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Sustainability Research Institute

The 2030 imperative: A race against time

Is the 1.5-degree trajectory still feasible for the world's energy system and what would be required to meet it?

Life Is On | Schneider Electric

Introducing our Sustainability Research Institute

Progress on energy and sustainability is at an all-time high. How will that momentum fare in a new decade — and under radical new circumstances?

It is our responsibility, as large organizations, to make a positive impact by reducing energy consumption and CO_2 emissions, contributing to societal progress, while being profitable.

At Schneider we have ambitious targets with our 2021–2025 Schneider Sustainability Impact (SSI), in line with the United Nations Sustainable Development Goals; our technologies reconcile growth, access to energy for all, and a carbon-free future for our planet. Our own climate commitments aim to minimize carbon emissions for our customers and our own company. For Schneider, this means the neutrality of our business ecosystem by 2025, net-zero carbon from our operations by 2030, and net-zero carbon of our end-to-end supply chain by 2050.

With pioneering technology and end-to-end solutions for sustainability, we've been building momentum.

The Schneider Electric Sustainability Research Institute examines the issues at hand and considers how the business community can and should act: we seek to make sense of current trends and what must happen to maintain momentum, and preview the changes that we believe are yet to come.

In this white paper, we take a look at a possible decarbonization pathway to 2030, consistent with a global warming target of 1.5-degree by end of century. We find that there is still a chance to remain within this trajectory, though the challenge is daunting. It requires a nearly 3-fold acceleration from current pledges and will mainly revolve around a greater focus on demand-side decarbonization.

To achieve sustainability goals set out by hundreds of global organizations, bold steps are required to reduce emissions and operate more sustainably.

Join us in this series where we explore compelling predictions and conclusions in the areas of energy management, digital innovation, climate action, goalsetting and confidence, and fresh financing mechanisms.

It is time to embrace sustainability as a business imperative, and to capture the momentum now, for the future.

Oliver Blum

Chief Strategy and Sustainability Officer, Schneider Electric

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SVP Strategy Prospective and External Affairs, head of the Sustainability Research Institute, Schneider Electric

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Executive summary

It is now widely acknowledged that the world's economy needs to reach net-zero greenhouse gas emissions by 2050. What the Intergovernmental Panel for Climate Change (IPCC) also demonstrated in its 2018 review[1] is that not only must these emissions be zeroed by 2050, they also need to be significantly abated by 2030, if the world is to stay within a global warming trajectory of 1.5-degree. We estimate that CO_2 emissions should notably reduce by 30-50 percent by 2030 compared to today's levels.

In this report, we explore the feasibility of such trajectory. We look at only a subset of energy-related CO_2 emissions, corresponding to around 30GtCO_2/y in 2019 (power generation and demand-side energy use). We find that, while current pledges put the world on a 3GtCO_2/y abatement by 2030 (10 percent), **the effort must in fact be 3-5 times higher** to stand a chance to remain within target, or in absolute terms 10-15GtCO_2/y to be abated by 2030 over the scope reviewed.

Our modelling suggests 10GtCO_2/y can realistically be abated by 2030.

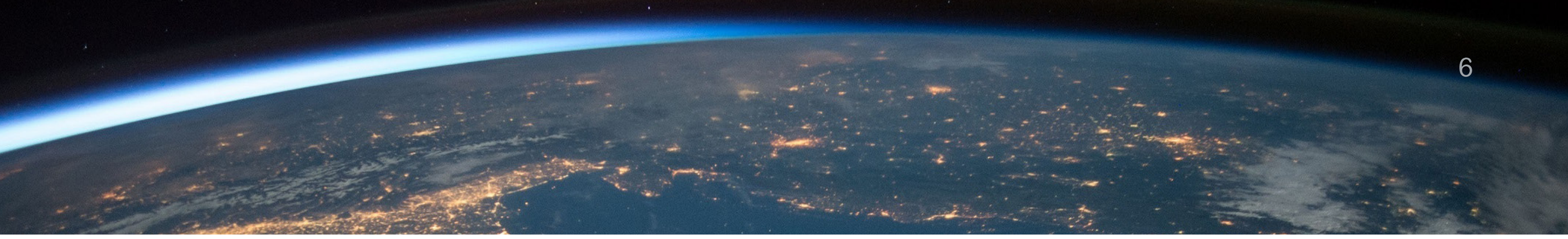
This abatement spans across all sectors of the economy. While power generation has long been a key area of focus, we find that decarbonization of the demand side proves absolutely key, **contributing half (or above) the total opportunity**, across all sectors of economic activity: buildings and construction, industry, and mobility.

We also find that – provided the right frameworks are put in place – savings on demand-side are likely to yield **additional consumer benefits** (notably in terms of energy costs), hence facilitating rapid adoption. In other words, "building back better" is as much about decarbonizing the economy as about fostering its transformation for the benefit of all.

A pathway is therefore possible, but the challenge to 2030 remains daunting. The right level of focus should thus be placed on these transformations, which we consider **"easy to abate"**.

We acknowledge that the world is currently not short of scenarios, yet as many countries around the world accelerate on their pledges, there is a need to set concrete policies and commitment across both the government and corporate communities, grounded on facts and data. We hope that this research will contribute to this debate, as 2021 is certainly an inflection point in the race toward net-zero, with the COP26 due in Glasgow in November.

[1] IPCC (2018), Global Warming of 1.5 degree Celsius



2030 is a critical milestone to stay within a 1.5-degree global warming trajectory

In 2018, the Intergovernmental Panel for Climate Change[2] (IPCC) published a critical report on possible trajectories to keep global warming below 1.5-degree. 4 scenarios have been developed (Figure 1). They all converged to net-zero greenhouse gas (GHG) emissions by 2050.

This is already widely known.

What this report however also showed is that a rapid drop of emissions was to happen by 2030 across 3 of the 4 scenarios developed. The root cause of this is simple: greenhouse gas emissions accumulate in the atmosphere. This is because their lifetime range between decades (methane) and centuries (carbon dioxide, F-gases, etc.). Hence, emissions released today build up global warming for decades to come.

This is what has led to the evaluation of carbon budgets, or the total amount of emissions that can still be released in the atmosphere from a given point in time, while keeping the concentration in the atmosphere, and the corresponding global warming impact, within key temperature boundaries.

These carbon budgets vary across the scientific community, because of the models on which they are based, key assumptions on historic emissions and warming to date, possible climate reinforcing loops, as well as the likelihood to reach or overshoot a given temperature target. In 2018, the IPCC estimated the global carbon budget between 420-570GtCO_2/y (67 percent chances to remain within 1.5-degree) and 580-770GtCO_2/y (50 percent chances). As current carbon emissions range slightly below 40GtCO_2/y (growing around 1 percent per year pre-Covid), this analysis showed that the entire carbon budget available could be consumed by 2030[3].

This is why the scenarios from the IPCC assume a sharp decline of CO_2 emissions before 2030. In average, we estimate the reduction in emissions to range around 30-50 percent[4] compared to current baseline. The challenge of mitigating climate change is thus not only about reaching ultimately a net-zero carbon economy, but also to realize within a decade a turnaround on the way our current economy operates, and "buy time" to complete the journey to 2050.

This challenge is daunting, by its magnitude and the pace at which it needs to be realized, we could say unprecedented. There is no better way to realize the inertia of the "system" than by looking at recent history. In 2020, the Covid-19 crisis hit the world unprepared, forcing many economies into lockdown and driving one of the worst economic recessions ever, not finished yet. The associated economic downturn obviously had a direct impact on CO_2 emissions. Yet, they fell by only 5.8 percent[5] in 2020. Despite all efforts under way to mitigate emissions and renewed government ambition, emissions are still projected to increase 4.8 percent in 2021, a near full recovery from pre-Covid levels. By 2021, they would only be 1.2 percent lower than 2019 emissions. In fact, emissions would have to drop by a similar magnitude (5-6 percent) every year from now to 2030 to stand a chance.

So, can it be done? And what would it take? This is what this report sets out to explore.

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[2] IPCC (2018), Global Warming of 1.5 degree Celsius

[3] Carbon Brief (2018), IPCC (2018), Global Warming of 1.5 degree Celsius, Levin K. (2018)

[4] In its report, the IPCC details 4 illustrative pathways, with emissions abatement ranging between -4 and 58 percent by 2030. Our 30-50 percent estimate is based on 2019 estimated CO_2 emissions of ~37GtCO_2/y and the range provided by the IPCC in its research, as shown in Figure 1. The lower-bound target implies partial overshoot

[5] © OECD/IEA (2021), Global Energy Review 2021

Global total net CO_2 emissions

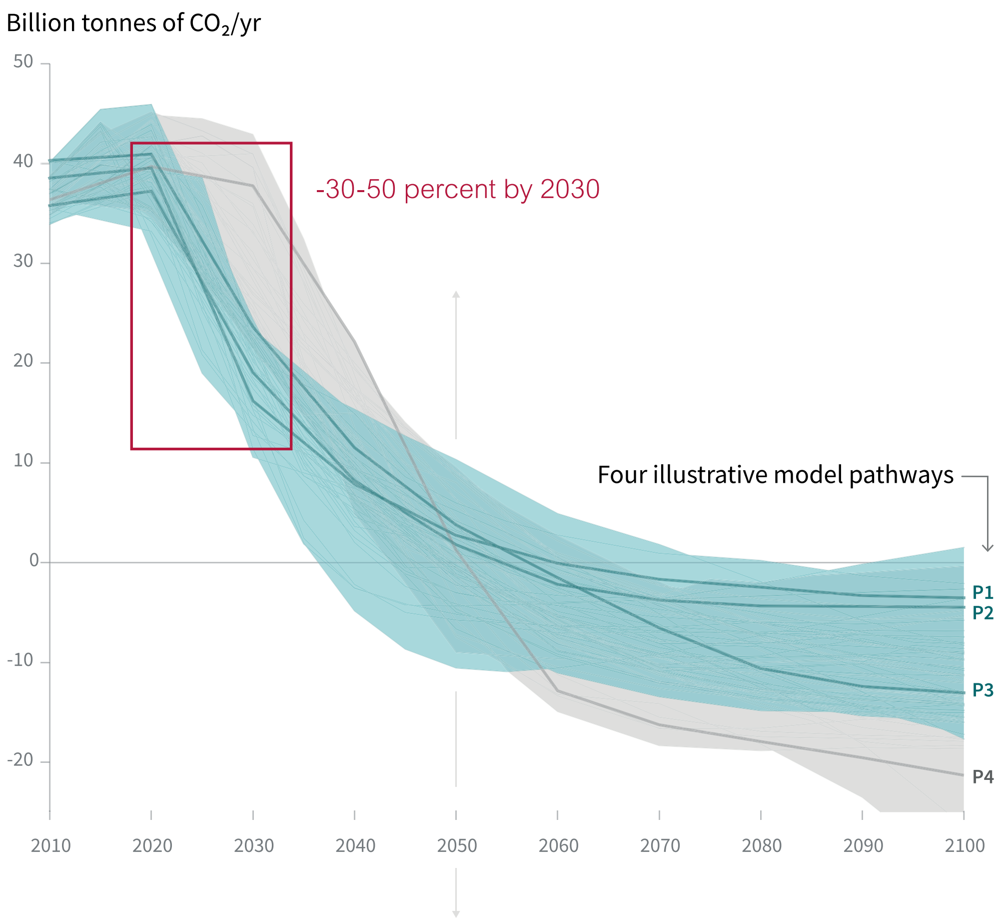


Figure 1 – IPCC pathway to 1.5 degree

The need to accelerate

Global greenhouse gas emissions stand at around 50GtCO_2e/y[6]. Total CO_2 emissions range around 37GtCO_2/y, with the rest coming from other greenhouse gases (notably Methane). Energy-related emissions (including all greenhouse gases) amount to 35GtCO_2e/y (Figure 2).

In this report, we focus on **energy-related CO_2 emissions** stemming from power generation and demand side direct emissions only. They form the bulk of energy-related emissions at around 30GtCO_2/y[7].

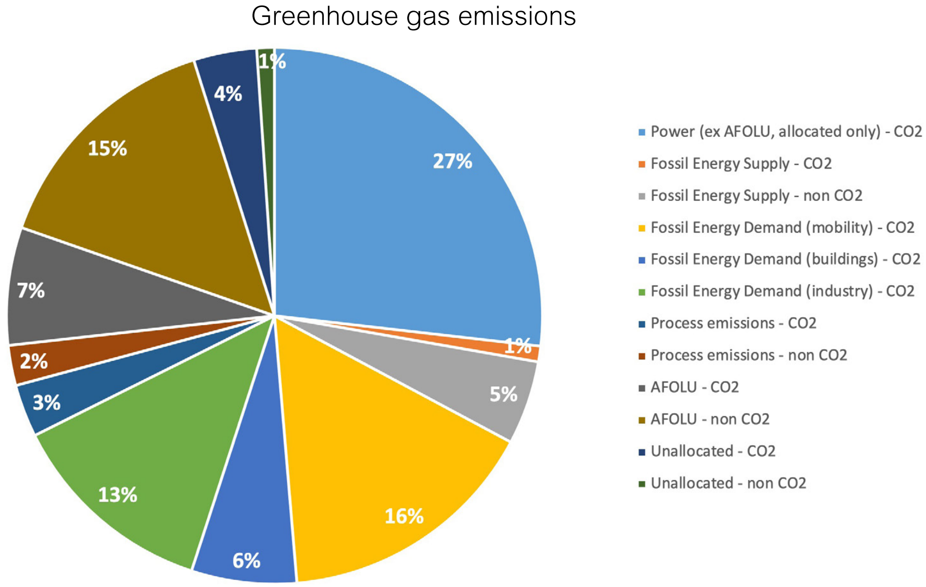


Figure 2 – Global greenhouse gas emissons

A 30-50 percent reduction by 2030 of these emissions thus corresponds to **10-15GtCO_2/y to be abated**, on the scope reviewed. This is the target to reach.

[6] Climate Watch (2020), Historical GHG emissions, Schneider Electric Research

[7] © OECD/IEA (2020), World Energy Outlook, Climate Watch (2020), Historical GHG emissions, Schneider Electric Research

No silver bullet: successful decarbonization will engage all sectors of the economy

Industry emissions account for 40 percent of total emissions covered in this analysis, followed by buildings at 35 percent and mobility at 25 percent. Within these emissions, power generation accounts for nearly 45 percent of total emissions. This is largely due to the prevalence of coal-fired power generation globally, which still accounts for 72 percent of global power generation emissions in 2019[8] (Figure 3). Direct consumption of fossil fuels in demand-side sectors takes up the rest (55 percent of total emissions).

A first key finding is thus that **decarbonization pathways need to reach all sectors of the economy** to carve out the 10-15GtCO_2/y to abate.

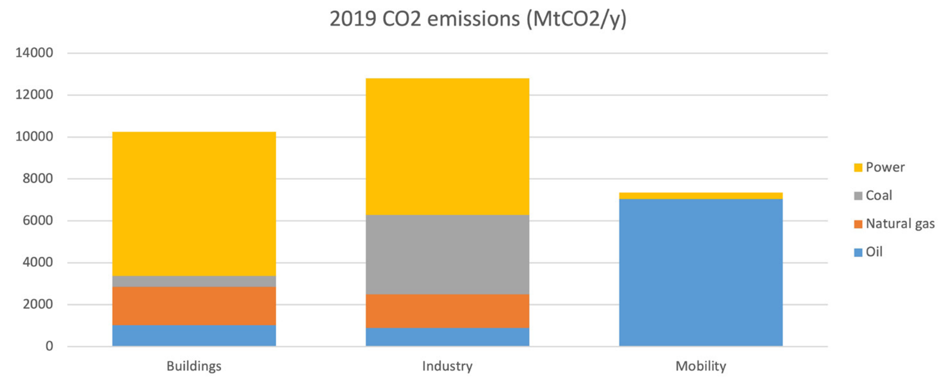


Figure 3 – CO2 emissions per sector

By 2030, emissions from power generation drop nearly 7 percent with the progressive penetration of decarbonized energy sources (within current policy frameworks). While building direct emissions are also set to decline by 8 percent, those of industries and mobility are however expected to rise by 5 percent globally[9] (Figure 4).

The building stock progressively moves away from coal and oil, but natural gas remains prevalent, increasing in share and emissions. In Industry, natural gas emissions rise by around 25 percent, while coal emissions reduce by a mere 2 percent. Finally, the rising demand for mobility leads to an increase in oil-related emissions. Road transport represents around 80 percent of total energy demand from the mobility sector, and light-duty vehicles around 50 percent of total[10].

[8] © OECD/IEA (2020), World Energy Outlook, Schneider Electric Research, BloombergNEF (2019), New Energy Outlook.

[9] © OECD/IEA (2020), World Energy Outlook (STEPS scenario), Schneider Electric Research, BloombergNEF (2019), New Energy Outlook. We assume here the implementation of policies as committed by end 2020, and consider additional electrification for mobility does not contribute to increased emissions from the power sector as it is delivered by net-zero carbon sources (see Box 1).

[10] Schneider Electric Research.

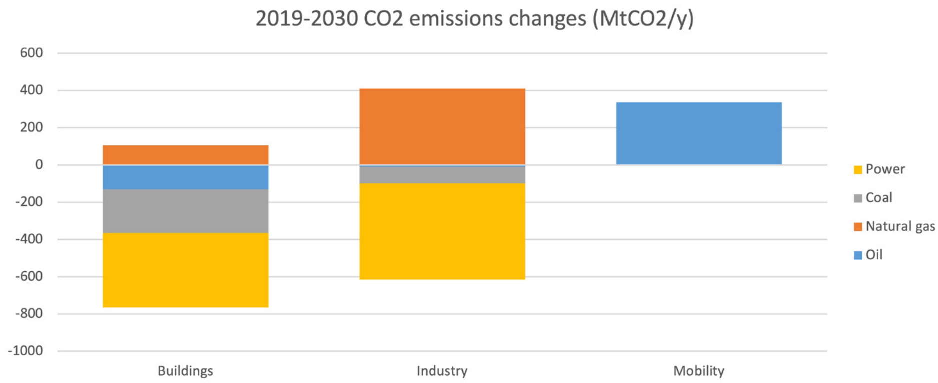


Figure 4 – 2030 emissions changes per sector

A significant acceleration is required

10-15GtCO_2/y need to be carved out of the energy system by 2030. This will have to span across all sectors of the economy.

Since the COP21 in 2015 in Paris, 192 countries (out of 197 participants to the COP) have submitted Nationally Determined Contributions (NDCs), covering 93.2 percent of total greenhouse gas emissions[11]. However, only 29 of those have communicated long-term strategies, covering only 28.2 percent of emissions. As recently as April 2021 during President Biden's Earth Day summit, new pledges have been made, further reinforcing commitments from various nations around the world. To date, the European Union, for instance, has committed to reduce its emissions by 55 percent (compared to 1990 levels) ; the United States by at least 50 percent (compared to 2005) ; Japan by 46 percent (compared to 2013) ; and China to peak its emissions before 2030[12]. We estimate the exact impact of these commitments (on the scope defined in this paper) to translate in nearly 3GtCO_2/y savings compared to 2019 levels[13].

This figure needs now to be compared to the 10-15GtCO_2/y abatement required to remain within a 1.5-degree trajectory: around 30 percent of the objective.

While current pledges clearly go in the right direction, more effort is in fact required. Can these ambitions be exceeded? And where to find more abatement opportunities?

[11] Climate Watch (2021), Overview of Commitments.

[12] Newburger E. (2021), CNBC.

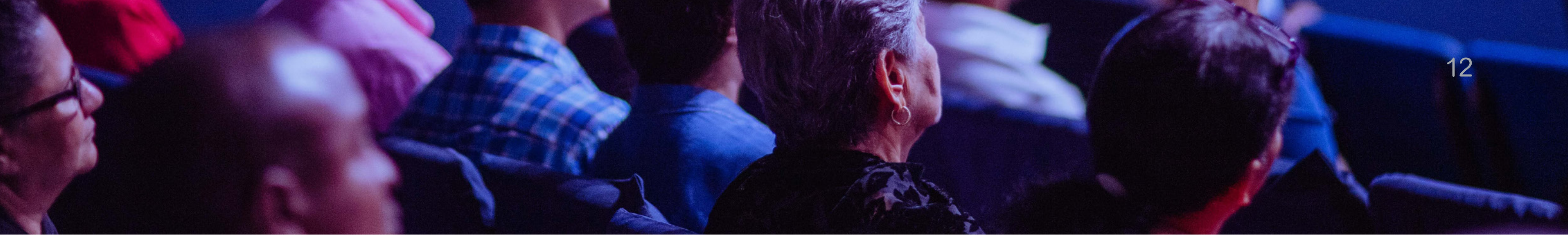
[13] © OECD/IEA (2008), World Energy Outlook, © OECD/IEA (2012), World Energy Outlook, Schneider Electric Research. Details on implementation are still missing at the time of writing as actual policies are yet to be communicated. These figures are thus estimates and are not integrated in the 2030 baseline outlined in Figure 4, and used further down.

The sectorial review presented above helps identify key areas eligible for rapid decarbonization. Table 1 summarizes these opportunities. They amount to ~18GtCO_2/y[14].

Sector	Total 2019 emissions (*)	Abatement opportunities
Power	13.7GtCO_2	Existing coal-fired power generation (~7GtCO_2/y)
Buildings	3.4GtCO_2	Oil, Coal substitution (~1GtCO_2/y) Natural gas substitution (~1.3GtCO_2/y)
Industry	6.3GtCO_2	Oil, Coal substitution (~3.4GtCO_2/y) Natural gas substitution (~1GtCO_2/y)
Mobility	7GtCO_2	Oil substitution in mobility, specific focus on road transport (~4GtCO_2/y)

Meeting this global target would require realizing 55-80 percent of the ~18GtCO_2/y abatement opportunity.

[14] We have intentionally focused on 4 key regions: North America, Europe, China, and OECD countries from Asia. They represent 70 percent of global emissions and are the largest economies. They are thus prime targets for decarbonization, as well as those with the greatest latitude for rapid change in the coming decade. In other words, we look at what can be achieved in those 4 regions to reduce global emissions by 10-15GtCO_2/y by 2030



There is a way to get there, in time

This research explores the opportunity to abate 10-15GtCO_2/y of carbon emissions by 2030 on a 30GtCO_2/y scope. We found already that current pledges would enable to reach around 30 percent of the lower-bound of the target at best, or around 3GtCO_2/y.

Where to find the rest?

We have identified key areas where lie the bulk of emissions. We can thus explore to which extent these opportunities can turn into additional savings.

Methodology

This analysis builds on a simple 3-steps framework (Figure 5).

First, all measures that can help reduce the size of the issue are explored. This corresponds to all efforts that help reduce the volume of energy demand, hence its associated emissions. As was seen earlier, demand-side emissions correspond to 55 percent of 2019 total. Optimizing energy use hence provides significant benefits, yet additionally also reduce emissions on the supply side, particularly in our case on power generation (lowered demand for fossil fuels also turn into lower fugitive emissions, but these savings are not estimated in this exercise).

Second, power generation accounts for 45 percent of emissions and decarbonization is on its way. We thus explore to which extent power can be further decarbonized by 2030. In addition, blends of natural gas with decarbonized sources could, to a certain extent, help decarbonize supply further.

Third, as electricity does generate no emissions at end-use, it is the ideal vector for decarbonizing demand (55 percent of 2019 total emissions). This requires however all additional electricity demand to be provided by zero-carbon sources (Box 1).

Box 1 – The electrification paradox

Several debates have emerged in recent years on the value of electrifying the demand side to reach decarbonization goals. As of 2019, power generation indeed shows more than twice higher carbon intensity than natural gas for instance (~500gCO_2/kWh compared to ~210gCO_2/kWh). Despite progress on decarbonizing the power generation mix, 2030 levels are not expected to be lower than those of natural gas, except in few key regions of the world (notably Europe). Several arguments have thus emerged to instead switch sectors that could be electrified to natural gas, as a transition fuel, until electricity is totally decarbonized.

This argument however fails to recognize the dynamics of development of the power sector. It is a given that current electricity demand – largely reliant on existing fossil-fuel power generation plants – must be decarbonized rapidly, as it generates currently 13.7GtCO_2/y. Yet, new electricity demand (stemming from electrification) will be provided by additional capacities to be deployed. If those new capacities are zero-carbon sources, then the net impact of this additional electrification comes in fact with zero-emissions (no emissions at production nor at end use), unlike a switch to natural gas which continues to generate emissions both at production and end-use levels.

In the last 5 years, the share of decarbonized sources in new capacities has topped 70 percent. This ratio is expected to reach above 90 percent in the decade to 2030[15], in business as usual scenarios, notwithstanding further policy developments. Consequently, all additional electricity demand can reasonably be considered as zero-carbon.

3 actions to carve out 10-15GtCO_2/y by 2030

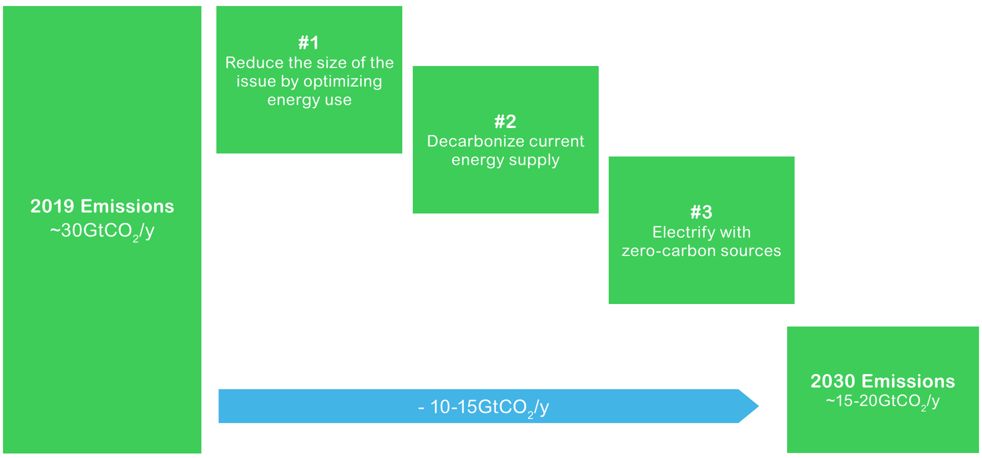


Figure 5 – 3 actions to carve out 10-15GtCO_2/y by 2030

[15] © OECD/IEA (2020), World Energy Outlook, BloombergNEF (2019), New Energy Outlook, Schneider Electric Research

10GtCO$_2$/y can potentially be abated

Our detailed modelling of the implementation of these 3 steps yields around 10GtCO$_2$/y of abatement opportunity in the 2030 timeframe.

Figure 6 summarizes overall results per sector[16]. Total carbon emissions from the scope reviewed fall from ~30GtCO$_2$/y to ~20GtCO$_2$/y by 2030, or approximately 10GtCO$_2$/y of abatement.

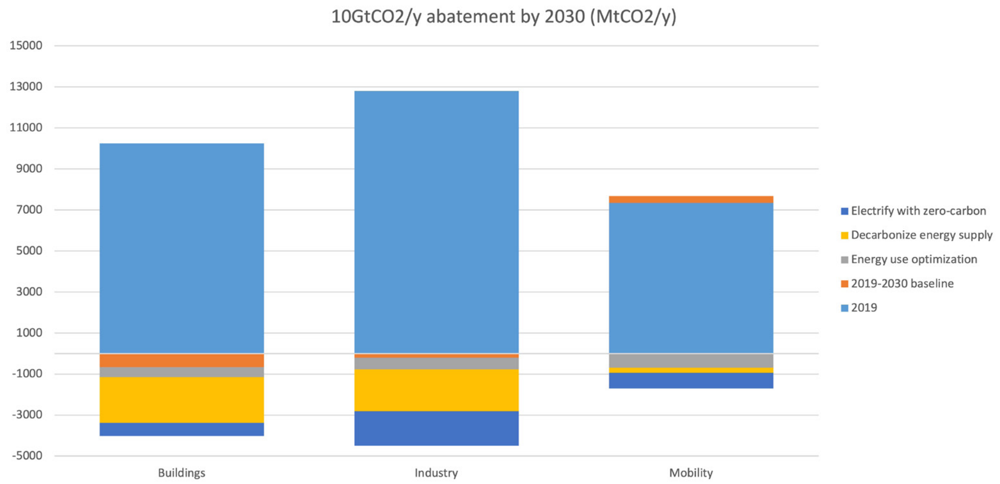


Figure 6 – 10GtCO$_2$/y abatement

Industry and buildings contribute the most, by respectively 4.5GtCO2/y and 4GtCO2/y, while mobility contributes by 1.4GtCO2/y only[17].

The decarbonization effort is shared almost equally between decarbonization of supply and transformations on the demand side (energy use optimization and electrification) (Figure 8).

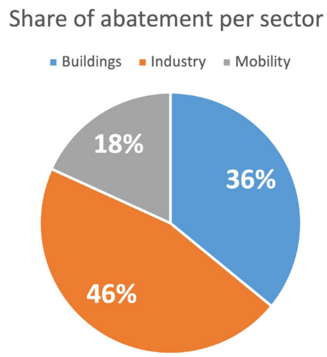


Figure 7 – Abatement per sector

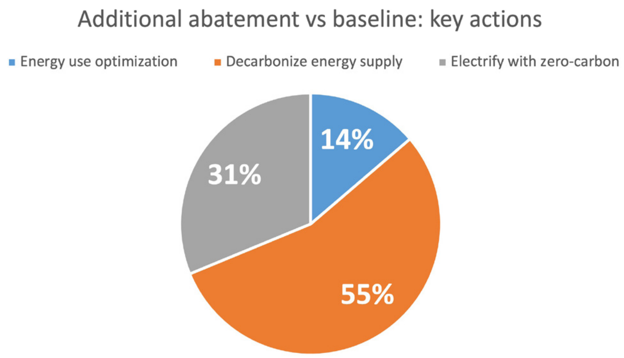


Figure 8 – Abatement per action

[16] 2030 baseline is derived from Figure 4

[17] These figures include both abatements from the power generation side as well those already included in the baseline

Figure 9 summarizes emissions by sector in 2030 in a 1.5-degree scenario, compared to current[18].

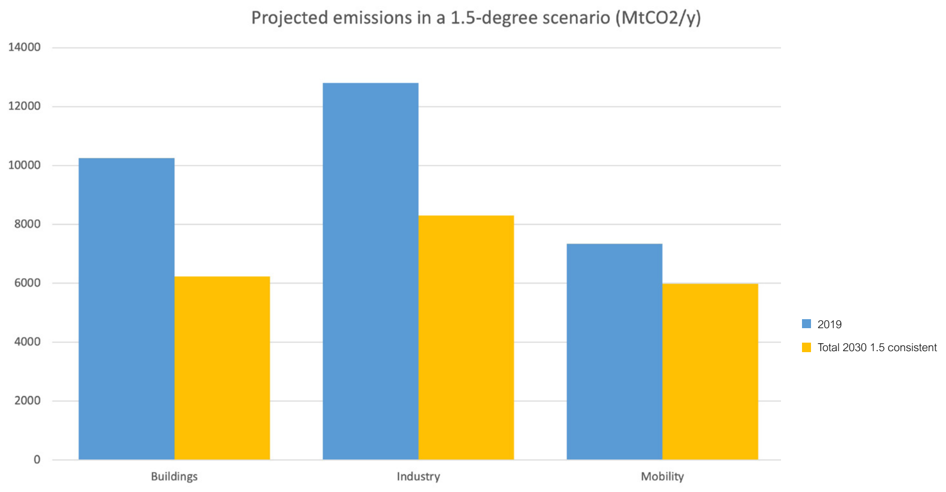


Figure 9 – Projected emissions in a 1.5-degree scenario

Box 2 - the role of energy use optimization

In this scenario, energy use optimization accounts for 14 percent of total abatement (additional actions on top of current baseline). Though an apparent lower contribution than the rest, its share in the total decarbonization effort will increase over time, as further stock turnover materializes.

The deployment of energy use optimization actions also plays a fundamental role in fostering the transition. Energy use optimization indeed helps reduce the overall baseline of energy demand, against which all other efforts are measured. In its latest report, the International Energy Agency[19] notably estimates that without measures on the demand side, overall energy demand could be 90 percent higher than in their projected scenario. Such measures therefore reduce the need for additional supply capacities (particularly power generation), facilitating the transition to low-carbon solutions.

They also help make the case for electrification of the economy more viable for end-users, while reducing overall consumer spend, enabling a better distribution of the overall effort. Finally, the International Energy Agency also estimates that such solutions are faster to deploy, hence providing a key opportunity to rapidly tame current emissions. When realized with advanced digital technologies, such optimization also comes with highly competitive paybacks (see Box 3).

The challenge is daunting

Our research finds that 10GtCO_2/y can potentially be abated by 2030. This requires an effort across all sectors of the economy. This challenge is daunting. Here we explore further what it will take to reach such level of abatement.

[18] These figures include abatement on the power generation side

[19] © OECD/IEA, Net Zero by 2050, A roadmap for the global energy sector

Buildings

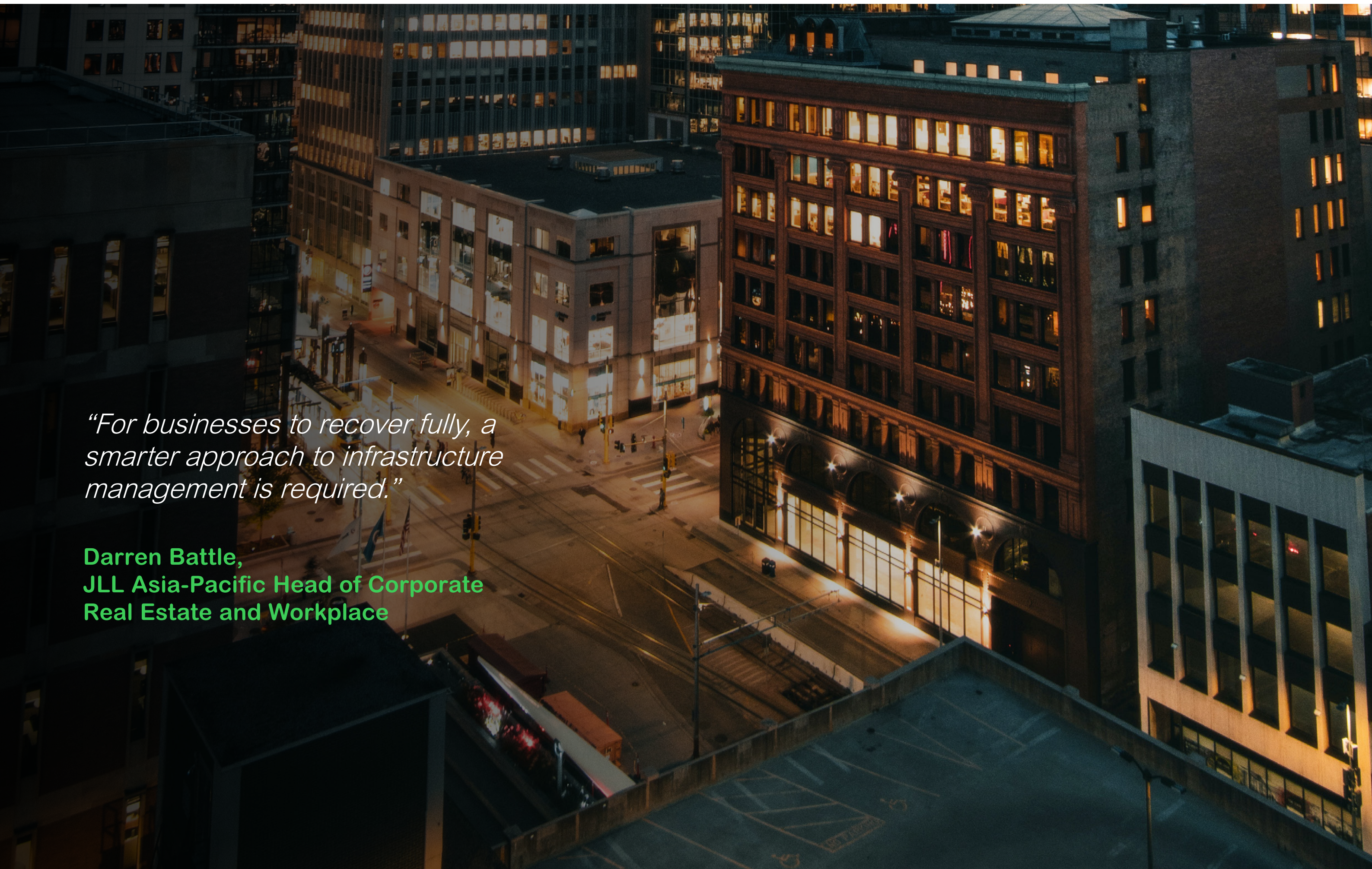
An unprecedented effort needs to be undertaken to transform the existing stock of buildings[20]. Accounting for natural transformation from new building construction, an estimated 40 percent of the stock needs to be upgraded by 2030. This first requires all new building constructions to meet the highest standard in terms of carbon footprint. Yet, since new construction rates barely top 1-2 percent per year, this also implies a significant renovation effort on the existing stock, which is an order of magnitude above current levels.

For each renovation or new construction, we assume 40 percent energy savings compared to current 2030 baseline, a target widely reachable with current technologies. Digital technologies can notably be a powerful contributor in both commercial and residential buildings as they typically provide such levels of savings, with paybacks generally below 5 years[21]. While we assume all new buildings to use electric provisions for heating and cooking purposes, renovations are at large focused on switching away from most polluting sources such as oil or coal heating.

Finally, the post-Covid19 reconfigurations of the building stock (with building repurposing and slightly lower demand overall for new constructions in the commercial space) also provide opportunities for some level of savings, although these remain negligible compared to the above in the given timeline.

[20] In the regions considered in this analysis

[21] See Box 3



Box 3 – Digital technologies to optimize energy demand in the building stock

Digital technologies can be a powerful accelerator to increased efficiency in buildings. Several studies have shown indeed saving potentials between 20-30 percent for the residential sector, and up to 50 percent in the commercial sector, with paybacks generally lower than 5 years. These solutions build on time and space occupancy. As a result, they turn out to be very competitive as they do not imply massive works on envelopes[22]. The International Energy Agency[23] also estimated that up to 10 percent of global energy demand could be saved by 2040 with the deployment of digital technologies (assuming simple controls only and partial deployment: across geographies, and across the stock).

Finally, a more recent report from the World Economic Forum[24] has illustrated how digital technologies could help optimize building energy demand and corresponding provisions on the grid infrastructure thru better load management, thereby creating benefits both at building level as well as at system level (grid), with a significant potential for overall costs optimization.

[22] Ecofys (2017), Optimising the energy use of technical building systems. Energie 3.0 (2013), Débat sur la transition énergétique : les solutions concrètes de la filière éco-électrique

[23] © OECD/IEA (2017), Digitalization and Energy

[24] World Economic Forum (2021), Net Zero Carbon Cities: An Integrated Approach

Industry

Similarly to the building sector, existing industrial footprints must undergo a massive renovation effort. We estimate that 40 percent of the stock could be upgraded by 2030, accounting for new constructions[25]. Through a detailed review of opportunities across sectors, we estimate that around 10 percent of energy demand[26] could be saved from deep retrofits, notably thanks to the further penetration of digital technologies, with highly competitive paybacks[27].

Circularity could further expand the optimization of industrial energy demand. An acceleration of demand services (products lifetime extension, products reuse, resell, refurbishing, and sharing services) could help mitigate demand for new products (hence demand from manufacturing and associated materials), while a drastic acceleration of recycling could help additionally reduce the embodied carbon footprint (and associated energy demand) of new products. Recycling is notably many times less energy-intensive than virgin material production (typically 50–80 percent savings depending on the sector). We remain conservative with our assumptions here however, assuming only a partial adoption of recycling by 2030 (which translates into cumulated savings on energy demand of heavy industries of around 5 percent[28]). Fuel switching strategies on the existing stock retrofitted would aim primarily at displacing oil and coal use. While the manufacturing sector is largely eligible to electrified heating provisions, primary industries would switch in part to electric heating and in part to natural gas.

[25] In the regions considered in this analysis

[26] On the industrial footprints of the regions considered in this analysis. Overall efficiency gains projected in this scenario remain conservative as typically the deployment of Best Available Technologies in energy-intensive sectors provide up to 18-20 percent savings. Gutowski et al. (2013), The energy required to produce materials: constraints on energy-intensity improvements, parameters of demand

[27] © OECD/IEA (2017), Digitalization and Energy

[28] On the industrial footprints of the regions considered in this analysis

"We have to push our R&D teams to find ways to make better products with a lower carbon footprint. And energy savings have provided fuel for innovation."

Richard Brunel,
Vice President of Purchasing in North America, Saint-Gobain

Mobility

We consider the aftermath of the Covid19 will be felt long after the world recovers, with a relative reduction of business and entertainment travels. Our modelling exercise however suggests savings associated will only slightly contribute to the overall decarbonization effort, as the bulk of emissions from the sector continues to stem from road transportation.

We also consider accelerated deployment of Transport as a Service (TaaS) in cities, with up to 30 percent kilometer-travelled reduced in cities[29].

Emissions savings from fuel switching strategies on road travels will prevail in the sector. We assume in our forecast that private and light commercial road transportation switch to electric powertrains for 30 percent of the total stock by 2030, while 20 percent of heavy-duty road transportation switches to more environmentally friendly propulsion systems (batteries, fuel cells, CNG/LNG, etc.)[30].

[29] In the regions considered in this analysis

[30] Ibid

"The market for electric cars is growing rapidly and a functioning infrastructure is becoming increasingly important. The real estate company Galären wanted to create a future-proof garage in the environmentally certified new production project with 127 homes, Coop store, conference and recreation floor, office space and 100 underground parking spaces in the Hägern district in Luleå, Sweden."

Tobias Johansson,
Project Manager at Galären

Power generation

Existing power generation must be decarbonized rapidly to stand a chance to stay within a 1.5-degree target. The heart of the challenge lies with coal-fired power generation, which accounts today for around 72 percent of global emissions of the sector. We therefore assume a significant displacement of coal-fired power generation in our scenario, with a 50 percent reduction globally of associated emissions. This assumes a near-all displacement of current capacities in OECD economies, and a lower rate of reduction in China, yet significant. Oil generation capacities are also assumed to be fully disposed of by 2030[31]. All these capacities are replaced by zero-carbon sources.

As well, all new power generation capacities (from additional electricity demand) are assumed to be zero-carbon, with the bulk of it coming from renewable energies expansion. In our scenario, global electricity demand increases 1.5 times compared to current level. In 2019, zero-carbon sources account for 37 percent of global power generation, and they are expected to reach 48 percent by 2030 in a baseline scenario. This ratio tops 67 percent in our scenario[32].

In the 2030 baseline, mix changes between coal and natural gas help explain the 7 percent decarbonization of the power mix (renewable energies expansion largely meets new demand). In our scenario, additional zero-carbon sources are required to further accelerate displacement of coal-fired (and oil-fired) power plants. They account for nearly 30 percent of the increase in share. The rest comes from additional electrification of demand which is entirely supplied by zero-carbon sources (Figure 10). Compared to current trends, this assumes a tripling of current rates of zero-carbon sources deployment[33].

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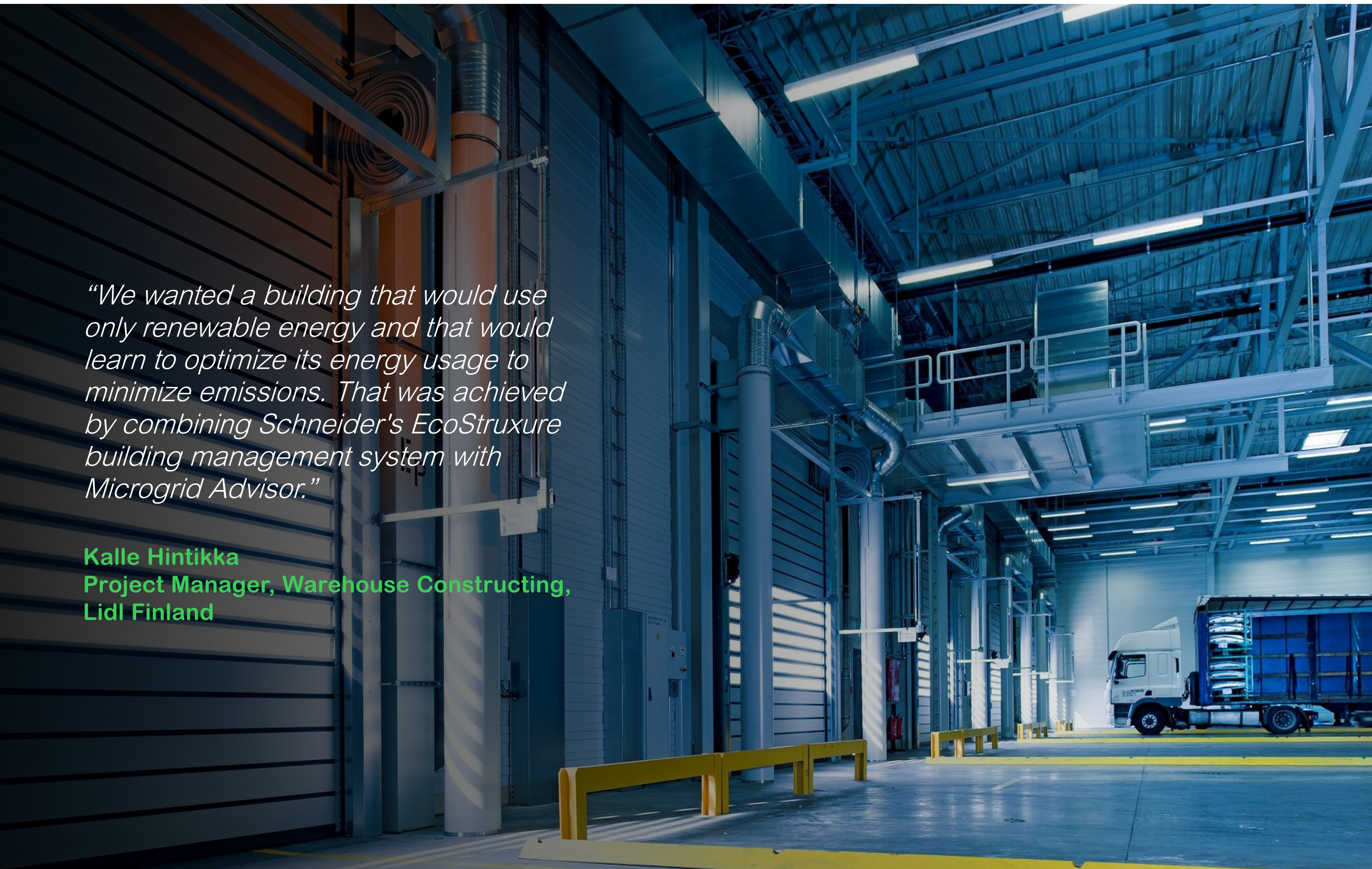
[31] Ibid

[32] At global level. This ratio tops 77 percent in the regions considered in this analysis

[33] In the regions considered in this analysis



"We wanted a building that would use only renewable energy and that would learn to optimize its energy usage to minimize emissions. That was achieved by combining Schneider's EcoStruxure building management system with Microgrid Advisor."

Kalle Hintikka
Project Manager, Warehouse Constructing, Lidl Finland

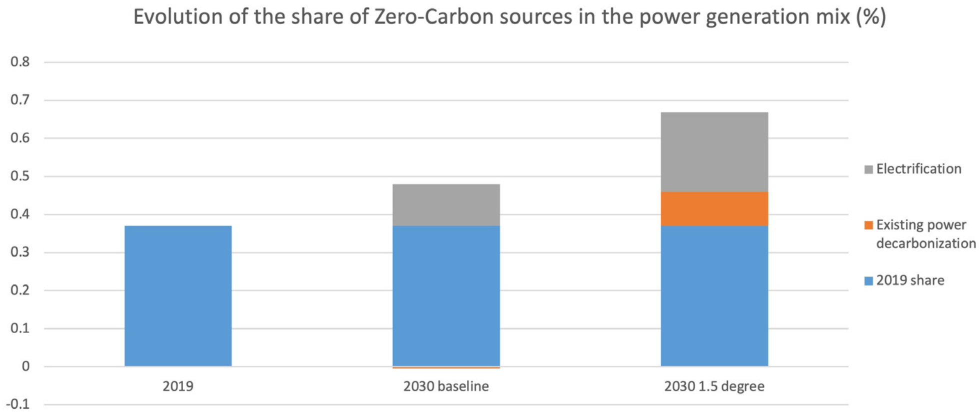


Figure 10 – Power generation mix evolution

Box 4 – Tripling current rates of zero-carbon sources penetration with distributed generation

The challenge of tripling current rates of zero-carbon sources deployment is massive. This will require large investments in power generation capacities and grids. Distributed generation (which we define as local generation at building sites, essentially rooftop solar, although geothermal energy can also play a role) could partially contribute to the challenge, removing some of the hurdles associated with utility-scale installations (such as construction permitting for instance).

Several studies have evaluated the potential of distributed generation as a contributor to the overall energy transition. Deng et al.[34] for instance find a global potential of around 20,000TWh by 2030. The International Energy Agency[35] comes in close with an evaluated potential of 9,000GW today. This corresponds to 15-20 percent of total final energy demand which could ultimately be supplied by distributed generation, would the entire potential be eventually harvested. This figure would also go up with technology improvements over time.

Google[36] also estimated that around 39 percent of final energy demand in the US could be supplied with distributed energy alone, a finding consistent with the above considering the specific footprint of residential settings in the US.

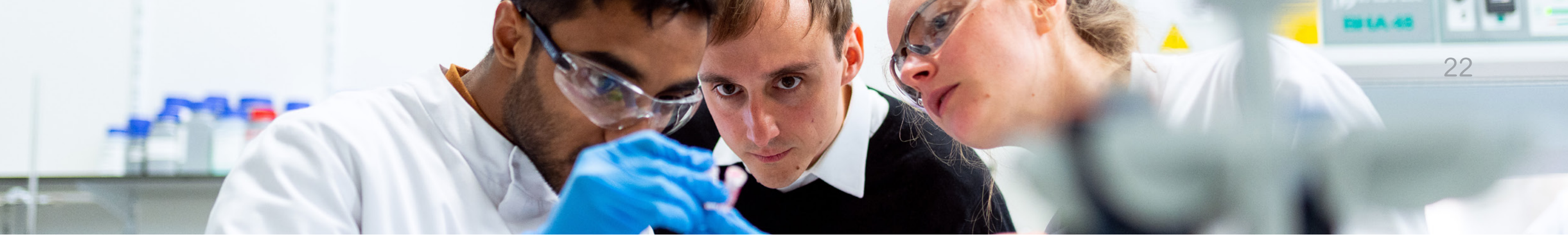
The potential for harvesting rooftops across the building stock could therefore be a powerful contributor to accelerate the rate of deployment of zero-carbon sources in the power generation mix.

We mentioned above that nearly half of the decarbonization effort comes in this scenario from transformations of the demand-side. Accounting for the potential of distributed generation, this share could in fact be significantly higher (since we can consider distributed generation as a transformation on the demand side).

[34] Deng et al. (2015), Quantifying a realistic, worldwide wind and solar electricity supply

[35] © OECD/IEA (2019), Renewables 2019

[36] Google (2016), Reaching our solar potential, one rooftop at a time



The need to focus on what can realistically be achieved

A scenario that is also realistic

Our research suggests that it is feasible to reach 10GtCO_2/y abatement by 2030 over the scope covered, or 30 percent reduction in CO_2 emissions, a trajectory compatible with a 1.5-degree pathway, and approximately **3 times current pledges**.

An effort of such magnitude will necessarily build on all sectors of the economy, as supply and demand almost equally share current emissions. While supply-side emissions have long been under scrutiny, **decarbonization of demand represents the major case for change in the coming decade**.

Ultimately, this scenario is based on the assumption that a massive renovation effort is launched across all sectors, at rates significantly higher than current, while new constructions are built net-zero from the start. This also assumes that most polluting energy resources are displaced first, particularly coal, across all its uses. This renovation of the stock will finally build on a repetitive principle: optimize and electrify demand use, while decarbonizing the supply of electricity. Eventually, we find that electricity could grow 1.5 times in the energy mix, a finding consistent with other references[37]. Half of the effort (or more if accounting for distributed generation) will stem from demand-side transformations, while supply side decarbonization will take up the rest. The decarbonization of the power system would require a tripling of current rates of deployment of zero-carbon sources.

Despite its ambition, this scenario is designed on feasible assumptions. All technologies associated to these transformations of the stock already exist. When considering alternative pathways to 2030, we have challenged current assumptions to identify other reasonable models. We found that any scenario that would further accelerate the decarbonization of a given sector relative to others would necessarily lead to significant asset destruction and increased burden on consumers. For example, a more rapid displacement of coal-fired power generation would come in many countries as a significant economic burden considering relatively young asset bases. As well, the penetration of electric vehicles could be fostered, but turnover times remain in excess of a decade in the sector, while the challenge of ramping up charging infrastructures, notably outside cities, will remain prevalent in the coming years. Finally, we consider retrofit rates of the building and industry stocks to be reasonable (~3 percent CAGR), though highly ambitious, particularly in the residential sector.

We also find that this approach to decarbonization holds the potential of **significant benefits to users, thus fostering rapid and smooth adoption**, something we argue is key for meeting the 2030 deadline. For instance, optimization of energy use yields lower costs of energy or their associated services (building heating, mobility, etc.), once investments are realized. As well, electrification comes with net savings in a variety of sectors[38]. Finally, with costs of renewable energies collapsing for over a decade, it has become widely acknowledged that power systems dominated by renewable energies are likely to come at a net-benefit[39].

[37] Energy Transitions Commission (2021), Making Clean Electrification Possible: 30 Years to Electrify the Global Economy

[38] For Buildings: Schneider Electric (2021), Building Heat Decarbonization For Industry: Beyond Zero Emissions (2018), Electrifying Industry

[39] We have not made a precise forecast on these savings in this paper, this could be the object of a more refined analysis. For more, see also Rewiring America (2020), Handbook ; Energy Transitions Commission (2021), Making Clean Electrification Possible: 30 Years to Electrify the Global Economy

In other words, $10GtCO_2/y$ can **realistically** be abated by 2030. This is a momentous effort, but if aimed at the right objectives, one that could in fact benefit users and consumers, hence fostering further adoption of decarbonized technologies. This is also why we argue that the **demand-side is key to accelerate decarbonization** in the short run, with a contribution half (or more) of the total effort.

We also acknowledge that this is one scenario among other possible routes, and hope that this analysis will be a positive contribution to current debates, shedding light on key issues associated with rapid decarbonization of the economy, demonstrating the role and potential of demand-side transformations and their side benefits, while also reinforcing the imperative to focus on the next decade as a critical milestone in the journey toward net-zero.

Focus on easy-to-abate first!

Decarbonization of the economy is a race against time. The sooner emissions are reduced, the lower the carbon budget depletion, and the higher the chances to remain within global warming limits. In this regard, 2030 is a critical milestone which requires actions to be undertaken now. **Only 8-9 years to go!**

While the global conversation has very much revolved on “hard-to-abate” sectors in recent years, short-term action plans should still revolve around abating what can be done with current technologies and value chains available, what we refer to here as **“easy-to-abate” sectors**. In addition, since most of these sectorial transformations ultimately come at a net-benefit for consumers, they are better to be understood as critical modernization programs which will not only achieve stringent decarbonization objectives, but also fair redistribution, economic growth and employment opportunities. In short, modernizing the economy in a rapid “Marshall-like” plan is the best way to meet decarbonization objectives. Climate change might in fact be a historic opportunity in this regard, supported by current low costs of capital. For that to happen however, current policy frameworks must reflect these transformational objectives.

We can take stock of the modelling exercise above to identify key areas for renewed policy focus (Table 2).

Main sector	Indicative list of priorities
Full modernization of the private sector by 2030	Although often representing a minor share of the total stock, large industrial setups and commercial buildings can at large “show the way”. Fueled by private capital, and under growing pressure from the financial community (ESGs), their transformation can be significantly accelerated. • Mandates on new constructions or performance levels on the existing stock should therefore be put in place, with aggressive timelines. • As these sectors also significantly rely on small and medium enterprises (SMEs) as part of their supply chain, such efforts can also help boost the transformation of the larger value chain (what is referred to as Scope 3 emissions).

Main sector	Indicative list of priorities
Support of more fragmented sectors	Smaller commercial activities and consumer-driven demand are harder to reach. They are more fragmented ecosystems, with less self-financing capabilities. They also face further roadblocks in that value chains are not always properly geared to deploying new available technologies. For instance, there are considerable differences in access costs for decarbonized heating solutions in residential settings across the globe, an illustration of the lack of development of strong value chains[40]. The same would hold true with limited charging infrastructures for electric vehicles, both in rural areas and in dense city settings (with limited individual parking spots). • Mandates on new build will play a critical role, but beyond financial incentives will be instrumental in fostering adoption. • The development of effective value chains will also prove key, and this can be accelerated by creating a sizeable market for these technologies, notably thru large retrofit programs as well as a focus on public buildings for instance.
Development of a future-ready infrastructure backbone	With accelerated electrification of the energy system will necessarily come the need for significant investments on current power grids. • This will obviously include the development of a stronger distribution system as well as greater interconnection capabilities across regions. • Yet, the infrastructure backbone must also build on advancing technological developments. This will include a stronger focus on distributed energy systems (and their seamless integration in the overall grid) and overall digitization.
Accelerated decarbonization of the power system	The decarbonization of the power system will play a critical role in overall emissions abatement. • All new power capacities deployed must be zero-carbon. • Practical plans to proactively decommission coal-fired and oil-fired power plants will require to be put in place. • Distributed generation penetration needs to be promoted as a key enabler of accelerated penetration of renewable energies in the overall mix.
Common framework for change	Transformation will be all the more rapid as a common framework is put in place to funnel investments, monitor progress and reward early adopters. This should include • A common taxonomy on green technologies, to help the finance community funnel capital to the right projects and activities. • A convergence of international standards and metrics around key technologies associated with decarbonization and their deployment within build assets. For instance, current building sector indexes and certifications should take stock of the technologies that can help foster decarbonization, including digital technologies, electrified heat solutions, distributed generation, etc. • A reform on energy taxation regimes to better reflect decarbonization objectives. As electrification is the cornerstone of rapid decarbonization, taxation regimes should better incentivize the switch to modern electricity[41].

Table 2 – Policy recommendations

[40] Schneider Electric (2021), Building Heat Decarbonization

[41] Carbon price is one of these incentives. Another one could be to review current taxation policies across different energies. See notably tax regimes on natural gas and electricity in Europe. In average for the EU-27, taxes on natural gas are more than 4 times lower than on electricity. Eurostat (2020), Data for Households

We highlight 2 main areas which we consider have the potential to be largely transformational in the current decade, on top of what is already engaged

- **Create the market for change**: the development of effective value chains will prove key. For these to develop, a sizeable market needs to be developed.
  - This will be enabled by clear mandates on new constructions, as well as a focus on accessible retrofits, notably public buildings.
  - More importantly, **large industrial and commercial activities represent a significant opportunity:** often neglected, these activities have in fact a greater potential for rapid transformation. Since these activities involve a large ecosystem of smaller proximity organizations, their transformation spans also largely beyond their own activities (scope 3 emissions). In this regards, mandates and updated metrics (including new technologies to foster decarbonization, such as digital and distributed generation ones) will prove critical.
- **Reform taxation regimes**: policies must continue to evolve to create an environment favorable to decarbonization. This notably includes a renewed focus on taxation regimes across various energy sources, notably between electricity and natural gas[42].

The bigger picture

This report has focused on a subset of global greenhouse gas emissions. Out of 50GtCO_2e/y of greenhouse gas emissions, our 2030 scenario finds 10GtCO_2/y abatement opportunity from a 30GtCO_2/y baseline, a significant acceleration from current pledges (ranging around 3GtCO_2/y).

There remains however around 20GtCO_2e/y which this report has not covered thru detailed modelling (Figure 11).

AFOLU (Agriculture, Forestry and Other Land Use) emissions account for over 10GtCO_2e/y, stemming from a wide range of practices, notably livestock, land burning and deforestation. More sustainable approaches, particularly as they relate to land use and evolving diets will prove key in the overall abatement strategy. Other energy emissions include upstream emissions and some transformation industries and international bunkers we have not accounted for here. Fugitive emissions (nearly 3GtCO_2e/y) represent a sizeable share of this total[43]. Process emissions are related to industries where the production process generates greenhouse gas emissions, such as cement for instance.

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[41] Carbon price is one of these incentives. Another one could be to review current taxation policies across different energies. See notably tax regimes on natural gas and electricity in Europe. In average for the EU-27, taxes on natural gas are more than 4 times lower than on electricity. Eurostat (2020), Data for Households

[42] Ibid

[43] Climate Watch (2020), Historical GHG emissions Schneider Electric Research

Both energy and process emissions will in fact benefit from some of the measures we have detailed in the above research. The reduction of fossil fuels demand on the demand side (and for power generation) has an immediate impact on the volume of fugitive emissions. Similarly, circularity measures can contribute to mitigate the need for primary virgin materials (and their associated process emissions). These industries will however be in need for a specific focus as the world targets net-zero by 2050. Some technologies exist in certain sectors already, but more is needed. This is why these sectors are often referred to as "hard to abate"[44]. This is also why Dr. Birol from the International Energy Agency has recently voiced concerns about the need for further innovation in the route to 2050[45].

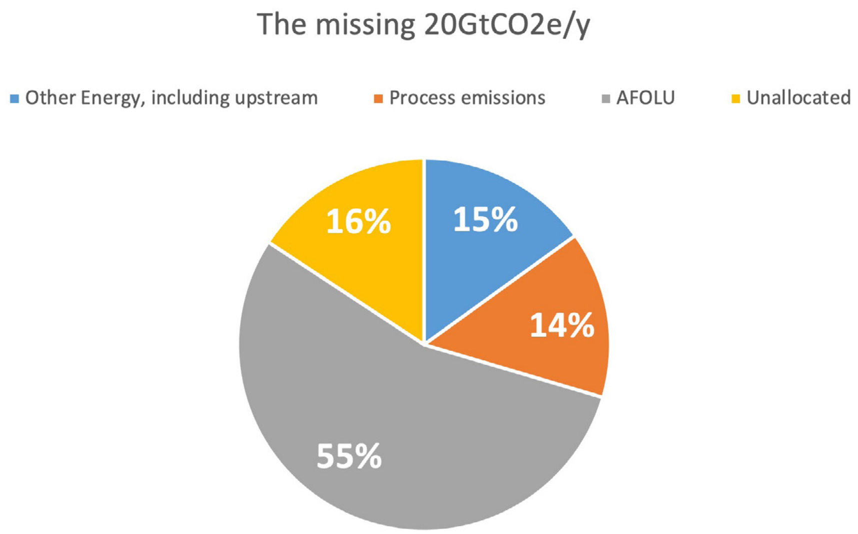

Figure 11 – other greenhouse gas emissions

As important as abating emissions from these sectors will be in the near-term, they should not however come at the expense of a critical focus on 2030 "easy-to-abate" actions, which will form the bulk of the effort to 2030. In this regard, the COP26 due in November will be a critical milestone.

[44] Energy Transitions Commission (2018), Mission Possible Energy Transitions Commission (2020), Making Mission Possible: Delivering a Net-Zero Economy

[45] Cornelissen A. (2021). 'Much more innovation is needed to meet CO_2 targets by 2050'

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