INTERNATIONAL UNION
OF RAILWAYS

4TH ZERO WASTE RAILWAYS WORKSHOP

Cross-sector collaboration and innovations

Birmingham, 22 November 2023

INTERNATIONAL UNION
OF RAILWAYS

AGENDA

Agenda

Time	Subject	Speaker
9.00	Registration	
9.15	Welcome and introduction round 15’	UIC and CE Sector Chair
	Opening 15’	SBB
9.30	Keynote on how systems thinking can facilitate the successful implementation of circular economy in railways 45’	Leo Bürki, BSK Organisationsentwicklung
10.15	Discussion 15’	
10.30	Value of redundant assets 15’	Melina Kakouratou, Transport for London
11.05	Break 25’	
11.30	An Infra manager’s view: Nothing to waste in ballast 15’	Bénédicte Gourmandin SNCF Réseau + Partner
11.45	Collaboration with the social community and regional government 15’	Speaker (tbc), KORAIL
12.00	Discussion 15’	
12.15	Collaboration with national authorities: Achieving climate-neutral and circular infrastructure 15’	Katja Nelissen, ProRail (online)
12.30	A collaborative success story: Using recycled plastic in rail infrastructure 15’	William Mainwaring, SICUT
12.45	Lunch Break 45’	
13.30	An integrated approach to sustainability along the life cycle of rail projects: commitment, best practices, and cross-sector innovations 15’	Marco Montesi, RFI (FS Group) Almona Tani, Italferr (FS Group)
13.45	Discussion	
14.00	Supply industry 15’	Ludovic Kasperski, WABTEC
14.15	Learnings from circular buildings projects 30’	Hans Hammink, CIE Architekten
14.45	Coffee break 15’	
15.00	Systems thinking presentation and discussion 45’	Leo Bürki, BSK Organisationsentwicklung and ALL
15.45	Wrap up 15’	
16.00	End of workshop	

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WELCOME

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OPENING

Heike Kiefer
Cornelia Schalch

Grüezi & Welcome

Zero Waste Railways Workshop
Cross-Sector Collaboration & Innovation

24 April 2024

SBB Center of Competence Circular Economy
Contact

Cornelia Schalch
MSt Sustainability Leadership

Co-Lead CoC Circular Economy
Sustainability Project Lead

cornelia.schalch@sbb.ch
www.linkedin.com/in/cornelia-schalch-363a7563

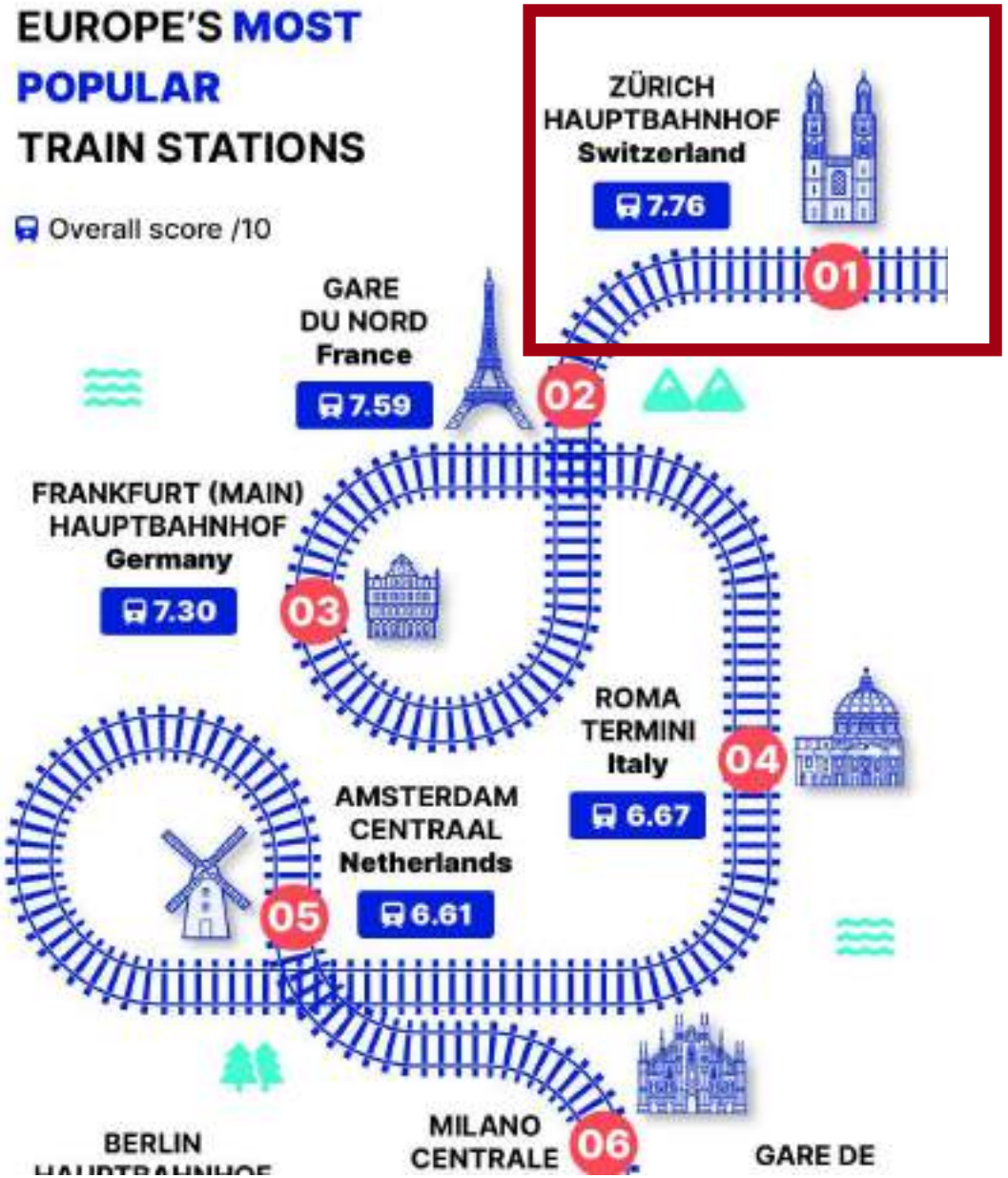
Heike Kiefer
MA Int. Management
MSSc Int. Marketing

Co-Lead CoC Circular Economy
Sustainability Project Lead

heike.kiefer@sbb.ch
www.linkedin.com/in/heikekiefer

EUROPE'S MOST POPULAR TRAIN STATIONS

Overall score /10



Source: European Train Station Index - Bounce (usebounce.com)

"SBB is the backbone of sustainable mobility in Switzerland. Every day, it safely transports 1.25 million passengers and 205 000 tonnes of freight on time and in an environmentally friendly manner[1]."

Organizational structure SBB Group

- Passenger Services Market
- Passenger Services Production
- Real Estate
- Infrastructure
- Freight section (4 controlled subsidiaries)

1 SBB (2024) SBB takes responsibility, online: Responsibility | SBB, accessed 19.04.2024

Sustainability- focus on environment.

Overview of action streams.

Environment	Society	Employees
We are kind to the climate and the environment.	We are a pioneer in sustainable transport development.	We are a responsible employer.
Climate & Energy	Sustainable mobility	Attractive employer
Circular economy	Security & resilience	Health and occupational safety
Sustainable living spaces	Sustainable procurement	Equal opportunities

- Implement governance and compliance
- Transparent reporting
- Dialogue with stakeholders

SBB‘s Ecological Action Plan by 2030

Different focus areas of activity and milestones to reach climate goals.

Climate & Energy

- Halve operational greenhouse gas emissions by 2030 compared to the base year 2018
- Save 850 gigawatt hours of energy per year compared to 2010 and increase energy efficiency by 30 per cent compared to the uninfluenced development.

Circular Economy & Conservation of Resources

- Anchoring the circular economy in our processes and corporate culture and making it a company-wide standard.
- Avoid operational waste, recycle valuable materials and dispose of hazardous waste in accordance with the law.

Biodiversity & Sustainable Construction & Areas

- Maintain one fifth of our embankments in a near-natural state.
- Apply sustainability standards to new buildings and replace all fossil-fuelled heating systems with renewable alternatives.

Climate Goal SBB:

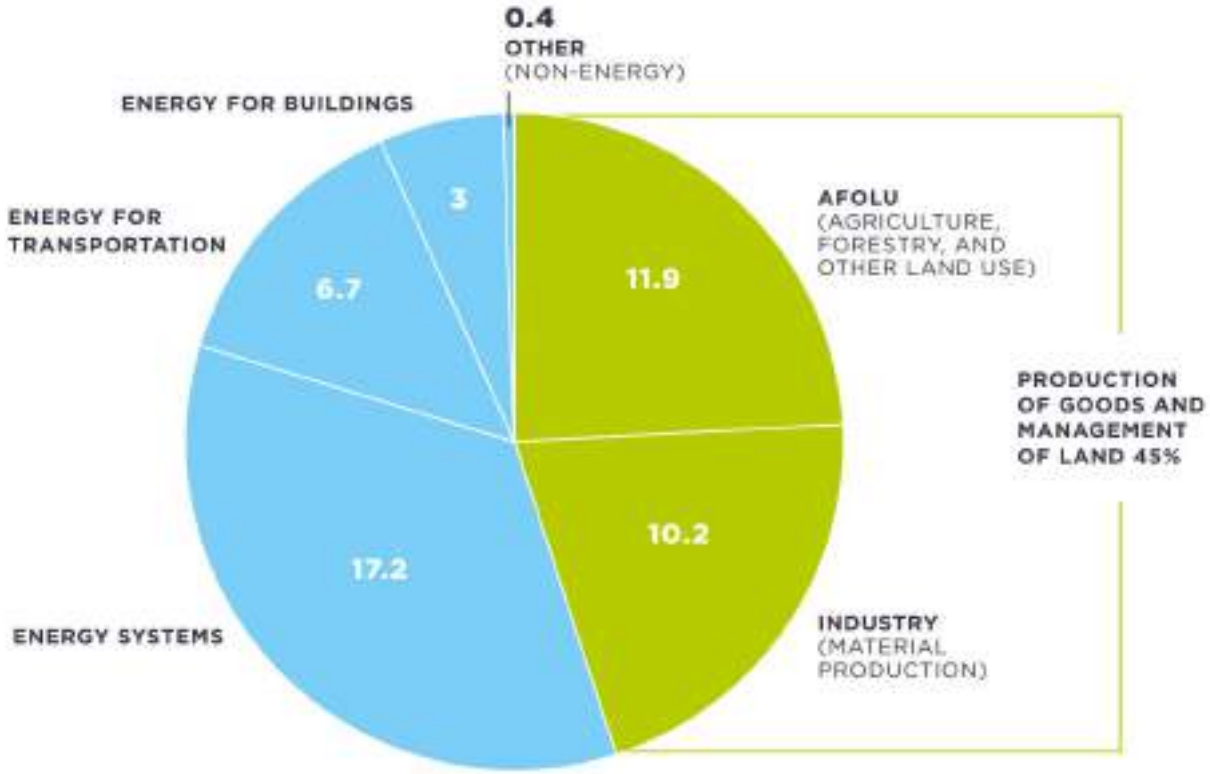
0 CO_2 eq

until 2040

The role of production

Closing material loops is vital.

„**45% of global GHG emissions** can be attributed to the production of materials, products, and food, as well as the management of land[1].”



1 Ellen MacArthur Foundation (2021) Completing the picture – How circular economy tackles climate change, onlne: Completing the Picture - How the circular economy tackles climate change.pdf (thirdlight.com), accessed: 19.04.2024

SBB Center of Competence Circular Economy

Knowledge building and sharing is key.

COC CE

Management and Realisation Project Portfolio

Circular Internal Operations
- Initiation and support of operational projects
- Scaling of CE approaches
- Process modifications

Circular External Operations
- Transformation of excisting customer offers into circular
- Creation of new circular buseinss models

Cultural Change

Anchoring within SBB
- Key Notes
- Learning journeys
- Knowledge Management

Establishing Network & Know-How

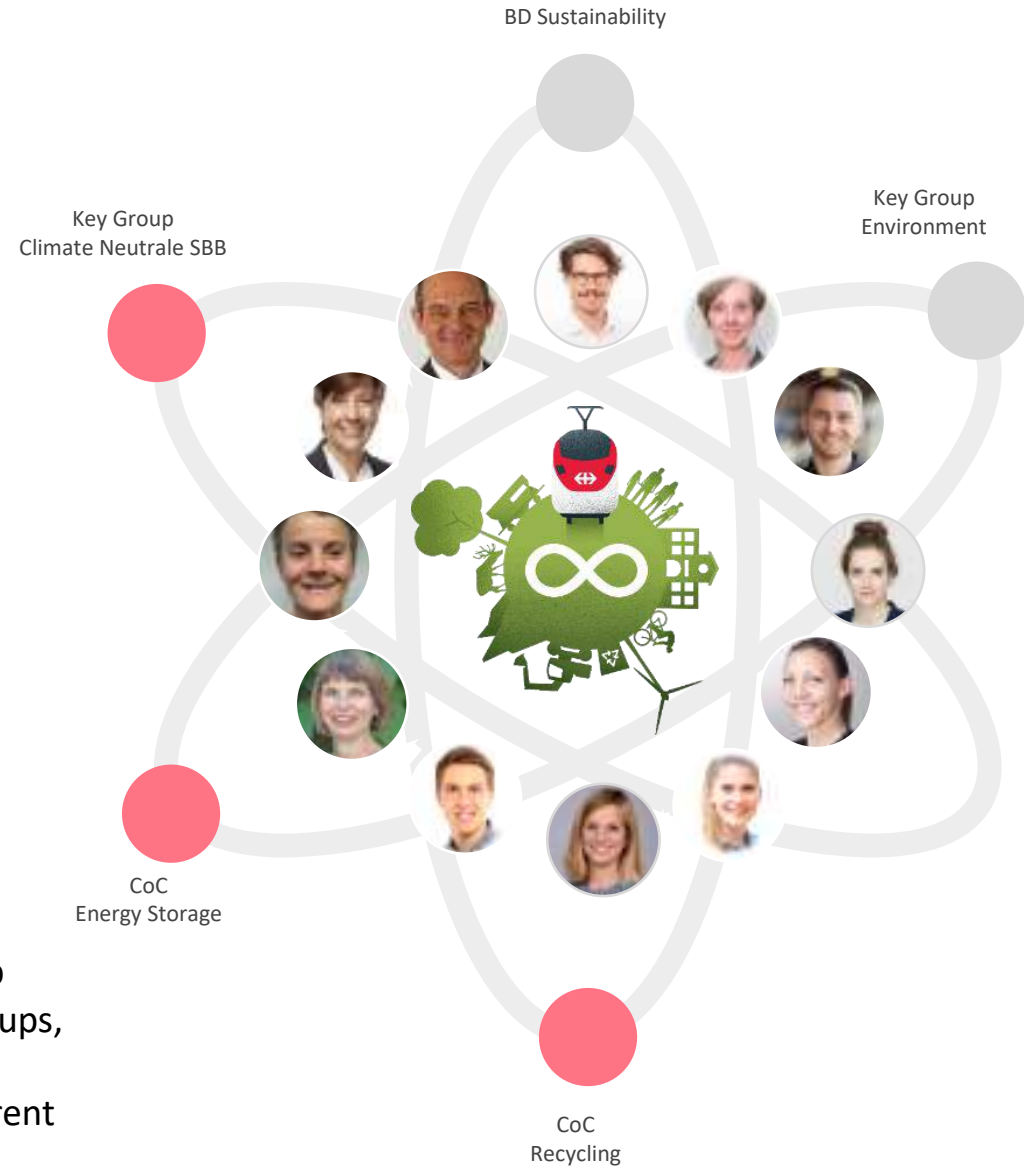
Communication

- Internal Communication
- External Communication

Research, Know How, Best Practice

Program Management

Centralised professional knowledge, shared throughout the organsation



- Established in 2021
- Cross-functional core team with representatives of every division of the Group
- Network of other environmental-related internal and external stakeholder groups, CoCs and research institutes
- Support and consulting of various projects throughout the entire SBB on different levels, building up and leveraging practical CE knowledge


Time to be better.
Time to get greener.
We live sustainability.


SBB CFF FFS
Become zero &
benefit from today’s collaborations !
circular@sbb.ch

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KEYNOTE

Embracing Systems Thinking for Sustainable Innovations in the Railway Sector

Leo Bürki

Inhaber «BSK Organisationsentwicklung»

Professor Berner Fachhochschule (Systemik/Agilität)

Senior Consultant & Coach Systemik@Agile

Embracing Systems Thinking for Sustainable Innovations in the Railway Sector

Transformative potential of "Systems Thinking" in tackling complex challenges in sustainability, circular economy, and innovation

Prof. Leo Buerki
Systemik & agile Leadership Scenario & Strategy

systems thinking

All models are "wrong"
… but some are "useful"

- Structure determines behavior – dynamics emerge from interactions (physics, availability of information, roles).
- Mental models are important – very important: It is not enough to simply change the physics, structure, information, and incentives.
- The often deeply ingrained "no-failure-allowed" mindset inevitably leads to the search for culprits. This is an inappropriate approach in complex systems.

systems thinking and innovation

Systems innovation can be understood as a combination of systems thinking (understanding complexity) and the process of innovation (learning from the future) to *enable change* (Transformation) within a complex system.

Creativity is not the same as "Systems Innovation"

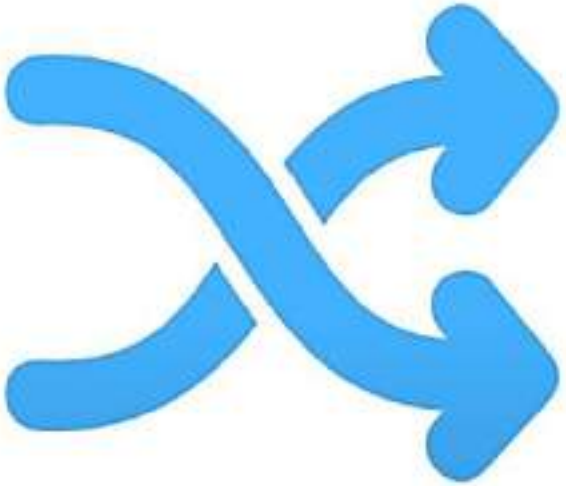
It's creative and too it makes sense - but it's not innovative if nothing changes - if the initial situation remains the same!

Are you familiar with those kinds of situations? Do you ever find yourself feeling lost in them? What comes to mind when you look for ways to navigate through these challenges?

Systems Innovation

Systems Thinking

Transformative Change



Complex Organization

Iceberg Model (systemic dynamics): Events, Patterns, Structures, Models

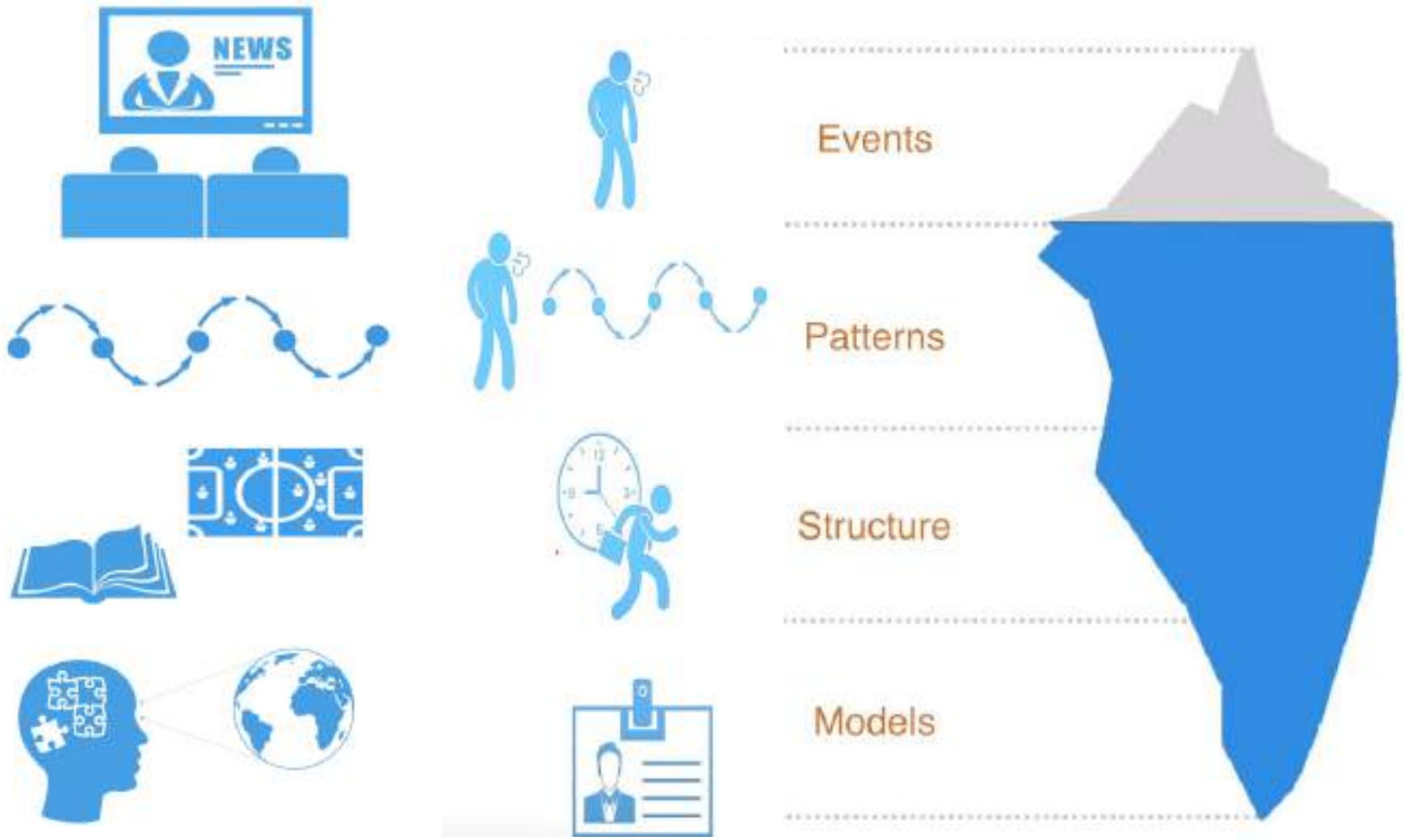
Systemic:

holistic,
dynamized Set
of Variables

interconnection
of variables
Loop Diagram

Holistic system
structure and roles
interpretation

Causal Network
and Scenarios
Mental Models



Iceberg model – the structure determines the behavior

Hierarchical Organizational Development:

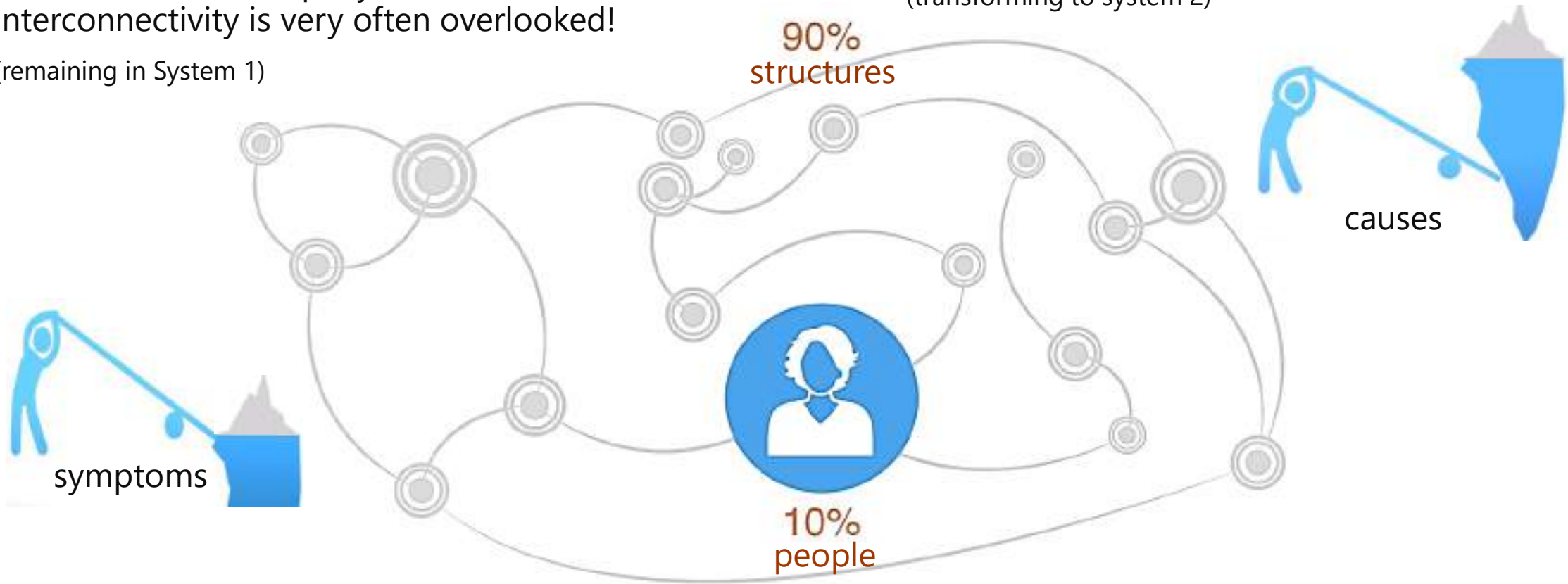
Most organizational development methods focus on elements, parts, departments, and areas within the company – the interconnectivity is very often overlooked!

(remaining in System 1)

Systemic Organizational Development:

Do not try to change people – instead, actively design structures that enable successful work!

(transforming to system 2)



https://vimeo.com/101867695

The six thinking traps in managing complex systems

1. **Thinking Trap: Inadequate Goal Description**
   Outcome-Oriented Goal Setting with Purpose

   Goals are often unclear and lead to inefficient decisions. Clear, meaningful, and continuously reviewed objectives are critical for success.

2. **Thinking Trap: Disconnected System Analysis**
   Make things as simple as possible, but no simpler

   Important connections in complex situations are often overlooked. Holistic modeling is essential for understanding.

3. **Thinking Trap: Unilateral, Sometimes Irreversible Focus Formation**
   Initial success does not necessarily mean sustainability

   Preference is often given to approaches that are successful in the short term but not sustainable. Flexible thinking is required to avoid being trapped in irreversible decisions.

Source: Dieter Dörner - The Logic Of Failure:
Recognizing And Avoiding Error In Complex Situations

4. **Thinking Trap: Unattended Side Effects**
   Consider "If-Then" beyond linear-causal relationships

   Direct consequences are considered, indirect ones are often neglected. An understanding of scenario thinking is important and promotes "learning from the future."

5. **Thinking Trap: Tendency of Oversteering**
   Plan for time-delayed effects

   Overreactions often lead to new difficulties. It is important to consider delayed effects and adjust behavior accordingly.

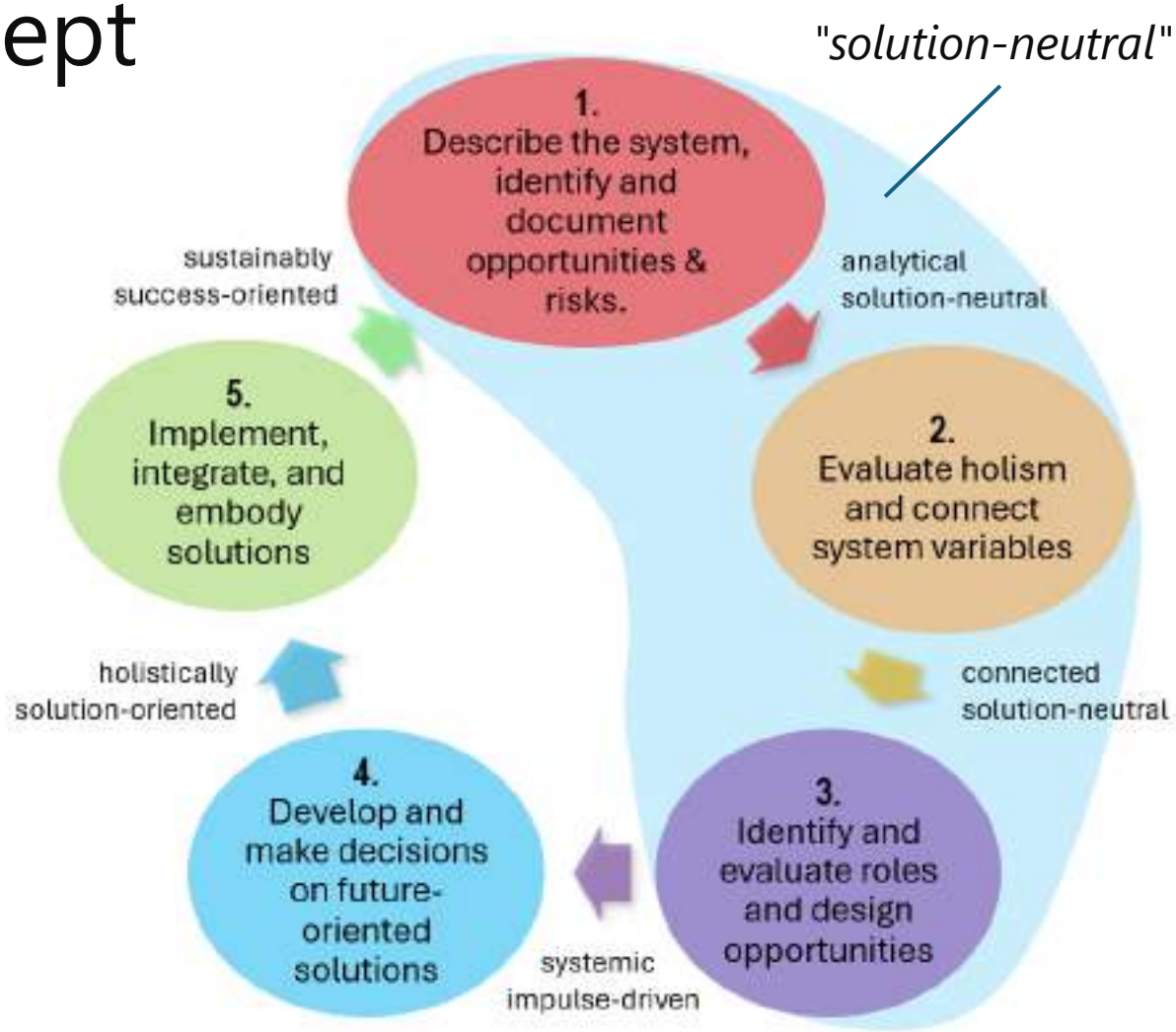
6. **Thinking Trap: Tendency towards Authoritarian Behavior**
   Utilize existing forces through redirection

   More effective than authoritarian approaches is the use of and redirection of existing resources to promote cooperation and shared sense-making.

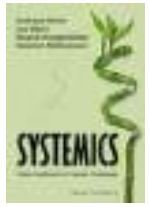
The order corresponds to the thinking traps most frequently encountered by project and leadership personnel.

Systemic Approach Concept

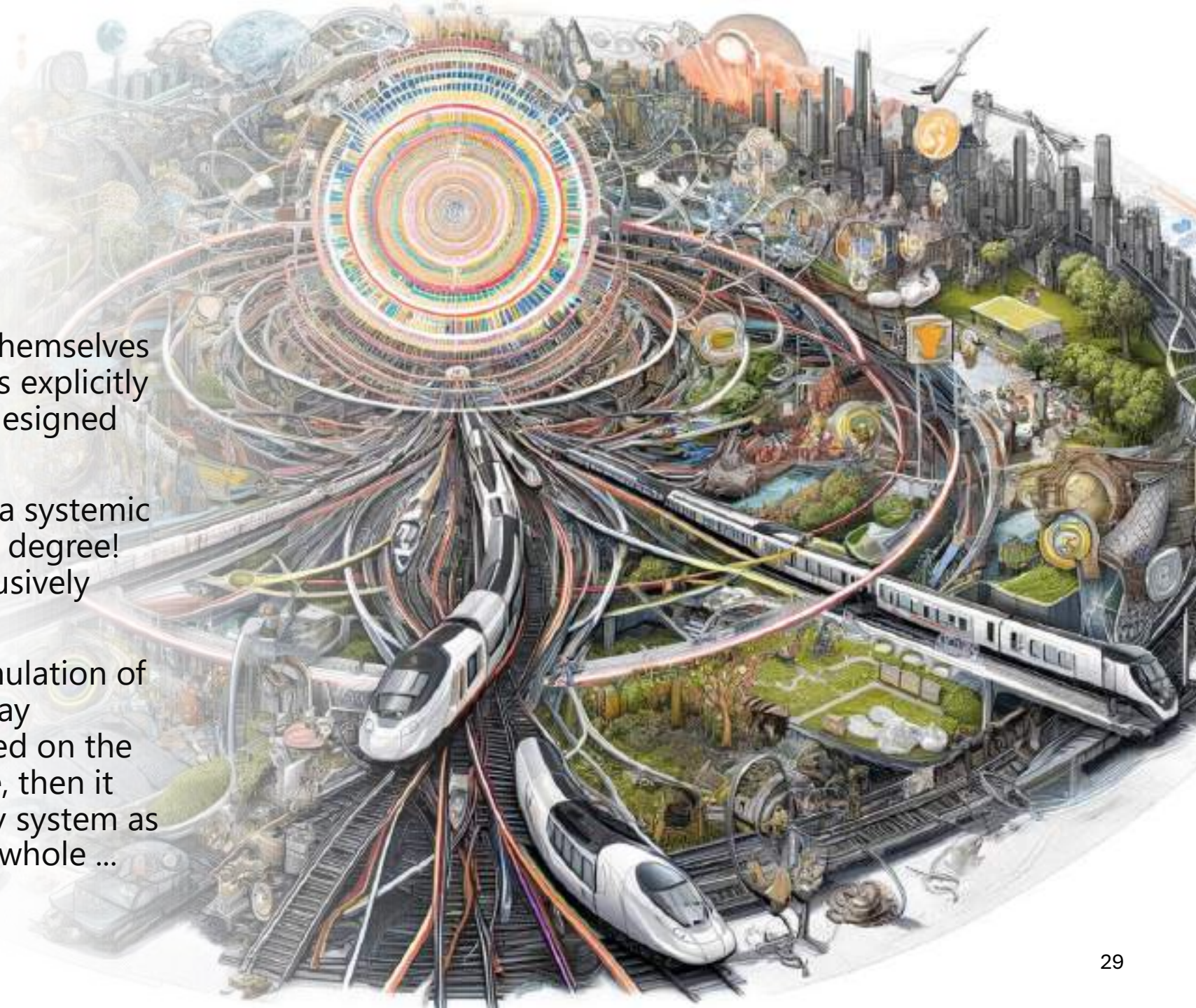
- Systems Thinking for Complex Tasks: *Systemic Solution Loop*
- Uncover existing forces, interactions, dynamics, and behavioral patterns. Critically important: the first three steps in the approach are "*solution-neutral*".
- Visualization tools provide a basis for decision-making, current analyses and scenarios lay the foundation for a *holistic understanding of the system and enable "learning from the future*".



Systemics: Viable Solutions for Complex Challenges
Ninck, Bürki, Hungerbühler, Mühlemann



1. thinking trap: Inadequate Goal Description



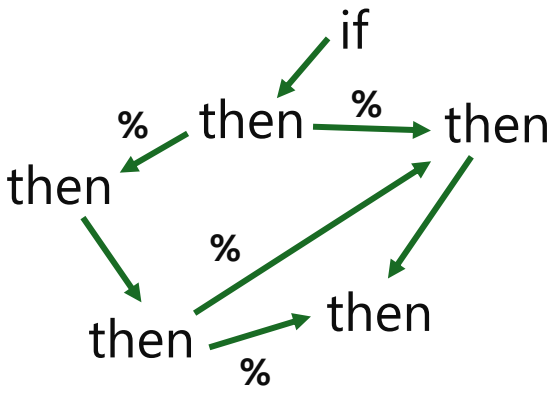
- Complex systems reference themselves with respect to developments explicitly and implicitly based on the designed future images - the goals.
- "Lack of goal formulation" is a systemic development trap of the first degree! For example, hospitals - exclusively mention curing sick people.
- What exactly is the goal formulation of circular economy in the railway industry? If this is only focused on the railway in the narrower sense, then it does not include the mobility system as a whole and the society as a whole ...

2. thinking trap: Disconnected System Analysis

- We humans like it simple - simplify your life. However, simplicity and strategic orientation should never be developed based on over simplistic and too one-sided perspectives.
- For example, manufacturers of personal care products, where the market for young people is further subdivided to better match their preferences.
- If the railway system optimizes itself without including surrounding systems, it leads to the consequences we know today: Roads and railways are planned and built separately, thus preventing potential synergies. Are such issues considered in the circular economy? Are there any new potentials?

complicated: Systems Engineering & complex: Systems Thinking

complicated



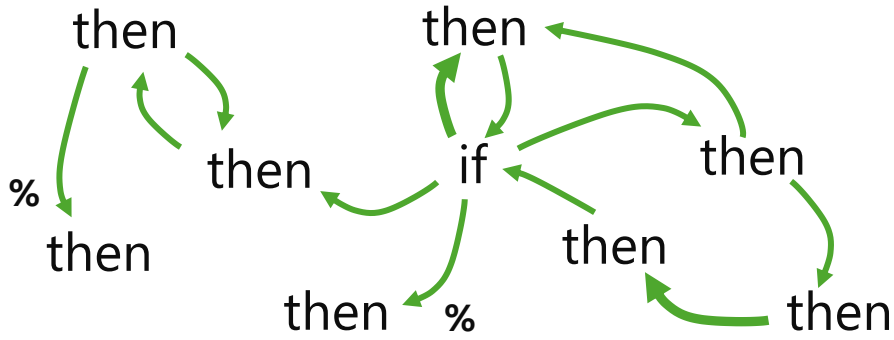
goal clearly defined before realization

closed for information

chain structure

defined response patterns

complex



goal of viability – continuous development

open for information

network structure

large, changing scop of action

Method Competence:

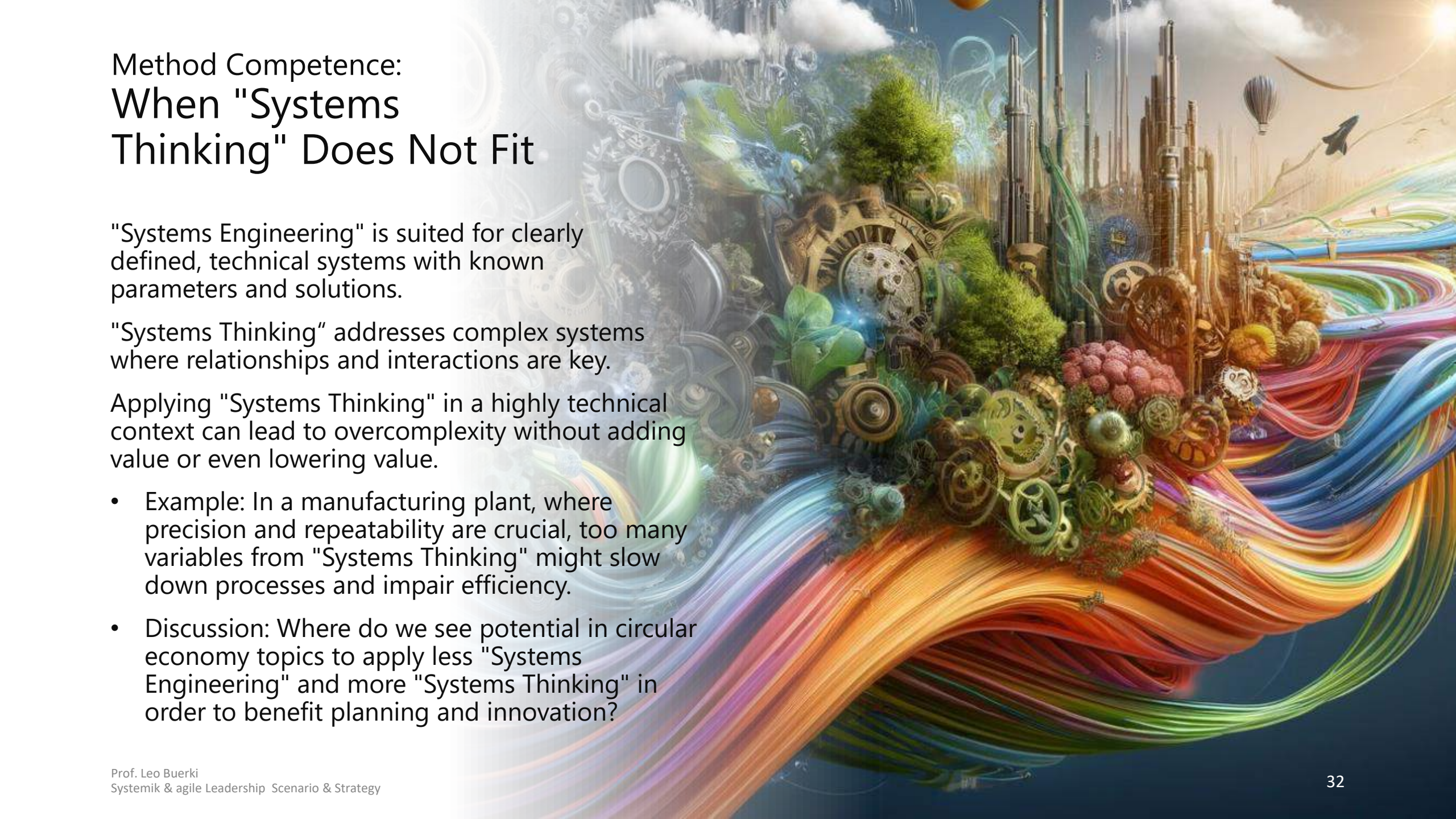
When "Systems Thinking" Does Not Fit

"Systems Engineering" is suited for clearly defined, technical systems with known parameters and solutions.

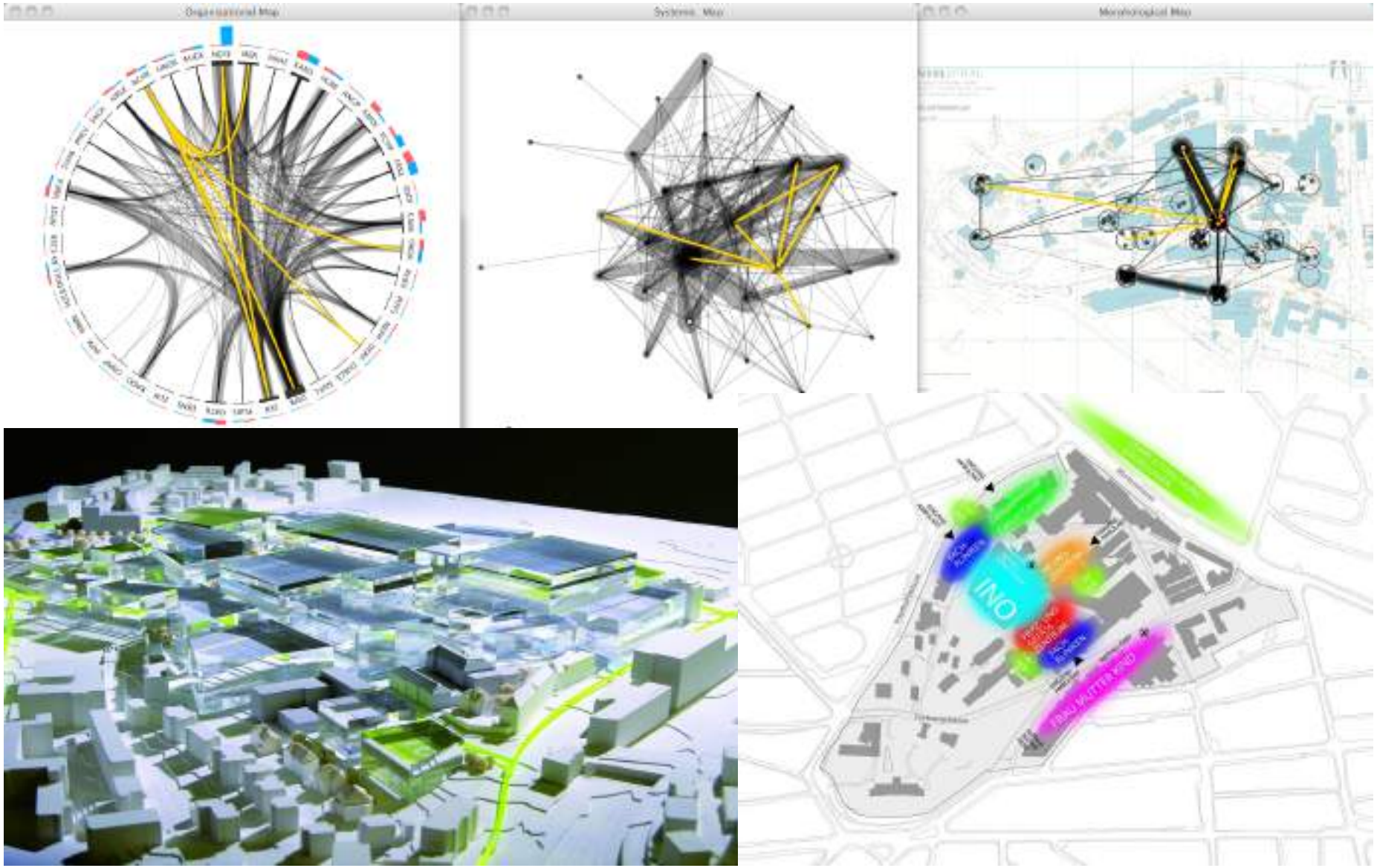
"Systems Thinking“ addresses complex systems where relationships and interactions are key.

Applying "Systems Thinking" in a highly technical context can lead to overcomplexity without adding value or even lowering value.

- Example: In a manufacturing plant, where precision and repeatability are crucial, too many variables from "Systems Thinking" might slow down processes and impair efficiency.
- Discussion: Where do we see potential in circular economy topics to apply less "Systems Engineering" and more "Systems Thinking" in order to benefit planning and innovation?



Systemic Innovation Management – University Hospital Berne



Organizational Transitions

old:
focus on
parts

new:
focus on
connections

Masterplan
University Hospital Berne
From competitive clinic thinking to a holistic competence centers
The new
Anna-Seiler-Haus

Impact in Networks = Resonance

Those who want to leverage the potential of self-amplification – a self-reinforcing dynamic – must develop the ability to grasp the values and attitudes of people from different perspectives: Empathy is the central key competence.

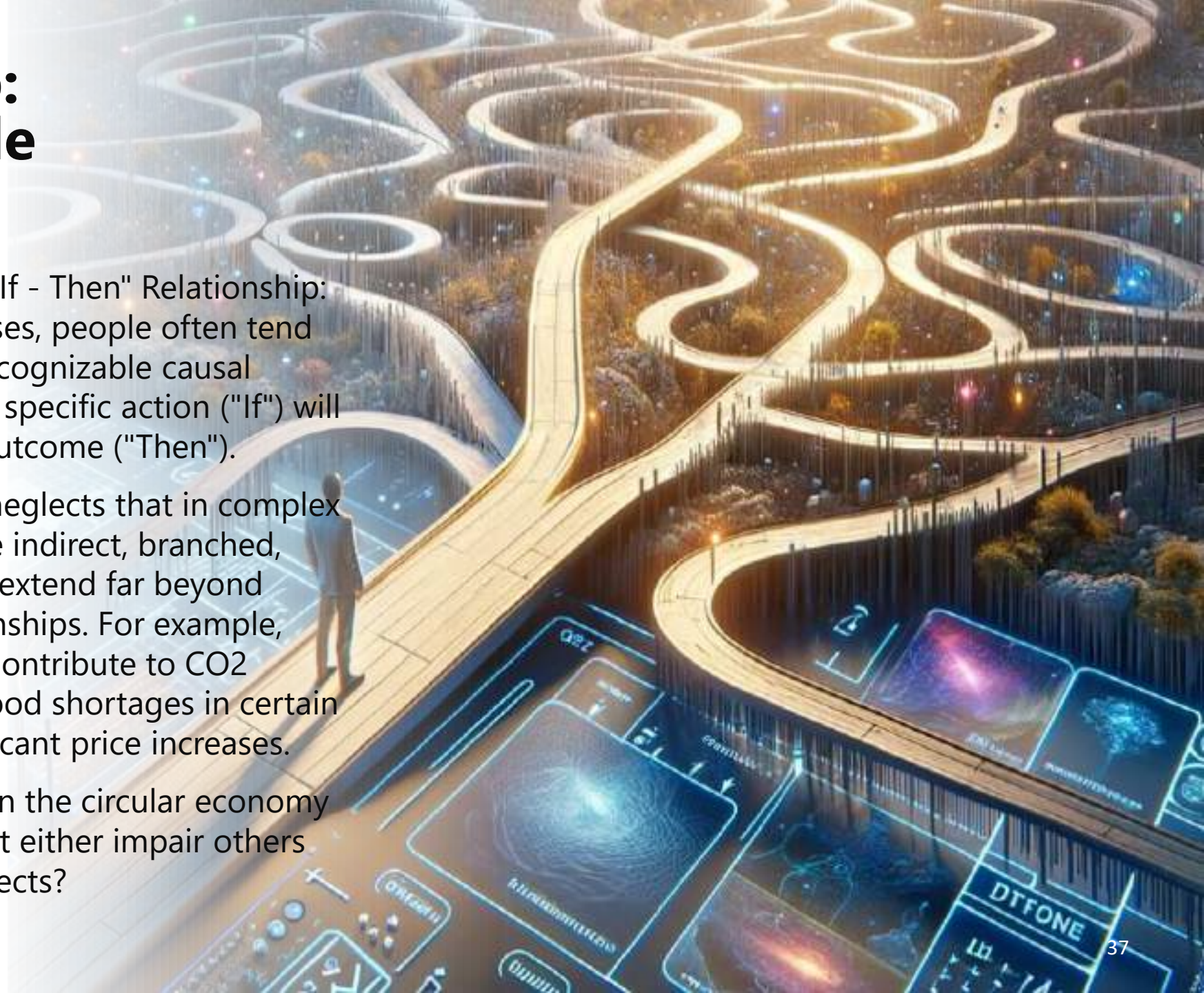
3. thinking trap: Unilateral, Partly Irreversible Focus Formation

- A systemic thinking trap that stems from the success of a defined and implemented strategy. We feel validated in our correctness - we fall in love with this!
- An example familiar to us all from countless quotes is the company of Kodak - which became blind to new developments due to its market dominance and was unable to trigger new developments.
- What about the circular economy for the railway? Circular economy has arrived there - have the requirements changed as a result - do we need new focal points to give the right impulses to current developments?

Prof. Leo Buerki
Systemik & agile Leadership Scenario & Strategy

4. thinking trap: Unattended Side Effects

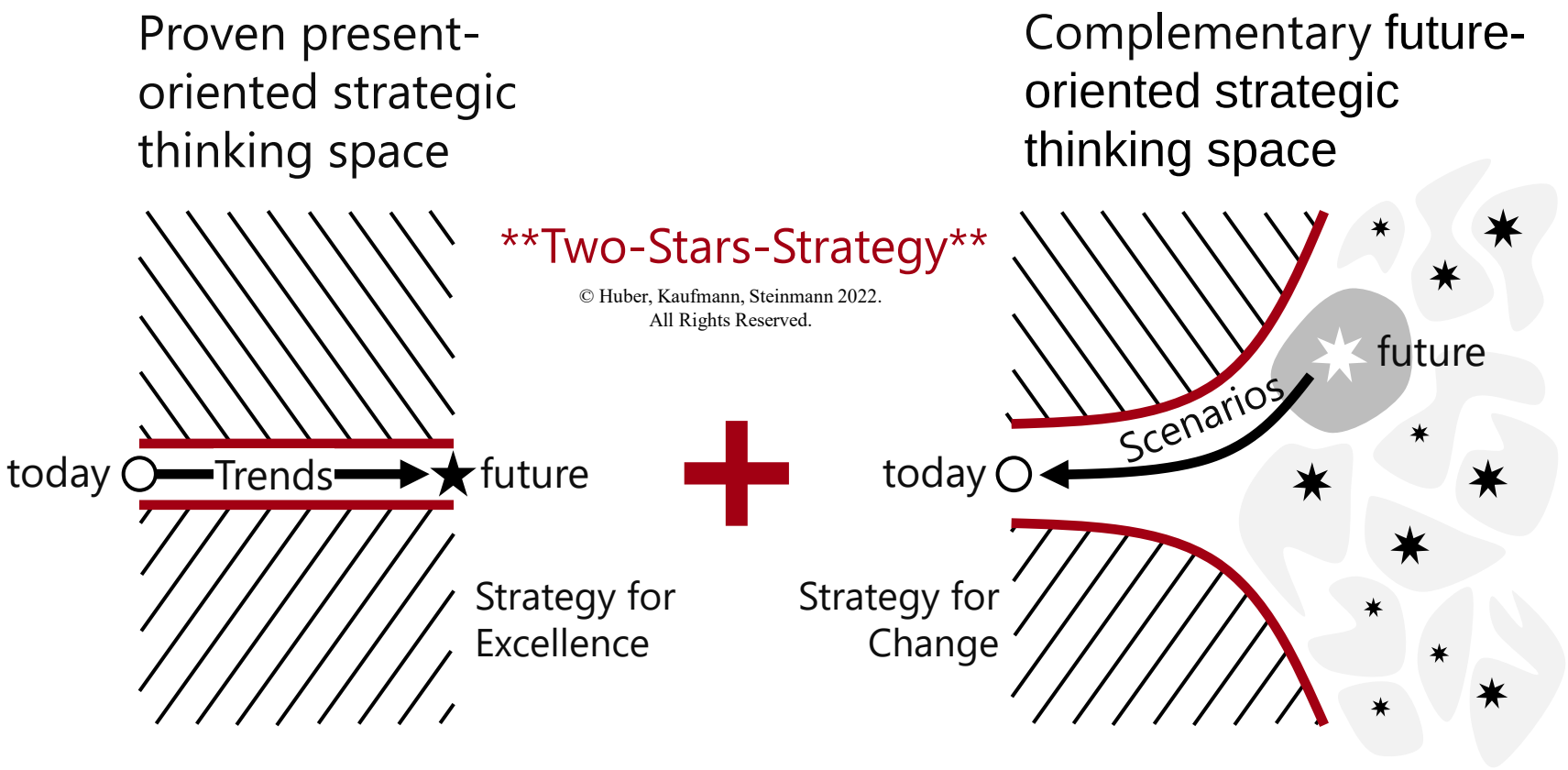
- Beyond the Linear-Causal "If - Then" Relationship: In decision-making processes, people often tend to focus on direct, easily recognizable causal chains. It is assumed that a specific action ("If") will directly lead to a specific outcome ("Then").
- However, this perspective neglects that in complex systems, actions often have indirect, branched, and long-term effects that extend far beyond simple cause-effect relationships. For example, biofuels were intended to contribute to CO2 reduction but resulted in food shortages in certain countries, leading to significant price increases.
- Are there also side effects in the circular economy and its implementation that either impair others or diminish the positive effects?



5. thinking trap: Tendency of Oversteering

- Considering the time-delayed effect:
  In complex systems, intuitive understanding of process inertia is often inadequate. Decision-makers respond to immediate problems with rapid and forceful interventions, hoping to effect quick solutions.
- This behavior can lead to unintended consequences, particularly when the interventions have time-delayed effects that are not visible at first. We are familiar with this from the so-called "Potato Cycle."
- How does this look in the area of the circular economy? Are there activities where this risk exists - an overreaction or underreaction to significant developments in society?

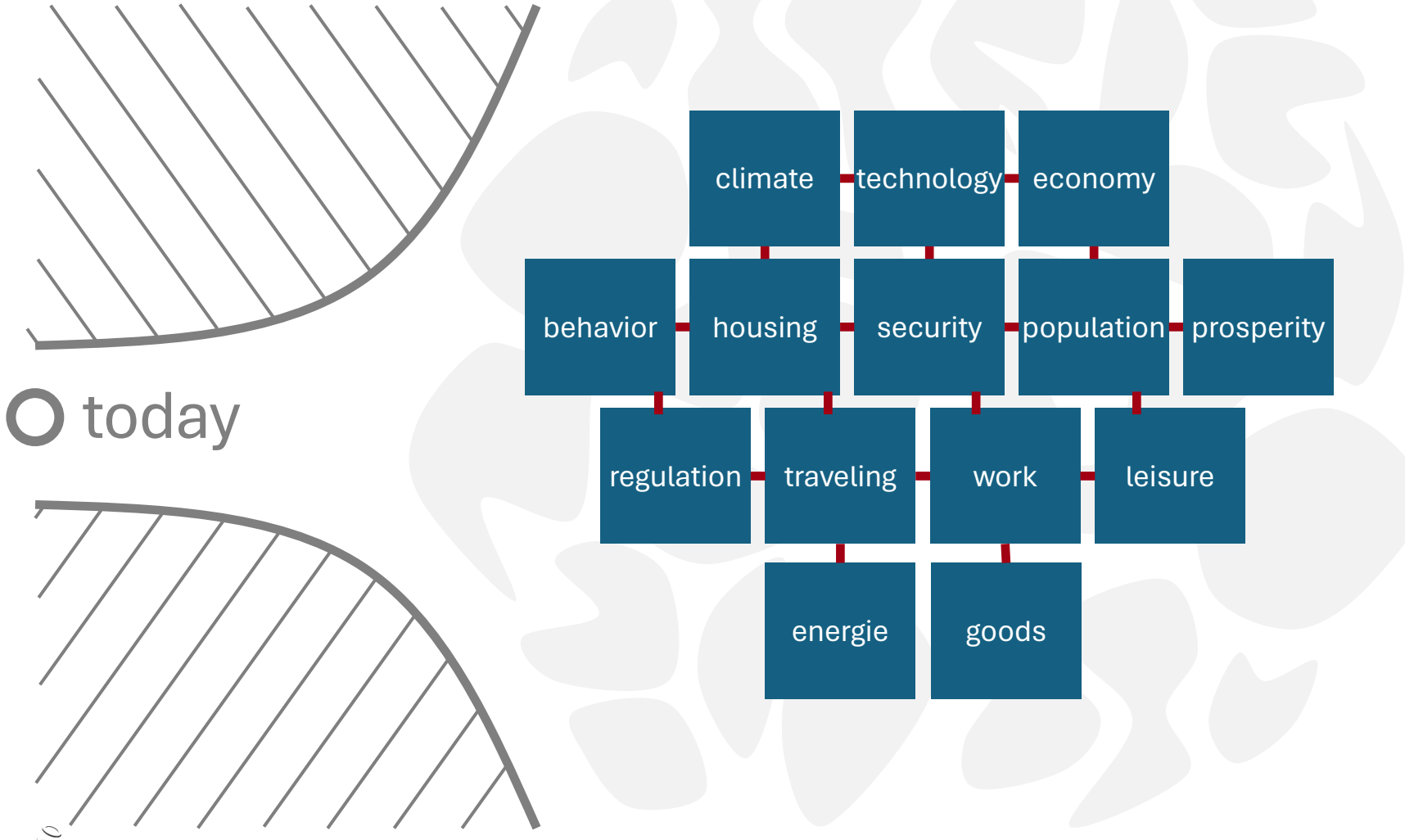
Expanding the future-oriented thinking space – development of a "two-star strategy"



Scenario Space

The future is viewed as an open space of possibilities, not as a continuation of the present.

Fourteen building blocks for holistic mobility scenario spaces

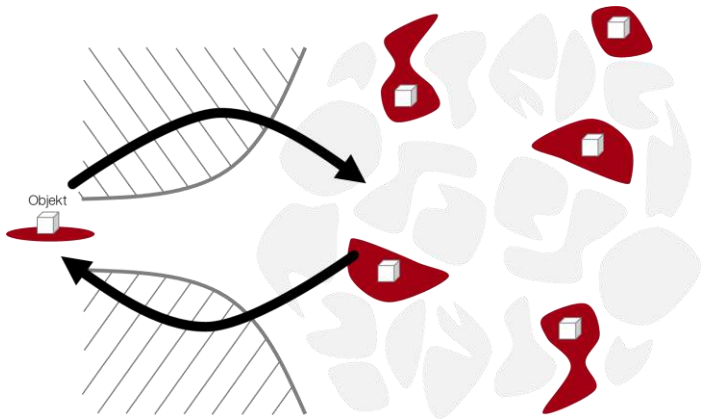


The scenario space consists of 14 dimensions, which allow a holistic description of mobility scenarios:

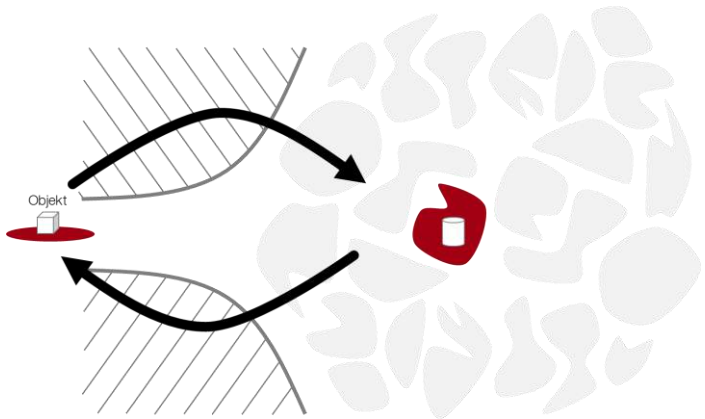
Storytelling along the building blocks in a morphological matrix enables to discover the future space in multidimensional views.

Systemic “scenario space” addressing various questions

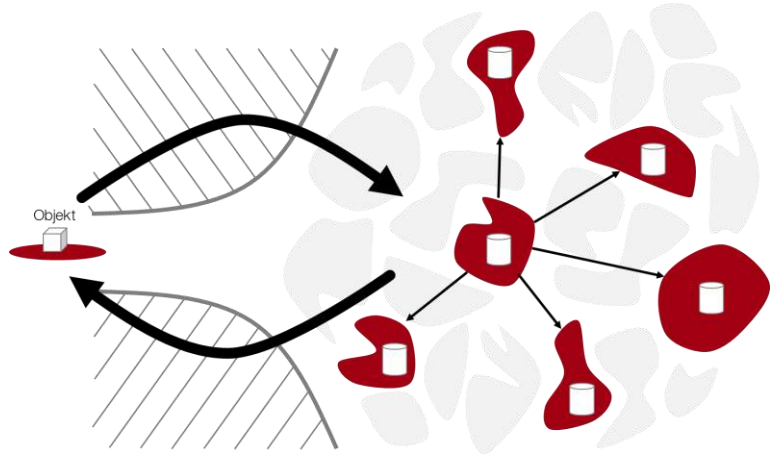
Opportunities and risks of a current object / system in different scenarios (Wind-tunneling)



Strategic implications for today derived from a defined scenario (learning from the future).



Assessment of the resilience / future viability of a future object / system (Scenario antifragility).



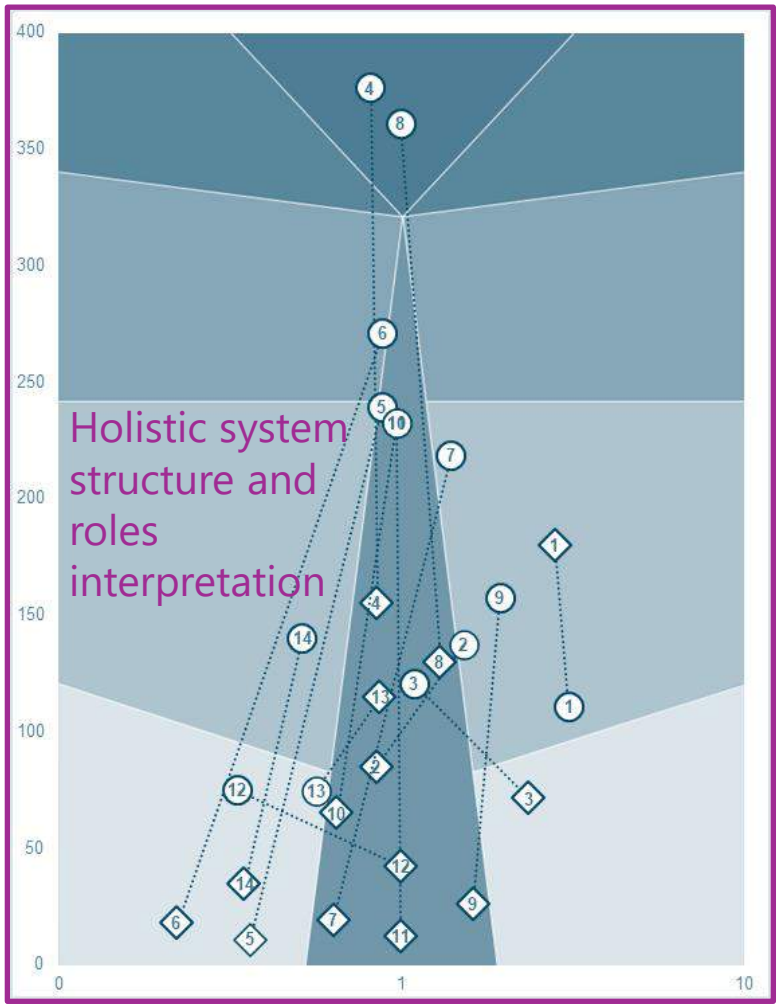
We use AI to develop mobility scenarios - and let ourselves be surprised by the scenarios that emerge. How can the circular economy benefit by using the "learning from the future" approach? What divergent strategies for different scenarios could make the circular economy antifragile?

Dynamic scenario methodology provides structural interpretation possibilities

F	V01	V02	V03	V04	V05	V06	V07	V08	V09	V10	V11	V12	V13	V14	AS
V01	2,00	0,50	0,50		0,50	0,50							0,50		4,50
V02		1,00			2,00	2,00		0,50	1,00		2,00	1,00	1,00	1,00	11,50
V03	0,50	1,00	1,00	0,50	0,50	0,50	1,00	2,00			1,00			0,50	8,50
V04		0,50	0,50	1,00	0,50	0,50	1,00	2,00		1,00		1,00	0,50	0,50	9,00
V05					1,00	1,00		0,50	0,50		1,00		0,50	1,00	5,50
V06	0,50			0,50	0,50	1,00	0,50		1,00	0,50	1,00	0,50	0,50	0,50	7,00
V07				1,00	0,50	0,50	1,00	2,00		1,00	1,00	1,00		0,50	8,50
V08					0,50		2,00	1,00			0,50			0,50	4,50
V09	0,50			0,50	0,50	1,00		0,50	1,00		1,00		0,50	2,00	7,50
V10				0,50				0,50	0,50	1,00		1,00			3,50
V11				0,50	0,50	1,00	0,50		1,00		1,00	0,50	0,50	0,50	6,00
V12				0,50	0,50		1,00	0,50		1,00	0,50	1,00			5,00
V13	0,50				0,50	0,50			0,50		0,50		1,00	1,00	4,50
V14					0,50	0,50			0,50		0,50			1,00	3,00
PS	4,00	3,00	2,00	5,00	8,50	9,00	7,00	9,50	6,00	4,50	10,00	6,00	5,00	9,00	

double-cross-impact-analyze

H	V01	V02	V03	V04	V05	V06	V07	V08	V09	V10	V11	V12	V13	V14	AS
V01	1,00						0,50								1,50
V02		1,00	0,50	0,50		1,00	0,50	1,00							4,50
V03			1,00			0,50			0,50	0,50	1,00		0,50	0,50	4,50
V04	0,50			1,00	0,50				0,50						2,50
V05				0,50	1,00		0,50								2,00
V06						1,00	1,00	1,00							3,00
V07							1,00		0,50						1,50
V08				0,50	1,00	1,00		1,00	0,50	0,50	1,00		0,50	1,00	7,00
V09							1,00	1,00	1,00						3,00
V10										1,00					1,00
V11								1,00			1,00				2,00
V12												1,00			1,00
V13							0,50	0,50					1,00		2,00
V14	0,50			0,50				0,50						1,00	2,50
PS	2,00	1,00	1,50	3,00	2,50	3,50	5,00	6,00	3,00	2,00	3,00	1,00	2,00	2,50	

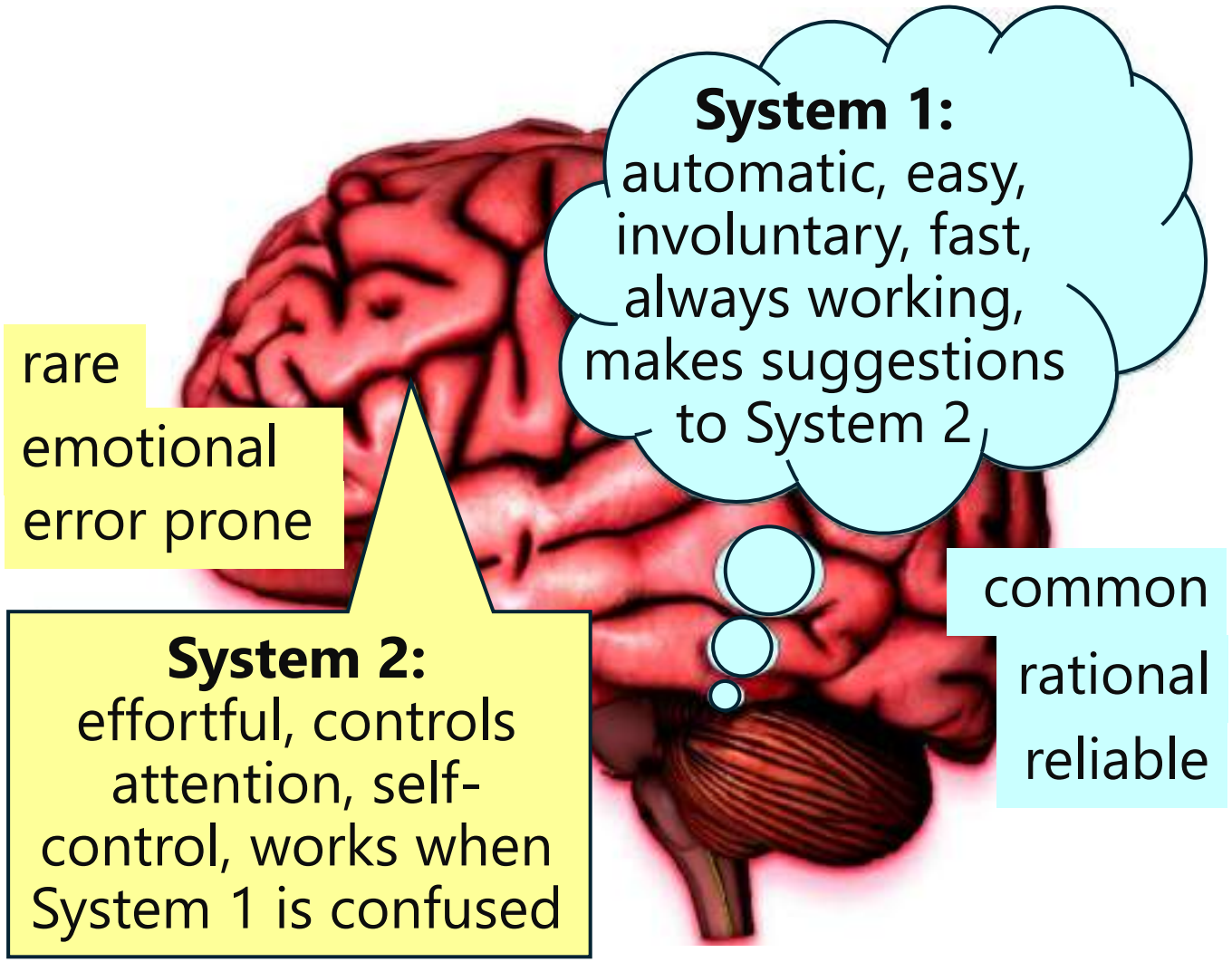


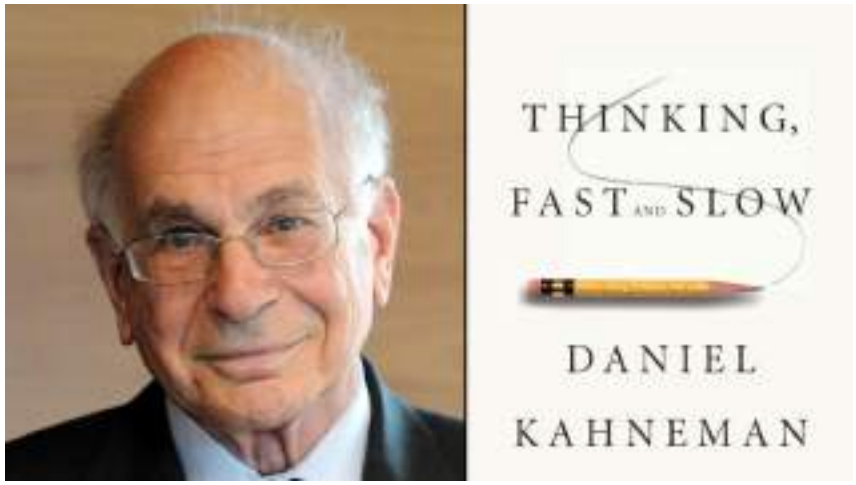
In reference to the iceberg model: Systemic analyses connect subsystems into recognizable patterns, reveal behavioral structures, and enable thinking about of new model developments.

For example: We identify within the system which subsystems are drivers - or merely indicators, we analyze loops and the overall dynamics (positive or negative feedback) and recognize explicit or implicit goal of an overall system.

«Thinking fast and slow»

(Daniel Kahneman, Nobel Prize in Economics - one of the most influential psychologists of our time)





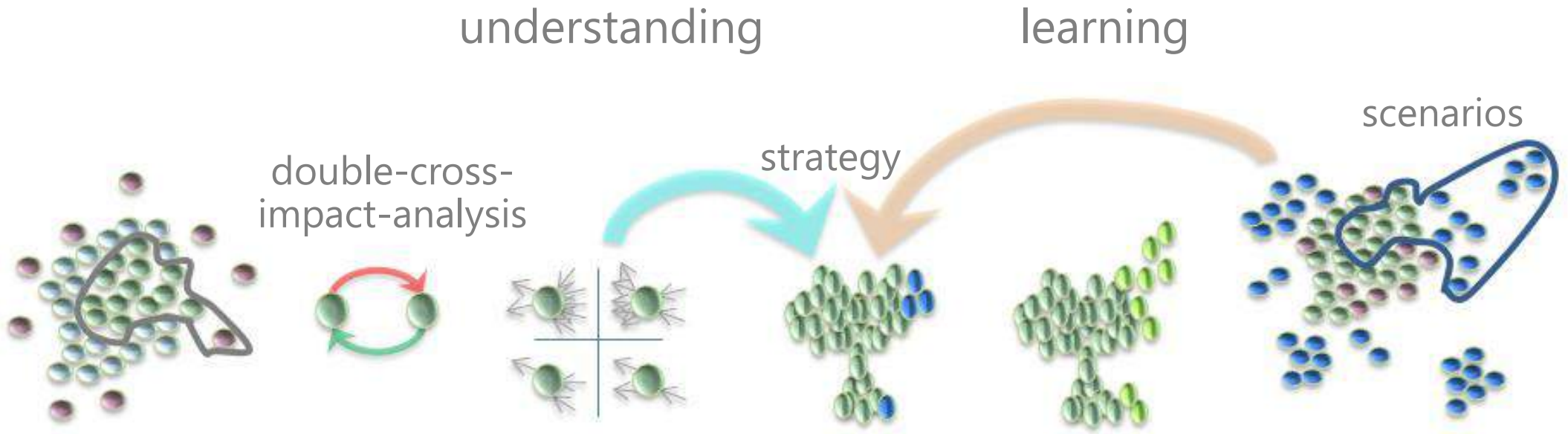
Systems Thinking

"disrupts System 1"

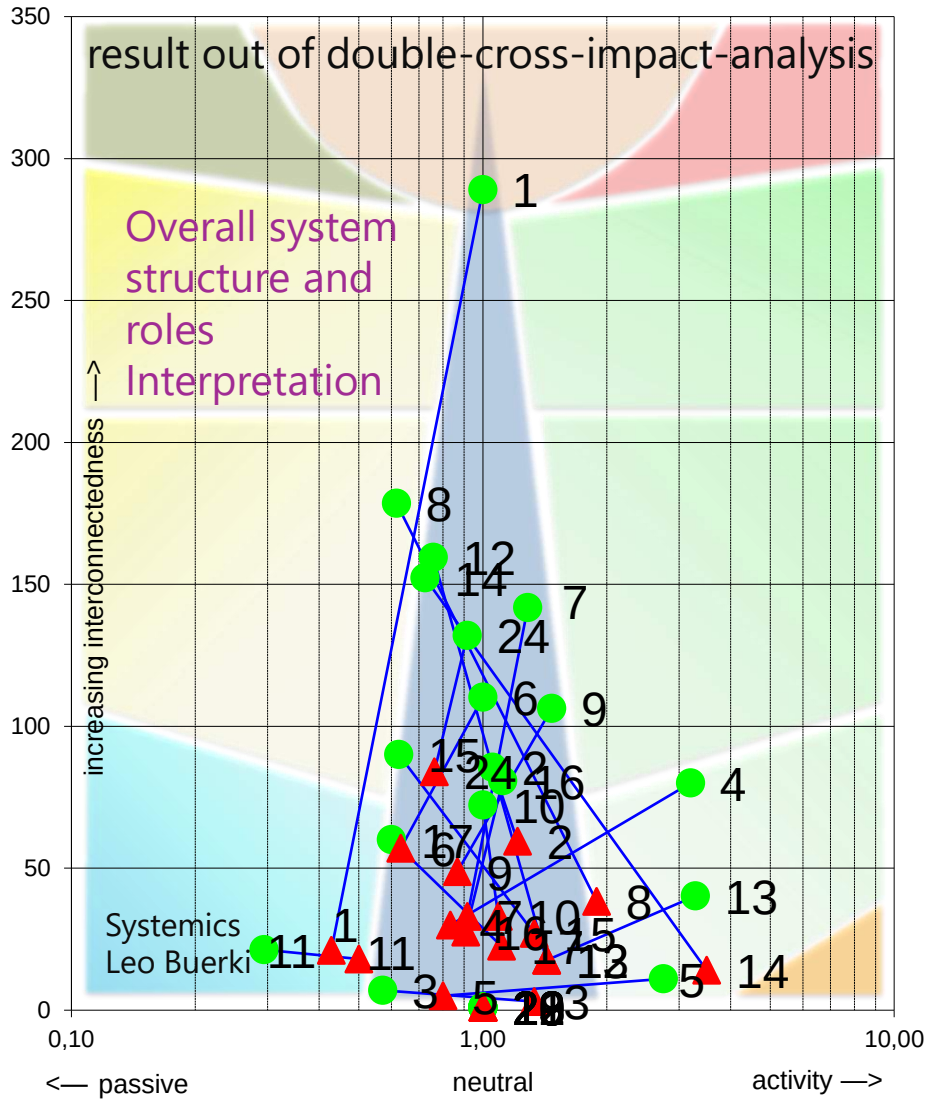
and

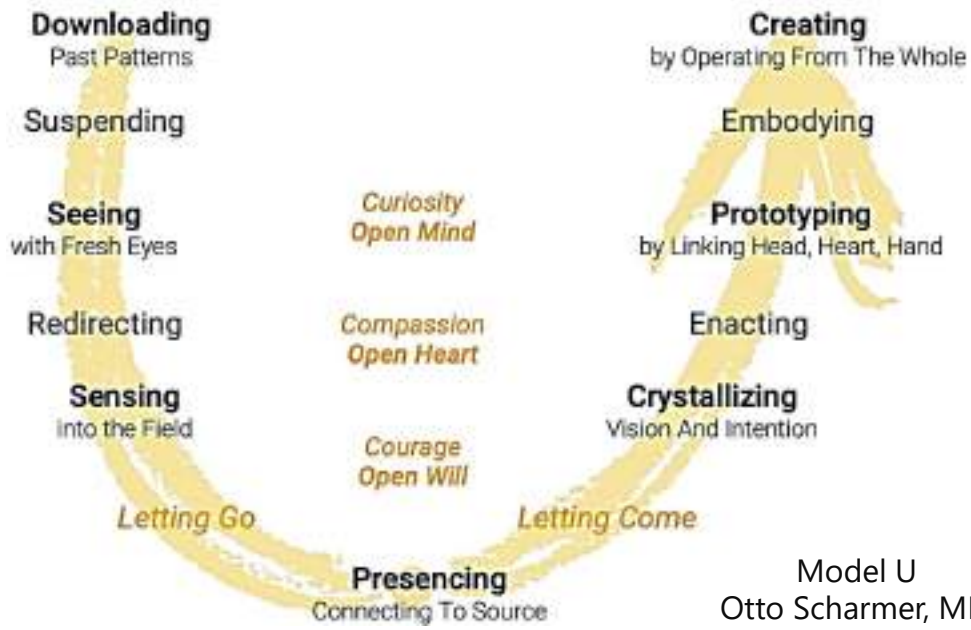
"inspires System 2"

System-Analyze & Emerging Future



System-Analyze (understanding) & Emerging Future (letting come)





Model U
Otto Scharmer, MIT

Example of an IT company

Revealed The system analysis revealed that the company had been engaging in symptom management for years, which did not address the identified challenges but protected the current structures. This insight mobilized forces for a genuine change!

Systemic Indicator for the "Shifting the Burden" Archetype: Short-term improvement followed by a return to the initial situation. Are there such phenomena in the circular economy?

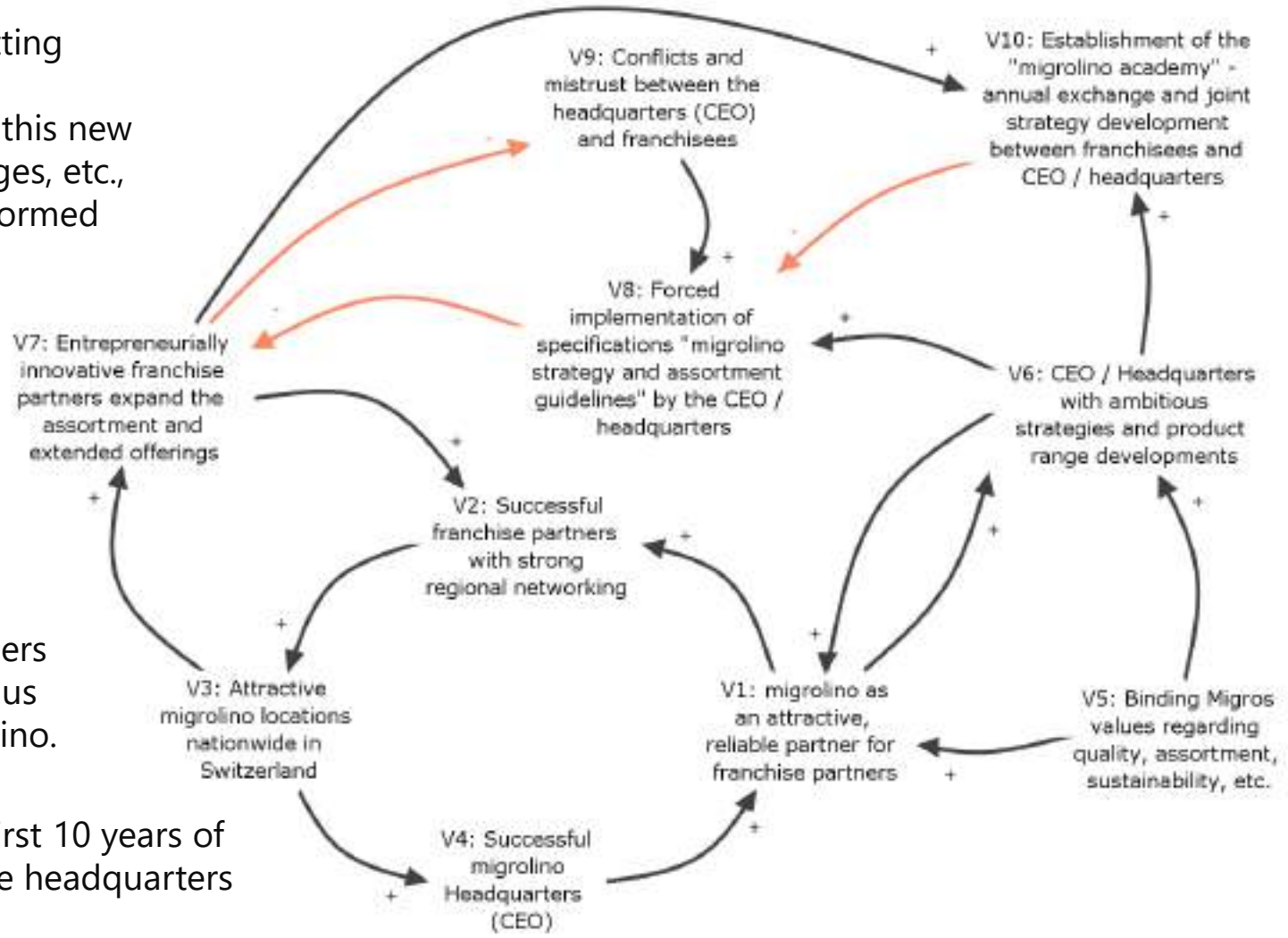
Antifragile structure - migrolino

4. To harness the innovation potential of both the franchisees and the headquarters/CEO without pitting them against each other, migrolino established an antifragile structure: the migrolino academy. With this new structure, disruptions, signals, requirements, changes, etc., from the entire Swiss market can be quickly transformed into positive developments.

3. The franchise partners increasingly deviated from the migrolino guidelines, causing the headquarters to enforce their defined strategic visions more vehemently. This reduced the success of the franchisees and heightened conflicts and mistrust towards the headquarters.

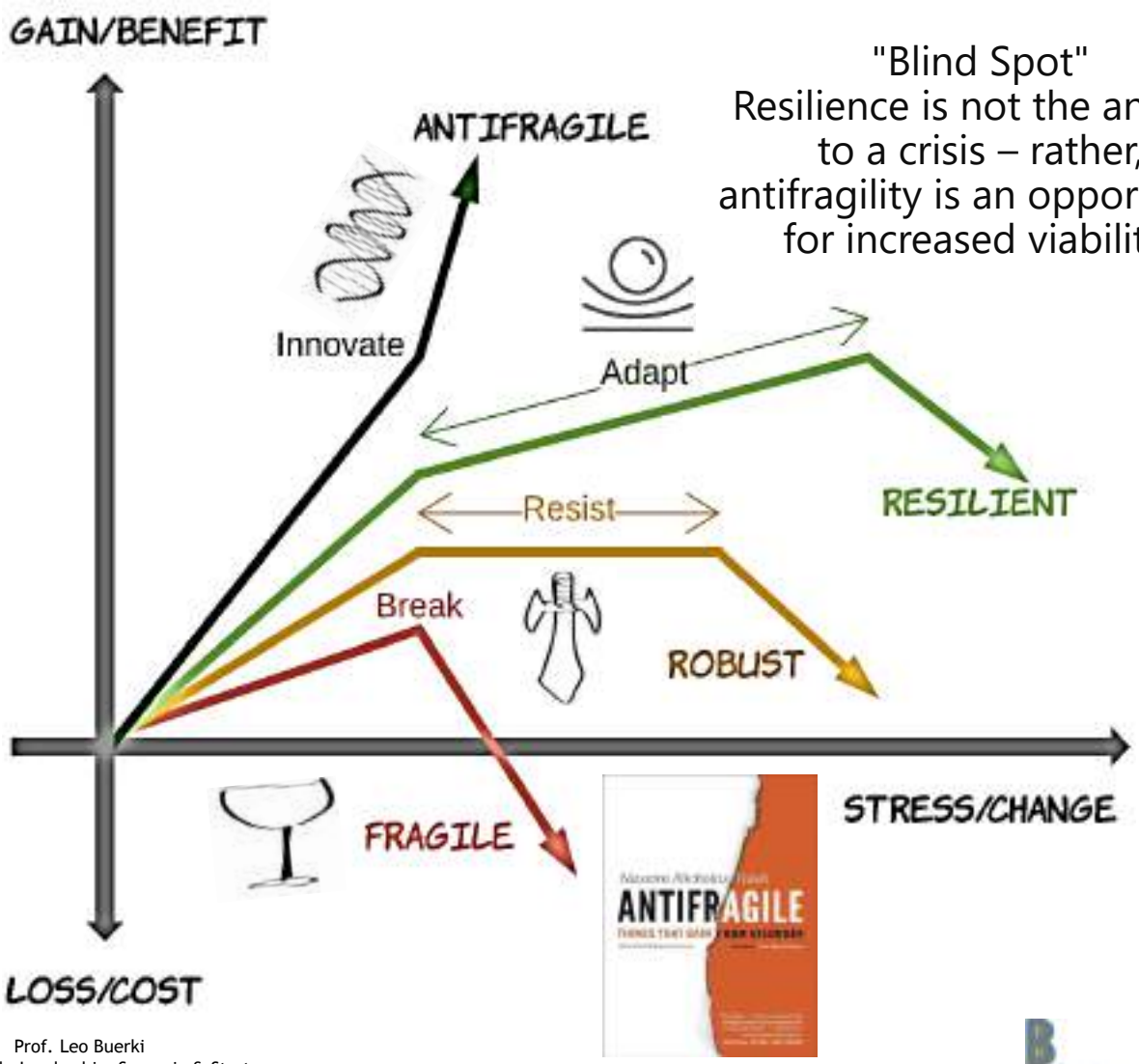
2. The entrepreneurially innovative franchise partners expand the assortment and extended offerings, thus disproportionately increasing the results of migrolino.

1. Very positive, reinforcing developments in the first 10 years of migrolino - for the parent company Migros, for the headquarters / CEO of migrolino, and also for the franchisees.



Dynamic Developments – from Fragile to Antifragile

- **Fragile:** Loses value continuously throughout its lifecycle and eventually becomes "worthless".
- **Robust:** Resists external influences up to a threshold – beyond that, the system "breaks".
- **Resilient:** After an event, the system is weakened – it then recovers to its previous level.
- **Antifragile:** Events - including crises - trigger new development opportunities in antifragile systems and enhance viability.



"Blind Spot"
Resilience is not the answer to a crisis – rather, antifragility is an opportunity for increased viability!


You never change things
by fighting the existing reality.
To change something, build new solutions
that make the old ones obsolete.
Richard Buckminster Fuller (Architect)

Call to actively implement “systems thinking"

Now more than ever, it is time to look beyond the conventional and actively incorporate the principles of the circular economy into the strategies of the railway and overall mobility. How can we shape the opportunities arising from current trends and technologies and proactively support an environmentally friendly mobility future?

Possible topics could include:

1. **Circular-oriented interdisciplinary cooperation**: How can experts from different fields collaborate to implement circular economy solutions in the railway sector?

2. **Innovation barriers to a circular economy**: What structural obstacles exist for circular economic innovations in the railway sector and where can systemic approaches overcome them?

3. **Antifragility and circular economy**: How can the concepts of antifragility be integrated to anchor circular economy principles in the infrastructure of the railway sector?

4. **Reevaluation of existing practices**: Which current practices in the railway sector are compatible with circular economy approaches, and which need to be rethought to enhance sustainability?

5. **Strategies for Circular-oriented Overall Mobility**: How can the railway sector serve as the cornerstone of a comprehensive, circular-oriented mobility strategy and create synergies with other modes of transport?

Thank you very much for your interest in "systems thinking" and the associated methods and mindsets.

I wish the circular economy continued successful development and success!

INTERNATIONAL UNION
OF RAILWAYS

REDUNDANT ASSETS VALUE

Embracing Systems Thinking for Sustainable Innovations in the Railway Sector

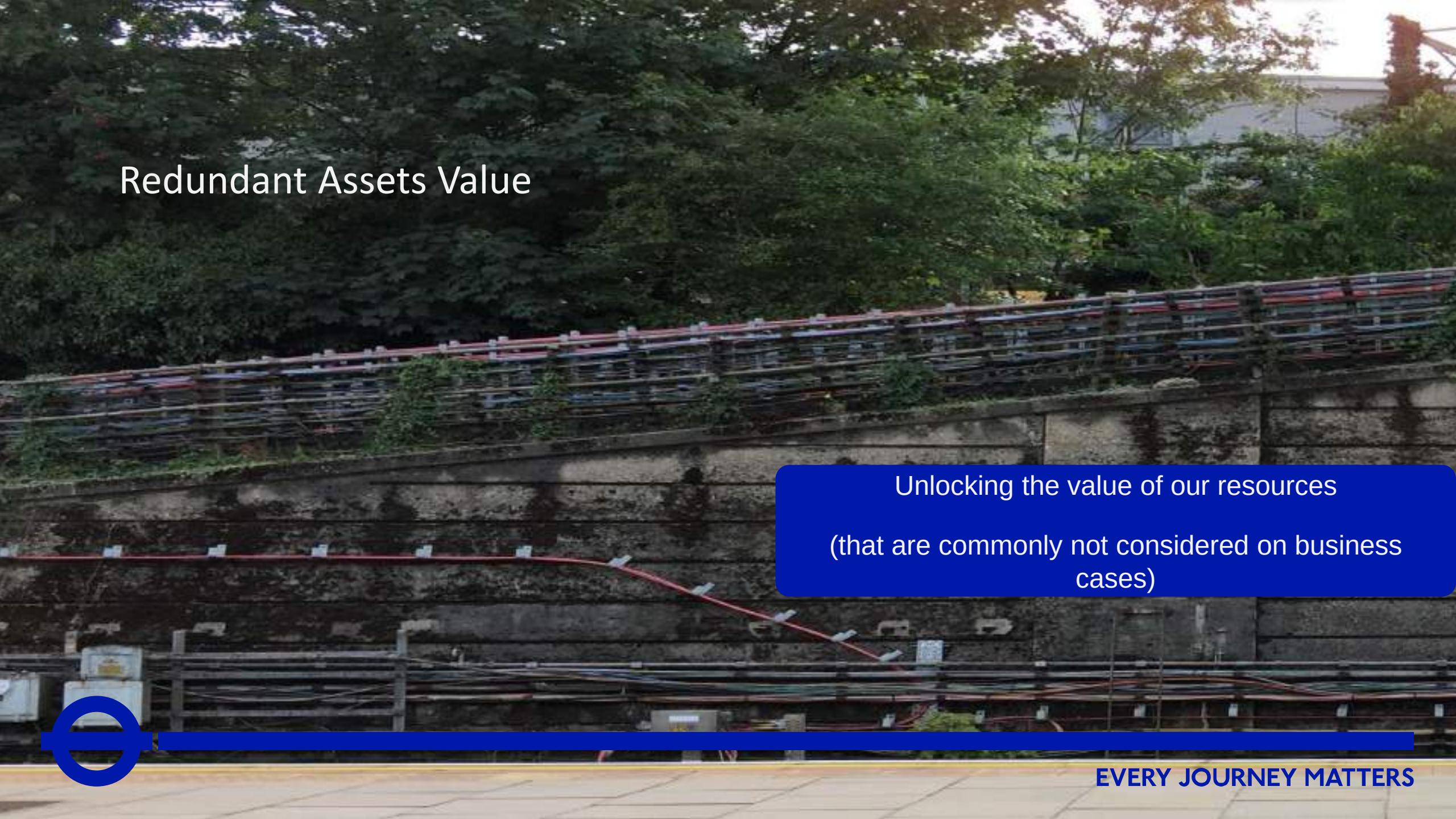
Melina Kakouratou

External Risks Engineer

Infrastructure Protection TfL Engineering

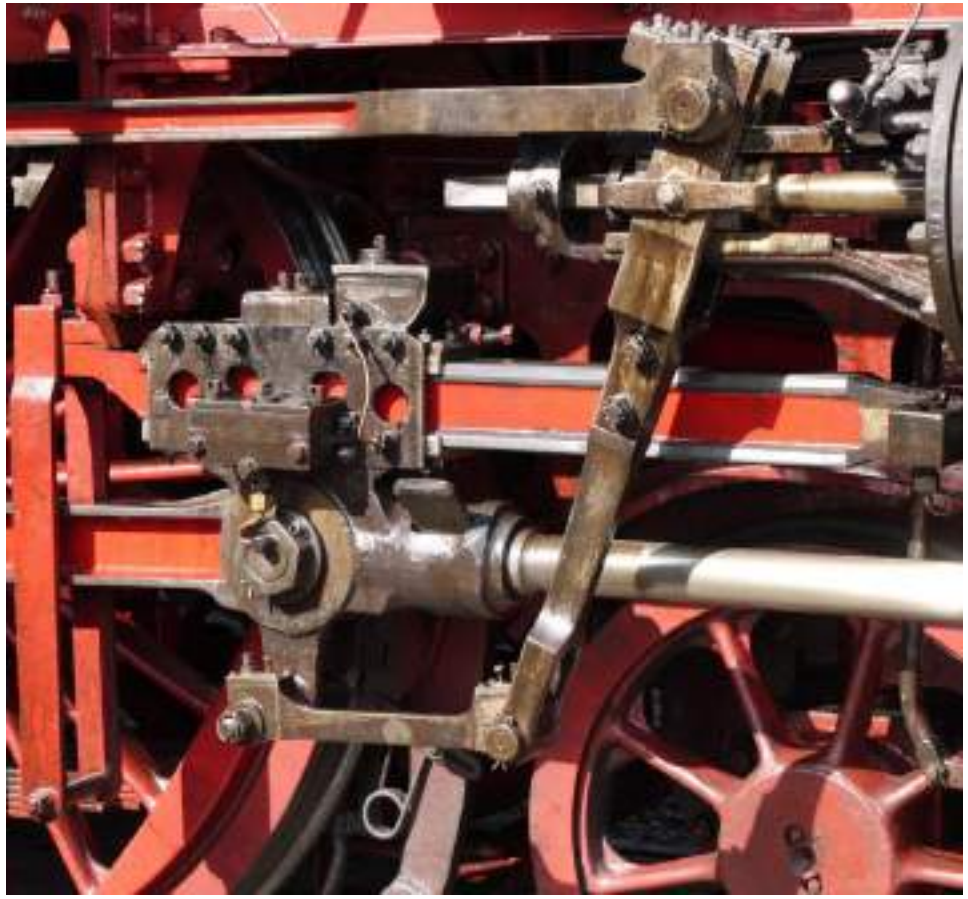
melinakakouratou@tube.tfl.gov.uk

Redundant Assets Value

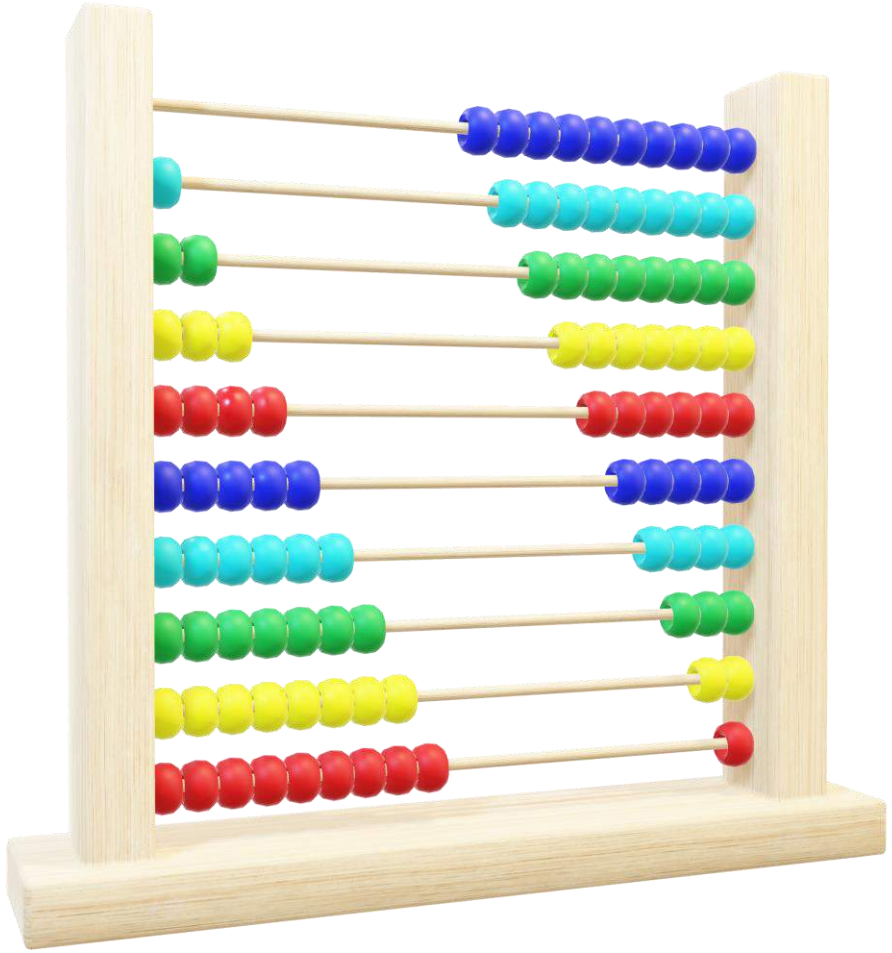


Unlocking the value of our resources

(that are commonly not considered on business cases)



A component of a system has it is own value plus the many values related with the system which is part of



The Problem

A. Cable identification

B. Deviation from the Strategy for Redundant Assets

Sustainability/Circularity issues and Interdependencies

- **Maintenance of cable runs**
- **Cables' maintenance**

- **Cost of cable removal**

- **Removal implications**

PROJECT'S UNCALCULATED COSTS ROLLED BACK TO THE BUSINESS

Maintenance of civils structures

Sustainability

E. Future costs

- **Costs associated with new cable routes and new and tailored cable posts**
- **Cost of Space identification, Design around existing assets**

Sustainability

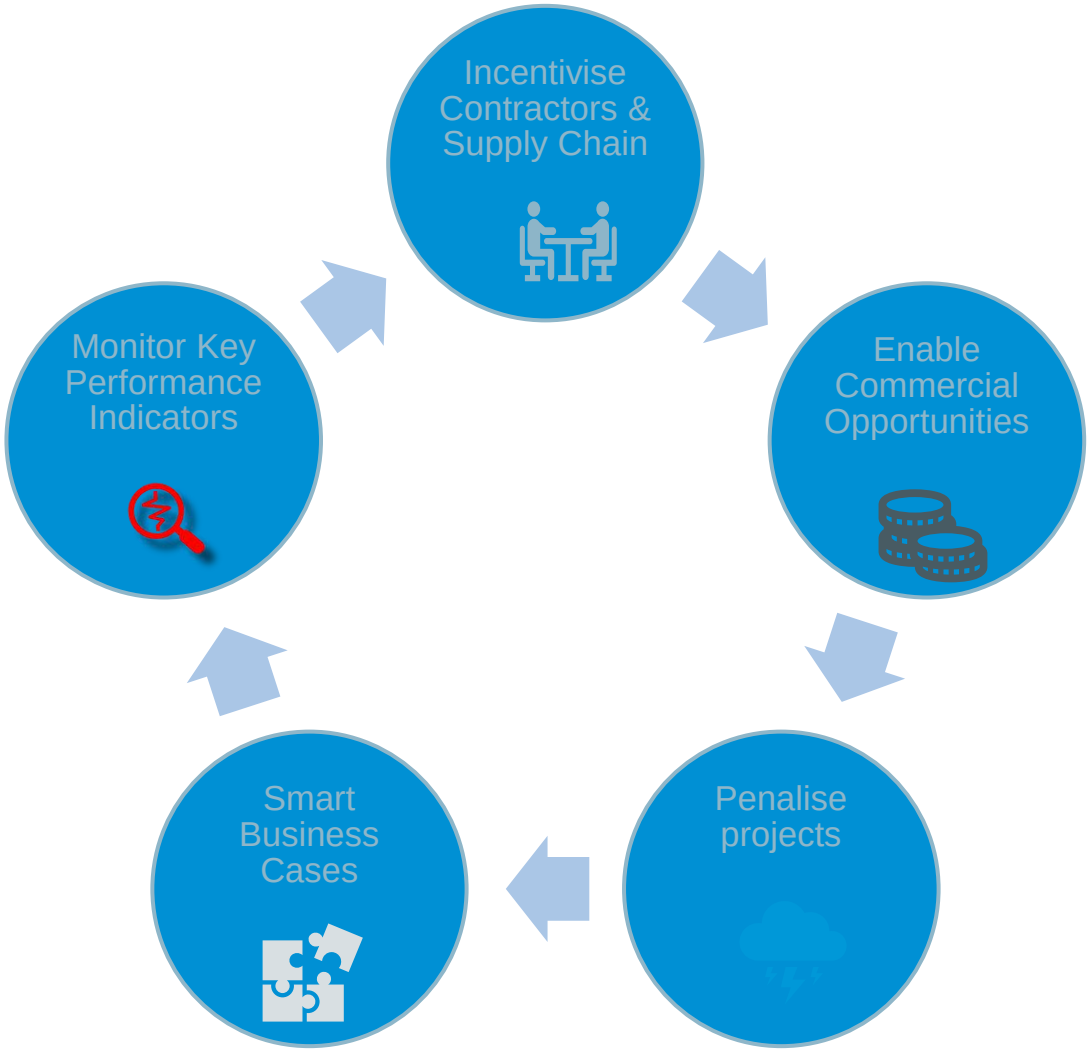
F. Value leakage

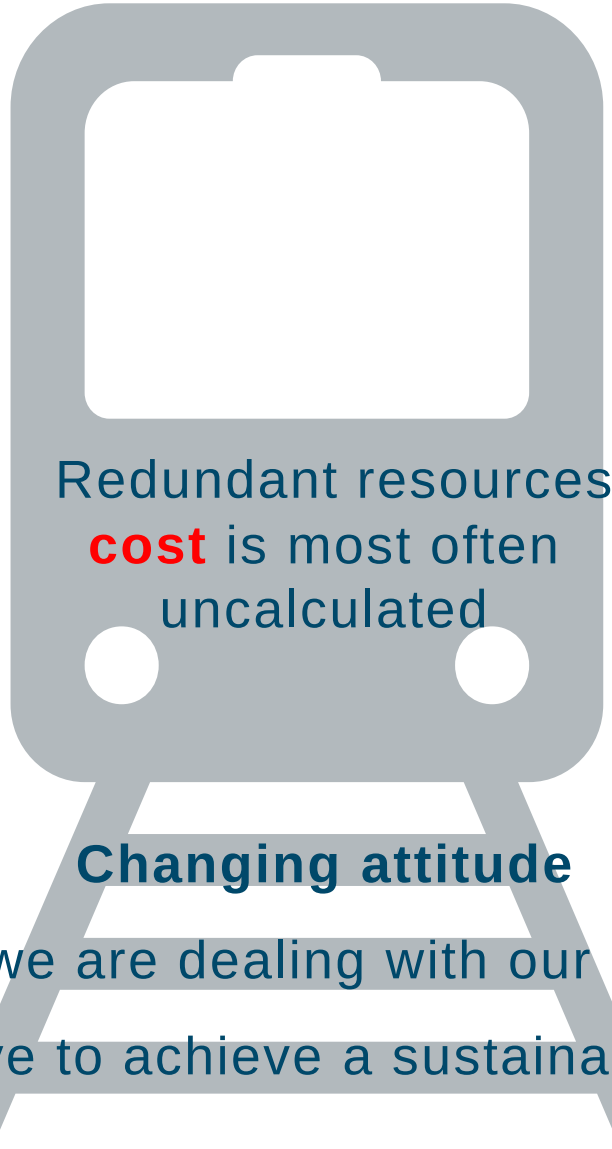
- Space rent revenue
- Copper is a valuable metal that should be reused

Sustainability

G. Health and Safety implications and cost associated with incidents

Circular Economy VS Business As Usual ?





Redundant resources **cost** is most often uncalculated

Collaboration between **stakeholders** and **supply chain** on creating coherent and unified specifications is imperative too!

Changing attitude

on how we are dealing with our resources

is imperative to achieve a sustainable transport

THANK YOU

Melina Kakouratou
External Risks Engineer
Infrastructure Protection TfL Engineering
melinakakouratou@tube.tfl.gov.uk

EVERY JOURNEY MATTERS

INTERNATIONAL UNION
OF RAILWAYS

COFFEE BREAK

11.05 – 11.30 CET

Bénédicte Gourmandin

Engineer in circular economy

Network Technical Direction of SNCF Réseau.

Nothing to waste in ballast

SNCF Réseau & F.E.G

29 avril 2024

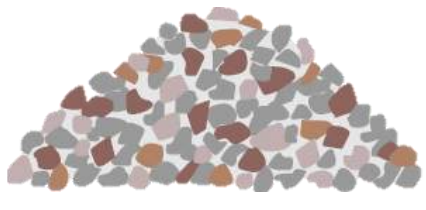
The project

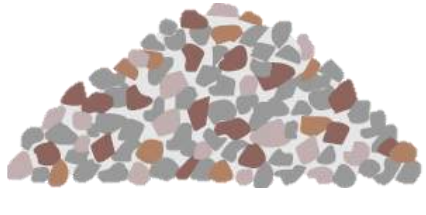
How do we go from 0% to 25% of ballast reused by 2026 ?

An industrialised renewal of the railway that produce 40% of the ballast removed from the track per year.

A profound transformation of thinking our inflow

From this





To that

A 3 steps process

Collect, treatment, distribution

Collect all ballast

Objective of 100% of main product, such as ballast, collected by 2026. A mix in quality.

Treatment of ballast

Since 2021, we wash, sort and control the quality of ballast. A product good as new

Distribution

The ballast is loaded on the work train to be put back on the track, even on high velocity lines

A partnership

F.E.G

3 company in 1 holding: F.E.G (Frugal Eco Matériaux)

- Cantaur: dealing in refuse ballast
- AFC Recycling: develop and invent treatment for product of the track (ballast, concrete sleepers, plastics nabla, rails)
- Metis solutions: control the quality of ballast using laser video and AI, inventor of the ballast shower with recycling water system

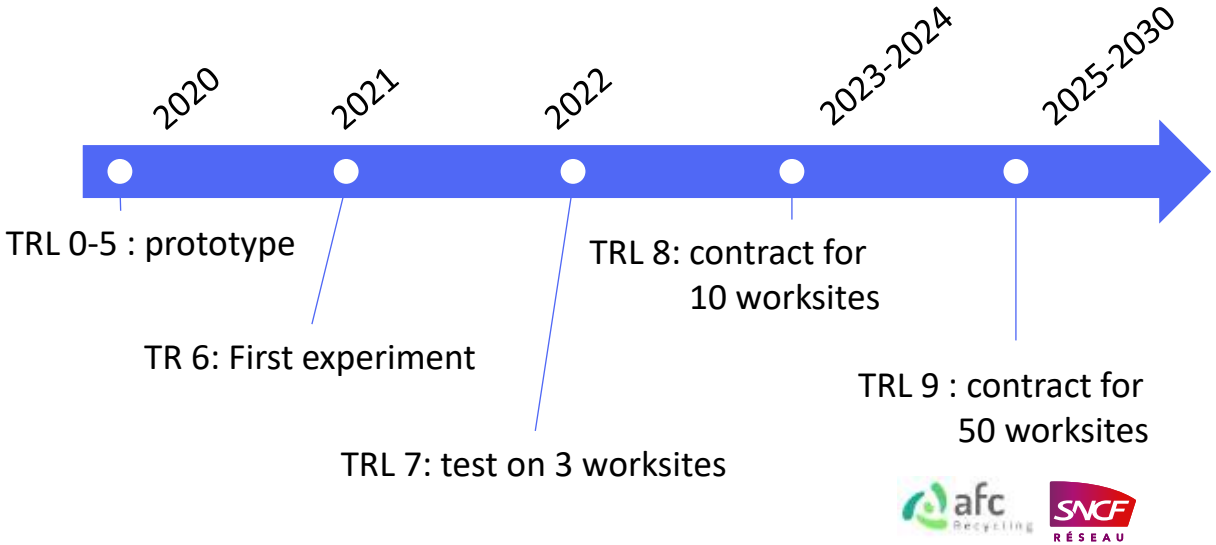
A partnership

F.E.G

Since 2018, Cantaur society was already under contract with the SNCF for the evacuation of used ballast for the industrialised renewal of tracks, with an innovation budget within the contract

a concept built together

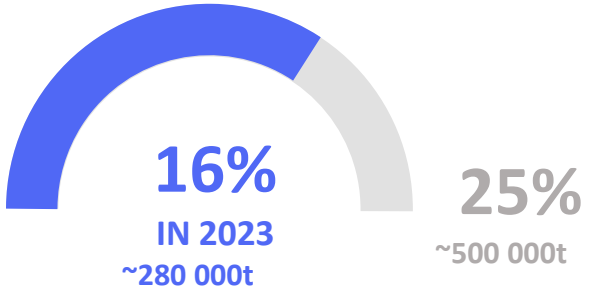
- SNCF Réseau worked on the strategy: concept, volumes, performances, controls
- AFC Recycling and Metis: worked on the technology



What is next ?

Development and innovation

Result in 2023



Next steps: Working with the small line program

- Value analyses of the ballast: prove the economical and societal relevance for both the artificial quarry and on-site treatment of ballast
- Study on the extension of the granulometry size range (20-40)

Contact

SNCF Réseau – Benedicte GOURMANDIN
benedicte.gourmandin@reseau.sncf.fr

AFC Recycling – Paul-Louis NEBOIS
Paul-louis.nebois@afc-recycling.com

THANKS

Park, Doo-byung

Major in Environmental engineering

Assistant Manager Environment Management Department

KORAIL

KORAIL's waste resource circulation case

Establishment of electronic waste resource circulation system

2024. 4. 24.

KORAIL

CHAPTER 1.

Background

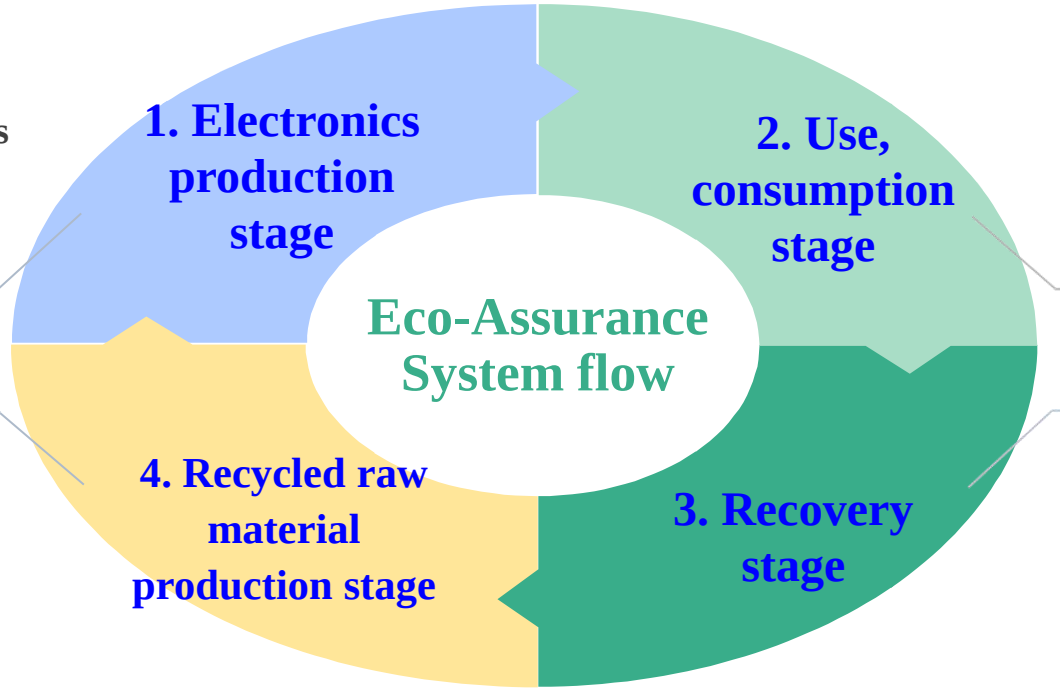
1 Background

1-1 Strengthening regulations on discharging electronic waste

- Standards for the use of recycled raw materials in electronic products have been gradually strengthened with the implementation of the Eco-Assurance System in 2008.

  → Integrated management under the ‘Act on Resource Circulation of Electrical Product and Cars’

- **Mandatory use of recycled raw materials**
- Compliance with hazardous substance content standards



- **Proper disposal of waste electronic products**

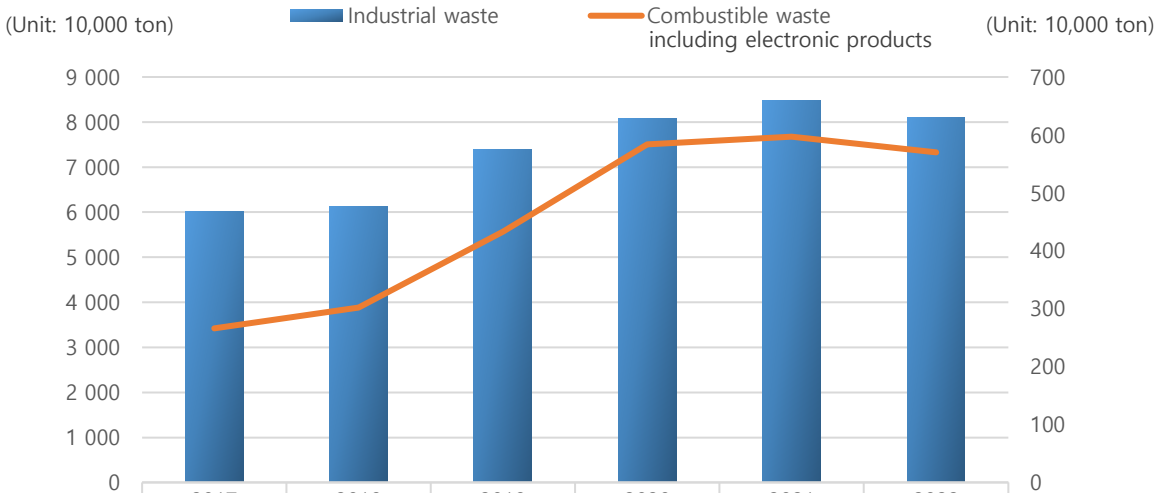
- **Compliance with recycling methods and standards for each product**
- Appropriate licensing for each business product

- **Obtain appropriate permits for waste collection and transportation**
- Create and submit collection and transportation management table

1 Background

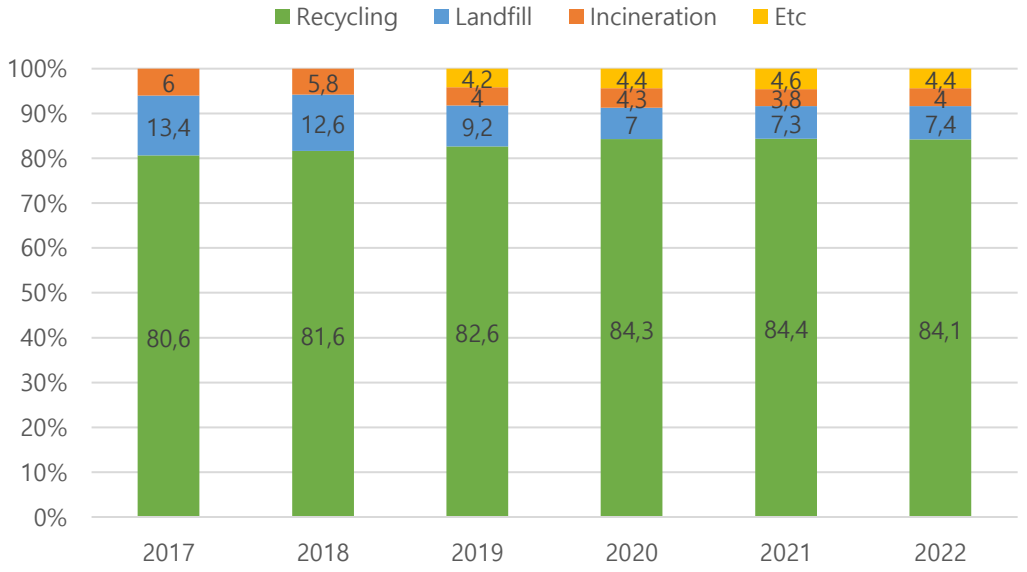
1-2 Changes in the recycling trend of waste including electronic products

- Waste generation tends to increase as population increases, living standards improve, and the industry develops rapidly.
- As the amount of domestic electronic waste recycling is increasing, KORAIL also needs to follow the recycling trend.



	2017	2018	2019	2020	2021	2022
Industrial waste	6 018	6 122	7 396	8 087	8 490	8 106
Combustible waste	266	302	433	584	597	570

<Fig 1> Trend of industrial waste generation by year.



<Fig 2> Disposal method of industrial waste by year.

※ Data source: National waste generation and disposal status (Ministry of Environment of the Republic of Korea, 2023)

1 Background

1-3 Difficulties in disposing of electronic waste from KORAIL

- Approximately 890 electronic waste generated by KORAIL in 2023 (computer, laptop, monitor etc.).
- A plan to recycle of electronic waste is needed due to the absence of a disposal method.
- As regulations on electronic waste are strengthened, appropriate measures need to be prepared.



<Fig 3> The electronic waste generated by KORAIL.

CHAPTER 2.

About E-Cycle Governance

2 About E-Cycle Governance

2-1 What is E-Cycle Governance?

- A non-profit public interest corporation approved by the Ministry of Environment of Republic of Korea to establish a collection system for electronic waste and lead eco-friendly recycling.
- In cooperation with the government, public institutions, companies, and civic groups, a proper resource circulation system is operated for electronic waste, leading to ESG management advancements in the field of recovery and recycling.

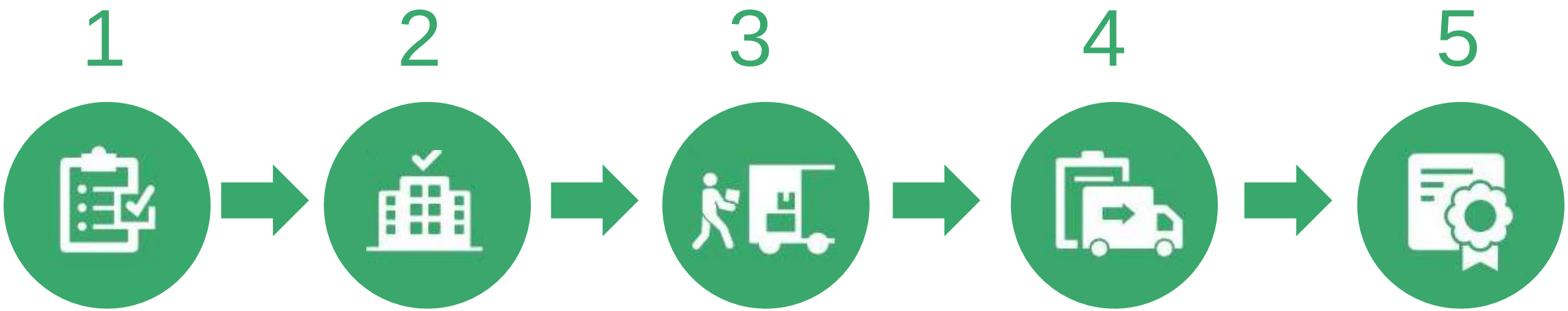
2-2 Recycling Center Status

- Collaborating with over 50 recycling centers nationwide

※ Picture: E-Cycle Governance provision

2 About E-Cycle Governance

2-3 Operation process



※ Picture: E-Cycle Governance provision

CHAPTER 3.

Electronic waste discharge and recycling process

3 Electronic waste discharge and recycling process

3-1 Electronic products that can be recycled

- Office electronics

  Computer, Laptop, Monitor

- Screen transmitter

  TV, Electronic signboard

- Small electronic devices

  Cell phones, Radios, PDAs

- Daily electronic devices

  Coffee pot, Vacuum cleaner, Microwave oven

- Large electronic equipment

  Washing machine, Refrigerator, Air conditioner

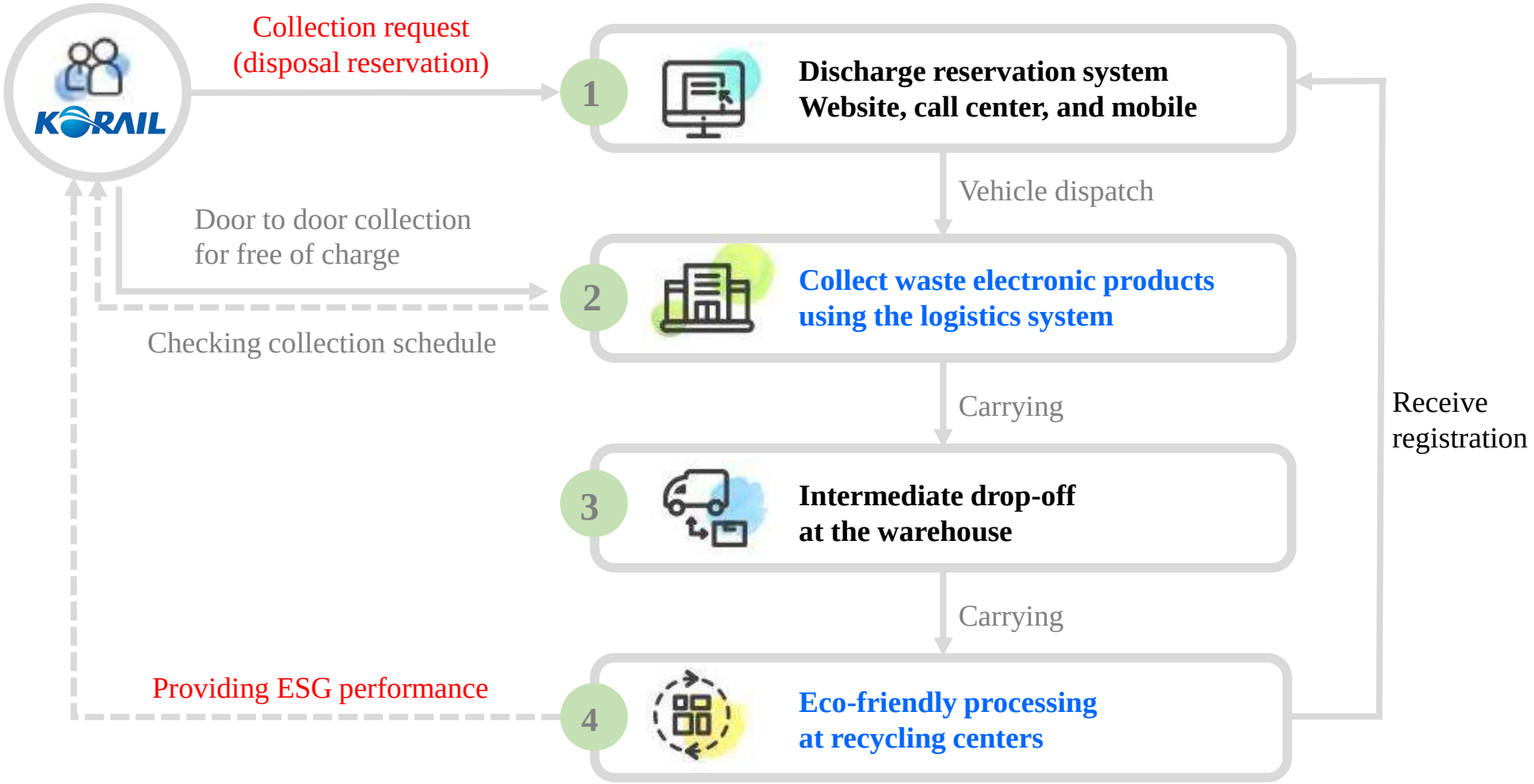
- Other devices

  Vending machines, Ticket machines

※ Picture: E-Cycle Governance provision

3 Electronic waste discharge and recycling process

3-2 KORAIL's electronic waste disposal process



※ Picture: E-Cycle Governance provision

3 Electronic waste discharge and recycling process

3-3 Discharge process (website)

1. Visit internet website (www. esg.modubiom.or.kr)

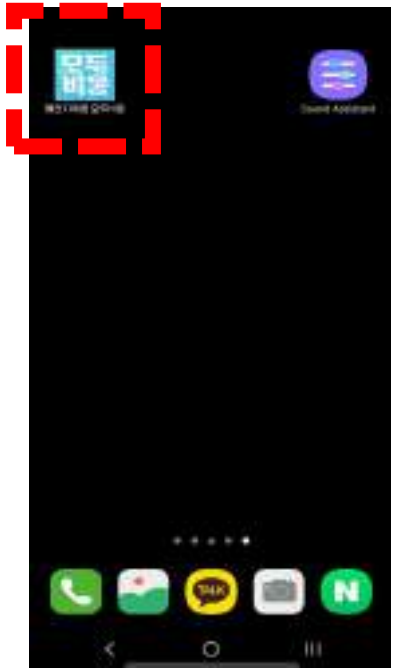
2. Select discharge item and quantity

3. Enter emitter information

4. Enter discharge location and desired date

3 Electronic waste disposal and recycling process

3-4 Discharge process (mobile)



1. installation application

2. Reservation reception

3. Enter item and quantity

4. Enter user information

5. Enter the discharger location

6. Enter discharge date

3 Electronic waste discharge and recycling process

3-5 Recycling process

1. Collection

2. Preprocessing

3. 1st sorting (Cu, Al)

4. Recycling

3 Electronic waste discharge and recycling process

3-5 Recycling process

5. 2nd sorting (plastic)

6. Shredding

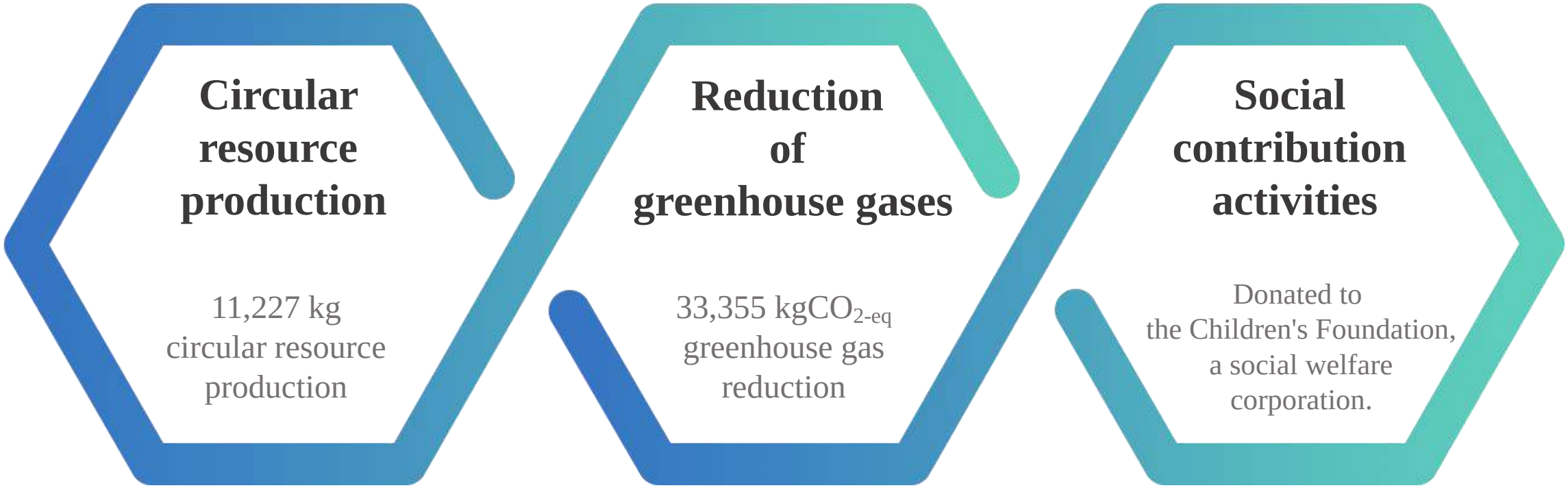
7. Manufacturing

8. Recycling

CHAPTER 4. Collaboration results

4 Collaboration results

4-1 Collaboration results as of 2023



4 Collaboration results

4-2 Resource circulation certificate

전자제품 자원 순환에 의한
순환자원 생산 확인서

사 업 자 명 한국철도공사
사업자번호 314-82-10004
사 업 기 간 2023.01.01 ~ 2023.12.31

이 사업자는 순환경제 활성화를 통한 탄소중립을 실천하기 위해 폐전자제품 12,243 kg을 회수하여 친환경 시설에서 재활용 시켰으며, 11,227 kg의 순환자원을 생산하는 자원 순환 활동을 전국적으로 수행하였음을 확인합니다.

2023.12.28

순환거버넌스 이 사 장 정 덕 기

Circular resource production

KOREA SCOPE3 ASSOCIATION

Scope3 온실가스 감축 인증서

- Greenhouse gas (GHG) Avoided Emissions Certificate -

한국철도공사

사단법인 한국스코프쓰리협회
회 장 김 익

Carbon reduction activities

전자제품 자원 순환에 의한
사회공헌 활동 확인서

사 업 자 명 한국철도공사
사업자번호 314-82-10004
사 업 기 간 2022.12.01 ~ 2023.11.30

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2023. 12. 28

순환거버넌스 이 사 장 정 덕 기

Social contribution activities

4 Collaboration results

4-3 Expectation effectiveness

1

Prevention of environmental pollution through safe disposal of hazardous chemicals

2

Prevent external leakage of personal information using resource recovery system

3

Recovery and recycling of resources such as valuable metals and rare earths

4

Environmental conservation activities through recycling of Electronic waste

※ Picture: E-Cycle Governance provision

Thank you for your attention

Q & A

E-mail : pdb0625@korail.com

William Mainwaring

CEO Sicut Enterprises Limited

Responsible Stewardship of Resources
Track Circularity Case Study

Sicut Composite Sleepers

William Mainwaring

CEO Sicut Enterprises Limited

Introduction

Network Rail has historically installed up to 600,000 new sleepers each year

The majority are made from reinforced concrete, but about 100,000 have historically been either tropical hardwood or creosote treated wood

Creosote is carcinogenic, damaging to the environment and is being banned across Europe, and the use of tropical hardwood is not sustainable and contrary to global commitments to reverse deforestation

While sleepers contribute only 10-15% to the installed cost of track infrastructure they represent 30% of the embodied carbon – their installation another 25%

Network Rail identified sleepers as a significant opportunity to deliver against several Environmental and Sustainability Strategy targets as well as improve track availability and long-term value

Network Rail also concluded that applying circular economy principles to the procurement of its track materials was central to a responsible stewardship of its resources

Though a competitive tender in 2019, Network Rail selected Sicut Enterprises, the market leader in the manufacture of recycled polymer composite sleepers, as its partner

Safety & Performance

Designed for Reliability

Full Network Rail DfR, CSM, HAZID and RAM Assessment processes followed

Independently tested in accordance with ISO 12856-3:2022; EN 13481; EN 13146 – including approximately 50 years of simulated track testing

A wide range of track testing across the full range of applications over 24 months

Full Acceptance granted in 2022

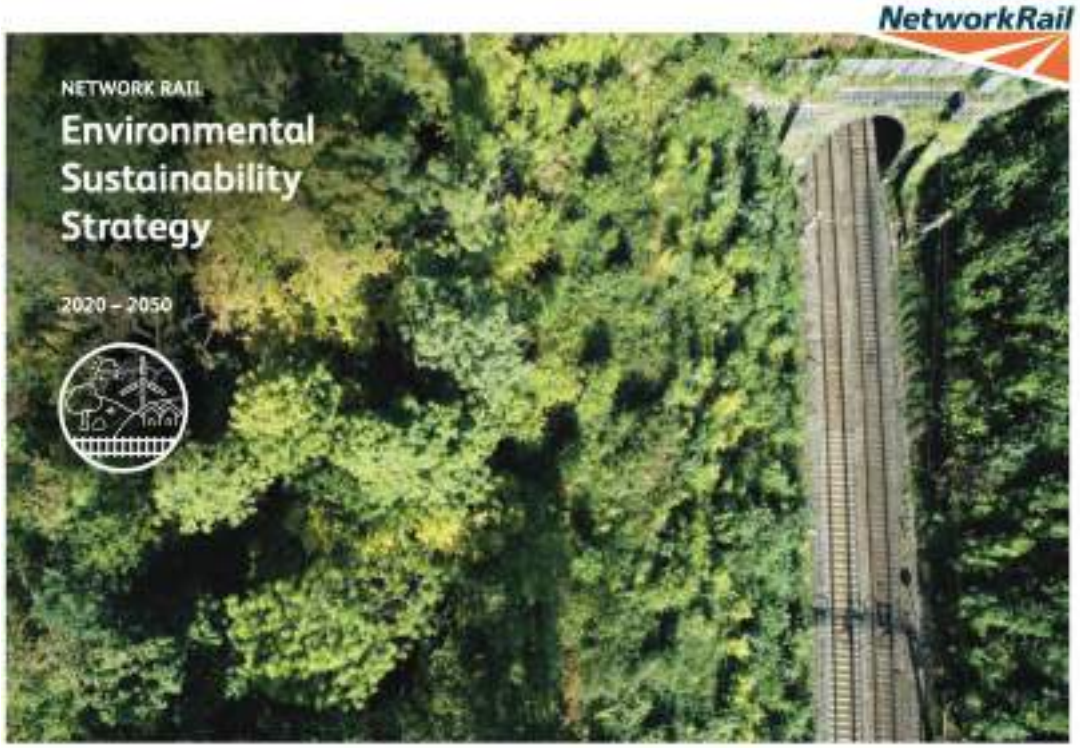
Safety & Performance

Through extended track trials and evaluation NR identified several advantages of the Sicut Sleeper

- Increased durability – Ability to withstand poorer track bed/wetter/dirtier ballast conditions – resistant to tamper damage
- No material degradation expected over time leading to minimum maintenance through life - reduced maintenance interventions
- Long service life leading to a reduction in disruptive possession due to increased time between renewals – increasing capacity – improving safety
- Pre-fabrication options simplified for faster, lower risk installation
- No risks associated with electrical conductivity – 3rd/4th rail; signaling; E&P
- Suitable for spot replacement with softwood and hardwood sleepers for track refurbishment
- Can be used for all baseplate designs, including guard/check rail (fastclip option too) and can be short ended and chamfered
- Better fire performance in tunnels vs hardwood
- Reduced manual handling risks – no creosote & light weight

Improved Sustainability

Network Rail, like all European railways, has committed to delivering against challenging environmental targets



"We have an opportunity to change the way that we design, build and operate our assets so we can minimise our whole-life carbon and air pollution emissions, make an important contribution to the UK's targets and look after the safety and wellbeing of our employees."

"Besides the emissions from powering trains, our carbon emissions come from wide range of business activities. These include energy required for our stations and offices to operate (such as lighting, heating and escalators) energy used by our road fleet vehicles, and emissions associated with building and maintaining our infrastructure."

Network Rail is to "go beyond embodied carbon assessments to whole life carbon assessments, to support infrastructure projects"

Improved Sustainability – Reducing Embodied CO_2e

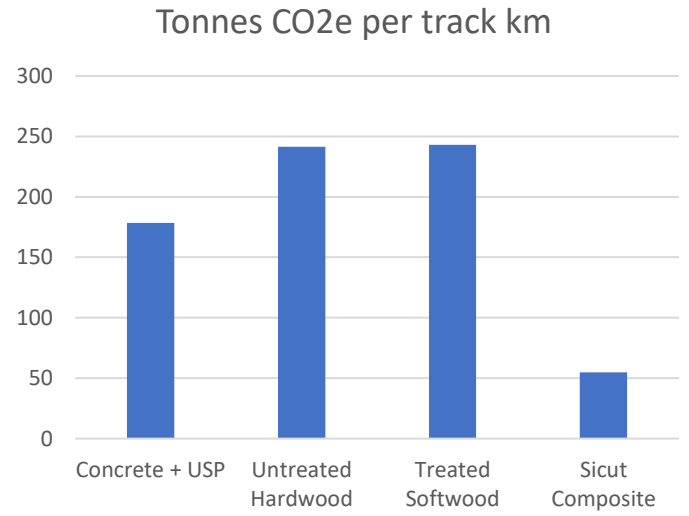
Low-emission Railway

Using the Sicut sleepers in place of hardwood or concrete delivers a substantial reduction in embedded carbon of up to 200,000 $kgCO^2e$ per km

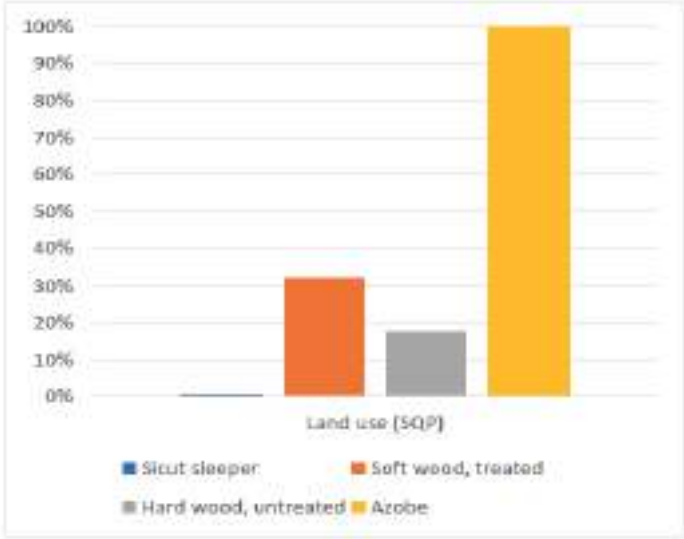
Whole life carbon saving for the track infrastructure might be 5 or 6 times this and GWP calculations do not capture other environmental savings such as land and water use

These saving can be delivered today without any further R&D

Sicut EPD available to support PAS 2080



Result of GWP comparison of the life sleepers (Kg CO_2e).



Result of the indicative comparison of the life cycle of the sleepers (relative environmental impact on land use (soil quality potential)

Improved Sustainability – Resilience to Climate Change

A reliable railway resilient to climate change

Hardwood (and concrete) sleepers are known react badly to repeated emersion in water – taking on moisture leads to shorter service life; increases maintenance and renewal interventions; and reduces the resilience of the track asset

NR's evaluation of the performance of a Sicut sleeper showed that it did not degrade with time, even in the most demanding environments

"Climate change adaptation" is action taken to **improve the resilience of assets, networks** and systems to future weather conditions. This means avoiding, minimising or mitigating the impact of more severe or frequent adverse and extreme weather events and gradual or erratic changes in weather patterns due to climate change."

10 Year Accelerated Weather Testing Conducted by Poo Chow, Ph.D., University of Illinois, Wood Products Lab

		Hardwood	Sicut
Sleeper Plate Compressive Modulus	Before Exposure:	22 Mpa	18 MPa
	After Exposure:	7 Mpa	21 MPa
Face Hardness	Before Exposure:	16 kN	28 kN
	After Exposure:	4.4 kN	35 kN
Cut Spike Insertion Force	Before Exposure:	49 kN	32 kN
	After Exposure:	17 kN	31 kN
Cut Spike Withdrawal Force	Before Exposure:	38 kN	12 kN
	After Exposure:	8.4 kN	15 kN
% Surface Area Loss From Checks/Splits	Before Exposure:	0.9%	0.0%
	After Exposure:	4.5%	0.0%

Improved Sustainability – Reversing Deforestation

Improved biodiversity of plants and wildlife

Network Rail's historical demand for hardwood sleepers had required the felling of more than 120 acres of tropical hardwood forests in Brazil each year

Using hardwood sleepers with a life of about 15-20 years vs >100 years for the hardwood tree to grow to maturity is not sustainable

The use of Sicut sleepers in place or hardwood will allow Network Rail to support global commitments to reverse deforestation made at COP26

"Biodiversity" is the measure of the variety of plants and animals in the natural environment. A good level of biodiversity on land and in lakes, rivers and oceans, means it is more likely it is that a wide variety of different species of plants and animals will survive and thrive in the future."

Improved Sustainability – Addressing Plastic Waste

Minimal waste and the sustainable use of materials

The UK is targeting 70% recycling by 2025 (currently 31%) and 30% recycled content in new plastic products

Sicut sleepers contain nearly 100% recycled content and are 100% recyclable

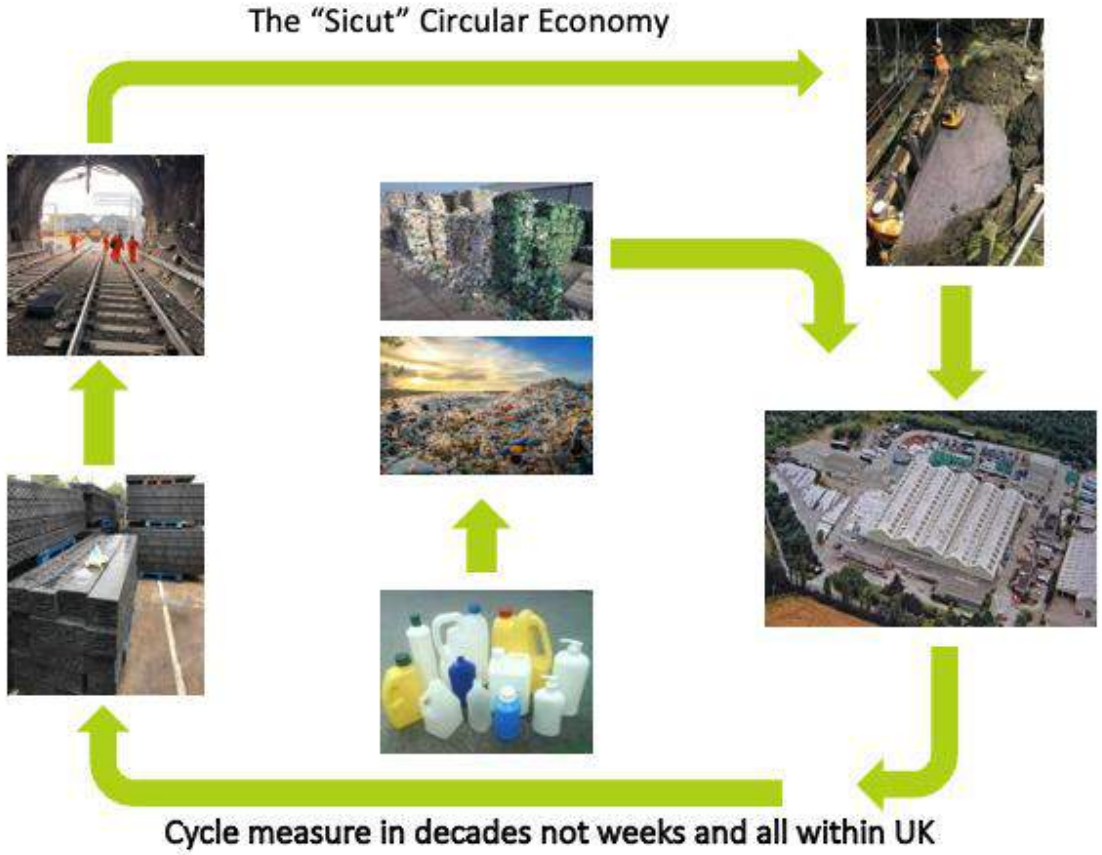
Using Sicut instead of 100,000 wood sleeper replacements each year would make effective use of over 7,000 metric tons of plastic waste (400m bottles), keeping it out of landfill and the oceans

A consistent demand for such volumes of waste material would incentivize investment in long term sustainable capacity growth for recycled plastic processing in the UK and improve recycling rates

Improved Sustainability – Circular Economy

Delivering a Circular Economy

A “circular economy” seeks to move away from ‘take-make-dispose’ and towards a system of designing out waste, keeping products and materials in use as long as possible, reusing, recycling and repurposing materials at the end of their life rather than throwing them away, and reducing the over-extraction of finite natural resources.



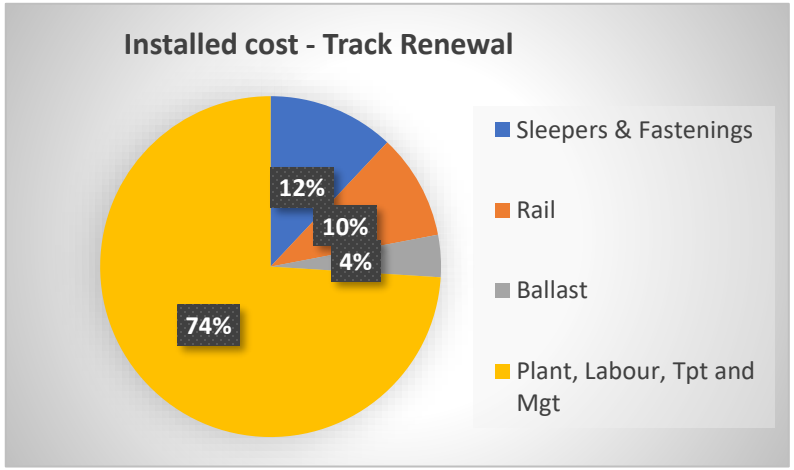
Hardwood is not reusable or recyclable nor can it form part of a sustainable circular economy

Reducing Whole Life Cost – Delivering Value

Network Rail's Technical Authority compared the Sicut sleeper with hardwood and calculated an annual saving of £46 to £87 per sleeper installed over a 50-year asset life (£1,800 - £4,400 per sleeper or up to £6.7m per km)

Network Rail also calculated that using Sicut instead of hardwood would only increase total forecast 'wood' sleeper installation costs by less than 0.5%

The total life cycle saving delivered by using Sicut instead of hardwood over the next 5-year budget period was estimated to be as much as £750m (assuming just 40,000 per annum)



Responsible Stewardship of Resources
- A Network Rail Success Story

- Significantly better performance and longer asset life than wood (but also concrete and steel)
- Improved H&S – No creosote; reduced weight and more opportunities for prefabrication
- Substantial reduction in whole life carbon; Improved climate change resilience; supporting greater biodiversity; and deliver true circularity - PAS 2080:2016
- Huge reduction in whole life costs (>10x unit cost vs hardwood)

They also:

- Make effective use of up to 6 million waste plastic bottles per km
- Offer a new, simple to understand and enduring demand for recycled plastic, driving investment in collection and recycling infrastructure; treating plastic waste as a resource not a problem
- Help protect the Amazon rainforest in Brazil and support targets for the reversal of deforestation

Turning Today's Waste into Tomorrow's Infrastructure

OFFICIAL

Darren Sharp
Principal Engineer
Supply Chain Operations, Track
Date : Oct 2023

Composite Sleepers – A Substitute for Tropical Hardwood

Phase out of Tropical Hardwood Sleepers by June 2024

This bulletin is alerting all users, purchasers and specifiers of the business decision to cease procurement of hardwood sleepers.

In 2021, Network Rail ceased the procurement of softwood sleepers due to environmental and safety concerns. The tropical hardwood used in the production of our hardwood sleepers can take up to 100 years to grow and the increasing demand for this material contributes to deforestation of the world's tropical rainforests.

To continue our journey towards improving sustainability of our track, the next phase and in agreement with the Executive Leadership Team is to cease the procurement of tropical hardwood sleepers by June 2024. These will be replaced by composite sleepers made from recycled plastics.

Katja Nelissen

Circular ambassador

Program manager Strategy to climate neutral and circular infrastructure projects

ProRail

ProRail

“ProRail working towards a climate neutral and circular infrastructure;

Steps and advantages”

ProRail

ProRail Who we are

We connect cities, people and companies by rail, now and in the future. We make pleasant travel and sustainable transport possible.

Connects

Improves

Sustainable

ProRail

Our Sustainable Rail Roadmap comprises four areas (‘tracks’)

The Sustainable Rail Roadmap is the strategic framework for ProRail’s priority *Sustainalise*.

It consists of four tracks on which ProRail can make significant impact towards a sustainable society.

Track 1: Mobility

With more (inter)national trains instead of cars, trucks and planes, we are on our way to meet the Paris climate obligations.

Track 2: Energy

A sustainable rail system produces its own renewable energy on roofs and next to tracks. We use less energy and replace fossil fuel by renewable energy.

Track 3: Materials

A circular rail system maintains its (scarce) resources for future use and replaces polluting substances by sustainable alternatives.

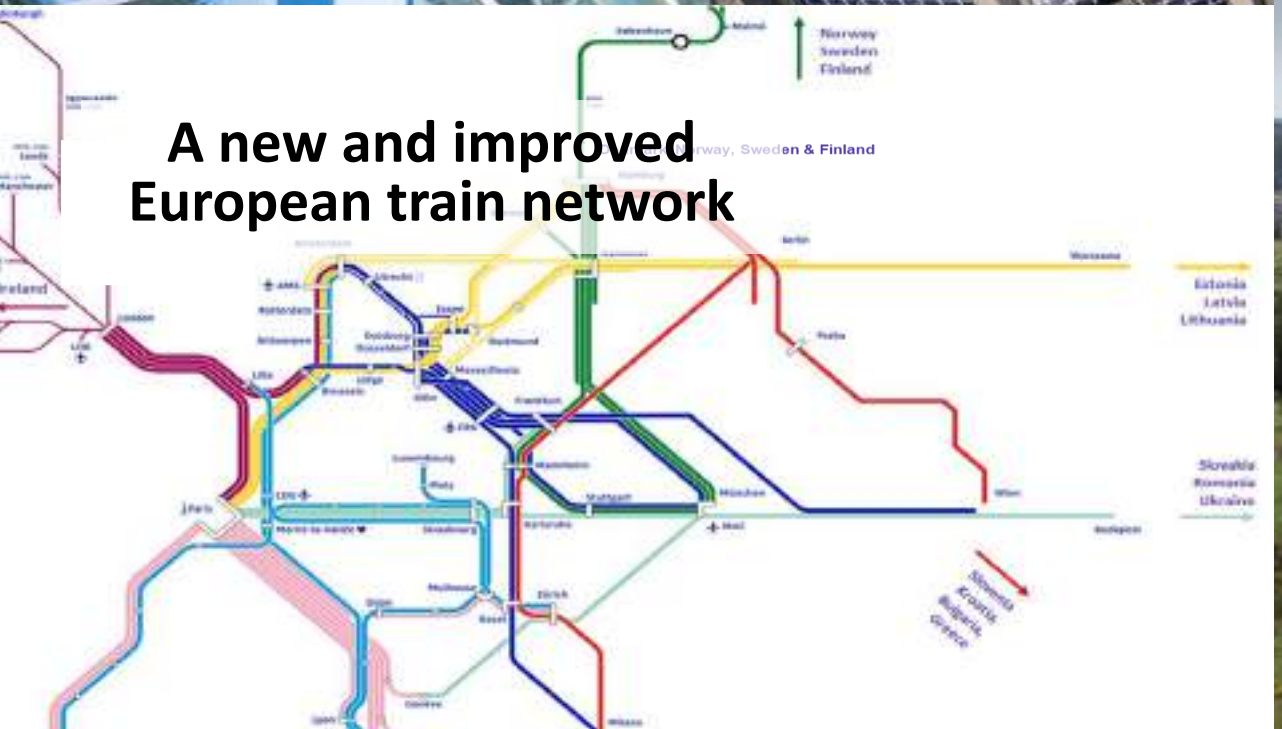
Track 4: Nature

Our land as missing link between nature areas. Functioning as breeding ground and safe haven for new nature.

Solar cells as station roof at Delft Campus

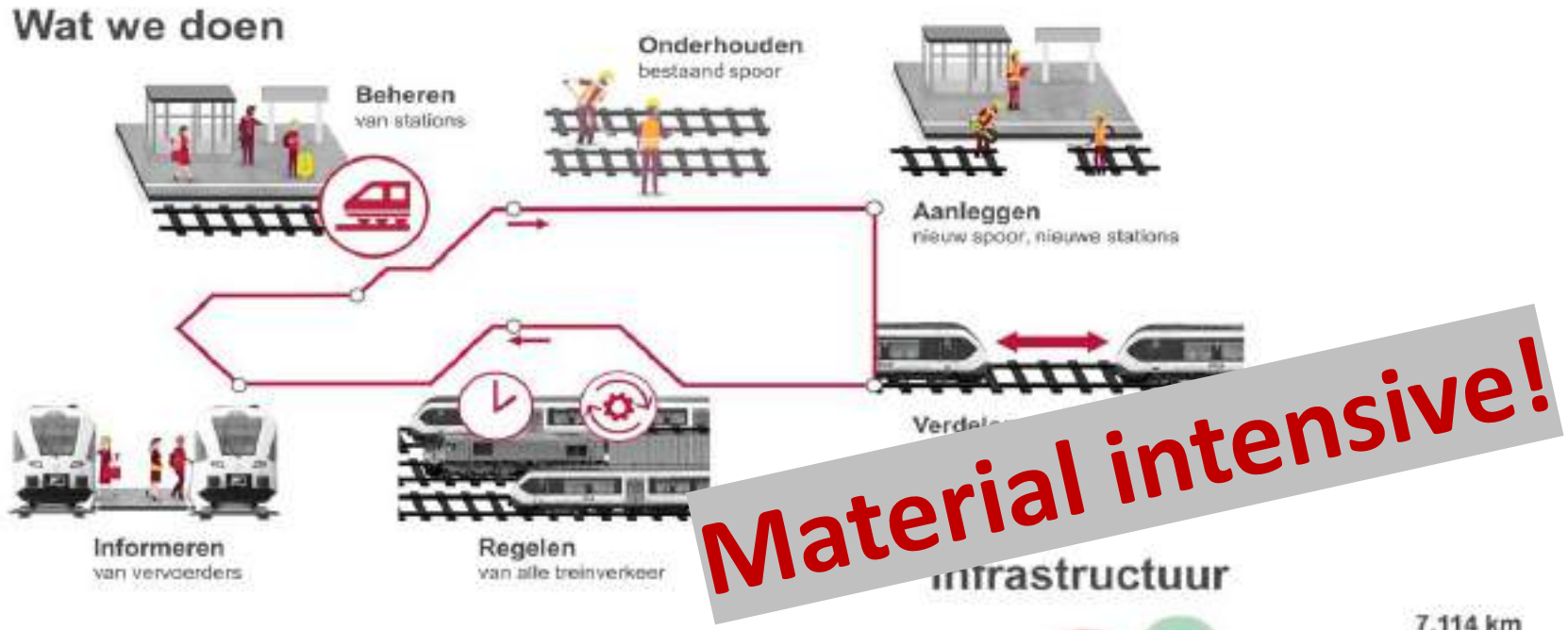
Refurbishing and reusing used tracks

A new and improved European train network

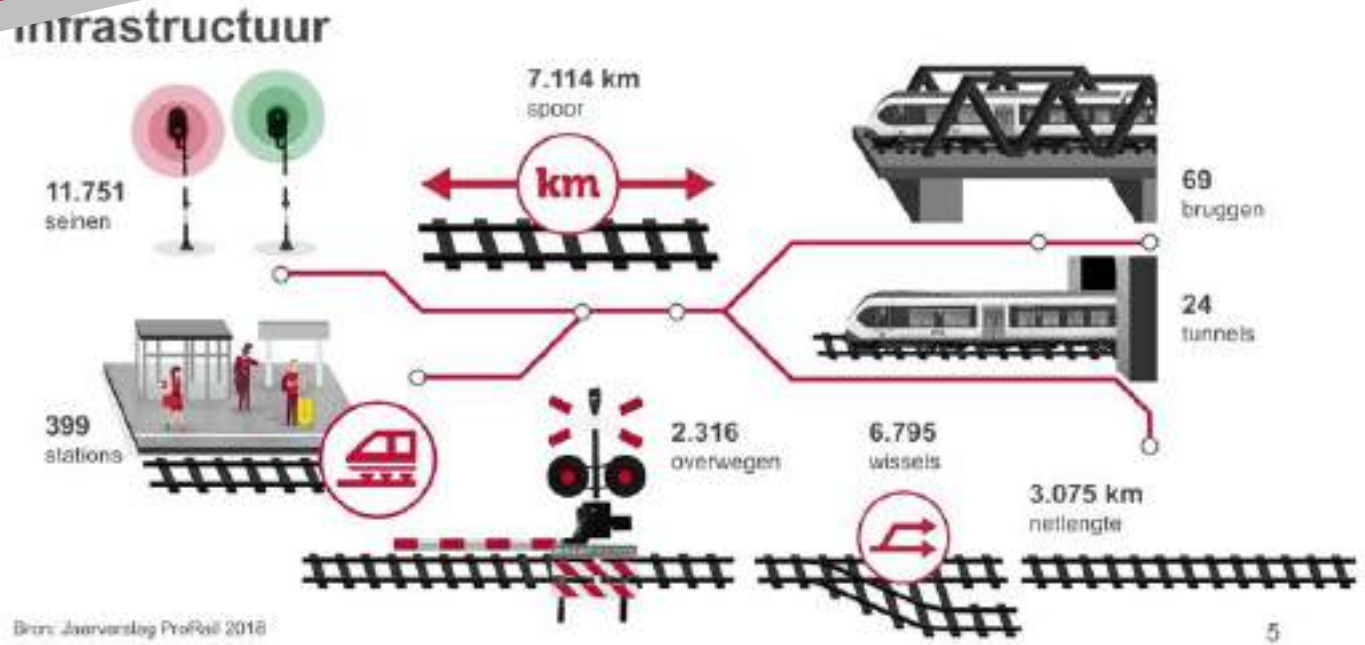


Ecoducts bridge the tracks to connect nature

ProRail What we do



Material intensive!



Bron: Jaarverslag ProRail 2018

The KCI ambition

Goal = being climate neutral and circular in 2030;

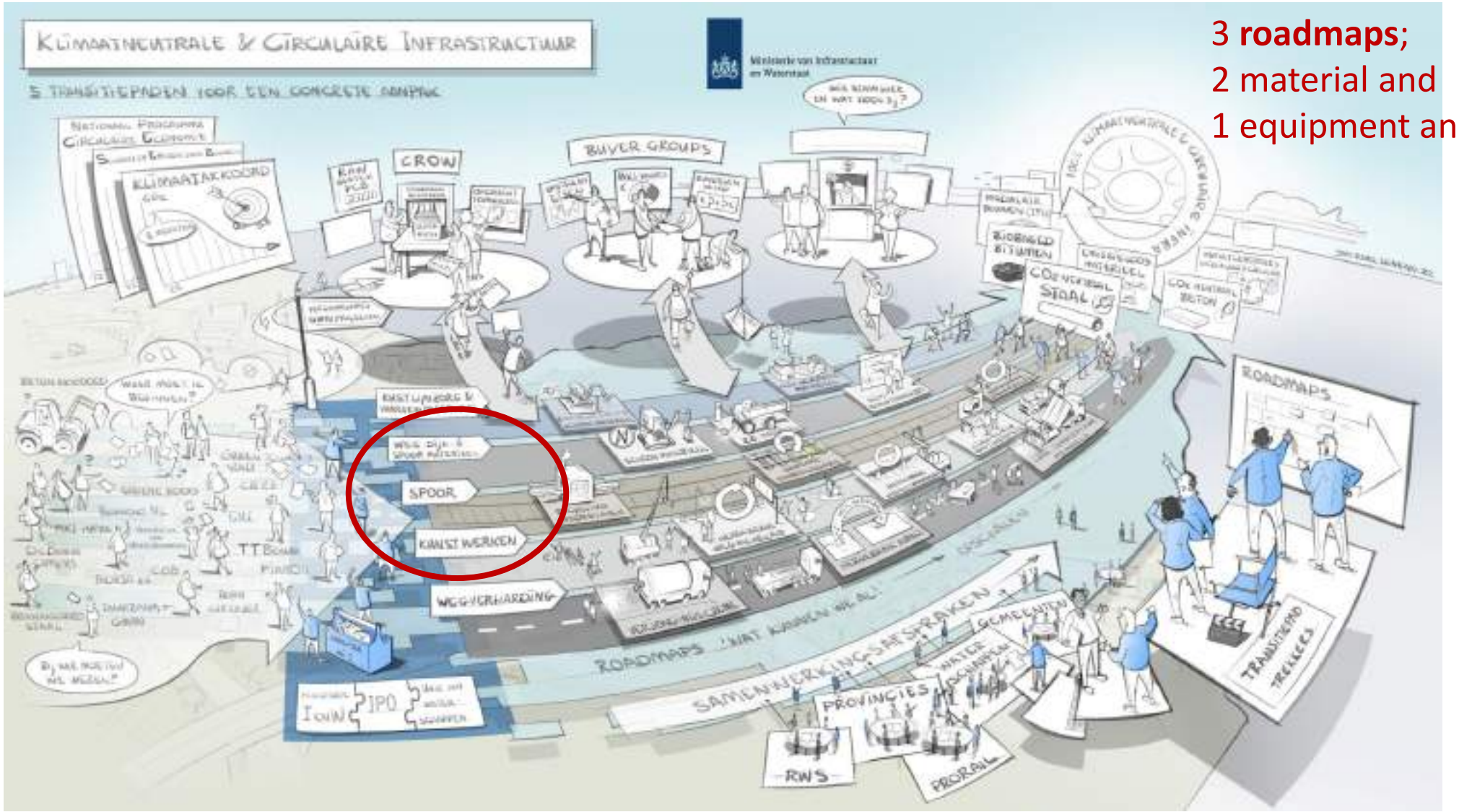
- high quality reuse of all materials and halving the use of primary raw materials
- focus on the areas of work with most CO2 emissions and use of materials (mass)

In 2030:

✓ we achieve a SCI-reduction of 50% (compared to 2019)
✓ 50% of all materials in our infra projects will be secondary
✓ We will have an emission free construction site

➢ Together with all ‘lower’ government (x4)
➢ Leader and peloton approach
➢ Offer perspective to the market

KCI playing field



3 **roadmaps**;
2 material and
1 equipment and transport

ProRail

I’m wondering….

What are our shared values and goals?

What about the transition; when will we be proud of ourselves?

What is our biggest struggle in becoming a circular sector?

How can we collaborate in a way 1 + 1 makes 3?

INTERNATIONAL UNION
OF RAILWAYS

LUNCH BREAK

12.30 – 13.30 CET

Hans Hammink

Architect | Associate | Circularity Lead

Teacher at the Amsterdam Academy of Architecture

Focus: combining technology and architecture.

Specialty: integration of architecture with sustainable and circular principles

de Architekten Cie B.V.

Cie.

Learnings from circular buildings; Hans Hammink, de Architekten Cie.

Cie.

de Architekten Cie.:

- Architectural office; building sector
- 60+ Persons, various nationalities
- Full service
- Urban design, architecture, interior

- Offices, apartments, public buildings
- Complex; divers
- The Netherlands and abroad

Hans Hammink:

- Large, complex projects
- Circular projects
- Associate Architect, Head of Circularity Team

Cie.

2014: Noorderparkbad, Amsterdam; 5.500 m2

Cie.

2022: Het Dok Amsterdam, 450 apartments

Cie.

Current: Redevelopment Parliament Buildings, Den Haag


Cie.
2017-2023: Circl, Amsterdam; 3.000 m2


2018: EDGE Olympic, Amsterdam; 12.500 m2


2018: Galileo, Noordwijk; 1.500 m2


2022: EDGE West, Amsterdam; 48.000 m2

Cie. 2017-2023: Bicycle Parking Building, Eindhoven; 5.000 bicycles

2024: Winclove Probiotics, Amsterdam; 6.000 m2

Current: Laga student rowing club, Delft; 2.500 m2

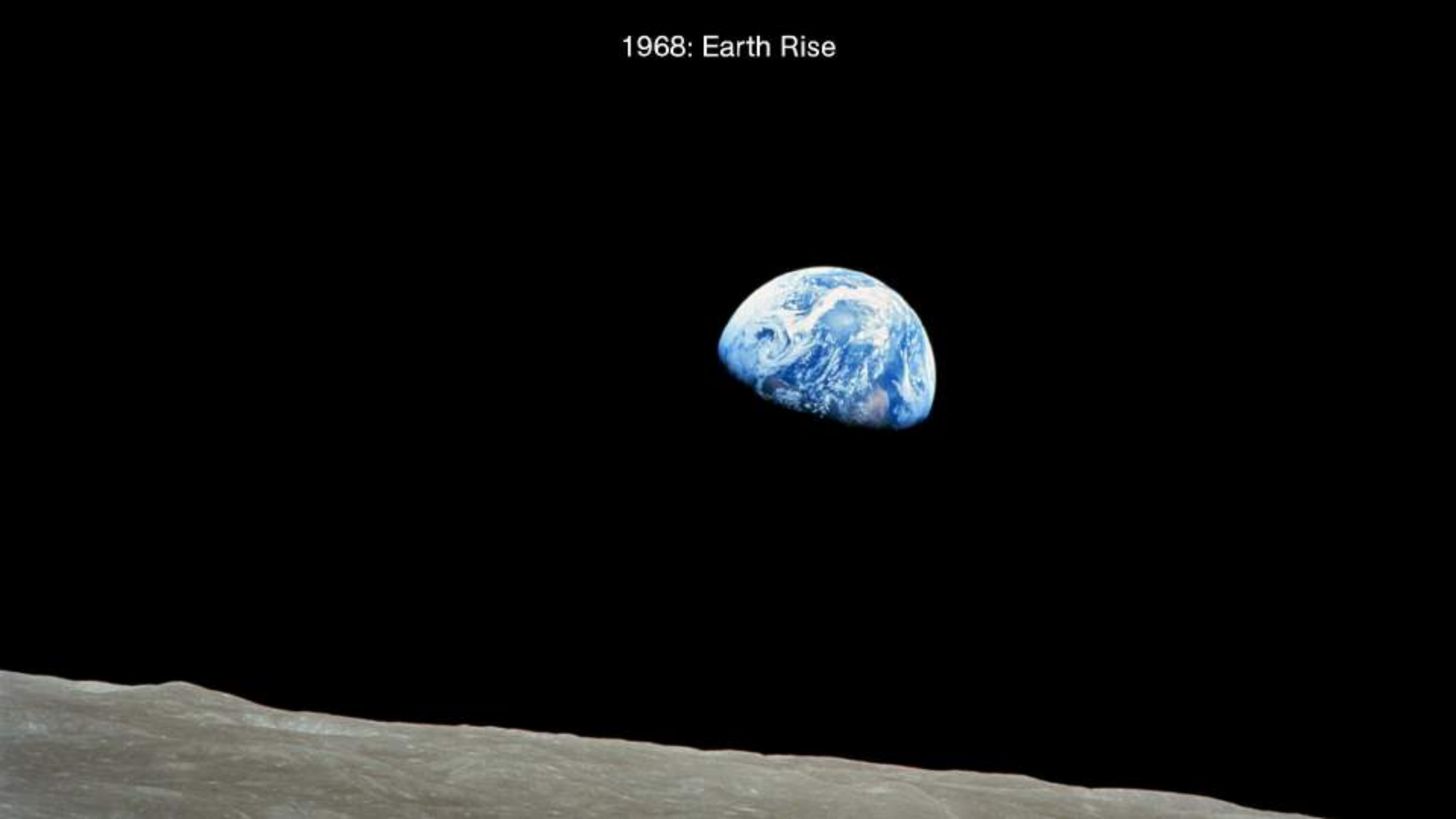
Current: Bicycle Parking Building, Amersfoort: 750 bicycles

Cie.

Current: Groei, Amsterdam, 223 apartments

Current: DUET, Nijmegen, 400 apartments

1968: Earth Rise



Ellen MacArthur Foundation (2013):

- Minimise energy use
- Minimise CO2 footprint
- Use non toxic materials
- Materials are getting scarce.
  Extend the life span

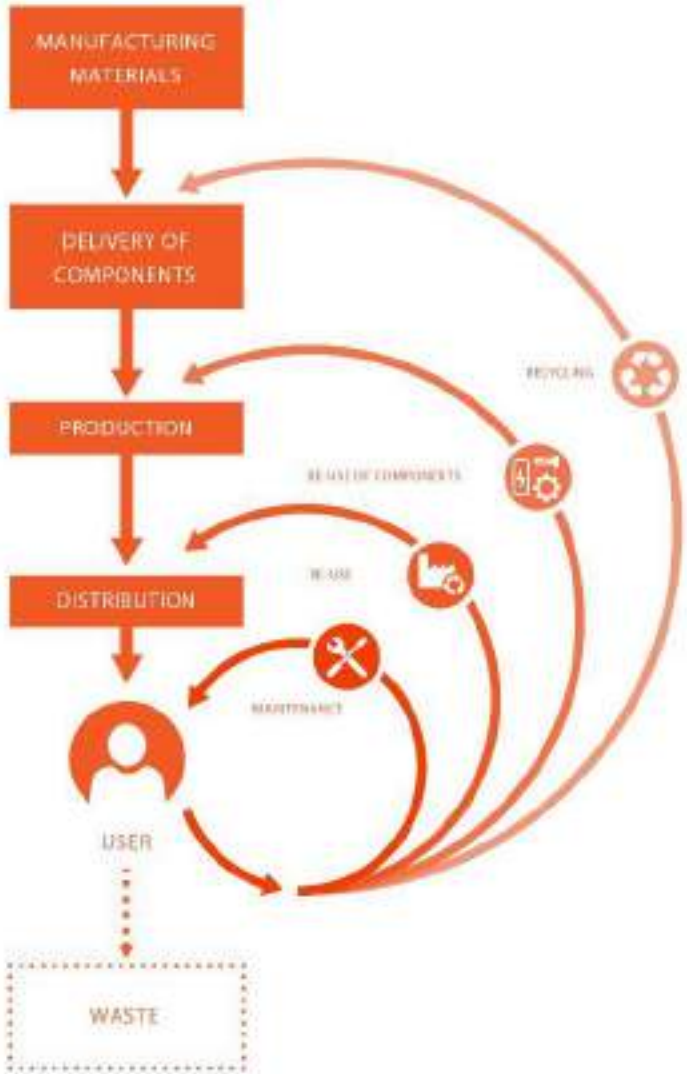
CB23 (2023):

Protect resources:

- Materials
- Environment
- Existing value

Cie.

Circularity



Ellen McArthur Foundation

Structure	100 years
Skin	50 years
Services	25 years
Space	10 years
Stuff	4 years

Stewart Brand

Cie.

Some materials are already getting scarce

Cie.

More commissions with existing buildings (e.g. EDGE West, Amsterdam)...


Cie.
... and YSY Tokyo
200.000 m2

Circularity, incentive for Cie.:

- 2016: first circular project
- 2017: understanding its implication: circularity is not an ideology
- 2018-2022: more, small scale circular projects
- 2022-current: scaling up, 'the new normal'

Cie.

Circularity in the Netherlands:

- Densely populated
- Few resources
- Vulnerable environment

Cie.

Circularity in the Netherlands:

- 1996: energy performance regulation EPC
- 2008, 2012: upgrade energy performance regulation EPC
- 2018: circularity performance regulation MPG (energy, materials, CO_2 emission)

Cie.

MPG:

$$\frac{\text{environmental performance} \times \text{gross floor area}}{\text{life span}}$$

Cie.

2017-2023: Circl, Amsterdam; 3.000 m2

Cie.


Cie.

Cie.

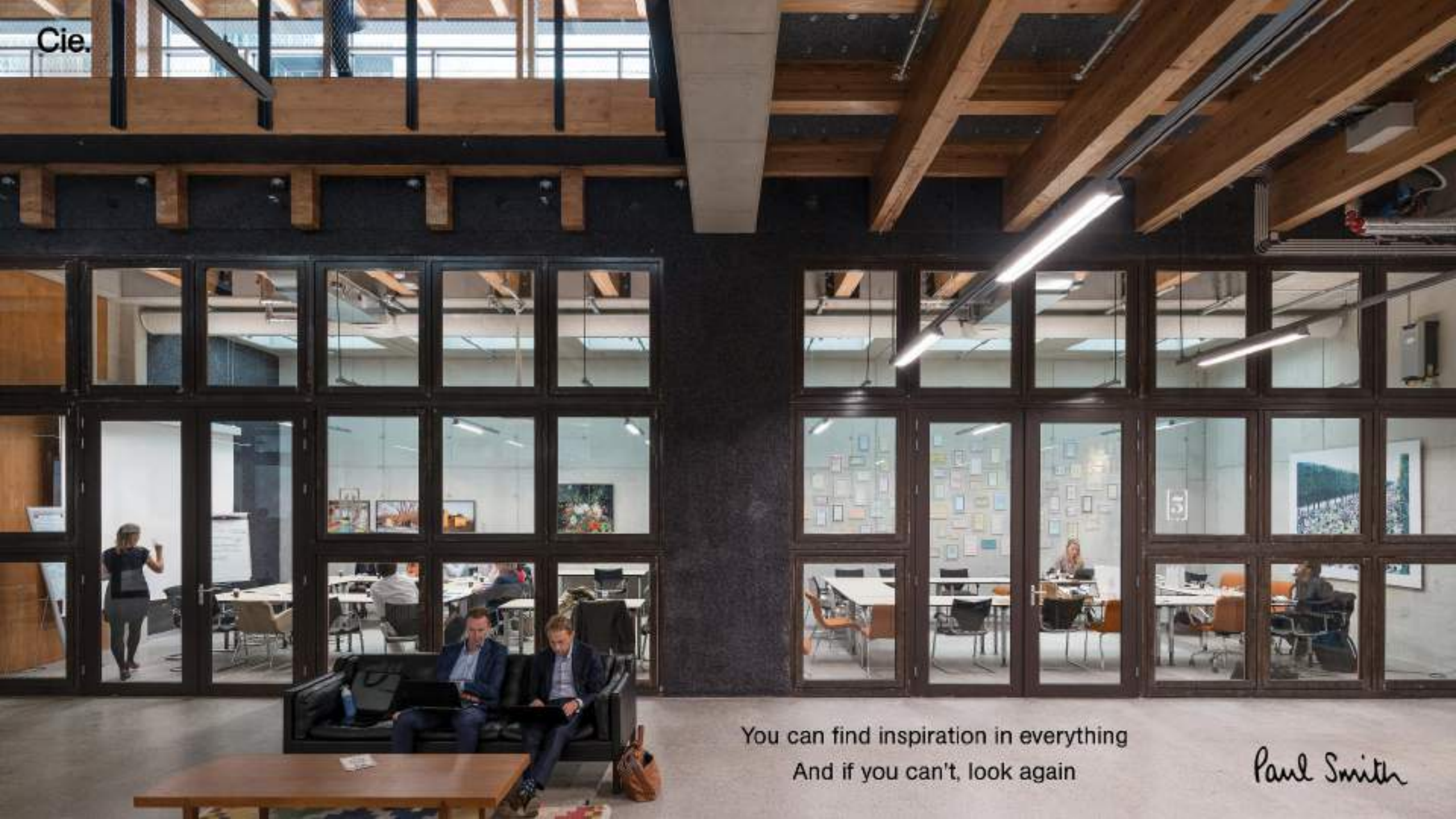
1800 m2 Basement: meeting space

1200 m2 Ground floor: restaurant, multi use space

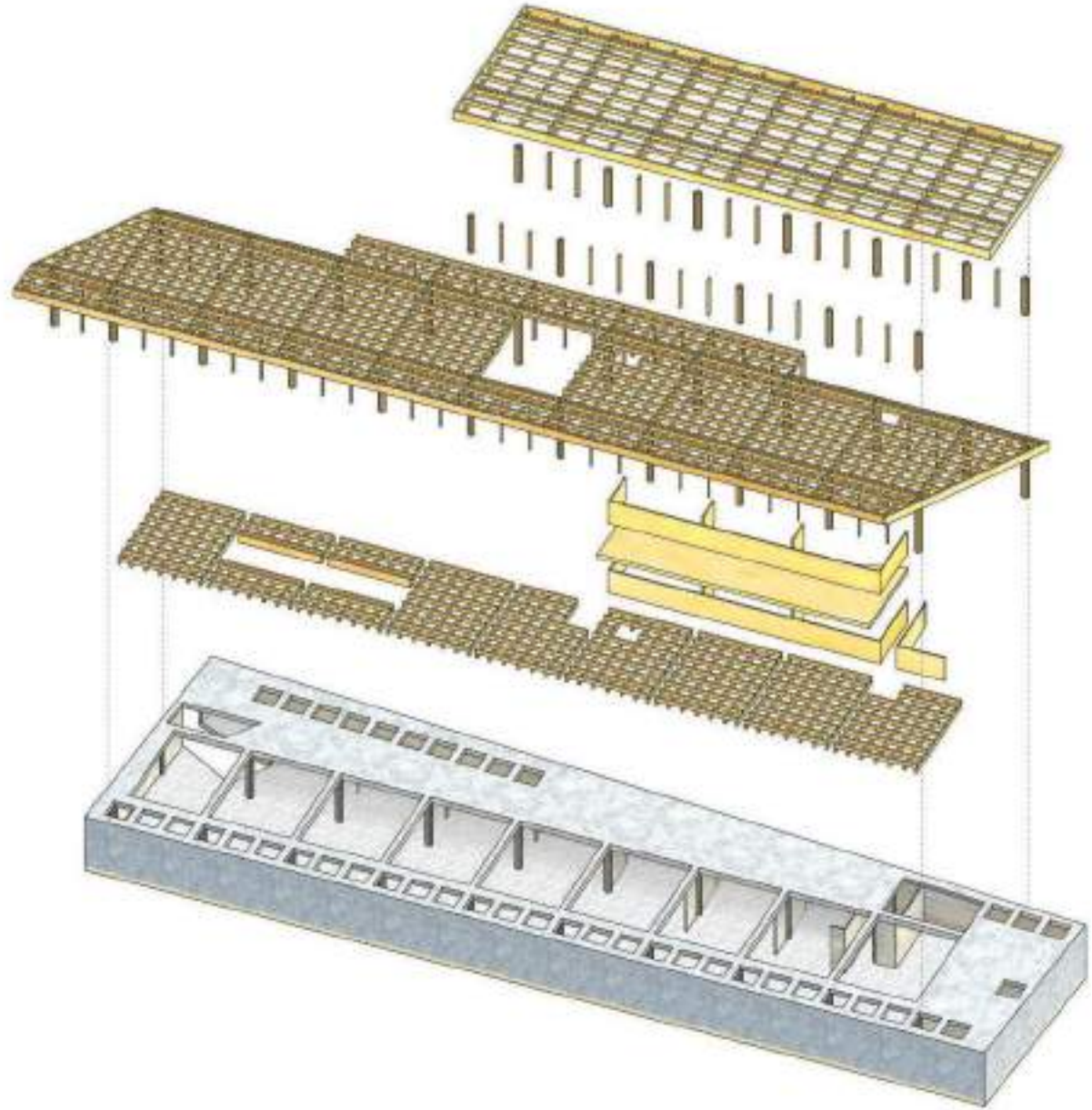
First floor: roof garden, Rooftop Bar


Cie.
another day
another day


Cie


Cie.
You can find inspiration in everything
And if you can't, look again
Paul Smith

Cie.




Cie.
Regus

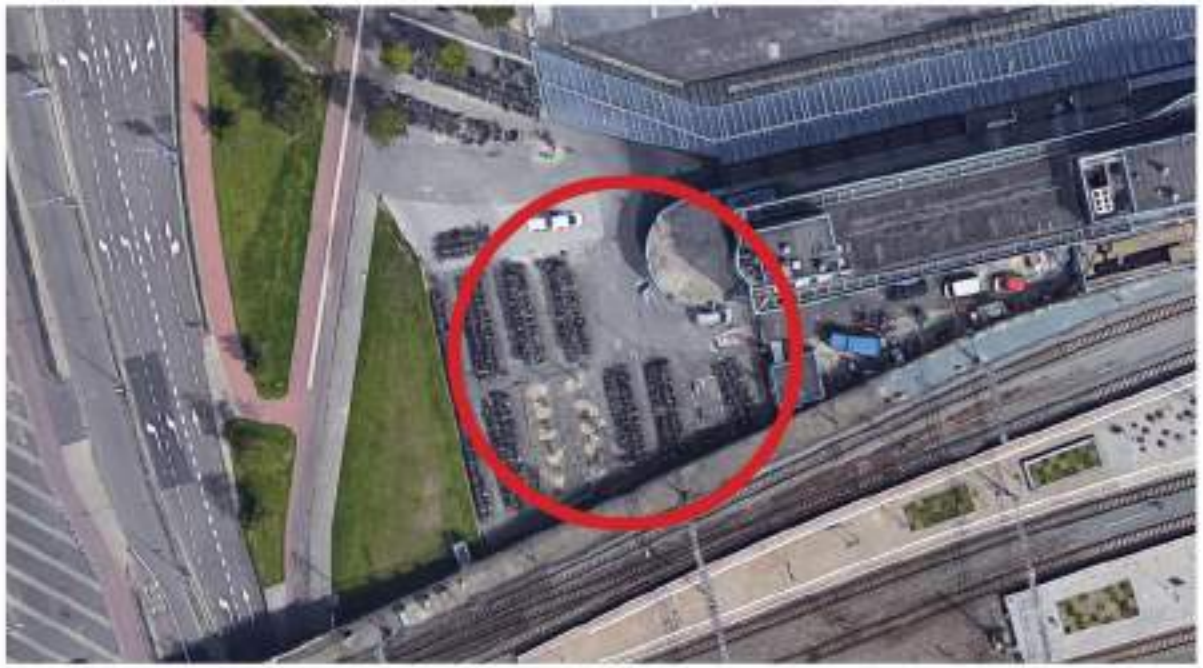

Design for Disassembly
Login
Nederlands
Together towards a circular future
Come to CIRCL:
RESTAURANT
AGENDA
or book a:
MEETING / EVENT
STUDIO
TOUR CIRCL
ABN AMRO will cease all physical activities in Circl from 2 june.
From that date it is no longer possible to rent the rooms or the studio.
READ MORE
AN INITIATIVE OF ABN·AMRO

Cie.

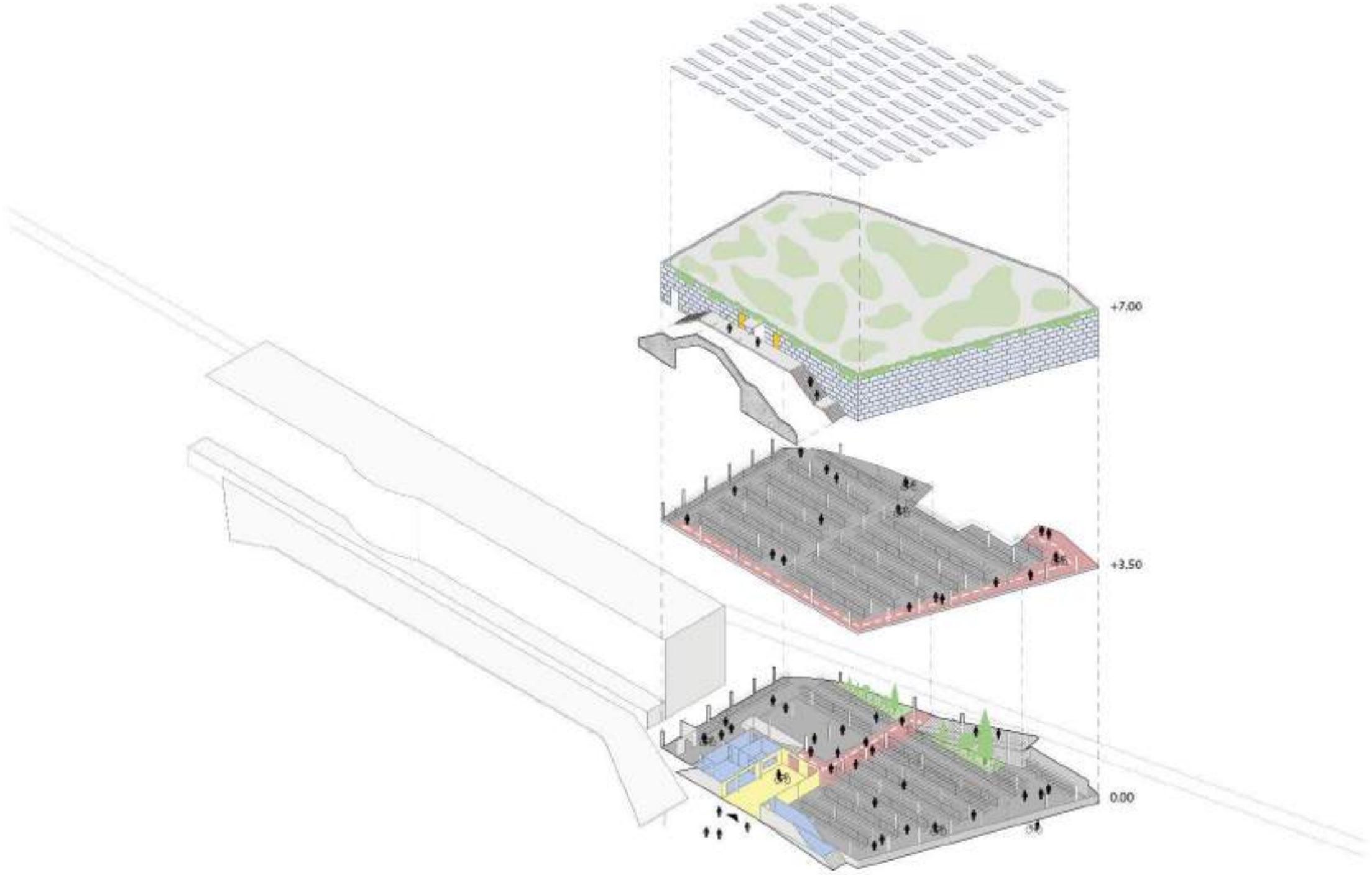
2018-2023: Bicycle parking building,
Eindhoven; 5000 bicycles
ProRail, Eindhoven, NS

Cie.

Current and future site



Cie.




Cie.
2986
2986


Cie.
ProRail


Cie.

Cie.

Cie.


Cie.
G1B


Cie.

Cie.

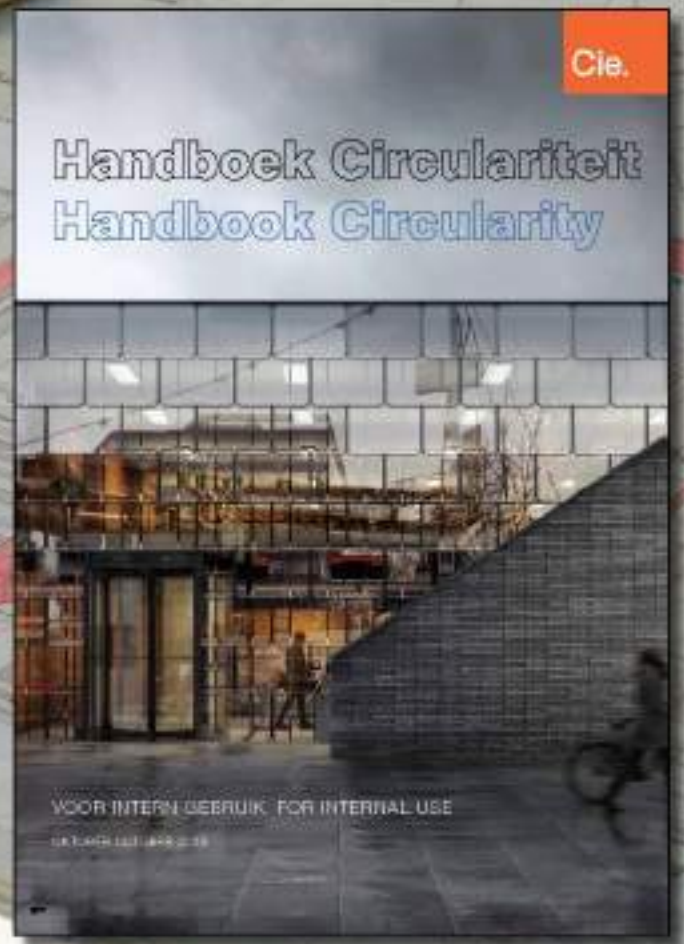
Approx. 600 train windows, 1260x930 mm, mint condition... anyone interested?

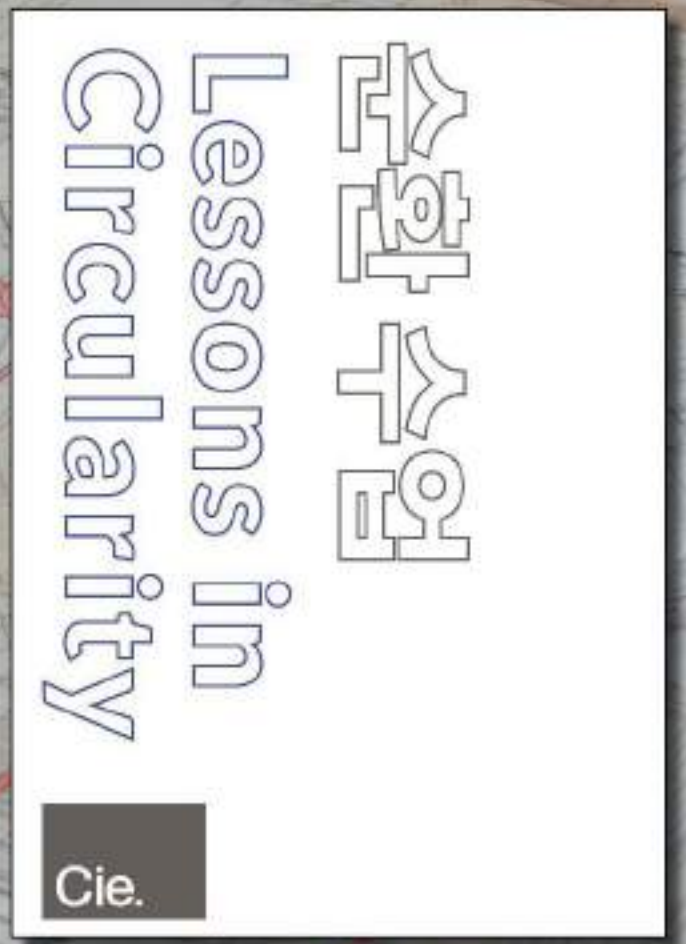
Cie.


Lessen in Circulariteit
Lessons in Circularity
Cie.
BETREFT: GEWAPEND-BETONCONST
LIFTWAND - BALK
KANTOORGEBOUW
BASISWEG
SFB
AMSTERDAM


Cie.

Cie.


Cie.
Handboek Circulariteit
Handboek Circularity
VOOR INTERN GEBRUIK FOR INTERNAL USE


Lessons in Circularity
Cie.

Cie.

Thank you for your attention - any questions?

Marco Montesi

Sustainability specialist at RFI

Promotion of sustainable investments and rail infrastructures through sustainable methodologies and approaches

Almona Tani, Dr.

Sustainability specialist at Italferr

Sustainable design of railway infrastructure projects and contribution to innovations (CE, renewable materials, energy, and ecosystem services)

UIC – ZERO WASTE RAILWAYS

4th workshop

An integrated approach to sustainability along the life cycle of rail projects: commitment, best practices, and cross-sector innovations

Marco Montesi - Sustainability Specialist RFI SpA

Almona Tani - Sustainability Specialist Italferr SpA

April 2024

RFI RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE

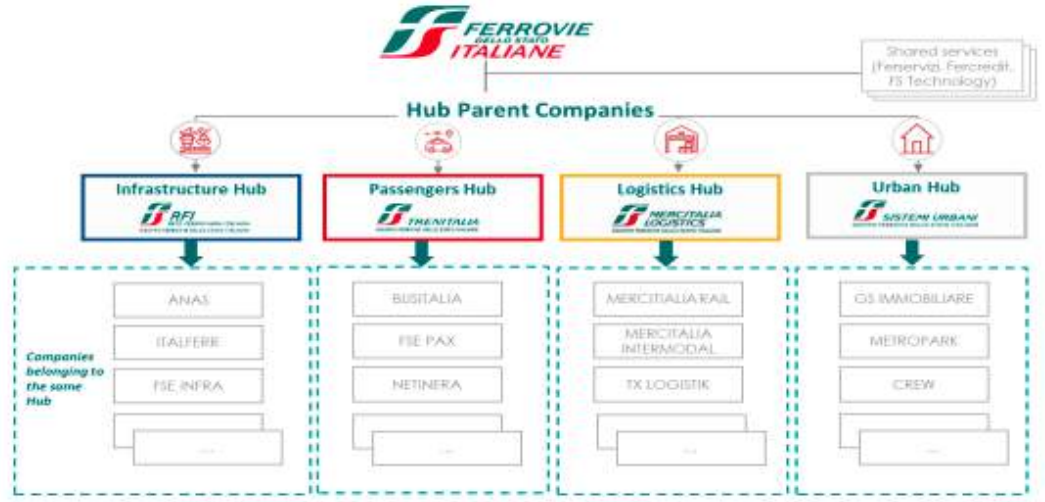
ITALFERR
GRUPPO FERROVIE DELLO STATO ITALIANE

CREW
GRUPPO FERROVIE DELLO STATO ITALIANE

MILANO CORTINA 2026 MILANO CORTINA 2026
PREMIUM PARTNER

Overview of FS Group

The FS Group is one of the largest industrial companies in Italy having the mission to develop, upgrade and manage more than 17,000 kilometers of rail network (included over 1,000 km of High-Speed/High-Capacity services). The Group also operates a road network o f about 32,000 kilometers.



The new governance of FS Group is divided into **FOUR BUSINESS UNITS** - Infrastructure, Passenger, Logistics, Urban – each consisting of different Group companies.

INFRASTRUCTURE BUSINESS UNIT

Construction and maintenance of accessible, integrated, resilient and interconnected rail and road works

Sustainability as a key value

VISION

To create projects and services that can generate value for the community in a long-term perspective, by implementing an integrated and sustainable mobility and logistics offering

E **Preserving natural balance** through a sustainable development model

S **Meeting the needs** of people, promoting **safety,** and fostering **relationships with communities**

G Enhancing various assets by organizing activities and processes to **create value, in the medium and long term perspective, for all stakeholders**

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PREMIUM PARTNER

An integrated approach to implement a systemic vision of sustainability

Strategic Investment Planning

- Integrate sustainability criteria in assessments for identifying investment priorities.

Feasibility Studies Alternative Analysis

- Integrate sustainability criteria in choosing the «rigt» project;
- Promote dialogue with stakeholders to analyze needs and enhance the territory.

Design

- Integrate sustainability principles/criteria in design standards and during project development phase.
- Rethinking the approach to communicate the meaning of the work for the sustainable transformation of territories and communities

Sustainable Procurement

- Introducing sustainability criteria in the procurement process, tender procedures and tender specifications.

Realization and Monitoring

- Sustainable Construction Site Management;
- Monitoring of sustainability indicators;
- Implementation of the circular economy model for all RFI construction sites.

Envision Protocol

Carbon Footprint
(ISO 14064)

Life Cycle Assessment
(ISO 14040)

Management System
(ISO 9001 – 14001 – 45001)

Suistainable Building
(LEED/BREEAM/WELL)

Collaborative and mutidisciplinary approach to integrate sustainability criteria

- **Internal and external collaboration**
- **Supply chain synergies**
- **Innovation projects**
- **International collaboration**

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PREMIUM PARTNER

Our commitment to design and realize sustainable projects

Integrate sustainability criteria into design and construction manuals

Specifications on how to design and construct rail infrastructures are provided by the RFI Civil Works Design Manual which constitute the global reference for the development of railway projects.

Manual and technical specification

Sustainability criteria

- EPD/LCA of construction materials (e.g. steel, concrete, ecc)
- Management of the excavated soil (internal and external reusing)
- Naturalistic engineering
- Inert materials - Recycling, reuse and valorization
- Unsing of refurbished/remanufactured TBM

Cross sector approach

Integrate criteria and assessments oriented towards the implementation of a **systemic vision of Sustainability** - with a **zero waste perspective –** also to guide the entire supply chain

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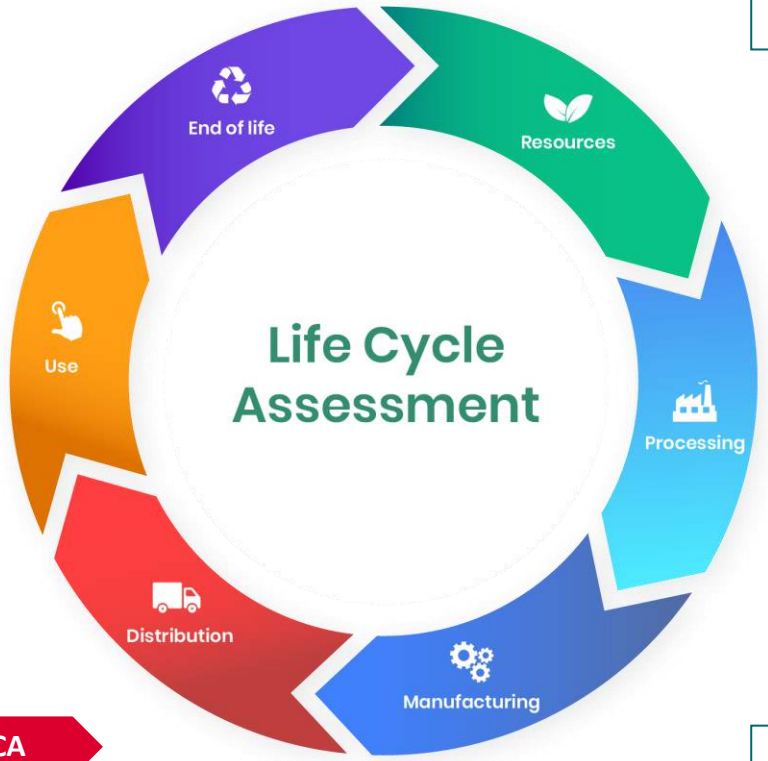
Life Cycle Assessment / Environmental Product Declaration

Commitment in orienting suppliers through sustainability policies

Supply chain main phases

- **Production**
- **Extraction and processing of raw materials**
- **Transport on site**



- **UNI EN 15804:2021 - PCR**
- **UNI EN ISO 14067:2018 – CFP**
- **UNI EN 14040:2021 – LCA**
- **UNI EN 14025:2010 – EPD**

Incentive for materials coming from nearby production plant

Motivate for the use of EPD certification

Awareness regarding the importance of environmental protection

Push the supplier and the contractor towards green solutions

Reduce the possible impacts associated with manufactured and products consumption

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Management of the excavated soil

Increasing the amount of reusing of excavated material on site

Specific design assessments to resue materials in external site (e.g. regeneration of quarries)

Construction activities planning in order to maximize the reuse of soil and rock on site

Minimize the amount of material transported ON and OFF site

Lime treatment for silt and fine clay

Prefer interventions that requires the same or compatible excavation's soil and rocks

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Inert materials - recycling, reuse and valorization

Reduction of waste production and decreasing of raw material consumption

WHAT WE DO

- Use of recycled aggregates for earthworks (backfills, embankments)
- Asphalt millings to replace virgin raw materials for road paving

NEXT STEPS

- Used as layer for construction track (low mechanical characteristics)
- Use of by-products from industrial process (eg marble/porphry)
- Reuse of concrete railway sleepers and inert
- Dedicated treatment plants for railways materials
- Implementing incentives for the use of recycled materials in the procurement

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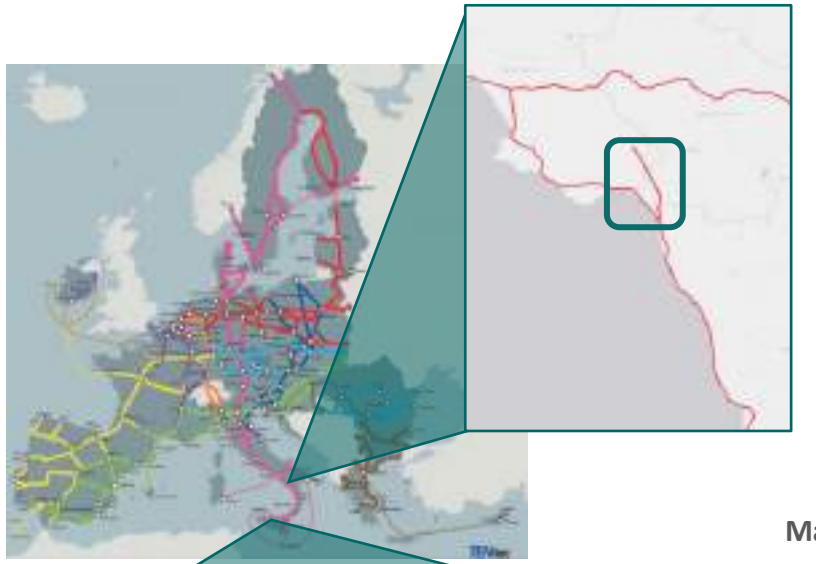
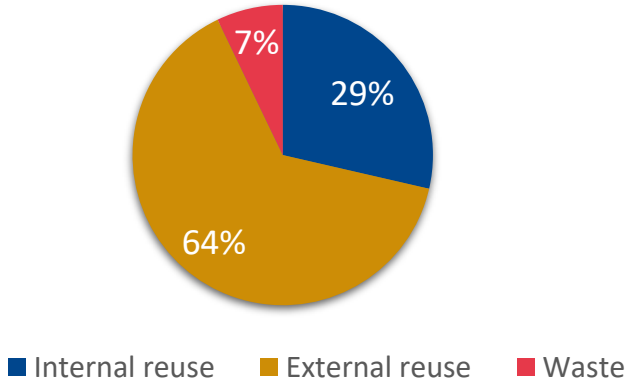
New HS Railway Lines of the TEN-T Scandinavian – Mediterranean Corridor

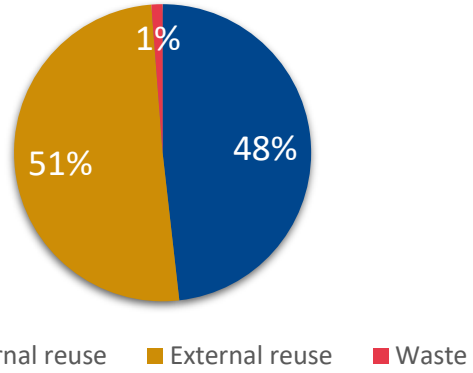
Sustainable management of excavated soil and rocks in railway projects



Management of excavated soil and rocks (m3)
Salerno-Reggio Calabria Lot 1C



Management of excavated soil and rocks (m^3)
Palermo-Catania Lot 5



Cross collaboration among designers, client, local authorities and quarry managers to reduce the use of virgin materials, and related costs and emissions, and restore ecosystems of decomissioned quarries

RFI RETE FERROVIARIA ITALIANA ITALFERR CREW

Railway station – Milano Romolo (Milan, Italy)

Upgrading of the existing railway station for the urban reconnection and sustainable mobility

New station Plaza paving:
REUSE of the existing platform paving (90% of the total Plaza surface)

Plaza paving reused from existing railway platform: Pietra di Serizzo (1300 sqm)

Sustainability Framework:

- LCA implementation and assessment of the circularity of materials;

- Italian Regulations e.g. Minimum Environmental Criteria.

Role of Designer for Innovative Solution:

- Designer proposal of paving conservation in accordance with RFI, in order to reduce use of virgin material and avoid transportation;

- Selective demolition guidelines for the Contractor.

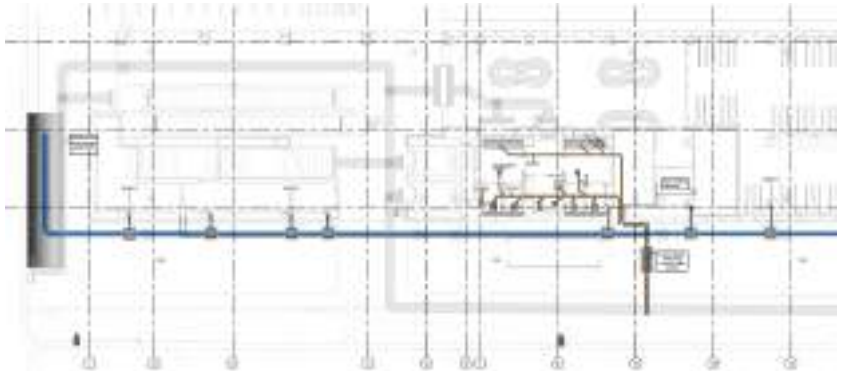
RFI RETE FERROVIARIA ITALIANA ITALFERR CREW

PREMIUM PARTNER

Railway station – Milano MIND (Milan, Italy)

New railway station for the urban reconnection and sustainable mobility

Underground harvesting tank for the water reuse (capacity 26000 l)



The rainwater from the roofs is conveyed via downspouts into an underground accumulation tank. The collected water is reused for the following non-potable water use purposes:
- irrigation of green areas;
- toilet drains;
- photovoltaic panel washing system.

Sustainability Framework:

- Infrastructure Environmental Protocol ENVISION;

- Italian Regulation e.g. Minimum Environmental Criteria.

Role of Designer for Innovative Solution:

- Designer proposal of water reuse in accordance with RFI, in order to reduce use of potable water;

- Coordination with Consorzio Est Ticino Villoresi for the hydraulic invariance and with the Water Authority (Service Conference) for the water reuse.

RFI RETE FERROVIARIA ITALIANA ITALFERR CREW

PREMIUM PARTNER

Research and Development and Innovation

Research Projects

R&D&I
in collaboration with universities, resesearch centers, consultancy companies and other partners from different sectors

RECONMATIC
Automated solutions for sustainable and circular C&D waste management

MOST
National center for sustainable mobility

IAM4RAIL
Holistic and integrated asset management for Europe's rail system

HORIZON EU

PNRR

ERJU

LIFE

MOST- H_2
Novel metal organic framework adsorbents for efficient storage of hydrogen

LIFE SILENT
Sustainable innovations for longlife environmental noise technologies

NEW!

SYMBIOSIS
Systemic mobilisation for joint Biodiversity and Infrastructure

RFI RETE FERROVIARIA ITALIANA ITALFERR CREW

PREMIUM PARTNER

Horizon Europe RECONMATIC

Funded by the European Union

UK Research and Innovation

Automated Solutions For Sustainable And Circular Construction And Demolition Waste Management

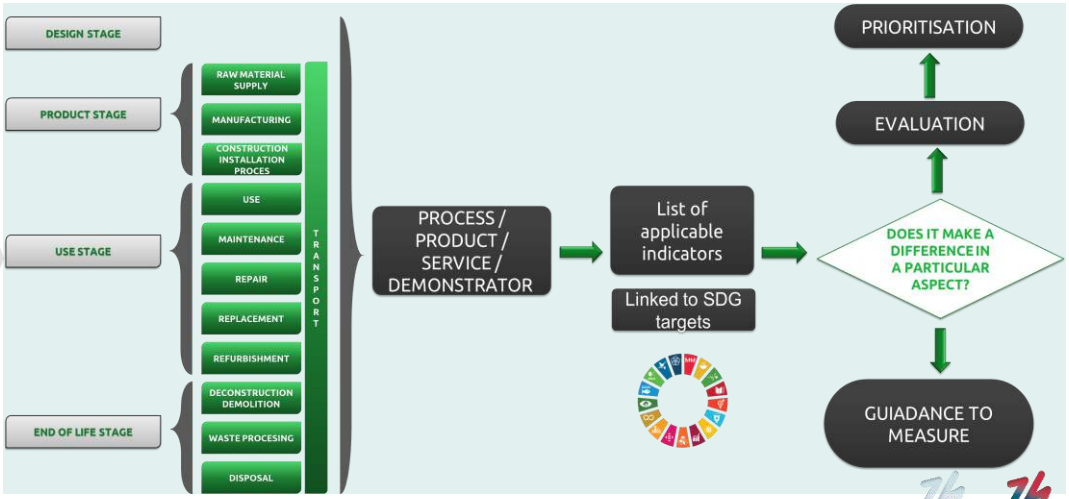
Develop, test and promote digital tools and innovative solutions for material and/or component tracing and C&D waste management in construction or demolition sites

- Implement cross-sectoral holistic solutions from different perspectives
- Assess the value of the solutions in economic, business, environmental and societal terms

PARTNERSHIP
23 Partners
7 Countries

Collaboration among different stakeholder categories of the construction supply chain

- Analysis of the state of the art: identifiaction of stakeholders and current practices supported by QUESTIONNAIRES
- Build an assessment framework for sustainability and circularity through KPIs through INTERVIEWS AND WORKSHOPS



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LIFE SILENT

Sustainable Innovations for Long-life Environmental Noise Technologies

Development of sustainable and eco-friendly solutions to mitigate noise in complex urban environments, where multiple and diverse noise sources, mainly roads and railways, coexist across densely populated areas.

- Upgrade and revisit low noise pavements and low-height noise barriers produced with recycled materials
- Assess the sustainability of LIFE SILENT technologies, beyond noise reduction, to ensure a long-term outlook of benefits

PARTNERSHIP
10 Italian Partners

Collaboration for the development of innovative technologies and their sustainability assessment

- The production of low noise pavements and low-height noise barriers with recycled materials
- The identification of innovative metrics and KPIs for LCSA also through surveys to the local community

RFI RETE FERROVIARIA ITALIANA · ITALFERR · CREW

PREMIUM PARTNER

Thank you

Marco Montesi - Sustainability Specialist RFI SpA (m.montesi@rfi.it)

Marco Fantozzi – Environmental Specialist RFI SpA (ma.fantozzi@rfi.it)

Francesca Cantù – Environmental Specialist RFI SpA (fr.cantu@rfi.it)

Almona Tani - Sustainability Specialist Italferr SpA (a.tani@italferr.it)

Chiara Ravagnan – Sustainability Specialist Italferr SpA (c.ravagnan@italferr.it)

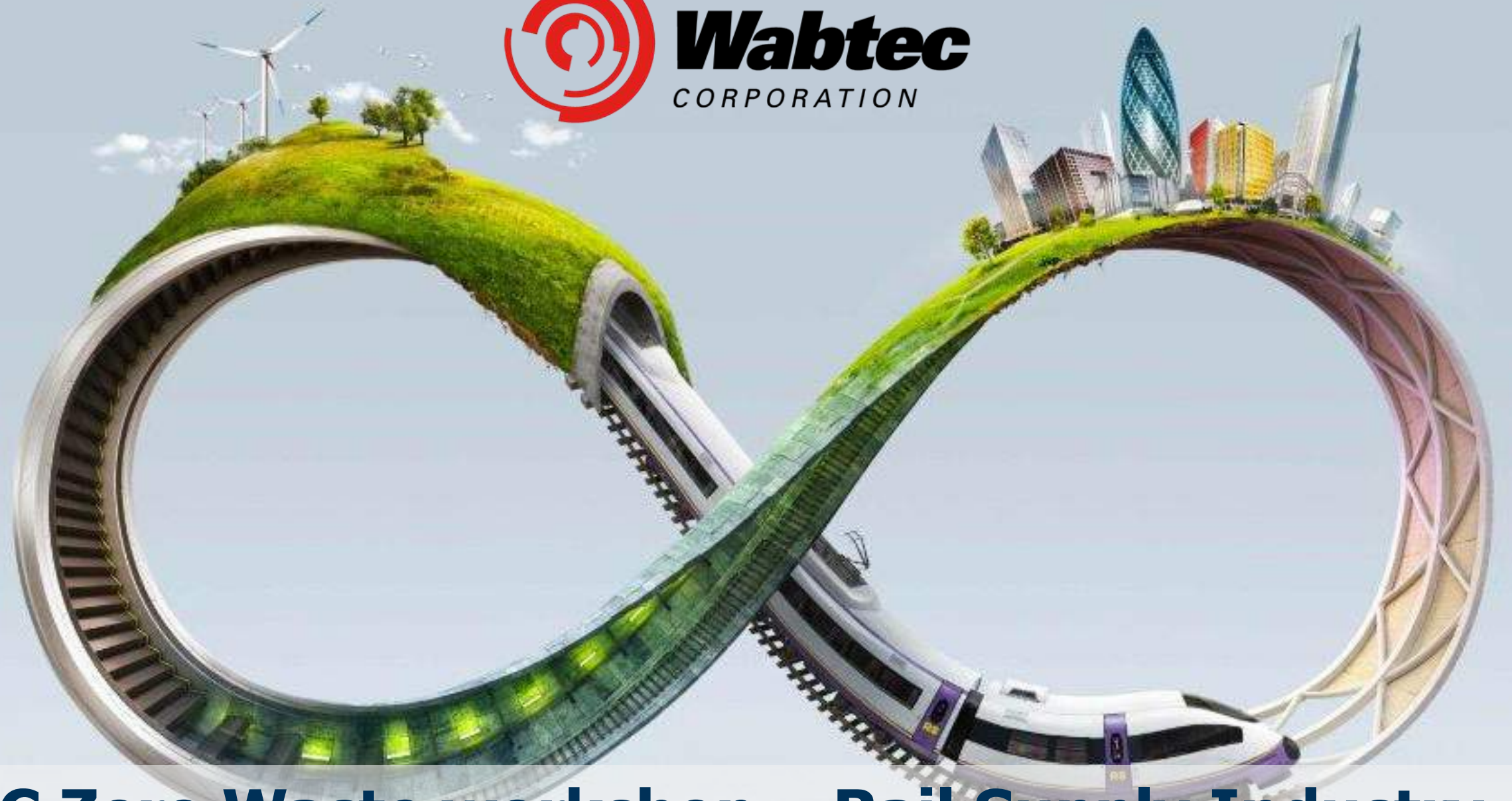
Veronica Andreis – Sustainability Specialist CREW Cremonesi Workshop Srl (v.andreis@crew.it)

Ludovic Kasperski

Engineer and project manager

Wabtec’s Sustainability Strategy lead for transit business

Focus : education and empowerment as lever for sustainability transformation



UIC Zero Waste workshop – Rail Supply Industry

Zurich 23.4.24 L. Kasperski

Wabtec's vision of circularity

Interventions along the value chain

Customers success stories

UIC Zero Waste workshop – Rail Supply Industry

Zurich 23.4.24 L. Kasperski

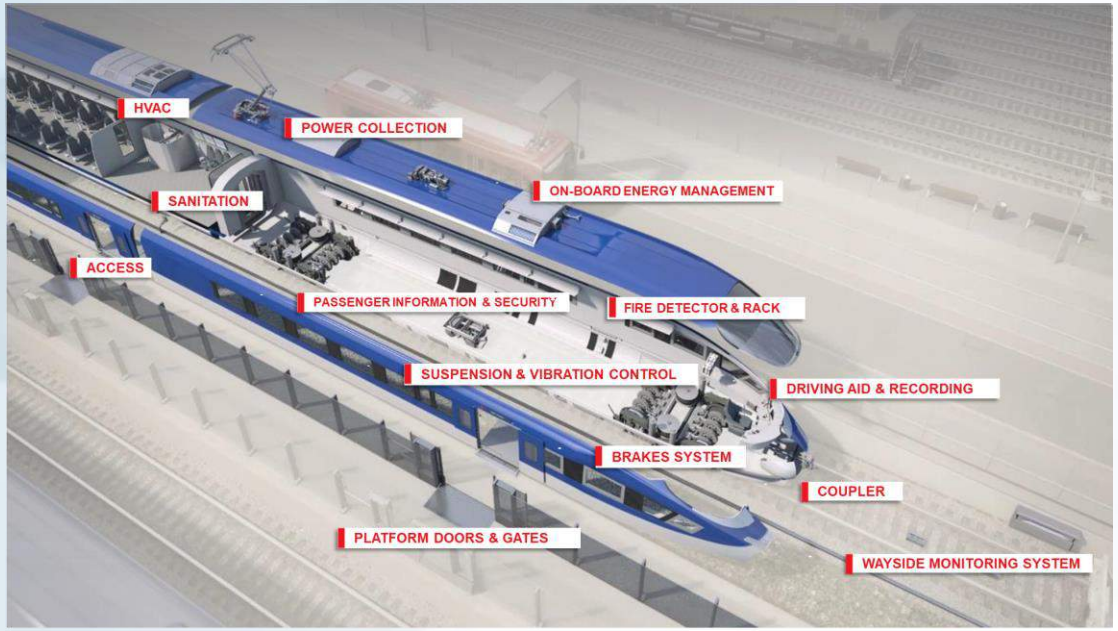
Wabtec CORPORATION

Equipment manufacturer

Lifelong service provider

Remanufacturing leader

Carbuilders



Operators

Wabtec CORPORATION

Equipment manufacturer

Life Cycle Thinking
Energy efficiency for use phase
Limit use phase pollution
Sustainable material sourcing
Sustainable procurement
Low-carbon manufacturing

Before use
Creating the best value

Lifelong service provider

Lifetime extension
Product availability
Customer proximity
Modernisation / Upgrade

During use
Optimising value

Remanufacturing leader

Refurbishment
Remanufacturing
End Of Life management
Take back

After use
Circularise value

A key role for product circularity in the rail industry

During use
Optimising value

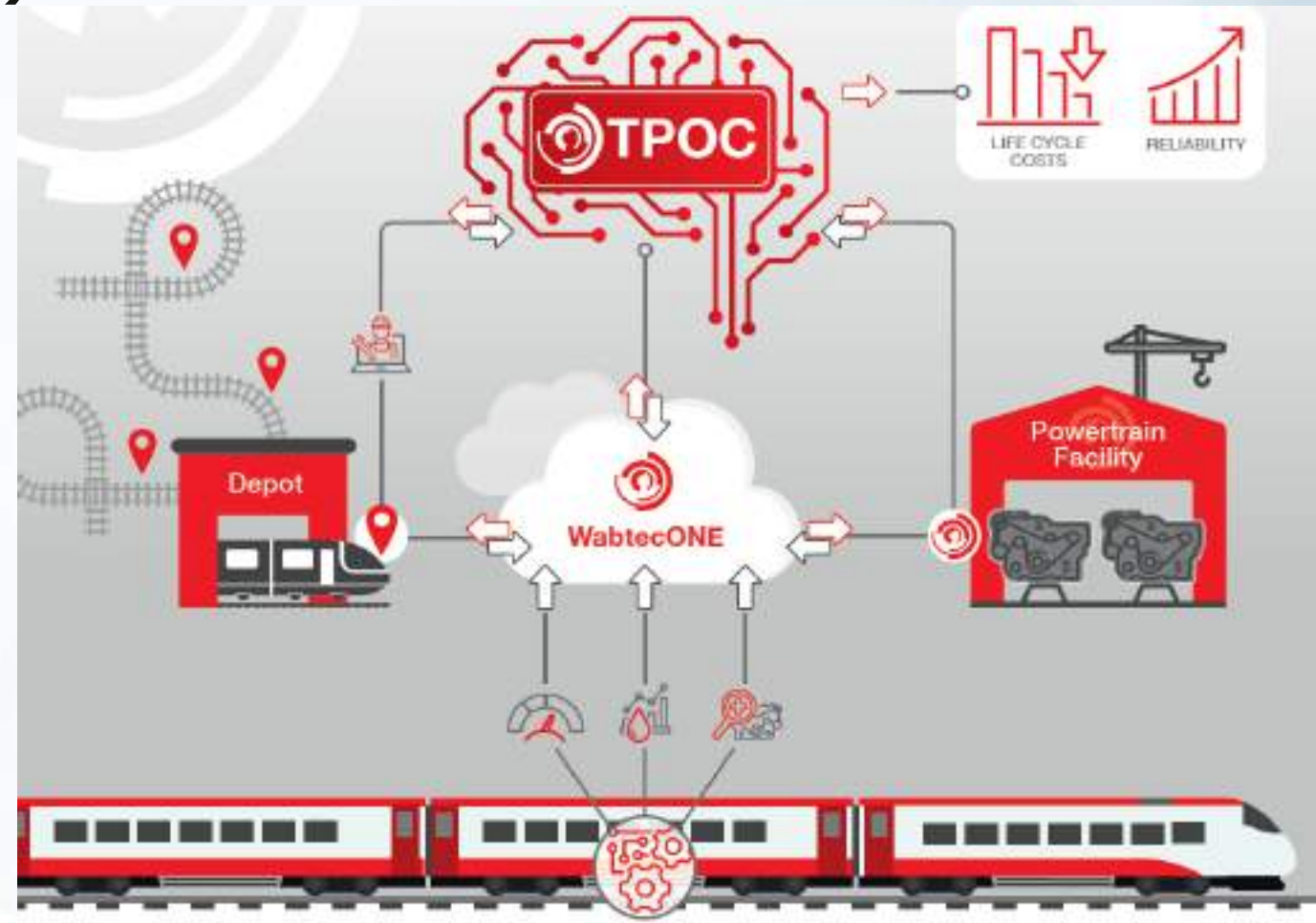
Product availability Through Life Care ® (TLC)

Transit Performance Optimisation Centre (TPOC)

- ✓ Maximising Customer Asset Performance
- ✓ Minimising Lifecycle Cost
- ✓ Enabling Sustainable use of Resources

Operating Model founded in collaboration

- ✓ Asset Owners (Leasing Companies)
- ✓ Train Operators
- ✓ Wabtec internal stakeholder teams – Product Line, Field Service and Engineering



Wabtec CORPORATION

During use
Optimising value

Modernization / upgrade
HVAC Energy saving : RegenAir ®

Main characteristics

- ✓ **Monitoring** of the onboard energy flux
- ✓ **Real time calculation** of the heating needs
- ✓ Up to 95% of braking **energy reused** for heating
- ✓ **Adaptable** to any HVAC unit

Zoom on LRV

20% saving on heating*

*Measurements winter 2018-19

Upgrade benefits

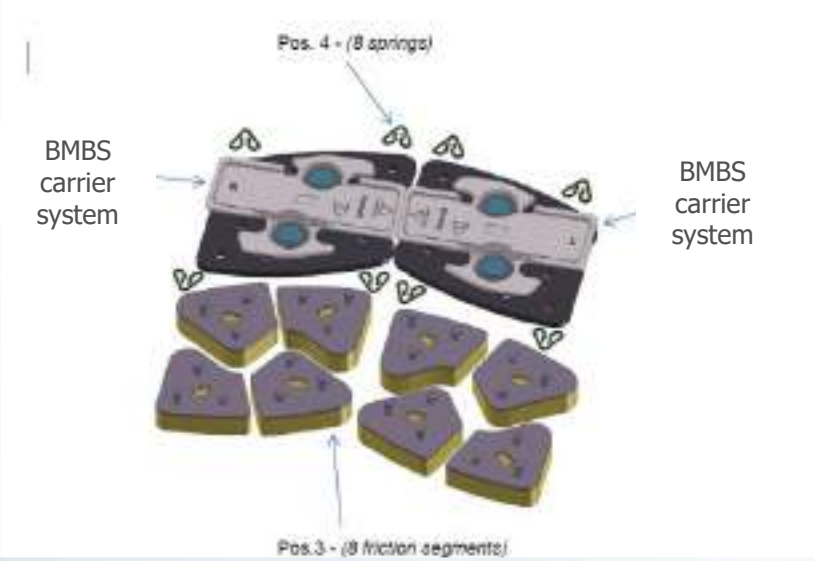
- ✓ Immediate saving $ + kWh (up to 25%)
- ✓ Quick deployment / low downtime
- ✓ Particularly well adapted to Urban & Suburban transportation (high fluctuations of passenger load)

Wabtec CORPORATION

After use
Circularise value

Remanufacturing / Take back
Becorit Modular Brake System ® (BMBS)

Circular solution for plate



- ✓ Re-usable carrier system
- ✓ Worn friction elements can be changed.
- ✓ Recycling in the workshop by the customer or in Becorit‘s factory.
- ✓ Becorit offers training, hardware and measuring equipment for recycling.

Circular solution for used pads & blocks

Wabtec CORPORATION

After use
Circularise value

Remanufacturing / Take back
(Towards) Circular Carbon strips

Friction strip
Today : large scale recycling or waste-to-energy

Screws and connections
Today : large scale steel recycling

Horns
Today : large scale steel recycling

Strip career
Today : large scale alu recycling

Tomorrow : switch to Reman (Reuse) to increase product circularity

Challenges to increased circularity	Solutions
Collect EOL products	Increase **logistic cooperation with operators** (Milk Runs, quality controls etc..)
2nd life material insufficient for raw material feedstock (Production growth, insufficient certified reusable material, …)	For all new material feedstock required beyond Reman potential, **supply chain cooperation** to maximise recycled content, up to 80%
Safety for Reman / reused components	Revision of technical specs + Full serial re-qualification

Wabtec CORPORATION

After use
Circularise value

Refurbishment
Overhaul success story - door systems

Fleet Condition Assessment (FCA) → Scope of overhaul incl. modernization → Overhaul logistic scenario → Overhaul execution

Main scope of overhaul

Complete electric and mechanical overhaul of the doors

Product availability

- ✓ Downtime : overhaul execution performed on customer site by our local Italian Team
- ✓ Fleet reliability : DCU and Electric motor are overhauled in our premises to bring reliability back at revenue service level

Modernization / Upgrade

- ✓ Obsolescence management: replacement by new Micro-switches technology
- ✓ Safety upgrade : new asymmetrical anti-drag + Emergency Egress Device and Emergency Access Device
- ✓ Availability upgrade : new lock-out device + new handles on the door leaves

Customer : Azienda Mobilità e Trasporti di Genova

Fleet : 12 T67A trains in service now for 34 years from Firema

Wabtec CORPORATION

AMT MOBILITÀ E INNOVAZIONE

After use
Circularise value

Refurbishment
Overhaul success story - couplers

Fleet Condition Assessment (FCA) → Scope of overhaul incl. modernization → Overhaul logistic scenario → Overhaul execution

Main scope of overhaul

Complete overhaul of Automatic couplers, Semi Permanent bars as bogie steering device.

Product availability

- ✓ Fleet reliability : Automatic coupler, draft gear, electrical coupler, bogie steering overhauled in Wabtec workshops to bring reliability back at revenue service level

Modernization / Upgrade

- ✓ Obsolescence management : replacement by new pneumatic valves
- ✓ Safety upgrade : new draft gear patented + new articulation steering+ Steering bogie device.
- ✓ Components EOL management : all components of couplers are recycled

Our customers : Rennes Metropole, GTT & Transdev CDG.

Fleets : VAL 206, VAL208, VAL208NG &VAL208 NG3 from Siemens in service now for 30 years.

Wabtec CORPORATION

Wabtec circularity vision

Rail circularity enablers:
| Digitalization |
| Product innovation |
| Industrial technology |
| Logistics |

A key role for product circularity in the rail industry

Wabtec CORPORATION


Wabtec
CORPORATION

INTERNATIONAL UNION
OF RAILWAYS

WRAP UP

WRAP UP

Having listened to the speakers and participants sharing their experience, Leo Bürki suggests from a systems thinking perspective

- Setting NEW **GOALS**
- Think how to ensure **1+1=3**
- **TIME** is a key factor= do everything (maintenance) in less time
- Invite also the **STRATEGY LEADS** of the stakeholders of the value chain to our events
- If endorsed at top management level, **new ideas can become the new rules**
- Open our closed-loop way of thinking
- **AI will increase** possibilities **for innovation**

Feedback from the group

GOALS

- promote modal shift to rail transport
- Funds are needed to achieve the goals of Paris agreement (govt., investors, green investments)
- Achieving Circularity will ensure sustainability of rail transport
- Making the right incentives: use of public transport systems
- Integrating all regions in order to help them increasing multimodality
- Increase the cost of virgin materials, True pricing of materials
- Advocate for tax shift
- Reduce cost of tickets
- Increase collaboration across the supply chain.
- Exchange of data should be made possible (too expensive now) to lift barrier to shift from linear to a circular business model

- Trust must be built (long term perspective) to be able to achieve shift to circular business Model
- Feeding AI with data will help avoiding need of huge data bases to solve issue of data sharing (on material exchange)
- Increase rail in rural area with low-traffic lines
- Let’s start to act!
- UIC CE sector should focus on knowledge exchange

INTERNATIONAL UNION
OF RAILWAYS

Stay in touch with UIC:

www.uic.org

#UICrail

Thank you for your attention.