

# CE COSP - Circular Economy and Raw Material Competence for Sustainable Production

## 03 June 2020

KAVA Reference (17065, CE-COSP Circular Economy and Raw Material Competence for Sustainable Production):  
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Please register your interest to participate in this PhD course latest by 15 May 2019 at <a href="http://tiny.cc/CECOSP">http://tiny.cc/CECOSP</a> .....	11

## 1. Introduction

Based on a need for raw material solutions for a European sustainable industry, CE COSP course will train PhD students, as future experts in manufacturing and material science with regards to circular economy. Through CE COSP course, PhD students will develop circular perspective, innovation competence and entrepreneurial mind set focussing on recyclability of raw materials.

The course combines theoretical studies with industry visits and practical problem solving, as well as training on entrepreneurship and innovation. The CE COSP course is based on innovative elements including blended learning and constructivist methods. In CE COSP, PhD students will be given the opportunity to reflect and adjust their research to contribute in the transformation to a more resource efficient and circular utilization of primary and secondary raw materials. Further, via clear integration of entrepreneurial mindset there is an opportunity for contribution of the attendees of green growth in Europe.

Sustainable production among several other aspects, should rely on raw material efficiency, circularity of materials, components and products, clean technologies and cost benefits. In order to achieve positive environmental gains, these aspects have to be considered in a holistic view. In practice this means that the use of raw materials in production downstream has to be managed carefully and relevant knowledge about raw materials need to be spread. The course CE COSP, therefore, provides both theoretical and practical competence about raw materials and circularity.

## 2. Course structure

Workload of the programme: 7.5 credits for the PhD students including

- 2.5 credits for theory
- 1.5 credits for local field trip (**alternatively digitalized company interactions**)
- 3.5 credits for a case study (including preparation, report writing and presentation at the final workshop)

The whole course last for 10 weeks where students are required to put 6 hrs/week to fulfil the requirements for theoretical part. Afterwards, a field trip is taken for a week, that students visit several companies within either of Eastern node (Germany) or Northern node (Sweden). (**Alternatively, digitalized company interactions are taken for a week, that students can listen to extended presentations, have live discussions and Q&A sessions with several different company representatives from both Eastern node (Germany) or Northern node (Sweden)**). Next, within three weeks, students in groups work on their case projects. Eventually, the final virtual workshop will be digitally hold by Tallinn University of Technology; this workshop will be finalized with online presentation of the cases projects by students.

The teaching format includes theory (video lectures), practical application (videos from laboratories and industry) and web-meetings for discussions (once per week). The duration for

video lectures is up to 20 min/video and for virtual classroom for discussions between 60-90 mins). Underneath table represents the content and schedule of this course.

Time plan (2021)	Duration	Content	Communication mode
May, June 2020	> 1 month	Call for PhD students and application period	
Beginning of July 2020		Decision about the accepted students to the course and put students in groups	
<b>Course kick-off</b> Sep 29 <sup>th</sup> , 2020 (week 40)	Half a day	Introduction meeting and kick-off to course. Guiding students through information about the course goals, theoretical studies, online platform (OPAL), virtual classrooms, field trips ( <b>alternatively digitalized company interactions</b> ), case projects, workshop and final presentations, credits, groups etc.	Web meeting, Online video on OPAL
<b>Theoretical Part</b> Sep 28 <sup>th</sup> – Nov 8 <sup>th</sup> , 2020 (weeks 40 – 45)	1 week (6 hrs)	<ul style="list-style-type: none"> <li>• Circular economy</li> <li>- Sustainability</li> <li>- Life Cycle Assessment (LCA)</li> <li>- Materials Efficiency (ME)</li> <li>• Product design</li> </ul>	Online video on OPAL (pre-recorded), Virtual classroom
	1 week (6 hrs)	<ul style="list-style-type: none"> <li>• Part I Ferrous Materials</li> <li>- Raw materials production</li> <li>• Part II Non-Ferrous</li> <li>- Raw materials production</li> <li>• Manufacturing aspects</li> <li>- Processability</li> <li>- Machinability</li> <li>• Quality aspects</li> </ul>	Online video on OPAL (pre-recorded), Virtual classroom
	1 week (6 hrs)	<ul style="list-style-type: none"> <li>• Critical raw materials Availability</li> <li>• Industry 4.0</li> <li>• Compliance, social responsibility and legal aspects</li> </ul>	Online video on OPAL (pre-recorded), Virtual classroom
	1 week (6 hrs)	<ul style="list-style-type: none"> <li>• Entrepreneurship</li> <li>• Business canvas model</li> <li>• Preparation of the field trip and task preparation for the case studies</li> </ul>	Online video on OPAL (pre-recorded), Virtual classroom
<b>Field trips</b> <b>(alternatively digitalized company interactions)</b> Nov 9 <sup>th</sup> - 13 <sup>th</sup> , 2020 (week 46)	1 week (5 full days)	Field trip Eastern node (10-20 students) 9-13 November, 2020	Physical participation ( <b>alternatively, Live online communication</b> )
		Field trip Northern node (10-20 students) 9-13 November, 2020	Physical participation ( <b>alternatively, live online communication</b> )

<b>Group work on case projects</b> Nov 16 <sup>th</sup> – Dec 4 <sup>th</sup> , 2020 (weeks 47, 48, 49)	3 weeks	Working and collaboration on case projects together in your international and interdisciplinary team of 5 PhD students, writing report and prepare the final presentation	Online discussion (Virtual classroom via OPAL)
<b>Final virtual workshop and case project presentations</b> (week 50) Dec 7 <sup>th</sup> – 10 <sup>th</sup> , 2020	2,5 days	Final presentation of the case studies and workshop in Tallinn, Estonia for all students	Live online communication

## 2.1. Theoretical part

The course includes 8 main contents:

- Circular economy
- Product design
- Metallurgy – ferrous
- Metallurgy - nonferrous
- Recyclability
- Compliance, Social responsibility, legal aspects
- Industry 4.0
- Entrepreneurship

Since PhD students will come from different background (construction, material sciences, engineering, economy, among others), the course will be given with modules on different knowledge levels.

Starting from the introduction into the circular economy and product design for circularity, the CE COSP course will provide a sound understanding of the materials value chain. The course will include reachability aspects and the challenges for future materials as well as a sound understanding of the requirements for the development of circular material use including newest European roles of the Circular Economy strategy of European Union and their effects and impact for future production and material science.

## 2.2. Field trip (alternatively Digitalized company interactions)

A one-week field trip to industry is planned for two nodes (Northern or Eastern). The PhD students are divided into two groups where the first group only participates in Northern node while the second group only participates in Eastern node. Both groups will consist of 10 PhD students of different European countries.

Alternatively, a one-week digitalized company interactions with industry is planned for two nodes (Northern or Eastern). The PhD students are able to listen to presentations from several different companies (within different parts of value chain) from both Eastern node and Northern node.

## Northern Node 9<sup>th</sup> -13<sup>th</sup> November 2020 in Sweden:

This field trip in northern node will be taken place in Sweden with 10 PhD students and 5 seniors. The accommodation and travel costs within the scheduled dates are covered by the course. The course also covers lunches and breakfasts within the scheduled dates. However, additional costs should be covered by students which include flight from Estonia or Germany to the starting point in Sweden at Arlanda Airport, hotels on 22<sup>nd</sup> and 27<sup>th</sup> September (if necessary), dinners within the schedule dates and travel back from KTH campus in Stockholm, Sweden to Estonia or Germany. The detailed scheduled plan includes

### Monday 9<sup>th</sup> November 2020

*Start of Field trip - meet in Stockholm (Arlanda airport) at 08:00 on Monday 23 September, 2019*

Flight: Stockholm (Arlanda) – Luleå (north Sweden). Stay in Luleå for 2 nights.

#### Swerim - former Swerea MEFOS (in Luleå):

- Start of Field trip – introduction, details for the week, etc.
- Swerim visit– to make cars/vehicles you need steel, and focus will be on e.g. the processes how steel is made, from iron ore or scrap

### Tuesday 24 September 2019:

#### Boliden Mines – visit to Aitik (outside Gällivare):

- During visit, e.g. overview of the copper mine (open pit mine), and then more focus on the concentrator plant, with mineral flotation processes. The main product from Aitik is the copper concentrate, that is later sent by train to Rönnskär smelter.

### Wednesday 25 September 2019:

#### Boliden Smelters – visit to Rönnskär smelter (outside Skellefteå):

- During visit, e.g. copper smelter processes, primary from copper concentrate and secondary from recycled electronics.
- Flights: Skellefteå - Stockholm (Arlanda) – Ängelholm (south of Sweden). Stay in the Helsingborg area for 2 nights

### Thursday 26 September 2019:

#### Höganäs AB (in Höganäs):

- During visit, e.g. different processes of metal powders, including the "show room" with different applications where metal powders are used (e.g. different parts in cars) and the surface coatings laboratory.

#### Boliden Smelters – short visit to Bergsöe smelter (in Landskrona):

- During visit focus on the recycling process for lead, e.g. from scrapped car batteries.

### Friday 27 September 2019:

Flight: Ängelholm - Stockholm (Arlanda)

#### RISE and the unit Surface, Process and Formulation (on KTH campus in Stockholm):

- RISE visit – focus on surface analysis (e.g. minerals, metals), and surface modification (e.g. to prevent frost formation on heat exchangers).

- End of Field trip – discussions, questions, reflections, etc.

*End of Field trip will be at RISE (KTH campus in Stockholm), latest 17:00 on Friday 27 September 2019*

**Field Trip, northern node**



1. Swerim (Luleå)
2. Boliden Mines – Aitik (Gällivare)
3. Boliden Smelters – Rönnskär (Skellefteå)
4. Höganäs AB (Höganäs)  
Boliden Smelters – Bergsöe (Landskrona)
5. RISE Bioscience and Materials (Stockholm)

## Eastern node: 9<sup>th</sup> -13<sup>th</sup> November 2020 in Germany:

This field trip in Eastern node will take place in Germany with 10 PhD students and 5 seniors. The accommodation and travel costs within the scheduled dates are covered by the course. The course also covers lunches and breakfasts within the scheduled dates. However, additional costs should be covered by students which include flight from Estonia or Sweden to the starting point in Germany at TU Bergakademie Freiberg, hotels on 6<sup>th</sup> and 11<sup>th</sup> October (if necessary), dinners within the schedule dates and flight back from TU Bergakademie Freiberg in Germany to Estonia or Sweden. The detailed scheduled plan includes

### Monday 07 October 2019

*Start of Field trip - meet in TU Bergakademie Freiberg at 08:00 on October 7<sup>th</sup>, 2019  
Bus from Berlin Airport on Sunday, 07 October 2019 is available*

#### BGH Edelstahlwerke Freital GmbH:

- Visit of the integrated plant, where highly alloyed materials are produced. Two rolling mills equipped with state-of-the-art control systems which roll high-speed steel and nickel base alloys to the highest standards.

### Tuesday 08 October 2019

#### Freiberg Network of Recycling and Waste Disposal Companies FIRE e.V.:

- 22 recycling companies are strongly cooperating in the network of FIRE e.V. The visit will give an insight into different recycling technologies of industrial partners using ferrous and nonferrous metallurgy.

### Wednesday 09 October 2019

**Nickelhütte Aue GmbH:**

- The visit will give a deeper understanding about the problems and innovations for the recycling of catalysts, Cu-,Co-, Ni- and Lithium-Ion batteries.

**Volkswagen Sachsen GmbH Zwickau:**

- The visit will follow the complete production process of a car starting with coils of steel up to the final acceptance inspection of a car.

**Thursday 10 October 2019**

**Arcelor Mittal Eisenhüttenstadt GmbH:**

- The visit will give an overview about the whole metallurgical process from ore to steel. It focusses on different types of steel for the car production as well as Zn-Fe-alloys including sustainability aspects.

**Friday 11 October 2019**

**Helmholtz Institute Freiberg for Resource Technology:**

- The visit will focus on flotation practices for processing, leaching and solvent extraction for metallurgy and recycling.

**TU Bergakademie Freiberg / Institute for Iron and Steel Technology**

- Visit of VIGA atomization unit & VIM vacuum induction furnace
- End of Field trip – discussions, questions, reflections, etc.

*End of Field trip will be at TU Bergakademie Freiberg latest 17:00 on Friday 11 October 2019  
Bus to Berlin Airport is available.*

## 2.3. Final workshop and presentations

The final workshop and presentation of case studies will be taken place live on an online platform, hosted by Tallinn University of Technology between 7th and 10th December 2020. The agenda include:

**Monday 7<sup>th</sup> December 2020**

- Entrepreneurship programs at Estonia and in EIT level
- STARTERtech Lecture

**Tuesday 8<sup>th</sup> December 2020**

- Inspirational speech at 09:00 by Cleantech Cluster from Tehnopol
- What to have in Pitch deck
- How to be good entrepreneur
- Funding opportunities for your Idea/Solution
- Video pitch recording

**Wednesday 9<sup>th</sup> December 2020**



- Final workshop at 09:00 – Pitching the solutions
- Competition
- Reflection
- End at 14.00

## 2.4. Online cooperation of groups on case projects

Interdisciplinary groups of 5 PhD students from different universities and countries will be working together on case projects. The groups define their own case projects, which must include background from all 8 course content areas. The case projects be innovations from a challenge or even a business idea (start-up) but must be relevant for needs and challenges defined by companies. Case projects can include the following materials (selection of the materials depends on the interests of the PhD students):

- New composites
- Ni
- Zn
- Cu
- Co
- Li
- Pb
- Low and high alloyed steel
- CRM
- Precious metals (Au, Ag, Pt, Pd, Rh etc.

In case of start-up case project, it should be directed towards start-ups for EIT - European Institute of Innovation and Technology.

For the case projects, we emphasize on peer to peer learning, which facilitates cooperate and interact between students. This will happen through our online platform (OPAL) where students have the opportunity to discuss ideas, share files and work together.

## 2.5. Final presentation and entrepreneurial training

PhD students groups handover their reports a week before the final presentation at Taltech, Estonia. They also present their case projects in powerpoints in front of industry. The certificate of participation in the CE COSP course will also be distributed.

### 3. Learning outcomes

CE COSP Learning Outcomes	Description
Technical skills and competencies	A sound understanding of the value chain of critical materials including the challenges for future materials safety. A sound understanding of the requirements for the development of circular material use including newest European roles of the Circular Economy strategy of European Union and their effects and impact for future car production and material science
Making value judgements and sustainability competencies	The ability to identify short- and long-term future consequences of plans and decisions from an integrated scientific, ethical and intergenerational perspective and to merge this into their professional activities, moving towards a sustainable society
Entrepreneurship skills and competencies	The ability to translate innovations into feasible business solutions and to lead and support others in this process
Creativity skills and competencies	The ability to think beyond boundaries and systematically explore and generate new ideas and to inspire and support others in this process and contribute to the further development of those ideas
Innovation skills and competencies	The ability to apply their research experiences combined with the knowledge, ideas, and technology of others to create, test and implement new or significantly improved products, services, processes, policies or new business models by developing a project in group work
Intellectual transforming skills and competencies	The ability to autonomously and systematically transform practical experiences into research problems and challenges and to lead and support others in this process
Leadership skills and competencies	The ability of decision-making and leadership based on a holistic understanding of the contributions of Higher Education, research and business to value creation
Crossdisciplinarity thinking	The ability to think beyond the own disciplinary boundaries and implement perspectives of different scientific fields into the own methodological thinking

### 4. E-learning Platform

The course will be hosted on the E-learning Platform OPAL. Participants can get free access. The platform allows to implement videos, virtual classroom, forum, wiki, tests and quizzes. The login information and structure will be provided.

Please register your interest to participate in this PhD course  
latest by 30<sup>th</sup> April 2020 at <http://tiny.cc/CECOSP>