Sustainable Chemistry: Contributions to a Low-Carbon Economy

Alexis Bazzanella
ISC_3 Innovation Hub

International Sustainable Chemistry Collaborative Centre

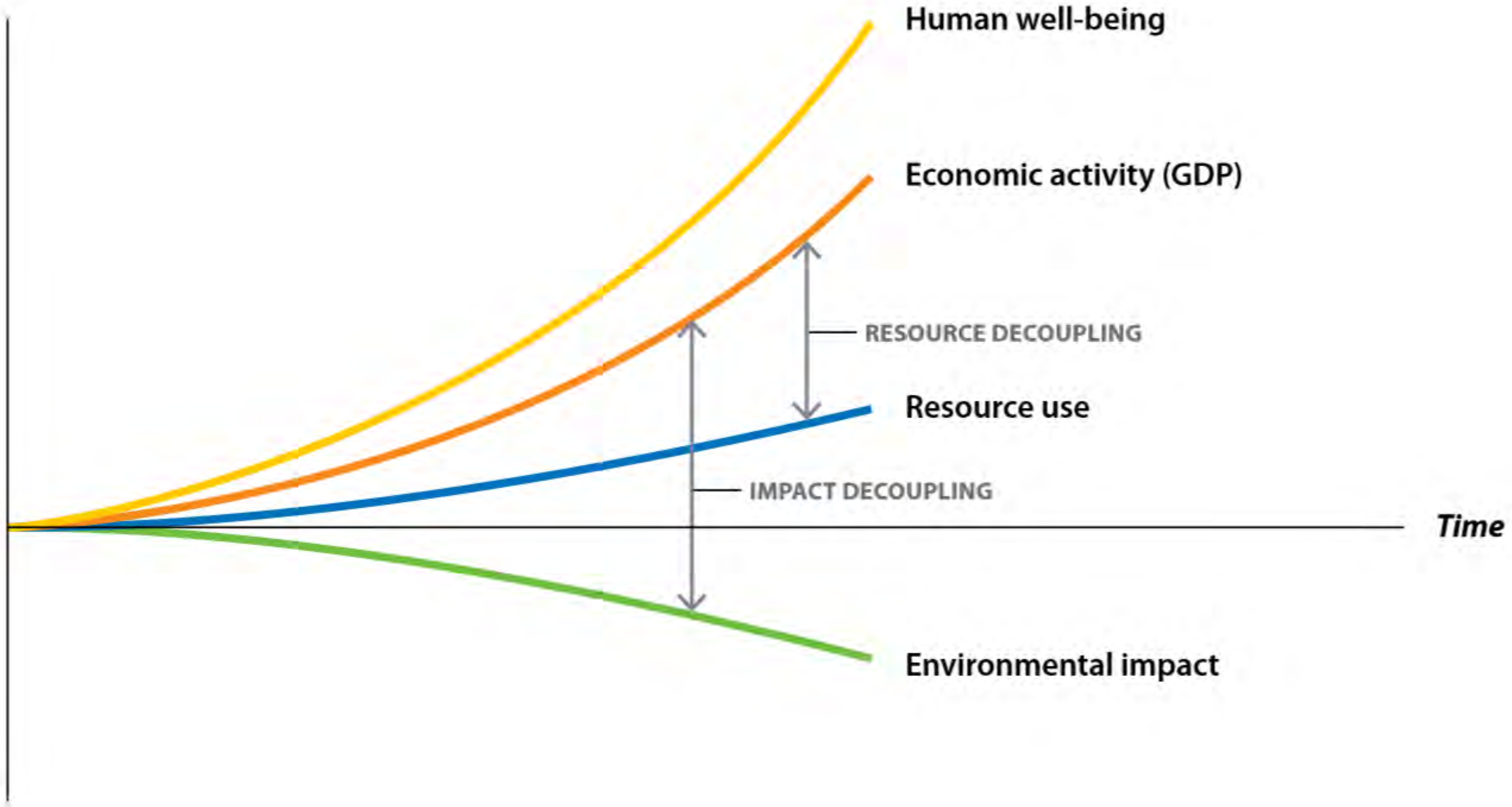
ISC_3

- Launched May 2017
- Headquarter GIZ;
  Innovation Hub@DECHEMA,
  Research Hub@ Leuphana
- Mainstreaming sustainable chemistry internationally
- Life-cycle of products, Resource Sustainability, Circular Economy

International Sustainable Chemistry Collaborative Centre

Impact of decoupling human well-being from resource consumption (UNEP)

International Sustainable Chemistry Collaborative Centre

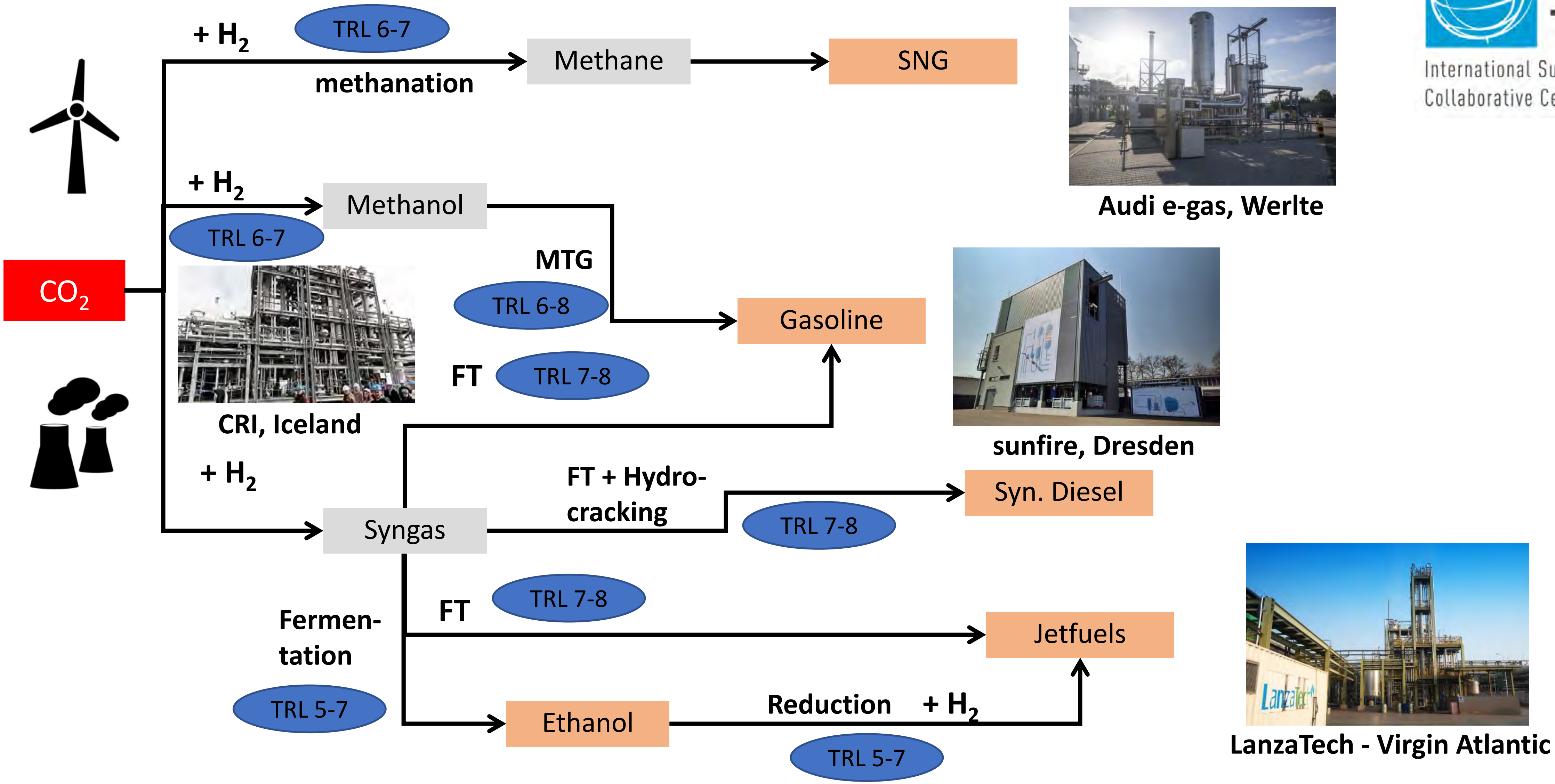


Aspects of Sustainable Chemistry

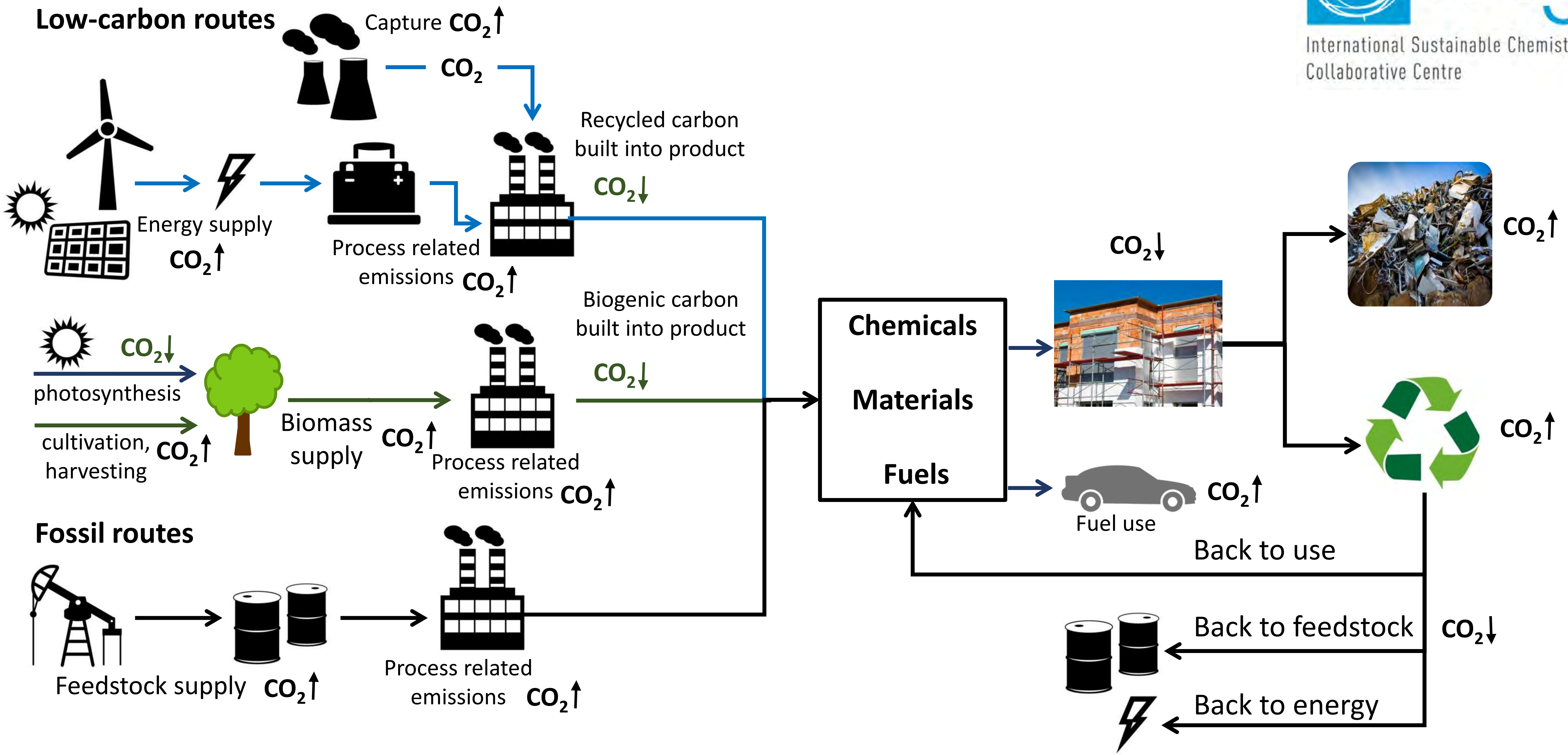
- Substance(s) used less (eco)toxic
- Substance(s) used better degradable
- Less use of non-renewable resources
- Less use of resources in the product‘s life cycle
- Less energy consumption in the product‘s life cycle
- Use of secondary resources
- Use of regional renewable resources (spec. cond.)
- Recycling of used substances/products possible
- More occupational safety
- Value-creating products/services
- Longevity of product
- …
- Contributing to the SDGs

Low carbon technologies: CO_2 utilisation

ISC3 International Sustainable Chemistry Collaborative Centre



Impact during the lifecycle



Life cycle aspects of products

ISC3
International Sustainable Chemistry Collaborative Centre

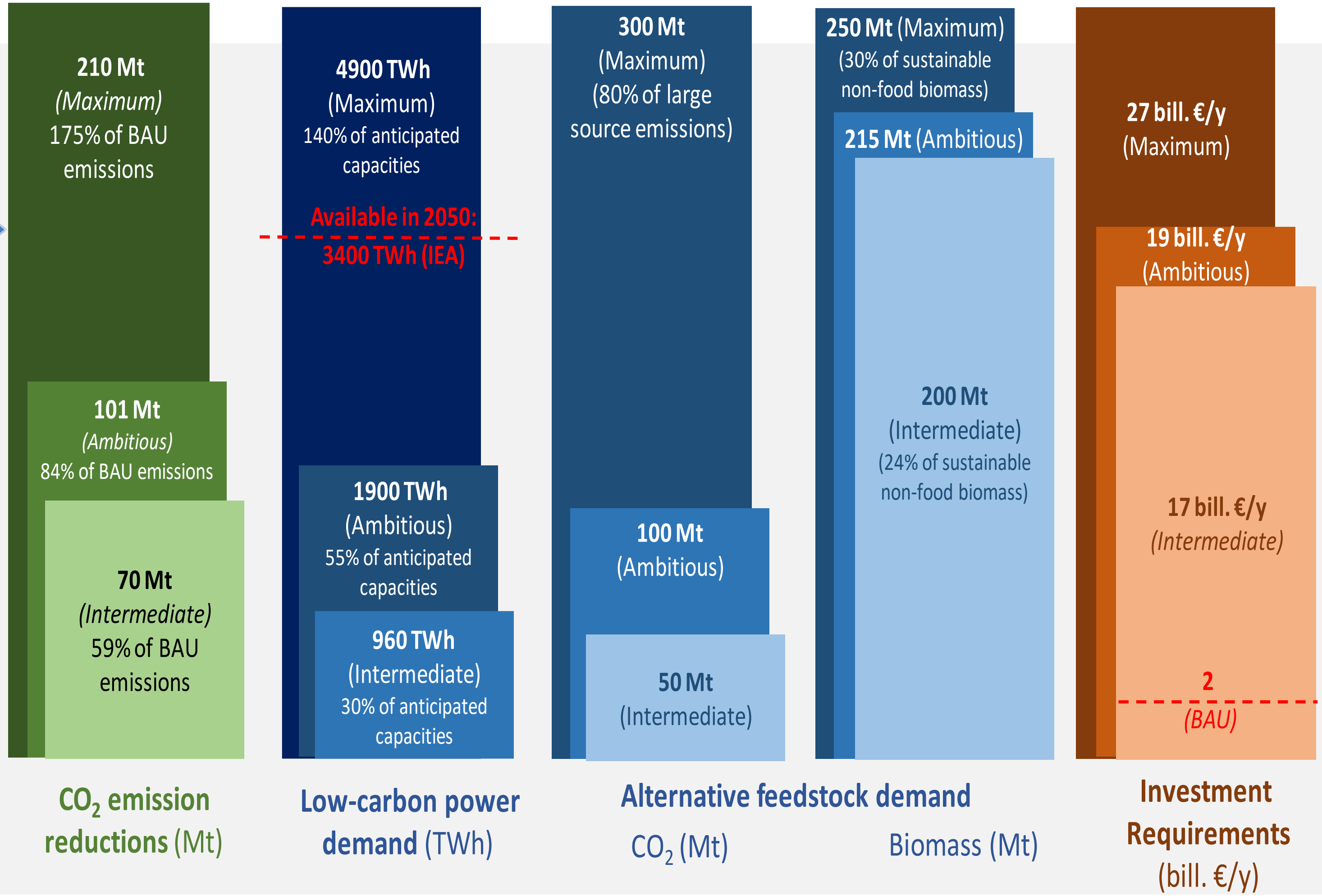
Low carbon production route → Efficient products → Recycla-bility

Life cycle aspects of products

ISC3 International Sustainable Chemistry Collaborative Centre

Low carbon production route

- Limited resources
- Competing pathways
- High energy demand
- High biomass demand
- High metal dependency
- Economic gap factor >2



DECHEMA 2017, Low carbon energy and feedstock for the chemical industry

Life cycle aspects of products

Low carbon production route

- Limited resources
- Competing pathways
- High energy demand
- High biomass demand
- High metal dependency
- Economic gap factor >2

Efficient products

- Downstream energy/GHG savings to be considered
- Leverage factor: 2.1 to 2.6 tCO_2e savings per emitted t

ICCA/ McKinnsey, 2009:
Innovations for Greenhouse Gas Reductions
A life cycle quantification of carbon abatement solutions enabled by the chemical industry

Life cycle aspects of products

ISC3
International Sustainable Chemistry Collaborative Centre

Low carbon production route

- Limited resources
- Competing pathways
- High energy demand
- High biomass demand
- High metal dependency
- Economic gap factor >2

Efficient products

- Downstream energy/GHG savings to be considered
- Leverage factor: 2.1 to 2.6 tCO_2e savings per emitted t

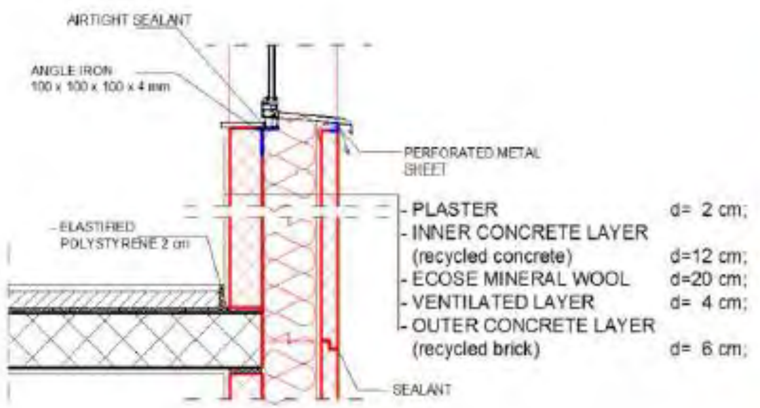
Recycla-bility

- 54 Mt p.a. products
- 44 Mtoe energy required
- ~425 Mtoe of EU energy consumption could be reduced in a fully formed circular scenario

accenture, 2017: Taking the European Chemical Industry into the Circular Economy

Example: Precast concrete sandwich panel

International Sustainable Chemistry Collaborative Centre



ECO-SANDWICH®

- 50% secondary raw material
- 12 cm thick layer of recycled concrete
- 20 cm of mineral wool,
- 4 cm layer for ventilation purposes
- 6 cm external skin, crushed bricks from demolition material

Qualitative comparison of a conventional precast concrete sandwich board and the ECO-SANDWICH®

ISC3
International Sustainable Chemistry Collaborative Centre

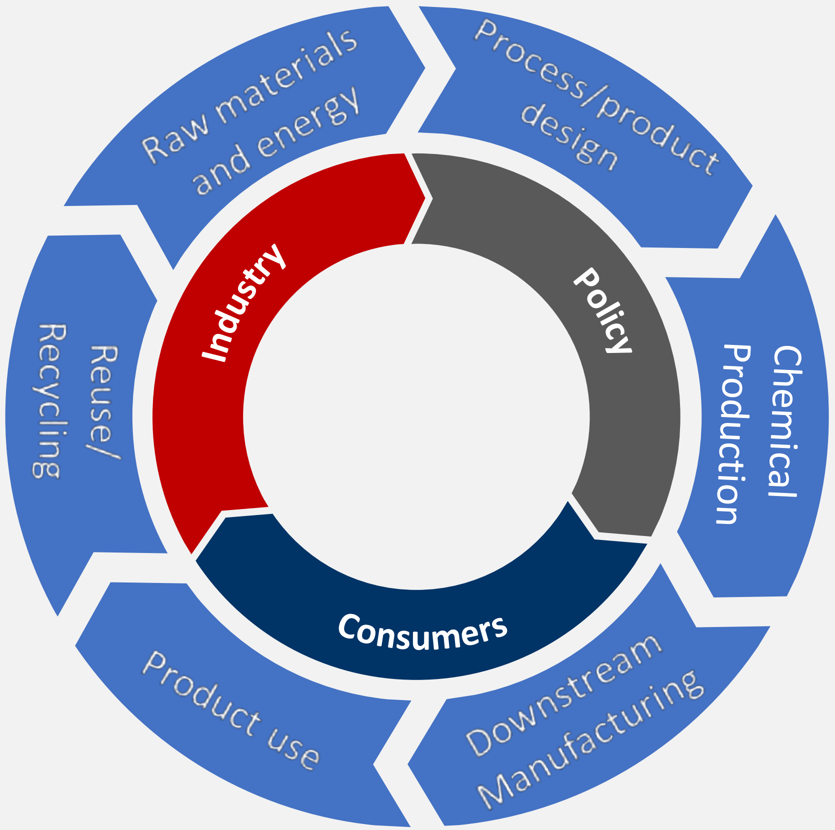
Indicator	Precast concrete sandwich board	ECO-SANDWICH®
GHG emissions	+++	+
Energy input and intensity	++	+
Raw material input	Widely available mineral raw materials	Partly mineral secondary raw materials
Waste – Production	0	?
Processing	+	+
After use	Recyclability questionable	Presumably not recyclable
Raw material intensity	High	Average
Critical contents		Phenol formaldehyde resins
Technical advantages/ disadvantages	Prefabricated element for the facades of large buildings	Presumably also intended for residential buildings
Economic advantages, employment	Inexpensive, easy workability	Labour-intensive due to complex manufacture; presumably competitive in low-wage countries
Market presence	High	Not known

Sustainable products: holistic thinking required

- **Current examples of bio-based chemicals and polymers unsustainable?**
  - Highly functionalized molecules are simplified (degraded) with high need of chemicals and energy!
- **Degradability of polymers, a prerequisite?**
  - Position 1: all down-stream and consumer products must fulfill the criterion of full and fast mineralization
  - Position 2: proper end-of-life solutions once the polymers cannot be sustainably recycled anymore; depolymerize or chemical recycle mixed plastics in an economical and environmental-friendly way
- **How should we generally deal with highly functional materials that often comprise material mixes and composites?**

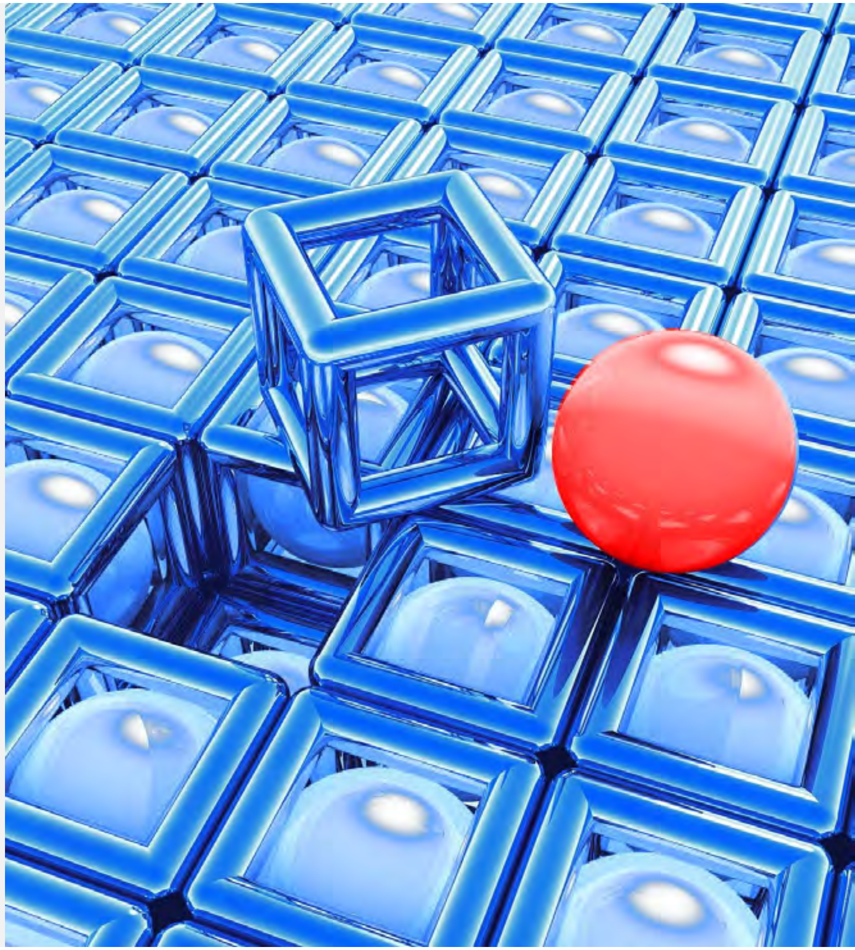
Value Chain collaboration

- Sustainable chemistry provides solutions to combat climate change
- Chemical industry can’t deliver alone
  - Value chain partners
  - Energy sector
  - Other process industries (industrial symbiosis)
- Incentives and matching policy frameworks necessary



Conclusions

- **Chemical industry provides important contributions/solutions to combat climate change**
  - Value chain collaborations required to leverage full potential
- **Sustainable innovations require holistic life-cycle thinking**
  - Limited view on only manufacturing or use phase or recyclability can be misleading
- **Higher energy /GHG efficient solutions have to be checked for other impacts**
  - Contradicting sustainability goals possible



We shape transformation

ISC3
International Sustainable Chemistry Collaborative Centre