PAITool SCDI SLOVAK CENTRE FOR DIGITAL INNOVATION acrosslimits

ENERGY MANAGEMENT
Handouts for trainers

Introductory instructions for trainers

We have prepared materials for trainers to follow. They include

- Introduction

- The complete texts as read by the machine voice. The trainer can choose what to say, for example by highlighting certain sentences or concepts.

- Recommendations on where to turn the sound on or off

The presentation can run in two modes

- With audio on

- Without audio on

Presentation with audio on

- In this mode, a machine voice is heard explaining the displayed texts, diagrams and animations.

- This mode is suitable for self-learning.

- The trainer is not recommended to go through the entire content in this way. The trainee's attention may be lost, and the trainee may not focus on what is most important in the content.

- We recommend using this mode no more than 2 times during the presentation.

Presentation with audio off

- If the presenter turns off the sound, they can give the participants an abbreviated version of what the machine voice is saying in the background.

- They can also highlight what is most important about the content being shown.

- The trainer needs to go through the course several times.

- This is because the background machine voice is running all the time, and until the narration is finished, the trainer has no opportunity to move on to the next step in the presentation.

The trainer can either

- do the content switching and scrolling on their own (recommended for online webinars)

- **or** their partner can do it, but it has to be well coordinated with them (recommended for larger audiences)

Link to the course

https://paitool.eu/courses/paitool-course/lessons/energy-management/

Educational objectives

Each presenter must understand their educational objectives. In the case of AI, participants should gain the following knowledge:

- Understand artificial intelligence as an information system that is capable of learning,

- Know how to identify those processes where it makes sense to use artificial intelligence or machine learning,

- Know the prerequisites for deploying AI in the conditions of a specific company, such as the need for data, the personnel required, etc,

- Recognize the benefits of implementing AI and the risks associated with implementing the project.

Course of training

Introduction

Hello. Today we will look together at how Artificial Intelligence can play a key role in optimising energy management. This topic is important not only in terms of economic savings, but also in terms of environmental protection.

We will introduce energy management and its importance for companies. Today, energy costs form a significant part of a company's total costs, and it is therefore crucial to manage energy efficiently. Artificial intelligence can be our ally in this challenging task. Together with consumption and production forecasts, we can achieve significant savings and contribute to a more sustainable energy environment.

I am now going to give you a presentation, the voice of which belongs to artificial intelligence, as a demonstration of one of its capabilities

⊙ *START THE PRESENTATION*

🔇 *STOPTHE SOUND OF THE PRESENTATION*

The text will be retold by the speaker in their own words:

Slide 1 Introduction

Using artificial intelligence to increase energy efficiency

Slide 2 Energy management and artificial intelligence

Slide 3 Energy - a significant part of the company's costs

In a company, energy accounts for a significant part of costs. This affects the company's financial results but also its competitiveness. It must reflect its costs in the price of the products.

At the same time, energy management itself is complicated. When purchasing electricity, the customer is interested in optimizing the setting of reserved capacity. The higher it is, the higher the monthly fees; on the other hand, the company is obliged to pay a fine if it exceeds the reserved capacity. Therefore, the company should be able to anticipate its consumption, know how it will be affected by switching on an energy-intensive appliance, know the external influences and anomalies in its consumption, and know where it has reserves. If a company uses renewable resources, it should be able to estimate in advance what its production will be at a particular time.

Slide 4 Energy management

Energy management means

1. Identification of inefficient devices

2. Identification of inefficiently operated equipment

3. Increasing the energy efficiency of buildings

4. Optimization of the production plan and operation of energy-intensive equipment during off-peak hours

5. Avoidance of fines for exceeding the reserved capacity

6. Optimization of electricity costs by taking responsibility for the deviation

7. Integration of renewable energy sources

8. Optimizing the management of energy management of companies, cities, or energy communities

To make their operations more efficient, companies are implementing Energy Management. It is intended for all companies where energy consumption in the building or the production process plays a significant role. The result is a reduction in consumption, which transforms into lower energy costs, a better environment for building users, or environmental protection by reducing the carbon footprint.

Slide 5 Energy management using artificial intelligence

We need to know the past to do quality energy management and manage the future. We need to set up systematic monitoring, controlling, and implementing measures to reduce energy intensity and improve energy efficiency. The principle "You can't control what you don't measure" applies here. Due to the complexity of the issue, artificial intelligence is being used more and more today.

How does it work?

One of the methods is the analysis of the so-called envelope. By analysing the total consumption and combining the obtained data with the production data from the past, it is possible to evaluate the impact of consumption on individual devices and detect the least efficient devices or any anomalies.

Anomalies are unwanted phenomena, such as leaks, damaged equipment, or even negligence. At present, a massive installation of intelligent metering systems supplements the current consumption information with other data, based on which quality can also be evaluated. The use of artificial intelligence is based on the detection of changes compared to the "Normal state." Therefore, during machine learning, it is necessary to train on data where anomalies are already clearly identified.

But it's not just about machines. There are also buildings. Their energy efficiency is also affected by the way and mode of use, whether it is a working day or a weekend. In addition, there are external factors such as seasons, clouds, or sunny weather.

With the help of artificial intelligence, experts create a prediction model. It then works with data from technical devices, assigns external data to them, identifies anomalies, and makes a forecast of energy consumption in the future.

🔊 *START THE PRESENTATION SOUND*

Slide 6 Building microgrids

The company can

- buy electricity at the most convenient time
- sell surpluses
- store the surplus in batteries
- charge electric cars
- offer energy to the city and create an energy community with it
- optimize its operation

If the company uses renewable resources to cover its consumption, it is called an active consumer.

We refer to this trend as building microgrids. They can be deployed within a company, city, or energy community. Their operation depends on several variables, including the impact of meteorological conditions.

Both consumption and production forecasts can be used in several ways. A company that knows its future consumption can operate in the energy market, buy electricity when it is most convenient, sell surpluses in the short-term market, store them in batteries, charge electric cars or offer surpluses to the city with which it can create an energy community. It can also optimize its operation, such as switching machines, air conditioners, or other significant appliances on and off when it is convenient.

In addition to savings, the company will also reduce the carbon footprint of production. Thus, artificial intelligence has implications for the economy and competitiveness and helps combat climate change.

🔇 *STOP THE SOUND OF THE PRESENTATION*

⏸ STOP THE PRESENTATION

Discussion 1
- *Energy is the big topic of the day, so we probably don't need to say that companies are paying attention to it. But to what extent do you think interest in smart solutions has increased?*
- *If so, what types of companies are involved? Larger or smaller businesses? Can the most active sectors be identified? Does this apply to your business as well?*
- *To what extent is your company also dealing with the idea of becoming producers as well as consumers? So-called PROSUMERS?*
- *Do companies have clarity on the topic of energy management? Are they clear about what all Smart Energy solutions encompass?*
- *Do customers also directly express a demand for the introduction of artificial intelligence? At least indirectly, e.g., by requesting the generation of predictions or the processing of unstructured data or similar?*
- *How long does it typically take you to negotiate with suppliers from first contact to contract and project start?*

⊙ START THE PRESENTATION

🔇 STOP THE SOUND OF THE PRESENTATION

The text will be retold by the speaker in their own words:

Slide 7 Presumptions

Slide 8 Process

Processes related to the collection and analysis of collected data and implementation of relevant measures

- Evaluating the effectiveness of the measures taken
- Identification of technical and non-technical losses
- Energy market trading processes
- Identification of objects with irregular consumption

Key processes:

For more information, click on the number buttons one by one.

1. **Processes related to the collection and analysis of the data collected and the implementation of relevant actions**

In addition to the collection and analysis of measurements, it is vital to put in place a method to analyse the collected data and especially the design and implementation of measures.

2. **Evaluating the effectiveness of the measures taken**

It is equally important to implement a subsequent process to evaluate the effectiveness of the measures.

3. **Identification of technical and non-technical losses**

Identifying technical and non-technical losses has a significant impact on the efficient operation of the company.

4. **Processes related to energy market trading**

If a company trades in the energy market, it certainly has processes that ensure consumption and demand predictions, which it uses effectively in its pricing.

5. **Identification of facilities with irregular consumption**

If the company has taken responsibility for its consumption deviation, then identifying objects with irregular consumption can significantly impact the ability to predict and the overall efficiency of consumption planning.

Slide 9 Data

By monitoring consumption in real time and observing historical data, machine learning systems can identify trends, interrelationships, and scenarios to improve the consumption management process of companies, cities, or entire energy communities. At least the following data sources are required for data collection:

- continuous measurement of energy consumption

- data collection from indoor operating conditions

- data collection from outdoor operating conditions

- the number of people located in the analysed object

Click on the icon buttons one by one to view the data sources.

Slide 10 Information systems

Energy management uses data from various information systems. The most common are these systems:

1. **Head-end systems** for collecting and storing data from measuring devices

2. **MES:** Manufacturing Execution System, production information system for industrial production

3. **SCADA**: Systems for visualization and control of industrial technologies and building automation.

4. **Building management system** providing complex data on buildings

5. **DERMS**: Distributed energy resources management system, real-time microgrid management systems

6. A **virtual power plant** that allows aggregators to trade surpluses from several producers and active consumers

7. Real-time **energy management systems**

Slide 11 Infrastructure

The necessary infrastructure for efficient energy management consists of the infrastructure for data collection and their subsequent storage, processing, analysis, and management. The most common are these devices:

- IoT metering equipment and data collection infrastructure

- Data storage

- Analytical infrastructure

- Management infrastructure

Slide 12 People

On the client's side:

Competent people, whether on the side of the client or the supplier, are a crucial prerequisite for the successful implementation of effective energy management.

Sponsor

The top position on the customer side is the project sponsor, who is responsible for its financing and at the same time ensures the necessary cooperation or eliminates resistance to change in its teams.

Expert in the field of energy management

From a technical point of view, the critical role is an expert in energy management who provides all the necessary inputs.

Support team

Equally important is the support team, which performs various sub-tasks and oversees artificial intelligence training.

IT expert

If the related applications are operated on the client's infrastructure, it is necessary to have in the team an IT expert who provides operational tasks.

Slide 13 People

On the supplier's side:

Architect

Architect, providing the design of the necessary infrastructure, whether it is the infrastructure on the customer's premises or a cloud solution.

Consultant

A key role is also the consultant, who actively communicates with an expert in energy management and sets up a system for data collection and analysis according to his instructions.

IT experts

In the case of more complex solutions requiring the creation of unique algorithms, the implementation team is also a member of the supplier's team, with programmers, testers, and other IT experts.

Expert in visualisation

Due to the need for graphical interpretation of data, a visualization expert is usually part of the supplier's team.

Slide 14 Organization

Practical cooperation between the professional teams of the supplier and customer is essential for the success of the project. Fundamental factors, in this case, are the design of measures to achieve energy savings, a project plan with appropriately set milestones, a communication model defining the system of project meetings, but mainly sufficient allocation of professional teams, and a flexible process model supporting the proactive definition of requirements and timely response to suggestions from the implementation team.

- **Project plan** with appropriately set milestones and sub-objectives of the project

- **Communication model** assuring the interaction of professional teams, regular meetings formulation of requirements, responding to suggestions from the implementation team

- **Human capacity**, sufficient allocation of the experts, flexible process model

> *Discussion 2*
> - *Building an IT environment is a gradual process, it starts with simpler solutions and can progress to artificial intelligence. What does this evolution look like in the cases you have personally encountered?*
> - *In your opinion, is the customer willing to pay for the analysis of their needs as well, or are they trying to take on this role themselves? When you come into contact with supplier companies, to what extent do you have clarity on what you need?*

- *What problems do you encounter in getting data? Do we mean both technical problems (fragmented and distributed data) and, say, organisational or competency problems?*
- *How much of your projects are about integrating your solution to third-party systems? How did it work, was it necessary to involve the suppliers of these solutions or did you as a client manage it with your own staff?*
- *How long does the project probably take?*
- *Did you experience any problems in getting sufficiently skilled staff? Did you have trouble freeing them up in sufficient numbers for the project?*
- *What has been your experience supporting management? Are they aware of their role in the project?*
- *Have you been willing to purchase or upgrade your technical infrastructure in projects if the existing one proved to be inadequate?*

▷ *START THE PRESENTATION*

🔇 *STOP THE SOUND OF THE PRESENTATION*

The text will be retold by the speaker in their own words:

Slide 15 Benefits and risks

Slide 16 Benefits

An increasing number of companies worldwide are launching programs to optimize energy management. A systematic approach to energy management brings significant benefits.

The result of all efforts is

- a significant and sustainable reduction of energy consumption and costs,

- a reduction in the adverse effects of energy consumption on the environment,

- and an increase in the competitiveness of the company, city, or energy community. Energy efficiency helps mitigate climate change.

Savings typically range from 5 to 10 percent of total annual consumption.

Higher yields can be achieved because reliable energy management allows decisions based on actual energy consumption.

The expected return on investment in implementing measures to increase energy efficiency and reduce energy consumption in the renewal of technical and technological equipment usually ranges from 4 to 10 years.

Slide 17 What we should be careful about

As with any project, there are several risks in the case of energy management deployment that can negatively impact a successful outcome. The most serious ones include:

Deployment of the solution without aftercare and further development.

Unfortunately, although it is pretty common for companies to implement an information system that can collect and analyse data, after the system's deployment, the project ends there for them.

Insufficient improvement after the introduction of artificial intelligence.

This effect usually occurs in cases where the nature of the data is too random, and it is not possible to make a more accurate prediction from the input parameters. Or the information is elementary, and no artificial intelligence is needed to achieve great accuracy. It is crucial to do a so-called Proof of concept within the project to eliminate these risks. The possibilities and accuracy of the models are evaluated in laboratory conditions without significant investments.

❚❚ *STOP PRESENTATION*

Discussion 3
Do you have a solid business plan and payback calculation at the beginning of the project? If so to what extent are these realistic cost-benefit calculations?
Have you been able to frame the cost of the project in past cases? What might the price be based on?
What are the most common false expectations you have registered in your projects?
How long after project deployment did you contact the contractor for assistance? Did they provide it under warranty, or was it for services beyond warranty?
Is there an ex-post cost-benefit evaluation after the project is completed in the company?

Slide 18 - Collaborators in the development of the course

Conclusion:

Artificial intelligence plays a key role in energy efficiency. By leveraging modern technologies, we can reduce costs, optimise consumption and contribute to environmental protection. However, we cannot forget that the success of this vision depends on competent people, on cooperation between contractor and client and on a systematic approach to energy management.

Energy management supported by artificial intelligence is not only economically efficient, but also beneficial for the environment and the competitiveness of the company. In the fight against climate change, it is one of the key technologies that can help us achieve positive results.

Finally, I would like to thank all the participants for their attention and openness in listening. I hope you were inspired by our presentation and if you have any questions or need more information, we are here to help.