

INDUSTRIAL DEVELOPMENT REPORT 2020

BRIEF NO 7

The contribution of ADP technologies to environmental sustainability

Executive summary

Advanced digital production (ADP) technologies contribute to environmental sustainability through two main channels. By making production more efficient, ADP technologies unlock efficiency gains in energy and material use. Progress in production efficiency also entails lower emissions and less pollution. Moreover, new technologies contribute to environmental sustainability by fuelling some of the product innovations that lie beneath environmental goods. When they are diffused, environmental goods help make production and consumption patterns “greener”.

Key findings

- » Improvements in production efficiency in manufacturing effected by ADP technologies are associated with energy and material savings, as well as with lower CO₂ emissions.
- » Patents for goods fuelled by ADP technologies are significantly “greener” than the average patent.
- » Environmental goods increase our quality of life while minimizing our impact on the environment.



From ADP technologies to environmental sustainability

Two major channels link the widespread diffusion of ADP technologies to the achievement of environmental sustainability. One is production efficiency. ADP technologies make manufacturing more efficient, which means that firms consume less energy—as well as materials and other inputs—per unit of output. Greater production efficiency can also contribute to minimizing environmentally harmful emissions, as well as waste and pollution. ADP technologies thus open opportunities for simultaneous improvements in environmental and economic performance.

The second channel relates to the introduction of environmental goods fuelled by new technologies. Environmental goods are more energy-efficient, made of eco-friendly materials and components—the Fourth Industrial Revolution is associated with advancements in new materials, some of which have a strong sustainability dimension—and they can be recycled, refurbished and re-used within circular economy business models. When they diffuse and become items of mass use, our consumption patterns start becoming more sustainable.

Greater production efficiency helps save energy and reduce emissions

ADP technologies, such as the Internet of Things (IoT), connected robots or big data analytics, increase efficiency in the use of materials, energy and labour. Qualitative evidence collected by UNIDO in in-depth case studies of manufacturing firms from around the globe suggests that these efficiency gains can arise from multiple sources (see Box 1). Consider, for instance, energy efficiency. The introduction of new software tools can help firms optimize energy use. At the same time, firms can leverage ADP technologies—such as 3D printers—to directly replace energy-intensive production processes.

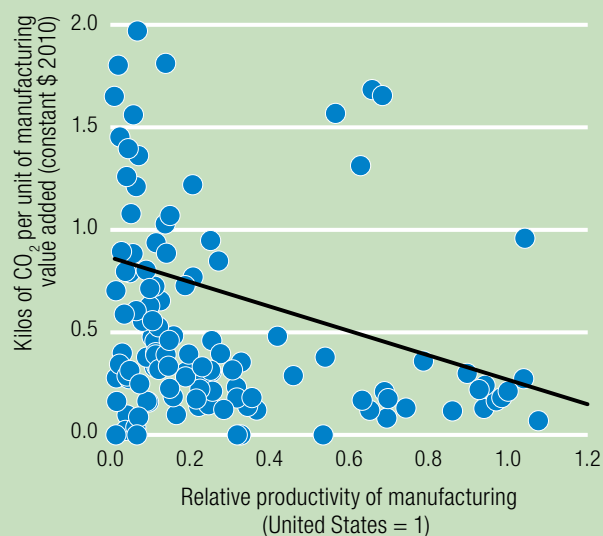
Evidence at the macro level corroborates these observations. Figure 1 plots the relationship between changes in relative labour productivity in manufacturing—a commonly used proxy for production efficiency—and the intensity of carbon dioxide (CO₂) emissions resulting from manufacturing production—an indication of the environmental harm associated with production. The relationship is negative. Economies that are closer to the production efficiency frontier tend to emit less CO₂ per unit of production, that is, they cause less environmental damage.

ADP technologies fuel environmental goods

Production efficiency is only one side of the story. ADP technologies are also the engines that fuel the development of environmentally friendly capital goods, as well as new environmental goods for consumers. Environmental goods are those manufacturing goods that generate a higher quality of life while minimizing the use of natural resources and toxic materials and the emission of waste and pollutants over the life cycle of the good.

Figure 1

Higher production efficiency is associated with lower CO₂ emissions



Source: UNIDO IDR 2020, Figure 1.6 page 36

Box 1. Case studies point to a positive relationship between ADP technologies and sustainability

In the IDR 2020, UNIDO documents the experience of several technologically advanced firms located in developing and emerging industrial economies. On average, firms adopting ADP technologies report having introduced improvements in energy efficiency, material use and waste. ADP technologies unlock efficiency gains in the use of energy. This is particularly true in heavy industries: the Chinese steel firm Baowu, for instance, increased its energy efficiency by 5 per cent. Secondly, ADP technologies, such as 3D printing, lead to a more efficient use of materials, namely by consuming less energy and minimizing use. Moreover, 3D printers can rely on environmentally friendly materials. One such case is PLA-plastic, which is based on sugarcane and corn, used by the Kyrgyzstan-based Genesis Bionics for 3D-printed bionic prostheses. Finally, new production technologies can minimize hazardous and polluting processes. The Uruguayan firm AVS Technology AG has developed smart modular plants for producing chlor-alkali directly at water treatment plants, thus eliminating the need to store or transport chlorine in liquefied gas form, with potential leakages that can be harmful to both human health and the environment.

Patent data provides some insights about the contribution of new goods to environmental sustainability. Patents in ADP technology are generally “greener” than the average patent: over 10 per cent of patents filed for the development of an ADP technology include an environmental dimension (see Box 2). The share of environment-friendly patents rises to approximately 20 per cent when considering a subset of ADP technologies—

Figure 2

Patents for ADP technologies are greener than the average patent

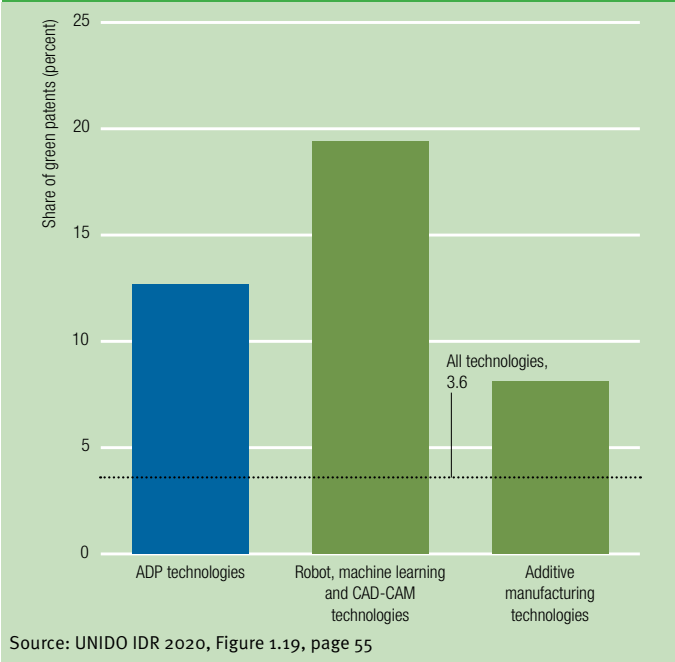
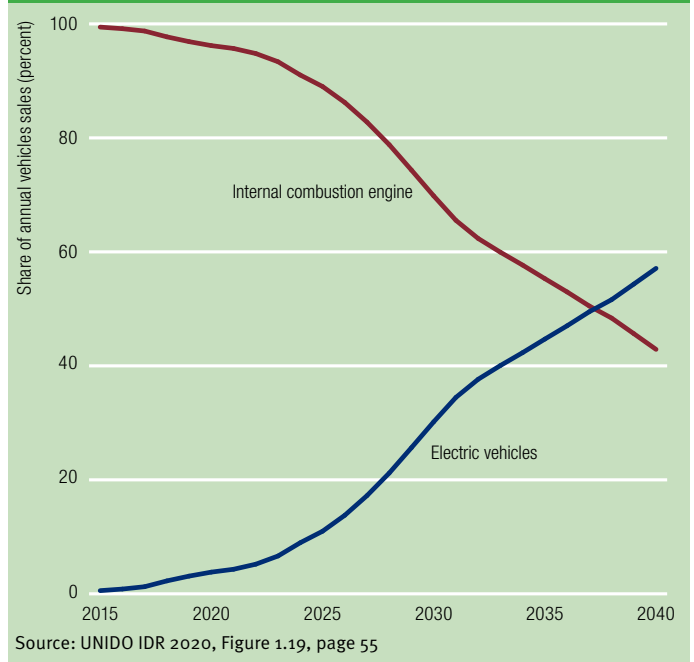


Figure 3

Electric vehicles are projected to diffuse widely



robots, machine learning and CAD-CAM technologies. By contrast, only around 3 per cent of patents filed for other technological domains contribute to advancing sustainability (Figure 2).

Robots and 3D printers are—at least for now—goods that are not widely accessible to consumers. Yet ADP technologies also play an important role in the development of environmental consumer goods. Electric vehicles are an interesting case in point. Increasingly reliant on software and digital technologies, electric cars have the potential to reduce greenhouse gas emissions and at the same time, improve air quality and reduce other externalities such as noise. According to recent projections, electric vehicles could take over up to 50 per cent of the global car market by 2040 (Figure 3). It therefore comes as no surprise that several emerging industrial countries have identified electric vehicles as a strategic industry in their policy planning to adapt and catch up with the smart manufacturing frontier.

Box 2. Identifying the green content of patents: the Yo2 tag

When patent examiners determine that a patent contributes to climate change mitigation, they attach a tag to it. Patents with an environmental dimension are marked with the “Yo2” tag. This tag makes it possible for researchers to identify the subgroup of patents that refer to “green” technologies.

Conclusions

- » Environmental sustainability is associated with ADP technologies for three main reasons. First, due to the energy efficiency gains they afford to producers. Second, because they are often developed starting from sustainable materials. Finally, because they contribute to reducing emissions, waste and pollution.
- » Patents filed for the development of ADP technologies are “greener” than those in other technology fields. This is particularly the case for technologies such as robots, machine learning and CAD-CAM software.

References and/or suggestions for further reading

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