ACADEMY AWARD

Eva-Mari Aro

IN THE PROCESS of photosynthesis plants and cyanobacteria transform energy obtained from solar radiation into chemical energy, enabling the creation of new biomass. In the course of millions of years this biomass has been compressed into what we know nowadays as fossil fuels, i.e. oil, coal and natural gas, which we are then able to make use of as sources of energy. With this in mind, attempts are now being made to mimic photosynthesis in order to extract energy in a cleaner form.

The Finnish Academy of Science and Letters decided that its Academy Award for 2018 should go to Academician Eva-Mari Aro, professor of molecular plant biology at the University of Turku, whose whole scientific career has been spent on studying photosynthesis.

"The evolution that gave rise to our present forms life was promoted to a decisive extent by the development a couple of billion years ago of the process of photosynthesis in cyanobacteria, by which they were able to break down water molecules and release oxygen into the atmosphere, the oxygen which we now breathe. In the course of this process nowadays both plants and blue-green algae capture energy from the sun's rays, use it to split water molecules and store the resulting energy in the form of chemical compounds. We are attempting in our research to find means by which solar energy can be transformed into chemical energy more efficiently."

"Oxygen evolving photosynthesis as such has been functioning in practically the same manner for a couple of billion years, and the cyanobacteria and plants have developed a variety of mechanisms to protect themselves against the highly oxidative reactions involved in the water splitting process which would otherwise have destroyed the photosynthesizing cells. In addition, the environmental variations involved under natural conditions place further demands on these defence mechanisms," Eva-Mari Aro explains.

"Our research is concentrated to a great extent at present on describing the

Academician Eva-Mari Aro has spent her whole scientific career on studying photosynthes

mechanisms that regulate photosynthesis, in order to assemble cyanobacteria and microalgae into living cell factories producing the desired chemical compounds that function as a storage of solar energy. Hydrogen is one of the cleanest energy carriers that cyanobacteria and microalgae produce naturally, but we have been able to make this bioprocess considerably more efficient in recent years."

Although photosynthesis has been studied for a long time, it is only since the threats posed by climate change have become apparent that anything has been done to develop applications for this process. In 2006 a group of European photosynthesis experts gathered together to consider the possibility of replacing fossil fuels with devices and living cell factories that mimic the mechanisms by which photosynthesis functions. Eva-Mari Aro was one of these people, and it is under her direction that Finland has emerged as one of the world's leading countries for photosynthesis research. At present she is coordinating an Academy of Finland Centre of Excellence in this field which has finance up to the end of 2019, and also the Nordic "NordAqua" Centre of Excellence which is due to function over the period 2017-2022.

"My duty is beginning to be one of ensuring the continuity of this research. The potential for photosynthesis to serve the purposes of producing clean energy has now become obvious to the EU Commission, which has issued a 'roadmap' for the adoption of this form of energy production."

The European SUNRISE project "Solar Energy for a Circular Economy" received a total of a million euros in funding for a year beginning in spring 2019, with the aim of developing a roadmap for a large European research programme in this field.

"The aim of the project will be to offer a sustainable alternative to the energy-intensive, fossil fuel-based production of fuels and chemicals. This should be grounded in the transformation of solar energy and the utilization of widely available raw materi-

als such as carbon dioxide, water and nitrogen. The project will be consistent with the recently published long-term European Commission strategy, which is aimed at rendering Europe climatically neutral by 2050," Eva-Mari Aro continues.

The project will bring together researchers, representatives of industry, political and governmental decision–makers, citizens' organizations and global actors in the energy, chemicals and automotive sectors, who will together draw up a roadmap for an extensive programme of research in the fields of energy, the environmental and climate change.

In order to attract researchers, the EU Commission has also announced a competition for a prototype for an artificial process mimicking photosynthesis, with a prize amounting to five million euros. The EU is obviously intent on moving forward as fast as possible.

"More than 10 years had elapsed after 2006 before the EU Commission showed any interest in the scenarios that the European photosynthesis researchers had put forward. As climate change progressed further it nevertheless became evident that no easy answers could be found to the problem of replacing fossil fuels with clean technologies, and thus it was necessary to turn at once to future technologies such as artificial photosynthesis and cell manufacturing techniques," Aro recalls.

Eva-Mari Aro, who is vice-president of the European Academies' Science Advisory Council (EASAC), also appreciates that the Commission has awakened to the value of research results as a basis for informed decision-making.

Shortly we hope to have solutions available for one of the most difficult issues facing mankind at the moment – the generation of clean energy.

The Academy Award is the highest honour that the Finnish Academy of Science and Letters can confer on a scholar in recognition of his life's work. The Academy has awarded the Academy Award since 1945.

Photo: Matti Immonen / Academy of Finland