Now

10:30–11:00

How CIRCULOOS resolved the procurement problem in the context of circular economy

Themis Kolyvas, project manager & CIRCULOOS coordinator, European Dynamics

THE PROBLEM

CIRCULOOS

Embracing Change in Circular Economy Production Models

The Shift from Process Reconfiguration to data driven, dynamic value chains

1

CASCADING CHANGE IN PROD. LIFECYCLE

Circular products are designed for multiple lifecycle changes, maximizing value through recycling, refurbishment, remanufacturing, redistribution, and maintenance.

2

DYNAMIC CONTEXT AND UNCERTAINTY

Questions about product availability, reusable parts, and new procurement challenge

3

COMPLEXITY IN EMERGING SUPPLY CHAINS

New roles and increased data volumes necessitate critical timing in communication and rapid decision-making.

4

INNOVATIVE CIRCULAR ECONOMY MODELS

Advocated by the Circular Economy Action Plan, models are to be **customer-centric, customizable, and collaborative**, leveraging digital technologies like IoT, big data, blockchain, and AI.

RETHINKING

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circular economy needs **new partnerships**

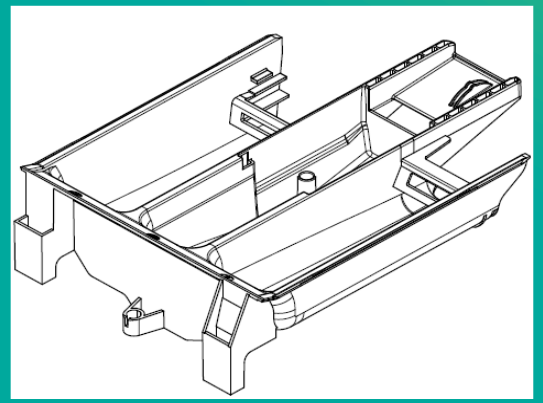
circular manufacturing needs **visibility** and traceability of resources

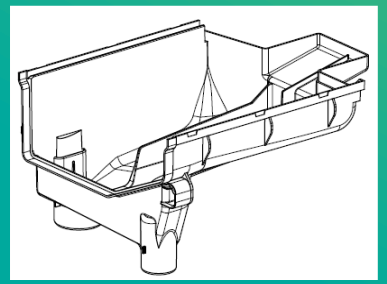
decisions can be made **objectively**

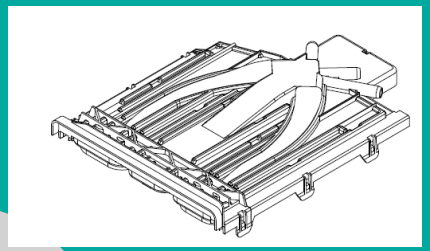


EXAMPLE

A PRODUCT









PIECES	kWh/piece	Weight (kg/piece)	Raw Material
Lid	0.11	0.10	[PP + 50% CO3Ca] ISOFIL H50 C2V NATURALSIRMAX
Distributor	0.11	0.25	[PP + 50% CO3Ca] ISOFIL H50 C2V NATURALSIRMAX
Fixed tub	0.24	0.22	[PP + talco 30%] Hostacom HKC 182 L W92607 WHITE
Sliding tub	0.24	0.20	[PP + talco 30%] Hostacom HKC 182 L W92607 WHITE
Siphon	0.03	0.03	ISOFIL HK 30 TFH2 BL2092

RETHINKING

CIRCULOOS

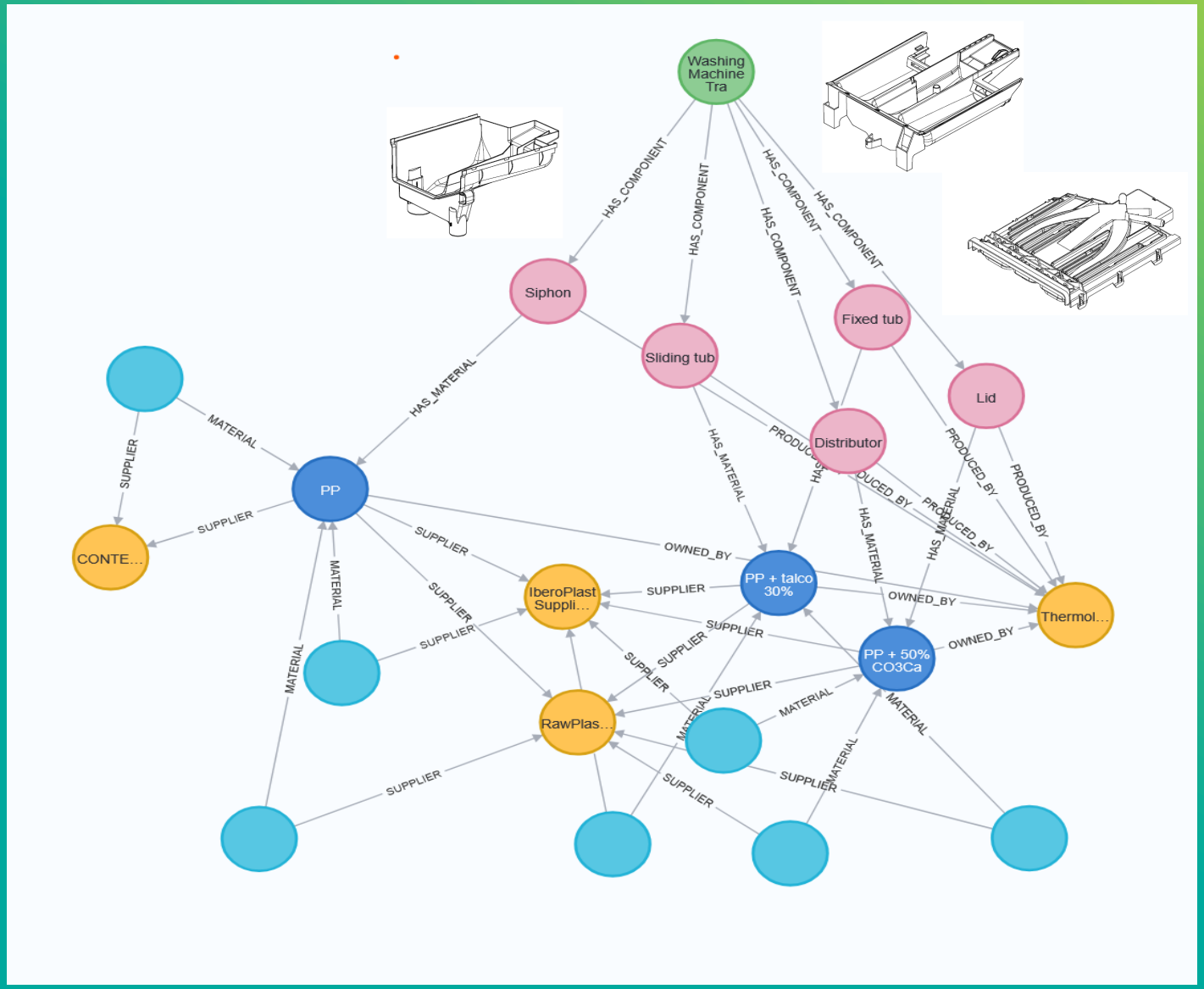
circular economy needs new **partnerships**

circular manufacturing needs **visibility** and traceability of resources

decisions can be made **objectively**



GRAPH VIEW OF A PRODUCT



PRODUCT IN NUMBERS

STEP 3

Processes 1

Packing&Labeling	PRC_Nm: Name of Process
10	Duration(h): Estimated/Averaged duration for process
Packing&Labeling: Details e.g [CO2: 0.5 kg/h], [ElectricConsumption: 2 kW]	Details: Details on units, type, quantity to be optimized, LCA Indicators
uuid*	RefID: Reference LCA uuid if exists
This is the process for the sending product	Description: Short Description of the Process
Label & Good_Product	Inputs: What are the inputs of the process
[2, 1]	In Q: Array with input quantities
[u, u]	In_Units: The units of the input quantities
Finished_Product	Outputs: products AND/OR Byproducts of the process
[1]	Out Q: Array with input quantities
[u]	Out_Units: The units of the output quantities
On available materials, 3h/day	Triggering

STEP 4

Inputs/Outputs

Label	
uuid*	RefID: Reference LCA uuid if exists
[ ]	From: Process List
35	Q: Initial Quantity for simulation purposes
u	Units
[Supplier_III, Supplier_IV]	Supplier List: Names of the suppliers
Good_Product	
uuid*	RefID: Reference LCA uuid if exists
[Quality_control]	From: Process List
35	Q: Initial Quantity for simulation purposes
u	Units
[]	Supplier List: Names of the suppliers

These are outputs from Processes

If not defined will be developed by SCDT with zero initial quantitie

IF they are further processed, it is required that they are detailed

STEP 5

Processes 2

Quality_control	PRC_Nm
0.5	Duration(h)
Quality_control:Details	Details
uuid*	RefID: Reference LCA uuid if exists
	Description: Short Description of the Process
Whole_Product	Inputs
[1]	In Q: Array with input quantities
[u]	In_Units: The units of the input quantities
Good_Product	Outputs
[15]	Out Q: Array with input quantities
[u]	Out_Units: The units of the output quantities
Assembly	PRC_Nm
1	Duration(h)
Assembly:Details	Details
uuid*	RefID: Reference LCA uuid if exists
	Description: Short Description of the Process
Cover & Distributor & Fixed_Cubet & Mobil_Cubet & Sifon & Tubo & Brida_metalica_cincada	Inputs
[1, 1, 1, 1, 1, 4, 2]	In Q: Array with input quantities
[u, u, u, u, u, u, u]	In_Units: The units of the input quantities
Whole_Product	Outputs
[1]	Out Q: Array with input quantities
[u]	Out_Units: The units of the output quantities
Injection_Machine_1	PRC_Nm
1	Duration(h)
Injection_Machine_1:Details	Details

Inputs/Outputs

Whole_Product	
uuid*	RefID: Reference LCA uuid if exists
[Assembly]	From
20	Q
u	Units
[ ]	Supplier List: Names of the suppliers
Cover	
uuid*	RefID: Reference LCA uuid if exists
[Injection_Machine_1]	From
20	Q
u	Units
[ ]	Supplier List: Names of the suppliers
Distributor	
uuid*	RefID: Reference LCA uuid if exists
[Injection_Machine_1]	From
20	Q
u	Units
[ ]	Supplier List: Names of the suppliers
Fixed_Cubet	
uuid*	RefID: Reference LCA uuid if exists
[Injection_Machine_2]	From
20	Q
u	Units
[ ]	Supplier List: Names of the suppliers
Mobil_Cubet	

PRODUCT AS DATA

CIRCULOOS


```
[{    "id": "urn:ngsi-ld:ManufacturingMachine:washingMachineTray:001",
    "type": "ManufacturingMachine",
    "name": {  "type": "Property",
        "value": "Washing Machine Tray Assembly"},
    "description": {"type": "Property",
        "value": "Complete washing machine tray with all components"},
    "dateCreated": {
        "type": "Property",
        "value": {
            "@type": "DateTime",
            "@value": "2025-10-22T12:00:00Z"
        } },
    "hasComponent": {
        "type": "Relationship",
        "object": [
            "urn:ngsi-ld:ManufacturingComponent:lid:001",
            "urn:ngsi-ld:ManufacturingComponent:distributor:001",
            "urn:ngsi-ld:ManufacturingComponent:fixedTub:001",
            "urn:ngsi-ld:ManufacturingComponent:slidingTub:001",
            "urn:ngsi-ld:ManufacturingComponent:siphon:001"
        ]
    },
    "totalEnergyConsumption": {
        "type": "Property",
        "value": 0.73,
        "unitCode": "KWH"    },
    "totalWeight": {
        "type": "Property",
        "value": 0.79163,
        "unitCode": "KGM"    }}]
```



```
   {id": "urn:ngsi-ld:ManufacturingComponent:lid:001",
        "type": "ManufacturingComponent",
        "name": {
            "type": "Property",
            "value": "Lid"},
        "energyConsumption": {
            "type": "Property",
            "value": 0.11,
            "unitCode": "KWH"},
        "weight": {
            "type": "Property",
            "value": 0.10,
            "unitCode": "KGM"},
        "hasMaterial": {
            "type": "Relationship",
            "object": "urn:ngsi-
ld:Material:PP50CO3Ca:001"},
        "producedBy": {
            "type": "Relationship",
            "object": "urn:ngsi-
ld:Company:thermolympic“},
        "stockLevel": {
            "type": "Property",
            "value": 2},
    },
```


..... 20 more ids

RETHINKING

CIRCULOOS

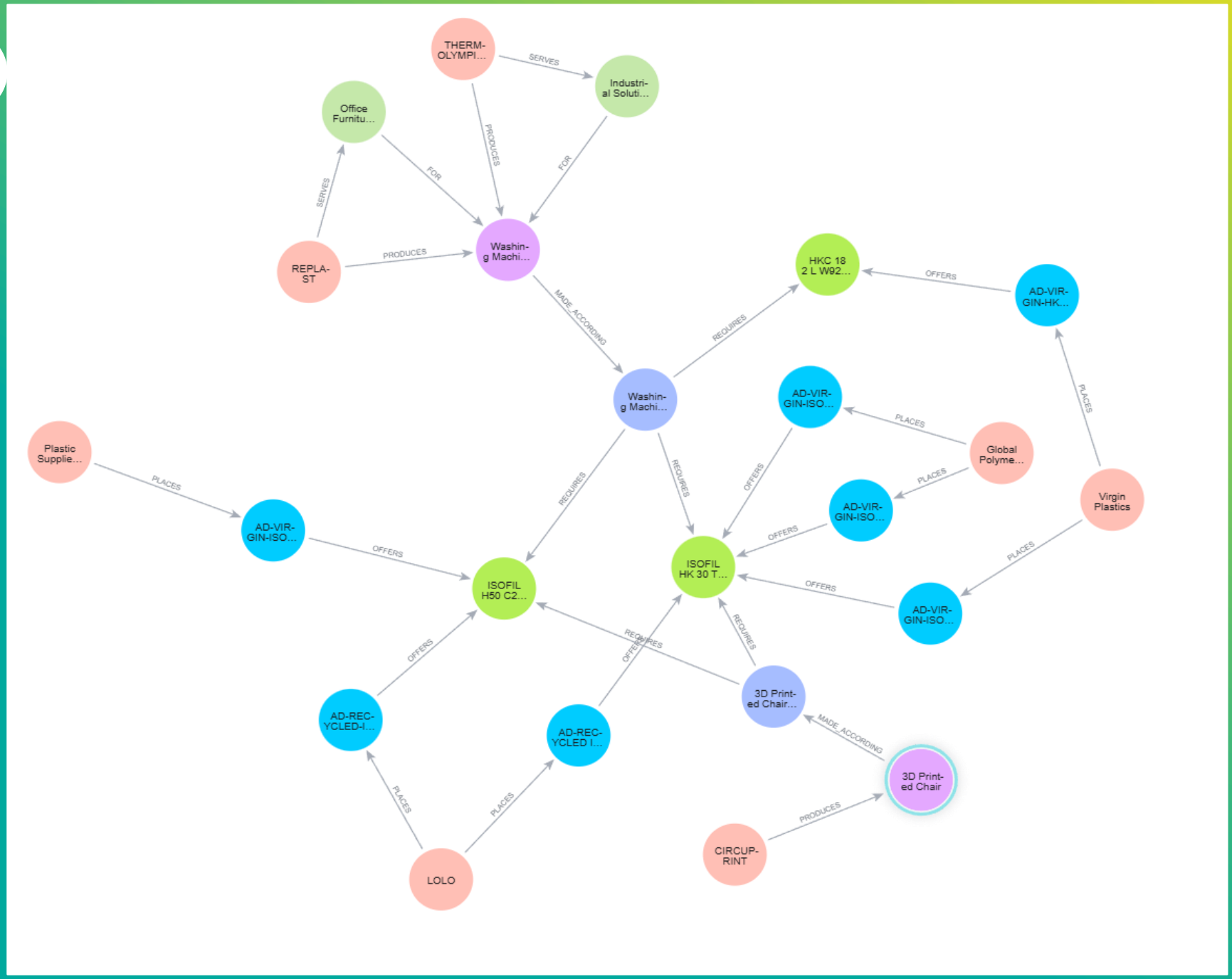
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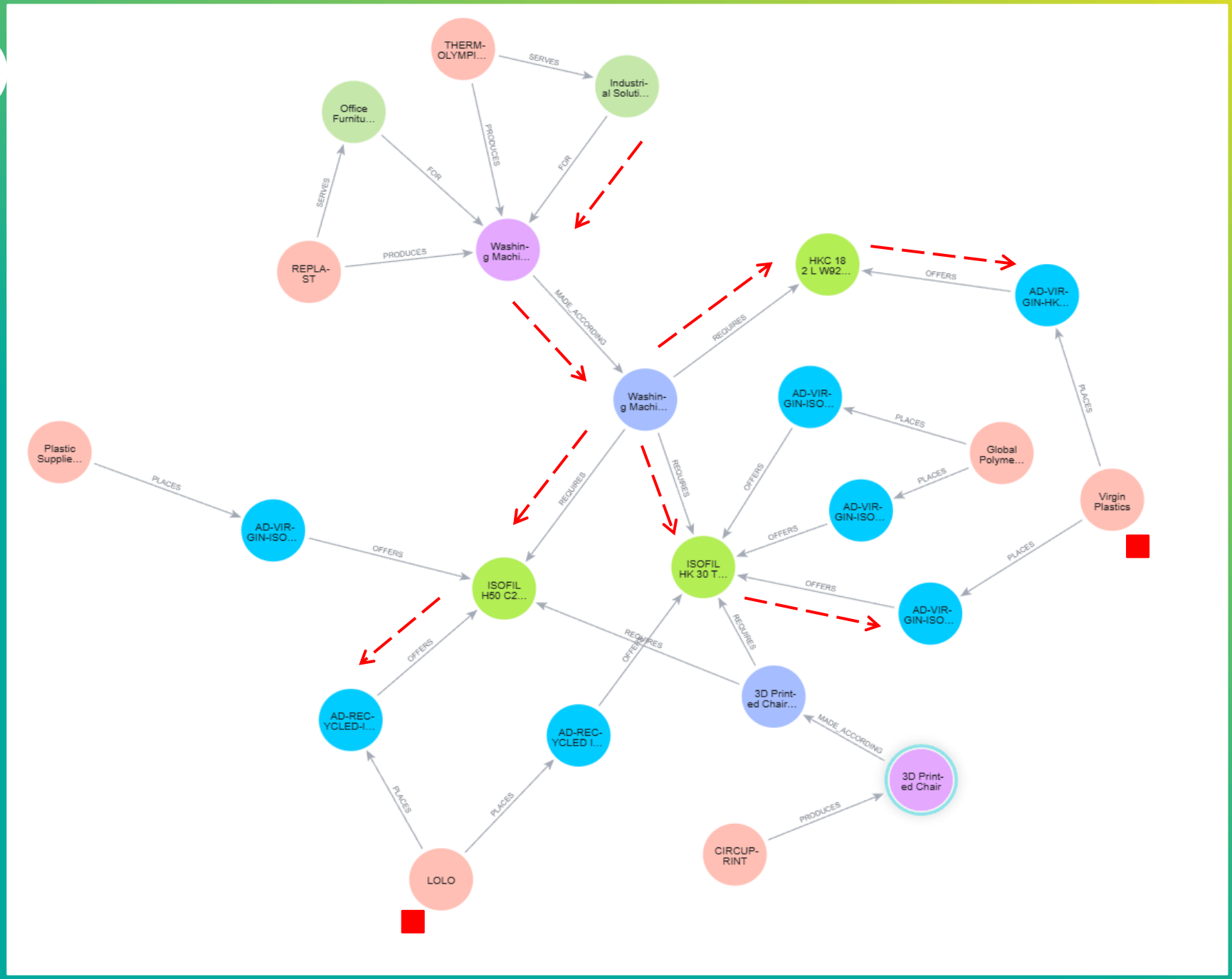
decisions can be made **objectively**



WIDER VIEW OF THE SC



WIDER VIEW OF THE SC



DECISION MAKING

match all viable options

filter viable options

calculate cost

get metrics

```
// Find ads that THER-001 should use to fulfill ORD-001, sorted by environmental cost
MATCH (company:Company {id: 'THER-001'})-[:SERVES]->(order:Order {id: 'ORD-001'})
MATCH (order)-[:FOR]->(product:Product)
MATCH (product)-[:MADE_ACCORDING]->(recipe:Recipe)
MATCH (recipe)-[req:REQUIRES]->(resource:Resource)
MATCH (ad:Ad)-[:OFFERS]->(resource)
MATCH (supplier:Company)-[:PLACES]->(ad)

// Calculate required quantity accounting for scrap rate
WITH company, order, product, recipe, resource, req, ad, supplier,
     order.quantity * req.quantity_kgr * (1 + req.scrap_rate) as required_quantity

// Filter ads that meet minimum order quantity and have sufficient availability
WHERE required_quantity >= ad.min_order_quantity
  AND required_quantity <= ad.max_order_quantity
  AND required_quantity <= ad.available_quantity
  AND ad.status = 'ACTIVE'

// Calculate environmental cost
WITH company, order, product, resource, req, ad, supplier, required_quantity,
     required_quantity * ad.carbon_footprint_kg_per_kg as environmental_cost,
     required_quantity * ad.price_per_unit as financial_cost

// Sort by environmental cost (lowest first), then by financial cost
ORDER BY resource.name, environmental_cost ASC, financial_cost ASC

RETURN
  resource.name as resource_name,
  ad.title as ad_title,
  supplier.name as supplier_name,
  supplier.trusted as is_trusted_supplier,
  required_quantity as quantity_needed_kg,
  ad.price_per_unit as price_per_kg,
  financial_cost as total_cost,
  ad.carbon_footprint_kg_per_kg as carbon_per_kg,
  environmental_cost as total_carbon_footprint_kg,
  ad.recycled_content_percentage as recycled_content,
  ad.available_quantity as available_quantity
```

RETHINKING

CIRCULOOS

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decisions can be made **objectively**

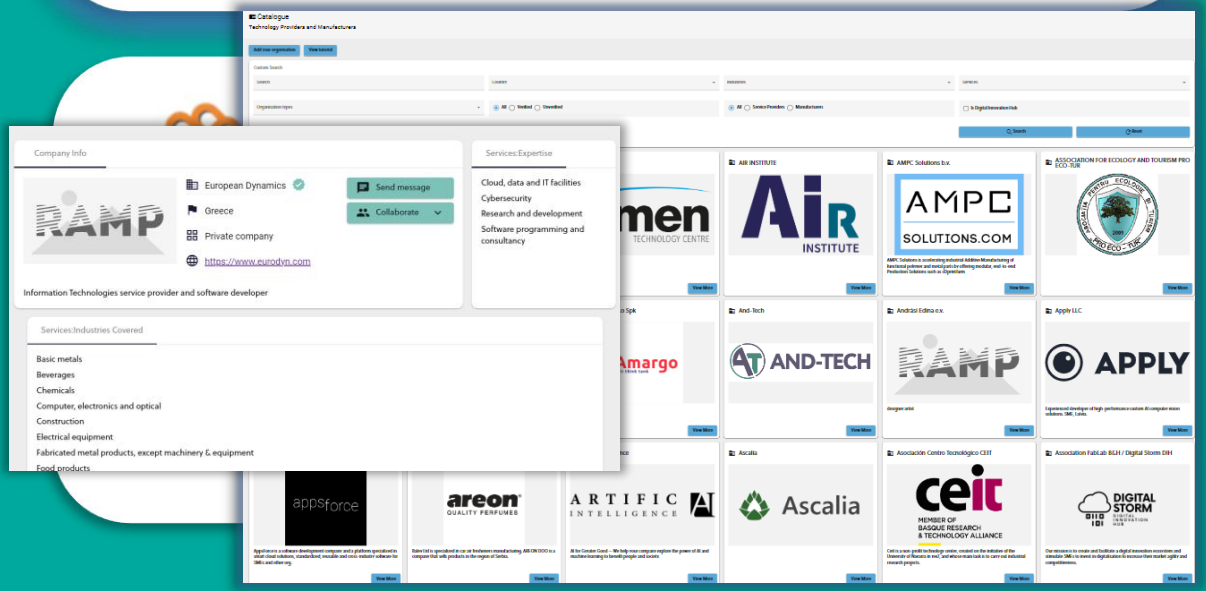


NETWORKING

Find a partner

Connect with the Right Partners

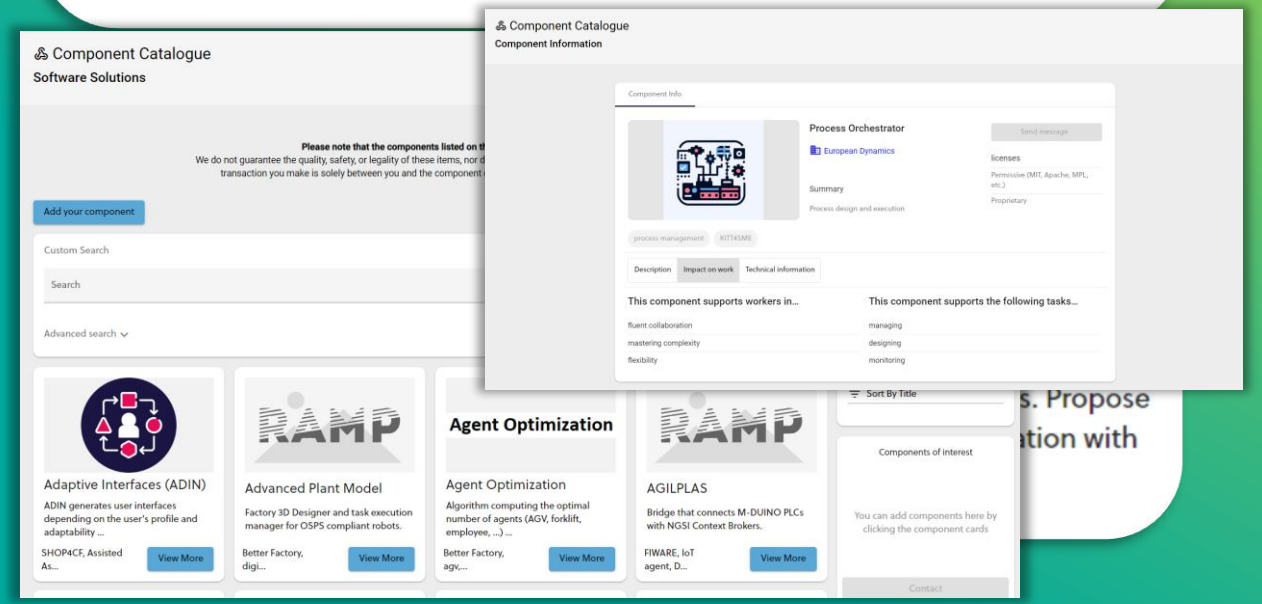
Find partner organizations based on profiling information, including country, expertise, and services. Our 'Premium' features offer ad and promotion options. Messaging is seamlessly integrated for effective communication. No operational constraints for premium users.



Discover solutions

Power Your Operations with Technology

Find software and hardware solutions for digitization, automation, and robotics. Consider 'Premium' features for ad promotions and hosting. Integration is simple with messaging features. No operational constraints for premium users.



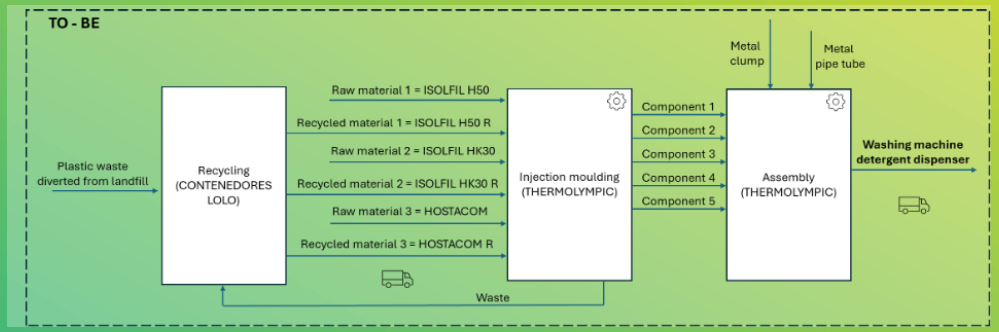
MORE TOOLS..

FOOTPRINT

CIRCULOOS

LCI







TO BE

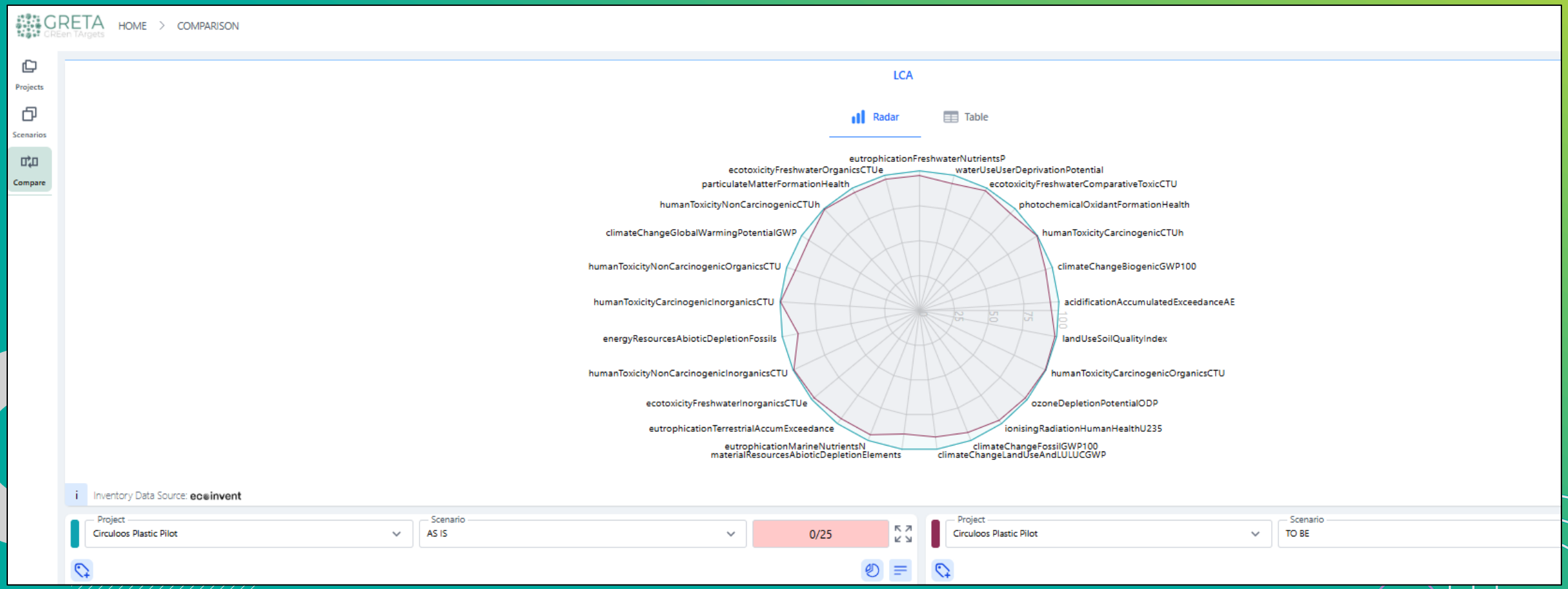
Washing machine detergent dispenser



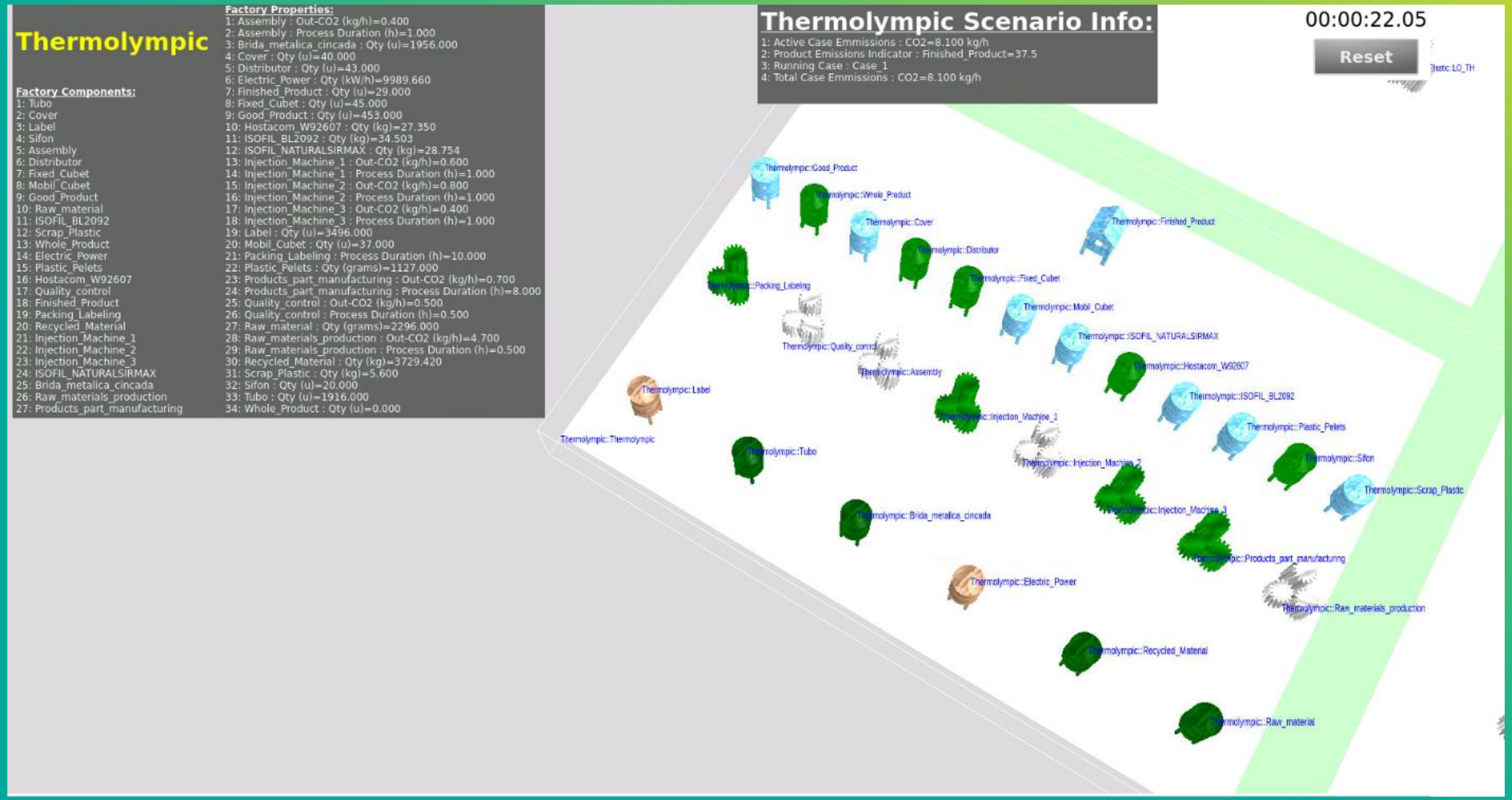
50% Recycled!

Scenario	Product	Process	Location of the Process	Variable	Unit	Value	Data Source Type
		Raw material production		Hostacom HKC 182 L	kg	0.2125	Primary
				Recycled Hostacom HKC 182 L		0.2125	Calculated
				ISOFIL H50 C2V	kg	0.1735	Primary
				Recycled ISOFIL H50 C2V		0.1735	Calculated
				ISOFIL HK 30 TFH2	kg	0.03	Primary
				Recycled ISOFIL HK 30 TFH2		0	Calculated
				Clamp	kg	0.00187	Primary
				Pipes	kg	0.00976	Primary
		Injection Moulding	Zaragoza (Spain)	Electricity consumption	kWh	0.7265	Primary
				Injection moulding process per kg plastic produced (electricity modified with primary data)	kg	1	Secondary1
		Assembly	Zaragoza (Spain)	Electricity consumption	kWh	0.01	Primary
		Incineration	Zaragoza (Spain)	waste from ISOFIL H50 C2V	%	0	Primary
				waste from ISOFIL HK 30 TFH2	%	0	Primary
				waste from Hostacom HKC 182 L	%	0	Primary
		Recycling	Avila (Spain)	Electricity consumption	kWh	0.3	Primary

FOOTPRINT

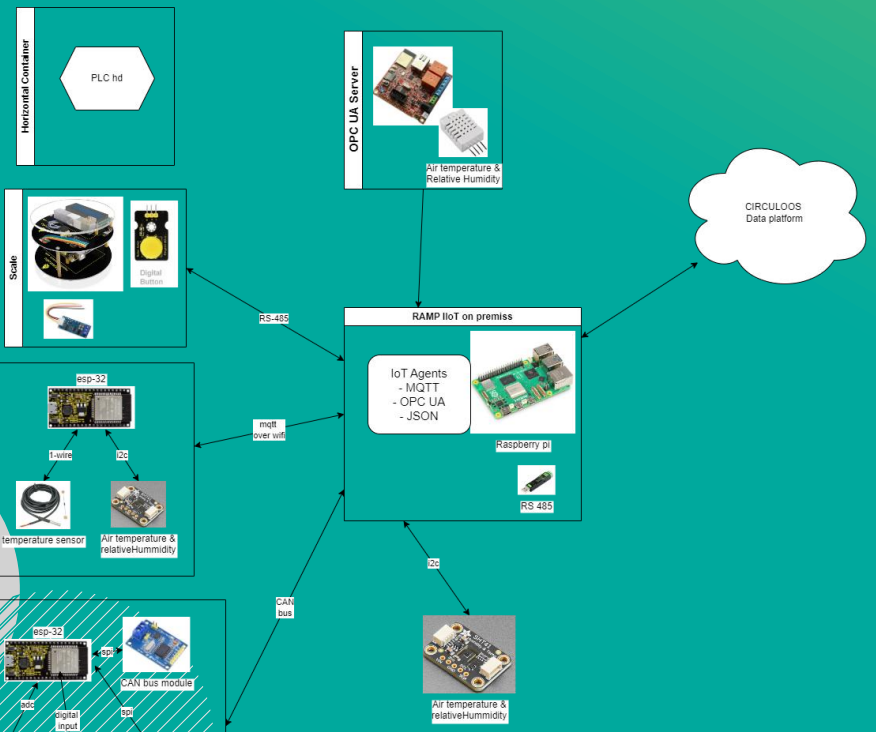

GRETA
GREen TArgets
HOME
COMPARISON
Projects
Scenarios
Compare
LCA
Radar
Table
eutrophicationFreshwaterNutrientsP
waterUseUserDeprivationPotential
ecotoxicityFreshwaterComparativeToxicCTU
photochemicalOxidantFormationHealth
humanToxicityCarcinogenicCTUh
climateChangeBiogenicGWP100
acidificationAccumulatedExceedanceAE
landUseSoilQualityIndex
humanToxicityCarcinogenicOrganicsCTU
ozoneDepletionPotentialODP
ionisingRadiationHumanHealthU235
climateChangeFossilGWP100
climateChangeLandUseAndLULUCGWP
materialResourcesAbioticDepletionElements
eutrophicationMarineNutrientsN
eutrophicationTerrestrialAccumExceedance
ecotoxicityFreshwaterInorganicsCTUe
humanToxicityNonCarcinogenicInorganicsCTU
energyResourcesAbioticDepletionFossils
humanToxicityCarcinogenicInorganicsCTU
humanToxicityNonCarcinogenicOrganicsCTU
climateChangeGlobalWarmingPotentialGWP
humanToxicityNonCarcinogenicCTUh
particulateMatterFormationHealth
ecotoxicityFreshwaterOrganicsCTUe
25
50
75
100
Inventory Data Source: ecoinvent
Project
Circuloos Plastic Pilot
Scenario
AS IS
0/25
Project
Circuloos Plastic Pilot
Scenario
TO BE

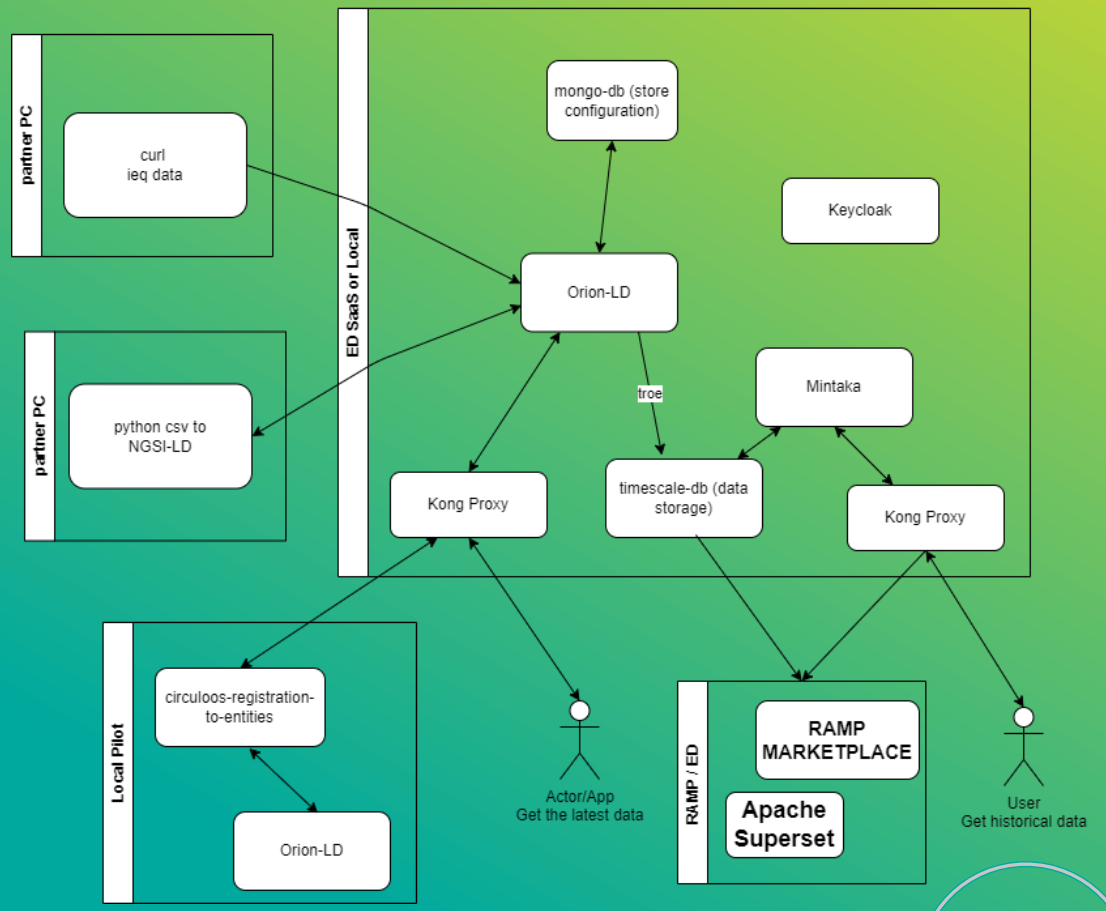
DIGITAL TWIN



BACKEND

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DIGITAL TRUST

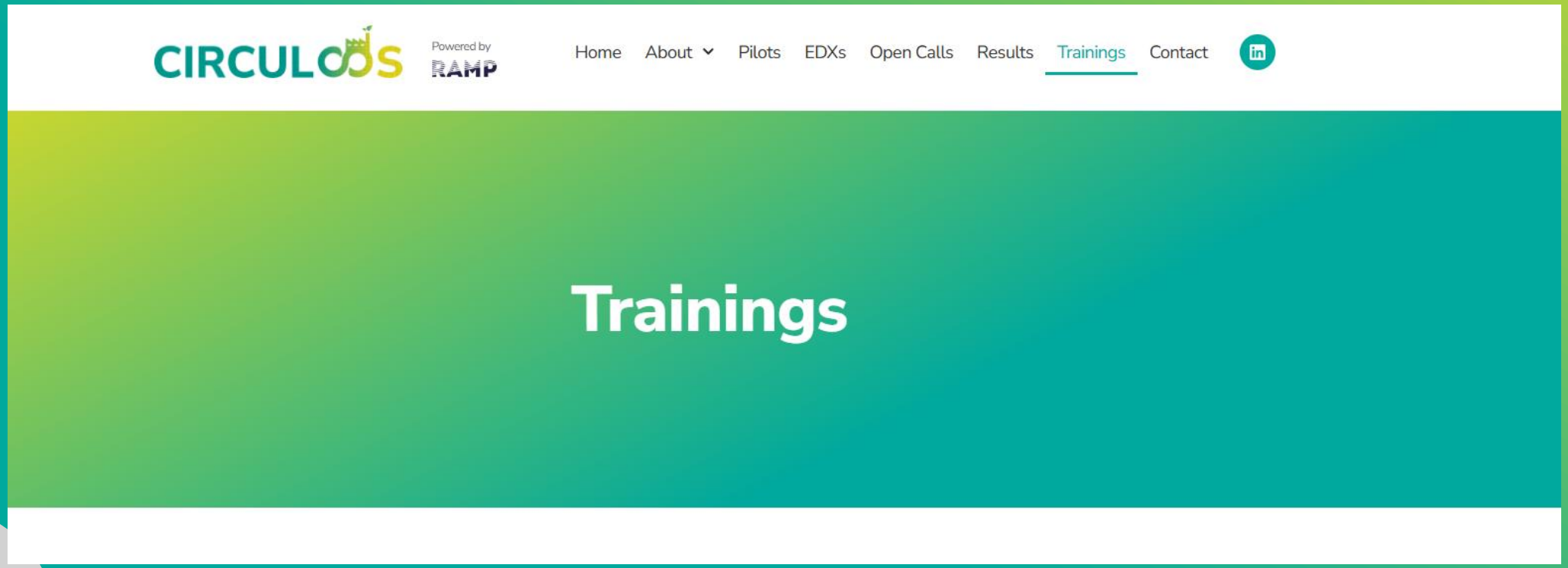
CIRCULOOS

Idea *Digital systems (sensors) can contribute data without being authorized by a central Authority*

Implementation *Verifiable Credentials are a way of providing proof to the ecosystem that a digital system is a* ***'trusted member'*** *of the community*

Trust = traceability → state of the information shared across the ecosystem (metadata) is stored in an immutable ledger (blockchain)

TRAINING



find more on https://circuloos.eu/trainings/