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Trade and Investment Barriers in Solar and Wind Global Production Networks

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Introduction

Commercial investment in clean energy has increased significantly over the last decade driven by public incentives and removal of trade and investment barriers. The bulk of investment has been in solar and wind technologies. Over the last decade, investors have poured \$890 billion and \$760 billion, respectively into solar and wind.

Innovation in solar and wind technologies appears to have intensified over the last several years. Costs of solar and wind have fallen very rapidly, becoming competitive with conventional fuels in some countries. Solar is receiving a significant share of venture capital/private equity investment. Patenting in solar and wind technologies has grown rapidly.

The burgeoning investment in solar and wind, technological breakthroughs, and relatively free trade and investment have led to a huge increase in production and the creation of global production networks (GPNs) in both of these industries.

Global production networks have played a major role in the declining costs of solar and wind and the huge expansion of production. China has become the largest producer and global supplier of low cost solar PVs that has led to a boom in installation of solar power around the world. Solar and wind accounted for about half of the global generation capacity installed in the last decade.

A number of countries have enacted “green industrial” policies since 2008 to foster development of their solar and wind domestic manufacturing industries to generate jobs and economic growth. Although they may benefit domestic manufacturing industries, many of these policies have negatively impacted trade and investment in solar and wind GPNs. Solar and wind GPNs require free flows of trade and investment and the ability to globally source goods and services at the lowest market price to remain competitive and innovative. The proliferation of “green industrial” policies has prompted an escalating number of trade disputes in the WTO and imposition of tariffs.

The scaling up of renewable energy is an essential element to help mitigate climate change. Solar and wind are by far the most rapidly growing renewable industries. The IEA estimates cumulative investment of \$53 trillion in renewables will be needed by 2035 to help meet the target of limiting the globe’s average temperature from rising past two degrees. The IEA estimates that projected cumulative investment is \$48 trillion based on today’s policies. The impact of “green industrial” policies on solar and wind GPNs could be significantly hampering investment in these sectors.

This paper will examine the adverse effects of trade and investment barriers on solar and wind GVCs. It will explore and recommend further research on alternative measures to encourage trade and investment and help domestic producers in solar and wind.

Global production networks in solar PV and wind

International trade, foreign direct investment, and the relocation of manufacturing to China and other countries have fueled the rapid growth and global integration of solar PV and wind GPNs. These networks allow firms to lower their production costs by sourcing activities such as equipment manufacturing based on countries' comparative advantages in costs, skills, materials and other location specific activities (OECD 2015). The sourcing of activities, particularly manufacturing, to other countries has made solar PV and wind increasingly reliant on intermediate inputs. For countries where manufacturing has been outsourced to other countries, the share of employment, value added and investment in downstream activities, including project development, installation, maintenance has increased relative to manufacturing (OECD 2015).

New investment¹ in the solar sector has increased exponentially over the last decade from \$12 billion in 2004 to \$151 billion in 2014 (BNEF 2015). International trade has been the primary driver of globally integrating the solar PV energy sector. Domestic and foreign investment has also soared in the United States, Japan, and China over the last decade. Greenfield FDI has also been a major driver of global integration, accounting for about 1/3 of total asset finance in solar in 2012.

The rapid expansion of the solar sector, the globalization of production, and cost reductions in silicon and equipment, and technological advances have driven an exponential rise in generation capacity. Between 2004 and 2014, the solar sector added 186 gigawatts in generation capacity to reach 191 gigawatts in 2014 (BNEF 2015).

New investment has also grown rapidly in the wind sector over the last decade, rising steadily from \$18 billion in 2004 to \$104 billion in 2014 (BNEF 2015). In the wind energy sector, manufacturing of turbines is increasingly globalized and concentrated. Wind turbine manufacturers often invest in plants located close to emerging and large consumer markets (Brazil, India, United States) because of high transport costs and competition.

Greenfield FDI has been the major driver of global integration of the wind sector, especially in the EU and the United States. China is an exception with growth stemming mainly from domestic investment. The top wind manufacturers have been increasing their greenfield FDI investment in emerging and developing markets, such as China.

Wind energy has become the second largest clean energy technology after large hydro as measured by total installed capacity. Over the last decade, capacity has grown exponentially from 44 gigawatts to 361 gigawatts, a cumulative gain of 317 gigawatts (BNEF 2015).

Domestic “green energy” policies to support solar and wind manufacturing industries

The emergence of solar and wind as successful and rapidly growing industries has prompted several OECD and developing countries to enact “green industrial” policies to generate growth and employment in their local solar and wind manufacturing industries.

¹ New investment consists of asset finance, public markets (new equity), venture capital/private equity, re-invested equity, small distributed capacity, corporate R&D, and government R&D.

Four types—local content requirements, domestic incentive measures, technical barriers to trade, and trade remedies—have had the most impact on harming trade and investment.

Local content requirements

Local content requirements typically require developers and investors to source a specific share of manufactured components or equipment locally in order to be eligible to bid on projects or receive financial support or incentives (OECD 2015). Local content requirements have been implemented in 6 OECD countries—Canada, France, Greece, Italy, Spain, and the United States—and twenty developing countries, including Brazil, China, Russia, South Africa, and Turkey.

Governments have used local content requirements in several ways to support their local industries. The most common approach is using LCRs as eligibility criteria to qualify for the full Feed-in Tariff (FiT)² program or for a possible variable part of the FiT and premiums provided on top of the base FiT (OECD 2015). The LCR is determined based on renewable energy components and equipment and varies considerably across countries. Fifteen countries have used LCRs for qualifying for FITs. For example, China included a 70% LCR in bidding for wind power plants between 2004 and 2009. Several countries have also used LCRs as eligibility criteria to qualify for direct financial transfers such as public subsidized loans and loan guarantees.

Technical barriers to trade

Technical barriers are the second type of barriers that have primarily affected the wind industry. They consist of technical regulations, domestic voluntary product standards applied by the importing country that are inconsistent with international standards, and certification and conformity assessment procedures. These measures have primarily affected the wind industry in several countries, notably China, India and South Africa (OECD 2015).

Domestic incentive measures

Governments have provided generous support to domestic PV and wind-turbine manufacturers, primarily through tax reductions and feed-in tariffs (OECD 2015). There are two main categories:

- Demand-side or demand pull policies that affect consumption, such as FiTs, renewable portfolio standards, and carbon taxes;
- Supply side (or technology push) policies that stimulate production, including R&D, direct investment, and government subsidies.

Preferential access to financing

² A Feed-in Tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically based on the cost of generation of each technology. Feed-in tariffs often include "tariff degeneration", a mechanism according to which the price (or tariff) ratchets down over time. This is done in order to track and encourage technological cost reductions.

Emerging economies have frequently used preferential access to financing to support technology development and deployment in solar-PV and wind-turbine equipment (OECD 2015). These policies include subsidized loans, loan guarantees, and direct financial transfers. Emerging economies have also provided access to financing for state owned companies, particularly in countries with large state-owned banks, notably Brazil, China, and the Ukraine.

Developed countries have also provided preferential access to financing through direct financial support or tax credits to support their domestic solar-PV and wind industries (OECD 2015). Many of these programs were enacted as part of stimulus packages following the Great Recession in 2008. For example, the United States provided about \$14 billion in loan guarantees to domestic solar projects as part of the American Recovery and Reinvestment Act in 2009.

Trade remedies for solar and wind industries

OECD and emerging economies have used by trade remedies for the solar and wind sectors since 2010. Countries have initiated trade remedies to protect domestic manufacturers against unfair trade practices and alleged distortion (dumping and actionable subsidies) [OECD 2015]. Governments have initiated 15 anti-dumping investigations and nine countervailing duty investigations. In addition, governments have imposed nine duty measures and seven countervailing duty measures on solar PV and wind energy products. OECD countries have used trade remedies to attempt to create a level playing field because they believe their domestic industries face unfair competition. Developing economies have also more recently used trade remedies. Most trade investigations now originate in the top solar and wind markets: China, the EU, and the United States.

Implications for new research agenda

Research conducted by the OECD, other organizations, and academics indicates that “green industrial” policies, defined as initiatives to build capacity in domestic solar-PV and wind manufacturing industries, are restricting or distorting trade and investment in solar-PV and wind GPNs. Maximizing growth of trade and investment to promote growth of solar and wind production is critical for the effort to mitigate climate change.

The research agenda going forward consists of five main elements:

- Inform and educate policymakers about the value added and jobs generated at all stages of solar and wind GPNs, especially downstream activities;
- The international community needs to do more comprehensive and timely monitoring of “green industrial policies;”
- Conduct more research on value added and jobs captured by developing countries in solar and wind GPNs;
- More research is needed to quantify the impacts of “green industrial policies on trade, investment, and innovation, especially in developing countries;
- Research is needed to evaluate proposed policies and to develop new policies that build domestic manufacturing capacity that do not restrict trade and investment.

The remainder of this section will provide further explanation of each element of the research agenda.

Inform and educate policymakers about the value added and jobs generated in downstream activities of solar and wind GPNs.

The rise of GPNs in solar and wind means that a country's domestic production and exports rely on an increasing share of intermediate goods imported from other countries. In the solar PV sector, foreign companies account for an increasing share of value added for solar PV module manufacturing. In the United States, 70% of the value added of PV modules is imported (largely from China) compared to 27% of the value of the total system imported from abroad (OECD 2015). The EU has similar shares for the foreign content of PV modules and the entire PV system.

Although the manufacture of solar PV modules generates jobs and value added, especially in emerging markets, downstream activities including construction, installation, system integration, operation, maintenance, and sales are employment intensive. Manufacturing activities in developed countries typically account for 18-24% of total employment in the solar GPN (OECD 2015). Several studies estimates at least 50% of solar PV jobs and value added are captured by downstream activities. In the US solar sector, downstream activities employ 70% of total jobs; cells and module manufacturing account for 20% and 10%, respectively of jobs.

Need a more robust monitoring of national trade, investment, and other policies that affect domestic solar and wind industries.

The OECD, and the IEA, to some extent, have done substantial research and analysis to monitor the various "green industrial policies" that are affecting solar and wind GPNs. The OECD has done a thorough and timely analysis of these policies, analyzed the effects of some of these policies on trade and investment, and cited research that also examined the effects of these policies on trade and investment. In addition, the OECD and IEA have done substantial reporting efforts of domestic incentive measures but the international community has not adopted guidelines for calculating all types of energy subsidies and harmonizing reporting standards.

A more comprehensive, robust, and timely effort is needed to monitor national policies in a comprehensive and timely manner. A more concerted effort is needed to monitor on-going developments and changes in "green industrial policies" that affect solar and wind GPNs perhaps by several organizations, such as the UN working with the OECD and IEA.

Conduct more research on value added and jobs captured by developing countries in solar and wind GPNs

Research needs to be conducted on the value added and jobs generated in all activities of solar and wind GPNs in developing countries. Although a considerable share of value added and jobs is captured by China's manufacture of solar modules, other developing countries are likely to capture far less value added and jobs in their domestic solar industries because China is the world's largest global producer of low cost solar modules. The situation is similar in wind manufacturing; several countries have become major producers and exporters of wind turbines

Evaluate and develop new policies to replace LCRs. In addition, well-designed LCRs may work in limited circumstances but more research needs to be done.

Several empirical studies have concluded that LCRs have mixed or negative impacts on international investment, trade, employment and welfare of solar and wind GPNs in the implementing country (OECD 2015). An OECD study on international investment flows found that FiT policies play a significant role in attracting investment flows in solar and wind sectors. But LCRs have a detrimental effect on global international investment and hamper the effectiveness of FiT policies that are coupled with LCRs to destination countries. In addition, the OECD's survey in 2014 of global investors in clean energy found that investors identified LCRs as the main impediment to international investment.

A separate OECD study on the impact of LCRs on international trade show that LCR's that cause a fall in intermediate imports reduces imports in both the implementing country's main trade partners and globally (OECD 2015). Although LCRs are intended to develop an entire domestic industry, the outcome is developing a domestic intermediate industry at the loss of developing downstream activities and final goods.

LCRs have benefits, particularly in countries that have large markets and carefully design their LCR program (OECD 2015). LCRs may attract international and domestic investment in the implementing country or regional hub if the LCR are backed by large bids and aggressive development policies. LCRs may also attract technology transfer. LCRs may lead to an increase of local job creation in the short-run, which may expand public support for renewable energy and developing ambitious renewable energy policies and targets.

Research should evaluate policies recommended by the OECD to replace LCRs that build domestic capability without harming trade and investment:

- Well targeted R&D support in solar and wind has the potential to stimulate innovation in solar and wind energy manufacturing, build local manufacturing, and encourage technology transfer without favoring domestic firms;
- Training and programs and promotion measures can improve the technological skills of midstream manufacturers, build local capability of downstream firms, and encourage innovation across the entire value chains.
- Demand side instruments, including well designed feed in tariffs, auctions, tax incentives or carbon pricing instruments can encourage wider deployment of solar and wind energy or more cost-effective carbon pricing instruments.

Additional policies to replace LCRs should be developed. A "toolbox" of policies that can be tailored to meet each country's role in the solar-PV and wind GPNs could be useful. A second area of research is to examine the feasibility and develop the design of LCRs for countries that have large markets that would have minimal or no impact on trade and investment.

Quantify the impacts of technical restrictions on the wind sector

Technical restrictions can drive up transaction and financing costs, and act as a de-facto market access barrier (OECD 2015). They can reduce transparency for foreign project developers and investors. They may have a negative effect on imports. Foreign firms may not be willing to provide downstream activities. Although these measures are often used for protecting human health, ensuring safety, or protecting the environment, they can distort international trade and investment and help protect the domestic industry.

The OECD and European Wind Energy Association carried out a study of the impact of technical restrictions on international trade and investment of wind energy in Brazil, Canada, China, India, and South Africa. The study found that technical standards are likely to negatively affect trade and investment in Brazil, China, India and South Africa.

Research needs to better quantify how technical standards on the domestic wind industries of Brazil, Canada, China, India, and South Africa affect local and global trade and investment. Are these technical standards a minor or major hindrance to wind GPNs?

Conduct further research the impacts of preferential access to financing:

Most demand and supply-side policies indirectly affect trade and investment by changing relative prices domestically and abroad by affecting investment, production, and consumption decisions (OECD 2015). Policies that can discriminate between domestic and international investors include:

- Preferential access to financing, including direct financial transfers such as grants, equity injections and subsidized loans) that favor domestic manufacturers or associated with a local content requirement;
- Export subsidies;
- Preferential tax incentives for producers or investors;
- Government procurement of below-market-price inputs.

Preferential access to finance may lead to inefficiencies and over-capacity in solar-PV and wind manufacturing by reducing the incentive for domestic manufacturers to reduce costs through innovation or rationalization (OECD 2015). For example, China's substantial support to its domestic solar-PV manufacturers may have boosted Chinese PV exports and harming manufacturers in Europe and the United States, and leading to over capacity in the sector.

Export subsidies consist of direct grants or concessional loans. They distort international trade by lowering the cost of exported solar-PV and wind turbine inputs that otherwise would be non-competitive by domestic manufacturers.

Emerging economies that provide access to financing for state owned companies that can hinder market access and investment of foreign and domestic independent power producers in solar and wind energy. This issue is particularly important in countries with large state-owned banks, notably Brazil, China, and the Ukraine

Future research should examine the how the various policies for preferential access to financing impact the relative prices and domestically abroad, and if and to what degree they affect on trade and investment.

Research measures to limit use of trade remedies or develop alternative policies

Although trade remedies can help offset foreign incentives that negatively affect domestic industries, several studies have concluded that trade remedies have negative impacts on the solar PV and wind energy GPNs (OECD 2015). The direct impact of trade remedies is the reduction of trade volume. Trade remedies have been particularly harmful on trade in solar products. Trade remedies are likely to increase cost of inputs in downstream activities in solar and wind GPNs, particularly in the solar GPN.

Trade remedies may hinder competitiveness and investment in solar PV and wind energy sectors (OECD 2015). Higher inputs costs may hamper the continued development of specialization, skills, and innovation which are essential for solar and wind GPNs to remain competitive and innovate. Increases in solar PV prices may raise electricity prices, which would reduce the cost competitiveness of solar PV vs. electricity generated from fossil fuels. Investor's perception of risk and uncertainty on investment decisions have increased in reaction to trade disputes because of the unpredictability of duties. In addition, renewable energy importers have faced the possibility that the trade remedies could be posed retroactively, which increases uncertainty.

Governments have several policy options to limit use of trade remedies according to the Swedish National Board of Trade. Options that would limit trade remedies:

- Impose duties at a level lower than the margin of dumping but adequate to remove injury (known as the *lesser duty rule*).
- Reduce the scope of trade remedies to specific product or import value.
- Reduce the time that the duty is imposed.

A second option is to align or even replace anti-dumping rules with competition rules, aimed at targeting truly harmful anti-competition behavior (OECD 2015). Under this approach, higher thresholds would be set for companies that have a dominant market share (e.g. 40% or greater) compared with anti-dumping rules that would be triggered if the exporter has a market share of 1%. Competition rules may also lead to stronger international rules on the trade and investment effects of state owned enterprises (SOEs).

Future research should identify the most effective policies to limit or replace trade measures. This research could be used to develop consensus among producing countries and in the WTO to agree on a single, consistent approach. In addition, more research is needed on competition rules that could supplement or replace trade remedies. What would be the appropriate threshold for companies that have a dominant market share? What competition rules could have an impact on the policies of SOEs that distort trade and investment?

Research needed on the impact of “green industrial” policies on innovation in solar and wind GPNs

Innovation has been rapid in the solar and wind industries over the last decade with deep declines in prices, technological development, increases in patenting activity, and substantial early stage financing in the solar technology. Innovation is vital for the solar and wind industries to continue their rapid growth and technological progress, and to sustain the GPNs in each of these sectors. It does not appear that much research has been done on the impact of “green industrial” policies on innovation. An important priority is to conduct in-depth research on the effect of “green industrial” policies on innovation.

Conclusion

The solar and wind industries have expanded rapidly over the last decade. Costs have fallen far more rapidly than most observers could have predicted a few years ago. Solar and wind has now become competitive with fossil fuels in many countries. The globalization of production in these two industries has been a major factor in their success.

But a number of countries have enacted “green industrial” policies to foster development of their solar and wind manufacturing industries. Many of these policies lead to reduced

investment and trade domestically and globally in solar and wind GPNs. These barriers are inhibiting the investment needed to further build renewable energy capacity that is needed to help mitigate climate change.

What should be the next steps to implement the proposed research agenda on green industrial policies and solar-PV and wind GPNs?

Organizations such as the OECD, UN, and IEA should hold meetings with senior officials in energy, finance, and development from countries involved in solar-PV and wind GPNs to emphasize that downstream activities may generate as much or more value added and jobs than upstream activities, such as manufacturing.

A stronger and more concerted monitoring of green industrial policies could be implemented by several organizations working together, such as the UN, OECD, and IEA. These organizations could share and divide the work of monitoring green industrial policies.

The research agenda could be implemented through creating a multi-disciplinary group of researchers with expertise in economics, innovation, development, and renewable energy. An international organization could provide resources and facilities for the research group. The research group would disseminate its work through the sponsoring international organization, other organizations such as the UN, OECD, and IEA, and peer reviewed journals.

Questions for discussion

Are there other topics on fostering growth of solar and wind GPNs that merit research?

Is there research or insight from GPN's in other industries on facilitating trade, investment, and innovation that can be applied to solar and wind GPNs?

Will the TPP have any impact on trade and investment barriers in solar and wind GVCs?

How should innovation be measured in solar-PV and wind GPNs?

Are patenting and other forms of intellectual property having an adverse or beneficial impact on solar and wind GVCs?

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