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Fostering environmentally sustainable electronic commerce

KEY POINTS

- Developing countries can leverage e-commerce to boost economic growth and development
- The e-commerce logistics chain (warehousing, packaging, transport, returns) needs to be rethought, to limit the environmental impacts of this growing sector, particularly of emissions and waste
- Governments, businesses and consumers need to work together to reduce environmental impacts, by regulating environmental impacts, promoting eco-friendly practices, encouraging informed consumer behaviour and improving the evidence base for informed policymaking
- Global international e-commerce and digital trade discussions need to explicitly integrate environmental sustainability concerns and make use of international cooperation and technical assistance to address such concerns

Electronic commerce (e-commerce) is reshaping the global economy, transforming consumption patterns while driving economic growth. The value of the sector rivals that of global trade in goods and services, and keeps expanding. E-commerce platforms help millions of businesses, many of which are small and medium-sized enterprises, sell online, overcoming barriers such as physical market access, infrastructure gaps and social constraints. However, the benefits of e-commerce remain uneven, with most developing countries lagging in the adoption of online shopping. It is also critical to ensure that this global transformation does not compromise environmental sustainability. The environmental impact of e-commerce depends on the type; business-to-consumer e-commerce implies a growing number of smaller packages, deliveries and returns, while business-to-business e-commerce may be more efficient, with bulk orders requiring less packaging and allowing for streamlined delivery. The different stages of the business-to-consumer e-commerce logistics chain for goods (warehousing, packaging, transport, returns) are examined in this policy brief, along with changing consumer behaviour. In addition, the need to rethink these elements is highlighted, to reduce the environmental footprint of e-commerce, while creating a regulatory framework that balances environmental sustainability with economic growth.[1]

E-commerce as a catalyst for development in developing countries

Reducing emissions through the use of renewable energy and optimized logistics

Warehousing and distribution are central to business-to-consumer e-commerce but significantly add to the carbon footprint. Large-scale warehouses used for inventory and order fulfilment often emit more greenhouse gases than traditional retail centres due to increased transportation and energy use from heating, cooling and lighting. E-commerce typically relies on large, centralized warehouses far from urban areas, increasing last-mile delivery emissions. However, emerging innovations can significantly reduce the environmental impacts. For example, in China, in 2023, solar-powered logistics centres used by one e-commerce platform reduced emissions by over 21,000 megatons of carbon dioxide equivalent.[2] In Pakistan, an e-commerce platform uses solar-powered facilities and a courier company has adopted solar air-conditioning in order to reduce energy demand.[3] In addition, locating warehouses closer to consumers can reduce emissions by shortening delivery routes. For example, in Kenya, the integrated logistics hub

[1] This policy brief builds on the findings in chapter 5 of UNCTAD, 2024, *Digital Economy Report 2024: Shaping an Environmentally Sustainable and Inclusive Digital Future* (United Nations publication, sales No. E.24.II.D.12, Geneva).

Note: Mention of any firm or licenced process does not imply the endorsement of the United Nations.

[2] See https://www.alibabagroup.com/en-US/document-1620276223567462400.

Note: All websites referred to in footnotes were accessed in January 2025.

[3] See https://www.telecoalert.com/2021/08/22/daraz-revitalizes-the-e-commerce-ecosystem-with-100-recyclable-packaging-and-tree-plantations/ and https://futuresupplychains.org/fedex-sustainable-warehouse-technology/.

of one company reduced vehicle trips and carbon dioxide emissions.[4] However, such micro-level fulfilment centres also pose challenges. The use of smaller sites closer to consumers may increase energy consumption and inventory across multiple sites and might adversely affect the health of local populations.[5] Therefore, businesses should balance logistics optimization and environmental sustainability, by adopting technologies that streamline inventory and reduce excess stock.

Recommendations

- Governments: Provide incentives for renewable energy use in warehouses; and promote logistics centres that reduce last-mile delivery emissions
- Businesses: Invest in renewable energy and smart warehouse management systems, to minimize energy consumption and emissions

Reducing packaging and waste through innovation and regulation

Excessive packaging is a highly visible element of e-commerce. Goods purchased online often require more packaging than those purchased at traditional retail centres, to protect individual items during transit, increasing the use of cardboard and single-use plastics, as well as carbon dioxide emissions and waste. For example, in the Republic of Korea, a study found that e-commerce generated nearly five times more packaging waste than brick-and-mortar retail.[6] Some innovative practices in sustainable packaging are emerging. Certain companies ship products in their original containers, without additional packaging. For example, in India, Amazon has replaced single-use plastics with recyclable paper-based materials and in Latin America, Mercado Libre uses Forest Stewardship Council-certified packaging, to ensure sustainable sourcing.[7] In addition, Governments are increasingly regulating packaging waste. For example, in China, policies have been implemented to reduce plastics use in logistics and in Rwanda and other countries, plastic bags have been banned.

Recommendations

- Governments: Strengthen recycling systems; promote recyclable and biodegradable packaging; and provide incentives for businesses using eco-friendly packaging
- Businesses: Use recyclable biodegradable materials; and adopt innovative, waste-minimizing designs, such as right-size packaging

[4] See https://group.jumia.com/news/jumia-opens-integrated-warehouse-facility-to-reduce-delivery-time.

[5] Buldeo Rai H, 2023, Urban warehouses as good neighbours: Findings from a New York City case study, *Transportation Research Interdisciplinary Perspectives*, 19.

[6] Kim Y, Kang J and Chun H, 2022, Is online shopping packaging waste a threat to the environment? *Economics Letters*, 214.

[7] See https://www.aboutamazon.in/planet/improving-packaging and https://sustentabilidadmercadolibre.com/en/iniciativas/sustainable-purchasing.

Reducing emissions from transportation and last-mile delivery

Transporting online orders significantly contributes to greenhouse gas emissions, particularly during last-mile delivery to consumers. Emissions are due to the use of fossil-fuel–powered vehicles and inefficient routes and the demand for fast shipping, which often requires air transport and routes that prioritize speed over the reduction of emissions. In certain circumstances, e-commerce can result in lower levels of emissions, for example if consumers choose home delivery instead of driving long distances to buy a single item at a store. However, the use of expedited shipping often offsets such benefits. The provision of same-day delivery can double emissions compared with standard shipping times.[8] To address such challenges, some e-commerce businesses adopt the use of electric vehicles and alternative delivery methods. For example, in China, a study found that replacing fossil-fuel–powered vehicles with electric bicycles for the last-mile delivery of books reduced emissions by up to 71 per cent.[9] Governments can support such shifts by investing in infrastructure for electromobility, such as charging stations. Encouraging consumers to choose slower delivery times that enable optimized delivery routes and more sustainable transport modes can further reduce emissions.

Recommendations

- Governments: Promote the use of electric vehicles for last-mile delivery through subsidies and infrastructure investment; and create public awareness campaigns to encourage slower, sustainable shipping
- Businesses: Invest in low-carbon delivery fleets; and optimize delivery routes using artificial intelligence and data analytics

Reducing return rates

Return rates in e-commerce, particularly for clothing, are higher than in traditional retail, often due to inaccurate descriptions and poor sizing. In 2022, returns in the United States of America led to $816 billion in lost sales.[10] Moreover, returns involve packaging waste, transportation emissions and, at times, the destruction of unsold goods, which is particularly harmful since disposal generates 5–20 times more emissions than reuse or resale.[11] Innovative solutions such as the use of augmented reality technology could help reduce returns by allowing consumers to virtually try products before buying. In addition, some retailers, to encourage more deliberate purchases, charge nominal return fees. In Africa, Jumia uses “keep-and-refund” practices, reducing reverse-logistics emissions by permitting customers to keep certain low-value items rather than returning them.[12]

[8] See https://kontinentalist.com/stories/how-online-delivery-in-asia-hurts-essential-workers-and-the-environment.

[9] Zhang L and Zhang Y, 2013, A comparative study of environmental impacts of two delivery systems in the business-to-customer book retail sector, *Journal of Industrial Ecology*, 17(3):407–417.

[10] See https://nrf.com/media-center/press-releases/2022-retail-returns-rate-remains-flat-816-billion.

[11] See https://www.ellenmacarthurfoundation.org/circular-examples/frances-anti-waste-and-circular-economy-law.

[12] See https://group.jumia.com/news/jumia-shares-first-environmental-social-governance-report-highlighting-its-current-sustainability-practices.

Recommendations

- Governments: Ban destruction of returned items; and encourage eco-design principles, for durable and repairable products
- Businesses: Improve product descriptions; use digital tools such as augmented reality; charge nominal return fees; and adopt improved reverse-logistics solutions
- Consumers: Make informed purchasing decisions by reviewing product information; and avoid over-ordering, to reduce unnecessary returns

Driving change through consumer behaviour

Consumer behaviour significantly impacts the environmental footprint of e-commerce. The convenience of online shopping drives overconsumption, impulsive buying and the making of frequent small purchases, increasing emissions and waste. Marketing tactics such as flash sales and personalized advertisements further exacerbate overconsumption. Younger consumers are increasingly aware of environmental impacts; a survey of 16,000 consumers in 16 countries found that, in a comparison by demographic cohort, over 90 per cent of millennials expressed concerns about sustainability, compared with only 77 per cent of baby boomers.[13] Such awareness offers an opportunity for Governments and businesses to promote responsible shopping habits; Governments could encourage the creation of environmental labels, to certify sustainable e-commerce practices, enabling informed choices; and businesses could offer eco-friendly options, such as carbon-reduced shipping, carbon offsetting and/or minimal packaging.

Recommendations

- Governments: Launch public awareness campaigns on the environmental impacts of fast shipping and overconsumption; and introduce environmental certifications for e-commerce, to help consumers evaluate product sustainability
- Businesses: Provide transparent environmental information on shipping options; and offer incentives for eco-friendly alternatives

[13] See https://www.just-style.com/news/sustainability-conscious-consumers-leading-value-purchases-study/.

Leveraging e-commerce platforms for circularity

E-commerce has an environmental impact, yet platforms can promote resource efficiency and waste reduction by enabling reuse, resale, swaps and the renting of products and services between individuals. Doing so can facilitate the transition to circular and sharing economies, easing pressure on scarce resources such as water, non-renewable energy sources and raw materials.[14] Platforms for classified advertising enable consumers to trade used electronics, furniture and clothes; in India, for example, one platform reported a reduction of carbon dioxide emissions by 8 million tons in one year, by reducing the need for new products.[15] Innovative applications allow users to swap clothing and track environmental benefits with an impact calculator, as used for example in Ireland.[16] Peer-to-peer platforms can also support the sharing economy, such as through the use of ride-sharing. However, rebound effects, whereby the benefits of circular and sharing systems are counteracted by increased overall consumption, can offset initial environmental gains by increasing emissions.

Recommendations

- Governments: Establish regulations to mitigate rebound effects
- Businesses: Advance circular initiatives, such as by offering repairs or promoting resale options
- Consumers: Participate in sharing systems, prioritizing repairs over replacements and demanding circularity-focused policies

Making e-commerce more environmentally sustainable

E-commerce presents both opportunities and risks with regard to responsible consumption and production. Making e-commerce more environmentally sustainable requires collaboration from Governments, businesses and consumers, to address the aspects highlighted in this policy brief. Policymakers need to combine regulations, tax incentives and other measures, to reduce carbon dioxide emissions and waste, while supporting the development dimension of e-commerce. Consumers play a role, by adopting sustainable habits and encouraging businesses to prioritize sustainability. In 2024, the General Assembly adopted the Pact for the Future, including the Global Digital Compact, the goal of which is an inclusive, open, sustainable, fair, safe and secure digital future for all, with five objectives, including with regard to digital inclusion; advancing digital inclusion requires a predictable and transparent enabling environment that, among other actions, facilitates the growth of e-commerce. Integrating sustainability with e-commerce growth can help support environmental and social goals. In addition, environmental dimensions need to be emphasized in international trade agreements. For example, a protocol on digital trade under the African Continental Free Trade Area Agreement was adopted in February 2024;

[14] See https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-109-accelerate-action-to-revamp-production-and-consumption-patterns-the-circular-economy-cooperatives-and-the-social-and-solidarity-economy/.

[15] See https://www.thehindubusinessline.com/news/how-olx-india-users-helped-reduce-their-carbon-footprint/article24078672.ece.

[16] See https://www.theguardian.com/fashion/2021/jan/29/reselling-repairing-and-swishing-the-rise-of-sustainable-fashion-apps.

implementation of the protocol could help streamline e-commerce operations across Africa, fostering cross-border trade and easing logistics. In addition, a joint statement initiative on e-commerce, negotiated among 91 members of the World Trade Organization, is aimed at establishing rules for digital trade.[17] However, at present, neither the protocol nor the initiative has made explicit reference to the environmental footprint of e-commerce. As a follow-up to both processes, capacity-building efforts need to address environmental sustainability. In this context, UNCTAD and other international organizations can provide technical assistance, funding and training with regard to integrating sustainability dimensions into e-commerce strategies. Doing so can help empower developing countries to adopt more sustainable technologies, improve logistics and promote responsible consumption. By fostering collaboration among Governments, businesses and consumers, international efforts could create a more cohesive global approach to sustainable e-commerce, ensuring that it supports both economic development and environmental preservation.

Policy recommendations

Promote better e-commerce practices

- Government and business collaboration: Governments could create regulations and incentives for sustainable practices; and businesses could innovate and embed sustainability into operations
- Sustainable warehousing and transportation: Governments could promote resource-efficient infrastructure and delivery; and businesses could invest in energy efficiency and electric vehicles
- Packaging and returns management: Governments could regulate excessive packaging and returns, promoting reusable and biodegradable materials; and businesses could eliminate single-use plastics, minimize packaging and implement fees and technology use, to reduce returns

Encourage more environmentally conscious consumer behaviour

- Regulation and green labels: Governments need to prevent false claims; and could mandate certified environmental labels on e-commerce platforms
- Consumer awareness campaigns: Governments and businesses could raise awareness about the environmental impacts of consumer choices and the environmental costs of products
- Incentives for eco-friendly choices: Businesses could offer discounts for sustainable packaging and shipping options; and highlight sustainability attributes through recognized eco-labels

[17] See https://www.wto.org/english/tratop_e/ecom_e/joint_statement_e.htm.

Improve the evidence base for informed policymaking

- Data collection and research: Governments could mandate data collection on the environmental impact of e-commerce and the disclosure of sustainability performance
- International collaboration: International organizations could advance research and share data and strategies for e-commerce sustainability
- Partnerships for innovation: Governments and international organizations could foster partnerships with digital, e-commerce and financial technology-related companies, to invest in sustainable digital innovation

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