

China's Global Renewable Energy Expansion

How the World's Second-Biggest National Economy Is Positioned to Lead the World in Clean-Power Investment



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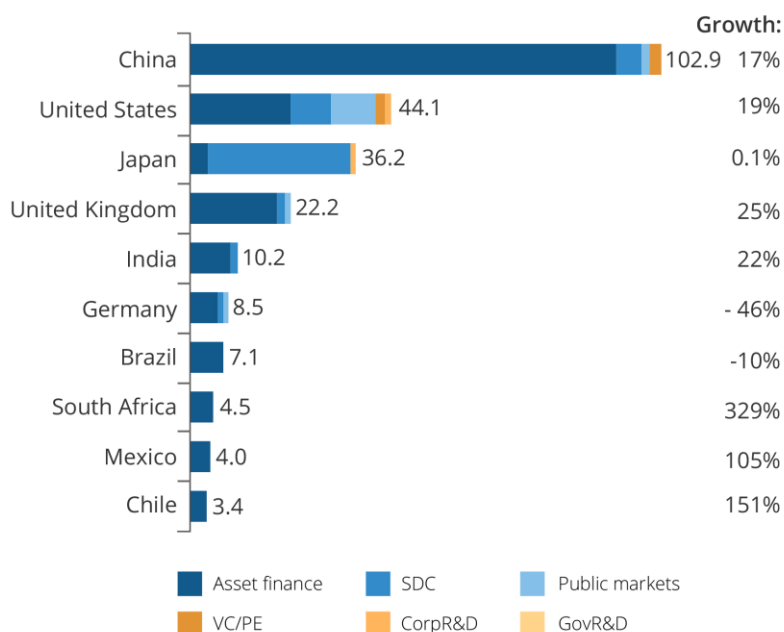
This report by the Institute for Energy Economics and Financial Analysis (IEEFA) examines 30 corporate case studies to explore China's rising global leadership in the low-carbon-emission energy industry. The extent of China's domestic investment in renewables has surpassed all expectations, with the resulting technology development and economies of scale driving down costs to the point where renewables are exceeding grid parity in an increasing number of market segments.

In renewables, China is now actively pursuing a "Going Global" strategy, particularly in conjunction with its "One Belt, One Road" program, which aims for a Pan-Asia development approach; 2015 saw eight foreign investment decisions by Chinese firms exceeding US\$1 billion each and worth a total of US\$20bn. In 2016, the total foreign investment in deals exceeding US\$1bn each rose 60% year on year (yoy) to US\$32bn across eleven transactions by Chinese firms. IEEFA expects this trend to accelerate in 2017. A change in leadership in the U.S. is likely to widen China's global leadership in industries of the future, building China's dominance in these sectors in terms of technology, investment, manufacturing and employment.

Executive Summary

China is the world leader in domestic investment in renewable energy and associated low-emissions-energy sectors. China invested US\$103bn in this sector in 2015, up 17% yoy, according to Bloomberg New Energy Finance (BNEF)—two and half times the amount undertaken by the U.S.

Figure i: New Investment in Renewable Energy by Country and Asset Class, 2015 and Growth on 2014 (US\$bn)



Source: UNEP, Bloomberg New Energy Finance

According to the International Energy Agency (IEA), China will install 36% of all global hydro electricity generation capacity from 2015-2021. Similarly, China will install 40% of all worldwide wind energy and 36% of all solar in this same period. Given that the rapidly improving cost competitiveness of renewable energy is driving expansions of renewable energy capacity in an ever-increasing number of countries around the globe—in Europe, India, the Middle East, Latin America, and North America—and given that multibillion-dollar renewable energy tenders are being announced weekly, China is performing no small feat by being responsible for over a third of all investment across the three sectors.

Five of the world's six largest solar-module manufacturing firms in 2016 are in China. At a time when First Solar of the U.S. has announced it will retrench 25% of its global staff, China National Building Materials (CNBM) is building a US\$1.6bn 1.5GW thin-film solar module facility. CNBM clearly seeks to challenge First Solar's absolute dominance of this subsector. Dow Chemical U.S.'s decision in 2016 to sack 2,500 staff and exit the building-integrated photovoltaic (BIPV) solar manufacturing sector will only assist CNBM's move.

On the wind front, Goldwind, a Chinese company, overtook Vestas in 2015 to become the largest wind-turbine manufacturer globally. Counting its more domestic-focused companies, which included United Power, Ming Yang, Envision and CSIC, China owns five of the ten top wind-turbine manufacturing firms.

China's Tianqi Lithium is the largest lithium ion manufacturer globally following its acquisition of Talison Lithium in 2012 and Galaxy's Jiangsu processing facility in 2015. It comes as no surprise to see Tianqi spending US\$2.5bn in September 2016 to acquire a 25% minority stake in SQM of Chile, the world's fourth-largest lithium firm. Lithium prices skyrocketed in 2016 as the world recognised electric vehicles (EV) are set to challenge the historic dominance of the global automotive sector by internal-combustion engines. While Tesla attracts Western media attention, its global lithium ion battery and EV leadership is being challenged by two Chinese firms, BYD and CATL.

Chinese leadership and control of the global lithium sector is developing along the lines of the rare-element mining and processing sector, which is now 90% and 72% controlled respectively by Chinese enterprises after the financial collapse of Molycorp US in 2015.

State Grid Corp of China (SGCC) is the world's largest electricity utility, employing over 1.9 million staff and generating annual sales of US\$330bn. In 2012, SGCC set a target for US\$50bn of foreign investments by 2020. As of 2015, SGCC had invested US\$30bn of that amount, including in three separate multi-billion dollar transactions in Brazil and Pakistan. SGCC made the largest renewable energy and electricity distribution deal of 2016 in the US\$13bn acquisition of a controlling stake in Brazil's CPFL Energia SA. International grid connectivity is a key priority of SGCC.

China Three Gorges Corp (CTGC) commissioned the world's largest hydro-electric facility at 22.5 gigawatts (GW) in 2012—a project with almost 20 times the Hoover Dam's 1.35GW capacity. In 2016, CTGC now operates 60GW of electricity capacity. With PowerChina, it dominates global investment and construction of hydro-electric dams.

In 2014, a consortium of industrial partners including EDF, AREVA, China General Nuclear Corporation (CGN) and China National Nuclear Corporation (CNNC) committed to invest in the £16bn Hinkley Point C nuclear power station in the U.K. China is now the world leader in technology control and investment in new installations of nuclear power generation. While nuclear power is neither renewable nor low-cost and fast to implement, this investment illustrates the breadth of China's export investment focus across the energy system.

China's alternative energy industry has been developing rapidly, while applications of green-and-smart energy have become the focus of the world. In a series of government development policies for "Going Global" that include "One Belt, One Road", the "Silk Road Fund," the "China-Pakistan Economic Corridor," and the "Bangladesh-China-India-Myanmar (BCIM) Economic Corridor," international renewable energy investment has become a key focus for China.

Investment and employment of course go together. The IEA's World Energy Outlook 2016 estimates that China holds 3.5 million of the 8.1 million renewable energy jobs globally.

Chinese institutional investment assets under management rose by 500% from 2005-2015, from US\$1.1 trillion to US\$7.1 trillion. This makes China the second or third-largest institutional investment market globally, and its presence in this space is expected to increase to US\$10 trillion by 2020. The fact that only 2% of the current total is invested offshore is a key statistic: If China increases this ratio to 10% by 2020, it would amount to US\$1 trillion of new foreign investment.

China has led the development of the Asia Infrastructure and Investment Bank (AIIB) and the New Development Bank. When combined with the US\$40bn Silk Road Fund and the foreign investment capacity of the China Import Export Bank, the China Development Bank et al, China is clearly building the financial capacity to drive M&A and to fund follow-up capital expenditure programs required to drive electricity-sector transformations across Asia, Africa and South America.

Figure II: Key Chinese Renewable Energy Investments Overseas 2015-16

Date Announced	Acquirer/Investor	EV/deal size (US\$bn)	Target/Development	Sector	Target/Development Country
Jul-16	State Grid Corporation of China	13.0	CPFL Energia SA	Electricity distribution and generation inc RE	Brazil
Dec-16	Cheung Kong Infrastructure	5.4	DUET	Electricity & Gas distribution	Australia
Sep-16	Tianqi Lithium	2.5	SQM	Lithium	Chile
Oct-16	Shanghai Electric	1.8	K-Electric	Electricity network	Pakistan
Jul-16	ZHEFU Hydropower	1.7	Hydropower plant	Hydropower	Indonesia
Feb-16	Beijing Enterprises Holdings Ltd	1.6	EEW Energy from Waste GmbH	Waste to Energy	Germany
Jun-16	China Three Gorges Corp	1.6	WindMW GmbH	Offshore wind power generation	Germany
Oct-16	China Three Gorges Corp	1.2	Duke Energy Brazil hydropower assets	Hydropower	Brazil
Jul-16	TBEA	1.2	Solar EPC contract	Solar power generation	Egypt
Dec-16	China Light & Power	1.1	500MW of wind and solar PPAs	Renewable energy	Australia
Nov-16	JA Solar	1.0	New Solar factory	Solar cell/module manufacturing	Vietnam
Total		32.1			

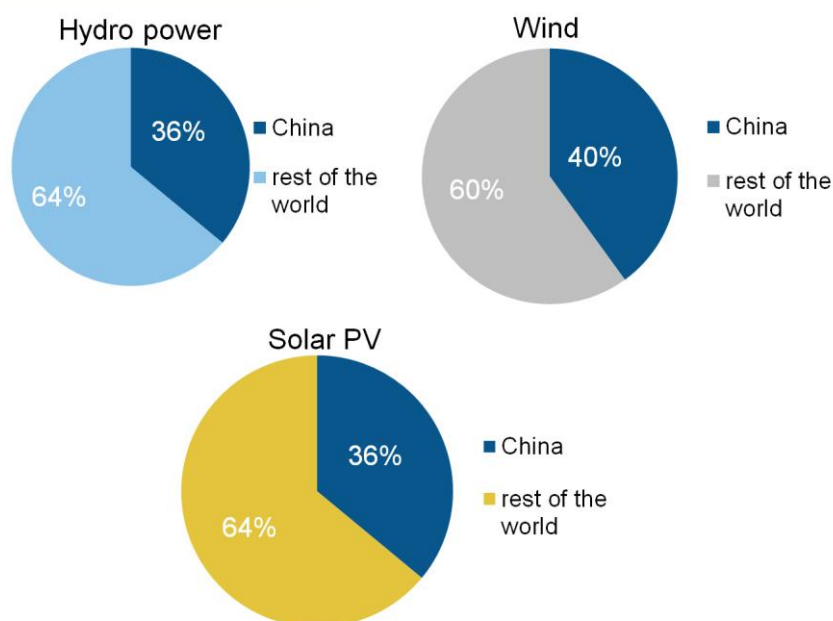
Date Announced	Acquirer/Investor	EV/deal size (US\$bn)	Target/Development	Sector	Target/Development Country
Jan-15	China Energy Engineering Group	4.7	Kirchner & Cepernic hydro plants	Hydropower construction	Argentina
Nov-15	China Three Gorges Corp	3.7	Jupia & Ilha Solteira hydro plants	Hydropower	Brazil
Mar-15	China Three Gorges Corp (CSALL)	2.5	Renewables project development	Hydro, Renewables	Pakistan
Dec-15	State Power Investment Corporation	2.2	Pacific Hydro	Hydro, Renewables	Australia
Jul-15	State Grid Corporation of China	2.2	Belo Monte-Rio Transmission line	Electricity transmission	Brazil
Apr-15	State Grid Corporation of China	2.1	Matiari-Lahore Transmission line	Electricity transmission	Pakistan
Apr-15	Zonergy	1.5	Solar PV Plant	Solar power generation	Pakistan
Dec-15	Cheung Kong Infrastructure	1.1	Iberwind	Windfarms	Portugal
Total		20.0			

Source: IEEFA estimates

China: From Domestic to Global Investment

China's impressive drive into renewable energy (RE) has made it the world's largest investor in clean energy with US\$102.9bn invested in renewables (excluding large hydro) in 2015, up 17% over 2014. This represents well over one third of global investment, with the U.S. in second place, but well behind, at US\$44.1bn.¹ Most of this Chinese investment has been domestic but Chinese companies and institutions are increasingly looking overseas for opportunities in renewable energy development.

Figure 1: China's Share of Global Renewable Capacity Growth, 2015-21



Source: IEA World Energy Outlook 2016

Annexure I lists the largest M&A deals in the renewables sector from 2012 to 2015. At the beginning of the period shown the list is dominated by companies from North America, Europe and Japan, but recently Chinese companies have become more prominent.

In 2015, three of the top five deals involved Chinese companies, with China Three Gorges Corporation's acquisition of the Jupia and Ilha Solteira hydro plants in Brazil indicative of the growing trend of Chinese renewable power companies expanding overseas. Also in 2015, and just outside the top five deals for the year, China's State Power Investment Corporation (SPIC) bought Pacific Hydro of Australia for A\$3bn.² The deal adds Pacific Hydro's wind and hydro generation assets in Australia, Chile and Brazil to SPIC's energy portfolio of over 100GW of capacity located across 25 countries.

Chinese acquisition of overseas renewables assets has continued in 2016 including Trina Solar's purchase of a Dutch solar cell factory from Solland Solar,³ Beijing Enterprises Holdings' US\$1.6bn acquisition of German Waste to Energy firm EEW Energy⁴ and the

¹ UNEP/BNEF, Global Trends in Renewable Energy Investment 2016.

² <http://www.smh.com.au/business/energy/china-state-power-investment-snaps-up-pacific-hydro-20151216-glp7cg.html>

³ http://www.pv-magazine.com/news/details/beitrag/trina-solar-acquires-200-mw-dutch-solar-cell-factory-from-solland-solar_100023334/-axzz4QyXZepih

⁴ <http://www.bloomberg.com/news/articles/2016-02-04/buyout-firm-eqt-agrees-to-sell-eew-to-beijing-enterprises>

Golden Concord Holdings Ltd (GCL) deal to acquire a majority stake in Australian PV distributor One Stop Warehouse.⁵

After years of rapid growth in the domestic renewable energy sector in China, the nation's renewables firms are now facing a lull in the domestic market with proposals to cut wind and solar tariffs from 2018. As a result, Chinese firms are looking abroad for opportunities to continue growth. Seeking more developed markets, these companies are expanding into North and Latin America as well as Australia.⁶ World-leading wind turbine manufacturer Goldwind recently won an Australian Renewable Energy Agency (ARENA) grant for its planned White Rock solar project,⁷ which will add to its existing wind generation capacity in Australia. Also this year, Goldwind Americas purchased the 150MW Rattlesnake Wind Project in Texas as part of a five-year growth strategy in the U.S.⁸ Texas, along with California and New Jersey, are hotspots for Chinese renewables investment, influenced by pro-renewable energy policies in those states.⁹

Mexico, Brazil, Argentina and Chile are amongst the most attractive countries for renewable energy investment, and Chinese companies already have a major and growing presence across Latin America. Last year, Shanghai-based Envision Energy, one of the top 10 global wind turbine suppliers, acquired a controlling stake in a portfolio of wind energy projects being developed by Vive Energia of Mexico totalling over 600MW.¹⁰ Meanwhile JinkoSolar had a winning tender in Mexico's first and highly successful renewable energy auction in April 2016.¹¹

In Brazil, the expanding wind and developing solar generation sector has attracted Chinese firms such as Huawei, Goldwind, BYD and Yingli. State Grid Corporation of China is in the process of taking over Brazilian electricity utility CPFL Energia,¹² a purchase that will be the largest by a Chinese company in Brazil, beating China Three Gorges Brazilian deal from 2015 (refer Annexure I). The deal will also give State Grid control of CPFL Renovaveis SA, a renewable energy firm 52% owned by CPFL. Argentina held its first round of renewable energy auctions in 2016 and at least half of the winning wind projects and three quarters of the solar bids involved Chinese capital and technology, as many U.S. and European companies consider Argentina too risky for investment.¹³

Other Chinese renewables firms are turning to developing nations for opportunities. Zenergy, the renewable energy company whose major shareholder is telecommunications giant ZTE, is capitalising on the fact that renewable energy is cost competitive without subsidies in many developing countries as they are often an alternative to expensive diesel generation in remote areas. In addition, developing nations are often afflicted by energy shortages, so energy developers are less likely to be affected by the low utilisation rates that they may suffer in China. Zenergy has committed to a US\$1.5bn 900MW solar project in Pakistan, one third of which is already completed,

⁵ <http://www.rechargenews.com/solar/867324/gcl-buys-australian-pv-distributor-one-stop-warehouse>

⁶ <http://www.scmp.com/business/china-business/article/2039364/chinese-renewable-energy-firms-look-abroad-growth-offset>

⁷ <http://reneweconomy.com.au/arena-announces-large-scale-solar-grant-winners-480mw-in-total-97091/>

⁸ <https://solarthermalmagazine.com/2016/05/18/chinese-subsidiary-acquires-160-mw-rattlesnake-wind-project-texas/>

⁹ <https://www.americanprogress.org/issues/green/news/2015/07/30/118379/chinese-direct-investment-in-the-u-s-energy-economy/>

¹⁰ <http://dialogochino.net/chinese-investment-generates-latin-americas-renewable-energy-expansion/>

¹¹ <https://www.greentechmedia.com/articles/read/Solar-Stuns-in-Mexicos-First-Clean-Energy-Auction-1860-MW-Won-at-50.7-P>

¹² <http://www.reuters.com/article/cpfl-energia-ma-state-grid-corp-previ-idUSL1N1A5007>

¹³ <https://www.chinadialogue.net/article/show/single/en/9419-China-s-impressive-stake-in-Latin-America-s-renewables>

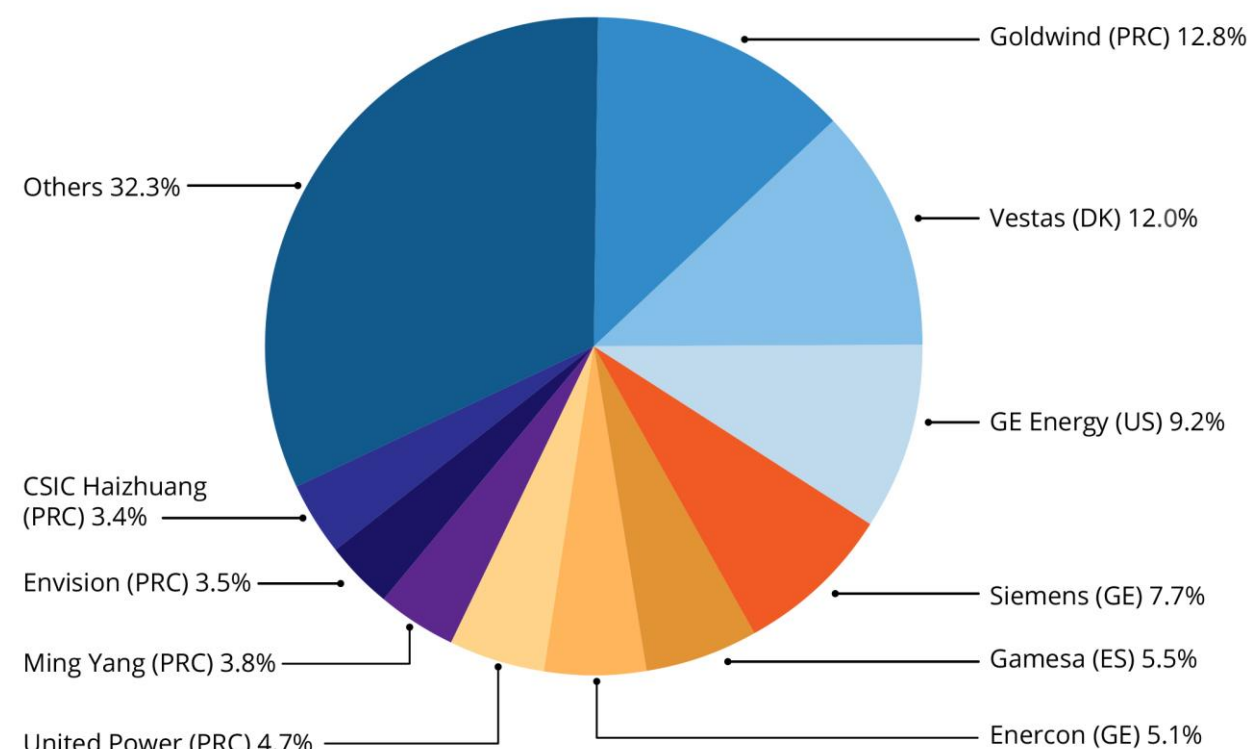
and has also built small-scale off-grid solar projects in countries such as Ethiopia, Chad and Namibia.¹⁴

Chinese companies operating as main contractor were responsible for 30% of new generation capacity additions in sub-Saharan Africa in 2010-15,¹⁵ equal to the total of the next four largest countries combined; 56% of these additions were from renewable sources although this was led by hydro, where Chinese companies dominate. However, there is increasing Chinese involvement in wind energy in places such as South Africa and in Ethiopia, where there is also significant involvement in bioenergy. In solar PV, Chinese companies have generally been PV suppliers rather than construction contractors so far. Chinese companies have entered the Sub-Saharan market through South Africa, where JinkoSolar has invested in a PV factory with an annual capacity of 120MW.

In 2016, JinkoSolar is expected to become the largest solar PV module manufacturer in the world, overtaking another Chinese firm, Trina Solar¹⁶. Five of the top six solar PV manufacturers in the world are Chinese, the others being JA Solar, Canadian Solar and GCL.

Similarly, a Chinese firm has taken the leading position among wind turbine manufacturers, with Goldwind taking over from Denmark's Vestas.¹⁷ With United Power, Ming Yang, Envision Energy and CSIC Haizhuang also making the list, Chinese firms make up half of the top 10 global wind turbine suppliers (refer Figure 2 below).

Figure 2: Top 10 Wind Turbine Suppliers by Market Share, 2015



Source: Clean Technica, Navigant Research

¹⁴ <http://www.scmp.com/business/china-business/article/2039364/chinese-renewable-energy-firms-look-abroad-growth-offset>

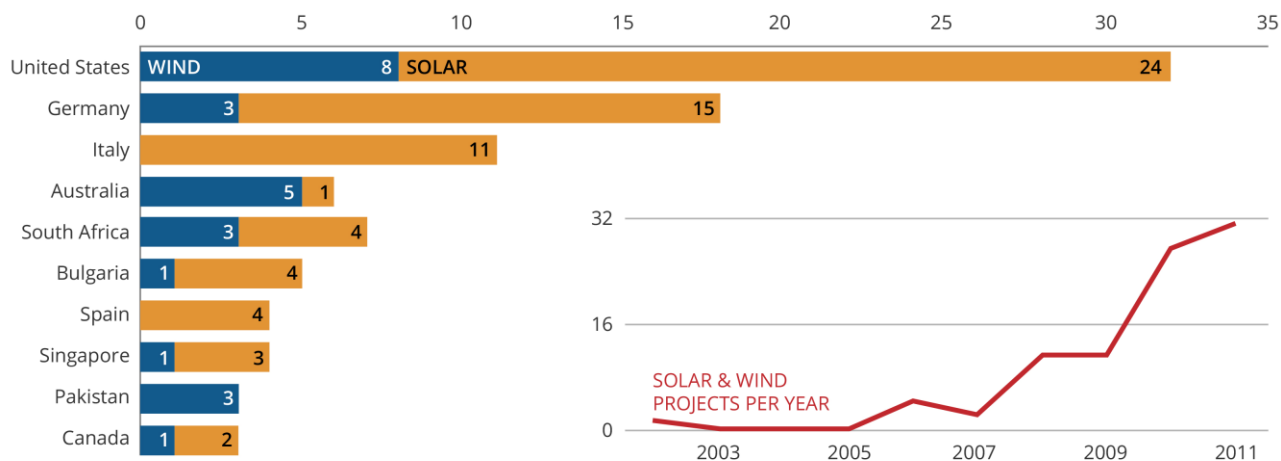
¹⁵ IEA, Boosting the Power Sector in Sub-Saharan Africa: Chinese Involvement, 2016

¹⁶ <http://www.pv-tech.org/editors-blog/top-5-solar-module-manufacturers-in-2016>

¹⁷ <https://cleantechnica.com/2016/05/19/goldwind-edges-vestas-worlds-leading-wind-turbine-supplier/>

The expanding rate of foreign investment by Chinese firms was examined in the 2013 report by the World Resources Institute, which tracked 124 investments over the decade to 2012 (Figure 3). Investment has clearly accelerated since the global financial crisis, taking advantage of the retreat from global markets of Western firms, particularly banks.

Figure 3: China's Overseas Investments in Renewables 2002-2012



Source: World Resources Institute, April 2013¹⁸

China's top destinations for overseas investment across all asset classes are the U.S., Australia, Canada, Brazil and Britain, as detailed in Figure 4.

In Australia during this period, state-owned enterprises (SOEs) represented 89% of the total. Energy (35%), mining (26%) and agriculture (13%) were the three largest sector exposures.

Figure 4: Top Five Destinations for Accumulated Chinese Investment (US\$m)

Country	Total value 2005-2013	Global share (%)
US	59,900	13
Australia	57,250	12
Canada	37,650	8
Brazil	29,180	6
Britain	18,530	4

Source: "Demystifying SOE Investment in Australia", KPMG & Uni of Sydney, August 2014, The Heritage Foundation China Global Investment Tracker database.

China's strategic expansion under its "One Belt One Road" investment program involves a multi-billion-dollar investment program in roads, railways, grid transmission and energy generation. An illustration of this strategy was seen in the October 2016 US\$1.77bn move by Shanghai Electric to acquire the Karachi Electricity Supply Corp in Pakistan (K-Electric).

¹⁸ http://www.wri.org/sites/default/files/pdf/chinas_overseas_investments_in_wind_and_solar_trends_and_drivers.pdf

The Major Players

In this section we identify and outline the major companies and institutions that are already either demonstrating significant presence and influence on renewable energy investment around the world or that are likely to become increasingly important in the sector.

State Grid Corporation of China

Headquartered in Beijing, the State Grid Corporation of China (SGCC) is the world's largest electricity utility company with over 1.9 million employees and more than 1 billion customers. It is second on the 2016 Global Fortune 500 list. With annual sales of US\$330bn, its revenue is larger than that of Boeing and Apple Inc. combined. Wholly owned by the government of China, SGCC is likely to come under pressure at home as Beijing seeks to end the monopoly that power distributors have by allowing customers to negotiate directly with energy generators.¹⁹ As a result, companies like SGCC are likely to show increased interest in overseas expansion.

In 2012, SGCC targeted US\$50bn of international assets by the end of the decade. By 2015, SGCC had invested US\$30bn on this front. SGCC now has a significant presence in Australia, Brazil, Italy, Portugal, Greece and the Philippines and has plans to expand elsewhere South America, Africa and Asia. SGCC's vision is for a global network of ultra-high-voltage transmission lines that can carry electricity beyond continental boundaries, allowing the transmission of energy from regions of high renewable resources to those of high demand.

In 2008, SGCC acquired a 25-year concession over a 40% stake in National Grid Corp. of the Philippines (NGCP) for US\$3.95bn in an effective privatisation.²⁰ As a result of increased military tensions in the South China Sea,²¹ the Philippine government decided in 2015 that while SGCC would be allowed to remain a 40% shareholder in NGCP, the operational control of NGCP would be returned to Philippine hands.

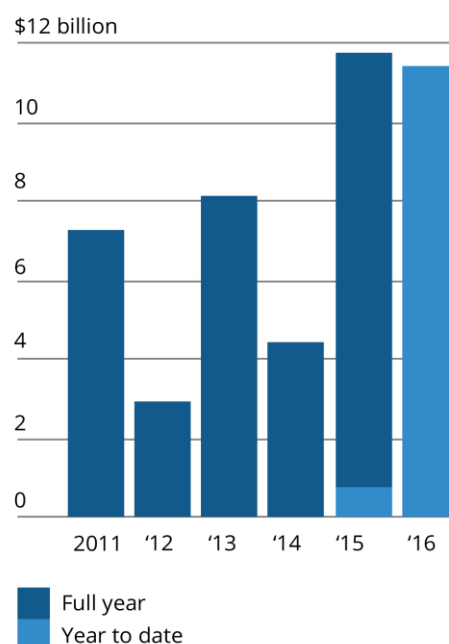
In 2012, SGCC bought 25% of Portuguese grid operator REN (Redes Energéticas Nacionais) for €387m,²² securing a role as REN's "principle industrial and strategic partner." As part of the deal, SGCC provided guarantee financing of €1bn,

Figure 5: Chinese M&A in Overseas Power and Utilities

Power Up

China is writing big cheques for power assets across the globe.

Total outbound mergers and acquisitions in power and utilities



Source: Wall Street Journal, Dealogic

¹⁹ <http://www.bloomberg.com/news/articles/2016-03-31/chinese-power-behemoth-with-global-ambitions-targets-australia>

²⁰ <http://www.gmanetwork.com/news/story/134348/money/personalfinance/senate-oks-franchise-for-national-transmission-grid>

²¹ <http://www.gmanetwork.com/news/story/442229/money/companies/chinese-firm-to-still-own-40-of-ngcp-after-management-change-says-doe-s-petilla>

²² <https://www.ft.com/content/41a0c572-4dba-11e1-b96c-00144feabdc0>

secured through the China Development Bank, to help refinance REN's debt at competitive rates.

In 2012, SGCC purchased 41% of the ElectraNet electricity transmission network business in South Australia from Powerlink of Queensland for A\$500m.

In 2013, SGCC bought a 20% stake in Australia's listed company SP AusNet Ltd for A\$0.82bn from Singapore Power. SGCC also acquired a 60% stake in Singapore Power's Australian power distribution, gas transmission and distribution assets held in the infrastructure company Jemena, with a total asset base of A\$8.9bn.²³

In 2014, SGCC created a 51%/49% owned joint venture with Brazilian state owned electricity company Eletrobras to link a proposed new 11GW hydroelectric dam at Belo Monte in the Amazon (due for commissioning in 2019) to the grid at Sao Paulo. This investment was SGCC's first overseas UHV DC transmission project with commissioning due in 2018 and a planned carrying capacity of 11GW over 2,084km in distance.

In July 2015, a second bid, to build a 4GW 2,250km transmission linking the Belo Monte power plant to Rio de Janeiro, was won by SGCC. The combined cost of these two transmission projects was US\$4.7bn, with the second 100% owned project totalling US\$2.2bn.²⁴ Zhang Jianping of China's National Development and Reform Commission said at the time:²⁵

"In addition to the high-speed rails and nuclear power plants, the UHV transmission technologies can be the third flagship product of China's advanced technology and equipment,"

In Africa, SGCC is installing a 500-kilovolt line between Ethiopia and Kenya from the former's especially controversial Gilbel Gibe III Dam.

In November 2014, SGCC paid €2bn for a 35% stake in Cassa Depositi e Prestiti Reti ("CDP RETI") from Cassa Depositi e Prestiti Spa ("CDP"), which is 80% owned by the Italian Government Treasury.^{26,27} CDP RETI holds a 30% stake in Terna S.p.A. and a 30% stake in Italian gas distribution company Snam S.p.A., both publicly listed Italian companies. Investment into CDP RETI is the largest single overseas investment ever made by SGCC. It is also the largest single investment ever made by a Chinese company in Italy. SGCC stated it "will closely work with CDP by leveraging its advantages in terms of technology, capital resources and management etc., to further promote the steady development and strengthen the overall competitive advantages of CDP RETI." This deal followed the People's Bank of China acquiring a 2% stake in Italy's ENEL in March 2014 for €0.82bn.²⁸

In April 2015, SGCC signed a cooperation agreement with Pakistan's Ministry of Water and Power for the US\$2.1bn Matiari-Lahore and Matiari/ Port Qasim-Faisalabad Electricity Transmission Project. This project is Pakistan's first electricity transmission and transformation project open to foreign investors, and requires energy cooperation for the China-Pakistan Economic Corridor. SGCC will construct the US\$2.1bn²⁹ grid transmission using HVDC technology with 900km transmission distance and 4GW transmission capacity.³⁰

²³ <https://www.bloomberg.com/news/articles/2013-05-17/china-state-grid-buys-19-9-stake-in-sp-ausnet-for-a-824-million>

²⁴ <http://www.sgcc.com.cn/ywlm/mediacenter/corporatenews/07/327598.shtml>

²⁵ http://news.xinhuanet.com/english/2015-08/04/c_134480636.htm

²⁶ <http://www.sgcc.com.cn/ywlm/mediacenter/corporatenews/11/311305.shtml>

²⁷ <http://www.wsj.com/articles/china-inc-pursues-power-glory-with-big-brazil-deal-1470742277>

²⁸ <http://www.reuters.com/article/us-italy-china-idUSKBN0FT1H020140724>

²⁹ <http://pkonweb.com/2016/09/chinese-investor-refuses-to-accept-lower-tariff-for-matiari-lahore-transmission-line/>

³⁰ <http://www.sgcc.com.cn/ywlm/mediacenter/inspotlight/05/326144.shtml>

In March 2016, SGCC announced a memo of understanding to explore the idea of a North Asia grid interconnector, linking China (SGCC), Russia (PJSC ROSSETI), Japan (SoftBank) and South Korea (KEPCO).³¹

SGCC is also exploring the possibility of grid interconnectivity with India, Mongolia, Pakistan and southeast Asian so as to better manage the variable supplies of renewable energy assets that often face curtailment in China as domestic demand stagnates.³²

In July 2016, SGCC announced its proposed US\$1.8bn acquisition of a 23.8% shareholding in Brazilian electricity distribution company CPFL Energia SA.³³ This would be one of the largest electricity deals by a Chinese company in Brazil. The deal would also give State Grid an indirect stake in CPFL Renovaveis SA, a renewable energy firm 52% owned by CPFL. Brazil's economic situation and the large distances between its hydro generation facilities and demand centres make it an ideal target for investment by a company specialising in ultra-high voltage, long-distance power transmission. SGCC is required to bid for all shares in CPFL according to an understanding that, if all shareholders accept, would make the deal worth US\$13bn including debt.³⁴

In September 2016, SGCC acquired an additional 29.4% stake in Brazilian power distributor CPFL Energia SA from local pension fund Previ in a deal valued at 7.5 billion reais (US\$2.3bn). Combined with the July transaction, this takes SGCC's holding to 52.4%.³⁵

In August 2016, Greece's state-owned power company PPC agreed to sell a 24% stake in ADMIE, Greece's grid operator, to SGCC for €320m.³⁶

In August 2016, SGCC was blocked on national-interest grounds (in conjunction with Cheung Kong Infrastructure Holdings of Hong Kong) from bidding to acquire a 99-year lease on a 50.4% stake in Australia's Ausgrid (New South Wales' largest electricity distribution network owner-operator) for US\$7.5bn.³⁷ In 2015, SGCC was an underbidder for the 99-year lease on 100% of NSW transmission business TransGrid.

China Three Gorges Corporation

China Three Gorges Corp (CTGC) is a state-owned power company, the largest clean energy group in China, and the world's largest hydropower developer. The company constructed the Three Gorges Dam project, which went into operation in 2008 as the world's largest hydro-electric plant. In addition to hydro, the company also invests in solar and wind power. At the end of 2015, the CTGC held almost 60GW of generation capacity and in 2015 produced more than 200 TWh of electricity.

CTGC stated mission is to "build an international first-class clean energy group,"³⁸ and the company has been investing overseas for a number of years toward that goal already. In 2011, China Three Gorges paid €2.7bn for a 21% stake in Energias de Portugal (EDP) to become the utility's largest shareholder.³⁹ The 21% stake was the government of Portugal's

³¹ <http://asia.nikkei.com/Politics-Economy/International-Relations/SoftBank-partners-eye-Northeast-Asian-clean-power-grid>

³² <https://www.bloomberg.com/news/articles/2016-11-01/china-seeks-to-export-power-amid-signs-it-built-too-many-plants>

³³ <http://www.reuters.com/article/cpfl-energia-ma-state-grid-corp-previ-idUSL1N1A5007>

³⁴ <http://www.reuters.com/article/us-cpfl-energia-m-a-state-grid-corp-idUSKCN11635E>

³⁵ <http://www.wsj.com/articles/chinas-state-grid-to-acquire-additional-stake-in-brazils-cpfl-1474887072>

³⁶ <http://www.wsj.com/articles/greeces-ppc-sells-stake-in-electricity-operator-admie-to-chinas-state-grid-1477935773>

³⁷ <http://www.bbc.com/news/business-37043119>

³⁸ China Three Gorges Corp. 2015 Annual Report, p. 12

³⁹ <http://uk.reuters.com/article/utilities-mediterranean-china-idUKL6N0QB5NF20140810>

residual shareholding in the utility following a progressive privatisation and sell-down after the 2009 financial crisis. The Portuguese government said CTGC would also invest up to €2bn to acquire minority stakes in EDP's Portuguese wind farms and extend €4bn in credit lines to EDP. China Three Gorges offered a 53% premium to the utility's then share price.⁴⁰ CTGC and EDP have set up a joint venture, Hydroglobal, to develop hydro-electric power projects in South America and Africa.⁴¹

In 2014, CTGC and EDP jointly invested in three hydro power stations in Brazil (Jari, Cachoeira and Sao Manoel) whilst CTGC acquired 49% of EDP's 321MW Brazilian wind portfolio for US\$137m.⁴² The following year, the company completed a US\$589m deal in which it acquired Brazil's Garibaldi and Salto hydroelectric plants with a combined capacity of over 300MW.⁴³ Toward the end of 2015, CTGC acquired the 3.4GW Ilha Solteira and 1.6GW Jupia hydro plants for about US\$3.7bn to become the second largest private generator in Brazil.⁴⁴

In November 2014, China Three Gorges commissioned its first wind farm in Pakistan, a 50MW, US\$130m investment. At the project opening ceremony, China Three Gorges Chairman Lu Chun said that Pakistan was a key strategic investment market for the company due to its close strategic ties with China as well as its abundance of clean energy resources and strong market demand.

In order to foster its expansion into Pakistan, China Three Gorges established China Three Gorges South Asia Investment Limited (CSAIL), an investment holding company in Pakistan that aspires to become the country's largest renewable energy company. In March 2015, it was reported⁴⁵ that CSAIL had over 2 GW of solar, wind and hydropower projects in the pipeline, with key projects that have already entered the construction phase, including two hydropower plants with expected capacities of 720MW and 1.1GW respectively. CSAIL has already obtained the support of some heavyweight backers, including the World Bank's International Finance Corporation, which has acquired a 15% equity stake in CSAIL. China's \$40 billion Silk Road Infrastructure Fund, whose establishment was announced by Beijing in November 2014, has also expressed strong interest in either investing in or cooperating with CSAIL in the South Asian market.

In Asia, the 944MW Murum hydro-electric dam began commercial operations in 2014.⁴⁶ Located in Sarawak, Malaysia, the project was constructed by China Three Gorges, which also developed the 100MW Nam Lik 1-2 and 180MW Nam Ngiep 2 hydropower projects in Laos, completing them in 2010 and 2015, respectively. CTGC is also a major contractor of hydro projects in Africa with five plants totalling 1.8GW of capacity completed or under construction from 2010 to 2015 (refer Figure 13).

In July 2015, Guinea in West Africa increased generating capacity with the US\$526m 240MW Kaleta hydroelectric facility, built by China International Water & Electric Corp. (CIWEC), a subsidiary of China Three Gorges Corporation. Guinea funded 25% of the project and China Exim Bank provided 75% with a preferential buyer's credit. This is the largest hydropower project developed in cooperation between China and Guinea.⁴⁷ In

⁴⁰ <https://www.ft.com/content/916aacd6-2cc1-11e1-aaf5-00144feabdc0>

⁴¹ <http://www.reuters.com/article/us-edp-china-three-gorges-idUSKBN0OY1HU20150618>

⁴² <https://renewables.seenews.com/news/edp-to-sell-49-in-321-mw-brazilian-wind-portfolio-to-china-three-gorges-456239>

⁴³ <http://www.powerengineeringint.com/articles/2015/08/chinese-power-firm-to-buy-three-utility-companies-in-brazil.html>

⁴⁴ <https://www.bloomberg.com/news/articles/2016-01-07/china-three-gorges-becomes-brazil-s-no-2-private-power-operator>

⁴⁵ <https://cleantechnica.com/2015/03/18/china-three-gorges-builds-first-wind-farm-pakistan/>

⁴⁶ <http://www.freemalaysiatoday.com/category/nation/2016/09/28/rm4-1b-murum-hydro-electric-damn-launched/>

⁴⁷ <http://www.hydroworld.com/articles/2015/09/guinea-increases-generating-capacity-with-us-526-million-240-mw-kaleta-hydroelectric-facility.html>

September 2015 CIWEC disclosed it was in talks with the Guinea government for the proposed US\$2bn, 550MW Souapiti dam, which would nearly treble Guinea's hydro generating capacity.⁴⁸

In October 2016 China Three Gorges Corp launched China's largest to-date green bond at Rmb6bn (US\$900m).

In October 2015, CTGC acquired a 30% stake in the proposed 1.1GW Moray Firth offshore project in Scotland from Portuguese developer EDP Renovaveis (EDPR).

In June 2016, CTGC acquired Blackstone Group's 80% interest in German company WindMW GmbH in a transaction that values the company at EUR1.7bn.⁴⁹ WindMW owns the 288MW Meerwind wind farm in the North Sea, one of Germany's largest offshore wind farms.

In October 2016, the company's Brazil interest was further demonstrated when CTG agreed to purchase Duke Energy's Brazil assets for US\$1.2bn.⁵⁰ The assets to be sold include 10 hydro-electric plants with a total capacity of over 2GW.

In July 2016 Peru's private investment promotion agency, ProInversión, San Gabán S.A. and a consortium made up China Three Gorges Corporation and EDP – Energías de Portugal, signed the contract to develop the San Gabán III hydroelectric power plant. The project involves the design, finance, build, operation and maintenance of a new 205.8 MW power plant. It also includes the development of a 220 kv line to connect the plant to an electrical substation. The concession contract will be for a period of 30 years post commissioning and the total project investment is estimated at US\$438m.⁵¹

In December 2016, it was reported that CTGC is among the companies bidding for Toronto-based renewable energy generator Northland Power Inc⁵². Northland has a value of around US\$2.8bn and has generation facilities in Canada, the U.S. and Germany that produce electricity from sources that include solar, wind and biomass.

State Power Investment Corporation and Shanghai Electric

The State Power Investment Corporation (SPIC) is one the five largest state-owned electricity generators in China. The company was formed by the merger of the China Power Investment Corporation and the State Nuclear Power Technology Corporation in 2015 and operates 107GW of generation capacity, 35% of which is from clean energy sources (68GW of thermal, 21GW of hydro, 5GW of solar and 10GW of wind). SPIC employs 140,000 and owns a number of subsidiaries including China Power International Development Ltd and China Power New Energy Development Company Ltd., both of which are listed on the Hong Kong stock exchange, and Shanghai Electric, listed in Hong Kong and Shanghai. SPIC has a presence in 36 countries including Japan, Australia, India, Turkey, Pakistan and Brazil with US\$113bn in total overseas assets.

⁴⁸ <https://www.bloomberg.com/news/articles/2015-09-15/china-s-cwe-in-talks-to-build-2-billion-dam-in-guinea>

⁴⁹ <https://www.bloomberg.com/news/articles/2016-06-13/blackstone-sells-majority-stake-in-windmw-to-china-three-gorges>

⁵⁰ <https://www.bloomberg.com/news/articles/2016-10-10/duke-to-sell-brazilian-assets-to-china-three-gorges-for-1-2b>

⁵¹ <http://www.hydroworld.com/articles/2016/07/chinese-portuguese-companies-sign-deal-to-develop-206-mw-san-gaban-iii-hydro-in-peru.html>

⁵² <https://www.bloomberg.com/news/articles/2016-12-05/china-three-gorges-sdic-said-among-bidders-for-northland-power>

In December 2015, SPIC agreed to buy Australia's Pacific Hydro for US\$2.2bn (A\$3bn), a deal that included Pacific Hydro's portfolio of 19 hydro- and wind-generation assets in Australia, Chile and Brazil amounting to 900MW as well as a significant pipeline of wind and solar projects in Australia⁵³. The vendor was Industry Funds Management (IFM) of Australia, one of the world's largest infrastructure investors on behalf of superannuation funds.⁵⁴ Pacific Hydro generated EBITDA of A\$175m, putting the transaction at 17 times current-year earnings. In March 2016, SPIC signed an agreement to buy Taralga Wind Farm Pty Ltd from Banco Santander for US\$227m.⁵⁵ The wind farm, in New South Wales, has a capacity of 107MW.

In November 2016, Pacific Hydro announced two solar projects with a potential capacity of 1,200MW in Northern Queensland.⁵⁶

SPIC subsidiary Shanghai Electric is the single largest Chinese enterprise engaged in the design, manufacture and sale of electrical system equipment for both power generation and transmission and distribution (T&D). The group has three listed companies: Shanghai Electric Co. Ltd.; Shanghai Electric Apparatus Co. Ltd.; and Shanghai Diesel Engine Co. Ltd. Shanghai Electric has participated in the construction of several major projects in China, including in transnational power transmission from west to east, transnational gas transmission from west to east, the Three Gorges project, the Qinshan Nuclear power station, Pudong airport, Shanghai Metro's railway control system and vehicles, and comprehensive sewage treatment of Suzhou River and the Pudong Waste incineration plant.⁵⁷ The company is also the leading developer of offshore wind farms in China.

Shanghai Electric has been active in seeking to expand overseas. It has completed two small solar projects in Japan as well as new energy projects in Turkey, Malta, Tanzania and Mozambique.⁵⁸ Shanghai Electric was also involved in Argentina's first renewable energy auction in 2016 under the nation's RenovAR program. JEMSE, whose partners include Shanghai Electric, Power China and Talseun, won contracts for 300MW of solar PV projects in the first tender.⁵⁹

In February 2016, Shanghai Electric took a 30% stake in Manz AG of Germany for €93m, giving it a strategic stake in a leading global manufacturer of advanced production equipment solutions in the fields of electronics, energy storage and solar power.⁶⁰

In October 2016, Shanghai Electric bid US\$1.77bn to acquire a 66% stake in K-Electric (previously known as Karachi Electricity Supply Corp) in Pakistan from the private equity firm Abraaj Group of Dubai.⁶¹ Nationalised in 1952, K-Electric was privatised in 2005 and Abraaj took a controlling stake in 2009. Operating 2.3GW of thermal power generation capacity, K-Electric is a vertically integrated electricity firm that also runs the transmission and distribution network for Karachi, with 2.5 million customers.⁶² Shanghai Electric has announced plans to spend US\$9bn overhauling electricity infrastructure in Karachi by 2030.⁶³ Given major national electricity generation shortages, the Pakistan government

⁵³ <http://www.smh.com.au/business/energy/china-state-power-investment-snaps-up-pacific-hydro-20151216-glp7cg.html>

⁵⁴ <http://www.afr.com/street-talk/chinas-state-power-investment-corp-set-to-buy-pacific-hydro-sources-20151216-qlon5a>

⁵⁵ <http://www.reuters.com/article/us-renewables-m-a-spic-idUSKCN0WG0S2>

⁵⁶ <http://www.pacifichydro.com.au/sun-shines-brightly-on-massive-growth-at-pacific-hydro/?language=en>

⁵⁷ <http://www.cccme.org.cn/Shop/cccme0639/index.aspx>

⁵⁸ <http://www.scmp.com/business/companies/article/2042021/shanghai-electric-scores-transformative-deal-its-purchase>

⁵⁹ http://www.pv-magazine.com/news/details/beitrag/argentina--jujuy-announced-that-it-was-awarded-300-mw-of-solar-projects-during-tender_100026357/-axzz4Rv2oZXy8

⁶⁰ http://www.shanghai-electric.com/Lists/NoticeList/Attachments/1321/e_voluntary%20announcement.pdf

⁶¹ <https://www.bloomberg.com/news/articles/2016-10-30/abraaj-to-sell-stake-in-pakistani-utility-for-1-77-billion>

⁶² <http://www.ke.com.pk/category/our-business/index.html>

⁶³ <http://energy.economicstimes.indiatimes.com/news/power/chinas-shanghai-electric-to-invest-9-billion-in-pakistan-upgrades/55876564>

has announced plans to install 3GW of renewables by 2018, a near trebling of the current 1.13GW of installed renewable capacity currently.⁶⁴ This acquisition is consistent with the Chinese government's planned US\$46bn China-Pakistan Economic Corridor unveiled in 2015.

BYD

With its shares up 200% over the last five years, BYD has made very significant progress and will be a key challenger to Tesla in the electric vehicle (EV) and battery manufacturing sectors globally. BYD reported revenues growing 44% year on year to Rmb44bn (US\$6.4bn) in the first half of 2016.⁶⁵ BYD reported a 131% year-on-year increase to 49,000 automotive sales for the half, representing a 27% share of the Chinese EV market, and a leading 65% market share in the plug-in hybrid sector. BYD models took first, second and fourth place in China electric car sales ranking in the year-to-August 2016.⁶⁶ With China on track to potentially reach 1 million EV sales in 2017, BYD is very well positioned.

BYD also is looking to equal Tesla in terms of lithium ion battery manufacturing capacity by 2020. This is a very credible target given BYD has a long history of rechargeable battery production, being one the world's leading mobile phone assembly companies.

BYD's EVs are in more than 200 cities in 48 countries, including Japan, the U.S., the U.K., Germany, The Netherlands and Australia.

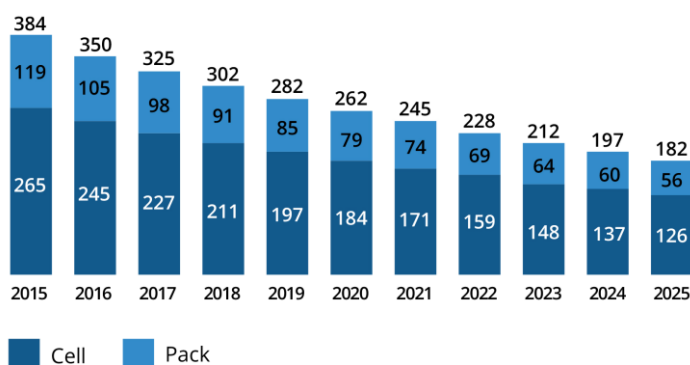
A US\$2bn equity raising in July 2016 significantly enhanced BYD's financials to drive investment in lithium battery and EV production capacity, as was the announcement that Korea's Samsung Electronics Co. invested US\$450m for a 2% stake in BYD as part of a strategic partnership.⁶⁷

BYD is one of the world's leading manufacturers of electric buses, and expects to deliver more than 6,000 eBuses in China and globally this year. China aims to introduce 154,000 eBuses by 2020 (giving eBuses a 70% market share) with the intent of cutting diesel fuel subsidies. This eBus boom suggests enormous growth potential. In 2014, BYD commissioned a new eBus factory in Lancaster, California, where in 2016 alone it expects to supply 300 eBuses for the U.S. market.⁶⁸

In May 2016, BYD signed a contract to supply 200 eBuses to Canada, representing the country's biggest order for pure electric buses. BYD also has signed a cooperation memorandum with Indonesian companies Smart Group and Infiniti Wahana Group to

Figure 6: Forecast Decline in Lithium Ion Battery Costs
Battery prices keep tumbling

Lithium Ion forecast (\$/kWh)



Source: Bloomberg New Energy Finance

⁶⁴ <http://tribune.com.pk/story/1253502/power-islamabad-leads-green-energy-initiatives/>

⁶⁵ <http://www.hkexnews.hk/listedco/listconews/SEHK/2016/0828/LTN20160828041.pdf>

⁶⁶ <https://cleantechnica.com/2016/09/19/byd-takes-1-2-4-china-electric-car-sales/>

⁶⁷ <http://www.reuters.com/article/us-byd-samsung-elec-equity-idUSKCN1011GJ>

⁶⁸ <http://www.aiche.org/chenected/2016/02/chinese-electric-buses-rolling-california-assembly-line>

introduce 500 eBuses into the Indonesian market. In September 2016, BYD won the Electric Bus of the Year Award from the Los Angeles Sustainability Coalition. BYD also supplies associated rechargeable batteries for such buses.

In September 2016 BYD won an Italian order for 19 12-meter BYD ebuses. The contract won by BYD has a total value of €10m.⁶⁹ In November 2016 BYD won a 21 electric bus supply contract in South Korea, the largest electric bus order to-date.

In July 2016, BYD formed a joint venture with Qinghai Salt Lake Industry Group Co for 30,000tpa of lithium resource mining and processing in northwest Qinghai province.⁷⁰

In August 2016, BYD announced plans to build a US\$45m, 200MW solar module manufacturing and assembly facility for commissioning in early 2017 and to operate alongside its eBus assembly factory in Brazil. BYD chose Brazil for its solar-manufacturing plant because of the country's growing solar capacity. Brazil's solar sector is expected to install 2.7 GW of projects by 2019.⁷¹

BYD is the world's largest company that manufactures both solar modules and energy storage systems for residential and grid scale applications. BYD says it holds a 60% market share for frequency-regulation energy storage in the U.S.⁷²

Beijing Enterprises Holdings Ltd

Beijing Enterprises Holdings Ltd (BEHL) is a Hong Kong listed but 61% China state-owned conglomerate with holdings that span piped gas (Beijing Gas Group), brewing (Beijing Yanjing Brewery Co., Ltd.), sewerage and water treatment (Beijing Enterprises Water Group Limited), plus several newly established Energy from Waste (EfW) projects in China. The diversification into EfW is a strategy designed to align BEHL with the government's 13th Five-Year Plan. In March 2016, BEHL stated its plan to accelerate investment and technology development to "strive to expand rapidly and consolidate its own leading position in this golden development era of environmental protection industry."⁷³

In February 2016, BEHL announced the US\$1.6bn acquisition of EEW Energy from Waste GmbH, the market-leading EfW Company in Germany⁷⁴. EEW operates 18 EfW facilities across Germany, the Netherlands, and Luxembourg. EEW Energy was owned by Swedish private equity firm EQT Partners AB. The acquisition value was US\$1.6bn, over three times net book value of assets. It set a historic price-earnings multiple of 22 times 2015 net profit after tax. The entire acquisition cost was funded 100% by a EUR1.665bn facility provided by Bank of China.

BEHL clearly articulates its logic for the "acquisition of EEW is another significant capital operation in actively expanding into overseas market with proactive implementation of the 'Going Global' strategy by state-owned enterprises, facilitating international capacity cooperation, and supporting the government's "One Belt, One Road" strategy. This acquisition will enhance the company's operation scale and industry standing in the solid-waste treatment and environmental protection sector, and open a communication

⁶⁹ <http://www.byd.com/news/news-381.html>

⁷⁰ http://europe.chinadaily.com.cn/business/2016-06/23/content_25822509.htm

⁷¹ <https://cleantechnica.com/2016/08/22/byd-agrees-new-brazilian-solar-pv-facility/>

⁷² <https://au.finance.yahoo.com/news/byd-showcases-energy-solar-zero-215600238.html>

⁷³ <http://file.irasia.com/listco/hk/behl/annual/2015/res.pdf>

⁷⁴ <http://www.bloomberg.com/news/articles/2016-02-04/buyout-firm-eqt-agrees-to-sell-eew-to-beijing-enterprises>

channel for learning and introducing the advanced solid waste and environmental protection ideas, technologies and management experience in Europe.”⁷⁵

China Huadian Corporation (Huadian)

China Huadian Corp. (Huadian), a Fortune 500 company, is one of five large state-owned power generation corporations in China, with more than 135GW of installed capacity as of the end of 2015 (including 20GW of hydro-electricity) and over 100,000 employees.

Huadian holds stakes in seven listed companies including Huadian Fuxin Energy Corp., which owns renewable power projects in China that include wind farms and hydropower plants. Huadian’s main listed arm is Huadian Power International Corp., which trades in Hong Kong and Shanghai with a market value of about US\$6.8 billion.

Like many other major Chinese companies, Huadian has expressed an intention to expand overseas as the strategy of domestic investment in infrastructure has reached a high-water mark.⁷⁶ This “Going Global” strategy was first articulated at the start of this decade with an initial focus on export orders, but Huadian took a major step up in 2014.

In May 2014, Huadian and Sinopec took a combined 15% stake in the new Canada-based 12Mtpa proposed Pacific North West liquified natural gas (LNG) project.

Huadian began its overseas expansion into clean energy with the purchase of a 28MW Spanish wind farm from Gamesa for an undisclosed amount.⁷⁷ More recently, Huadian has shown an interest in European renewables with the company reported as the preferred bidder for the wind generation assets of Infinis Energy Plc, which operates 16 onshore wind farms in the U.K. totalling 274MW with another 170MW in development. Infinis Energy was acquired by Terra Firma Capital UK in October 2015. If the deal goes ahead as expected it is expected to be valued at around US\$500m.⁷⁸

Huadian is also reported as being in the running to acquire the Russian power generation unit of Italy’s Enel.⁷⁹ Enel initially paid EUR2.6bn for its controlling stake in OGC-5, which became Enel Russia. With sanctions imposed on Russia by the West since the Ukraine conflict, Russia is increasingly looking east for investment.

In response to China’s “One Belt, One Road” initiative, Huadian has been active in south and south-east Asia both in coal-fired and hydroelectric technology. In addition to proposed coal-fired projects in Vietnam, Indonesia and Bangladesh, Huadian is expanding internationally in hydro-electricity project construction and operation.

In 2014, Huadian commissioned its 338MW Lower Stung Russei Chrum Downstream Hydropower Station in Cambodia at a cost of approximately US\$500m.⁸⁰ This is Huadian’s largest overseas hydropower project to date, and was announced as a key project to implement the strategy of “Going Global”.⁸¹

⁷⁵ <http://file.irasia.com/listco/hk/behl/interim/2016/intrep.pdf>

⁷⁶ <http://www.wsj.com/articles/china-takes-its-debt-driven-growth-model-overseas-1438882687>

⁷⁷ <http://www.gamesacorp.com/en/communication/news/gamesa-agrees-the-sale-of-a-28-mw-spanish-wind-farm-to-china-huadian-corporation.html?idCategoria=0&fechaDesde=&especifica=0&texto=&idSeccion=0&fechaHasta=>

⁷⁸ <https://www.bloomberg.com/news/articles/2016-07-08/terra-firma-said-to-discuss-sale-of-u-k-wind-farms-to-huadian>

⁷⁹ <http://www.reuters.com/article/us-enel-russia-sale-idUSKBN13K1DA>

⁸⁰ <http://www.power-technology.com/news/newscambodia-starts-operations-at-china-built-338mw-hydro-power-generation-project-4488250>

⁸¹ <http://english.cec.org.cn/No.106.1502.htm>

Huadian derives financing for most of its overseas investments from the Import and Export Bank of China and China Development Bank.⁸²

China Longyuan Power Group Corp

China Longyuan Power Group Corp (Longyuan) is a large Hong Kong-listed power generation firm that is one of the five largest wind farm owners globally, and has been adding 1.5-2.0GW annually of new wind in China this decade. Longyuan is 57% owned by China Guodian Corporation, one of the five largest, state-owned power generators in China. Like the other four, it is administrated by the State-owned Assets Supervision and Administration Commission of the State Council.

Longyuan focuses on the development, construction and operation of wind farms: at the end of September 2016, Longyuan had installed capacity of 18,671MW, of which wind power comprised 16,547MW, making it the largest operator of wind energy in China⁸³. The company is also a domestic leader in off-shore wind farm development. In addition to wind, Longyuan holds smaller capacities in solar, biomass and tidal power. In addition to operations in China, the company has a presence in Canada and South Africa.

Longyuan's overseas expansion began in Canada with the 100MW Dufferin wind project in Ontario⁸⁴. This was one of the earliest moves by a Chinese, state-owned power major into overseas renewables markets. The project came online in 2014, and Longyuan is now embarking on a second-stage expansion to add 150MW.

Longyuan won two bids totalling 244MW to build wind farms at De Aar in South Africa under the third round of the South African government's renewable energy procurement program⁸⁵.

More recently, Longyuan has partnered with Czech engineering firm SWH Group to invest in US\$600m of green energy investments throughout central and Eastern Europe.⁸⁶ The agreement was signed in March 2016. Specific locations and countries to site developments are yet to be disclosed, but the focus will be on wind energy.

The company has made it clear that it intends to accelerate the pace of "going-out" into international markets in line with the "One Belt, One Road" initiative.

China General Nuclear Power Group

China General Nuclear Power Corp (CGN) operates a fleet of 17.1GW of nuclear power plants across China. In 2007 CGN commenced an investment program to diversify the company into the renewable energy sector. In December 2016 CGN commissioned its latest Chinese windfarm, taking its cumulative operating wind projects to 10GW in total.⁸⁷ CGN owns and operates the 150MW Rudong offshore wind farm in east China, and in November 2016 CGN won the final approval to develop a 300MW offshore wind farm in

⁸² http://europe.chinadaily.com.cn/epaper/2015-01/16/content_19332831.htm

⁸³ China Longyuan Power Group Corporation Ltd, 2016 Interim Report.

⁸⁴ <http://renewables.seenews.com/news/china-longyuan-puts-online-100-mw-wind-farm-in-canada-449485>

⁸⁵ Boosting the Power Sector in Sub-Saharan Africa: Chinese Involvement, International Energy Agency, 2016

⁸⁶ <http://renewables.seenews.com/news/china-longyuan-czech-swh-to-pour-usd-600m-in-european-wind-520825>

⁸⁷ <http://en.cgnpc.com.cn/n1305391/n1305404/c1312417/content.html>

Fujian province. CGN targets to continue adding 2GW annually of new wind farm capacity.

CGN also operates 1.9GW of solar projects and 2.2GW of hydroelectricity projects, making it one of the largest renewable energy investors globally with 14GW in operation.

In December 2014 CGN acquired an 80% stake in three English onshore Clover project wind farms with 72MW of capacity from EDF of France.

In the same month CGN commissioned its 10MW waste biomass power plant in Singapore with an associated 0.5MW solar project.

In February 2015 CGN acquired the onshore Fujin wind farm project in France from and completed an equity transfer deal with Eolfi.

In December 2015 in the solar segment, CGN joined with French solar energy company Inovia Concept Development to build up to 500MW of distributed solar energy generators across France in the next few years.

Also in December 2015, CGN inked a preliminary agreement to co-develop 500 MW of solar and wind power projects in Namibia, in south-western Africa, with French utility Electricite de France (EDF)'s new energy unit and French solar farms developer InnoSun.⁸⁸

In July 2016 CGN won the tender, along with French new energy group Eolfi, for a pilot 24MW floating offshore wind power project (4 turbines of 6MW each) off the island of Groix, in Brittany, France. This is the first of its kind in Europe, with commissioning due 2020. Construction will be carried on cooperation with naval defence and energy group DCNS providing the installation, Vinci supplying concrete, and GE the wind turbines.⁸⁹

In September 2016 CGN bought Belgium's largest onshore wind farm, the 81MW Esperance project from renewable energy project developer Windvision.

In September 2016 CGN joined with EDF to co-finance the construction of the 3.2GW Hinkley Point nuclear power plant in the UK. CGN will take a 33% stake in the project, which has an estimated whole of life capital investment cost of £37bn. CGN also announced plans to take a two-thirds stake in the rebuild of the Bradwell B nuclear power facility in the UK and in doing so, to use China's third generation nuclear technology HPR1000.⁹⁰ CGN also plans to take a 20% stake in the Sizewell C UK nuclear plant rebuild, again alongside EDF. These three moves illustrate the strategy of overseas deployment of Chinese technologies underpinned by Chinese financial capital.

In November 2016, CGN European Energy Company in conjunction with Italy's Chemtech Solar bought a 90% stake in a 44MW Senegal solar project in Malicounda. This project has plans to expand to 100MW and marks CGN's first investment to-date in west Africa.

In December 2016 CGN announced the acquisition of 100% of Irish renewable energy company Gaelectric's 230MW Douvan wind power group of projects in Ireland.⁹¹ It is claimed that the deal is the biggest investment by a Chinese company in Ireland by far and comes on the back of CGN completing deals for France's offshore floating wind

⁸⁸ <http://www.scmp.com/business/companies/article/2053910/chinas-clean-energy-giants-overseas-shopping-sprees>

⁸⁹ <http://en.cgnpc.com.cn/n1305391/n1305404/c1311732/content.html>

⁹⁰ <http://en.cgnpc.com.cn/n1305391/n1305404/c1311540/content.html>

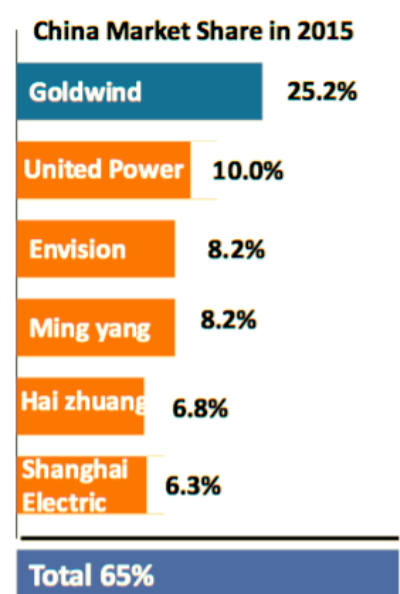
⁹¹ <http://en.cgnpc.com.cn/n1305391/n1305404/c1312450/content.html>

power project, Belgium's largest wind power farms in operation, and Senegal's solar power project.

Goldwind

Xinjiang Goldwind Science & Technology Co., Ltd (Goldwind) is listed on the Shenzhen and Hong Kong Stock Exchanges and is the largest wind turbine manufacturing company in the world. China Three Gorges holds about 25% of the company's shares. Goldwind's shares have rallied 300% over the past five years,⁹² putting the company's market capitalisation at a near record HK\$51 bn (US\$6.5bn). China is the No. 1 country globally in terms of total cumulative wind installs, which reached 154GW by June 2016, up 40GW in the past 18 months alone.⁹³ Goldwind held a leading 25% share of the Chinese domestic market in 2015, more than double second-place United Power at 10%. As of June 2016, Goldwind had a contracted order backlog of 7.7GW.

Figure 7: Goldwind China Market Share, 2015



Source: Goldwind Investor Briefing, Sept 2016

Goldwind entered 2016 with 864MW of cumulative overseas installed capacity across the U.S., Australia, Panama, Romania, Pakistan, Thailand, Ecuador and Chile. Taking the technology and development lead from its dominant domestic onshore and offshore wind farm base, Goldwind is carefully and progressively expanding to be a global leader in the wind turbine supply and installation market and in associated fields such as wind-powered hydrogen generation and storage. Goldwind "seeks to become a leading international provider of integrated clean energy and energy conservation solutions."

In 2010, Goldwind started development in NSW, Australia, with its Gullen Range Wind Farm using Goldwind turbines. The wind farm is owned by Beijing and Jingneng Clean Energy (HK) Co. (75%) and Goldwind Capital (25%).⁹⁴

In 2011, Goldwind built the 270MW Penonomé I and II wind projects in the Coclé Province of Panama's southern coast, providing critical domestic sourcing of electricity generation to diversify Panama from overreliance on hydropower.⁹⁵

In 2015, under China's "One Belt, One Road" strategy, Goldwind built on the success of its first project in Pakistan to win a total of 400MW of turbine supply contracts over 2016-2017, which will comprise one-third of planned wind capacity in Pakistan.⁹⁶ The same year saw Goldwind win an EPC contract to supply its first wind farm in South Africa, the 120MW Golden Valley project, owned by Biotherm Energy of South Africa.⁹⁷ In July 2015, Goldwind established itself as the first Chinese company to issue green bonds outside of China, with an issue of US\$300m.

⁹² Share price as of 25 November 2016 at HK\$11.78 per share, converted at 7.76/US\$1.

⁹³ <http://www.goldwindglobal.com/upload/files/201610/201610311239369.pdf>

⁹⁴ <http://gullenrangewindfarm.com>

⁹⁵ <http://www.goldwindamericas.com/penonome-panamas-foray-wind-energy>

⁹⁶ <http://www.goldwindglobal.com/upload/files/201604/201604251643352.pdf>

⁹⁷ <http://www.goldwindglobal.com/web/news.do?action=detail&id=201504221058170000>

In May 2016, Goldwind signed an agreement with Renewable Energy Systems Americas Inc. (RES) to acquire the proposed 160 MW Rattlesnake Wind Project in Texas. Rattlesnake will install 64 Goldwind 2.5 MW Permanent Magnet Direct-Drive (PMDD) wind turbines, and the project can be scaled to 300MW over time.⁹⁸

Goldwind was awarded a A\$6m Australian Renewable Energy Agency grant for its A\$45m 20MW White Rock solar project adjacent to its NSW Australia wind project, a pioneering solar/wind hybrid project, in September 2016. In October 2016, Goldwind shipped 8 2.5MW turbines to Newcastle Port for assembly and installation at its 175MW White Rock wind farm.⁹⁹ Initial development of the project was undertaken by Epuron. Goldwind acquired White Rock from Epuron in 2014. China Energy Conservation and Environmental Protection Group Wind-Power Corporation (CECWPC) acquired a 75% interest in WRWFPL with Goldwind retaining a 25% interest.

Goldwind continues to advance plans initially started in 2013 to build the A\$350m Cattle Hill Wind Farm in Tasmania, Australia, with a capacity of up to 300MW, although the project to-date is hobbled by grid connectivity issues.

The company installed its first turbine for its new 80MW wind project in Thailand, its third project in that country, in October 2016. In November 2016, Goldwind entered into an exclusive agreement with Viridis Eolia, LLC, a Wyoming corporation, for the conditional supply of up to 1,870 MW of Goldwind PMDD wind turbines for use in Carbon County, Wyoming, over 2017-2022, another piece of its five-year strategy to capitalize on the robust growth of the U.S. wind market.¹⁰⁰ In the same month, Goldwind won an 80MW wind turbine supply contract in the Punta Sierra project in Northern Chile from Pacific Hydro (now owned by State Power Investment Corp of China).¹⁰¹ This is Goldwind's second Chile project, building on its 33MW Negrete project in Southern Chile.

In December 2016, Goldwind announced a strategic agreement for Apple Inc. that sees a new joint venture with Apple owning 30% stakes in 285MW of Chinese windfarms alongside Goldwind, with an associated green electricity supply agreement to Apple in China.¹⁰²

Envision Energy Jiangsu Co. Ltd. (Envision)

Envision is one of the largest wind turbine manufacturing companies in China, ranking in the top 10 globally as of the beginning of 2015. This private company has annual sales of some US\$2bn and is based in Shanghai but has an innovation centre in Silkeborg, Denmark, and a battery storage centre in Osaka, Japan. Other Envision overseas operations include a digital innovation centre in California, a "centre of excellence" in Hamburg, Germany, and an office in Mexico.¹⁰³

The company's Mexico presence allows Envision to capitalise on a renewable energy boom taking place in that country. Envision began its foray into Latin America in Chile. Envision has since entered into a joint venture with Mexican energy developer Vive Energia to invest US\$200m in two wind farms, the first of which is expected to be

⁹⁸ <https://solarthermalmagazine.com/2016/05/18/chinese-subsiary-acquires-160-mw-rattlesnake-wind-project-texas/>

⁹⁹ <http://www.whiterockwindfarm.com>

¹⁰⁰ <http://www.goldwindglobal.com/web/news.do?action=detail&id=201611031127172572>

¹⁰¹ <http://www.goldwindglobal.com/web/news.do?action=detail&id=201611290138343637>

¹⁰² <http://renewables.seenews.com/news/apple-to-take-part-in-chinese-wind-power-jvs-with-goldwind-549656>

¹⁰³ http://www.envisioncn.com/en/aboutus_intro.aspx

completed in 2017.¹⁰⁴ Envision entered the Mexican renewables market in October 2015 when it purchased a controlling stake in a 600MW wind energy portfolio owned by Vive Energia,¹⁰⁵ the largest Chinese direct investment in Mexico's renewable energy space. The investment takes advantage of bilateral cooperation agreements between the two countries.

IEEFA considers Mexico one of the most promising markets to invest in which to invest in renewable energy. The state's historic electricity-sector monopoly has been open to private-sector competition, and in March 2016, Mexico held its first electricity auction; initially over-subscribed by 15 times, the auction resulted in 16 wind and solar projects receiving energy supply contracts with a combined capacity of 2.1GW¹⁰⁶. Chinese firm JinkoSolar was one of the winners of the first auction, and Envision won a 90MW wind contract. Mexico aims to generate 35% of its electricity from clean sources by 2024.

Argentina aims to increase the share of renewables in electricity generation from 2% to 8% by 2017 and 20% by 2025. Under its RenovAR program, the country held its first renewable energy auction in July 2016. Envision Energy was awarded the largest contract, with four projects totalling 185MW of 708MW of wind generation allocated.¹⁰⁷ Argentina is still suffering financial difficulties and is considered too risky for investment by many U.S and European companies. This has not stopped Chinese investment. In addition to Envision's success in the first auction, 75% of the solar winners stand to benefit from low-cost Chinese capital as a result of agreements with provincial governments in Argentina.¹⁰⁸

Golden Concord Holdings Ltd (GCL)

GCL, with almost 30,000 employees, is one of the major solar PV manufacturers in the world with its subsidiary GCL System Integration Technology (GCL-SI) currently ranked as the sixth-largest global PV supplier.¹⁰⁹ Hong Kong-listed GCL-Poly Energy Holdings Ltd (GCL-Poly) and GCL New Energy Holdings Ltd are part of the group, which also has subsidiaries in Taiwan, the U.S., Canada, Singapore, Indonesia, Ethiopia and elsewhere.

Figure 8: Top 6 Global Solar Module Manufacturers, 2016

2016 ranking	Company	Country of HQ	2016 Guidance manufacturing range
1	JinkoSolar	China	6.6-6.7GW
2	Trina Solar	China	6.3-6.55GW
3	Canadian Solar	Canada	5.1-5.2GW
4	JA Solar	China	4.9-5.0GW
5	Hanwha Q CELLS	South Korea	4.8-5.0GW
6	GCL-SI	China	> 4.0GW

Source: PV-Tech

In early 2016, GCL-SI acquired a majority stake in Australian PV distributor One Stop Warehouse, noting a need to find new international markets as anti-dumping and anti-

¹⁰⁴ http://usa.chinadaily.com.cn/world/2016-05/09/content_25144579.htm

¹⁰⁵ <http://www.power-technology.com/news/newschinas-envision-energy-acquires-stake-600mw-wind-portfolio-based-mexico-4693767>

¹⁰⁶ Renewable Energy Country Attractiveness Index, Ernst and Young, May 2016

¹⁰⁷ <http://www.iea.org/policiesandmeasures/pams/argentina/name-158884-en.php>

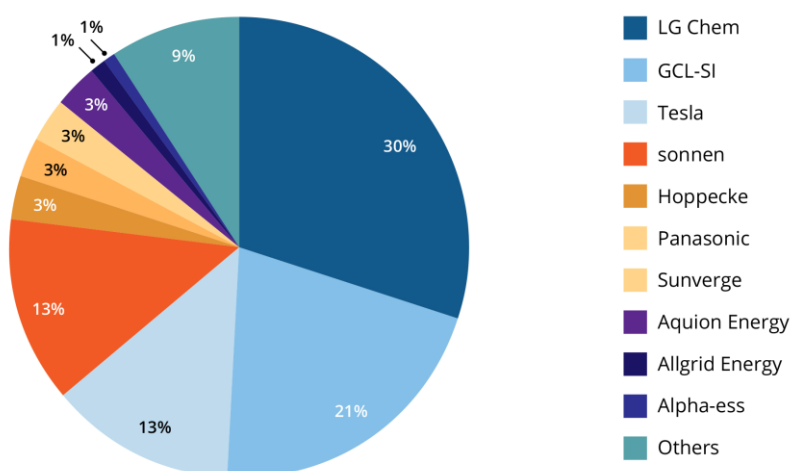
¹⁰⁸ <https://www.chinadialogue.net/article/show/single/en/9419-China-s-impressive-stake-in-Latin-America-s-renewables>

¹⁰⁹ <http://www.pv-tech.org/editors-blog/top-5-solar-module-manufacturers-in-2016>

subsidy policies in the European Union and the U.S. increased pressures on Chinese solar companies in those territories.¹¹⁰

GCL-SI has built up a 21% market share in the booming Australian battery storage sector, particularly in the distributed behind-the-meter home energy storage segment. (Several other global-economy competitors are investing in this rapidly emerging sector, including Korea (LG Chem and Samsung SDI), Japan (Panasonic), Germany (Sonnen and Hoppecke) and the U.S. (Tesla, Sunverge).¹¹¹

Figure 9: Australian battery storage market share, Jan-Jun 2016



Source: EuPD Research December 2016

In August 2016, GCL-Poly, the world's largest maker of polysilicon for solar cells, agreed to buy SunEdison's solar-material business for US\$150m.¹¹² GCL-Poly is a developer of solar PV generation projects and has been active in the U.S., particularly in California.¹¹³ As at the end of June 2016, GCL-Poly was a part owner of 150MW of solar farms in South Africa.

In November 2016, GCL-SI announced plans to partner with China National Complete Engineering Corporation (CCEC) to develop a 1GW solar PV plant at Chernobyl, the site of the nuclear disaster in Ukraine 30 years ago.¹¹⁴

JA Solar

JA Solar is one of the top six solar module manufacturers in the world (refer Figure 8). Founded in 2005 and listed on the NASDAQ in 2007, the company manufactures silicon wafer, cells and modules and is an investor, developer, builder and operator of solar PV power plants. JA has a global module manufacturing capacity of 5.5GW per year with a

¹¹⁰ <http://www.rechargenews.com/solar/867324/gcl-buys-australian-pv-distributor-one-stop-warehouse>

¹¹¹ <https://www.greentechmedia.com/articles/read/euro-gigafactory-rivals-line-up-against-tesla>

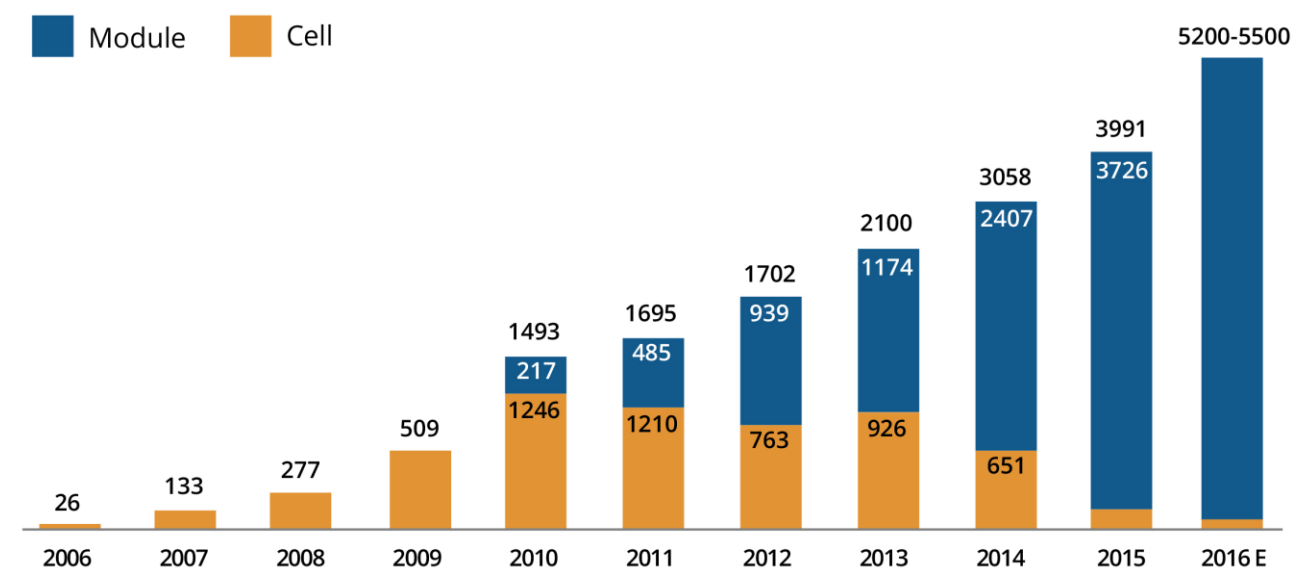
¹¹² <https://www.bloomberg.com/news/articles/2016-08-29/gcl-poly-to-buy-sunedison-s-material-business-for-150-million>

¹¹³ <https://www.americanprogress.org/issues/green/news/2015/07/30/118379/chinese-direct-investment-in-the-u-s-energy-economy/>

¹¹⁴ <http://reneweconomy.com.au/chinese-companies-plan-1gw-solar-plant-chernobyl-nuclear-site-23330/>

cumulative shipment of 17.5GW. Since 2010, the company has focused increasingly on sales outside of China, in 2015, 57% of revenues were generated from overseas customers.

Figure 10: JA Solar Annual Module and Cell Production (MW)



Source: JA Solar

In November 2016, JA Solar broke ground on its US\$1bn solar cell factory in Vietnam, which is expected to drive an additional US\$500m a year in revenue once fully operational.¹¹⁵ This and its already operating Malaysian plant are aimed especially at U.S. and European markets, where various trade barriers make cells and modules manufactured in China less competitive. Other Chinese Tier 1 solar PV companies have invested in overseas manufacturing plants for the same reasons.

In 2015, JA Solar and Essel Infraprojects Ltd signed a memo of understanding to construct a 500MW solar cell factory followed by a similar-size module plant in Andhra Pradesh, India.¹¹⁶

In early 2016, JA Solar signed a contract for construction of a 300MW manufacturing plant in Brazil,¹¹⁷ a move that supports its plans for expansion into Latin America. The company supplied 85MW for two projects in Guatemala in 2015. Also in 2015, JA entered into a joint venture with German developer Soventix to build large-scale solar projects in Chile¹¹⁸. Elsewhere in Chile, the El Romero solar PV project¹¹⁹ will soon become the largest solar PV plant in Latin America at 246MW and will use modules from JA Solar and another Chinese supplier, Hareon. Part of the plant's output will supply Google's Chilean Data Centre.

Expansion into Africa began in 2014 with a joint venture agreement with Powerway to open a 150MW module assembly plant in Port Elizabeth.¹²⁰ The agreement aimed to take

¹¹⁵ http://www.pv-magazine.com/news/details/beitrag/ja-solar-breaks-ground-on-1bn-vietnam-solar-cell-factory--reports_100027025/-axzz4S2QvoPfk

¹¹⁶ <https://www.bloomberg.com/news/articles/2015-09-01/ja-solar-essel-set-to-begin-building-solar-cell-module-plants>

¹¹⁷ http://www.pv-magazine.com/news/details/beitrag/ja-solar-orders-equipment-for-brazilian-solar-module-factory_100023252/-axzz49Tsy1Mgt

¹¹⁸ http://www.pv-tech.org/news/ja_solar_launches_chile_jv_with_soventix_1290

¹¹⁹ <http://www.accion-energy.com/areas-of-activity/photovoltaic/major-projects/el-romero-solar-pv-plant/>

¹²⁰ http://www.pv-tech.org/news/ja_solar_and_powerway_to_open_150mw_pv_module_assembly_plant_in_south_africa

advantage of the significant growth potential for solar PV in southern African includes an option to expand capacity to 600MW. In 2016, JA Solar was chosen as sole module supplier to the 86MW Orange Solar Project in Northern Cape, a project awarded under round 4.5 of South Africa's Renewable Energy Independent Power Producer Procurement Program (REIPPP). It is not clear whether the modules will be supplied from JA's Port Elizabeth plant.¹²¹

Zhongli Science and Technology Group Co Ltd

Zhongli Science and Technology Group Co., Ltd (Zhongli) is a Chinese company primarily engaged in the communications and photovoltaic industries. Zhongli's major products include cables, copper conductors, cable compounds, optical cables and other cables, marine cables, photovoltaic modules and solar cells.

In November 2015, integrated PV module manufacturer Zhongli Talesun Solar, a division of Zhongli, commenced production at its 500MW solar cell and module production plant in Thailand.¹²² Zhongli also announced plans to build 1GW of solar projects across Thailand by 2018.

JinkoSolar

JinkoSolar (NYSE: JKS) is expected to become the world's largest solar module producer in 2016 with 6.6-6.7GW of module shipments (refer Figure 8). The company employs 15,000 and has sales offices around the world. It has 16 overseas subsidiaries and has manufacturing plants in Malaysia, South Africa and Portugal in addition to those within China. Jinko claims the number one market share in Chile, Mexico, Brazil, South Africa and Italy—and in China itself. In addition to manufacturing, Jinko owns downstream solar PV generation projects in China with a combined capacity of 1.3GW.¹²³ In 2016, JinkoSolar was ranked 16th in Fortune magazine's 100 fastest growing companies in the world.¹²⁴

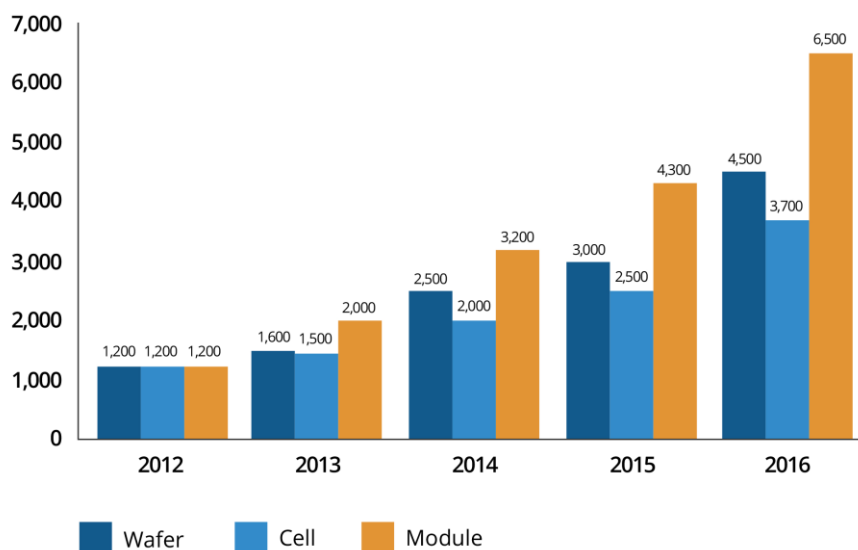
¹²¹ <http://www.htxt.co.za/2016/02/24/northern-cape-solar-power-plant-project-gets-a-supplier/>

¹²² <http://www.pv-tech.org/news/talesun-supplying-modules-to-96mw-us-pv-power-plant-from-thailand-facility>

¹²³ JinkoSolar Q3 2016 Earnings Call Presentation.

¹²⁴ <http://beta.fortune.com/100-fastest-growing-companies/list>

Figure 11: JinkoSolar Manufacturing Capacity (MW)



Source: JinkoSolar Q3 2016 Earnings Presentation

Jinko is playing a significant role in the boom in renewable energy development in Latin America as it looks for downstream generation project opportunities overseas. The company won a contract in 2016 for 241MW in Mexico's first Clean Energy Auction in which solar PV projects dominated.¹²⁵ Solar PV projects totalling 516MW were awarded in round 1.5 of Argentina's renewable energy tender program in 2015 with Jinko winning the 80MW Iglesia Guanzuli project in San Juan.¹²⁶

Jinko announced an agreement in early 2016 to supply 1GW of solar PV modules to U.S. independent power producer sPower, its largest contract in the U.S. to date.¹²⁷ More recently, Jinko has supplied 140MW of solar modules to the Minnesota North Star project. Also in 2016, Jinko announced that it is the supplier of modules to Kuwait's first integrated renewable energy project.¹²⁸

South Africa has become the entry point into the continent of Africa for Jinko, which has built a module manufacturing plant in Cape Town with an annual capacity of 120MW. The plant puts Jinko in a strong position to benefit from South Africa's renewable energy procurement plan. Jinko is also in position to gain from the likely increased uptake in solar projects across sub-Saharan Africa as renewable energy cost reductions increase the chances that the continent will leapfrog straight to clean energy sources.

Trina Solar

Trina Solar (NYSE: TSL) is a Tier 1 solar PV manufacturer expected to rank second in the world in 2016 with 6.3-6.6GW of solar modules shipped. The company has over 14,000 employees and has a cumulative shipment of 21GW of solar modules and cells. An investor consortium led by Trina's Chairman and CEO, Jifan Gao, is proposing to acquire

¹²⁵ <https://www.greentechmedia.com/articles/read/Solar-Stuns-in-Mexicos-First-Clean-Energy-Auction-1860-MW-Won-at-50.7-P>

¹²⁶ http://www.pv-magazine.com/news/details/beitrag/argentina--516-mw-of-solar-awarded-at-usd-5495-per-mwh_100027041/-axzz4Rv2oZXy8

¹²⁷ <http://www.pv-tech.org/news/order-focus-jinkosolar-to-supply-1gw-of-solar-modules-to-spower>

¹²⁸ http://www.jinkosolar.com/press_detail_1212.html

and delist the company for US\$1.1bn. A shareholder vote at an Extraordinary General Meeting in December supported the plan.¹²⁹

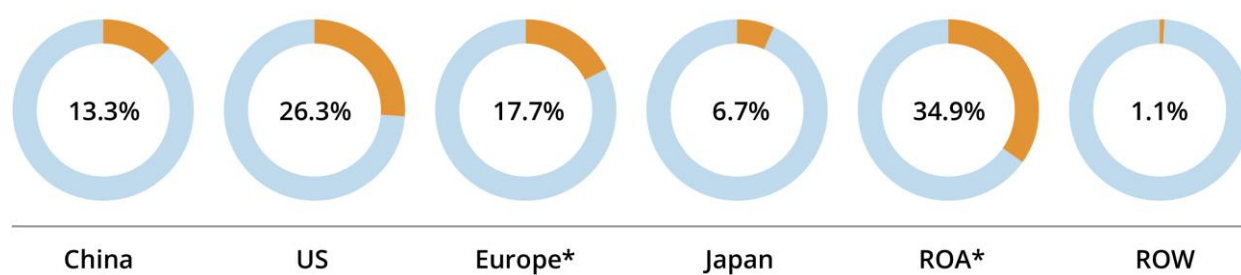
Like other Chinese Tier 1 solar module manufacturers, Trina has sales offices globally and regional headquarters in California, Zurich, Singapore and Tokyo. In addition to its production base in Changzhou, Trina has production facilities across China and in Malaysia, Thailand and the Netherlands.

Trina's 200MW Netherlands manufacturing plant, located in Heerlen, was acquired in February 2016 from Solland Solar. Chairman Jifan Gao said at the time that the acquisition was part of Trina's ongoing global expansion strategy which has a particular focus on Europe and the U.S.¹³⁰ The Heerlen plant increases Trina's production of non-tariff products in Europe and the U.S. Along with JinkoSolar, GCL-SI, JA Solar and others, Trina withdrew from the EU's minimum import price undertaking (MIP) in 2016 calculating that they are now better off incurring anti-dumping and anti-subsidy tariffs than operating within MIP rules. Also in February, Bloomberg New Energy Finance named Trina's solar modules as the most bankable in the industry.¹³¹

The company also has a number of downstream solar generation projects in China totalling just over 1GW of capacity. Trina also has 31MW of utility-scale capacity in Europe and 4MW in the U.S. In addition to operating solar generation projects under PPAs and other contractual arrangements, the company also sells completed solar projects to third party buyers.

Trina is also an important investor in research and development overseas: the Australian Centre for Advanced Photovoltaics based at the University of New South Wales recently reported a 12.1% efficiency rating for a 16cm² perovskite solar cell.¹³² The research was partially funded by Trina Solar and has achieved a record high efficiency for a perovskite solar cell on a larger glass substrate.

Figure 12: Train Solar Q3 2016 Module Sales by Region



Source: Trina Solar Q3 2016 Earnings Presentation

*Europe includes Turkey, ROA includes India

¹²⁹ <http://www.pv-tech.org/news/trina-solar-shareholders-vote-overwhelmingly-for-privatisation>

¹³⁰ http://www.pv-magazine.com/news/details/beitrag/trina-solar-acquires-200-mw-dutch-solar-cell-factory-from-solland-solar_100023334/-axzz4QyXZepih

¹³¹ <https://about.bnef.com/pv-module-bankability-2016-quality-on-the-rise/>

¹³² <http://www.pv-tech.org/news/suntech-and-trina-solar-funding-unsw-perovskite-rd>

Canadian Solar

Although Canadian Solar has its headquarters in Canada, the great majority of its solar module and cell manufacturing capacity is located in China.

In December 2016, Canadian Solar opened a 350-400MW solar module assembly plant operated by electronics subcontractor Flextronics International. The plant is designed to meet local content rules for low-cost project financing for PV power plants being built in Brazil. The module assembly plant is one of the first in Brazil to start operating and the largest to date. Canadian Solar has a portfolio of 390 MW of solar projects in Brazil that are expected to enter commercial operation in 2017 and 2018. The new plant will supply the products for Canadian Solar projects and for the domestic market. Canadian Solar previously won auctions to build three PV power plants in Pirapora and Vazante, in the state of Minas Gerais. The 191.5MWp Pirapora I project is due to be operational in the third quarter of 2017.¹³³

Power Construction Corporation of China (PowerChina)

The Power Construction Corporation of China (PowerChina) is a state-owned entity that provides planning, design, construction and consultancy in hydropower, renewable energy, thermal power and infrastructure. Ranked 200 in the Fortune Global 500 in 2016, the group had assets of US\$77bn and 210,000 employees as at the end of January. As at the beginning of 2016, the company had completed 1,863 projects overseas across 116 countries. Much of PowerChina's overseas projects are completed under its international branding, which includes Sinohydro, SEPCO, HydroChina and HYPEC.

Sinohydro develops transport and water infrastructure and major building works in addition to energy projects. Much of Sinohydro's construction work takes place in Africa, which is the largest market for many Chinese state-owned energy and construction companies. Such companies dominate the sub-Saharan energy market, with Sinohydro being the largest of all. Five Chinese companies added three-quarters of the Chinese-built generation capacity from 2010 through 2015¹³⁴ (refer Figure 13). Sinohydro itself had 24 projects over this period with a total capacity addition of 3.8GW. Another PowerChina subsidiary, SEPCO is also on the list, with four projects for a total of 1.8GW.

¹³³ <http://www.pv-tech.org/news/canadian-solar-starts-ramping-first-module-assembly-plant-in-brazil>

¹³⁴ IEA, Boosting the Power Sector in Sub-Saharan Africa: China's Involvement, 2016

Figure 13: Main Chinese Power Plant Contractors in sub-Saharan Africa, 2010-15

Company	Parent company	Number of projects*	Average scale (MW)	Total capacity added (MW)
Sinohydro	PowerChina	24	160	3 832
Gezhouba	CEEC	7	379	2 654
CNEEC	Sinomach	5	204	1 020
CWE	CTGC	5	368	1 838
SEPCO	PowerChina	4	448	1 790

* Completed or under construction.

Notes: CEEC = China Energy Engineering Corporation; CTGC = China Three Gorges Corporation.

Source: IEA

In the Democratic Republic of Congo, Sinohydro is part of a Chinese consortium along with China Three Gorges competing with Spanish and South Korean and Canadian consortia to win a contract for the Inga III dam. The project would add 5GW of capacity, and South Africa has signed an agreement for offtake of 2.5GW.¹³⁵ The US\$14bn project looked close to proceeding in early 2016¹³⁶ but has been delayed after the World Bank withheld funding. Inga III is part of the Grand Inga Project, a highly controversial plan to build a series of six phases with a combined capacity of 44GW, almost twice the capacity of the Three Gorges Dam.

In May 2016 China granted a credit line to be used to finance an energy distribution project supplying 420,000 residences in the Angola provinces of Cabinda, Huambo, Huila and Luanda, in all a total investment of US\$840m.¹³⁷ Four Chinese companies have been selected and approved by a presidential order signed to carry out the development. SinoHydro Group will be responsible for the contract of electrification to 337,500 homes in the city of Luanda (the capital city of Angola), requiring an investment of US\$675m. China Machinery Engineering Corporation (CMEC), was selected to ensure electricity distribution to 30,000 homes in the city of Huambo, with an investment of US\$60m. China's CBITEC won a US\$60m bid to implement the infrastructure distributing electricity to 30,000 homes in the city of Cabinda. The last presidential order, attributing US\$45m to the Chinese Tiesiju Civil Engineering Group, is to ensure distribution of electricity to 22,500 residences in the cities of Lubango and Matala in the province of Huila.

In June 2016 SinoHydro agreed to invest US\$533m in an additional 300MW capacity in Zimbabwe's 750MW Kariba hydroelectricity power plant, with commissioning due December 2017.¹³⁸

PowerChina has built hydropower installations across Asia, including in Malaysia, Laos and Cambodia. Sinohydro is currently constructing the 1.4GW Tarbela 4 hydropower plant in Pakistan. In October 2016, it commissioned a 30MW wind farm in Pakistan. The company also plans to build the 1.4GW Hat Gyi Dam in Myanmar, which is to provide power into the Thai electricity market. Sinohydro is to design and build a 24MW wind farm in northeast Thailand after having won the contract in late 2016.¹³⁹ In Laos, having commissioned the 120MW Nam Ngum 5 Hydropower for US\$220m in 2012, the company has commenced

¹³⁵ IEA, Boosting the Power Sector in Sub-Saharan Africa: China's Involvement, 2016

¹³⁶ <https://www.theguardian.com/environment/2016/may/28/construction-of-worlds-largest-dam-in-dr-congo-could-begin-within-months>

¹³⁷ <http://www.angola-today.com/news/chinese-credit-electrification/>

¹³⁸ <http://www.herald.co.zw/kariba-hydro-power-project-on-course/>

¹³⁹ <http://renewables.seenews.com/news/sinohydro-bags-24-mw-wind-job-in-thailand-539047>

the first of seven cascade hydropower projects developed in the Nam Ou River basin, with a total planned capacity of 1.1GW.¹⁴⁰

In Latin America, PowerChina was responsible for the 1.5GW Coca Codo-Sinclair hydropower plant in Ecuador. More recently, PowerChina has won a 100MW wind project in Argentina's round 1.5 of its RenovAR renewable energy program¹⁴¹ as the company adds new renewable technology development to its already dominant position in hydropower.

Cheung Kong Infrastructure Holdings Ltd (HK (CKI))

Hong Kong's billionaire Li Ka-shing holds (via CKH Holdings strategic stake in Hutchison Whampoa Limited) a 76% stake in Cheung Kong Infrastructure Holdings Ltd (CKI), a global infrastructure conglomerate investing in energy, transportation, water, waste and EFW infrastructure assets.¹⁴² Listed in Hong Kong in 1996, it has a market capitalization of HK\$170bn (US\$22bn), with 2016 1HCY2016 of net profit running at an annualised HK\$11bn (US\$1.4bn).¹⁴³

CKI has a significant U.K. (55% of 1HCY2016 gross profits), Hong Kong (23%) and Australia (11%) portfolio, plus smaller investments in China, Canada (Canadian Power, which operates 1.4GW of gas-fired cogeneration plants), New Zealand (Wellington Electricity, an electricity distributor acquired for NZ\$0.8bn and EnvironZ, a leading waste management company acquired for NZ\$0.5bn) and Europe.¹⁴⁴

In the U.K., CKI owns a direct 40% of U.K. Power Networks (acquired for £5.8bn), 40% of Northumbrian Water (acquired for £4.8bn), 47% of Northern Gas Networks, 30% of Wales & West Gas Networks (acquired for a collective £3.4bn), and 25% of Seabank's 1.1GW gas-fired power plant (acquired for £0.2bn). In April 2015, it created a joint venture with CKH Holdings to acquire Eversholt Rail, one of the three major U.K. rolling stock (railway) companies for £2.5bn.

CKI Holdings also owns a 39% stake in Power Assets Holding (PAH), formerly known as Hongkong Electric Holdings, which was the sole electricity generation firm in Hong Kong until these assets divested via a Hong Kong IPO in 2014 (retaining a 33% stake). Power Assets retains generation assets and electricity transmission assets in North America, the U.K. (owning 40% of UK Power Networks, 30% of Wales & West Gas Networks, 25% of Seabank Power and 41% of Northern Gas Networks all alongside CKI), Asia and Australasia.

In Australia, CKI has been active since 1999 in the thermal power sector and now owns 23% (51% inclusive of PAH) of SA Power Networks (acquired for an initial A\$3.4bn, it undertakes electricity distribution across South Australia), 23% (51% inclusive of PAH) of Victoria Power Networks (an electricity distribution network acquired for a collective enterprise value of A\$3.7bn), a 45% stake (73% inclusive of PAH) in Australian Gas Networks (acquired for A\$4.6bn and fully privatised in 2014) and a 6.7% stake in Spark Infrastructure.

¹⁴⁰ http://www.chinadaily.com.cn/m/powerchina/2013-06/27/content_16683175.htm

¹⁴¹ <http://renewables.seenews.com/news/argentina-awards-1-282-mw-in-renovar-1-5-tender-548539>

¹⁴² As at 30 September 2016, converted at HK\$7.8/USD

¹⁴³ http://www.cki.com.hk/english/PDF_file/announcement/2016/20160728_1.pdf

¹⁴⁴ http://www.cki.com.hk/english/PDF_file/ir_presentation/20160728_1.pdf

In 2013, CKI/PAH acquired a 55% stake in Dutch Enviro Energy (EfW) for €0.94bn.

In late 2015, CKI (in a joint venture with Power Assets) acquired Iberwind for €978m, a leading wind farm owner-operator in Portugal, with 684MW of capacity across 31 wind farms.

In December 2016, CKI announced a A\$7.3bn (US\$5.4bn) all-cash offer for the Australian-stock-exchange-listed DUET Group, which owns the 2,000km Dampier-to-Bunbury gas pipeline of Western Australia, a stake in Victorian electricity distribution company United Energy, the gas distribution company Multinet, and Energy Developments.¹⁴⁵ This follows a setback in August 2016 when CKI (as part of a Chinese consortium) was knocked back from bidding for the NSW state-owned electricity distribution company Ausgrid.

China Light & Power Holdings (HK (CLP))

Hong Kong's largest power generation company, founded in 1901 and listed in 1998. CLP has a market capitalisation of US\$26bn. As of June 2016, the group operated 23GW of generation capacity across all fuel sources (62% coal, 17% gas, 17% renewables and 3% nuclear) in Hong Kong, China, India, Southeast Asia, Taiwan and Australia. CLP sees Hong Kong, China and India as its primary growth markets, with Southeast Asia and Taiwan as secondary growth markets.

CLP is looking either to restore value in its Australian generation and electricity retailing business by IPO or exit if possible. CLP Australia (EnergyAustralia) operates 583MW of wind farms in addition to its 4.4GW of thermal power generation capacity.

In December 2016, CLP's EnergyAustralia announced plans to sign PPAs for 500MW of Australian renewable energy projects worth A\$1.5bn (US\$1.1bn).¹⁴⁶

CLP India is one of the largest private investors in wind farms. Existing projects in Rajasthan and Tamil Nadu have been expanded by the early 2016 commissioning of a new windfarm in Madhya Pradesh, bringing total Indian wind capacity to 1,025MW as at June 2016 (90% of this is commissioned, with the 101MW Yermala project under construction). CLP India's total assets are HK\$17bn with operating earnings of HK\$612m in 2015.¹⁴⁷

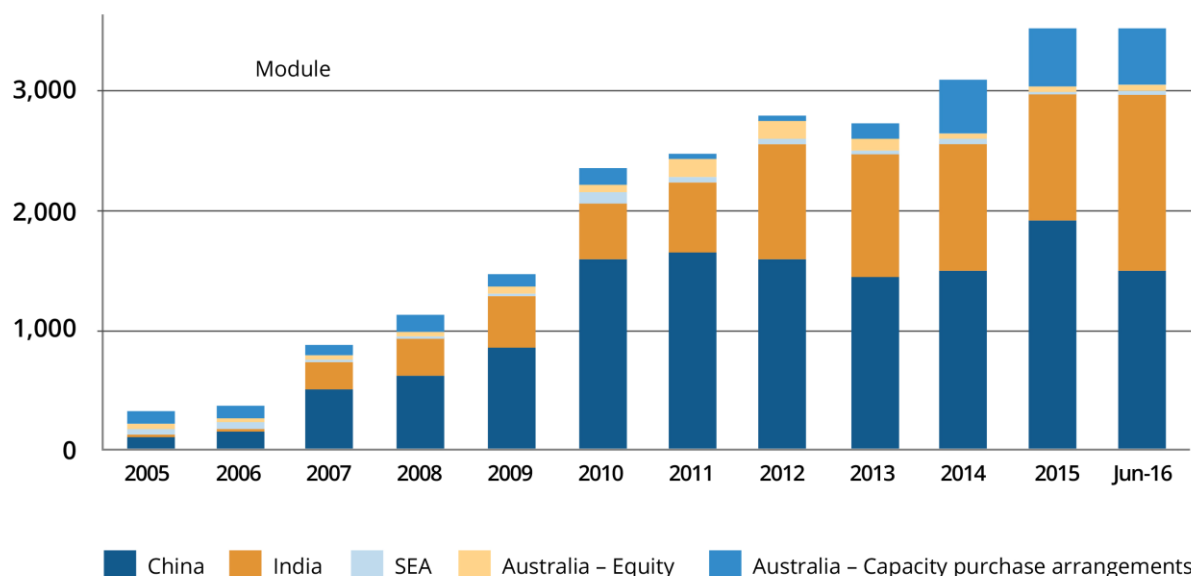
In June 2016, CLP entered into the Indian solar sector by buying into a 49%/51% joint venture with Suzlon of India to build the 100MW Veltor solar project, due for commissioning in March 2017 (CLP has an option to acquire Suzlon's 51% interest). In 2016 CLP also signed a MoU for a new 132MW solar project at Jhajjar in Haryana.

¹⁴⁵ <https://www.bloomberg.com/news/articles/2016-12-04/billionaire-li-ka-shing-bids-5-4-billion-for-australia-s-duet>

¹⁴⁶ <http://renewables.seenews.com/news/energyaustralia-to-seal-wind-and-solar-ppas-worth-usd-1-1bn-549628>

¹⁴⁷ <https://www.clpgroup.com/en/Investors-Information-site/Analyst%20Brief%20Document/CLP%20Holdings%20Introductory%20Pack.pdf>

Figure 14: CLP's Renewable Energy Portfolio – Equity Share & PPAs (MW)



Source: CLP Holdings Corporate Presentation, September 2016

CLP has also developed a 63MW solar project in Thailand in a 33%/67% joint venture with Electricity Generating Public Company that was commissioned in 2013. CLP targets 20% of its generation will come from renewables by 2020.

Tianqi Lithium Industries (“Tianqi”)

Tianqi is China's leading lithium company, with a market capitalization of US\$5.5bn.¹⁴⁸ It is 36% owned by Chengdu Tianqi Industry Group. Founded in 1995 and listed on the Shenzhen Stock Exchange in 2010, Tianqi is the world's largest lithium producer utilizing hard-rock feed, offering a wide range of lithium products including battery-grade and technical-grade lithium carbonate, lithium hydroxide, lithium chloride and lithium metal. Tianqi owns 51% of Talison and is the sole distributor of technical-grade lithium concentrate for Talison in China.

Tianqi is the 51% majority owner of the 65,000tpa Talison Lithium mine at Greenbushes in Western Australia, which produces about a quarter of the world's lithium supply. Tianqi acquired Talison for A\$800m in 2012¹⁴⁹ and then sold a 49% stake to Albermarle for US\$475m in 2014.¹⁵⁰

In 2015, the global lithium market was estimated to be 170,000 tonnes, and demand is forecast to nearly double by the end of this decade and to quadruple by 2025.¹⁵¹

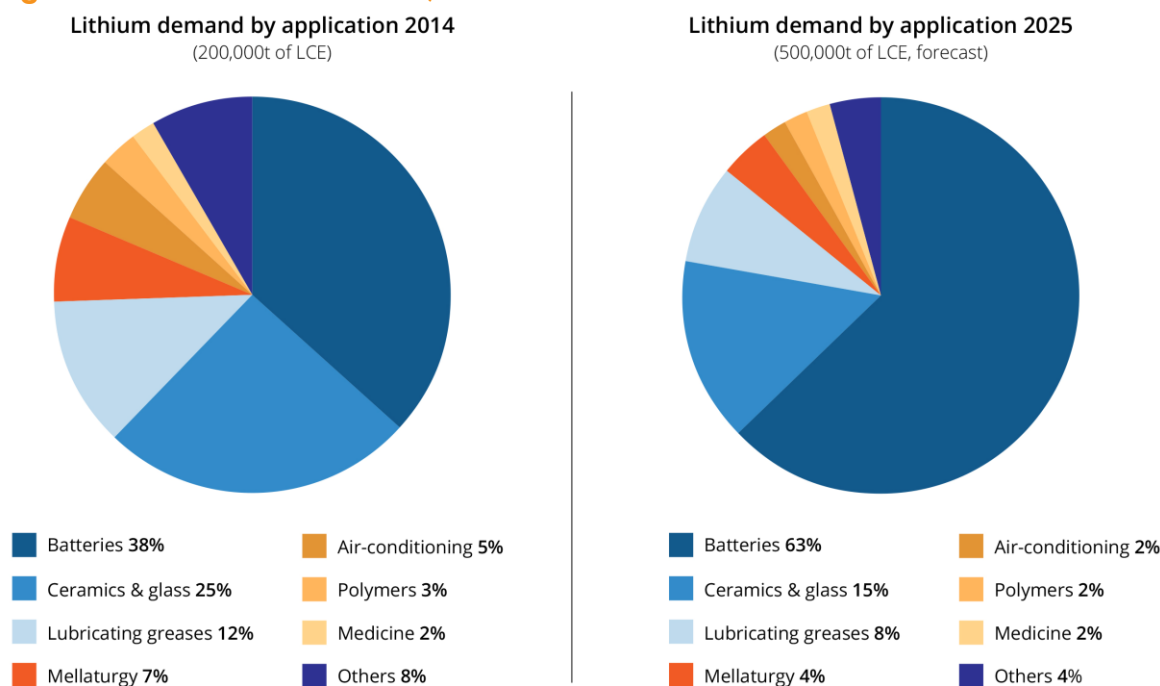
¹⁴⁸ Calculated on 2 December 2016 using a share price of Rmb38/share, 994m shares and a US\$/Rmb6.88 exchange rate.

¹⁴⁹ <http://www.theaustralian.com.au/business/mining-energy/talison-lithium-backs-815m-chinese-takeover/story-e6frg9df-1226532473917>

¹⁵⁰ <http://www.businesswire.com/news/home/20140528005569/en/Rockwood-Completes-Acquisition-49-Interest-Talison-Lithium>

¹⁵¹ <http://www.businessinsider.com.au/the-facts-and-fiction-of-the-lithium-mining-boom-in-australia-2016-8>

Figure 15: Lithium end markets, 2014 vs 2025¹⁵²



Source: signumBox estimates

The other three major producers are Albermarle (US), which has the other 49% of the Talison Lithium mine at Greenbushes, SQM (Sociedad Quimica y Minera) in Chile and FMC Lithium (U.S.). According to Deutsche Bank, these four firms accounted for about 83% of global production in 2015.

In April 2015, Tianqi paid US\$230m to acquire the Australian Stock Exchange-listed Galaxy Resources Ltd's Jiangsu Lithium Carbonate Plant I in Zhangjiagang, Jiangsu.¹⁵³ This gave Tianqi control of the world's largest battery-grade lithium carbonate production base with the highest degree of automation.

In September 2016, Tianqi Lithium announced plans to build a A\$400m (US\$300m) lithium manufacturing facility in Kwinana, Western Australia.¹⁵⁴ The plant will take ore from the Greenbushes mine to produce 24,000tpa of lithium hydroxide, boosting Tianqi's processing capacity by more than 50%.

Also in September 2016, Tianqi acquired a US\$210m stake in Chilean-based rival SQM.¹⁵⁵ Tianqi bought a 2% stake with an option on another 7%, and signed a non-binding agreement with Soc. de Inversiones Oro Blanco SA to acquire a further 23% stake in SQM (at the price of the first 2%, this 23% stake is valued at US\$2.3bn).¹⁵⁶ SQM is one of the four largest lithium companies globally (a global market share of 26%, producing 44,000t in 2015 generating revenues of US\$315m), but also produces potassium, specialty plant nutrients and iodine.

¹⁵² <http://www.afr.com/personal-finance/shares/the-hot-commodities-with-leverage-to-the-electric-vehicles-boom-20161030-gsecjk>

¹⁵³ <http://www.asx.com.au/asxpdf/20140430/pdf/42p8t1th24tgkw.pdf>

¹⁵⁴ <http://fortune.com/2016/09/06/tianqi-lithium-plant-australia/>

¹⁵⁵ <https://www.bloomberg.com/news/articles/2016-09-26/tianqi-s-search-for-lithium-sources-sends-chile-s-sqm-soaring>

¹⁵⁶ <http://www.afr.com/business/mining/chinas-tianqi-looking-beyond-lithium-bubble-with-400m-plant-20161011-gs0ag3#ixzz4RTaXTbNC>

Rare Earths Sector

In some respects, the rare earth sector doesn't quite fit the theme of this report. China already controls 90% of rare earth production globally, and domestic Chinese industry consumes 70% of all rare earth production.¹⁵⁷ In other respects, the rare earth industry profile provides a perfect case study of China's long-term industry-development vision, combined with patience and continued investment in research and development to drive technology leadership, as well as ill-disciplined pricing.

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. Rare earths, then, are a small but critical component in the production of a wide range of products that includes electric vehicles, wind turbines, solar modules, electronic devices critical for military applications, and so on.

Thirty years ago the U.S. was both the world's technology leader and the largest producer and processor of rare earths, principally from the enormous Mountain Pass mine in California. Over time, the Mountain Pass mine's higher-quality ore was progressively depleted as China progressively acquired/built up its capacity in both mining and downstream processing. By 2010, China dominated global rare earth supply and used its monopolistic position to require downstream processing be undertaken within China. A prolonged supply squeeze at the start of this decade saw rare earth prices rise by as much as tenfold.

2010 saw a U.S.-listed company, Molycorp, raise US\$1.7bn in debt and equity financing to recommission the Mountain Pass mine. Molycorp also spent US\$1.3bn in 2012 at the height of the rare earth price boom to acquire the largest non-Chinese downstream processor of rare earths, the then-Canadian-listed company Neo Materials Technologies.¹⁵⁸ When the rare earth price bubble then burst, Molycorp was left with excessive leverage and a half-commissioned mine, going into Chapter 11 in 2015.¹⁵⁹ Neo Performance Materials was spun out in August 2016, absent Mountain Pass, which remains idle.¹⁶⁰

China Northern Rare Earth Group High-tech Co Ltd (previously called Inner Mongolia Baotou Steel Rare-Earth Hi-Tech Company)¹⁶¹ and China South Rare Earth Group¹⁶² were created in 2015 through a consolidation of a myriad collection of smaller Chinese rare earth companies. These two state-owned enterprises now control the global rare earth industry, with Lynas Corp. of Australia holding a 5% share of upstream supply and Neo Materials the only materially independent downstream firm.

¹⁵⁷ <http://www.mining.com/chinese-rare-earth-giant-born-62354/>

¹⁵⁸ <http://www.reuters.com/article/us-molycorp-idUSBRE82800T20120309>

¹⁵⁹ <http://www.wsj.com/articles/molycorp-bankruptcy-auction-flop-stirs-bondholder-rancor-1457473434>

¹⁶⁰ <https://globenewswire.com/news-release/2016/08/31/868672/0/en/Molycorp-Inc-Emerges-from-Chapter-11-as-Neo-Performance-Materials.html>

¹⁶¹ <http://www.mining.com/chinese-rare-earth-giant-born-62354/>

¹⁶² http://www.china.org.cn/business/2016-06/29/content_38779521.htm

Asian Infrastructure Investment Bank

Initiated by China in 2013, The Asian Infrastructure Investment Bank (AIIB) is a multilateral development bank with 57 founding member states that include countries around the world (Japan and the U.S. are the only major economies that are not members). The bank became operational in December 2015 with a capital base of US\$100bn, about half that of the World Bank and two-thirds that of the Asian Development Bank (ADB). China has contributed one-third of the capital of AIIB and holds a 29% share of the vote¹⁶³. This compares to an ADB vote share of 5.5% by China, which is dwarfed by Japan and the U.S. which have close to 13% each.

In October 2016, the AIIB published an Issue Note for discussion on the subject of sustainable energy as it sought stakeholder input for the preparation of its draft Energy Strategy¹⁶⁴. The note recognised the need to cater to energy growth in Asia whilst transitioning toward a lower-carbon future. It identified energy efficiency and renewable energy as key areas of focus for the bank. Moreover, the note states an intention to focus on hydro power ahead of solar and wind, a sector where Chinese companies dominate. In addition, power distribution and transmission is identified as an area of importance, which is likely to prove beneficial to Chinese power companies that are already investing internationally in this area. Financing of nuclear power has been ruled out for now and the Issue Note states that the funding of coal-fired power generation will occur only in exceptional and specific circumstances.

The AIIB sees a need to catalyse private capital in the same way the World Bank, the Asian Development Bank and the African Development Bank are doing in support of renewable generation projects. With China holding the major share of voting rights in the AIIB, it seems likely that many of the Chinese companies outlined in this report will benefit from AIIB investments in renewable energy projects.

New Development Bank

Formerly known as the BRICS Development Bank, the New Development Bank (NDB) was set up by the BRICS nations (Brazil, Russia, India, China and South Africa) as a multilateral development bank focusing on, but not limited to, funding infrastructure projects. Unlike the Asian Infrastructure Investment Bank, the NDB has equal voting rights among its five members (each contributed US\$10bn giving a US\$50bn capital base, slated to increase to US\$100bn over time). In 2016, the NDB prioritized renewable energy projects¹⁶⁵, and its first round of funding was dedicated to renewable projects across the BRICS¹⁶⁶.

¹⁶³ <http://www.aiib.org/html/aboutus/governance/MoB/?show=1>

¹⁶⁴ Asian Infrastructure Investment Bank, AIIB Energy Strategy: Sustainable Energy for Asia, Issue Note for Discussion, October 2016.

¹⁶⁵ <http://www.ndb.int/brics-bank-to-prioritize-renewable-energy-projects-official.php>

¹⁶⁶ <http://mg.co.za/article/2016-04-21-brics-bank-backs-renewable-energy>

Figure 16: Projects Receiving First Round of NDB Funding

Project	Loan amount
National financial intermediary project for renewable energy in Brazil	US\$300m
National financial intermediary project for renewable electricity installations in India	US\$250m
Renewable energy transmission project in South Africa	US\$180m
Hydropower and green energy project in Russia	US\$100m
Smart new energy trial project in China	US\$81m

Source: NDB, Chinadialogue

The NDB adds to the ranks of multilateral development banks focusing on renewable energy. With more funding available for such projects, China stands to benefit from the advantage it has gained already in the BRICS nations. Chinese companies have made major investments in Brazil and are increasingly present in South African, where Chinese companies have set up solar module plants. India's ambitious solar PV roll-out is highly dependent on Chinese manufacturing, with over 87% of solar module imports coming from China.¹⁶⁷

China Huaneng Group

China Huaneng Group (CHNG) is one of the five largest state-owned electricity utility companies in China, with 83GW of generation capacity as of December 2016. The group's move into overseas markets began early; a subsidiary, Huaneng Power International (HPI), acquired Singapore power generator Tuas Power in 2008 for US\$3bn, which included 2.6GW of generation capacity. CHNG bought 50% of Australian energy company OzGen for US\$227m in 2003, and in 2011 entered into a joint venture to acquire 50% of Boston-based power plant developer and operator InterGen for US\$1.2bn.

CHNG owns a controlling stake in Hong Kong listed Huaneng Renewables Corp., with 10.8GW of renewable energy capacity installed across China (93% wind, 7% solar) as of June 2016, up 20% or 1.8GW on June 2015. To date, Huaneng Renewables Corp. has yet to invest outside of China. Huaneng Renewables Corp. focuses on the development and operation of renewable energy projects, principally wind energy. With the company slowing development of renewable projects in China after power price cuts¹⁶⁸, it may be poised to expand into international markets, a stated intention toward becoming an internationally competitive renewable energy provider.¹⁶⁹

In 2014, CHNG acquired a 51% stake in Cambodia Se San River II Hydropower Co., Ltd. The project takes the form of BOT, and the cooperative operation period is 40 years post construction. The first generator unit will go into operation by the end of 2017. The Se San

¹⁶⁷ <http://energy.economictimes.indiatimes.com/news/renewable/indias-87-solar-cell-imports-from-china-in-apr-sept-piyush-goyal/55875335>

¹⁶⁸ <http://www.scmp.com/business/companies/article/1926376/chinas-huaneng-renewables-slows-down-expansion-after-power-price>

¹⁶⁹ Huaneng Renewables Corporation Ltd, Annual Report 2015, p. 6.

River II Hydropower Project is in the Westmount District, Stung Treng Province, Cambodia. The power station has an installed capacity of 400MW.¹⁷⁰

China Datang Corporation

China Datang Corporation is one of the five largest state-owned power generation companies in China. The group has several listed subsidiaries. Datang International Power Generation Co. Ltd has total assets of over US\$45bn and 42GW of installed generation capacity across China (31GW of coal fired power, 6GW of hydroelectricity, 3GW of thermal combustion capacity and 2GW of wind power).¹⁷¹ Datang's subsidiary China Datang Corporation Renewable Power Co. was listed on the Hong Kong stock exchange in 2010 and operates 7.3GW of renewable energy projects. Facing a slowdown in the domestic market, Datang is considering international opportunities along with other Chinese power generators. The deputy general manager of Datang subsidiary China Datang Renewable Power has indicated that Datang is likely to seek projects abroad as domestic installation is likely to decline in 2018 and 2019.¹⁷² The company is particularly targeting North and South America and Australia for new opportunities.

In October 2016 Datang Corporation Renewable Power Co issued Rmb500m of green bonds, 5-year duration offering a 3.1% pa interest rate.¹⁷³

State Development and Investment Corporation

Established in 1995, the State Development and Investment Corporation (SDIC) is a state-owned investment holding company with US\$75bn in total assets, 74,000 employees and 2015 revenues of US\$15.9bn. Its strategic business sectors include an international business unit for overseas direct investment and international engineering contracts. Other strategic units include infrastructure (including power generation and rare earths), emerging industries and financial services.

In 2016, SDIC acquired the rights to the 784MW Inch Cape offshore wind project and a 25% stake in the 664MW Beatrice offshore wind project from Repsol for €238m.¹⁷⁴ Both projects are located off the east coast of Scotland. SDIC has stated an intent to find further investment opportunities as Scotland, which aims for renewable sources to generate the equivalent of 100% of gross annual electricity consumption by 2020. SDIC subsidiary Red Rock Power Ltd has recently opened new offices in Edinburgh.¹⁷⁵

SDIC Power Holdings Co. is reported to be among the bidders for Canadian renewable energy producer Northland Power Inc.¹⁷⁶ Northland, which owns or has investments in power generation facilities in Canada, Germany and the U.S., is valued at around US\$2.8bn. China Three Gorges Corp. is also thought to be a bidder.

¹⁷⁰ <http://english.cec.org.cn/No.106.1533.htm>

¹⁷¹ <http://upload.dtpower.com/2016/0429/1461940590711.pdf>

¹⁷² <http://www.scmp.com/business/china-business/article/2039364/chinese-renewable-energy-firms-look-abroad-growth-offset>

¹⁷³ <http://www.hkexnews.hk/listedco/listconews/SEHK/2016/1024/LTN20161024537.pdf>

¹⁷⁴ <http://www.windpoweroffshore.com/article/1385190/chinas-sdic-acquires-uk-offshore-projects-repsol>

¹⁷⁵ <http://www.renewableenergymagazine.com/panorama/scottish-first-minister-welcomes-sdic-to-scotland-20161116>

¹⁷⁶ <https://www.bloomberg.com/news/articles/2016-12-05/china-three-gorges-sdic-said-among-bidders-for-northland-power>

China National Building Materials (CNBM)

The state-owned China National Building Materials (CNBM) acquired the German CIGS thin-film manufacturer Avancis in September 2014. Avancis reported in May 2016 that its solar module technology had achieved an ESE certified record 17.9% efficiency.

In October 2015, Avancis announced plans to build a US\$1.62bn 1.5GW solar module manufacturing facility in Bengbu, Anhui Province, in China. Avancis is part-funding the project via its engineering and project development branch CTIEC, with partners Bengbu Investment Group and the Bengbu Gaoxin Investment Group also stumping up capital.¹⁷⁷

In June 2016, specialist PV manufacturing equipment supplier Singulus Technologies signed an equipment supply contract worth €110m (US\$123m) for CIGS (cadmium-free) thin-film production solar equipment for two 300MW CIGS production plants and a 150MW pa CdTe fabrication plant to be built in China using technology from Avancis for CNBM's entry into building integrated solar) BIPV and BAPV markets in 2017.¹⁷⁸

Avancis was a previous customer of Singulus for its current 100MW pa manufacturing facility in Torgau, Germany, which supplies CIGS modules for the European market.

CNBM has ambitions to expand CIGS production to 10GW in China and 5GW overseas.

ZHEFU Hydropower

Zhejiang Fuchunjiang Hydropower Equipment Company Ltd (ZHEFU Hydropower), is part of the ZHEFU Holding Group Company Ltd, which is listed on the Shenzhen Stock Exchange. The group has hydropower, nuclear energy, oil and gas businesses, amongst others. ZHEFU Hydropower has evolved from a hydro turbine-generating unit supplier to an EPC supplier and has been increasingly involved in overseas markets.

ZHEFU Hydropower owns 18% of Genex Power, an Australian-listed entity which is about to embark on an A\$120m 50MW solar PV project in north Queensland and intends to follow with a 250MW pumped-storage hydro project in 2017.¹⁷⁹

In July 2016 it was reported that ZHEFU Holdings will invest in the Rmb11bn / US\$1.67bn¹⁸⁰ 510MW Badan Tulu Indonesian hydropower project after purchasing 97% of Indonesia's PT. Dharma Hydro Nusantara for US\$57m.¹⁸²

¹⁷⁷ Read more: http://www.pv-magazine.com/news/details/beitrag/china-owned-cigs-manufacturer-avancis-breaks-ground-on-15-gw-fab_100021614/#ixzz4SqzO80al

¹⁷⁸ <http://www.pv-tech.org/news/singulus-receives-further-cigs-thin-film-equipment-pre-payment-from-china>

¹⁷⁹ http://www.genexpower.com.au/uploads/6/6/1/2/6612684/capital_raising_presentation.pdf

¹⁸⁰ <http://af.reuters.com/article/energyOilNews/idAFL4N19T1PQ>

¹⁸¹ <http://www.cninfo.com.cn/finalpage/2016-07-07/1202457715.PDF>

¹⁸² <http://www.4-traders.com/ZHEFU-HOLDING-GROUP-CO-LT-6500281/news/Zhefu-Takes-Control-of-Indonesia-Hydropower-Project-22572784/>

Zonergy

Zonergy is the renewable energy unit of Shenzhen-based telecommunications equipment giant ZTE. Zonergy has built over 900MW of solar farms in China and abroad. Zonergy began its venture into renewable energy by building solar farms at telecoms base stations that are not connected to the power grid.

Zonergy has committed to a US\$1.5 billion, 900 MW project in Pakistan's Punjab province, of which a third has been completed and is generating power.¹⁸³ The Quaid-i-Azam Solar Park at Bahawalpur, Pakistan, is one of the largest multi-developer solar industrial parks globally, with 100MW operational since March 2015 and a target of 1GW of solar projects in total. This project is a central part of the Pakistan government's National Sustainable Development Strategy.¹⁸⁴ Consistent with workforces attached to many Chinese thermal power developments in Asia, it is reported that 675 Chinese workers were building Zonergy's solar projects.

China National Chemical Corp's Bluestar Elkem

Bluestar Elkem is an 80% owned division of SOE China National Chemical Corp.

In May 2015, Elkem acquired Norway's REC Solar for US\$640m, giving it control of the relatively new 1.3GW Singapore solar module manufacturing facility.¹⁸⁵

Sany Group

In November 2016, Chinese conglomerate Sany Group signed a memo of understanding with the Gujarat government in India to invest US\$2bn over the next five years in various energy and infrastructure projects in the state. Sany Group will invest in five projects, including development of a 1GW wind energy project, another 1GW of wind-plus-solar power generation project and the setting up facility to manufacture wind turbines.¹⁸⁶

IEEFA notes that Sany Group announced a similar proposal to set up 2GW of renewables in Maharashtra and Andhra Pradesh, but we are not aware of any progress to date.

Shunfeng International Clean Energy Limited (SFCE)

SFCE has gradually transformed from a Chinese developer of solar products and solar power plants into a diversified service provider of comprehensive clean energy solutions. Its 2016 annualised revenues are running at Rmb9bn (US\$1.3bn), 30% higher than 2015, including the commissioning of 1.8GW of solar projects in China.¹⁸⁷

¹⁸³ <http://www.dawn.com/news/1217587/solar-park-producing-12pc-more-power-than-target>

¹⁸⁴ <http://energy.economictimes.indiatimes.com/news/renewable/pakistan-setting-up-worlds-biggest-solar-park/55715529>

¹⁸⁵ http://www.pv-magazine.com/news/details/beitrag/rec-to-push-into-china-under-new-ownership_100018229/#axzz4SiXyElms

¹⁸⁶ <http://energy.economictimes.indiatimes.com/news/power/chinas-sany-group-to-invest-2-bn-over-5-years-in-gujarats-energy-and-infrastructure-sectors/55672884>

¹⁸⁷ <http://www.hkexnews.hk/listedco/listconews/SEHK/2016/0930/LTN20160930671.pdf>

In 2014, SFCE acquired the German firm S.A.G. and its subsidiary meteocontrol. By June 2016, meteocontrol offered monitoring, operation and maintenance services to over 41,000 solar power plants with an accumulated capacity exceeding 12GW.

In August 2015, SFCE acquired the award-winning but loss-making US-based gallium nitride (GaN) on silicon LED producer, Lattice Power.

In October 2015, SFCE acquired a 59% majority shareholding in U.S.-based PV cell/modules manufacturer, Suniva Inc. Suniva has been operating for a decade with manufacturing facilities in Georgia and Michigan with combined module capacity of 430MW.¹⁸⁸

Xinte Energy Co / TBEA Sunoasis Co

Xinte Energy Co also trades as TBEA Sunoasis Co (TBEA) and listed on the Hong Kong stock exchange in December 2015. TBEA is China's largest solar engineering, procurement and construction (EPC) firm, as well as a polysilicon, solar cell, module and inverter manufacturer with 2015 revenues of US\$1.3bn (+28% year over year).

In March 2015, TBEA won a 14MW solar project tender in Chile, its first in Latin America. April of that year saw TBEA put into operation its newly constructed Jinnah 100MW PV project in Punjab, Pakistan, at a construction cost of US\$130m, the largest in operation to date in that country.¹⁸⁹

In July 2016, TBEA signed a memo of understanding for the construction of two 500MW solar projects in Egypt for two government agencies.¹⁹⁰ IEEFA would estimate a cost of US\$1.2bn.

¹⁸⁸ <http://www.pv-tech.org/news/shunfeng-profits-hit-by-curtailment-issues-and-losses-from-acquisitions>

¹⁸⁹ http://www.pv-tech.org/news/chinese_firm_wins_pakistan_mega_solar_project_contracts

¹⁹⁰ <http://renewables.seenews.com/news/chinas-tbea-sunoasis-to-build-1-gw-solar-park-in-egypt-534339>

Conclusions

The Paris COP21 Climate Agreement was reached largely on the back of the 2014 China-U.S. pledge to cooperate on emissions reductions. That pledge laid the foundation for other countries to pledge their own reductions.

While shared responsibility was the basis on which COP21 was built and while it stands as a catalyst to renewable-energy investment, the global boom in renewables has market-driven momentum.

In the event that the incoming U.S. presidential administration reduces U.S. COP21 commitments, IEEFA views it as extremely unlikely that China will turn away from renewable energy investment. Liu Zhenmin, China's vice-foreign minister, stated at the recent Marrakech COP22 conference that any change in U.S. policy "won't affect China's commitment to support climate negotiations and also the implementation of the Paris Agreement."¹⁹¹

In fact, Chinese companies are poised to accelerate international renewable energy build-out and fill any void left by reduced implementation from other countries.

An increased presence of Chinese renewable energy companies in international markets is very much in line with Chinese government policy. The government's 13th Five-Year Plan, published in 2015, clearly indicates that China sees a huge opportunity in extending its domestic renewable energy build-up overseas with ambitions of making the country the global leader in the new energy technology.

Chinese companies have been encouraged to internationalise since the "going abroad" policy of the 10th Five-Year Plan (2001-2005), and the early wave of Chinese investment abroad is now being augmented by Chinese investment in the renewable energy sector.

The "One Belt, One Road" initiative launched by President Xi Jinping in 2014 is further driving the increasingly outward-looking nature of Chinese infrastructure companies¹⁹². Under this initiative, smaller and developing Asian countries like Myanmar, Laos and Cambodia, are seeing accelerated economic growth driven by Chinese investment, which in turn is developing new markets for Chinese exports¹⁹³. Any reduced U.S. commitment to Asia could allow China's share of development to expand more.

Latin America is currently one of the most attractive regions in the world for renewable energy development, and Chinese companies are already highly active in renewables investment in Mexico, Brazil, Argentina, Chile, Peru and elsewhere in the region. President Xi Jinping has recently returned from a visit to Latin America during which he granted Chile and Ecuador China's highest diplomatic status. The visit was Xi's third since becoming president in 2013. On this most recent trip he agreed to more than 40 deals spanning energy, finance, agriculture, technology and other sectors.¹⁹⁴ Chinese investment in Latin America has reached US\$237bn a year compared to U.S. investment of US\$268bn. However, with an agreement in place to increase Chinese investment in the

¹⁹¹ <https://www.theguardian.com/environment/2016/nov/22/donald-trump-success-helps-china-emerge-as-global-climate-leader>

¹⁹² <https://www.bloomberg.com/quicktake/china-s-silk-road>

¹⁹³ <https://www.bloomberg.com/news/articles/2016-12-05/china-transforms-frontier-neighbors-with-cash-for-rails-to-power>

¹⁹⁴ <https://www.bloomberg.com/news/articles/2016-12-02/china-seizes-opening-in-u-s-backyard-after-trump-upends-policy>

region to US\$500bn¹⁹⁵, and the distinct possibility of the U.S. leaving the Trans Pacific Partnership (which includes Mexico, Peru and Chile), China seems better positioned to capitalise on the renewables boom taking place across South and Central America.

Such a boom requires considerable investment to sustain, and China is again uniquely positioned to provide such investment. Chinese institutional investment assets under management rose by 500% from 2005 to 2015, from US\$1.1 trillion to US\$7.1 trillion. This makes China the second-or third-largest institutional investment market globally, and the figure is expected to increase to US\$10 trillion by 2020. The fact that only 2% of the current total is invested offshore is a key statistic: If China increases this ratio to 10% by 2020, it would amount to US\$1 trillion of new foreign investment.

China's recognition of renewable technology as the energy provider of the future is now dovetailing with its policy of internationalising its major companies and expanding its economic influence around Asia and elsewhere. Chinese companies have become more prevalent in the renewables sector globally, and international announcements of reverse-auction PPA contract awards feature Chinese firms at some stage of the development as a matter of course.

Going forward, this China presence can be expected to increase as the second-largest economy in the world sees strategic advantage in becoming the global leader in renewable energy.

¹⁹⁵ http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1227318.shtml

Annexure I

Top Renewables Deals 2012-2015

No.	Value of transaction (US\$bn)	Target name	Target nation	Acquirer name	Acquirer nation	Date announced
1	6.2	Three Gorges Jinshajiang Chuanyun Hydroelectric Power Development Co. Ltd	China	China Yangtze Power Co Ltd	China	07 Nov 15
2	3.7	Power Station (Jupiá and Ilha Solteira Hydro Plants)	Brazil	China Three Gorges Corp	China	25 Nov 15
3	3.5	Enel Green Power SpA	Italy	ENEL SpA	Italy	18 Nov 15
4	3.2	Longtan Hydropower Development Co Ltd	China	Guangxi Guiguan Electric Power Co Ltd	China	29 Jan 15
5	2.5	Invenergy Wind Projects	United States	SunEdison Inc	United States	06 July 15

No.	Value of transaction (US\$m)	Date announced	Target name	Target nation	Acquirer name	Acquirer nation
1	2,372	17 Nov 14	First Wind Holdings Inc.	United States	SunEdison Inc; TerraForm Power Inc.	United States
2	1,587	26 Sep 14	Himachal Baspa Power Co. Ltd.	India	JSW Steel Ltd.	India
3	1,116	26 Nov 14	Power Station; Kaidi Sunshine Bio-energy Investment Co Ltd; Wuhan Kaidi Green Energy Development & Operation Co Ltd.	China	Wuhan Kaidi Electric Power Co. Ltd	China
4	1,064	31 Jan 14	London Array 1 wind farm	United Kingdom	Caisse de Depot et Placement du Quebec	Canada
5	930	28 Nov 14	Energisa SA	Brazil	Brookfield Renewable Energy Partners LP (40%)	Canada

No.	Value of transaction (US\$m)	Date announced	Target name	Target nation	Acquirer name	Acquirer nation
1	2,000	02 Jan 13	Power Station (Antelope Valley Solar Project)	United States	Berkshire Hathaway Inc	United States
2	900	26 Sep 13	PPL Montana hydroelectric facilities	United States	Northwestern Corp	United States
3	774	27 June 13	Kraftgarden AB (25.673%)	Sweden	Kymppivoima Oy; EPV Energy Ltd; Helsingin Energia Oy	Finland
4	719	10 Sept 13	London Array Ltd (Offshore Electricity Transmission Asset)	United Kingdom	Mitsubishi Corp; Barclays plc	Japan
5	615	8 Aug 13	Renova Energia SA (Stake%)	Brazil	Companhia Energetica de Minas Gerais – CEMIG	Brazil

No.	Value of transaction (US\$m)	Date announced	Target name	Target nation	Acquirer name	Acquirer nation
1	1,217	17 Dec 12	Power station (Wind and solar power portfolio)	Canada	Mitsui & Co Ltd (30%/30%); Fiera Axiom Infrastructure	Japan
2	898	05 Dec 12	IP Maestrale Investments Ltd (80%)	United Kingdom	ERG SpA	Italy
3	888	09 Mar 12	Power station (four 480MW wind power stations)	United States	Algonquin Power & Utilities Corp	Canada
4	760	21 Dec 12	Power station (19 Hydroelectric facilities)	United States	Brookfield Asset Management Inc	Canada
5	600	29 Jun 12	Alcoa Inc (351MW Tapoca hydroelectric project)	United States	Brookfield Asset Management Inc	Canada

Source: PwC Power & Renewables Deals Reports 2012-2015

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