ABSTRACT

This article describes Siemens Energy's path towards sustainability. It details the company's definition of sustainability, which extends beyond decarbonization.
After outlining the company's areas of sustainable operations, we explain our current decarbonization strategies and goals for our operations, suppliers, and customers. The last point has become the most urgent: We intend to make improvements in product materials, processes, our use of renewable energies, and new standards to form a circular energy economy.
The article also addresses the introduction of revolutionary products, like the ones used to eliminate climate-harming F-gases in the future.

KEYWORDS:

sustainability, decarbonization, greenhouse gas emissions, net zero emissions, renewable energies, circular economy

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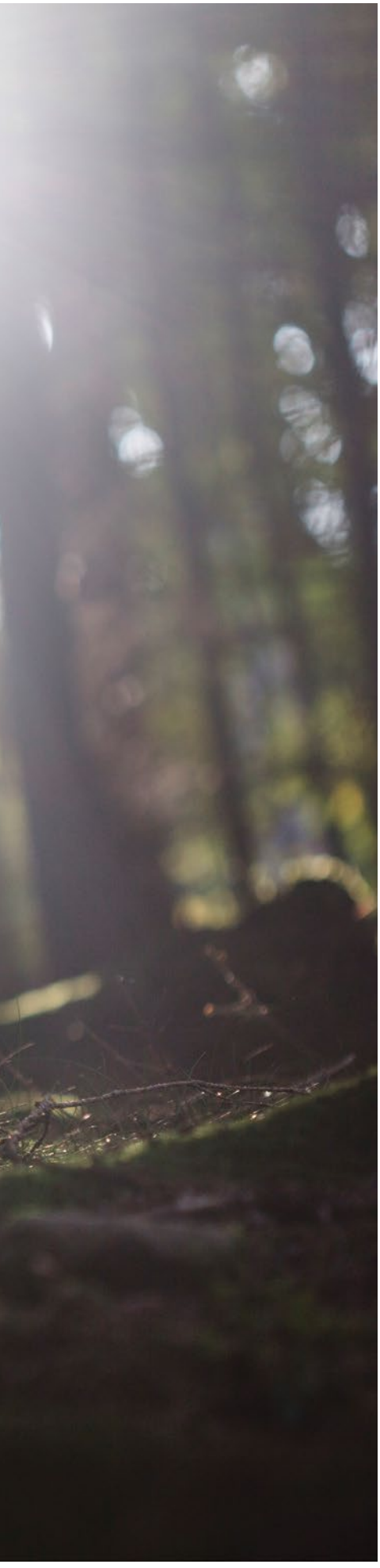

Today our focus is on how and when we shift toward a greener future for all

How ambitious sustainability goals extend beyond decarbonization in Siemens Energy's own operations and must be pursued holistically

Introduction

We've grown up hearing about sustainability from the news, politicians, NGOs, activists, our favorite food packages, singers, entertainers, and even cartoons. We've been flooded with messages about the importance of addressing this issue: but what does sustainability actually mean, and what do we need to do to realize it?

In 1987, the Brundtland Commission defined sustainability as "The development that meets the needs of current generations without compromising the ability of future ones to meet their own needs." We know that this definition has evolved due to the complexity it's accrued over the years. That's why at Siemens Energy, we use sustainability as the umbrella term for all our activities that contribute to enabling prosperity and creating societal value while reducing negative impacts on people and the planet. This includes capturing new business opportunities and managing risks.

As Siemens Energy, we are tackling three goals: inclusion and diversity, safety, and decarbonization. Mastering the increasing threats posed by global warming, decarbonization is at the core of our business strategy. We aim to reduce greenhouse gas (GHG) emissions to net zero across the value chain of our own operations, suppliers, and customers. This means that reducing Scope 3 emissions (including emissions from the supply chain and the use phase of products) is of the utmost importance at Siemens Energy.

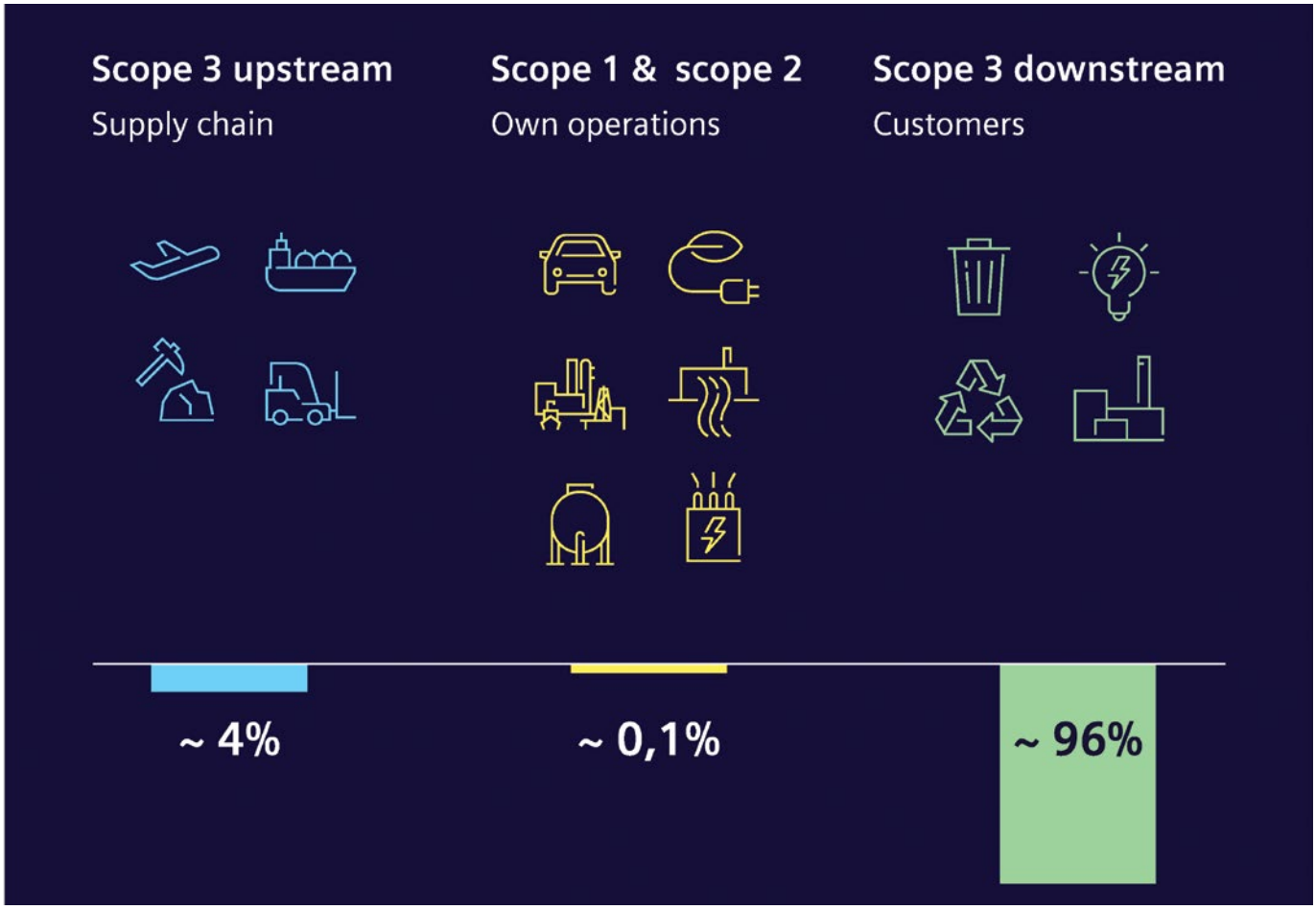

Figure 1. Greenhouse gas emissions along the value chain by the example of a 300 MVA generator step-up transformer at 75 percent load with a CO_2-intensitivity of 226 g CO_2/MWh in the transmission grid

It is evident we must form strong partnerships with our external stakeholders – including customers, suppliers, policymakers, climate activists/NGOs – in order to achieve net zero

Using transformers as an example: Over the asset's lifecycle, the Scope 3 downstream emissions resulting from transformer losses account for approximately 96 percent of the transformer's total emissions, while Scope 1 at just 0.1 percent is from our own operations, and around 4 percent is from Scope 3 upstream emissions (supply chain). Therefore, it's evident that we need to form strong partnerships with our external stakeholders – including customers, suppliers, policymakers, and climate activists/NGOs – in order to achieve net zero.

The path to sustainability itself is clear: The necessary action items are well known. The question is how and when we can implement them as quickly and comprehensively as possible.

Decarbonizing the supply chain using alternative or carbon-reduced materials

We're continuously working to reduce emissions from our purchased materials. To anchor this goal, we're increasingly using alternative or carbon-reduced materials in transformers, which mainly consist of steel, copper, oil, and pressboard.

A best-practice example is the use of natural esters because they generate a low cradle-to-gate footprint thanks to the benefits of biogenic carbon capture during plant growth. In addition, it's more fire-resistant and biodegradable, which aligns with the goal of circularity. Regeneration and full recycling of synthetic esters are also proven concepts.

The use of "green" steel is another good example of our use of carbon-reduced material in the transformer core. Carbon-reduced steel from thyssenkrupp Electrical Steel was introduced for the first time in high-voltage direct-current transformers in the German transmission system operator Amprion's Ultranet project. This reduced carbon emissions by about 50 percent compared with conventional core steel and has enabled us to save more than 200 tons of CO_{2e} emissions from just one transformer.

We also care about creating transparency and acting diligently with our partners to assist them with their decarbonization process. We're committed to working together to identify measures for expanding sustainability, decreasing carbon emissions, and increasing the percentage

Figure 2. For the German high-voltage direct-current project ULTRANET, Siemens Energy is supplying transformers with carbon-reduced steel from thyssenkrupp Electrical Steel

of recycling to ultimately achieve a circular economy for all parties involved.

Decarbonizing the factory footprint using renewable energies

A key reason for the company's success in reducing greenhouse gases is its use of renewable energies. At Siemens Energy, 90 percent of the electricity required for operations comes from renewable sources. Our efforts are aimed at concluding 100 percent green electricity contracts at all sites by 2023, electrifying as many processes as possible, and reducing energy consumption through a variety of factory initiatives. We firmly believe that the main causes of emissions in our factories can be tackled effectively. Switching to 100 percent green electricity, replacing emission-intensive processes, and reducing energy consumption are the most effective approaches.

Our locations are also utilizing the potential of renewable energy generation to produce green electricity for own consumption. A good example from our factory network is the transformer factory in Zagreb, which is generating its own electricity with solar panels on its rooftop. They provide up to 17 percent of the factory's electricity, leading to a reduction of 415 t CO_2/year.

This is just one of many examples that demonstrate our factories' commitment to finding solutions for shrinking our footprint throughout the entire supply chain – and more are still to come, with new practices that implement alternative materials and renewable energies.

We're committed to working together to identify measures for expanding sustainability, decreasing carbon emissions, and increasing the percentage of recycling to ultimately achieve a circular economy for all parties involved

Designing highly efficient and sustainable products

Highly efficient and recyclable transformers with intelligent asset management can ensure reduced emissions in operation. At Siemens Energy, we've been delivering extremely efficient transformers according to EcoDesign directive Tier 2 from July 2021, and we can even offer assets with higher standards: Increasing the efficiency of a typical 300-MVA power transformer by just 0.1 percent, for example, reduces emissions by 650 t CO_2/year.

Figure 3. Photovoltaic panels on the roof of the transformer factory in Zagreb, Croatia

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While losses are the main reason for emissions during operation, it's important to consider the shortage of resources and, therefore, the end-of-life treatment of our transformers. In times of material shortages and long delivery periods, we need to think about alternative options for ensuring that the grid can be expanded and continue to deliver electricity to consumers as a reliable backbone of the energy transition. We already offer to refurbish and reuse existing transformers and even increase their efficiency rates compared to their year of manufacturing. If refurbishment isn't an option, fortunately, over 95 percent of our transformers' weight can be fully recycled and reused by our sub-suppliers, which helps us close the resource loop.

With the goal of increasing transmitted energy and optimizing transformer lifecycles based on real-time information, Siemens Energy has launched Sensformer Advanced with digital twin technology. Through digitalization, this technology provides real-time information about the transformer's performance and health status at any time and place while also providing a dynamic and volatile condition assessment that enables load and aging prediction. Digitalization helps operators manage the growing complexity of their grids with versatile, intelligent assets capable of processing large volumes of data and recommending the optimal course of action to take.

Siemens Energy is also setting new standards in other fields of high-voltage equipment. We've witnessed a growing awareness of the issue of F-gases in power grids among transmission and distribution system operators. It's not surprising when you reflect on the fact that SF_6 – which is still the standard solution in most substations – has 25,200 times the global warming potential of CO_2. According to the U.S. Environmental Protection Agency, they make up roughly 80 percent of those that are in use worldwide in the switchgear industry. Therefore, it's clear that tackling this segment is paramount. Manufacturers are definitely not taking risks posed by SF_6 lightly, and the current state-of-the-art technology keeps the SF_6

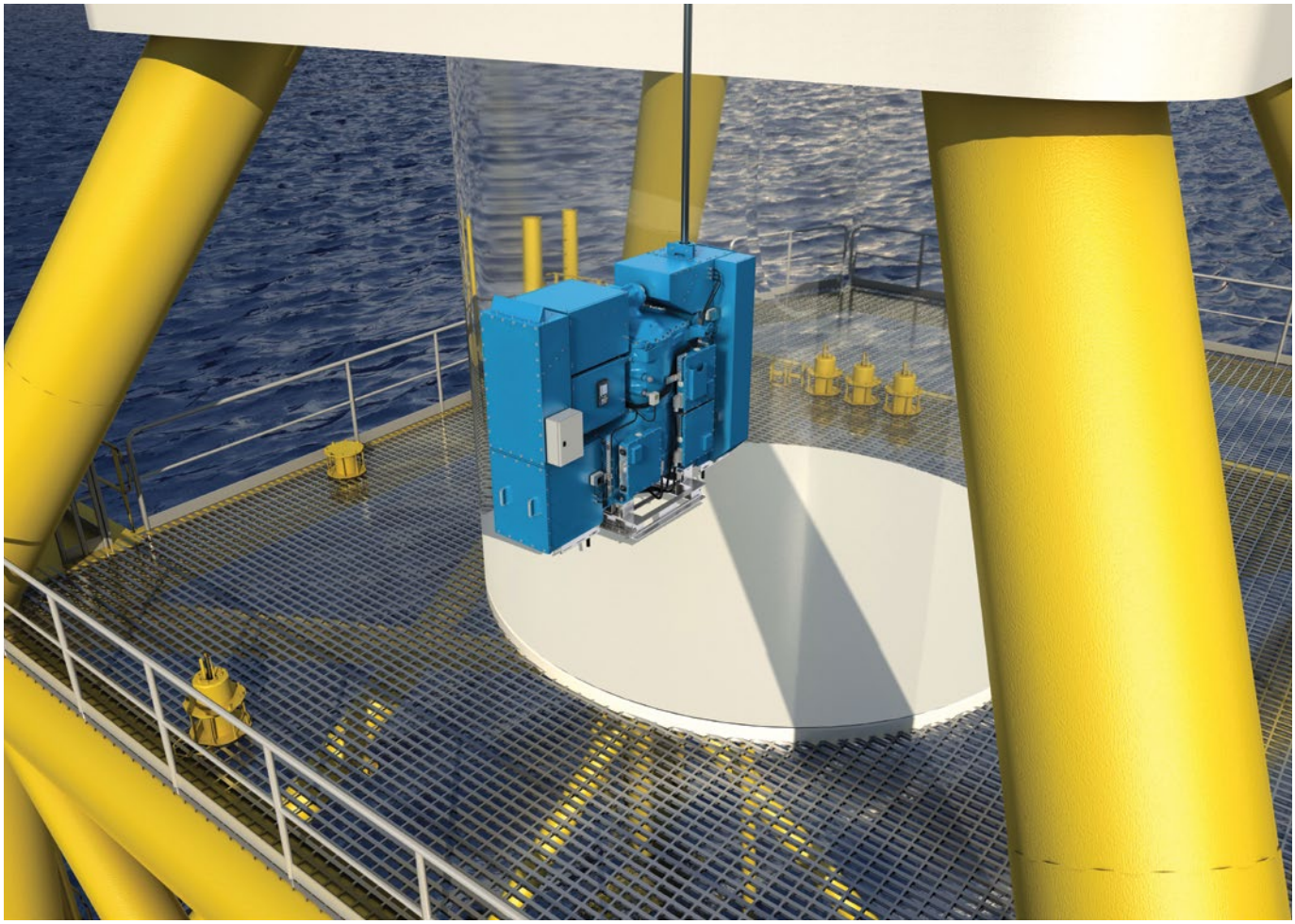

Figure 4. F-gas-free gas-insulated switchgear from Siemens Energy in a wind turbine

leakage rate below 0.1 percent per year. System engineers are all sensitized to and trained in the careful handling of switchgear components containing SF_6. But why take the risk when climate-neutral alternatives are available? In this case, technology isn't the issue.

In Berlin, Siemens Energy is investing over €60 million in more environmentally friendly equipment at a new production facility. In the future, vacuum interrupters will be manufactured on 6,200 m^2 at the company's switchgear plant. The vacuum interrupters are the technological core of our F-gas-free Blue portfolio. The new manufacturing facility is scheduled to be operational in 2023.

Committed to a greener future

Satisfying the world's hunger for energy that's sustainable, safe, and affordable is one of the core tasks of our time. At Siemens Energy, we've made it our mission to support our customers in their transition to using clean energy. Our goal is to drive sustainability beyond decarbonization, form strong partnerships with our stakeholders, prioritize decarbonization in our value chain, and set new standards. We're on the right track but still a long way from where we need to be. Prioritizing and working together holistically along this path is the key to getting closer to achieving our goals. Ultimately, this race isn't about who gets there first but rather how well we can work together and support each other to successfully achieve our final mutual goal. We've seen improvements on this journey that are small wins in terms of reaching net zero. However, it's not an easy journey. It requires bold decisions, now more than ever, and a synergistic collaboration of all parties with a high degree of commitment: There's no other way.

Our goal is to drive sustainability beyond decarbonization, form strong partnerships with our stakeholders, prioritize decarbonization in our value chain, and set new standards

Author

Christina Iosifidou is the Head of Sustainability Grid Technologies at Siemens Energy. In this role, she drives the decarbonization of products, solutions, and services across the value chain. She holds a Master's degree in Business Engineering from the Technical University of Berlin and started her career at Siemens Energy as a product lifecycle manager at Large Power Transformers, where she later worked as Global Innovation Sales Manager and acquired valuable experience in Austria and Brazil.