Green energy and sustainable products

Sustainability is one of the most important focal points of our time. Both in relation to the products we surround ourselves with in everyday life and the energy we use for transport, heating, electricity, etc.

The demand for research into sustainability and green energy has risen in step with the increased focus by society. Companies, authorities and organisations are queuing up to work with researchers on e.g. how to address the challenges of transitioning to a fossil-free society or how to determine the essential indication parameters for sustainability through life-cycle assessment and sustainable design.

"Never before has there been so much focus on sustainability. One example is the UN campaign for the 17 Sustainable Development Goals that has garnered great visibility and interest. The same applies to the Circular Economy, a concept which has become increasingly prominent with the increased awareness of the world's scarce resources, growing waste mountains and plastic in the oceans," says Professor Tim McAloone.

Professor Tim McAloone and his team work with Circular Economy in companies to achieve improved sustainability conditions in both production and products. Over the past few years, the research has increasingly been focused on systemic thinking; meaning to account for the entire value chain from the first thoughts on developing and designing a new product to its use and disposal, with the intention of closing the loop for product and materials.

Tools for testing sustainability

One of the examples of this heightened focus on systemic sustainability thinking is the project MATChE, Making the Transition to Circular Economy, which is supported by the Danish Industry Foundation and carried out in close cooperation with Danish companies, their trade organisation, DI, and the Danish Environmental Protection Agency. One of the tools that has been developed in the project is a so-called readiness app, where companies can answer 30 simple questions with the purpose of assessing which areas of their business, organisation or product development need to be strengthened to facilitate the transition to Circular Economy.

"Overall, the goal is to reduce Danish companies' carbon footprint, consumption of raw materials and the amount of waste generated, whilst simultaneously strengthening their global competitiveness. Many Danish companies are interested in Circular Economy, but need tools that can help them work systematically. They get this through the MATChE project," explains Tim McAloone.

Although the readiness app is only a year old, over 100 companies have already registered and used it to assess their readiness to transition to the circular economy. The participating companies subsequently improve the areas of production, services and business development identified by the app and with the help of the MATChE team, in so-called accelerator programmes.

The 17 Sustainable Development Goals of UN.

Development of methodology for the circular economy

A similar project is taking place in the Nordic countries, CIRCit - Circular Economy Integration in the Nordic Industry (supported by the Nordic Green Growth Initiative). DTU Mechanical Engineering's task is to develop new methods that can bring industry one step further towards Circular Economy and to even greater sustainability. This is done by preparing new tools for companies' work on innovation, development, use and recycling of technical products and systems.

"Sustainability needs to be considered when new product ideas are conceived, and during the development and design phases. This applies to all three dimensions of sustainability, namely environmentally, socially and economically. In the same way, we consider the services that support the use of the product so that it is utilised as much as possible during its lifetime."

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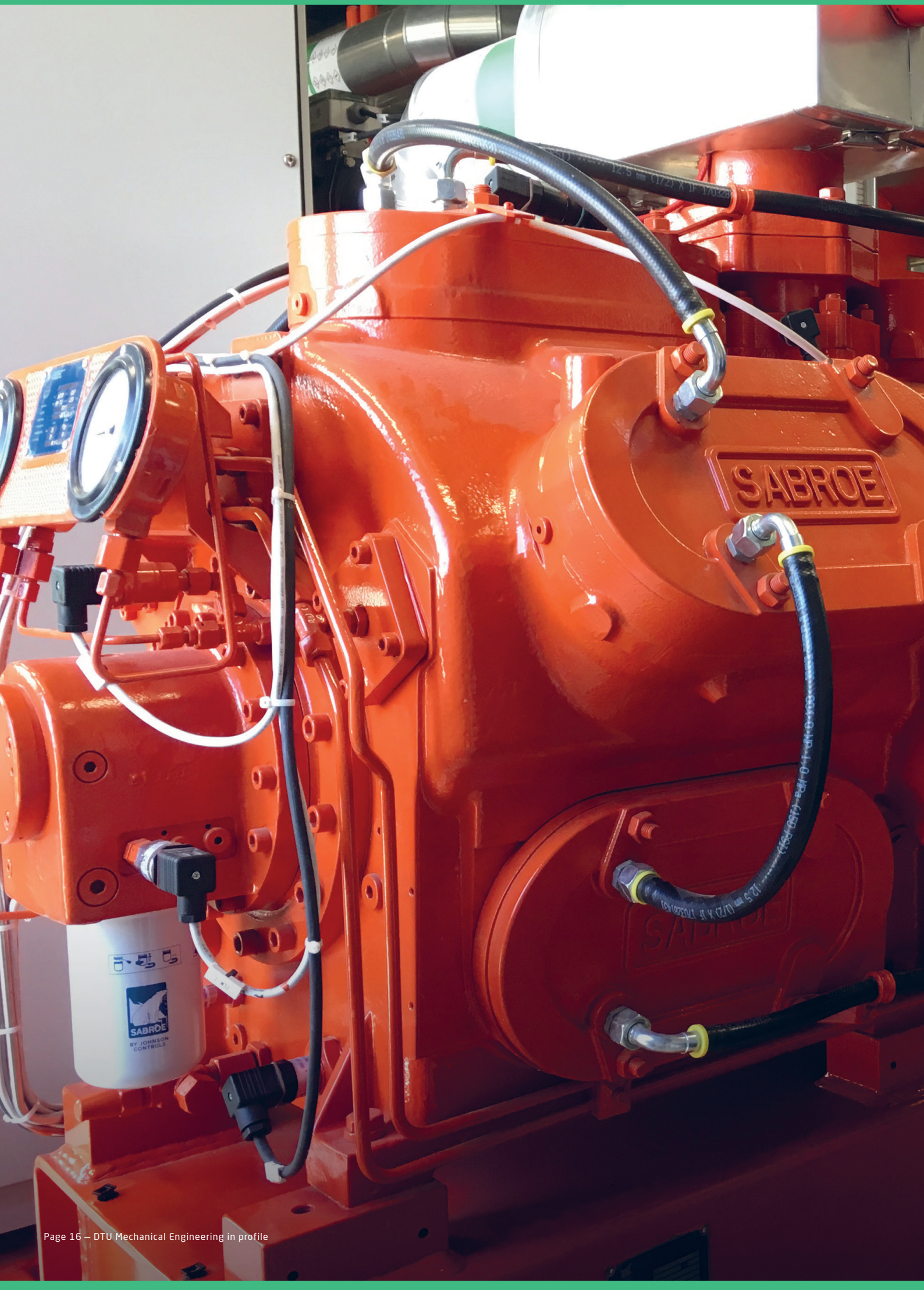
As an example, Tim McAloone mentions the possibility of sharing city bikes or cars or product life prolonging services on industrial products, such as cranes and ships. All of these initiatives can help to ensure that we as a society receive the greatest possible value, by using as few resources as possible.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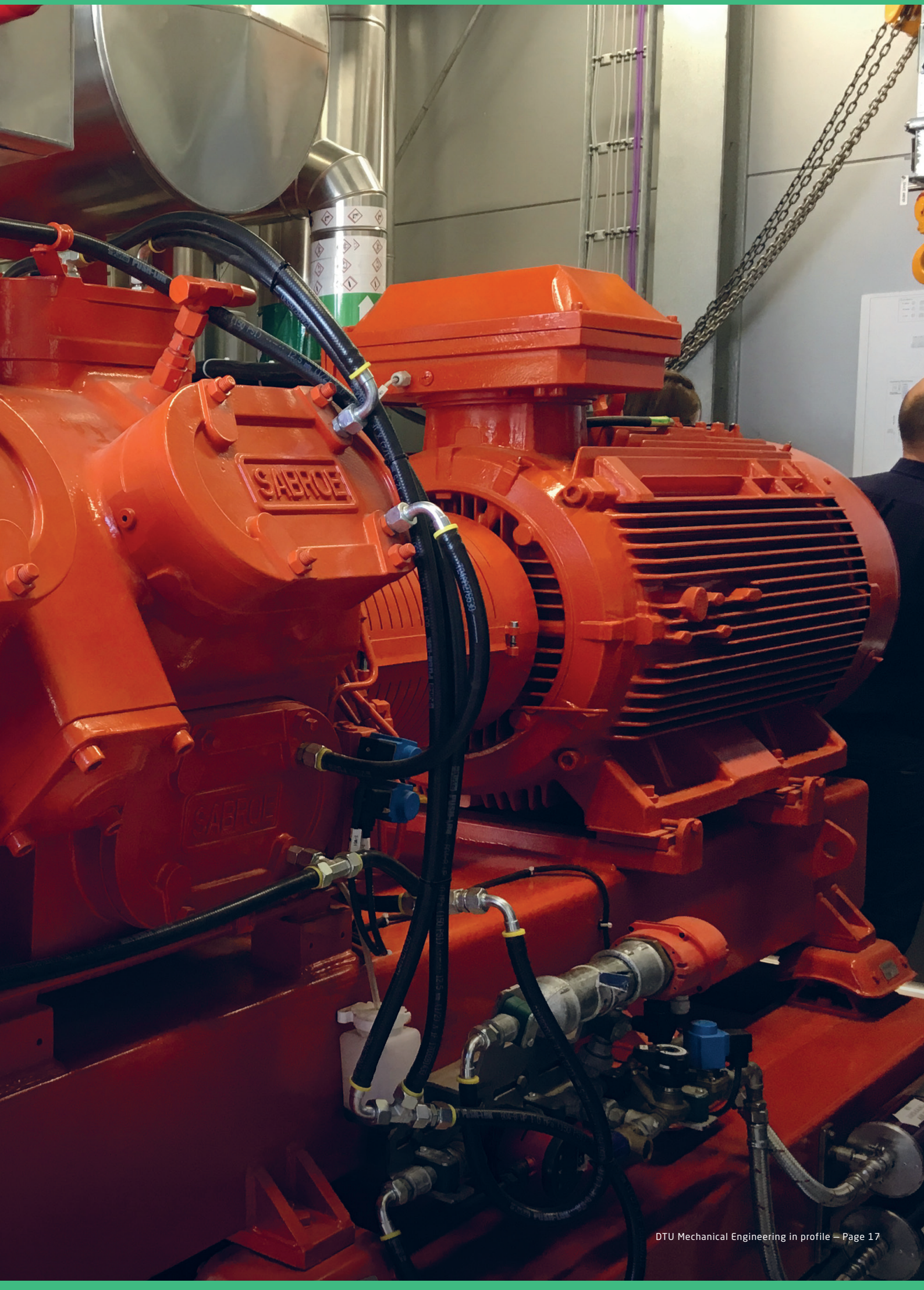
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The CIRCit project is based on a collaboration with a large number of companies in Sweden, Norway, Finland, Iceland and Denmark and focuses on increasing the circularity potential and the sustainability of their production and products.

Green energy

The research at DTU Mechanical Engineering also contributes to sustainability in a completely different area, where the focus is to ensure sufficient sustainable energy for the world's growing population. This is based on the processes that convert various resources into use in our energy supply.

"This can, for example, be fuels for use in the transport sector, or fuel cell systems for production of electricity and heat. As researchers, we focus on process optimisation, so that we can utilise the resources at highest possible efficiency while also ensuring as little emission of undesirable substances as possible of, for example, CO_2," says Professor Brian Elmegaard.

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The research takes place in close collaboration with companies that are subsequently using the solutions. This is done in several projects, which are typically intended to investigate how traditional energy technology can be used in new, different and more efficient ways and in combination with novel solutions.

"The future supply of energy and electricity will be increasingly digitalised, so that data from consumption and production can be included to make the operation as efficient as possible. But even if we get this smart integration, the physical systems will not disappear - on the contrary, they must be able to adapt and function even better with the changes that are taking place continuously in the world," says Brian Elmegaard.

At the moment, the focus is on adapting the energy supply so that it can be profitable and function optimally during the fluctuations that occur, both in the consumers' use of energy over the day and in the supply of energy coming from renewable sources such as wind or sun, which are affected by the weather conditions. In the future, the energy supply may have to be able to handle completely different conditions. These changes are part of the research focus.

Sustainable energy supply

DTU Mechanical Engineering participates in several projects regarding sustainable energy supply in the new city district of Nordhavn in Copenhagen. In one of the projects, work is being done to utilise a large heat pump for the heat supply for some of to the district's companies. This makes it important to investigate how fast and how large load changes a heat pump can perform to participate in the load control of the electricity grid. This is an entirely new use of heat pumps. Other projects focus on the integration of heat pumps, district heating and heat sources e.g. seawater, wastewater and excess heat from cooling processes. In this context, the researchers are considering the possibility of including refrigeration systems, e.g.in supermarkets, as heat producers in the district heating system, even when there is no direct need for cooling.

"Within the transport area, we are working on improving engines and processes for production of alternative energy sources based on biofuels or electricity from renewable energy. We have especially worked on improving the combustion performance in gas engines, so that as much methane as possible from the fuel is burned instead of ending up in the atmosphere. Methane has a far greater greenhouse effect than CO_2, which makes it desirable to limit emissions as much as possible," says Brian Elmegaard.

At the same time, the researchers are working on utilising excess heat, for example generated by ship or truck engines. By regaining the heat in a so-called ORC process, Organic Rankine Cycle, the engine power can be increased to create further propulsion.