



# THESEUS: A First-of-a-kind Hub for circularity demonstrator for Attica and peripheral regions

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H4C Community of Practice Webinar  
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# THESEUS

Hub4Circularity

A First-of-a-kind **Hub** for **circularity**  
demonstrator for Attica and peripheral regions

***HORIZON-CL4-2024-TWIN-TRANSITION-01-38***

*Hubs for circularity for industrialized urban peripheral areas*

***Duration:*** 60 months, December 2024 - November 2029

***Total Budget:*** 23,5 m €

***EU contribution:*** 20 m €



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the European Union**

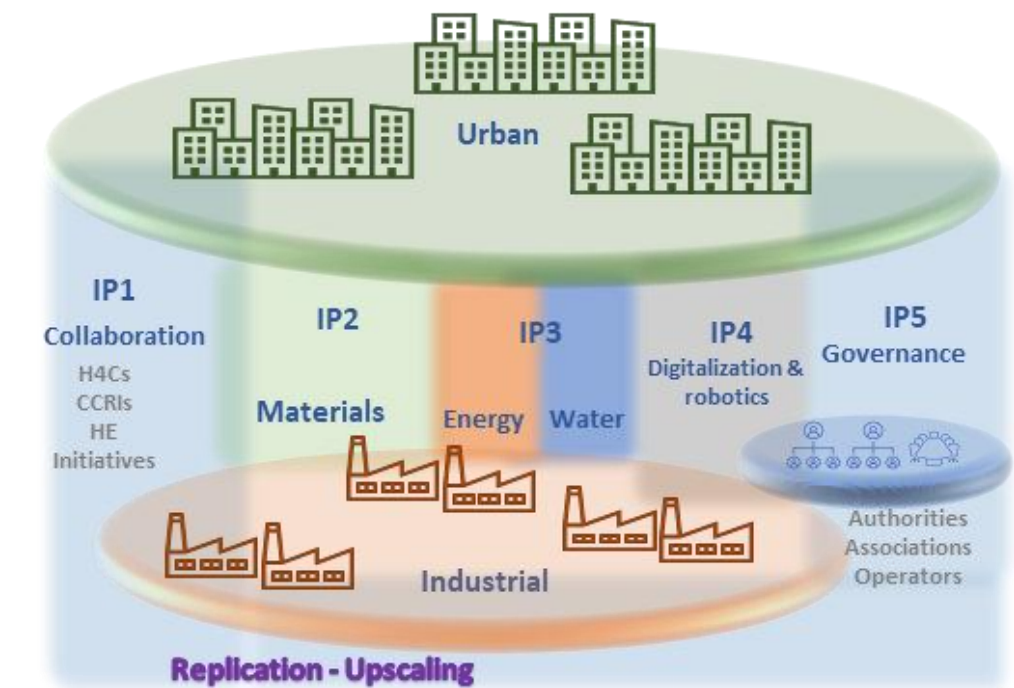
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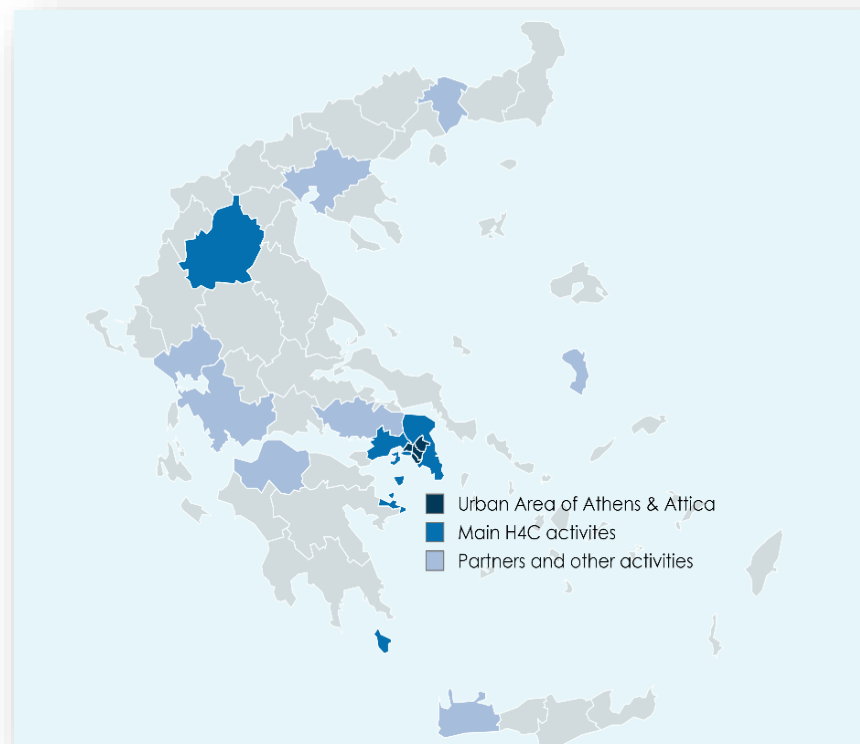
# Main Idea & Innovation Pillars

The establishment of a **first-of-a-kind** hub for circularity in Greece from the **region of Athens/Attica** towards whole country, closing loops through Industrial-Urban symbiosis to become climate neutral by 2050, in line with Processes4Planet partnership objectives.

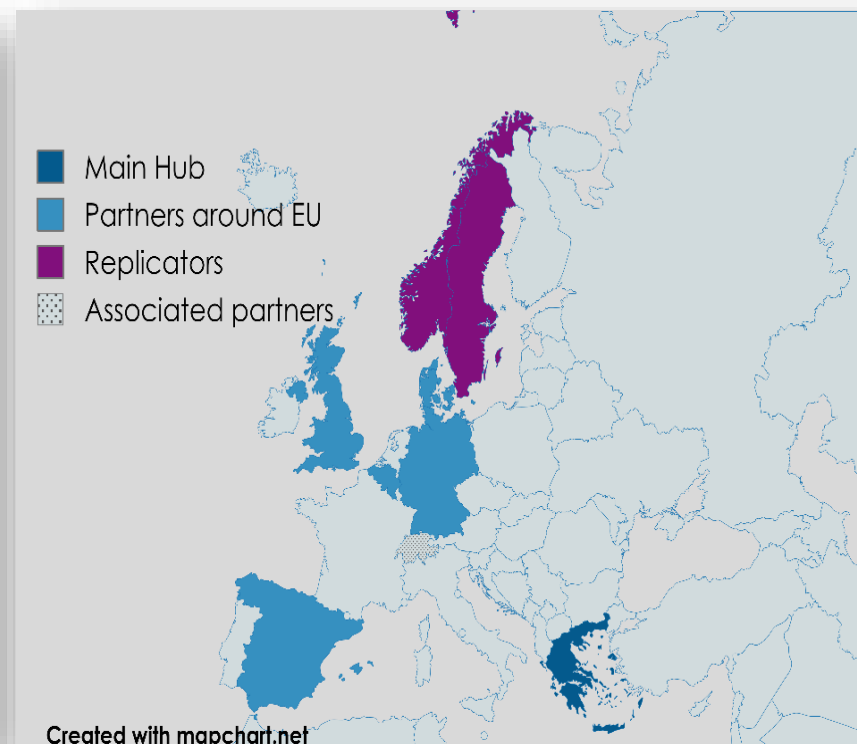
A systematic approach of **5 Innovation pillars** through collaboration with 2 replicator regions and streamlining expertise between existing H4Cs and a model for new ones.



*1 main H4C in Attica and Greece*



*2 replicators (Sweden, Norway)*



- IP1:** Cross-sectoral **collaboration** and **knowledge exchange** with replicators, other initiatives and projects
- IP2:** **Materials circularity** of complex material streams
- IP3:** **Energy & Water** solutions
- IP4:** Advanced **digitalization** and **robotics** for optimizing flows
- IP5:** **Governance** models and policy alignment.

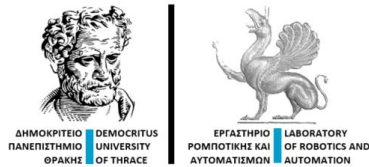
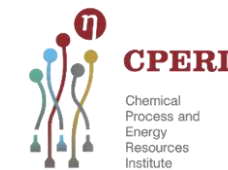
*The systemic solution of Theseus is expected to have significant impact on the region, while metaphorically recalling the mythical figure of **Theseus**, king and great reformer of Athens.*



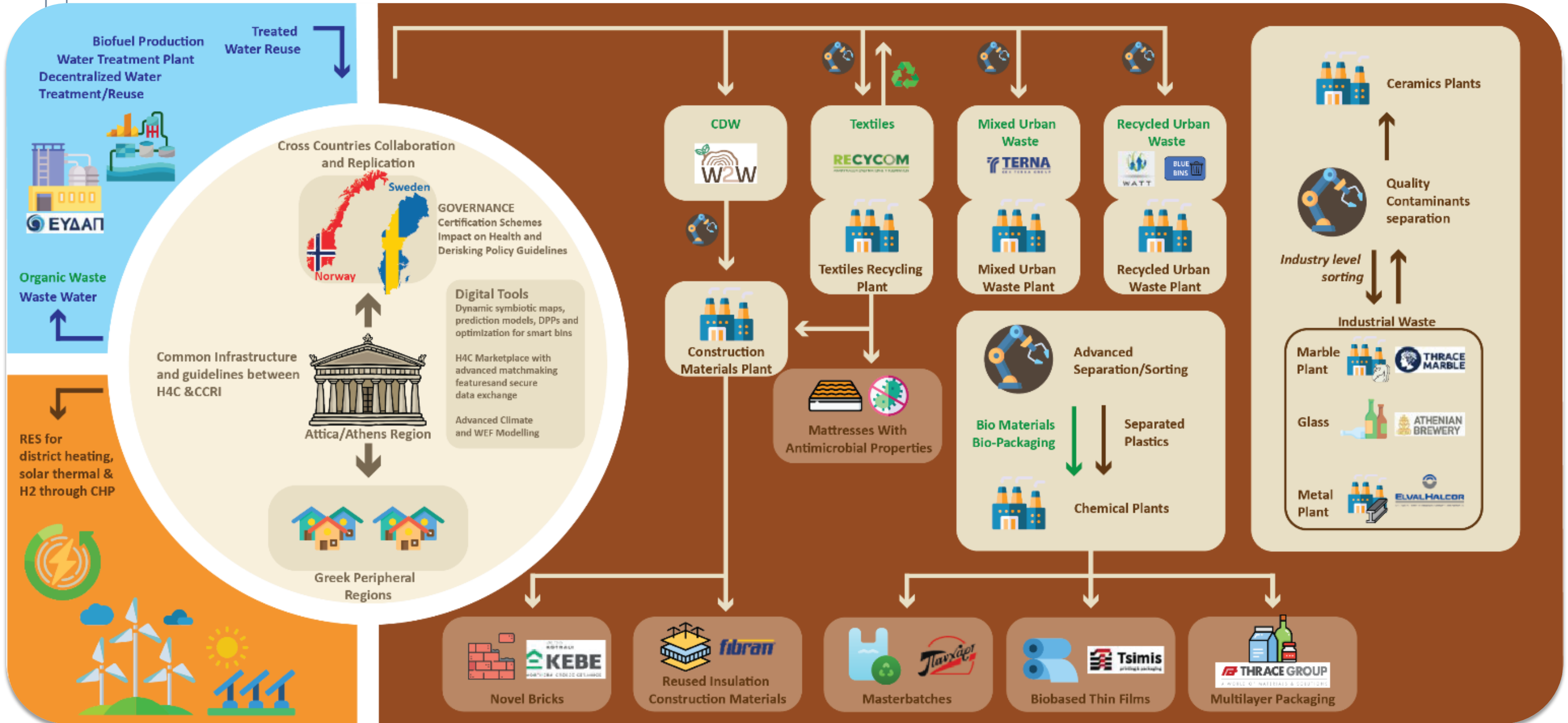


# Our Partners

52 (48 + 5 associated)



# In a nutshell



# The Development of Technological Solutions



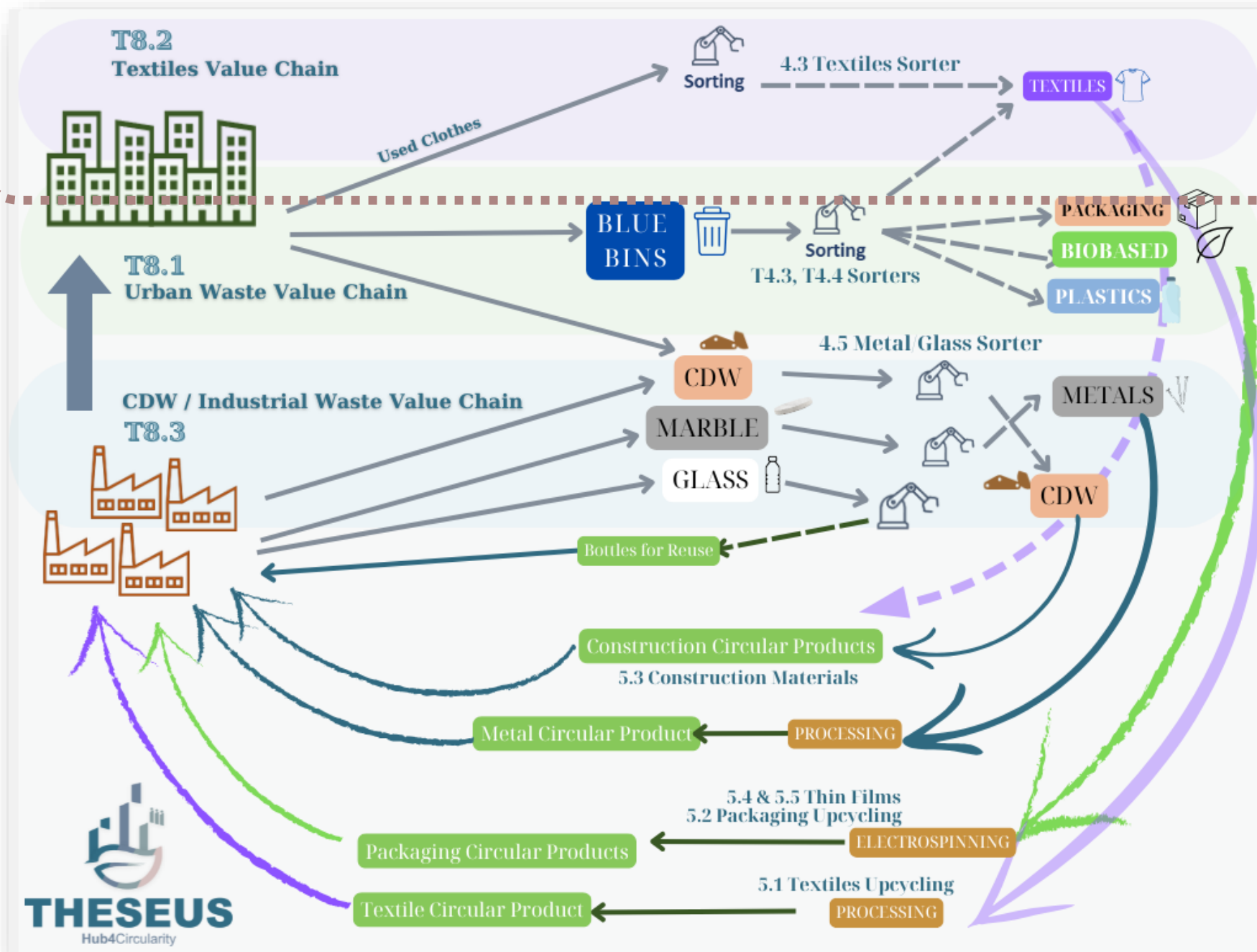
- New or existing innovative technologies will be designed, developed and tested on materials, energy and water (WPs 5,6,7)
- Sorting technologies will be developed for specific material flows (WP4)
- All these technologies will be integrated and formed as solutions to be demonstrated in real environment in the 5 pilots (WP8)
- All the above activities will be supported and facilitated by digital solutions (WP3)



# key characteristics of the different value chains main players and technologies



## Pilot #1 - Textiles



Textiles Waste Collector

**RECYCOM**  
ANAKYKASEH ENZYMATON & YITOSHIMANTON

Sorting

*Fibre-spinning process (melt spinning for thermoplastic or solvent/wet spinning for natural fibres) combined with encapsulation of active compounds within fibres.*

*Glycolysis reactor with ionic liquids and supported by microwave technology, followed by post-condensation and spinning steps*

fibre-spinning

glycolysis

Recycled Fiber  
**COMO**  
FELT & WADDING PRODUCERS  
Textiles Industry

Thin Films & Multi Layers

Bricks and cement

**Tsimis**  
printing & packaging  
Packaging Industry

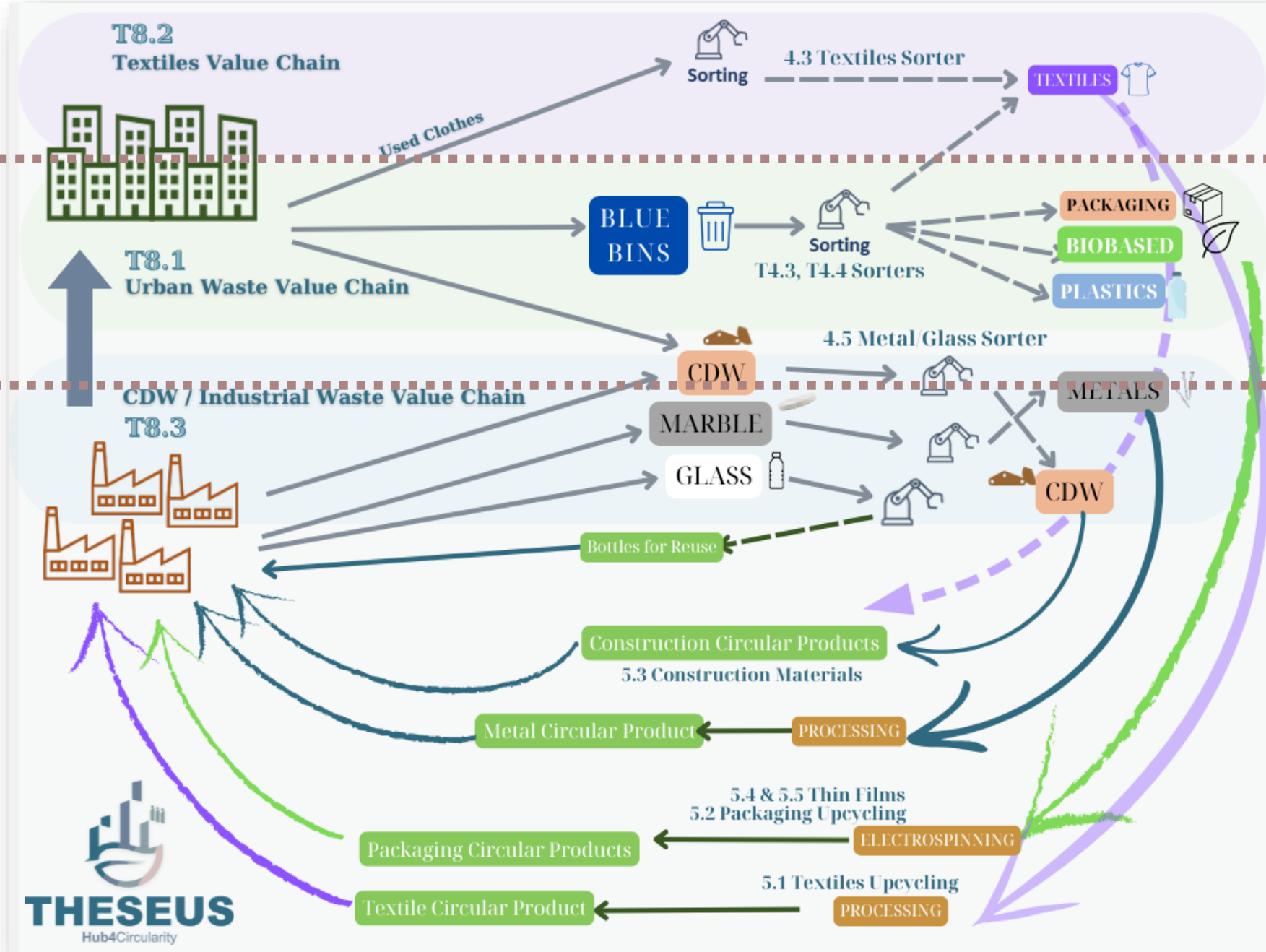
**KEBE**  
NORTH GREECE CERAMICS  
Ceramics Industry  
**fibran**  
Construction Materials Industry

**THRACE POLYFILMS**  
MEMBER OF THRACE GROUP  
Plastics Industry

# key characteristics of the different value chains main players and technologies



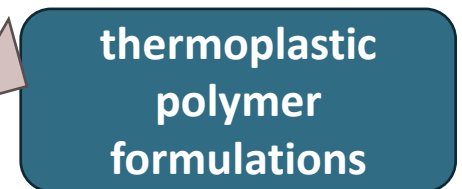
## Pilot #2 – Urban Waste



Recycling Urban Waste Collector  
(Blue bins in Attica)



Thermoplastics processing via melt-mixing, thermomechanical recycling processes and physicochemical characterization.

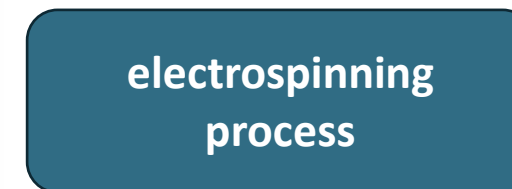


Masterbatches



Packaging Industry

Electrohydrodynamic process of electrospinning for fabrication of polymeric micro- or nano-structured fibres, micro and nano-films that act as coatings in materials.



National Technical University of Athens

Biobased Thin Films



Plastics Industry

Robotic materials system automating synthesis and characterization of bioplastic formulations



DEMOKRITOS  
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH

Multi Layers



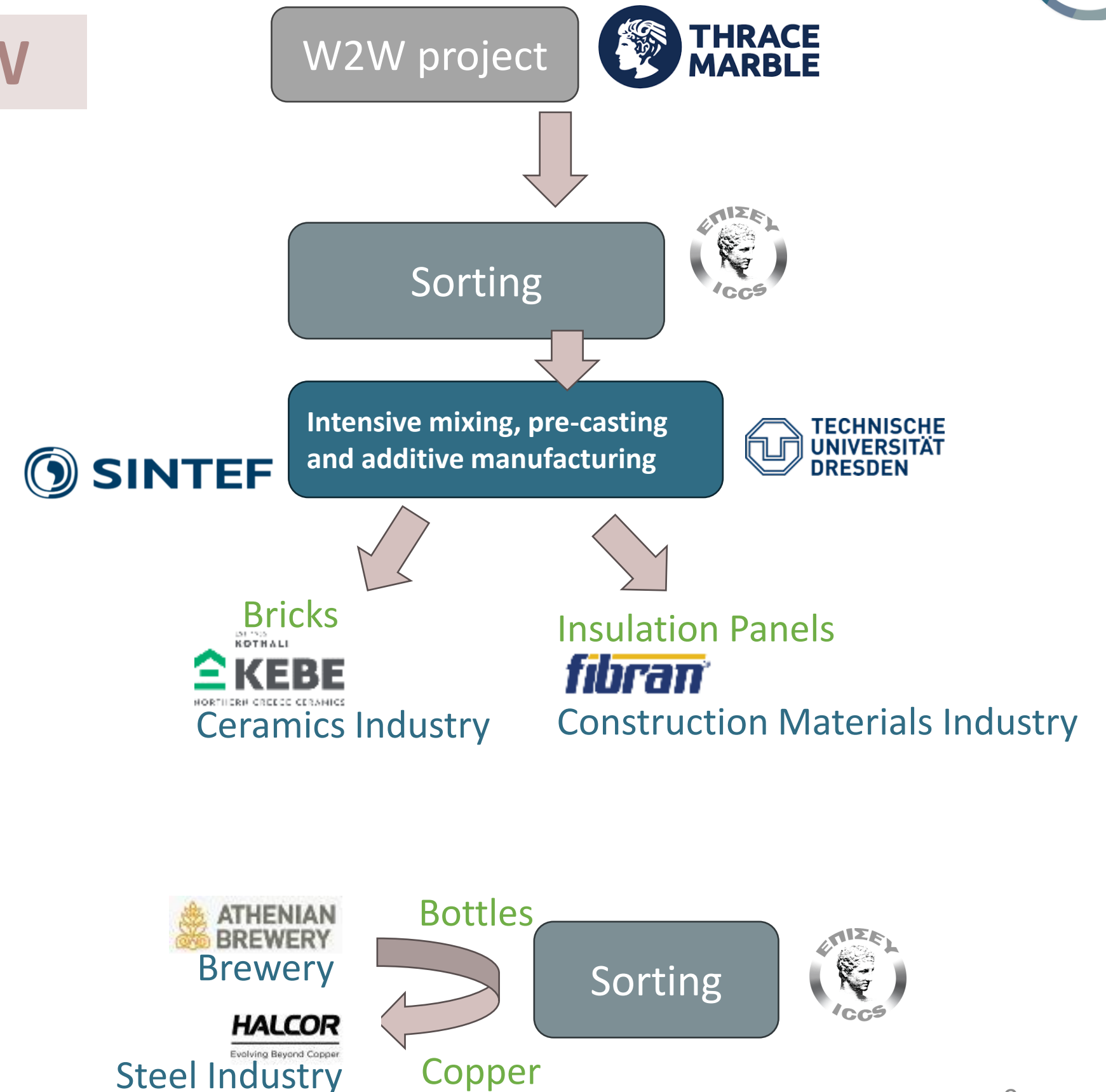
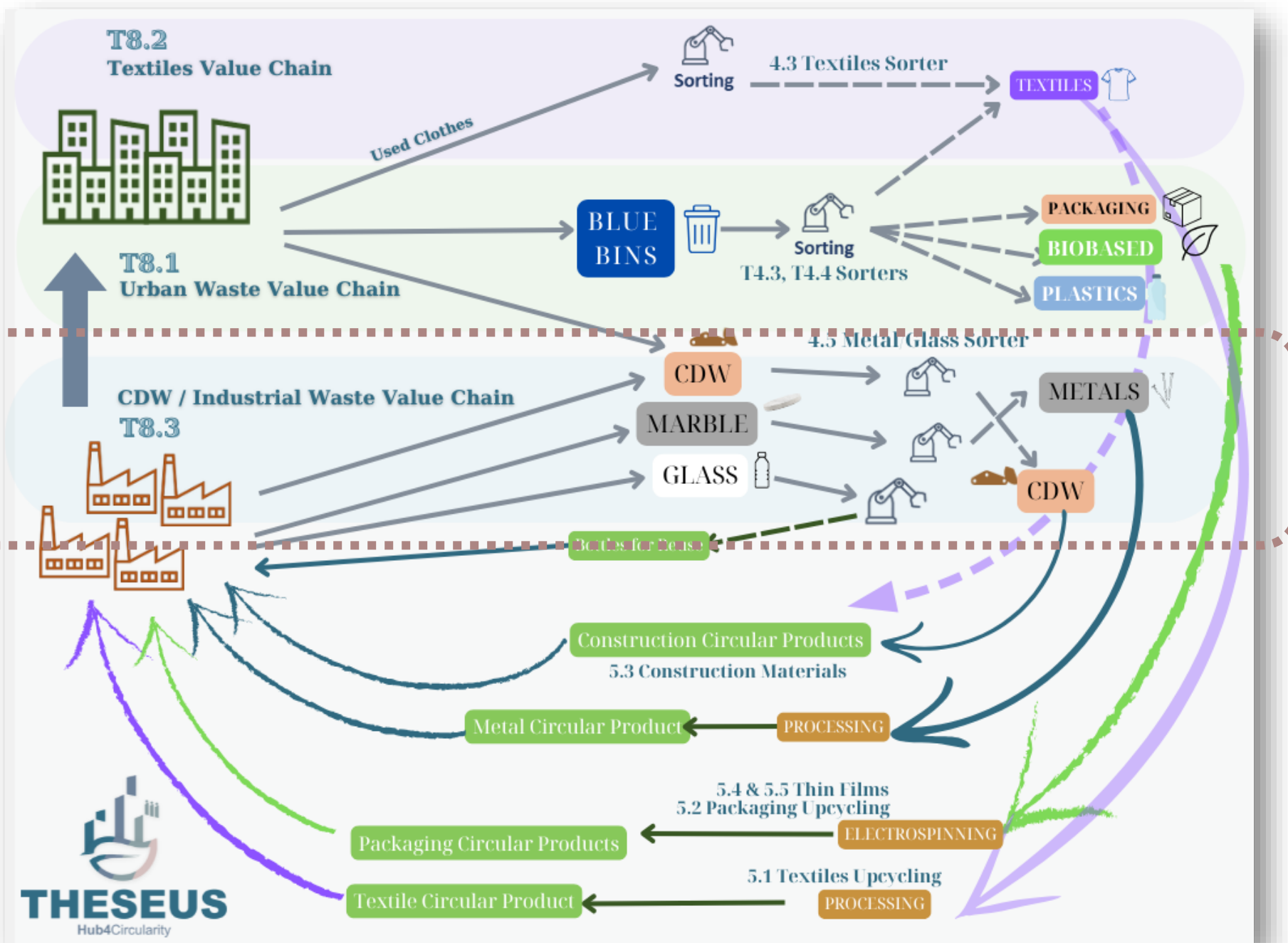
Packaging Industry



# key characteristics of the different value chains main players and technologies



## Pilot #3 – CDW



# key characteristics of the different value chains main players and technologies



## Pilot #4 - Energy

- ✓ **Hot water utilized** via High vacuum Flat Panels (HVFP) Solar thermal panels **for heating and cooling** purposes of 2 buildings via enhancing the existing District Heating (DH) network.
- ✓ **Combined heat and power (CHP)** for the utilization of green H<sub>2</sub> for production of heat and electricity
- ✓ **Studies** on:
  - RES for District Heating (DH) of Ptolemaida
  - Digitalization of DH network



## Pilot #5 - Water

- ✓ **Sewer Mining System: Reclaimed Water** to be used for irrigation of crops and urban uses
- ✓ **Natural Based Solutions: Harvested Rainwater and Stormwater** used for green spaces and urban farming
- ✓ Production of **biochar, biooil and gas from Sewage Sludge** via Fast pyrolysis and torrefaction



# Horizontal technologies

## IP4 Digitalization & robotics

**Marketplace H4C platform:** facilitating circularity, management, matchmaking, modelling and optimization and decision making, under secure data exchange, including:

- ✓ GIS tool for dynamic symbiotic maps
- ✓ Matchmaking and symbiotic models
- ✓ Collaboration, Documentation, Knowledge Transfer
- ✓ Digital Product Passport
- ✓ Prediction of resource logistics
- ✓ Material Flow Analysis

**Sorting & Separation mechanisms (in Pilots #1,2,3):**

- ✓ Textiles
- ✓ Metals from CDW
- ✓ MSW and urban smart bins
- ✓ Plastics
- ✓ Glass

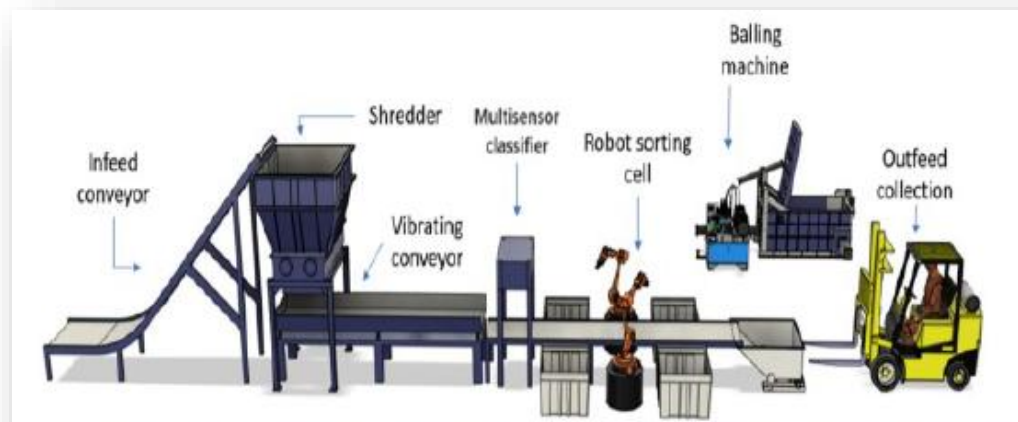


Figure 5: Indicative proposed concept for scrap metal sorting

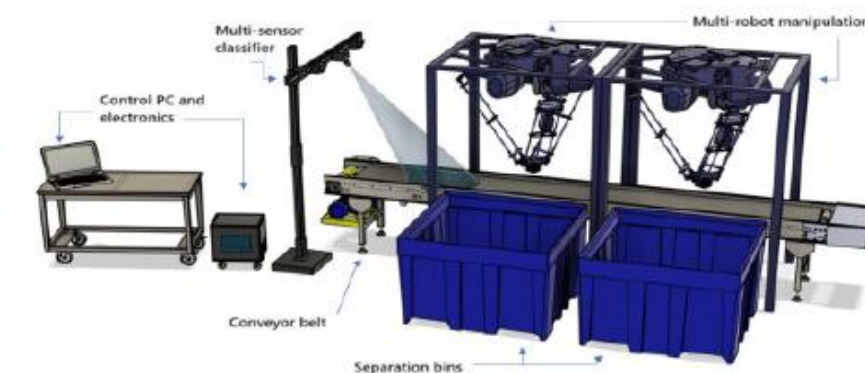


Figure 6: Indicative proposed concept for mixed waste sorting





Generally , THESEUS will follow TRL5 → TRL7 (initial → targeted)  
Especially:



### *IP1 Collaboration & IP5 Governance*

- Collaboration Framework Guidelines, AR app and Replication Tool **SRL\*5 → SRL7**
- Governance & Roadmaps Governance Model, CERMes, Policy and Standards **SRL5 → SRL7**

\*Symbiosis Readiness Level

### *IP3 Symbiotic flows (water / energy)*

- CHP system H2 for production of heat and electricity through a CHP **TRL5 → TRL7**
- DH system New generation of HVFP solar thermal technology for greening DH **TRL5 → TRL7**
- Water management systems
  - Sewer Mining System for wastewater valorization **TRL5 → TRL7**
  - Centralized reclaimed water fertigation **TRL5 → TRL7**
  - NBS for rain/stormwater harvesting and valorization **TRL5 → TRL7**
  - Fast pyrolysis and torrefaction for sewage sludge valorization **TRL4 → TRL6**



Generally , THESEUS will follow TRL5 → TRL7 (initial → targeted)  
Especially:



### *IP2 Symbiotic flows (**materials**) and upcycling*

Packaging and fibres circular products from MSW, USW and textiles **TRL5 → TRL7**

- Biobased Thin films & Multi Layers (packaging)
- Masterbatches (packaging)
- Fibres (textiles)

Circular materials for construction from CDW and textiles **TRL5 → TRL7**

- Bricks
- Insulation Panels

### *IP4 Digitalization & robotics*

- Urban sorters Automated textiles separation, sorting for mixed waste & plastics and XR app **TRL5 → TRL7**
- Industrial sorters Glass/copper & metals sorting system **TRL5 → TRL7**

## Key Exploitable Results

KER	Focus	KER name	Value chain
Innovation Pillar 1 COLLABORATION			
KER1	Projects & sites	Roadmap for collaboration (i)between sites (GR, SWE, NO) and ii) between Hub & CCRI & Replication Roadmap Tool	All
KER2		Common hub circularity guidelines	All
KER3	Citizens	AR for social awareness and acceptance	All
Innovation Pillar 2 SYMBIOTIC FLOWS (MATERIALS)			
KER4	Materials Circular products /technologies	Circular construction material	CDW, Textiles
KER5		Biobased thin films for packaging	MSW
KER6		Electrospinning for thin films	MSW
KER7		Biological recycling & spinning for upcycling	Textiles
KER8		Upcycled packaging, masterbatches	MSW
KER9		Strategic Master Plan on Circularity	All
Innovation Pillar 3 SYMBIOTIC FLOWS (WATER/ENERGY)			
KER10	Water	Decentralized sewage mining and NBS for water reuse	Water
KER11		Sewage sludge <u>valorisation</u>	Water
KER12		Centralized reclaimed water fertigation	Water
KER13	Energy	H2 for production of heat and electricity through a CHP	Energy/Water
KER14		New generation of HVFP solar thermal technology for greening District heating and covering cooling loads of buildings	Energy
Innovation Pillar 4 DIGITALIZATION & ROBOTICS			
KER15	Sorting	Automated textiles separation system	textile
KER16		Automated sorting for mixed waste and plastics	MSW
KER17		Industrial sorting systems: Glass/copper & metals sorting system	CDW & Industrial
KER18		XR for human-robot interactions/collaboration	MSW textiles
KER19		Dynamic symbiotic maps, prediction models, DPPs and optimization for smart bins	MSW
KER20	Digital	H4C Marketplace with advanced matchmaking features & secure data exchange	All
KER21		Models: i) WEF nexus, ii) Cities climate & impacts	All
Innovation Pillar 5 GOVERNANCE			
KER22	Recommendations	Analysis of symbiotic flows in the context of EU and local regional plans. Regional and Intraregional development guidelines	
KER23		Policy guidelines based on Material Flow Analysis, impact on the health and de-risking assessment	
KER24	Standards	Contributions to CEN and/or ISO standards	



# Existing facilitation structures in Attica



THESEUS will be the first Hub for Circularity in Greece. There is no existing hub or dedicated authority as an active facilitator for circular economy. However:

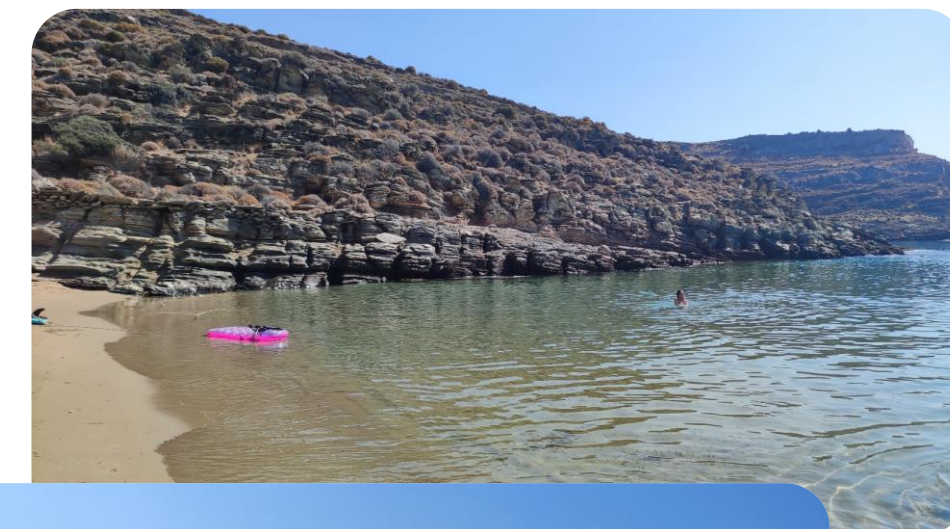
- ✓ The **Ministry of Environment and Energy** is the highest responsible authority.
- ✓ Regions and Municipalities have strong roles, especially:
  - The **solid waste association (EDSNA)** under the authority of the **Region of Attica (Theseus Partner)** is the main responsible for solid wastes management within the region.
  - Municipalities are collecting and distributing the urban solid wastes. They also perform dedicated actions of recycling.
  - An electronic system (HMA) is used from Ministry and EDSNA, for reporting waste streams, mandatory for both Municipalities and Industries.
- ✓ Especially for water, in the metropolitan area of Athens the responsible authority is the Water Utility Manager (**EYDAP, Theseus partner**)
- ✓ For energy, the scenery is complex, having several different providers. In our case, the **municipal energy utility of Ptolemaida is Theseus Partner**.
- ✓ Also, some research communities and Industrial areas/parks exist within the region, performing their own circular plans and actions.

# Great Challenges in Attica & Greece

Some of the Greek challenges related to H4C, CE, IS, I-US activities:

- ☐ Not clear or contradictory regulations and laws, many related challenges in public-private partnerships
- ☐ In many cases, not clear ownership or use status on the land
- ☐ Different uncoordinated agendas and goals between authorities, organizations, executives and people.
- ☐ Complex and overlapping responsibilities between different authorities e.g., Ministry, regions, municipalities, utility managers
- ☐ Severe bureaucracy, especially in procurement and licenses and in the
- ☐ Lack of communication (or other conflicts) even between departments of the same organization
- ☐ Lack of basic infrastructure and personnel for basic needs (to not mention innovation).
- ☐ Lack of culture of what systemic approach and sustainable development means (many fragmentary solutions from different actors)
- ☐ Other complex political, cultural, social acceptance issues (even suspicion about the role of the private sector in public procurement because of unsuccessful public-private partnerships)

Yes, we have sun and sea, BUT.....

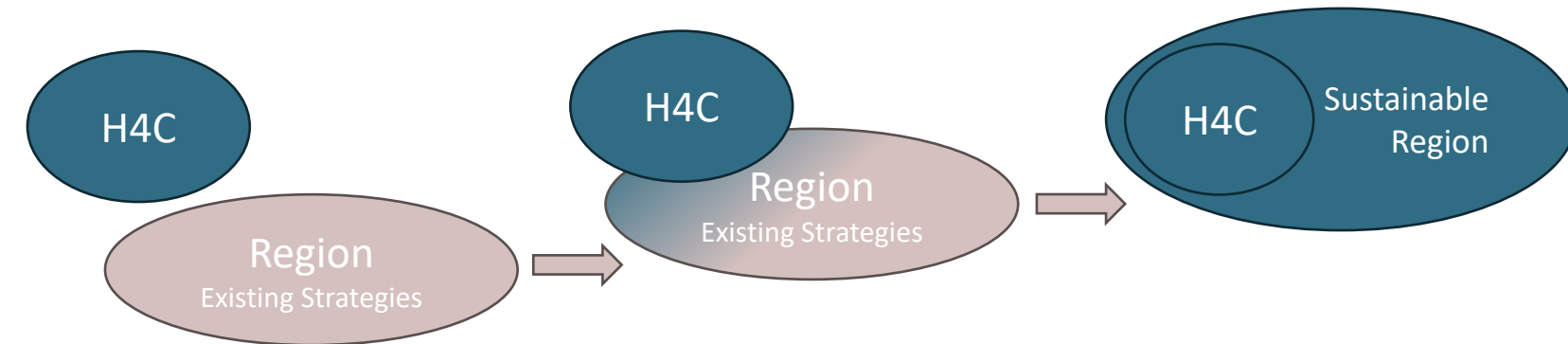




# Involving Regional Stakeholders

A strong asset is that the below are **Theseus partners**:

1. The Region of Attica (the official regional authority)
2. Athens Water Utility Manager (EYDAP)
3. Athens Municipality (via its Development Company)
4. Municipal company of Energy of Ptolemaida
5. 13 Greek Industries
6. 10 Greek Universities/RTOs



Also, Theseus activities include (under Innovation Pillars 1&5 for Collaboration and Governance):

**A systemic & holistic solution, based on sustainable regional science & regional development approaches integrating H4C activities into the overall regional strategy for sustainability.**

**Regional & national plans**, materials flows, territorial, interregional interactions with peripheral regions analyses

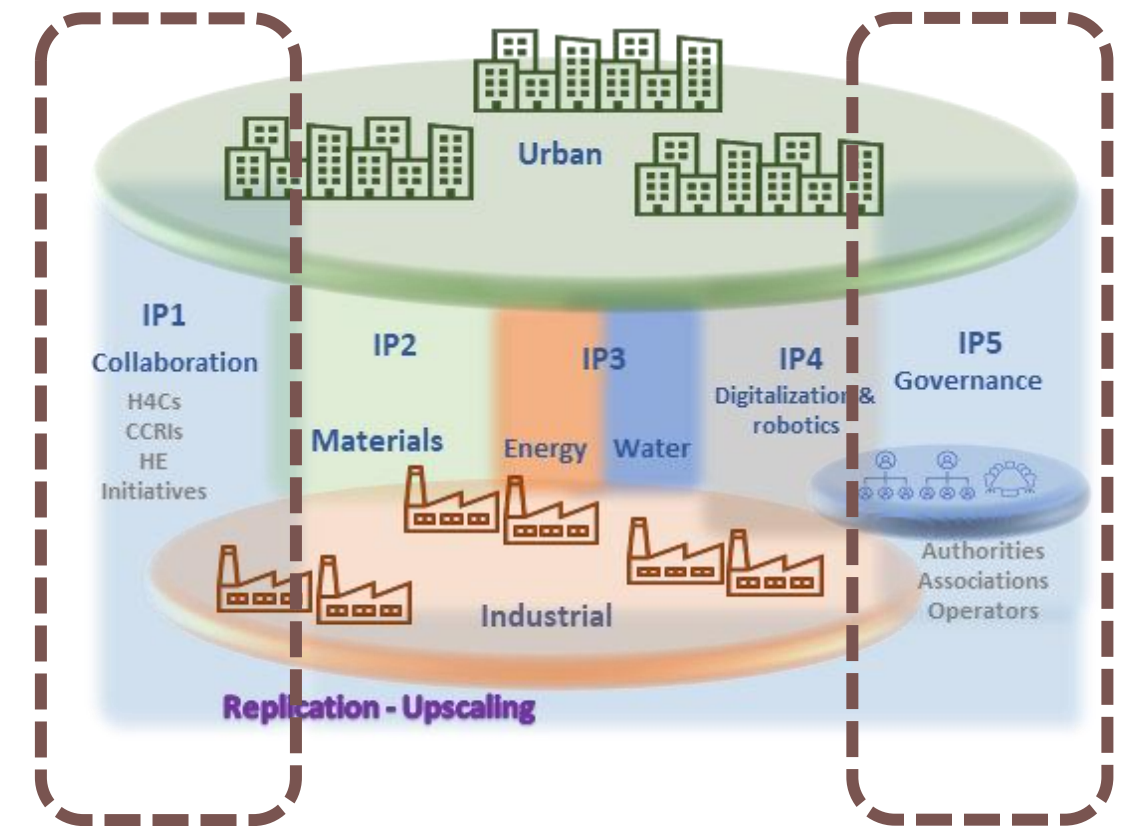
**Circular economy roadmaps (CERMs)**, exploitation, standardization, policy recommendations, regional institutional capacity and overall sustainable regional development.

**I-US governance model**, collaboration structures between involved stakeholders, different sites, private and public sector

**Existing I-US practices, methodologies, technologies and tools** from H4Cs, projects, H4C CoP (thought A.SPIRE, CIRCE)

**Mutual learning between the main hub and replicators.**

**Modelling activities on holistic approaches** e.g., Cities climate modelling, Water-Energy-Materials-Waste nexus, integrated assessment models





# Involving Regional Stakeholders



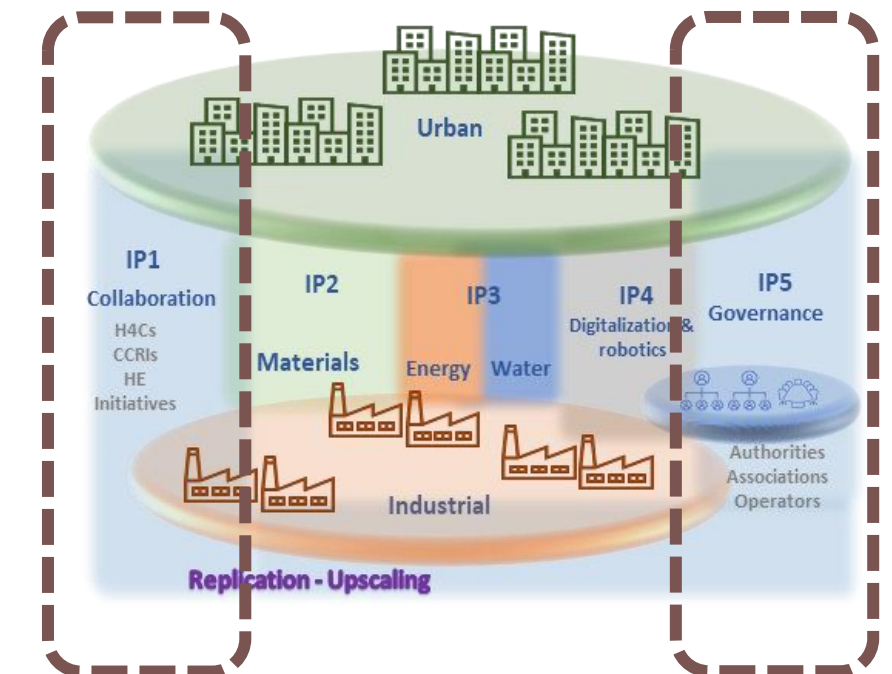
Especially, Theseus includes:

1. Two (2) dedicated tasks for Governance models, Participatory approaches and co-creation
2. Two (2) dedicated tasks to Regional Science, Regional Development and Policy recommendation
3. Three (3) dedicated tasks to Upskilling & Training activities in region cities and universities and the Impact on the health of citizens, Social Awareness increase through AR
4. Task dedicated to Stakeholder engagement , creating the **Theseus bubbles**:

Stakeholders, standardization bodies, local authorities and decision makers, experts, companies and associated EU projects, local communities brought together to establish three core Bubbles.

- I. Policy, Local Authorities, and Standards Harmonization Hub
- II. Community Engagement Hub
- III. Market Accelerator Hub

Bubbles will include collaborative working sessions, organization of workshops, On-site demonstrations and presentations to engage stakeholders and demonstrate practical applications of project results.



# Knowledge transfer & Upscale

- Towards Attica and Greek Regions to whole Greece
- Between different sectors
- Between different regions & countries

## The 2 Replicators

A) Sweden: Malmö is the 3rd largest city in Sweden.

Knowledge transfer to the main Greek Hub on:

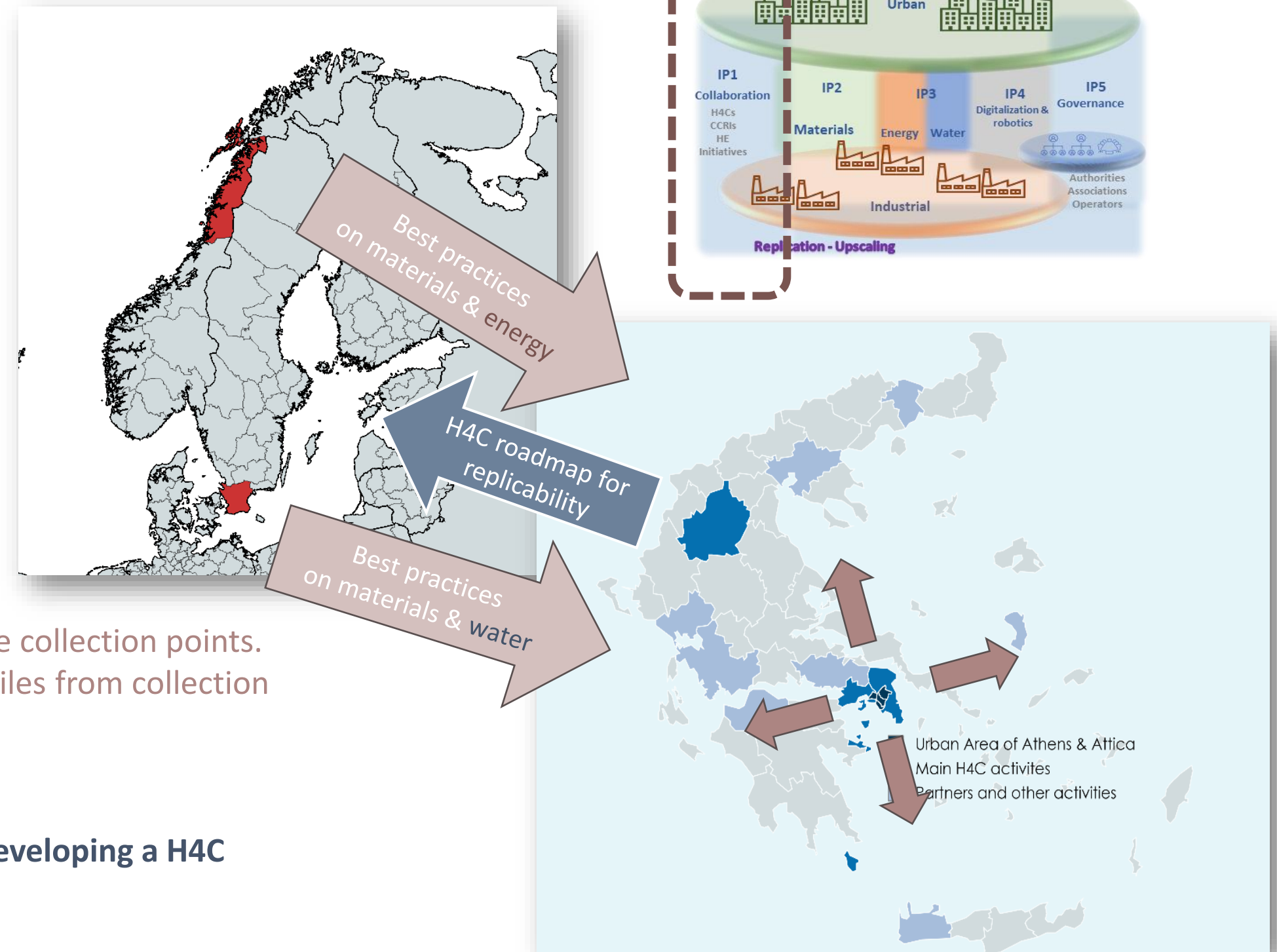
- Industrial and urban **residual flows**
- **District Heating residual heat**
- **Textiles**: automated sorting
- **Plastics**: better separation from the waste streams, food etc.

B) Norway: Mo i Rana (MO) the second largest industrial center in Norway.

Knowledge transfer to the main Greek Hub on:

- **CDW**: from urban and industrial building stocks.
- **Plastics**: sorted from household mixed waste and industrial waste collection points.
- **Textiles**: sorted from household mixed waste and end-of-life textiles from collection points.
- **Water sludge**: Urban and from on land fish farming.

And vice versa, knowledge transfer from the main on methodologies and developing a H4C





**Theseus** project will unfold the outlined impacts across Europe via:

- 1. Replication** activities & **collaboration** between Theseus sites (GR, SWE, NO) other H4Cs, H4C CoP, CE/IS projects, CCRIIs. Creation of a **Roadmap for replicability to additional sites**.
- 2. Recommendations** & analysis in the context of EU and local regional plans
  - Regional and Intraregional development guidelines
  - Policy guidelines, impact on the health and de-risking assessment
  - Contributions to CEN and/or ISO standards.
- 3. Synergies** with the cities selected by the Cities Mission, Regional Innovation Valleys and other initiatives via networking activities on methodologies or sectors (e.g., ECOSYSTEX on textiles)
4. Creating cross-sectoral **universal Modelling methodologies** e.g., Cities climate modelling, Water-Energy-Materials-Waste nexus, integrated assessment models
- 5. Dissemination & Exploitation** activities





# THESEUS

Hub4Circularity



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