Student projects 2018

Big data to improve our understanding of energy use of 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.
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 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. Currently, these data are gathered. 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.

The role of hydrogen and other solar fuels in 100% sustainable energy systems

Several scenarios have been constructed that show that a transition to 100% sustainable energy by 2050 is feasible. Most of these scenarios rely primarily on solar energy, wind energy and bio-energy. Regarding the latter there are questions whether sufficiently rapid scale-up is possible within sustainability constraints. At the same time, the costs of wind and solar electricity have come down substantially. This suggests that it might be possible to rely much more on hydrogen and other fuels produced with renewable electricity.
This raises to research questions:

- How would an efficient energy system look like that has a high share of these fuels?
- Can the capacity of wind and solar power generation, electrolysis etc. be scaled up sufficiently fast?

An energy system simulation model is already available, see: P. van Exter's master thesis:
https://repository.tudelft.nl/islandora/object/uuid%3Aa0df8a13-e477-4f44-817b-def39496d679

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

100% sustainable electricity systems for islands

Islands are an obvious target for the transition to sustainable energy: they often have abundant renewable energy resources and the costs of conventional energy are quite high. Earlier research has shown that 50 – 70% solar and wind energy can relatively easily be integrated in electricity systems of islands. To achieve higher shares it is necessary to add storage, or additional resources, like ocean energy sources.

In addition, flexibility of electricity demand may facilitate higher shares of renewable energy. Flexibility of demand can be achieved e.g. through controlled charging of electric vehicles, vehicle-to-grid technology, heat storage and industrial heating. The aim of the thesis project is to investigate the role that these flexibility options can play.

This project builds on previous master thesis research, e.g.:
https://repository.tudelft.nl/islandora/object/uuid:9115fc4a-8589-4f6a-baa7-b4d868fdb5a8?collection=education. A simulation and optimization model is already available that can be expanded with demand side flexibility options.
Suitable master programmes are: Sustainable Energy Technology, Industrial Ecology.
For more information, please contact Kornelis Blok, k.blok@tudelft.nl.

Better modelling of energy efficiency in Integrated Assessment Models

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. Although energy efficiency improvement is widely considered as one of the most important options to reduce greenhouse gas emissions, the modelling of energy efficiency options in IAMs is relatively weak. The aim of this project is to design 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.