



FESIO (Flexible Energy Systems Integration and Optimization)

Heat Recovery in Waste Water 20230510.

Sören Mattbäck, Novia

Heat Recovery from Waste Water

Agenda:

- presentation of Novia UAS and our RDI activities
- presentation of FESIO project
- Heat Recovery from Waste Water in Technobothnia laboratory
- Heat Recovery from Waste Water sub-project



WELCOME TO NOVIA UNIVERSITY OF APPLIED SCIENCES

- The largest Swedish-speaking University of Applied Sciences in Finland
- Number of students: 4 800
- Number of staff: 320
- Novia is located in four cities on the west coast of Finland

Novia UAS offers:

- Bachelor's Degree Programmes in Swedish and English
- Master's Degree Programmes in Swedish and English



NOVIA'S DEGREE PROGRAMMES

Novia's degree programmes are planned with focus on tomorrow's working life in order to give our students

- good opportunities on the labour market
- skills in their professional field
- good communicative and social skills
- co-operation and team-working skills
- capability to work in an international environment

Bachelor level studies

- 210 – 270 credits
- 3,5 – 4,5 years

Master level studies

- 60 – 90 credits
- 1,5 – 2,5 years (in general blended learning as part-time studies)



ONE UNIVERSITY – SEVERAL **CAMPUSES**

Campus Vaasa
2200 students

Campus Raasepori
300 students

Campus Turku and
Aboa Mare Turku
1360 students

Campus Allegro Pietarsaari
350 students

BACHELOR'S DEGREE PROGRAMMES IN ENGLISH 2023

Health and Welfare

Bachelor of Beauty and Cosmetics, [Beauty Care](#), 210 ECTS/3,5, Vaasa

Bachelor of Health Care, [Biomedical Laboratory Scientist](#), 210 ECTS/3,5 years, Vaasa

Bachelor of Health Care, [Nursing](#), 210 ECTS/3,5 years, Vaasa

Technology and Seafaring

Bachelor of Maritime Management, [Maritime Management, Captain](#) 270 ECTS/4,5 years, Turku

Bachelor of Maritime Management, [Maritime Management, Captain](#), 270 ECTS/4,5 years, Turku

Bachelor of Engineering, [Maritime Technology](#), 270 ECTS/4,5 years, Turku

Bachelor of Engineering, [Information Technology](#), 240 ECTS/2 years, Vaasa

Bachelor of Engineering, [Energy Technology](#), 240 ECTS/2 years, Vaasa *

Arts and Humanities/Culture

Master of Culture and Arts, [Entrepreneurship In the Art, Music Production](#), 60 credits/1,5 years, Pietarsaari

Bioeconomy

Bachelor of Natural Resources, [Sustainable Coastal Management](#), 240 ECTS/2 years, Raasepori *

* Notice! Eligibility criteria: 120 ECTS of previous university level studies in a relevant field.



APPLICATION
4-18 January 2023





MASTER'S DEGREES IN ENGLISH 2023

BUSINESS ADMINISTRATION

- Master of Business Administration, Digital Business and Management, 90 ECTS, Vaasa
- Master of Business Administration, Service Design, 90 ECTS, Turku

HEALTH AND WELFARE

- Master of Health Care/Master of Social Services, Health Care and Social Services, 90 ECTS, online studies

TECHNOLOGY AND SEAFARING

- Master of Engineering, Automation Technology, 60 ECTS, Vaasa
- Master of Engineering, Industrial Management and Engineering, 60 ECTS, Vaasa
- Master of Engineering/Master of Maritime Management, 60 ECTS, Turku
- Master of Engineering, Autonomous Maritime Operations, 60 ECTS, Turku
- Master of Engineering, Structural Engineering, 60 ECTS, Raasepori

BIOECONOMY

- Master of Natural Resources, Natural Resources Management, 60 ECTS, online studies

ARTS AND HUMANITIES

- Master of Culture and Arts, Entrepreneurship in the Art, Music Production, 60 ECTS, Pietarsaari, New 2023



RESEARCH, DEVELOPMENT AND INNOVATION

- RDI activities at Novia UAS are based on long-term sustainability and carried out within six selected focus areas.
- We co-operate closely with enterprises, municipalities and other organisations in order to support regional development and our education.
- We conduct versatile project activities and have substantial know-how of various external funding schemes.
- We co-operate with other institutions of higher education in Finland and abroad.
- RDI activities are ongoing on each campus and are realized through various projects.
- In 2021 Novia undertook 137 projects with a total value of 20.4 million euros.

Novia RDI, Our areas of expertise



Sustainable
Energy Technology



Automation and
Maritime Simulation



Interprofessional
Health and Welfare



Business
Development



Arts, Culture and
Entrepreneurship



Bioeconomy and
Sustainable Use of
Natural Resources



Novia RDI within the focus area Sustainable Energy Technology

Basics

- One of five R&D focus areas at Novia.
- Operations almost entirely based on external funding.
- Most of the funding in the form of public funded projects.

Personnel

- Now 25 R&D personnel.
- Approximately 15 teachers and other personnel doing R&D.
- In total about 40 persons involved in project work locally.

Topics

- Environmental chem.
- Data analysis.
- Vibrational spectroscopy.
- Biogas production.
- Wind power.
- Energy systems.
- IoT, AI, Robotics
- Building maintenance.

Projects

- About 40 ongoing projects.
- Range 5-550 k€ (Novia), 1-3 years.
- Typical national proj. 2 years, 100 k€.
- Typical internat. proj. 3 y., 350 k€.

Financing

- Interreg, ERDF, EAFRD, ESF, Business Finland, AIKO, Private funds, Purchase services, etc.
- Horizon eventually?

Future

- A continuous need for new projects and partners.
- Partnership in Horizon projects.
- Larger partnerships and projects.

John Dahlbacka, John.Dahlbacka@novia.fi
more at <https://www.novia.fi/forskning/projekt/hallbar-energiteknik>

Novia RDI, Competences



Intelligent systems

- IoT applications
- Automation technology
- VR, AR, MR and XR
- Additive manufacturing
- Multivariate analysis, machine learning and AI
- Compositional Data Analysis (CoDa)
- Experimental planning (Design of Experiments)

Measurement technology

- Laser Scanning, Trimble X7
- Point clouds
- Aerial photography
- Noise measurements
- Thermography
- Infrared spectroscopy

Environmental technology and sustainability

- Anaerobic digestion
- Nutrient cycling
- Acid sulfate soils
- Life cycle analysis
- Circular economy
- Sustainable procurement
- Carbon-efficient construction

Energy technology

- Distributed energy systems
- Fossil-free fuels
- Off-grid system solutions
- Dynamic simulations
- Mechanical engineering and engine technology
- Real estate technology and HVAC



FESIO

Flexible Energy Systems Integration and
Optimization

Presentation of Abstract in FESIO:

The world shows strong commitment to decarbonise its economy and the energy sector is considered one of the main enablers for achieving this. The ambitious goal for the Flexible Energy Systems Integration and Optimization (FESIO) project, a joint research, development, and innovation (RDI) initiative of Novia University of Applied Sciences (Novia) and Vaasa University of Applied Sciences (VAMK), is to contribute to the paradigm change of the energy industry and to support the local region and companies in the leading energy cluster in the Nordic countries, the Vaasa region. FESIO aims at executing cross disciplinary RDI activities for improved research quality and competitiveness in four interlinked work packages, in collaboration with stakeholders within the applications of energy, marine (off grid), transport and logistics:

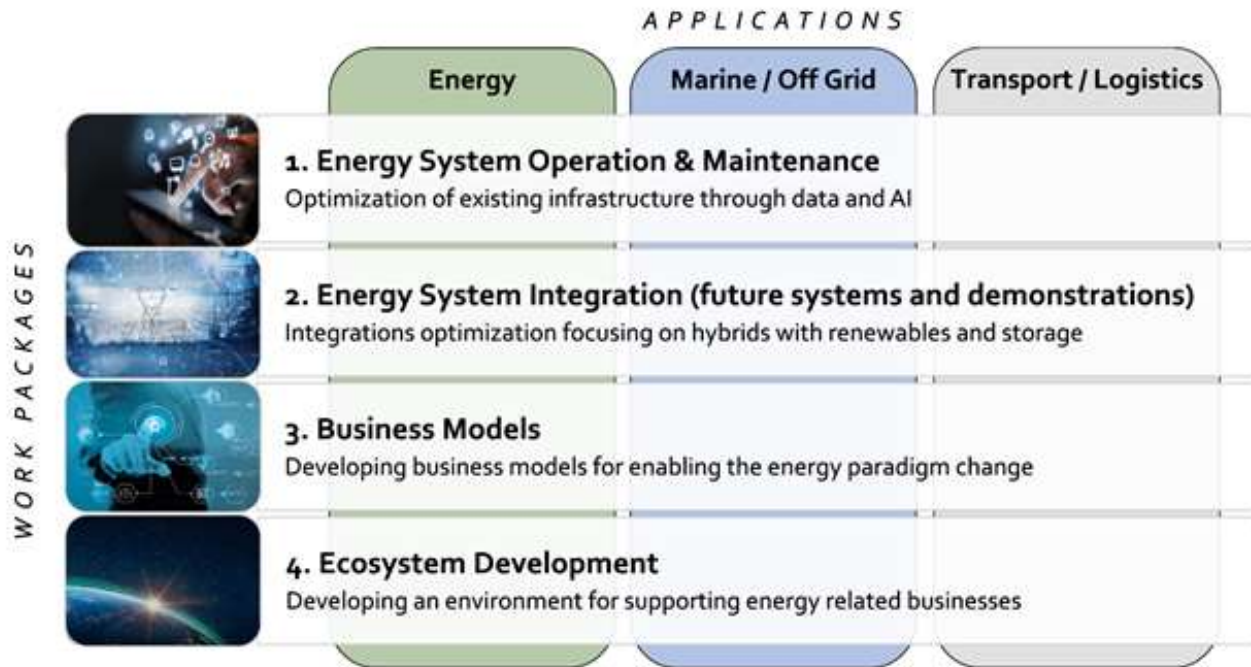
- Energy system operation and maintenance (WP1).
- Energy system integration (WP2).
- Business models (WP3).
- Ecosystem development (WP4).

FESIO provides new and innovative opportunities for energy system management and optimization driven by artificial intelligence (AI). It strengthens the regional RDI expertise regarding energy storage and integration and enhances competences and ecosystem collaboration towards international acclaim. The project directly supports energy technology development for enabling a smoother transition to a low carbon future.



Strategic initiatives

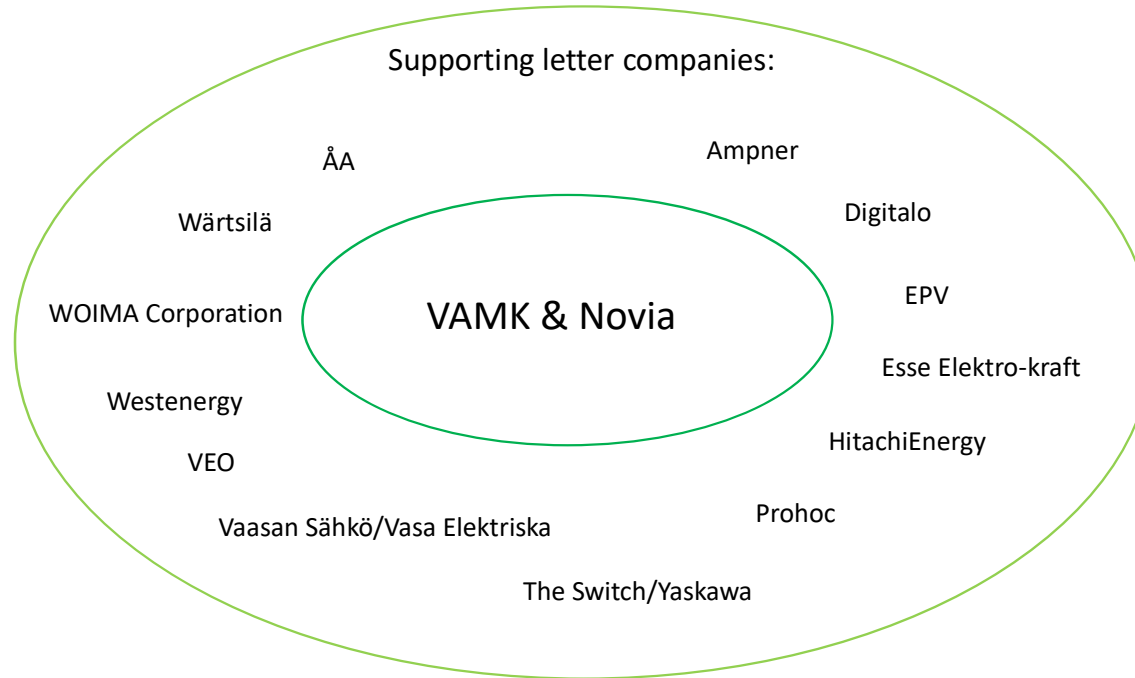
Flexible Energy Systems Integration and Optimization (FESIO), a project funded by the Ministry of Education and Culture.



WP4 FESIO Ecosystem development core team

Task 4.1 Actor identification and ecosystem mapping

Task 4.2 Networks facilitation to develop new capabilities and competencies for competitive advantage

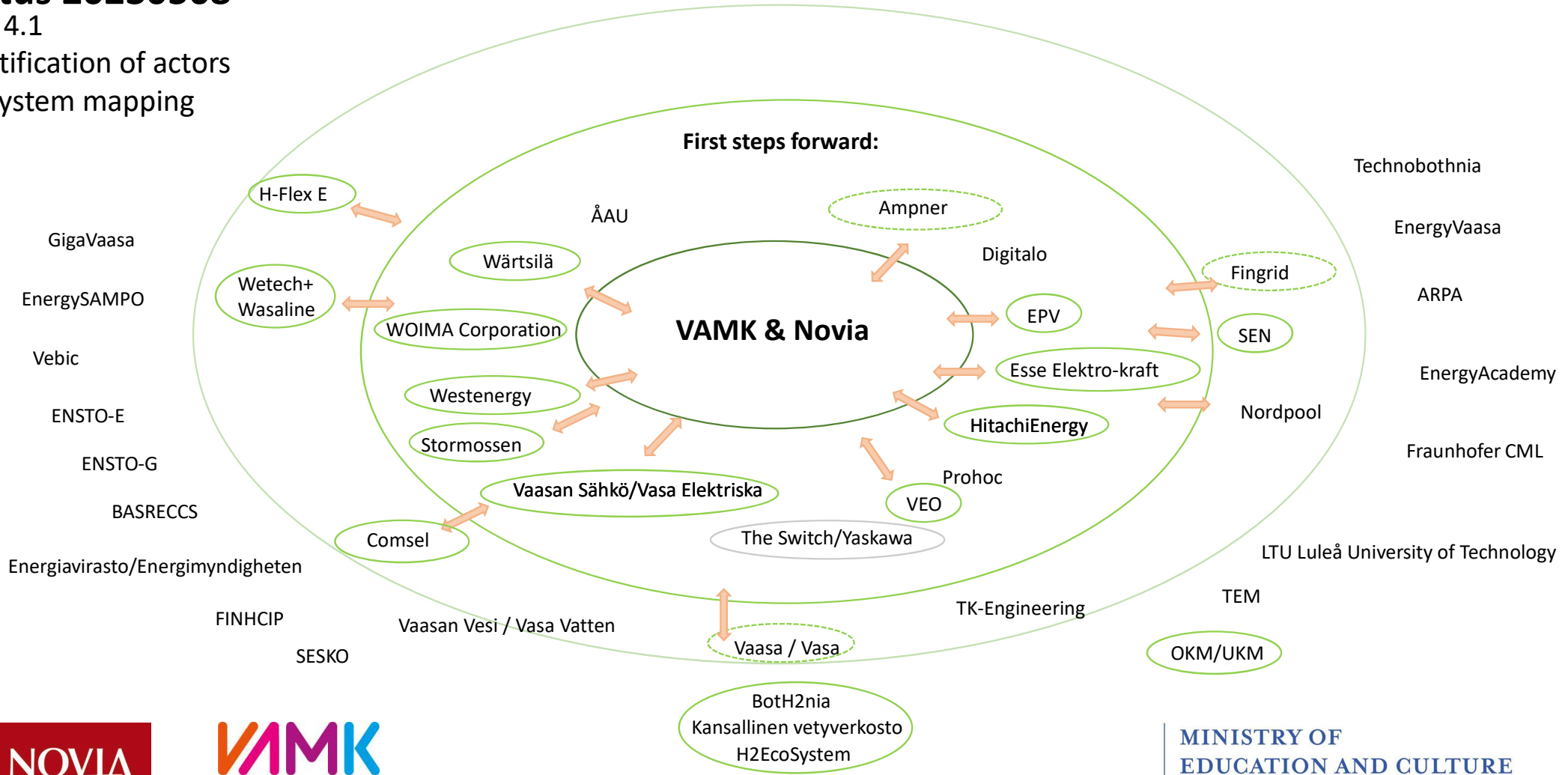


WP4 FESIO Ecosystem development core team extended and players around status 20230508

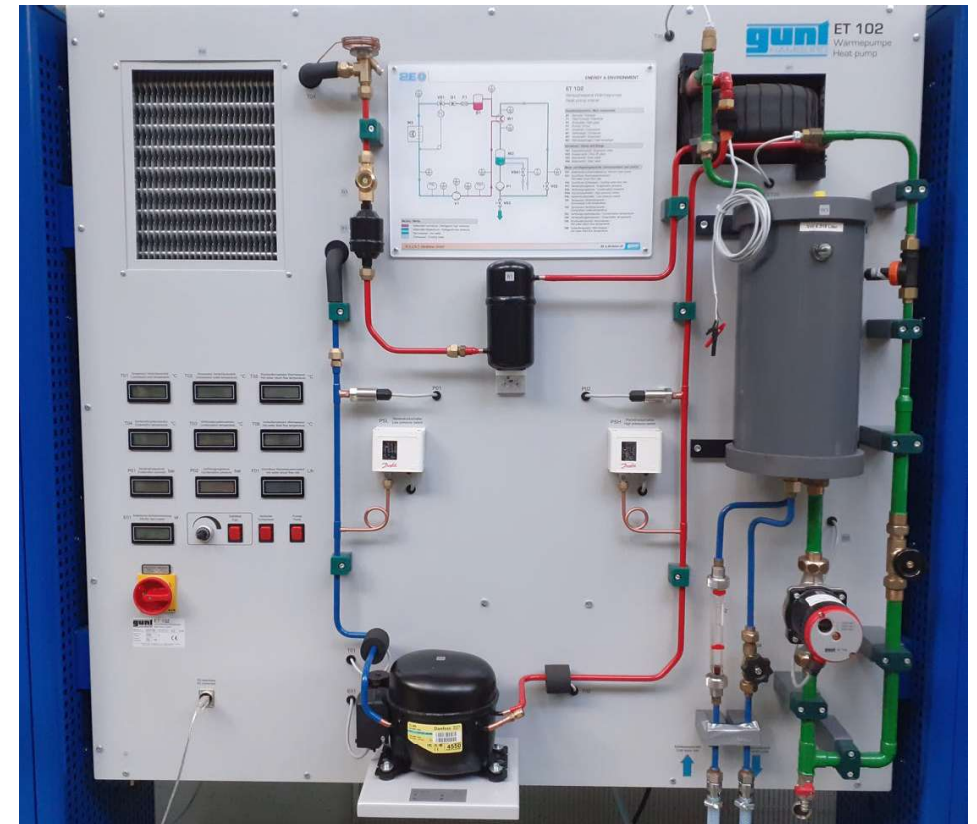
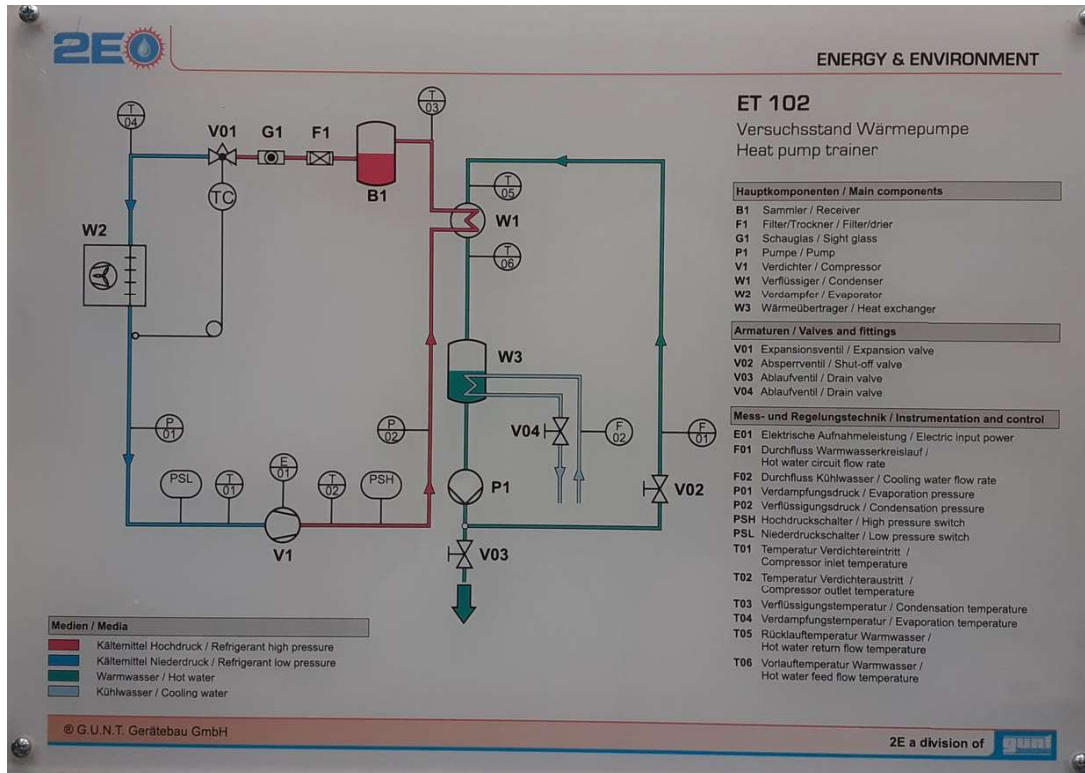
Task 4.1

Identification of actors

Ecosystem mapping



Heat Pump laboratory equipment in Technobothnia Energy laboratory



Here in the EnergyLab students can make laboratory work regarding e.g. Heat pump systems.
 -heat energy transformation, input electricity, output heat energy
 -efficiency, COP value calculation

Heat Recovery from Waste Water within FESIO WP1

Optimization of Heat pump system using a mixed integer linear optimization (MILP) model.

Basic idea

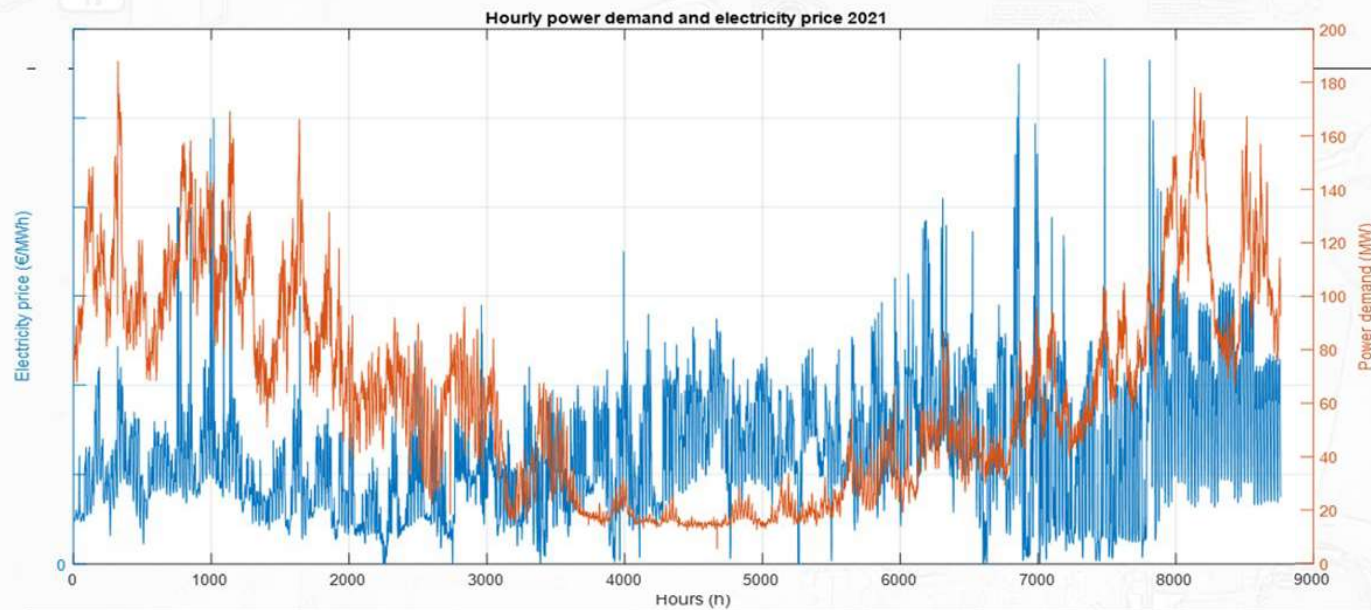
- A set of boilers with given costs (operating, startup, shutdown, preheating) are available.
- Each boiler has minimal and maximal power level constraints when operated.
- We assume that the power demand and the spot prices are known or can be estimated.
- An optimization problem is formulated that computes the minimal total cost of operating the boilers, so that the given power demand over some future time horizon in (for example 24h, 48h, 1 week ,...) is satisfied.

Novias team:
M.Borg
R.Pörn
J.Westö
S.Mattbäck

Heat Recovery from Waste Water within FESIO WP1

Optimization of Heat pump system using a mixed integer linear optimization (MILP) model.

Spot prices and power demand (tuotantotehot) year 2021



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YRKESHÖGSKOLAN
NOVIA

Forskning
Utveckling
Innovation

Ray Pörn

8.5.2023

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NOVIA
UNIVERSITY OF APPLIED SCIENCES

VAMK
VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES



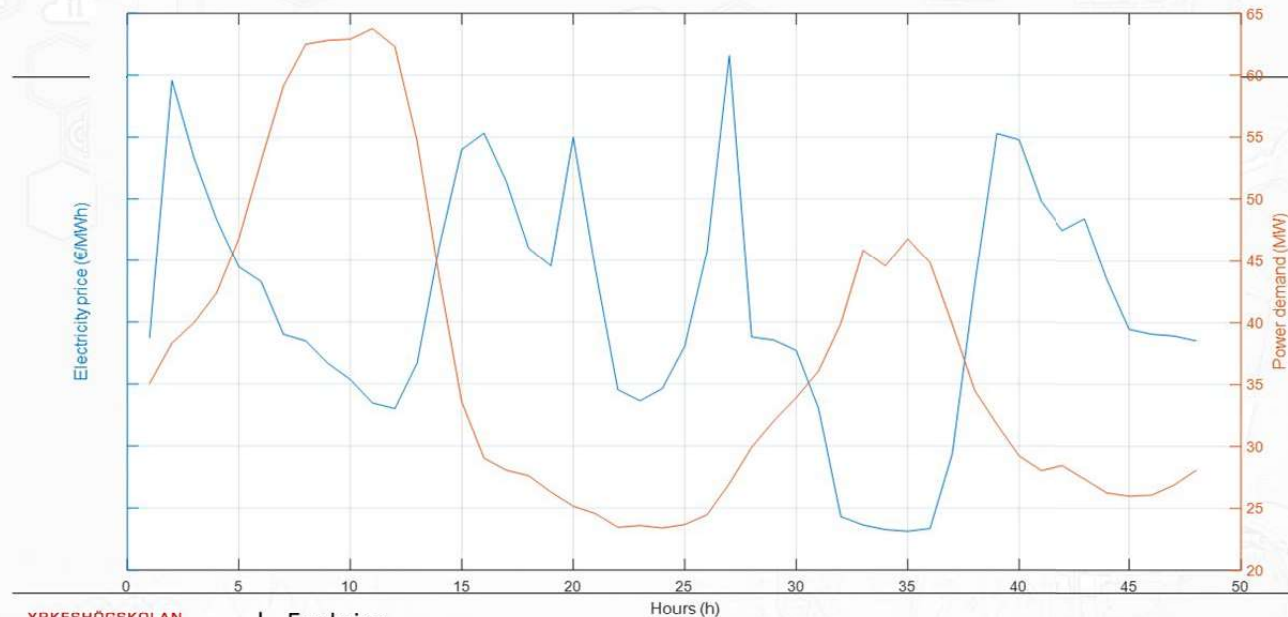
**Seinäjoen
Energiä**

MINISTRY OF
EDUCATION AND CULTURE
FINLAND

Heat Recovery from Waste Water within FESIO WP1

Optimization of Heat pump system using a mixed integer linear optimization (MILP) model.

Example 1: Spot price+x and power demand over 2 days



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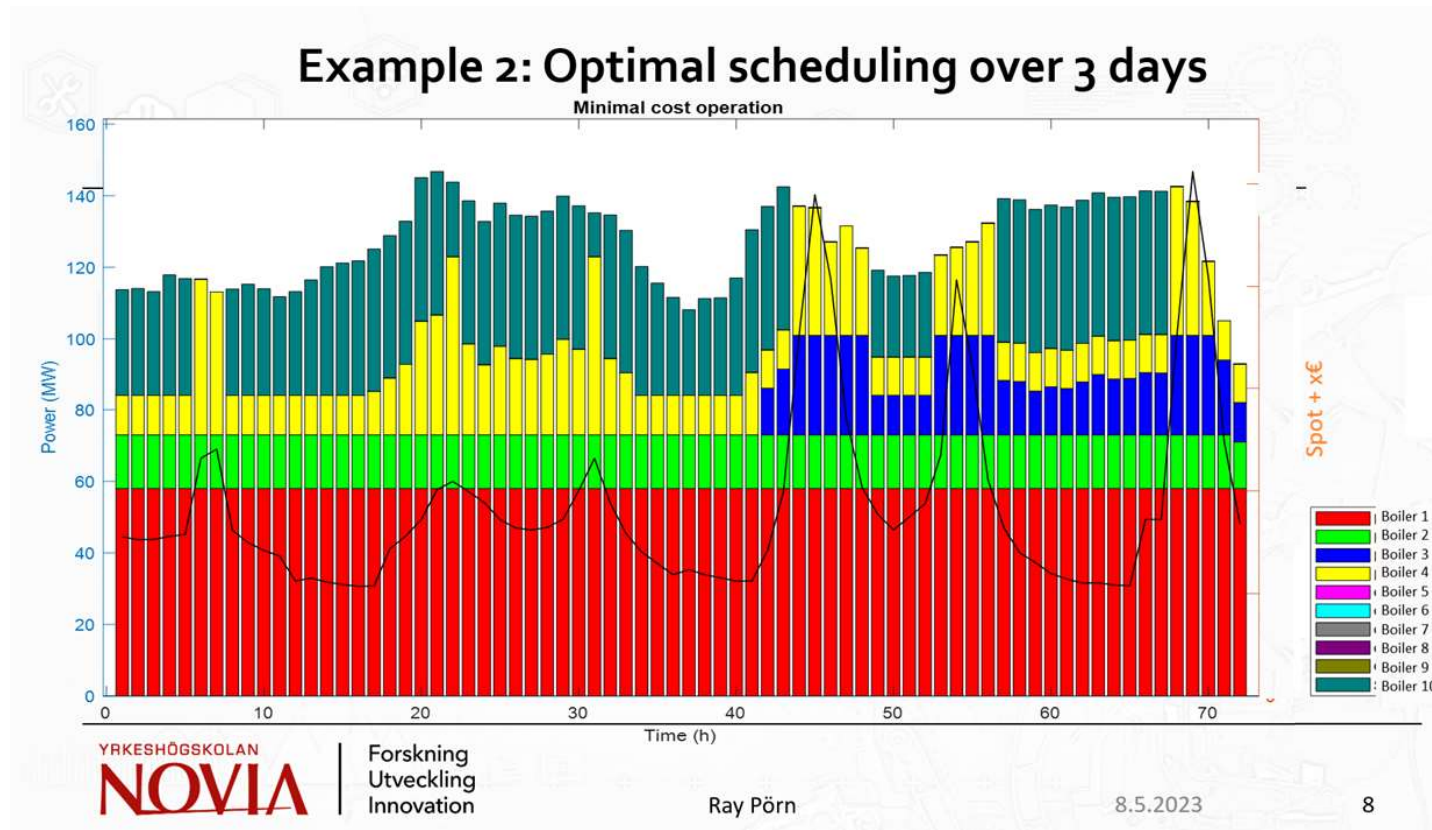
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Heat Recovery from Waste Water within FESIO WP1

Optimization of Heat pump system using a mixed integer linear optimization (MILP) model.




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Heat Recovery from Waste Water within FESIO

Optimization of Heat pump system using a mixed integer linear optimization (MILP) model.

Optimization model

Minimize	Total operating costs (including production/startup/shutdown)
Constraints	At each time interval the given power demand must be satisfied Power limits of boilers, $P_{min} \leq P \leq P_{max}$ or $P=zero$, at each time step Some additional constraints that model startup and shutdown costs
Variables	Power variables that are continuous Binary (logical) variables that determines which boilers are on/off in each time step.

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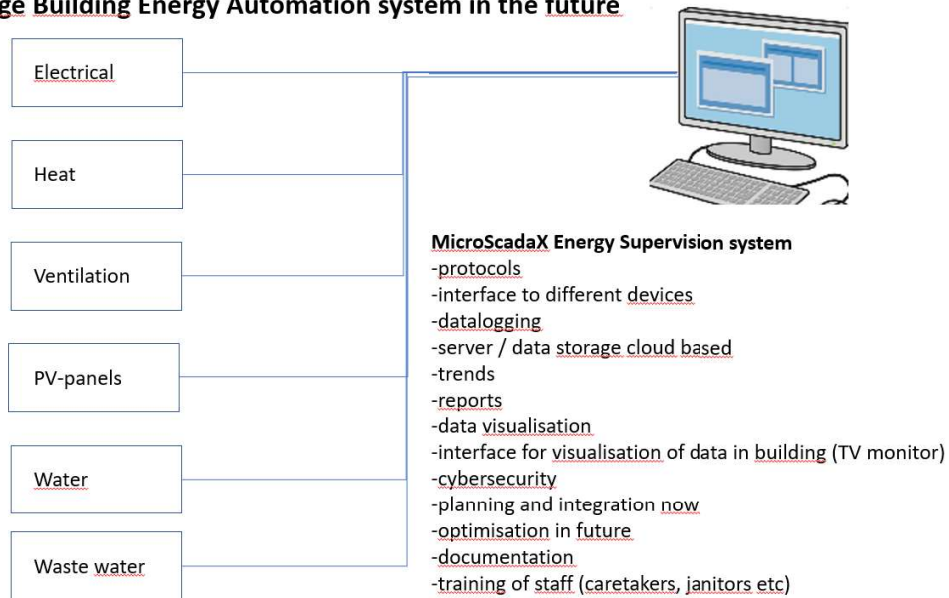
Ray Pörn

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Novias team:
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S.Mattbäck

How can FESIO bring added value for old large buildings and their energy consumption?

FESIO- Old Large Building Energy Automation system in the future

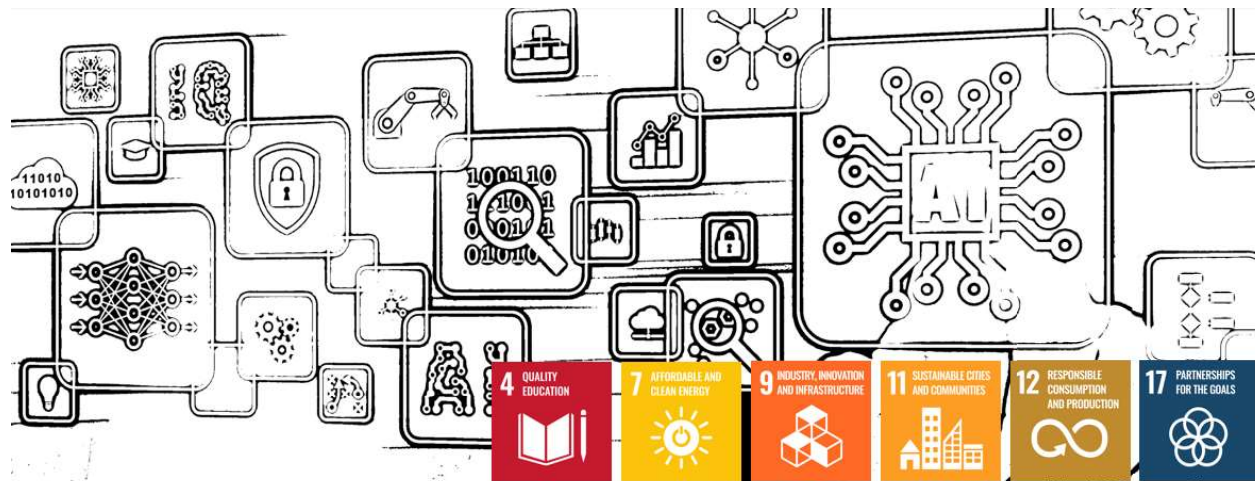


Can heat recovery in large buildings from waste water be utilized?
By measuring we get data, that can be analysed further on, to find out the answer.



Strategic initiatives

Intelligent systems institute, a research platform.



Intelligent Systems Institute

Applied intelligent systems research platform

We facilitate digitalization by making applied intelligent systems knowledge and resources readily available for companies. The intelligent systems institute @ Novia gathers collective knowledge from multiple experts with the intent to build and strengthen collaboration with companies. We want to get experts to tackle your relevant research challenges, and to provide hands-on assistance on real problems. We think that successful collaborations rely on researchers understanding the needs and challenges you face. Hence, we are more than happy to visit you onsite and to start exploring the opportunities you have.

THE MARITIME INDUSTRY – A TECHNICAL INDUSTRY

The shipping industry is being digitalised and ship technology is evolving rapidly. This means that modern-day seafarers need to have versatile technical knowledge.

As a maritime student at Novia, you can undertake practical exercises using state-of-the-art simulators, designed to replicate actual ship bridges.



» [Ten ship bridges \(simulators\) at Novia, Aboa Mare](#)

A CAREER AT SEA OR ON LAND

Shipping is an international industry. Our maritime study programmes provide students with all the skills they need to serve as an Officer in both national and international traffic – for example, on cruise ships, yachts, expedition vessels, tankers or cargo ships.

The training also furnishes the skills required to work ashore – for example, for maritime authorities, shipping company offices and ports, or in fairway maintenance or on maritime survey assignments.



INTERNATIONALISATION

- Novia UAS has an extensive network of international partners within the Nordplus and the Erasmus+ (European and Global) programmes. Double Degrees, common projects or other forms of deeper co-operation are initiated with strategic partners.
- Our objective is to offer students and staff an international study environment through Internationalisation at Home (IaH) and abroad, to promote tolerance and understanding and to develop skills needed for working in an international environment.
- We promote student and staff mobility in co-operation with institutions of higher education in the Nordic and Baltic Countries, Europe, China and beyond.
- Annually about 200 international degree students and 100 exchange students are studying at Novia UAS.

STRATEGIC PARTNERS



ÅBO
SVENSKA
TEATER





A **CERTIFIED** ORGANISATION

- The Finnish Education Evaluation Centre awarded Novia a quality label, valid 2019-2025. The quality system fulfills the national criteria set for quality management of institutions of higher education and corresponds to the European principles and recommendations for the quality management of institutions of higher education.
- Novia UAS' quality management system is certified by the international standard ISO 9001.



NOVIA

UNIVERSITY OF APPLIED SCIENCES