

China 2017 Review

**World's Second-Biggest Economy
Continues to Drive Global Trends in
Energy Investment**



**Institute for Energy Economics
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Executive Summary

China continued to be a global leader of investment in clean energy projects in 2017, defying an overall slowdown in Chinese overseas investment as the country further positioned itself to dominate in new energy technologies such as batteries and electric vehicles.

This report documents this trend and follows an IEEFA report published in January of last year —“China's Global Renewable Energy Expansion”—that highlighted how, in addition to being the world's largest investor in domestic renewable energy, China was taking the global lead.

A key development since our previous report was the Trump administration's decision to pull out of the Paris climate agreement, a move that led to China's quick reaffirmation of its emissions-reduction pledge that allows it to further project itself globally as a responsible major power while addressing its domestic air pollution concerns and building world-leading capacity in new energy markets.

Domestically, China began reorganizing its large state-owned power generators in 2017, a shift seen as an effort to move Chinese power companies away from reliance on coal and to restructure incentives for the largest coal and power companies. August 2017 saw China's top coal mining company being merged with one of the nation's “Big Five” power utilities. The combination of China Guodian Corp. and Shenhua Group Corp., now renamed China Energy Investment Corp., created the world's largest power generator by installed capacity at about 225 gigawatts (GW). The deal also created a company no longer so reliant on coal since Guodian brought significant clean energy assets with it. It also ensures that Shenhua's growth trajectory will no longer depend on the single-minded pursuit of more coal at the highest possible price—a strategic posture which has burdened China's power companies and limited their appetite for innovative new clean energy technologies.

2017 was a record-setting year for renewable installation in China while efforts to reduce renewable energy curtailment began to yield results. China is estimated to have installed at least 50 GW of solar-powered generation in 2017, and Bloomberg New Energy Finance now predicts a total of 54 GW—compared to the 34.5 GW it forecast in 2016. Going forward, according to the International Energy Agency (IEA), China will continue to lead the world in renewable energy development.

Internationally, China's Belt and Road Initiative (BRI) has continued to drive Chinese energy investments overseas. The initiative already has driven US\$8 billion of solar equipment exports from China and helped China become the number one exporter of environmental goods and services, overtaking the U.S. and Germany.

The Belt and Road Initiative is technology-agnostic. While international markets provide opportunities for Chinese builders of older technology capacity such as coal and hydropower, Chinese energy investment overseas will follow the global trend toward increased renewable energy capacity. IEA figures show that renewable energy capacity grew by 165 GW in 2016 compared to 55 GW for coal-fired capacity. Given that the IEA sees renewables contributing 60% of global additions to electricity generation capacity over the next five years, it makes sense for China to continue to build on its position as the global leader in renewable energy by looking for opportunities to develop international standard EPC and operating credentials.

The Belt and Road Initiative has defied Chinese curbs on domestic companies making overseas acquisitions. For the first three quarters of 2017, outbound M&A deals by Chinese firms slumped by 35% to US\$96 billion due to tightened investment controls intended to restrict capital outflows. However, Chinese M&A activity in countries that are part of the BRI soared in 2017. Through the whole of 2016, Belt and Road-related investments totaled US\$31 billion; this figure was surpassed in 2017 by the month of August, and the international accounting firm PwC sees Chinese overseas M&A activity picking up once again in 2018, driven in part by the Belt and Road Initiative.

The initiative was enshrined in the Communist Party constitution in 2017, creating more pressure than ever for it to succeed and confirming China's desire to expand its role in the global economy.

Among our key findings:

- **IEEFA's identified list of large overseas clean energy projects for 2017 is even greater than the prior year's list.** The total for large projects (valued at US\$1 billion or more) in 2017 exceeds US\$44 billion (see Figure 1). This compares to US\$32 billion identified in 2016, which was itself a record year for Chinese low-emissions-sector investment overseas.
- **Chinese solar manufacturers account for about 60% of global solar cell production, and China's solar manufacturing leadership was cemented in 2017.** The first half of 2017 saw an increase in global manufacturing capacity expansion announcements over the second half of 2016. Geographically, the new capacity expansion announcements were more heavily weighted toward China than in 2016. China in 2017 accounted for 70% of planned expansions. Chinese solar module manufacturers continued to feature strongly in overseas solar generation projects. In 2017, Chinese companies took part in projects across Asia, Latin America, Australia, Africa and the Middle East. In the secondary market, they took ownership of solar plants in the U.S.
- **Major Chinese wind energy companies, including the world's largest wind power developer, continued to expand overseas.** China Energy Investment Corporation, Xinjiang Goldwind (one of the world's largest manufacturers of wind turbines), and China Three Gorges (a company historically associated with hydropower) all made major wind power investments in international markets in 2017, buying stakes in operating or expanding wind farms.
- **Large Chinese hydropower companies continued to either acquire or to win contracts to build major hydro projects abroad.** Latin America, Africa and Asia continued to be areas of focus for Chinese hydro companies even as Belt and Road hydro projects started to face some strong headwinds in Pakistan and Nepal.
- **State Grid Corporation, the world's largest power utility by revenue, leads persistent Chinese international investment in power grids.** Having completed the acquisition of a controlling stake in Brazil's CPFL Energia SA in January 2017, the company announced later in the year that it had increased its holding to 94.75% by way of a US\$3.45 billion transaction. State Grid has become the largest power distribution company in Brazil. The company is also involved in Belt and Road Initiative power transmission projects in Pakistan and Egypt, and it is considering further investment in Europe. State Grid continues also to

be highly ambitious with various schemes for transcontinental “supergrids”. One such plan that would link China, Japan, Mongolia, Russia and South Korea has the backing of Japan’s Softbank and received support from South Korea’s KEPCO in 2017.

- **China is outmaneuvering other economies in securing supplies of new energy commodities.** Battery makers and car manufacturers with electric-vehicle (EV) ambitions sought to secure supplies of lithium and nickel in 2017; this trend has also seen Chinese companies maneuver to dominate the cobalt market, with the majority of supply heading back to China. Chinese miners are expected to be responsible for 62% of global supply in 2017, and China also continues to dominate the rare earths mining and processing sector.
- **Securing new energy commodities will allow China to dominate battery and EV manufacturing going forward.** Bloomberg New Energy Finance sees Chinese companies producing 121 gigawatt-hours (GWh) of battery production capacity by 2020, dwarfing Tesla’s 35 GWh. Chinese battery makers such as Contemporary Amperex Technology Ltd. (CATL) and BYD are key players in this expansion. BYD is already targeting the stationary energy battery storage market in key markets such as the U.S. and Australia. Assisted by government policy, Chinese EV manufacturers are rapidly building domestic capacity. Gaining a strong head start in the electric vehicle sector domestically is a prelude to a push into international markets.
- **China is by far the largest market for smart meters globally as the country aggressively seeks significant energy efficiency gains.** Chinese investment in energy efficiency showed the strongest growth of any country in 2016, at 24%, and China’s attention to this sector started to move overseas in 2017. In a significant investment, Hong Kong’s Cheung Kong Infrastructure (CKI), a seasoned non-government-linked infrastructure investor, agreed to a US\$5.3 billion deal to acquire Germany’s Ista, one of the world’s largest smart metering and energy management companies.
- **China’s energy sector has many major financial institutions at its disposal to support its overseas energy ambitions.** The China-dominated Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB) are multilateral institutions that are scaling up lending and that in 2017 signaled a preference for clean energy financing over coal investments. China has also set up the Silk Road Fund to directly support its Belt and Road Initiative. China is home, too, to a number of the largest commercial banks in the world and has a range of large “policy banks” with a technology-agnostic view that act as the financial arm of China’s foreign policy. The previous backing of the policy banks for coal projects overseas is set to change going forward as the world turns toward renewables. Other large Chinese financial institutions, including China’s national pension fund, its sovereign wealth fund (China Investment Corporation) and the leading insurance companies also are seeking to diversify their holdings by increasing overseas investments.

Figure 1: Key Chinese Renewables, New Energy and Network Investments Overseas 2017

Date Announced	Acquirer/Investor	EV/Deal size (US\$bn)	Target/Development	Sector	Target/Development Country
Jan-17	China Three Gorges	6.0	Karot hydro plus 2 other hydro and 3 solar projects	Hydro/solar power	Pakistan
Nov-17	China Gezhouba/PowerChina	5.8	3GW Mambilla hydro development	Hydro power	Nigeria
Jul-17	CK Infrastructure-led consortium	5.3	Acquisition of Ista	Metering & Energy Management	Germany
Oct-17	Shanghai Electric (with ACWA Power)	3.9	Construction of 700MW CSP solar plant in Dubai	Solar thermal power	U.A.E
Nov-17	China Energy Investments Corp	3.5	Acquired 75% of 4 Greek wind farms plus other projects	Wind/solar/other power	Greece
Nov-17	SCIG/CXIG/QYEC	3.0	1 GW of hydro power developments	Hydro power	Nepal
Sep-17	State Power Investment Corp	2.4	Sao Simao Hydroelectric project	Hydro power	Brazil
Jan-17	China Gezhouba Group	1.8	Suki Kinari 870MW Hydro project	Hydro power	Pakistan
Jan-17	China Three Gorges	1.6	West Seti Hydro 750MW project development	Hydro power	Nepal
Jan-17	State Grid Corporation	1.5	Mafiarri to Lahore power transmission line	Electricity transmission	Pakistan
Jan-17	State Grid Corporation	1.5	Mafiarri (Port Qasim) to Faisalabad transmission line	Electricity transmission	Pakistan
Aug-17	SANY Group	1.5	Wind energy developments in Punjab	Wind power	Pakistan
Aug-17	China Three Gorges/Hubei Energy+	1.4	Purchase of 456MW Chaglla project	Hydro power	Peru
Jun-17	Pacific hydro (SPIC)	1.3	Haughton Solar Farm, Queensland	Solar PV	Australia
Jul-17	PowerChina	1.0	EPC for 500MW Wawa project	Pumped-hydro and storage	Philippines
Sep-17	State Grid Corporation	1.0	2nd phase of Egypt transmission development	Electricity transmission	Egypt
Oct-17	Shanghai Electric	1.0	Takeover of Rio Grande do Sul transmission project	Electricity transmission	Brazil
Oct-17	CIC Capital	0.5-1.0	10-20% of Equis Energy	Solar/Wind power	Singapore
Total		44.3			
	Growth year on year	38%			

China's Energy Trajectory 2017

In January 2017, IEEFA published “China's Global Renewable Energy Expansion,”¹ report highlighting how, in addition to being the world's largest domestic investor in renewable energy, China is positioning itself to lead the world in overseas clean energy investment. This report tracks progress since then by China, and explores its role in the ongoing global energy transition. Rather than simply focus on wind and solar technology or Chinese public investment abroad, this report considers a broader range of sectors in which China is building up its capacity. In addition to wind, solar and finance, this report considers energy efficiency, electric vehicles, batteries and the commodities required to make them in order to assess the role China is building for itself across all new energy opportunities.

A key development in energy markets over the past year was U.S. President Donald Trump's decision to pull out of the Paris climate agreement. While many analysts at the time of Trump's announcement saw reduced emissions control commitments worldwide as a potential result, what has happened instead is that many nations have committed anew to tackling carbon emissions. Given cover by Trump to reduce its commitment to Paris, China took a more progressive path, reaffirming its emissions-reduction pledge.²

This policy stance has both a geo-strategic and a domestic economic policy rationale. China's approach is allowing it to further project itself globally as a responsible major power and offers China an opportunity to dominate the global market for renewable infrastructure by acting as a helpful partner to client states which will bolster China's market position. Domestically, its carbon pledge helps meet the government's need to be seen as successfully tackling the air pollution crisis in many Chinese cities³ and ensures that China's massive domestic market can be used to support technology leadership. At the Chinese Communist Party Conference in October 2017, President Xi Jinping vowed to continue efforts to reduce smog and to promote a clean energy “revolution”⁴ –a statement which would have been read as signaling renewed economic and political intent.

Beyond Peak Coal

China began reorganizing its large state-owned power generators in 2017, a move seen as a policy initiative aimed at forcing power companies away from reliance on coal for electricity generation. The building up of domestic clean energy capacity will enable further expansion of Chinese new energy technology overseas.

An August announcement that China's top coal miner and a power generator in its own right, Shenhua Group Corp., would be merged with one of the nation's “Big Five” power utilities was of special note. The combination of Shenhua and China Guodian Corp. created

¹ <http://ieefa.org/ieefa-report-china-set-dominate-global-renewable-energy-boom-expands-lead-u-s/>

² https://www.washingtonpost.com/world/asia_pacific/as-us-backs-away-from-climate-pledges-india-and-china-step-up/2017/06/01/59ccb494-16e4-4d47-a881-c5bd0922c3db_story.html?utm_term=.7ea69d8ccd98

³ <http://www.afr.com/business/mining/iron-ore/chinas-longlasting-battle-against-pollution-could-hit-iron-ore-demand-20171023-gz6qkz>

⁴ <https://energy.economictimes.indiatimes.com/news/renewable/chinas-president-xi-says-will-continue-years-long-war-on-smog/61129502>

the world's largest power company by installed capacity (about 225 GW). The new company, **China Energy Investment Corp**,⁵ has an estimated payroll of 326,000 employees, a workforce almost four times larger than that of the entire U.S. coal-fired power sector in 2016.⁶

By absorbing China Guodian, Shenhua is no longer as reliant on coal as it has been historically, since Guodian brings significant clean energy assets with it, and 23% of the generation capacity of the new company will come from renewables, mostly wind, solar, and hydro⁷ (Shenhua was dependent on coal for 90% of its generation capacity⁸). In addition to having its own thermal, hydro and renewables power generation portfolio, China Guodian is the owner of **China Longyuan Power Group Corp** (Longyuan), a Hong Kong-listed company that has been adding 1.5-2.2 GW of new wind annually in China. The combined entity is the largest developer of wind power in the world.⁹

In November, China Energy Investment Corp. signed a memorandum of understanding with the U.S. state of West Virginia to invest US\$84 billion over 20 years in shale gas projects¹⁰ there, highlighting China's technology-agnostic approach to seeking alternatives to coal. China lags on shale gas technology and does not have the gas pipeline infrastructure needed to economically integrate shale gas into the fuel mix. Nevertheless, more gas is a key part of China's energy future and overseas experience in the sector should help leading companies come up the learning curve. China's liquefied natural gas (LNG) imports for the first 10 months of 2017 were up 48%¹¹, driven by the government's desire to switch from coal to gas in an initiative to curb air pollution.

More mergers involving the largest Chinese power generators (Figure 2) are expected. China Huaneng Group, for one, is reported to be in talks with **State Power Investment Corporation (SPIC)**, another of China's "Big Five" utilities.¹² Any combination involving the Huaneng Group would be significant given their size, reputation for quality operations, and international experience. A combination with SPIC could position the combined group to become a major global developer and operator of renewable infrastructure.

SPIC is planning to sell seven Chinese clean energy companies to its indirectly held Hong Kong-listed subsidiary **China Power International Development**.¹³ Like the Shenhua-Guodian combination, this asset injection can be seen as a strategic move to give the listed state-controlled power utilities a more diversified asset mix with growth increasingly coming from a growing renewables portfolio. This aligns with the government's goal to shift new investment in power generation away from coal and to encourage provincial authorities and the local banks to facilitate capital redeployment toward more renewable energy infrastructure. In the

⁵ <https://www.bloomberg.com/news/articles/2017-08-28/china-approves-guodian-shenhua-group-to-merge>

⁶ <https://www.reuters.com/article/us-china-power-shenhua-guodian-factbox/factbox-shenhua-and-guodian-chinas-latest-state-marriage-idUSKCN1B918I>

⁷ <https://www.bloomberg.com/news/articles/2017-08-28/china-approves-guodian-shenhua-group-to-merge>

⁸ <https://www.ft.com/content/ff8c98de-ae4f-3c34-b37d-f90b6d41320c>

⁹ <https://www.reuters.com/article/us-china-power-shenhua-guodian-factbox/factbox-shenhua-and-guodian-chinas-latest-state-marriage-idUSKCN1B918I>

¹⁰ <http://www.reuters.com/article/us-trump-asia-energy-west-virginia/china-energy-investment-signs-mou-for-83-7-billion-in-west-virginia-projects-idUSKBN1D90S9?il=0>

¹¹ <http://www.afr.com/markets/commodities/energy/soaring-china-demand-could-tip-balance-in-lng-market-in-2018-20171219-h07hey>

¹² <https://www.bloomberg.com/news/articles/2017-08-28/china-approves-guodian-shenhua-group-to-merge>

¹³ <https://theasset.com/belt-road-online/33584/china-power-international-development-acquires-renewable-energy-assets--news-961-o>

meantime, SPIC aims to have clean energy sources generating half of its power by 2020, up from 43% currently.¹⁴

Figure 2: Generation Capacity of China's 'Big 5' Power Utilities and Shenhua



Source: Bloomberg New Energy Finance

In December, the Chinese government confirmed that it was creating the world's largest carbon market¹⁵ in which about 1,700 utilities will be required to pay for the right to release carbon dioxide. The initiative is meant to encourage further transition from fossil fuels to renewables.¹⁶ China's cap-and-trade system will cover more carbon emissions than the European Union's entire carbon market and will increase the proportion of global carbon emissions covered by some kind of pricing mechanism by 25%. China's move is a highly significant step as it joins the EU in placing a price on carbon while the U.S. under its current administration retreats from action on emissions and seeks desperately to sustain and expand reliance on coal.

In his opening address to the 2017 Communist Party Conference in August, President Xi hinted that the government intends to lock in control of the Chinese economy through policies aimed at making state-owned enterprises "stronger, better and bigger."¹⁷ State-owned power utilities are being prepared for a future in which coal plays a progressively smaller role and the Party is now keen to take tangible steps to transform incentives for the energy and power sector in ways that align with China's long-term opportunities associated with clean energy and transportation. Additionally, the government is looking to these companies to

¹⁴ <https://energy.economictimes.indiatimes.com/news/renewable/chinas-spic-plans-to-raise-clean-energy-power-capacity-to-50-per-cent-by-2020/59474200>

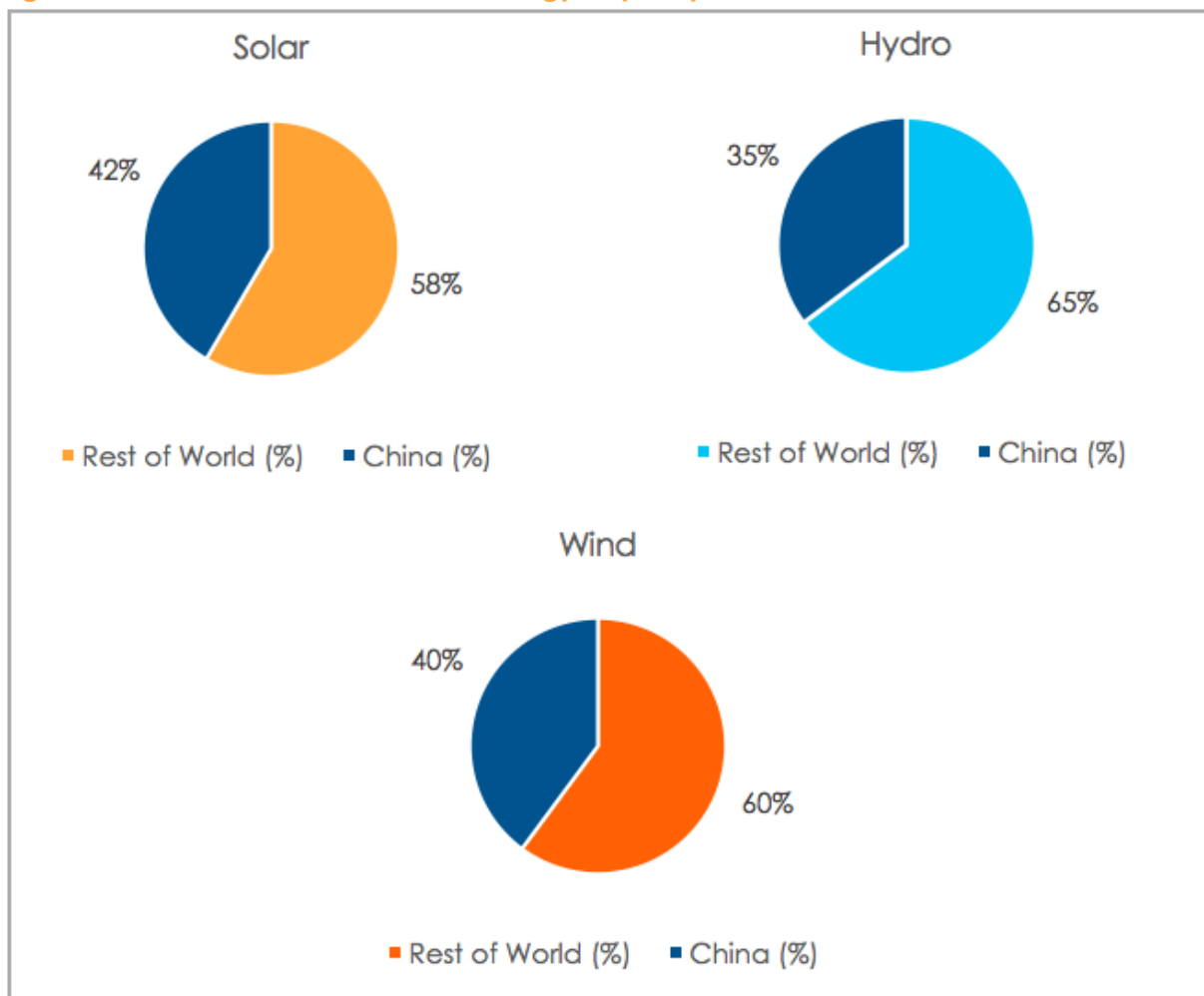
¹⁵ <https://www.bloomberg.com/news/articles/2017-12-19/china-heads-toward-carbon-price-in-climate-fight-quicktake-q-a>

¹⁶ <https://www.bloomberg.com/news/articles/2017-12-19/china-unveils-plan-for-world-s-biggest-carbon-trading-market>

¹⁷ <http://www.afr.com/opinion/columnists/worries-about-chinese-dynamism-as-beijing-seeks-greater-economic-control-20171018-gz3qyz>

lead the overseas rollout of China's renewable energy technology and the expansion of its capital in foreign markets, processes that are already well under way.¹⁸

Figure 3: China's Share of Renewable Energy Capacity Growth 2017-2022



Source: IEA Renewables 2017: Analysis and Forecasts to 2022

As 2017 unfolded, data on fast-moving 2016 global renewable installation trends became steadily apparent—and strikingly so. China continued to dominate the world's renewable energy expansion, responsible for about 68 GW, or about 41% of total global renewable capacity additions of 165 GW which was a new record. By comparison, the U.S. added 24 GW and the EU 21GW. Growth was driven by solar, which increased by 50% to a total of 74 GW installed in 2016. Solar installations in China made up 46% of the global total. China also led the world in installation of onshore wind power with 19 GW (compared to 8 GW for the runner-up, the U.S.), hydro with almost 13 GW (compared to 5 GW in Brazil) and bioenergy with 1.8 GW (compared to 0.9 GW in Brazil).¹⁹

¹⁸ <http://ieefa.org/ieefa-report-china-set-dominate-global-renewable-energy-boom-expands-lead-u-s/>

¹⁹ IEA, Renewables 2017: Analysis and Forecasts to 2022

Such is China's significance in energy markets on the world stage that its shift toward clean generation technology is driving the trend at the global level.

Going forward, China will continue to dominate renewable energy development. In its 2017 renewable energy installation forecast to 2022, the IEA sees 42% of all solar capacity being developed in China over the next five years, up from the 36% projected in 2016. China's wind power capacity additions will account for 40% of all additions in that sector globally, and 35% of global hydro additions will be made by China (Figure 3).²⁰

Belt and Road

China's domestic renewable energy manufacturing capability is a good fit with the nation's Belt and Road Initiative, which aims to catalyze an infrastructure boom crossing scores of borders along ancient land and sea silk trading routes linking China to Central and South Asia as well as the Middle East. The Belt and Road Initiative, known also as One Belt, One Road, will tie together more than half (4.4 billion) of the world's population²¹ in 28 countries. It will mobilize as much as \$1 trillion in new investment.

China has been laying the groundwork for this initiative for years, earmarking large state-owned enterprises for internationalization. As laid out in our January 2017 report, "China's Global Renewable Energy Expansion"²², the nation's power companies have been turning their attention increasingly overseas in search of renewable energy investment opportunities. Belt and Road gives this shift momentum.

Various motives have been assigned to the Belt and Road initiative. It has been described as "a program of unprecedented size and scope with the strategic intent of constructing a Chinese-led regional order in Eurasia."²³ But aside from further cementing its regional leadership position and forging a Chinese-style globalization on China's terms, Belt and Road may be part of a broader effort to shift the Chinese economy toward higher-end manufacturing and to increase the importance of the renminbi, China's currency. The plan may also be a way of providing further capacity for Chinese manufacturing in a future in which domestic infrastructure build-out slows. This job creation motivation has been particularly strong in 2017 as many second-tier engineering and infrastructure SOEs have struggled to avoid downsizing as domestic demand for large-scale infrastructure has fallen off. The year 2017 has been an extraordinary one for domestic Chinese renewable energy build-out, especially in solar. However, China's power utilities and renewables manufacturers will take further advantage of BRI to seek new markets outside China, thereby "future-proofing" against any slowdown in the growth rate of the Chinese economy.

Belt and Road already has driven US\$8 billion in solar equipment exports from China²⁴ and helped China become the number one exporter of environmental goods and services, overtaking Germany and the U.S. This trend has been evident for a while: By 2015, for

²⁰ IEA, *Renewables 2017: Analysis and Forecasts to 2022*

²¹ <http://www.smh.com.au/world/chinas-new-silk-road-the-one-belt-one-road-explained-20170512-gw3ntx.html>

²² <http://ieefa.org/ieefa-report-china-set-dominate-global-renewable-energy-boom-expands-lead-u-s/>

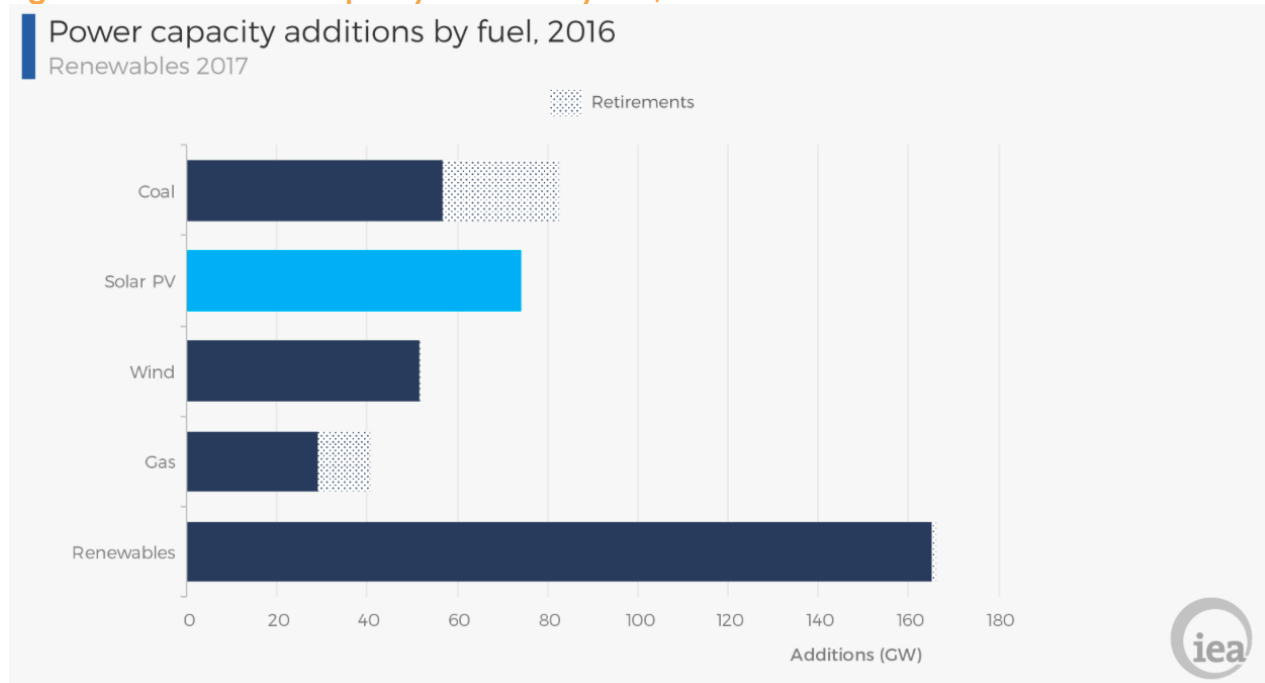
²³ https://www.washingtonpost.com/opinions/china-has-a-plan-to-rule-the-world/2017/11/28/214299aa-d472-11e7-a986-d0a9770d9a3e_story.html?utm_term=.166825debcc1

²⁴ <https://www.bloomberg.com/news/articles/2017-12-05/china-assumes-green-power-mantle-leaving-germany-u-s-behind>

instance, China had secured 16% of this market with about US\$71 billion in exports. Going forward, China is certain to extend its lead with exports of batteries and electric vehicles set to rise.

It should not be ignored that China also exports its coal-fired power manufacturing capability. In October 2017, China announced it had ceased or postponed work on 151 domestic coal-fired power plants, many of which were already under construction.²⁵ With clear guidance from the Chinese government discouraging the overbuilding of new coal generating capacity, it is no surprise that Chinese companies involved in the construction of coal-fired power stations already have a presence overseas, particularly in developing countries in need of more power capacity. For example, Chinese power companies are front and center in the China-Pakistan Economic Corridor initiative, which involves 19 energy projects across renewables, transmission and coal-fired power.²⁶ In addition, **PowerChina** has been lined up to build the controversial Lamu coal-fired power station in Kenya²⁷. Both Pakistan and Kenya are included in the new maritime silk road that makes up part of the Belt and Road Initiative. China is also building coal plants in Bosnia and Egypt.

Figure 4: Global Power Capacity Additions by Fuel, 2016



Source: IEA

Other overseas investments confirm that China has a technology-agnostic view. The Chinese government-backed Yancoal in 2017 bought Rio Tinto's thermal coal mine operations in Australia's Hunter Valley,²⁸ and Chinese companies have a major stake and "strategic

²⁵ <https://www.theguardian.com/environment/2017/oct/16/world-going-slow-coal-misinformation-distorting-facts>

²⁶ <https://www.reuters.com/article/us-pakistan-energy-coal/pakistan-ramps-up-coal-power-with-chinese-backed-plants-idUSKBN17Z019>

²⁷ https://www.the-star.co.ke/news/2017/05/31/lamu-china-coal-deal-is-bad-for-kenya_c1570541

²⁸ <http://www.abc.net.au/news/2017-06-29/rio-tinto-nsw-coal-mines-taken-over-by-china-backed-company/8664914>

relationship" in Australian gas producer Santos.²⁹ **China General Nuclear** has a 33% stake in the Hinkley Point nuclear power station in the U.K., seen as a first step toward increased involvement in the U.K.'s nuclear industry (although that plan is now endangered by huge cost overruns and delays at Hinkley).

All that said, IEEFA expects Chinese energy companies to ultimately follow the broader global trend toward increased renewable energy capacity. The recent trend of Chinese public finance institutions leading the world in the financing of coal projects will change going forward. Figure 4 shows global power capacity additions in 2016; renewable capacity grew by 165 GW compared to 55 GW for coal-fired capacity. What is missing from the picture now, but will surely change in 2018 and 2019, is clearer and more distinctive corporate leadership as China's energy champions become more confident in their renewable energy expertise.

Furthermore, given that the IEA sees renewables contributing 60% of global additions to electricity generation capacity through 2022³⁰ and dominating over the next two decades (Figure 6), it makes sense for China to continue to build on its position as the global leader in renewable energy development as the world moves away from fossil fuel-based capacity and toward renewables. Under the Trump administration, a policy shift in the U.S. that aims to give coal a leg up over renewables—assuming it works—will allow China to further consolidate its leadership of the global clean energy transition.

Progress around the Belt and Road initiative has defied a broader slowdown among Chinese companies making overseas acquisitions. For the first three quarters of 2017, outbound M&A deals by Chinese firms slumped 35% to US\$95.9 billion due to tightened investment controls intended to restrict capital outflows.³¹ However, Chinese M&A activity in countries that are part of the Belt and Road initiative grew robustly in 2017. Belt and Road-related acquisitions totaled US\$33 billion by August³², already surpassing the \$31 billion in all of 2016. In December 2017, the Chinese government, aiming to discourage overly risky overseas deals, released a new code of conduct for private companies investing abroad. However, private enterprise investing abroad is still officially encouraged, particularly within the Belt and Road Initiative.³³

Furthermore, the global accounting firm PwC sees broad Chinese overseas M&A activity picking up once again in 2018, influenced in part by the Belt and Road Initiative. EY, another global accounting major, sees China as the driver of M&A activity across the Asia-Pacific region over the next two years at least as Chinese companies focus on overseas acquisition as a key growth strategy.³⁴

At the Communist Party Conference in August, Belt and Road was enshrined unexpectedly in the Communist Party constitution itself, giving the initiative even greater weight³⁵ and creating greater pressure for it to succeed.

²⁹ <http://www.afr.com/business/energy/oil/santos-tightens-links-with-chinese-shareholders-20170626-gwz6ch>

³⁰ IEA, Renewables 2017: Analysis and Forecasts to 2022

³¹ <http://www.scmp.com/business/companies/article/2115565/chinese-firms-deal-making-set-back-beijing-and-washingtons>

³² <https://www.reuters.com/article/us-china-m-a/exclusive-chinas-belt-and-road-acquisitions-surge-despite-outbound-capital-crackdown-idUSKCN1AW00K>

³³ <http://www.scmp.com/news/china/economy/article/2124964/china-issues-new-code-conduct-tame-overseas-investors>

³⁴ <http://www.scmp.com/business/companies/article/2121322/chinese-companies-boost-overseas-acquisitions-2018-analysts-say>

³⁵ <http://www.reuters.com/article/us-china-congress-silkroad/pressure-on-as-xis-belt-and-road-enshrined-in-chinese-party-charter-idUSKBN1CT1IW?il=0>

Solar

Domestically, China in all likelihood will have installed at least 50 GW of solar-powered electricity generation in 2017, with Bloomberg New Energy Finance now predicting 54 GW compared to 34.5GW in 2016.³⁶ That would have China installing more solar capacity in one year than the total, cumulative solar capacity of any other country as of the end of 2016.

June and July 2017 alone saw China install 25 GW.³⁷ By October, China had installed 42GW for the year, taking total cumulative solar capacity to 120 GW. According to IEA numbers, China accounts for about half of all global solar demand.

Such has been the rate of domestic solar installations that China has now exceeded its original 2020 solar capacity target of 110 GW. The China National Renewable Energy Centre, an influential think tank and key advisor to the National Energy Administration, is now recommending a 2020 target of 200 GW of solar-powered electricity.³⁸

China has also made significant progress in addressing its renewable energy curtailment issues. Historically, much of the solar and wind energy generated in west China has been wasted due to a lack of transmission capacity to carry the generation to population centers in the east. However, during the first nine months of 2017, curtailment of solar power fell by one-third to 5.6%.³⁹

On the manufacturing front, Chinese solar manufacturers account for about 60% of global solar cell production.⁴⁰ And contrary to some perceptions, China's dominance in solar manufacturing does not come at the expense of quality. A recent ranking that takes quality into account finds that seven of the top ten largest high-quality manufacturers supplying the U.S. residential market are China-based (Figure 5).⁴¹

China's solar-manufacturing leadership was future cemented in 2017. The first half of the year saw an increase in global manufacturing capacity expansion announcements over the second half of 2016. This trend was driven by growing global demand and migration to high-efficiency solar technologies. Geographically, the new capacity expansion announcements were more heavily weighted toward China than in 2016; China accounted for 70% of planned expansions, with runners-up Malaysia at 8% and Taiwan at 7%.⁴²

Already one of the largest solar module manufacturers in the world, **Canadian Solar**, which is headquartered in Ontario but bases most of its manufacturing in China, continues to ramp up production and was likely to surpass 8 GW of production capacity by the end of 2017. By 2018, the company expects to exceed 10 GW of production capacity⁴³, buttressing China's solar-manufacturing dominance.

³⁶ <https://www.pv-tech.org/news/bnef-raises-chinas-solar-installation-forecast-to-54gw>

³⁷ <http://reneweconomy.com.au/china-set-add-50gw-new-solar-pv-2017/>

³⁸ <https://www.pv-tech.org/news/influential-think-tank-recommends-200gw-solar-target-for-china>

³⁹ <https://energy.economictimes.indiatimes.com/news/renewable/chinas-renewable-power-wastage-declined-during-jan-sept-nea/61408976>

⁴⁰ IEA Renewables 2017: Analysis and Forecasts to 2022

⁴¹ <http://news.energysage.com/best-solar-panel-manufacturers-usa/>

⁴² <https://www.pv-tech.org/editors-blog/planned-solar-manufacturing-capacity-expansions-bigger-than-expected-in-1h>

⁴³ <https://www.pv-tech.org/news/canadian-solar-plans-to-reach-over-10gw-of-module-production-in-2018>

Figure 5: Best Solar Panel Manufacturers 2017 – Quality, Volume and U.S. Market Share

2017 Rank	Company	Manufacturing base	Change from 2016
1	Trina Solar	China	-
2	JA Solar	China	-
3	Hanwha Q Cells	South Korea	-
4	Jinko Solar	China	+2
5	Motech Solar	Taiwan	+3
6	First Solar	USA	-1
7	Longi Leri	China	new entry
8	Canadian Solar	China	-4
9	Yingli Solar	China	-2
10	Suntech	China	-

Source: energysage.com, NREL

In November, China's **Tongwei** announced an initial US\$1.8 billion investment to increase its solar cell manufacturing capacity in a bid to make it the largest such manufacturer in the world.⁴⁴ Two new 10 GW plants will bring Tongwei's manufacturing capacity to 30 GW. The new capacity is expected to come online gradually over the next three to five years according to demand.

Chinese dominance in solar manufacturing will continue to be felt internationally as well.

Jinko Solar maintained its world-leading solar module shipments position in 2017. In announcing its third quarter results, Jinko offered guidance suggesting that it would reach full-year shipment totals of 9.6-9.8 GW, giving it about 10% of global share.⁴⁵ It is possible that in early 2018, when Jinko reports complete 2017 shipments, it may become the first company to reach 10 GW of solar module shipments in a year. While reporting the details of what has been a strong year for Chinese domestic solar, the company is also highlighting key overseas emerging markets that will drive its sales beyond Europe and the U.S., markets that include Brazil, Australia, Egypt, Jordan and Mexico.

Jinko has achieved its market-leading position by way of a truly global sales presence. The company ranks number two in the Chinese and Japanese markets, third in India, and fourth in the U.S. It ranks number one in Europe and in the rest of the world, hence it is a top-four supplier in every key region.⁴⁶

However, dependence on one nation (China) for solar module supplies is not without risk. China's record-breaking 2017 domestic solar buildout has taken up much its module output, leading to higher prices for international customers, and some Indian solar developers are reporting that Chinese suppliers are renegeing on deals and asking for price increases.⁴⁷

⁴⁴ https://www.bloomberg.com/news/articles/2017-11-08/china-s-tongwei-to-spend-1-8-billion-on-solar-cell-factories?utm_content=buffer3e23c&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

⁴⁵ <https://www.pv-tech.org/news/jinkosolar-retains-leadership-in-2017-with-module-shipment-guidance-increas>

⁴⁶ <https://www.pv-tech.org/editors-blog/jinkosolar-poised-to-hit-10gw-annual-shipment-target-but-what-next>

⁴⁷ <http://www.livemint.com/Industry/Od63ll7qolyDCncKm76eiO/Chinese-solar-module-firms-renegeing-on-India-contracts.html>

Longi, another large Chinese solar manufacturer, plans to set up a 500 MW solar module manufacturing plant in India in response to the Indian government's ambitious solar installation targets combined with its proposals to make the use of locally manufactured solar equipment mandatory.⁴⁸ Longi would become the first Chinese manufacturer to set up a factory in India, although other major Chinese firms such as **GCL-Poly** and **Trina Solar** have been considering doing so as well. Chinese solar modules already dominate the rapidly growing Indian market.

In December, **Hareon Solar** announced that it had agreed to a joint venture in Morocco, which is pushing aggressively into solar energy.⁴⁹ Hareon will work with the Moroccan state investment agency and an engineering, procurement and construction (EPC) contractor to develop solar generation projects and produce solar modules locally.

Major Chinese solar module player **JA Solar** is likely to have logged full-year shipments of 6.8 GW in 2017 with an expected 50% year-on-year increase in shipments in the fourth quarter.⁵⁰ Although China remains the key market for JA Solar and other major Chinese manufacturers, the company also ships significant quantities of its products to North America (17%), Asia-Pacific (16%) and Europe (14%).

JA Solar reports cumulative shipments of more than 20 GW globally to 92 countries. In 2017, the company passed the 1 GW mark for cumulative shipments to India.⁵¹ The company sees itself as a market leader in India as that nation continues its drive toward its ambitious and world-leading renewable energy installation targets.

Elsewhere, JA Solar increased its presence in Latin America after launching a Mexican subsidiary in April.⁵² JA acknowledged the expanding Latin American market for solar and said it expects the region to account for 10% of global solar demand by 2020, and JA stated also that Mexico alone has the potential to pass 40 GW of installed solar capacity by 2021. In June, the company opened a subsidiary in Brazil, which is increasingly insisting on domestically produced manufacturing content in projects.⁵³ Chinese clean energy companies have been building a significant position in Latin America for years, a trend that continued in 2017. Other Chinese energy companies operating in clean energy in the region include Envision, Jinko Solar, Canadian Solar, BYD, Yingli, State Grid Corporation, China Three Gorges and Goldwind.

Mexico reported record-low power tariffs in November when bids in its latest round of tariff auctions came in at an average of US\$20.57/MWh.⁵⁴ Unsurprisingly, Chinese involvement in the bidding was substantial. Chinese-Canadian module manufacturer Canadian Solar successfully bid for 367 MW of solar, taking its pipeline in Mexico up to 435 MW⁵⁵. **Trina Solar**, another Chinese solar manufacturing giant, won a 62 MW solar tender in consortium with

⁴⁸ http://www.livemint.com/Industry/oIBK2RcB4f5G75kTGR9J8I/Chinas-LONGi-plans-solar-equipment-manufacturing-facility-i.html?utm_source=Mailer&utm_medium=ET_batch&utm_campaign=etenergy_news_2017-12-14

⁴⁹ <https://www.pv-tech.org/news/hareon-solar-board-backs-moroccan-jv>

⁵⁰ <https://www.pv-tech.org/news/ja-solar-on-track-to-increase-module-shipments-by-almost-50-in-2017>

⁵¹ http://en.jasolar.com/News_corporatedetails/807-JA+Solar's+cumulative+module+shipments+to+India+reach+1GW

⁵² http://www.jasolar.com/News_corporatedetails/809-JA+Solar+Establishes+New+Subsidiary+in+Mexico

⁵³ <https://www.pv-tech.org/news/ja-solar-establishes-new-brazilian-subsiary>

⁵⁴ <https://www.pv-magazine.com/2017/11/16/mexicos-power-auction-pre-selects-16-bids-with-average-price-of-20-57mwh-and-2-56-gw-of-combined-capacity/>

⁵⁵ <https://www.pv-tech.org/news/canadian-solar-bags-367mw-mexico-capacity>

Mitsui & Co. of Japan. In December, Canadian Solar won a 114 MW solar project in Brazil's most recent power auction.⁵⁶

Meanwhile in Australia, **Pacific Hydro**, a subsidiary of State Power Investment Corporation, received planning permission for a new solar plant in Queensland of up to 1 GW.⁵⁷ The first stage will consist of 500 MW with an option to double capacity and a total investment of A\$1.7 billion.⁵⁸ In December, Chinese-Australian renewables developer **Maoneng** announced that it had signed Australia's largest-ever solar power purchase agreement.⁵⁹ The agreement, for 300 MW of solar, was signed with utility AGL as part of a plan to replace the aging Liddell coal-fired power plant, which is to close in 2022.

Hong Kong-listed **Panda Green Energy Group** is seeking to invest US\$3 billion in a series of solar plants along the Belt and Road.⁶⁰ The company passed a milestone when it reported having 1.5 GW of grid-connected solar plants in operation in 2017, and in the first half of the year, it made its first overseas acquisition with the purchase of 82 MW of operating solar plants in the U.K.⁶¹

ET Energy, a subsidiary of **China Power Engineering Consulting Group**, signed a contract in November to develop a 61 MW solar power plant in Malaysia.⁶² ET is a vertically integrated solar player offering financing, installation and operational services. It also manufactures panels. The Malaysian project was awarded in the first round of a large national solar-bid program, and Malaysia is now running a second round, which is heavily over-subscribed.⁶³

Unisun Energy continued its overseas expansion in 2017 via an agreement with partners to develop a 40 MW solar plant in Vietnam.⁶⁴ The company is also building on the 80 MW of solar capacity it has already in Japan,⁶⁵ and has acquired a stake in an Indian solar farm owned by Suzlon Energy, in which **China Light and Power's** Indian subsidiary has also acquired a stake.⁶⁶

Bangladesh falls under the scope of Belt and Road too, and is rapidly expanding its power generation capacity as it seeks to become a middle-income nation. While Bangladesh has the world's biggest solar home system program, much of its energy policy focus has been on fossil-fuel and nuclear-powered generation expansion, funded by arms of the Japanese and Russian governments that are exporting their domestic generation technology. Nonetheless, Bangladesh has potential for utility-scale solar that Chinese companies could be well placed to provide.⁶⁷

⁵⁶ <https://www.pv-magazine.com/2017/12/21/canadian-solar-awarded-112-mw-project-in-brazil/>

⁵⁷ <http://www.pacifichydro.com.au/sun-rises-on-new-era-of-solar-development/?language=en>

⁵⁸ <https://www.energymatters.com.au/renewable-news/1-7-billion-solar-farm-application-lodged-queensland/>

⁵⁹ <http://maoneng.co/en/mn-news/maoneng-australia-group-portfolio-update>

⁶⁰ <https://www.reuters.com/article/us-panda-green-power-idUSKBN1AA0C5>

⁶¹ <https://www.pv-tech.org/news/panda-green-surpasses-1.5gw-of-grid-connected-solar-assets>

⁶² <https://theasset.com/belt-road-online/33802/et-energy-of-china-to-develop-solar-plant-in-malaysia--news-988-o>

⁶³ <https://www.pv-tech.org/editors-blog/navigating-solar-snags-in-southeast-asia-land-bankability-and-regulation-so>

⁶⁴ <https://www.pv-tech.org/news/bcg-partners-unisun-and-coara-for-40mw-solar-project-in-vietnam>

⁶⁵ <https://www.oilandgas360.com/boosting-japan-energy-upgrade-unisun-obtains-another-loan-from-local-bank/>

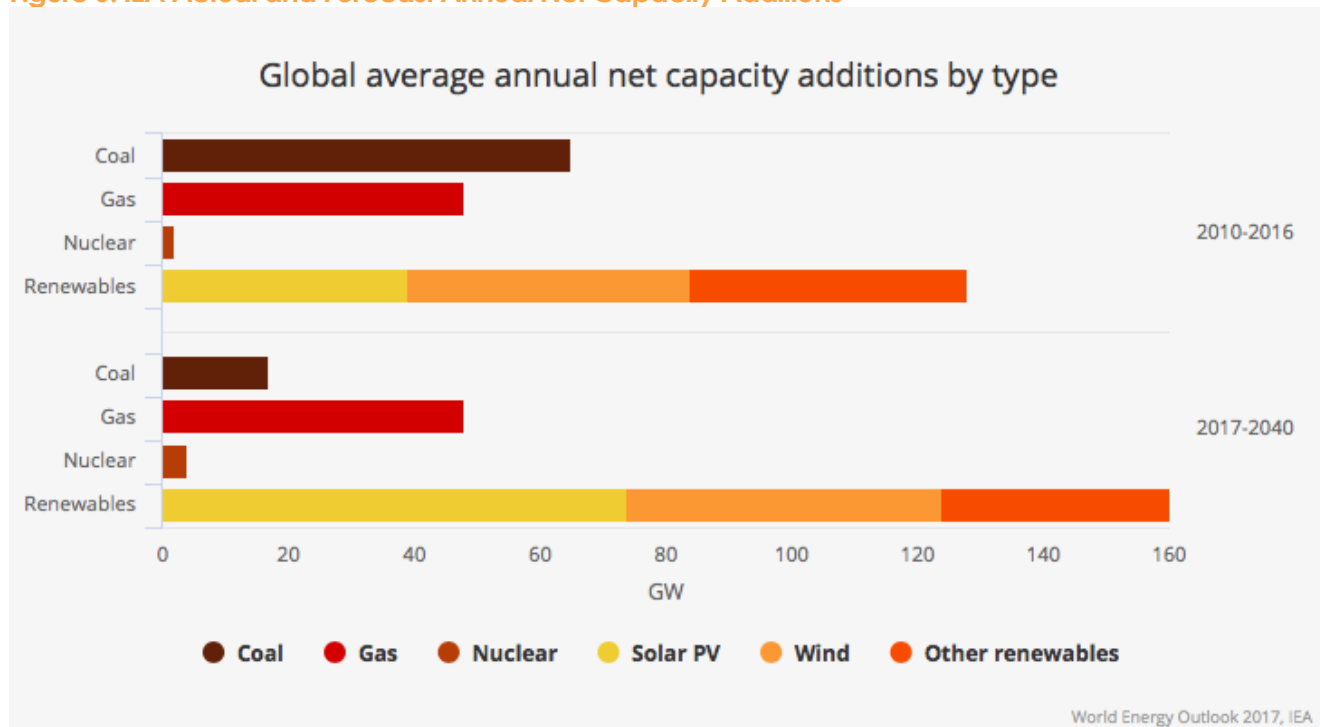
⁶⁶ <https://economictimes.indiatimes.com/industry/energy/power/suzlon-energy-set-to-sell-stake-in-130-mw-projects/articleshow/57116056.cms>

⁶⁷ <http://www.dhakatribune.com/bangladesh/foreign-affairs/2017/10/07/foreign-secretary-bangladesh-supports-chinas-one-belt-one-road/>

Teesta Solar Limited, a new joint venture set to build a 200 MW solar plant in Gaibandha, Bangladesh, will be 80% owned by Bangladesh's Beximco Power and 20% by China's **TBEA Xinjiang Sunoasis**. Teesta has reportedly signed a power purchase agreement with the Bangladesh Power Development Board.⁶⁸ TBEA, founded in 2000, is a clean-energy focused company offering silicon wafers, modules, inverters and other power equipment. It also finances, builds and operates solar- and wind-powered plants and has operations in 20 countries. Notably, TBEA was the EPC contractor for the first 100 MW of the 1,000 MW Quaid-e-Azam Solar Park in Pakistan⁶⁹.

The Bangladesh Economic Zone Authority (BEZA) in 2017 announced a plan to develop a 1,000 MW solar park in Chandpur district.⁷⁰ BEZA has begun acquiring land with **PowerChina** and the Bangladesh Power Development Board reportedly interested in developing what would be the nation's largest renewable energy hub.

Figure 6: IEA Actual and Forecast Annual Net Capacity Additions



Source: IEA

PowerChina, having previously focused on hydro and coal projects in developing countries, is turning increasingly to renewables in frontier markets such as those in Africa as solar gains a foothold in the region. PowerChina, under the **Sinohydro** brand, is contracted to build a 200 MW solar park in Bui, Ghana. Sinohydro already has constructed a 400 MW hydro project at Bui and the intention is now to make the plant a hybrid generator by adding solar.⁷¹

⁶⁸ <http://www.dhakatribune.com/bangladesh/power-energy/2017/10/27/beximco-set-200mw-solar-power-plant-gaibandha-chinese-company/>

⁶⁹ http://en.tbeaenergy.com/content/details53_1517.html

⁷⁰ <http://www.dhakatribune.com/bangladesh/power-energy/2017/06/23/1000-mw-solar-electricity-zone-setup-beza/>

⁷¹ <http://www.ghananewsagency.org/economics/powerchina-president-pays-courtesy-call-on-bui-power-ceo-120055>

In Kenya, after some delays, work began in April on a 50 MW solar project at Garissa.⁷² Jinko Solar is collaborating on the project with **China Jiangxi Corporation for International Economic and Technical Cooperation (Jiangxi International)**, an engineering and construction company that focuses on Africa and other developing parts of the world. The US\$116 million project is to be financed by the Export-Import Bank of China and is expected to be the largest solar plant in East Africa once completed.

In the secondary market, the largest-ever renewable energy generation acquisition included Chinese involvement as Singapore-based Equis Energy was taken over by Global Infrastructure Partners and other investors for US\$5 billion (including debt).⁷³ Co-investors included Chinese sovereign wealth fund **China Investment Corporation (CIC)**, which is expected to take a 10-20% stake. Equis has a 2.4 GW solar portfolio with an additional 4.3 GW in the pipeline, including a 1 GW project in Queensland, Australia.⁷⁴ The company also has a wind portfolio of 2.3 GW with a further 2 GW under development. CIC's involvement in this investment is significant as the major Chinese asset owners and insurance companies have lagged their global peers in gaining exposure to the renewables sector. The infrastructure asset class forms a major part of many asset owner portfolios and CIC may now be in a position to gain much-needed expertise relative to China's ambitions.

In October, **Shenzhen Energy** announced that it would spend US\$232 million to buy three Californian solar plants from Recurrent Energy, the solar power plant construction arm of Canadian Solar.⁷⁵ Canadian Solar has turned to solar plant construction as solar-panel supplies have grown plentiful in a boom led by Chinese manufacturers. The company seeks purchasers of the plants upon completion. This is a good fit for Shenzhen Energy, which is seeking expansion abroad via the Belt and Road Initiative and beyond. The company has opened offices in the U.S., Indonesia, Greece, Italy and Serbia, and Shenzhen is among the potential bidders for Australia-based Lyon Group's A\$1.5 billion solar and battery storage portfolio.⁷⁶ Major Japanese trading houses and power utilities are also said to be interested.

Chinese presence in the U.S. renewables market is increasing across the supply chain as well. **Harmony Solar**, which manufactures mountings for solar panels both at utility scale and for rooftops is a subsidiary of Chinese energy engineer **Northman Energy Technology**. It entered the U.S. market in late 2017. North America and the Middle East are priority areas of growth for Harmony, although its executives have stated that it also is interested in India, Latin America and Southeast Asia. Harmony also may expand its range of services in international markets to include full engineering, procurement and design services.⁷⁷

On the concentrating solar power (CSP) front, **Shanghai Electric**, a subsidiary of State Power Investment Corporation, will build a 700 MW CSP plant in Dubai in a partnership with Saudi Arabia's ACWA Power. The US\$3.9 billion⁷⁸ plant is proceeding after the consortium won a bid

⁷² <https://www.pv-magazine.com/2017/04/21/cjic-starts-construction-of-kenyas-first-large-scale-pv-plant/>

⁷³ <https://www.bloomberg.com/news/articles/2017-10-25/global-infrastructure-acquires-equis-energy-in-5-billion-deal>

⁷⁴ <http://reneweconomy.com.au/equis-plans-1000mw-solar-farm-in-heart-of-queenslands-gas-country-90246/>

⁷⁵ <https://theasset.com/belt-road-online/33613/cccc?id=33613&subm=belt-road-online>

⁷⁶ <http://www.afr.com/street-talk/global-investors-stalk-lyon-groups-15b-solar-battery-projects-20171122-gzqj52>

⁷⁷ <https://www.pv-tech.org/news/major-chinese-epc-enters-us-market-as-a-mounting-manufacturer>

⁷⁸ <https://cleantechnica.com/2017/09/19/dubai-awards-700-mw-solar-csp-contract-mammoth-mohammed-bin-rashid-al-maktoum-solar-park/>

at US\$73/MWh.⁷⁹ The project will be the single-largest CSP project globally and will have the world's tallest solar tower (260 meters). It will be built at the Mohammed bin Rashid Al Maktoum Solar Park, which is expected to have 1 GW of solar power by 2020 and 5 GW by 2030.

Shanghai Electric also has partnered with **China Energy Investment Corp** in an R&D joint venture called **NICE PV Research**, which aims to develop copper indium gallium selenide (CIGS) thin-film solar technology. Shanghai Electric purchased CIGS thin-film production equipment from Germany's Manz AG in early 2017 for €263 million with the intention of delivering a 44 MW R&D/300 MW commercial production line by the end of 2019.⁸⁰ Shanghai Electric also bought Manz's R&D unit for €50 million, an acquisition that will be incorporated into NICE PV Research. IEEFA views this deal as being driven in no small part by the Chinese government's desire for Chinese energy companies to embrace new technologies. While Manz R&D will continue in Germany, Shanghai Electric in the meantime appears to be evaluating the entire thin-film value chain, including manufacturing and electricity sales. Thin-film solar panels may find a range of applications, including integration into transport such as aircraft.

India has not wanted to be a part of the Belt and Road Initiative, but this has not kept China from gaining admission to the India-led **International Solar Alliance (ISA)**.⁸¹ The ISA, whose creation was announced at the 2015 Paris climate conference, became a United Nations treaty body in December 2017. Most ISA member countries are tropical, so tend to have high levels of sunshine; most also need energy development. Having China, the world's largest solar manufacturer, counted among ISA members is highly significant.

⁷⁹ <https://www.dewa.gov.ae/en/about-dewa/news-and-media/press-and-news/latest-news/2017/09/dewa-awards-aed142-billion-largest-csp>

⁸⁰ <https://www.pv-magazine.com/magazine-archive/building-pillars-of-pv/>

⁸¹ <https://energy.economictimes.indiatimes.com/news/renewable/india-scores-victory-in-climate-talks-china-announces-plan-to-join-international-solar-alliance/61712843>

Wind

Wind power in China—like solar power—has benefitted from government initiatives to address renewable energy production curtailments created by a shortage of transmission capacity. During the first nine months of 2017, curtailment of wind energy production dropped 6.7 percentage points compared to the same period in 2016; as a result, 12% of wind power production was curtailed versus almost 19% in 2016.⁸² By the end of September 2017, installed capacity of wind power in China had reached 157 GW.

Meantime, Chinese investment in wind power overseas continued apace.

Having absorbed China Longyuan owner China Guodian, **China Energy Investment Corporation** is now the world's largest developer of wind energy, and in November the group bought a 75% stake in four Greek wind projects⁸³. Project developer Copelouzos noted that the two companies intend to cooperate on further energy projects with an expected total investment of US\$3.5 billion.

China has been investing heavily in Greece since 2009, when it invested in Greece's largest harbor, which is intended to become a major shipping hub linking Europe with Asia and is now majority owned by COSCO Shipping, China's largest freight company. In 2016, the Greek state-owned power company PPC agreed to sell a 24% stake in ADMIE, Greece's grid operator, to State Grid Corporation of China for €320 million.⁸⁴ During the first half of 2017, China Longyuan sought potential wind power projects abroad as a way to fulfill the objectives of China's thirteenth five-year economic-development plan⁸⁵.

In July, **PowerChina** emerged as one of the companies considering bidding for the assets of Brazilian renewable energy company Renova Energie SA and power generator Light SA. Advisory firm CIRI International Technology had indicated that PowerChina is seeking to further globalize its operations and that a Chinese investor may be willing to inject capital into additional projects.⁸⁶

Beijing Jingneng Clean Energy's Australian arm, BJCE Australia, acquired a 100 MW wind farm project in New South Wales in November. The company, which has had a presence in Australia since 2014, intends to have a 1 GW renewable energy portfolio in Australia by 2020. It currently operates 3.3 GW of renewables in China.⁸⁷

The first wind power project in the China-Pakistan Economic Corridor (CPEC) was completed in 2017. CPEC forms one of the key components of the Belt and Road Initiative, linking

⁸² <https://energy.economictimes.indiatimes.com/news/renewable/chinas-renewable-power-wastage-declined-during-jan-sept-nea/61408976>

⁸³ <https://energy.economictimes.indiatimes.com/news/renewable/chinas-shenhua-buys-75-per-cent-stake-in-four-greek-wind-energy-parks/61483419>

⁸⁴ <http://www.wsj.com/articles/greeces-ppc-sells-stake-in-electricity-operator-admie-to-chinas-state-grid-1477935773>

⁸⁵ China Longyuan Interim Report 2017

⁸⁶ <https://www.reuters.com/article/us-renova-energia-m-a-china/chinese-may-bid-for-brazil-clean-energy-assets-letter-idUSKBN1A42MJ>

⁸⁷ http://reneweconomy.com.au/china-wind-giant-buys-100mw-wind-project-nsw-77316/?utm_source=RE+Daily+Newsletter&utm_campaign=3199da2b0d-EMAIL_CAMPAIGN_2017_11_05&utm_medium=email&utm_term=0_46a1943223-3199da2b0d-40324105

western China with Pakistan ports on the Arabian Sea. Chinese-built CPEC energy products include solar, wind, hydro and coal-fired power as well as transmission⁸⁸. The Gharo-Jhimpir wind corridor, originally mapped by the U.S. National Renewable Energy Laboratory has the potential for 11,000 MW of wind-generated power.⁸⁹ An initial 50 MW project was developed by Sachal Energy Development, a subsidiary of Pakistan's Arif Habib Group, and was financed by the **Industrial and Commercial Bank of China**. There are said to be 21 other wind projects under development in the Jhampir Wind Corridor with a total capacity of more than 1 GW.⁹⁰

Wind corridors in other parts of Pakistan are also being assessed, including in Punjab, where China's **SANY Group** plans to invest US\$1.5 billion in wind energy development.⁹¹ SANY Group is the largest construction machinery manufacturer in China and the fifth-largest globally. In May 2017, SANY signed a memorandum of understanding with the Punjab Power Development Board to install 1 GW of wind energy projects over five years.

Separate from the activity of the China SOEs, **China Light and Power** (CLP), the largest electricity generator in Hong Kong which is controlled by the Kadoorie family, is seeking investment opportunities in India as it expands its generation capacity in response to economic and electricity demand growth. CLP has built a sizeable renewables portfolio across the Asia-Pacific region over the past 15 years and is reported to be eyeing coal, wind, solar and run-of-river hydro projects. Its focus will most likely be on clean energy production in line with India's commitments to renewable energy and because Indian coal-fired power generators are underutilized.⁹² CLP already has 925 MW of wind power capacity in India, and the chairman of CLP Holdings has said India and China will be key growth markets for CLP as the company targets clean energy capacity of 30% of its total by 2020.

Chinese interest in purchasing existing wind power developments in Europe also continued in 2017. In December, Statkraft announced it had sold its 30% holding in the Dudgeon Point offshore wind farm, which is off the coast of the U.K., to a consortium led by **China Resources**, a state-owned Chinese company with investments in several sectors, including power.⁹³ The purchase price: US\$743 million. Meanwhile, **Shanghai Electric** is among the companies considering making a bid for Spanish wind power company Eolia Renovables de Inversiones in a sale that could be valued at US\$1.2 billion.⁹⁴

Xinjiang Goldwind, the world's third-largest manufacturer of wind turbines (Figure 7), is looking at investing in overseas projects to drive demand for its products. Most Goldwind turbines are currently used in Chinese domestic wind farms, and the company sees overseas markets as key to expansion. As of June 2017, Goldwind had cumulative orders for more than 1 GW of turbines for foreign projects.⁹⁵

The company is looking also at investing in projects in Brazil, where wind-powered electricity

⁸⁸ <http://cpec.gov.pk/energy>

⁸⁹ <https://www.reuters.com/article/us-pakistan-energy-windpower/in-coal-focused-pakistan-a-wind-power-breeze-is-blowing-idUSKBN1A21B4>

⁹⁰ <http://nation.com.pk/19-Nov-2017/work-on-21-wind-energy-projects-of-1000mw-in-full-swing-in-thatta>

⁹¹ <https://tribune.com.pk/story/1479163/chinese-firm-invest-1-5b-developing-wind-farms-punjab/>

⁹² <https://www.bloomberg.com/news/articles/2017-10-06/hong-kong-s-clp-seeks-acquisitions-to-diversify-expand-in-india>

⁹³ <https://www.statkraft.com/IR/stock-exchange-notice/2017/statkraft-sells-30-per-cent-share-in-dudgeon-offshore-wind-farm/>

⁹⁴ <https://www.bloomberg.com/news/articles/2017-08-09/oaktree-is-said-to-weigh-sale-of-spanish-wind-power-firm-eolia>

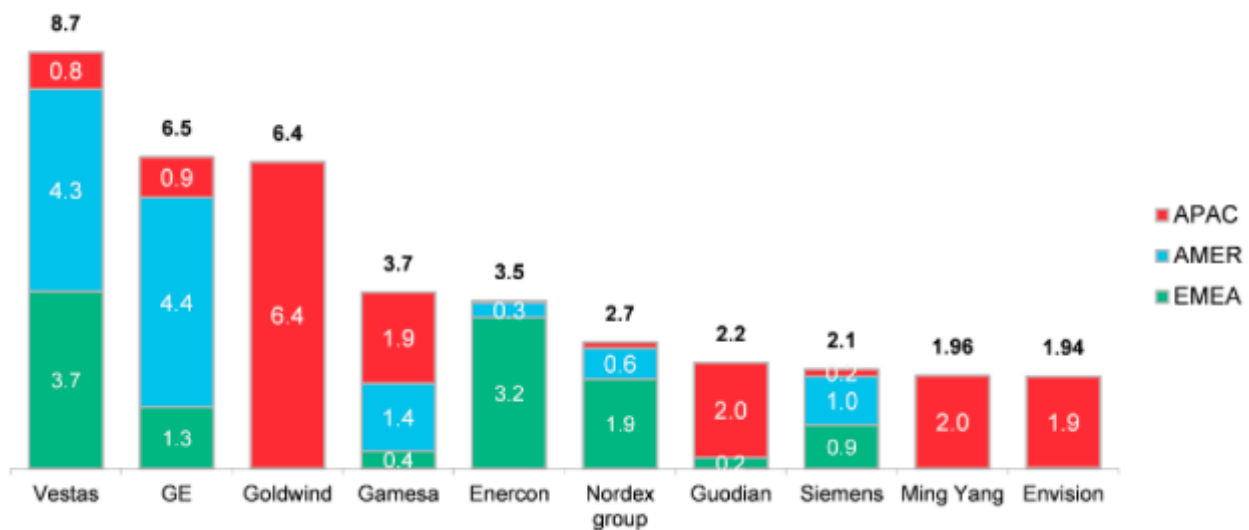
⁹⁵ Xianjing Goldwind Interim Report 2017

generation is growing fast. Goldwind is reportedly interested in projects of between 200 MW and 300 MW of capacity in several regions, including in the state of Ceara.⁹⁶ Goldwind entered the Argentinian market for the first time in 2017 with the acquisition of the 150 MW Loma Blanca Wind Power Project, laying the groundwork for more expansion in South America.⁹⁷

Goldwind also is looking to increase the presence of its turbines in the U.S., Canada and Mexico, targeting 2 GW of orders across those markets by 2020.

In 2017, the company's 160 MW Rattlesnake Wind Project in central Texas (which it acquired from Renewable Energy Systems Americas Inc. (RES) in May 2016) attracted the largest-ever financing for Goldwind equipment in the U.S. and is the first Goldwind project to receive all-Western financing.⁹⁸ Goldwind is aiming openly to challenge U.S. market leaders GE, Vestas and Siemens.

Figure 7: Top 10 Onshore Wind Turbine Manufacturers 2016 (GW)



Source: Bloomberg New Energy Finance⁹⁹

In May 2017, Goldwind Australia announced its purchase from Origin Energy of the 530 MW Stockyard Hill Wind Farm project in Victoria,¹⁰⁰ which will be the largest wind farm in Australia. The A\$100 million deal is of special note because it comes with an offtake agreement for just A\$52/MWh to 2030.¹⁰¹ In 2017, Goldwind also reached an agreement to develop the A\$300 million Cattle Hill Wind Farm in Tasmania, a project that will increase the wind capacity of that

⁹⁶ https://renewablesnow.com/news/goldwind-wants-to-set-foot-in-brazil-via-project-buys-report-587349/?utm_source=Renewables+Now_subscribers+and+newsletter&utm_campaign=1f25c7b02a-Renewables_Now_The_Daily_Newsletter_15_06_15_2017&utm_medium=email&utm

⁹⁷ Xianjing Goldwind Interim Report 2017

⁹⁸ <http://www.windpowermonthly.com/article/1432921/goldwind-project-financing-a-significant-milestone>

⁹⁹ <https://about.bnef.com/blog/vestas-reclaims-top-spot-annual-ranking-wind-turbine-makers/>

¹⁰⁰ <http://www.goldwindaustralia.com/press-release-stockyard-hill-wind-farm/>

¹⁰¹ <http://reneweconomy.com.au/origin-stuns-industry-with-record-low-price-for-530mw-wind-farm-70946/>

Australian state by 50%.¹⁰²

Goldwind in 2017 also increased its stake in its German turbine-efficiency retrofitter Best Blades GmbH, taking its holding to 75%.

Three other Chinese firms are among the top ten shown in Figure 7; Guodian (now part of China Energy Investments Corp), Ming Yang and Envision.

In November, **Pacific Hydro**, purchased by **State Power Investment Corporation** (SPIC) for A\$3 billion in 2015, secured the largest group purchase of wind power in Australia with partners that included National Australia Bank, Australia Post and the city of Melbourne.¹⁰³ The 10-year agreement will underwrite construction of Pacific Hydro's new 80 MW Ararat Wind Farm in Victoria.

In June, state-owned **China Three Gorges** acquired 49% of Energias de Portugal's (EDP) share of Portugal's largest wind power development (422 MW) for US\$290 million, with further investment expected.¹⁰⁴ This deal is the latest of several between the two companies following the acquisition of a 21% stake in EDP by China Three Gorges in 2011.¹⁰⁵ Portugal has one of the highest penetrations of renewable energy in Europe, and this is seen as a knowledge-building exercise to support further wind power investments by a company traditionally associated with hydro.

¹⁰² <http://reneweconomy.com.au/goldwind-to-build-144mw-wind-farm-in-tasmania-90769/>

¹⁰³ <http://www.afr.com/news/nab-nextdc-join-city-of-melbourne-bid-to-underwrite-pacific-hydro-wind-farm-20171121-gzpxun>

¹⁰⁴ <http://www.sxcoal.com/news/4560338/info/en>

¹⁰⁵ <http://uk.reuters.com/article/utilities-mediterranean-china/china-state-grid-quietly-builds-mediterranean-power-network-idUKL6N0QB5NF20140810>

Hydro

China Three Gorges — along with its other overseas renewable energy activities — continued international expansions within its core hydropower capability in 2017. While the China-Pakistan Economic Corridor (CPEC) is a particularly controversial part of the Belt and Road Initiative due in large part to the fact that the corridor passes through Pakistan-occupied Kashmir (PoK), Three Gorges is accelerating its build-out there of the US\$1.7 billion¹⁰⁶, 720 MW Karot hydropower plant. The project, started in December 2016, is now expected to be finished nine months ahead of its scheduled December 2021 completion date. Three Gorges investment in Pakistan is aligned with China's broader CPEC strategy, and its focus in Pakistan is on clean energy. The company has a Pakistan portfolio of US\$6 billion across three hydro and three solar plants.¹⁰⁷

Recently, Chinese companies have had some setbacks. Three Gorges was in the running for the contract to build a US\$14 billion, 4.5 GW Diamer-Bhasha hydro project on the Indus River. Pakistan has since cancelled the project, citing difficult financing terms from China. This follows the scrapping of a US\$2.5 billion hydro project in Nepal that was to have been contracted to **China Gezhouba Group**.¹⁰⁸ Myanmar announced in November 2017 that it would not proceed with large hydro power projects after cancellation of the China-backed US\$3.6 billion Myitsone Dam project, which had been intended to export 90% of the electricity generated to China's Yunnan province (which has since secured sufficient power supply).¹⁰⁹

Indeed, large Belt and Road hydro projects face strong headwinds generally. The Diamer-Bhasha project was one of five that would have made up the "Indus Cascade,"¹¹⁰ a series of proposed dams with a combined 22,000 MW of potential capacity. China Three Gorges was the frontrunner on the construction of the Indus Cascade. China has offered to provide the US\$50 billion in required financing¹¹¹ in addition to the US\$57 billion it is putting into the rest of the CPEC corridor. The status of these projects is less certain now than when they were originally proposed.

However, in Nepal, a participant in the Belt and Road initiative, Three Gorges in November 2017 agreed to a joint venture with the Nepal Electricity Authority to build the 750 MW West Seti hydro project.¹¹² Financing for what, at US\$1.6 billion, will be the largest Chinese investment in Nepal will come from China Three Gorges itself and the **Export-Import Bank of China**.¹¹³

¹⁰⁶ <http://www.scmp.com/business/companies/article/2119898/china-three-gorges-pakistan-dams-will-benefit-electricity-starved>

¹⁰⁷ <https://www.bloomberg.com/news/articles/2017-09-18/china-quickens-work-on-pakistan-utility-in-area-claimed-by-india>

¹⁰⁸ <https://energy.economicstimes.indiatimes.com/news/power/cpec-in-dock-after-pak-nepal-withdraw-from-dam-projects-in-china/61852052>

¹⁰⁹ <https://www.japantimes.co.jp/news/2017/04/06/asia-pacific/china-may-shelve-controversial-myitsone-dam-exchange-interests-myanmar/> - .WgOhblcW3zl

¹¹⁰ <https://www.thequint.com/news/world/indus-river-dam-project-china>

¹¹¹ <http://www.hydroworld.com/articles/2017/05/china-and-pakistan-sign-mou-for-us-50-billion-earmarked-for-indus-river-cascade.html>

¹¹² <https://southasianmonitor.com/2017/11/06/china-three-gorges-nepal-electricity-sign-jv-deal-west-seti-hydropower-project-month/>

¹¹³ <http://www.hydroworld.com/articles/2017/01/nea-ctgc-agree-to-joint-venture-to-construct-nepal-s-750-mw-west-seti-hydropower-plant.html>

Other Chinese firms are active in hydropower in Nepal too. In November, the Butwal Power Company of Nepal signed a joint venture agreement with three Chinese firms with the intention of developing up to 1 GW of hydro capacity backed by an investment of US\$3 billion. **Sichuan Provincial Investment Group, Chengdu Xingcheng Investment Group** and **Qing Yuan Consulting Co.** are the Chinese participants in the joint venture that will begin with a 100 MW project in western Nepal.¹¹⁴

China Three Gorges continued to maintain its interest in South American expansion in 2017. Three Gorges, which already has a presence in hydropower in Brazil, led a consortium that acquired the 456 MW Chaglla hydro project in Chile for a reported US\$1.4 billion. **China's Hubei Energy Group** is a member of that consortium.¹¹⁵ **Sinohydro**, one of the main overseas hydro units of **PowerChina**, continued to win projects in South America in 2017. After completing the 1,500 MW Coca Coda Sinclair project in Ecuador in late 2016, it won a contract to build the US\$550 million, 280 MW Ivirizu plant in Bolivia.¹¹⁶ Sinohydro is also involved in consortia building the 124 MW San Jose project in Bolivia and the 240 MW Chicoasen 2 project in Mexico. Sinohydro, in a consortium with **Shenzhen Energy**, also won a contract, in January 2017, to build the Ramu 2 hydro project in Papua New Guinea. The 180 MW project is expected to be completed in 2020 and will require an investment of about US\$900 million.¹¹⁷

State Power Investment Corporation (SPIC) expanded its presence in the Brazilian power market by winning a US\$2.4 billion bid in September for the right to develop the Sao Simao hydro project.¹¹⁸ SPIC has also proposed acquiring Brazilian energy company Cemig's 22.4% stake in the Santo Antonio hydro plant; Santo Antonio is a 3.6 GW hydro development on the Madeira River in Brazil's Rondonia state.¹¹⁹

Africa, long a key market for Sinohydro, saw the completion of the Soubre hydroelectric power station in Cote d'Ivoire. With an installed capacity of 275 MW, the project investment totalled US\$572 million, 85% of which was financed by the Export-Import Bank of China with the Cote d'Ivoire government funding the rest.¹²⁰ The country is aiming to double its installed hydro capacity to 4,000 MW by 2020, and Sinohydro will build a 112 MW hydro project 15 kilometers downstream from the Soubre dam. The company was also expected to commission the Kariba South Power Project for Zimbabwe in December 2017.¹²¹

In the Philippines, PowerChina in July won the EPC contract to build a US\$1 billion, 500 MW pumped hydro project.¹²² The project is being developed by San Lorenzo Ruiz and Equis Energy, which was acquired by a consortium that included China Investment Corporation in October (see Solar section).

¹¹⁴ <https://energy.economictimes.indiatimes.com/news/power/china-firms-sign-3-billion-deal-to-generate-hydro-power-in-nepal/61795741>

¹¹⁵ <http://www.hydroworld.com/articles/2017/08/chinese-partnership-to-buy-peru-s-456-mw-chaglla-from-odebrecht.html>

¹¹⁶ http://www.chinadaily.com.cn/business/2017-08/19/content_30826511.htm

¹¹⁷ <https://theasset.com/belt-road-online/33613/-shenzhen-energy-acquires-california-solar-assets--news-966-o>

¹¹⁸ <https://macauihub.com.mo/2017/09/28/pt-grupo-chines-state-power-investment-corp-obtem-concessao-de-central-hidroelectrica-no-brasil/>

¹¹⁹ <https://www.bnamericas.com/en/news/electricpower/chinas-spic-submits-bid-for-brazil-hydro-stake>

¹²⁰ http://news.xinhuanet.com/english/2017-11/03/c_136723780.htm

¹²¹ <https://www.esi-africa.com/news/kariba-south-power-project-commission/>

¹²² <http://asian-power.com/project/news/powerchina-seals-deal-ovpi-us1b-philippine-hydropower-project>

China Gezhouba Group made its first entry into Malaysia in 2017 through a joint venture in which it holds a 70% stake that won a contract to build a 1,285 MW, US\$715 million¹²³ hydropower plant in Sarawak.¹²⁴The Baleh project is the second hydropower project within the Sarawak Corridor of Renewable Energy (SCORE), which has three other projects earmarked for development. China Gezhouba, part of the state-owned **China Energy Engineering Corporation**, constructs highways, railways, bridges and thermal, wind and hydro projects in China and abroad. The company has a long track record of seeking development opportunities overseas.

China Gezhouba Group was part of a consortium that in 2017 agreed to a contract with the Nigerian government to build the long-delayed 3 GW, US\$5.8 billion Mambilla hydro project in Taraba State. Other consortium members include PowerChina's Sinohydro and **CGCOG Group** (formerly CGC Overseas Construction Group).¹²⁵ The China Export-Import Bank will provide 85% of the funding with the Nigerian government covering 15%.¹²⁶ January 2017 saw financial close achieved on the 870 MW, US\$1.8 billion Suki Kinari Hydropower project in Pakistan. China Gezhouba is one of the sponsors of the project, which is being financed by the Export-Import Bank of China and the Industrial and Commercial Bank of China (ICBC).¹²⁷

China Huaneng, one of China's "Big Five" power utilities and the parent company of publicly listed Huaneng Power International, continues an overseas expansion with the intention of increasing its international generating capacity by 60% in three years.¹²⁸ Coal-fired generation in Pakistan will make up part of Huaneng's overseas capacity expansion from 10 GW to 16 GW by 2020. The company also expects to commission a 400 MW hydro project in Cambodia by the end of 2017. China is the largest investor in hydropower in Cambodia, with a total of seven projects invested by Chinese companies to date.¹²⁹

Hydro developments continue to dominate annual listings of major overseas clean energy projects (Figure 1). China's exploitation of hydro resources domestically over many decades has led to a significant capacity and expertise build-up that serves now as a foundation internationally for new projects as domestic opportunities become scarcer.

¹²³ <https://www.thestar.com.my/business/business-news/2017/08/02/china-gezhouba-untang-jaya-to-undertake-main-civil-works-for-sarawak-baleh-hydro-dam/>

¹²⁴ <http://hydro.energy-business-review.com/news/sarawak-awards-malaysian-hydro-power-project-contract-to-china-gezhouba-untang-jaya-jv-030817-5890690>

¹²⁵ <https://www.esi-africa.com/news/chinese-consortium-head-nigerian-hydroelectric-power-plant/>

¹²⁶ <http://www.hydroworld.com/articles/2017/09/nigerian-government-approves-contract-to-build-3-050-mw-mambilla-hydropower-plant.html>

¹²⁷ <https://www.thenews.com.pk/print/177900-Suki-Kinari-hydropower-project-of-870MW-achieves-financial-close>

¹²⁸ <http://www.scmp.com/business/companies/article/2110706/huaneng-aims-generate-60-cent-more-electricity-power-plants-along>

¹²⁹ <http://en.people.cn/n3/2017/0926/c90000-9273848.html>

Grid Investment

China's focus on overseas investment by the State Grid Corporation fits nicely with China's overall ambitions in the renewables space. Grid operators and investors bring with them strong relationships with equipment suppliers and maintain an influential position in discussion of the future generation mix. Given China's goal to control the technology and production infrastructure for renewables, overseas investment in power grids is a natural facilitator.

Domestically, investment in high-voltage power transmission lines remains key to solving China's renewable energy curtailment issues. With the curtailment reduced in 2017, the government is aiming to fully resolve the issue by 2020.¹³⁰ **State Grid Corporation**, the world's largest power utility by revenue and with almost two million employees, will play an important role. State Grid logged a significant achievement during the year after conducting an experiment in which it ran Qinghai province entirely on renewable energy, including hydro, solar and wind, for seven days in July.¹³¹

State Grid also has continued its run of significant investments abroad after acquiring a controlling stake in Brazilian utility CPFL Energia SA for US\$4.5 billion¹³² and a minority stake in Greek grid operator ADMIE for US\$356 million.¹³³ State Grid, now the largest power distribution company in Brazil, has announced its interest in participating in Brazil's next round of power line project licensing.¹³⁴ The company already has invested almost US\$21 billion in power projects in Brazil and expects to double this amount over the next three years.¹³⁵ In November, State Grid increased its stake in CPFL to 94.75% in a US\$3.45 billion transaction.¹³⁶

The company, ranked second on the 2017 Fortune Global 500 list,¹³⁷ is close to completing the initial phase of power grid build-out in Egypt,¹³⁸ and in 2017 won a US\$1 billion contract for a second phase of Egyptian power transmission development.¹³⁹ Also, as part of the China-Pakistan Economic Corridor (CPEC), State Grid will build a power transmission line linking Lahore and Matiari in Pakistan in a project involving a US\$1.5 billion investment.¹⁴⁰ In addition, State Grid has a second transmission line project in Pakistan linking Faisalabad and Matiari,¹⁴¹ a further US\$1.5 billion project (although there are reports that it may be put on hold while its requirements are assessed).

¹³⁰ <https://energy.economictimes.indiatimes.com/news/renewable/chinas-renewable-power-wastage-declined-during-jan-sept-nea/61408976>

¹³¹ <https://www.businessinsider.com.au/china-renewable-energy-qinghai-province-2017-6>

¹³² http://www.chinadaily.com.cn/business/2017-01/25/content_28048787.htm

¹³³ <https://energy.economictimes.indiatimes.com/news/power/chinas-state-grid-seals-acquisition-of-stake-in-greek-power-grid/59246240>

¹³⁴ <https://energy.economictimes.indiatimes.com/news/power/chinas-state-grid-says-interested-in-brazils-power-line-licensing-round/61873456>

¹³⁵ <https://www.powertransformernews.com/2017/09/05/chinas-state-grid-is-brazils-largest-power-distribution-company-chairman/>

¹³⁶ <https://www.reuters.com/article/cpfl-energia-delisting/state-grid-buys-3-4-bln-in-cpfl-from-minority-shareholders-idUSL1N1O02LI>

¹³⁷ <http://fortune.com/global500/state-grid/>

¹³⁸ <https://dailynewsegyp.com/2017/08/14/state-grid-complete-construction-electric-lines-along-800-kms-next-month/>

¹³⁹ https://www.abo.net/en_IT/briefs/egypt-china-eng.shtml

¹⁴⁰ <https://www.reuters.com/article/pakistan-china/china-to-fund-4000-mw-power-transmission-line-in-pakistan-idUSL4N1EP21U>

¹⁴¹ <https://pakobserver.net/matiari-lahore-faisalabad-transmission-lines-opening-soon/>

In December, State Grid was reportedly negotiating the purchase of a 20% stake in Eurogrid International SCRL, which owns one of the four transmission system operators in Germany. Eurogrid is the owner of 50Hertz Transmission, which operates in north and east Germany and is also responsible for the transmission of offshore wind power in the Baltic Sea to the grid.¹⁴²

In further recognition of State Grid's growing international ambitions and funding capacity, November 2017 saw the company sign an agreement with the International Renewable Energy Agency (IRENA) at the UN Climate Change Conference in Bonn, COP23¹⁴³. The agreement will see State Grid technical experts seconded to IRENA for a year to assist with IRENA's Clean Energy Corridor programs in Africa, Central America and Southeast Asia, which aim to help integrate more renewable energy generation into electricity grids.

Figure 8: Northeast Asia Supergrid Proposal



Source: Bloomberg, Shivee Energy

State Grid continues to be highly ambitious with various schemes for transcontinental "supergrids." One such scheme is a grid connection linking Mongolia, China, Russia, South Korea, and Japan (Figure 8). State Grid is carrying out the feasibility study for the plan, which has the support of partners that include Japan's Softbank Group and Korea Electric Power Company (KEPCO).¹⁴⁴ Softbank prioritizes renewable energy and sees such an interconnection as a way to import renewable energy into Japan as a means of reducing the nation's over-reliance on fossil-fuel imports. In November, KEPCO stated that such an interconnection was feasible both technically and economically.¹⁴⁵ KEPCO, Softbank and

¹⁴² <https://renewablesnow.com/news/chinas-state-grid-negotiates-buy-of-20-in-german-tso-50hertz-594628/>

¹⁴³ <http://www.irena.org/newsroom/articles/2017/Nov/IRENA-and-State-Grid-Corporation-of-China-Team-Up-to-Scale-Up-Regional-Renewable-Capacities>

¹⁴⁴ <https://www.bloomberg.com/news/articles/2017-06-07/tokyo-nights-lit-up-from-1-700-miles-away-is-big-mongolian-bet>

¹⁴⁵ <http://www.koreaherald.com/view.php?ud=20171102000144>

State Grid are already collaborating on a pilot project to link with Mongolian solar and wind power that has been expanded to include Russia in a Northeast Asia supergrid after an agreement was signed at an Eastern Economic Forum in September.¹⁴⁶

Other Chinese power companies also are looking to invest in power grids overseas. Hong Kong's **China Light and Power** (CLP) has decades of grid operation experience in Hong Kong and already owns generation capacity in India, including 1,320 MW of coal, 655 MW of gas, 925 MW of wind and 100 MW of solar. The company is now looking to enter the power transmission sector in India. In September, CLP bid for a 200 kilometer transmission project connecting India's northern and western grids.¹⁴⁷

Shanghai Electric signed an agreement in November 2017 to take over a Brazilian power transmission project currently owned by a subsidiary of Eletrobras.¹⁴⁸ The project in Rio Grande do Sul State requires an investment of about US\$1 billion.¹⁴⁹ Shanghai would be joining a wave of Chinese investment in Brazilian power markets that already includes major investments from State Grid Corp and China Three Gorges.

China Machinery Engineering Corporation (CMEC) cites the Belt and Road initiative specifically as an opportunity to expand into new markets. The company's stated mission is to become the world's leading international engineering contractor. International engineering accounts for 54% of CMEC revenues while 68% of revenues and 78% of gross profits are attributable to the power sector. CMEC has undertaken projects in 48 countries worldwide; in January 2017, a ribbon-cutting ceremony was held for CMEC's 220 kV electric transmission project in Angola. May 2017 saw the commencement of another CMEC Angola project, the 400 kV power transformation station for the Lauca Connection Line Project. Elsewhere in Africa, the supporting transmission infrastructure for the Liouesso hydropower project in the Republic of Congo passed final acceptance testing.¹⁵⁰ CMEC is a subsidiary of **China National Machinery Industry Corporation**, also known as **Sinomach**.

Another subsidiary of Sinomach, **China CAMC Engineering Corporation (CAMC)**, is increasing its presence in Zimbabwe. In November, it was reported that CAMC was in final negotiations with Zimbabwe Electricity Transmission and Distribution Co. on a US\$150 million investment for the construction of a 400 kV power line in the east of the country.¹⁵¹

Earlier in the year, CAMC was awarded a US\$131 million contract¹⁵² to build a 285 kilometer, 220 kV transmission line between Isiolo and Garissa in Kenya funded by the **Export-Import Bank of China**. The power line is expected to enable transmission of wind and solar power to other parts of the country, including from a Chinese-built-and-financed 55 MW solar plant.¹⁵³ Kenya is planning thousands of kilometers of new transmission lines over the next five years in an initiative Chinese firms are well placed to capitalize on, since Kenya lies on one of the key routes of the Belt and Road Initiative.

¹⁴⁶ <http://www.koreaherald.com/view.php?ud=20171102000144>

¹⁴⁷ <https://www.bloomberg.com/news/articles/2017-10-06/hong-kong-s-clp-seeks-acquisitions-to-diversify-expand-in-india>

¹⁴⁸ <https://renewablesnow.com/news/to-the-point-eletrosul-signs-deal-for-transmission-project-in-rio-grande-do-sul-591751/>

¹⁴⁹ <https://www.reuters.com/article/us-eletrbras-divestiture-shanghaielctr/chinas-shanghai-electric-near-deal-for-brazil-transmission-project-idUSKBN1CS2KF>

¹⁵⁰ China Machinery Engineering Corp, 2017 Interim Report

¹⁵¹ <https://www.esi-africa.com/news/zimbabwe-china-hold-sway/>

¹⁵² <https://www.standardmedia.co.ke/business/article/2001247980/chinese-firm-gets-sh13-5-billion-power-line-tender>

¹⁵³ <https://www.standardmedia.co.ke/business/article/2001237139/design-of-africa-s-largest-solar-plant-in-garissa-gets-ready>

Energy Efficiency

Energy efficiency (EE) receives less attention than the rapidly developing renewable energy market, yet energy efficiency gains, and the resulting decrease in energy intensity, are largely responsible for the flattening of global carbon emissions since 2014. Three quarters of the impact of rising GDP on energy sector carbon emissions were offset by declining energy intensity. The other quarter resulted from the growth of renewables and other low-emission energy sources. This decline represents an energy-productivity bonus that was valued at US\$2.2 trillion in 2016 — China's efforts in reducing energy intensity accounted for half of this premium while the U.S. contributed a quarter.¹⁵⁴

Chinese EE investment showed the strongest growth of any country in 2016 at 24%. Global growth in energy efficiency investment was 9%, representing a total value of US\$231 billion. While Europe remains responsible for the largest share of worldwide investment in EE (30%), China has led in implementing mandatory EE policies in recent years, accounting for more than half of the increase in the IEA's Efficiency Policy Progress Index (EPPI) from 2000 to 2016 (the EPPI measures changes in strength and coverage of mandatory EE policies).

Figure 9: Largest Markets for Electricity Smart Meters 2017



Source: Bloomberg New Energy Finance

China dominates in new technologies and services that will drive energy efficiency gains going forward. The global energy service company (ESCO) market expanded by 12% to US\$26.8 billion in 2016. China, with its supportive government policies, makes up more than half of this market with the U.S. in second place with about 25%. EE investment in transport

¹⁵⁴ IEA Energy Efficiency 2017

grew by 5% in 2016, a key part of which were electric vehicle (EV) sales, which grew by 40%, led mainly by China (refer to the Electric Vehicle section below).¹⁵⁵

Four billion connected devices were in use worldwide at the end of 2016. An additional estimated one billion were added in 2017 at a rate of increase that may triple by 2020. Such devices enable “smart” homes to allow real-time control of energy consumption. Connected devices coupled with smart meters allow consumers to react to changes in electricity prices in real time. China is the largest market by far for smart meters, with almost 500 million installed, more than six times the total in the U.S., which is the second-largest market (Figure 9).

China's focus on increasing domestic capacity in this realm is a probable prelude to the rollout of such products in international markets, an eventuality that has been seen now for many decades with Chinese hydro technology, particularly in developing countries. Chinese solar, wind and battery technologies are now increasingly present in overseas markets, and EV, EE and energy-management systems are set to follow.

Wasion Group is the leading provider of advanced metering, distribution and energy efficiency management in China and is committed to becoming a leading player in international markets, particularly across Asia, Africa and Latin America.¹⁵⁶ Belt and Road has already helped Wasion expand overseas into almost 30 countries; in the first half of 2017 international turnover of Wasion products increased by 63% year on year. The company maintains a leading position in Bangladesh, Indonesia, South Africa, Tanzania and Egypt.

In July, Hong Kong's **Cheung Kong Infrastructure** (CKI) agreed to a US\$5.3 billion¹⁵⁷ deal to acquire Germany's Ista, one of the world's largest smart-metering and energy-management companies. Ista operates in European countries that include Denmark, France, Germany, Italy, the Netherlands and Spain. CKI is in a consortium with sister company Cheung Kong Property Holdings that will own 65% while CKI will own the balance. CKI has been making acquisitions globally in recent years, including that of Australian energy company DUET Group in 2017 for A\$7.4 billion. CKI has made it clear that it intends to make further acquisitions.¹⁵⁸ Investment in smart meters at this time is made more attractive by the European Union's goal of replacing at least 80% of traditional meters by 2020. Moreover, the Cheung Kong Group, with its significant electricity grid and property exposure, is doubtless keen to harvest the type of data that will be available via smart meters.

¹⁵⁵ IEA Energy Efficiency 2017

¹⁵⁶ Wasion Group 2017 Interim Report

¹⁵⁷ <http://www.scmp.com/business/commodities/article/2104407/cheung-kong-buys-energy-manager-ista-eu45-billion-adding>

¹⁵⁸ <https://www.ft.com/content/0c6f9073-4941-3d07-bd26-f3188ed30cd8>

New Energy Commodities

Lithium

Lithium-ion batteries are a significant and growing source of lithium demand. Currently around 37% of mined lithium is used in such batteries and there are likely to be shortages in the near term, although Bloomberg New Energy Finance expects these shortfalls to be resolved as new projects come on line in the early 2020s. However, there is the chance of further shortages from the late 2020s unless additional projects are added to the pipeline¹⁵⁹.

Citi analysts stated in October 2017 that the Chinese electric vehicle (EV) industry will remain the key driver of lithium demand. Chinese EV battery production is expected to grow at 30% a year to 2020 with Chinese EVs accounting for 24% of global lithium demand by that date (up from 14% in 2016).¹⁶⁰ Although sufficient reserves have been identified, it is questionable as to whether mining operations can be up and running in time to meet growing demand from EVs.¹⁶¹

The lithium industry has traditionally been dominated by a few large companies, including US-listed Albermarle, FMC and SQM of Chile. Recently, they have been joined by Chinese companies **Tianqi Lithium** and **Jiangxi Ganfeng Lithium**. However, the increasing demand for lithium is bringing a number of smaller players into the market as well.

In Australia, 2017 has seen progress on two new lithium developments from smaller industry players that are expected to go into production in 2018. Altura Mining's Pilgangoora lithium project in Western Australia is supported by two Chinese off-takers; **Shaanxi J&R Optimum Energy** and **Lionergy**. J&R Optimum Energy is the major shareholder in Altura while Lionergy will use part of the project's output in its Chinese lithium carbonate and hydroxide plant whose completion is expected to coincide with Altura's project coming online.¹⁶²

Meanwhile, Altura's neighbor, Pilbara Minerals, also has a lithium project at Pilgangoora. Chinese car maker **Great Wall** is to take a A\$28 million stake in the company as part of an off-take agreement for the second stage of the project. This follows Ganfeng taking a 20% stake in an Argentinian project earlier in the year¹⁶³. The Great Wall equity investment replaces the expected investment by another Chinese company, **China General Lithium**, which was halted by regulators. However, China General Lithium remains a key off-taker¹⁶⁴.

Tianqi has warned smaller lithium players that high quality lithium projects that will come online in the next few years will outcompete smaller, lower-quality operations. Tianqi owns

¹⁵⁹ <https://about.bnef.com/blog/end-sight-near-term-lithium-supply-shortages/>

¹⁶⁰ <http://www.afr.com/business/mining/chinas-tianqi-lithium-warns-increasing-supply-will-wipe-out-some-producers-20171018-gz34u3>

¹⁶¹ <http://www.afr.com/markets/galaxy-orocobre-agree-the-world-will-not-get-enough-lithium-in-time-20171113-gzk9lu-ixzz4yNuxdK89>

¹⁶² <http://www.afr.com/business/altura-sees-double-on-pilbara-lithium-production-20171112-gzjw59>

¹⁶³ <http://money.cnn.com/2017/11/20/investing/lithium-china-electric-car-batteries/index.html>

¹⁶⁴ <https://thewest.com.au/business/mining/china-car-maker-great-wall-drives-28m-deal-for-pilbara-minerals-lithium-ng-b88613933z>

51% of the world's largest hard rock lithium mine at Greenbushes, Western Australia. The company is investing A\$400 million in a plant to convert Greenbushes output into battery-grade lithium. Tianqi is already considering a further A\$371 million investment to expand the plant as it plans for increased production to meet future EV demand.¹⁶⁵

It is reported that the Chinese government has instructed its state-owned enterprises to secure lithium sources outside of China as the nation seeks to dominate the global EV supply chain. China appears to be outmaneuvering both the U.S. and Europe, neither of which have significant lithium reserves of their own.¹⁶⁶

Cobalt

In May 2016 it was announced that a Chinese company had made the largest private investment in the history of the Democratic Republic of Congo (DRC). Mining company **China Molybdenum** paid US\$2.65 billion for one of the largest copper mines in Africa yet it was pointed out at the time that at least part of the rationale for the project was to secure the Tenke mine's cobalt reserves.¹⁶⁷

Chinese companies are now in position to dominate the cobalt market with the majority of supply heading to China. Once a niche metal, cobalt has grown in importance as it is required to make the cathodes in rechargeable batteries. After the Tenke deal, Chinese miners were expected to be responsible for 62% of global supply in 2017¹⁶⁸. The move into a dominant position in cobalt reflects the rise of Chinese battery companies (see the following section).

The DRC accounts for the majority of the world's supply of the metal – 63% in 2016. While Glencore produced a quarter of the world's supply of cobalt in 2016 from its DRC Mutanda mine, seven of the ten largest cobalt producers in the country are Chinese-owned.¹⁶⁹ Glencore's Mutanda and the Tenke mine now owned by China Molybdenum were by far the two largest producers of cobalt in DRC last year. China Molybdenum itself controls 15% of the world market. **Guangdong Jiana Energy Technology Co, Jinchuan Group** and **Huayou Cobalt Co** are other Chinese companies that have invested in cobalt-bearing assets in DRC. **Jiangxi Copper** is also looking to invest in Africa.

The chairman of Guangdong Jiana Energy Technology Co has warned of China's over-reliance on DRC and pointed toward Chinese investment in Australia and Canada as a way to diversify supply. Jiana has already been looking at possible Canada investments. More recycling of cobalt will also become important. The risk was highlighted in September 2017 when the DRC government ordered that Chinese joint venture **Sicomines** stop exporting raw copper and cobalt.

Chinese battery maker **Contemporary Amperex Technology Co Ltd (CATL)** is seeking to

¹⁶⁵ <http://www.afr.com/business/mining/chinas-tianqi-lithium-warns-increasing-supply-will-wipe-out-some-producers-20171018-gz34u3>

¹⁶⁶ <http://money.cnn.com/2017/11/20/investing/lithium-china-electric-car-batteries/index.html>

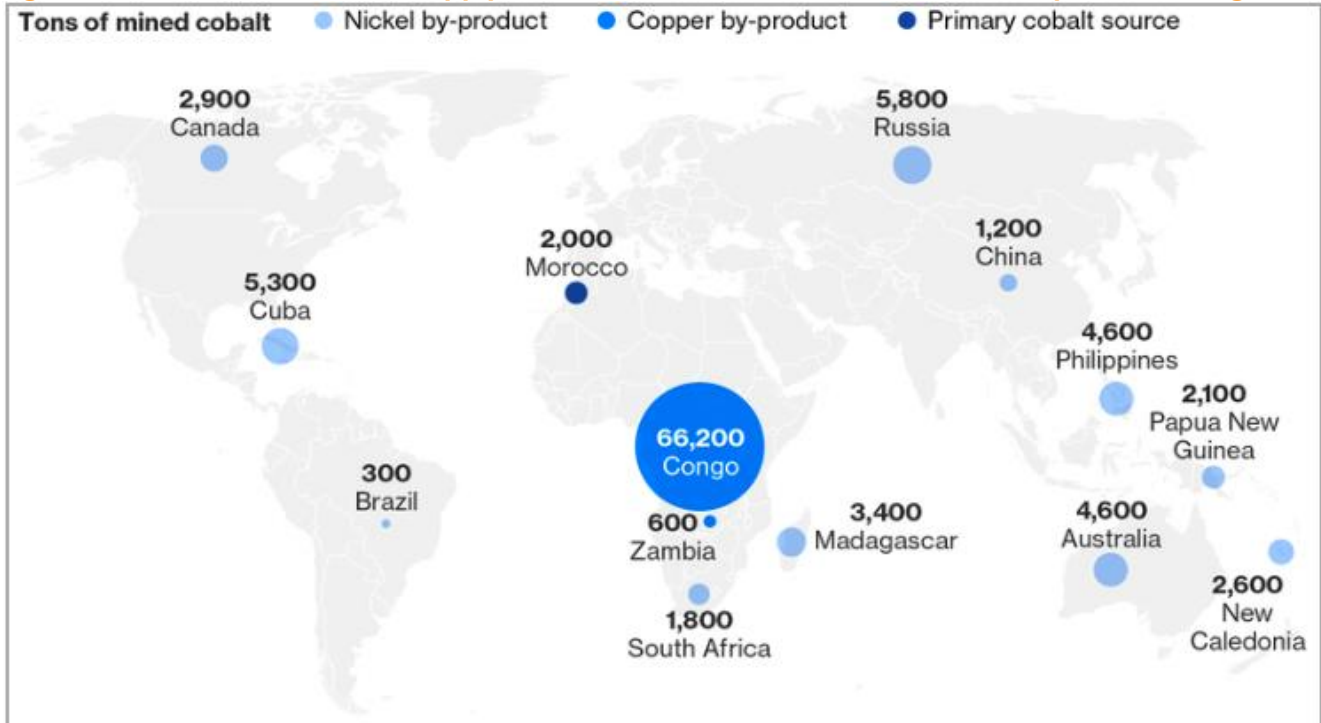
¹⁶⁷ <https://www.ft.com/content/054bbb3a-1e8b-11e6-a7bc-ee846770ec15>

¹⁶⁸ <https://www.ft.com/content/054bbb3a-1e8b-11e6-a7bc-ee846770ec15>

¹⁶⁹ <https://www.bloomberg.com/news/articles/2017-10-26/battery-boom-relies-on-one-african-nation-avoiding-chaos-of-past>

secure upstream supplies, particularly of cobalt, as EV growth drives battery demand. Several Chinese companies including car maker **Great Wall Motor Co.** have acquired stakes in cobalt mines or have been linked to such moves in 2017. CATL also has invested in a cobalt recycling firm to reduce dependence on cobalt suppliers.¹⁷⁰

Figure 10: 63% of Global Cobalt Supply in 2016 Was Sourced in the Democratic Republic of Congo



Source: Bloomberg, Darton Commodities Ltd

Cobalt use in battery making increased from 12,300 metric tons in 2006 to 47,200 metric tons in 2016, a compound annual growth rate of 13%¹⁷¹. Cobalt prices were up 84% for the year as of November 2017, having passed US\$60,000 a metric ton on the London Metals Exchange¹⁷². Driven by the EV boom, China's cobalt consumption is set to rise 17.4% in 2017 to 54,000 metric tons.

Nickel

Nickel sulfate is another key ingredient in lithium-ion batteries, hence nickel is seeing increased demand as battery and EV manufacturers look to shore up supply. Demand for nickel may rise 50% to three million metric tons by 2030¹⁷³. Most nickel is used in the production of stainless steel, but the share used in batteries is rising quickly. The amount of nickel used in

¹⁷⁰ <https://www.reuters.com/article/china-catl/update-2-chinese-battery-maker-catl-eyeing-upstream-cobalt-investments-idUSL3N1ND479>

¹⁷¹ <https://seekingalpha.com/article/4111202-china-quietly-pushed-tesla-gm-vw-rest-auto-industry-brink-cobalt-cliff>

¹⁷² <https://www.reuters.com/article/china-catl/update-2-chinese-battery-maker-catl-eyeing-upstream-cobalt-investments-idUSL3N1ND479>

¹⁷³ <http://www.afr.com/markets/australias-nickel-industry-is-at-a-natural-turning-point-20171101-gzd3xf>

battery production is growing at close to 6% annually¹⁷⁴. In addition, the distribution of nickel around the globe is far less localized than that of cobalt. Since lithium-ion batteries most commonly are based on a nickel-containing chemistry, mining and energy consultant Wood Mackenzie forecasts a structural shortage in the nickel market to emerge by 2025 after years of large stockpiles¹⁷⁵. Nickel prices were up 29% year-to-date as at November 2017 at around US\$13,000 per metric ton¹⁷⁶.

Jinchuan Group, China's top nickel producer, is to build a new plant in 2018 that will produce raw materials for EVs, citing "explosive" demand. The project will have an annual production of 30,000 metric tons of nickel and 3,000 metric tons of cobalt by 2020. The chairman of Jinchuan stated that "We really feel the decline of momentum in traditional industries. At the same time, we deeply feel...the strategic transformation brought by the new economy"¹⁷⁷.

UBS estimates the EV boom could drive an incremental 300,000-900,000 metric tons per year increase in nickel demand by 2025. Jinchuan owns 60% of a project in Indonesia that will produce 50,000 metric tons of nickel as well as 5,000 metric tons of cobalt per year by 2020. The company intends to double its nickel production from 150,000 to 300,000 metric tons a year by 2020.

Rare Earths

Rare earths are 17 chemical elements with specific properties that are crucial to the production of many high-tech manufactured goods, particularly magnets and modern batteries. The growth in EV demand is expected to see the use of magnetic rare earths in such vehicles increase from 2,000 metric tons in 2016 to 12,000 metric tons by 2024. Wind power growth will see their use in wind turbines double to 4,000 metric tons by 2024.¹⁷⁸

Such is China's dominance in rare earths supply that its move to restrict exports caused prices to spike in 2010-11. The year 2017 saw prices spike once again as increasing demand from new energy technologies coincided with Chinese government attempts to crack down on illegal mining.

China produced more than 80% of rare earths globally, dominated by state-owned producers such as **China Northern Rare Earth Group High-Tech Co.** and **China Minmetals Rare Earths Co.**, both of which have seen strong market value growth following the recent price surge. In 2016, the U.S. relied on imports for 100% of its rare earths requirements, 70% of this supply came from China.¹⁷⁹

Australia's first heavy rare earths mine began operation in 2017 after Northern Minerals signed an off-take agreement with Lianyugang Zeyu New Materials Sales Co Ltd, a 51% owned

¹⁷⁴ <https://www.reuters.com/article/column-russell-nickel-china/rpt-column-nickel-loses-its-electric-car-fizz-realises-its-still-a-steel-play-russell-idUSL3N1NQ1HG>

¹⁷⁵ <https://www.ft.com/content/38cb62fc-b8c8-11e7-8c12-5661783e5589>

¹⁷⁶ <https://www.reuters.com/article/us-china-metals-electric-vehicles/china-urged-to-ease-reliance-on-drc-for-cobalt-idUSKBN1D70GT>

¹⁷⁷ <https://www.reuters.com/article/us-china-congress-jinchuan-cobalt/chinas-jinchuan-eyes-new-nickel-cobalt-project-to-tap-electric-vehicle-boom-idUSKBN1CP0VI>

¹⁷⁸ <https://www.bloomberg.com/news/articles/2017-09-07/rare-earth-metals-electrified-by-china-s-illegal-mining-clean-up>

¹⁷⁹ <https://thediplomat.com/2017/08/revisiting-rare-earths-the-ongoing-efforts-to-challenge-chinas-monopoly/>

subsidiary of the **Guangdong Rare Earths Group**. Lianyugang Zeyu will take 100% of the pilot project's dysprosium production¹⁸⁰. Modules for the processing plant were built in China and shipped to Western Australia. As part of the agreement, Northern Minerals issued 14 million shares to Lianyugang Zeyu and it also received 40 million unlisted options on Northern Minerals shares with a strike price double the then market price¹⁸¹. Northern Minerals is listed on the Australian Stock Exchange but is majority Chinese-owned. As of August 2017¹⁸², major shareholders were Australian Conglin International Investment Group (26.3%), a subsidiary of China's Baotao Anchang Trading Company¹⁸³, Huatai Mining (21.5%), a subsidiary of Shandong Taizhong Energy.¹⁸⁴ and Jien Mining (3.5%), a subsidiary of Jilin Jien Nickel Industry. Aside from the Northern Minerals project, China is home to all significant dysprosium sources.

Figure 11: Rare-Earth Prices Surged in 2017



Source: Bloomberg, Shanghai Steelhome E-Commerce

In July 2017, Chinese firm Leshan Shenghe Rare Earth Co. acquired part of the Mountain Pass Mine in the California desert south of Las Vegas for just \$20 million. This mine was the largest producer of rare earths globally from 1965 to 1985, at which point China took over global production leadership. Mountain Pass was shuttered from 2002 to 2012 because it could not compete with the low prices coming out of China. After a brief revival from 2012 to 2015 and a failed capex program of more than US\$1 billion, Mountain Pass closed for good in 2016 and its owner, Molycorp, filed for bankruptcy.¹⁸⁵

¹⁸⁰ Northern Minerals Presentation August 2017

¹⁸¹ <https://www.businessnews.com.au/article/Major-Chinese-player-in-60m-off-take-deal-with-Northern-Minerals>

¹⁸² Northern Minerals Presentation August 2017, p. 30

¹⁸³ <http://www.conglingroup.com.au/profile.html>

¹⁸⁴ <https://www.businessnews.com.au/article/Northern-in-30m-funding-deal>

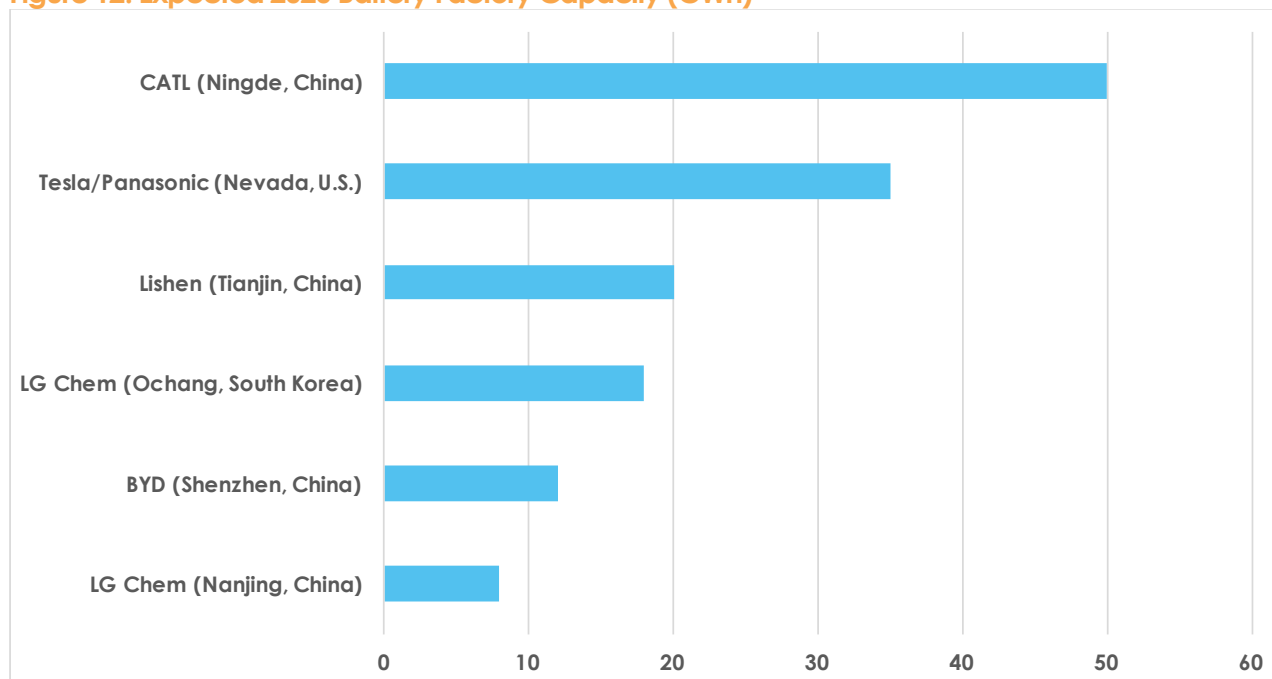
¹⁸⁵ <https://www.seeker.com/tech/materials/chinas-monopoly-on-rare-earth-elements-tightens-with-purchase-of-us-mine>

Batteries and Storage

Tesla gets much of the western press on new battery capacity by way of its Gigafactory venture with Panasonic. What is not as widely reported is that Tesla's capacity will shortly be overtaken by the growing lithium-ion capacity of China. Bloomberg New Energy Finance (BNEF) sees Chinese companies producing 121 gigawatt-hours (GWh) of battery production capacity by 2020, dwarfing Tesla's 35 GWh.¹⁸⁶

Contemporary Amperex Technology Ltd (CATL), an obscure company compared to Tesla, is China's fastest-growing battery maker and is central to the government's goal of making China the leading country in the global EV supply chain. In 2016 CATL produced 7.6 GWh of batteries but intends to expand and produce more than Tesla by 2020, potentially making CATL's plant the largest battery factory in the world. CATL already has battery supply arrangements with BMW and Volkswagen. The company overtook major Chinese battery and electric vehicle maker **BYD** in terms of battery sales in the summer of 2017, selling more than 5 GWh in the first half of 2017.¹⁸⁷ A US\$2 billion IPO is planned to help fund CATL's ambition to become the world's largest supplier of EV batteries. Goldman Sachs sees China dominating the global market for EV batteries, a market that could reach US\$40 billion by 2025. BYD itself has a battery factory near Shenzhen that is currently eight times larger than Tesla's, and BYD exceeded Tesla's annual production target of 1 GW three years ago.¹⁸⁸

Figure 12: Expected 2020 Battery Factory Capacity (GWh)



Source: Benchmark Mineral Intelligence, Financial Times

¹⁸⁶ <https://www.ft.com/content/8c94a2f6-fdcd-11e6-8d8e-a5e3738f9ae4>

¹⁸⁷ <https://www.reuters.com/article/china-catl/update-2-chinese-battery-maker-catl-eyeing-upstream-cobalt-investments-idUSL3N1ND479>

¹⁸⁸ <http://www.afr.com/business/transport/automobile/chinas-byd-has-overtaken-tesla-in-the-battery-and-electric-car-business-20170517-gw6wa1>

South Korean and Japanese companies such as LG Chem and Panasonic have been the traditional leaders in battery production, but Chinese government policies that include subsidies for EVs and restrictions on foreign companies operating in China are driving Chinese battery companies to the top of the industry. In February 2017, the Chinese government called for battery makers to double their capacity by 2020 and start investing in production facilities overseas. As part of efforts to overtake Japan and South Korea, Chinese firms are actively recruiting Korean battery expertise away from companies such as LG Chem and Samsung SDI. These efforts include relocating personnel to China with significant financial incentives (e.g. BYD) or recruiting via Korean-based operations (e.g. **Great Wall Motors**).¹⁸⁹

In addition to building up capacity domestically, Chinese battery producers plan to export aggressively into global markets. In 2016, China's lithium-ion battery shipments increased by 80% year on year.¹⁹⁰ BYD, currently best known as an electric car and bus maker, started out as a battery manufacturer, and its battery business has helped its EV business margins. The company is now considering an expansion of its battery business with additional capacity supplying other EV makers. BYD is said also to be considering a spin-off of its battery unit.¹⁹¹

China also accelerated the global push for storage of stationary energy in 2017. In October, the Chinese government announced a major storage push to help address curtailment of domestic renewable energy generation. Under the program, the government will issue subsidies to encourage the construction of energy storage facilities. Trials of new storage technology will also be run testing pumped hydro storage, compressed air storage, magnetic energy storage, and large-scale battery storage deployments.¹⁹² The Chinese government aims to maintain domestic manufacturing control over the whole supply chain for energy storage—from raw materials, battery technology and super capacitors to micro-grid and smart-grid equipment. Given such strong support from government, the Chinese battery sector is expected to see significant growth; other forms of China's electricity storage sector will grow as well.

These trends put China in a strong position to dominate the sector at the global level. In its "Energy Storage Forecast 2017-30," BNEF sees energy storage booming along a trajectory similar to that seen across the solar industry from 2000 to 2015. BNEF predicts that US\$103 billion will be invested in the storage sector between now and 2030.¹⁹³ Eight countries will lead the expanding rollout of storage solutions: China, the U.S., India, Germany, Japan, the U.K., South Korea and Australia. Behind-the-meter storage will become ubiquitous in many countries that already have high rooftop solar penetration and high solar radiation incidence. Australia is a prime example. BNEF sees such systems comprising more than half of total storage capacity.

¹⁸⁹ <http://www.koreaherald.com/view.php?ud=20171119000204>

¹⁹⁰ <http://reneweconomy.com.au/china-set-add-50gw-new-solar-pv-2017/>

¹⁹¹ <https://www.reuters.com/article/us-byd-results-breakingviews/breakingviews-buffett-backed-byd-could-use-a-battery-ram-idUSKBN1DL09M>

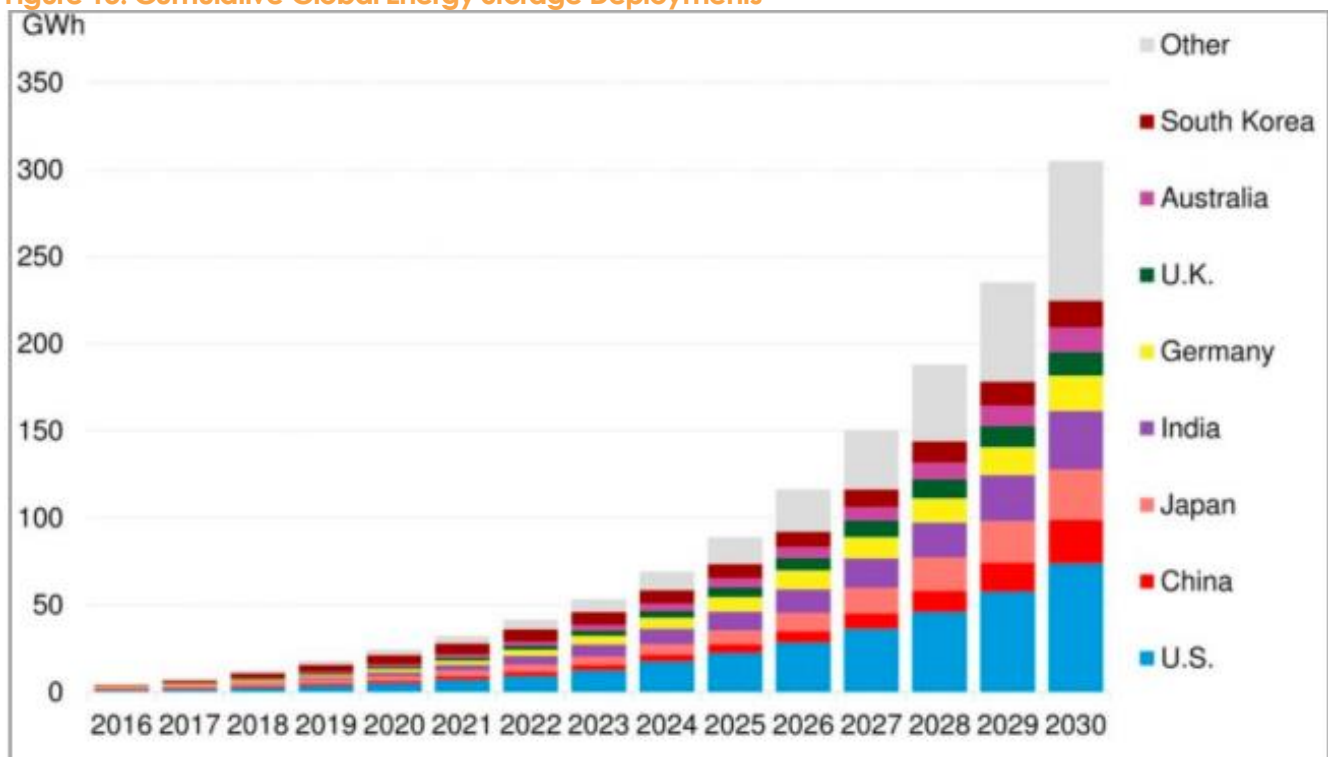
¹⁹² <https://www.reuters.com/article/china-power-storage/china-to-boost-energy-storage-capacity-to-fuel-renewable-power-use-idUSL4N1MN1NA>

¹⁹³ <http://reneweconomy.com.au/australia-lead-storage-boom-home-batteries-become-ubiquitous-22221/>

While BYD has established a market in Europe already, the company is now turning its attention to Australia as a key emerging market for its home electricity storage products.¹⁹⁴ Australia's high electricity prices are a strong incentive for households to buy storage solutions to pair with rooftop solar panels, and BYD is now challenging other major players in the Australian market, including Tesla, LG Chem and Sonnen.

BYD is expanding sales of its battery storage systems in the U.S. too, where it is selling its products to the largest energy storage facility in the state of Massachusetts via a project owned by a subsidiary of the French utility Engie. BYD reports already having a 25% share of the U.S. energy storage system (ESS) market and a 50% share of the ESS-for-frequency-regulation market.¹⁹⁵ BYD's huge operational scale is currently setting battery prices in North America.¹⁹⁶

Figure 13: Cumulative Global Energy Storage Deployments



Source: Bloomberg New Energy Finance

¹⁹⁴ http://reneweconomy.com.au/byd-hones-focus-australia-home-battery-market-99971/?utm_source=RE+Daily+Newsletter&utm_campaign=d380f41538-EMAIL_CAMPAIGN_2017_10_18&utm_medium=email&utm_term=0_46a1943223-d380f41538-40324105

¹⁹⁵ <https://insideevs.com/byd-6-mwh-energy-storage-system-in-massachusetts/>

¹⁹⁶ <http://www.afr.com/business/transport/automobile/chinas-byd-has-overtaken-tesla-in-the-battery-and-electric-car-business-20170517-gw6wa1>

Electric Vehicles (EVs)

As with battery capacity, Tesla has received the lion's share of publicity on electric vehicles (EVs), particularly with the release in 2017 of its "game changing" Model 3, which has seen enormous demand but has had a sluggish rollout. Among Tesla rivals, **BYD** is already a major EV player in China, which is the world's largest EV market, and is planning significant expansion both domestically and overseas. The company is planning a significant expansion that will include increasing its 2016 revenue tenfold by 2025 to one trillion yuan (US\$151 billion).¹⁹⁷ BYD's electric trucks will provide direct competition to Tesla's; BYD already builds such vehicles and is intending to open a new electric truck manufacturing facility in Canada.¹⁹⁸

BYD is also the leading manufacturer of electric buses (e-buses). Some 27,000 BYD e-buses are now in service around the world, mostly in China, and the company has overseas expansion plans. In October 2017, BYD opened a new e-bus production facility in California, a move that expands the company's U.S. capacity to 1,500 vehicles per year (the company has been manufacturing e-buses in California since 2014). BYD also opened a factory in Hungary in 2017 to add to production facilities in Brazil, France, India and Japan.

BYD's trajectory is perhaps the most visible example of China's electric vehicle strategy, which involves the building-up of a domestic market for EVs through cheap financing combined with subsidies and government policy. In 2016, global sales of EVs increased by 55% to 695,000, a trend driven primarily by China,¹⁹⁹ which overtook the U.S. that year to become the world's largest EV market. In 2017 the trend persisted. In the third quarter of 2017, global EV sales surged to 287,000, up 63% year on year, driven mostly by China. BNEF expects global EV sales for 2017 to exceed 1 million units.²⁰⁰ The Chinese government is working on producing a timetable that would phase out sales of internal combustion-engine cars, a move that will see China join France, Norway and the U.K. in establishing such a deadline.

Once domestic EV capacity has been scaled up, China will have established the foundation of a new export industry.²⁰¹ BYD has stated that it sees itself as an international company; it wants overseas sales to be larger than domestic sales in the long run.²⁰² China's aggressive rollout of EV technology is driven by motivations that include reducing air pollution and enhancing national energy security through reduced dependence on oil imports. China also sees a clear opportunity to dominate the EV value chain globally. Chinese car makers have often failed to compete successfully overseas with international manufacturers. Gaining a head start on EV technology will allow Chinese companies to become global market leaders.

By way of example, a previous effort by **Great Wall Motors Company** to enter the Australian market failed on safety and quality issues. Now the company is targeting growth through EVs and has taken a stake in Australia's Pilbara Minerals as part of a lithium off-take agreement to

¹⁹⁷ <http://www.scmp.com/business/companies/article/2120752/byd-aims-dominate-chinas-electric-car-market-trillion-yuan-sales>

¹⁹⁸ <https://cleantechnica.com/2017/11/18/byd-opening-electric-truck-factory-canada-cites-friendlier-environment-evs-us/>

¹⁹⁹ <https://www.bloomberg.com/news/articles/2017-09-07/rare-earth-metals-electrified-by-china-s-illegal-mining-clean-up>

²⁰⁰ <https://www.bloomberg.com/news/articles/2017-11-21/global-electric-car-sales-jump-63-percent-as-china-demand-surges>

²⁰¹ <https://www.bloomberg.com/news/articles/2017-11-28/electric-cars-and-energy-storage-seen-arriving-early-next-decade>

²⁰² <http://www.afr.com/business/transport/automobile/chinas-byd-has-overtaken-tesla-in-the-battery-and-electric-car-business-20170517-gw6wa1>

secure minerals for battery production.²⁰³ Great Wall is said to be in discussions with BMW, the second-largest premium car brand in China, with a view to a joint venture to produce EVs.²⁰⁴

China is home to a long list of EV makers, many of whom are largely unknown overseas.

Geely is the owner of Volvo, which in 2017 said all new models released from 2019 on would be electric or hybrid.²⁰⁵ Geely also purchased a majority stake in Lotus and a 49.9% stake in Proton during 2017. **BAIC Motor Corp**, which has the largest EV market share in China (BYD is second),²⁰⁶ is partnered with Daimler, home to Mercedes-Benz, and has opened an R&D centre in California.²⁰⁷ **Zotye** agreed on a deal with Ford in November to co-produce electric cars under a new Chinese-market brand.²⁰⁸

Figure 14: Chinese EV Manufacturers



Source: Northern Minerals

Chinese EV startup **Nio** (formerly known as NextEV) raised more than US\$1 billion in November in a fundraising round that put the firm's valuation at US\$5 billion. Nio's first mass-produced EV is an SUV designed to compete with, and undercut, Tesla's Model X.²⁰⁹ The company promises more features at a lower price than Tesla, and aims to export autonomous EVs to the U.S. by 2020. **Chongqing Changan Automobile Company** has announced plans to invest US\$ 15.2 billion to help the company produce 21 EV models by 2025 in an initiative that includes ending its production of internal combustion engine models by the same date.²¹⁰

²⁰³ <https://thewest.com.au/business/mining/china-car-maker-great-wall-drives-28m-deal-for-pilbara-minerals-lithium-ng-b88613933z>

²⁰⁴ <http://www.caradvice.com.au/591533/bmw-mulling-electric-venture-with-great-wall-for-china-report/>

²⁰⁵ <https://www.theguardian.com/business/2017/jul/05/volvo-cars-electric-hybrid-2019>

²⁰⁶ https://www.bloomberg.com/gadfly/articles/2017-09-20/everyone-wins-if-china-relaxes-electric-car-venture-rules?utm_content=gadfly&utm_campaign=socialflow-organic&utm_source=twitter&utm_medium=social&cmpid=socialflow-twitter-gadfly

²⁰⁷ <https://cleantechnica.com/2017/11/23/6-10-big-electric-car-companies-china/>

²⁰⁸ http://www.chinadaily.com.cn/business/motoring/2017-11/09/content_34310412.htm

²⁰⁹ <https://www.bloomberg.com/news/articles/2017-12-17/chinese-electric-car-startup-nio-prices-debut-model-at-67-783>

²¹⁰ http://www.chinadaily.com.cn/bizchina/motoring/2017-12/01/content_35148933.htm

Finance

China's energy sector has an array of large financial institutions either at its disposal or over which it has significant influence and through which abundant funding is available to support Chinese clean energy projects internationally.

The **Silk Road Fund** is a Chinese state-owned investment vehicle dedicated to financing projects within the Belt and Road Initiative. At the outset of the fund's creation in 2014, the Chinese government pledged US\$40 billion in seed money.²¹¹ In May 2017, President Xi pledged a further US\$14.5 billion to the fund as part of a US\$124 billion package of funding to support Belt and Road.²¹² At the same time, Xi also announced US\$57 billion in loans from Chinese policy banks and \$US9 billion in foreign aid for developing countries along Belt and Road routes. In addition, he encouraged Chinese financial institutions to expand their overseas fund businesses by a collective US\$45 billion.

In November, the fund entered into an agreement with GE Energy Financial Services with a view toward jointly establishing an energy infrastructure investment unit.²¹³ The Chinese State Administration of Foreign Exchange announced that the joint platform would invest in power grids and new energy as well as oil and gas.²¹⁴

The Silk Road Fund has also been seeking investment opportunities in Europe, where clean energy development is occurring rapidly, by seeking to partner with the European Investment Bank (EIB).²¹⁵ This follows US\$320 million of investment by the EIB in climate-related projects in China in 2016. The strict emissions standards of the EIB will limit the fund's involvement in any coal-related projects. The EIB also has established a good working relationship with the Asian Infrastructure Investment Bank.

The **Asian Infrastructure Investment Bank (AIIB)** became operational in December 2015 with a capital base of US\$100 billion. China contributed one third of that capital and holds a 29% share of the AIIB's vote. This contrasts with China's stake in the Asian Development Bank, in which it has only a 5.5% share of the vote (the Asian Development Bank is dominated by the U.S. and Japan, each of which control 13%, and neither of which are members of the AIIB). China's influence over the AIIB means it is well placed to complement the Belt and Road Initiative across Asia and beyond. In October 2017, the AIIB announced its first funding for projects in Africa, lending US\$210 million for 11 solar projects in Egypt.²¹⁶ The bank also has invested in hydro and power transmission projects and is by no means limited to Belt and Road projects. India has not participated in Belt and Road, but this has not stopped AIIB

²¹¹ <http://www.silkroadfund.com.cn/enweb/23773/index.html>

²¹² <https://www.reuters.com/article/us-china-silkroad-africa/china-pledges-124-billion-for-new-silk-road-as-champion-of-globalization-idUSKBN18A021>

²¹³ <https://www.reuters.com/article/us-trump-asia-china-deals-ge/general-electric-chinas-silk-road-fund-to-launch-energy-investment-platform-idUSKBN1DA057>

²¹⁴ <https://www.reuters.com/article/us-china-risk-mortgages-specialreport/special-report-hidden-peril-awaits-chinas-banks-as-property-binge-fuels-mortgage-fraud-frenzy-idUSKBN1DY1AS>

²¹⁵ <http://www.scmp.com/news/china/diplomacy-defence/article/2081067/chinas-silk-road-fund-seeking-investment-projects>

²¹⁶ <https://www.pv-tech.org/news/aiib-providing-us210-million-for-470mw-of-egyptian-solar>

activity there. In 2017, the AIIB contributed US\$150 million in an anchor investment to Morgan Stanley's US\$1 billion Indian infrastructure fund.²¹⁷

The bank approved an estimated US\$2.5 billion of new loans in 2017, taking its cumulative total to US\$4 billion since it was established in 2015. In 2018, the AIIB aims to approve an additional US\$3.5 billion in new loans.²¹⁸ The total project value on which the bank has approved lending is US\$16 billion across 10 countries.²¹⁹

The AIIB has committed also to supporting sustainable development and to assisting member countries with their Paris climate accord pledges. While its Energy Sector Strategy, released in 2017, has been criticized for loopholes that could allow the financing of coal projects under certain circumstances,²²⁰ AIIB Vice President Thierry de Longuemar stated in a 2017 interview that “there are things [the AIIB] won't finance, like coal-fired power plants.”²²¹ Further, AIIB's vice president for policy and strategy, Joachim von Amsburg, has stated that the bank invests “in renewable and low-carbon energy as a priority” and that there are no coal projects in AIIB's pipeline. As at October, the AIIB had committed US\$610 million in funding to renewable energy projects and aims to greatly increase this²²² amount. While the bank appears to be staying away from coal financing, it has lent to gas-fired projects.

The **New Development Bank (NDB)** counts China as one of its five members—each has an equal vote share (in contrast to how the AIIB operates). After devoting its first round of funding in 2016 to renewable energy projects, the NDB expanded its loan portfolio in 2017 to include energy efficiency, water infrastructure, and transportation projects.²²³ The NDB has taken note of the falling cost of renewable energy and has stated that it will consider very carefully any potential loans to coal-fired power projects. Citing sustainability concerns, NDB President K. V. Kamath has stated that 60% of lending is targeted to renewable energy projects;²²⁴ NDB aimed to lend US\$2.5bn in 2017 and plans to lend an additional US\$4 billion in 2018.

At the COP23 climate conference in Bonn in November, the NDB and AIIB were among nine multilateral development banks that issued a joint statement reconfirming their commitment to the Paris climate agreement and pledging to align their resources accordingly.²²⁵

While the new development finance banks have attracted a great deal of attention, China is home to some of the world's largest commercial banks, all of which play a major role in the Belt and Road Initiative and in financing overseas projects by Chinese firms more generally. The sheer size of some of these banks gives them significant capacity to support the continued rollout of Chinese energy technology around the world. **The Industrial and Commercial Bank of China (ICBC)**, the world's largest by assets, made new “Going Global”

²¹⁷ <https://energy.economictimes.indiatimes.com/news/power/morgan-stanley-to-make-first-close-of-400-500-million-next-month/60472102>

²¹⁸ <https://about.bnef.com/blog/asian-infra-bank-reach-4-billion-loans-year-end-qa/>

²¹⁹ https://www.washingtonpost.com/opinions/china-has-a-plan-to-rule-the-world/2017/11/28/214299aa-d472-11e7-a986-d0a9770d9a3e_story.html?utm_term=.16ab27b0c6d7

²²⁰ <https://www.reuters.com/article/us-aiib-asia-china/china-backed-aiib-touts-growth-sustainability-idUSKBN199061>

²²¹ <http://foreignpolicy.com/2017/06/14/even-china-backed-development-bank-wont-touch-coal-projects/>

²²² <https://about.bnef.com/blog/asian-infra-bank-reach-4-billion-loans-year-end-qa/>

²²³ <https://www.ndb.int/projects/list-of-all-projects/>

²²⁴ https://www.ndb.int/president_desk/ndb-president-60-funding-will-renewables/

²²⁵ https://www.ndb.int/president_desk/truly-global-response-climate-change/

project loans totaling more than US\$15 billion in the first half of 2017, bringing cumulative “Going Global” loans to more than US\$88 billion.²²⁶ **China Construction Bank (CCB)**, the world’s second-largest bank by assets, names national strategies like Belt and Road as a key priority.²²⁷ The **Bank of China** and the **Agricultural Bank of China** round out China’s “Big Four” commercial banks, and their involvement is substantial as well. The 700 MW Shanghai Electric/ACWA solar thermal project announced in 2017 highlights the role played by these banks in China’s international clean energy push. Most of the US\$2.5 billion in debt funding will come from the “Big Four”²²⁸ and in addition to state-owned commercial banks, China has policy banks such as the **Export-Import Bank of China** that will reinforce the government’s ‘Going Global’ policies across all energy technologies. The policy banks’ past support for coal projects overseas is set to change as the world, and Chinese policy in particular, turns toward renewables. In one indication of their influence, Chinese banks dominate the list of top fee earners in 2017 in Asian capital markets covering equity, bonds, loans and M&A.²²⁹

To finance the BRI program, Chinese banks are required already to lend large sums to counterparties that they would likely otherwise avoid. Beset by poor governance, corruption, and instability, more than half the nations that have taken up Belt and Road projects have credit ratings below investment grade.²³⁰ The risk that this poses to China emphasizes just how important the Belt and Road Initiative is in the eyes of China’s leadership.

The overseas lending expansion by Chinese banks contrasts with trends among European and U.S. banks, which have been reducing their international exposure. In 2016, three of the “Big Four” recorded higher growth rates for overseas loans versus domestic loans for the first time. “Big Four” banks have recently come to dominate Asia-Pacific syndicated loan league tables.²³¹ Historically active in supporting the ambitions of Chinese companies abroad, the banks are now seeking to diversify toward more international borrowers. Other Chinese commercial banks that have been growing their foreign loan books include **China Merchants Bank** and **China Everbright Bank**, which saw overseas loans increase by 72% and 81% respectively in 2016. Through the first half of 2017, China Merchants Bank’s overseas lending stabilized, rising just 1%²³² while China Everbright Bank raised its overseas lending by a further 25%.²³³

China’s national pension fund is also seeking to increase its international investment. The US\$317 billion **National Social Security Fund** intends to increase overseas investment in order to diversify its portfolio away from purely domestic holdings (and hence reduce risk). The fund is recognized as a notoriously cautious investor but has indicated it will be looking at investments in the Belt and Road program. At the end of 2016, international investments made up just 6.7% of total National Social Security Fund invested assets,²³⁴ and the fund is

²²⁶ ICBC Interim Report 2017

²²⁷ CCB Interim Report 2017

²²⁸ <https://www.reuters.com/article/admie-china/greek-power-grid-operator-turns-to-china-for-fresh-funding-idUSL8N1N92AU>
<https://af.reuters.com/article/commoditiesNews/idAFL8N1JH32G>

²²⁹ <https://theasset.com/capital-markets/33887/chinese-banks-dominate-wallet-share-in-asia-in-2017-news-1000-o>

²³⁰ <https://www.nytimes.com/2017/05/13/business/china-railway-one-belt-one-road-1-trillion-plan.html>

²³¹ <https://www.gfmag.com/magazine/november-2017/stars-china-lenders-world>

²³² China Merchants Bank 2017 Interim Report

²³³ China Everbright Bank 2017 Interim Report

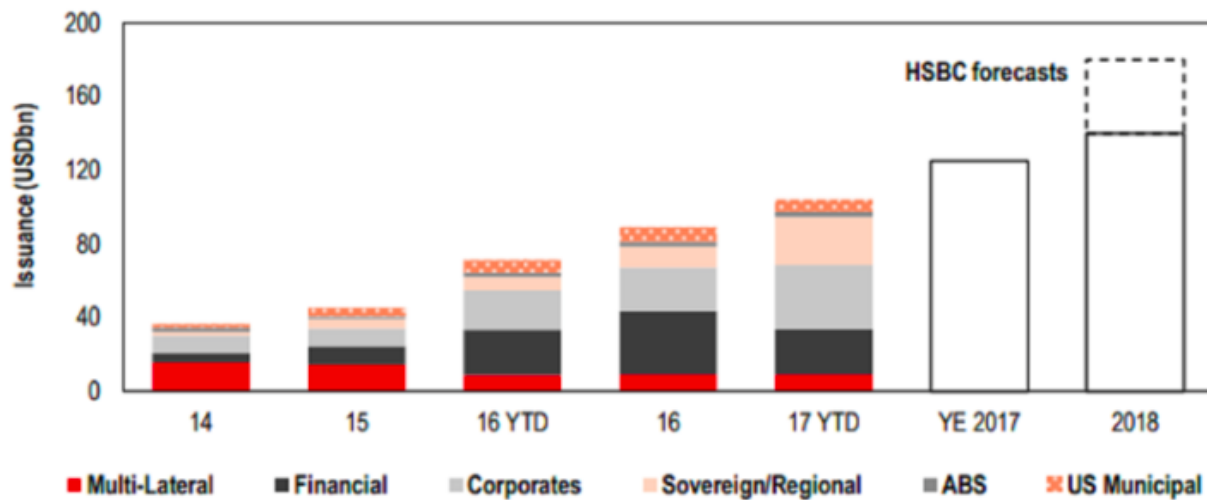
²³⁴ <http://www.scmp.com/news/china/economy/article/2116388/chinas-pension-fund-has-us317-billion-its-sleeve-and-now-its>

under some pressure to grow its assets as China's population ages. Increasing its international investment may be part of a strategy to achieve this goal²³⁵.

China's largest life insurer is also on the hunt for overseas investments. **China Life Insurance Group** is focusing on infrastructure investments in Europe and the U.S. in addition to new technologies, according to comments from a 2017 interview with the deputy CEO of the company's US\$515 billion alternative investment arm.²³⁶ China Life has shown increased interest in renewables domestically and is reportedly considering an investment in China Three Gorges' new energy unit, which is looking to raise US\$1.5 billion to develop offshore wind power in China and to acquire existing wind and solar projects.²³⁷

China's US\$800 billion sovereign wealth fund, **China Investment Corporation (CIC)**, also has been diversifying its investments to include more international holdings. In 2016, a strong year for Chinese investment overseas, CIC invested \$19 billion outside of China, almost triple the amount invested internationally in 2015.²³⁸ CIC recently was part of the consortium that invested US\$5 billion to acquire Singapore-based Equis Energy, a holder of solar and wind generation assets across the Asia-Pacific region.

Figure 15: HSBC forecast Green Bond Issuance



Source: HSBC, Dealogic, Bloomberg

Green bond issuance for 2017 passed the US\$100 billion mark in November after the China Development Bank issued a US\$1.5 billion bond. The Industrial and Commercial Bank of China issued its first climate bond, for US\$2.1 billion, in October to support renewables, energy efficiency, low-carbon transport and water management. China became the largest green bond issuance location in 2017 (US\$16 billion), just ahead of France (US\$15 billion).²³⁹

²³⁵ <http://www.scmp.com/business/global-economy/article/2096245/chinas-pension-fund-join-new-silk-road-investment-spreed>

²³⁶ <https://www.bloomberg.com/news/articles/2017-11-28/china-life-gears-up-for-deals-as-capital-curbs-restrain-rivals>

²³⁷ <https://www.reuters.com/article/us-threegorges-fundraising/china-three-gorges-unit-seeking-1-5-billion-from-new-investors-sources-idUSKCN1BA0YA>

²³⁸ <https://www.ft.com/content/7a20bcf8-6615-11e7-9a66-93fb352ba1fe>

²³⁹ <http://www.climateactionprogramme.org/news/green-bonds-reach-100-billion-milestone>

Issuance of green bonds for EE investments more than doubled in 2016, to US\$18 billion (accounting for 22% of the green bond market), with Chinese issuance growing rapidly since the country entered the green bond market in 2015 after the **People's Bank of China** introduced regulations making China the first country in the world to publish official standards for green bond issuance. China is already the second-largest country for total EE issuance (at 13%), just behind France (15%), even though it only joined that market in 2015.

China's green bond issuance is increasingly international; ICBC's US\$2.1 billion bond, issued on the new Luxemburg Green Exchange, was the first Belt and Road climate bond; its issuance marked the first time a Chinese institution issued a bond aligned with green bond requirements put out by both the International Capital Markets Association and the People's Bank of China.²⁴⁰ The Bank of China issued a bond in November from its Paris branch on the Euronext Exchange in tranches across three currencies, the yuan, the euro and the U.S. dollar.²⁴¹ In 2018, the green bond market is expected to expand significantly with increased issuance by Chinese firms; HSBC forecasts US\$180 billion of green bond issuance in 2018, a 44% increase over the estimated 2017 total.

China's vast financial capacity allows it to support clean energy growth on its own terms rather than those of such institutions as the Green Climate Fund (GCF). China does not intend to fill the gap left in the GCF by the departure of the U.S. from the Paris agreement.²⁴² Instead of taking an overt leadership position on climate finance action as the U.S. abdicates responsibility, it is adopting a more under-the-radar path that will attract praise for its effect on expanding new energy technology globally while perhaps drawing less criticism for its support of fossil-fuel projects than if it were to take a more high-profile leadership role.

²⁴⁰ <https://theasset.com/awards/33888/these-30-deals-defined-asias-capital-markets-in-2017-news-1000-o>

²⁴¹ http://www.chinadaily.com.cn/business/2017-11/18/content_34683643.htm

²⁴² <https://www.chinadialogue.net/article/show/single/en/10284-Is-the-Belt-and-Road-compatible-with-Paris->

Conclusions

China is undoubtedly a major funder of coal-fired power projects around the world. Many large, state-owned corporations have seen opportunities for new, domestic coal-fired power stations dry up and are looking for projects abroad.

However, indications are that renewable energy will dominate global power capacity additions for at least the next two decades. China is preparing now to lead this new energy world.

While China has historically been a major international player in hydro and coal-fired power construction, its international presence in power transmission construction is now highly significant, led by State Grid Corporation—the world's largest utility by revenue.

More recently, Chinese involvement in renewable energy capacity construction has come to the fore. China dominates solar module manufacturing and in 2017 cemented its position in this regard. China's presence in wind power globally is also on the rise, led by international activities of companies such as Goldwind and by China Three Gorges' diversification away from hydroelectricity.

China is also rapidly developing its domestic battery and electric vehicle capacity, and Chinese companies are looking to dominate new technology resources such as cobalt and lithium—much as China did previously in the rare-earths sector. Companies like BYD that are building capacity to serve the world's largest EV market also have an eye on international expansion. Domestic capacity build-up on this front is likely to be followed by an international rollout of Chinese new energy technology.

China's robust global presence in electricity and new energy is being aided by the Belt and Road Initiative, which has gained prominence in 2017. Despite an overall slowdown in Chinese M&A activity abroad, activity in Belt and Road countries grew in 2017.

Globally, IEEFA has identified large Chinese international clean energy projects and takeovers totaling more than US\$44 billion for 2017, compared to the US\$32 billion identified in 2016, which itself was a record year for Chinese investment in low emissions projects overseas.

China has the financial clout to back up its plans for international new energy expansion. Some of the largest banks in the world are Chinese, and China has many other large financial institutions at its disposal, including the China-controlled Asian Infrastructure Investment Bank.

China was quick to reaffirm its emissions reduction pledge following the Trump administration's announcement that the U.S. would withdraw from the Paris climate agreement. It may not be the case that China is intentionally seeking a climate leadership position, but it certainly appears that the nation is striving to be the global leader in new energy markets.

As the global transition toward renewables gains pace and as battery storage and electric vehicles technologies pick up momentum, China is setting itself up to dominate these sectors globally over the next several decades of this century. As this process plays out, and the companies mature, we expect to see new global leaders emerge in China and, hopefully, the innovative strategies needed to provide better clean energy outcomes.

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