw materials, according to 2021 corporate filings.[104] State media reports announced that Sokesi also participates in the state-sponsored "organised transfer of labour from poor families in ten deeply impoverished counties in the three prefectures of southern Xinjiang." The labourers work in Sokesi's facilities in the Changji High-tech Zone within the Zhundong Economic and Technological Development Zone, which "transferred" more than 700 labourers from Hotan through "surplus labour" programmes in March 2020 alone. State media reported Sokesi would sign three-year contracts for surplus labourers in 2020.[105] There is not much more information about Sokesi accessible in publicly available documents. [See textbox about Zhundong Economic and Technological Development Zone]

Production of Xinjiang Metallurgical-Grade Silicon

RANK	COMPANY	TONS/PER YEAR
1	Xinjiang Hoshine Silicon Industry	498500
2	Changji Jisheng New Building Materials	114800
3	Xinjiang China Silicon Technology	46400
4	Xinjiang Jingweike New Energy	33950
5	Xinjiang Yusi Technology	31200
6	Xinjiang Jagesen New Energy Materials	30000
7	Xinjiang Jierong Silicon Industry	19850
8	Xinjiang Xintao Silicon Industry	19600
9	Xinjiang Jinteng Silicon Industry	16350
10	Yili Jinjing Silicon Industry	16000

Source: Ferroalloy Online

Aside from Daqo's two main suppliers, there are a number of other smaller enterprises engaged in producing the metallurgical-grade silicon that is essential in the production of polysilicon. An industry website ranked the top ten metallurgical-grade silicon producers in Xinjiang in terms of their 2020 production, and Hoshine ranked first, with a total production that amounted to more than four times the amount of its closest competitor. Indeed, Hoshine produced 52% more than the amount produced by all nine competitors combined. Information about these other smaller raw materials producers in Xinjiang is more difficult to come by and we are not able to find much more than the corporate addresses for a few of these companies. Nonetheless, investigation of these companies provides some evidence of additional potential risk of forced labour and XPCC involvement in the photovoltaic raw material industry.

Zhundong Basin

Xinjiang East Hope developed its own raw materials subsidiary, **Changji Jisheng New Building Materials Company** (昌吉吉盛新型建材有限公司), which ranks as Hoshine's distant second place competitor. Their raw materials base is located adjacent to its main polysilicon processing facility, as part of the company's ambition to keep the entire process as cost efficient as possible.[106] As is documented in the discussion of East Hope in the polysilicon section below, East Hope's XUAR campus significantly benefits from the utilization of labourers transferred through state-sponsored programmes operating in rural regions of southern Xinjiang.

Xinjiang China Silicon Technology Company (also known as Zhonggui, 新疆中硅科技有限公司), reports having received critical support from the XPCC to transport raw materials during the COVID-19 pandemic.[107] A local CCP organization committee reported via their official social media that Xinjiang China Silicon participated in a job recruitment fair for "surplus labourers."[108] The company also advertised that "local ethnic minority" citizens account for 68% of all their employees, and that the company has "played an important role in solving the employment of local surplus labourers."[109]

Xinjiang Jingweike New Energy Development Company (新疆晶维克新能源发展有限公司) and **Xinjiang Jingxin Silicon Industry Company** (新疆晶鑫硅业有限公司) jointly own Xinjiang Fuxin Energy Company (新疆富鑫能源有限责任公司) with the XPCC (through its Shihezi Guoneng Energy Investment Company), according to the PRC's National Enterprise Credit Information Public System (NECIPS).[110] Xinjiang Jingweike engaged in surplus labour transfer job fairs.[111] In October 2019, when Xinjiang Jingweike recruited new hires, the company specifically indicated that it was hiring 40 "general workers" who would be responsible for "silicon smashing" and working the furnace, for which the workers would be paid CNY 2000 a month and CNY 40 per ton of silicon crushed. While it was unclear whether the company was recruiting "surplus labourers" for these positions, the advertisement specified no ethnicity requirement for those labour-intensive jobs. Tellingly, for all of the professional-level jobs (such as warehouse managers, accountants, cashiers, lab technicians, sales and office clerks), Xinjiang Jingweike required the candidates to be Han nationality.[112] This is clearly indicative of racially discriminatory hiring practices. Xinjiang Jingxin was reported to have employed "surplus labour" by local state government via their social media, which also details that the labourers in question are subjects of a land transfer scheme run by the government to transfer rural farmers' land use rights to the government, while transferring the farmers into industrial labour.[113]

Several raw materials processing companies are located in the Xinjiang Production and Construction Corps' Jingang Circular Economy Industrial Park (新疆伊犁州巩留县七十三团金岗工业园): Xinjiang China Silicon Technology Company, **Xinjiang Yusi Technology Company** (新疆宇硅科技有限公司), **Xinjiang Jiagesen New Energy Materials Co., Ltd.** (新疆嘉格森新能源材料股份有限公司), and **Xinjiang Guopeng Technology Co., Ltd.** (新疆国鹏科技有限公司), along with several other raw material manufacturers.[114] The park is the "Xinjiang Silicon Industry Base," with silicon raw material mining and manufacturing as one of its primary industries, and is intended to become the largest silicon production base in the XUAR.[115] The park is a joint development of the Tokkuztara County (Chinese: Gongliu 巩留) government and the 73rd Regiment of the 4th Division of the XPCC, as a model of "military-land integration."[116] It was designed to make the 73rd Regiment a "'stabilizer' for the frontiers, a 'melting pot' for gathering people of all ethnic groups, and a 'demonstration zone' for advanced productivity and culture."[117] Over 130 workers from Kashgar have been transferred to this park.[118] The park has documented engagement in surplus labour programmes, and the company has indicated to state media that 485 of their 946 employees hail from local villages.[119] When Xinjiang Yusi posted an open recruitment advertisement for workers in 2017, safety and financial personnel jobs were limited to Han people only; manual labour jobs such as silicon crushing were open to ethnic minorities who were "able to bear hardships and hard work" and had "no bad record,"[120] indicating a clear discriminatory policy toward minoritized citizens.

The raw materials supplier with the eighth highest reported capacity is **Xinjiang Xintao Silicon Industry Co., Ltd.** (新疆鑫涛硅业有限公司). In 2019, Xinjiang Xintao indicated that the company's "labour demand is about 300 people, which can effectively solve the employment of surplus labour in the surrounding area."[121] Until 2019, Xinjiang Xintao's shareholder was Western Oasis International Industry Group (西部绿洲国际实业集团有限公司), a wholly-owned subsidiary of the XPCC, according to NECIPS.[122] According to a November 2020 press release, Xinjiang Xintao's customers include Xinte Energy, Beijing Zelin, Qinghai Baitong, Xuzhou Zhengxu, Shanghai Chaojin.[123]

Beijing Dadi Zelin Silicon Industry Company (北京大地泽林硅业有限公司) has a silicon powder production base in Changji High-Tech Industrial Development Park[124] and is a supplier for Asia Silicon.[125] Several Chinese media reports document labour transfers to this industrial park, though none name this particular company.[126] Satellite imagery reveals a camp, detention centre, and prison in the midst of construction across the street from this industrial park.

It is important to note that GCL-Poly and East Hope (both discussed in the polysilicon section below) operate raw materials processing facilities in the Uyghur Region that provide at least part of the feedstock for their manufacturing.

Implications

Xinjiang Hoshine Silicon presents a useful case study for understanding how the deployment of compulsory labour transfers can potentially put an entire supply chain at risk. Hoshine has benefited from a wide variety of government-sponsored incentives programmes designed to require the industrial employment of all indigenous people of the region deemed employable by the government, and the company has actively engaged in the ideological re-education efforts associated with those programmes. The company has accepted the government's assistance in seeking impoverished rural workers to work in its facilities, exploiting the rural poors' vulnerability to such mandatory government programmes. The "transferred" labourers are put to work directly in the production of the silicon, manning the furnaces and inspecting the final products. Furthermore, Hoshine likely sources its quartz from companies likely engaged in labour transfers and perhaps employing detainees from internment camps. Because Hoshine's metallurgical-grade silicon is sold directly to Daqo, who supplies the four top-selling module manufacturers in the world, this has significant effects on the entire supply chain.

While the rest of the raw materials producers in the Uyghur Region have less of a public presence through which we can examine labour practices, it is clear that several of them are also engaging in labour transfers. Many of them are significantly supported by the XPCC, which itself employs and facilitates forced labour transfers, though we cannot be sure if it does so for these particular silicon manufacturers. Some raw materials companies appear to be bringing on minoritised workers for the significant manual labour of crushing the silicon for processing, which is not necessarily forced labour but is an indicator of discriminatory hiring practices that should be carefully examined in corporate due diligence. Furthermore, these recruitment advertisements also give clear proof that the multi-stage process of producing silicon is not so technologically advanced as to preclude the employment of unskilled surplus labourers as some in the industry have suggested.[127]

The widespread adoption of state-sponsored labour programmes in the Uyghur Region means that it is nearly impossible to avoid forced-labour-tainted raw materials if they are being sourced in the XUAR under the current regime. Wherever the raw materials originate, however, there is an even further forced labour risk in the next step of production in the solar module supply chain – the manufacture of polysilicon.

3. POLYSILICON

Once quartz has been processed into metallurgical-grade silicon, it is then ground up and purified even further. The purification process requires extraordinarily high temperatures, which consumes significant electricity,[128] making the Uyghur Region's coal fields an ideal location for polysilicon producers. The Uyghur Region's coal reserves account for 40% of the PRC's reserves and is one of the largest untapped reserves in the world.[129] The mono-grade or multi-grade polysilicon that results from this purification process is a major export of the XUAR region.

As was described in the introduction, the last ten years (and in particular the last three or four years) has seen significant growth in polysilicon ingot and wafer manufacturing in the Uyghur Region. By 2020, four of the six highest-capacity polysilicon producers were companies with significant manufacturing bases in the XUAR – Daqo New Energy Corp, GCL-Poly, TBEA/Xinte, and East Hope. All four of them utilise state-sponsored labour transfers, the end products of which are sold into the international solar module market.

Because polysilicon can be blended and ingots can be made from several feedstocks, companies downstream of these polysilicon giants run significant risk of having their supply chains tainted by Xinjiang forced labour.

Daqo New Energy Corp

Daqo New Energy Corp's (大全新能源股份有限公司) main product is high-purity polysilicon. The company's XUAR subsidiary is located in the XPCC 8th Division city of Shihezi. Daqo began building a polysilicon plant with the support of the Shihezi government in the XUAR in 2011.[130] While Daqo is a publicly-traded company (NYSE: DQ) and not state-owned, the company is significantly subsidised by the Xinjiang Production and Construction Corps.In 2013, Daqo negotiated a deal with the 8th Division Deputy Party Secretary and acting mayor of Shihezi to invest an additional CNY five billion in developing the Daqo Photovoltaic Industrial Park inside the Shihezi Economic and Technological Development Zone. It was planned to be the company's only solar-grade polysilicon production base.[131]

Daqo polysilicon production facility. Source: Daqo New Energy Corp

100% of Daqo's now 80,000 MT polysilicon capacity is produced in its Shihezi, Xinjiang facility.[132] In 2020, Xinjiang Daqo claimed it held 19% of the domestic market share of polysilicon.[133] This indicates that Daqo's direct engagement in labour transfers or any forced labour in its own supply chain represents a significant exposure for the solar market.

Participation in Forced Labour Programmes: In 2020, in the IPO prospectus for Xinjiang Daqo, a principal operating subsidiary controlled by Daqo New Energy, the company indicated that it had received subsidies for "labour placements" (劳动力安置) from the Chinese government, which may indicate that the

company employs state-sponsored labour transfers in its own facilities, as "placement" is a term the central government and Xinjiang local and regional governments sometimes use for labour transfers.[134] There is no additional information available that elaborates on the nature of those placements.

In response to accusations that the company had employed forced labour in its factories or within its supply chain, Daqo CEO Zhang Longgen reported in April 2021 that only 18 of Xinjiang Daqo's 1,934 employees are from communities designated as minorities in the PRC.[135]

Supplier Exposures: Daqo's two primary raw material suppliers, Hoshine Silicon and Xinjiang Sokesi, are both engaged in state-sponsored labour transfer programmes, putting Daqo's downstream supply chain at risk.[136]

Relationship with the XPCC: Xinjiang Daqo and the XPCC are in a long-term, mutually beneficial relationship. In return for its investment in the XPCC's Shihezi Industrial Park, Xinjiang Daqo has continuously received subsidies, incentives, energy, and special price negotiation dispensations from the XPCC. These XPCC subsidies include, most recently, corporate social security subsidies post-Covid. [137] XPCC subsidies to Xinjiang Daqo are significant and include CNY 77.36 million in financial subsidies from the Shihezi government in 2018 and CNY 35.14 million in 2019.[138] The company operates several research and innovation programmes in collaboration with the XPCC.[139]

Xinjiang Daqo purchases the majority of its energy from Xinjiang Tianfu Energy Co Ltd, an XPCC company, which is co-located in the same industrial park and which offers Daqo special pricing. The ultimate controller of Tianfu is the State-owned Assets Supervision and Administration Commission of the 8th Division of the XPCC.[140]

Potentially Affected Supply Chain: Xinjiang Daqo supplies Chinese companies with polysilicon, which those companies then manufacture into ingots, wafers, and cells for sale into the domestic and international markets. Supply chain mapping indicates that its polysilicon is likely to pervade much of the solar market. Nearly every Chinese company that sells solar panels is in one way or another downstream of Daqo. The company has confirmed current contracts with the top four solar module producers in the world – LONGi Green Energy Technology (through 2022),[141] JinkoSolar Holding (through 2021),[142] Trina Solar (through 2023),[143] and JA Solar (through 2023)[144] – as well as the second largest producer of silicon wafers in the market, Tianjin Zhonghuan Semiconductor Co (through 2023).[145] The company also has current contracts with Wuxi Shangji Automation (through 2024),[146] and Gaojing Solar (through 2024).[147] The company's recent SEC filings suggest a broader downstream market, including supplying Eaton Corp PLC (US).[148] Sunshine Energy Holdings/Solargiga (TW), and Huantai Group.[149]

In a response to a request for comment, Daqo's representative for investor relations and board secretary, Kevin He, indicated that the labour placements (安置) listed in Daqo's IPO document were "a very common subsidy scheme utilized by local governments globally." He claimed that in the context of their IPO, "placement" was a mistranslation of 安置, which he suggested is better understood as "helping to settle down (from another place) securely and peacefully." Furthermore, He indicated that with "Xinjiang being in a remote location, the availability of talent is generally limited, and the government provides employment related incentives and subsidies to attract skilled labor to work in the Xinjiang area." He said that Daqo's hiring process is entirely independent of the state and that Daqo has "NEVER" participated in any poverty alleviation, surplus labour, or labour transfer programs of minority citizens. He reiterated that they only have 18 ethnic minority citizens working at their factory in Xinjiang. He further indicated that Daqo has zero tolerance for forced labour, has sent a formal statement articulating their policies to their suppliers, and has received written reassurance from their suppliers that they are not engaged in forced labour. He wrote, "We don't see any clear evidence of forced labor issue in their plants."

GCL-Poly Energy Holdings Company

GCL-Poly Energy Holdings Company (保利协鑫能源控股有限公司) considers itself the world's leading supplier of photovoltaic materials. The company produces polysilicon chunks and granules and mono-crystalline and multi-crystalline wafers that are incorporated into the manufacture of solar modules. In September 2016, Xinjiang Changji Hui Autonomous Prefecture signed a cooperative agreement with Xinjiang GCL to invest CNY 30 billion in the construction of the GCL Silicon-based Industrial Park,[150] located in the enormous Zhundong Economic Development Zone (see text box about Zhundong).[151] Around half of GCL-Poly's polysilicon production capacity is located in its XUAR facilities;[152] the company also produces polysilicon in Xuzhou, Jiangsu province.

Caption from original source: "Xinjiang GCL New Energy Material Technology Co., Ltd. conducts military posture training for transferred personnel." Source: Worker Times

Participation in Labour Transfers: An XUAR-based subsidiary of GCL-Poly, Xinjiang GCL, employed coerced surplus labourers as part of a scheme that brought "more than 1,800 poor labourers [who] are all beneficiaries of the organised transfer of labour from poor families from ten deeply impoverished counties in three prefectures of southern Xinjiang." According to state media, the workers "were placed in Xinjiang state-owned enterprises affiliated with the region or central government enterprises based in the region, while enterprises in Urumqi's seven districts and one county as well as the three county-level cities in Changji prefecture and three industrial parks had organized transfer for employment."[153] The article about the transfers depicted the labourers being trained in "military posture" and in "etiquette" by Xinjiang GCL.

In late 2018, within the first few months of operation, GCL-Poly's facility in Changji had employed more than 60 people through surplus labour transfers. A state media report about the transfer explained that workers at the facility, including those from the XUAR, live far from family, as the location is the most remote among all enterprises in the industrial park.[154]The company's party committee magazine highlighted the isolation of one of the transferred labourers in its factories who commented that when she returns home, she'll treat her parents and daughter to a new Chinese food she learned about, a sign that she had to leave her family behind for work.[155]

According to GCL's promotional materials on corporate sustainability, by December 2019, Xinjiang GCL had achieved a ratio of nearly 50% local workers on staff, having recently recruited 121 "minority" employees. The company achieved this in part through "acceptance of poor minority people from southern Xinjiang," which is likely a state-sponsored labour transfer.[156]

Supplier Exposures: Xinjiang GCL has its own operation in the desert of the Zhundong Economic and Technological Development Zone, where it produces its metallurgical-grade silicon. Hoshine's corporate filings report that it has been a supplier to Xinjiang GCL and GCL subsidiary Jiangsu Zhongneng.[157]

Relationship with the XPCC: In June of 2020, GCL-Poly subsidiary Henan GCL and the 13th Division of the XPCC brokered a CNY 2.15 billion deal.[158] The nature of this investment is unclear, but it is likely connected to the development of photovoltaic power generation plants. Yili GCL Energy Co., Ltd. is owned 56.51% and 43.49% by Suzhou GCL New Energy and the XPCC, respectively. The address of the registered office and principal place of business of GCL Ili is the XPCC Division of Khorgas Economic and Technological Development Zone, Ili Prefecture.[159]

Potentially Affected Supply Chain: GCL-Poly has significant current contracts with many of the major producers of solar wafers, including LONGi Green Energy Co (CN) (through 2023),[160] Wuxi Shangji Automation Co (CN) (through 2021),[161] and Tianjin Zhonghuan Semiconductor Co (CN) (through 2026).[162] GCL-Poly also signed contracts in 2019 to supply wafers to Canadian Solar (CA),[163] Astronergy/Chint Solar, Daycare Photovoltaic, and Akcome Optoelectronics.[164]

TBEA Co. & Xinte Energy Co

TBEA Co. (特变电工) specialises in the research and development of photovoltaic energy products and silicon-based new materials.[165] The company has two additional listed subsidiaries, both of which are located in the XUAR: Xinjiang Zhonghe/Joinworld (新疆众和股份有限公司), and Xinte Energy (新特能源公司). The company's polysilicon production capacity has increased by nearly four times since 2016.[166]

Unlike many of its competitors, TBEA's headquarters are located in Xinjiang. The company has two primary locations, one in the capitol Urumqi, in the Ganquanbao Economic and Technological Development Zone and another in the Zhundong Economic and Technological Development Zone in Changji Prefecture.

As indicated in the sections below, TBEA Group has taken extensive advantage of the PRC's Xinjiang policies and "poverty alleviation" programmes, through locating its facilities in government industrial parks, receiving significant government subsidies, and receiving "surplus labour" transfers. It is unclear from company media campaigns and the C.E.O.'s speeches regarding labour transfers to what extent Xinte Energy, its polysilicon-manufacturing subsidiary, is the direct recipient of the transfers or a party to the pairing programmes that match TBEA employees with indigenous labourers for ideological indoctrination. However, it is clear that the parent company is heavily invested in these programmes, and it may be the case that these programmes are employed throughout and supported by all of its Uyghur Region subsidiaries and facilities.

Participation in Forced Labour Transfers: Of all the companies studied, TBEA has most enthusiastically heeded the call to engage in Xinjiang's "poverty alleviation" programmes. By May of 2020, TBEA had invested a total CNY 30 million in various "poverty alleviation" programmes in the Uyghur Region and significantly engaged in surplus labour transfers.[167]

Zhang Xin, TBEA's C.E.O., is Secretary of the Party Committee of TBEA and a representative of the National People's Congress.[168] He is an enthusiastic promoter of the Xinjiang government's so-called "poverty alleviation" and "Becoming Family" (结对认亲) programmes.[169] TBEA has adopted two villages in Hotan where it engages in extensive "poverty alleviation" and labour transfer social engineering experiments.

TBEA poverty alleviation walnut processing plant in remote Hotan village. Banner reads: "Employ one person, alleviate poverty for a household; Labour is great; Getting rich is glorious; Let's unite as one and run toward a well-off life together." Source: Tencent Video

TBEA announced in 2018 that it had "developed employment positions," for which the company transferred 200-300 poor people into work.[170] TBEA was one of four companies that were recipients of 139 eighteen- to sixty-year-old "transfer labourers" from Jimsar County [Chinese Jimusaer 吉木萨尔] for work in the company's power plant in the Zhundong Economic

and Technological Development Zone. The labourers were assigned Han minders/trainers that were dubbed fictive "in-laws" to ensure their enculturation in the new site.[171] The company's factories engage in political education that is explicitly meant to pacify Uyghur dissent. Zhang Xin noted in 2018 that TBEA "launched a series of activities to educate and guide all employees to clearly oppose national separatism [and] insisted on maintaining stability as the overriding priority."[172]

TBEA plays an active role in the "Thousands of Enterprises Help Thousands of Villages" (千企帮千村) programme, through which TBEA promised to assist "360 impoverished households or 1,600 people" from two poor villages in Hotan to "fully overcome poverty" before 2020.[173] TBEA adopted these two rural villages in Hotan in 2017,[174] where the company has invested CNY 1 million in agricultural businesses that employ rural labourers recruited from the town.[175]

Image of Uyghur family from Chinese media about TBEA's engagement in poverty alleviation programmes, including redesigning Uyghur domestic spaces and providing televisions to watch state media. Source: Tencent Video.

In addition to conscripting the villagers into manual labour, TBEA has instituted much more invasive "poverty alleviation" programmes. They have instituted a programme whereby they redecorate the villagers' houses with Chinese furniture and restructure the living spaces to better resemble Han practices. The company's "poverty alleviation" teams also restructured the courtyards of hundreds of Uyghur homes – a traditional space of family gathering. TBEA has installed 921 televisions in Uyghur homes in a programme explicitly designed for "spreading the voice of the Party and modern culture to every household" and to "stimulate endogenous motivation" for poverty alleviation. TBEA also had to build an elder care facility to care for the elderly who have been left behind by their family members who have been recruited to work outside the village through the state-sponsored surplus labour programmes. TBEA workers "regularly carry out education to encourage being grateful to the party, listening to the party, and following the party."[176]

The company actively participates in the "Becoming Family" programme, whereby a Han TBEA employee is assigned to be a "relative" to a Uyghur household. In their visits, they are assigned to educate and monitor their assigned family. CEO Zhang Xin himself has adopted a family that he monitors in the name of "poverty alleviation."[177]

Zhang has authored a report called "Recommendations on further deepening the Xinjiang government's 'Thousands of Enterprises Helping Thousands of Villages' targeted "poverty alleviation work."[178] Speaking to reporters at the 2020 Two Sessions, he encouraged the government to "continue to intensify its efforts in industrial poverty alleviation, to combine the advantageous industrial capabilities of the central and eastern regions [of the PRC] with Xinjiang's resource advantages to even more vigorously promote the improvement of hematopoietic capacity."[179] Hemotopoeisis (造血) is a term used to describe the positive effect that "poverty alleviation" and labour transfers are supposed deliver, namely, a metaphorical shift from the people of the region needing a "blood transfusion" (输血) to their "producing their own blood' (造血).

Supplier Exposures: Xinte sources its metallurgical-grade silicon from Xinjiang Xintao Silicon Industry Co., which may engage in labour transfers. [180]

Relationship with the XPCC: TBEA has a strategic cooperative agreement with the XPCC 2nd Division

in Tiemenguan City. Since at least 2017, the company has provided power generation and infrastructure construction support "to meet the development needs of Tiemenguan City."[181] The 2nd Division Tiemenguan government has brought in transferred surplus labourers from Kashgar to work in a textile factory and likely have transferred other workers as well.[182]

Potentially Affected Supply Chain: TBEA and its subsidiary Xinte have confirmed current contracts with JA Solar (through 2025),[183] Qinghai Gaojing Solar Energy Technology Co. (through 2025),[184] Beijing Jingyuntong Technology Co (through 2021),[185] LONGi Green Energy Technology Co (through 2025),[186] and Wuxi Shangji Automation Co/Hongyuan New Materials (Baotou) Co. (through 2025).[187] TBEA has otherwise primarily served a vast PRC-based corporate customer base in the recent past, according to SEC filings, which may affect additional downstream customers.

East Hope Group

East Hope Group (东方希望) produces metallurgical-grade silicon and solar-grade polysilicon, as well as other chemical and metallurgical products.

In 2010, Shanghai-based East Hope heeded "the national 'Go West' call," (西部大开发) establishing Xinjiang East Hope Nonferrous Metals and Xinjiang East Hope Photovoltaic Technology Co., Ltd. with the deliberate intention of taking advantage of the Zhundong region's significant coal deposits. The company has invested more than CNY 30 billion in the XUAR and intends to reach CNY 100 billion in investments in its industrial park there.[188] East Hope's ambition in Zhundong is to produce the cheapest (though not necessarily the purest) polysilicon on the market, aiming for cash costs under CNY 25/kilogram (US $3.85/kilogram) as opposed to Daqo's approximately US $5/kilogram. Recent global average prices have run as high as US $20/kilogram and are likely to continue to rise.[189]

Participation in Forced Labour Transfers: East Hope has engaged in "surplus labour" programmes since at least 2017.[190] In that year, the Zhundong Economic and Technological Development Zone's official social media reported on job fairs to recruit rural surplus labourers[191] and the prefectural public security's official social media account reported on visits to check on the well-being of the surplus labourers working for East Hope.[192] The report indicated that 95 labourers from southern Xinjiang had been "transferred" to this site. The Qira County (Chinese: Cele, 策勒) citizens who had been transferred approximately 1,500 km from their homes were instructed to remember, know, appreciate, and repay the kindness of the Party and to "observe discipline and promote unity" in their work placements.[193]

In 2018, East Hope engaged more transferred labourers, pairing them with "teachers" to train them, in an effort to "transform [them] into qualified industrial workers as soon as possible."[194] The company held "national family unity" (民族团结一家亲) programming in which "the southern Xinjiang labour transfer personnel are encouraged to continue to study, work diligently, and exchange sweat for a better tomorrow."[195]

In March 2020, Xinjiang East Hope reported that it had recently employed at least 235 transferred labourers in its plants.[196] It appears that in March of 2020,

Suntech International Clean Energy Ltd. representatives visit transferred labourers at East Hope Zhundong facility. Source: Weixin.

there were "express transit" programmes running from rural villages to industrial parks in the midst of COVID-19 train stoppages, and East Hope was a beneficiary of this mass forced migration in the midst of the pandemic.[197]

On its corporate social responsibility page, East Hope Group announced that it has also invested CNY 800,000 for the transformation of rural villages in Kashgar through the "Fang Huiju" (访惠聚 or 访民情, 惠民生, 聚民心, translation: "Visit the People, Benefit the People, and Get Together the Hearts of the People") visitation programme, whereby Han cadres go for required surveillance visits in Uyghur homes.[198]

Supplier Exposures: East Hope Group established Changji Jisheng New Materials Building Co. in the Zhundong Economic and Technological Zone to process its metallurgical-grade silicon. The company positioned the raw materials facility adjacent to the East Hope polysilicon manufacturer to maximize efficiency.[199]

Potentially Affected Supply Chain: Despite ambitions to produce the world's cheapest polysilicon, East Hope has not provided much in the way of publicly available evidence of its customers. The company has not managed to reach the production capacity it had anticipated in 2017,[200] so it may be that the company is consuming its own supply in its solar generation plants. However, if East Hope is able to increase its production as anticipated in 2021, it could become a major source of polysilicon for the solar module supply chain.

Non-Xinjiang-Based Polysilicon Suppliers

Despite the XUAR's dominance in the manufacture of polysilicon, 35% of the world's polysilicon still comes from regions of China outside of the XUAR. While critical attention must be paid to the polysilicon manufacturers that operate facilities in the Uyghur Region, other significant polysilicon suppliers may be purchasing raw materials that originate in the XUAR. And because both metallurgical-grade silicon and the more refined polysilicon can be blended from different sources, products sourced from the Uyghur Region could be integrated into the polysilicon and silicon ingots produced by companies outside the region. For this reason, BloombergNEF solar expert Jenny Chase recently declared that "any silicon-based solar panel may have at least a small amount of Xinjiang silicon."[201]

Tongwei Solar Company (通威股份) produces high-purity polysilicon and solar cells.[202] According to Bernreuter Research, Tongwei is the manufacturer with the highest capacity for polysilicon production in the world, and thus represents a significant share of the PRC's non-Xinjiang-sourced polysilicon.[203] Tongwei seems in many ways like the safest bet in the Chinese polysilicon market. Nonetheless, there are some potential risks in Tongwei's supply chain that merit further investigation.

Tongwei sources its raw materials from Sichuan Hengye Silicon Industry Co (四川恒业硅业有限公司).[204] There are no discernable links between Hengye and Xinjiang or forced labour. It is unclear if Hengye is the sole or primary raw material source for Tongwei's polysilicon. However, if Hoshine Silicon's claims in the online investor forum (discussed above) are correct, then Tongwei is a customer of raw materials from Hoshine, which engages in labour transfers. However, it appears that Tongwei's raw materials are typically sourced from companies proximate to their polysilicon facilities, which could rule out Hoshine as a primary supplier.[205]

Tongwei's corporate filings do indicate that the company is a customer of LONGi Green Energy, Tianjin Zhonghuan, and JinkoSolar,[206] all of which have upstream suppliers that are engaged in labour transfers (see the next chapter for information regarding these manufacturers). These relationships seem to involve a circular transaction. Tongwei supplies polysilicon to LONGi, for instance. LONGi then turns the polysilicon into ingots and wafers for resale back to Tongwei.[207] Then Tongwei uses the wafers in the manufacturing of solar cells. This does not present a risk unless LONGi blends the Tongwei polysilicon with polysilicon purchased from suppliers Daqo, Xinte, or Xinjiang GCL for resale back to Tongwei subsidiaries. Since polysilicon from multiple suppliers is often blended, an investigation

into those practices could be critical in understanding Tongwei's exposure.

In terms of the employment of forced labour or labour transfers, there is nothing that suggests that Tongwei itself is involved. Tongwei did win an award for "absorbing" "more than 10" workers through a "poverty alleviation" labour transfer programme outside of the XUAR, but it is unclear where the workers originated from. Without further information, this is not conclusive evidence.[208]

Determining the source of all of Tongwei's raw materials is critical to determining the company's exposure to forced labour. This is important because Tongwei does supply some of the world's most significant solar module manufacturers with polysilicon. The company has current contracts with JinkoSolar Holding Company (through 2023),[209] Trina Solar (through 2023 and joint venture),[210] Tianjin Zhonghuan Semiconductor Company (through 2021),[211] Jiangsu/Baotou Meike Silicon Energy Company (through 2023),[212] and LONGi Green Energy Technology Company (through 2023).[213]

Asia Silicon (Qinghai) Company (亚洲硅(青海)有限公司) is a manufacturer of solar-grade polysilicon materials.[214] The company is registered in the PRC and majority-owned by Australian citizens. Asia Silicon's most significant exposure to labour transfers is through the company's immediate suppliers of raw materials, Hoshine,[215] Beijing/Qinghai Dadi Zelin Silicon Industry,[216] and Xinjiang Guopeng Technology.[217] Asia Silicon is currently expanding its Xining polysilicon production site, but as it stands, raw materials sourcing is what determines Asia Silicon's (and its customers') exposure to forced labour. Asia Silicon has a confirmed contract to supply wafer manufacturer LONGi Green Energy through 2025.[218]

Implications

The metallurgical-grade silicon made by Hoshine and its competitors significantly impacts the solar supply chain, but the Uyghur Region-based polysilicon manufacturers add significantly more risk. All four of the major companies located in Xinjiang participate in state-sponsored labour transfer programmes, and some of them are engaged in programmes that promote the invasive transformation of rural Uyghur life across the XUAR. While Asia Silicon does not have a polysilicon facility in the Uyghur Region, it does appear to be transporting raw materials out of the XUAR to its Qinghai locations. This is a reminder that XUAR raw materials are being shipped to polysilicon manufacturing facilities elsewhere, tainting even the polysilicon produced outside of the region. Thus, the reach of forced-labour-tainted metallurgical-grade silicon is clearly much wider than a portrait of the XUAR-based companies alone can reveal. This finding suggests that the larger Chinese supply chain requires close investigation to identify further downstream exposure to Xinjiang's state-sponsored forced labour programmes.

To that end, the next chapter will show that while the XUAR is home to only one ingot/wafer production facilities and one (possibly shuttered) module manufacturing facility, the forced-labour-tainted polysilicon produced in the region reaches many other solar module manufacturers in the interior of China.

Zhundong Economic and Technological Development Zone

Spanning 15,500 square kilometers across the Gobi Desert, the Zhundong Economic and Technological Development Zone provides the vast coal reserves – 7% of the PRC's total coal reserves – necessary for the cheap production of a wide range of industrial products.[219] Ironic though it may seem, Xinjiang regional and local governments advertise the Zhundong coalpits as a lure for renewable energy manufacturing. As of 2020, the Zhundong Zone had the capacity to produce 94,000 tons of polysilicon, which constituted 46% of the Uyghur Region's output and 22% of the PRC's.[220]

Zhundong Economic and Technological Development Zone. Source: Wo Ai Zhundong Promotional Video.

To encourage polysilicon companies to make the distant move out to the XUAR in the mid-2010's, the government promoted the development of the Zhundong Coal Power Base, which has powered the polysilicon giants that moved into the region (and will eventually power a great deal of the PRC).[221] To better facilitate the growth of the new energy economy in Zhundong, the government planned an expansion of the railroad and airports into the otherwise largely deserted region as well.[222]

Some of the PRC's leading new energy giants have taken full advantage of the benefits of proximate and cheap coal to fuel their polysilicon production. Xinjiang GCL and East Hope both call the region home. TBEA has a coal plant there, and their factories for both polysilicon manufacture and other electrical products they create are located just outside (though their official addresses use the closest urban area, Urumqi).

The Zhundong Zone employs 80,000 people.[223] The Zone also has a strong relationship with the local labour transfers programmes. The Wucaiwan Industrial Park, where East Hope is located, is just one park located inside the enormous Zone. It operates its own Wucaiwan Supply and Marketing Cooperative Member Service Center that "actively communicates with the transfer of labour in various towns and villages in Jimsar County" and with the corporations located in the park to determine matches between workers and available jobs. The Center had successfully matched companies with 9,000 rural surplus labourers by 2016, before the internment camp system was operational. Since 2016 and the increasing rise of repression in the Uyghur Region, labour transfers continued apace upon a backdrop of internment camps, supplying the PRC's solar industry with labourers who were compelled to participate.[224] The Human Resources and Social Security Bureau of Changji Prefecture boasted in 2018 that it had conducted 11,631 transfers of surplus labour to date.[225] The compulsory programmes continue even now, supported by incentives provided by the Bureau to companies within Zhundong for absorbing the transfers. By 2020, the Bureau announced that it had distributed "1.6 million yuan in rewards and subsidies to 52 labour service cooperation organizations, and allocated 800,000 yuan in special funds for small factories…to absorb poor labourers."[226]

Coal transport in Zhundong Economic and Technological Development Zone. Source: Wo Ai Zhundong Promotional Video.

4. INGOTS, WAFERS, CELLS & MODULES

Polysilicon is melted and shaped into ingots, which are in turn sliced into wafers, which are in turn used to construct photovoltaic cells. Many of the large Chinese solar module producers are vertically integrated from the ingot to the module. Alternately, a company might sell polysilicon to a wafer manufacturer who then sells the wafers back to the first company's module manufacturing subsidiary, as in the collaborative effort between Tongwei and LONGi described above.

Ranking of Market Share of Module Manufacturers

RANK	MANUFACTURER	HEADQUARTERS
1	LONGi Solar	China
2	Jinko Solar	China
3	JA Solar	China
4	Trina Solar	China
5	Canadian Solar	Canada/China
6	Hanwha Q-Cells	South Korea
7	Risen Energy	China
8	Astronergy/Chint Solar	China
9	First Solar	United States
10	Suntech	China

From Energy Sage

Of the top ten module producers in the world, there are seven Chinese companies (and one that is registered in Canada but manufactures in the PRC).[227] A significant proportion of the solar modules manufactured in the PRC are utilised domestically. The PRC government has set an ambitious target of 25% of the primary energy consumption being supplied by non-fossil-fuel-based energy by 2030.[228] However, 71% of the world's solar modules and 97% of the wafers that go in all of the world's modules are manufactured by Chinese corporations.[229] Nonetheless, Chinese solar companies export and often distribute their panels through their own international subsidiaries.[230] Many of them have international offices and even manufacturing plants. Because they export to their own subsidiaries, their customers are a bit more difficult to identify. However, based on corporate disclosures, it is clear that energy companies, developers, governments, and individual consumers have been buying solar panels that are at high risk of being at the end of a supply chain tainted by forced labour in the Uyghur Region.

JinkoSolar Holdings Company

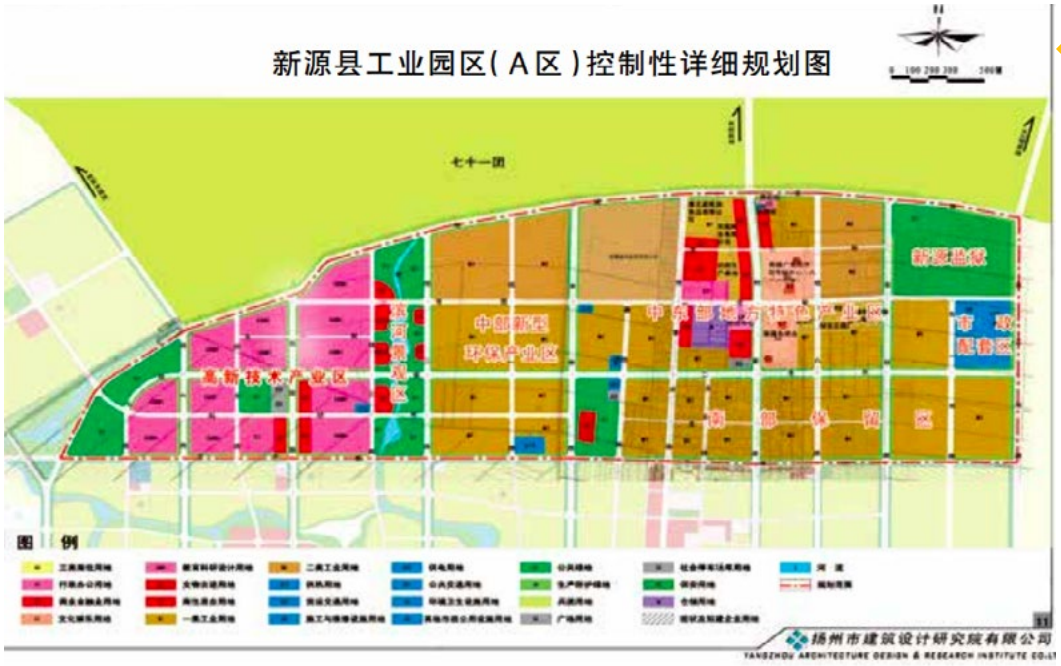
JinkoSolar Company (晶科能源控股有限公司) is one of the world's largest photovoltaic materials manufacturers. It is an international, vertically-integrated company concentrating on research and development, manufacturing, and sales of photovoltaic products, including wafers, cells, and modules. According to corporate reports, JinkoSolar held 12.6% of the global market share in solar modules in 2019.[231] JinkoSolar produces 42% of its ingots and the same proportion of its wafers in its XUAR facility.[232] JinkoSolar established its subsidiary in Xinjiang in 2016, just as the mass internment campaign against the Uyghurs and other ethnic minorities was beginning.

Participation in Labour Transfers: In the spring of 2020, Xinjiang JinkoSolar accepted 78 "registered unemployed personnel" from the Kunas County (Chinese: Xinyuan, 新源) government on one-year or longer contracts. Their names and educational levels, ranging from junior high to undergraduate, were publicly listed, suggesting that the company's employee requirements are not limited to highly skilled or educated technicians. According to a Kunas County government press release on the transfer, the recruits were given CNY 1,000 state subsidies to work at JinkoSolar.[233] In July 2020, Xinjiang JinkoSolar was awarded further subsidies for "accepting forty poor labourers from southern Xinjiang."[234] 2020 may not have been the earliest Xinjiang JinkoSolar received labour transfers; the relatively small Xinyuan Industrial Park in which JinkoSolar is located brought in rural surplus labourers starting at least as early as 2018.[235]

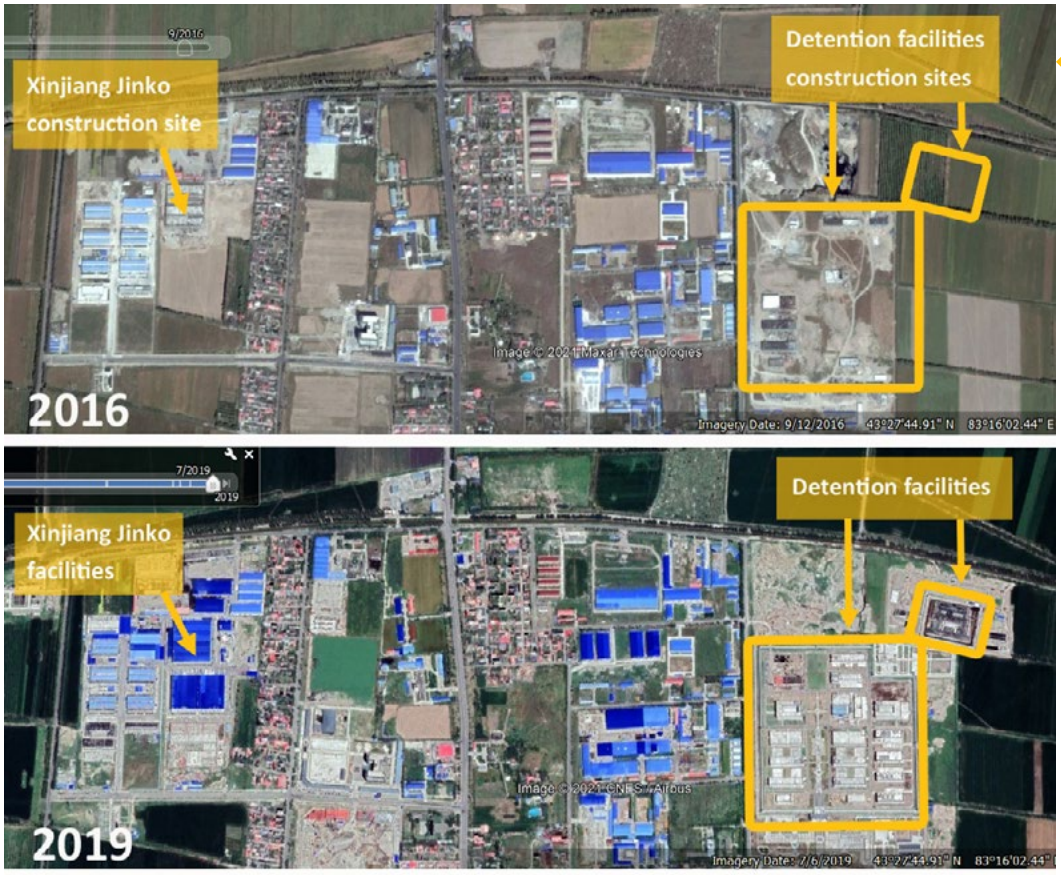
According to media reports, 54% of JinkoSolar's employees at its Kunas plant are ethnic minorities from the local area, including former farmers and herdsmen.[236] It is unclear how many of the workers are recruited through state-sponsored labour programmes, but it is clear from the above that at least some of its workers are. This is also interesting in light of claims that only highly skilled and highly educated workers are capable of working in polysilicon plants.

Co-Location with Detention Centre and Prison: Another potential issue for JinkoSolar is the fact that the company invested CNY 3 billion in the Xinyuan Industrial Park,[237] which houses the JinkoSolar factory complex as well as a high-security prison (identified by industrial park documents) and an internment camp (identified by ASPI).[238] This facility was by far the largest the company owned in the world at over 165,000 square meters, until they built the Leshan, Sichuan ingot production facility in 2019.[239] Historical satellite imagery from Google Earth reveal that at the same time as JinkoSolar's silicon ingot facilities were being built, the prison and detention centre were being built in the same industrial park, merely one and a half miles away. According to the early plans for the park, there are also local craft, textiles, agricultural and food factories across the street from the detention centre.[240] In 2015, the Kunas government invested CNY 400 million in building the high-security prison and CNY 3 million for a fund to reward citizens and employees who inform on others who undermine social "stability."[241] The prison appears to have opened in late 2017 using personnel from Urumqi.[242] There is no conclusive evidence that either the internment camp or prison provide labour for JinkoSolar, but because some companies co-located in industrial parks with camps have utilized forced labour of detainees (see introduction), JinkoSolar's co-location represents a heightened risk.

Supplier Exposures: JinkoSolar is also exposed to forced labour in its supply chain. According to Daqo's 2020 and 2021 corporate filings, JinkoSolar is its second largest customer.[243] In September 2019, Daqo signed a purchasing agreement with JinkoSolar through December 2022.[244] Xinjiang Daqo's 2021 IPO prospectus indicates that at least through 2020, Daqo supplied not only Xinjiang Jinko but also JinkoSolar's Sichuan subsidiary and JinkoSolar in Jianxi.[245] Because 100% of Daqo's polysilicon is produced in the Uyghur Region, and its direct suppliers are implicated in labour transfers, this is a significant exposure for JinkoSolar.



Schematic for Xinyuan Industrial Park. JinkoSolar facilities in pink on the left. Note site of Xinyuan Prison (新源监狱) is marked in green in top right corner. The blue box below the prison is designated for the Municipal Supporting Facilities Area (市政配套区). Source: Xinyuan Investment Guide.



Xinyuan Industrial Park Site 2016, 2019. Source: Google Earth Pro

Potentially Affected Supply Chain: Because JinkoSolar largely distributes its products through its own distributors, it is necessary to look at their corporate disclosures alone to ascertain which companies might be sourcing modules from JinkoSolar. In JinkoSolar's 2019 and 2020 annual reports, the company indicated that the following international companies were their most significant customers: Vivint Solar (US),[246] CIMIC Group (AU), Consolidated Edison (US), Consolidated Electrical Distributors (US), Copenhagen Infrastructure Partners K/S (DK), Decmil Group (AU), Elecnor SA (ES), Enel SpA (IT), Engie SA (FR), Fuji Electric Co (JP), Green Light Contractors Pty (AU), Henan Senyuan Electric Co (CN), Hengtong Optic-electric Co (CN), Innotech Corp (JP), Jiawei Renewable Energy Co (CN), Kenya Electricity Generating Co PLC (KE), MAONENG Group (AU), Metka-Egn (GB),[247] MVV Energie AG (DE), NextEra Energy (US), Sungrow Power Supply Co (CN), Swinerton Builders (US),[248] and Sustainable Power Group (US).[249]

LONGi Green Energy Technology Company

LONGi Green Energy Technology Company (隆基绿能科技股份有限公司) is mainly engaged in the research and design, production and sales of monocrystalline silicon ingots, silicon wafers, cells and modules.[250] It is the world's largest monocrystalline wafer producer, and when it expanded in 2019, became the world's largest solar module manufacturer.[251]

LONGi's production facilities are located across the PRC, but the company does not manufacture in the Uyghur Region. It does run solar power generation plants in the XUAR, however. LONGi does engage in "poverty alleviation" programmes in the Uyghur Region, but, as far as records reviewed for this report show, its poverty alleviation efforts generate power for the grid in that region and are not involved in any identified labour transfers.[252]

Supplier Exposure: LONGi is a customer of many of the polysilicon companies that are engaged in labour transfers in the Uyghur Region. In a deal brokered in early 2021, LONGi agreed to procure polysilicon from GCL-Poly for all of its seven monocrystalline ingot/wafer subsidiaries from March 2021 through 2023.[253] In late 2020, LONGi signed an agreement to purchase 270,000 tonnes of polysilicon from Xinte through 2025. LONGi also has a purchasing agreement with Daqo for 112,000 tons of polysilicon that lasts through December 2022.[254] In 2019, LONGi awarded Daqo with a "Strategic Partner Award," celebrating that it is one of Daqo's largest customers.[255] LONGi also has a long-term purchasing relationship with Asia Silicon, and in late 2020 signed a five-year agreement to purchase nearly 125,000 MT of polysilicon from that company through 2025.[256]

Relationship with the XPCC: Xian LONGi Clean Energy Co., Ltd has three solar energy generation plants in the Liushuquan Farm (Willow Springs Farm) of the 13th Division of the Kumul (Chinese: Hami 哈密) Xuanli Division of the Xinjiang Production and Construction Corps.[257] LONGi's Liurui New Energy Development Co., Ltd. (哈密柳瑞新能源开发有限公司) is also located in that park.

Potentially Affected Supply Chain: U.S. Customs records accessed via ImportGenius suggest that LONGi mainly ships directly to its own international distributors. Customs records also indicate that the company ships to a transport company called Amass International, as well as a Texas company called FC Felhaber. LONGi also recently announced that they sent a large shipment of modules to the Southhampton port in the United Kingdom, but it is unknown who the end customer for those panels will be.[258] Solar Supplies UK, Plug-inSolar, and Segen sell LONGi's modules online.[259] LONGi's 2020 half-year report includes the following companies as customers: Vina Cell (CN/VN), Shanghai EZ New Energy Technology Co, Ltd., Taizhou Zhonglai Optoelectronics Tech Co, and Jiangsu Runergy Photovoltaic Technology Co., Ltd.[260] LONGi also brokered a three-year deal to be a supplier to Astronergy. [261] A 2019 news report announced a LONGi deal with Sunnova (US).[262] LONGi also has a long-standing relationship with Tongwei, as described in the chapter above.

Trina Solar Energy Company

Trina Solar Company (天合光能股份有限公司) is a multinational corporation that produces silicon ingots and wafers, cells, and modules.[263] In 2014, Trina Solar began manufacturing photovoltaic modules in Toksun County (Chinese: Tuokexun, 托克逊), Turpan, Xinjiang, where the company invested CNY 180 million in a plant.[264] By January 2021, Cooper Chen noted in PV Magazine that it appears that the little module manufacturing that was happening in the Uyghur Region had been "halted," which would suggest that Trina's Xinjiang plant (the only module manufacturer in the region) may not be operating currently, but Trina's most recent corporate filings do not provide any specific confirmation of that.[265]

Participation in Labour Transfers: In the 2015 announcement of Trina's module production facility in the XUAR, the company explained its hiring strategy, which echoes much of the government labour transfer rhetoric. Trina committed to helping to "solve the employment problem of the local people of all ethnic groups." The company reported that the plant employs more than 150 people, of which "more than 120 local ethnic minority employees have been absorbed."[266] The language of "absorption" is often used to describe labour transfers in the XUAR. It is otherwise unclear to what extent Trina has been involved in labour transfers since its facilities opened and, importantly, since the system of mass internment has been developed.

Supplier Exposure: Trina Solar is primarily exposed to forced labour through its supplier, Daqo. Trina has a contract to purchase as much as 37,600 tons of polysilicon from Daqo through 2023.[267] Trina is also supplied by other companies with exposure to forced labour, including GCL-Poly, LONGi, Asia Silicon, and Tianjin Zhonghuan. Trina signed an agreement to buy 1.2 billion units of silicon wafers from Tianjin Zhonghuan at the end of 2020.[268] Tianjin Zhonghuan's own supply chain is affected by multiple suppliers reported above who employ labour transfers (see Tianjin Zhonghuan section below).

Relationship with the XPCC: According to Trina's corporate reports, subsidiary Wujiaqiu Energy rents land from the XPCC Sixth Division 106th Regiment 3rd Company for its Xinjiang corporate offices. [269] It is possible it also receives other subsidies for its operation of power plants in that city, which is governed by the XPCC. Trina's subsidiary Xinjiang Tianyuan Smart Energy Company also has a project in the Camel Circle Industrial Park of the 13th Division of the XPCC.[270]

There is no further indication as to whether the company's other power generation plants are supported by the XPCC. It is possible that the company does receive XPCC support because of the particular cities where its plants are located.

Potentially Affected Supply Chain: In April 2021, the UK Ministry of Defense announced that it had signed a purchasing agreement to install 4,248 Trina Vertex panels as part of Project PROMETHEUS at its Defense School of Transport, Leconfield.[271] SelectSolar, Sunstore, and Segen (among others) sell Trina's modules direct to contractors and consumers online.[272] In its 2020 IPO prospectus, Trina listed the following companies as customers: Xinjiang TBEA,[273] NextEra Energy (US), Sungrow (CN), Enel Green Power North America (US), Enviromena Power Systems (UAE), JGC Corporation (JP), X-ELIO Energy, S.L. (ES), Ortiz Energia, S.A. (ES), Greenko Group (IN), TOYO Engineering (JP), Hero Future Energies (IN),[274] WEG S.A. (BR), Greening Components B.V. (NE), BayWa r.e Renewable Energy GmbH (DE), Aldo Componentes Eletronicos Ltda (BR), Marubeni Corporation (JP), Sol Distribution Pty Ltd. (AU), Changzhou Shengping Photovoltaic Technology Co., Ltd. (CN), Sonepar Group (FR), IBC SOLAR AG (DE),[275] China DaTang Co. Ltd. (CN), Changjiang Huasheng Energy (CN), Saving Service Co., Ltd. (CN), Scatec Solar (NO), Solar City (subsidiary of Tesla, US), Downer Utilities Australia Pty Ltd. (AU), Cypress Creek Holdings (US), Zhejiang Energy Group Co., Ltd. (CN),[276] Hero Solar Energy Private Ltd. (IN), Niagara Renewable Energy Ltd. (CA), and COBRA Infraestructuras Internacional, S.A. (ES).[277] Newcomer Matrix Renewables (ES) has brokered a significant deal with Trina that runs through at least 2022.[278]

JA Solar Holdings Company

JA Solar Holdings Company (上海晶澳) manufactures silicon wafers, solar cells and solar modules.[279] The company is in a multi-year process of significantly expanding wafer production capacity.[280] JA Solar does not have any solar module manufacturing facilities in the Uyghur Region, and it does not appear to directly participate in any Xinjiang government "poverty alleviation" or surplus labour programmes. However, the company does have a long-term lease with the XPCC for land that JA Solar operates power generation plants on.

Supply Chain Exposures: JA Solar's most significant exposure to forced labour in Xinjiang is through suppliers Daqo, Xinte, and GCL-Poly. In September 2020, JA Solar agreed to buy 97,000 tons of polysilicon from Xinte through December 2025.[281] In December 2020, JA Solar agreed to buy up to 43,000 tons of polysilicon from Daqo.[282] A JA Solar report indicates that GCL-Poly is a supplier.[283]

Relationship with the XPCC: JA Solar runs several power generation plants in the XUAR (Beitun Haitianda Photovoltaic Power Generation Co., Ltd and Beitun Haitianda Photovoltaic Power Generation 184th Mission Branch) that operate in the 184th Regiment of the 10th Division of the XPCC. They have a lease with the XPCC through December 2040.[284] In April 2020, JA Solar created a new subsidiary, Tiemenguan JA Solar Co., Ltd., which is located in the XPCC's Tiemenguan city, where it operates a power station. It is possible that the XPCC provides other subsidies for the power plants.

Potentially Affected Supply Chain: ImportGenius/U.S. Customs records indicate that JA Solar mainly ships directly to its own subsidiaries and distributors in the United States, which makes it difficult to know precisely which international companies' supply chains are at heightened risk. Customs records indicate that JA Solar ships directly to a company in the Dominican Republic, Escala Solar Energias Renovables. JA Solar's recent corporate filings indicate that the company primarily supplies other Chinese solar companies, but it also reports selling to Acciona SA (ES),[285] Exel Solar SAPI de CV (MX),[286] Acciona Energie Chile (CL), Cypress Creek EPC (US), Iberdrola SA (ES), and the PRC's Sungrow, which has international distribution.[287]

Other Potentially Exposed Module Manufacturers Operating in the PRC

Tianjin Zhonghuan Semiconductor Company (天津中环半导体股份有限公司) is a state-owned manufacturer of silicon ingots and wafers. Tianjin Zhonghuan owns a 27% stake in Xinjiang GCL and purchased CNY 900 million of "new energy materials" (likely polysilicon) from them in 2019.[288] Additionally, Zhonghuan's subsidiary signed a purchasing agreement with GCL-Poly for 350,000 tons of granular polysilicon materials from GCL's subsidiary Jiangsu Zhongneng in Xuzhou and its future plant in Leshan through 2026.[289] Zhonghuan also has a purchasing agreement with Daqo through 2024.[290] Zhonghuan is a "long-term partner" of French oil and gas company Total's subsidiary SunPower (US) and has recently taken a minority share (28.8%) of Maxeon Technologies (US).[291] Its annual reports do not indicate customers, so it is difficult to know how this affects the downstream solar supply chain.

Qinghai Gaojing Solar Energy Technology Company (青海高景太阳能科技有限公司) is a newcomer to the wafer production sector. As the company is currently still under construction, and they are located outside the Uyghur Region, they had the opportunity to operate with low risk of exposure to forced labour in the Uyghur Region. However, in March 2021, Gaojing signed two contracts that put it in the direct XUAR supply chain, one with Xinte and the other with Daqo.[292] It is unclear who Gaojing's customers are at this time.

Canadian Solar (阿特斯阳光电力集团) is a vertically-integrated manufacturer that produces ingots, wafers, cells, and modules in its manufacturing facilities across Asia and the Americas and develops solar farms around the world.[293] Canadian Solar owns U.S. energy developer Recurrent.[294] While the company is a registered Canadian business, with headquarters in Guelph, Canadian Solar modules are largely manufactured in the PRC, including in the company's original and larg-

est plant in Suzhou.[295] Canadian Solar's primary exposure to forced labour in the Uyghur Region is through supplier GCL-Poly. Canadian Solar has a joint venture with GCL-Poly on a solar cell production facility in Jiangsu, which may be affected if that facility is importing polysilicon from the GCL subsidiary in Xinjiang.[296] Canadian Solar operates a solar power generation facility in the XPCC 3rd Division city of Tumxuk (Chinese: Tumushuke 图木舒克), Xinjiang, and likely benefits from that relationship with the XPCC. In December of 2013, the XPCC approved a plan to fix high prices for electricity provided by 29 new photovoltaic plants, and Canadian Solar may have benefited from the plan.[297] U.S. Customs records indicate that Canadian Solar mainly ships directly to their own distributor/subsidiary in the United States. They also ship to a Puerto Rican company, Power Solar LLC, as well as a Texas company, FC Felhaber.[298]

Risen Energy Company (东方日升新能源股份有限公司) primarily produces photovoltaic cells and modules. Risen also develops and builds solar energy generation facilities worldwide, including in the United States, European Union, India, Latin America, Australia, and Asia.[299] In 2020, Risen purchased a polysilicon manufacturing plant in Inner Mongolia, initiating the company's entry into the polysilicon production business.[300] Risen has no known direct investments in Xinjiang, nor is there any evidence of employing forced labour in its manufacturing. Nonetheless, Risen Energy's supply chain is potentially affected by their relationship with Wuxi Shangji Automation Co. Risen Energy has a three-year contract to purchase silicon wafers from Wuxi Shangji,[301] who purchases polysilicon from Daqo, Xinte, and GCL-Poly. Risen struck a deal to provide modules to Tokai Engineering M Sdn Bhd. of Malaysia in Spring 2020 and to Asia Pacific renewables company UPC-AC Energy SA in fall 2020.[302] They reported a shipment of modules to Malaysia-based Armani Energy Sdn Bhd in early 2021.[303]

Astronergy/Chint Solar (正泰新能源) Astronergy is supplied by GCL-Poly[304] and LONGi,[305] both of whom represent high risk of forced labour in their supply chains. There is no discernable evidence that Chint Solar itself participates in any labour transfer programmes.

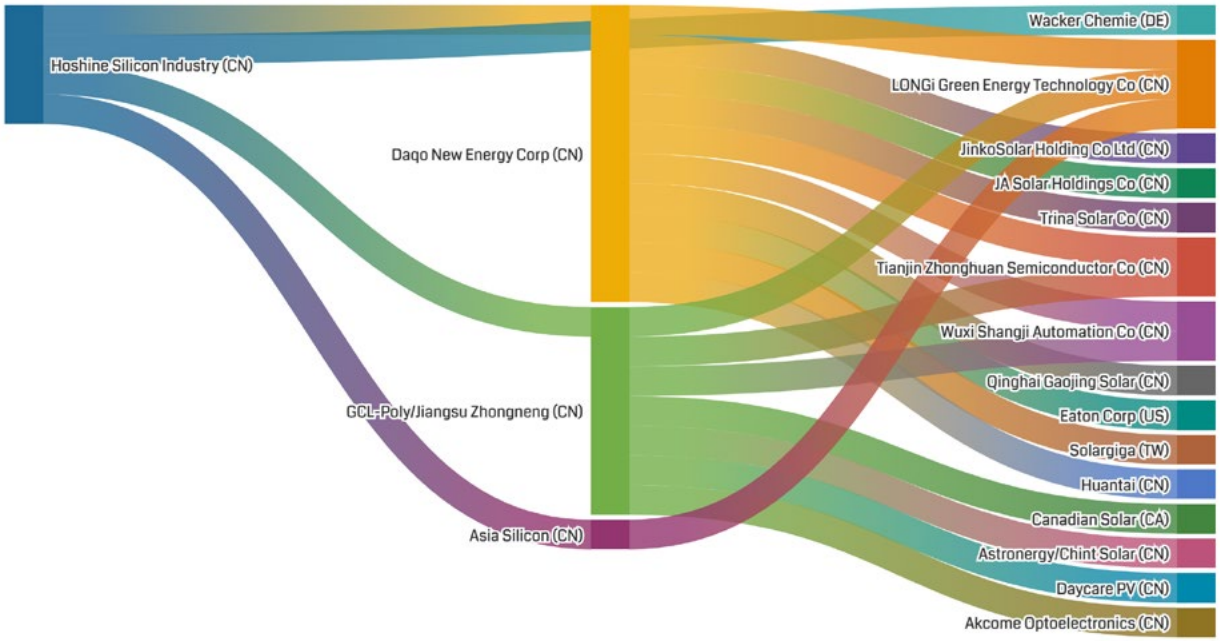
Wuxi Suntech Power Company (无锡尚德太阳能电力有限公司) was an early leader in Chinese photovoltaic module manufacturing. It has not been a significant exporter in recent years, but it is still in operation. Suntech manufactures solar cells and modules. The company has built solar power generation farms in the United States, United Kingdom, Europe, India, Yemen, Brazil, Thailand, and Kazakhstan.[306] In 2008, Suntech established a subsidiary in Xinjiang, Xinjiang Suntech Energy Engineering Co., Ltd.[307] It is focused on power generation plants and engineering. The company does not manufacture solar modules for domestic or export use in its Xinjiang subsidiary. We have located no evidence that Suntech is engaged in forced labour in any direct way, including in its power plants in Xinjiang. It is possible that these plants receive subsidies from the government, but there is little record of Suntech's finances nor is there much in the way of corporate filings that would allow a sound determination. Given this lack of information, no clear determination can be made.

Implications

The pervasive impact of Xinjiang labour transfers on the solar supply chain is made evident when examining Chinese module manufacturers. Nearly every major Chinese end product manufacturer in the industry has a stake in Xinjiang, whether through their investments in solar energy power plants or through their suppliers. With two major international manufacturers – JinkoSolar and Trina Solar – operating potentially compromised bases within Xinjiang and with the significant evidence of forced labour transfers throughout the supply chain, the vast majority of the PRC solar supply chain is at very high risk of being tainted by forced labour in the Uyghur Region.

The final section of this report suggests some alternatives available and on the horizon.

5. CONCLUSIONS & FUTURES

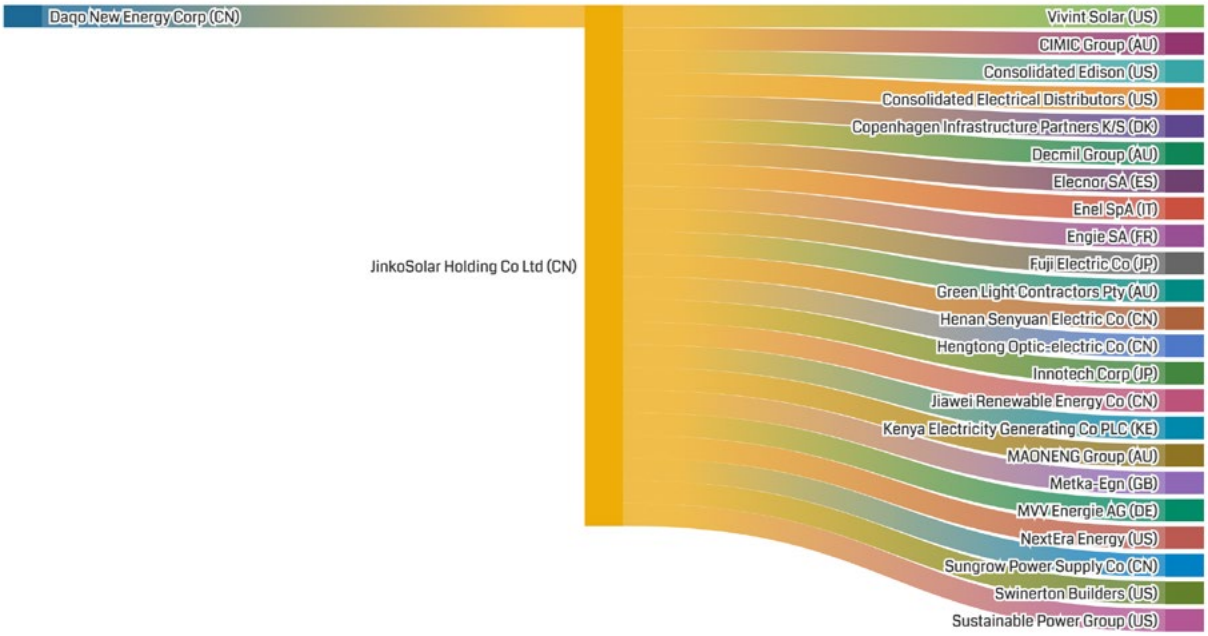


Hoshine Silicon Industry's downstream customers

A mapping of Hoshine's confirmed downstream supply chain alone begins to give us a sense of how significant the effects of Xinjiang forced labour are on the international solar market. Hoshine has indicated in its own corporate filings that it supplies polysilicon manufacturers Daqo, Jiangsu Zhongneng (a subsidiary of GCL-Poly), Asia Silicon, and Wacker. Daqo alone supplies all four of the solar module manufacturers with the largest market share in 2019 – LONGi, JinkoSolar, JA Solar, and Trina Solar.[308] The fifth, seventh, and eighth ranked module manufacturers – Canadian Solar, Risen, and Astronergy/Chint – all also have a risk of labour transfers in their supply chains.

The downstream companies that are potentially affected by forced labour span the globe (see the Supply Chain Exposures table at the end of this report). JinkoSolar's connection to Daqo alone and its own engagement in labour transfer programmes affect end users globally. A review of JinkoSolar's confirmed recent contracts is indicative of the potential global exposure to Xinjiang forced labour.

With the recent call to action and due diligence protocol released by the Solar Energy Industries Association designed to "ensure the solar supply chain does not include abhorrent forced labour practices,"[309] this issue has garnered significant attention within the industry. The call to action has been signed by 245 solar industry companies as of the end of March 2021,[310] which suggests a nearly industry-wide commitment to addressing the problems reported in this study.[311] Signatories include JinkoSolar, LONGi, JA Solar, and Trina Solar, all of whom would have to make significant



Daqo New Energy > JinkoSolar downstream customers

changes to adhere to their commitment to ensure that they are not purchasing raw materials made with Xinjiang forced labour or participating in labour transfers themselves. In addition to the companies that have publicly announced contracts with the suppliers employing forced labour programmes in Xinjiang, there are scores more that have signed on to the SEIA pledge and may yet be exposed through relationships with suppliers that we have not identified here. The work to identify all affected companies in the solar supply chain will be an arduous task, but it is not at all impossible. This report is intended to assist in that process.

While Xinjiang-made raw materials and polysilicon dominate the market, there are alternatives. Polysilicon market analyst Johannes Bernreuter reminds us that while Xinjiang accounts for 45% of the world's solar-grade polysilicon supply, 35% more of it comes from other regions of China, and 20% from outside of China. [312] Experts agree that this is enough to supply the United States and Europe's needs for solar modules.[313] However, this does not account for the companies in the interior of China and internationally whose supply chains are likely affected by manufacturing in the Uyghur Region, especially those whose supply chains reach back to Hoshine. The extent to which Xinjiang metallurgical-grade silicon and polysilicon pervades the market means that module manufacturers that want to avoid producing goods that are potentially tainted by forced labour in Xinjiang will have to scrutinise their supply chains thoroughly, all the way to the raw quartz materials, to determine if they are produced with forced labour or blended with affected materials. They will have to demand that the polysilicon that goes into the manufacture of their wafers is not sourced from companies engaged in forced labour transfers. This effectively leaves only a few Chinese alternatives with no confirmed exposure to forced labour in the Uyghur Region.

As the United States ponders the Uyghur Forced Labour Prevention Act, locating alternatives to Xinjiang-sourced solar energy products becomes increasingly critical – not only for U.S. manufacturers and retailers but also for those other global markets where U.S. sanctions could mean Xinjiang-made goods head their way. Bernreuter predicted in March that "what will likely happen is this: Wafer manufacturers, who usually blend polysilicon volumes from different suppliers, will exclude feedstock from Xinjiang from the

mix for part of their production in order to offer 'Xinjiang-free' wafers. Those can then be used for solar cells and modules destined for export to the U.S.; European customers will probably demand products untainted by forced labour as well."[314]

Indeed, in February 2021, JinkoSolar announced that the company had "already undertaken necessary steps to ensure" that their products sold in the United States would not be made of products produced in whole or in part in Xinjiang. However, S&P Global reported that in JinkoSolar's SEC filings the company noted that "some products it sells into the U.S. could contain material from Xinjiang, adding that it 'may' reconfigure its supply chains if Washington enacts tight trade restrictions on the region."[315] JinkoSolar did not indicate how this shift in shipments would affect its other international customers. Presumably, the Xinjiang-originated products would go to markets other than the United States if the legislature enacted a law prohibiting those products and JinkoSolar complied.

The alternatives to Xinjiang-sourced metallurgical-grade silicon and solar-grade polysilicon seem to be contracting in some places and expanding in others in recent months, but the industry could see a significant expansion if there is increased demand from consumers, manufacturers, or governments.

Expansion of Chinese Production Beyond Xinjiang

Perhaps pre-empting legislative mandates, in November of 2020, JinkoSolar signed a contract with Tongwei to purchase 93,000 metric tons of polysilicon, which is not produced in Xinjiang and has a decreased risk of including metallurgical-grade silicon from Xinjiang, though blending is always a possibility.[316] If Tongwei expands as expected, it will be in a position to meet significant demand for non-Xinjiang polysilicon,[317] but Tongwei's relationships with LONGi and others will require some scrutiny to ensure that its cells are not produced with polysilicon that is blended with the materials coming from Xinjiang.

Chinese manufacturers seem to be turning toward Inner Mongolia for expansion of their raw materials mining and processing and for polysilicon production. JA Solar is investing significantly in the expansion of its Baotou, Inner Mongolia wafer-production subsidiary.[318] In February 2021, TBEA announced plans for Xinte to create one of the world's largest polysilicon plants in Baotou as well.[319] This could potentially represent an alternative to TBEA's Xinjiang polysilicon.[320] However, the Baotou site is unlikely to be completed soon enough to meet short-term demand spurred by shifting supply chains out of the Uyghur Region, so this is not currently a viable alternative to TBEA's Xinjiang operations. Furthermore, it would be important to monitor rights abuses in Inner Mongolia, as recent reports have pointed to government policies aimed at ethnic assimilation in the region and experts are concerned about the potential for increased repression, given the precedents in Xinjiang and Tibet.[321]

Global Alternatives

Hanwha Q CELLS is a manufacturer of solar cells and modules for the international market whose affiliate, Hanwha Solutions [formerly Hanwha Chemical], previously manufactured polysilicon as well. Hanwha closed its polysilicon manufacturing base in 2020, due to non-competitive electricity costs. Hanwha has no known facilities or direct ties to Xinjiang or to the XPCC. It is unclear who is currently supplying Hanwha; we were unable to find any listing of its suppliers. Hanwha has not released details on its plans in response to the Solar Energy Industries Association's call to action, though it is a signatory. Given the anxieties about forced labour in the Xinjiang-based polysilicon manufacturing sector and Korea's stringent carbon emissions policies for green energy, Korean manufacturer Hanwha may be looking outside China for its supply.

OCI is a chemical company that manufactures polysilicon and operates in Korea, China, Malaysia, the Philippines, Vietnam, and the United States. After the closure of its polysilicon manufacturing base in Gunsan, Korea, OCI manufactures all of its solar-grade polysilicon in its Malaysia plant.[322] The company owns and operates Mission Solar in San Antonio, Texas, where it manufactures solar panels as well.[323] OCI has no con-

firmed exposure to forced labour in the Uyghur Region through its subsidiaries. However, Hoshine's response to a query on an online investor forum named OCI as a customer; [324] if that is in fact the case (though we have located no other evidence that it is), then OCI has exposure to forced labour through that supplier. In December 2020, OCI announced a US $55 million debottlenecking of production capacity in its Malaysia polysilicon facility.[325] Malaysia remains an important alternative for low-priced hydropower electricity for the production of polysilicon. In February 2021, LONGi Green Energy recommitted to buying polysilicon from OCI,[326] and while it did have a previous three-year contract with OCI, and thus this is not necessarily a new development, this contract does at least represent an alternative to polysilicon sources in Xinjiang.

American and European manufacturers may present additional options, as they currently account for approximately 15% of polysilicon production globally. Germany's **Wacker Chemie** currently retains the third highest polysilicon manufacturing capacity in the world (though it is on track to lose that placement in the course of the coming year with Daqo's and Xinte's planned expansions); however, if Wacker is indeed purchasing raw materials from Hoshine, that presents a significant forced labour risk. **Hemlock Semiconductor** continues to produce polysilicon, though the company has also reduced its production capacity by half.[327] **REC Silicon** has a closed polysilicon factory that might be brought back online.[328]

Another option might be an alternative to polysilicon-based modules altogether. U.S.-based **First Solar** is ranked ninth among module manufacturers and is not exposed to Xinjiang polysilicon because the company uses thin film technology which does not require polysilicon at all. First Solar has expanded capacity recently and announced that it is considering developing yet another facility, but at this time, solar analyst Chase has reminded the industry that First Solar will not be able to supply the world alone.[329]

If the Uyghur Forced Labour Act is passed or if similar forced labour legislation is passed in other countries, this will put the onus on companies to shift suppliers. Chase suggests consumers "will pay an almost unnoticeable amount more for modules" if module manufacturers refuse Xinjiang polysilicon.[330] Other Chinese suppliers as well as the above listed non-Chinese companies could make up for the loss of the Xinjiang supply. Still, the cost of energy in Korea, the United States, and the European Union is rarely if ever as low as can be supported by the government-subsidised coal industry in Xinjiang. This is what has made Chinese competitors so strong in recent years. Shifting the green energy supply chain out of Xinjiang to avoid human rights abuses could be encouraged by subsidized energy costs for the production of green energy, investments in polysilicon and wafer production facilities outside of China, and acceptance of slightly higher prices for new energy solutions.

Moving away from forced-labour-tainted polysilicon may spur innovation as well. Such a shift in the supply chain may even provide an impetus for further work on more efficient processes, which has already advanced significantly in recent years. It might also encourage the development of alternatives to polysilicon in the manufacture of modules.[331] An emphasis on lower carbon impact may also work hand-in-hand with calls to excise forced labour from the supply chain, as the two are intertwined in the Xinjiang region.[332]

Extracting forced labour from the solar supply chain may seem complicated and may come at a cost to manufacturers and customers. However, as this report indicates, the solar supply chain is relatively easy to map, and identifying forced labour exposure in Xinjiang is less of a challenge than in industries such as textiles or agriculture. And doing so is critical, as it would not only address the forced labour issue in Xinjiang but would also substantially reduce the carbon emissions of the solar industry. From a human rights and climate perspective, the alternative of basing our green energy future on coal's high carbon emissions and on the forced labour of oppressed communities is a higher and longer-term price to pay.

APPENDIX A: FORCED LABOUR EXPOSURES

Corporate responses to requests for comment will be included in an appendix available on the website for this report.

Raw Materials

COMPANY	XINJIANG MANUFACTURING LOCATION	FORCED LABOR EXPOSURE	CAMP CO-LOCATION	XPCC RELATIONSHIP	CURRENT OR RECENT DOWNSTREAM CONTRACTS*
Xinjiang Hoshine Silicon Industry Co./ Hesheng 新疆合盛硅业有限公司	Raw materials facility	Labour transfers	Within 6 miles, where likely suppliers are co-located	Significant subsidies, located in XPCC industrial park	Daqo, Asia Silicon, GCL-Poly/ Jiangsu Zhongneng, Wacker Chemie
Xinjiang Sokesi New Material Co. 新疆索科斯新材料有限公司	Raw materials facility	Labour transfers	Unknown	None known	Daqo
Changji Jisheng New Building Materials Co. 昌吉吉盛新型建材有限公司	Raw materials facility	Labour transfers	Unknown	None known	
Xinjiang China Silicon Technology Co./ Xinjiang Zhonggui 新疆中硅科技有限公司	Raw materials facility	Labour transfers to industrial park, job fair	Unknown	Yes, direct beneficiary, located in XPCC industrial park	Unknown
Xinjiang Jingweike New Energy Development Co. 新疆晶维克新能源发展有限公司	Raw materials facility in XPCC park	Labour transfers (job fair)	Unknown	Has joint venture with XPCC	Unknown
Xinjiang Jingxin Silicon Industry Co. 新疆晶鑫硅业有限公司	Raw materials facility	Labour transfers	Unknown	Has joint venture with XPCC	Unknown
Xinjiang Yusi Technology Co./Yu Silicon 新疆宇硅科技有限公司	Raw materials facility in XPCC park	Labour transfers to industrial park	Unknown	Yes, direct beneficiary, located in XPCC industrial park	Unknown
Xinjiang Jiagesen New Energy Materials Co., Ltd. 新疆嘉格森新能源材料股份有限公司	Raw materials facility	Labour transfers to industrial park	Unknown	Yes, direct beneficiary, located in XPCC industrial park	Unknown

COMPANY	XINJIANG MANUFACTURING LOCATION	FORCED LABOR EXPOSURE	CAMP CO-LOCATION	XPCC RELATIONSHIP	CURRENT OR RECENT DOWNSTREAM CONTRACTS*
Xinjiang Guopeng Technology Co. 新疆国鹏科技有限公司	Raw materials facility	Labour transfers to industrial park	Unknown	Yes, direct beneficiary, located in XPCC industrial park	Asia Silicon
Xinjiang Xintao Silicon Industry Co. 新疆鑫涛硅业有限公司	Raw materials facility	Likely labour transfers	Unknown	XPCC was a shareholder until 2019	Xinte, Beijing Zelin, Qinghai Baitong, Xuzhou Zhengxu Silicon Material, Shanghai Chaojin
Beijing Dadi Zelin Silicon Industry Co. 北京大地泽林硅业有限公司	Raw materials facility	Labour transfers to industrial park	In park adjacent to possibly not-yet-finished camp, prison, and detention centre	Unknown	Asia Silicon Daqo (until 2020)

Polysilicon

COMPANY	XINJIANG MANUFACTURING LOCATION	FORCED LABOR EXPOSURE	CAMP CO-LOCATION	XPCC RELATIONSHIP	CURRENT OR RECENT DOWNSTREAM CONTRACTS*
Daqo New Energy Corp 大全新能源股份有限公司	Polysilicon facility	Labour transfers, in immediate supply chain	None	Direct beneficiary	LONGi, JinkoSolar, JA Solar, Trina Solar, Tianjin Zhonghuan, Wuxi Shangji, Qinghai Gaojing, Eaton Corp, Sunshine/Solargiga, Huantai
GCL-Poly 保利协鑫能源控股有限公司	Polysilicon facility	Labour transfers, in immediate supply chain	None	Direct beneficiary	LONGi, Wuxi Shangji, Tianjin Zhonghuan, Canadian Solar, Astronergy/Chint Solar, Daycare PV, Akcome Optoelectronics
TBEA/Xinte 特变电工/新特能源公司	Polysilicon facility	Labour transfers, corporate participation in rural "poverty alleviation," possible in supply chain	None	Strategic cooperative agreement	LONGi, JA Solar, Qinghai Gaojing, Beijing Jingyuntong, Wuxi Shangji
East Hope Group 东方希望	Polysilicon facility	Labour transfers	None	Unknown	Unknown
Tongwei Solar Company 通威股份	None	Possible in supply chain	None	None known	JinkoSolar Holding, Trina Solar, Tianjin Zhonghuan, Jiangsu/Baotou Mieke, LONGi
Asia Silicon (Qinghai) Company 亚洲硅（青海）有限公司	None	In immediate supply chain	Unknown	Unknown	LONGi

Ingots Wafers, Cells & Modules

COMPANY	XINJIANG MANUFACTURING LOCATION	FORCED LABOR EXPOSURE	CAMP CO-LOCATION	XPCC RELATIONSHIP	CURRENT OR RECENT DOWNSTREAM CONTRACTS*
JinkoSolar Holdings Company 晶科能源控股有限公司	Ingots and wafers	Co-located in park with detention centre and prison, labour transfers, in supply chain	Internment camp and prison in industrial park	None known	Vivint Solar, CIMIC Group; Consolidated Edison, Consolidated Electrical, Copenhagen Infrastructure, Decmil Group, Elecnor SA, Enel SpA, Engie SA, Fuji Electronics, Green Light Contractors, Henan Senyuan, Hengton Optic-Electric, Innotech, Jiawei Renewable, Kenya Electricity Generating Co, MAONENG Group, Metka-Egn, MVV Energie, NextEra, Sungrow, Swinerton Builders, Sustainable Power Group
LONGi Green Energy 隆基绿能科技股份有限公司	None	In supply chain	None	Power generation plants supported by XPCC	Amass Int'l, FC Felhaber, Vina Cell, Shanghai EZ New Energy, Taizhou Zhonglai, Jiangsu Runergy, Sunnova, Tongwei, Astronergy
Trina Solar Energy Company 天合光能股份有限公司	Modules (facility may be closed)	Possible labour transfers in plant, in supply chain	None	Power generation plants may be supported by XPCC	UK Ministry of Defense, Xinjiang TBEA, NextEra, Sungrow, Enel Green Power, Enviromena Power, JGC Corporation, X-ELIO Energy, Ortiz Energia, Greenko Group, TOYO Engineering, Hero Future Energies, WEG S.A. Greening Components, BayWa r.e Renewable Energy, Aldo Componentes Eletronico, Marubeni Corp, Sol Distribution, Changzhou Shengping, Sonepar Group, IBC SOLAR, China DaTang, Changjiang Huasheng, Saving Service Co., Scatec Solar, Solar City, Downer Utilities Australia, Cypress Creek, Zhejiang Energy, Hero Solar Energy, Niagara Renewable Energy, COBRA Infraestructuras, Matrix Renewables
JA Solar Holdings 上海晶澳	None	In supply chain	None	Power generation plants supported by XPCC	Escala Solar Energias Renovables, Cypress Creek, Acciona SA, Acciona Chile, Exel Solar SAPI, Iberdrola SA, Sungrow
Tianjin Zhonghuan Semiconductor 天津中环半导体股份有限公司	27% equity in Xinjiang GCL	Shareholder in Xinjiang GCL, in supply chain	None	None known	SunPower, Maxeon Technologies

COMPANY	XINJIANG MANUFACTURING LOCATION	FORCED LABOR EXPOSURE	CAMP CO-LOCATION	XPCC RELATIONSHIP	CURRENT OR RECENT DOWNSTREAM CONTRACTS*
Qinghai Gaojing Solar Energy Company 青海高景太阳能科技有限公司	None	In supply chain	None	None known	Unknown
Canadian Solar 阿特斯阳光电力集团	None	In supply chain	None	None known	Power Solar LLC, FC Felhaber
Risen Solar 东方日升新能源股份有限公司	None	In supply chain	None	None known	Tokai Engineering M Sdn Bhd., UPC-AC Energy, Armani Energy Sdn Bhd
Astronergy/Chint Solar 正泰新能源	None	In supply chain	None	None known	Unknown
Wuxi Suntech Power Company 无锡尚德太阳能电力有限公	None	Unknown	None	None known	Unknown

* Downstream contracts are not an exhaustive lists of all customers.

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Note: Links may expire or be deleted. Most links here are to archived versions of the cited sources. Where pdfs are cited, the original link is included, and the full pdf has been archived at the Sheffield Hallam Helena Kennedy Centre website.

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