

Local-content rules for renewables projects don't always work

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ABSTRACT

Some countries with large renewables markets have sought to create domestic supply chains and jobs by implementing local-content requirements. We focus on three key renewables markets with local-content requirements – Brazil, India and South Africa – and analyze whether these rules have helped create local manufacturing capacity or benefited local companies. We find that companies in all three countries have tended to take on roles that are more easily borrowed from other industries, such as project development or ancillary services. It is more difficult to set up manufacturing capacity and such growth as there has been is in less sophisticated components. We also find that local content rules have contributed to increasing project costs.

1. What are local-content requirements?

Local-content rules require that a minimum level of goods and services are bought and/or manufactured locally. In renewables, they can be implemented in various ways, for example, as a share of the project value, or investment held by local companies, percentage of workers, or use of local equipment and raw materials. Sometimes these requirements must be met to participate in an auction or qualify for a feed-in tariff, or they are used as evaluation criteria. Alternatively, they may be a prerequisite to access financing, as a tie breaker to assess competing offers or to adjust a company's 'comparative' price bid price based on the project's local-content share.

Many countries have attached local-content requirements to renewable energy subsidies. However, such regimes vary in their success at promoting local manufacturing and companies. They are also controversial. Critics argue that while they may help government achieve certain short-term objectives, they often lead to specialization in less sophisticated or lower value-added parts of the supply chain, can undermine long-term industrial competitiveness and may prevent the attraction of job and technology-providing foreign firms [1]. Critics also observe, in line with other more general objections to industrial policy, that the implementation of local content rules is subject to political capture and that they tend to remain in place even after they have ceased to be effective [2].

Kuntze and Moerenhout [3] outline several preconditions for the

effectiveness of local content requirements. The first is the stability and size of the market. The benefits from local content rules are more likely to accrue when demand is predictable and both lead firms and local suppliers can be confident in the durability of any relationships they establish. The second condition concerns the percentage of local content required. There is little benefit to setting targets below the level at which local firms already participate; at the same time, too demanding requirements risk jeopardizing the quality of inputs. A third factor is the capacity for resolving coordination problems within the supply chain. Local content rules are effective only when they work to ensure that local sourcing occurs on a competitive basis against imported content and incentivize upgrading on the part of domestic firms [4,5].

We focus on three countries that have auctioned the most renewables capacity to date and have implemented local-content requirements: Brazil, India, and South Africa.¹ All three introduced such rules while the renewables market was relatively immature in order to favor the local economy. In the case of Brazil and India, their goal has been to incentivize the development of local players and, specifically, domestic manufacturing capacity. However, South Africa's auction program is designed to create jobs and promote socio-economic empowerment for 'historically disadvantaged South Africans'. The form taken by the local content requirements has also differed: as outlined below, India took a direct approach by requiring project developers to source certain pieces of equipment from domestic companies (albeit only where certain technologies were used). Brazil and South Africa's approach is less

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¹ Each of these three countries have relatively well-documented and established local content rules in place.

Table 1

Example of local content rules: wind and PV in Brazil (as of August 2019).

Wind	I (Jan 13-)	II (Jul 13-)	III-IV (2014-15-)	V (Jan 15-)	VI (Jul 15-)	VI (Jan 16-)
May produce in house or source from local third party						
Tower	1 of 4 criteria for tower, blade, hub & nacelle	Steel 70%. Cement 100%	Tower interior components		At least 60% of foundation slabs	
Blades		n/a	40%	50%	60%	
Must source locally and assemble in house						
Hub	At least 1 of 4 criteria for tower, blade, hub & nacelle	At least 1 of 4	At least 2 of 4	At least 3 of 4	All 4 hub parts	
Nacelle		Business plan for plant	Plant under construction. Equipment ordered	Construction done. Equipment installed	Assembly	All components made locally
PV crystalline silicon		I (Aug 14-)	II (Jan 18-)	III (Jan 20-)		
Module (min 36%)	Assembly Metallic frame Junction box Cell	Mandatory Mandatory Optional Optional Local 20%	Mandatory			
Electronic components & metallic frame					Mandatory	
Inverter		Optional	Local 20%			

Source: BNDES, BloombergNEF.

Table 2

Local content rules, India (as of August 2019).

	National Solar Mission		'Make in India' order (2019-)
	Phase I (2010-12)	Phase II (2013-17)	
Solar thermal	30% domestic content		
PV			
• Crystalline silicon	Batch I: locally manufactured modules. Cells may be imported Batch II: locally manufactured modules & cells	DCR category: locally manufactured modules & cells. Open category: no rules	<i>Not applicable</i>
• Thin film	May be imported		Modules: 100%
• Grid-connected	Not applicable		Other components: 40%
• Off-grid/decentralized			70%
• Wind			80%
Small hydro			80%
Biomass			80%
Municipal solid waste			60%
Waste to energy			80%

Legend: Current rules.

Source: Ministry of New & Renewable Energy, BloombergNEF.

direct: for the former, local content rules are enforced through the financing process, and in the latter, domestic content is one of multiple criteria used to assess auction bids.

Our analysis is concerned with electricity generation, though similar considerations apply to renewables more broadly.

1.1. Brazil

In Brazil, local content is neither a precondition for participation in auctions nor a criterion for evaluating bids. Rather it is required to obtain low-cost financing for machinery or equipment from the country's development bank, BNDES, as part of its Finem program. Local financing is in Brazilian Reals, eliminating high currency exposure as all power-purchase agreements are denominated in local currency. Thus,

while a project could use non-local equipment, the developer would be ineligible for loans from BNDES, which offers interest rates that are broadly half those offered by commercial banks. As a result, most wind farms in Brazil have been developed with financing from BNDES, making it the top lead arranger in the world (see [Tables 1 and 2](#)).

However, BNDES's place at the center of Brazil's renewable market has been weakened by the country's economic crisis. The bank is cash-constrained, making it necessary for developers to obtain a second source of project debt, while a regional Brazilian development bank, Banco do Nordeste (BNB), has begun to provide cut-rate financing in the northeast of the country. We expect the presence of BNDES to contract over the near term as it implements a gradual increase in rates offered for new loans over the period 2018-23. Rates will rise to par with commercial levels, with 2019 being the first year in which developers will have felt the impact of the changes.

Brazil first incentivized renewables build through the Proinfa system,² which began in 2002 and offered a feed-in tariff to small hydro and wind projects. This required that 60% of the equipment and services be manufactured locally—somewhat of a hurdle as there was only one supplier in the Brazilian market at the time (Germany's Enercon, which did not qualify as local). In addition, developers had to show a “degree of industrialization,” which also proved to be difficult as it was not clearly defined.

In 2004, Brazil switched their primary RE fiscal support scheme to auctions, holding the first round for biomass and small hydro three years later. The first auction for wind projects was held in 2009, and there have been 19 further rounds to date, contracting 16 GW of onshore wind capacity. BNDES implemented more ambitious local-content requirements in 2012, releasing a six-phase ‘roadmap’ whereby the rules toughened with each phase. Since January 2016, all hubs and nacelles must be made locally. Tower and blade components may be sourced from a local third party, with at least 60% local content. This share was reduced to 50% until 2018, to account for the impact of volatility on production costs. At the end of that year, BNDES changed its accreditation methodology from a 60% local-content requirement to 30% plus additional parameters such as the share of export revenue and labor participation.

² https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Brazil.pdf?la=en&hash=D645B3E7B7DF03BDDAF6EE4F35058B2669E132B1.

In 2014, BNDES announced the local-content rules for solar equipment and held the first auction for PV. The roadmap followed the same set-up as the wind plan, but with mandatory and optional items. Currently, crystalline silicon PV projects seeking financing from BNDES must use modules assembled in a local facility, using a frame produced in Brazil. The electronic components and metal structure must also be sourced domestically.

1.2. India

In India, local-content requirements and an ambition to create a domestic manufacturing industry have been at the heart of the National Solar Mission. This initiative aims to secure 20 GW of grid-connected solar power in India by 2022, to create “favorable conditions for solar manufacturing capability” and to reach “a 4–5 GW equivalent of installed [annual manufacturing] capacity by 2020”. In Phase I of the program (2010–12), the local-content rules only applied to crystalline-silicon technologies but in the second phase (2013–17), project developers had to source locally made PV, to participate in the ‘DCR’ category of the auctions held as part of the National Solar Mission.³ Alternatively, they could take part in the ‘Open’ category (where local-content rules did not apply), or in both by submitting separate bids.

The rules have been a source of controversy and friction between India and the U.S. In February 2016, the World Trade Organization (WTO) supported U.S. government allegations that India’s local-content requirements under Phase I and II (Batch I) broke international trade rules and unfairly discriminated against imported cells and modules. The Indian government was instructed to remove the local-content requirements for subsequent auctions as part of the National Solar Mission, such as those held by the Solar Energy Corporation of India (SECI).

The market had been broadly expecting this outcome, as the decision had been leaked in the preceding year. Over the two years following the 2016 decision the U.S. repeatedly said India had not complied with the WTO decision and in January 2018 it sought permission to impose retaliatory measures. In the same month, India asked for a WTO panel to be established to review its compliance with the decision and resolve the dispute.

Despite the setback at the WTO, the Indian government remains committed to boosting domestic manufacturing and in July 2018 it introduced a 25% safeguard duty on solar imports from Malaysia and China. Because the duty period was set at two years (the minimum time needed to set up new manufacturing capacity), it failed to draw new manufacturers to India or help relieve beleaguered local players.⁴ In addition, some Chinese players (e.g. Canadian Solar, JA Solar and Trina Solar) could circumvent the duty as they already had production capacity in Indonesia, Vietnam and Thailand. Other reasons why it did not help manufacturers were that some projects delayed commissioning so that developers paid the lower duty rate and the uncertainty of long-term demand.

In December 2018, the Ministry of New and Renewable Energy (MNRE) issued an order for the implementation of ‘Make in India’ rules for public procurement in the clean power sector. The order applies to

³ “In case of crystalline Silicon technology, all process steps and quality control measures involved in the manufacture of the Solar Cells and Modules starting from P-type (or N-type) wafers till final assembly of the Solar Cells into Modules shall be performed at the works of PV manufacturers in India. The requisite P-type (or N-type) wafers and other raw materials can be imported. In case of Thin-film technologies, the entire Modules assembly comprising of Thin-film Solar Cells shall be manufactured in India. The starting substrate (without any semiconductor junction) and other requisite raw materials can be imported.” Ministry of New and Renewable Energy.

⁴ The duty fell to 20% in July 2019 and will decline then to 15% in January 2020.

renewables projects tendered by the federal government, ministries and ‘public sector undertakings’ (companies in which the federal government owners at least a 51% stake). The required share of local content varies by technology, with 100% for solar modules in grid-connected plants and 70% for off-grid/decentralized solar projects. The National Solar Mission auctions are excluded from the order due to the WTO ruling.

The government intends to kickstart the ‘Make in India’ initiative through the ‘CPSU’ program approved in July 2019. Under this program, public sector units (PSUs) must auction 12 GW of grid-connected solar capacity by 2022. The solar cells and modules must be manufactured domestically, and the local-content requirements may be increased to include wafers, ingots and polysilicon based on an annual review by the energy ministry. Another driver will be the \$5 billion scheme known as the ‘Pradhan Mantri Kisan Urja Suraksha Evam Uttham Mahabhiyan’ (PM KUSUM) program to develop decentralized, small-scale solar for agricultural consumers. The program components focused on solar water pumps mandate the use of domestically manufactured cells, modules and balance-of-system parts. This could create up to 15.75 GW of additional demand over the next three years for companies in India.

India did not have explicit local-content rules for wind projects until the ‘Make in India’ order, which set an 80% requirement. Previously, it had implemented customs and excise duties to promote imports of wind-turbine components rather than imports of already assembled turbines. In addition, India has a national certification program requiring that any manufacturer wanting to sell turbines in the country must have quality certification for its devices together with a local assembly unit and an operations & maintenance (O&M) team. This is done to ensure that only quality equipment is installed domestically but has also prevented several turbine makers (especially Chinese) from setting up shop in India (unlike the PV module business).

1.3. South Africa

South Africa set its first renewables target in 2003 and implemented a feed-in tariff (without local content requirements) in 2009. The Integrated Resource Plan (IRP) – the energy plan first published in 2010 – envisaged that 19 GW of wind and solar capacity would come online by 2030. Also that year, the government kicked off the ‘New Growth Path’, which aimed to create 5 million new jobs by 2020 and focused on five sectors including the green economy. This was meant to spur a shift away from the apartheid era characterized by high levels of inequality and unemployment. Based on dialogue with industry, the government signed ‘Green Economy Accord’ in 2011, which included a goal to create 300,000 green jobs by 2020. It also focused on inclusivity and the need for the green economy to facilitate broad-based black economic empowerment, and included a commitment to realize the renewables targets in the IRP. Also that year South Africa announced a competitive bidding process known as the Renewable Energy Independent Power Procurement Process (REIPPP) – the principal mechanism to enable the country to meet the IRP goals.

This background meant that the at the heart of South Africa’s auction program is the need to create jobs and enable socioeconomic empowerment. As a result, the regime is unusual in placing so much weight on non-price criteria. An application must exceed “thresholds” set in the request for proposals and score additional points if it exceeds certain targets. These thresholds cover six areas: environment, land, commercial & legal, economic development, financial and technical. The actual prices bid to deliver the power then account for 70% of the project’s total score for consideration, with 30% covering local content, job creation, ownership, management control, preferential procurement, enterprise development and socio-economic development. Local content specifically comprises 7.5% of the total score (see Figs. 1 and 2).

South African local content requirements have ratcheted up over time, while the scope covered has also evolved. In addition, in Round 2,

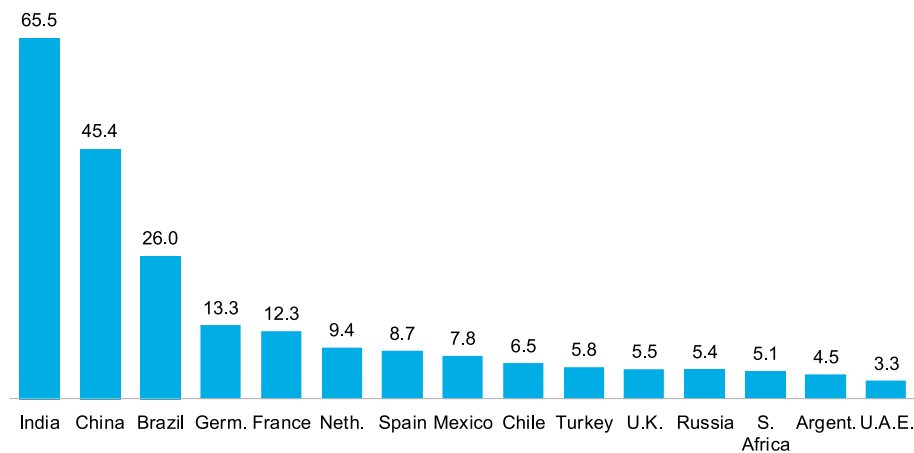


Fig. 1. Top countries for renewable energy capacity signed through auctions (2010-1H 2019, GW).
Source: BloombergNEF.

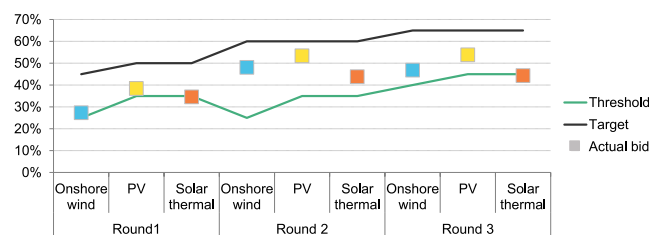


Fig. 2. Local content requirements and results, South Africa.
Source: PPIAF, South Africa's Renewable Energy IPP Procurement Program: success factors and lessons, May 2014; BloombergNEF.

the government identified certain components as being priorities for manufacturing domestically and the scoring methodology changed.⁵ The preferred bidders for Round 4 were announced in 2015, beginning nearly three years of political stalemate between the government, utility Eskom and the renewable energy sector. In April 2018, Energy Minister Jeff Radebe signed the PPAs for the outstanding projects. While there have been murmurs about a potential fifth auction round, a definitive schedule has yet to be announced although the latest Integrated Resource Plan (which sets the volume of capacity to be procured by auction) was adopted in 2019.

2. Do local-content rules promote local manufacturing?⁶

One of the primary goals of local content rules is to spur the development of domestic manufacturing capacity. The development of such capacity is expected to benefit the local economy and create jobs,

⁵ Bidders did not receive points for commitments up to or equal to the threshold, while the compliant proposal with the highest economic development share was awarded full points, provided its commitment exceeded the target level. Other compliant bidders received points in proportion to their position between the highest scorer and the threshold, or zero if no threshold was set.

⁶ All figures in this section show capacity built to manufacture wind or PV equipment. The colors in the figures indicate the ownership of that capacity: blue signals that capacity belongs to a company with its headquarters in the relevant country, while purple shows how much capacity is held by companies with their headquarters in another country. For example, Fig. 3 illustrates that in Brazil, most of its nacelle manufacturing capacity is held by 'foreign' players from Germany (Enercon, Nordex, Siemens Gamesa), Denmark (Vestas) and the U.S. (General Electric)

thereby increasing public support for these technologies. For nascent industries, local-content requirements may promote innovation and increase competition for international equipment manufacturers [6]. The presence of a domestic supply chain may also decrease technology costs in the long term, despite a potential increase in costs for project developers over the short term. Our cases, however, also point to some of the limitations to local content requirements, particularly there is uncertainty over their duration or implementation, as in South Africa, or when the market is small, or demand fluctuates unpredictably, as in both South Africa and Brazil. They also illustrate the tendency for local suppliers to specialize in relatively unsophisticated components, such as casings and other items that are similar to those used in other manufacturing value chains and benefit from transferable expertise [7–11].

2.1. Brazil

Development bank BNDES has played an integral role in financing wind and solar project development in Brazil, having been lead arranger for 71% of renewables capacity in the country. Local-content requirements have helped to boost manufacturing capacity of some wind components such as blades, while developers have had to rely on imports for more complex parts including nacelles. The creation of a local solar supply chain has been impeded by demand uncertainty, due to the break in auctions over 2015–17.

2.1.1. Wind

The Proinfa feed-in tariff, which began in 2002, does not seem to have spurred significant build-out of renewables manufacturing capacity. This was probably because wind plants could meet the 60% threshold by sourcing components locally while importing only the hub, gearbox, and pitch mechanisms and bearing (Fig. 3). This did not account for the nebulous “degree of industrialization”. However, the local-content requirements helped spur a significant uptick in blade-manufacturing capacity over the period between the announcement of the rules and the date when the 40% rule for blades came into effect. Capacity rose by a further third in 2016, with the commissioning of Tecsisa's 2.7 GW plant – a necessary expansion to meet the new 60% local content rule for blades.

Brazil has developed a wind manufacturing industry specializing in the less technologically sophisticated components – such as blades, towers, bearings and castings – as they can more easily be produced locally and transported across country. Thus, by 2016, it had 8.7 GW of blade-manufacturing capacity, of which domestic companies have taken the lion's share (79%). Tecsisa in particular was able to leverage its experience in the aeronautical sector, and its former employees set up

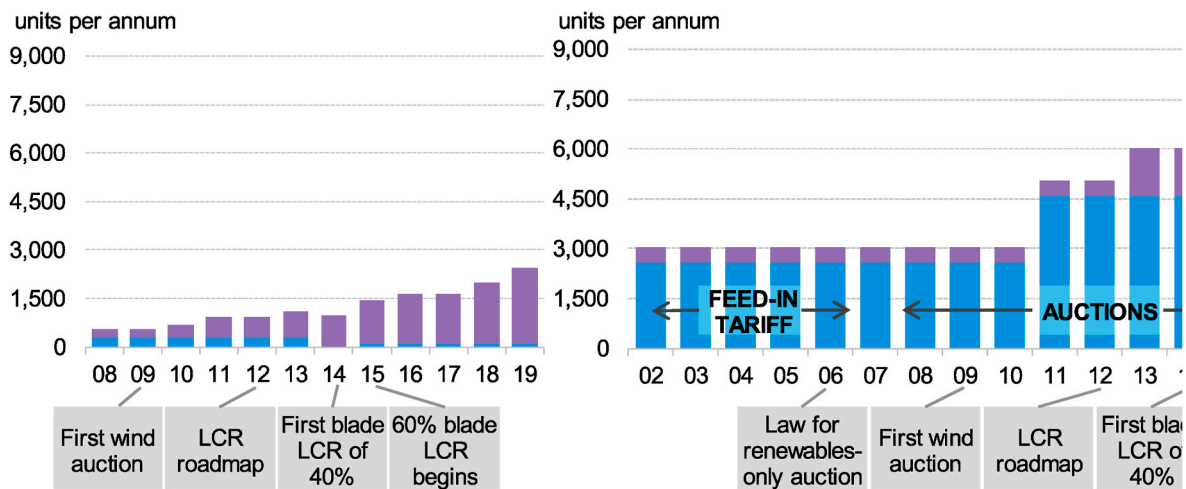


Fig. 3. Onshore wind manufacturing capacity in Brazil.
Source: BloombergNEF

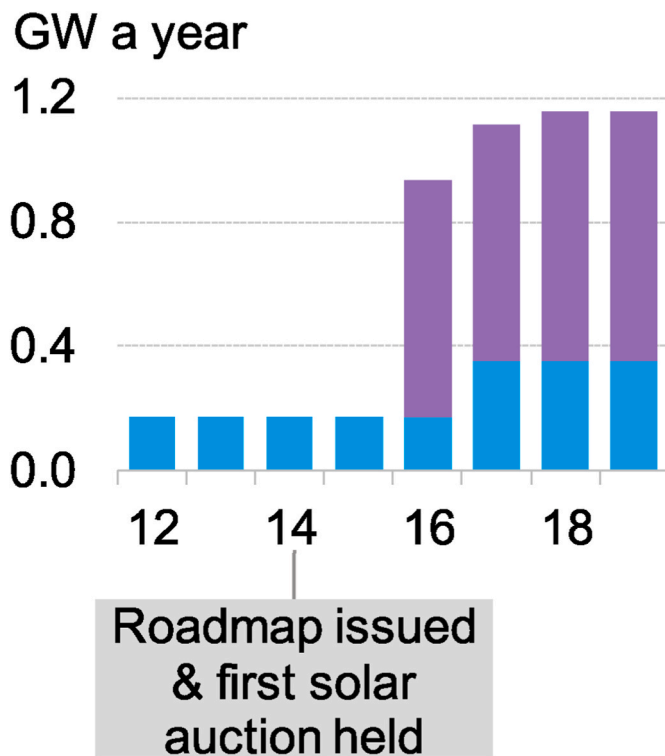


Fig. 4. Solar manufacturing capacity in Brazil (MW/pa).
Source: BloombergNEF

the other player, Aeris Energy. In contrast, at end-2016, local companies accounted for only 6% of the 1.6 GW nacelle manufacturing market, which is spread among Enercon (Germany), Vestas (Denmark), GE (U.S.) and Siemens Gamesa (previously Spain, now Germany, following the merger in 2016). Nacelle manufacturing has not undergone the same domestic growth as blades, with the share held by local players falling to 4% by mid-2019.

While local-content requirements enabled Brazil to double its blade manufacturing capacity from the first wind auction in 2009 onward, the overall supply chain had trouble keeping up with the development. In December 2016, for example, some 575 MW of projects were delayed as the wind farms had no turbine contracts. The economic crisis also prompted BNDES to cut credit disbursement for infrastructure in 2015

and 2016. In October 2016, it announced new financing conditions for solar projects, in an attempt to boost the solar market: they are now eligible to finance as much as 80% of capex costs (up from 70% in previous years). For wind projects, BNDES kept the same participation of 70%.

2.1.2. Solar

In 2015, Brazil's fledgling solar sector was struggling in terms of equipment supply, high financing costs and questions over future demand. However, the main reason today for the sector's modest growth was the gap in auctions held between end-2015 and end-2017. Fig. 4 indicates that local-content rules have had little impact on manufacturing build so far because the bulk of manufacturing capacity was commissioned well before the solar roadmap was released.

Historically, uncertainty over PV demand in Brazil has meant that international suppliers have been reluctant to set up camp in the country. But this uncertainty has now decreased after the government said it would hold five auctions between October 2019 and September 2021. In addition, PV projects will now be able to compete in A-6 auctions as well as A-4 rounds.

Despite greater certainty of future demand, BNEF does not expect BNDES's local-content requirements to drive substantial build of solar manufacturing capacity in Brazil. As mentioned in Section 0, its role in the sector is likely to contract in the near term as it gradually increases its rates for new loans.

2.2. India

India has borne witness to some of the unintended consequences of local-content requirements as discussed in the solar sub-section. However, the government's commitment to developing a local solar manufacturing industry has been successful to some extent. The 2018 'Make in India' policy is likely to further this success in solar, but may have little impact on the domestic wind supply chain, which is already quite mature.

2.2.1. Solar

India has seen growth in some areas of solar manufacturing, though the local-content rules also had unintended consequences (Fig. 5). The country already had a modest manufacturing industry before the National Solar Mission was launched: in 2008, India had 16 crystalline-silicon module manufacturers, six for cells and one thin-film silicon module maker (see Fig. 6).

However, when the auctions began, the local-content rules in Phase I

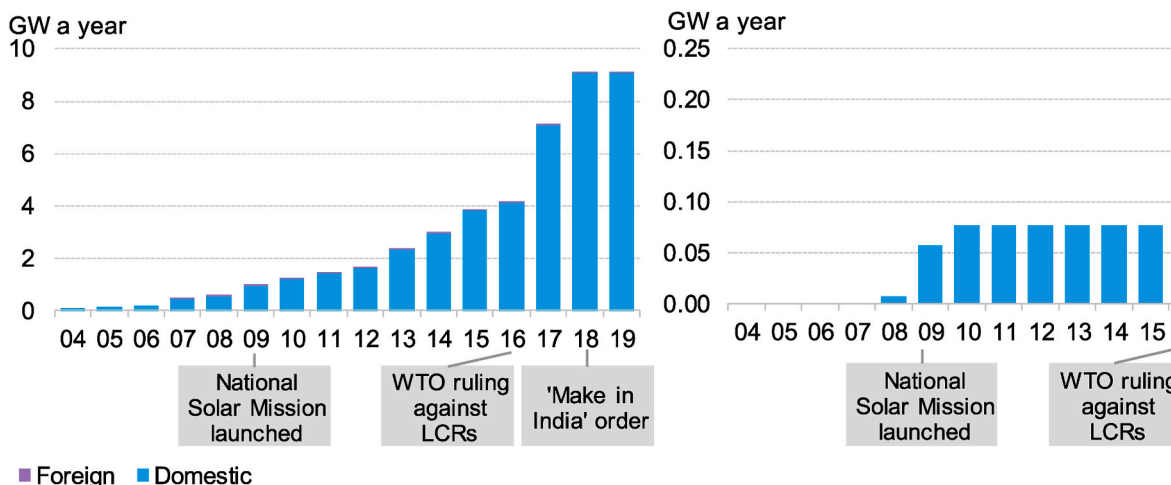


Fig. 5. Solar (crystalline-silicon) manufacturing capacity in India.
Source: BloombergNEF

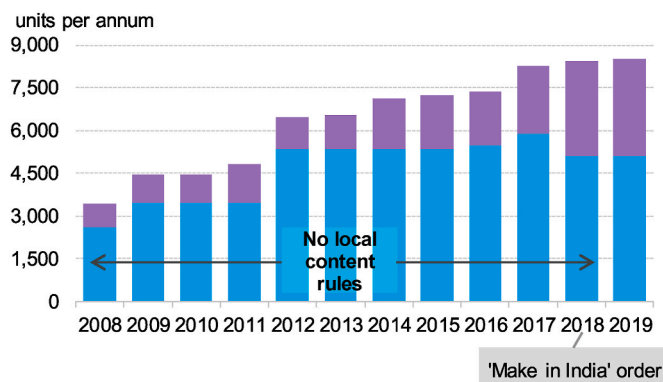


Fig. 6. Onshore wind manufacturing capacity, India.
Source: BloombergNEF

favoring thin-film products from outside India as they were exempt from the requirements, tended to be cheaper and were often coupled with low-cost international financing. For example, the U.S. Export-Import Bank and Overseas Private Investment Corp. offered low-interest (around 3%) U.S. dollar-denominated loans – compared with over 14% for rupee loans from local banks – to Indian solar project developers on the condition that the latter would buy equipment from U.S. companies. Over 2010–11, the U.S. Ex-Im Bank lent \$248 million to Indian companies that bought thin-film modules.

As a result, half of installations in Phase I Batch I used thin-film technologies, rising to 59% in the following batch. In comparison, thin-film solar accounted for 14% of capacity installed globally on a capacity basis in 2011. Other reasons for the thin-film preference were that PV manufacturing in India was not cost-competitive – and is still not competitive with Chinese imports – and the warm climate offered ideal conditions to maximize thin-film efficiency.

Nonetheless, the local-content requirements were at least partly responsible for the 135% growth in manufacturing capacity of crystalline silicon modules in Phase I (2010–12). Another driver was local manufacturers' assumption that Chinese imports would be subject to import taxes, blunting their cost advantage. This led to significant overproduction, prompting domestic manufacturers to scale back operations, operate below capacity or close down altogether. Nonetheless, demand for solar equipment in India led to an overall increase in capacity, and the government closed the loophole in Phase II by making thin-film products also subject to local-content rules for projects

competing in the domestic content requirement (DCR) auction category.

Construction of crystalline silicon module-making capacity accelerated even faster to 27% a year in Phase II (2013–17) – up from 9% a year in Phase I. The WTO ruling in 2016 seemed to have little effect on construction, as capacity expanded 30% annually over the subsequent three years and another 1.3 GW is planned. Many of these projects would have already begun at the time of the ruling, however. A total of 0.5% of this capacity is owned by a foreign company. BNEF estimated that imported modules are still \$0.01–0.03/W cheaper than locally manufactured equivalents.

Following the announcement of the 'Make in India' order at end-2018, domestic manufacturers like Adani Solar have already said they intend to expand cell- and module-making capacity. The new local-content rules will also benefit independent power producers with domestic manufacturing capabilities like Adani and module makers such as Vikram Solar and Waaree Energies. Developers without local capacity may have to agree deals with local suppliers or build their own facilities. We expect some Chinese companies to fast-track their plans to manufacture modules and cells in India. For example, Longi Green Energy Technology announced in 2018 plans to build 500 MW each of cell and module-making capacity. However, it would take them some 2–3 years to fulfil these plans, taking account of land acquisition, permitting, construction and commissioning.

2.2.2. Wind

The 'Make in India' order is the first time that wind farms are subject to local-content rules in India. However, the country already has a well-established supply chain: major domestic and international turbine manufacturers have production and assembly lines in India and source most turbine parts from local suppliers because manufacturing costs are low but transporting large parts is expensive. Most existing turbine makers will not be affected, while new entrants will have to set up local factories for assembly. Imports will still be required for newer technology components for making gearboxes, controllers and blades.

2.3. South Africa

Of the three countries we focus on here, South Africa has the weakest value chain for wind and solar. The local-content rules ramped up in Round 3 (2013) with the aim of incentivizing companies to build manufacturing capacity. However, this does not seem to have had a significant effect: one blade-manufacturing plant came online in 2011, with capacity of 150 units a year by a local firm, Isivunguvungu Wind Energy Converter (I-WEC), but this was liquidated two years later

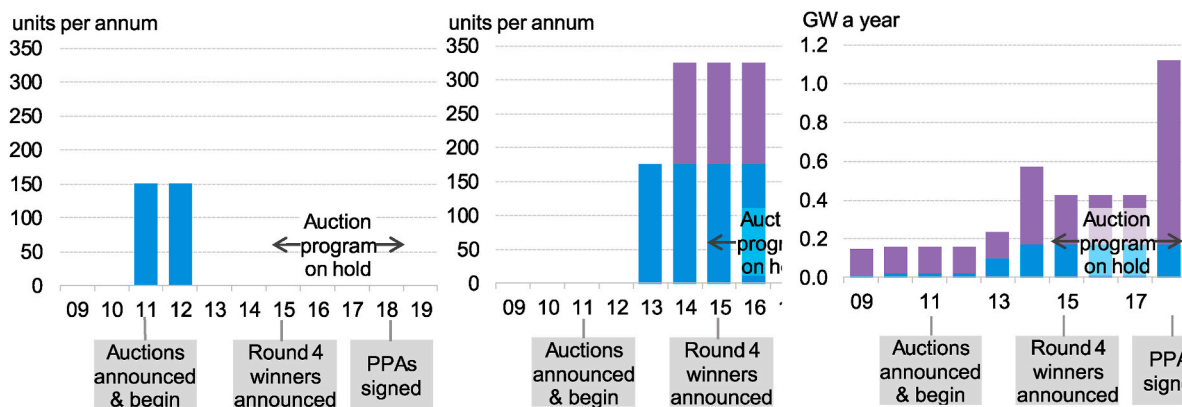


Fig. 7. Manufacturing capacity in South Africa.

Source: BloombergNEF

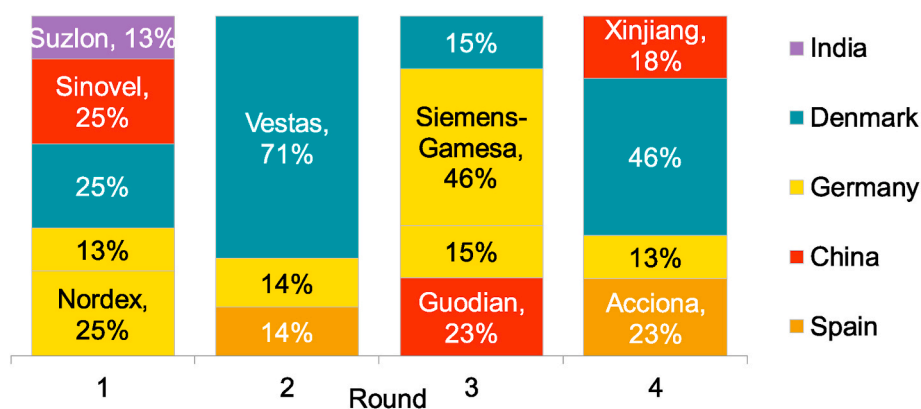


Fig. 8. Turbine manufacturer market share by auction round, South Africa.

Source: BloombergNEF

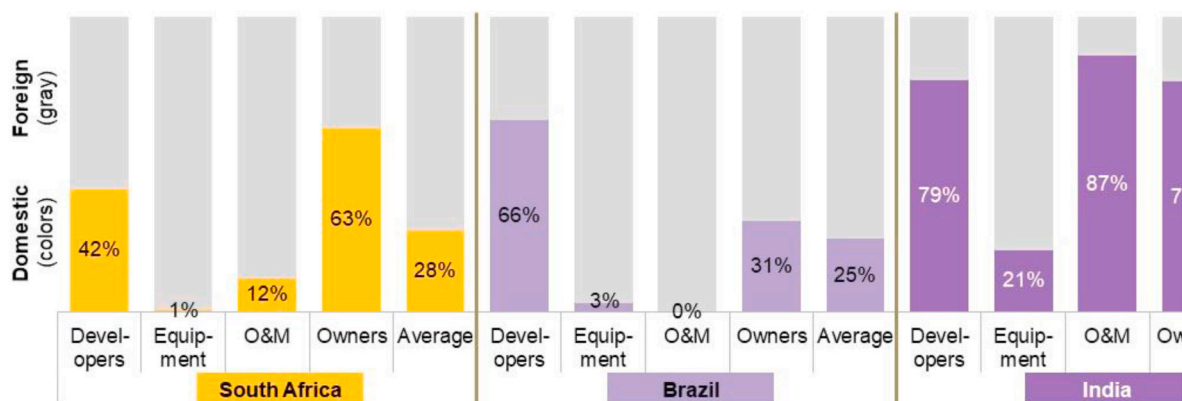


Fig. 9. Domestic players' share of wind and solar auctioned project capacity subject to local-content rules.

Source: BloombergNEF. Note: Only includes auctioned capacity subject to local-content rules and where the player for each role has been announced publicly. India only includes solar because local-content rules for wind only came into force at end-2018.

(Fig. 7). The country was also home to two tower manufacturers: South African company DCD Wind Towers opened its doors in 2013 but closed three years later amid the delay to the auction program. Spain's GRI Renewable Industries also paused tower manufacturing due to the halted scheme but in early 2019 resumed operations to supply various wind farms that won support in Round 4.

The question therefore is why local-content requirements and auctions have not spurred the same level of manufacturing additions as seen, say, in Brazil and India. One reason is that manufacturers thinking

of entering the South African market had to weigh up whether government support of the renewables auction program was sufficiently strong and sustained to warrant them setting up local capacity. It is easy to see – with hindsight – why players may have been reluctant to set up shop in the country: renewables investment and the auction program ground to a halt after Eskom refused to sign power-purchase agreements with the renewables auction winners. International players with offices in South Africa have also indicated that the market is too small and uncertain for a viable manufacturing industry.

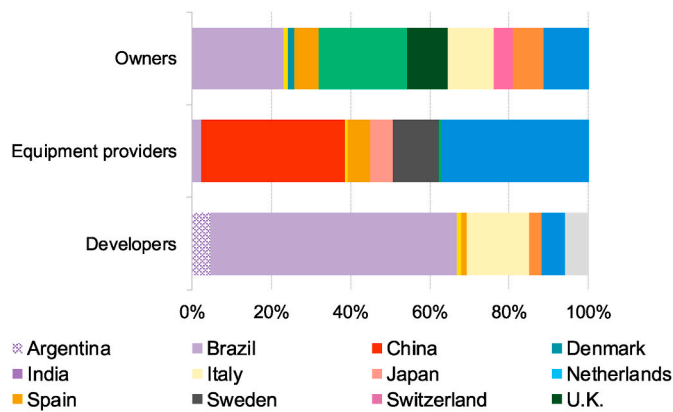


Fig. 10. Parent company headquarters for PV auction projects by role, Brazil (%).

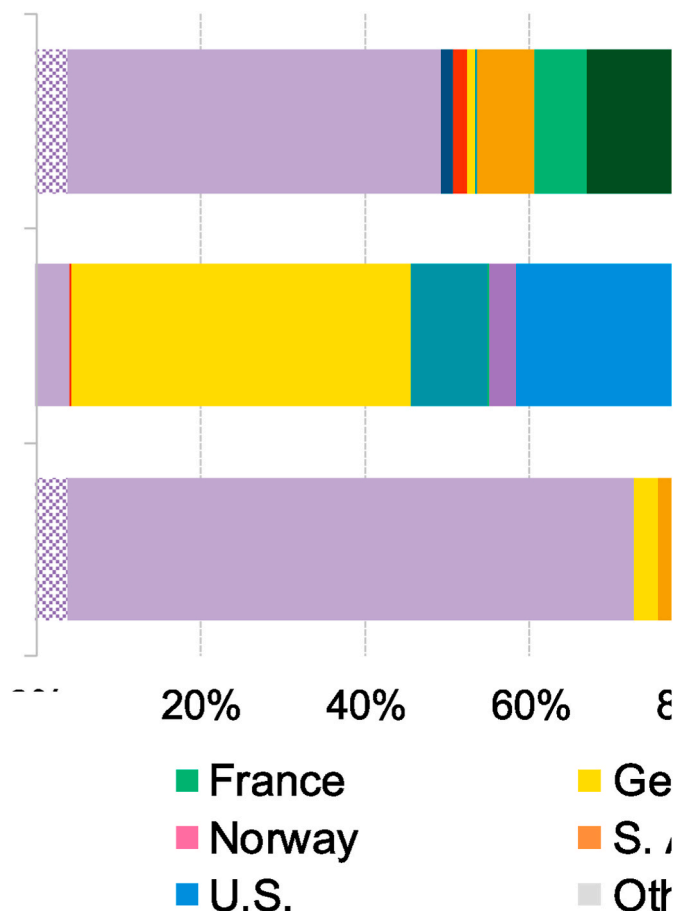


Fig. 11. Parent company headquarters for onshore wind auction projects by role, Brazil (%).
Source: BloombergNEF

In any case, nacelle manufacturing tends to be one of the last parts of the value chain to be established. The process requires specialized labor, and players may be deterred by quality concerns and higher input costs in South Africa. Certification issues mean that developers prefer to collaborate with manufacturers with which they already have a long-standing relationship. The South African manufacturing market has been hindered by strong competition from Chinese imports (Fig. 8). It also has limited capacity for exports and as yet wind-project demand in Sub-Saharan Africa is modest.

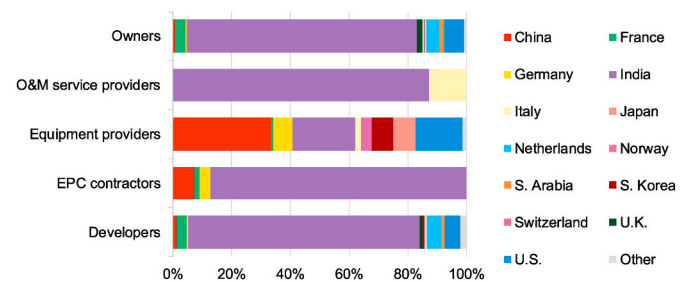


Fig. 12. Parent company headquarters for PV auction projects by role – India (%).

Source: BloombergNEF

3. Do local-content rules benefit local companies?

Another angle to consider when assessing the role of local-content requirements in renewables auctions is whether domestic companies benefit. One of the principal objectives of local-content rules is to create jobs to the benefit of the local population. This contrasts with the approach of some infrastructure projects in Sub-Saharan Africa, for example, where most of the workforce is temporarily imported for the project and then exported when construction is completed. Some auction programs such as South Africa's REIPPP scheme have sought to benefit the local economy by requiring that a share of the project value go to local players. For example, all projects must have South African "entity"⁷ participation of at least 40%. This includes local subsidiaries of foreign-owned parent companies.

Overall, local companies in India and Brazil have benefited more from auctions in their countries than those in South Africa, as defined by their share of auctioned project capacity.⁸ Fig. 9 was calculated by allocating a project's capacity to each participant based on the number of companies with that role for that project: for example, for a 100 MW plant, if there were two equipment providers, then 50 MW was attributed to each one. If a company was based in the local market but had a parent with headquarters elsewhere, it was deemed to be foreign, though it should be noted that some foreign manufacturers such as Siemens-Gamesa and ABB often have a high degree of localization in their supply chain. Even if an independent power producer had undisclosed amounts of equity invested in foreign firms, whether they were categorized as domestic or foreign was determined by the location of their headquarters. Domestic companies are more likely to have roles like project developers and owners – i.e. the roles that are more easily 'transported' from other industries. In contrast, it is more difficult and costly to set up manufacturing capacity in a country – hence the lower share of equipment providers.

3.1. Brazil

As explained above, domestic players have accounted for more auctioned capacity in Brazil at the owner and developer levels compared with equipment providers. Local firms Casa dos Ventos Energias Renováveis and Solatio Energia were developers for more than a third of the wind and PV capacity. The provider with the biggest share to date is General Electric (U.S.), which commissioned its first turbine-manufacturing plant in 2011. GE has also entered the PV market in Brazil, along with other U.S. players such as Canadian Solar. However,

⁷ These must be based and registered in South Africa and involve shareholding by South African citizens.

⁸ These companies are builders, developers, engineering, procurement & construction (EPC) contractors, equipment providers, operations & maintenance (O&M) service providers, operators and owners. We acknowledge that a company's success at auction does not automatically imply its longer-term profitability or survival.

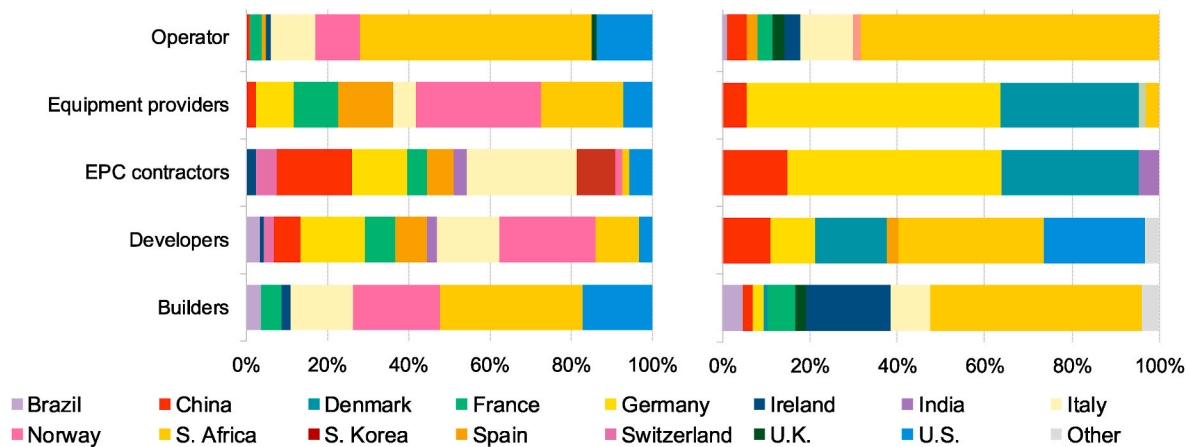


Fig. 13. Parent company headquarters for auction projects by role, South Africa (%).
Source: BloombergNEF

China-based equipment providers have taken the lion's share, in particular BYD (see Figs. 10–12).

3.2. India

India's local-content requirements may not have spurred the construction of as much manufacturing capacity as anticipated. But local power purchasers have benefited from the trend towards localization of production, and it helped push India toward its ambitious renewables targets. This was why the government did not implement import taxes on Chinese modules (besides the lack of local manufacturing capacity). In addition, auctions have at least favored domestic players, with companies such as Azure Power and Acme Group taking on multiple roles in the value chain. Generally major independent power producers tend to have internal O&M teams for solar projects as their large portfolios justify the need for a permanent team. Most big solar power producers also often have their own engineering, procurement and construction, or EPC, divisions (which double up as O&M providers) to save costs in the highly competitive auctions.

The exception was in equipment providers, where Chinese and U.S. manufacturers secured more capacity. In particular, First Solar – the U.S. thin-film module maker – benefited from the thin-film exemption from the local-content rules in Phase I of the National Solar Mission. However, manufacturing capacity of crystalline-silicon modules has ramped up in recent years, reaching 9.2 GW in 2019. Local players Adani Group, Waaree Energies and Vikram Solar account for nearly a quarter.

3.3. South Africa

Compared with Brazil and India, the South African market has a lower average domestic share, which has in fact shrunk from Round 1 (39%) to Round 4 (18%). Even if you count local subsidiaries of foreign-owned companies as 'domestic' players – as do the local-content requirements – the domestic overall average share only rises to 34%. The local companies tend to be the owners or developers of projects – eg, Mulilo Renewable Energy and BioTherm Energy. Thus, foreign-owned players have complied with local content rules by setting up subsidiaries in South Africa to act as project developers, O&M providers and EPC contractors, or by forming joint ventures or other strategic alliances with local players. In addition, they have contracted local companies for services such as catering and logistics, rather than for the role types directly involved with the project. The country spread in Fig. 13 highlights the dominance of certain players in certain markets: for example, Vestas (Denmark) is the equipment provider for 40% of the onshore wind capacity.

4. Conclusions

The successful creation of a local manufacturing sector requires more than just local-content requirements. Other influential factors include whether the domestic market for renewables is stable and has potential for growth. This stability also applies to the policy itself: manufacturers will be reluctant to invest millions of dollars in building production capacity if, as in South Africa, it is not clear if/when the next renewables auction will be held or if the feed-in tariff expires in a few years. Without careful management by the government, local-content requirements can result in both oversupply in local production capacity, hurting manufacturers, as in India's solar sector, and undersupply of equipment, resulting in project delays.

Local-content requirements have also come under fire for incentivizing suppliers to invest inefficiently in order to improve the competitiveness of local products, and for raising project costs. This is due in no small part to the time it takes for developers to understand the rules, to find local suppliers and to complete the paperwork. But the rules also often force them to use local equipment, potentially creating a situation where only one or two companies supply a given component and can increase their prices. Manufacturers will then come under pressure from developers, which want to bid low prices at auction.

Credit author statement

Morgan Bazilian: Conceptualization; Victoria Cuming: Data curation, Writing - Original draft preparation; Thomas Kenyon: Writing - Reviewing and Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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