

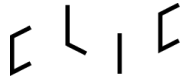


4R recycling ecosystem RDI roadmap

Recycling technologies for retail packaging

24.8.2022 v2.2





SYSTEMIC CHALLENGE

that stems from diversified waste material streams

**FUNCTIONAL
BIO-BASED AND
CIRCULAR
SOLUTIONS FOR
RETAIL PACKAGING**



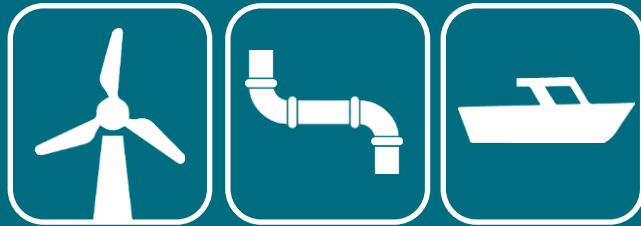
**RECYCLING
TECHNOLOGIES
FOR
RETAIL PACKAGING**



**PLASTICS AND
COMPOSITES IN
CONSTRUCTION
INDUSTRY**



**RECYCLING OF
BULKY FIBRE-
REINFORCED
PLASTIC PRODUCTS
AND INDUSTRIAL
SIDE-STREAMS**





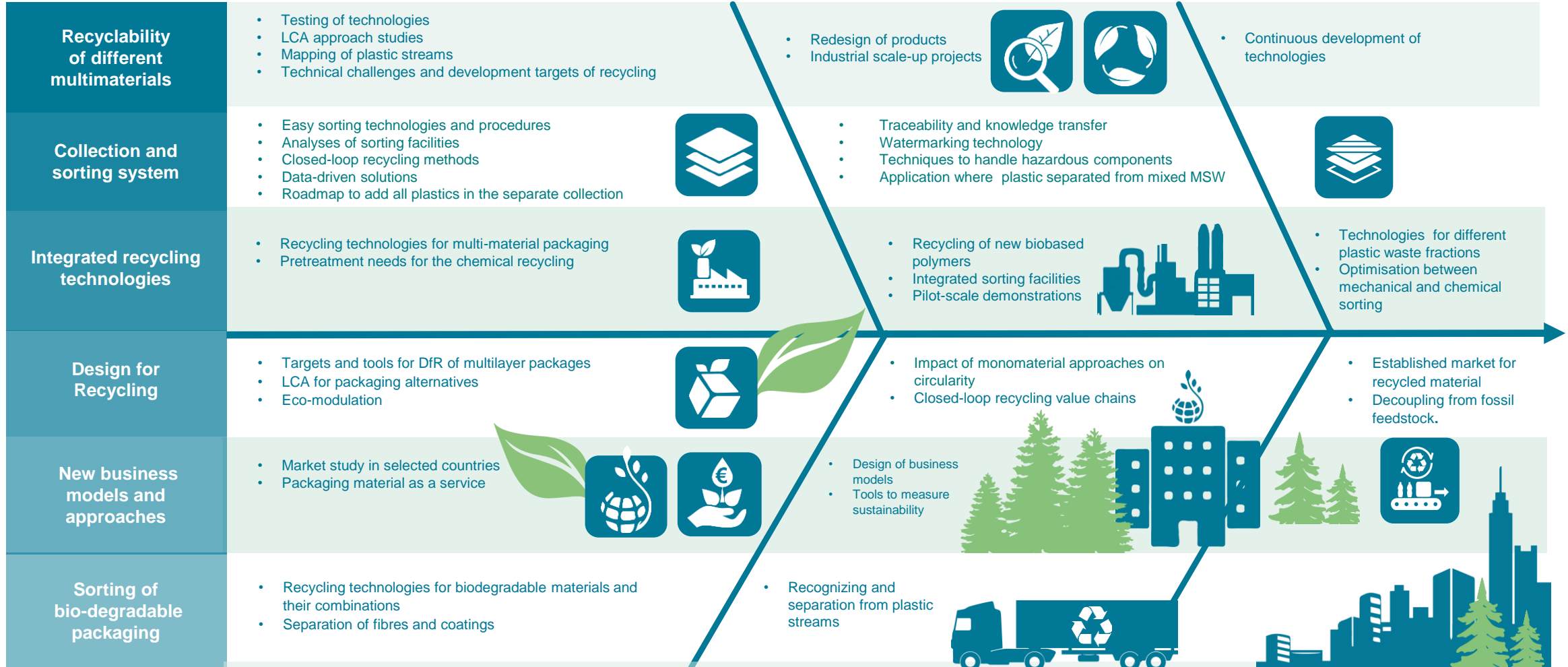
RECYCLING TECHNOLOGIES FOR RETAIL PACKAGING

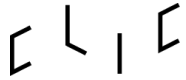
GOALS → **2023** → **2027** → **2030**

Techno-economic feasibility proven

Business cases demonstrated

Technologies in commercial scale available

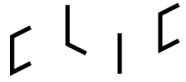




Goals 2023

Techno-economic feasibility of technologies and approaches proven

- ✓ Collection diverting from landfill and from incineration
- ✓ Easy sorting possibilities for all
- ✓ Lifecycle approach verified
- ✓ Ecodesign and design for recycle solutions in place
- ✓ Techno-economic feasibility of the technologies proven



Goals 2027

Business cases demonstrated

- ✓ Processes for converting packaging waste into end products in place
- ✓ For multimaterial packaging either ecodesign, technical feasibility of recycling demonstrated or phasing out of market started
- ✓ Business case feasibility verified for grocery packaging recycling
- ✓ First industrial scale investments for novel recycling technologies to produce polymers/carbon as new products (-2028)

- ✓ ***Finland' target: Meeting the EU plastic recycling rate with domestic collection sorting and recycling resources***



Goals 2030

Technologies in commercial scale available for selected applications

- ✓ The whole cascade for PC plastic completed
- ✓ Separation of components into pure material streams in commercial operation or sunset date set for multimaterial designs
- ✓ Industrial-scale plants in operation, international business established
- ✓ ***Finland's target: Chemical or other recycling technology in commercial scale, complementing mechanical recycling and providing products for food contact***
- ✓ ***Finland's target in line with EU targets***

Recyclability of different multimaterials

2023

- ✓ **Testing** with matrix of **technologies** and materials
- ✓ **LCA approach studies** for different multimaterials
Desktop case studies for alternative routes: material-streams, recycling technologies and recycling products
- ✓ Rough level of **mapping of** Finnish grocery **plastic packaging waste streams**
What in theory could or should end up in mechanical recycling or in chemical recycling. Where are the gaps?
- ✓ Defining key **technical challenges and development targets for both mechanical and chemical recycling** of multimaterial plastics

Recyclability of different multimaterials

2027

- ✓ **Re-designing of products** so that the multilayers can be easily separated from each other
- ✓ **Industrial scale-up projects** to commercialise the developed technologies for multi-material plastic waste recycling

2030

- ✓ **Continuous development of technologies**

Collection and sorting system

2023

- ✓ **Easy sorting technologies and procedures;** including target markets
- ✓ **Analysis of current sorting facilities,** capacity requirements vs. sorting accuracy
- ✓ Demonstrations of the **closed loop recycling methods,** e.g. digital water marks, for certain multilayer fractions
Investments in post sorting of residual waste is required.
- ✓ Evaluation of the potential of **data-driven solutions** and distributed identification of materials to improve the collection and sorting of plastics
- ✓ **Roadmap, how to add all plastic items in the separate plastic collection;** not only packaging

Collection and sorting system

2027

- ✓ **Traceability and knowledge as a part of product history**; development of advanced identification technologies and robotics for separation
- ✓ Readiness to use the **watermarking technology** developed in the current projects
- ✓ Develop of **techniques to handle risks of hazardous components** in the processes
- ✓ **First application** in use in Finland, where **plastic is separated from mixed municipal waste**

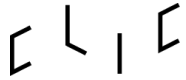
Integrated recycling technologies

2023

- ✓ Research on **recycling technologies for multi-material grocery packaging**
- ✓ Further research of the **pretreatment needs for the chemical recycling**; providing the possible additional demands for mechanical recycling step

2027

- ✓ Development of **recycling of new biobased polymers**
- ✓ **First sorting facilities in use**, which are feeding mechanical & chemical recycling.
- ✓ **Pilot-scale demonstrations** of integrated recycling technologies



Integrated recycling technologies

2030

- ✓ **Right recycling technologies are used** and further developed for the right plastic waste fractions
- ✓ Good **optimisation between advanced mechanical and chemical sorting**, where the selected recycling process depends on the quality of available raw material, on the recycling sustainability, and on the desired application. Through this we can replace virgin plastics with recycled.

Design for Recycling

2023

- ✓ Development of common **targets and** approved **tools for Design for Recycling of multilayer packages**
Integration also with recyclability research.
- ✓ **LCA studies** about monomaterial and multimaterial **packaging alternatives**.
- ✓ Implementation and further design of the **eco-modulation** fee structure

2027

- ✓ Development of understanding on the **impact of monomaterial approaches on circularity**
- ✓ Design of **closed-loop recycling value chains**

2030

- ✓ **Established market for recycled plastic materials**, transparent value chains in place.
- ✓ Standardized tools to evaluate degree of **decoupling from fossil feedstock**.

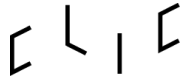
New business models and approaches

2023

- ✓ **Market study in selected countries** to create an understanding of the market status, infrastructures, regulatory frameworks and general acceptance
- ✓ **Packaging material as a service**

2027

- ✓ **Design of potential business models** for international markets
- ✓ **Developing tools to measure** the effect of plastic packaging choices on **sustainability**



Sorting of bio-degradable packaging

2023

- ✓ **Recycling technologies** and routes for **bio-degradable materials and their combinations**
- ✓ **Separation of fibers and coatings** improved

2027

- ✓ **Recognizing and separation** from plastic streams