



**KYKLOS 4.0** – An Advanced Circular and Agile Manufacturing Ecosystem based on Rapid Reconfigurable Manufacturing Process and Individualized Consumer Preferences

# KYKLOS 4.0 Project Overview

[www.kyklos40project.eu](http://www.kyklos40project.eu)

Project Manager: Jason Mansell - TECNALIA



# KYKLOS 4.0 Factsheet



KYKLOS 4.0

<b>KYKLOS 4.0</b>	An Advanced Circular and Agile Manufacturing Ecosystem based on rapid reconfigurable manufacturing process and individualized consumer preferences
<b>Project Number</b>	872570
<b>Starting Date</b>	01/01/2020
<b>Project Duration</b>	48 months
<b>Call (part) Identifier</b>	H2020-DT-2019-1
<b>Topic</b>	Digital Manufacturing Platforms for Connected Smart Factories
<b>Budget</b>	€19.227.110



# KYKLOS 4.0 Consortium



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NO	PARTICIPANT	SHORT NAME	COUNTRY	TYPE
1	FUNDACION TECNALIA RESEARCH & INNOVATION	TECNALIA	ES	RI
2	MAGGIOLI SPA	MAGG	IT	LE
3	CENTRO DI RICERCHE EUROPEO DI TECNOLOGIE DESIGN E MATERIALI	CETMA	IT	RI
4	TWI ELLAS ASTIKI MI KERDOSKOPIKI ETAIREIA	TWI	GR	RI
5	JOTNE EPM TECHNOLOGY AS	Jotne	NO	SME
6	F6S NETWORK LIMITED	F6S	UK	SME
7	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	FOKUS	DE	RI
8	EUROPEAN DIGITAL SME ALLIANCE	DIGITAL SME	BE	NPO
9	CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA	CIMNE	ES	RI
10	CIRTES SRC	CIRTES	FR	SME
11	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	CERTH	GR	RI
12	GFT ITALIA SRL	GFT	IT	SME
13	KONNEKT ABLE TECHNOLOGIES LIMITED	KT	IE	SME
14	ADVANTIC SISTEMAS Y SERVICIOS SL	ADSYS	ES	SME
15	UNIVERSIDAD POLITECNICA DE MADRID	UPM	ES	UNI
16	PDM E FC PROJECTO DESENVOLVIMENTO MANUTENCAO FORMACAO E CONSULTADORIALDA	PDMFC	PT	SME
17	ENGINEERS FOR BUSINESS IPIRESIES TECHNOLOGIAS KAI MICHANIKIS ANONIMI ETAIRIA	EfB	GR	SME
18	ALGOSYSTEMS ANONIMI TECHNIKI EMPORIKI ETAIRIA PLIROFORIKIS AUTOMATISMON KAI METROLOGIAS	ALGOSYSTEMS	GR	SME
19	UNIVERSIDADE DE COIMBRA	UC	PT	UNI
20	INNOV-ACTS LIMITED	INNOV-ACTS	CY	SME
<i>END USERS</i>				
21	ASTILLEROS DE SANTANDER SA	AST	ES	LE
22	GE MEDICAL SYSTEMS ISRAEL LTD	GRC	IL	LE
23	VESTEL ELEKTRONIK SANAYI VE TICARET ANONIM SIRKETI	VESTEL	TR	LE
24	PRO MEDICARE SRL	Pro Medicare	IT	SME
25	DIAD GROUP SRL	DIGRO	IT	LE
26	AGROTIKOS PTINOTROFIKOS SYNETERISMOS IOANNINON "I PINDOS"	PINDOS	GR	LE
27	CONTINENTAL AUTOMOTIVE ROMANIA SRL	CONT	RO	LE
28	KANFIT3D LTD	KANFIT3D	IL	SME
29	SOFTWARE IMAGINATION & VISION SRL	SIMAVI	RO	LE

# Rationale

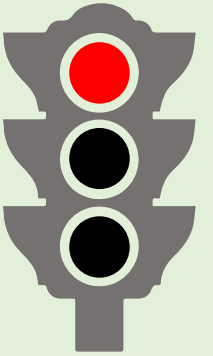


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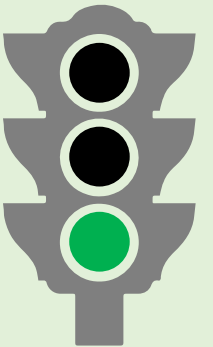


Manufacturing companies **consume** high amounts of energy as well as **natural resources** in their product-making processes:

- The respective amounts and overall costs of product making are increasing
- EU energy prizes are continuously increasing
- Raw materials price trend is ascending, increasing short term volatility



**Optimizing** the manufacturing processes becomes “a must” to ensure **sustainability**

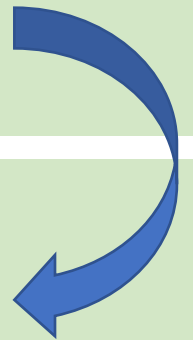


KYKLOS 4.0 aims at providing a **Circular Technology Ecosystem** which creates and supports the configurations, methodologies, production techniques, decision and actions at all different levels and stages of the manufacturing value chain so as to achieve:

- 🏭 **Increased energy efficiency**
- 🏭 **Decreased use of raw materials (second use o parts or materials)**
  - 🏭 **Customer-centricity**
  - 🏭 **On-demand manufacturing**

Meeting Industry 4.0 objectives:

- 🏭 **Operational excellence**
- 🏭 **Mass customization and personalization**
  - 🏭 **Increasing efficiency**
  - 🏭 **Reducing waste**
- 🏭 **Boosting competitiveness**



# KYKLOS 4.0 contribution to Circularity



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The future of manufacturing will see a gradual development towards a **high-quality circular manufacturing industry**, in which the demand for scarce raw materials is met by raw materials from the value chain wherever possible, considering the following five strategic goals

## Five Strategic Goals of Circular Manufacturing

(Source: World Manufacturing Foundation)



Redesign Products & Materials Selection



Conserve & Recover Resources



Develop New Ways of Production



Implement Service-based Model



Shift to Renewable Raw Materials

In the global landscape, KYKLOS 4.0 is promoting low-cost and easy-to-use tools and data platforms, so that SMEs could adopt Circular Economy principles with limited investments from an ICT platform and data space point of view

**How EU-funded research contributes to Industry 5.0**

Some examples

- 1 BEYOND 4.0**  
Examining the future impact of new technologies on **JOBS, BUSINESS MODELS AND WELFARE**
- 2 HuMan Manufacturing**  
Demonstrating ways **FACTORY WORKERS AND AUTOMATION** can operate in harmony, increasing productivity, quality, performance, satisfaction and safety
- 3 KYKLOS 4.0**  
Showing how cyber-physical systems, product life-cycle management, life-cycle assessment, augmented reality, and artificial intelligence technologies and methods can transform **CIRCULAR MANUFACTURING**

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#EUScienceInnov #Industry5.0 #ResearchImpactEU

From shareholder to stakeholder value  
**INDUSTRY 5.0**  
human-centric, sustainable and resilient

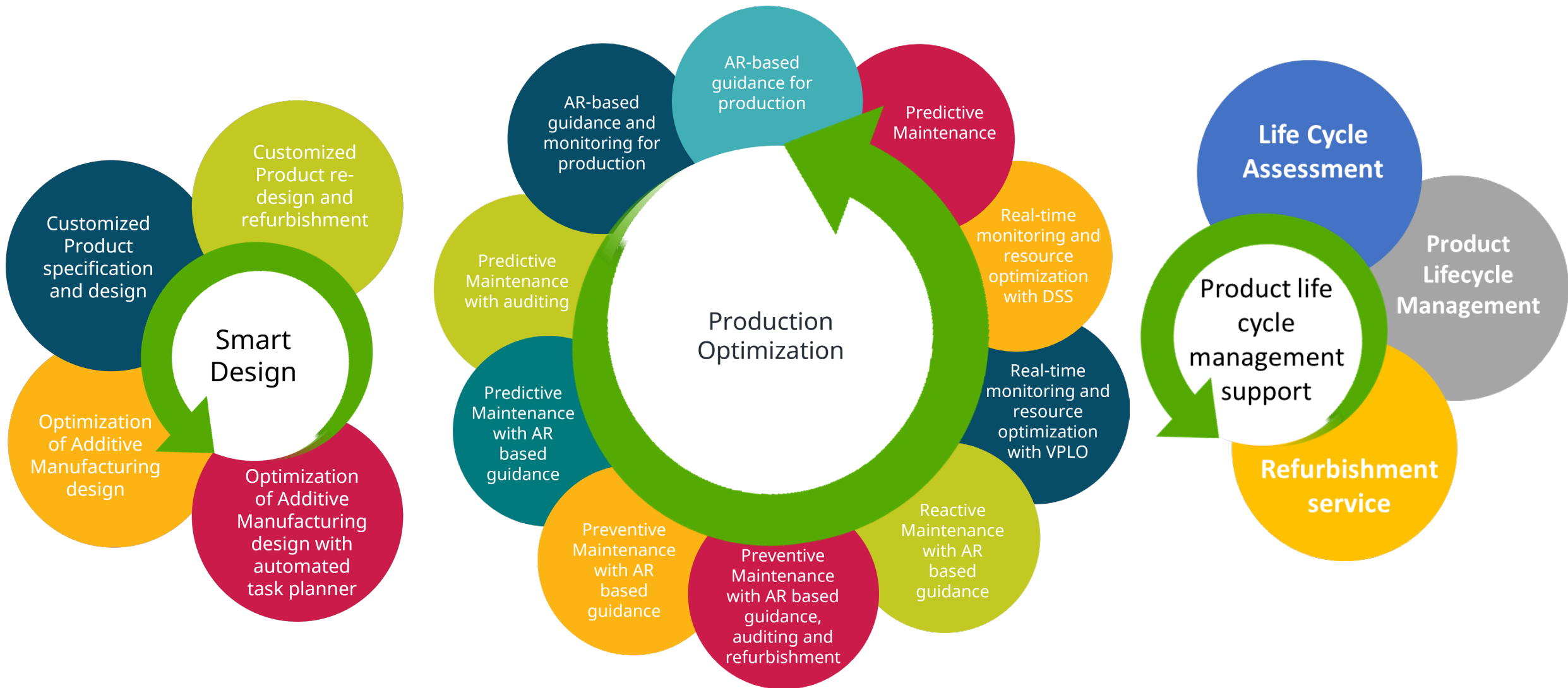
European Commission



# KYKLOS 4.0 Services



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# Service 1: Advanced support for production



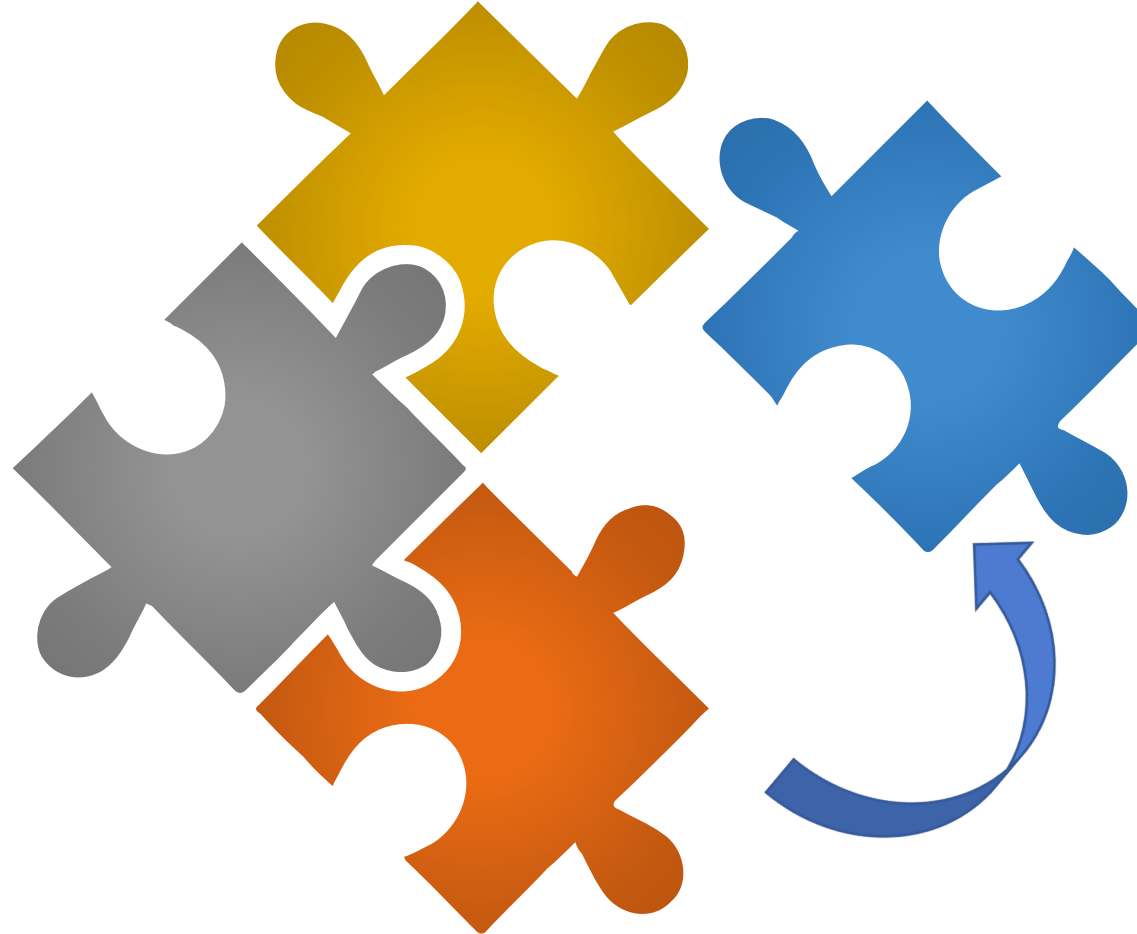
KYKLOS 4.0

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**KYKLOS 4.0 Backend / PLM:**  
Delivers secure data collection and access

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**LCA Simulations Engine:** Calculates the environmental impact of the process in (near) real-time



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**Industrial Use Case:**  
*The service delivers secure data collection, AR-based guidance, and monitoring for production and environmental impact information*

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**Augmented Reality Tool:** Guides the operator when performing manufacturing tasks and provides real-time information from IoT systems and LCA



# Service 2: Personalized product design and refurbishment

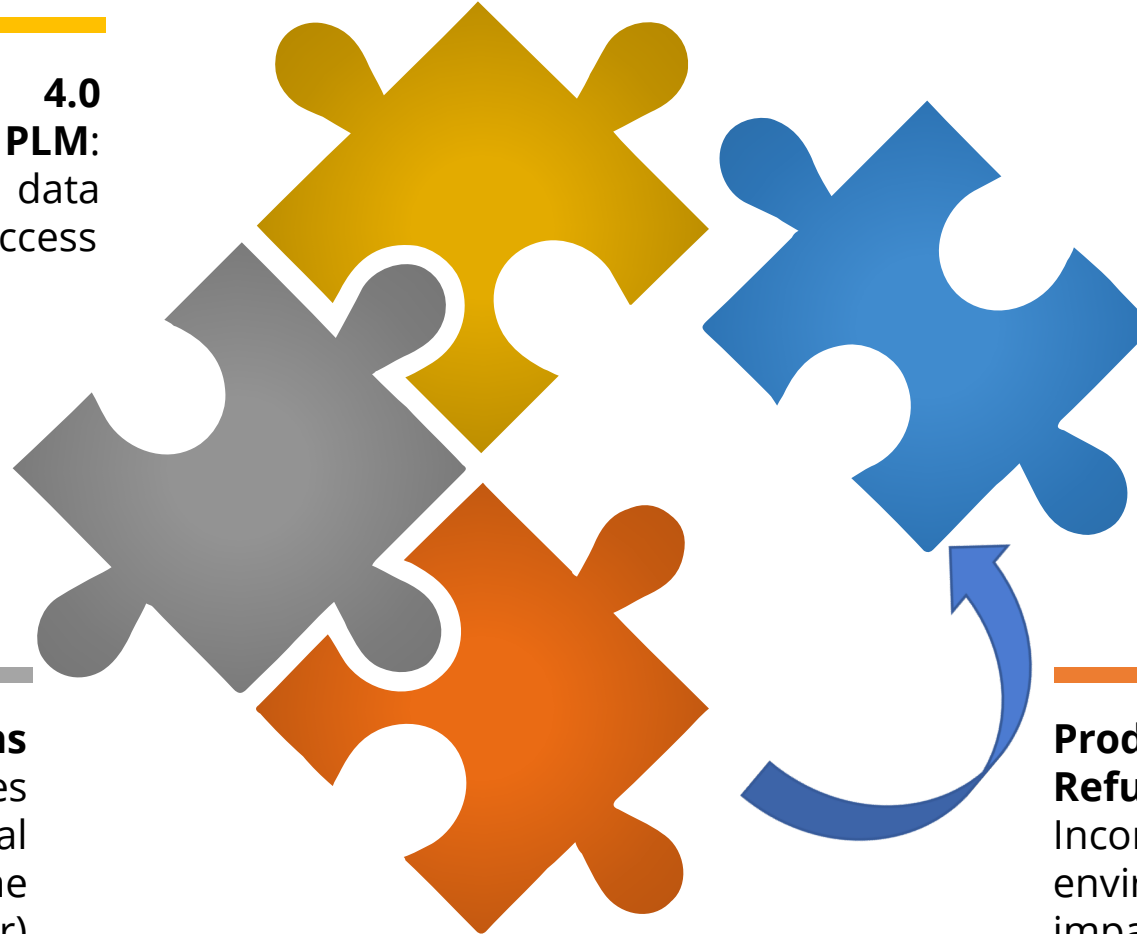


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**KYKLOS 4.0 Backend / PLM:**  
Delivers secure data collection and access

**Web 3D Modelling / Rapid Prototyping Module:** Design and deployment of the product on the web / optimization of process parameters

**LCA Simulations Engine:** Calculates the environmental impact of the process in (near) real-time



**Industrial Use Case:**  
*The service enables web-based configuration of the product for customer, environmental impact monitoring, product tracking and certification*

**Product Refurbishment:**  
Incorporate the environmental impact data into a refurbishment certificate

# Service 3: Circular indicators monitoring



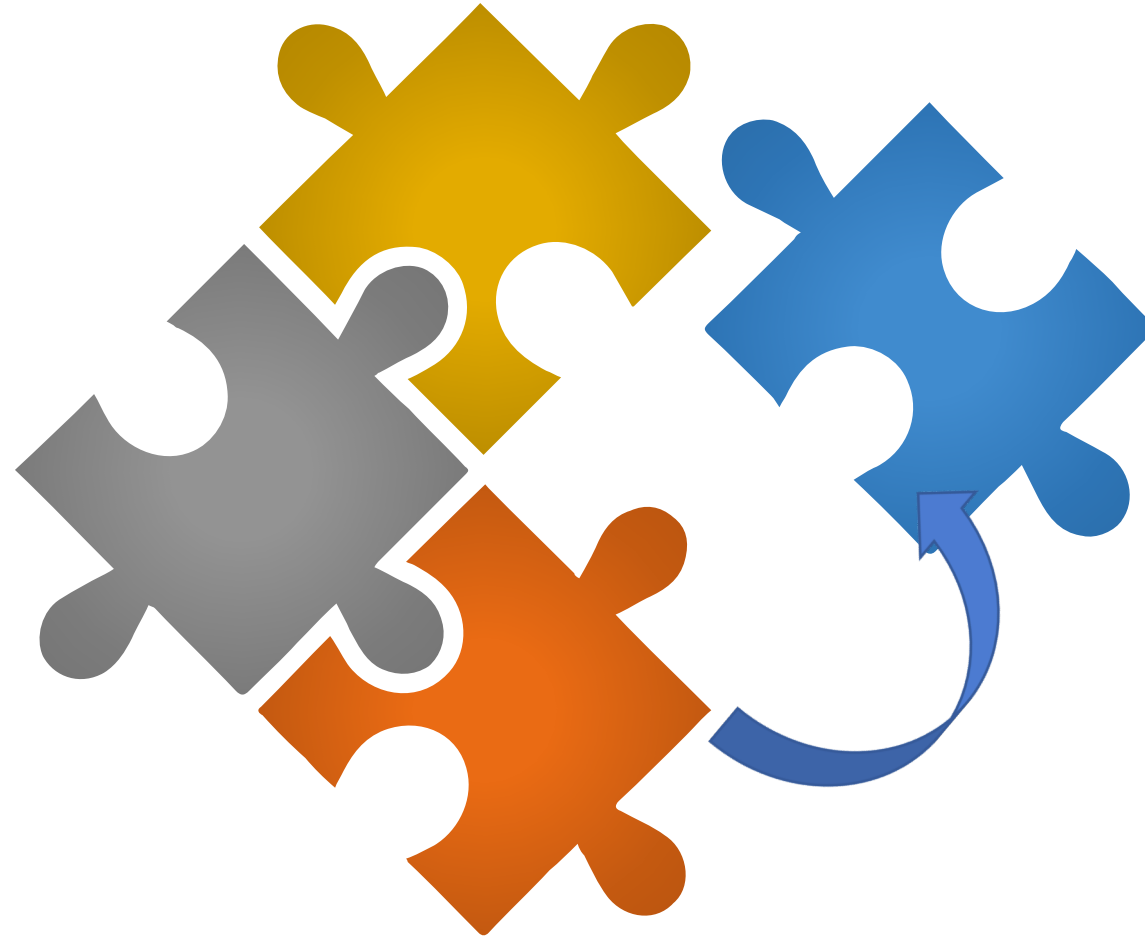
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**KYKLOS 4.0 Backend / PLM:**  
Delivers secure data collection and access

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**LCA Simulations Engine:** Calculates the environmental impact of the process in (near) real-time



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**Industrial Use Case:**  
*The service enables the formulation of long-term strategies to enhance production efficiency and circularity*

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**Decision Support System:** Provides circularity suggestions based on real-time LCA information

# KYKLOS 4.0 Circularity Approach: Circular Economy Indicators



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## RI: Reducing inputs and the use of natural resources

- Feedstock intensity
- Circularity Transition Indicators (CTI) - water Circularity

## RR: Increasing the share of renewable and recyclable resources

- Circularity Transition Indicators (CTI) - renewable energy
- Circularity Transition Indicators (CTI) - % Circular inflow

## RL: Reducing valuable materials and energy losses

- % to upcycling
- Disassembly time
- Reusability/Recyclability/Recoverability rate

## DU: Increasing the value durability of products

- Longevity
- Use Phase Circularity Indicator

## Reducing emissions levels

- Ecoefficiency

# KYKLOS 4.0 Circularity Approach: Circular Economy Indicator Dashboard



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🕒 🔍 👤 Kt Test

**Circular Indicators Overall**
Circular Indicator Formulas
02-2023 - 03-2023
Enabled

ID	Name	Description & Formula	Base Scenario	Future Scenario
CIR01	Feedstock Intensity	Feedstock intensity (FI)* estimates the fraction of mass of primary feedstock needed in production (Mprimary.mat) in relation to the total mass of products (Mprod) and useful co-products (Mco.prod).	30.00	40.00
		$\text{Feedstock Intensity (\%)} = \frac{M_{\text{primary\_mat}}}{M_{\text{prod}} + M_{\text{co\_prod}}}$		
CIR03	Circularity Transition Indicators (CTI) - renewable energy	The renewable energy* estimates the renewable energy consumption per total energy consumption in plant.	15.00	10.00
		$\text{Renewable energy (\%)} = \frac{\text{Renewable energy (annual consumption)}}{\text{Total energy (annual consumption)}} * 100$		

### Closeness Coefficiency

	Base Scenario	Future Scenario
Si-	0.20	0.08
Si+	0.08	0.20
<b>Closeness Coefficient</b>	<b>0.71</b>	<b>0.29</b>



# KYKLOS 4.0 Pilots



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Search



**Aerospace Pilot – Additive manufacturing technology for aerospace – aircraft part customization systems (KANFIT3D)**

2	1	5	3	2
Validations	Places	Components	Value Propositions	ICT Problems

**Automotive Pilot – Addressing the critical components of each piece in automotive industry**



1	1	6	2	2
Validations	Places	Components	Value Propositions	ICT Problems

**Electronic Equipment Industry Pilot**



6	1	10	8	17
Validations	Places	Components	Value Propositions	ICT Problems

**Medical Pilot – Custom and smart wheelchair systems manufacturing (PROMEDICARE)**

3	1	9	6	6
Validations	Places	Components	Value Propositions	ICT Problems

**Aerospace Pilot – Jet engine manufacturing & maintenance**



1	1	3	2	3
Validations	Places	Components	Value Propositions	ICT Problems

**Electronic Devices/Equipment Pilot – Electrical Equipment Manufacturers (VESTEL)**



2	1	5	5	1
Validations	Places	Components	Value Propositions	ICT Problems

**Food Industry Pilot – Reduction of Energy Consumption and Waste Management (PINDOS)**



2	1	4	3	6
Validations	Places	Components	Value Propositions	ICT Problems

**Shipyard Pilot – Product Service Solutions in Shipyards**



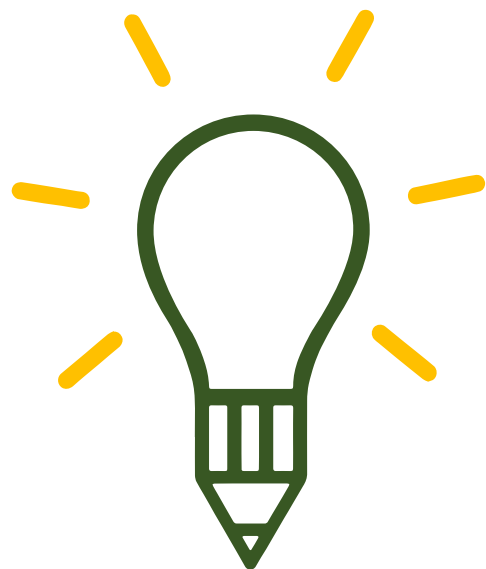
2	1	6	7	5
Validations	Places	Components	Value Propositions	ICT Problems



# KYKLOS 4.0 Open Calls



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KYKLOS 4.0 has organized two Open Calls during the project with the objective of **engaging European SMEs** in the design and implementation of highly innovative experiments/prototypes using research infrastructure available within the framework of the project

A total of **€3M** has been assigned to the KYKLOS 4.0 Open Calls.

## 1<sup>st</sup> Open call projects (7):

ADME  
BEERco2  
D4CM  
DREAM  
EFIN-FOOD  
METALICA  
PET-Circle

[MORE INFO HERE](#)

## 2<sup>nd</sup> Open Call (17)

ANATOLIA	ARACOWELD	ARETRO
ATILIUS	CE4Con	DLP4CME
DYBLI-ML	EasyPrint	ERMES
MaChAwAI	POET4POEM	MainSol
PUMP	RoboWeldAR	ROCTex
SMARTER-MAN		VirtFuse

[MORE INFO HERE](#)



# KYKLOS 4.0 Open Call Project Results



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More info on Open Call project results on  
<https://www.youtube.com/channel/UCjExattPrmLOetNPI4OxD0g>



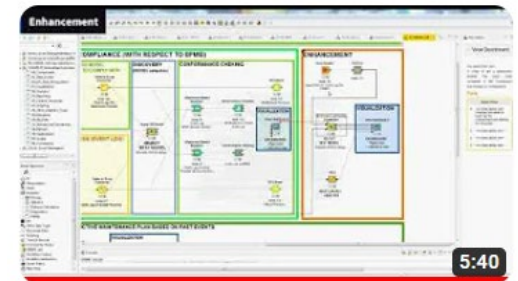
EasyPrint : Empowering your ideas through 3D printing



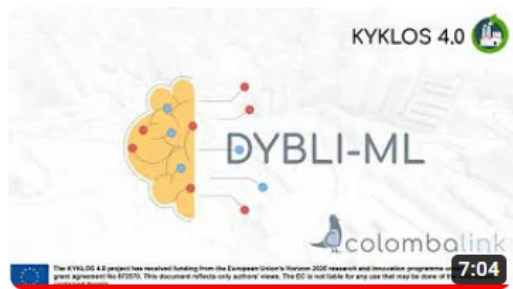
ATILIUS : Innovation in Space propulsion



RoboWeldAR : Cognitive robotic welding solution for shipbuilding



ERMES : Optimize maintenance of your



DYBLI-ML : Fault detection revolution



Aretro : Virtual interface for machinery



DLP4CME : Product digital lifecycle passport technology



Unlock your solar potential with Solario by Anatolia



# KYKLOS 4.0 Marketplace



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The KYKLOS 4.0 Marketplace uses an ontology that represent all **offers** from **suppliers**, and all **requests** from **clients**, while being small enough to be workable

KYKLOS 4.0 Marketplace provides the following:

- A **catalogue** of products and services enriched with contextual and semantic information
- Improved searching results by finding close **matches** that are still semantically relevant but would otherwise be ignored
- Focus on **circular economy** of materials, creating specific handling for greener alternatives
- Specific **LCA** information related to materials and services available in the market





# KYKLOS 4.0 Marketplace



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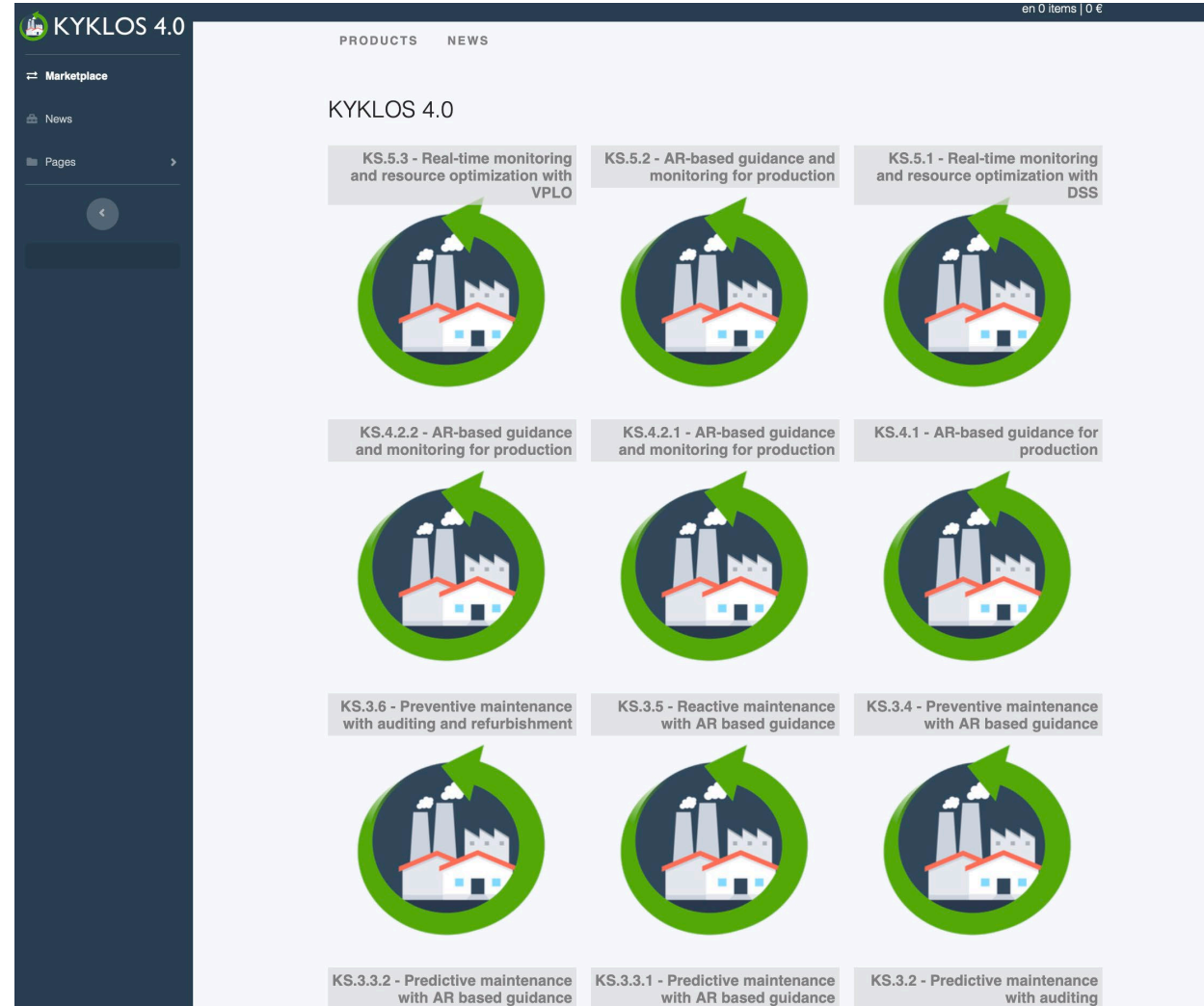
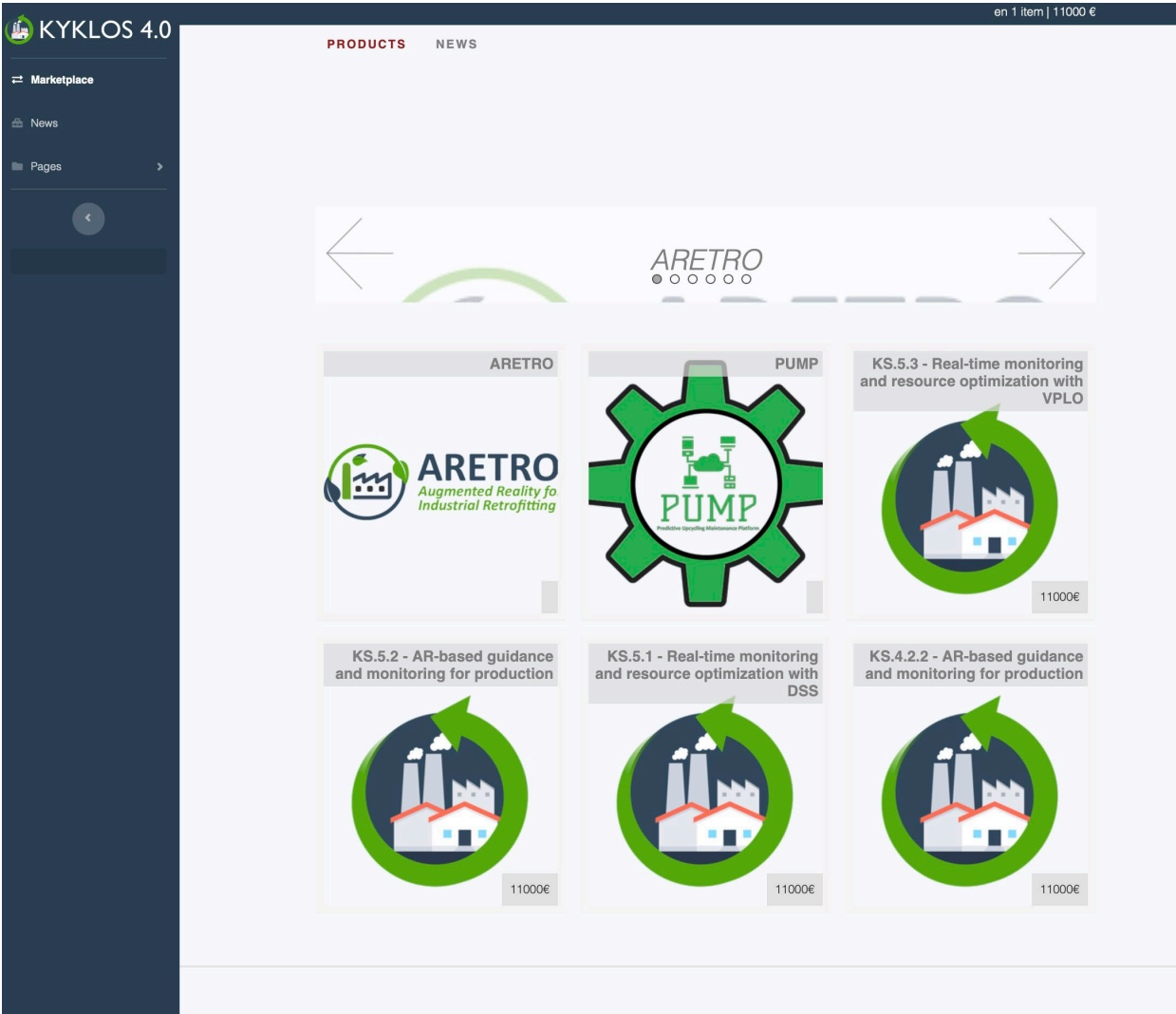


Image by Pete Linforth from Pixabay



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# KYKLOS 4.0 Marketplace



KYKLOS 4.0

KYKLOS 4.0 en 0 items | 0 €

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Marketplace

News

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## ARETRO


The ARETRO Platform specifically targets industries who want to bring added value to their machines, by virtually retrofitting them with Augmented Reality (AR) interfaces.



We know how difficult, costly, and time-consuming it is to develop custom AR Interfaces for industrial machines, that is why we developed the ARETRO Platform. Using just a web browser, and with no coding skills, you can effortlessly design, create and deploy AR interfaces for your machines, including:

- Rich step-by-step maintenance instructions;
- Enjoyable training tutorials;
- Different types of panels, with different colours, transparencies and rotations;
- Include videos, images, and data coming from other KYKLOS 4.0 Services.
- Access to machine manuals and schematics.

Once an AR interface is created, it can be validated on the provided desktop application (Windows and MAC), and immediately experienced on the Industrial shopfloor by a machine technician. The AR interface can be seen through any compatible iOS/Android device (e.g., Apple iPad or Samsung Galaxy Tab).



The ARETRO platform is fully dedicated to an innovative circular manufacturing ecosystem by contributing to the circular economy's waste reduction goals by allowing manufacturers to increase their machines' values by performing this new type of retrofit. The AR interfaces are versatile and applicable to various machine types, making it very easy to apply this type of retrofitting to different machines models. This flexibility aligns with the circular economy principle of keeping products and materials in use for as long as possible, regardless of specific machine configurations. There is also less need for physical modifications or replacing entire machine components (e.g., monitors), which can lead to significant material waste.

The ARETRO dedicated webpage: <https://aretro.albesmart.pt/>

KYKLOS 4.0 en 1 item | 11000 €

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## KS.5.2 - AR-based guidance and monitoring for production

Production Optimization > Resource use monitoring and optimization



These services support the production manager or plant manager by monitoring in real-time the production as well as providing simulation of the process in case some of the inputs change.

KYKLOS 4.0 components also:

- provide a decision support system based on the indicators calculated during the production phase in order to enhance both the production and the circular indicators.
- allow to orchestrate multiple services involved into the manufacturing process of a product line so all of them are synchronized and efficiently managed.

# KYKLOS 4.0 on IoT Catalogue



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The IoT Catalogue brings together IoT users and **technology providers**



Learn more about **KYKLOS 4.0 Use Cases and Components** on <https://www.iod-catalogue.com/projects/61eecf88120630002afdfef6>





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Find **demo videos** of KYKLOS 4.0 Components on  
<https://www.youtube.com/channel/UCjExattPrmLOetNPI4OxD0g>

[www.kyklos40project.eu](http://www.kyklos40project.eu)

