

1. Energy Audit, flexibility & dashboarding

This module presents an overview of energy audits to identify opportunities for energy cost and energy (electrical and thermal) reduction in existing installations. Students will gain an understanding on how to procure an energy audit, how to carry out an energy audit, how to evaluate energy audits results and how to plan the implementation of the opportunities. Students will also be able to specify, procure, and review energy audits. Efficient dashboards are used to facilitate strategic energy goal and energy flexibility.

Syllabus	Lectures	Tutorials	Laboratory
Energy audits	14	0	0
General context of Energy audits	2		
Audit workflow - planning - data collection	3		
Preliminary analysis - trends & balance sheet	2		
Preliminary analysis - current performance	2		
Measurement plan and Technical audit	3		
Audit reporting and closing meeting	2		
Dashboarding	4	0	0
Key Performance Indicators	1		
Dashboard design	2		
Dashboard examples	1		
Smart Buildings - wellbeing	2		
Energy flexibility	4	0	0
Energy market	2		
CO2 market	2		
Projects	2	20	6
Project audit			
Project dashboarding	2	20	6
Module Total	24	20	6
Learning outcomes			
The student is able to plan, procure and carry out an energy audit.	ICT1.1		
Based on the results of an audit, the student evaluate the results and make a plan to implement the opportunities.	ICT1.2		
The student is able to select KPI's for dashboarding, to set up analytical methods for dashboarding and to design and implement a managerial as well as a technical dashboard, with appropriate follow-up and action procedures.	ICT1.3		
The student understands the drivers for energy flexibility.	ICT1.4		

2. Big Data & Internet of Things

Sensor & monitoring devices create a massive flood of data. In this module you learn to design an IT back-end that can handle that kind of data. Using cloud services you collect, process, and analyze real-time, streaming data so you can get timely insights and react quickly accordingly.

Syllabus	Lectures	Tutorials	Laboratory
Sensors	3	0	0
Sensors and interfaces	3		
Storing Data	10	0	8
Intro	2		
Relational databases	2		
Linux workshop			4
NoSQL	2		
Influx DB praktijk			4
NoSQL + opdracht	2		
Batch data	2		
Cloud Services	6	0	8
Intro to Cloud	2		
Cloud in practice			4
Streaming Data	2		
Overview data architecture	2		
Review			4
Learning outcomes			
The student can use cloud services to collect, process, and analyze real-time, streaming data.	ICT2.1		
Module Total	19	0	16

3. Artificial Intelligence & Machine Learning

In this module the student is introduced to the world of Artificial Intelligence. Machine learning & Neural Networks are applied to the energy flexibility context.

Syllabus	Lectures	Tutorials	Laboratory
Introduction	6	2	2
- Data Science - Introduction to AI use cases			
Machine Learning	12	12	4
- Regression - SVM, Hyper Parameter Tuning - Naive Bayes & Random Forests - Unsupervised Learning			
Introduction to Neural Networks	2	0	2
Introduction - Neural Networks & AI			
Energy cases	0	0	9
Learning outcomes			
The student can identify AI and ML opportunities in time series data.	ICT3.1		
The student is able to select the right machine learning method to predict future values.	ICT3.2		
The student can apply basic AI and ML on energy cases	ICT 3.3		
Module Total	20	14	17

4. Renewables, storage and smart grids

Future grids face major challenges, in this module the intention is to go deeper into those challenges and to investigate how these challenges can be tackled with new innovative technologies. By analyzing consumption and yield profiles and implementing smart control strategies and storage systems, a techno-economic optimum can be achieved.

Syllabus	Lectures	Tutorials	Laboratory
Renewables	9	4	7
Introduction	2		1
Renewables	5		
Dimensioning renewables by consumption and yield profiles (python)	2	4	6
Energy storage	10	2	4
Storage systems	6		
Dimensioning storage systems	4	2	4
Smart grids	8	6	10
LEC	2		
District heating	1		
Power Quality	1		
HV and HV	2		
Digital twins	2		
Smart grids		6	10
Module Total	27	12	21
Learning outcomes			
The student knows renewables and their applications.	ICT4.1		
The student knows energy storage systems and their applications.	ICT4.2		
The student can make an integrated optimisation in renewable heat and electricity applications on basis of consumption and yields	ICT4.3		
The student knows smart grids in electricity and heat	ICT1.3		

5. Blockchain & Security

This module focusses on all aspects of information security. It approaches the threats of information management and data flow and provides best practices and solutions. By using a practical approach and many hands on scenario's the pitfalls of both technical and policy security for any implementation is being detailed. Blockchain technology is discussed as a novel method for sharing trusted data in a digital interconnected world.

Syllabus	Lectures	Tutorials	Laboratory
Information Security Management	7		0
- Risk management and threat modelling - Technical cybersecurity frameworks - Legal cybersecurity frameworks			
Cryptography	4		0
- Symmetric and asymmetric cryptography - Hashing - Digital signatures - Secure multiparty computation			
Case Study	4		14
Case study in energy context			
Blockchain Technology Fundamentals	8		0
- Blockchain 1.0 - Blockchain beyond cryptocurrency - Consensus mechanisms - advanced blockchain concepts			
Blockchain for Business	3		0
- Blockchain use-cases - The network economics of a successful blockchain - Blockchain Technology landscape			
Learning outcomes			
The student is able to understand the security implications of the selected components.	ICT5.1		
The student is able to evaluate potential blockchain use cases and implement according to current best practices.	ICT5.2		
Module Total	26	0	14