FB2 Circular Bioeconomy and Biorefineries - Focus System Integration

Fluid Dynamics | **Circular Bioeconomy and Biorefineries** | Separations and Experiments | Process Simulation and LCA

The research focus *System Integration (SI)* explores potential long-term impacts (positive and negative) caused by the scale-up, demonstration, market introduction, diffusion of, and interaction between sustainable technologies.

Inter-disciplinarity:

Integrating perspectives from

- **Engineering**

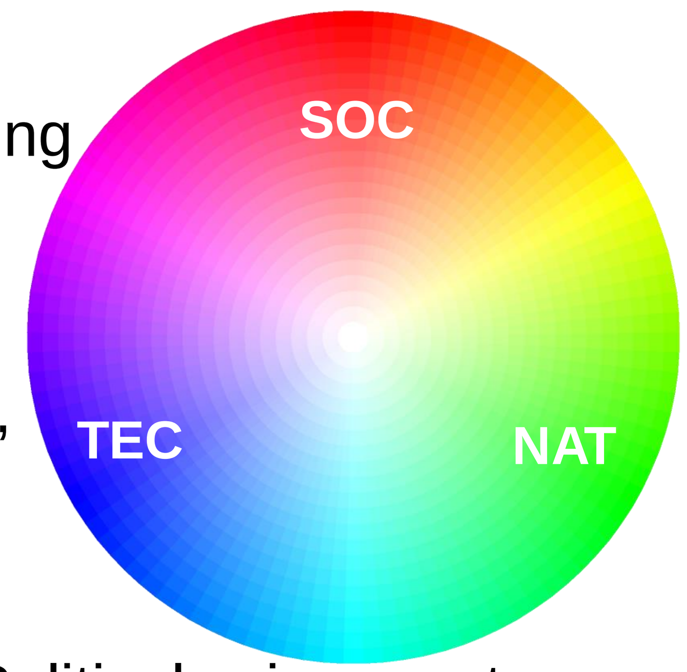
Environmental engineering
Technology assessment

- **Natural science**

Chemistry, Mathematics, Physics, Bionics, etc.

- **Social science**

Economics, Sociology, Political science, etc.



System engineering:

Different types of resources must be continuously extracted, generated, processed, converted, traded, stored, deployed, wasted, recycled, and recovered to meet humanity's energy, material, and food requirements.

We **identify beneficial framework conditions for system change** via

- Fundamental research
- Inter- & trans-disciplinary engagement
- System modelling, quantitative & qualitative future studies
- Policy support & consultancy

System change measures:

➢ **Efficiency measures**

"Making more with less" by reducing or valorizing resources that would be lost or wasted otherwise

➢ **Substitution measures**

"Making things differently" by fulfilling the same functionality with another type of resource

➢ **Reliability measures**

"Making things that do not fail" through enabling the shifting of surplus resources to times, places, sectors, and people in need

➢ **Sufficiency measures**

"Rethinking what is needed" by scrutinizing the urgency of resource consumption and adequacy of non-consumption

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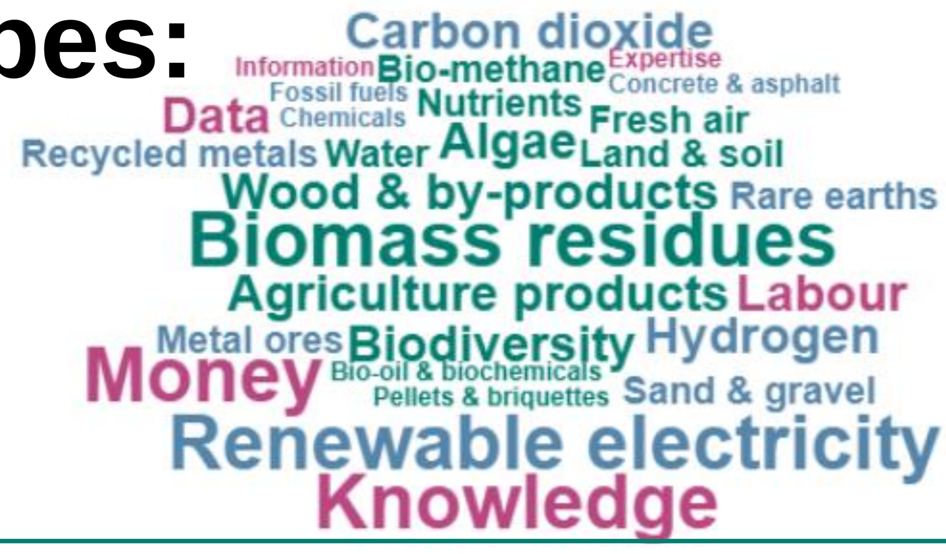
These four measure types must be well balanced to reduce the systemic risks of their dynamic impacts!

Resource types:

Relevant resources can be **biogenic** or **abiotic**, in different states of matter (solid, liquid, gaseous), or even **intangible**.



Selected challenges:

1. Resilience / reliability / robustness:
   How to measure and valorize economic, environmental & social resilience in models, and the economy?
2. Levels of uncertainty:
   How to model variabilities, probabilities, extreme events, cascading failures, epistemic uncertainty?
3. Resource network characteristics:
   How do different network topologies, densities, its heterogeneity and symmetry affect network resilience?

Professional networks:

- International Energy Agency Bioenergy Technology Collaboration Programme (IEA Bioenergy TCP) → https://www.ieabioenergy.com/
- Circular bioeconomy engineering (CBE @ TUW) → https://colab.tuwien.ac.at/x/4RqSAg
- Scientist for Future Austria (S4F AT) → https://at.scientists4future.org/

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