Resilient Conversion Systems for Renewable Energy and Carbon Sources

Aktuelle Energiekrise:

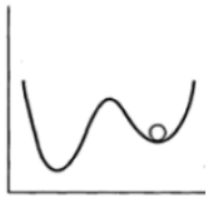
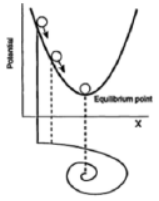
- Abhängigkeit von einzelnen Ländern
- Abhängigkeit von fossilen Rohstoffen
- Abhängigkeit von wenigen/spezialisierten Technologien/Transportpfaden/Standorten (z.B. NS/Schwedt)

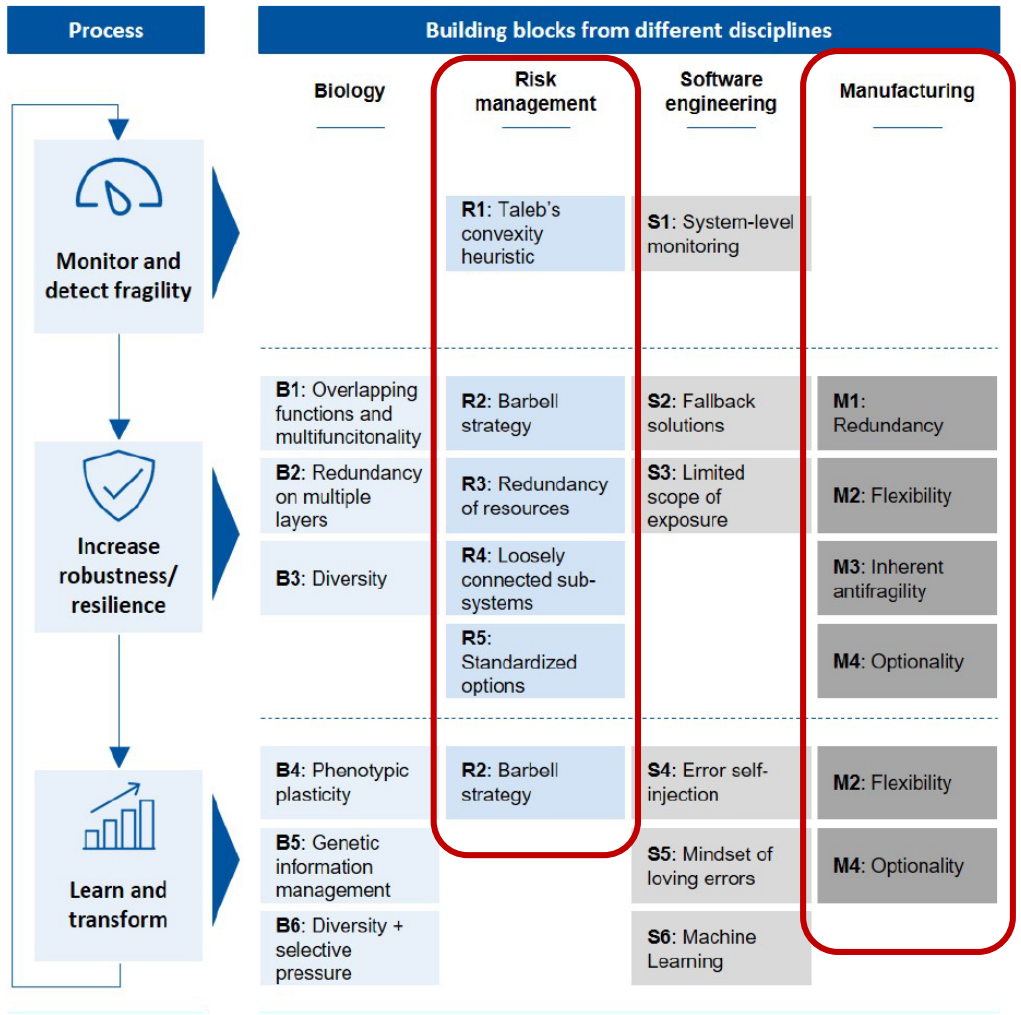
→ **Entwicklung eines resilienten Conversion Systems for Renewable Energy and Carbon Sources**

→ **Resilient: Resistent gegen techno-ökonomische, umweltbedingte, geopolitische und sozio-ökonomische Stressoren**

→ **„Building back better“ – Fähigkeit eines Systems mit multiplen Stressoren umzugehen und sich dabei weiterzuentwickeln**

→ **Transformation: Entwicklung von fossil zu erneuerbar**

	Ecological resilience	Engineering resilience	Supply chain resilience
Background	• Ecological science: Biology	• Environmental science: Engineering, Physics, Mathematics	• Economic science
Definition	• ...determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist.	• ...a systems' speed of recovery after a disturbance • ...preserving critical functions, ensuring a controlled shutdown and using generic capabilities and adjustable engineering solutions to assist a fast recovery of complex systems in the event of an unexpected disaster.	• no generic accepted definition • various definitions highlight different aspects • most important definition elements: focus event, performance level, speed, adaptive framing
Attributes	• persistence • change • unpredictability • variability	• efficiency • constancy • predictability • control	• efficiency • flexibility • mitigation • contingency
Functional focus	• Existence of function	• Efficiency of function	• Cost-efficient function
Equilibrium	• multiple equilibriums	• one global equilibrium	• not discussed
Stability view	• focus on boundaries of the stability domain	• focus on centred equilibrium and its near surroundings	• not discussed
Assessment approach	• mainly qualitative • inductive theory	• mainly quantitative • deductive theory	• qualitative and quantitative
Resilience measurement	• size and shape of the stability domain • strength of rejecting forces at the boundary • resistance of the domain to perturbation • state-variable approach	• return time or rate of return to its previous condition and initial equilibrium after perturbation • ITAE • resilience triangle • cost/time/performance related measures	• resilience indices • general measures • optimization approaches
Visualization of equilibrium			• not discussed. • some authors refer to the realisation of a "better state" after a disturbance, but without providing a clear specification.
Resilience phases	• adaptive cycle: exploitation, conservation, creative destruction, renewal	• prepare, prevent, protect, respond, recover	• readiness, response, recovery, growth • anticipation, resistance, recovery, response



Becker, Kasprowicz, Kurkina, Davari, Gipperich, Trauth, Gramelsberger, Bergs, Schwaneberg: Towards antifragile manufacturing: Concepts from nature and complex human-made systems to gain from stressors and volatility

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Resilient Conversion Systems for Renewable Energy and Carbon Sources

Multiple Sources
→ CO2/Biomasse/Abfall, Elektrizität/H2; geopolitische Streuung

Multiple Funktionalität
→ (chemische) Plattformen als Ausgangspunkt mit vielen Anschlussmöglichkeiten für Energy/Chemicals, Speicherung

Diversität / Optionalität
→ Vielfalt an Technologien, Vielfalt an Ressourcen, Vielfalt an Prozesspfaden

Flexibilität
→ flexible Prozess(pfad)e, Speicher- und Transportfähigkeit zur Entkopplung und Überbrückung räumlicher und zeitlicher Disparitäten

Loose verbundene Systeme
→ Transporte/Speicherung, (internationaler) Handel, globale diversifizierte Supply Chains

Building / Bouncing Back Better / Adaptivität
→ adaptive Systeme, Entwicklungsfähigkeit, Technologieoffenheit

Ableitung von Projekten und Forschungsthemen im Bereich Resilienz

Framework für Antrag?

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Resilient Conversion Systems for Renewable Energy and Carbon Sources

- Niklas van der Aßen → Prozesspfade, techno-ökonomische, umweltorientierte Resilienz
- Roß-Nickoll/Du → Toxikologie einzelner Moleküle und Blends
- Alexander Mitsos → Flexibilität, Adaptivität auf Prozessebene
- Katrin Arning → individuelle Akzeptanz → vom Advisory Board als „nicht so relevant“ bezeichnet
- Grit Walther (?) → Systembewertung und -gestaltung, techno-ökonomische Resilienz → geopolitische Resilienz, Risikobewertung

- assoziiert: Sandra Venghaus → sozio-ökonomische Resilienz, Policy/Governance

!!! Herausforderung: Modellierung des globalen Gesamtsystems, „Energieweltmodell“