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Fiber industries on their way to decarbonization: finding the right energy system design

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The defining issue of our time

The UN has called climate change "the defining issue of our time".[1] Shifting weather patterns and rising sea levels threaten our food production and coastlines; global temperatures are rising, glaciers are shrinking; and extreme weather events from storms to wildfires are becoming larger and more frequent. The impact and magnitude of climate change are unprecedented in scale. "Without drastic action today," writes the UN, "adapting to these impacts in the future will be more difficult and costly."[2]

Within the next thirty years, the world's population will increase from around 7.5 billion people today to roughly 9 billion people, placing a tremendous strain on the demand for resources such as power, water, and infrastructure.[3] According to the US Energy Information Administration (EIA), in that time energy consumption alone is expected to rise by nearly 50 percent.[4] Increased demand puts the world under further pressure to develop and transform our production and use of energy if we are to meet the Paris Agreement objectives and limit the increase of the global average temperature to 1.5°C above pre-industrial levels.

Global energy-related emissions rose year-on-year to reach an all-time high of 33.3 gigatons in 2018 before flattening out in 2019.[5] To put that into perspective, the amount of carbon we currently release into the air is around twenty times the weight of the current population.[6] Along with other greenhouse gases, all that carbon absorbs heat from our planet's surface and keeps it from escaping into space, causing a gradual increase of the earth's atmosphere. To slow down this greenhouse effect requires us to rethink our policies, processes, and behaviors – and take decisive action. In the fiber industry, this means we can incorporate best practices, leverage digital tools for energy and resource efficiency, and rely on new sources of power.

Content

Fiber as an energy-intensive industry

Staggering global energy efficiency opportunities

The current hold on emission levels is due largely to changes in power generation thanks to an increased capacity for renewable energy, fuel switching from coal to natural gas, and, in some areas, a higher nuclear power output.[7] Other sectors have also made gains over the years, but there still remains staggering unrealized potential for energy efficiency: a further 82 percent of the energy used in the buildings sector could be made more efficient, 80 percent in power generation, 62 percent in transport and 56 percent in industry. In every one of these economic sectors the benefits still to be reaped are massive.

Energy efficiency can be thought of as a "hidden fuel"[8] that boosts economic growth while reducing energy demand. It is the most economic and immediate action we can take to reduce emissions around the world. And to date, the resulting savings from energy efficiency have been larger than those from any other fuel.[9] With new digital technologies that gather and analyze real-time data on energy and asset performance, the potential for efficiency exponentially increases, especially when coupled with automation and integrated control systems that can self-execute changes on the factory floor to optimize business.

Digitalization enables the Smart Factory and allows businesses to create a picture of their entire energy system, uncovering pinch points and leading the way to an optimal energy system design – one that further minimizes carbon emissions with alternative sources for fuel while at the same time maximizing financial returns. In some cases, companies should not be drawing power from the grid at all, but rather be selling surplus power into the energy market. With more than 100 years of expertise in the fiber industry, we offer seamlessly integrated solutions based on the best available techniques and advanced technologies that help our customers make their businesses more environmentally friendly, resource-efficient, and profitable for the fiber industry of the future.

Industry is the second-largest source of carbon emissions

The industrial sector is the economic powerhouse, providing millions with employment and making materials integral to our everyday lives like cement, steel, plastic bags and food containers, even pulp and paper. Industry contributes around 25 percent of the world's gross domestic product. So it comes as no surprise that in 2017 it also consumed more than a third of the world's energy usage or around 156 exajoules.

Break that down into demand and growth, this represents a 1 percent annual increase in energy consumption since 2010 with 1.7 percent growth in 2017.[10] In that time, India saw the highest growth in industrial energy consumption (around 3.9 percent) and China had the largest absolute growth in energy demand. What's more, industrial energy consumption will continue to grow, largely due to rising production in energy-intensive subsectors like chemicals, iron and steel, food and tobacco, and pulp and paper. These subsectors are expected to grow at 1.5 percent in non-OECD countries and 0.5 percent in OECD countries.

Of course, production, energy consumption, and greenhouse gas (GHG) emissions are related. The industrial sector is responsible for 23 percent of the GHG released into the atmosphere – of which 90 percent is carbon dioxide (CO_2).[11] In fact, industry is the second-largest source of CO_2 emissions, and projections show that within the next ten years it will be responsible for most of the GHG emissions. A quarter of the current industrial emissions come from processes while the majority comes from energy use.

Gains in energy efficiency have already been realized thanks to improvements in productivity and renewable heat uptake, alongside progressive policies and innovations. But there is still more to be done. To keep the entire industry sector on target with the Sustainable Development Scenario (SDS) launched by the IEA, direct industrial CO_2 emissions must peak and drop to 8.3 gigatons by 2025.[12] The scenario outlines a major transformation of our global energy systems and how we can reach the UN's three main energy-related sustainable development goals (SDG): universal access to energy, reduction in air pollution, and climate change. The key to these challenges is to decouple growth in production from growth in energy consumption.

Increasing carbon prices will affect investment decisions

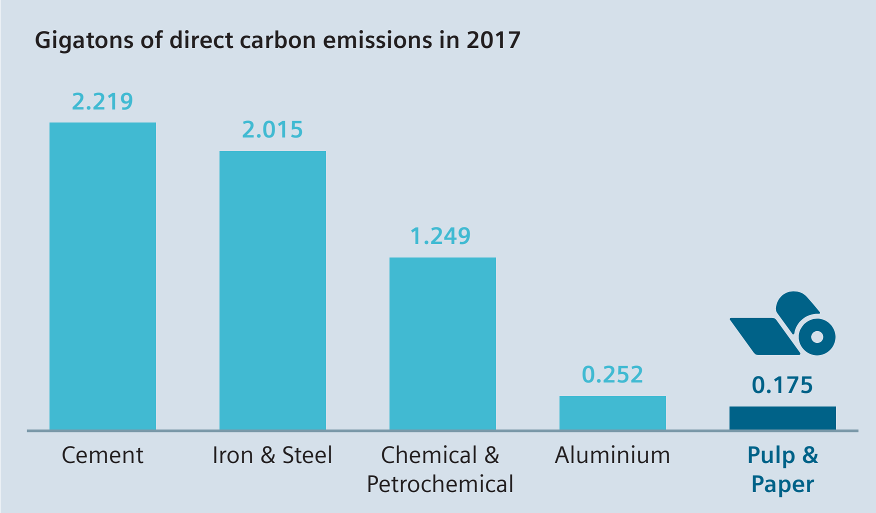
Carbon pricing is an instrument that captures the external costs of CO_2 emissions that the public pays for and connects them to their source through a price or tax on emissions. Today there are worldwide carbon pricing initiatives covering around 11 gigatons of carbon dioxide equivalent (CO_2e), translating to about 20 percent of total GHG emissions.

Around 46 countries and more than 28 cities, states, and regions are already putting a price on carbon, and high pricing levels are expected to remain with further increases in the future to especially since current carbon prices are too low to meet the objectives of the Paris Agreement. Estimates suggest that carbon prices of US$40 to 80 per metric ton of carbon dioxide equivalent (tCO_2e) are needed by 2020 and must rise to US$50 to 100 by 2030.[13]

In the European fiber industry, Sweden has one of the highest carbon price rates with €112 per tCO_2e, followed by Switzerland, Finland, and Norway. These countries in the north also offer more positive examples for lowering emissions through efficiency than countries in the south that have lower carbon price rates. In any industry and in any sector of the economy, future potential carbon penalties will affect investment decisions.

How pulp and paper compares to other energy-intensive subsectors

Let's face it, some consider the pulp and paper industry to be one of the world's biggest polluters and one of the heaviest users of fresh water – making just one A4 sheet of paper



Pulp and paper is the fifth largest consumer of global electrical and heat energy consumption among the energy-intensive subsectors and correspondingly the fifth largest source of CO_2 emissions.

uses as much as 20 liters of water! Few people know, however, that the industry also consumes around 4 percent of the world's energy.[14]

Yet in comparison with other industrial subsectors, pulp and paper, a timeho-nored industry – the first mecha-nized paper machine was installed in Eng-land in 1803 – has already taken significant steps to reduce energy and carbon emissions. The industry has been at the forefront of decarboniza-tion and, according to the IEA, "over the last almost two-decades the sector has experienced a decoupling of energy use from production thanks to energy efficiency improvements and process integration measures."[15]

Pulp and paper is the fifth largest consumer of global electrical and heat energy consumption among the energy-intensive subsectors and correspond-ingly the fifth largest source of CO_2 emissions. It was responsible for 0.175 gigatons of direct carbon emissions in 2017, far behind cement (2.219 giga-tons), iron and steel (2.015 gigatons), chemical and petrochemical (1.249 gigatons), and aluminum (0.252 gigatons).

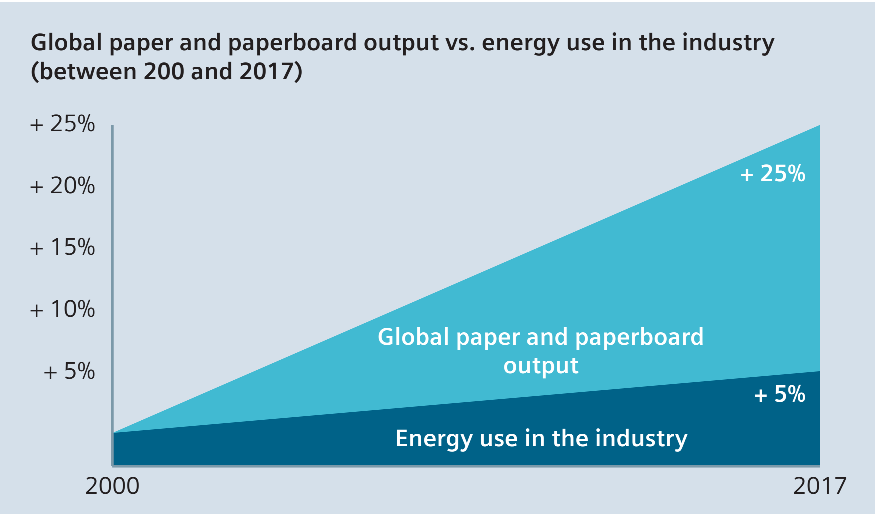
Like other industrial subsectors, the pulp and paper market is also expected to grow over the next decades. For all subsectors in general, this means they will have to reduce their GHG emis-sions by some 80 to 95 percent in order to offset that growth and meet climate change objectives. For pulp and paper in particular, this means that while paper and pasteboard production is expected to increase, energy use will have to decline around 0.4 percent per year and the share of recovered fiber in the total fiber fur-nish will have to expand to over 60 percent in order to get the industry on track with SDS by 2030.[16]

The challenges to decarbonizing pulp and paper

According to the IEA's 2019 Tracking Industry report, the fiber industry continues to make promising progress in decoupling energy use from produc-tion. While global paper and paper-board output increased by more than 25 percent between 2000 and 2017, energy use in the industry only rose by less than 5 percent.[17] The majority of that energy is used to produce heat, but around a third is for electricity.[18]

In addition, between 2000 and 2017, the share of recovered fiber (postcon-sumer and manufacturing waste) in the total fiber furnish also increased by more than ten percentage points.[19] By using recycled sources to produce more paper, the industry can reduce its energy use. However, the IEA does point out that "structural effects – such as shifts in product mixes or regions of production – can also influence energy use, and data quality issues make it difficult to draw firm conclusions about energy intensity trends."[20]

Looking at the correlation between production and energy more closely, we find that, between 2000 and 2016, production expanded on average by 1.4 percent per year and energy use increased by 1.8 percent per year. Most recently, production expanded by an increased rate of 2.3 percent and energy use by 1.8 percent in 2017. So even with the progress made in the industry, growth in production and energy use remain linked. Paper and paperboard production is now expect-ed to steadily increase by 0.9 percent annually.[21] As demand and production are scaled up, where can the industry scale down its use of energy?



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Pinch points, underperformance, and energy waste in pulp and paper

On average, 21 percent of production costs in pulp and paper come from fuel and electricity, which is hardly surprising for an industry that characteristically uses a myriad of pumps, blowers, and fans. These rotating elements are needed to pump water, remove fumes, or transport pulp and wastepaper. Walk into a pulp mill and you will clearly see why a good portion of the industry involves high energy consumption.

These rotating elements are connected to industrial electric motors that transform electrical energy into mechanical energy. The costs of installation over the lifetime of these motors consists of 5 percent capital costs and 95 percent energy costs. On average, pumps consume around 25 percent of power, compressed air around 16 percent, and fans around 13 percent. These assets are where the pinch points limiting energy efficiency in the industry begin, and they are connected to the way other assets and processes perform, from wasted energy use that could be utilized elsewhere to the calorific value of black liquid.

It is important to think of the factory as an integrated whole. The failure or underperformance of one asset affects the others. For example, when particles fly up from the recovery boiler into superheated sections because of poor combustion, you waste valuable steam to blow soot instead of pushing it into the turbine. Or what occurs when steam entering the evaporator is superheated? It damages the evaporator, pollutes condensate, and builds up deposits in the boiler tubes and steam turbine, causing a loss of heat transfer and power generating efficiency. For every micrometer of buildup, around 250 kilowatts of energy is lost. Similar costly inefficiencies occur when assets are only partially integrated. Imagine roughly €2 million per year are being lost in some pulp and paper factories because the turbine and the black liquor boiler are not being operated and synchronized by the same process controls.

Pinch points, underperformance, and energy waste continue to be issues in the paper machine. The majority of energy consumption in the forming section, for example, is taken up by the sectional drives (ca. 42 percent), the vacuum system (ca. 35 percent) and the shower water system (ca. 11 percent). Are these areas performing optimally? Often in non-OECD countries, the sizes of the sectional drives are not based on normal running load (NRL) or recommended drive capacity (RDC) – in fact, those regions frequently use twice the RDC, resulting in far less energy efficiency. And vacuum systems and shower water systems often lack variable frequency drives (VFDs). When the vacuum seal water temperature runs too high, we lost valuable sealing water efficiency, and constant shower pressure on the wire section can damage the wire and felt. What is the condition of the uhle boxes? Is the broke collection using a pilot impeller with no NRL and a no load much higher than actually putting it into top speed? Are there leakages in the compressed air system? For every four-degree rise in the compressor's inlet temperature energy consumption goes up by 1 to 2 percent.

The majority of energy consumption in the press section is taken up by the sectional drives (ca. 60 percent), the vacuum system (ca. 20 percent) and the hydraulic system (ca. 15 percent). The drive power here is much larger because the section's huge granite rolls and drying cylinders have bigger RDC power requirements. At around 60 percent of overall electricity usage, we can clearly see where the power is being used. This is major area where an expert can optimize the sizing and efficiency of these drives, but it is important that that expert sees your factory and entire energy system as one. It is important that an expert thinks in terms of energy efficiency and decarbonization. Without even changing your source of fuel, he or she can help your company take massive strides in lowering energy consumption.

How energy can be optimized

We are well aware that pulp and paper is the fourth most capital-intensive industry in the world, requiring large amounts of investment to produce goods and having a high percentage of fixed assets. By locating where your company stands on the Green Energy Radar, we can identify together the most reliable and cost-effective ways to decarbonize that are unique for your situation. Starting with where you are and what you have, you will be able to make the most of your investments now while planning for a decarbonized future.

Of course, it is not just the pulp and paper industry. No industry can afford to move directly into deep decarbonization, which is why we take a bottom-up approach that balances decarbonization with affordability. With our support any immediate efficiencies you make on the factory floor pave the way for the near future and fuel shifts from coal to gas, from liquid to gas, or to hybrid energy systems. And these steps in turn pave the way for the long-term future with CCUS and Power-to-X, which uses electrolysis to transform electricity from renewable sources like solar and wind into car-bon-neutral hydrogen.

Wherever you are along the path to decarbonization, an experienced energy consultant can provide you with assistance and take it all one step further, using data analytics and digital tools to find the right energy system design for your business.

The benefits of digitalization, advanced automation, and variable fixed drives

Twenty years ago, to become a Fortune 100 company earning a billion dollars in revenue took around two decades. Today unicorn companies are doing it in a quarter of that time. What's their secret? Digitalization. Digitalization

leverages digital technol-ogy to provide business with new opportunities for efficiency, revenue, and value. It is already playing a major role in maximizing energy efficiency by allowing buildings, power plants, and industrial processes to be systematically analyzed, automated, and adjusted for optimization. For example, a combined-cycle power plant in the US was able to reduce production costs by 27 percent by using digital technologies to connect their turbines and boilers, fine tune parameters, optimize fuel combustion, and extend the life of their assets while minimizing downtime.

In one procedure, the company used digitalization to look at their fuel modules and weather forecasts to see on which days they could enhance fuel consumption and on which days they needed to preheat their heaters to provide air going to the plant. This kind of optimization is critical in saving costs and tackling climate change.

Yet globally, only 13 percent of companies are exploiting digital technologies for greater efficiency. Pulp and paper has been equally slow, but could catch up quickly with the use of advanced automation and intelligent controls.

Let us take a look at a single instance where the industry can profit by automating boiler blowdown. Often, the blowdown valve is left open on the bark boiler, thus wasting valuable energy. But if digital technologies are used to preheat the boiler feedwater, energy consumption can be reduced by two or three percentage points for every one-degree rise in temperature.

A further point to consider is whether the boiler feedwater pump is running on fixed or variable fixed drive (VFD) technology? VFD is a motor controller that can vary the frequency and voltage control of its power supply. It offers the capacity to ramp a motor up or down and can be used with a process control system (PCS) for automation. By leaving the blowdown valve open all the time, the energy cost requirements for pumping water increases. With digitalization, VFDs and PCS this entire process can be controlled, from your motor to your drives.

There are numerous areas like this where digitalization and automation can save energy and costs. For example, almost 50 percent of control loops are either under or over tuned. How often are the basis weight valve or dryer controls checked? Is too much steam being used? Are the valves or the pumps passing? What do motor vibrations reveal about the drive train?

Partial discharge? Voltage problems? Downtimes? Is this data being gathered with field sensors and analytics? Is it being used for trending to see how the pulp mill is performing? How could remote condition monitoring be used to improve production efficiencies and reduce energy?

Siemens offers a number of digital applications that include data acquisition on the factory floor, data analysis and diagnostics, predictive maintenance, applications for certain asset groups such as valves, pumps, and drive trains, and an Industrial Internet of Things (IIoT) platform that provides secure data storage and worldwide access to all plants and all locations so that the information you need is always at your fingertips.

Taking the whole energy system into account

It bears repeating: It is important to think of your factory as an integrated whole. Poor performance of one asset affects the others down the line causing underperformance, wasted energy, and harmful carbon emissions – on top of the damage you may be causing to vital components. Of course, the opposite is true as well. Improved performance in one asset affects the others down the line allowing you to match your operations to the best industry standards, increase the calorific value of black liquid, and reduce emissions.

However, we can do more than only think of the factory as integrated whole. Digitalization lets us actually see that whole.

By measuring and analyzing data from assets and processes, we can generate a multi-modal energy system design that reveals how total expenditures can be saved, how carbon emissions can be further reduced, and what synergies can be achieved by taking the whole energy system into account – water, heat, and electricity.

Multi-modal energy systems are systems that both optimize efficiency and reduce costs and emissions of energy use in one energy form by converting it into one or more different forms of energy by using decentralized or distributed generation, including on-site generation at industrial factories.

There are three steps to developing an optimized, multi-modal energy system design:

1. Optimization of the auxiliary energy system,
2. utilization of waste and heat, and
3. modelling a holistic process and energy system design.

The first measure is to optimize your assets and processes on the factory floor in order to reduce typical demand on your auxiliary energy systems. Then we take that energy demand and enter it into an optimization system.

Now we can see where there are further pinch points or where available energy is wasted that could be put to use. For example, where can we add a heat pump? Where there is surplus steam of 100°C and parts of the dry section that could use this steam in the intermediate or final section.

Finally, you receive a holistic process and energy system design that uses multi-modal sources of energy. Is it possible and cost-effective for you to generate and use electricity from renewables? At what price and at what quantities? With Power-to-X we can take this electricity and generate hydrogen for running storage, tractors, and logistics in the pulp mill, or we can feed it into the gas turbine for power generation. And what about your effluent plants? Are there gases we could bring into gas storage or burn in the gas turbines and engines? How much surplus are you generating? Do you have sufficient energy to export into the grid?

With a multi-modal energy design, your operating income is not necessarily restricted to just pulp. It could also include biochemicals and carbon-neutral power. Generating this additional income can then be invested back into your decarbonization strategy.

Decarbonization is a result of many different optimization measures

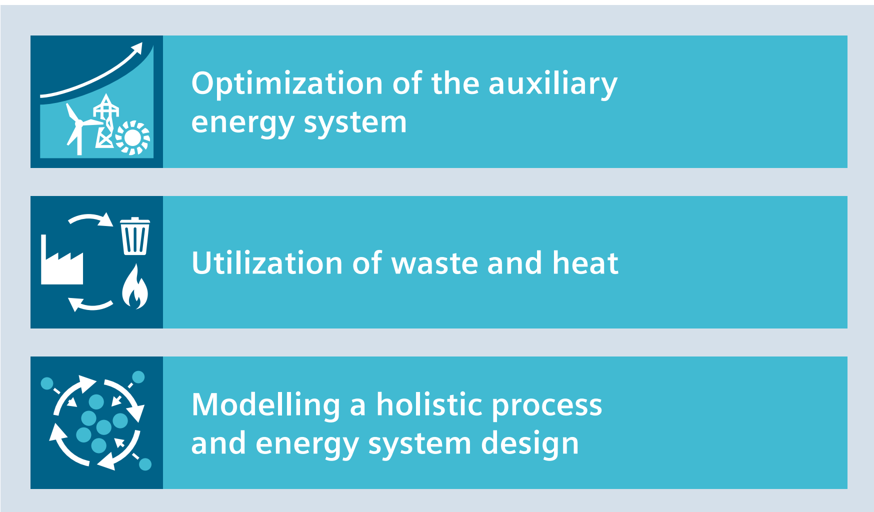
Bear in mind that deep decarbonization or fully "going green" is costly. And it is important to assess CO_2 reduction goals with the total cost of debt (totex). We have a broad portfolio of solutions for present and future energy systems that allows us to balance CO_2 improvement with cost optimization and capex-based solutions with opex-based ones.

In a case study for a European paper mill, we used the holistic process and design energy system to evaluate costs versus benefits. On average, the paper mill required 486,000 megawatt hours in total electricity demand and was already generating around 58 percent of its own energy. However, 40 percent was derived from coal and the mill, with an emission factor of 229 kilograms of CO_2 per megawatt hour, was paying a large amount for carbon taxes. Focusing entirely on capex-based, multi-modal energy solutions that reduced CO_2, what could we learn from the trade-off between costs and carbon emissions?

In a first step, we showed what would happen if they shifted from coal to natural gas, which would require the purchase of a 25-megawatt gas turbine and heat recovery steam generators. Carbon taxes would drop by more than half with a capex of around €30 million. In a second step, we showed what happens when the mill goes further and adds 1,500 megawatts of on-site solar energy to the mix. Carbon taxes continue to drop and capex rises to €50 million. Now what would happen if the customer added hydrogen to its energy system with a 20-megawatt electrolyzer, an 80-megawatt heat pump, and 1,100-megawatt storage capabilities? Again taxes drop and capex swells to €100 million. And if the mill wanted to stop drawing any power from the grid and become a "green island"? Carbon taxes disappear completely, but capex balloons to €900 million.

Generally speaking, a pulp mill costs around €1,200 per ton to build brand new, a paper machine €1,400 per ton. In this case study, with the amount of money being invested into decarbonization, the company could build entirely new facilities. Now imagine, to go entirely green from today until 2050 will cost the economy US$21 trillion, according to one estimate by McKinsey & Company. We all would like to see the economy decarbonize overnight, but the truth is that the money is not there.

We recommend a gradual approach that starts with energy efficiency and recycling, continues with improving data collection, and then increasing the use of alternative fuels with the help of multi-modal energy systems



Three steps to developing an optimized, multi-modal energy system design

A look into the future of pulp and paper

designs. Start with an approach to decarbonization that favors operational expenditures over capital expenditures.

Many of the areas for yielding quick gains in energy efficiency, carbon reduction, and profitability are opex-based: chipper control and debarking, cooking and screening, evaporation, recovery boiler control, process pumps, extraction of steam at correct pressure and temperatures, paper machine stock preparation, optimizing paper machine NRL and RDC, steam conditioning on paper machine, proper winder control using automation. Take the simple example of an opex-based approach to a dryer system that draws too much power and trips the electric circuit. In this case, the NRL and RDC are too high because the clearance between the siphon and cylinder is incorrect. By bringing down the siphon clearance the power requirement comes down too.

There is also no single path to a zero-carbon world, but there are diverse solutions and gradual steps that can minimize disruption and maximize financial returns. Ultimately, decarbonization will be the result of many different optimization measures.

Hydrogen as an option for the future

"Hydrogen is today enjoying unprecedented momentum," says the IEA in their The Future of Hydrogen report.[22] "The world should not miss this unique chance to make hydrogen an important part of our clean and secure energy future."

Hydrogen is a versatile energy carrier that, like electricity, must be produced from another substance. It has the highest energy content of any common fuel by weight (about three times more than gasoline), but also the lowest energy content by volume (about four times less than gasoline).[23] Today, hydrogen is used chiefly in oil refining and chemical production; since 1975, demand has tripled.[24] But this hydrogen is primarily derived from fossil fuels, resulting in significant CO_2 emissions. However, hydrogen can be produced from almost any energy sources, including renewable energy sources such as wind and solar power, with the use of electrolyzers.

Power-to-X is the conversion, storage, and reconversion of electricity from renewable energy sources into gas or liquid "green" hydrogen. This hydrogen can then be further converted into other carbon-neutral synthetic fuels such as synthetic natural gas or syngas (SNG) or stored and transported using the current gas infrastructure. Today, less than 0.1 percent of hydrogen production comes from Power-to-X, but the costs for electrolyzers and renewable electricity have been rapidly declining. There are currently around "50 targets, mandates and policy incentives in place today that directly support hydrogen".[25]

Over the next ten years, hydrogen will play a greater role in the decarbonization of our economy. In that same time, our gas turbines will have 100-percent hydrogen-burning capability and hydrogen will be key to the pulp and paper industry. We are currently working together with customers to create a demonstration site in France that will use surplus renewable energy from the national power grid to produce hydrogen and use it to power an SGT-400 gas turbine at an industrial facility, showing how existing assets can produce green energy and heat. This same technology will allow industries to generate hydrogen for chemical manufacturing, industrial applications, alternative fuels for transport as well as for power generation. The potential for its support to new business models and a clean energy transition is enor-mous.

Upgrading to cogeneration for the highest efficiency

Cogeneration is the generation of electricity and useful heat at the same time by making use of the steam left over from electricity generation for heating. Like any industry that generates electricity on site, pulp and paper can employ the heat from the generators to produce steam and generate even more electricity. Or the heat can be directly used in industrial processes such as drying pulp. When we produce only power in a simple cycle, we are putting only 33 percent of our fuel to use. When we use the exhaust heat to produce more power using a steam turbine or Organic Rankine Cycle (ORC) in a combined cycle, we increase that fuel use to 55 percent. When we use the exhaust heat for process, heating, or cooling as well as for combined heat and power or cogeneration, we create the highest possible fuel efficiency at 80 percent.

Maintenance and Remote Diagnostic Service

Service is an often forgotten aspect in the path to decarbonization – thought of as a cost and not an opportunity. Service increases the performance and availability of your assets by keeping them in step with accurate guidelines or rules of thumb based on experience. Steam turbines, for example, can lose up to 1.5 megawatts of power with as little as half a kilogram of copper oxide buildup. Without service and maintenance, causes of underperformance such as this one go undetected, and yet over half of all issues are predictable and often avoidable.

Pairing service with digitalization takes asset management a step further,

Taking decisive action today against climate change

allowing companies to compare daily operational data , identify abnormal vibrations in assets, and detect potential failures before they impact operations. It can also quicken response times by enabling Remote Diagnostic Service, further increasing the availability of your assets. In our experience, more than 50 percent of all service trips can be solved remotely.

All of this of course allows us to plan outages and offer the best operational advice for your company. We see things you cannot see in your control room.

Storage technologies

Typically, electricity from our grids is not stored because it would be a vastly expensive undertaking. As a consequence, gas-fired power plants are often used to ramp up or down power generation depending on demand, contributing to more CO_2 emissions. And even as renewable energy sources make up more and more of our energy mix, operators must continue to rely on these gas-fired power plants to keep our grids stable on cloudy, windless days. Here is where energy storage technologies will play a significant role in decarbonization.

For pulp and paper, storage technologies can act as a generation, transmission, or distribution asset that allows you to ensure a more reliable power supply and draw energy from the grid when it is most cost-effective. There are already a number of technologies available that offer differing size and time scales: rotating masses (SynCon, Flywheel), Li-Ion battery systems (SiestartTM), thermal energy storage and Power-to-Gas (hydrogen with Silyzers). Where you use any one of these technologies depends on the point of application.

On September 19, 2019, one day before a UN Climate Action Summit to urge governments to adopt more ambitious national climate plans, millions of people across the globe joined the largest climate change protest in history.[26] More than ever, we are aware of the harmful implications climate change has on our well-being and the urgent need to take up the banner of individual and corporate social responsibility.

We are at a tipping point. "Ecosystems as diverse as the Amazon rainforest and the Arctic tundra, may be approaching thresholds of dramatic change through warming and drying. Mountain glaciers are in alarming retreat and the downstream effects of reduced water supply in the driest months will have repercussions that transcend generations."[27] Conservative estimates see "unabated climate change leading to global costs equivalent to losing in-between 5 to 20 percent of global gross domestic product each year, now and forever."[28]

Yet we can take decisive action today. We can improve our energy use, decrease our CO_2 emissions and, in the pulp and paper industry, increase our profitability with new forms of revenue that, in turn, we can reinvest into decarbonization.

Siemens can help you reach your targets. We understand your business and can offer essential solutions in accelerating energy efficiency or increasing the use of alternative fuels. By implementing best available techniques, controls, automation and digitalization we can help you reduce emissions without even changing your fuel source. And with multi-modal energy system designs we can help you find the right energy system design for your company by changing fuels and pairing operations with renewable sources of power that can be converted into green hydrogen and stored for later use or export. Climate change is real. We live up to our responsibility – with intelligent and sustainable solutions.

Hand in hand with our clients, Siemens is ready to go!

Source-list:

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Published by
Siemens Gas and Power GmbH & Co KG
Werner-von-Siemens-Str. 1
80333 Munich Germany

SE O CM MK, WP.0720.1.RS_V1

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