

FACTORY IN A BOX

MICROFACTORIES CAN
MAKE PRODUCTION
MORE RESILIENT,
SUSTAINABLE AND FAIR

Spotlight
Series

May 2022

FI INSTITUTE

Future Investment Initiative Institute

Impact
on Humanity

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MICROFACTORIES CAN MAKE PRODUCTION MORE RESILIENT, SUSTAINABLE AND FAIR

An unprecedented series of recent supply chain disruptions has highlighted the need for alternatives to complex global systems. Fast and versatile, microfactories the size of shipping containers can make supply chains more resilient and value creation more decentralized – with significant social and environmental benefits.

THE ISSUE AT STAKE



THE WORLD IS IN THE MIDST OF A MAJOR supply chain crisis. According to an index from the Federal Reserve Bank of New York, global supply chain pressure remains at historically high levels¹ – the result of disruptions ranging from Covid-19 and the 2021 Suez Canal blockage to the recent war in Ukraine. These incidents have highlighted the fragility of complex, interconnected models that span continents to deliver almost every product we consume.

Such models have been designed to maximize economic efficiency. Production in the 21st century often involves shipping raw materials across the globe to huge factories, typically in low-income regions, to produce goods as quickly and cheaply as possible. Then the products are sent to consumers around the world via an equally complex distribution system.

When it works, the benefits are obvious: a vast selection of affordable products are readily available to billions of people; cross-border cooperation and investment has increased, providing the Global South with access to jobs.

But as the last two years have shown, globalization also has its shortcomings, some of which are seriously undermining these benefits. Shipping times have increased massively. Three years ago, it took just under 50 days for goods to ship from a supplier's warehouse in China to a port in the United States. According to US logistics firm Flexport, that has now more than doubled to approximately 111 days, largely thanks to continued pandemic restrictions.² Shipping

costs have also exploded in the last two years. In April 2020, it cost around \$1,400 to ship a standard 40-foot container; since July 2021, the price has hovered around the \$10,000 mark – an increase of just over 600 percent.

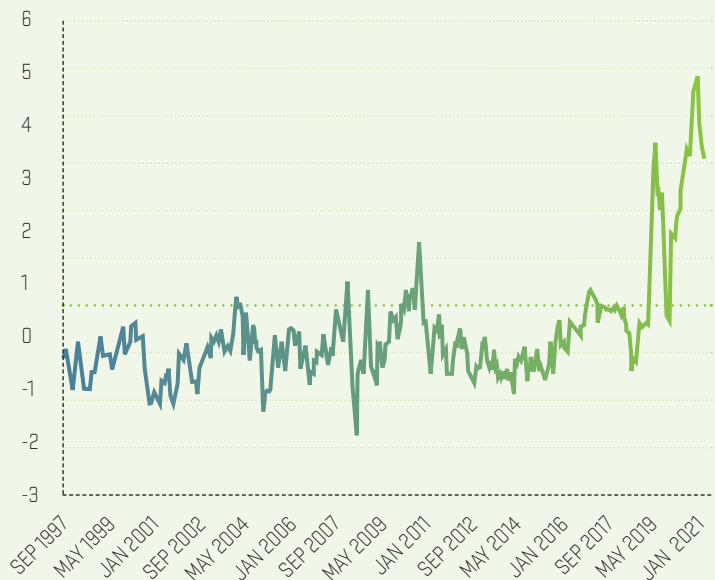
GROWING ENVIRONMENTAL IMPACT

The global supply chain is also taking a social and environmental toll. Ninety percent of world trade is now transported by sea – a hard sector to decarbonize. Between 2000 and →

INCREASE IN SUPPLY CHAIN PRESSURE

Standard deviations from average value

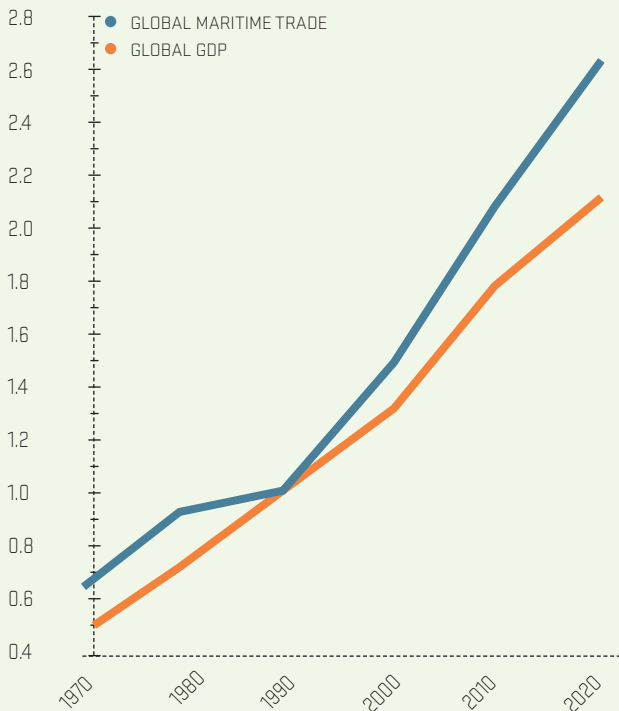
● GLOBAL SUPPLY CHAIN PRESSURE INDEX



SOURCE: FEDERAL RESERVE BANK OF NEW YORK(1)

GLOBAL SHIPPING OUTPACES GDP GROWTH

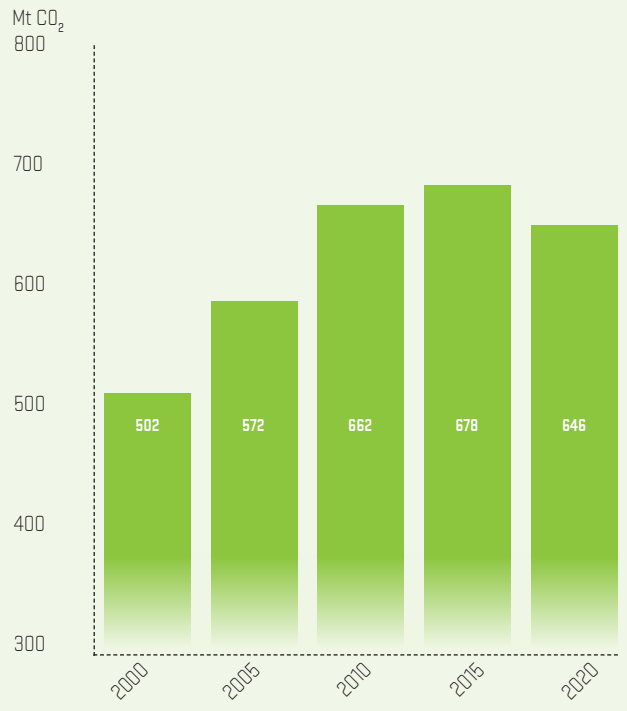
Increase in global maritime trade vs. global GDP (1990 = 1)



SOURCES: UNCTAD AND WIKIMEDIA COMMONS (3)

DANGEROUS WATERS

Global CO₂ emissions from shipping



SOURCE: IEA (4)

→ 2019, CO₂ emissions from international shipping grew 40 percent.⁵ Shipping now accounts for between 2 and 3 percent of global emissions.

And it isn't just raw materials and products being sent around the globe. In a bid to reduce

Companies need to think more sustainably and locally

recycling costs, many rich nations are also shipping vast amounts of waste to poorer countries. The UK, for example, ships two-thirds of its plastic waste overseas.⁶ Between 2001 and 2019, hazardous waste shipments from the EU doubled from 3.9 million tons to 8.1 million tons.⁷ Yet many developing countries lack the necessary infrastructure to safely and effectively recycle waste materials, exposing workers to harmful substances and creating further pollution.

BRINGING INDUSTRY CLOSER TO HOME

As the need to fight climate change grows, and businesses and governments look to strengthen supply chain resiliency, one area is attracting growing attention: greater localization.

In a 2021 Economist Intelligence Unit report on the business costs of supply chain disruption, Omera Khan, Professor of Supply Chain Management at Royal Holloway University of London, said: "To really change the way they tackle these disruptions, companies need to change the way they work and think. Companies need to think more sustainably and more locally." Shorter supply chains would lessen the impact of trade on the environment and achieve more resilient systems, the report says.⁸

Localizing production wouldn't just solve supply chain issues for international corporations. It could also benefit remote areas in low-income countries, many of which have little or no production infrastructure. Housed in robust, easily transportable shells such as shipping containers, microfactories can serve as a valuable starting-point for food processing or the production of basic goods for local communities. By providing tools and infrastructure when and where they are →



Boxpower: Refining its SolarContainer and Minibox products for rural areas.

→ needed most, microfactories can help to break the vicious circle of poverty and dependency.

MICROFACTORIES BRING MACRO BENEFITS

There are many remote areas in developing nations that lack ready access to basic industrial infrastructure. South Africa-based company AFRI.CAN has developed a range of microfactories that can help such areas efficiently process and package food, drink or household products, or make their own biodiesel. This can empower local producers to increase their income and learn new skills.

On an even smaller scale, the Indian Institute of Food Processing Technology has developed a fleet of mobile processing units for fruit and vegetable farmers across the country.⁹ Housed in vans, the units can help reduce post-harvest losses, which can be as high as 30–40 percent due to a lack of infrastructure in some parts of India.

With their water purification microfactories, the likes of AFRI.CAN and Swedish company Wayout offer a solution to a more fundamental problem: two billion people, one-quarter of the world's population, lack immediate access to clean drinking water.¹⁰ Wayout's "smart pod" solution can produce up to 8,000 liters of drinking water a day,

from any kind of source water, by means of a chemical- and plastic-free process.

POWER TO THE PEOPLE

Of course, production needs power. But in Africa alone, 600 million people lack access to electricity to run either homes or businesses.¹¹ Now, a host of start-ups are developing mini-grid solutions to deliver renewable energy to remote areas without the need for diesel generators.

Africa GreenTec's Solartainer, for example, can be set up to deliver electricity in just 48 hours and is capable of powering up to 40 commercial customers or 10 communal facilities via its pop-up solar panels. Energy storage comes in the form of specially cooled lithium-ion batteries. "We help people in the Global South ... by providing renewable energy and technologies that help them generate value locally and self-sufficiently," says Africa GreenTec founder Torsten Schreiber.¹²

French company ERM Energies has deployed similar solutions in Burkina Faso and Mauritania. Its Fabtainer also serves as a fabrication and training workshop to teach technical skills.

These solutions are not needed only in developing regions. Californian firm Boxpower has refined its shipping contain- →



Africa GreenTec: Delivering renewable energy to remote areas.

→ er-sized SolarContainer and MiniBox products to also bring energy to rural areas around the world, from remote parts of Alaska to disaster-hit areas of the Caribbean.

ENHANCING CIRCULAR ECONOMIES

In a bid to reduce the distance traveled by waste materials for recycling, US start-up Circular Economy Manufacturing has brought microfactory technology to New York City. On Governors Island, a stone's throw from the Statue of Liberty, a repurposed shipping container uses solar power to shred and melt locally collected plastic before turning it into products such as compost bins, kids' chairs and traffic cones. "This is something that could scale globally," Roth says. "Large urban areas can use it, since cities generate so much waste. But it could also be valuable in remote and disadvantaged communities. Since it's a self-enclosed system, you don't even have to be on the power grid to use it."¹⁴

PHOTO: AFRICA GREENTECH

Mini-grids

Without a reliable source of power, factories have to rely on manual labor or diesel-powered generators. This is where mini-grids come in. A set of small-scale (preferably renewable) electricity generators, a mini-grid supplies electricity to a localized group of customers, typically independent of the national grid. According to the United Nations, 47 million people worldwide are connected to 19,000 mini-grids. However, it also says a further 180,000 mini-grids are needed, including 140,000 in Africa, to connect hundreds of millions of people.¹³

→ On the other side of the world, Veena Sahajwalla is motivated by a similar goal. The director of the Centre for Sustainable Materials Research and Technology at the University of New South Wales in Australia has developed a series of micro-recycling facilities to turn local waste into commercial materials and products. “My vision is for decentralized, modernized recycling and manufacturing where we value our materials and strive for greater material sustainability,” says Sahajwalla.¹⁵ Operable on a site of just 50 square meters, the microfactories can be located near waste stockpiles. Sahajwalla even

ploy, they can help reduce global economic inequality. What’s more, as technologies such as 3D printing and 5G connectivity mature, microfactories may find a wider range of commercial uses. Sometimes, smaller is better. ←

Microfactories offer significant potential for low-income regions

envisions them forming local ecosystems across multiple urban sites, with each module performing a different function.

As well as improving circular economies for waste, microfactories can also improve sustainability by shortening production and distribution chains: workers produce goods for local communities using resources from the surrounding environment.

A LONG ROAD TO WIDESPREAD ADOPTION

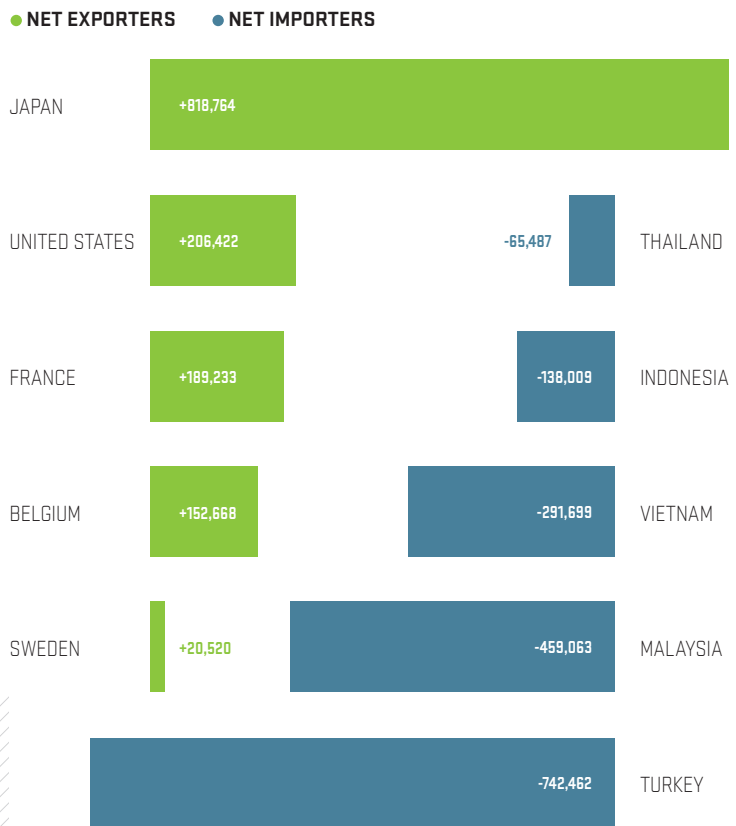
With supply chain interruptions likely to become more common, according to the Economist Intelligence Unit report, and sustainability growing in importance, interest in greater localization of industrial infrastructure is likely to increase. Indeed, 60 percent of the executives surveyed in the report said redundancy and resilience are now more important than speed and efficiency.

Despite their size, it is important to note that microfactories face many of the same issues as their larger counterparts. Operators must consider the local environmental footprint, for instance, as well as any disruption microfactories may cause to existing local economies, particularly if they are only a temporary solution.

While use cases for richer nations and big businesses are currently limited, microfactories offer significant potential for low-income regions. Versatile and easy to de-

WHICH COUNTRIES EXPORT AND IMPORT PLASTIC WASTE?

Selected countries by net export balance of plastic waste and plastic scrap in 2020 (in tons)



SOURCE: STATISTA (UN COMTRADE DATABASE)⁽¹⁶⁾

Global waste and The Basel Convention

The Basel Convention was initially adopted by the United Nations in 1989 to establish an agreement on global standards for hazardous waste, including the trade and disposal of toxic waste. However, because the Convention doesn’t ban the transboundary movement of such materials, critics say it falls short. Until recently, China was by far the biggest importer of waste materials. But in 2018, the Chinese government imposed a ban on imported waste, seriously affecting the global recycling industry, especially for plastic. Since then, Southeast Asia, Turkey and parts of Eastern Europe have seen major spikes in plastic waste imports.¹⁷



WHAT CAN YOU DO?

- ☛ **Credit-pooling:** Financing microfactories is a small-scale business. National and regional development banks could provide pooled credit facilities that allow a certain level of scalability to pave the way for greater private investment.

- ☛ **Boxes for Basics:** Scaling up tiny factory units makes particular sense for the most basic needs, such as food processing or water purification.

- ☛ **Closing circles:** Governments and businesses must do more to close recycling loops and improve circular economies. International regulations and decentralized waste processing can speed up the process.

ABOUT FII INSTITUTE

→ **THE FUTURE INVESTMENT INITIATIVE (FII) INSTITUTE** is a new global nonprofit foundation with an investment arm and one agenda: Impact on Humanity.

Global, inclusive and committed to Environmental, Social and Governance (ESG) principles, we foster great minds from around the world and turn ideas into real-world solutions in five critical areas: Artificial Intelligence (AI) and Robotics, Education, Healthcare and Sustainability. We are in the right place at the right time: when decision-makers, investors and an engaged generation of youth come together in aspiration, energized and ready for change.

We harness that energy into three pillars: THINK, XCHANGE, ACT. Our THINK pillar empowers the world's brightest minds to identify

technological solutions to the most pressing issues facing humanity. Our XCHANGE pillar builds inclusive platforms for international dialogue, knowledge-sharing and partnership. Our ACT pillar curates and invests directly in the technologies of the future to secure sustainable real-world solutions. Join us to own, co-create and actualize a brighter, more sustainable future for humanity. ←



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