INFORMATION NOTE – JULY 2018

The Role of Trade Policy in Enabling the Global Diffusion of Electric Vehicles

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This information note is intended to identify and better understand trade-related issues and knowledge gaps related to the scale-up and global deployment of electric vehicles. This includes the impact of various types of trade and investment-related barriers on electric vehicle supply chains and the role that international trade governance can play in facilitating, or indeed accelerating, a global transition towards electric vehicles.[1]

1. Transport Sector Decarbonisation and Electric Vehicles: Driving Environmental Protection and the Sustainable Development Goals

Road transportation was the second most important source of emissions after heat and electricity generation in 2014, accounting for nearly 23 percent of global CO_2 emissions. Transport-related emissions grew 0.5 percent from 1990 to 2012 in the developed world and averaged 4.8 percent in the developing world. In addition to greenhouse gas (GHG) emissions, transport is also a major source of air pollution, including in the form of fine particulate matter—less than or equal to 2.5 micrometres in aerodynamic diameter, known as $PM_{2.5}$. According to the 2017 *State of Global Air* report published by the Health Effects Institute, air pollution, particularly $PM_{2.5}$, was the leading environmental cause of death on the planet, causing 4 million deaths worldwide in 2015 (HEI 2017). Electrifying road transport, combined with other measures, can help tackle climate change and air pollution. It also has other economic benefits, such as increased energy security through reduced oil imports in fossil-fuel importing countries, according to projections by Bloomberg,[2] and the creation of "green jobs" along various segments of the EV value chain.[3]

1 This note synthesises a longer ICTSD (2017) paper entitled "International Trade Governance and Sustainable Transport: The Expansion of Electric Vehicles."

2 According to a recent report by Bloomberg New Energy Finance (2018), growth in EVs is also expected to displace oil consumption. By 2040, as EVs surpass 50 percent of all new vehicles sold, 7.3 million barrels per day is expected to be displaced mainly in China (2.5 million barrels per day), followed by the United States (2.3 mbpd) and Europe (1.1 mbpd), and the remainder in the rest of the world.

3 These "green jobs" would include mining of raw materials, the manufacturing of vehicles, batteries, charging equipment and related parts, as well as end-of-life battery recycling. For lithium ion batteries, for instance, a report from the International Renewable Energy Agency (IRENA 2017) highlights added challenges to recycling due to different lithium-ion battery chemistries but with promising technology pathways now being developed and expected to be commercially available in the 2020s.

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Consequently, electric vehicle deployment can help in the drive towards four important United Nations sustainable development goals and related targets, adopted by heads of state and government in September 2015 and which came into force on 1 January 2016. Table 1 illustrates how EV deployment and related policies can be supportive of specific SDGs.

Table 1. The relevance of electric vehicle deployment for Sustainable Development Goals

SDGs	Relevant targets	Electric vehicle relevance
Goal 3: Ensure healthy lives and promote well-being for all at all ages	**3.9:** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	• Reduced transport-related air pollution through increased deployment of zero-emission EVs • Sustainability considerations along the EV life cycle from extraction of raw materials to final disposal, recycling, and reuse.
Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	**8.2:** Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labour-intensive sectors **8.4:** Improve progressively, through 2030, global resource efficiency in consumption and production, and endeavour to decouple economic growth from environmental degradation in accordance with the 10-year framework of programmes on sustainable consumption and production with developed countries taking the lead	• Creation of green jobs through increased activity along the EV supply chains, including mobility-related services such as EV charging and EV car-pooling. • Reduction in transport-led fossil-fuel consumption and reduction in fossil-fuel imports from greater uptake of EVs
Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	**9.1:** Develop quality, reliable, sustainable and resilient infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all **9.4:** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	• Greater access to electric mobility options through roll-out of EV charging infrastructure facilities
Goal 13: Take urgent action to combat climate change and its impacts	**13.2:** Integrate climate change measures into national policies, strategies and planning	• Reduced transport-related GHG emissions through electrification of transport

Key messages

- Facilitating transport-sector decarbonisation through greater global deployment and diffusion of electric vehicles can contribute to climate-change mitigation efforts, reduction of harmful air pollution, and the pursuit of important United Nations Sustainable Development Goals (SDGs).
- The electric vehicle (EV) industry is global in scope but with quite concentrated production and manufacturing hubs both for vehicles and batteries. Conducive domestic policies, regulations, and incentives have been key to EV sales growth. The declining trend in EV battery costs will further expand markets.
- Trade policy can play an important role in the global diffusion of electric vehicles by enabling better economies of scale and an efficient and optimal supply chain. This requires countries to address trade-related barriers that contribute to raising final EV costs, including both tariffs and non-tariff measures (NTMs).
- Lowering existing applied tariffs on EVs and related components could be an immediate option available to policymakers to reduce trade-related costs.
- There is a no clear evidence that non-tariff measures have impeded production or trade in electric vehicles. However, as electric vehicle markets grow and tariffs on EV trade are progressively dismantled, NTMs could emerge as important barriers in future. Issues of access to technologies by firms and countries (including the infrastructure for charging EVs) may also need to be addressed.
- Based on sound research, it may be desirable for governments to consider immediate, near, and medium-term options to address any trade-related barriers that impact EV supply-chain costs and also ensure that future domestic regulations, trade policies, and governance frameworks to promote EVs are designed in a manner that is supportive of rapid EV scale-up and diffusion.

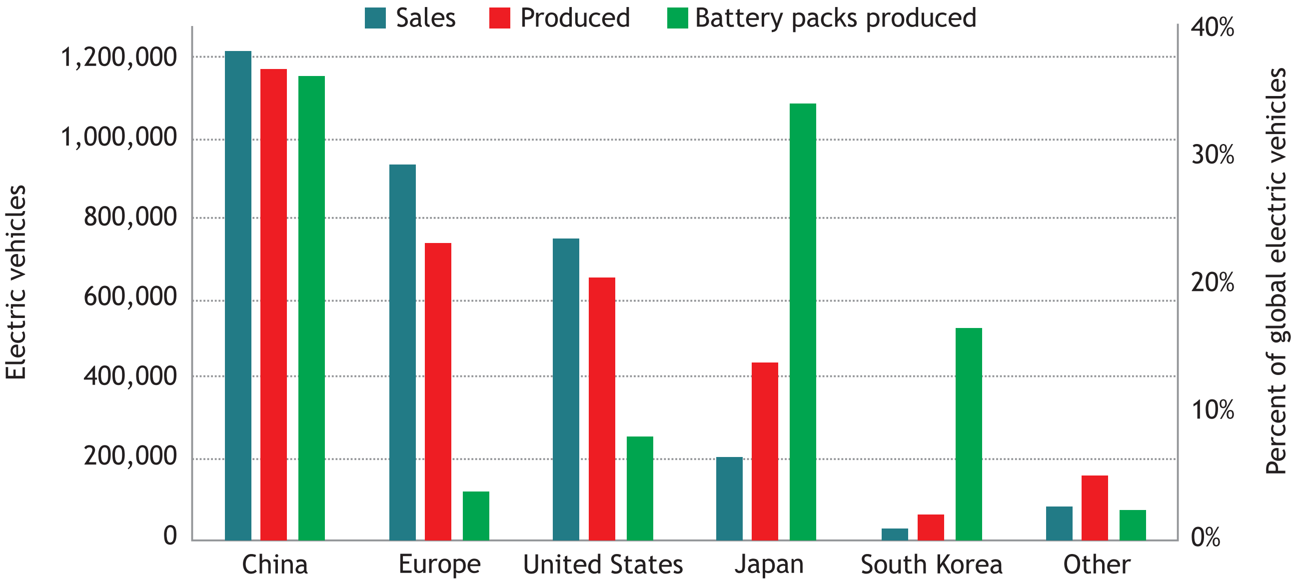
2. Electric Vehicles and Battery Packs: Concentrated Production Hubs and Markets

The EV value chain is diverse. In the finished vehicles category, it can include (1) battery electric vehicles (BEVs) that use electric power as their only source of fuel; (2) plug-in hybrid electric vehicles (PHEVs), which mainly run on electric power and can be charged from external charging points while also having a back-up fossil-fuel or biofuel engine; (3) hybrid electric vehicles (HEVs), with an electric motor and a gasoline or biofuel driven engine—its electric motor cannot be charged from off-board sources, however, and instead is charged using regenerative braking or from the fossil-fuel engine; and (4) fuel cell vehicles (FCVs) that run on hydrogen fuel which is converted to electricity within a fuel cell.

In addition to cars, the EV universe also includes electric heavy-duty vehicles, such as trucks and buses that use batteries or fuel cells, as well as electric bikes. An electric vehicle is also made up of specific components, most notably the battery, that distinguish it from internal combustion engine (ICE) vehicles. Batteries themselves vary depending on the materials and technology used. Lithium-ion batteries, at the time of writing, are the dominant technology, and in addition to lithium, EV batteries may also use other materials such as cobalt, graphite, and nickel. EVs reliant on external battery charging are also dependent on charging equipment that may draw power from various electricity sources. A truly clean transport footprint would therefore require electricity sources to be powered by renewable energy as well.

According to a recent study by the International Council on Clean Transportation, manufacturing of electric light-duty vehicles as well as batteries, while global in nature, is still concentrated in a select number of countries. Europe, China, Japan, South Korea, and the United States account for nearly all of global EV production, with China accounting for 50 percent, followed by Europe (21 percent), the United States (17 percent), Japan (8 percent), and South Korea (3 percent). While Japan was the leading battery pack producer from 2011 to 2015, China has now overtaken both Japan and South Korea in battery cell manufacture with 11 times more production than the United States and 22 times more than Europe in 2017. Based on expected realisation of industry announcements through 2022, China accounts for more than half of battery cell production compared to 12–17 percent each for Europe, South Korea, and the United States. Figure 1 shows cumulative electric vehicle sales and production, as well as battery cell production, from 2010 through 2017 for the major markets (Lutsey et al. 2018).

Figure 1. Electric vehicle sales, electric vehicle production, and electric vehicle battery production by region from 2010 through 2017



Source: Lutsey et al. (2018)

According to Bloomberg New Energy Finance (2018), the sales of electric vehicles (i.e. electric cars) are on pace to reach over 1.6 million in 2018 and forecast to hit 11 million by 2025, 30 million by 2030, and 60 million by 2040, equivalent to 55 percent of the global car market. The report also notes the rapid decline in battery costs from an average price of about US$1,000 per kilowatt hour (kwh) per battery pack in 2010 to US$209/kwh by the end of 2017, a remarkable drop of 79 percent. The average energy density of batteries is also improving at an average rate of about 5–7 percent every year. This will certainly lead to a much more rapid uptake of EVs in the future. While battery production appears concentrated in a select number of countries, upstream components and materials may be sourced from many economies.

3. Setting up the Framework for Deployment: The Role of Domestic EV Policies

Government policies have played an important role in EV deployment. These policies have included "market pull" policies that have incentivised demand for EVs and related parts and components, including subsidies to consumers such as vehicle tax reductions and income tax credits. These are complemented by "technology push" policies aimed at increasing the supply of electric vehicles and batteries, such as direct support to domestic EV and battery manufacturers. EV deployment policies may be driven by countries, provinces, or even cities, and include specific goals (such as banning future sales of ICE vehicles within a specified time frame), mandates, targets, and incentives, as well as "EV-friendly" laws and regulations such as access to congestion zones and free parking and free charging points.

In addition, global initiatives, declarations, and platforms for international collaboration have also helped to establish a shared vision while enabling learning and sharing of knowledge and best practice. Notable examples include the Electric Vehicles initiative (EVI), a multi-government policy forum established in 2009 under the Clean Energy Ministerial, the Paris Declaration on Electro-Mobility and Climate Change (UNFCCC 2015) launched at the 21st UNFCCC Conference of Parties (COP21), the EVI Government Fleet Declaration announced at the 22nd Conference of Parties (COP22) in Marrakech, and the International Zero-Emission Vehicle Alliance established in 2015 as a collaboration of national and subnational governments. There have also been several announcements led by the private sector, from notable car manufacturing companies such as Tesla, Renault-Nissan, BMW, Ford, Honda, and Volvo, aiming to promote EVs through industry-led incentives and targets.

4. Why Does Trade Policy Matter?

Trade policy can play an important role in the global diffusion of electric vehicles by enabling better economies of scale and an efficient and optimal supply chain. This requires countries to address trade-related barriers that contribute to raising final EV costs, including both tariffs and non-tariff measures.

4.1 Tariffs

The automobile industry, which also includes electric vehicles, still faces import tariffs in major markets. Many countries apply tariffs on finished vehicles, including electric vehicles. Most major economies, with the exception of Japan and the United States (in the case of electric motorcycles), do not provide duty-free treatment for electric vehicles and apply fairly similar tariff protection for both electric and spark-ignition ICE vehicles, a situation that does not appear to have changed over the last decade (see, for instance, Vossenaar 2010b). Japan has the most open trade regime for automobiles among the major economies and applies zero duties for both spark-ignition ICE as well as electric vehicles. Average applied tariffs on electric cars have a range of 10 percent in the European Union, 8 percent in Korea, and 2.5 percent in the United States. They are higher in developing country markets such as Brazil (35 percent), China (25 percent), and India (60 percent). Developing country markets also have tariff escalation, with finished vehicles attracting higher duty rates than parts and components.

Batteries make up a significant proportion of the EV power train, and up to 75 percent of its cost, according to Wolfram and Lutsey (2016), which amounts to one-third of the purchase price of an electric vehicle (Niti Aayog and Rocky Mountain Institute 2017). Import tariffs on electric accumulators (storage batteries) used for transport vehicles are relatively low, with few exceeding ad valorem rates of 10 percent (OECD 2015). Given their important contribution to EV costs, however, a tariff reduction or elimination on batteries as well as their components could further help with cost reduction.

Given the significance of EVs from the perspective of climate change mitigation, and given prevailing tariff levels on EVs as described, countries could consider further lowering applied most-favoured-nation (MFN) tariffs on electric vehicles in order to provide a cost advantage for EVs relative to ICE vehicles. While electric vehicle costs may presently be high, these are set to fall further in the future as battery costs decline. An immediate reduction in MFN applied tariffs for EVs would therefore constitute a “low-hanging fruit” that could be implemented fairly easily by the major economies and complement the domestic incentives for EV deployment at the national level. Such reductions could be integrated into bilateral, plurilateral, and regional trade initiatives and also multilaterally under the World Trade Organization (WTO). Given the political sensitivity of the automotive sector in general for most economies, such a reduction may not be easy, of course, and could involve protracted trade negotiations. On the other hand, countries could immediately undertake unilateral tariff reductions in the interests of EV deployment. A small but symbolically important step has been the undertaking by the small island states of Bahamas, Saint Lucia, and Saint Vincent and the Grenadines to reduce import duties on certain types of vehicles, including hybrid and electric cars, as part of their nationally determined contributions under the Paris Agreement (Brandi 2017).

Box 1: Electric vehicles and the Harmonized System

With regard to Harmonized System (HS) classifications used in international trade, electric vehicles for the transport of persons were previously hidden within HS code 870390, a basket item that includes all vehicles which are not named elsewhere under heading 8703 (Vossenaar 2010a). This made it rather difficult to track global trade in finished electric cars. Certain countries, however, have specific tariff nomenclatures for electric vehicles and thus some country-specific trade flows could be mapped.

In 2017, the World Customs Organization put into effect accepted amendments to the HS nomenclatures (HS 17). These amendments have now created separate HS six-digit codes for various types of EVs, such as HEVs, PHEVs, and BEVs, as well as motorcycles (including mopeds and bikes), with an electric motor for propulsion (WCO 2015). This will make it easier to identify tariff barriers and to track global trade flows in EVs in the future, as presently trade data reflecting the HS 17 amendment is not yet available. These amendments will also help to identify any possible correlation that may exist between specific trade policy and other domestic policy measures and changes in trade flow numbers on EVs.

Three new HS codes for electric vehicles that were introduced are listed in this table.

HS codes	Description
HS 870230	Motor vehicles for the transport of 10 or more persons, including the driver; with both spark-ignition internal combustion reciprocating piston engine and electric motor as motors for propulsion
HS 870380	Other vehicles with only electric motor for propulsion
HS 871160	Motorcycles (including mopeds) and cycles fitted with an auxiliary motor, with or without side-cars; side-cars with electric motor for propulsion

Rechargeable batteries, including those used in EVs, are classified under **HS 8507** (electric accumulators), with lithium-ion batteries having their own HS six-digit code, **HS 850760**. Identifying their specific end-use may be difficult, however, given their use in applications other than transport. Tracking trade flows related to their end-use in transportation may therefore require an examination of national statistics in cases where separate national tariff lines exist for EV lithium-ion batteries.

Source: WCO (2015)

4.2 Non-Tariff Measures

Non-tariff measures that affect trade in EVs will be more complex to tackle than tariffs as they are often related to domestic regulatory measures, including various public policy objectives such as health, safety, and the promotion of domestic manufacturing jobs.

Some examples of non-tariff measures that could affect trade in EVs and their related components are:

- investment-related restrictions[4]
- subsidies[5]

4 These include joint-venture requirements for foreign automobile firms to manufacture in a country. For example, a 50 percent joint-venture requirement for automobile manufacturing was used by China until April 2018, when it was lifted, starting with electric vehicles. Also see Horwitz 2018.

5 These include federal or provincial subsidies provided to local car manufacturers or even to consumers that purchase local car brands.

- local-content restrictions[6]
- export restrictions[7]
- discriminatory practices in government procurement of electric vehicles[8]

There is no clear evidence that non-tariff measures listed above have impeded production or trade in electric vehicles. However, as electric vehicle markets grow and tariffs to EV trade are dismantled, NTMs could emerge in future and it may be desirable for governments to consider pre-emptively ensuring that future domestic regulations and policies to promote EVs are not designed in a manner that is discriminatory or trade-restrictive.

4.3 Other Measures with Possible Trade Impacts

Two other measures that could be undertaken for meeting genuine public policy objectives but could also impact trade flows of EVs and their components include social and environmental considerations and standards.

- Social and environmental considerations that arise now or in the future

These considerations include the environmental impact of mining raw materials, as well as the use of child labour such as that reported by the United Nations Children Fund (UNICEF), African Resources Watch, Amnesty International, and more recently by CNN (Thompson 2018). Such concerns will need to be addressed by EV companies, which may in turn require their supply chain partners to comply with new norms and sourcing standards.

- Standards

Standards are important for the smooth functioning of EVs and interoperability with electric vehicle supply or charging equipment, as well as facilitating international trade and economies of scale in EVs. Industry associations, utilities, and automobile firms such as Tesla have been involved in the development of EV standards, in addition to national standards bodies such as the Standardization Administration of China and international organisations such as the International Organization for Standardization and the International Electrotechnical Commission. Due to efforts made to harmonise various protocols and standards, so far standards have not emerged as a major impediment in the scale-up of production and trade in EVs, but given their evolving nature and the steady growth of EV markets, it may not be possible to rule out standards as a source of trade friction in the future.

- Access to Technology and Intellectual Property

Access to technologies and technology diffusion will also play a role in shaping EV supply chains. Technology diffusion is relevant not only for EVs and their components such as batteries but also for the related charging infrastructure. While there is no monopoly of EV-related technology on the part of

6 These require manufacturers to use locally made components. Such local content requirements may also be linked to provision of subsidies.

7 Such restrictions may be imposed by countries on minerals and materials critical for use in electric vehicles. Some, such as lithium, cobalt, nickel, and graphite, face supply-related concerns as they are concentrated in a handful of countries, as in the case of lithium (Argentina, Bolivia, and Chile, with production ramping up in Australia) and cobalt (with 65 percent of supplies coming from the Democratic Republic of Congo). On 13 July 2016, the United States and the European Union filed a complaint at the WTO Dispute Settlement Understanding regarding China's export restrictions on a range of minerals such as antimony, cobalt, copper, graphite, lead, magnesia, talc, tantalum, and tin, used in sectors such as the aerospace, automotive, electronics, and chemical industries, among others (ICTSD 2016). A panel was subsequently established on 8 November 2016 (*See China – Export Duties on Certain Raw Materials*, WT/DS508/6, World Trade Organization).

8 Such practices may affect opportunities for foreign suppliers of EVs. Compliance with the provisions and obligations under the WTO's Government Procurement Agreement (GPA) may need to be studied to assess consistency with WTO obligations in the event that the procuring party is a member of the GPA.

one company, US companies dominate the patent landscape in the electric vehicle industry (including hybrid-electrics), led by Ford and General Motors, followed by Japanese firms such as Honda and Toyota Motors (Brachmann 2015). Concerns about intellectual property (IP) may influence investment or joint venture decisions by EV manufacturers in countries such as China. Different companies may also choose to follow different licensing models. Further research into the role that IP plays in promoting access to technologies, innovation, building markets, and enabling competition in the EV space will be useful. What may be required is a balanced, market friendly approach that incentivises global companies to invest in and enter new markets and enable technology diffusion through greater trade and increased foreign direct investment. At the same time, IP governance models that could help in EV deployment as part of a bigger "trade and technology governance ecosystem" involving a number of factors such as trade and investment policies and the development of human capital should also be explored. The role of the Technology Mechanism and Green Climate Fund of the United Nations Framework Convention on Climate Change (UNFCCC) in providing a supportive framework could also be considered.

5. The Way Forward for Trade Policy

In response to some of the specific domestic and trade-related challenges and policy measures identified earlier, Table 2 lays out immediate and near- to medium-term options whereby trade policy could be supportive of EV scale-up. In many cases, due to information and knowledge gaps that persist, additional and targeted research will be needed in the immediate term in order to identify specific barriers that exist. It will be important to ensure that future government measures as well as trade policy frameworks address such barriers and also provide the right kinds of rules and governance frameworks, whether in bilateral, plurilateral, regional, or multilateral settings, that help in rapid global deployment of electric vehicles.

Table 2. Assessing trade-related challenges and options for electric vehicle deployment

Domestic and trade-related challenges and policy measures	Impact on electric vehicle supply chain costs	Immediate option	Near- to medium-term options
Tariffs	Yes	Unilateral removal of existing applied tariffs on finished EVs and their components (such as batteries)	Bind tariff elimination through bilateral, plurilateral, regional, and multilateral initiatives
Investment measures (including local-content requirements) and subsidies to domestic manufacturers	Limited evidence	Review and better assessment of how existing investment and trade policy frameworks and WTO rules affect EV value chains and trade opportunities. Review of WTO's agreements on Trade-Related Investment Measures and on Subsidies and Countervailing Measures, as well as the General Agreement on Trade in Services.	Remove restrictive requirements; enable "EV friendly" trade and investment policy frameworks consistent with WTO rules and supportive of EV scale-up. Possible reform of WTO rules to respond to the needs of EV scale-up
Government procurement	Anecdotal examples of tendency to favour domestic EV manufacturers	Review and better assessment of how procurement policies affect EV value chains and trade opportunities. Review of WTO's government procurement rules	Ensure government procurement policies for EVs do not discriminate in favour of domestic producers; reflect commitments within trade agreements such as the WTO Government Procurement Agreement
Standards	So far no discernible impact on trade	Closely monitor standard-setting along the EV value chain andthe evolution of standards	Harmonise standards based on international standards to the extent possible
Export restrictions on critical raw materials	Some examples of restrictive measures undertaken and submitted to WTO dispute settlement	Monitor any export restrictions as well as other trade-related restrictions affecting critical raw materials for EVs such as lithium, cobalt, and graphite	Remove any existing supply restrictions that are not justified and minimise risks of supply disruptions
Technology-related measures such as intellectual property rights and licensing practices	No discernible impact at present but some evidence that non-protection of intellectual property rights may discourage EV joint ventures	Better understand various IP governance models and their role in encouraging or discouraging EV deployment and uptake, particularly in developing countries	Ensure trade and investment policy frameworks encourage innovation and technology dissemination. Explore supportive role of WTO's Aid for Trade and UNFCCC's Technology Mechanism and Green Climate Fund in building a supportive framework for EV technology diffusion

Source: Adapted from ICTSD (2017).

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This information note was prepared by Mahesh Sugathan, ICTSD Senior Research Fellow.

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ICTSD welcomes comments and feedback on this policy brief. These can be sent to flehmann@ictsd.ch.

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