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The role of trade and services for enhancing science, technology and innovation to promote a fair transition to sustainable energy

Note by the UNCTAD secretariat

Summary

The Multi-year Expert Meeting on Trade, Services and Development is convened annually and addresses the role of trade in services in economic diversification. At the tenth session of the Multi-year Expert Meeting on Trade, Services and Development, the contribution of trade in services in support of the energy transition and the ensuing potential for economic diversification will be considered.

International trade in services can allow a broader sourcing of quality, reliable and affordable services that are relevant inputs to the energy sector's transition to sustainable energy. Some of these services are particularly important, as they convey information, skills and technologies that enhance the science, technology and innovation efforts needed to promote the transition to sustainable energy.

This services-assisted transition will reduce dependence on imported fossil fuels and exposure to price fluctuations. It can lead to a more diversified energy system, less prone to market shocks and with improved energy resilience and security. Services that enhance science, technology and innovation can also make the energy system more efficient. This type of sustainable energy matrix provides a basis for economic opportunities in many sectors, by facilitating activity upgrading and new endeavours. This is of particular importance to promoting economic diversification, including in developing countries.

This note provides background information on the linkages between trade in services, science, technology and innovation and the energy transition to facilitate an exchange of views and good practices at the meeting. The broad reach of these interlinkages allow space for experts to hold an innovative and holistic discussion. An area that experts may wish to discuss is how the trading system and trade policy can be coherently articulated with other policies to promote the role of trade in services in the energy transition, particularly for economic diversification in developing countries.

I. Introduction

A. Topic and context

1. The topic of the tenth session of the Multi-year Expert Meeting on Trade, Services and Development, "The role of trade and services for enhancing science, technology and innovation to promote a fair transition to sustainable energy" was approved by the Trade and Development Board approved, on 15 February 2023, at its seventy-third executive session. The selection of the topic responds to the call of paragraph 127 (ff) of the Bridgetown Covenant, to "support and promote activities and initiatives in developing countries through the improvement in trade in services" (TD/541/Add.2, para. 127 (ff)).

2. The overall focus of sessions of the Multi-year Expert Meeting on Trade, Services and Development is on harnessing trade in services for economic diversification. The tenth session of the Multi-year Expert Meeting on Trade, Services and Development will build on the insights from the ninth session, held in June 2022, which focused on the evolving landscape of digital trade in services.[1]

3. In the present note, background information is provided on the linkages between trade in services, technology transfer and the energy transition. International trade in services can expand the sourcing of services inputs to the energy transition. Notably, trade in services can support technology transfer to promote the energy transition. This sustainable energy matrix is a basis for economic opportunities in many sectors and ensuing economic diversification.

B. The imperative of a fair transition to sustainable energy

4. The Paris Agreement under the United Nations Framework Convention on Climate Change set the target of keeping global warming to no more than 1.5ºC.[2] Achieving this target requires reducing emissions by 43 per cent by 2030.[3] Reducing emissions will result from efforts in several different areas. The energy sector needs to play a central role in this reduction as, in recent years, the sector accounted for around three quarters of global greenhouse gas emissions.[4] This is why a transition from fossil fuels towards sustainable energy is imperative.

5. Sustainable energy can serve as a catalyst for structural transformation and economic diversification in developing countries by providing reliable and affordable access to clean energy sources. This can help to reduce reliance on fossil fuels and enable countries to meet their energy needs in a sustainable manner. In box 1, for example, shows how sustainable energy can support the fashion industry, an important creative industry.

Box 1
Example of the potential effects of the energy transition in the creative economy

The fashion industry, part of the creative economy, is a highly energy-intensive sector. It requires significant amounts of energy to produce, transport and retail textiles. Global greenhouse gas emissions from textile production are estimated to be around at 1.2 billion tons annually, more than emissions of all international flights and maritime shipping combined.[a]

Transitioning to renewable energy sources will reduce the environmental impact of the fashion industry and improve its sustainability. This can have a positive effect on the

[1] See also TD/B/C.I/MEM.4/26 and TD/B/C.I/MEM.4/27.
[2] See FCCC/CP/2015/10/Add.1, annex, article 2.
[3] See Intergovernmental Panel on Climate Change, 2022, *Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, p. 329.
[4] International Energy Agency, 2021, *Net Zero by 2050: A Road Map for the Global Energy Sector*, Paris, p. 48.

sector's reputation in the areas of sustainability and responsible business practices. This energy transition allows the fashion industry to diversify into new markets and attract environmentally conscious consumers who are increasingly interested in sustainable fashion products.

Moreover, transitioning to renewable energy sources can create products with higher value added and new job opportunities in the fashion industry. For example, developing and producing sustainable textiles, such as organic cotton and recycled polyester, requires skilled labour and innovative design solutions. The energy transition can therefore support the fashion industry growth through its sustainable economic diversification and upgrading.

Source: United Nations Alliance for Sustainable Fashion; see https://unfashionalliance.org/.
[a] Ellen McArthur Foundation, 2017, *A New Textiles Economy: Redesigning Fashion's Future*, available at https://www.ellenmacarthurfoundation.org/publications/a-new-textiles-economy-redesigning-fashions-future.

6. The deployment of sustainable energy should consider the different resources, capabilities, and energy paths of countries. A sustainable transition should also create conditions to allow investment in and deployment of clean technologies, job creation and minimal socioeconomic impact.

7. The adoption and deployment of renewable energies, such as solar, wind, hydropower and geothermal, can contribute to meeting the needs of access to energy without compromising the same needs of future generations. Furthermore, renewable energy prices have significantly decreased in recent years. For example, in 2021, approximately 73 per cent of new renewable power generation capacity had electricity costs lower than the cheapest fossil fuel options in the Group of 20 economies.[5] However, developing countries face particular challenges in pursuing transition to renewable energy. While global investments in renewable energy peaked in 2022 at $0.5 trillion, around 70 per cent of the world's population, mostly in developing countries and emerging economies, received only 15 per cent of global investments in 2020.[6] In addition, the development and deployment of renewable energy depends crucially on science, technology and innovation capacities.[7] Taken together, these issues point to the need for a substantial increase in financial flows, as well as technology transfer, to developing countries.

II. Trade in services and transition to sustainable energy: Key issues

A. The multiplicity of services inputs relevant for sustainable energy and the role of international trade in their provision

8. The transition to sustainable energy interconnects with energy production, energy distribution and energy consumption in, for example, transportation and industry.[8] Services provide key inputs to these sectors, as illustrated in table 1. Information and communications technology (ICT) services are increasingly important for the automation of energy systems and data analytics, contributing to their viability, efficiency and reliability, as shown in box 2.

[5] International Renewable Energy Agency, 2022, *Renewable Power Generation Costs in 2021*, Abu Dhabi, p. 34.

[6] International Renewable Energy Agency and Climate Policy Initiative, 2023, *Global Landscape of Renewable Energy Finance*, International Renewable Energy Agency, Abu Dhabi, p. 107.

[7] See UNCTAD, 2019, *The Role of Science, Technology and Innovation in Promoting Renewable Energy by 2030*, UNCTAD/DTL/STICT/2019/2, Geneva. See also Khan K and Su Cw, 2022, Does technology innovation complement the renewable energy transition? *Environmental Science and Pollution Research*, 30:30144–30154.

[8] Monkelbaan J, 2013, *Trade in Sustainable Energy Services*, International Centre for Trade and Sustainable Development, Geneva.

Table 1
Examples of services providing inputs to the energy transition

Service type	*Example*
Construction and installation services	Project management, engineering, site preparation, procurement, construction, electrical and plumbing services, and waste management services.
	Installation services for solar panels, wind turbines and other components.
	Testing services to ensure and demonstrate regulatory compliance.
Engineering services	Environmental engineering services to mitigate environmental impacts.
	Electrical engineering services for energy storage and distribution.
	Mechanical engineering for, among other areas, turbines for wind energy, panels for solar energy and generators.
Environmental services	Environmental impact assessment services.
Financial services	Debt and equity financing services.
	Financial advisory, project financing and risk management services to support investments in renewable energy projects.
Information and communications technology services	Data management and analytics services to collect, process and analyse data to optimize performance and improve decision-making.
	Automated components of predictive maintenance, monitoring and control systems for optimal performance and early problem detection.
	Smart grid systems to control energy flows, balance supply and demand, integrate and control multiple renewable energy sources and manage distribution to consumers efficiently and reliably.
Legal and regulatory services	Environmental and land use law services to help secure necessary permits.
	Energy law and contract law advisory services, dispute resolution and litigation services on legal and regulatory issues.
	Intellectual property law services to promote innovation in renewable energy.
Operational and maintenance services	Monitoring services of the performance of renewable energy systems in real-time.
	Maintenance and repair services for safe and efficient operation.
Research and development services	Research and development services to develop and improve renewable energy technologies, such as solar, wind, hydro and geothermal energy.
	Research and development services for new materials enhancing the performance and efficiency of renewable energy systems.

Source: UNCTAD.

Box 2
The role of information and communications technology services in digitalizing renewable energy projects

ICT services support the automation of operational, monitoring and control systems of renewable energy initiatives, such as advanced metering infrastructure.[a] These services also include solutions related to artificial intelligence and tools to analyse and model data generated from energy systems.

A key application of ICT services is in developing, implementing and operating smart grids. These grids are electricity networks that use digital sensors and the "Internet of things", automation and communication systems in energy transmission and distribution. This allows the real-time collection of data on energy demand and use. These data and the ensuing knowledge facilitate the effective management of energy flows through smart grids. This can help utilities to balance energy supply and demand in real time, reduce waste and increase grid efficiency. It also supports consumers in monitoring and managing their energy use. Furthermore, the predictive and corrective maintenance of grids is improved, maintaining reliability and extending the lifetime of grid assets.

Several ICT services can also support the installation and operation of new technologies, such as smart thermostats and smart lighting, in buildings. The use of these technologies could cut total energy use in residential and commercial buildings, between 2017 and 2040, by as much as 10 per cent. Cumulative energy savings over the period to 2040 would amount to 65 petawatt hours, which is equivalent to the total final energy consumed in non-Organisation for Economic Co-operation and Development countries in 2015.[b]

These examples stress the relevance of inputs from ICT services to digitalize energy systems. By bringing "Industry 4.0" technology to energy production, distribution and consumption, ICT services contribute to the viability and efficiency of energy systems and to meeting current and future energy demand.

Digitalization investment needs, to 2050, in the grid infrastructure are estimated to reach $5.1 trillion, which amounts to 24 per cent of total grid investments to support a net-zero trajectory. This mainly targets implementing power system automation, control and monitoring.[c] These investment needs underscore the importance of addressing the gaps between countries on financing and technological capacities.

Source: UNCTAD.

[a] Advance metering infrastructure is an integrated system of smart meters, data management systems and communication networks, allowing two-way communication between utilities and consumers.

[b] International Energy Agency, 2017, *Digitalization and Energy*, Paris, p. 42.

[c] Bloomberg New Energy Finance, 2023, Global net zero will require $21 trillion investment in power grids, 2 March.

9. The demand for this multiplicity of services inputs for sustainable energy initiatives is not anticipated to be fully met in optimal conditions by domestic providers. International trade can play a role in expanding the sources providing these services inputs with quality, reliability and affordability.

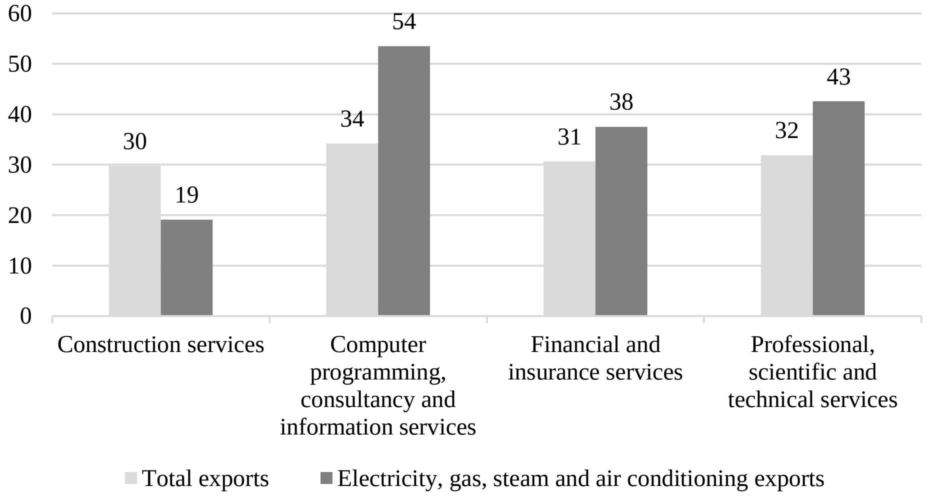
10. The importance of international trade can be attested by examining the origin of the value of services inputs incorporated in exports. Foreign inputs have a significant share in these total inputs, domestic and foreign sourced, for several services. In the figure, these shares are shown for the categories that capture many of the services included in table 1: construction services, ICT services (reflected in the figure as computer programming, consultancy and information services), financial services, and professional, scientific and technical services. The latter category incorporates, for example, engineering services, environmental services, legal services and research and development services. In 2018, foreign provision represented 54 per cent of the provision of ICT services for energy-related exports of electricity, gas, steam and air conditioning.[9] In the same year, foreign provision

[9] Electricity, gas, steam and air conditioning supply corresponds to division 35 of the International Standard Industrial Classification of All Economic Activities, in its fourth revision. This division includes (a) electric power generation, transmission and distribution, (b) manufacture of gas and distribution of gaseous fuels through mains and (c) steam and air conditioning supply. The latter class includes the production, collection and distribution of steam and hot water (for heating, power and other purposes), cooled air and chilled water (for cooling purposes) and ice (for food, cooling and other purposes).

was 43 per cent of the provision of professional, scientific and technical services, 38 per cent of financial and insurance services and 19 per cent of construction services (see figure).

11. Notably, for several services categories, foreign provision of services inputs is more important for exports than for all exports of electricity, gas, steam and air conditioning. For instance, in 2018, while foreign provision was 54 per cent of ICT services inputs for these energy-related exports, it was 34 per cent of ICT services inputs for total exports (see figure). This underscores the relevance of international trade in providing service inputs to the energy sector (box 3).

Contribution of foreign services inputs to total exports and to exports of electricity, gas, steam and air conditioning, 2018[a]
(Percentage)



Source: Organisation for Economic Co-operation and Development, Trade in value added database, available at https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm.
[a] By selected services category.

Box 3
Trade in services support the first renewable energy installation in Djibouti

In Djibouti, despite high resource potential, there are still 110,000 households without access to power. In the context of the national renewable energy development programme, the country established a contract with a consortium to build the first renewable energy installation in the country. With a capacity of 59 MW, this project is expected to almost double the installed power generation capacity in Djibouti coming from fossil fuel sources.

A foreign company in the consortium provides construction services to install the turbines of this new wind farm on a 395-hectare site and to undertake civil works of 10 kilometres of internal road and tracks, and engineering and other services to ensure the electricity interconnection. The foreign company will also provide maintenance services for at least 10 years, with an option for more.

These services are necessary for this installation which has the potential of enabling clean energy supply, decreasing the cost of electricity and allowing the population of Djibouti and its key industries to strengthen its electrical independence and economic development. Reliable and cost-effective energy access is a prerequisite for industrialization, agricultural advancements, and the expansion of municipal water systems. Furthermore, it increases opportunities for cross-border energy exports.

Source: Siemens Gamesa, 2020, Africa’s energy transition gains traction as Siemens Gamesa introduces renewable energy in Djibouti, 25 February.

B. Trade in services to enhance technology transfer for sustainable energy

12. International trade can be one of the main channels to this technology transfer for energy transition.[10] The main processes through which trade in services can facilitate technology transfer are:

(a) Trade in technology, where services firms voluntarily sell technologies, for example through licensing fees or royalties.

(b) Demonstration effects, where local firms upgrade technological capabilities learning from the example of a foreign services company.

(c) Vertical diffusion, where there are spillovers from a foreign services provider to local suppliers and customers.

(d) Horizontal diffusion, where there are spillovers from a foreign services provider to domestic competitors.

(e) Knowledge sharing through the movement of personnel between foreign and domestic firms.

13. Each of the modes of supply in relation to trade in services, according to the General Agreement on Trade in Services (see table 2),[11] tends to support different processes of technology transfer. Mode 1 (cross-border trade) and mode 2 (consumption abroad) allow for trade of technology and could also lead to technology transfer through demonstration effects. Mode 3 (commercial presence) potentially leads to the transfer of technology through vertical and horizontal diffusion. Mode 4 (presence of natural persons) could be instrumental for knowledge sharing.[12] With the adoption of digital technologies, commercial presence (mode 3) may become less relevant in favour of an increase in cross-border trade (mode 1). Table 2 gives some illustrations on how technology can be transferred by each mode of supply in relation to trade in services.

Table 2
Illustrations of technology transfer by mode of supply for trade in services

Mode of supply	*Illustration of technology transfer*
Mode 1. Cross-border supply, where services flow from the territory of one country into the territory of another country.	A company based in Country A provides a cloud-based monitoring platform for wind power systems located in Country B. This platform allows the company to track the performance of wind energy in real-time, provides alerts if issues or malfunctions are detected, and offers remote diagnosis and repair of the system, if needed.
Mode 2. Consumption abroad, where a service consumer moves into another country's territory to obtain a service	An employee from a company in Country A travels to Country B to be trained on how to install solar panels. This allows the scaling of the use of this technology by the company in Country B.
Mode 3. Commercial presence, where a service supplier of one country establishes a territorial presence in another country's territory to provide services.	An energy company originally from Country A decides to set up a subsidiary in Country B to deliver services for energy efficiency projects that are financed based on energy savings. This generates jobs in Country B and can potentially lead to knowledge-sharing between employees from both countries.

[10] Organisation for Economic Co-operation and Development, 2006, The linkages between open services markets and technology transfer, Trade Policy Working Papers, No. 29, OECD Publishing, Paris.

[11] World Trade Organization, 1994, Agreement Establishing the World Trade Organization, Annex 1 B (General Agreement on Trade in Services), article 1.

[12] Hoekman BM, Maskus K and Saggi K, 2004, Transfer of technology to developing countries: Unilateral and multilateral policy options, Policy Research Working Paper No. 3332, World Bank.

Mode of supply	*Illustration of technology transfer*
Mode 4. Presence of natural persons, where persons of one country enter the territory of another country to supply a service.	A consultant from Country A travels to Country B to conduct an energy audit of an industrial facility. His/her recommendations allow the company in Country B to make significant energy-efficiency improvements that are cost-effective.

Source: UNCTAD.

C. Trading system support for a trade in services-assisted energy transition

14. Three policy domains are involved in the contributions of trade in services to the energy transition: (a) trade in services, (b) science, technology and innovation and (c) sustainable energy. Supporting these contributions calls for discussing how these policy domains can better interact and be coordinated to achieve coherence. This coherence includes consideration of the national and international dimensions, as well as that the trading system and trade policy should be consistent with services sectoral policies, energy and environmental policies, industrial policy and science, technology and innovation policies.

15. For example, support in World Trade Organization agreements for elements of the Paris Agreement could contribute to this policy coherence. This includes incorporating into World Trade Organization agreements commitments to "facilitating access to technology, particularly for early stages of the technology cycle, to developing country Parties" (article 10.5 of the Paris Agreement) and that "developed country Parties should enhance support for capacity-building actions in developing country Parties" (article 11.3 of the Paris Agreement).

16. The international dimension of science, technology and innovation policies includes trade instruments for international technology transfer. This dimension also goes beyond improving channels for technology diffusion to improve absorptive capacitive both for technology reproduction (imitation) and creation of new knowledge (innovation). Instruments for implementing these policies include preferential treatments for developing countries, technical assistance, inclusive intellectual property rights, training and education services, and standards and regulations.

17. Traditionally, trade preferences targeted trade in goods, with the notable examples of Generalized System of Preferences schemes. The pertinence of discussing preferences that target trade in services increases due to the foreseen declining effects of tariff preferences and rising impacts of trade logistics, customs procedures, product regulations and standards. Expanding preferential treatment for services exports from developing countries can draw on and improve experience in relation to the World Trade Organization services waiver for the least developed countries.[13] Improving trade in services preferences includes targeting preferences in services that can contribute to economic diversification and structural transformation. An inclusive design of preferences also avoids conditionality that limits the policy space necessary to pursue the coherence between trade in services, science, technology and innovation and sustainable energy policies for economic diversification.

18. At the regional level, trade in services inputs can also be further considered in trade policy and regional trade agreements to promote regional value chains in the renewables industry. This could support productive diversification in low-carbon growth in developing countries.[14]

[13] UNCTAD, 2020, *Effective Market Access for Least Developed Countries' Services Exports: An Analysis of the World Trade Organization Services Waiver for Least Developed Countries* (United Nations publication, Sales No. E.20.II.D.4, Geneva).

[14] See TD/B/C.I/55, p. 5.

III. Areas for consideration

19. Experts at the tenth session of the Multi-year Expert Meeting on Trade, Services and Development may wish to consider the following questions:

(a) What are obstacles to unleashing the potential contribution of trade in services to technology transfer and science, technology and innovation capacity-building? What is the role for domestic policies? What is the role for international cooperation?

(b) How can countries achieve policy coherence among trade, industrial, energy and environmental policies in the context of transition to sustainable energy? What are some of good practice examples?

(c) What are some of the good practice examples of bilateral, regional and multilateral cooperation with the aim of leveraging trade in services in support of sustainable energy?