# MEMBRANES AND A SUSTAINABLE SOCIETY

These years' renewable energy resources, like wind – and solar power, are incorporated more and more into our energy supply chain. But how can we be sure that we have enough energy available at all times? Especially when the sun is not shinning or the wind not blowing. One thing is for sure; our future sustainable society needs to fulfil the high living standards of today. At Aarhus University in the Membrane Technology group, we believe that membranes can be part of the solution.

It is a well-known fact that energy consumption of the world has been increasing dramatically over the last decades and it is still increasing. At the same time the quantity and availability of fossil fuels, like coal and oil, is decreasing. In many aspects of our society today energy plays an essential role. If we as society want to maintain our high living standards and insure good development opportunities in the future, new sustainable solutions are needed. One of these solutions could be membranes used for in different applications.

### What is a membrane actually?

In general membranes can be characterized as something that can separate two or more different compounds from each other. When people hear the word "membrane", they often think of the biological membranes inside our human body. The body needs these membranes to selectively decide which compounds can enter a given cell or organ. Besides the biological membrane, a great variety of synthetic membranes exist and these are widely used in different industrial. An example of an industrial membrane application could be waste water treatment. Here the mem-



brane is used to remove harmful substances like heavy metals and bacteria from waste streams. In relation to energy applications membranes are of great importance allowing for example chemical energy to be transformed into electricity in fuel cells. In the future it could be interesting if membranes could be used for energy storage, like a battery, and thereby making it possible to rely more on renewable energies.

### 20 % from renewable energy by 2020

To promote the transition to more sustainable Europe, the European Union has decided that 20% of the final energy consumption should come from renewable energy sources by 2020. An ambitious target of 30% renewable energy by 2020 is what we in Denmark are facing.

A lot of initiatives have already been put into play in order to find sustainable and renewable solutions. Wind, solar, biomass and geothermal power have already been implemented as sources of renewable energy.

In Denmark a great effort is put into expanding the renewable energy from especially wind power. The issue with wind power is that you cannot be sure that the wind will always be blowing when you need the energy, and vice versa. Two options can be proposed on how to limit the consequences of the wind fluctuations. One is to combine the wind power production with other types of renewable energies. A second option is to find a way to store excess wind power for later use. The Membrane Technology group at Aarhus University is currently working with both these aspects. The main objective is to use membranes for energy sustainable solutions.

# Membranes can be of great importance to achieve sustainability

Several commercial membranes can be found on the market already and are used for different applications. Some of the major problems with using membranes are the price, stability, and processability of the membranes. Therefore, a lot of research groups and companies are looking for new materials that will give the desired membrane properties for their application. The objective of this research project in the Membrane Technology group is to prepare membranes to be used in different processes creating or storing energy.

Great effort and a lot of considerations have to be taken into account when preparing membranes. A few will just be mentioned here to give a real picture of it. The membrane material and structure is of great importance. Membranes can be made from metal networks, plastic-like materials or combinations of these. The material chosen will greatly influences the membrane structure. Membranes structures can range from completely dense (something like a plastic bag or bottle) to porous (more like a coffee filter or sieve). The structure of the membranes is what directly gives desired properties of a membrane, e.g. membrane selectivity.

As mentioned the prepared membranes can be used to create or store energy. In liquid processes, a concentration or pressure gradient across a membrane is used to create and store electricity. In another process connected to biogas, the membrane can be used to separate methane, hydrogen and carbon dioxide into pure gas streams. By doing so, it is possible to use for instance the hydrogen in fuel cells, and the methane for heat production.

## Contact:

PhD student Mette Birch Kristensen, mettebk@eng.au.dk