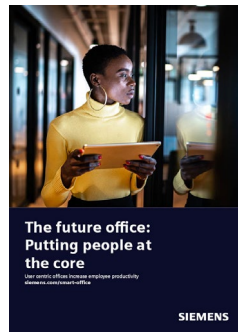# Offices at the forefront of creating sustainable buildings

Smart offices enable sustainability for people and spaces

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Sustainability
Offices at the forefront of creating sustainable buildings

Office buildings have the potential to play a crucial role in global emissions reduction especially as they are typically at the forefront of innovation in buildings. Sustainability for office buildings means the building – and the users inside – are carbon-neutral, resources are used at highest efficiency, the building becomes an energy prosumer, and the building is ready for the sector coupling of the smart city. There is a business case behind sustainability, and especially for early-adopters, sustainable office buildings help to win in the war for talent.

Foreword

This white paper is part of a series of papers discussing the future of the office – the smart office. There are three dimensions to this: user centricity, flexibility and sustainability. This paper discusses sustainability. To inform the white paper production, industry and expert interviews were conducted in June and July 2020. For more information, please refer to the other two white papers.

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Offices at the forefront of creating sustainable buildings

The case for sustainable offices

Buildings are responsible for about 36% of global energy consumption and 39% of global greenhouse gas emissions over their lifecycle.1 Accounting for such a considerable share of energy use and emissions, they are a key factor in the transition to a sustainable future. This also shows in political efforts: Buildings are a central element of the EU Green Deal, which calls for rates of renovation to at least double to reach Green Deal goals.2 Over the coming years, governments across the globe can be expected to pass legislation to make sure sustainability targets are reached.

Office buildings are well positioned to lead the way in sustainability innovation for three key reasons. First, offices need to be state of the art to ensure they are attractive for investors and tenants. This results in short renovation cycles, which present ample opportunities to upgrade building technology and incorporate the latest technology to suit tenants and office users.

Second, pressure to achieve sustainability goals comes not only from politicians and society at large. Firms set ambitious sustainability targets for themselves, not least because this is something demanded by their employees.

Being able to offer a sustainable office may make all the difference in winning the war for talent among environmentally minded candidates, especially millennials and Generation Z. Employers will be expected to have good answers to questions such as: How much energy does our building consume? Is our electricity renewably generated? Where does our office coffee come from?

Finally, sustainable office buildings have a business case behind them: Energy efficiency means low-cost operations, and in sustainable offices, value-added services can be offered to tenants that create additional revenue streams.

Decision makers who act now on their office portfolio can secure early mover advantages, as long as designated funds are available from public sources and sustainable offices are still the exception rather than the rule. But what exactly are we talking about when it comes to sustainable offices?

1 Abergel, Thibaut, et al. 2019. "2019 Global Status Report for Buildings and Construction: Towards a zero-emissions, efficient and resilient buildings and construction sector." International Energy Agency and the United Nations Environment Programme.

2 European Commission. 2019. "Building and Renovating: The European Green Deal."

"Buildings are the key to the energy transition, but little has happened in the sector so far. Office spaces provide a huge opportunity to showcase the impact buildings can have on reaching sustainability targets."

Project Manager, Real Estate Developer

**The four dimensions
of the sustainable office**

The sustainable office is characterized by four factors.
In a sustainable office...

1. office users are effectively carbon neutral,

2. resources are used with absolute efficiency,

3. the office building is an effective
energy prosumer and

4. the building is smart city ready.

Let us dive deeper into these dimensions.

First, the sustainable office can offer its occupants the chance to be effectively carbon neutral while inside – their emissions footprint is actively tracked, managed and offset, from using renewable energy to power personal devices to drinking ethically sourced coffee or eating organic fruit, the origin of which is tracked through blockchain.

Second, absolute resource efficiency means minimizing energy use, water consumption and waste production as much as possible. Based on typical office building consumption, this means minimizing the energy use arising from lighting, equipment, heating, ventilation and air conditioning and minimizing water use in toilets, sinks and cleaning. Resource efficiency also extends to the usage of consumables such as paper towels.

Third, the sustainable office is an intelligent energy prosumer. Sustainable offices are able to generate their own renewable energy and smartly utilize it to cover their own consumption. The power of distributed energy solutions enables sustainable offices to intelligently balance load, feed into the local grid, store energy and sell surplus energy on the market.

Lastly, the sustainable office integrates itself seamlessly into the smart city, enabling sector coupling, for example in heating and energy management, and optimized service delivery, for example in waste logistics. It is a building block the smart city can draw upon as a resource to intelligently manage and organize city infrastructure. → *graphic A*

To achieve these goals, the office needs the right infrastructure, including sensors, building, technology and a data platform. The office needs to become smart.
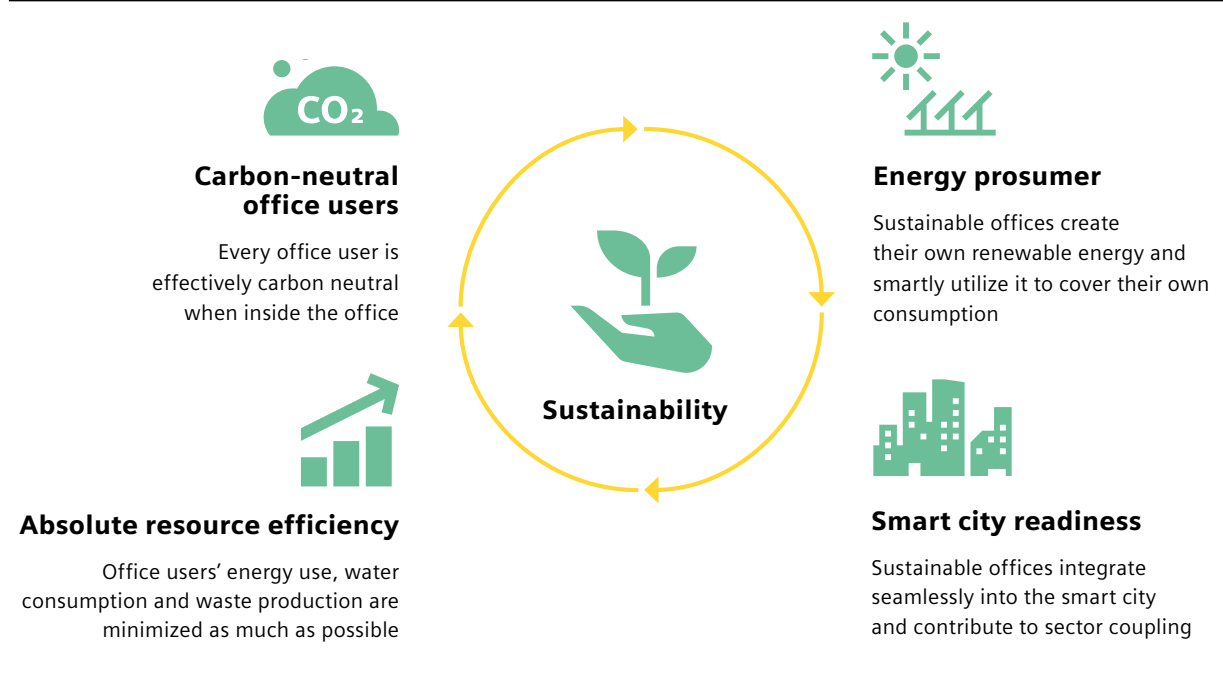
What does the smart office achieve? How are sustainability targets realized?

How does the office become smart? The process is based on deep integration of hardware and software. State-of-the-art building technology systems in HVAC, energy, water and waste are equipped with IoT sensors and intelligent controls and connected via a building twin as a central and open data platform that can also seamlessly integrate third party and public data streams.

The office not only monitors occupancy, environmental conditions, building functions and resource usage across the entirety of the building technology but incorporates external data streams into its monitoring and analysis as well.

This ensures total transparency – in real time – across all relevant sustainability data, from in-house energy consumption and water usage to integrated data on office consumables where available. External data may include information on electricity prices to enable energy trading, or weather information to forecast the building's own renewable energy production. With integration into the smart city, data exchange extends to city services such as waste management in order to optimize service delivery schedules and use fewer resources.

A: Four dimensions of sustainability in the smart office

Carbon-neutral office users

Every office user is effectively carbon neutral when inside the office

Energy prosumer

Sustainable offices create their own renewable energy and smartly utilize it to cover their own consumption

Sustainability

Absolute resource efficiency

Office users' energy use, water consumption and waste production are minimized as much as possible

Smart city readiness

Sustainable offices integrate seamlessly into the smart city and contribute to sector coupling

"No one collects data in our office right now. But we are prepared to invest in the hardware and software necessary to change that – we want the transparency."

Chief Technology Officer, Technology Provider

Full transparency on emissions, energy levels and resource consumption of spaces, people and the environment outside the office is the key to making offices more sustainable and achieving carbon neutrality for their occupants, driving resource efficiency, managing energy prosumption and being smart city ready. But how exactly is this realized?

Achieving carbon neutrality for office users and driving resource efficiency go hand in hand since minimizing resource intensity also means minimizing emissions.
The smart office decreases a building's consumption through intelligent building controls and incentivizes users to reduce their individual consumption. Emissions that remain can be offset automatically by the building.

Given full transparency, the smart office can also address consumption by itself. Intelligent fixture management helps switch off lighting, heating and ventilation in unoccupied areas of the office. By learning the behavior patterns of users, the smart office knows when to start heating or ventilating spaces to avoid peaks in energy use when people begin entering the office each day. Through the use of desk and work space booking in the smart office app, the building applies intelligent space management, for example to ensure users fully book spaces on one floor first before spreading to the next. Then, empty floors do not need to be lit or heated. The building continuously learns and adapts to the needs of its users and with less energy being used, carbon intensity and resource intensity decrease.

At the same time, the smart office can incentivize users to use fewer resources themselves, with a corresponding effect on carbon and resource intensity. With an awareness of total consumption, occupancy and individual time spent in the building, the smart office estimates each office user's personal share of overall consumption.

Users can then be contacted via their personal devices and encouraged to reduce their personal consumption levels via gamification elements. Virtual rewards (or perhaps physical ones in an office competition?) can be used to push environmentally conscious behavior even further. Smart ways of reducing consumption are suggested as well, for example not having a laptop plugged in the entire day but only when charging. As office users become more efficient, resource intensity decreases further, but what about emissions from the consumption that remains?

The smart office offsets the remaining emissions automatically. This is achieved both through environmentally conscious office design, incorporating as many green elements as possible, and through automatic certificate purchases. Green roofs and walls, automatically irrigated with intelligent building controls, not only bind CO_2 but also help reduce inside temperatures during summer and catch fine dust particles. Intelligent energy market trading software allows the smart office to offset all other emissions with green certificates to achieve carbon neutrality.

Third, establishing the sustainable smart office as a prosumer means taking advantage of distributed energy solutions to produce the necessary amount of electricity cost effectively, sustainably and reliably.

With an optimized mix of distributed energy resources, including renewable energy from solar panels or small wind turbines, and energy storage solutions such as batteries or hydrogen, the smart office generates its own electricity and optimizes allocation. As a small microgrid in its own right, the smart office can intelligently cover its own consumption with its own renewable power generation most of the time, thereby reducing energy costs.

"When working for us, we want our employees to feel good about their environmental footprint. We are spending money to provide the tools for each employee to also become active contributors themselves."

Corporate Facility Manager, Transport Provider

"It's important to us not to rely solely on externals for our renewable energy but to take responsibility ourselves. With the solar panels on our roof, the 'feel good' factor is huge."

Chief Strategy Officer, Logistics Provider

This is enabled by battery storage, which comes with additional benefits. Not only does it store surplus energy to improve the availability of renewable energy over longer periods of time, but it also enables black start functionality and optimizes frequency response, thereby aiding security of supply in the microgrid and the wider grid.

Additionally, sophisticated energy management systems monitor, control and operate the microgrid to integrate it into the energy market and generate revenue. Through continuous load forecasting, the smart office can run a resource optimization routine that purchases the energy it needs when market prices are low, sells surplus energy when market prices are high and offers additional services in the market such as frequency response.

As a prosumer, the smart office thus generates additional revenue for real estate players and allows office users to enjoy green energy.
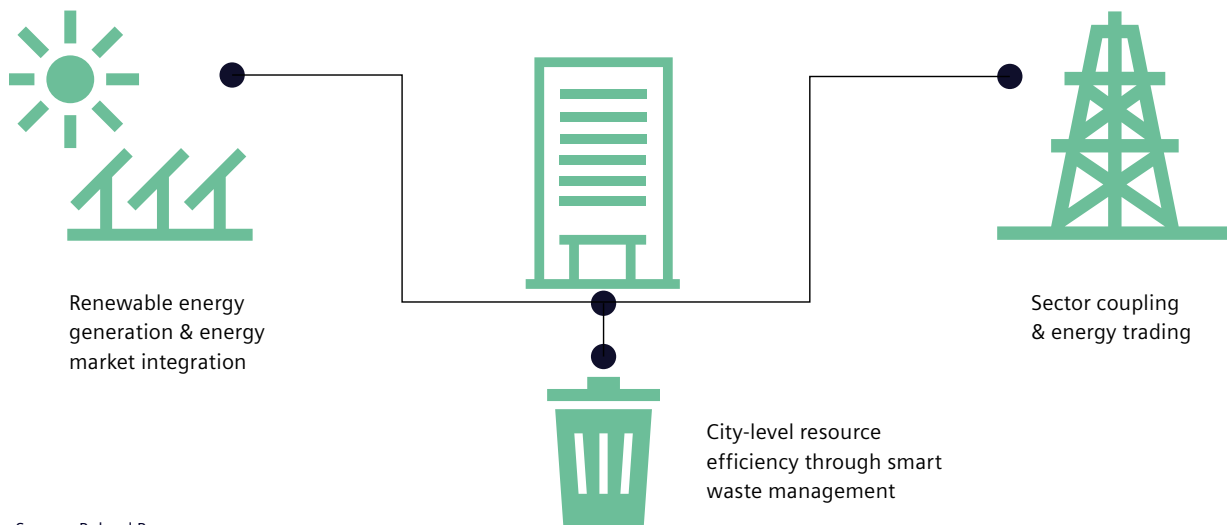
Fourth, the sustainable smart office integrates naturally into the smart city by establishing data links between itself and its environment – the smart office is at the center of an ecosystem: it allows for sector coupling and facilitates resource efficiency for city services.

B Sustainability use cases in the smart city

Renewable energy generation & energy market integration

Sector coupling & energy trading

City-level resource efficiency through smart waste management

Source: Roland Berger

As part of the drive towards electrification to enable sector coupling, the smart office shares generation and consumption capacities with the heating and energy systems of prosumers in the vicinity. By integrating microgrids and energy technologies, resources can be used even more efficiently to maximize the share of renewables in the energy mix. Furthermore, the smart office offers its renewable energy to external individuals in the ecosystem, for example through accessible EV charging stations.

To optimize resource efficiency in the smart city, the smart office even communicates the fill level of its waste system so that collections are only made when truly needed. → *graphic B*

In short, the sustainable smart office takes advantage of the information available about its spaces, users and environment to drive sustainability, but who benefits from this optimization?

"The office of the future focuses on its environment just as much as on its users – sector coupling is the key word here. The office will be hyper-connected as one element of the smart city."

Real Estate Market Expert

> **"Sustainability is not just about energy savings – it is also about the wellness of occupants. When office users understandthe benefits of the smart office, they will want to work for employers who can provide such an office."**
>
> Chief of Strategy & Operations, Smart Office App Provider

Who benefits? The sustainable smart office as a business enhancer

In realizing the sustainable smart office, real estate players improve the financial performance of their office portfolio, generate additional revenue through value-added services and enhance the level of attractiveness for tenants or employees, who benefit indirectly. → *graphic C*

Since the sustainable smart office ensures that energy, water and consumables are used as efficiently as possible, real estate players benefit from operational cost savings of up to 30%.[3] As a result, the financial performance of their assets improves.

The smart office affords real estate players the opportunity to provide value-added services to generate additional revenue – to tenants and to the wider market.

For tenants, they can integrate third party data streams regarding the carbon footprint of consumables such as coffee, fruit and paper towels into the building twin data platform, periodically supply such consumables to tenants and provide the smart office app to encourage sustainability-conscious behavior in the office.

To the wider market, they can provide frequency response services and sustainable energy, creating an additional, independent revenue stream.

Lastly, the sustainable smart office is a highly attractive place to rent for tenants and place to work for employees. Given the much more sustainability-focused mindset of the millennial generation and Generation Z, real estate players aid businesses in recruiting and retaining their future employees.

Stakeholders interviews.[3]

C Sustainable smart office benefits

Financial Performance

Cost
Lower operational costs through higher resource efficiency

Value-added services

Revenue
Additional revenue through provision of services that allow tenants and employees to be more sustainable

Sustainability mindset

Attractiveness
Higher attractiveness for future employees of businesses and new office tenants

Leading the way for sustainable buildings to become widespread

Real estate developers would be well advised to realize their early mover advantage as soon as possible. Sooner or later, tenants and employees as well as policy makers will force more drastic action to be taken for new office builds as well as for renovation and upgrades to existing real estate.

Offices are best placed to lead the way in the renovation and construction effort. With true, sustainable solutions and a clear business case, sustainable smart offices proactively address the global energy transformation.

Real estate players will best approach their portfolio with a clear strategy that addresses more than a single building and use offices to develop scalable and holistic solutions for the wider real estate market.

To achieve this goal, real estate developers need a strong partner with extensive experience to minimize building downtime when renovating and to access future-proof technologies. Why? Because sustainability in buildings does not only encompass environmental factors but social and financial aspects too. How real estate players can make their offices more user centric and more flexible is discussed in our previous two white papers: user centricity and flexibility.

Smart Infrastructure combines the real and digital worlds across energy systems, buildings and industries, enhancing the way people live and work and significantly improving efficiency and sustainability.

We work together with customers and partners to create an ecosystem that both intuitively responds to the needs of people and helps customers achieve their business goals.

It helps our customers to thrive, communities to progress and supports sustainable development to protect our planet for the next generation.

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