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China's involvement in South Africa's wind and solar PV industries

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ABSTRACT

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China is now a global leader in renewable energy production, an important player in development finance and climate change diplomacy, and the world's largest provider of energy finance. Meanwhile, in recent years, South Africa has emerged as a regional leader in renewable energy development following the launch of its renewable energy independent power producers' procurement program (RE IPPPP). In this paper we explore the different modes of involvement of Chinese companies in South Africa's solar PV and wind energy sectors, and how the differentiated technological and industrial trajectories of Chinese companies are interacting with South Africa's unique national context. In doing so we reveal complex interactions between evolving market dynamics, and international and domestic factors in both China and South Africa. Such dynamics, which may at once be political, technical, economic and social, include the highly globalized nature of production chains in wind and solar PV, accompanied by increasingly consolidated markets, and on-going trade disputes between Chinese, and EU and US solar PV manufacturing companies.

INTRODUCTION

The world's second largest economy, China is now a global leader in renewable energy production, an important player in development finance and climate change diplomacy, and the world's largest provider of energy finance through the China Development Bank and China Exim Bank.[1] In recent years, South Africa has emerged as a regional leader in renewable energy development following the launch of its renewable energy independent power producers' procurement program (RE IPPPP), a competitive bidding system for utility-scale renewable energy.[2]

RE IPPPP has drawn a diverse group of international players to South Africa, including a number of Chinese wind and solar photovoltaic (PV) companies. In this paper we explore the different modes of involvement of these companies, as well as how the differentiated technological and industrial trajectories of China's wind and solar PV industries are interacting with South Africa's unique national context. As we detail, Chinese companies take on a variety of roles: as project investors and developers; as engineering procurement and construction, and operation and maintenance contractors; as original equipment manufacturers; and technology suppliers.

Academic research on China's increasing involvement in Africa's energy, infrastructure, and transport sectors to date has tended to focus either on the macro-level, for instance on estimating the volume of this investment, or on the micro-level, in particular the social and environmental impacts of individual projects, including on local communities.[3] Less common however is a "meso-level" analysis into how patterns and types of investment and technology deployment within specific countries interact with the energy landscape of the country in question. This is the research gap that we address here. Such an analysis is important given the significant contextual differences among the numerous countries in the sub-Saharan region, including in terms of national energy policies, levels of energy access, infrastructure networks, technological capabilities, the investment climate, and socio-economic and political stability.

We focus on the involvement of Chinese companies in South Africa's emerging wind and solar PV sectors. In doing so we consider how this involvement has been shaped by growing Sino-South African trade links and cooperation, national energy trajectories and policies in both countries, global trends in renewable energy markets, and the rise of trade disputes and protectionism, particularly in the case of solar PV. Our research reveals active cooperation and competition between Chinese and Western companies in South Africa's wind and solar PV markets.

While the involvement of Chinese companies in electricity generation, transmission, and distribution of various sub-Saharan African countries is significant and increasing, China's involvement in the continent's utility-scale renewable energy sector is a relatively recent development and is thus an area that warrants further research. For instance, as of 2013, China was involved in wind energy projects in only three sub-Saharan African countries: Ethiopia, Tanzania, and South Africa.[4] Through our research, we find that Chinese renewable energy companies have been drawn to South Africa's wind and solar PV market not because of an overriding concern for low

carbon development, but rather due to a number of push and pull factors driven by commercial interests, with limited state facilitation or financial support. "Push" factors include a series of constraints in domestic and international markets and the importance of China's "going out" policy and "one belt, one road" strategy. "Pull" factors include the launch of RE IPPPP in South Africa.

The findings of this report are based on in-depth semi-structured qualitative interviews conducted in South Africa in November 2016 and in China in January 2017. In South Africa, eleven interviews were conducted with members of local and national government, industry, development finance corporations, renewable energy project developers, academics and NGOs. We also participated in a number of industry relevant fora, including South Africa's annual wind energy conference, the "Windaba," and a networking event of the South African Photovoltaic Industry Association (SAPVIA). In China, twelve interviews were conducted with government officers, financiers, renewable companies, and NGOs. Given the often political and commercial sensitive nature of the research topic, interviewees are not named here. In addition to interviews, we also conducted a content analysis of grey literature from both countries, including energy regulation and relevant national policies, reports from industry and finance, and media coverage including sources such as Recharge News, Engineering News and ESI-Africa.

The structure of this paper continues as follows. In the background section we explore the national trajectories of China's solar PV and wind energy sectors before examining South Africa's national energy policy context. This is followed by a discussion of the evolving bi-lateral relations, investment and development finance between the two countries. The analysis section provides an in depth examination of the modes of involvement of Chinese wind and solar PV companies in South Africa, and the last section concludes.

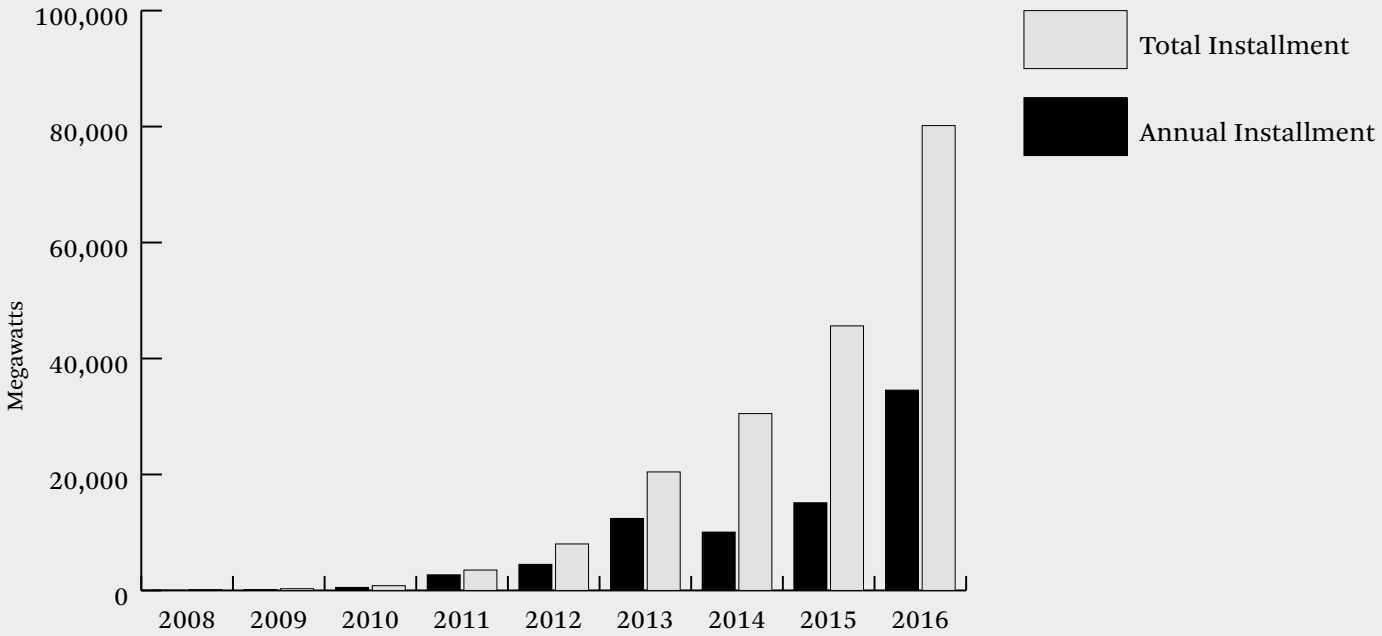
BACKGROUND

CHINA'S RENEWABLE ENERGY SECTOR IN CONTEXT

Since the early 2000s, China's wind and solar PV sectors have witnessed spectacular growth both in terms of power generation capacity and technological innovation.[5] China has more than a third of the world's installed wind power capacity and is home to four of the top ten wind turbine manufacturers, having overtaken Germany and the US in 2010.[6] The country has over a quarter of the world's installed solar PV capacity and is the world's largest manufacturer of solar PV technology, housing six of the world's top ten solar panel makers.[7] China overtook Germany as the original global market leader in 2008.[8]

China now ranks first in EY's renewable energy country attractiveness index (RECAI) and in 2016, accounted for 32 percent of global renewable energy financing (excluding large hydro) compared to 19 percent from the US and 25 percent from Europe.[9] Many of China's renewable energy companies now have international

Figure 1: China's Solar PV installed capacity, 2008-2016



Source: China Photovoltaic Industry Association (2017)

headquarters and/or subsidiaries in various countries, and are listed on the Hong Kong and New York stock exchanges, and/or the NASDAQ.

China's renewable energy market is highly protected. Despite the significant role that cooperation with European and, to a lesser extent, American companies played in the industrial development and technological innovation of China's solar PV and wind industries, the influence of international players is decreasing. Moreover, from the "going out" strategy of the late 1990s to the more recent "one belt, one road" initiative,[10] launched by President Xi Jinping in 2014, China's government has developed various policy instruments to promote the country's industrial activities abroad, particularly in the energy sector. However, Chinese wind and solar PV companies adopted very different trajectories.[11] While the country's wind industry was originally set up for domestic electricity generation, the solar PV industry was established as an industry for export.

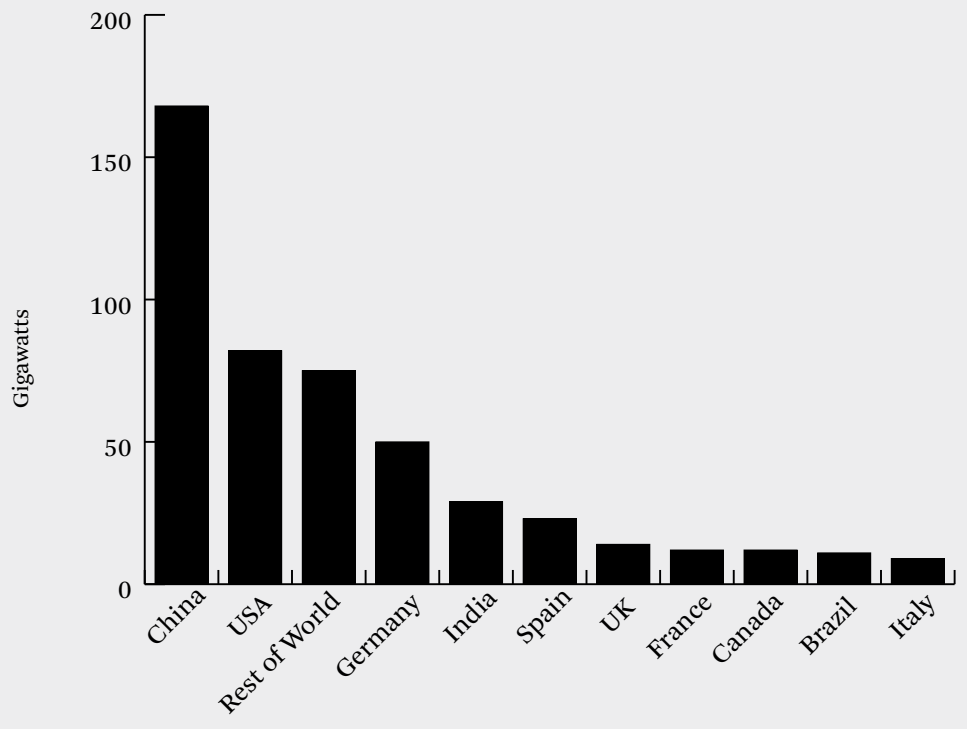
China's wind industry was heavily protected during its initial stages of market development and received tremendous support, mainly from large state-owned utilities or enterprises (SOEs) that had little interest in overseas markets.[12] SOEs are now the primary developers of Chinese wind farms, having squeezed out the European companies that held a majority market share until 2006. Most Chinese wind energy companies acquired relevant technology via patent licensing or joint ventures with companies such as German Jacobs, Repower and Vensys and the UK's Garrad Hassan.[13] In a later example, Vensys and the Dutch company Darwind were purchased by their

Chinese partners Goldwind and XEMC respectively, becoming their technology hubs and research and development centers.

China's solar PV panel producers on the other hand are mainly private companies, many of which established themselves in the early 2000s with limited domestic policy support and at a time when the global market was dominated by companies from the US, Japan, and Europe.[14] The ultimate aim of China's solar PV producers was to export to the then largely European market following the introduction of government subsidies and feed-in tariffs by European governments.[15] China's solar PV manufacturing companies acquired technologies mainly by importing production lines from overseas in the early 2000s. More recently a number of Chinese companies have used merger and acquisition strategies to buy out their western technology suppliers. One example of this is Hanergy's ambitious deals with major technology suppliers for thin-film solar cells, as a result of which the company has become the leading thin-film developer.[16]

In China's wind and solar PV markets, there is a distinct separation between power generation utilities on the one hand, and companies that operate as engineering procurement and construction (EPC) contractors, technology suppliers, or original equipment manufacturers (OEMs) on the other.[17] The former are mostly owned by giant SOEs, including the so-called "big five,"[18] which spun-off from the monopoly State Power Corporation 15 years ago.[19] EPCs and OEMs are usually private or quasi state-owned by local municipalities, such as Goldwind and Envision in the case of wind, and Jinko Solar and BYD in the case of solar PV. There are some exceptions, however, including the wind technology company United Power, which is a subsidy of the Guodian Corporation, one of the "big five."[20]

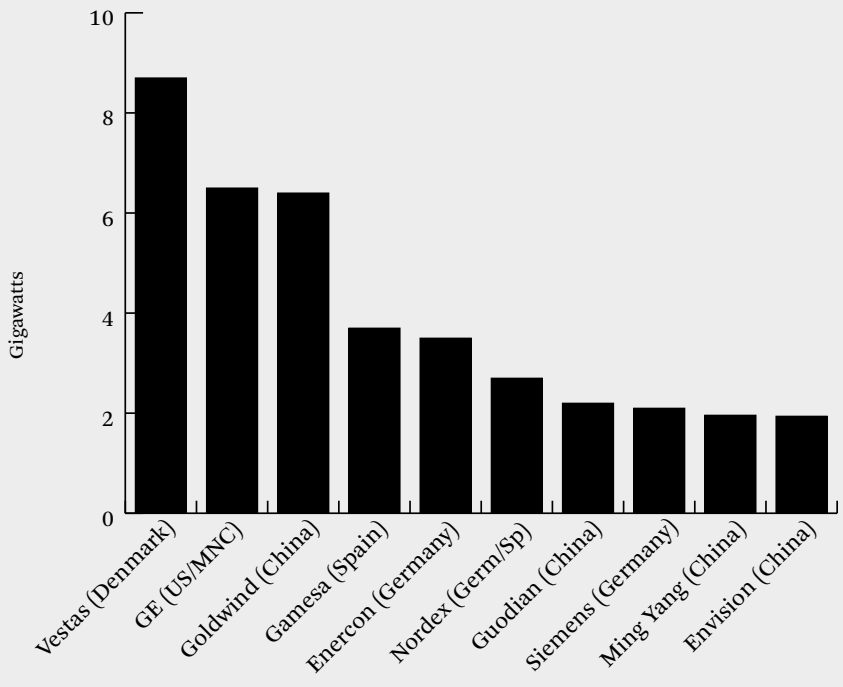
Figure 2: Global cumulative installed wind capacity, 2016



Source: GWEC (2017)

Such a separation is politically and economically determined. Given the strategic value afforded to power supply, generation companies are tightly controlled by SOEs, while manufacturing is viewed as politically less important. Entry barriers for developing and operating large wind and solar PV projects in China are usually

Figure 3: Global wind capacity commissioned, 2016



Source: BNEF (2017)

high given the need for substantial upfront finance and good relationships with national and provincial governments.[21] Consequently, the active involvement of large SOEs in China's wind and solar PV sectors has been key to the fast expansion of projects. Furthermore, SOEs and private companies usually have very different incentive structures behind their overseas strategies. While SOEs are generally more keen to follow the government's call under the "one belt, one road" and "going out strategy," private companies only do so when the government's strategy is in line with their own corporate interests. One reason for this is because SOEs have better access to state support, including export credit from Sinosure and finance, for instance from Exim Bank.[22]

Chinese solar PV and wind companies have started to focus on overseas markets, including emerging markets such as South Africa, due to severe domestic constraints. Production in both sectors now far exceeds market demand, partly because of the decline of China's energy-intensive, export-oriented economic growth model, which, despite a slight recovery in 2016, is not anticipated to return to its previous levels.[23] The decline has sparked intense competition among electricity generation companies, and renewable energy is particularly vulnerable given that the political and economic influence of the sector is limited compared to the country's long-standing fossil fuel industries.[24] Indeed, unlike large and well-established hydropower companies such as Sinohydro and China International Water and Electricity Corp (CWE), which focus only on overseas projects, there is no dedicated wind or solar PV SOE specializing in overseas activities.

FURTHER CHALLENGES FOR WIND

In addition to excess generation capacity which has resulted in competition for access to the transmission grid, since 2012 large amounts of newly installed wind capacity has been curtailed by the inability of China's various transmission grid companies to incorporate intermittent and variable sources into a grid that has otherwise been dependent upon coal-fired power and hydroelectricity.[25] In some provinces, curtailment levels reached 42 percent in 2015. Despite China's wind turbine manufacturers being the global leaders in terms of installed capacity, only 2 gigawatt (GW) of wind

technology capacity had been exported by 2015, compared to its domestic market of 149 GW.[26]

A further challenge is that international competition in the global wind industry, particularly in Europe where the market is now shrinking, is also fierce and has resulted in fewer and larger players as a result of mergers and acquisitions.[27] As one interviewee explained, as long as Western turbines are dominating Western markets, "going South" is an inevitable choice. Emerging economies with decent market potential and acceptable investment risk present the most attractive destinations for Chinese OEMs and EPC contractors, with South Africa as a prime example. However, interviewees in China indicated that as most Chinese wind companies see overseas markets as complementary to their core business, such companies lack targets and a clear roadmap for overseas expansion.

FURTHER CHALLENGES FOR SOLAR PV

Globally speaking, while Chinese firms dominate in the manufacturing of solar PV panels, other parts of the value chain are dominated by European, American, and Japanese companies.[28] According to Dunford et al. (2013) solar PV cells and modules made by Chinese manufacturers cost about 50 percent less than those provided by Germany.[29] Of the top ten solar PV panel suppliers in 2016, seven are from China, representing over 70 percent of market share.

However, a number of factors have posed serious challenges to China's solar PV manufacturing industry and have fundamentally altered its trajectory from one that was initially export-oriented to one that has since started to develop its own domestic market.[30] Such factors include the global economic slowdown and subsequent policy changes in a number of European countries after 2008, followed by trade disputes between China, and the EU, and the US. Before 2010, over 80 percent of Chinese PV exports were for the European market, but by 2016 this had dropped to around 11 percent. Similarly, Chinese PV exports to the US also have dropped to around 11 percent in 2016.[31] Chinese solar PV manufacturers have since sought replacement markets beyond Europe and the US, including Japan and India, and also South Africa. Meanwhile, a consolidation of the industry has ensued, with smaller producers shutting down, and some leading solar panel producers, including Suntech[32] and LDK, going bankrupt in 2013. In contrast to China's wind turbine manufacturers, which face significant competition from international companies in overseas markets, China's solar PV companies have started to compete with each other.

Chinese firms dominate the manufacturing of solar PV panels, but European, American, and Japanese companies dominate other parts of the value chain.

China's solar PV companies struggle to attract significant political attention due to their relatively obscured position as equipment suppliers and the relatively small size of individual transactions. Yet in late 2012, the Chinese government generated some domestic opportunities for the industry through mechanisms similar to those that once supported the wind sector, such as government bidding, subsidy programmes,

and financial support.[33] Despite the tremendous growth of China's domestic solar PV capacity since 2013 (see Figure 1), over 50 percent of the PV panels produced in China are still exported.[34] China's solar PV companies have allied with project developers from the EU or US with whom they have developed a working relationship elsewhere in order to explore new markets such as South Africa. For example, Trina Solar has allied with Spain's Gestamp, Jinko Solar with Spain's Acciona, and BYD with Germany's Juwi. Still, as in the case of wind energy, national transmission constraints have posed a significant challenge and contributed to the production glut. It is estimated that over-capacity in solar PV in China reached more than 40 percent in 2015.[35] Such a surplus has also contributed to a dramatic drop in global technology costs, particularly since 2010.[36] Further drops in technology costs are predicted.

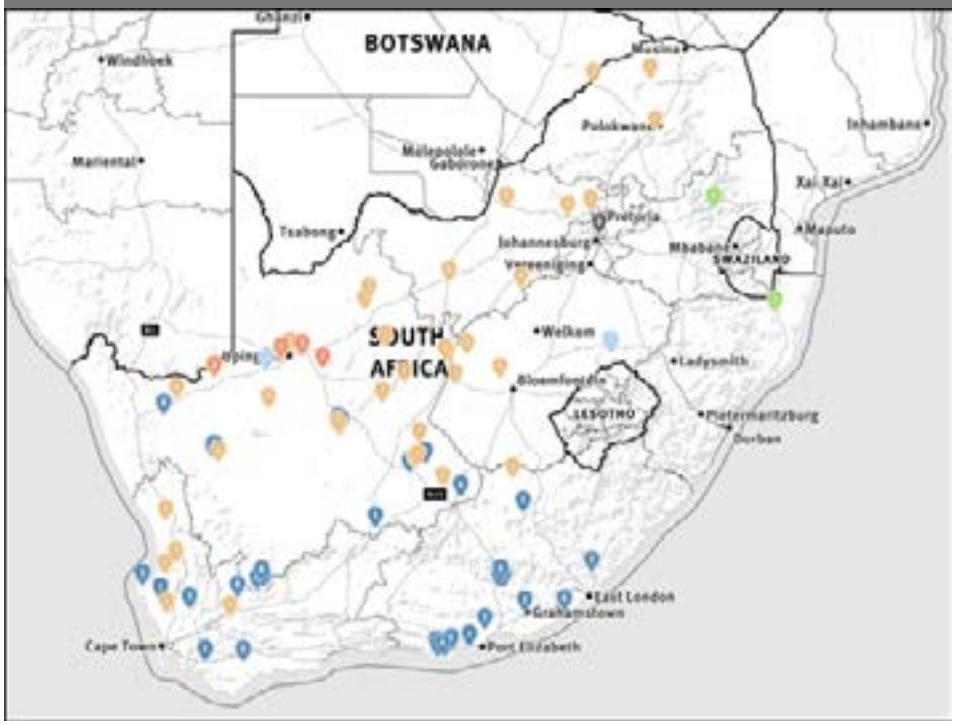
An additional significant challenge relates to a series of trade disputes, tariff adjustments, and anti-dumping (shuangfan 双反) legislation introduced by the EU and US, which have targeted Chinese solar PV panels since 2012.[37] Anti-dumping duties were imposed by the European Commission on imports of solar PV crystalline silicon modules and cells originating in or consigned from China in December 2013, applicable until December 2015.[38] Measures include minimum pricing and a quota system.[39] As we discuss below (see "Analysis"), these developments have had an impact in South Africa where Chinese companies are using South African manufacturing and assembly plants for "toll manufacturing" to Europe.[40]

SOUTH AFRICA: A NEW RENEWABLE ENERGY FRONTIER?

South Africa is the largest energy consumer in Africa. The country's state-owned monopoly utility Eskom owns the transmission grid, generates just over 90 percent of supply, and is responsible for 60 percent of distribution. Eskom has a nominal installed capacity of 42.8 GW, 85 percent of which is coal-fired.[41] Decision-making and control over South Africa's electricity sector is complex, contested, and political, and the utility has been subject to repeated scandals and corruption allegations in recent months. While various attempts to liberalize the country's electricity sector in the post-apartheid era failed, the introduction of RE IPPPP in 2011 marks the first time that electricity has been generated both by independent power producers and renewable energy generation sources.[42] Under RE IPPPP, renewable energy IPPs bid to construct and connect their renewable electricity projects to Eskom's transmission grid. Wind and solar PV dominate this program: of the MW selected 43 percent is generated by wind, and 42 percent by solar PV.

As a result of RE IPPPP, South Africa has become an important destination for renewable energy investment. The utility-scale, commercially generated renewable energy sector that has emerged now constitutes a small but significant source of electricity generation in the country (approximately two percent). Moreover, since mid-2015, solar PV has become competitive with the country's new coal-fired power plants.[43] The development of South Africa's renewable energy industry has brought an

Figure 4: Map of approved projects, RE IPPP rounds 1-4



Source: The Energy Blog, http://www.energy.org.za/

influx of foreign investment to the country currently dominated by EU and US actors with Chinese companies playing a small but significant role as discussed below.[44]

A total of 6.3 GW of renewable electricity generation under the first four bidding rounds of RE IPPPP has been approved thus far and as of May 2017, renewable IPPs were contributing 4,180 MW of peak capacity to the national grid.[45] A new tender framework for round five and beyond was to have been introduced in 2016, although the program has since been beset by severe delays as discussed below. Internationally, RE IPPPP has been held up as example for its high quality regulatory framework, tough qualification criteria, and strong economic development and community ownership requirements, all of which provided a long-awaited positive policy signal to investors and developers.[46] It ensures a 20-year government-backed, local currency denominated power purchase agreement, which provides the necessary regulatory certainty for investors seeking to enter the South African market. The program has further been celebrated for the savings it has created for the South African economy.[47]

The majority of RE IPPPP projects are financed and generally structured on the basis of a 70:30 debt to equity ratio of the capital cost of the project. Under RE IPPPP there has to be a minimum of 40 percent South African entity participation, as well as a minimum of 12 percent black ownership of the project company. Local communities must have a minimum 2.5 percent shareholding. Foreign equity investors therefore, can hold shareholdings of up to 60 percent of the project.[48]

However, despite RE IPPPP's success, the stability and future development of the country's renewable energy industry is threatened by a number of challenges.[49] Most

significantly the program is severely delayed due to Eskom's refusal to sign 37 outstanding power purchase agreements since 2015. Eskom has justified this move on the basis that it will lose money by having to purchase energy from IPPs, and that further electricity supply from renewable energy is not currently necessary. The utility's refusal has not only thrown those projects that have been approved into turmoil, but also discouraged previously enthusiastic investors and manufacturers from getting involved in the market.

Meanwhile the absence of a reliable electricity planning document has compounded confusion and uncertainty over the allocation for renewable energy generation in the country. South Africa has fallen in the rankings of EY's renewable energy country attractiveness index (RECAI) and now sits in 19th place, down from 11th in May 2016.[50] We return to this dynamic and its impact on Chinese companies below (see "Analysis").

Other challenges for South Africa's renewable energy sector relate to RE IPPPP's local content requirements, and the ability of the country to generate a national manufacturing base for renewable energy and create meaningful employment in a country with high levels of unemployment. Local content regulations under RE IPPPP require that a certain percentage of project spending be dedicated to locally produced goods and services. While such requirements have resulted in some impressive gains, such as the creation of over 24,000 job years, these regulations have been evaded by a number of project developers, particularly in the case of solar PV.[51] Moreover, the delays to RE IPPPP have also affected national renewable energy supply chains. In particular, a number of manufacturing facilities set up to supply to RE IPPPP have closed down.

CHINA AND SOUTH AFRICA RELATIONS

In the aftermath of the US's rejection of the Paris agreement, China is playing an increasingly important role in global climate change diplomacy. At a regional level, the political rhetoric of Sino-Africa "green cooperation" is also gaining prominence. In December 2015, at the summit of the Forum on China-Africa Cooperation (FOCAC) in Johannesburg, a cooperative action plan was released, in which green development was listed as one of the top 10 areas for future cooperation.[52]

Compared to other less developed countries in SSA, South Africa as an upper-middle income economy[53] has not been a large recipient of overseas development aid (ODA), receiving only 2.3 percent ($5512 million) of total ODA to Africa between 2000 and 2014.[54] Similarly, the country has received limited finance from Chinese development institutions as compared to other countries in the region. Recent exceptions include two loans from the China Development Bank (CDB): a $2.4 billion[55] loan facility agreement for South Africa's ports and rail operator Transnet in June 2015 to fund hundreds of diesel and electric locomotives manufactured by China South Rail (CSR) and China North Rail (CNR); and a $500 million credit facility agreement for Eskom with CDB in October 2016.[56] Such developments are a likely reflection of the

increasing levels of debt of South Africa's SOEs and shifting global trends of bilateral assistance.[57]

Despite relatively low levels of development finance, investment from China is highly significant for South Africa. China has been South Africa's largest trading partner since 2009, while South Africa is China's largest trading partner in Africa. South Africa comes fourth in the top ten country recipients of Chinese foreign direct investment (FDI) between 2003 and 2015.[58] Trade volumes between China and South Africa in 2016 reached an epic high of $35.3 billion compared to $16 billion USD in 2009.[59] Two recent Chinese investments in South Africa's energy sector include an investment by a subsidiary of Sinopec, China's state-owned oil, gas, and petrochemicals producer, into 75 percent of Chevron's South African assets, and a partnership between Eskom and the Chinese multinational ICT company, Huawei, in order to accelerate digital transformation in the power industry, including the development of smart grid innovations, which would better enable Eskom's distribution and transmission networks to accommodate renewable energy.[60]

Not all Chinese investment has been straightforward. Most recently, allegations of malpractice and rigging have emerged over Eskom's decision to award a contract to China's state-owned company Dongfang for a boiler supply for a coal-fired power plant in Mpumalanga. It is alleged that Eskom awarded the contract despite clear evidence that Dongfang's bid was significantly more expensive than that of its rivals. Such a deal has been linked to on-going scandals of state capture in which Eskom has been embroiled in recent months. This led to the Johannesburg High Court to order a halt to the implementation of the contract.[61]

ANALYSIS

MODES OF CHINESE INVOLVEMENT IN WIND AND SOLAR PV IN SOUTH AFRICA

Just over $14 billion in both debt and equity has been invested in renewable energy projects since RE IPPPP's launch in 2011, of which 24 percent comes from foreign investment.[62] Chinese companies have played a minimal role in this, contributing an estimated two percent of overall foreign investment under rounds one to four of RE IPPPP, compared to 67 percent from European and 14 percent from US companies. South Africa's four main national banks, the financial services group Investec, and national development finance institutions are the key providers of debt finance to renewable energy projects under RE IPPPP.[63] Finance from China plays an important, but less direct, role via the Industrial and Commercial Bank of China (ICBC). ICBC, China's biggest lender by assets has held a 20 percent stake in South Africa's Standard Bank since 2007 and in early 2015 bought a 60 percent stake of Standard Bank's London operations.[64]

Table 1: Modes of involvement of Chinese wind energy companies under RE IPPPP

Company	Type of involvement	Capacity of involvement (MW)	Type of ownership	Listed
China Longyuan Power (China Guodian Corporation)	Project developer/sponsor	244	SoE (57% owned by China Guodian Corporation)	Hong Kong stock exchange
United Power (China Guodian Corporation)	EPC/ OEM	244	SoE (China Guodian Corporation)	Hong Kong stock exchange
Goldwind	EPC/OEM	149	Not directly state-owned but is owned by a number of SoEs	Hong Kong and Shenzhen stock exchanges,
Sinovel	EPC/ OEM	53	Private	Shanghai stock exchange
Sany	OEM	None	Private	Hong Kong stock exchange

Source: Authors, publicly available resources

ONSHORE WIND

Chinese companies play a variety of roles in South Africa's wind energy sector as project developers/project sponsors; EPC and operation and maintenance (O&M) contractors; and OEMs. Although European companies dominate as developers, EPC contractors, and OEMs, Chinese companies hold a small but significant market share, reflecting their growing international presence. As shown in Table 1, we have identified five companies involved in wind energy under RE IPPPP.

LONGYUAN: GIANT PROJECT DEVELOPER "GOES OUT"

Longyuan group was initially established in 1993 as one of China's earliest state-owned wind energy companies. In 2002, during the country's energy sector reform, Longyuan was merged into one of China's 'big five' utility companies, China Guodian Corporation, as its specialized wing for renewable energy development. In the past decade Longyuan has developed into a dominant player in China's wind energy sector, owning and operating 270 wind farms with an installed capacity over 14GW by 2015. Longyuan is the largest wind farm operator in the world though this is mainly due to its domestic installed capacity.

The only Chinese developer involved in South Africa's wind industry, China Longyuan Power was awarded two projects with a combined capacity of 244 MW under Round 3 of RE IPPPP, the De Aar phase 1 and 2 projects (100 MW and 144 MW, respectively) in the Northern Cape Province. In both projects it operates as part of a joint venture with South Africa's black-owned company Mulilo Wind Enterprises. The projects will use 1.5 MW turbines provided by Guodian United Power, another subsidiary of China Guodian Corporation. Both of these projects are project financed and Chinese export finance has not been involved in either of them.

The main driver for Longyuan's involvement in overseas activities is to showcase projects in response to the central government's "going out" strategy and for the company's corporate investors (the company has been listed on the Hong Kong stock exchange since 2009). Less influential is the company's goal of gaining experience of operating wind farms abroad through which it hopes to acquire political clout and better its reputation. While the company is not expecting large revenues from foreign markets, according to those interviewed, profit making is still important under the "going out strategy." Longyuan is highly selective about the overseas projects in which it will get involved, and interviewees from the company indicated that it is reluctant to venture into countries elsewhere in SSA that are believed to carry high social and political risks. This cautious attitude is a sharp contrast to the company's highly aggressive strategy at home.

Over $14 billion in both debt and equity has been invested in renewable energy projects since RE IPPP's launch in 2011.

> As a state owned company we are very cautious of getting involved in overseas projects. We cannot afford bad investments because any loss on a project is eventually the loss of state-asset. Overseas project must be financially and politically viable, which significantly limits our choices as such 'perfect' projects are very rare and the competition can be insanely intense. South Africa is one of the very few acceptable countries in Africa.[65]

GOLDWIND: FROM TECHNOLOGY SUPPLIER TO EPC CONTRACTOR

Goldwind was established in 1998 as one of China's first wind turbine manufacturers. Now listed on the Shenzhen and Hong Kong stock exchanges, the company's success has been part of the massive expansion and innovative development of the Chinese wind energy market. Although the company is not directly state-owned, it has a number of SOEs as major shareholders including China Three Gorges which owns approximately 25 percent.[66] Internationally, the company now ranks third in terms of commissioned capacity in 2016 behind Vestas and GE, a step down from its global lead in 2015. It is the lead OEM in China accounting for more than a quarter of installed turbine capacity.[67] Over time the company has transformed itself from an OEM in the domestic market to a dedicated EPC contractor in its overseas activities, including in South Africa. In 2015 the company exported technology with a capacity of over 850 MW.[68]

Under round four of RE IPPPP, Goldwind was awarded two EPC and OEM contracts in South Africa: the Golden Valley project (117 MW) and Excelsior project (32 MW), both developed by BioTherm Energy (a South African-international joint venture). In South Africa Goldwind will deploy its 2.5MW turbines with permanent magnet direct drive (PMDD) technology, which it bought from German company Vensys in 2008. One of the original barriers for Goldwind to enter previous rounds of RE IPPPP in South Africa was that PMDD technology was not considered "bankable" under project finance norms, nor was it recognized under the RE IPPPP criteria given that it lacked international certification. Having finally acquired a certificate from international validation company DNV GL's IEC-B for these turbines in 2014, Goldwind secured the two EPC contracts. This marks the first time that PMDD technology has been deployed in the South African market. As one interviewee described:

> The technological acceptance is the biggest challenge for Chinese equipment suppliers, as most of our technologies are not yet world-recognized and properly certified at international level. Financiers and investors would think such technology 'unsafe'. That's the main reason why Goldwind are rejected in the first few rounds of bidding and only secure the deal in the fourth round after DNV's certification.[69]

Beyond South Africa and the domestic Chinese market, Goldwind's operations include the supply of turbines to the 51 MW first phase of the Adama wind farm in Ethiopia, a project developed by Hydro China International Engineering and backed by China Exim Bank.[70] While the company has limited interest in becoming a project developer, it is seeking further export opportunities for both onshore and offshore wind. More recently Goldwind has also become involved in late stage finance and investment for two Texan projects, which will enable it to further deploy its PMDD turbines.[71]

SINOVEL

Sinovel was the first Chinese company to gain entry into South Africa's wind market, securing two OEM contracts in the first round of RE IPPPP with a total 54 MW capacity. In one of these projects, the 26.2 MW Klipheuwel-Dassiesklip wind farm near Caledon in the Western Cape, the company was also involved in a joint venture EPC together with Spain's Iberdrola and South Africa's Group 5. This project was developed by a BioTherm Energy, the same developer involved in the Goldwind project. The second project is the 26.2 MW van Stadens wind farm, developed by the South African company Metrowind.

Yet, due to Sinovel's domestic troubles since 2012, its early success in South Africa has not continued, and it has failed to play any significant role in subsequent rounds of RE IPPPP. The company was the top turbine supplier in China in 2010; its 1.5 MW and 3 MW turbines were considered landmark achievements.[72] In 2011, Sinovel initiated its new "two seas strategy" (双海战略), shifting emphasis towards off-shore wind farms and overseas business simultaneously. Unfortunately, however, rising competition

from other turbine suppliers and global wind market turbulence between 2012 and 2014 almost shattered the company completely and undermined its previous ambition for overseas expansion.[73]

SANY

Sany is a newcomer to South Africa and is not involved in any wind energy projects. It is the world's sixth largest manufacturer of heavy machinery, including truck cranes and road construction machinery, of which 40 percent is exported. Wind energy technology is a relatively young, but fast growing segment of the company's operations. Domestically the company ranks 10th amongst domestic turbine suppliers with more than a three percent market share. In the African market, Sany supplied turbines for the 153 MW second phase of the Adama II wind farm in Ethiopia in 2013, which was promoted by President Xi Jinping during his visit to South Africa in 2015 as an example of Sino-African cooperation.[74] Following this event, Sany decided to open an office in Johannesburg and is now hoping to get involved in future rounds of RE IPPPP and other opportunities in the South African renewable energy market.

Sany has a good reputation in African markets and hopes that it has sufficient local knowledge and networks to expand into wind turbine sales. Interviews with company members revealed that it realized that the opportunities within China's wind energy market were drying up and therefore overseas markets would play an increasingly crucial role. Although South Africa is not the safest market, it is considerably less crowded compared to other popular destinations of wind energy investment, such as Japan and the US.

> The African market has been strategically important for the Sany group, as the demand for heavy machinery has been massive due to the region's strong economy growth and infrastructure development, which is partly driven by Chinese investment of course.[75]

SOLAR PV

The majority of solar PV projects approved under RE IPPPP are developed by European or US companies including Enel Green Power (Italy), Solar Reserve (US), and Scatec Solar (Norway), while EPC companies include Italian companies Enertronica and Terni Energia, Switzerland's ABB and German Siemens and Juwi.[76] Chinese companies meanwhile, dominate in the supply of technological components, particularly cells and modules. For instance, in 2013, South Africa imported cells and modules valued at $456 million out of a total of $531 million exported to Africa by Chinese companies.[77]

Chinese solar PV technology hardware deployed in South Africa has been either provided directly by Chinese companies or by companies headquartered elsewhere but who source from China.[78] As described in table 2, Chinese companies directly involved in the supply of solar PV equipment to South Africa include Jinko Solar (currently the

Table 2: Modes of involvement of Chinese solar PV companies under RE IPPPP

Company	Type of involvement	Capacity of involvement (MW)	Type of ownership	Listed
Jinko	Technology supplier, manufacturer	260 MW	Private	New York Stock Exchange
BYD	Technology supplier	247.2 MW	Private	Shenzhen Stock Exchange
GCL-Poly	Technology supplier, equity investor	150 MW	Private	Hong Kong Stock Exchange
Hanwha Solar One	Technology supplier	139 MW	Private	NASDAQ
Suntech (taken over by Shunfeng International Clean Energy Limited)	Technology supplier	89 MW	Private	Hong Kong Stock Exchange
JA Solar	Technology supplier	86 MW	Private	NASDAQ
Yingli Solar	Technology supplier	75 MW	Private	New York Stock Exchange
Chint	Technology supplier, equity investor	30 MW	Private	
Trina Solar	Technology supplier	20 MW	Private	New York Stock Exchange
Powerway	EPC	75 MW	Private	

Source: Authors, publicly available resources

market leader in China), Trina Solar (currently the global market leader), Yingli Solar, Suntech, Chint, Hanwha Solar One, JA Solar and BYD.[79] While many of these companies are now integrated into global financial markets and listed on the New York Stock Exchange and/or the NASDAQ, in recent years a number of them such as Yingli and Trina have run into high levels of debt.[80] In addition, a number of Chinese companies have set up manufacturing/assembly facilities for solar PV equipment in South Africa, discussed in further detail in the Analysis section.

The solar PV industry in South Africa illustrates the segmentation and division between Chinese and Western companies in the solar PV value chain, with European and US companies dominating as developers and Chinese as technology suppliers. The cases of Chint, Powerway and GCL-Poly are exceptions to this rule, as discussed below.

CHINT

Chint jointly invested in two projects approved under round one of RE IPPPP, together with the now bankrupt SunEdison (US): the 28 MW Soutpan solar park and the 30 MW Witkop solar park, both in Limpopo province. Based on our interviews, Chint's major motivation to become a project shareholder was to ensure that its panels be deployed on the project. Once project construction was completed in 2014, Chint then sold its equity investment having achieved its main objective of selling panels. Chint's early experience as a project developer in South Africa helped the company gain sufficient knowledge to undertake activities elsewhere, including in India, Romania, Bulgaria, South Korea and Turkey. Most of these investments are on the build-own-transfer model, in which Chint co-invests and sells on within couple of years after its completion.

> At the beginning, it was not Chint's aim to become an investor and shareholder in overseas projects, but our US partner insisted on such a model in order to share the investment risks between project developers and technology suppliers. We agreed to invest in the SA project in order to secure the supply contracts but in doing so, also learned how to operate a solar park.[81]

Self-designated as "the General Electric of China" and one of China's largest companies, Chint is now also a leading project developer in China, with over 800 MW capacity developed and owned since 2014.[82] In this sense, Chint has managed to transform itself from a panel supplier to a project developer. However not many Chinese solar PV companies have followed Chint's aggressive strategy of vertical integration, and many have a specific policy that forbids equity investment in greenfield solar PV parks in developing countries because of the perceived high risks, thereby limiting themselves to EPC and/or technology supply contracts.

GCL-POLY

While GCL-Poly does not make modules, in 2013 it was the world's largest producer of polysilicon and PV wafers. It is also an experienced project developer.[83] Its involvement in South Africa's utility-scale solar PV market is unusual in that it is involved as an equity investor as part of a consortium led by a South African subsidiary of US company Solar Reserve in two projects approved under round one of RE IPPPP, the Lesedi and Letsatsi solar PV plants. Both projects are 75 MW each and began commercial

operation in 2014. In both cases Chinese company Hanwha solar one supplied solar modules.[84]

POWERWAY

A provider of mounting structures for the solar PV modules, Powerway, is the only Chinese company involved in project construction under RE IPPPP, having been awarded the EPC contract for Solar Capital's 75 MW PV project in De Aar approved under round one of RE IPPPP.[85] Together with JA Solar, Powerway was to have opened a module manufacturing plant in the Coega Industrial Development Zone in 2014, but according to available information, appears not to have proceeded with this venture.[86]

LOCAL CONTENT, DELAYS TO RE IPPPP AND TOLL MANUFACTURING

In addition to the impact of the EU-China solar dispute discussed above (see "Background") and the delays to RE IPPPP, the manipulation of local content requirements has had a negative impact on Chinese and other companies that set up in South Africa with the intention to supply equipment to projects approved under RE IPPPP.

With each round of RE IPPPP, local content requirements have increased, meaning that by Round 3 solar PV developers should have deployed locally manufactured panels in addition to the purchase of non-module items such as civil works and grid connections.[87] In anticipation, a number of companies responded by setting up manufacturing/assembly plants for solar PV panels. For example, in 2014, Jinko Solar established a 120 MW production plant in Cape Town, which currently supplies one quarter of South Africa's total solar PV panel manufacturing capacity.[88]

> In view of the on-going protectionism and trade disputes with Chinese solar panel producers from the EU and elsewhere, China has two solutions. Firstly to open up domestic markets for solar investment. Secondly, to shift production capacities to the overseas market... Therefore, although the immediate motivation for establishing production lines in South Africa is due to the local content requirements of RE IPPPP, such a decision is in line with the historical trend and market logics.[89]

However, due to loopholes, the local content rules were open to manipulation and a number of international project developers were able to meet the requirements by transfer pricing. Under transfer pricing, a foreign component supplier in coordination with the project developer sets up a local company and imports technological hardware. The price of that hardware is then marked up and sold on to the developer. That mark-up constitutes local content.[90] Such developments have meant that the incentives for setting up a manufacturing plant have declined. Indeed, a number of manufacturing/assembly plants that were set up with the aim of supplying to projects approved under RE IPPPP have had less than two percent of their production capacity taken up by local orders. Two leading inverter manufacturers, Germany's SMA and AEG, set up

factories in 2014 but shut down in 2016, citing delays to the RE IPPPP program.[91] Others, including Trina Solar, refrained from setting up a manufacturing plant in the first place.[92] In 2015, Jinko Solar's chief strategy officer and head of emerging markets advised other solar producers "not to invest in South African production until Government provides clarity and Eskom solve their issues."[93]

Such manipulation of local content has also led to module manufacturers seeking foreign markets via "toll manufacturing" on behalf of Chinese manufacturers. In this case, "toll manufacturing" means that Chinese suppliers reconfigure their supply chains by sending component parts (e.g., frames, glass, cells, etc.) to South African companies that assemble the product, and the Chinese company then sells it to European developers. However, because the product has been assembled in South Africa, the Chinese company evades anti-dumping legislation.[94] In one example, France's Solairedirect produced modules as part of a three-year 120 MW toll manufacturing deal signed with China's ReneSola in April 2013, which also allowed for supply to other countries on the continent.[95]

CONCLUSION

This study has revealed complex interactions between evolving market dynamics, and international and domestic factors in both China and South Africa. Such dynamics, which may at once be political, technical, economic and social, include the highly globalized nature of production chains in wind and solar PV, accompanied by increasingly consolidated markets, and on-going trade disputes between Chinese, and EU and US companies over solar PV manufacturing. These dynamics have profoundly impacted the business decisions of Chinese companies, as well as the way in which renewable energy development in South Africa is evolving. In South Africa, as a latecomer to the global renewable energy market, competition as well as cooperation between the established European, US and Chinese companies is very evident.

The role of RE IPPPP has been critical in attracting Chinese investment and technological participation to South Africa. The program has enabled Chinese corporations to "test the water" with regards to market potential and investment risk in overseas renewable energy markets. Chinese companies, whose initial focus was on the domestic market, are particularly sensitive to the risks associated with investing abroad and whether or not there is some form of national government support, in particular a government-backed power purchase agreement in the host country. While RE IPPPP provided this much needed reassurance, delays to RE IPPPP now threaten to undermine the program's stability and may in turn see investors passing over South Africa in favor of other middle income markets that are deemed more reliable.[96]

We have also discussed how the South African market has enabled Chinese companies to move forward with their technological innovation strategies. For instance, as a major global technology supplier that until recently was excluded from European markets due to its lack of certification, Goldwind succeeded in deploying its PMDD technology in South Africa for the first time outside China as well as in

developing its EPC capabilities. Similarly, Jinko Solar has recently diversified from being a technology supplier in South Africa to a project developer in Mexico's renewable energy auctions launched in 2016.[97]

The case of South Africa also illustrates how Chinese wind energy companies have used various strategies along the value chain to enhance their competitiveness. The alliance between Longyuan and United Power as developer and EPC respectively offers a typical example of how sister companies of Chinese giant state-owned utilities cooperate at various stages in order to take full advantage of the market. In another example, Sany has drawn on its dominant market power of heavy machinery in Africa, with the hope of supplying wind energy technologies in the South African market. As for Chinese PV technology suppliers, competition increasingly comes from other Chinese companies, meaning that their success depends largely on their relationships with project developers that are often European. In addition, the challenges posed by trade disputes and penalty tariffs have driven Chinese solar PV companies to seek new production facilities in other markets, including South Africa.

The modes of Chinese involvement in South Africa also illustrate the differentiated response of China's wind and solar PV companies to periods of market turbulence and slowdown. On the one hand Chinese project developers that are also large SOEs, such as Longyuan Power, have been able to survive during times of market turbulence because of profits made largely from selling electricity generated by their wind energy projects. Chinese companies that operate as OEMs, EPCs, and technology suppliers, on the other hand, have had little option but to diversify within foreign markets in order to survive, despite having benefitted from some state support. It is perhaps for this reason that Chinese companies have been far more active in technology supply, and EPC and OEM contracts, than project development. A further finding is that with the exception of its important and less direct role through ICBC's share in Standard Bank, Chinese investment in RE IPPPP projects is small, particularly by comparison to companies from the EU and the US.

One other area remains for further exploration on this topic. While we have focused here on utility-scale wind and solar PV projects, new and smaller forms of renewable energy generation in South Africa are starting to emerge, including a small but growing roof top solar PV market among wealthy residential and commercial consumers.[98] Indeed, it is understood that Chinese company, Canadian Solar, one of the top six module manufacturers, is already playing a role in technology supply in this market.[99] How the consolidation of Chinese module manufacturers plays out in this sphere, in addition to their role in the utility market, is a further space to watch. ★

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