ecoenergy

Policy brief

Developing sustainable solutions for energy efficiency in manifacturing

The Ecoenergy Cluster aims at optimising energy usage and enhancing energy efficiency in manufacturing processes while considering various perspectives such as sustainability, digitalization, and interoperability.

Energy efficiency is crucial for sustainability and competitiveness in the manufacturing sector. This brief highlights methodologies and best practices from EU projects **E2COMATION** and **DENiM** aimed at optimising energy use across manufacturing processes. By employing techniques such as **digitalisation**, **lifecycle assessment**, and **energy monitoring**, these projects achieved notable **reductions in energy consumption**, ranging **from 10% to 40%** across pilot cases. The focus is on implementing advanced energy data measurement, digital twin technologies for process simulation, and efficient transportation to minimise CO2 emissions. The ultimate goal is to support manufacturers in adopting sustainable, energy-efficient practices that yield both environmental and economic benefits.

Key points:

- Digitalization & Innovation: embedding advanced digital technologies as key enablers to optimise manufacturing processes.
- Energy Management & Optimization: advanced monitoring systems reduce consumption by creating continuous insight that enables stakeholders to track efficiency in real-time.
- CO2 Emission Reduction: streamlined operations and transport minimise environmental impact driven by online lifecycle assessments.

Introduction

In manufacturing, energy efficiency is vital for achieving sustainability and reducing operational costs. Projects like E2COMATION and DENiM have developed tools and methodologies to improve energy use across various hierarchical levels of manufacturing, from process optimization to the entire lifecycle of products. These solutions aim to be adaptable across industries, emphasizing the role of digital technologies, real-time monitoring, and lifecycle analysis to improve energy performance. By addressing the need for smarter resource utilization, the brief demonstrates how these initiatives contribute to significant energy savings and reduced environmental impact, setting a benchmark for the sector.

Policy recommendations

Set Strategic Objectives for Digitalisation: organisations need to be supported to pinpoint inefficiencies and understand where the adoption of digital technologies can significantly enhance and streamline operations.

Integrated Energy Measurement Systems: implement layered architectures for real-time energy data collection and monitoring across processes. Employ advanced sensors to gain a detailed overview of energy flows across manufacturing value chain. Data quality monitoring an essential component for reliable energy management.

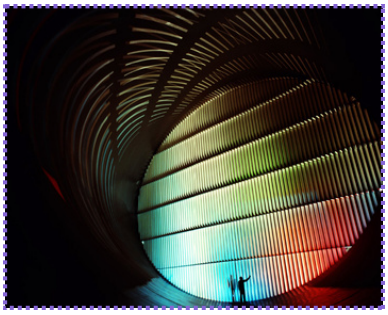
Data Driven Insights: data is the driving force behind energy efficient decision making. Strategies for cooperation across the value chain through shared data, knowledge and awareness will facilitate the creation of data-driven workflows to address energy efficiency. There is a need to improve interoperability and connectivity across manufacturing processes.

Digital Twin and AI Technology for Process Optimisation: encourage manufacturers to use digital twins to simulate, monitor, and dynamically adjust processes to improve energy efficiency without halting production. Combined with AI these technologies enable early detection of inefficiencies and proactive adjustments. This will unlock value of data to realise systematic continuous performance monitoring and auditing leveraging analytics, digital twin and robust assessment methodologies.

Embed Sustainable Production Practices: energy-efficient activities often occur in silos and impact is not typically considered across the whole facility. Leverage existing methodologies for optimising energy efficiency such as energy auditing, Lifecycle Analysis (LCA), Lifecycle Cost Analysis (LCCA), process optimisation and production scheduling. Automated assessment and decision support tools that can be utilised throughout the value chain are required.

Transport Optimization with Emission Assessments: promote sustainable practices to minimize CO2 emissions from logistics, such as route optimization and low-emission vehicles. Utilise Life Cycle Assessment (LCA) to evaluate the environmental impact of transportation and inventory management, fostering a sustainable supply chain. Maximize the use of onsite renewable energy generation and integration with production planning.

Strategic Approach to Address Skills Requirements: addressing digital skills gap is critical to ensure adoption of new technologies and practices. Promoting an interdisciplinary approach across the manufacturing, technology and education sectors will create new opportunities to bridge the skills gap.




Policy implications

The adoption of best practices in energy efficiency across manufacturing operations has multiple benefits: cost savings, reduced carbon footprint, and improved resource management. The integration of digital solutions, such as data analytics and process modelling, facilitates continuous assessment and optimization of energy use. This can lead to better operational decisions, enhanced sustainability, and compliance with regulatory standards. For example, digital twins and AI-driven analytics enable manufacturers to simulate and improve process parameters, while optimized transportation logistics minimize CO2 emissions. Projects like E2COMATION and DENiM have demonstrated that a comprehensive approach to energy efficiency, considering the whole production lifecycle and value chain, is not only feasible but also economically beneficial.

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Bibliography

Reference material from DENiM and E2COMATION Best Practices

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