Towards a low-carbon and resource-efficient circular economy in the Arctic: Case example of industrial circular economy flows in Kemi Arctic region
Circular Economy – Industrial perspective
The product should be used for as long as possible, it must be serviced and repaired and parts changed when necessary.

Consumer
Consumer demand creates a supply of sustainable products and commodities.

From company to company
Companies will procure and require their subcontractors to provide parts that can be easily repaired – instead of single-use parts.

Retail
Retailers will sell services instead of goods and inform customers about maintenance and repair services, environmental impacts, materials and further use in the final phase of the life cycle.

Distribution
Transport co-ordinated between different sectors, renewable fuels and jointly owned transport equipment will be used in distribution.

Manufacturing industry
Long-term products that can be repaired and maintained will be brought onto the market. Materials will be separated at the end of the product’s life cycle.

Primary sector (raw materials sector)
The raw materials are capital for the primary sector. Sustainable solutions are based on the wise use of raw materials.

Material processing
Process planning will reduce the energy needed to refine huge amounts of raw materials. The use of side streams will be taken into consideration.
Circular Economy

- Decoupling: Products, materials and their value remain in circulation
- Market based, direction through structures and incentives
- Biological & technical cycles
- Renewable energy & materials (resource efficiency)
- Access over ownership
- Cross-sectoral and across value chains
- Product design: life cycle, adaptability & high quality

Sources: Ellen MacArthur Foundation, Sitra
Digipolis - Kemi Technology Park: Development company and cluster organisation

- **Digipolis Kemi**, established in 1993
- Owned by the cities of Kemi & Tornio,
  - the University of Oulu and municipalities of Simo, Keminmaa and Tervola
- 50 companies, 500 employees in the technology park – network of more than 160
- industrial service businesses in Lapland, more elsewhere
- Development actions and services:
  - Team of 14 persons + service providers
  - Innovative environment especially for industrial service businesses

**New openings:**
- 2008-2016 Expertise on Arctic conditions & Industry,
  - novel wood constructions: CLT development platform
- 2012- Ecosystem of the Arctic Industry - Innovation Platform
- 2014- Arctic Industry and Circular Economy Cluster management
- 2016- Digipolis chosen as key actor in national circular economy
  - roadmap and implementation of the key project activities
- 2017- Establishment of Centre for industrial circular economy

- Start-Up, Business Incubation, Business Growth, Invest In services
- 21 ongoing development projects, 584 companies and organisations
LAPLAND WAS ELECTED one of the model areas for cluster development in Europe last year, along with five other European top areas.

THE ELECTED AREAS have the task of developing a new European cluster model which utilises the existing natural strengths of the participants in the areas extensively.

Lapland's strengths include:
A. Stable society
B. Great infrastructure
C. Management of Arctic conditions
D. Diverse natural resources

SUSTAINABLE NATURAL RESOURCES processing cluster work is continued in Lapland with the Arctic Business Concept (ABC) project. Especially, the development of the competitiveness, sustainable growth and internationalisation of small and medium-sized companies is supported in this cross-disciplinary cluster.
Modern Cluster of Arctic industry – Sustainable utilisation of the arctic natural resources

Model region to demonstrate EC new wave cluster policy:

• The region possesses the vast deposits of natural resources and pristine nature

• Lapland has potential to become one of the leading regions in the world in the sustainable exploitation of natural resources

• The region should focus on refining of Arctic natural resources in a socially and ecologically sustainable manner, combined with high value added generation from natural resources in the region

• Focus on to maintain the balance in the sustainable development
Modern Cluster of Arctic industry – Sustainable utilisation of the arctic natural resources

- The strong focus on circular economy and to accumulate the development of the emerging industries.
- Will be a mix of large-, medium-, and small scale industries and other actors, platforms and living lab arrangements with real-life pilot experiments.
- The clustering concept will also utilise efficiently the international and global pipelines and will be a tool for the SMEs in Lapland to improve their performance.
- Eco-innovative, resource efficient and competitive solutions with high extent of value addition to increase cross-sectoral activities in Arctic industries.
ECOSYSTEM OF ARCTIC INDUSTRY
Kemi-Tornio’s circular economy innovation platform

- Worlds northernmost hub of bio-, mining-, metal industry and services
- 1.7 Mt of by-products and residues (excluding waste rock)
- Responsible for 80% of Lapland’s industrial production, with over 5 billion EUR of exports annually (7-8% of the total export value of Finland)
- Industrial symbiosis estimated at 700 million EUR annually
MAIN INDUSTRY SITES IN KEMI-TORNIO REGION

Metsä Board and Metsä Fibre Kemi mills
- World’s northernmost linerboard production site
- World’s northernmost pulp mill

Outokumpu Chrome Kemi mine
- Europe’s only chromium mine

Outokumpu Tornio stainless steel mill and ferrochrome smelter
- Outokumpu’s site in Tornio is the most integrated stainless steel mill in the world
- Europe’s biggest user of recycled steel

Stora Enso Veitsiluoto Mill in Kemi
- World’s 2nd northernmost pulp mill
- World’s northernmost paper producer with three paper machines
- Oldest sawmill in production in Northern Finland

Manga LNG liquid natural gas terminal in Tornio 2018
FURTHERING THE CIRCULAR ECONOMY AND BIOECONOMY IN LAPLAND IN 2012–2016

Where did it all begin?
11/2012
The key players of Komi–Tornio industries and industrial services were interviewed in the side-stream evaluation of needs.

Lapland EU’s model region
7/2014
European Commission’s selection: Lapland EU’s model region in sustainable processing of natural resources

The FISS model
10/2014
FISS workshops, Finland benchmarking, business potential

Industry byproducts utilised
21 September 2016
Work carried out by the Kemi–Tornio region & Lapland and Digipolis and partners: Key project of Sitra’s Finnish circular economy action plan

Prioritisation of development tasks
4/2013
Prioritisation of development tasks with key players of industries and industrial services

Development of operations
2014
Side-stream recognition tool development together with industries across sectoral boundaries. Development of measures furthering the systematic process and taking the matter forward

Expansion of operations
2015-2016
Entire Lapland’s big industries involved in development. Synergies between mines and the processing industry, and entry of new service businesses. Expanding the process to northern Finland, northern Sweden and northern Norway.

Recognition for work
2017
Implementation of Sitra’s action plan

27 side-stream recognition. total volume:
1.4 million tonnes annually. = Over 100 trucks daily
<table>
<thead>
<tr>
<th>Stream</th>
<th>Quantity t/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferro-Chrome Slag</td>
<td>650000</td>
</tr>
<tr>
<td>Steel Slag</td>
<td>400000</td>
</tr>
<tr>
<td>Lumpy rock</td>
<td>220000</td>
</tr>
<tr>
<td>Sawmill by-products</td>
<td>170000</td>
</tr>
<tr>
<td>Calcite + Filter Dust</td>
<td>60000</td>
</tr>
<tr>
<td>Burnt Lime/Slaked Lime</td>
<td>30000</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>22000</td>
</tr>
<tr>
<td>Fiber Clay</td>
<td>20000</td>
</tr>
<tr>
<td>Water Purification Precipitate (Steel)</td>
<td>20000</td>
</tr>
<tr>
<td>Dolomite- Bricks</td>
<td>20000</td>
</tr>
<tr>
<td>Clacite</td>
<td>15000</td>
</tr>
<tr>
<td>Biosludge</td>
<td>12000</td>
</tr>
<tr>
<td>Ferro-Chrome Underflow</td>
<td>10000</td>
</tr>
<tr>
<td>Debarking Waste</td>
<td>9000</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>7000</td>
</tr>
<tr>
<td>Green Liquor Dregs</td>
<td>6300</td>
</tr>
<tr>
<td>Filter Dust (Lime)</td>
<td>5000</td>
</tr>
<tr>
<td>Green Liquor Dregs</td>
<td>5000</td>
</tr>
<tr>
<td>Bottom Ash</td>
<td>4000</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>3000</td>
</tr>
<tr>
<td>Knot Reject</td>
<td>2500</td>
</tr>
<tr>
<td>Bottom Ash</td>
<td>2400</td>
</tr>
<tr>
<td>Burnt Lime</td>
<td>2000</td>
</tr>
<tr>
<td>MgO-C Bricks</td>
<td>2000</td>
</tr>
<tr>
<td>Bottom Ash</td>
<td>1500</td>
</tr>
</tbody>
</table>

**Identification**

**Characterisation**

**Recognition**

**Classification**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples of utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting materials</td>
<td>Agriculture and road construction, concrete aggregate, mining areas</td>
</tr>
<tr>
<td>Bases</td>
<td>pH control, liming and soil amendments</td>
</tr>
<tr>
<td>Organic matter</td>
<td>Landscaping, combustion</td>
</tr>
<tr>
<td>Ashes</td>
<td>Agriculture and road construction, soil amendments, mine filling</td>
</tr>
<tr>
<td>Packing materials</td>
<td>Sealing layers of landfill sites</td>
</tr>
<tr>
<td>Symbiotic products</td>
<td>Multiple uses</td>
</tr>
</tbody>
</table>
From waste into profitable business
Finland has great potential to utilise industrial side streams (84 million t/a), which are currently classified as waste.

96% of waste is non-household generated.

VISION
Lapland world’s leading arctic bio- and circular economy region

Business potential

The current value of Lapland’s industrial symbiosis and the potential of the bio- and circular economy

CE-approved recycled materials from industrial side streams:
The annual use of ferrochromium slag in road construction (400,000 tonnes) saves 800,000 tonnes of virgin gravel and rock aggregate and reduces road construction carbon dioxide emissions by 200,000 tonnes.

Source: Outokumpu plant in Tornio

Industry byproducts utilised
Annually the Kemi–Tornio industries produce 1.7 million tonnes of industrial byproducts.
Utilisation categories include neutralisation, circulation of nutrients, excavation, landscaping, soil enrichment, building products, water treatment.

THE FUTURE OF THE CIRCULAR AND BIOECONOMY IN LAPLAND

4,000
The Kemi–Tornio industries currently employ 4,000 people in the region. With future investments in the bio- and circular economy (such as Boreal Bioref, Kaidi), the employment effects in northern Finland are estimated at 2,000 persons.
Utilisation of the arctic natural resources – Lapland's Arctic Industry

- Arctic Spring, Investment boom in Arctic regions
- Industrial- and mining service companies receive orders worth of hundreds of millions.
- International-industry standards, HSEQ
- Cleantech – growing need of sustainable solutions
- Enhancing Circular Economy
- Internationalization in home market, glocalization
- Internationalization in the surrounding countries
- Own products and services
Arctic Industry & Circular Economy Cluster

Sustainable exploitation of arctic natural resources
Arctic Industries: Story of Natural Resources Refining

- Global Markets
- Good Connections
- Arctic Solutions
- Cleantech Solutions
- 5 Bio Refineries
- 32 Sawmills
- 16 Mines
- 5 Metal Refineries
- 2 Aluminium Smelters
- 1 LNG Refinery
- 2 Chemical Plants
The Kemi-Tornio region in northern Finland has established an Arctic industry and circular economy cluster to enhance industrial symbiosis and strengthen the development of a holistic bioeconomy in the region. Via extensive analysis of the by-products and residue streams from companies in the region, value-added products are now being produced by combining and rethinking several by-product and residue streams. Examples include silvicultural thinning practices, bioenergy from forest residues with the possibility for future for largescale biofuel production, as well as two plants that enable recovery of metals from slags from the steel and ferrochrome production in the region.
**Opportunities and plans**

**Potential utilisation sites in Northern Finland area**
- Infrastructure Projects (incl. landfills and recovery sites)
- Mining Projects
- Other industrial projects
- Other projects

**Mine projects in Northern Finland**
- The cooperation has started with mines that are different stages of the life cycle
- Applications examples: construction, landfills, mine fillings, neutralization etc.

**Investment potential and job creation in Kemi-Tornio and Lapland**
- 500 000 000 € in 16 different IS investment projects
- 400 new employees
- Kaidi (in Kemi) and Boreal Bioref (in Kemijärvi) biorefineries are CE and IS cases, total Investments 1,68 billion €
- 1300 new employees in potentially circular value chains - ecosystems

**Plans**
- Making pilots, scale-ups and investments to happen, process of cluster funding
- Tighter cooperation and benchmarking through Scandic & European networks
- More resources through strategic alliance with Lapland UAS and growing capacity
- Modern cluster approach and cooperation
- Efficient development/funding tools
- Establishment of Centre for industrial circular economy
- Lapland UAS: CE curricula starts on 2018

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**Technical loops**

Competitive advantage from the decreased use of virgin raw materials and long lifecycle of materials and products.

**Key projects:**
- The Arctic industries ecosystem and Kemi-Tornio circular economy innovation platform. (Digipolis Oy)
- Circular economy demo plant for waste electrical and electronic equipment. (Technology Industries of Finland)
Finland becomes a world leader in the circular economy by 2025

**Roadmap’s ambition:**

- **Increased exports** and **growth** for companies from scalable and comprehensive circular economy solutions.
- Functional **domestic market**.
- Circular economy into the mainstream through **actions** and **concrete pilots**.

**Economy, environment & society:**

- Circular economy as a new cornerstone for the Finnish economy.
- Finland as a model country for the challenge of scarcity.
- From adapter to pioneer.
Digipolis key actor in Finland’s Circular Economy roadmap

Competitive advantage from the decreased use of virgin raw materials and long lifecycle of materials and products.

Key projects:
• The Arctic industries ecosystem and Kemi-Tornio circular economy innovation platform. *(Digipolis Oy)*
• Circular economy demo plant for waste electrical and electronic equipment. *(Technology Industries of Finland)*
Circular economy can be boosted through long-term systemic changes, quick experiments, scalable solutions, and stimulation of demand. Cooperation with European Climate Foundation – CE as a means for mitigating climate change. WCEF 2017 – World’s first global CE forum. A list of the most interesting companies in the CE in Finland. CE demonstration plant for recycling valuable metals of waste electrical and electronic equipment. Finnish industrial CE Centre in Kemi. Policy actions for creating functional domestic market. CE in public procurement. A list of the most interesting CE actions in municipalities. Large and small projects, and sharing best practices. CE to become a part of education and future decision-making: CE in study programs of schools and universities. Regional sustainable food system. Financing for revolutionizing transport in regions.
Finnish industrial circular economy centre - established in Kemi in 2017

In partnership with the Finnish Innovation Fund Sitra, City of Kemi, Digipolis – Kemi Technology Park and Lapland University of Applied Sciences

First industrial circular economy centre in Finland with national level mandate

Network of industry & university experts and intermediaries

International network including e.g. Nordic and Chinese cooperation partners

National level goals: competence building in industrial circular economy, spreading the operating models of the Kemi industrial circular economy in Finland

Regional/local level goals: new investments and jobs, contribution to sustainable and resource efficient industry modernization, cooperation culture
Kemi CE Centre Advisory Board

1. Martti Sassi, Senior Vice President – Head of Operations, Outokumpu Tornio Works
2. Juha Mäkimattila, Mill Director, Stora Enso Veitsiluoto Mill
3. Kari Ala-Kaila, Vice President – Technology, Metsä Fibre
4. Mikko Korteniemi, General Manager, Agnico Eagle Finland Kittilä Mine
5. Jukka Jokela, General Manager/Project Manager, Anglo American - Finland AA Sakatti Mining
6. Jari Hietala, National Division Leader, Eurofins Environment Testing
7. Juha Koskinen, R&D Manager, Tapojärvi Oy/ Hannukainen Mining Oy
8. Tuula Sivonen, Regional Manager, The Federation of Finnish Technology Industries
9. Kimmo Heikka, Managing Director, Kemin Digipolis Oy
11. Eija Virtasalo, Head of Financial Unit, Centre for Economic Development, Transport and the Environment
12. Eira Luokkanen, Head of Unit – Environmental Protection, Centre for Economic Development, Transport and the Environment
13. Jyri Seppälä, Director – Centre for Sustainable Consumption and Production, Finnish Environment Institute (SYKE)
14. Eero Yrjö-Koskinen, Secretary General, Finnish Network for Sustainable Mining and Director, Green Budget Europe
15. Riikka Aaltonen, Senior Adviser – Mineral Policy, Enterprise and Innovation Department, Ministry of Economic Affairs and Employment
16. Kari Herlevi, Project Manager – Circular Economy, Sitra
17. Nani Pajunen, Leading Specialist – Circular Economy, Sitra
18. Olli Dahl, Professor, Aalto University, Clean technologies research group
19. Riitta Rissanen, Managing Director, Lapland University of Applied Sciences
20. Tero Nissinen, Chair, Mayor, City of Kemi
Our business is based on circular economy

We are the world leader in sustainable steel production

Energy intensity\(^1\):

- 2013: 11.3
- 2014: 11.1
- 2015: 10.5
- 2016: 9.8
- 2017: 9.3

CO\(_2\) emissions intensity\(^2\), \(-31\%\):

- 2013: 0.51
- 2014: 0.42
- 2015: 0.39
- 2016: 0.31
- 2017: 0.32

Recycled content, %:

- 2013: 85
- 2014: 84
- 2015: 87
- 2016: 87
- 2017: 87

* Q1/18–Q3/18
1. GJ per tonnes crude steel
2. Direct and indirect, tonnes per tonne steel
Stainless steel 100% recyclable!

85% Recycled content

Sustainable Processes
Sustainability is key to Outokumpu’s long-term prosperity and growth. We develop our operations every day, step by step. This takes us closer to our target – a sustainable society.

Recycled steel use annually over 2,000,000 tonnes

Sustainable Stainless Steel
Outokumpu’s stainless steel enables efficient solutions benefiting both customer and society as a whole. Stainless steel’s superior life cycle properties give customer advantages in sustainability. Steel is the most recycled material in the world.

Our aim is to make steel with zero waste

The global growth rate (CAGR) is 5%

Building and construction (ABC), 50+ years
Transportation, <23 years
Food and drink, kitchenware, <23 years

85% Recycled content

End of stainless steel
Maintenance free, durable, fully recyclable

Recycling and delivery

Metal industry and machinery, ~48 years
White goods and other appliances, ~45 years

85% Recycled content

Conception, casting, recycling, cold forming

Melted stainless steel
Arctic steel industry

Use

The product should be used as long as possible, repaired and replaced when necessary. At the end of its lifetime, the parts or materials of the product can be recycled in another production life cycle.

Consumer

Each cycle of consumption other than their direct economic value, contributes significantly to maintaining the till their economic welfare, consumption of materials in the country and the environmental impact from recycling the products and materials is gained towards a sustainable future.

Business to business

Steel is a versatile and recyclable material that can be used in producing building products to buildings. Companies can benefit from recycling and using recycled materials to produce products that are environmentally friendly and ensure all stages of the process provide high-quality recycled materials and long-lasting products which can be recycled.

Retail

In addition to basic, the steel may often have additional properties, such as weathering and rust resistance.

Distribution

The recycled products are delivered to retailers and assembled.

Primary production

Outokumpu’s stainless steel cold rolling plant at the Kemi site which is the only stainless steel cold rolling plant in the EU. At the Ternio Alumina plant, electric conductivity is used to produce alumina in a dry material for steel-making. The by-product alumina is used for making brick materials of the steel.

In the Kemi area

A biogas is used, in the steel-making process, to produce electricity and heat. The green steel is delivered to the market where it is used in an electric arc furnace.

Recycling plant

The share of recycled material in Outokumpu's stainless steel is nearly 30 percent. The company's recycled material is bought from the raw materials are reused. The steel is melted in an electric arc furnace.

By-products from process used

Ferromanganese is used as a by-product at the Outokumpu Ternio site. The material is in the steel is used for the raw material. The material is also used to produce ferrous metal.

Material processing

Outokumpu produces stainless steel in Ternio. The most important step in production where stainless steel is melted in a process called ferromanganese. The material is used in the raw material of stainless steel.

Manufacturing industry

Siting the internal gases or emissions present in order to ensure that, the stainless steel, its physical properties, both surface and appearance are exactly what is needed in the final product. The type of the product determines the point of manufacturing. The steel is then manufactured in a manufacturing plant where the material in the form of a material determines how the material can be processed at the end of its cycle. The product design phase also affects the product's availability, durability, and serviceability.

Tapojärvi starts slag handling and metal recovery at Acciai Speciali Terni steel mill that belongs to ThyssenKrupp, a German giant listed company. The contract was signed in Terni, Italy on 4th of December 2018.

According to the contract Tapojärvi Italia s.r.l. will build a slag handling facility and thereafter starts to produce and develop slag-based products for the market. The contract consists of two year period of building the facility and ten years of operating time with additional option for another ten years of operations.

The goal of the contract is to bring Terni to the forefront of managing industrial byproducts.

Tapojärvi is a company specialized in mining services, industrial processes and material handling. The company has two unique metal recovery plants in Finland, where ferrochromium and stainless steel slags are produced into CE-marked byproducts.
EUROPE’S FIRST INTELLIGENT BICYCLE AND WALK PATH USING INDUSTRIAL RESIDUES

REAL TIME FROST MEASUREMENT & OTHER INTELLIGENT TRANSPORT SYSTEM APPLICATIONS

CIRCULAR ECONOMY INDUSTRIAL CLUSTER INNOVATION PILOT:
CAIM - Circular Arctic Infrastructure Materials
1.1 – 31.12.2017
The Arctic Industries ecosystem and Kemi-Tornio circular economy – Bringing best learnings forward

4 years of systematic development has lead to a full-scale industrial symbiosis and circular economy between various industry sectors in Northern Finland.

Now the key is to take the learnings and systematically bring the know-how to other industrial parks and facilities.

How to make it happen?
- Bring together cross-sectoral experts and project managers
- Create operational models on symbiosis
- Invite other clusters to open workshops to make sure the best techniques are put into practice
- Facilitate discussion between private and public entities to tackle administrative bottlenecks

A cluster optimizing resource and side-stream usage between different industry sectors: metal producers, pulp and paper mills, power plants and chemical industry

1.7 million tonnes of industrial by-products annually

8% of Finland’s exports

Next up! Transform 14 potential cases in the region into circular economy parks
THE DESCRIPTION OF OPERATIONAL MODEL
For Industrial Circular Economy

Priority in the needs and possibilities of the participating companies

Benchmarking & networking

Building and earning of trust

Identification of the needs of companies considering industrial symbiosis activities

Ownership

Funding

Communication

Toolbox of Industrial Symbiosis

Concrete start-up activities

Gathering of stakeholder network
Nordic Industrial Symbiosis Network

- A forum/club to promote joint Nordic initiatives in the field of Industrial Symbiosis
- Creating a Nordic network of Industrial Symbiosis actors
- Core partners at the start-up phase: Kalundborg (DK), Kemi-Tornio (FI), University of Linköping (SE), EYDE Cluster (NO). Nordregio, and Nordic Council of Ministers actively promoting the starting phase
- Introduction at the World Circular Economy Forum, Helsinki in 2017
- Not a closed club; new partners invited to join the network. New partners 2017-2018 include Paper Province, Värmland (SE) and ECO3, Nokia/Tampere (FI)
LAPLAND UNIVERSITY OF APPLIED SCIENCES
Advancing expertise of circular economy education in Finnish UAS’s

- Co-operation of 19 UAS’s in Finland
  o Coordinated by Lapland UAS
- 235 credits of circular economy related education
  o 50% of courses will be provided in English
  o Internationalisation and export of expertise
- Themes
  o Technology, Bio-based materials, General trends, Digitalisation, Effectiveness and regulation, Design, Business, Civil engineering
- Funded by Finland’s Ministry of Education and Culture
China Association of Circular Economy (CACE)

China Association of Circular Economy (CACE), a national cross-region and multi-sector organization, was founded in 2013. As a leading organization in enabling and promoting the circular economy in China, CACE is administrated by the State-owned Assets Supervision and Administration Commission of the State Council (SASAC), and accepts guidance from the National Development and Reform Commission (NDRC).

CACE has nearly 700 members nationwide while the secretariat of CACE has about 50 employees. The members of CACE cover all circular economy areas, including industrial circular economy, agricultural circular economy, waste reuse and recycling, and garbage utilization, etc. CACE was formerly named China Association of Resource Comprehensive Utilization from 1995 to 2013.
OUR STORY

CACE has been attending World Circular Economy Forum both in year 2017 and 2018. City of Kemi and Kemin Digipolis Oy had their first meeting with CACE in June 2017 in Helsinki during the 2017 forum. This meeting has been proved to be a significant start for a fruitful international cooperation between us.

After the June meeting, we realized that we share a lot in common in promotion circular economy both nationally and internationally, ever since, we have been working together to figure out how to make full use of the resources we both have to benefit not only China and Finland, but also other countries and regions.

CACE is under the guidance of China National Development and Reform Commission (NDRC), also directly in contact with the Department of Resources Conservation and Environmental Protection, Centre for Circular Economy in Kemi is under the guidance of Finnish Parliament and Finnish Innovation Fund SITRA, both can play the role of coordinators for promoting international cooperation in circular economy more actively and efficiently.
In November 2017, a delegation composed of Mayor of Kemi, CEO of Kemin Digipolis Oy, Director of Kemin Digipolis Oy, Principal of Lapland University of Applied Sciences visited CACE, to have a further discussion on the possible cooperation in innovative cleantech, circular economy education and pilot project in China, etc. A Memorandum of Understanding (MOU) among City of Kemi, Kemin Digipolis Oy and CACE was made after this meeting.

CACE is one of the leading players in active promotion of circular economy in China. It has organized delegations of Chinese companies and organizations in the field of circular economy to WCEF both in Helsinki and Yokohama. As an execution part of the MOU, in March 2019, CACE will bring a delegation of 10 Chinese companies to Kemi 150 celebration and The 2nd International Bio- and Circular Economy Forum held in Kemi to enhance the international cooperation between SMEs, universities and organizations in China and Finland.

With our combined forces, we expect that our expertise in development of circular economy on both sides can be utilized more efficiently and generate more sustainable solutions in tackling climate change matters.
DONGHUA UNIVERSITY, SHANGHAI

A public research university in Shanghai, China. Established in 1951, Donghua University is one of the state-key universities directly under the Ministry of Education of China and is a member of China’s Project 211 group of national universities. It is a Chinese Ministry of Education Double First Class Discipline University, and is especially well known for its engineering, management, design and materials disciplines.

Lapland University of Applied Sciences and Donghua University signed an Agreement of Cooperation in the beginning of 2018.

A delegation from Donghua University is planning on visiting Lapland University of Applied Sciences in May 2019.

Exchange programmes

• Students
• Staff
• Visiting lecturers
• RDI in resource efficiency
Sustainability Assessment Tool (SAT)

✓ Sustainability of the mills means assessment of environmental, economical and social issues with legal aspects using proper metrics. It also covers Regional Economic Dimension (RED)

✓ The purpose was to develop a “simple” tool for evaluation the sustainability of process industry

Challenges of industrial circular economy - process

Challenges of industrial circular economy - process was initiated in 6/2018 by the Advisory board of the Circular and Bioeconomy Centre, because the need for a common process was identified by industry and authority stakeholders.

- In the first phase of the process, challenges in developing circular economy were identified across lines of business – as a cross-sectoral approach
- In continuation, the second phase of the process will be launched with the broad-based Status Description - workshop crossing ministry and organisation lines
- A key goal is to develop the operating environment in Finland with the ultimate goal of joint EU-level influence in order to develop the circular economy operating environment
Challenges in by-product business

- Customers: 1. Competing natural materials, 2. Delivery time
- Authorities: No common understanding or definitions in the EU despite of the same EU regulation and "EC Decision-tree"
- Examples from the same kind of Outokumpu slag:
  - **UK**: popular "Green labelled End-of-Waste product" and authorities are recommending to prioritize in public road construction projects
  - **FIN**: by-product and construction material under the EU Construction Product Directive and REACH regulation
  - **SWE**: always waste, time consuming permits needed for the use => no real commercial possibilities
Summary of Challenges

• Long-term systematic work: challenge for all utilisation applications is development of the operating culture
• Promoting the use in smaller projects
  • Data bank for SMEs, at local level
• Potential users are not aware of the potential of industrial by-products and residues – measuring and communication
• Producers are not aware of the potential utilisation sites
• In large projects utilisation of by-products and residues should be taken into account at the design stage
• The operational model: from the need / from the supply → lab tests → real life pilots → scaling to sustainable solution through eco-innovative business models with process owner
• Business model – creating and sharing win-win – commercialization – shared responsibilities (productization)

Establishing common systematic operational culture is needed → Activation and cooperation of authorities, municipalities, industry, industrial services etc.
Case examples

Summary of Challenges

- Long-term systematic worked challenge for all utilization applications is development of the operating culture
  - Promoting the use in smaller projects
  - Data bank for SMEs, at local level
- Potential users are not aware of the potential of industrial by-products and residues – measuring and communication
- Producers are not aware of the potential utilization sites
  - In large projects utilization of by-products and residues should be taken into account at the design stage
- The operational model, from the need from the supply to lab tests to real life pilots to scaling up sustainable solution through eco-innovative business models with process owner
- Business model – creating and sharing win-win – commercialization – shared responsibilities (productivities)
- Establishing common systematic operation culture is needed – Activation and cooperation of authorities, municipalities, industry, industrial services etc.

Biofuel refinery project in Kemi
Thank You!

Interested in to do co-operation?
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