Open Research Day

9 April 2025

15:30-16:00

Single Session- *lightning talks followed by breakout session*

A108: Smart Society & Digitalized Industry I

Chair: Professor Jelena Zdravkovic, Stockholm University

A108: Smart Society & Digitalized Industry I

- Lightning talk: Session chair: Professor Jelena Zdravkovic, SU

1. Environmental Life Cycle Impacts of Digital Technologies and their use in Society (ELID) (II)
2. SimOPT Simulator-Embedded Nonlinear Programming for Optimized Process Design and Decision Support (II)
3. SHIFT-DT: Sustainable, Holistic, Integrated Framework for Ship Design and Production Transformation through DigitalTwins (RP)
4. Mixed Reality Shared Engagement in Cultural Events (SECE) (II)
5. RECOPS-Resilence and cost benefits of open-source software in the power sector (RP)
6. Digitalization driving sustainability – dealing with complexity (Seed)

Environmental Life Cycle Impacts of Digital Technologies and their use in Society - ELID

Anna Furberg
Department of Sustainable Development, Environmental Sciences and Engineering, KTH

annafur@kth.se

Principal Investigators: Göran Finnveden (KTH), Mattias Höjer (KTH) Jens Malmodin (Ericsson)
Participating researchers: Shoaib Azizi (KTH), Anna Furberg (KTH), Nina Lövehagen (Ericsson)

Shape a sustainable society through digital transformation…

This requires methods for assessing the sustainability of digital solutions.

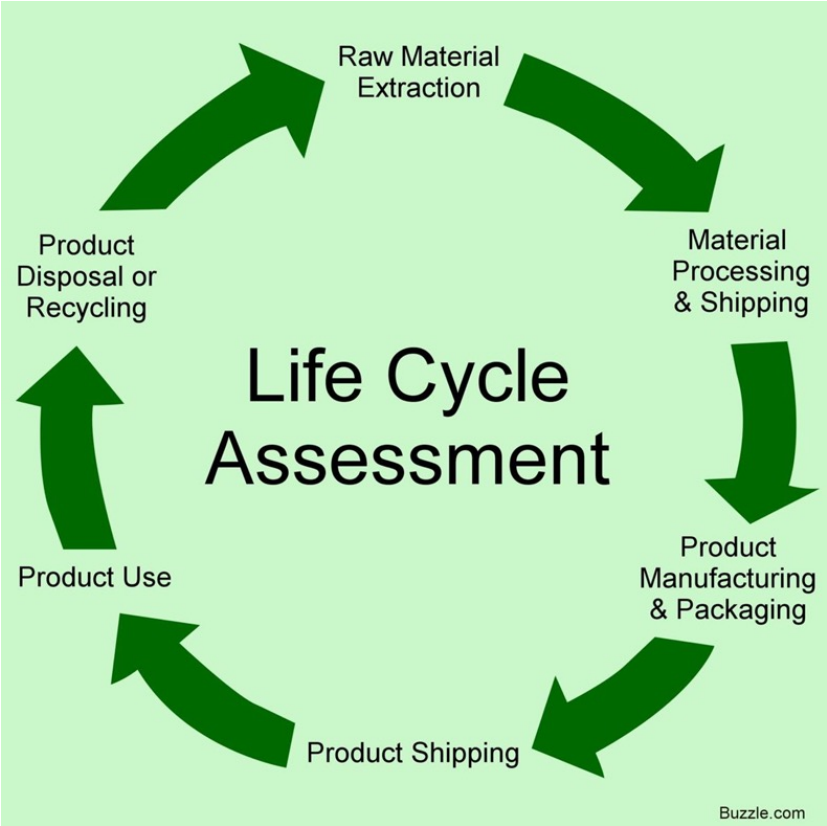
ELID project:

- Aims to further develop methodologies for estimating ***environmental impacts of ICT*** systems and solutions in a life cycle perspective and test them in case studies

- ***Life cycle assessment (LCA)*** is an established method for assessing potential environmental and resource impacts of a product or service over its life cycle, but there are needs for further development

Topics

- Simplified LCA methods
- Prospective LCA
- Not only climate impacts
- Assessment of enablement effects
- Impacts of changed consumption practises



Thank you

SimOPT: Simulator-Embedded Optimization for Process Design and Decision Support

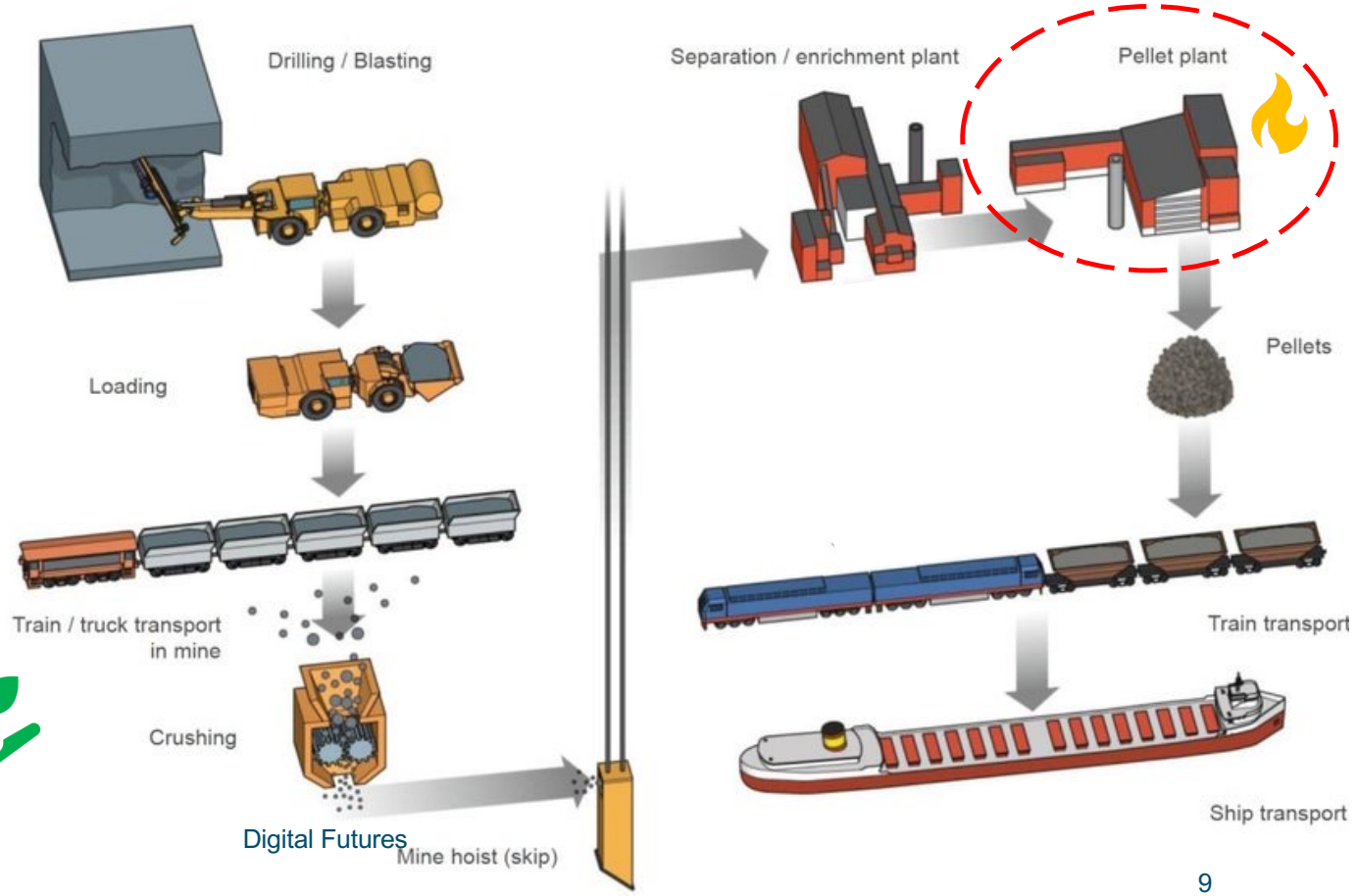
David Alejandro Liñán Romero

KTH-Department of Mathematics (Division of Optimization and Systems Theory)

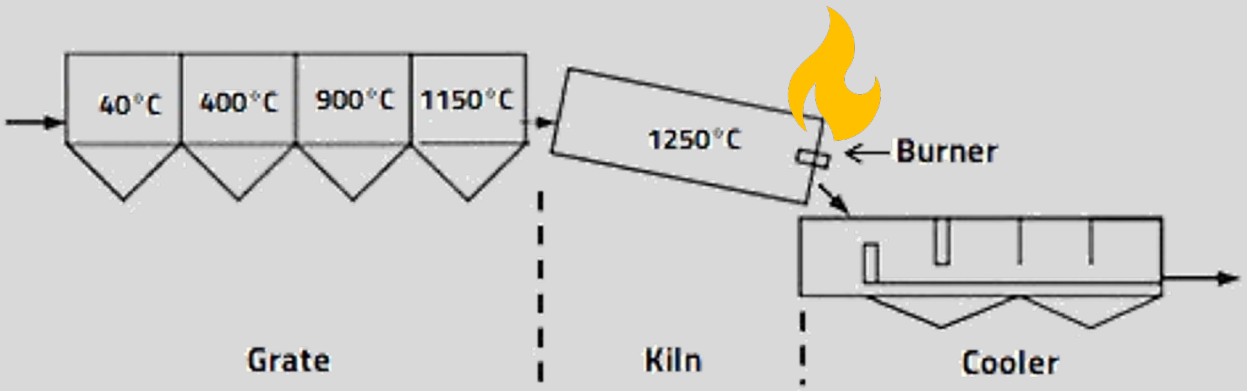
Introduction

Iron ore production

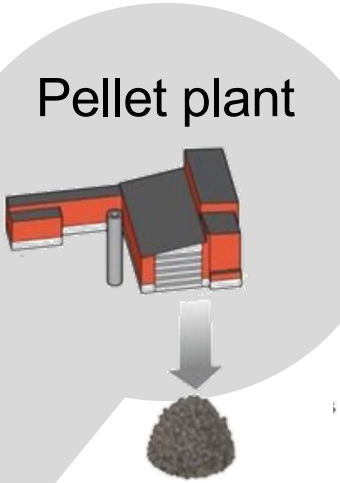
- Large contributor to CO_2 emissions
- Heating in the pelletizing plants is the major source of CO_2 emissions in the process
- By 2045: carbon-free



Problem statement



$$Fossil\ fuel + O_2 \rightarrow CO_2 + H_2O +$$



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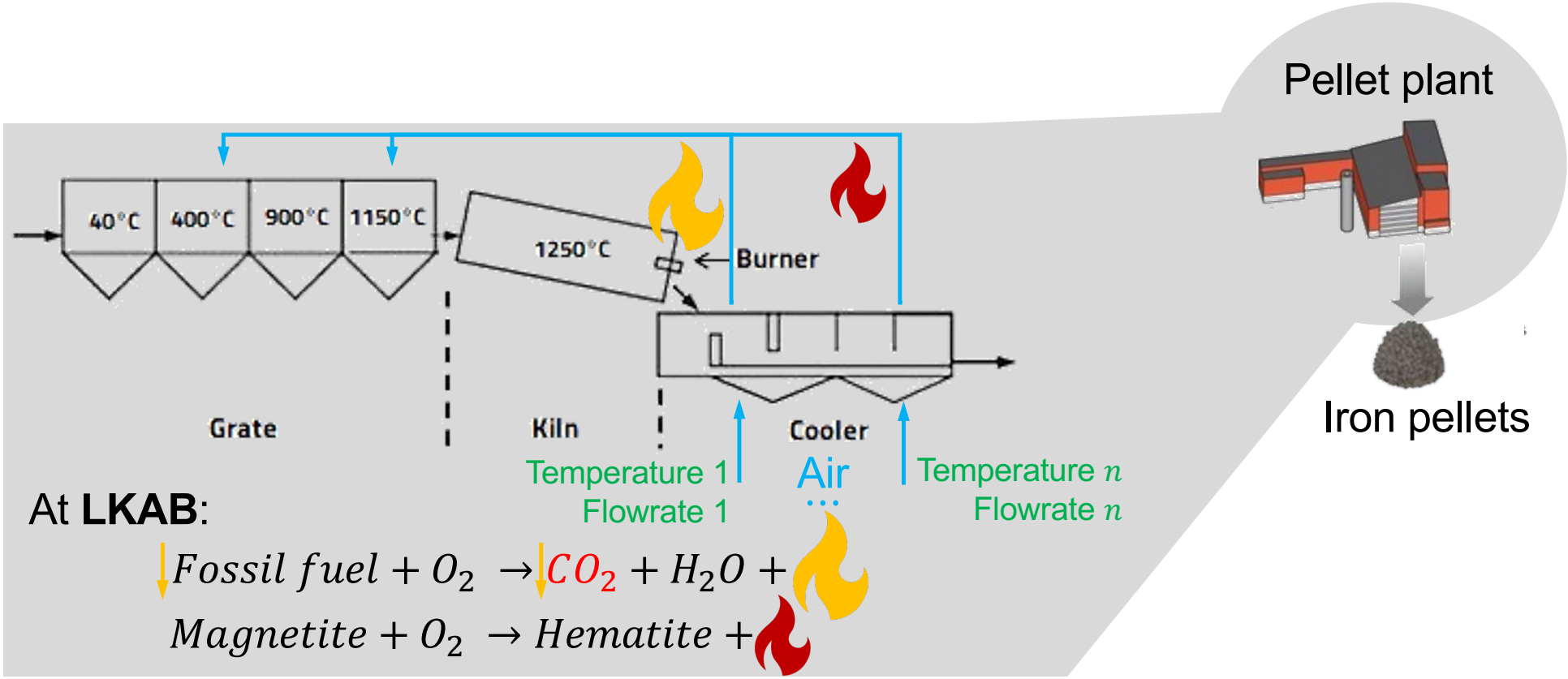


At **LKAB**:

$$Fossil\ fuel + O_2 \rightarrow CO_2 + H_2O + \text{🔥}$$

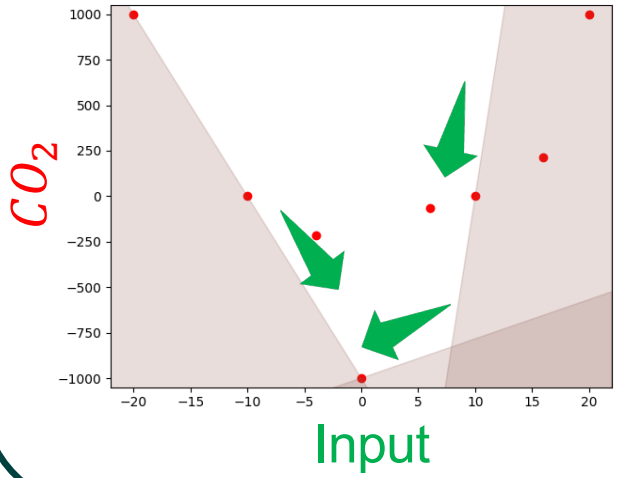
$$Magnetite + O_2 \rightarrow Hematite + \text{🔥}$$

Simulation-based optimization

Minimize CO_2 (output) by **numerically optimizing** air temperatures and flow-rates (inputs)

Numerical optimization

Cutting plane method

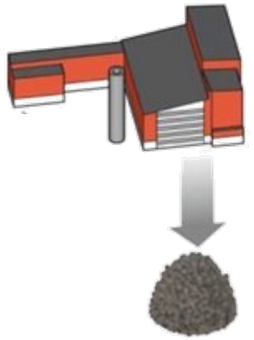


Input 1:
Input 2:
⋮
Input n:

CO_2

Computer simulation

Pellet plant



Iron pellets

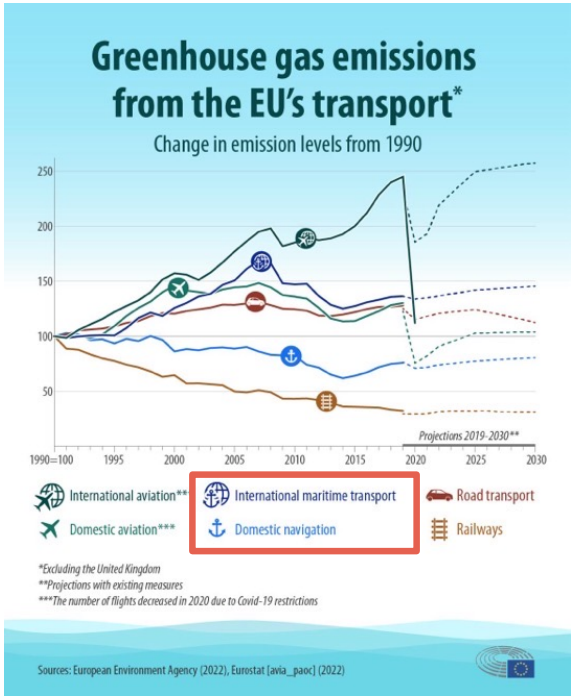
Thank you

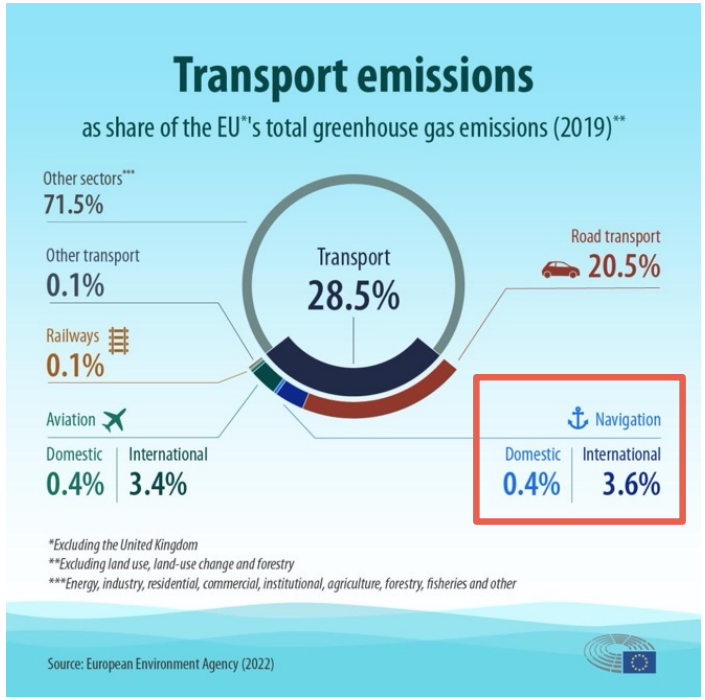
SHIFT-DT

Sustainable, **H**olistic, **I**ntegrated **F**ramework for Ship Design and Production **T**ransformation through **D**igital **T**wins

Yongkuk Jeong	assistant professor, KTH ITM
Abbas Dashtimanesh	assistant professor, KTH SCI
Chao Ye	postdoc, KTH SCI/ITM

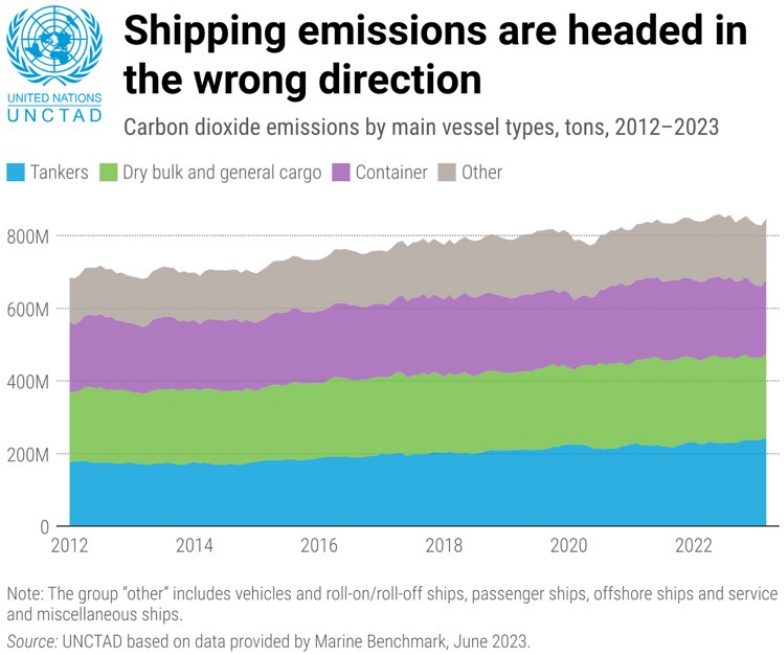
Maritime logistics plays a big role in global trade and in global emissions





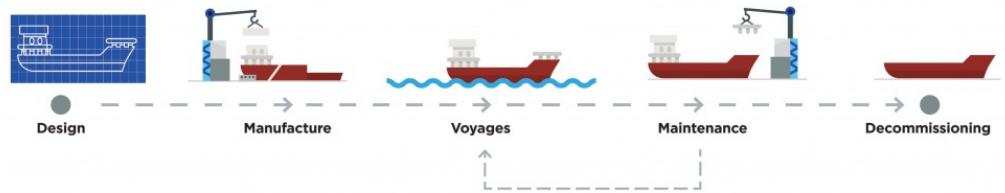
Maritime logistics plays a big role in global trade and in global emissions

- Maritime transport carries **over 80% of the world's trade by volume**, making it the backbone of international logistics—especially for developing countries
- At the same time, it is responsible for nearly **3% of global CO_2 emissions**, a figure that continues to rise



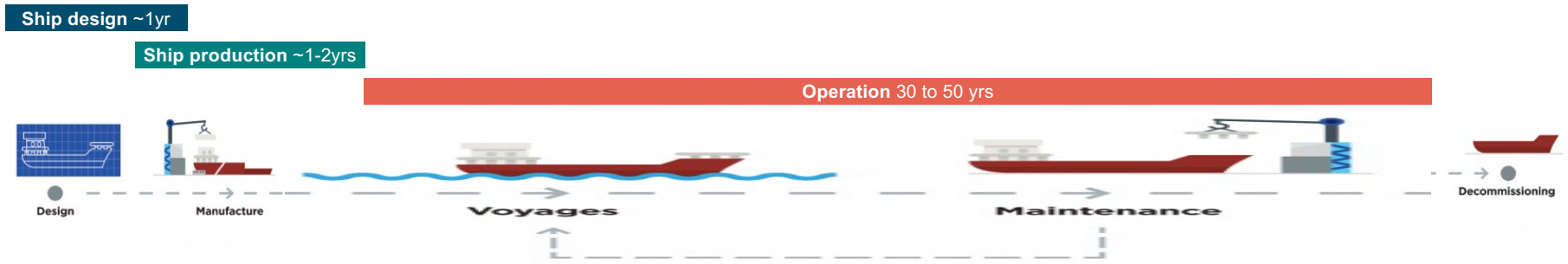
A ship’s environmental footprint is shaped long before it sails

Typical lifecycle of a ship

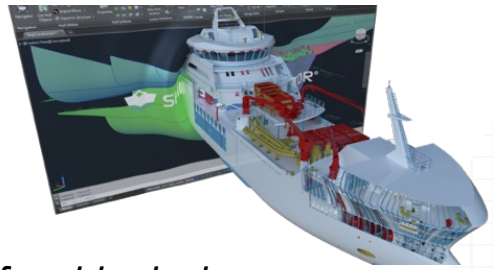


- Design and production decisions made in the **first 1–3 years lock** in the ship’s environmental performance for decades to come
- To drive a green transition in maritime logistics, **sustainability must be embedded from the very beginning**

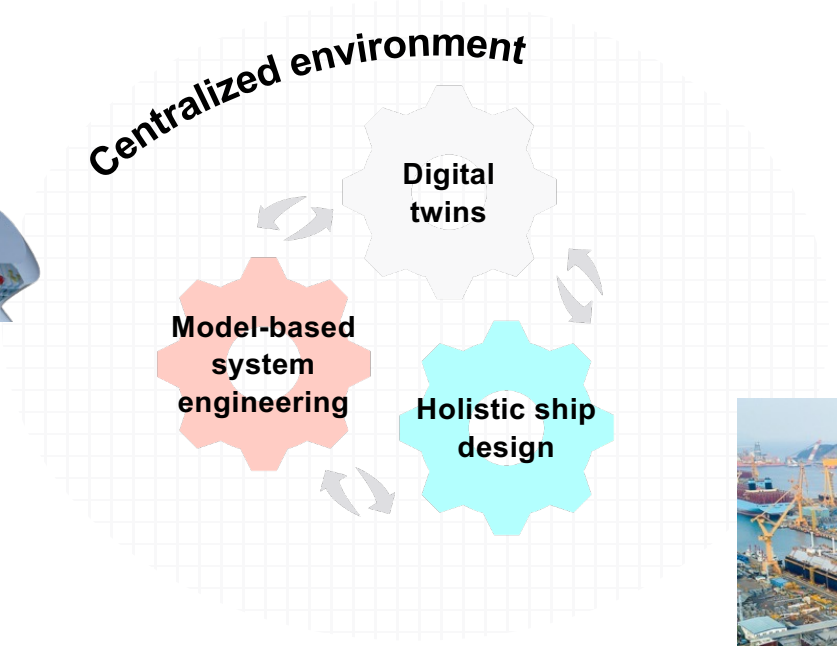
Actual lifecycle of a ship, including time dimension



Key methods in SHIFT-DT



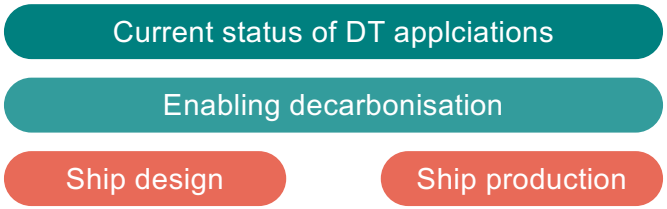
for ship design



for ship production

Exploring how DT in ship design and production can enable the decarbonisation of maritime logistics

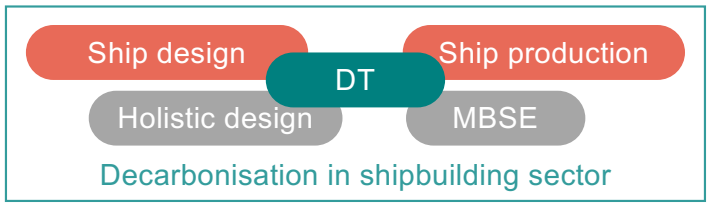
RQ1: What is the current status?



Literature review

Goal Identify SOTA research in the shipbuilding sector through a literature review

RQ2: What are the challenges in ship design, production, and their integration—and how can DT and MBSE help address them?



Goal Understand the integration challenges between ship design and production, and how to address them using DT and MBSE

Exploring how DT in ship design and production can enable the decarbonisation of maritime logistics

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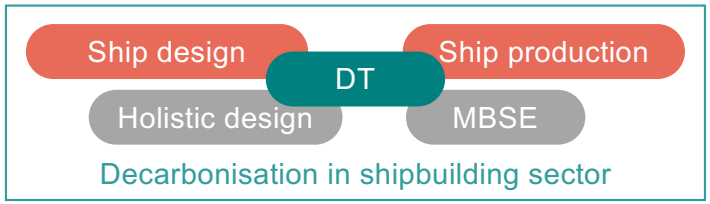
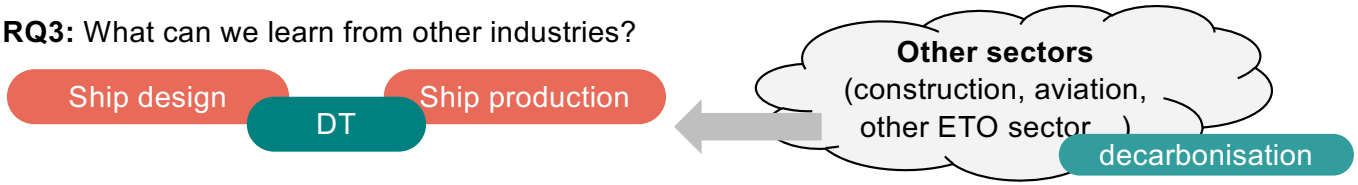


Goal Understand the integration challenges between ship design and production, and how to address them using DT and MBSE

RQ3: What can we learn from other industries?



Ongoing progress in DT architecture and methods for implementation

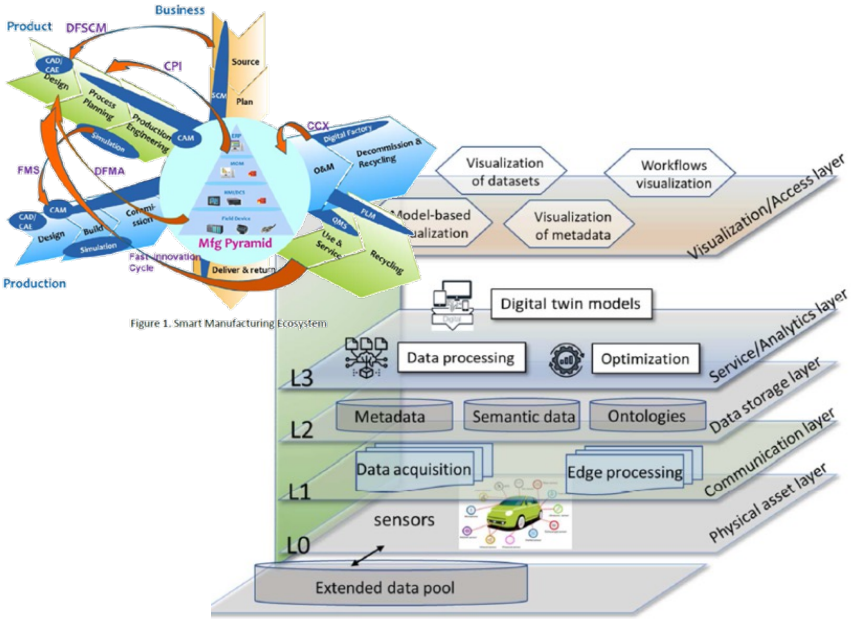
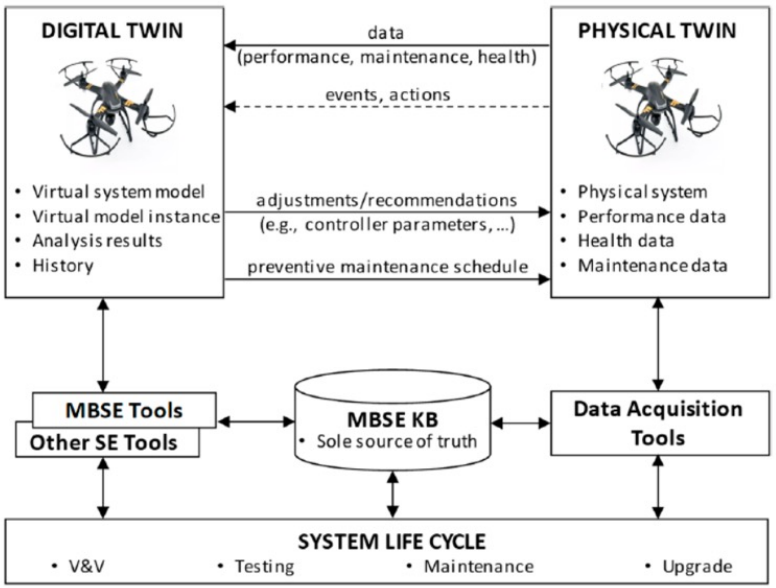


Figure 1. Smart Manufacturing Ecosystem



Current work on DT architecture

Current work on MBSE-based methods for DT implementation

SHIFT-DT

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Yongkuk Jeong	assistant professor, KTH ITM
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Thank you

Mixed Reality Shared Engagement in Cultural Events (SECE)

A Digital Futures Industrial Innovation project by Stockholm University, Ericsson Research and Kulturhuset Stadsteatern

Presented by Uno Fors, Luis Quintero, Antonio Braga
DSV, Stockholm University

Aims and Objectives

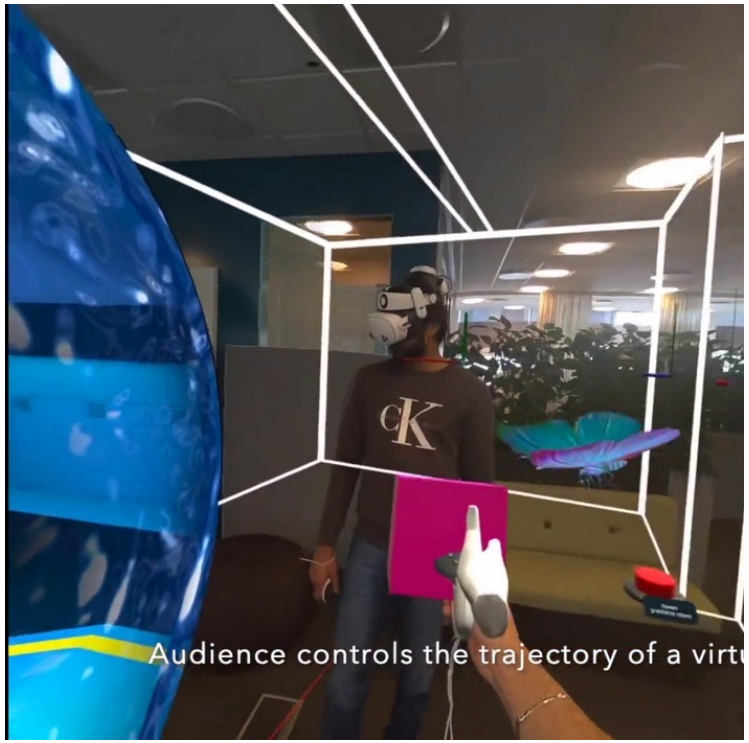
- Create a novel arena for immersive, participatory and creative cultural events using mobile communication and 3D Mixed Reality (MR) innovations
- Allow artists and audience participate in real-time performative events like theatre, music and dance, both indoor and outdoor
- Develop an mobile MR visualizing and auditive platform allowing creation of new types of artistic performances, utilizing co-location and spatial map technologies using 5/6G and WiFi6e/7

Specific goals

- Allow co-creation together with people at public events
- Dissolve the border between actors and audience
- Exploring what future mobile networks need to support for this type of events
- Showcase possibilities and limits of these new technologies
- Demonstrate how MR allow people to be a protagonist in an embodied event
- 2-year collaborative project between Stockholm University, Ericsson Research and Kulturhuset Stadsteatern
- Internal demo at KHST June 2025, final outdoor at Sergels torg event June 2026

What is special and new?

- Real-time co-location of multiple people and objects in large settings (10 x 10 m)
- Support for mobility and outdoor performances



Thank you

RECOPS:Resilence and cost benefits of open-source software in the power sector

Ilka Jahn (and Jagruti Thakur)
KTH Royal Institute of Technology

Open-Source vs. Power Sector

- Open-source software is flourishing (IT, robotics,…)
- The power sector needs software everywhere, but
- Slow open-source software adoption
  - Mostly academic
  - Some industrial initiatives
- Constraints: security and robustness, highly specialized applications

Our goal

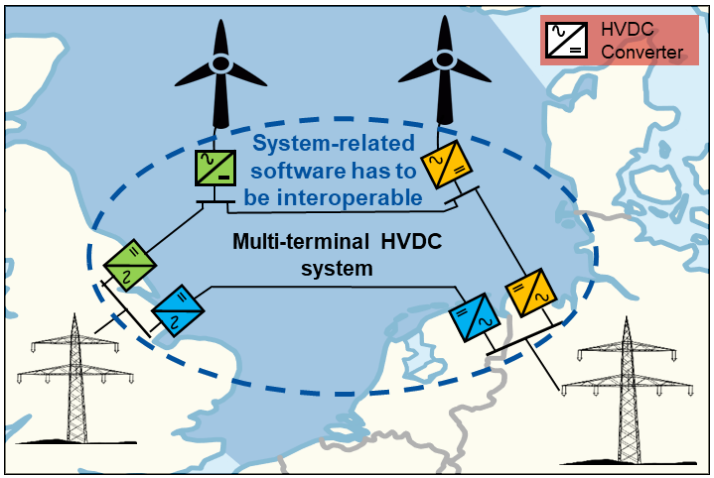
We believe:

Open-source software will be useful for power sector robustness and cost

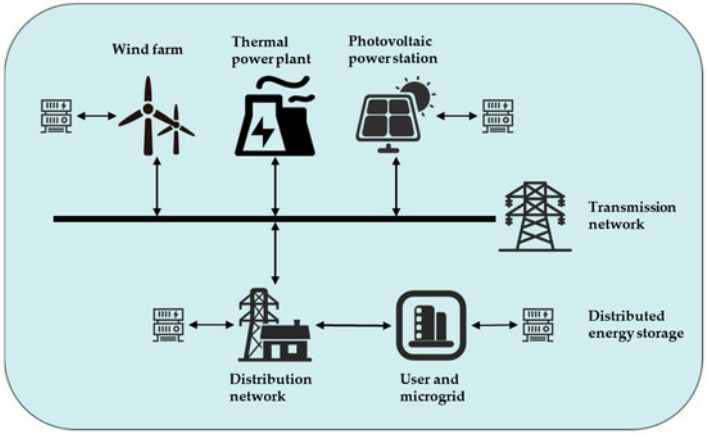
RECOPS goal: **justify above claim with**
(a) concrete examples and (b) a new assessment methodology

Two Case Studies

- High-Voltage Direct-Current (HVDC) technology with partially open control and protection software



- Distributed renewable resources (DERs) including electrolyzer with open-source modelling for harmonization, interoperability



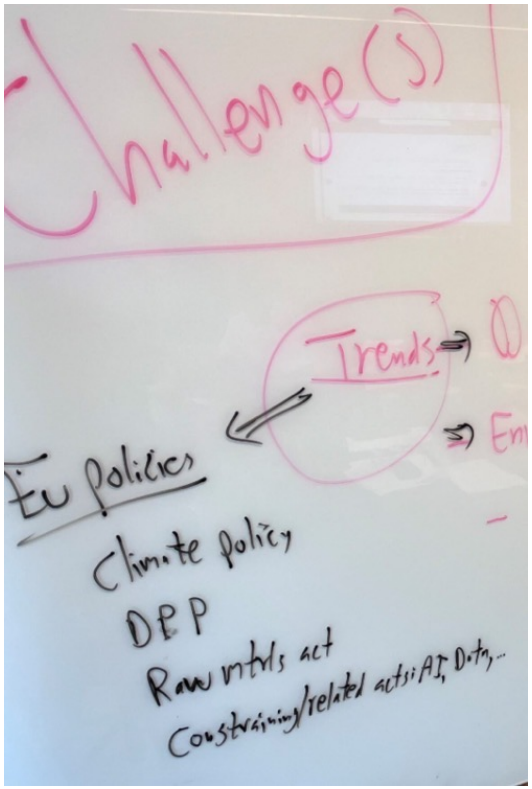
Source: Z. Liu, Review on Energy Storage, MDPI Energies, 2023

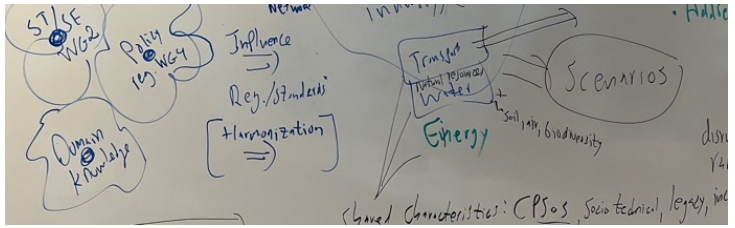
Thank you

Digitalization driving sustainability – dealing with complexity

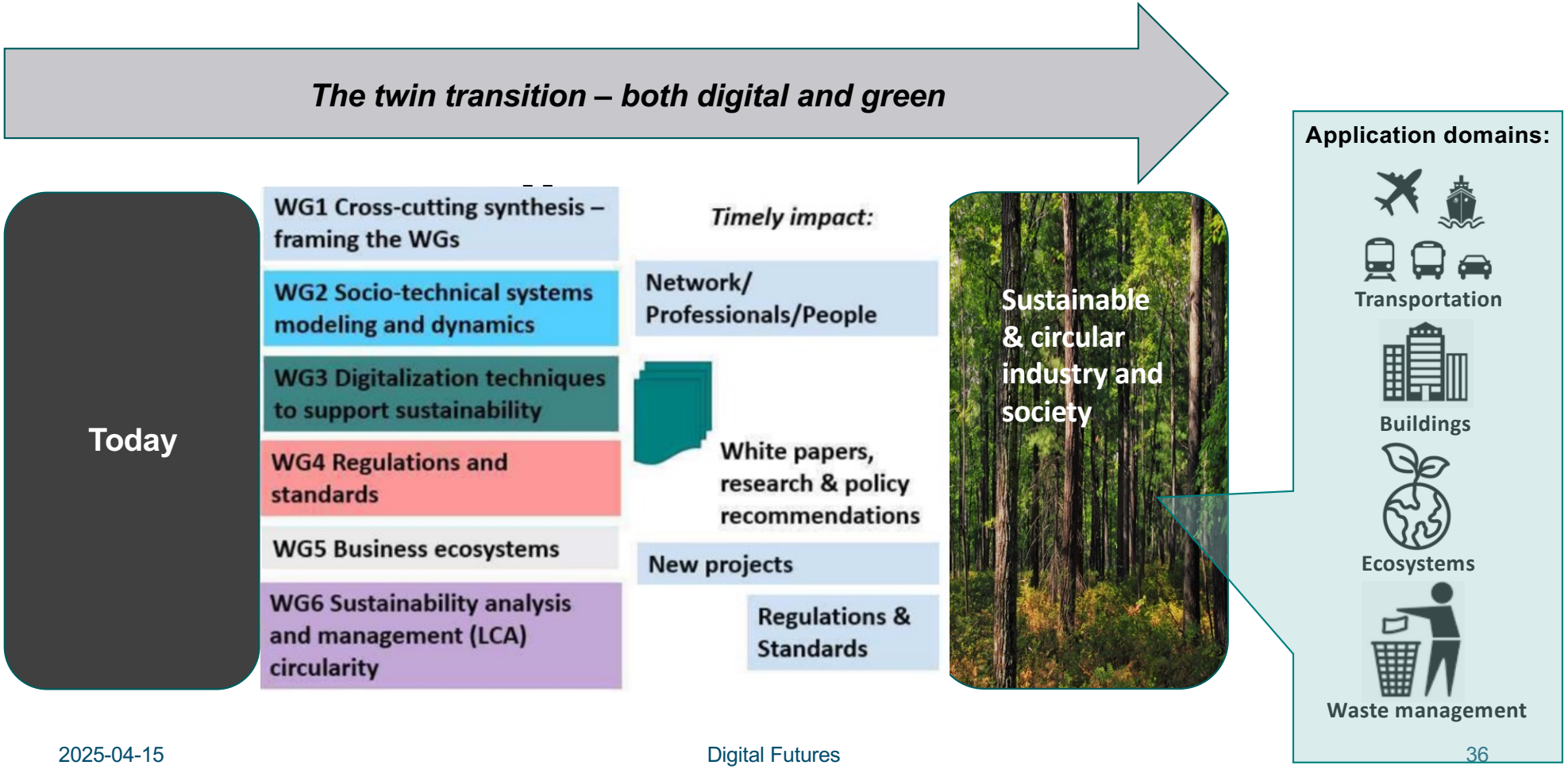
Ellen Bergseth
Engineering Design, ITM, KTH

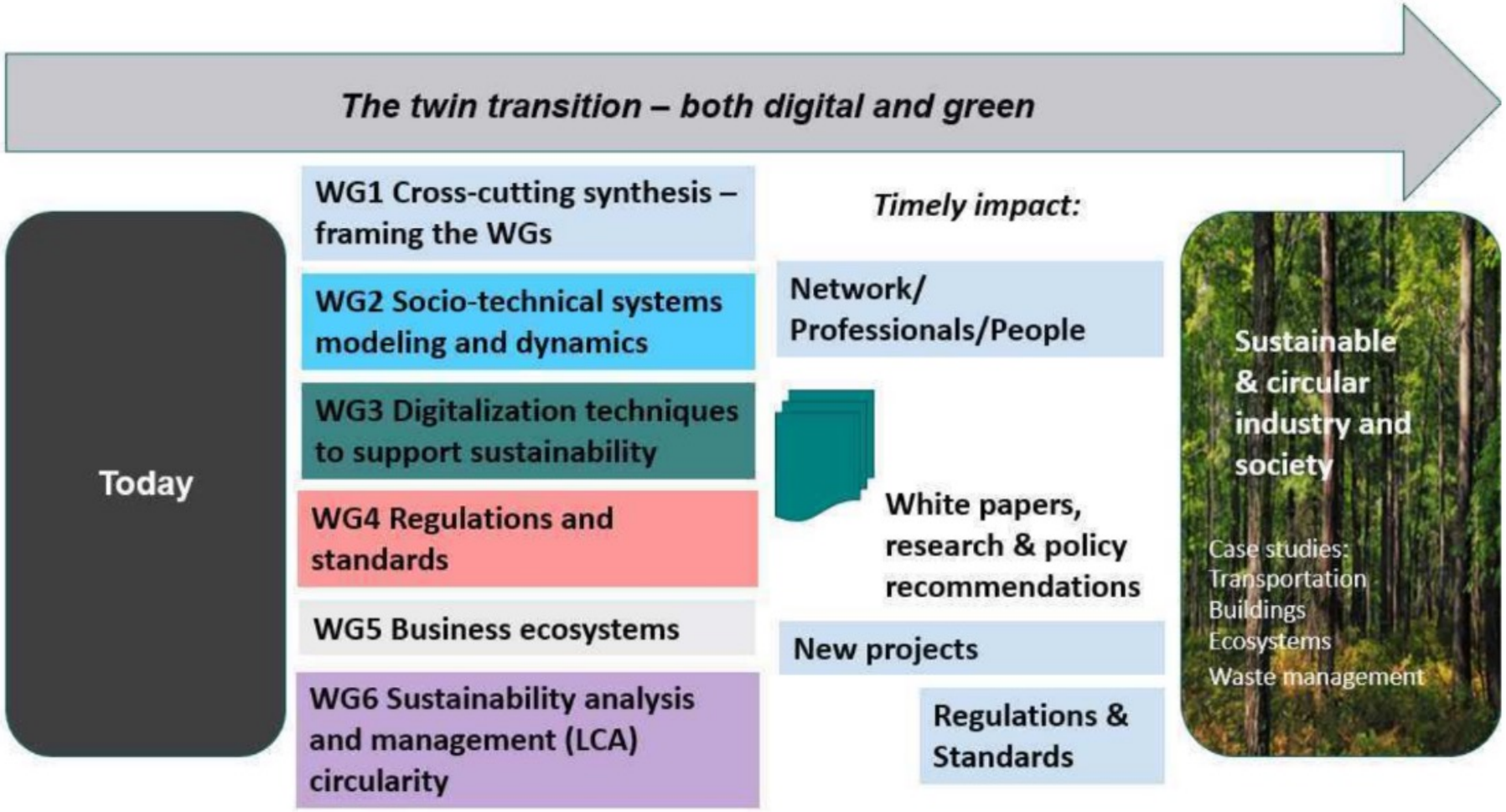
Paving the way for industry 5.0 - contributing to the twin transition – both digital and green





Creating a network – 28 participants from 13 countries


The twin transition – both digital and green
Today
WG1 Cross-cutting synthesis – framing the WGs
WG2 Socio-technical systems modeling and dynamics
WG3 Digitalization techniques to support sustainability
WG4 Regulations and standards
WG5 Business ecosystems
WG6 Sustainability analysis and management (LCA) circularity
Timely impact:
Network/ Professionals/People
White papers, research & policy recommendations
New projects
Regulations & Standards
Sustainable & circular industry and society
Application domains:
Transportation
Buildings
Ecosystems
Waste management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Transportation
Buildings
Ecosystems
Waste management

Thank you

digital futures

PARTNERS

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