Erasmus+

Co-funded by the European Union

2024-2-CZ01-KA210-VET-000266645

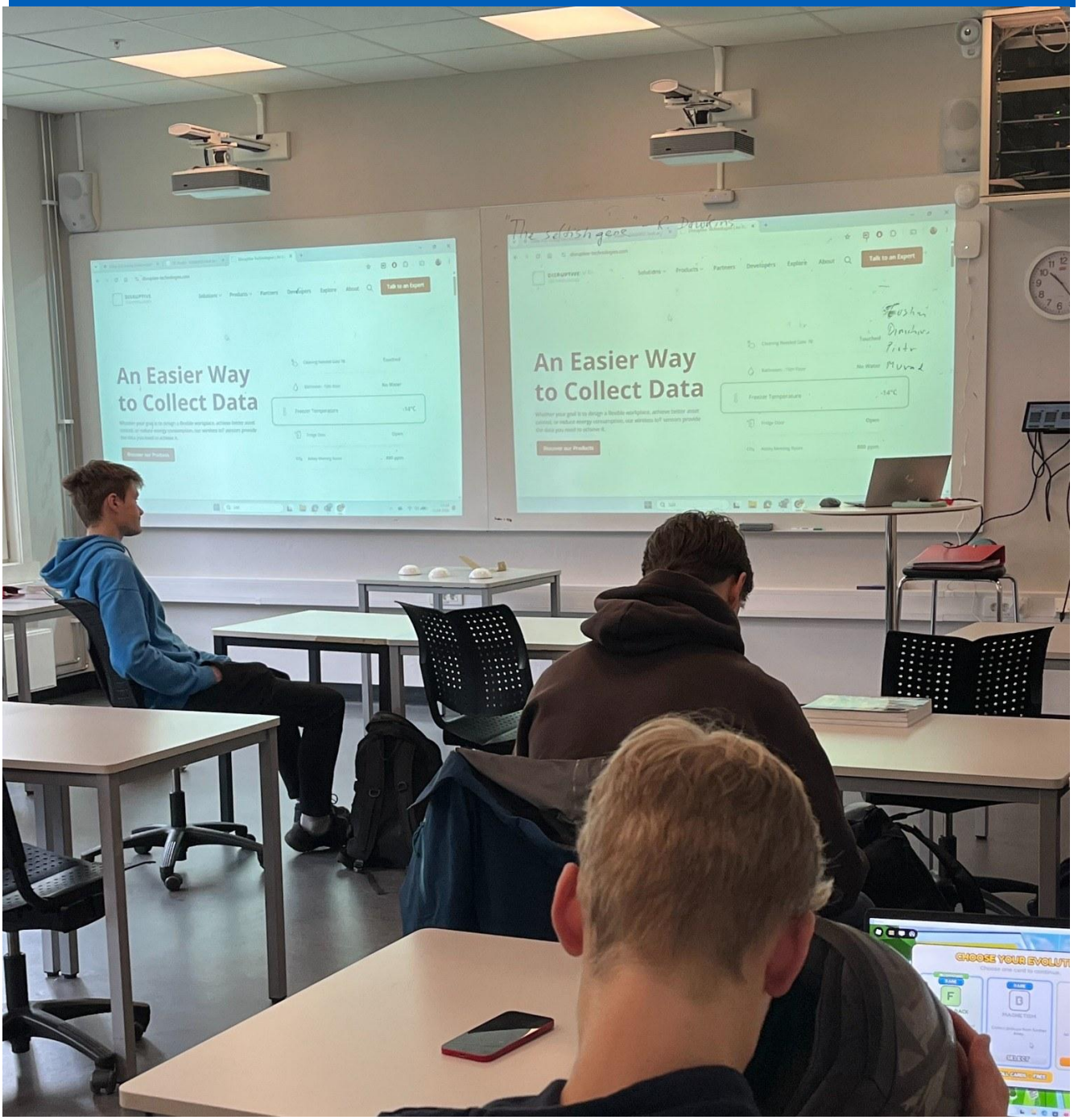
Education for the Future – Electromobility, Future Transport, Sustainable Transport

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Odda VGS - Project Outputs for Final Reporting

Erasmus+ Electromobility | Smart Building Energy Audit

Prepared by Lars Arne Bleie, teacher and project participant, Odda Upper Secondary School, Norway



Classroom introduction to Disruptive Technologies and the smart building sensor activity at Odda VGS.

Purpose of this report: to provide Jaroslav Kores and the Czech project team with structured input and traceable documentation for the final Erasmus+ Electromobility reporting. The report documents what Odda VGS contributed, how students worked, and how the activity connects to the project work packages.

1. Project overview

Odda VGS contribution to Erasmus+ Electromobility

Odda Upper Secondary School has participated in the Erasmus+ Electromobility project through learning activities related to smart buildings, energy efficiency, thermal imaging and sensor-based learning. The work connects electromobility to the wider challenge of energy use in buildings: schools, workshops and charging infrastructure all depend on electricity, capacity, heating, ventilation, operation and user behaviour.

The central educational idea was to let students investigate a real school building by comparing indoor temperature, outdoor temperature and room usage. This made energy use visible through data and gave students a practical role as energy advisers for their own school.

Core message from the Odda VGS activity: measure first - understand more - control better - save energy without reducing comfort.

1.1 Activities carried out

- Classroom introduction to smart buildings, energy efficiency and sensor-based learning.
- Use of thermal imaging as a starting point for understanding heat loss and building performance.
- Installation and demonstration of Disruptive Technologies temperature and motion sensors with a Cloud Connector / IoT sender.
- Student work with indoor temperature, outdoor temperature and motion/occupancy patterns.
- Creation of graphs, histograms, interpretations and realistic recommendations.
- Preparation of English/Norwegian teaching material, a student task and a sample Gamebook scenario.

1.2 Participants and vocational subjects

The project involved teachers and students at Odda VGS, especially students connected to vocational programmes in Electrical Engineering / Computer Technology and Technology and Industrial Production (TIP). The activity was suitable for 16-year-old vocational students because it combined physical equipment, digital systems, technical observation, group work and communication.

1.3 Example student group structure

Student	Role in the task	Project responsibility
Matias Frantzsen	Temperature	Read indoor/outdoor temperature data and describe thermal patterns.
Anna Oppedal	Movement / occupancy	Interpret motion data as an indication of room use.
Aleksander Knutson Espe	Presentation	Prepare summary, graphs and short presentation for reporting.

Note: Names and role categories are taken from the Odda VGS student group list. Photos in this report are not captioned with student names.

1.4 Submitted outputs from Odda VGS

English presentation	Norwegian version / summary
Student assignment: Smart Building Energy Audit	Photos of equipment, sensor placement and classroom activities
Screenshots and teaching visualisations	Examples of student analysis and recommendations
Energy Exhibition material	Gamebook scenario: The Energy Adviser

2. Educational concept

From theory to measurement, analysis and advice

Smart building concept used as visual support for the teaching programme.

2.1 Learning logic

1. Understand energy, power, heat and heat loss.
2. Map which rooms should be measured and how they are normally used.
3. Measure temperature, motion and outdoor reference data over time.
4. Analyse graphs and histograms to find patterns, deviations and possible waste.
5. Advise the school by proposing realistic operational and technical actions.

2.2 Sustainable Development Goals

The activity connects to Sustainable Development Goals 7, 9, 11, 12 and 13: clean energy, innovation, sustainable communities, responsible consumption and climate action. In the Odda VGS teaching programme, these goals are translated into a practical vocational activity: students measure first, then analyse and propose actions in a real building.

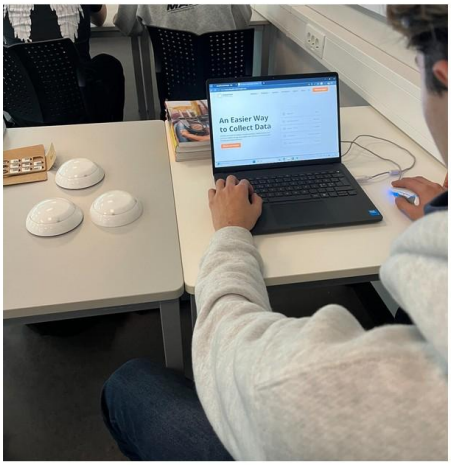
Sources/inspiration: UN Sustainable Development Goals; NDLA assignments on energy advisers, energy-efficient solutions and local energy/land-use discussions.

3. Equipment used in the smart building activity

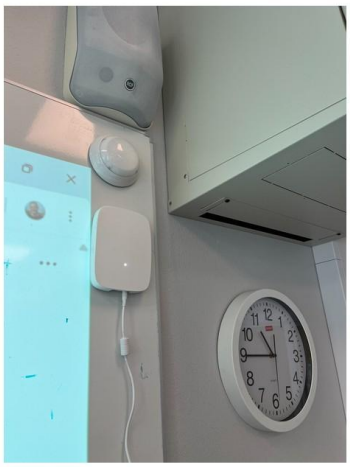
Sensors, cloud connection, thermal imaging and classroom data tools

Equipment and Classroom Introduction

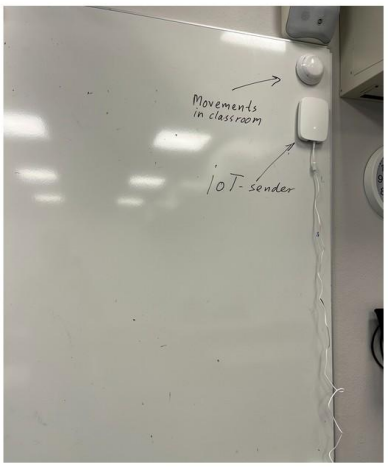
Students inspect motion sensors and sensor labels.



The platform is introduced on laptops in the classroom.



Cloud Connector and motion sensor installed near the board.



Whiteboard explanation: motion in classroom and IoT sender.

Photo documentation: equipment, classroom introduction and student handling of sensors.

3.1 Equipment overview

- Disruptive Technologies temperature sensors: used to record indoor and outdoor temperature over time.
- Disruptive Technologies motion sensors: used to indicate room activity and occupancy patterns.
- Cloud Connector / IoT sender: used to transfer sensor events to a cloud-based service.
- Laptop and classroom screen: used to introduce the platform, discuss data and prepare graphs.
- Thermal camera equipment: used as a visual entry point for heat loss, thermal bridges and technical installations.

Educational point: IoT becomes understandable when students can see the physical sensor, place it in a room, follow the data stream and interpret the result in relation to their own school building.

4. Sensor placement and data collection

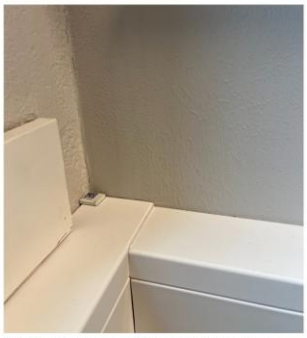
Five indoor sensors and one outdoor reference sensor

Sensor Placement at Odda VGS

Motion sensor and temperature sensor mounted in a room.

Motion sensor placed high to indicate room activity.

Indoor temperature sensor placed for local room measurements



Temperature sensor near an interior/exterior zone.

Outdoor temperature sensor used as weather reference.

Cloud Connector transfers sensor events to the cloud service.

Photo documentation: sensor placement in classroom, indoor areas and outdoor reference location.

4.1 Measurement setup

The sensor setup at Odda VGS was designed to compare room temperature, room use and outdoor temperature. The sensors were placed temporarily and used for educational purposes. The aim was not to create a building-management system, but to create a realistic learning situation in which students could investigate how a building is used and heated.

Location type	Sensor data	Reason for measurement
Classroom / learning area	Temperature and motion	Compare heating level with actual activity during school hours.
Workshop / practical area	Temperature and/or motion	Connect vocational activity to energy use and building operation.
Corridor / transition area	Motion	Understand traffic patterns and shared-space use.
Indoor wall/window zone	Temperature	Observe possible changes close to exterior walls or windows.
Outdoor location	Temperature	Reference signal for weather influence on indoor climate.

The project presentation describes a setup with 6 sensors for approximately one month: 5 indoors and 1 outdoors.

4.2 Data boundaries and privacy

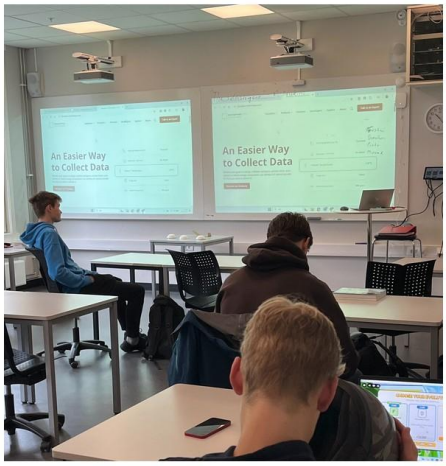
- The project measured room-level temperature and motion patterns.
- No cameras, no sound and no personal names were collected by the sensors.
- Results should be presented at room level, not individual level.

- For data quality, students record room, sensor ID, placement, start date and any deviations.

5. Classroom implementation and student activity

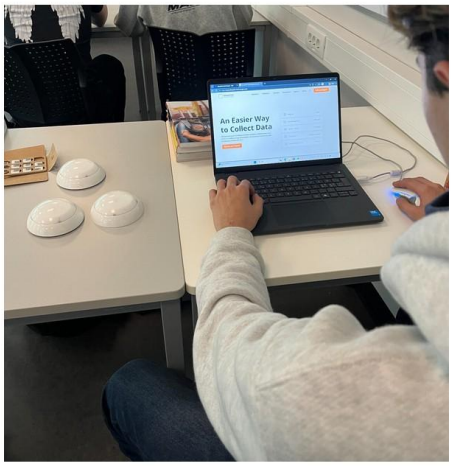
Hands-on learning with real equipment

Students Working with Smart Building Data

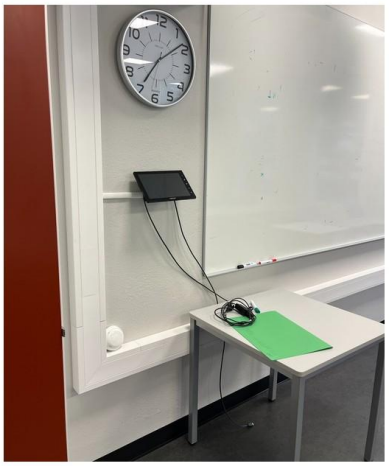


Students see Disruptive Technologies on the classroom screen.

Small-group work: sensors, labels and task discussion.



Students connect sensor technology to data collection.



Classroom and project equipment prepared for the activity.

Students work with sensors, laptops and classroom visualisation of the platform and learning task.

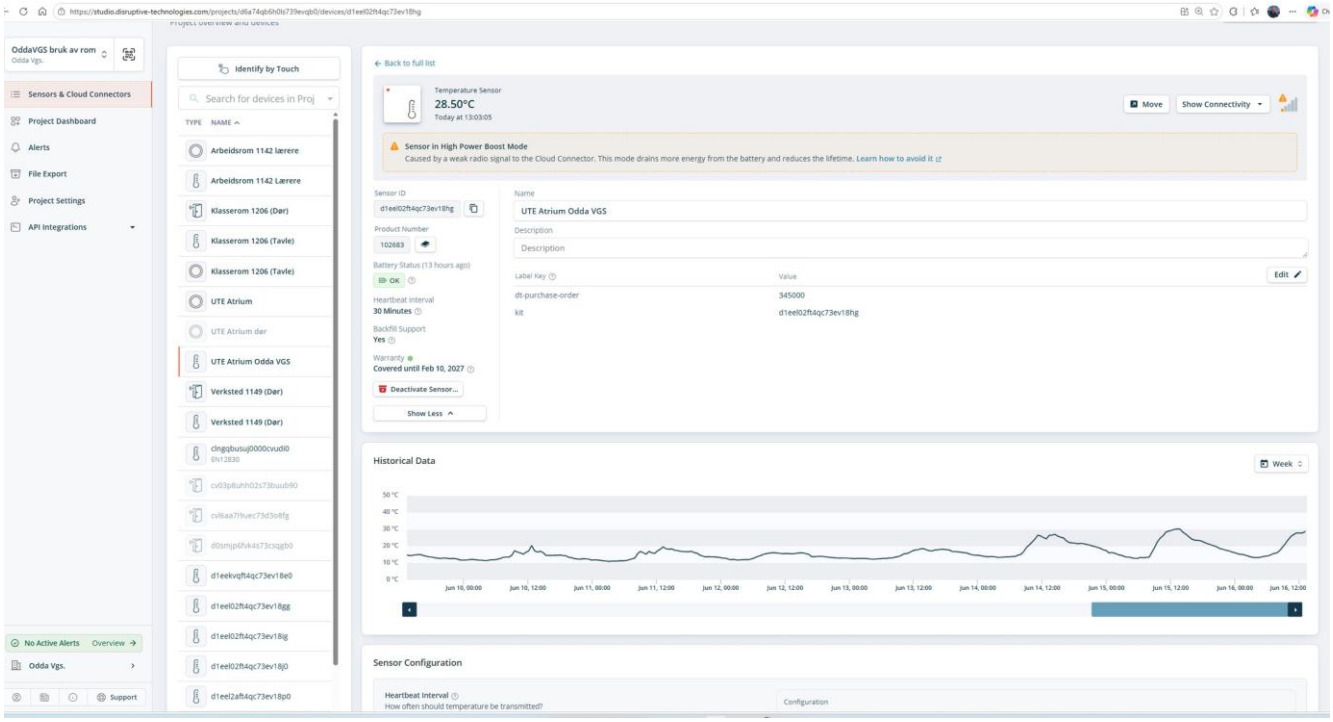
The classroom activity gave students a practical introduction to how sensors can be used in smart buildings. The students could see the hardware, discuss the purpose of different sensors, follow the platform on screen and connect the information to real questions about building use and energy efficiency.

5.1 What students were asked to investigate

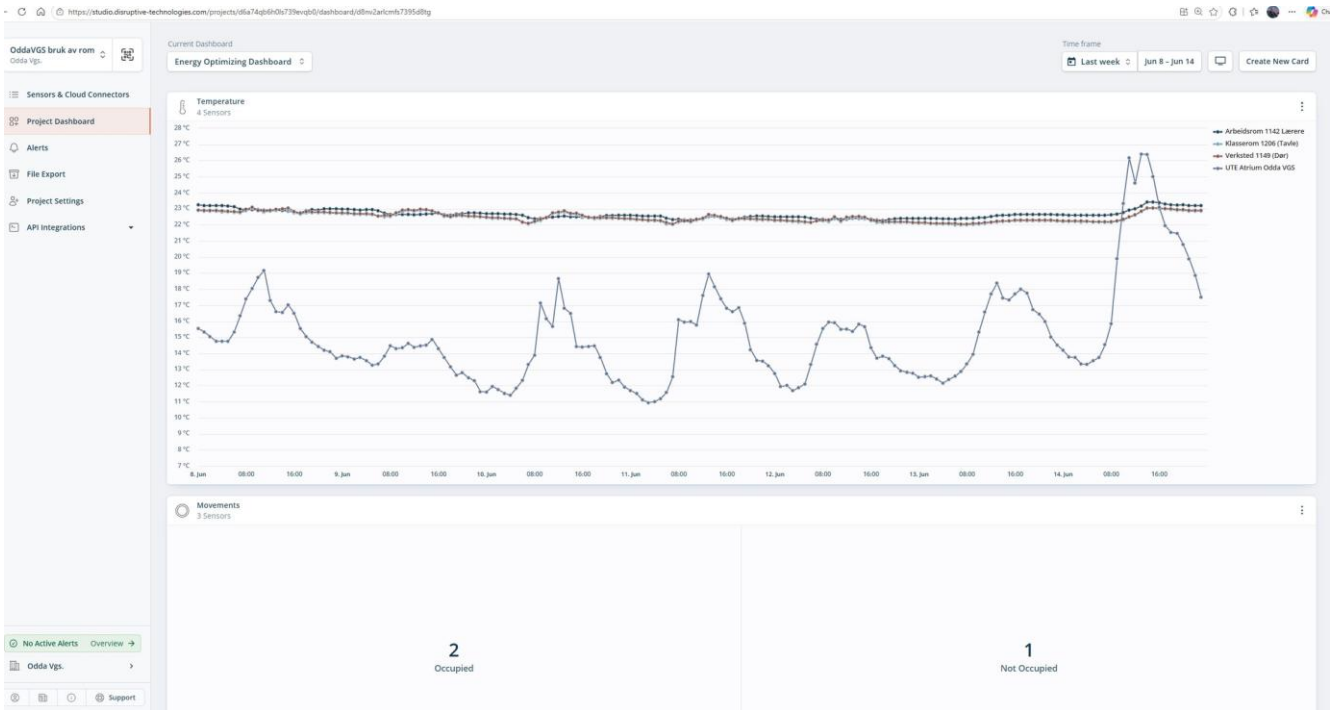
- Which rooms or areas are warm even when they are not being used?
- How does outdoor temperature influence indoor temperature?
- Does motion data match the expected timetable and use of the room?
- Are there periods where temperature remains high after activity has dropped?
- Which realistic measures could the school consider before making investments?

6. Time-series data and visualisations

From cloud-based sensor data to educational interpretation



Student project screenshot from the cloud service: sensor data visualised over time.

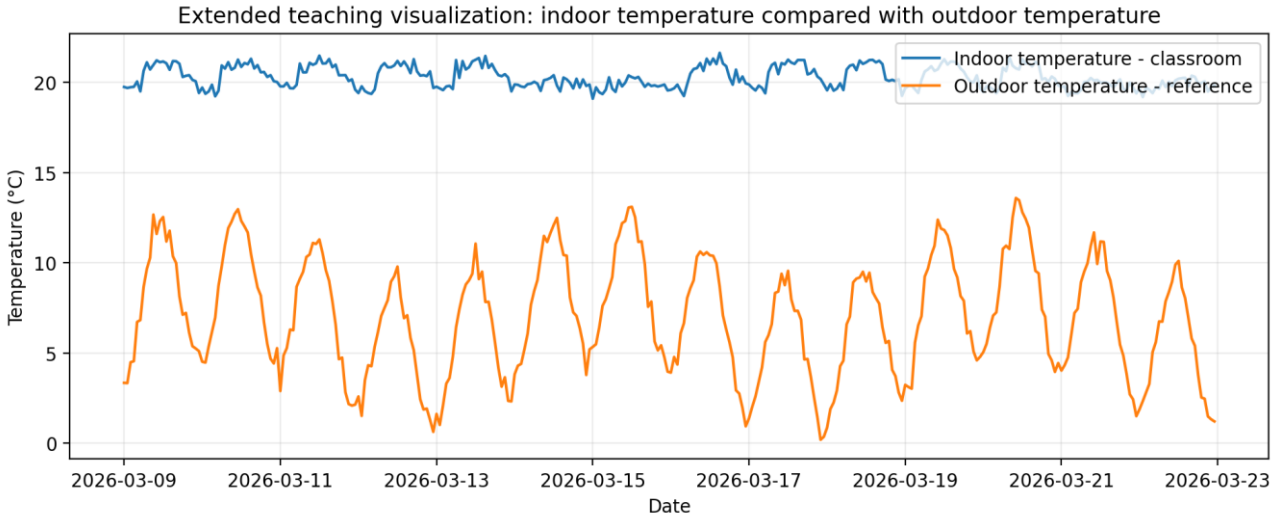


Student project screenshot from the cloud service: time-series view used for classroom discussion and analysis.

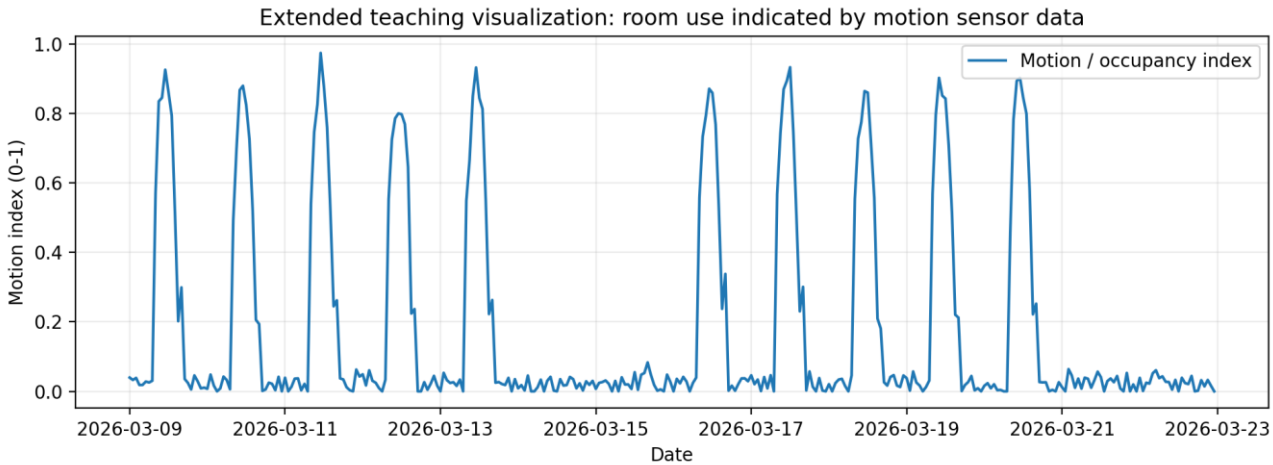
6.1 Extended teaching visualisations

The actual screenshots and photographs document the Odda VGS activity. Because the available sensor time series were limited, the following extended visualisations are included as teaching/reporting examples. They

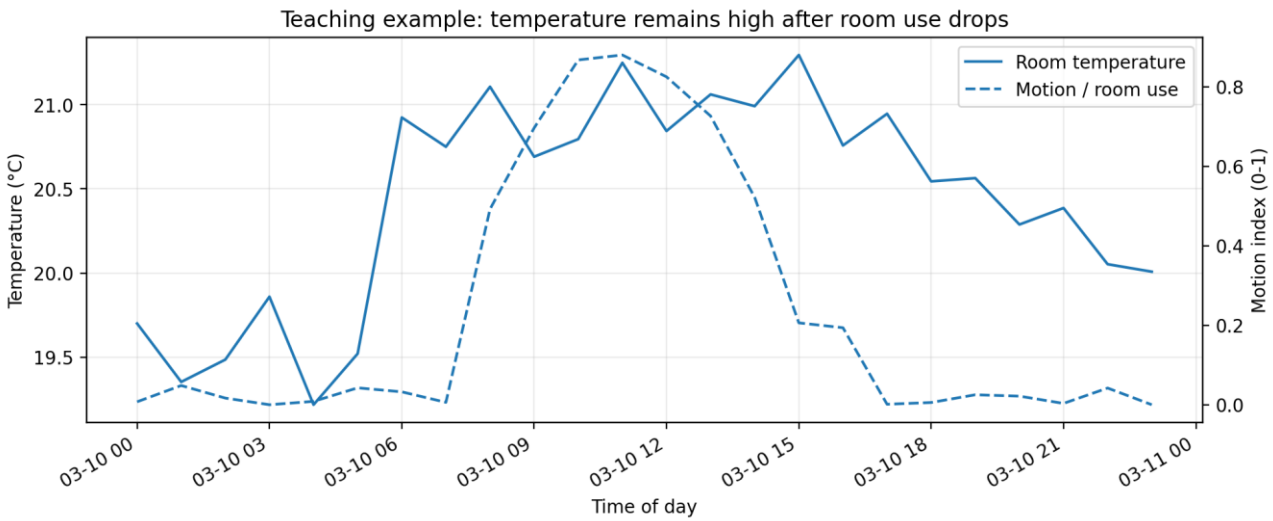
show the type of patterns students were trained to look for and can be used as model graphs in the e-learning material. They should be interpreted as illustrative examples, not as a full quantitative energy audit of the school building.



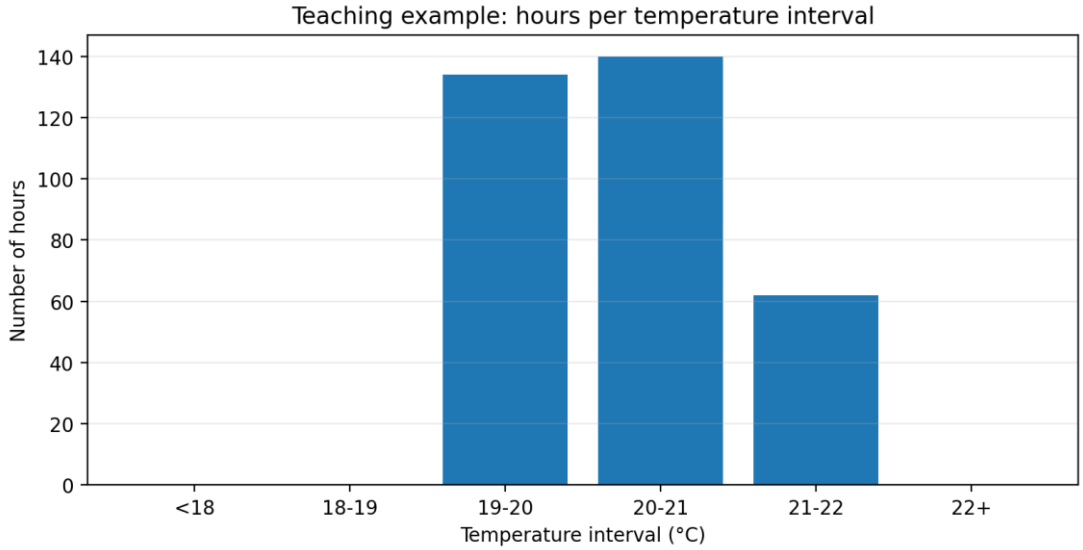
Extended teaching example: indoor temperature remains relatively stable while outdoor temperature changes more strongly.



Extended teaching example: motion data indicates weekday activity and low evening/weekend use.



Extended teaching example: room temperature may remain high after motion drops, indicating a possible energy-efficiency opportunity.

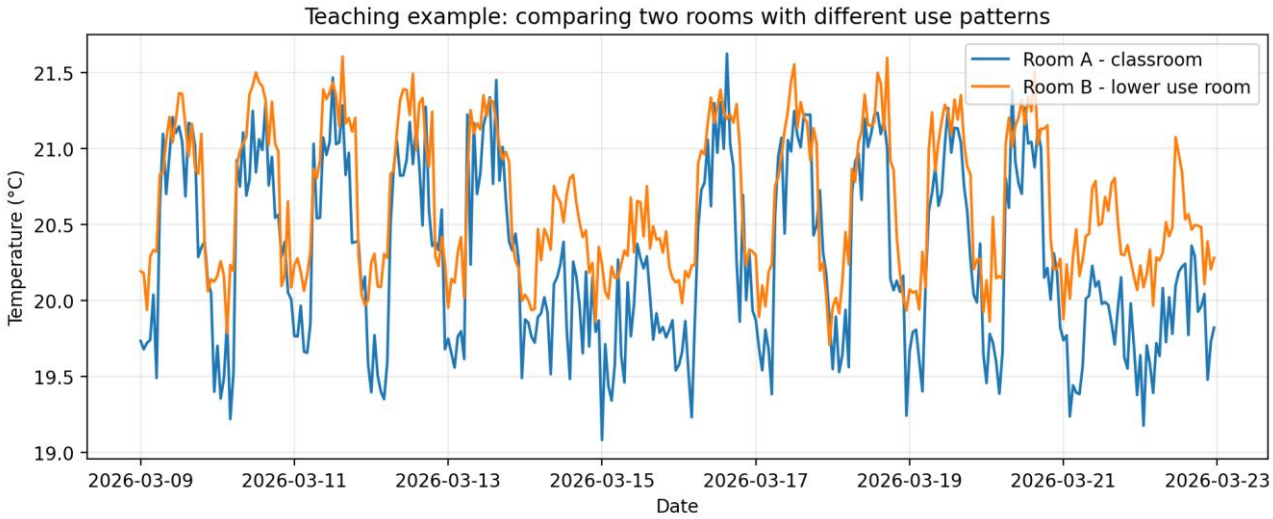


Extended teaching example: histogram showing how many hours a room is in each temperature interval.

Disruptive Technologies documentation describes Studio/project dashboards for visualising sensor data and viewing sensors in context with each other. The Odda VGS presentation uses the same educational logic: time series and histograms turn measurements into patterns for discussion.

7. Results and interpretation

Possible findings from comparing use and temperature



Teaching example: comparing two rooms can reveal different heating/use patterns.

7.1 Logical findings the students can document

- Rooms may stay within a comfortable temperature interval even when no activity is indicated.
- Outdoor temperature can vary significantly while indoor temperature remains stable, showing that heating control is active and can be analysed.
- Motion peaks during school hours can be compared with heating schedules and room booking patterns.
- Temperature may remain high in the afternoon or evening even after the room is no longer in active use.
- Some sensor positions may indicate local heat loss, draughts, thermal bridges or poor placement, requiring careful interpretation before conclusions are drawn.

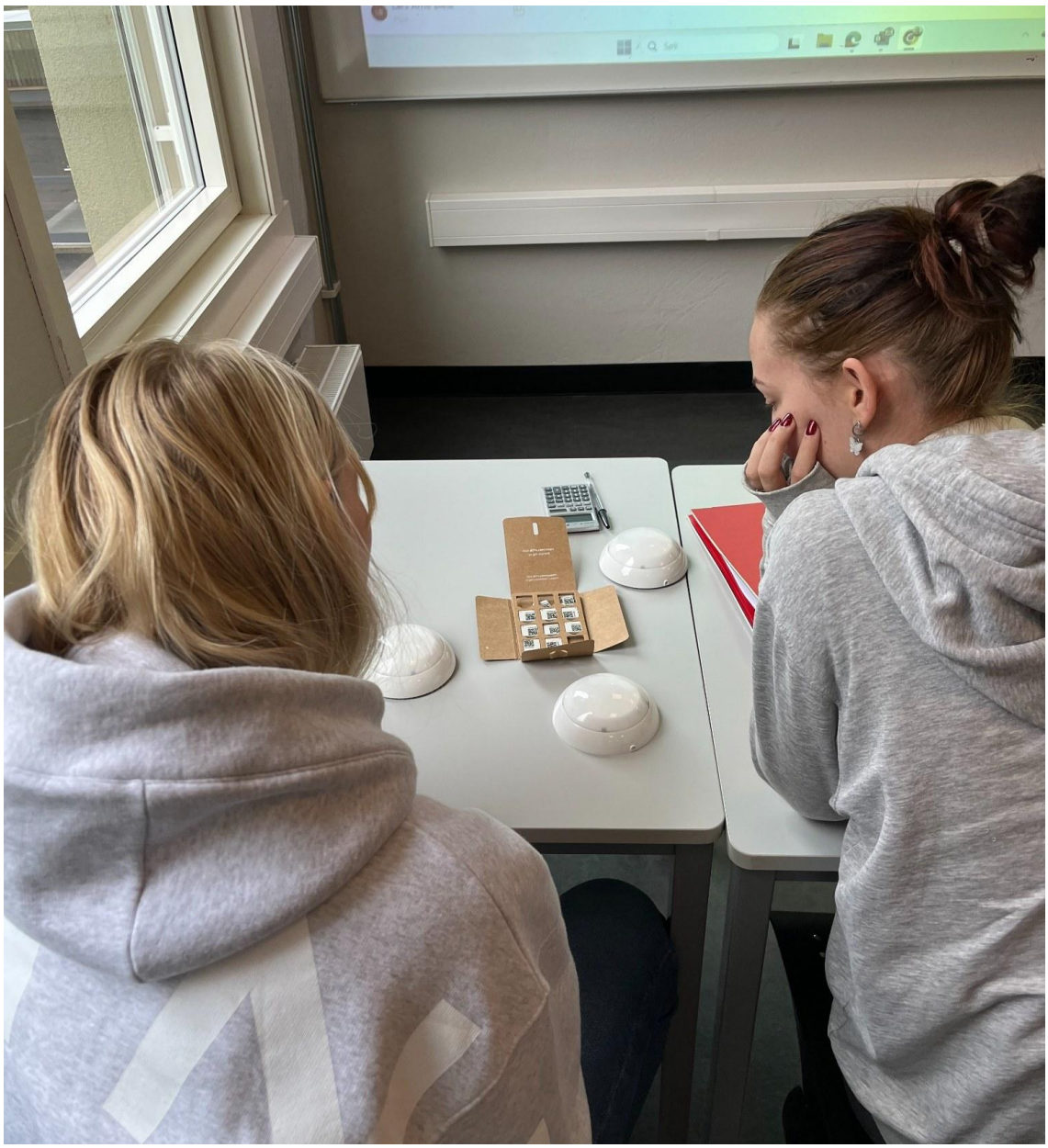
7.2 Possible energy-efficiency actions

- Adjust heating schedules, setpoints and night setback according to actual use.
- Coordinate timetables and heating for rooms with predictable occupancy.
- Improve routines: close doors, report cold/warm rooms and avoid heating unused areas unnecessarily.
- Check ventilation, draughts, thermal bridges, sensor placement and thermostats before major investments.
- Consider insulation, zoning or control-system improvements only where data indicates a likely effect.

A good energy recommendation must balance comfort, indoor climate, learning conditions, operating cost and climate impact.

8. Student task: Smart Building Energy Audit

Worksheet for a group of 16-year-old vocational students



Students working with physical sensor equipment before analysing data.

Group example

Group member	Role	Main responsibility
Matias Frantzsen	Temperature	Read indoor/outdoor temperature data and describe thermal patterns.
Anna Oppedal	Movement / occupancy	Interpret motion data as an indication of room use.
Aleksander Knutson Espe	Presentation	Prepare summary, graphs and short presentation for reporting.

Task

Your group will act as an energy advisory team for Odda VGS. You will investigate how one room or area of the school building is used and heated by comparing indoor temperature, outdoor temperature, motion/room usage and practical observations from the classroom.

Work steps

6. Observe the room and sensor positions. What do the sensors measure? Why is one sensor placed outdoors?
7. Read the data. When is the room most used? When is there little or no motion?
8. Identify patterns. Does the room stay warm when it is not in use? Does indoor temperature follow outdoor temperature?
9. Write down at least two findings. Distinguish clearly between observation, interpretation and uncertainty.
10. Suggest two or three realistic improvements, with a short explanation of benefit, cost and possible drawback.
11. Present the conclusion using one photo, one graph or histogram, two main findings and suggested measures.

Expected student output

- One-page energy report for one room/area.
- At least one time-series graph and one histogram.
- Short written analysis with two findings.
- Two or three realistic recommendations for facility staff or school management.
- Three-minute group presentation for Erasmus+ sharing.

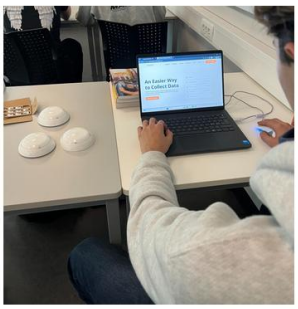
9. Energy Exhibition contribution

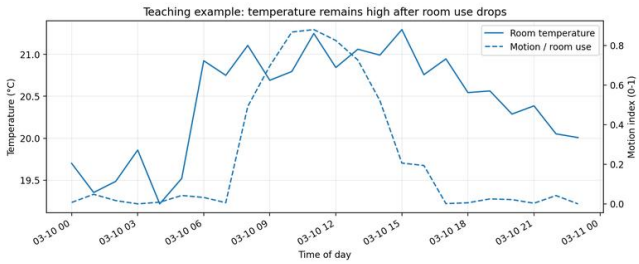
Sample material from Odda VGS

Odda VGS can document its contribution to an Energy Exhibition through a small poster or exhibition board based on the Smart Building Energy Audit. The aim is to show visitors how students used sensors and data to understand energy use in the school building.

Energy Exhibition: Smart Use of School Buildings

Odda VGS | Erasmus+ Electromobility





Student question:

Are rooms heated when they are not in use?

Data used:

- Indoor temperature
- Outdoor temperature
- Motion / room use
- Time of day

Possible findings:

- Warm rooms with low motion
- Delayed cooling after use
- Outdoor weather influence

Possible actions:

- Adjust setpoints
- Use night setback
- Check ventilation/doors
- Prioritise real deviations

Sample Energy Exhibition poster: smart use of school buildings based on Odda VGS sensor activity.

9.1 Exhibition story

- Students start with a practical energy question from their own school.
- They use sensors and thermal imaging to collect evidence.
- They turn time-series data into graphs and histograms.
- They present findings and propose realistic actions.
- The output can be shared with partner schools as e-learning material.

10. Gamebook scenario: The Energy Adviser

Interactive choice-based activity for WP4

The Gamebook scenario below can be used as Odda VGS input to the project Gamebook. It turns the sensor activity into a choice-based learning story that can be translated into Norwegian, English and Czech.

Step	Gamebook text / learning choice
Start	The school uses a lot of energy. You are appointed as an energy adviser. What will you investigate first?
Choice 1	Measure temperature and motion in rooms with high energy use.
Choice 2	Start with a thermal camera and identify possible heat leakage or thermal bridges.
Choice 3	Interview facility staff and compare their experience with sensor data.
Result A	You find a room that remains warm when motion is low. Suggest a heating schedule adjustment.
Result B	You find a possible thermal bridge. Suggest further inspection before investment.
End	Your group presents quick, inexpensive, technical and long-term actions to improve energy-efficient use of the building.

Suitable for WP4: translation, eTwinning sharing and an interactive learning resource where students in different countries can compare choices and solutions.

11. Contribution to Erasmus+ work packages

How Odda VGS outputs support the final report

Work package	Odda VGS contribution
WP1 - Coordination	Planning, coordination, sensor setup, HSE considerations, data collection plan and documentation of project activity.
WP2 - E-learning	Teaching material on smart buildings, energy efficiency, thermal imaging, sensor-based learning, learning objectives and student worksheets.
WP3 - School projects	Exposure to Energy: student teams investigate the school building, compare data and present energy advice.
WP4 - Translation and Gamebook	English and Norwegian material, project photos, screenshots, sample Gamebook scenario and materials suitable for eTwinning sharing.

11.1 Reusable deliverable idea

The Odda VGS activity can be packaged as a reusable learning resource for partner schools: **Smart School Building Audit**. The concept is simple enough to transfer to other EU regions: choose a school area, place sensors, collect room-level data, create graphs and present realistic energy-efficiency actions.

12. Conclusion

Traceable documentation of Odda VGS project outputs

Through these activities, Odda Upper Secondary School has contributed concrete outputs to the Erasmus+ Electromobility project. The activity demonstrates a practical link between electromobility, smart buildings, energy awareness and vocational education. Students used real equipment and real school environments to investigate energy use, while the teaching material provides reusable content for partner schools.

The documentation package shows:

- what Odda VGS carried out,
- which equipment and methods were used,
- how students participated,
- which learning outputs were produced,
- how the work connects to WP1-WP4,
- and how the material can support the final Erasmus+ reporting.

Sources and attachments

Used for professional framing and project documentation

Source / attachment	Reference / description
Disruptive Technologies - main website	https://www.disruptive-technologies.com/
Disruptive Technologies Help Center - Getting started with Studio	https://support.disruptive-technologies.com/hc/en-us/articles/360010668320-Getting-started-with-Studio
Disruptive Technologies Help Center - Project Dashboard	https://support.disruptive-technologies.com/hc/en-us/articles/360017234059-How-to-set-up-a-Project-Dashboard
Disruptive Technologies - Energy Optimization Solution	https://www.disruptive-technologies.com/energy-optimization-solution
NDLA - Oppdrag: Energirådgiveren	https://ndla.no/r/naturfag-el/oppdrag-energiradgiveren/21bac6b41c
NDLA - Energieffektive løsninger	https://ndla.no/r/naturfag-el/energieffektive-losninger/b744a20208
NDLA - Lokal kamp om energi og arealer	https://ndla.no/r/naturfag-el/lokal-kamp-om-energi-og-arealer/e26c4b9648
United Nations Sustainable Development Goals	https://sdgs.un.org/goals
Odda VGS presentation	Electromobility - Smart Buildings and Energy-Efficient Use, English and Norwegian versions
Odda VGS photo documentation	Classroom activity, sensor equipment and sensor placement photos, September 2026

Photo/privacy note: Student photographs should be used for external dissemination only where school photo consent and GDPR routines allow it. The report does not identify named students in any photograph.