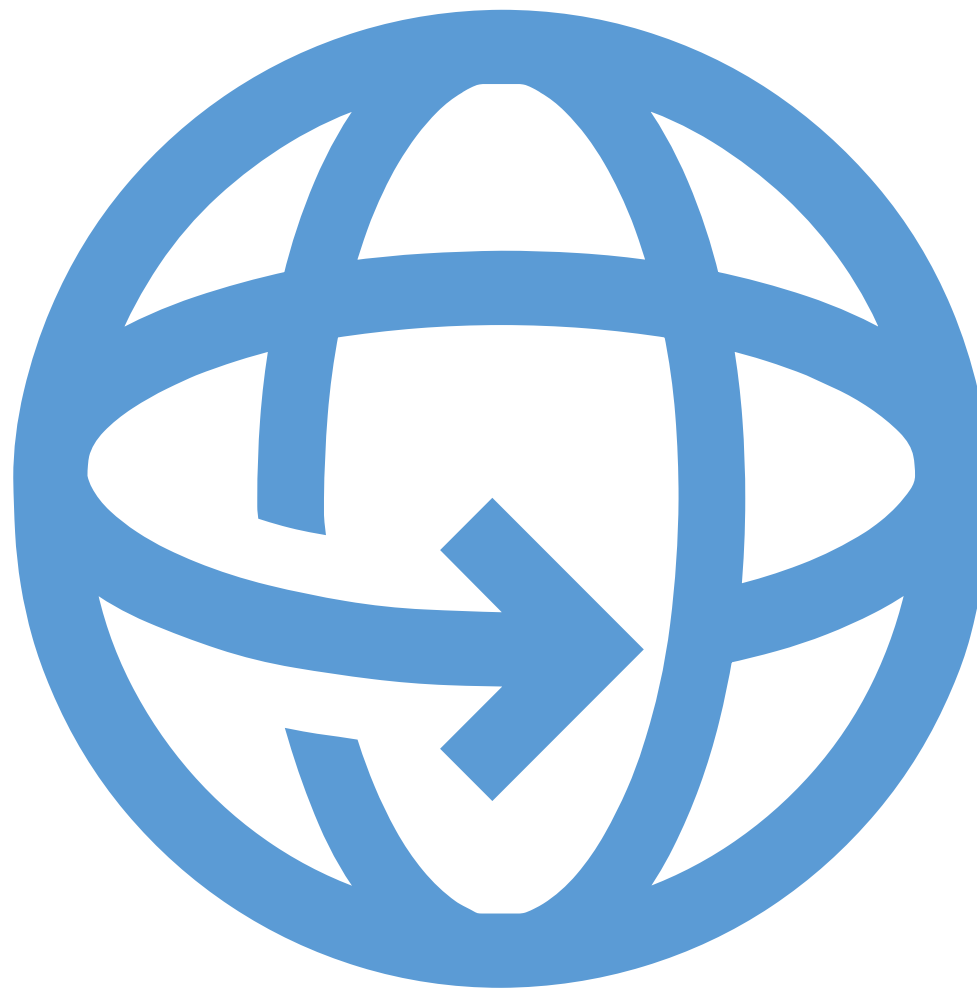




# **Towards the Circular Economy – experiences of CICAT2025 project**

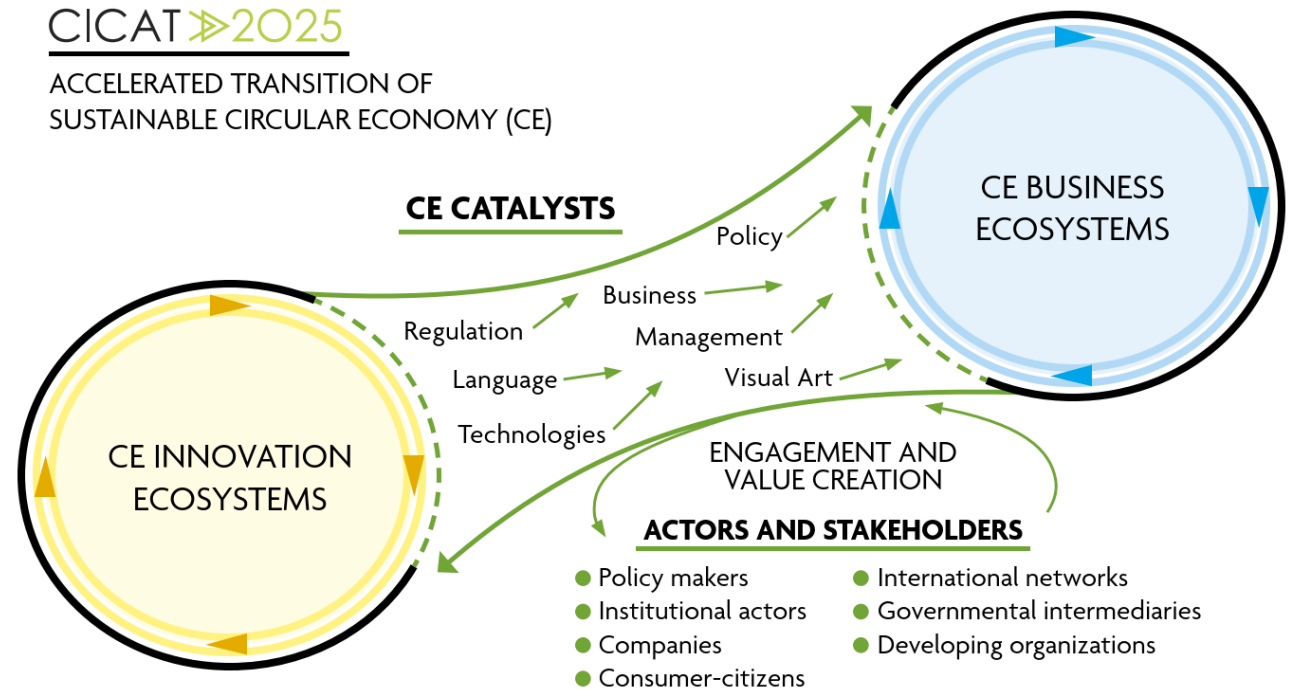
**Researcher Johanna Alakerttula, Tampere University, Finland**

Circular  
economy



# CICAT2025 – CE ecosystems and catalysts

- Focus on a systemic transition from CE innovation ecosystems to sustainable CE business ecosystems
- Studying on how diverse catalysts and change agents enable and accelerate the CE transition
- Duration 1.1.2019–31.12.2023
  - 6 Universities, over 40 researchers
  - 70 stakeholders in Finnish companies, municipalities, 3<sup>rd</sup> sector, ministries
  - 10 international research partners
  - Funding 5,95 M€



# CICAT2025 – CE ecosystems

- CICAT2025 is:
  - Increasing understanding of CE business ecosystems and dynamics and how CE business ecosystems differ from linear business-based ecosystems.
  - Producing multidisciplinary understanding and integrative knowledge on various CE catalysts and examine how they drive the transition process in an interrelated way
  - Increasing understanding of how ecosystem actors can become proactive agents during the transition
  - Examining how major systemic transition is achieved by refocusing attention to the positive potential that sustainable CE ecosystems offer to business and society



# Modelling and monitoring CE



CE Ecosystems



Catalysts and Dynamics

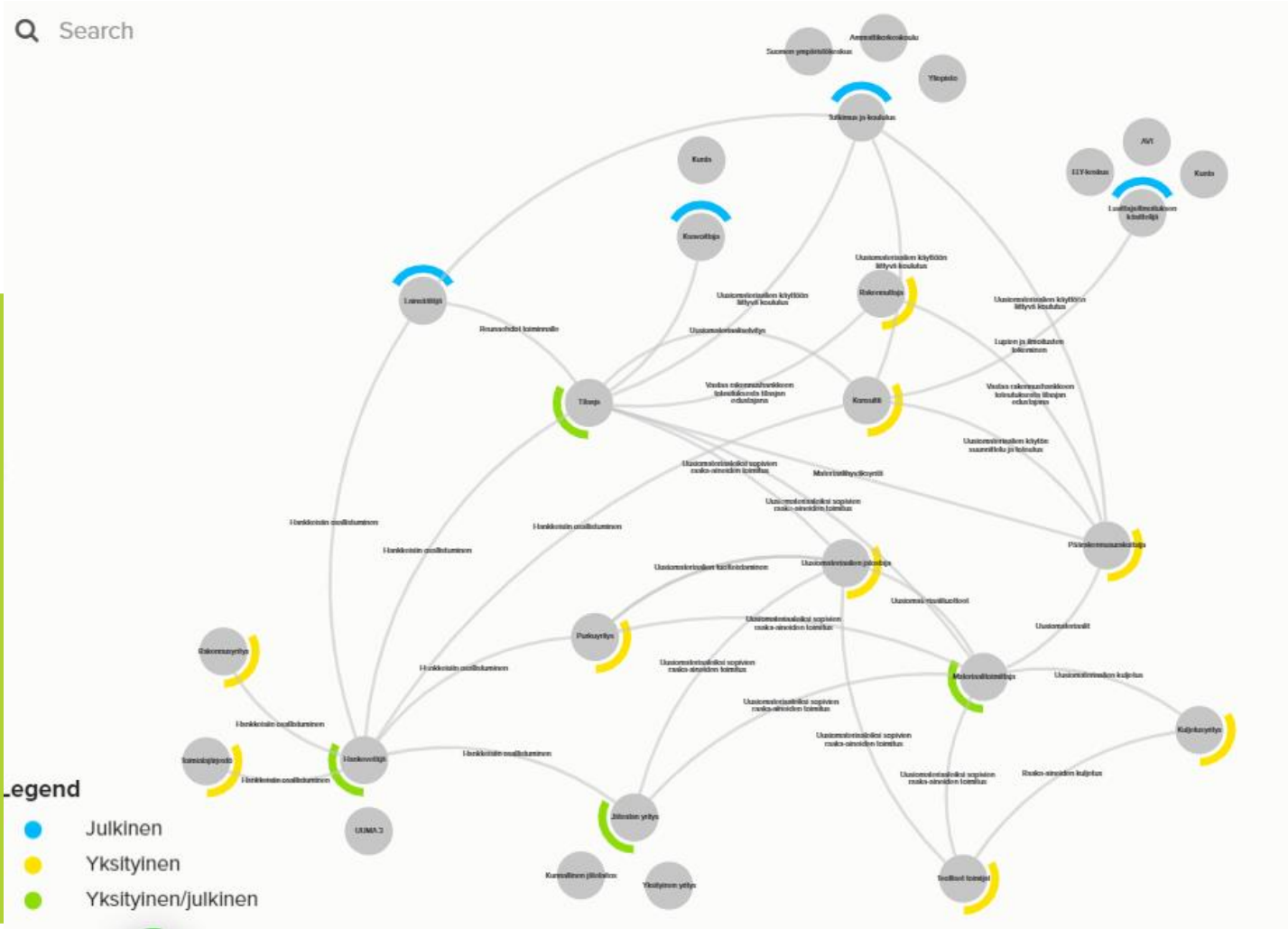


Change and Sustainability



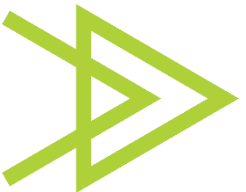


# Ecosystems



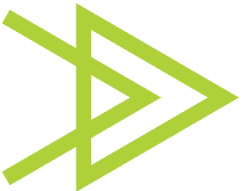
# Four types of ecosystems in focus in CICAT2025

Ecosystem types	<p>An established ecosystem</p> <p>An industry that is developing into CE business ecosystem</p>	<p>An emerging CE technology ecosystem</p> <p>Technology centered ecosystem</p>	<p>Regional ecosystem resembling a CE cluster</p> <p>Regional ecosystem, cluster</p>	<p>A hub centric business ecosystem for global CE business</p> <p>Business ecosystem</p>
Primary cases	<p>Construction</p> <p>Textile</p>	<p>Zero fiber ecosystem</p> <p>Food</p>	<p>Hiedanranta</p> <p>Tampere, Lahti, Espoo Smartcity, ECO3</p>	<p>Neste</p>



# CE ecosystem

- The circular economy ecosystem is a multi-actor networked entity in which interacting actors play complementary roles.
- The actors in the circular economy ecosystem can be companies, cities, ministries, universities, non-profit organizations and citizen-consumers.
- A single actor can belong to multiple ecosystems, intentionally or unintentionally. The ecosystem emerges or is created around a common goal.
- In a circular economy, the goal can be to enable resource recycling or reuse, develop circular economy knowledge, or execute a circular economy business.
- Circular economy ecosystems are characterized by features of many ecosystem types, such as innovation, business or platform ecosystems

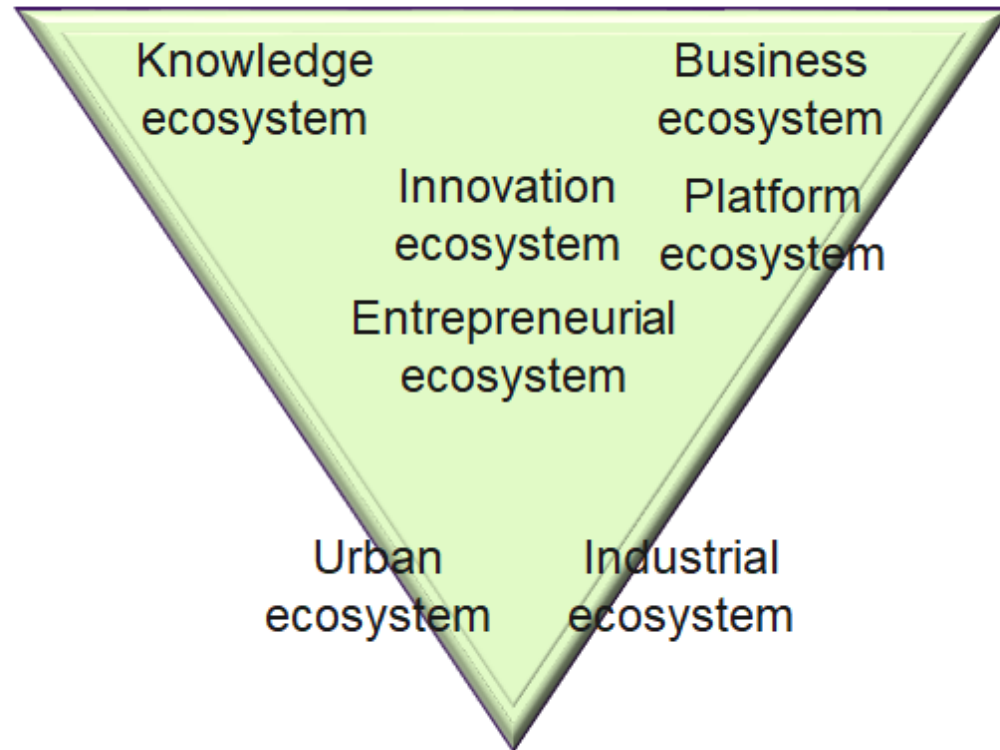




# Types of circular economy ecosystems

**Knowledge flow  
and development**

**Economic flow  
and business  
transactions**



**Material flow**

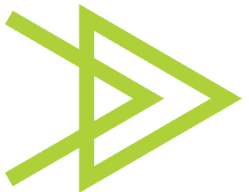


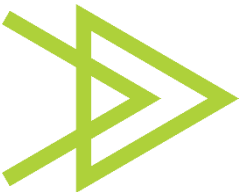
Table 17.1 Overview of CE ecosystems

Ecosystem category	Material flow		Knowledge flow		Value flow
<b>Category description</b>	Ecosystems that enable sustainable energy and material flows within a geographically defined context		Ecosystems that enable the production of CE knowledge within a geographically defined context		Ecosystems that enable the sustainable production of economic value
<b>Ecosystem type</b>	<i>Industrial ecosystem</i>	<i>Urban ecosystem</i>	<i>Knowledge ecosystem</i>	<i>Entrepreneurial ecosystem</i>	<i>Innovation, platform, and business ecosystems</i>
<b>Ecosystem outcome</b>	Sustainable production	Urban amenity	New knowledge	New business models	Value proposition
<b>Location Specificity</b>	Location specific	Location specific	Mostly location specific	Location specific	Non-location specific
<b>Ecosystem definition</b>	Production of sustainable industrial goods and services in symbiotic collaboration and resource use	Collective production of sustainable urban amenities	Collective translation of advances in research knowledge into sustainable products and services	Collective facilitation of start-up and scale-up of entrepreneurial new ventures focused on sustainable business opportunities	Delivery of a sustainable value proposition through collaboration
<b>Ecosystem actors</b>	Manufacturers, service providers, resource providers, utilities	Utilities, local government, city government, transportation authorities, service providers, consumer–citizens residents	Universities, public research institutions, for-profit firms	Investors, accelerators, coworking spaces, makerspaces, educational and research institutions, government	Focal firm, complementors, suppliers, consumer-prosumers
<b>Implications for agency</b>	Embedded in the institutional and economic environment	Mostly embedded in the institutional and economic environment	Distributed among ecosystem actors	Distributed among ecosystem actors	Driven by focal actors via various coordination structures (such as platforms) and shared among the rest of the ecosystem members
<b>Key source literature</b>	Frosch & Gallopoulos, 1989; Korhonen, 2001; Lowe & Evans, 1995	Decker et al., 2000; Lovell & Taylor, 2013	Clarysse, Wright, Bruneel & Mahajan, 2014; Järvi et al., 2018	Isenberg, 2010; Autio et al., 2018	Adner, 2017; Iansiti & Levien, 2004; Jacobides et al., 2018; Thomas & Autio, 2020
<b>Empirical examples</b>	Eco-industrial parks; Eco3	Hiedanranta; Smart cities	Telaketju and textile waste circulation projects	FRUSH	Neste; Netlet; ResQ Club

Aarikka-Stenroos, Ritala and Thomas, 2021: Circular economy ecosystems: a typology, definitions, and implications

# Motivation for the study: Studying ecosystems for circular economy

- CICAT2025 explores the emergence and structural dynamics of circular economy ecosystems as well as agency in circular economy ecosystems
- In particular, we are keen to explore ecosystems dynamics and agency as catalysts toward in transitions toward circular economy. In terms of outcomes, we create a structural map of circular economy business ecosystems and a typology of circular economy actors and change agents.
- What is a Circular Economy ecosystem:
  - Goals; Actors, Structure, Boundaries?
  - Ecosystem types/archetypes?
  - Local/business/industrial symbiosis/industrial level/EPR ecosystems
- How diverse CE ecosystem actors (co-)create value, to enable and enhance circularity and sustainability
- Case studies on CE ecosystems in Finland – case sampling motivated
  - Theoretically – to generate more understanding on diverse ecosystem concepts (particularly knowledge, innovation and business ecosystems) and analyze how they occur in the circular economy context
  - Pragmatically – to understand and support the relevant "CE ecosystems" in the Finnish society



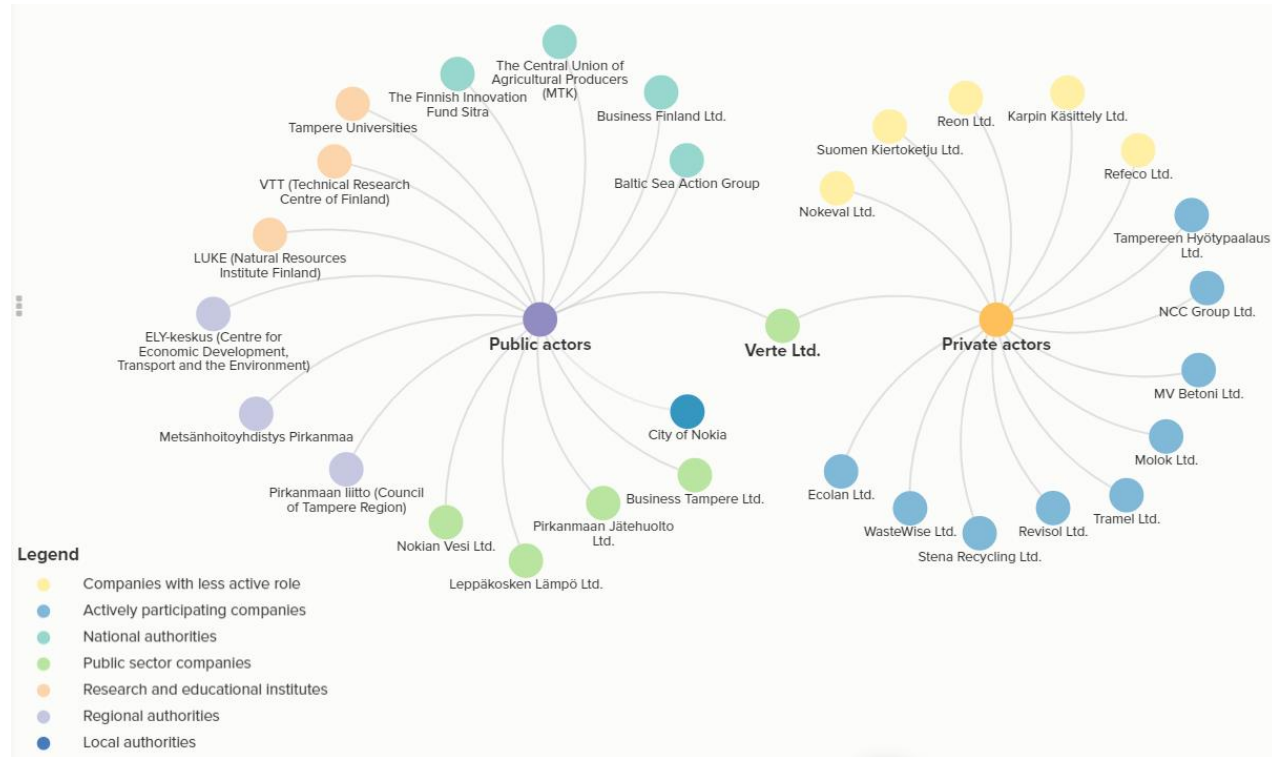
# Construction material cycles

- Ecosystem goal: reduction of construction and demolition waste and more efficient waste recycling
- There is not a single coordinator in the ecosystem, but several forums, projects and networks have been built around the circular economy of construction
- The circular economy of construction links actors at the micro, meso and macro levels. The client of the construction project is one of the key players
- From a life cycle perspective, the design phase of a building is a very important catalyst for the realization of a circular economy
- The catalysts are e.g. regulation (at the micro level can also be a barrier), language (waste term), leadership (pioneering) and business (market for recycled raw materials)
- In civil engineering, the circular economy is already a long way off, but in building construction it is a newer perspective

Value chain step	Relevant actors	Impact on circularity
Plan & design of building	Client Municipality (land owner, supervisor, land-use planner, mass-coordinator, client) Architect	Location CE principles in land-use planning CE principles in construction project planning Mass coordination
Manufacturing and transport of building materials and products	Raw material provider Product manufacturer Transport company	Renewable construction material Recyclable construction material Safe and long-lived materials Carbon footprint of logistics
Construction	Construction company Contractor Sub-contractor Consultant Reuse company	Resource efficiency construction Reuse of surplus construction material and products Recycling of CW
Operation	Owner Occupant User	Space sharing Lifespan extension
Maintaining	Limited liability housing company Property manager Maintenance company	Renewable construction material Resource efficiency construction Recycling of CDW Lifespan extension
End of life	Municipality Demolition company Waste company Material processor	Requirements for CW utilisation Reuse of modules and products Recycling of DW

# ECO3

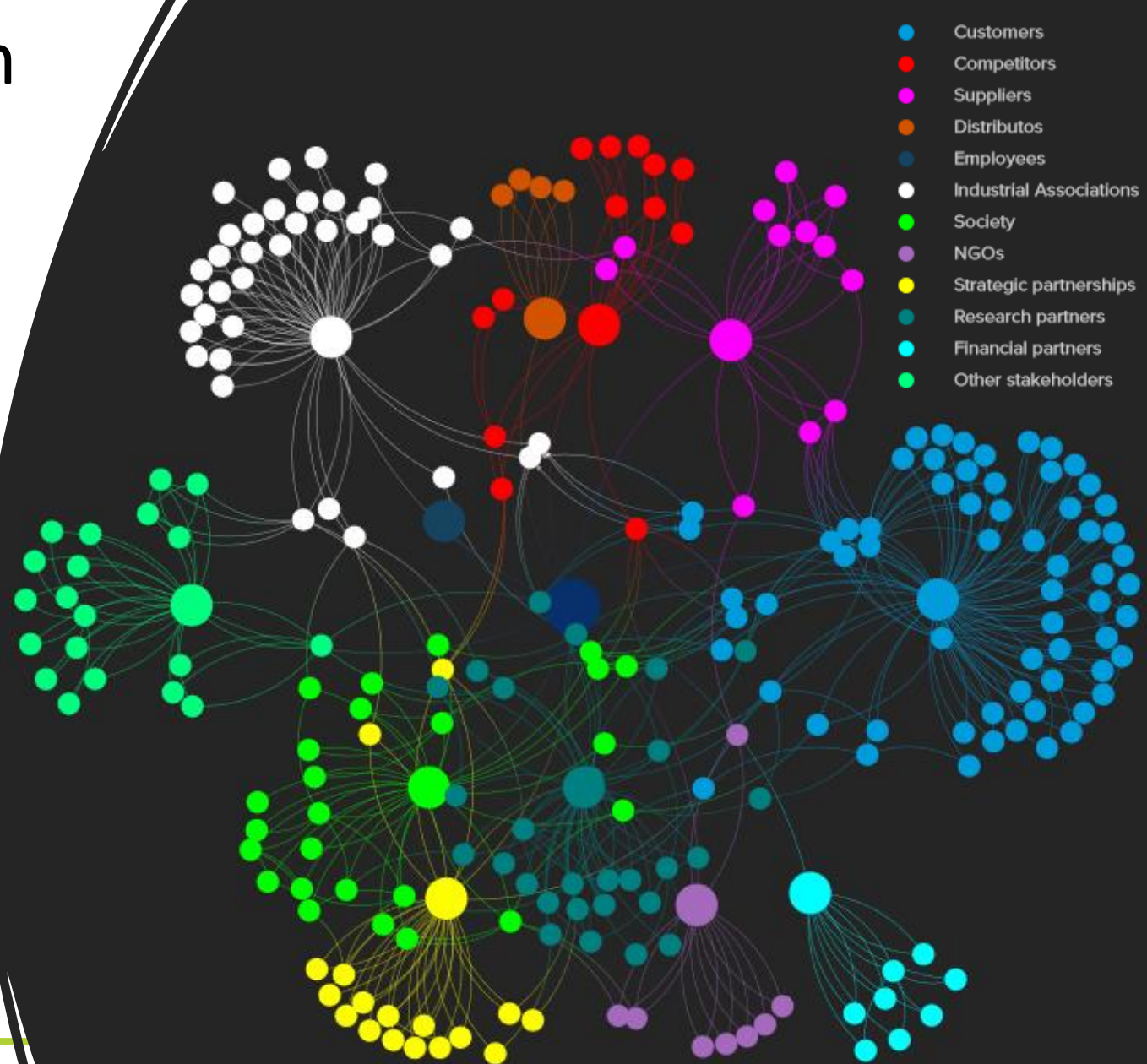
- An eco-industrial park (120 ha, expanding) was established in 2014 in the Kolmenkulma industrial area for Nokia, specializing in bio-based and circular economy on an industrial scale. At the heart of development are industrial symbioses.
- Directly and indirectly through industrial symbiosis public actors pursue regional prosperity and vitality by supporting local sustainable business; private actors are looking for new circular economy-based business opportunities.
- Primus motor is Nokia City Development Company Verte Oy, which is in active dialogue with collocated actors and a wide network of stakeholders
- Ecosystem development through industrial symbiosis as a dynamic dialogue within and between public and private actors, involving several actors at different levels (micro, meso, macro) and with varying levels of involvement and different timeframes of involvement
- A special feature is the public-private dialogue, a brand that extends beyond the physical area, the very strong presence of a public actor (Verte Oy) in the corporate interface
- Industrial and Urban symbioses overlap (regional by-products and actors of the business + regional development)
- Key catalysts e.g. organization and management (allocated coordinator) and stakeholder dialogue (coordination of the views of different actors)



The Process of Building Inter-organizational Collaboration for Industrial Symbiosis : Two cases from Finland: ECO3 & Envitech

# Sustainable transport with renewable fuels: Neste NExBTL ecosystem

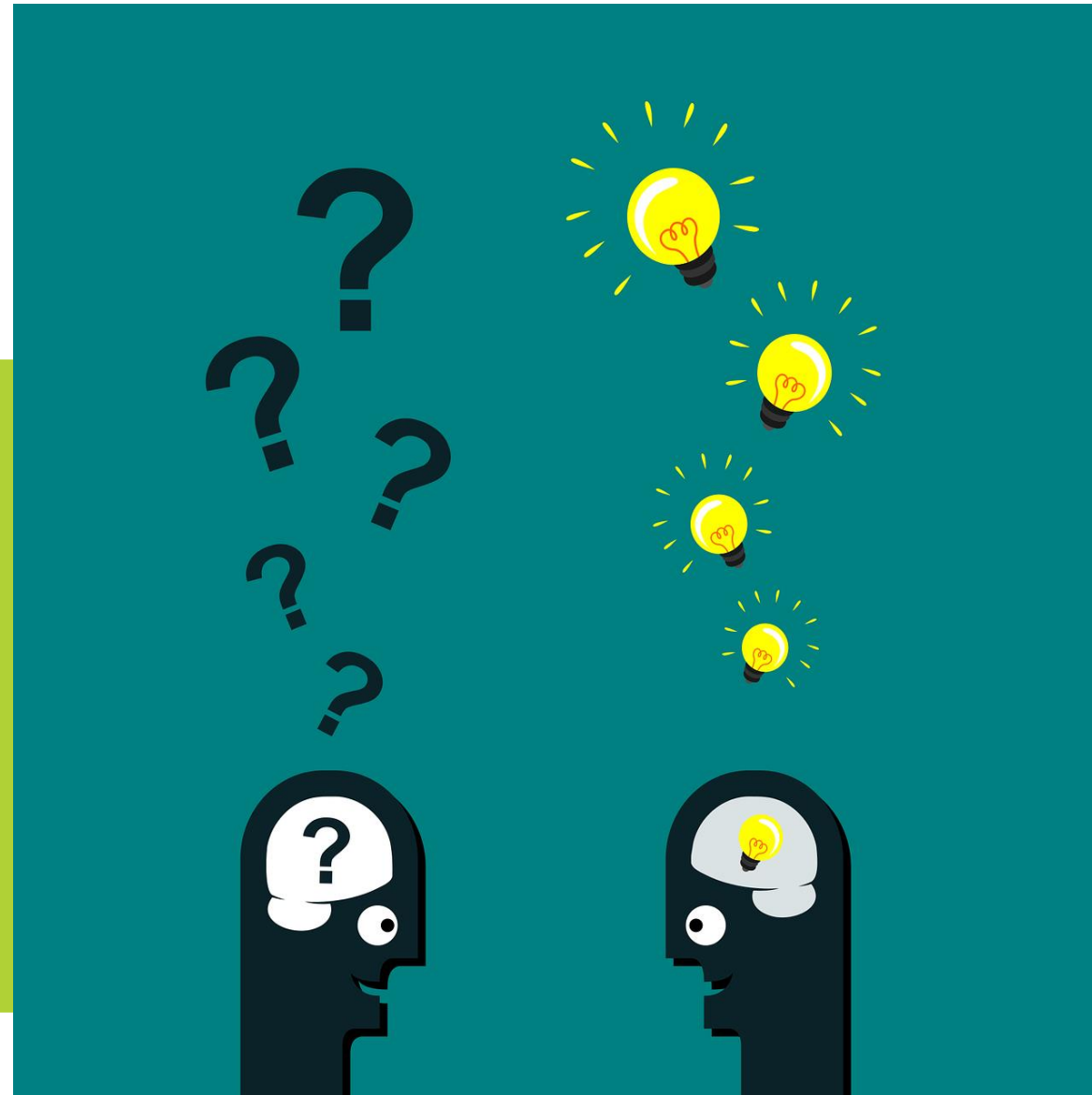
- Ecosystem goal: sustainable transport with Neste's NExBTL renewable diesel
- Neste as a central player, surrounded by geographically dispersed business stakeholders such as customers, suppliers, competitors, and various research organizations, NGOs and decision makers
- Cooperation between industry-oriented ecosystems: the renewable diesel ecosystem benefits mutually from cooperation with, for example, the aviation industry -> "the bad guys become good together/ with the help of each other"
- Radical technological innovation -> New business opportunities and business models -> building new value chains and the surrounding business ecosystem
- Catalysts:
  - Technology (chemical industry processes for the introduction of new raw feedstocks, digitalisation)
  - Business (New business opportunities, competitiveness, profitability)
  - Organization & leadership (resourcing, courage, vision)
  - Agency (so-called catalysts within the company)
  - Stakeholder cooperation (long partnerships and innovation together)
  - Regulation (international legislation vs. national implementation)



<https://cicat2025.turkuamk.fi/fi/wp2/strategic-renewal-process-towards-sustainability-an-ecosystem-approach/>

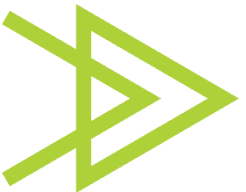


Catalysts



# Exploring and theorizing: Catalysts in sustainability transition

- A catalyst is a positive-force-for-change which accelerates transition
- Research on catalysts directs attention to turning points, where change is about to take place
- We use the concept of catalyst to understand how a complex systemic transition takes place in interaction between a variety of factors







Technology

Material and process technology, materials, nutrients, minerals

Business

Business models, commercialization, service models, public procurement, collaboration, customer references

Organization and leadership

Strategic management, leadership, change management, innovation culture

Regulation

EU and Finnish law, investments, contract law, regulation

Sustainable policy

Scalability, places and spaces

Language

Terminology, framing, discourse

Visual art

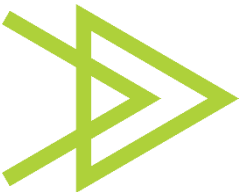
Visual arts, visual communication, visual service design

# Visual catalysts

- The Visual Catalysts exhibition brought together artists from around the world to create visions that will accelerate our journey into the circular economy. The exhibition was held in Tampere in the autumn of 2020. The exhibition can also be seen virtually here: <https://cicat2025.turkuamk.fi/fi/visual-catalysts-nayttely/>

# Implications to practitioners

- Understanding of the CE ecosystems has also pragmatic relevance as it can encourage and advice practitioners, companies and public actors, such as municipalities, and other organizations to organize and re-organize their activities and turn their ecosystems more sustainable.
  - How to initiate and “build up” an ecosystem for the CE
  - How to cope with actor diversity
  - To understand diverse functions of the CE ecosystems (knowledge, innovation, business, material flows)



# Publications, results

## JOURNAL ARTICLE

### **The Role of the CJEU in Shaping the Future of the Circular Economy**

The case-law of the Court of Justice of the European Union (CJEU) can have a crucial impact on the circular economy transition. Waste management and in particular the regulation governing the.....

## JOURNAL ARTICLE

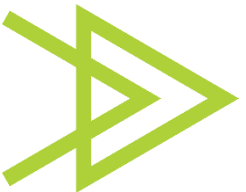
### **How to Reach a Safe Circular Economy?—Perspectives on Reconciling the Waste, Product and Chemicals Regulation**

The article examines the legal interface between waste and chemicals regulation and how this interface hinders the achievement of circular economy. The interface causes many problems for material.....

## JOURNAL ARTICLE

### **Defined Is Half Solved? The Regulatory Barriers for Circular Economy Business**

This article identifies and examines regulatory barriers that hinder the development of the circular economy transition and argues that such barriers must be defined before they can be solved.The.....



- [Cicat2025.fi](https://cicat2025.fi)
- Twitter: [@CICAT2025](https://twitter.com/CICAT2025)
- Instagram: [@CICAT2025](https://www.instagram.com/CICAT2025)

Join the CICAT  
Movement

Sign up for the CICAT2025 newsletter!

<https://cicat2025.turkuamk.fi/>

**Leena Aarikka-Stenroos**

*Consortium PI*

Tampere University

[leena.aarikka-stenroos@tuni.fi](mailto:leena.aarikka-stenroos@tuni.fi)

+358 50 301 5476

**Hanna Lehtimäki**

*vice PI*

University of Eastern Finland

[hanna.lehtimaki@uef.fi](mailto:hanna.lehtimaki@uef.fi)

+358 50 5732742

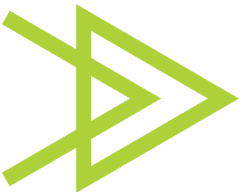
**Piia Nurmi**

*interaction*

Turku University of Applied Sciences

[piia.nurmi@turkuamk.fi](mailto:piia.nurmi@turkuamk.fi)

+358 40 355 0931





Thank you!

Johanna Alakerttula  
[johanna.alakerttula@tuni.fi](mailto:johanna.alakerttula@tuni.fi)