Institute for Sustainable Process Technology

ISPT Feedstock Transition event May 28

At the location of the Transit-exhibition of the Sustainable Industry Lab in Amsterdam, ISPT and partners from the programs **Circular Plastics Initiative**, **Separations for Circularity** and **Circular Carbon** came together **on May 28** to discuss the feedstock transition as a common denominator and connector of their programs. This transition from using homogeneous, well-defined fossil streams to heterogeneous sustainable carbon streams - which often vary by source and season and contain many impurities for the production of energy carriers and materials - is very challenging.

This requires new and intricate, energy-intensive raw material pretreatment steps, new and innovative conversion processes and downstream processing (including water purification and -treatment) in order to produce purified feedstocks with low impurities. To function properly, **balanced system integration** is needed. System integration is not only about smartly connecting different energy, material, and value chains so that carbon, molecules, and products are used as efficiently and circularly as possible (cascading principle). It also requires aligning functions, flows, and decision-making so the overall system becomes more efficient, flexible, and reliable.

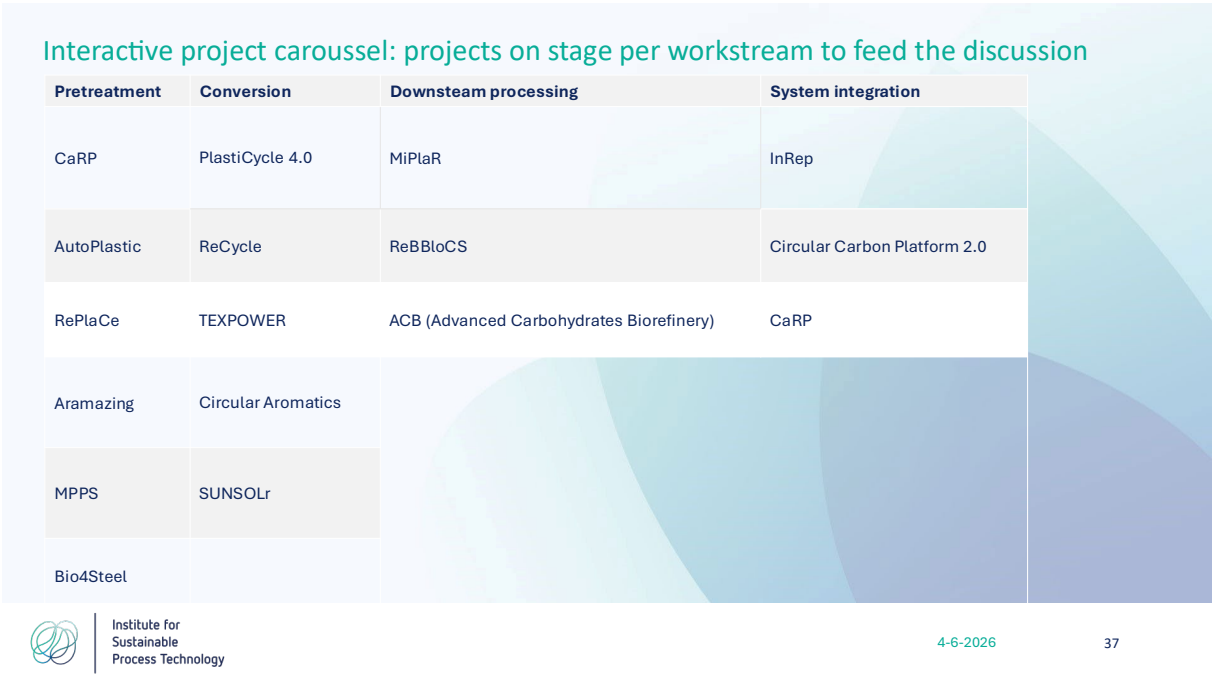
Sustainable Carbon Hub Northwest Europa
By working with a large and diverse group of stakeholders on technology based on sustainable raw materials and renewable energy, focused on the future demand for products, we contribute to the narrative of the Sustainable Carbon Hub Northwest Europe. This is achieved through collaboration in innovation programs and projects on at least the following two routes:

1. The adaptation of existing petrochemicals for the use of sustainable carbon, including mechanical and chemical recycling routes (conversion);
2. New chemical and biochemical transformations (new construction).

Recap of the day

The event started with **Ronald Korstanje** and **Irene ten Dam** explaining the above ISPT narrative and how we have moved from single projects to programs - and from a situation where there was no common understanding what route to follow - to programs guided by roadmaps. Next, **Sascha Kersten** and **Reinier Grimbergen** each took us through their keynotes, sharing experiences and lessons learned from over a decade of circular plastics recycling, as well as developments in the large-scale syngas-to-methanol value chain - an impactful pathway for defossilization.

The morning concluded with an interactive project carousel. Irene ten Dam moderated a discussion with project leaders from our ongoing ISPT programs (listed below by workstream), covering challenges, next steps, and requests for support.



Main takeouts and call to actions

The future of feedstock and materials

- The use of plastics will grow significantly, plastics recycling remains challenging, where 100% recycling is impossible. Realism is necessary among decision /policy makers and addition of virgin feedstock remains needed.
- The projection of the carbon balance in 2100 and the amount of carbon processed, will remain the same, since fuel use will decline.
- We need carbon processing in the Netherlands for geopolitical reasons, related to strategic autonomy and resilience.

- Much land will be needed for biomass and much energy will be needed to upgrade CO_2.

- It is uncertain what the future mix of materials and plastics will be. In any case the introduction of new polymers takes a long time, so using existing technology towards the current plastics remains a major task.

Obtained insights

- Actors in the different value chains towards a Sustainable Carbon Hub must learn to **speak a common language and find a joint, long-term interest** (the alignment of individual interests towards this is necessary as well). The “language challenge” concerns also design for recycling. This should become a more important element of the ecosystem approach and requires new language to be developed between material and product producers.

- It's all about **contaminants** (among other things chlorine). This is the key issue for all (pre-treatment /conversion/ downstream processing) technologies. Because gasification works on a really high temperature (1.300C) waste can probably be cleaned from many contaminants in this process.

- Both **biomass processing** and **plastic waste recycling** (solids, low density, many contaminants) are difficult, so much innovation and knowledge building is needed.

- **Purity**, among other things depending on feedstock composition, is very important in chemistry and because of this an issue for many producers / manufacturers.

- A lot of energy is needed to achieve a decent carbon efficiency, so **a cascade approach of technologies** is the logical thing to do. (The first 50% of recycling of plastics is easy, after that it becomes more difficult, then up to a maximum of 70% is realistic).

- **Legislation** and **permit processes** stimulating the transition to a sustainable carbon economy are needed.

- Technology needs to be scaled. The chemical recycling volume is only at the very beginning of the development curve.

Value chain development needed

- Syngas / MeOH is a logical, impactful route for defossilization.

- 76% of the emissions of polymers concerns scope 3, so a shift from fuels to materials does not solve the emission problem.

- Blue Circle Olefins is developing a **200-kiloton Methanol to Olefins (MTO) plant** in Rotterdam (7% from the market volume). MTO is a process that converts sustainable methanol into circular ethylene and propylene; the basic building blocks for about 60% of all products produced by the chemical industry in Europe. This will be **a drop-in solution** allowing the current system, designed and improved for existing products/materials, to be used.

- Concerning logistics and proximity: MeOH is easily shipped and waste is not suitable for shipping. As ethylene and propylene are not shipped as well, MTO needs to be organized **downstream**, what offers The Netherlands **opportunities** for a good position in the value chain.

- The **development of the ecosystem** (commercial, offtake agreements) is the real challenge, not the technology. Because of that, there is a need for involving end users / brand owners / retailers in the value chain. Having them present at ISPT activities is an important point of attention.

- **Scalable sustainable carbon process routes** like gasification are needed. Flag ship projects, to validate that gasification of biomass and waste works are needed. That is why ISPT started the **Circular Carbon Platform 2.0**: to drive the required framework conditions and shape a flagship gasification project, platform partners will produce a white paper - with chemical and waste sector experts - featuring techno-economic and life-cycle analyses of gasification-based recycling versus incineration + CCUS. The platform partners also aim to develop **interconnected value chains** (upstream & downstream), expanding the gasification value chain, and integrating with additional industries.

Call to action

Would you like to collaborate with us on developing **a workable cascade approach for (plastic) recycling technologies**, or do you have ideas or needs for **addressing challenges in pretreatment processes** (characterization, sorting, separation, etc.) using (vision) AI? Please let us know.

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