

D3.4 COLLIDER'S

“DEFINED PROJECTS THEMES” I

CO-CREATING SOLUTIONS FOR THE CHALLENGES OF THE FUTURE

Goal: To translate themes into project (Collider) challenges with open-ended questions, to design Collider formats, and to disseminate these challenges to students, vocational learners and professionals EuroTeQ-wide in order to prepare for the first run of the Collider.

REMINDING THE CONTEXT

D3.3 documented how the TT/WW Committee clustered the submitted ideas from the first call for ideas “Leave no waste behind”.

This delivery 3.4 will explain:

- How Collider theme ‘Leave no waste behind’ is translated into challenges
- How the first Collider will be organised as parallel Colliders at each partner location during the spring/summer semester (while fitting the different academic year structures at the partner universities).
- How the challenges will be disseminated to and engage students from the partner universities, vocational learners and professionals from the partner ecosystems.

DEFINITIONS

THE EUROTEQ COLLIDER CHALLENGES

As discussed in Deliverable 3.3, the theme of the first Collider is ‘Leave no waste behind’ whereas the overarching challenge question is the following: “In the spirit of ‘Leave no waste behind’, how would you innovate to make the biggest impact on cities, consumption or energy?”

Challenge designs will then vary slightly locally from each institution to fit each local Collider format. (This will be further elaborated on later in the deliverable)

In order to ensure consistency about the different challenges, all challenges developed must feed into the topics **Cities, Consumption and/or Energy** from a 'Leave No Waste Behind' perspective. These topics were defined by clustering the submitted ideas (see Deliverable 3.3). Additionally, challenge statements/questions should:

- frame opportunities
- not suggest a particular solution but give a frame for innovative thinking
- maintain a level of ambiguity, and open up the exploration space to a range of possibilities

Since this is the first pilot, there are no *junior*, *senior* or *expert* tracks for EuroTeQ Collider spring 2022. It is an ongoing discussion on how these tracks can be incorporated in future Colliders in relation to theme and challenge development and will be further evaluated post first Collider implementation.

Note: The terms 'Collider challenges' and 'defined project themes' are used interchangeably in this deliverable report.

DEVELOPING THE COLLIDER CHALLENGES

Once the EuroTeQ Collider theme and overarching challenge question was defined, each EuroTeQ university agreed to confer with Local Advisory Board (LAB) members in either a LAB group meeting or one-to-one meeting setting to further gain feedback and to encourage the formulation of challenges. At the same time, depending on how it was planned for EuroTeQ challenges to be integrated in the Collider format, researchers, teaching faculty and other academics were brought in to further develop challenges from an education context. This aims to ensure challenges are developed by different stakeholders in the local ecosystems.

The following terms and templates were developed in working group meetings to support each universities conversations with industry and academics.

EUROTEQ WASTE CHALLENGE COLLABORATOR

Instead of using the common terms of challenge partner or challenge owner, we developed the term **challenge collaborator** to emphasize the co-creation and collaborative process that should occur in developing challenges. Additionally, the accountability and ownership of a challenge do not fully lie with one stakeholder but many. EuroTeQ challenge collaborators for the first edition of the Collider are focused on industry but theoretically could also be public companies, knowledge organizations and other interest groups in future Collider editions.

Examples of 1-pager descriptions of what is a Challenge Collaborator is provided in Figure 1. below.

Become a EuroTeQ Waste Challenge Collaborator for DTU 13 week course!

Support DTU & EU leading universities in science and technology quest towards a LEAVE NO WASTE BEHIND future by being part of the waste conversation as a challenge collaborator.

DTU is in search of industry professionals to become challenge collaborators that have expertise and company cases in the overarching field of waste.

We are looking to develop challenges in the following areas:

- construction & building
- digital & data
- electronics
- energy
- fashion | textiles
- food
- life science
- plastic

As a challenge collaborator, you will work with DTU Skylab to scope a EuroTeQ waste challenge that is introduced into DTU spring 2022 courses as a project students would develop solutions towards and brought into a collider (an innovation 3 day sprint). The best solutions have the opportunity to be part of a EuroTeQathon (an EU innovation competition).

In being a challenge collaborator you would be expected to provide the following:

- industry know how
- personal and/or organization case examples, resources and network
- willingness to be interviewed & mentorship to student project groups

For DTU 13 week course in January Time Commitment: 15 hours (Timeslot Dec-May)

Dec Jan	2 hr waste challenge scoping with DTU (done via meetings, phone calls & email exchange)
Jan 31: May 09	6 hr Mentoring: providing feedback & support towards student group working on waste challenge
Feb 10	2 hrs EuroTeQ waste challenge kick off Optional
May 10-18	4 hr EuroTeQ COLLIDER activity as mentor, coach, visit, talk or other

Why Join as a Challenge Collaborator?

- strengthen your individual and/or organizational innovation capacity
- be part of the creative development process that brings new concepts and solutions from vision to reality in the field of waste
- meet talented students who can be a source of new knowledge & partnership
- support the EuroTeQ engineering university in the development of new challenge-based innovation approach connecting education, industry and society

Show Interest & learn more by contacting Stephanie.ste@dtu.dk, (DTU Skylab-EuroTeQ project manager).

Become a Waste Challenge Collaborator for our EuroTeQ Collider at TU/e

Eindhoven University of Technology (TU/e) joint forces with six leading universities of science and technology in EuroTeQ. Together we are creating the first EuroTeQ Collider in 2022.

An innovative learning journey towards desirable futures centered around the theme "Leave no waste behind". Within this overarching theme we are focusing on three different topic-domains, namely:

- | | | |
|--------------------------|-----------------------|--------------------|
| Cities | Energy | Consumption |
| - Construction/ building | - Renewable resources | - Food |
| - Public lighting | - Transport sector | - Plastics |
| - Streets (trash bins) | - Cities (storage) | - Fashion |

Within every topic domain we are looking for challenge collaborators that want to work together with TU/e staff and students to scope a EuroTeQ waste challenge. During the collider we will invite participants to explore different aspects of this challenge, develop solutions towards a desirable future, test and validate tools and create prototypes of their solutions. In doing so our participants will be working together in inter-disciplinary (and international) teams.

In being a challenge collaborator you would be expected to provide the following:

- industry know how on at least one of the topic-domains
- personal and/or organization case examples, resources and network
- willingness to be interviewed & mentorship to student project groups

Estimated timeline | Jan-Jun | Total Time Commitment: 15 hours

Dec Jan	2 hr waste challenge scoping with TU/e (done via meetings, phone calls & email exchange)
Feb. 10	2 hrs EuroTeQ Launch event attendance is optional (shared hybrid event)
Apr. Jun.	8 hr Providing feedback & support towards the teams flexible time investment (preferably on Friday afternoons)
Jun. 10	4 hr Final Pitch event TU/e Collider provide final feedback to the team (and advise our jury)

Why join as a Challenge Collaborator?

- strengthen your individual and/or organizational innovation capacity
- be part of the creative development process that brings new concepts and solutions from vision to reality in the field of waste
- meet talented students who can be a source of new knowledge & partnership
- support the EuroTeQ engineering university in the development of new challenge-based innovation approach connecting education, industry and society

Figure 1. 1-pager used to define what is EuroTeQ Challenge Collaborator, Examples from DTU (left) & TU/e (right)

COLLIDER CHALLENGE TEMPLATES

A **challenge canvas** was shared as an example of best practices to develop challenges with industry as EuroTeQ challenge collaborators. The point of a canvas is to ensure that the right conversations and questions are asked during development of Collider challenges. One proposed canvas model is presented in following Figure 2.

EuroTeQ Waste Challenge Canvas

<p>Waste Source / Waste Generators</p> <p>Who are the waste generators? What type of waste are we addressing? What is the waste source? Trends in society / current known ambitions.</p>	<p>Problem Statement / Research Question (Challenge Pitch)</p> <p>How might we ...</p>	<p>Desired Outcome</p> <p>Tell us the change that should occur as a result of a planned intervention</p>
<p>Collaborators</p> <p>Industry:</p> <p>Academia:</p> <p>Student organizations (if any)</p> <p>Other (if any):</p>	<p>Background / Context & Need</p> <p>Describing the current situation Why is it important? What are the assumptions? Which facts have already been validated?</p>	<p>Desired Impact</p> <p>Tell us the story, experiences and/or feelings of people or society as result of the change</p>
		<p>Optional: Technology Enablers</p>
		<p>EuroTeQ Waste Cluster:</p>
		<p>Title:</p>

Figure 2. EuroTeQ Waste Challenge Canvas used for challenge formulation inspiration

CHALLENGE/PROJECT DESCRIPTION – 1 PAGER

Similar to the challenge canvas, a **challenge description – 1 pager** is another way to develop Collider challenges that are tangible yet explorative for students and other stakeholders. See Figure 3.


<p>Leave No Waste Behind</p> <p>Waste Challenge Question: [insert the main question / theme here]</p> <p>Introduction [add introduction / context to question here]</p> <p>Who is behind this initiative? [add a short description of your organization and relevant stakeholders here]</p> <p>What is the waste challenge? [add a short description of the challenge that connects to the overall theme of 'leave no waste behind']</p> <p><i>Note: please make sure that the challenge is open-ended. The students are expected to explore the problem and identify opportunities for innovation and then develop solutions</i></p> <p>[add the key questions and/or overall challenges you would like the students to focus on]</p> <ul style="list-style-type: none"> • ... • ... • ... <p>Relevant considerations for the challenge / theme: [add any consideration or tips/tricks you have for the students, including boundaries of the theme and what you would leave out of scope]</p> <p>Relevant links: [add relevant links to information or key stakeholders that the students can explore, including contact information if possible]</p>	
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Figure 3. Challenge Description 1-pager template

Before going into the specific descriptions of how each EuroTeQ university further developed 'Leave No Waste Behind' into Collider challenges, it is important to mention in the chapter here below the shared principles of the EuroTeQ Collider as well as the divergences to gain a full understanding of the development of the Collider Challenges.

SHARED PRINCIPLES OF THE COLLIDER

COLLIDER SPRING 2022

The Collider is a new format where students, professionals and vocational learners can experience an innovative learning journey towards desirable futures. In this spring, the learning experience is centered around the theme "*Leave no waste behind*". Within this overarching theme, we are focusing on three different topic-domains, namely: Cities (e.g. construction/ building, public lighting, streets (trash bins)); Energy (e.g. renewable resources, transport, data (storing)) & Consumption (e.g. food, plastics, fashion).

Within every topic domain, we are looking for (local) challenge collaborators who want to work together with staff and students to scope a EuroTeQ waste challenge. During the Collider, we invite participants to explore different aspects of this challenge, develop solutions towards a desirable future, test and

validate tools and create prototypes of their solutions. In doing so, our participants will be working together in inter-disciplinary (and international) teams.

LEARNING OBJECTIVES

Learning objectives to the Collider have been developed and were approved in the EuroTeQ Management Board meeting on 20th December 2021.

After completion, all EuroTeQ Collider participants will be able to:

- Select and apply appropriate design, engineering and business approaches and tools to create an innovative and science-based solution to a real-life challenge.
- Develop a profound interpretation of a complex, real-life problem and its context using a system-thinking approach, taking into account multiple perspectives.
- Develop a problem-driven, creative and integrative design, demonstrated by a concrete prototype that balances desirability, feasibility and viability.
- Use disciplinary knowledge and expertise in an inter-disciplinary team to develop an innovative and scientifically sound solution in an European context.
- Communicate your ideas, at different levels of elaboration, via several mediums in an international context to a diverse set of stakeholders.
- Define and regularly reflect on personal and team development

LOCAL COLLIDER FORMATS

In the first edition of the Collider, we pilot different formats based on the academic calendars and preferences of each institute. Some institutes (TU/e, L'X) will offer the Collider as a new course (with its own course code), while others will connect the Collider to existing project-based courses (DTU, TalTech, TUM) and/or co-curricular activities (CTU). In all formats, the **study load** of the local Collider experience will be **5-6 ECTS** (eq. to 140 – 168 hours).

Diversity is one of the core values of both the EuroTeQ proposal and the design of the Collider. For the design of the Collider, we define three different types of diversity, namely **diversity in terms of discipline, home-institute and type of learner** (vocational, university, professional). While working on open-ended real-world challenges, it is essential for to work together with multiple disciplines (so no institute will offer the Collider to only one discipline and teams will be mixed as much as possible).

In this first edition, only the TU/e Collider has been included in the online EuroTeQ course catalogue (and will thus have some mixed teams with students from multiple institutes). For next editions, we aim to create a more international experience for all Collider participants. The inclusion of vocational learners has not been a priority for this first edition and will need more attention in the future. The inclusion of professionals happens via the role of 'challenge collaborator' and/ or mentor. We aim to further develop the inclusion of lifelong learners in collaboration with Work Package 4 - Professionals.

In summary, each EuroTeQ university took the shared principles of the Collider along with shared understanding and best practices of developing challenges to develop Collider challenges. In the next section, each EuroTeQ university will present their process of developing Collider challenges followed by the challenges that resulted.

RESULTS: COLLIDER CHALLENGES

As can be viewed in Appendix A, the local format of each Collider has different starting and ending dates where most are very active in April & May. This also means that at the time of this deliverable report, some universities are still developing their Collider challenges as the starting date is still quite 1-2 months away. In the below sections each university will further layout their past and/or ongoing process to develop Collider challenges.

COLLIDER CHALLENGES AT CTU

CTU Collider is an extra-curricular event on top of the regular study programmes at CTU. It is a 6-day event accessible for all students from CTU faculties and institutes. By the time of this report, the first Collider at CTU will place (5-8 May + 14-15 May). The aim is to have 5-6 teams with 5 students per team. Ideally, students will form teams from at least three faculties (disciplines) to ensure that the teams are multi-disciplinary.

Collider challenges were obtained from the Local Advisory Board (LAB) members of CTU. This was done in a three-round process. Round 1 was informing the LAB members of the theme “Leave No Waste Behind” and the sub-topics “Cities”, “Energy”, and “Consumption.” Since a Collider type event has not been done before at CTU, we could only show examples of similar projects done earlier at EuroTeQ partner school TU/e, and examples of challenges from the TUM science hack from November 2021. The LAB members obtained a challenge owner sheet that summarized everything (see Figure below).

EuroTeQ Challenge Owner & Collider


Challenge 2022: Leave No Waste Behind	LAB January 2022: What is your Challenge?	Kick-Off 10 Feb. 2022: Pitch your challenge	Collider May 2022: Teams work on challenges
Themes: CITIES, e.g.: <ul style="list-style-type: none"> • Buildings & materials. • (Public) transport. • Waste collection. • Digital Twin & waste monitoring. ENERGY, e.g.: <ul style="list-style-type: none"> • Power demand of social networks. • Reduce personal energy footprint. • More sustainable and renewable energy sources. • Energy out of waste. CONSUMPTION <ul style="list-style-type: none"> • Less single-use products. • Better food cycles. • Reduce plastic consumption. • Repair shops/life-extension shops. 	Do you have a: <ul style="list-style-type: none"> • resource, • expertise, • product, • service, • market... to solve Leave No Waste Behind? Example challenges: <ul style="list-style-type: none"> • https://www.youtube.com/watch?v=T40piFvacPY&t=3s (Agrifood Tech Robocup) • https://www.youtube.com/watch?v=5cg3f2Y_LN4 (Low cost CO2 capture) 	International and local meeting of all people in Collider. Pitch your challenge. Collider teams select their challenge. First get-together.	Three weeks in May 2022, teams work on the challenges. Final presentation at the end. Best two solutions continue to international EuroTeQaThon (3rd week of June 2022).
Homework: Create a challenge from your firm for Collider. Can someone be a mentor during Collider? Can teams work during Collider at your firm?			12. 12. 2021 Henri Achten achten@fa.cvut.cz 

Figure 4: The Challenge Owner chart for LAB members.

In the second round, we collected the challenges provided so far (three by one LAB member), and discussed them in a meeting with the LAB members. In the third and last round, we individually addressed LAB members who expressed interest in making a challenge, and thus obtained the fourth and last Challenge for the first Collider:

- (1) From Skupina PRE: PV on every rooftop;
- (2) From Skupina PRE: Flexibility in energy networks;
- (3) From Skupina PRE: Reachable charging infrastructure;
- (4) From GasNet: Detection management of gas leakages.

The Challenges were presented by the companies on the CTU Collider Launch Event on February 10, 2022. See Appendix B for challenge descriptions.

COLLIDER CHALLENGES AT DTU

The Collider at DTU can be described in the following manner: students can bring ideas and Waste projects from DTU courses and/or co-curricular events and enter them into the 'Collider', a 5-day innovation sprint. Each day contains a workshop to provide tools & frameworks to advance their ideas and concepts. This includes building your network with waste industry experts as mentors & coaches.

EuroTeQ waste challenges have been developed with different industry collaborators and integrated in various DTU open innovation courses. Additionally, it is possible to participate in the Collider if you have previously worked on a waste project / case that aims to leave no waste behind in cities, consumption or energy.

The Collider week will take place for 5 days between May 10 – 18.

The following Collider Challenges have been developed at DTU

- The carbon cycle: how to put waste & emissions back in the loop? (Haldor Topsoe)
- How might Vink Plast close the loop to all their offcuts? (Vink Plast)
- Waste from the residential heating sector - how to establish circularity in heating system materials? (Viessmann)
- How can coop phase out the use of new plastics in their product range? (Coop)

To develop the Collider challenges the following process was undertaken:

1. Identify DTU courses where a waste challenge could be integrated into

3 courses were identified where a EuroTeQ waste challenge could be integrated into the current curriculum of a course. The development of the waste challenges was influenced by the faculty/course coordinator needs such as specific topics/ questions to address when scoping the EuroTeQ waste challenge. All courses identified had an open innovation process.

2. Meet, update, connect and acquire recommendations with DTU LAB members

Each of the 5 LAB members was contacted and requested to have a 30 minute 1:1 meeting with the Collider organizer. During the meeting updates about the theme and overall challenge question was made as well as request for feedback and knowledge of who to talk to, next steps and any persons in their network that might have interest in being a EuroTeQ challenge collaborator. 1 LAB member agreed to advertise & promote the opportunity to their large industry network called Confederation of Danish Industry which prompted the use of the 1-pager about 'becoming a EuroTeQ Challenge Collaborator' as well as the following text on LinkedIn and newsletter platforms:

Are you the next EuroTeQ Waste Challenge Collaborator?

We are looking for practitioners that can work together with DTU students this spring 2022 and bring your industry and sector knowledge within the area of waste. This opportunity is part mentoring and part challenge developer.

An ideal candidate has a strong interest and understanding of waste within a particular sector that **impacts CITIES, CONSUMPTION or ENERGY**.

The role is most suitable for people that can spend 15-20 hours developing a challenge and mentoring throughout the spring.

Find out more [here](#).

We are flexible depending on your interests so **please reach out and start a dialog with XXXX**

3. Meet, update, connect and acquire recommendations with DTU researchers, professors

Various research, course coordinators and professors were identified to meet with. The aim of the meetings was to provide awareness of EuroTeQ Collider at DTU, gain their input in creating waste challenges and cases and further begin to understand how Collider challenges centered around waste could provide value to the DTU academic community. Collider challenges for the most part did not come directly out of these conversations but began the conversation of how researchers can be included in the Collider format.

4. Meet update, connect and acquire recommendations with DTU Learn for Life (continuing education & lifelong learners)

In an effort to include lifelong learners in the Collider format and challenges, collaborating and connecting with DTU Learn for Life is essential. Through conversations, the head of continuing education programs connected the Collider organizer to some companies that are well known for wanting to build individual and organizational learning capacity and would welcome the exploration of societal challenge connected to students. Developing a mentoring opportunity during the specific days of the Collider was also established to be of interest.

5. Map out the current local ecosystem of different waste challenge initiatives and projects already happening at DTU.

There are various student-driven as well as center-driven innovation activities happening on DTU's campus that speak into Leave No Waste Behind. After identifying these activities all were contacted to further explore if there were EuroTeQ challenge synergies that could lead to participation into the Collider.

Following the above process 10 companies and industry representatives were identified that had immediate interest to be a EuroTeQ waste challenge collaborator. Upon showing of interest, a 30-minute phone call was arranged and if still interested, a 1-pager challenge description was co-developed. After the initial phone call some realized they did not have the resources to be part of the Collider challenges this year or preferred to take a more mentoring / input role during the Collider this time. The four co-developed challenges that are in use this spring 2022 can be seen in Appendix C.

COLLIDER CHALLENGES AT TUM

Summary

TUM will be integrating the pilot Collider into its spring/summer semester. The learners participate in existing and partly adapted courses in various disciplines during the whole semester from April to July 2022. The learning units are offered from teachers at different TUM Schools contributing with specific suitable learning units. A specific container module “Collider” has been developed by the Professorship of Policy Analysis and will be made available to students to allow for recognition in the students’ regular study programmes.

For the actual work in mixed interdisciplinary teams, we foresee a forming phase at the beginning of the semester. Specific mentoring activities will be supporting the team-building process. The mixed teams are then encouraged to organise themselves and to further develop a topic and approach for the Challenge they have selected. The activities culminate in an intensive Collider week, in which the participants, ideally students, professional and vocational learners meet, get advice from experts and entrepreneurial coaching, and jointly work on the implementation of real-life solutions.

Collider challenges

The TUM challenges cover all three clustered topics. Most of them bridge two topics, involving “city” as the location where ideas shall be implemented and as framework condition for the co-creation processes taking place with and within the local eco-systems. For all challenges, we get already, or strive for input, and support from local public bodies, companies and start-ups.

Students’ initiated challenges

- The student initiative “Plant a Seed - Vertical Farming Team” wants to develop a vertical farming greenhouse at the TUM Garching Mensa (canteen) where students can watch their own food grow (**Vertical farming greenhouse**).
- The “Plant a Seed -Irrigation Team” wants to build an energy-technical prototype for a sustainable smart irrigation system to use for raised beds in community gardens (**Smart irrigation systems**).
- Students from “ElecTUM”, an already formed students’ research group, want to evolve a prototype of an energy calculator, which determines the electricity consumption of TUM students in online lectures and in presence. The further development of the first prototype should make the tool transferrable to different teaching formats and for different university contexts (**Energy calculator**).
- **ReTUM**, as the fourth student initiative, would like to develop an online tool to facilitate the sustainable exchange of furniture and household items between students at TUM and to raise awareness of circular product and consumption cycles.

Civil society initiated challenges

- In cooperation with civil society initiatives in Munich, we want to set up a challenge to support **food caring** initiatives that are committed to reduce the amount of food that ends up in the garbage, while increasing their reach through online applications.
- Linked to the afore-mentioned challenge, we are in contact with a start-up company that develops **smart and simple reusable systems**. The start-up aims at avoiding disposable packaging by providing food and drinks to go in reusable dishes.
- The waste management office of the city of Munich has also expressed interest in a challenge to **evaluate waste prevention incentives** and to develop smarter solutions.
- Within the scope of avoiding waste in industrial production processes as part of a digitized Industry 4.0 strategy, we are in contact with several companies (**Waste production**).

Academia initiated challenges

- Supported by a Behavioural Economics professor, challenge participants should bridge the attitude-behaviour-gap when it comes to sustainable consumption. By examining nudging instruments, the challenge participants should evaluate whether such instruments can help to persuade consumers to translate their expressed preferences for sustainable consumption into corresponding consumption behaviour (**Bridge**).
- Finally, as part of a challenge at the Professorship for Policy Analysis participants can investigate how TUM is positioned with regard to circularity and what governance instruments would be necessary to make more progress here (**Circularity governance**).

Companies initiated challenges

- Supported by Infineon, participants can analyse the use of semiconductors in circular processes.

Challenge formulation process

The pilot Collider is coordinated and implemented by the Professorship of Policy Analysis. In view of covering the different dimensions “cities”, “consumption” and “energy” of the overall Collider topic “Leave no waste behind”, TUM has chosen an approach that allows involving a broad number of status and stakeholder groups into the challenge formulation process. In doing so, we identified different institutions, social and student groups, companies and individuals and motivated them to submit challenges covering the dimensions “cities”, “consumption” and “energy”.

We, furthermore, reached out to colleagues within TUM, who are covering the clustered topic through their specific research fields. We encouraged them to submit a specific challenge and/ or to adapt their learning units to the overall Collider theme.

Finally, we are in contact with the companies of our Local Advisory Board. Our aim is to co-create with them company relevant challenges. To a certain extent, these companies are already involved in the challenges mentioned here above. We are shaping their perspectives, interests and input for the specific challenges and their real-life needs.

COLLIDER CHALLENGES AT L'X

L'X Collider is an optional course offered to all students (bachelor, master, engineers and PhD). For this pilot edition, the course has been designed over a period of about 10 weeks where students will be coached on several aspects:

- Definition of their own problematic
- Choice of their solution
- Prototyping options
- Learn notions and acquire skills in entrepreneurship and innovation.

The course will have common moments of gathering for all the teams and follow-up meetings between the teacher, the challenge collaborator and each group to support the development of their solution.

The challenges, as approached by the industry partners so far, are, to this step:

- Limit the environmental impact of detection tools (radar)
- Optimize electrical (re)charging
- Limit the impact of plastic waste
- Carbon capture efficiency

Final formulation the challenges is still a work in progress.

For the moment, we have used the opportunity of a Local Advisory Board gathering the EuroTeQ project industry partners to communicate with them. As they already had a first presentation of the project, and of the Collider, we had kept them informed about the choice of the theme and the Call for Ideas. This meeting was the opportunity to the latest advances on EuroTeQ Collider including:

- the choice of the three main topics (energy, consumption and cities).
- the opportunities to get involved as a challenge collaborator through the proposal of a challenge
- the next steps in the process of building the Collider.

At the end of this meeting, we sent them an email outlining how companies could get involved in the project and more specifically, what we expected in terms of format for the challenges. We shared with them, for reference, examples of challenges formulated for other courses in challenge-based learning and the canvas developed during the WP3 meetings. Three interested companies then came back to us with proposals that we are still working on today at the time of this written report.

COLLIDER CHALLENGES AT TU/E

Summary

TU/e created a new course code (5 ECTS) built on an existing similar 10-credit format (ISP), inspired by a 3-credit DLI pilot of '20 - '21 (in collaboration with DTU & TUM). Based on the set theme “leave now waste behind” and the formulated topic domains we reached out to make connections to our existing network in LAB (Local Advisory Board), TU/e, Brainport and Intelligent Lighting Institute).

On February 10th we facilitated a ‘local’ challenge reveal event where our three initial challenge collaborator each presented a potential challenge inspired by one of the topic domains (energy, consumption, cities) to a variety of involved stakeholders, registered participants and potentially interested students/ TU/e parties.

Challenge Collaborators are

Core Chemistry (energy)

Duur-Samen (consumption)

Intelligent Lighting Institute (cities)

From now until the end of March we will initiate and facilitate a process of onboarding and engaging from both perspectives to co-create our first set of challenge collaborators. We do have ideas for this but did not yet develop a concrete template at the time of this deliverable.

COLLIDER CHALLENGES AT TALTECH

Collider

The EuroTeQ project kicks off the Collider (Waste Challenge) at TalTech. For this edition, master students can join it either in the optional subjects or in curricula through existing subjects. It will run between February and May 2022 and is open to all TalTech master students across disciplines.

The courses provide a project-based learning method, in which entrepreneurs provide students with waste challenges in the field of sustainability, to which (interdisciplinary) students need to offer solutions as a team. Additionally, they will work on relevant material, have guest lecturers, practice presentation and work on their project.

Overall, for this academic year, five TalTech subjects participate in the EuroTeQ Collider, two of which are open to more than one discipline:

- **Startup Entrepreneurship for Built Environment** (EPX5020) – construction students, graduates of IT and economics are welcome to participate.
- **Social Entrepreneurship** (MMJ5240) – Master's students from all TalTech faculties are welcome to participate.

Students in the following courses can also take part in the Collider, but that would be without a free enrolment:

- Mechatronics and Smart Systems Project (UTT0110)
- Course Project (UTT0055)
- Design Studio 2: Context (EMD0053)

As a result, students can learn to work in multi-disciplinary teams, deal with open-ended challenges from practice, collaborate, and develop communication skills to complete their work. For the course participants it is not mandatory to participate in the Collider however, it is the only way for this edition. All students who complete the course will be awarded with 6 ECTS. More information - <https://taltech.ee/en/euroteq/projects-and-competitions>

Challenge formulation

Developing the Collider challenges has itself been a challenge. While gathering the challenges we use example challenge formulations since it was suggested by DTU and asked by many partners.

Here are the main steps we took and the results we got:

1. Contacted TalTech LAB (Local Advisory Board) members

This was the first approach we took. All of the LAB members were contacted by e-mails. As a result, we can say that it did not work as well as we expected since the engagement was fairly low.

2. Contacted professionals from relevant companies

As a second step, we contacted different companies through personal contact persons. This approach was much more personal and more successful as it helped us get 3 challenges.

3. Contacted TalTech professors

As a last step, we contacted our own TalTech professors to see whether they have their own contacts or even challenges. This approach was successful as well as it gave us additional challenges.

As a result, from the first two steps, we gathered 3 challenges from two companies:

- **AS Tallink Group** – Plastic bottle reuse, reduce, recycle.
 - Reduction of plastic waste pollution in the Baltic Sea or Estonian waters through innovative solutions for the recycling of plastic bottles.
- **Tallinn Strategy Centre** - Residual gas from closed landfill of Pääsküla.
 - Examination of the amount of residual gas. To do this, it would be necessary to carry out a small-scale excavation from the top and take a soil / waste sample from the body. Based on this, it is possible to assess what composition is currently in the body of the landfill. After the sampling site has been closed, a pavement patch must be installed to restore the soil to its original condition. Based on this, a much better picture would be given of the stage of waste in the body of the landfill.
- **Tallinn Strategy Centre** - Installation of solar panels for the closed landfill of Pääsküla.
 - Proposing a design / solution for solar panel substructures. The structure would be designed to be installed on top of the landfill without major damage to the pavement.

As a result, from the third step, some of the courses added additional challenges:

- **Start-up Entrepreneurship for Built Environment:**
 - Ülemiste City - Real-time monitoring of a smart city, more precisely wastewater management
 - Welement – Increasing the productivity of the construction process by applying the principles of industrial production in supply chains
- **Mechatronics and Smart Systems Project:**
 - Building Automation Occupancy Detection
- **Social Entrepreneurship:**
 - Will let students develop their ideas and then evaluate whether some of the projects fit under Leave no Waste Behind areas (cities, energy, consumption)

DISSEMINATION OF CHALLENGES

Challenges will be introduced in a number of EuroTeQ outreach activities including the following:

- Local launches at each EuroTeQ University (some already occurred on February 10 and have been mentioned above)
- Pop-up cafes (see D6.24)
- Public Event Series such as *Lobbying for a Change* – a collaboration between WP5 and WP3 (D6.25)

NEXT STEPS

With the development of the Collider challenges, the next focus is to develop the content and structure of EuroTeQ Colliders & Project Weeks. This includes experimenting with opportunities where local Colliders interact with one another as well as mentoring / coaching possibilities for industry and lifelong learners to collaborate with students and EuroTeQ waste challenges. This will be elaborated on in deliverable 3.5.

PROJECT LEARNINGS & REFLECTIONS

This will be further elaborated in Deliverable 3.8.

One of the ambitions of the first edition of the Collider is to pilot the different practices and approaches to developing challenge formulations within 'Leave No Waste Behind' while maintaining common principles and understanding.

All EuroTeQ universities have been successful in identifying waste challenges in Cities, Consumption and Energy in their local ecosystem.

The following are reflections thus far discussed in WP3 in no chronological order of importance:

- EuroTeQ Collider activities and chosen theme should amplify and accelerate the current local initiatives that aim to tackle grand societal challenges.
- As EuroTeQ Collider is new to our local ecosystems, a personal approach towards LAB members and industry increases success rate of involvement
- All our universities already have local initiatives and passion projects in waste which is important to tap into when developing the Collider
- Challenges developed thus far are different but by maintaining they should all speak into Leave No Waste Behind and provide a better future in cities, consumption and energy it should be possible to select and evaluate the best ideas in the EuroTeQathon although coming from different challenge collaborators
- Providing tools and templates to develop challenge formulation is essential for creating tangible challenges for students to approach

For the next iteration of the Collider challenges it would be of interest to develop a structure for student groups of multiple partner universities to work on the same challenge from the same challenge collaborator in some manner.

As Cities, Consumption and Energy are very large topic domains, it would be possible to continue to develop challenges within this framework for Collider edition 2.

- A. Visualization of different Collider formats at EuroTeQ Partner Universities
- B. 4 Examples of Challenge Descriptions from CTU
- C. 3 Examples of Challenge Descriptions from DTU (4 challenges in total)

A. Visualization of different Collider formats at EuroTeQ Partner Universities



Note: visualization is still being updated and not completely accurate but gives a quick overview.

CHALLENGE 1

PV on every rooftop

Theme: Energy communities in the center of EU energy transition

Introduction

Community-driven energy projects have been part of the European energy landscape since their inception in the early 20th century. The recent growth of decentralized renewable energy technologies has made direct participation in energy production and management more accessible. The participation of citizens and energy communities as partners in energy projects will play a significant role to achieve a successful transformation of the interconnected energy system. Community energy initiatives are offering new opportunities for citizens to get actively involved in energy matters. Community energy refers to collective energy actions that foster citizens' participation across the energy system. It has received increased attention in recent years, developing a wide range of practices to manage community energy projects.

The European Commission's Clean Energy for All Europeans Package confirms the prominent role prosumers and their collective forms will play in the future energy system. The EU legislative framework formally acknowledges and defines specific types of community energy as 'renewable energy communities' and 'citizen energy communities'.

These new concepts open the way for new types of energy initiatives aiming at, in particular, the empowerment of smaller actors in the energy market as well as an increased decentral renewable energy production and consumption.

Who is behind this initiative?

For more than 120 years, Pražská energetika, a.s. (PRE), has been a stable partner in the energy sector. PRE and its subsidiaries form a prosperous corporate group whose mission is to ensure the reliable supply, generation and sales of energy and related services in Prague as well as in the entire Czech Republic. PRE Group consists of more than ten companies. In their activities, all of the companies follow strict ethical standards, which primarily include a responsible attitude towards society, the environment and their own employees. In its business activities, PRE proudly embraces the principles of sustainable development and through its activities, it strives to contribute to the improvement of the standards of living in the region it operates in.

What is the waste challenge:

There are a lot of open questions concerning energy communities. To bring the idea to life means assessing the topic from various angles such as legal perspective, technical design and economic evaluation. The high level framework is given by the EU on one hand and the need to implement the solution in different environments on the other lays down opportunity to create new market design and links between market participants.

- What are the differences between “Citizen energy community” (CEC) and “Renewable energy community” (REC) from legal, technical and soci-economical point of view? What are the benefits of each variant?
- How should be CEC and REC designed to fit in current EU energy market design? Is current market design sufficient for CEC / REC? What is going to be different?

- Do you see CEC / REC as integral part of future proof market design?
- Design CEC using real site conditions (RES providing energy to block of flats, family houses or combination of both)
 - Find optimal RES installed power / power production to cover CEC needs (consider energy storage)
 - Calculate energy flows among CEC members during whole year to cover intraday and seasonal discrepancies
 - Design methodology how to share locally produced energy to CEC members including energy provided from storage and from the grid (calculate 15 minute measurement interval).
 - Design invoicing settlement methodology based on current electricity bill structure.
 - Provide condition for CEC to operate in terms of EU framework.
 - What are the main benefits and risks for CEC members?
- Based on your country's national energy mix, try to quantify, and determine the final environmental impact of your proposed CEC operation and implementation methodology. Determination of the expected value of carbon dioxide savings (saving conventional energy fuels).

Relevant considerations for the challenge / theme:

Clean Energy Package (CEP) provides new perspectives and introduces new players into electricity market design. The scope of this project is based on the CEP framework.

Despite the fact that CEP defined two types of energy communities, REC is to be considered only as a supplement, main focus of this theme is on CEC.

The outcome of this theme is rather practical based on real-world data and measurements. CEC It is advised to focus on specific conditions in one country.

Relevant links:

<https://publications.jrc.ec.europa.eu/repository/handle/JRC119433>

<https://enercommunities.eu/>

<https://www.ceer.eu/report-on-energy-communities>

https://energy.ec.europa.eu/index_en

https://extranet.acer.europa.eu/en/Electricity/CLEAN_ENERGY_PACKAGE/Pages/Default.aspx

CHALLENGE 2

Flexibility in energy networks

Theme: **Methodology proposal for free capacity calculations in the distribution network for flexibility transactions**

Introduction

As the global focus is set on the climate change problem and on the slowing down of global warming, every industry sector needs to do everything in their power to meet this common goal. For the energy sector, it means decarbonisation that is achievable by incorporating more renewable energy sources into the system.

The challenge lies in the management of the irregularity of the supply due to the weather dependency of these sources. Previously, production was able to adjust to the consumption as needed but with the increasing share of renewables in the system, this type of regulation will no longer be possible. This issue is solvable by an increase of accumulation which is however a costly option. The other way would be learning to adjust the consumption itself, in other word flexibility. It is the perfect tool to maximize the utilization of renewables and thus support their further expansion.

Who is behind this initiative?

PREdistribuce, a.s. is the owner and operator of the distribution system in Prague, capital city of Czech Republic. The main mission is to provide a reliable and safe supply of electrical energy to all of its customers. Due to the growing demands for continuity and the quality of electricity supply as well as growing share of new technologies such as electromobility, AMM or accumulation, the company aims to ensure well in advance readiness of the distribution system for the arrival of modern energy trends.

What is the energy challenge:

Flexibility could be an option how to utilize every bit of produced electricity. In connection with technology development (such as electromobility, accumulation ...) the potential of flexibility is growing and it is expected to grow further more. The key player in flexibility transactions securing is the DSO as its managed infrastructure allows the use of flexibility. The challenge is to create the best conditions for flexibility as possible and to put together a methodology for DSO that would describe the conditions for individual flexibility transactions in order to maintain safe and reliable distribution system.

- What types of flexibility could be determined?
- Simulations of different network conditions
- Principles derivation for free capacity calculation methodology in the distribution network for flexibility transactions
- Draft of conditions for flexibility transactions that ensure safe and reliable power system operation
- Decision-making of a customer based on price / How could be customers motivated to optimize their behavior?
- Flexibility encouraged by the tariff structure

Relevant considerations for the challenge / theme:

The modern trend among customers is to modernize their home to make it smart. If the DSO learns how to cooperate with these smart households and their functions, it could increase the potential of flexibility in the grid. Both customer and DSO could benefit from it, for the customer it is cost optimization and for DSO safety in the grid.

Relevant links below are given for inspiration only.

Relevant links:

[Energies | Free Full-Text | DSO Flexibility Market Framework for Renewable Energy Community of Nanogrids \(mdpi.com\)](#)

[Energies | Free Full-Text | Characterization of TSO and DSO Grid System Services and TSO-DSO Basic Coordination Mechanisms in the Current Decarbonization Context | HTML \(mdpi.com\)](#)

<http://www.cired.net/cired-working-groups/flexibility-in-active-distribution-systems-wg-2019-3>

<http://www.pre.cz/en>

CHALLENGE 3

Reachable charging infrastructure

Theme: **Public charging infrastructure - how to bring charging stations into the streets most effectively**

Introduction

The most significant for use of EVs in cities are shorter distances with parking on the street where there is the most suitable time for EV charging. What is common for this kind of usage of EVs is that the EVs are usually parked next to the public lighting poles. The idea of integrating the distribution network with public lighting poles could support and enhance the construction of connection points for the future use for EV charging. PREdi together with the city of Prague named this integrated solution "EV ready lamp".

Recommended target for penetration of charging points is at minimum one public charging point for every ten electric cars. Thanks to above mentioned synergy between distribution network (owned and maintained by PREdi) and public lighting network owned by the City of Prague (HMP) is reaching of this goal much more realizable and cost efficient.

Who is behind this initiative?

PREdistribuce, a.s. (PREdi) is the owner and operator of the distribution system in Prague, capital city of Czech Republic. The main mission is to provide a reliable and safe supply of electrical energy to all of its customers. Due to the growing demands for continuity and the quality of electricity supply as well as growing share of new technologies such as electromobility, smart metering or accumulation, the company aims to ensure well in advance readiness of the distribution system for the arrival of modern energy trends. PREdi proudly embraces the principles of sustainable development and through its projects, it strives to contribute to the improvement of the standards of living in the region it operates in.

What is the challenge for public charging?

The challenge is to create within the boundaries of existing, historic city that has been built for almost a thousand years appropriate numbers of public chargers without too much interference in the public space. Together with this it needs to be done in a way that is technically sound and is in accordance with safe operation of distribution network and with reasonable investments.

- What is the anticipated increase of EVs in Prague in next decade(s)?
- What is the necessary number of public charging stations in Prague to cover the needs of these EVs?
- What are the possible solutions for ensuring public charging concerning the synergy between public lighting and DSO?
- What is the suitable design for this solution if we want to achieve the maximal possible efficiency?

Relevant considerations for the challenge / theme:

Implementation of the EV ready lamp could ensure a sufficient number of charging points as well as the requirement of sufficient power to supply public charging points for current and soon-produced electric cars by bringing the distribution network within the public lighting pole, even with regard to investment. It is advised to focus on specific conditions in Czech Republic.

Relevant links:

<https://www.pre.cz/cs/profil-spolecnosti/media/zakaznicke-casopisy/dalsi-vydani-prefora/> (PREfórum 24/2020 – Smart public lamps with charging potential)
https://www.praha.eu/jnp/cz/o_meste/magistrat/tiskovy_servis/tiskove_zpravy/v_praze_se_elektromobilny_budou_nabijet.html
https://prazsky.denik.cz/zpravy_region/elektromobil-nabijecka-lampa-sloup-litacka-led-osvetleni.html
<https://www.ckcired.cz/konference-cired/konference-ck-cired-2021-29/o-konferenci.html>

CHALLENGE 4

Theme: Detection management of gas leakages

Introduction

Methane emissions are a significant contributor to the rising concentration of greenhouse gases in Earth's atmosphere and are therefore partially responsible for near-term global heating. Reducing methane emissions by capturing or utilizing the gas can produce simultaneous safety, environmental and economic benefits.

From network gas infrastructure perspective, the amount of methane emitted from a facility depends on equipment type and condition, maintenance procedures and the frequency of maintenance, and operations at the facility under consideration, moreover on the quality and swiftness by which gas leakages are being detected. Gas network operators work systematically on both, avoiding new leakages, and to detect existing leakages as soon as possible.

Who is behind this initiative?

GasNet is the operator of the largest gas distribution network in the Czech Republic. It provides reliable and secure natural gas supplies for more than 2.3 million customers.

GasNet has a roughly 80% share in the distribution of natural gas in the Czech Republic and manages 65,000 kilometers of gas pipelines in almost all regions of the Czech Republic.

The company's primary focus, in addition to reliably and safely delivering energy to 2.3 million customers, is to support the Czech Republic's decarbonization goals. These goals include the replacement of lignite for heat and power production by natural gas and biomethane in a first phase till 2030 to 2038. In phase 2, the goal of reaching net zero carbon emissions by 2050 by replacing natural gas by hydrogen and by eliminating emissions in GasNet's own operations shall be achieved.

To successfully manage this unprecedented transformation process, GasNet will intensely invest not only into the renewal and retrofit of its network, but also into new advanced technologies and new work approaches.

What is the challenge of gas and methane leakage detection?

The detection of natural gas leakages is equally important for safety, environmental and financial reasons. As the gas network includes various asset classes (gas mains, pressure reduction stations, meters), each of them with technical specifics, and as the network is for its majority installed beneath the ground and spread over a wide regional area, detection in time is a challenge.

This challenge has several dimensions:

- i. To apply the right detection technologies, or to invent further improved technologies
- ii. To select efficient inspection methods, depending on network specifics, city versus rural area or asset class (gas mains, pressure stations, meter devices)

- iii. To work and analyze collected data properly, to make the right conclusions and to feedback those into GasNet's operation

Interested university teams are asked to engage in either of the above areas or in a combination of those.

Detection technologies

- Existing technologies include detection sensors with manual application or by car
 - **CL - catalytic sensor (Pelistor):** works on the principle of catalytic combustion – the gas concentration is measured in accordance with the amount of heat released during a controlled combustion reaction. The reaction is prompted by a suitable temperature and the presence of a catalyst.
 - **Infrared cameras:** A Infrared detector (IR) uses an ability of gases with two or more atoms to absorb infrared (IR) light, e.g. carbon dioxide, methane. Infrared detectors use wavelengths specific corresponding to vibration or rotation of a bond between two atoms in the gas molecule. The higher gas concentration the lower IR signal (approx. logarithmic function).
 - **PID detection applications:** A Photoionization detector (PID) uses an ultraviolet (UV) light source to ionize chemicals to positive and negative ions that can be easily counted with a detector. Ionization occurs when a molecule absorbs the light energy. The gas becomes electrically charged. These charged particles produce a current that is then amplified and displayed on the meter as "ppm" or even "ppb".
 - **Electrochemical sensors:** Electrochemical sensor consists of 2, 3 or 4 electrodes, which are located in a gel electrolyte. A system of electrodes and the electrolyte is separated from the atmosphere by a diffusion barrier. Gas molecules diffuse through this barrier and react with the electrolyte. There are oxidation and reduction reactions at the electrodes and they cause a change of cell potential. The higher the gas concentration is, the higher the potential will be.

Inspection methods

- **Installations of detection equipment on handhelds, at cars, drones, or stationary installations.** Gas Net uses a variety of those and is planning to introduce further developed and innovative solutions.
- **Satellites** can track methane over very wide areas. The dynamic innovation process allows to see not only very large emissions and lack the resolution to identify sources but also to detect a vast number of smaller emissions, with year on year increasing precision. GasNet is willing to test satellite technologies.

Data Management

- Field data from the daily work shall be properly collected and (statistically) analyzed to make the right conclusions and to suggest optimized work approaches in the operations for various asset classes.

Relevant considerations for the challenge / theme:

A selection of the relevant focus area i) to iii) shall be made first, to identify whether the team wants to work on rather technological aspects or rather on statistical data management.

Students are asked to sign a NDA prior to the start of its work.

CHALLENGE 1

Challenge: **The carbon cycle: how to put waste & emissions back in the loop**

Introduction

With climate change problem and slowdown of global warming as main focus globally, innovation is reaching the new highs. Real effects require technical innovation beyond improvements on energy efficiency, operational optimization or incremental yield increase. We can already see energy sector electrifying through developments in renewable power generation and energy storage. The chemical sector is following when it comes to energy sources bringing the heat or power to a production process – the caveat however is replacement of feedstock (oil, gas, coal). Looking for new feedstocks to continue feeding our habits and progress, albeit in a sustainable way, some abundant sources come to mind – waste and polluting emissions. Tapping into waste and emissions as resource can solve both the problem of waste handling and air pollution, and it displaces the use of fossil feedstock. While there are many kinds of waste and emissions, let us zoom into plastic waste (300 MM TPY with less than 9% being recycled today) and CO₂ emissions (31.5 Gt). So, now we know where to find feedstock of chemicals of the future – the question is how will this recycling work, and what it takes to make this transition.

Who is behind this initiative?

Haldor Topsoe is a Denmark-based technology development and catalyst manufacturing company. We are the world leading technology provider for a number of chemicals and energy solutions. Throughout our 80+ years history, we have always been focused on solutions with a strong positive effect on society. From brining food self-sufficiency to the India/Pakistan region to coming up with solutions for energy crisis and clean fuels & air. Today we are on a mission to be the world leader in carbon emission reduction technologies. Our portfolio of new technologies is centered on Power2X and bio and waste utilization, and we see those as solutions the planet needs to stay in shape for the generations to come.

What is the innovation theme:

Waste and emissions as resource

Decarbonization is a term we continuously hear in the context of initiatives moving towards the greener and better world. Yet, the world and the products around us consists of carbon – just like humans. So, while decarbonization is a term very suitable for electrification and switch from carbon to electrons, we cannot phase out carbon but need to recycle/renew it.

The idea is that we can keep (or improve) our life standard while decoupling from fossil resources if we turn to resources such as waste and emissions to be our feedstock. This recycling journey is just beginning, and some questions remain to be answered.

- What sources (waste or emissions) are most likely to be used in the future as carbon-containing feedstock?
- What will the future landscape of petrochemical industry look like if we begin increasingly using waste or emissions as feedstock?
- How will the new infrastructure look (including waste collection or carbon capture, and transportation of both), what volumes can/will be processed?
- Do you see solutions being deployed locally or in a centralized way as today with large steam crackers driving the petrochemical industry?

- How can we bridge the extra costs for some of these new solutions, who should pay?
- How can we include third world countries which suffer from waste problem yet have underdeveloped chemical industry?
- How do you see the economy of scale of new solutions will compete with well-established production of today?
- What can be done by the governments to promote development?

Relevant considerations for the theme:

'Reduce, reuse, recycle' is a common approach to sustainable consumption of products/materials. While necessary, Reduce and Reuse are outside of the scope of this theme.

Plastic is seen as a villain by many but, in reality, it is our unsustainable management of waste that creates the problem. Plastics serves many crucial purposes including food preservation and allows for lighter products design. Discussions on how to phase out plastic are not in the scope of the theme. You can choose to zoom into plastic waste or carbon emissions as resource. Relevant links below are given for inspiration only.

Relevant links:

- [nova-Paper #12: Renewable Carbon – Key to a Sustainable and Future-oriented Chemical and Plastic Industry – Full version | Renewable Carbon Publications \(renewable-carbon.eu\)](#)
- [nova-Paper#11: Hitchhiker's Guide to Carbon Capture Utilisation \(CCU\) – Full version | Renewable Carbon Publications \(renewable-carbon.eu\)](#)
- [Alliance To End Plastic Waste](#)
- [A Circular Solution to Plastic Waste \(bcg.com\)](#)

CHALLENGE 2

Waste Challenge Question: **Waste from the residential heating sector - how to establish circularity in heating system materials**

Introduction

As the demand for renewable energy increases, so does the demand for sustainable heating systems. To meet the climate targets, emissions from the building sector must be reduced by nearly 50% by 2030. Thus, the requirements for heating systems in terms of efficiency and emission levels are becoming increasingly stringent. While it is important to implement sustainable energy generators, a different challenge arises with regard to waste: the recovery, recycling and disposal of radiators, boilers, ventilation and cooling systems. Their recycling becomes more and more important and increases to a new dimension of quantity. Two-thirds of all residential heating systems in the EU are outdated and unnecessarily inefficient. Although this sector seems to become a sleeping giant, there is little circularity in this industry. Manufacturers are obliged to take back old systems, nevertheless, the equipment is generally scrapped. As a manufacturer of heating systems, we want to close our material loops. To do so, we are interested in all kinds of possibilities for further processing. This includes reuse through recycling and upcycling, deconstruction and reprocessing as it is done in other industries, or recovery of valuable materials. But this can also refer to completely new business models or customer services.

Who is behind this initiative?

Heating, cooling, ventilating: Viessmann ensures an optimum climate and develops intelligent and sustainable energy systems and refrigeration solutions – for residential buildings, industry, and

commerce. As a family business in its fourth generation, we think long-term. Our purpose: we create living spaces for generations to come. All 12750 members of the Viessmann family in 74 countries follow this purpose. We see ourselves as a solution provider for the entire living space – inside and outside buildings. A healthy home, an emission-free city, a planet worth living on: at Viessmann, we keep these three levels in mind. We improve the quality of life in indoor spaces by ensuring the supply of hot water and electricity, a good indoor climate, and good air quality. By expanding local heating networks, energy management systems, and innovative solutions in the fields of PropTech – the digitalization of the real estate industry – and electromobility, we help to reduce CO2 emissions in metropolitan areas. With heating systems that protect the environment and resources, and by developing efficient, energy-saving heating and cooling systems, we are making a measurable contribution to the energy revolution.

What is the waste challenge?

The energy transition in the sector of buildings and heating will result in waste challenges for heating systems, boilers, ventilation and cooling systems. Resource-efficient utilization, recycling, dismantling and deprocessing are therefore becoming increasingly important. However, the sector lacks sustainable solutions with circular resource structures. The goal is to see how waste can be seen as an opportunity and part of the solution, not as an additional problem in the energy transition. Therefore, we are looking for your ideas in the following areas:

- How could a holistic solution for recycling heating systems look like?
 - What are the major challenges?
 - How can deconstruction and reprocessing be applied in this sector as it is done e.g. in the car industry? What about reuse of product components?
 - What are infrastructural challenges?
 - What re- or upcycling opportunities do you see in this sector?
 - Which materials could and should originate from secondary raw materials?
- What are potential business models or customer services that could emerge out of it?
 - What are the major benefits of recycling/reusing of heating systems for Viessmann customers?
 - Can you think of any solutions with end-customer focus that already exist today?
 - Could you think of any additional products or services that would enhance the experience?

Relevant considerations for the challenge / theme:

We are looking for solutions and ideas that do not only optimize already existing solutions and processes but that create something new. While Viessmann has a keen interest in technical solutions, we encourage you to keep the end-customer in mind. Therefore, we are looking for solutions that do not only address the technical and infrastructural challenges of circularity in the heating system sector but also make circularity visible and an experience for the customer.

Cradle 2 Cradle is an approach to a continuous and consistent circular economy. "Cradle-to-cradle products" are those that can either be returned to biological cycles as biological nutrients or kept continuously in technical cycles as "technical nutrients". To successfully implement this concept, it is essential to find beneficial solutions for every step in the cycle.

Relevant links:

<http://www.newtechpackaging.com/wp-content/uploads/2017/07/Cradle-to-Cradle.-McDonough-and-Braungart.pdf>

CHALLENGE 3

Challenge Question: **How might Vink Plast close the loop to all their offcuts?**

Vink Plast' challenges concerning our material waste and offcuts. Our goal is to have a closed loop for all our offcuts. We already have for some of our biggest material groups, but we are looking for a possible partner for PETP offcuts.

Company: Vink Plast ApS., Krstrup Engvej 9, DK-8940 Randers SØ.

Business activity: Distribution of semi-finished plastics and machining of finished parts.

Handling of off cuts at Vink Plast:

During the last years Vink Plast has found closed loops for a number of our offcut materials e.g. PMMA, PC and PP. We are working on take-back agreements on POM, PE 1000, PE 500 and PE HD. We have not yet found a loop for the material PETP.

PETP strengths: High mechanical strength, stiffness and hardness.
Very good creep resistance.
Low and constant coefficient of friction.
Excellent wear resistance (comparable to PA (Nylon) grades).
Very good dimensional stability (better than POM).
Excellent stain resistance.
Better resistance to acids than PA and POM.

PETP applications: PETP is mainly used as sliding pads, rings, manifolds, forms, gears, Rollers and a lot other machine components.

Industries: PETP is widely used in food processing equipment, pharmaceutical test equipment and sliding/wear components in wind turbines.

Why haven't we found a closed loop for PETP?:

We have not been successful in finding a closed loop for PETP offcuts. We believe that the reason is that it is a strong material but with a low volume. Designers and constructors often use PA or POM in their designs. Another reason is that it is not a widely used material in injection moulding, where PBTP – a material from the same "family" – is more well known.

What do Vink Plast do with PETP offcuts today?:

We trade the offcuts to "Scrap"/"Recycling" companies who often trade the materials out of Europe.

PETP offcut volume at Vink Plast: 30-35 tons /year.

Challenge for Vink Plast:

Our task is to find a company that will make a construction/application based on PETP raw materials made out of offcuts. Alternatively to find a company who can use raw materials made out of offcuts in their existing products.

Lowest price to be paid to Vink Plast is 100,- €/tons and picked up at our location. We prefer that the company is located in Denmark or alternatively in the south of Sweden or north of Germany.



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