ASSOCIAZIONE RETE ITALIANA LCA

DIFFUSIONE DI STRUMENTI PER IL MONITORAGGIO DELLA SOSTENIBILITÀ NELL'INDUSTRIA: APPLICAZIONE NEL PROGETTO E2COMATION

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CNR-STIIMA - Milano

Webinar DIRE – Approccio Life Cycle Thinking: sviluppi metodologici e strumenti – 14/07/2022

STIIMA E2COMATION

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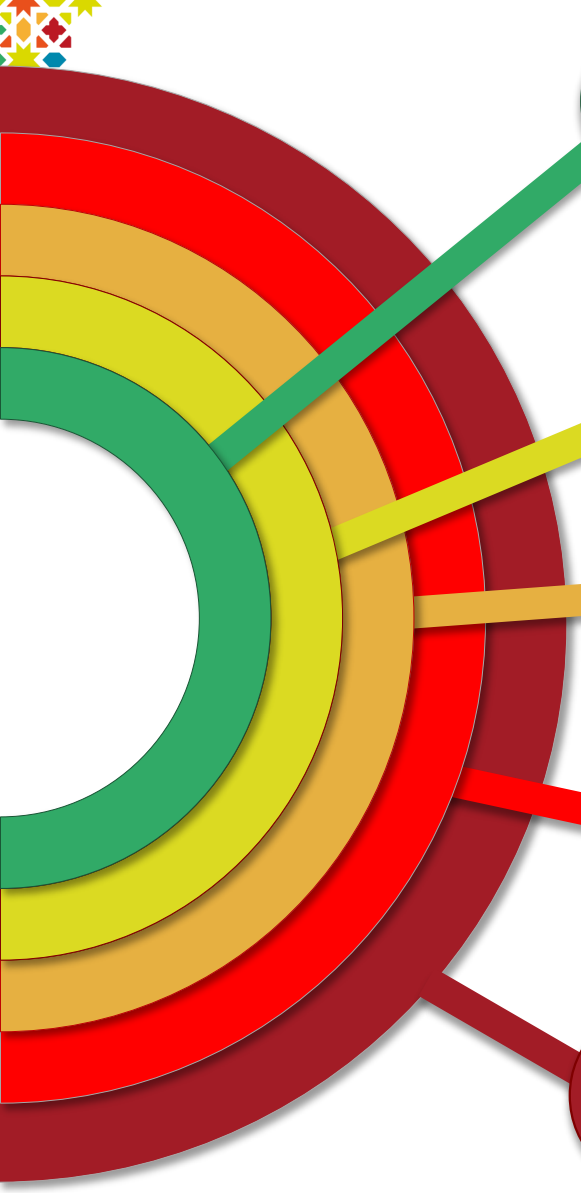

01 CONTEXT AND INTRODUCTION

02 E2COMATION PROJECT

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CONTEXT AND INTRODUCTION

CONTEXT

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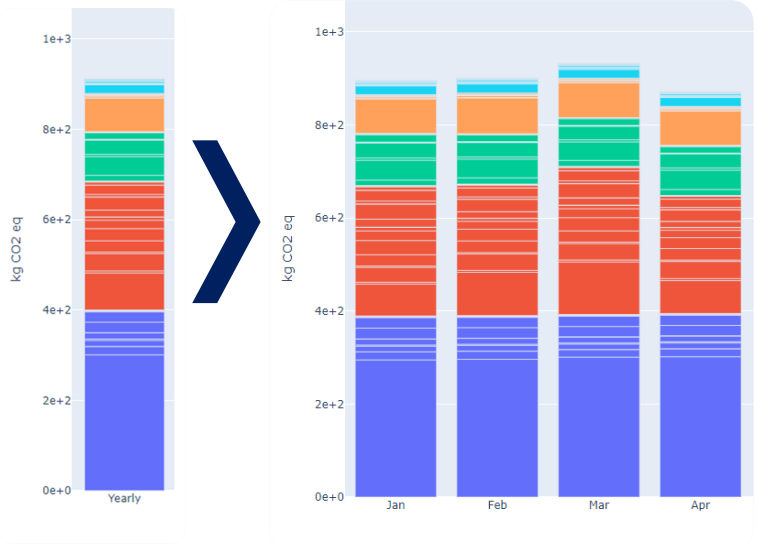
Static representation of environmental profile on an annual basis

Dynamic representation based on data that can be updated and monitored on a monthly basis

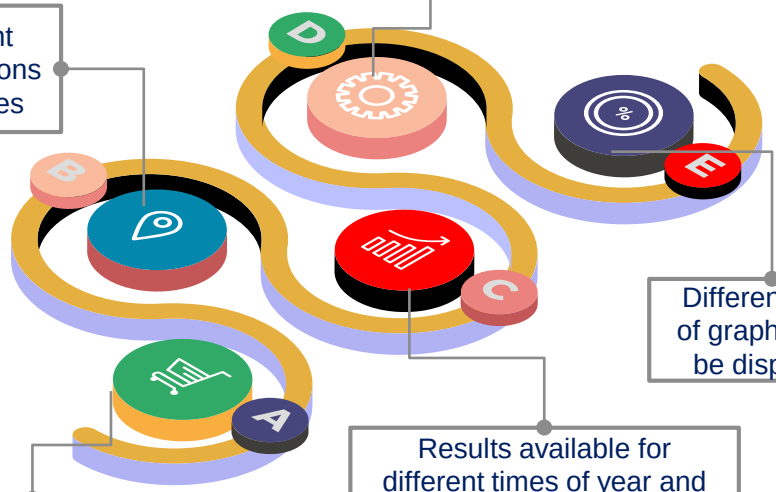


LIGHTHOUSE PROJECT

lighthouse plant

Possibility to take consumption data at different levels of aggregation

Different aggregations processes



Different types of graphics can be displayed

Results available for different times of year and different time step lengths

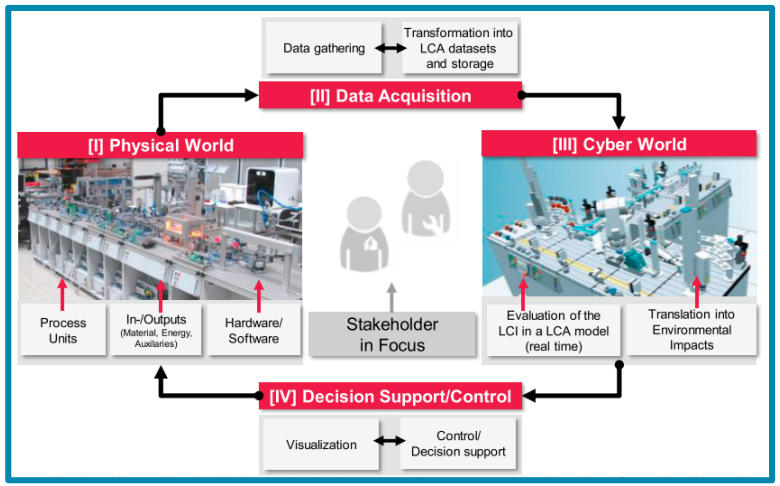
Different impact categories

E2COMATION PROJECT

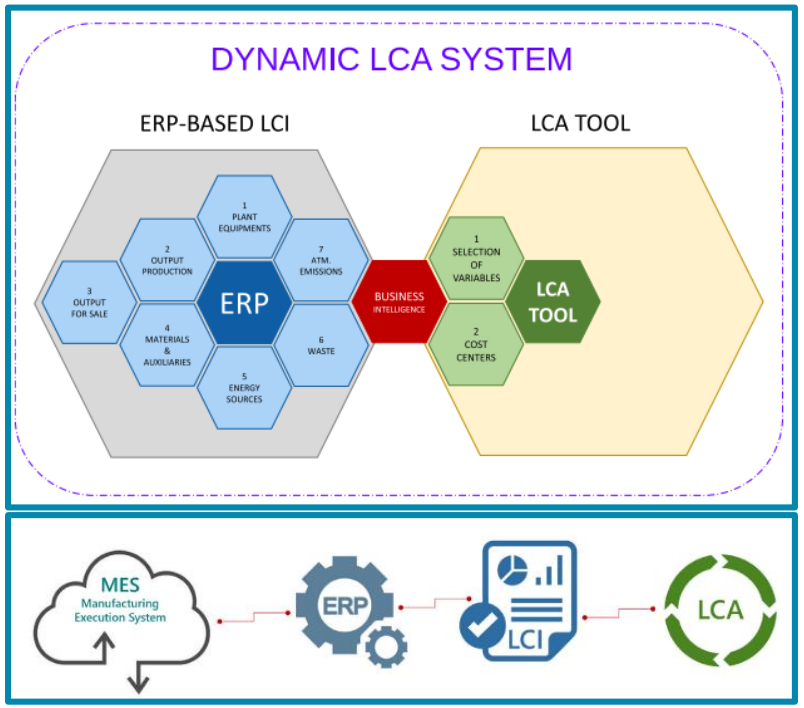
E2COMATION

INTRODUCTION

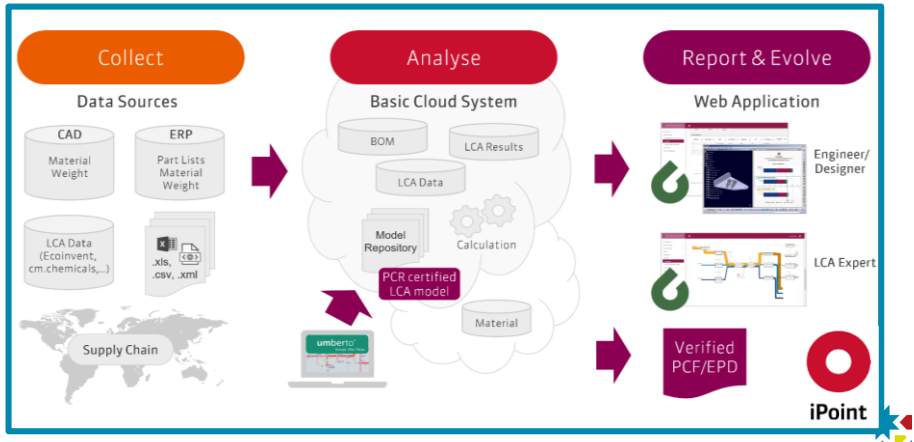
Tools to evaluate sustainability performance are spreading across the market both as application of research activities and commercial purposes



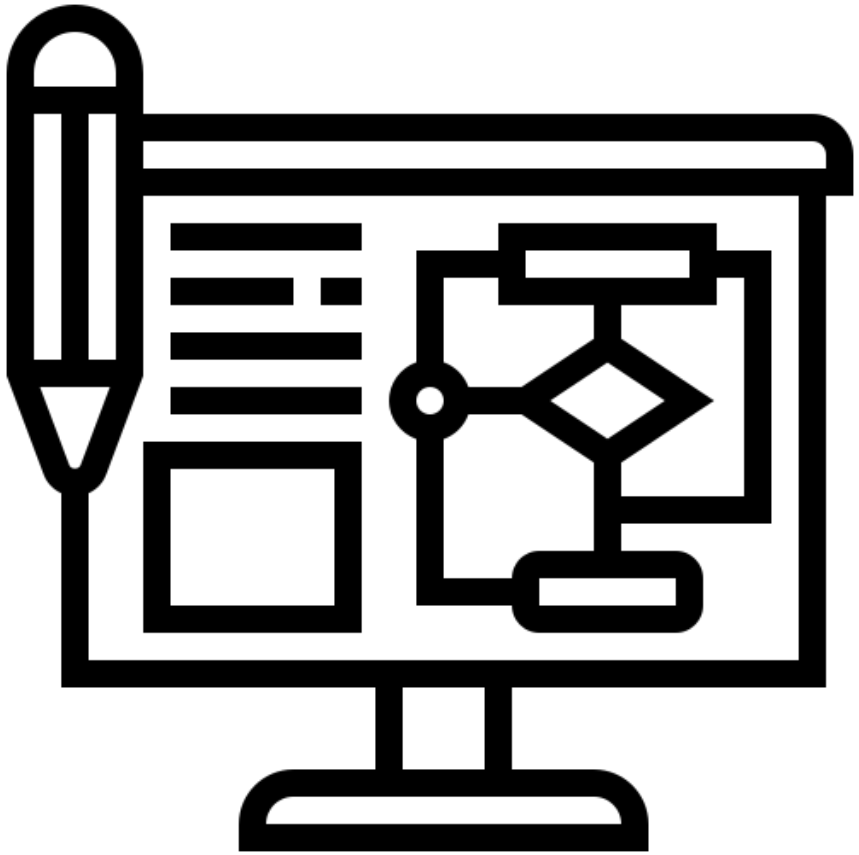
Source: Hagen, J., Büth, L., Haupt, J., Cerdas, F., & Herrmann, C. (2020). Live LCA in learning factories: real time assessment of product life cycles environmental impacts. Procedia Manufacturing, 45, 128-133.



Source: Ferrari, A. M., Volpi, L., Settembre-Blundo, D., & García-Muiña, F. E. (2021). Dynamic life cycle assessment (LCA) integrating life cycle inventory (LCI) and Enterprise resource planning (ERP) in an industry 4.0 environment. Journal of Cleaner Production, 286, 125314.



Source: https://www.ipoint-systems.com/solutions/lca/



E2COMATION PROJECT

E2COMATION PROJECT

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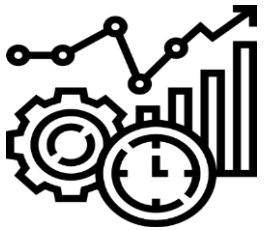
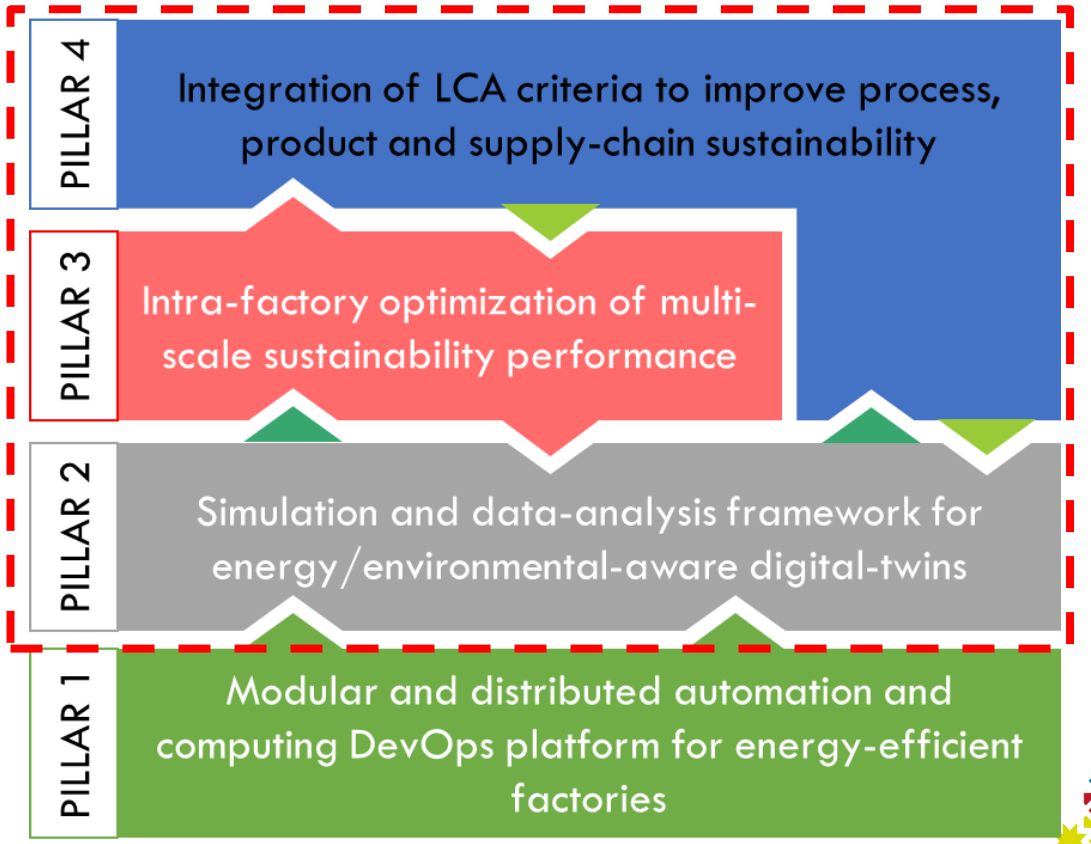
Improving industrial energy efficiency through integration of energy data into production management systems



Optimization of energy usage through multi-scale sustainability perspective

E2COMATION

- Energy Efficiency
- Production Planning
- Improvement of processes



MAIN OBJECTIVES RELATED TO LCAC

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01

Key Objective 1

Development of a scalable methodology for assessing the sustainability performance of manufacturing activities, with a focus on energy use

02

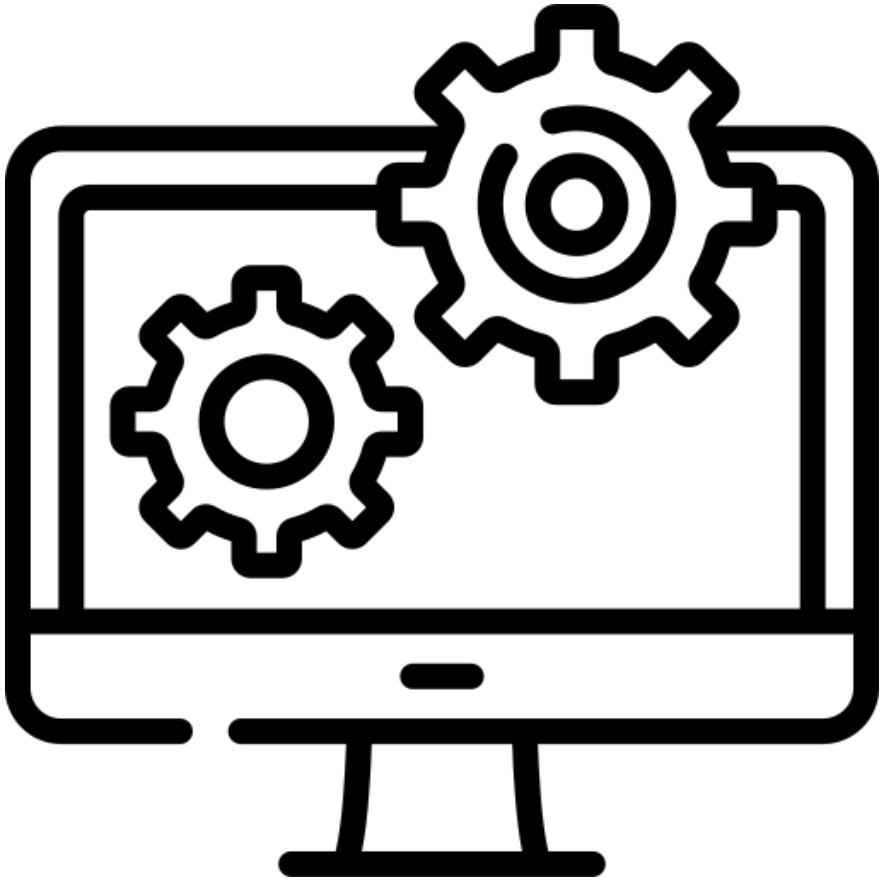
Key Objective 2

Implementation of LCAC monitoring with a specific tool within an E2COMATION plant, fully integrated both with its automation and with its digital twin infrastructure

03

Key Objective 3

Integration to develop specific consumption and emission patterns (“sustainability profile”) related to targeted activities, both in near-real-time and for production simulation



LCAC TOOL

CONCEPTUAL FRAMEWORK

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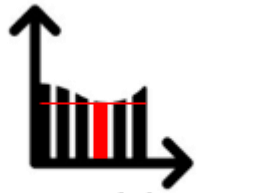
	OUTCOMES	MAIN BARRIERS	
LEVEL 3 *Visualization and reporting*	Contextualization of company-level environmental performance (CSR reporting, sectoral initiative etc.), simulation of prospective scenarios	➔ Effective communication to non-expert users, both in the company staff and in external stakeholders	
LEVEL 2 *Modular LCAC modelling*	Creation of consistent global balances, used to compute sustainability profiles, in accordance with standardization systems	➔ Management of discontinuous sampling ➔ Allocation of plant-level data to single products ➔ Flexible integration with external data sources	
LEVEL 1 *Inventory data retrieval*	Local energy and mass balance, collected by factory data management systems (EMS, ERP, MES)	➔ Data Collection costs ➔ Closely connect production and consumption data	

LCAC TOOL FUNCTIONALITIES

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1

DYNAMICALLY LINK AND TRACK ENERGY AND MASS FLOWS

Connection with the shop floor (PLCs, SCADA, MES, ERP)
Real Time
Near-real time

Support of intermediate DSC layer to collect and store relevant data for LCAC tool and other upper tools

2

DIGITAL ENVIRONMENTAL AND ECONOMIC PROFILE

Potential impacts for product and processes

Creation from near-real-time data and from production simulation data

3

CERTIFIABLE DATA TOWARDS MAIN ENVIRONMENTAL STANDARDS

Products
ISO 14026, ISO 14046, ISO 14067, PEF, EPD

Processes
ISO 50001, ISO TC 323, ISO 14004, OEF, IEC TC 111

LCAC TOOL FUNCTIONALITIES

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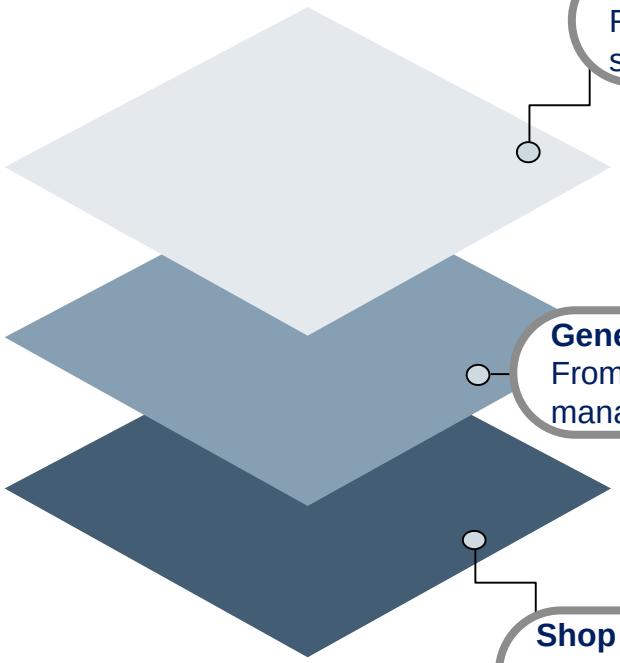
INPUT DATA TYPE

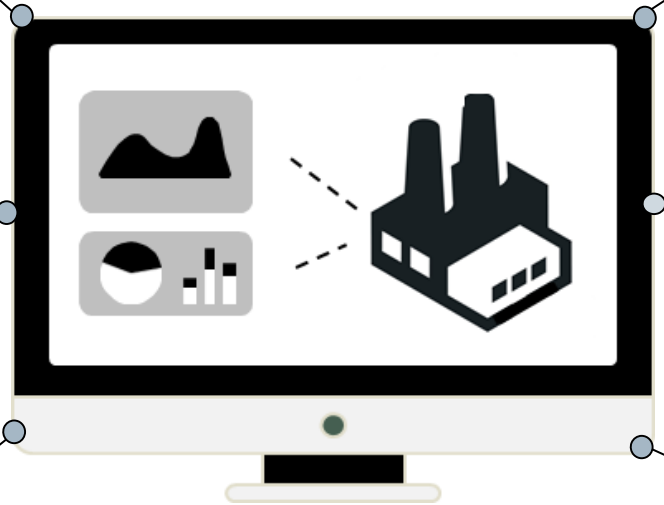


Simulated Data
From planning software

General Plant data
From Facility Data management systems

Shop Floor Data
From facility machines and sensors

LCAC TOOL



OUTPUT DATA TYPE

Dynamic profiles
Environmental and economic profiles for factory configuration

Simulated data
Potential environmental and economic impacts

Consolidated Data
Environmental data verifiable and aggregable for standardization

LCAC TOOL – INTERMEDIATE RESULTS

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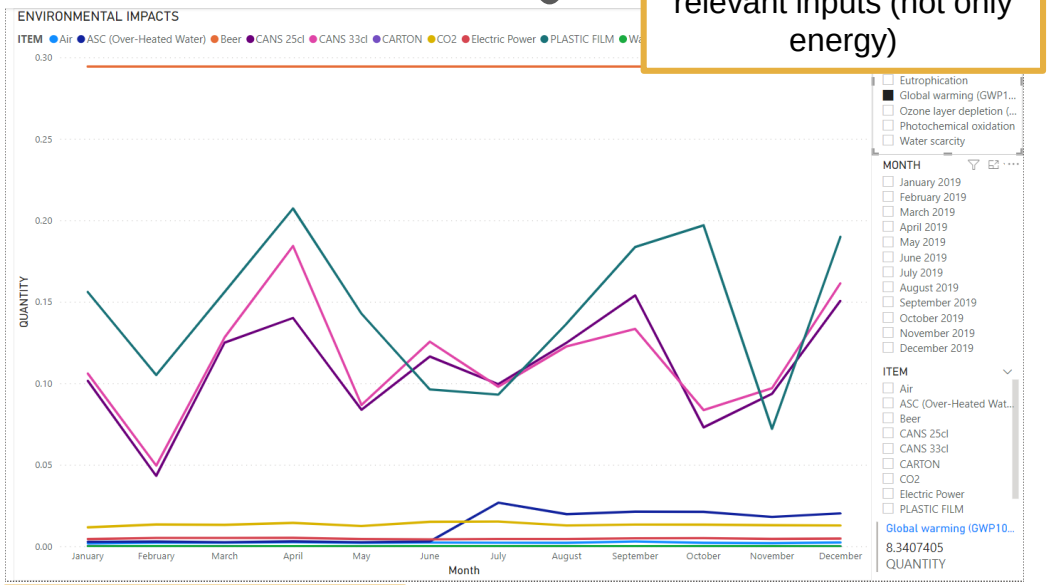
LCAC – REAL DATA - RESULTS

Evaluation of energy and materials consumption during production to obtain a high temporal resolution LCAC analysis:

- general consumption of the plant and allocations included

High variability of relevant inputs (not only energy)



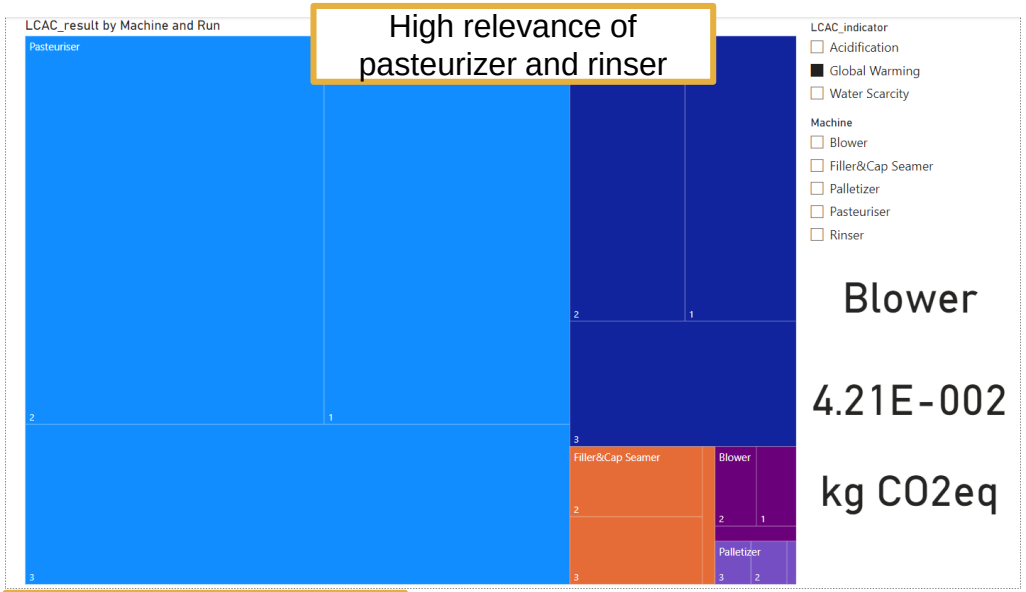
Item-based visualization

LCAC SIMULATION - RESULTS

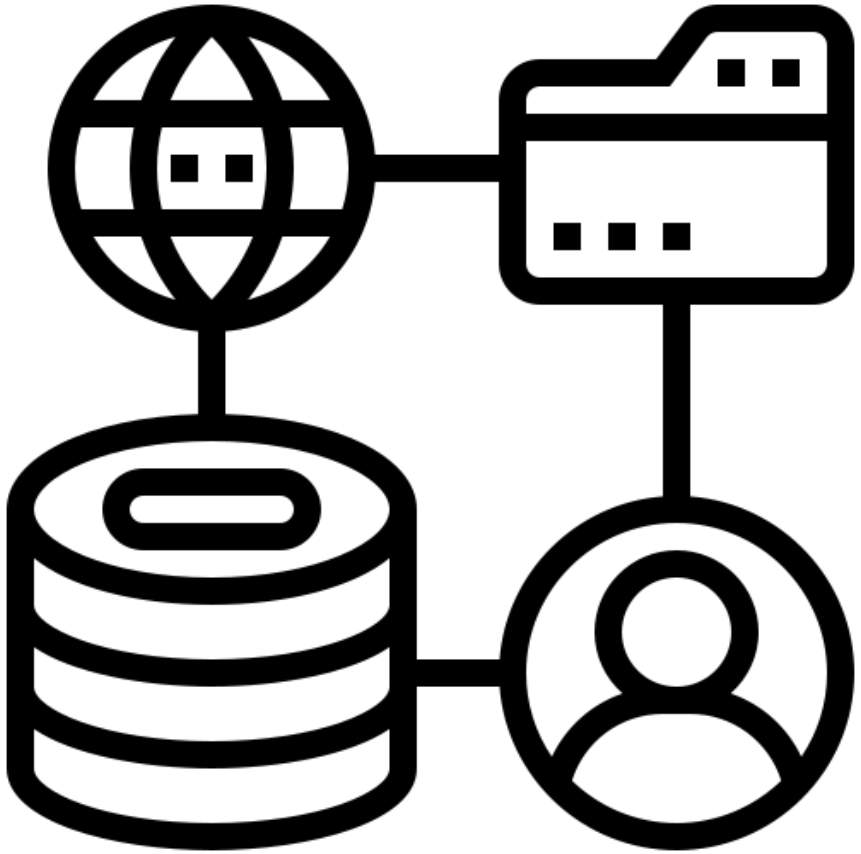
Together with project partners, simulated LCAC results associated to simulation runs for a specific configuration of the production:

- general consumption of the plant and allocations coming from external sources included

High relevance of pasteurizer and rinser



Machine-based visualization



E2COMATION ARCHITECTURE

ARCHITECTURE

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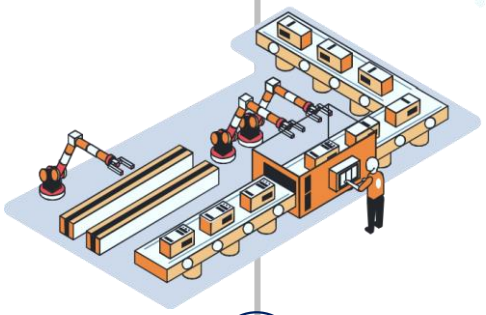
FINAL USERS >> INVENTORY SYSTEMS >> AGGREGATED DATA >> FUNCTIONS >> RESULTS

INVENTORY GENERIC DATA PLANT

AGGREGATED DATA BY INDUSTRIAL DATA MANAGEMENT SYSTEMS

SUPPORT FILES

SIMULATED PRODUCTION DATA



PROGRAMMABLE LOGIC CONTROLLER

DISTRIBUTED DATA-STREAM COMPUTING (DSC)

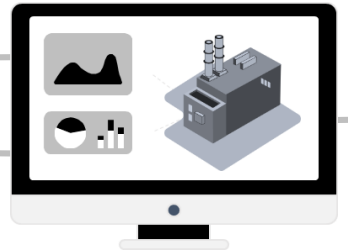
SHOP FLOOR

RAW SENSORS

DATA COLLECTION LAYER

WATCHDOG

LCAC TOOL



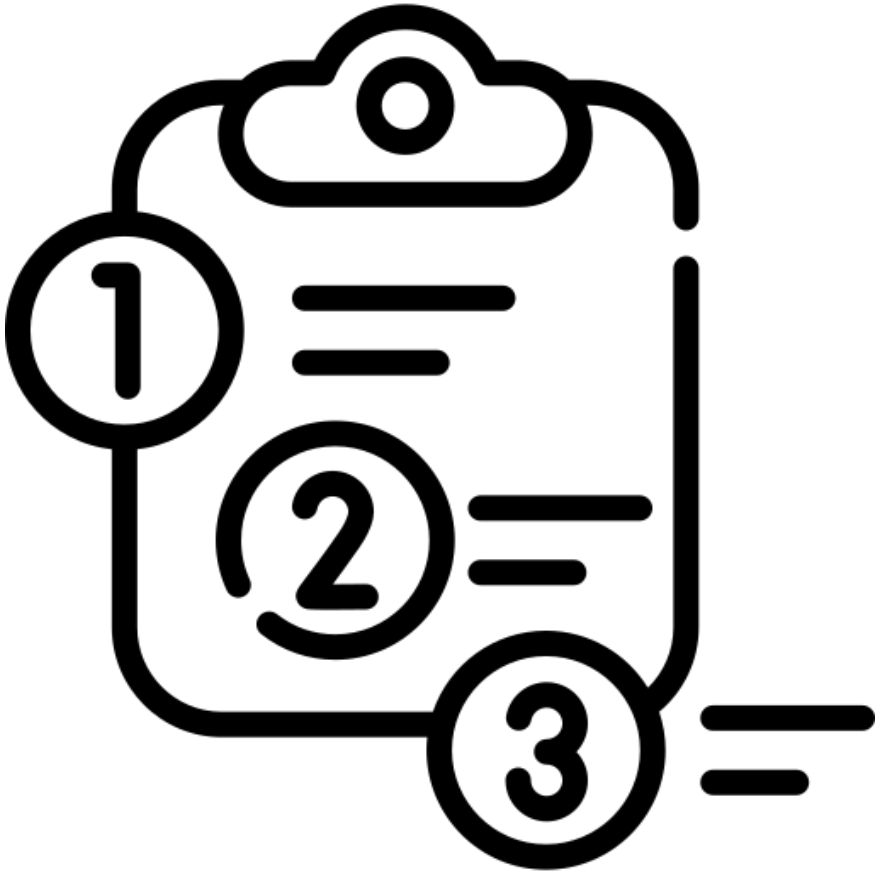
NEAR-REAL-TIME MONITORING

DIGITAL ENVIRONMENTAL & ECONOMIC PROFILES (DEEP)

SIMULATED DEEP

CUSTOMIZABLE DASHBOARD

READY-TO-CHECK DATA FOR STANDARDIZATION

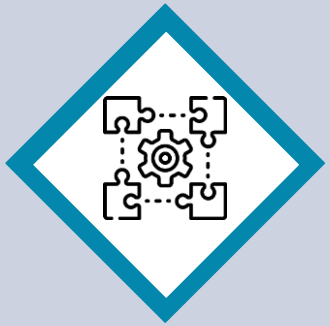


NEXT STEPS AND METHODOLOGICAL ASPECTS

NEXT STEPS

REFINEMENT OF THE OFFLINE TOOL

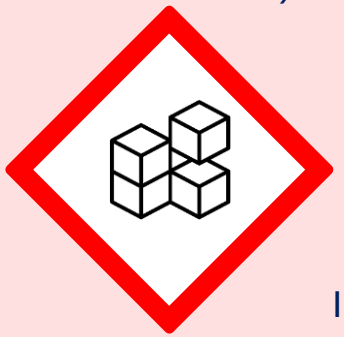
Consolidation of the models and assumptions

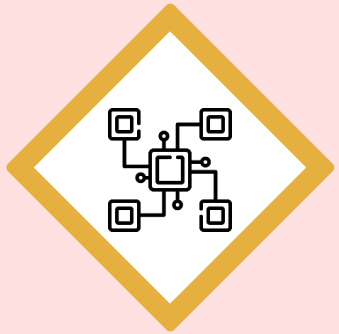


Discussion with the different partners in the value chains

DEVELOPMENT OF THE ONLINE TOOL

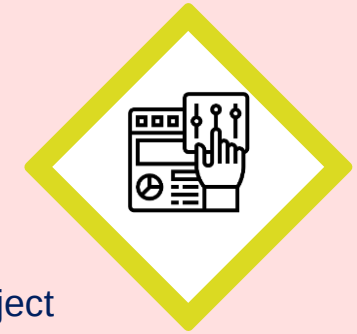
Creation of the different modules (data retrieval, data manipulation, LCAC calculation, LCAC results)





Integration with other project tools / layer:
INPUT: define communication protocols for data exchange
OUTPUT: define structure to store and share results

Creation of User Interface to be utilized by the companies to input the data and define temporal resolution of the analysis



Testing of the stand-alone tool and of the overall architecture

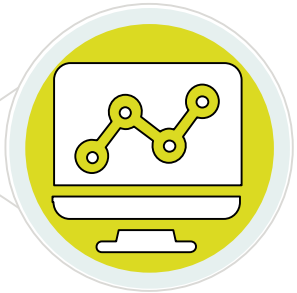
POTENTIAL CRITICALITIES

FACTORY PROCESSES

Understanding dynamic business processes to ensure correct characterisation factors

TEMPORAL RESOLUTION

Choosing the optimal time resolution for both modelling and business needs



COMMUNICATION

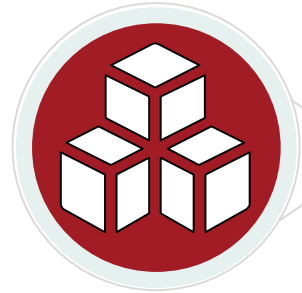
Provide an effective communication of the results both graphically and in terms of information to stakeholders

INTEGRATION

Integration of information from different sources (online and offline)

MODULARITY

Modular structure to be adapted to different use cases in different sectors and ensure possibility of upgrades



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Grazie per l'attenzione!

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