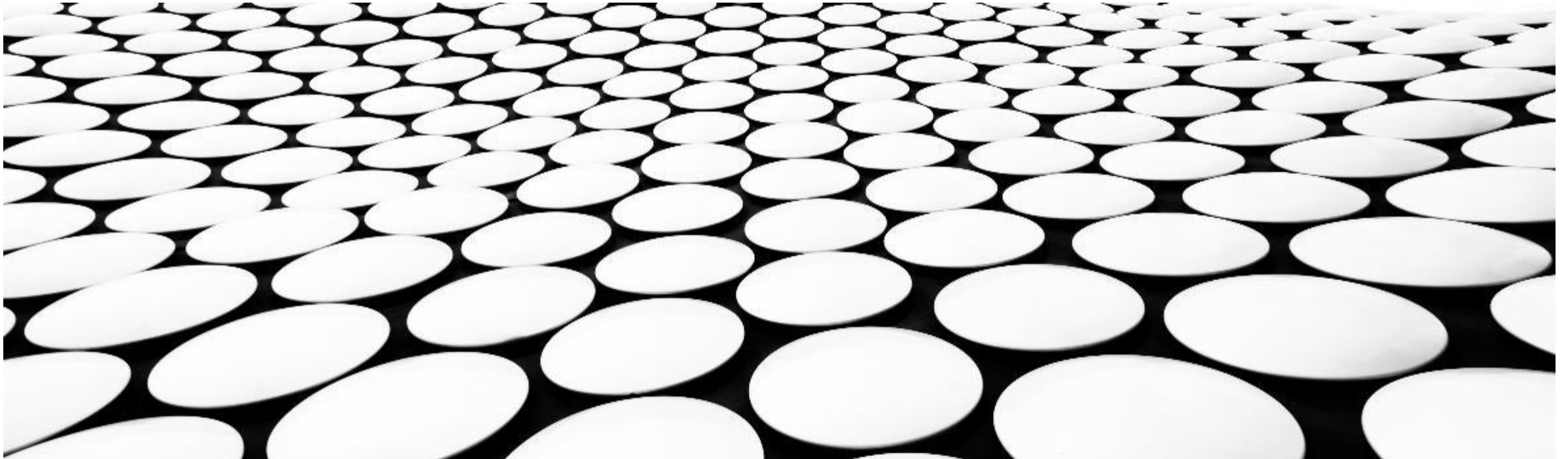


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# REGENERATION AKA REGENERATIVE SUSTAINABILITY

2024 03 12

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# OVERVIEW

## Regeneration - Phoenix Tailings as an illustrative example

- Regeneration, or regenerative sustainability, seeks to move beyond net-zero approaches and achieve net-positive outcomes
- Phoenix Tailings' vision and work touches upon some regeneration fundamentals
  - Systems thinking – Tomas' [The Hidden Costs of a Green Future](#) is 2<sup>nd</sup> & *n*th order thinking about our energy systems
  - Designing for circularity – PT's [Zero Waste Technology](#) is the development of internal & external recycling processes, beyond industry's status quo
  - Designing for more than just techno-economics – designing for socio- and eco-logical outcomes are critical
  - Net-positive – Rita's [CO2 GONE](#) carbon-negative minerals recovery is a great example
- I'm sharing my thoughts and recent experiences with you to hopefully spark a conversation, and we can see if there are other opportunities for collaboration
  - I recently received my diploma for CAS1 in Designing Resilient Regenerative Systems from ETH Zurich
- ETH Zurich's Designing Resilient Regenerative Systems (DRRS) executive program from their School of Continuing Education
  - MOOCs: free-of-cost Massively Open Online Courses on edX.org
  - CASs: Certificates of Advanced Studies – semester-long virtual courses with 10-day field trips in Italy, Norway, Mallorca
  - MAS: Master of Advanced Studies = CAS1 + CAS2 + CAS3 + MAS module in Zurich

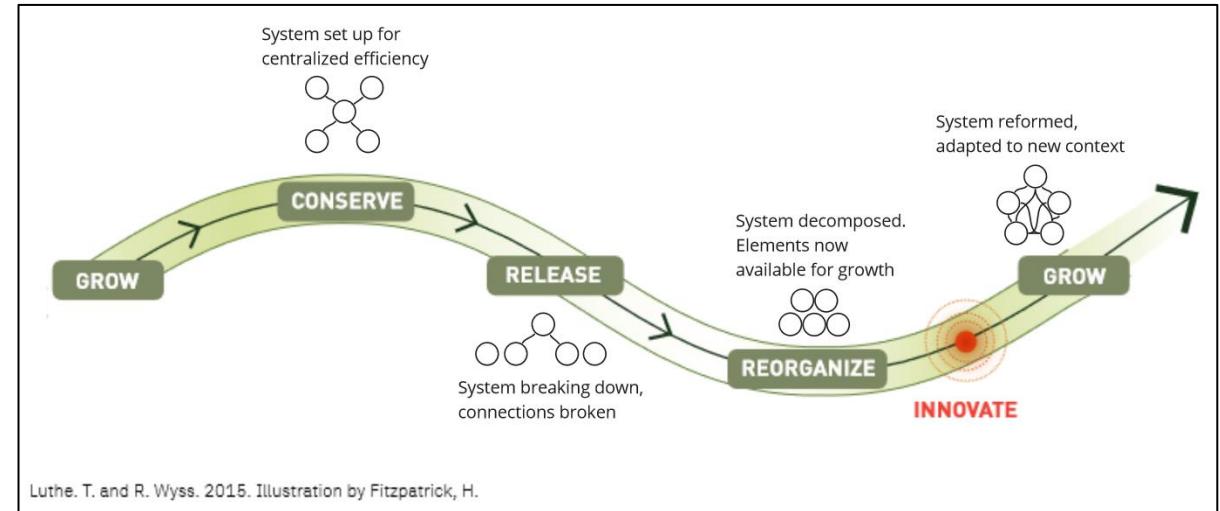
# REGENERATION

- “Sustainability” in modern usage has come to mean something like do things “100% less bad”
- 100% less bad is not good enough for repairing the damage done to the climate, ecosystems, biodiversity, water, society
- → **Regeneration**: all of our actions must be healing for a truly sustainable future
  
- Mainstream...
  - [Beyond Sustainability: The Regenerative Business \(forbes.com\)](#)
  - [Davos 2024: The future of sustainable business is 'regeneration' \(bbc.com\)](#)
  - [To thrive businesses must set their sights on regeneration | World Economic Forum \(weforum.org\)](#)
  
- ...to academic
  - [Regenerative Development: Going Beyond Sustainability – Kosmos Journal](#)
  - [Regenerative sustainability. A relational model of possibilities for the emergence of positive tipping points \(tandfonline.com\)](#)
  - [Regenerative—The New Sustainable? \(mdpi.com\)](#)



# RESILIENCE

- Resilience: a system's capacity to maintain its identity by adapting & changing itself
  - [Adaptive Wave](#) describes the resilience process →
  - Ship of Theseus is a good example: maintains its identity even though all its pieces are replaced



- Robust vs Resilient

- Seawall vs Salt Marsh
- Deep dive - Gaussian vs. Pareto models of risk: [Risk, Robustness and Resilience \(youtube.com\)](#) [10 mins]

- Inner resilience

- Think global, act local – so local that it's personal
- Practice adapting ourselves, not the “world out there”
- Transform ourselves to transform the world



**Robust**  
Seawall

**Survival through rigidity**  
Within its limits, efficient and effective, but not adapting.  
Beyond its limits, catastrophic failure

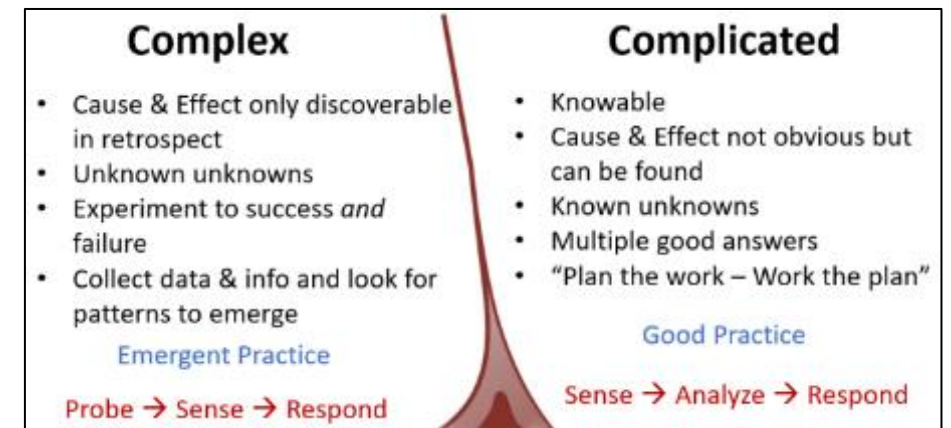
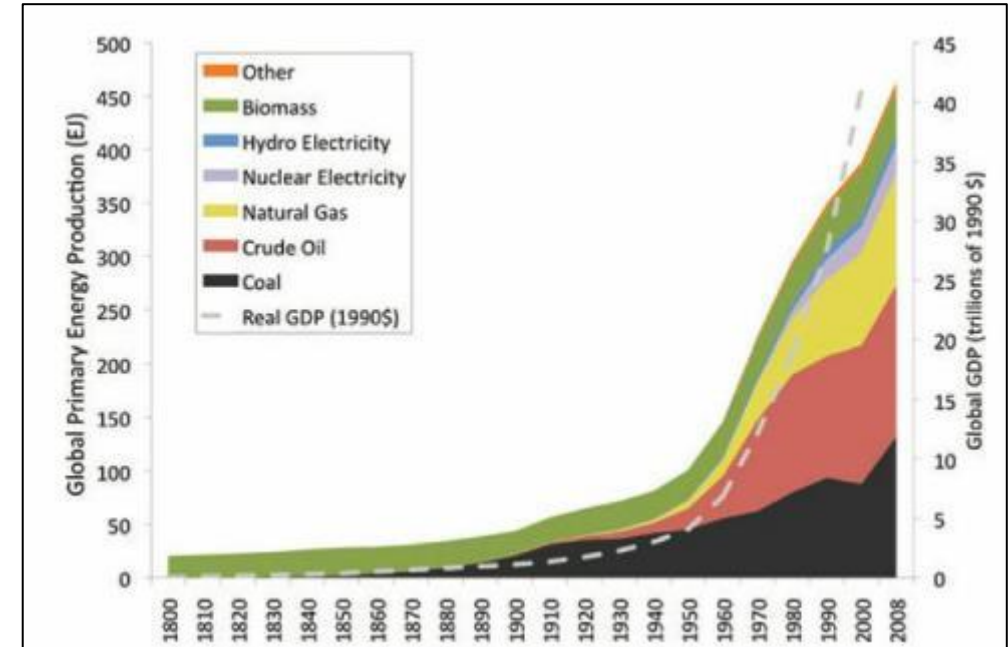


**Resilient**  
Salt Marsh

**Survival by change**  
Within its limits, not as efficient, but is adapting to changing conditions.  
Beyond its limits, limited failure, not catastrophic

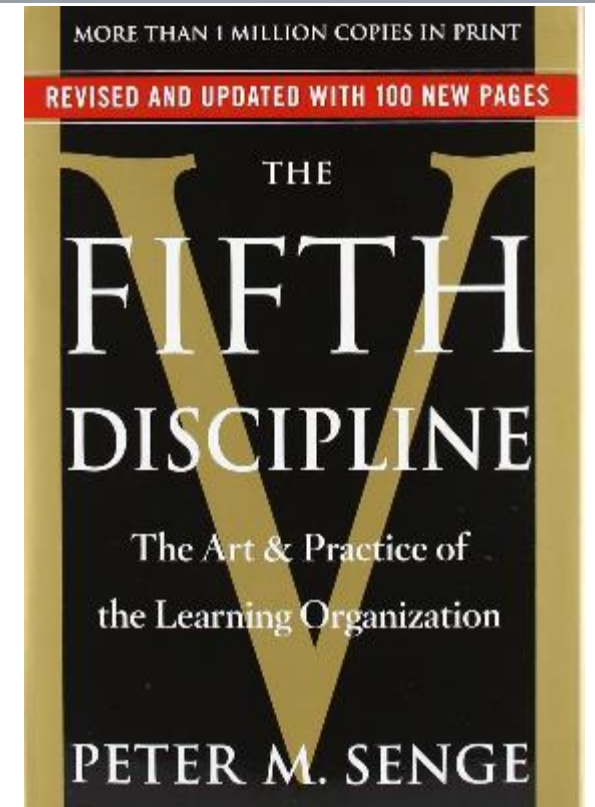
# BEYOND DRRS, WHAT'S GUIDING MY PROFESSIONAL JOURNEY

- Net Energy, Energy Returned on Energy Invested EROEI or EROI
  - [Net Energy](#) underlies all economic and technologic growth & development
  - [Energy Budgeting](#) [youtube, 12 mins]
  - [The Great Simplification](#) [youtube, 32 mins]
  - [EROI of different fuels and the implications for society](#) - Hall et al., *Energy Policy*, 2014
  - [Standard, Point of Use, and Extended Energy Return on Energy Invested \(EROI\) from Comprehensive Material Requirements of Present Global Wind, Solar, and Hydro Power Technologies](#) - de Castro and Capellán-Pérez, *Energies*, 2020
  - [Iñigo Capellán Pérez: "Net Energy Analysis: Through a Systems Lens"](#) - resilience [podcast, 1 hr]
- Complexity, and Complex vs Complicated
  - [Cynefin \(cunevin/kuh-nev-in\)](#) - Alcheme Tech
- System Dynamics & Thinking
  - Meadows - [Systems Leverage Points](#) - Alcheme Tech
  - Senge - The Learning Organization (next slide)



# SYSTEMS, AND THE LEARNING ORGANIZATION

- The Fifth Discipline is a great example of learnings born of Systems Dynamics & Thinking
- “Most of us at one time or another have been part of a great team, a group of people who functioned together in an extraordinary way [...] Many say that they have spent much of their life looking for that experience again. **What they experienced was a learning organization.** The team that became great didn’t start off great – it *learned* how to produce extraordinary results.”
- In a decade of searching, this is the best description of my first job, SustainX
- Recently, I’ve stopped searching. Rather, I’d like to help build learning organizations
- Have you experienced something like this?



- The Five Disciplines
  1. Personal Mastery
  2. Team Learning
  3. Mental Models
  4. Building Shared Vision
  5. Systems Thinking



# **ABOUT ALEX**



# EDUCATION



**University of  
New Hampshire**

College of Engineering  
and Physical Sciences

- BS Chemical Engineering, 2008
- Focus on clean energy



**DARTMOUTH  
ENGINEERING**  
THAYER SCHOOL

- Master of Engineering Management (MEM), 2010
- Hybrid program: 1/2 MS, 1/2 MBA
- Focus on entrepreneurship, startups, and clean energy

**ETH** zürich

- Program: **Designing Resilient Regenerative Systems**
- Completed courses:
  - Certificate of Advanced Study (CAS1) & MOOC1: Worldviews - From Sustainability to Regeneration
  - MOOC2: Beyond Systems Thinking
- Potentially on to a Masters



## EXPERIENCE OVERVIEW



- Compressed Air grid Energy Storage
- 1<sup>st</sup> job out of grad school
- Intern to R&D Manager



- Built environments retrofit insulation via polyurethane foam
- Director of Engineering
- R&D, and design and build of chemical delivery systems



- Li-ion grid energy storage
- Thermal systems consultant
- Modelling (in Excel) and designing liquid cooling systems



- Thermo-electric grid energy storage
- Consultant: Coolant corrosion chemistry design



- Now Largo Clean Energy
- Vanadium Redox Flow Battery
- Consultant: Thermal management system modeling, and materials compatibility design



- Carbon-free steel production via molten oxide electrolysis
- Design engineer for materials feeding, gas treatment systems



- Decarbonization of different industries via extreme electrochemistry technologies
- Consultant: Techno-Economic analysis
- “Sniff testing” of early concepts



- My consulting company, generally for clean energy
- [alcheme.tech](https://alcheme.tech)



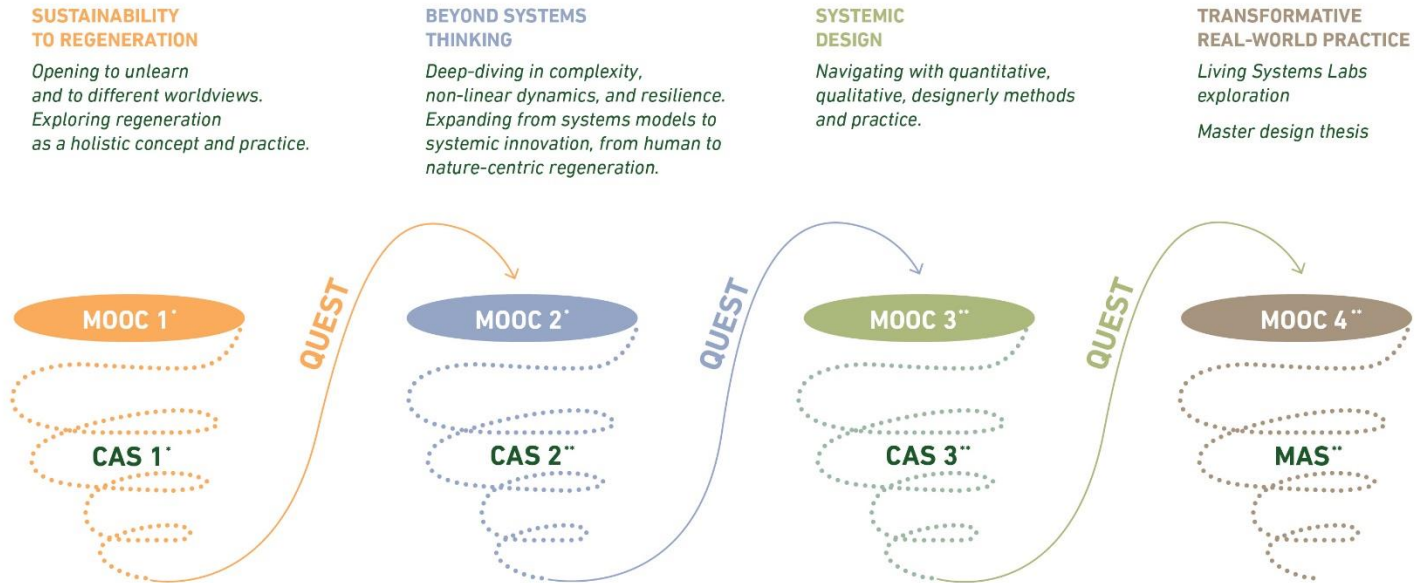
# **DESIGNING RESILIENT REGENERATIVE SYSTEMS (DRRS) PROGRAM**



# DESIGNING RESILIENT REGENERATIVE SYSTEMS

- ETH Zurich's DRRS – [Designing Resilient Regenerative Systems](#) executive program from their School of Continuing Education
  - MOOCs: free-of-cost Massively Open Online Courses on edX.org
  - CASs: Certificates of Advanced Studies – semester-long virtual courses with 10-day field trips in Italy, Norway, Mallorca
  - MAS: Master of Advanced Studies = CAS1 + CAS2 + CAS3 + MAS module in Zurich
  - QUEST: a tool to have learning guided by an evolving set of questions and thoughts

## MOOC TO MAS PATHWAYS



## Key concepts

|                                |   |
|--------------------------------|---|
| Systemic design                | ▼ |
| Hybridizing science and design | ▼ |
| Regenerative systems           | ▼ |
| Design for resilience          | ▼ |
| Sustainability science         | ▼ |
| Transformative praxis          | ▼ |
| Circularity                    | ▼ |
| Organic Emergence              | ▼ |

[Our research - Systemic Design Labs \(ethz.ch\)](#)

# MOOC 1

- Free, online MOOC# 1: [Worldviews - From Sustainability to Regeneration | edX](#)

Condensed syllabus:

- **1.1 Global crises with (local) interventions**

- Resilience
- Framing nested crises
- Community skills
- Root causes
- Call to action?

- **1.2 From sustainability to regeneration**

- Sustainability roots
- Mental models
- Sustainability science
- Towards regeneration

- Regeneration angles

- **1.3 Worldviews**

- Introduction with Daniel Wahl
- Jeremy Lent on Worldviews
- Indigenous Perspectives
- Eastern Philosophies and the Inner Self
- Scientific literature on Worldviews
- Chile fast fashion - by Delfina Van Ditmar
- Agriforest systems and knowledge types - by Jaboury Ghazoul
- Maps to view the world

- **1.4 Reframing complexity**

- The other side of complexity
- Complexity, Science & Systems Thinking
- Reframe it!
- Science and Praxis
- Warm data

- AI for regeneration?
- Complexities of decarbonization

- **1.5 Design as nature**

- Biodiversity
- Design for biodiversity
- Deep ecology - connecting with nature
- Nature-based design
- Bio-infused relation building
- Regenerative economics

- **1.6 Mind & Movement**

- Movement matters
- Mind, Action and Inner Development
- Flow and organic emergence
- Personal regeneration
- Leadership and mountaineering metaphors
- Mind, movement and bioregions

# MOOC 2

- Free, online MOOC# 2: [Beyond Systems Thinking | edX](#)

## Condensed syllabus:

- 2.1 (Critical) Systems Thinking
  - Systems Thinking - Birger Sevaldson
  - Systems Thinking - Fritjof Capra
  - Dancing with systems - Daniel Wahl & Donella Meadows
- 2.2 The View from Above
  - The View from Above
  - QUEST - Designing your Learning Journey
- 2.3 (Social) Networks
  - Motivating (Social) Networks
  - Social Network Analysis - Ulrik Brandes
  - General Networks
- 2.4 Resilience
  - Resilience - a Transformative Network Perspective - Tobias Luthe
  - Resilience Thinking
  - Inner Resilience - Mirjam Luthe
- 2.5 Circularity
  - Introduction to Circularities
  - The Circularity Gap Report
  - Circularity Examples across 8 Governance Scales
- 2.6 Systemic Innovation
  - Framing Systemic Innovation
  - Illustrations from Praxis
  - Tools & Practices for Systemic Innovation

# CERTIFICATE OF ADVANCED STUDY 1 - CAS 1

- [Certificate of Advanced Study 1 \(CAS 1\): From Sustainability to Regeneration](#)
- Field trip – Ostana, Italy
  - Learning Serious Game development – using board games to work through complex & difficult problems
    - Examples: [Game of Cruxes: co-designing a game for scientists and stakeholders](#), [From board games to immersive urban imaginaries: Visualization fidelity's impact on stimulating discussions on urban transformation](#)
  - **Systemic Cycles** is a multiple-day bicycle tour combined with a regional exploration of supply chain systems. It mainly serves two functions:
    - Offering a playful experience of a moving social adventure as alternative didactics on learning systemic design
    - Nudging processes of bio-regional weaving towards more circular, regional supply chain systems and ultimately regenerative cultures
  - Praxis – working with the local community to move towards regenerative practices, in part by serious gaming
- Deepening theory via weekly virtual speaker series
  - Sustainability to Regeneration
    - Bill Reed
  - Worldviews
    - Jeremy Lent
    - Lyla June
  - Reframing Complexity
    - Nora Bateson
    - Daniel Wahl
  - Design as Nature
    - Michael Shuman
    - John Fullerton
    - Kate Raworth



# **OTHER VIEWS OF REGENERATION**



# OTHER REGENERATION VIEWS

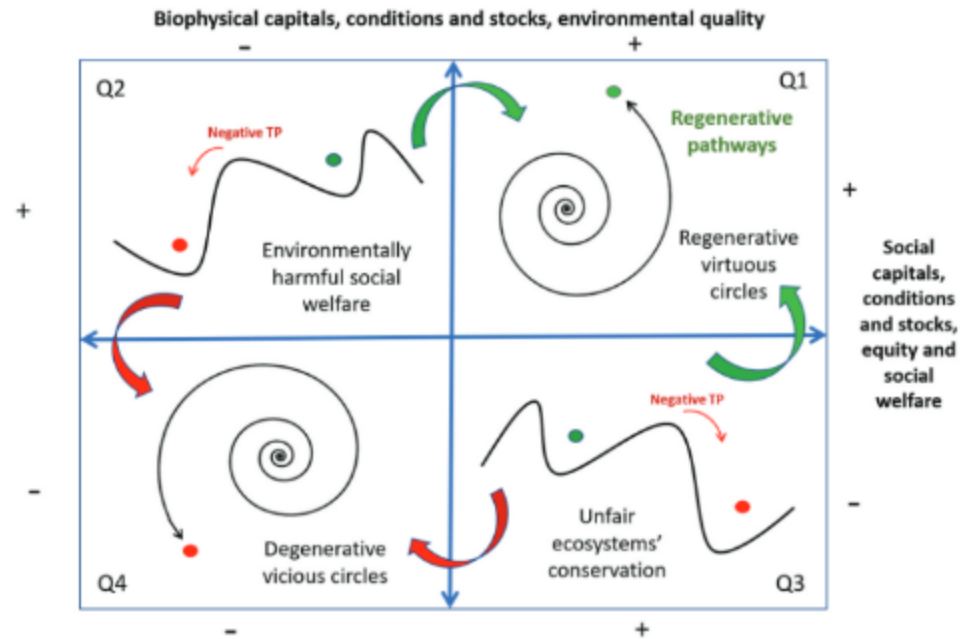
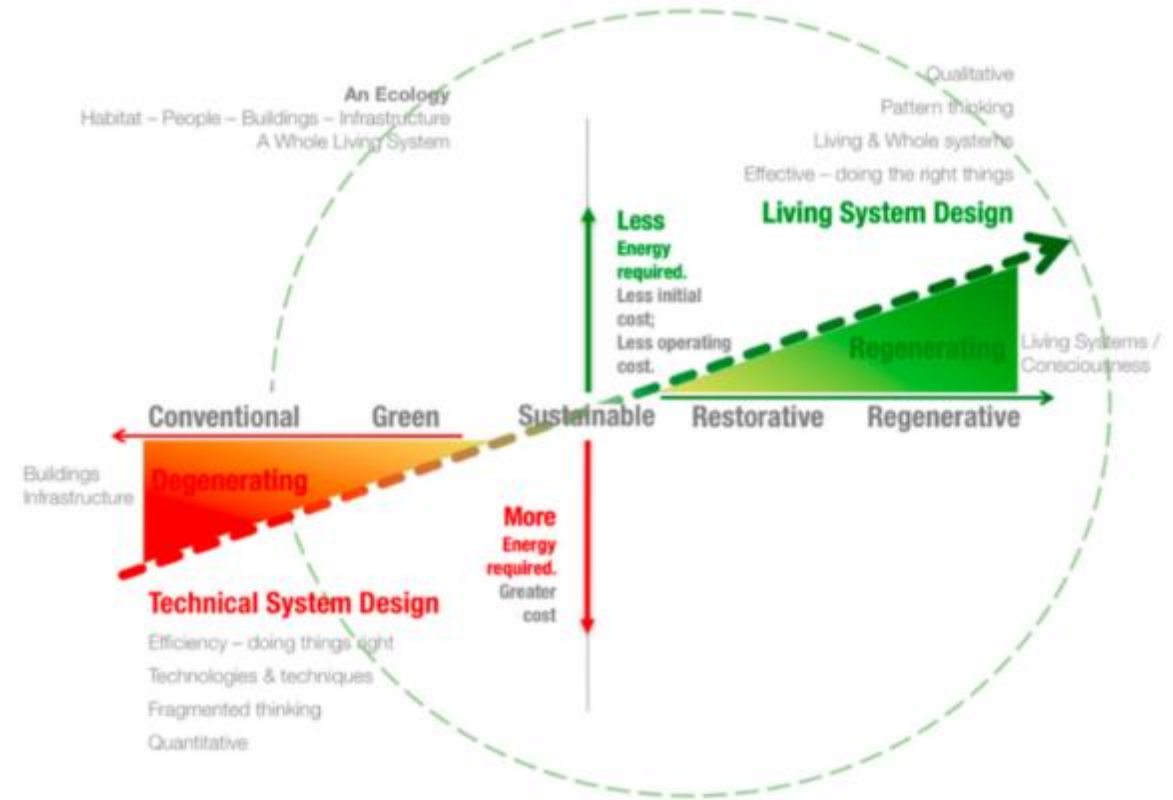


Figure 2. Moving towards regenerative development pathways depends on the extent to which human-systems interactions contribute to improving and restoring both social and biophysical capitals *at the same time* (Q1). In quadrants Q2 and Q3 social-ecological systems are unstable and tend to move toward negative development pathways or negative basins of attraction, eventually leading to degenerative vicious circles of development (Q4). In Q4 not only future opportunities for human welfare, dignity and equity are reduced, but also the basic conditions that make life possible on Earth are undermined. Achieving a net-positive tipping point leading towards Q1 requires deep transformations in social-environmental practices at different levels of agency and also in the ways humans conceive and perform all SEIC subsystems' interactions.

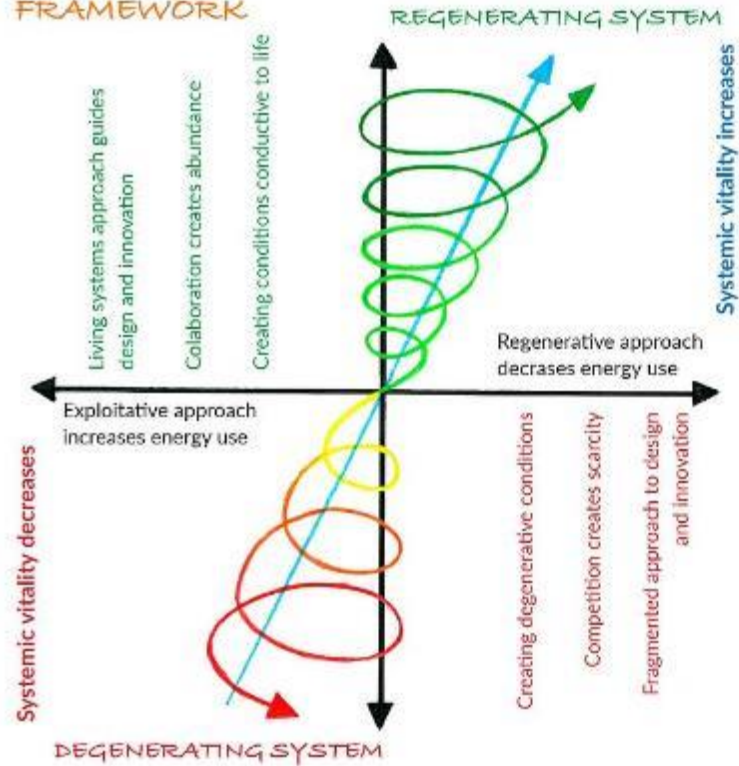


[Regenerative sustainability. A relational model of possibilities for the emergence of positive tipping points \(tandfonline.com\)](https://www.tandfonline.com)



# OTHER REGENERATION VIEWS

## THE REGENERATIVE DESIGN FRAMEWORK



Source: Designing Regenerative Cultures, 2016 - www.danielchristianwahl.com; Graphics: www.flavioagilto.com

**Regenerative**  
Appropriate participation and design as nature.

**Reconciliatory**  
Reintegrating humans as integral parts of nature.

**Restorative**  
Humans doing things to nature.

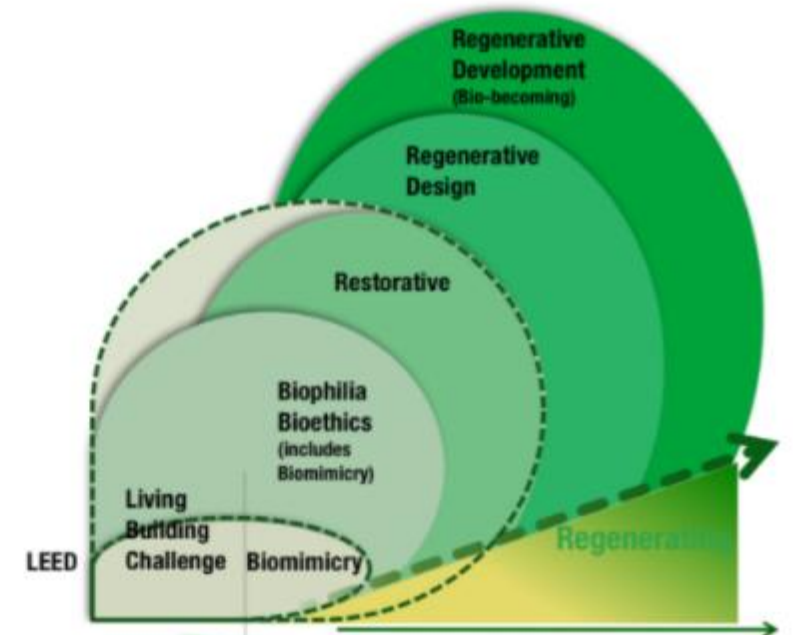
**Sustainable**  
Neutral point of not doing any more damage.

**Green**  
Relative improvements.

**Conventional practice**  
Compliants to avoid legal actions.

## Scales of Pattern Harmonization

- Gaia
- Biome / Region
- Watershed(s)
- Community
- Neighborhood
- Site
- Ecological Sub-systems
- Buildings / Shelter
- Organisms



Anthropocentric → Biocentric → Integral

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<https://www.filmsforaction.org/articles/the-regenerative-design-revolution/>