Student projects on Energy Systems Analysis 2018/2019

Accelerating the energy transition

The world is moving towards relying more and more on sustainable energy sources. However, to limit the threats associated with climate change, a much faster transition is necessary than what we see nowadays. The question is how can we speed up the transition, e.g. to use more wind and solar energy for electricity production? When we look at the world as a whole, we see some countries with a rapid deployment, whereas many other countries are lagging behind.

There may be many barriers, e.g. there is not enough space, industrial capacity cannot be scaled up fast enough, it may be too costly, adaptation of the electricity system needs more time, there is a lack of political will, etc. The aim of this proposal is to investigate what the role of each of these potential barriers is and whether these barriers can be overcome. The research would have a global character and could focus e.g. on the G20 countries.

Suitable master programmes are: Sustainable Energy Technology, Industrial Ecology, Complex Systems Engineering and Management. For more information, please contact Kornelis Blok, k.blok@tudelft.nl.

Energy efficiency as the critical enabler of low-carbon development

One of the challenges for the coming decades is to embark on greenhouse gas emission pathways that are compatible with a limited global temperature rise. Such pathways are developed using so-called integrated assessment models (IAM). In an IAM all sources of greenhouse gases and all mitigation options are simulated, e.g. for the period up to the year 2100.

Energy efficiency improvement is widely considered as one of the most important options to reduce greenhouse gas emissions, but the modelling of energy efficiency options in IAMs is relatively weak. The aim of this project is to develop better models for energy efficiency, e.g. in buildings and industry, in such a way that they can be integrated in the IAMs.

The project will be carried out in close cooperation with the Netherlands Agency for Environmental Assessment PBL in The Hague. This organisation runs the IMAGE model, which is one of the most well-know IAMs. For more information about this model, see:
http://themasites.pbl.nl/models/image/index.php/Welcome_to_IMAGE_3.0_Documentation.
Suitable master programmes are: Sustainable Energy Technology, Industrial Ecology, Complex Systems Engineering and Management. For more information, please contact Kornelis Blok, k.blok@tudelft.nl.

Big data for much more efficient buildings

Buildings are responsible for about 40% of global energy use. It is surprising how little we know about what all this energy is used for. This is especially the case for buildings in the service sector (offices, schools, hospitals, etc.). We only have anecdotal information of how much of all the energy is used for various categories, like lighting, computers, heating, ventilation and air conditioning. We also do not know how efficient the energy is used. Even less is known on how we can make buildings more efficient.

At the same time, lots of data are gathered, e.g. from smart meters, ICT systems, wifi connectivity, and building management systems. The aim of the master thesis project is to investigate whether we can get

a better understanding of energy use and energy efficiency improvement in buildings if we combine all these data in a smart way.

The idea is to use data for buildings at Delft University of Technology. The research work will include energy analysis of the buildings combined with statistical analysis of the data.
Suitable master programmes are: Computer Science, Sustainable Energy Technology, Industrial Ecology, Complex Systems and Management.
For more information, please contact Kornelis Blok, k.blok@tudelft.nl.

Hydrogen for urban energy supply

One of the big challenges for the coming decades is to convert the built environment (homes, office buildings, etc.) to zero-carbon energy. This can be done in different ways, for example by applying heat pumps fed by electricity from renewable sources, or by using heat from renewable sources (e.g. geothermal energy). An option that so far received little attention is the use of green hydrogen, i.e. hydrogen that is produced via electrolysis using electricity from renewable energy sources, such as solar and wind energy.

The application of hydrogen in urban situations can take different forms. One way is to replace the current natural gas supply by the supply of hydrogen and use the hydrogen in converted boilers. A second option is to use hybrid systems in which heat pumps and hydrogen-fired boilers are combined. A third possibility is to use the hydrogen in fuel cells to produce both heat and electricity. The aim of this project is to analyse the potentials and costs of these options and compare them with alternatives, Also, the consequences for the urban energy systems need to be investigated.

The analysis will be carried out for concrete cases in the Netherlands, e.g. Dordrecht and Goeree-Overflakkee.
Suitable master programmes are: Sustainable Energy Technology, Industrial Ecology, Complex Systems Engineering and Management (COSEM) or Architecture, Urbanism and Building Sciences (Track Building Technology). For more information, please contact Kornelis Blok, k.blok@tudelft.nl or Chris Hellinga, c.hellinga@tudelft.nl.

The role of hydrogen in a 100% sustainable energy system

The transition to a carbon-free electricity system requires that not only electricity, but also heat and fuels are produced from sustainable sources. In most scenarios, the provision of transportation fuels and industrial heat is to a large extent covered by bio-energy sources. Although bio-energy sources are available and can in principle be produced in a sustainable way, they have their limitations and sometimes lack social acceptance. An alternative is to produce hydrogen en other fuels on the basis of renewable electricity.

The aim of this research project is to explore what role these fuels can play in the development of the global energy system. It requires on the hand an analysis of the various production methods of these fuels, and second a scenario analysis to explore the role they can play in the integrated energy system.

The project builds on an earlier MSc thesis project by Pieter van Exter:
https://repository.tudelft.nl/islandora/object/uuid%3Aa0df8a13-e477-4f44-817b-def39496d679.
See also this blog about the role of hydrogen in this scenario:
https://www.navigantresearch.com/blog/hydrogen-as-an-energy-carrier-enabling-the-100-decarbonisation-of-the-energy-system.

Suitable master programmes are for example: Sustainable Energy Technology, Industrial Ecology, Complex Systems Engineering and Management (COSEM). For more information, please contact Kornelis Blok, k.blok@tudelft.nl.