

# GreenDelta

software / data / know-how

## Full Sustainability Assessment

Dr Andreas Ciroth  
GreenDelta GmbH

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## **Full Sustainability Assessment**

**Idea: how can an assessment look like, that is able to**

- 1) address the structural concept of sustainability**
- 2) address all aspects of sustainability**
- 3) provide reliable, correct information**

# 1, the structural concept of sustainability

in the end, sustainability is about enabling a system to “survive”, i.e. to maintain its properties even under stress

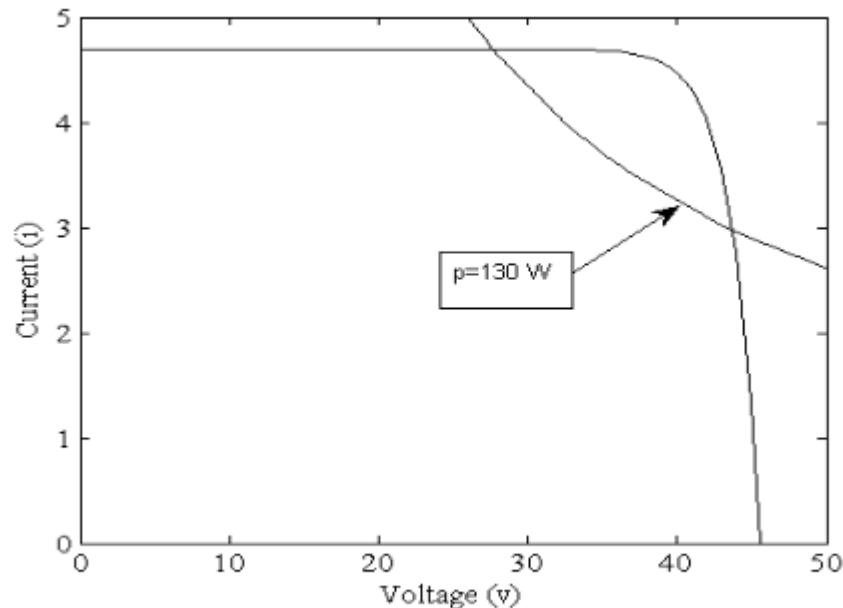
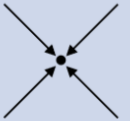

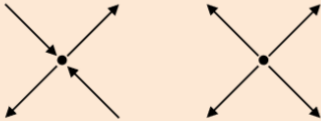
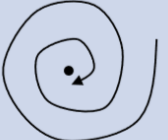
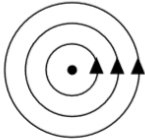
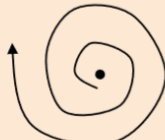


Fig. 2: i-v characteristic curve and power loading of PV system.

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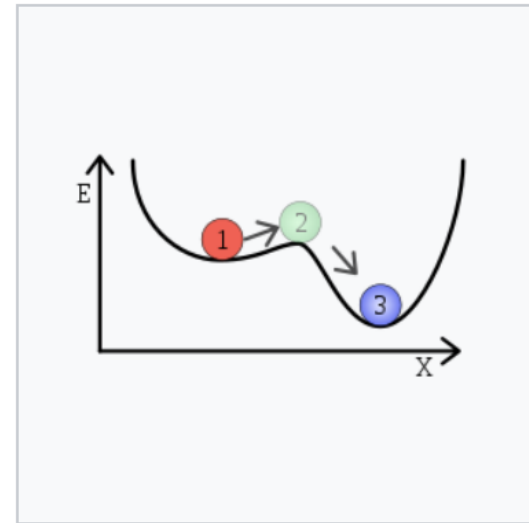
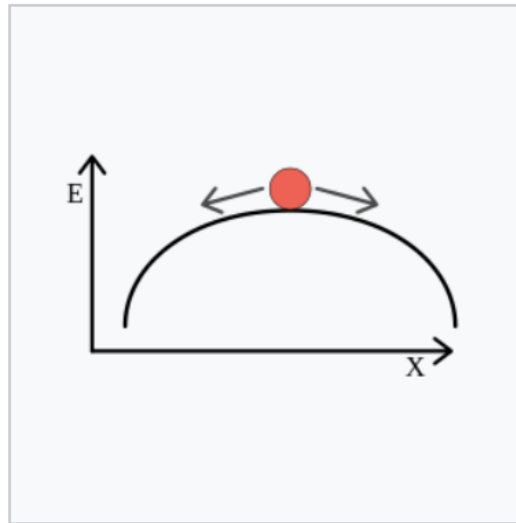
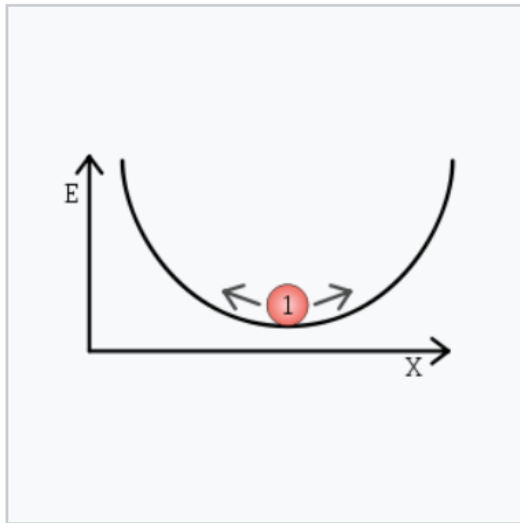
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	Stable $ \lambda_d  < 1$	Lyapunov stable* $ \lambda_d  = 1$	Unstable $ \lambda_d  > 1$
Real eigenvalues	Stable point $ \lambda_1  < 1,  \lambda_2  < 1$ 	Neutral point $ \lambda_1  = 1,  \lambda_2  < 1$ $ \lambda_1  = 1,  \lambda_2  = 1$ 	Saddle point    Unstable point $ \lambda_1  > 1,  \lambda_2  < 1$ $ \lambda_1  > 1,  \lambda_2  > 1$ 
Complex conjugate eigenvalues	 $ \lambda_1  =  \lambda_2  < 1$ Stable spiral focus	 $ \lambda_1  =  \lambda_2  = 1$ Neutral center	 $ \lambda_1  =  \lambda_2  > 1$ Unstable spiral focus

[https://math.libretexts.org/Bookshelves/Applied\\_Mathematics/Book%3A\\_Introduction\\_to\\_the\\_Modeling\\_and\\_Analysis\\_of\\_Complex\\_Systems\\_\(Sayama\)/5%3A\\_Discrete-Time\\_Models\\_II\\_-\\_Analysis/5.7\\_Linear\\_Stability\\_Analysis\\_of\\_Discrete-Time\\_Nonlinear\\_Dynamical\\_Systems](https://math.libretexts.org/Bookshelves/Applied_Mathematics/Book%3A_Introduction_to_the_Modeling_and_Analysis_of_Complex_Systems_(Sayama)/5%3A_Discrete-Time_Models_II_-_Analysis/5.7_Linear_Stability_Analysis_of_Discrete-Time_Nonlinear_Dynamical_Systems)

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This concept is so far not addressed in LCA (!)

## **2, address all aspects of sustainability**

**Aspects of sustainability are determined by what we want to protect (→ Areas of protection)**

- **People and ourselves**
- **Ecosystems**
- **Resources as „stock“ to be used later (also by others)**

## 2, address all aspects of sustainability

Aspects of sustainability are determined by what we want to protect

(→ Areas of protection)

.. and by the things that impact them

- social  
- environmental  
- economic (?)  
„impactors“

- People and ourselves
- Ecosystems
- Resources as „stock“ to be used later (also by others)



### 3, provide reliable, correct information

types of impacts:

- qualitative and quantitative
- deterministic and risk/uncertainty based
- comprehensive information: entire life cycle linked to an analysed product
- also metabolism pathways (yoghurt cup litter -> small plastic particles -> microplastic)
- impact pathways (unemployment -> alcoholism -> homeless with a certain chance)

information should be evidence-based

modeling information is of course also allowed.

**So far – this is quite everything.**

## Let's look at individual impacts:

- different impacts have a different scope, “regionality”

- there are indirect effects:

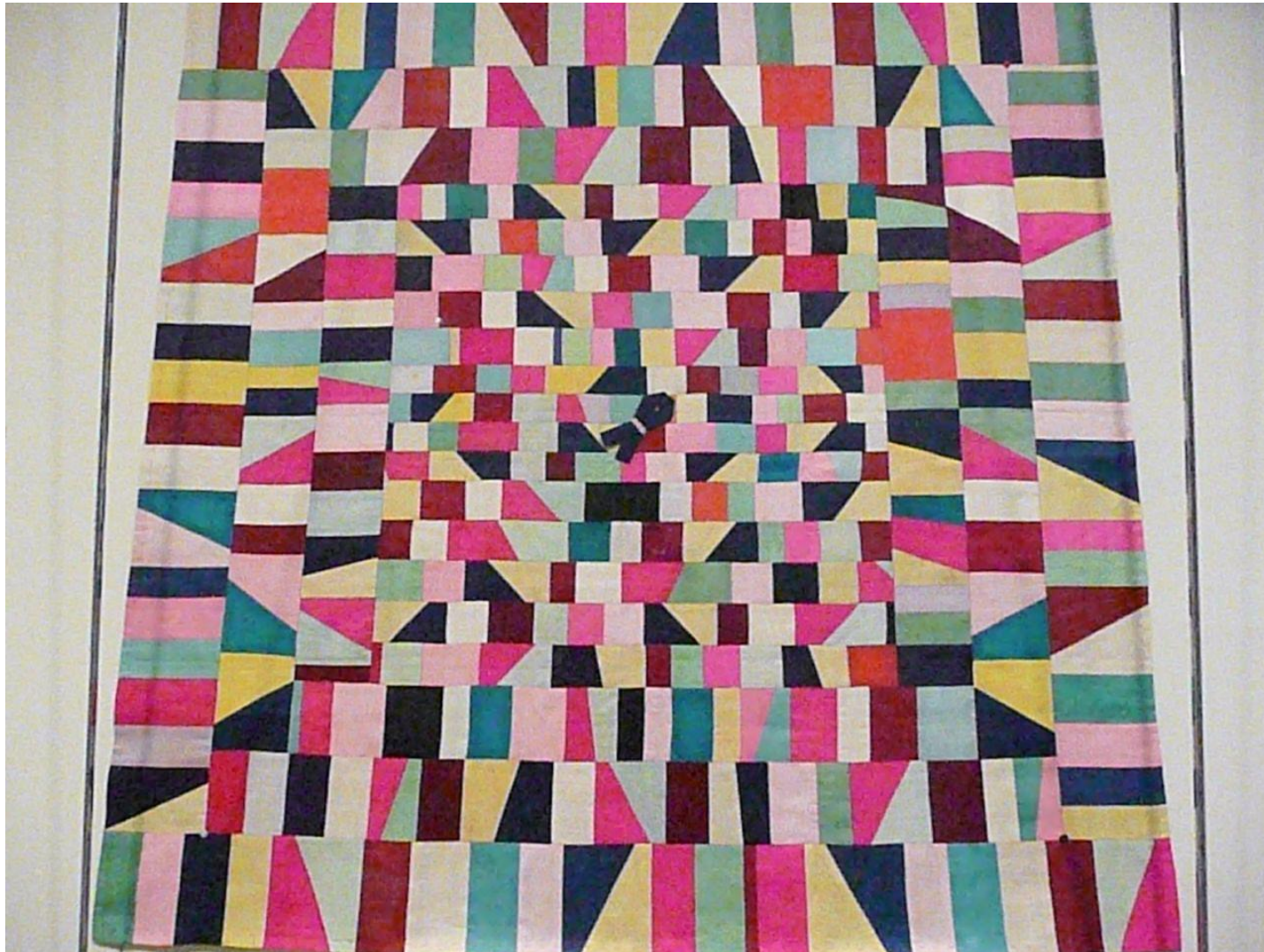
avoidance and compensation, and amplification

- noise: people can move away, but only to some extent;
- ashes and Sulphur emissions: basic ashes neutralize acid Sulphur

**Also: different AoPs have a different scope and regional extension**

- people are not living everywhere;
- there is only one coral reef;
- ...

→ overall, this establishes a patchwork of overlapping systems which are somehow connected, and each in different “stability statuses”



## **Some intermediate observations**

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**Stability of a system towards an impact depends on the actual background impact (acid rain; but not in a linear way – much more noise does not matter)**

**..and it depends also on the history (removing virgin forest once, wait some time, forest restores; remove the next forest too soon will deteriorate the next generation forest)**

## Some intermediate observations

**If a system can indeed be considered to be linear, this is much easier.**

- > the sum of all impact is the overall impact
- > averages can be calculated easily
- > etc.

**If a system can indeed be considered to be stable below a fix threshold, and unstable above a threshold, this is also convenient**



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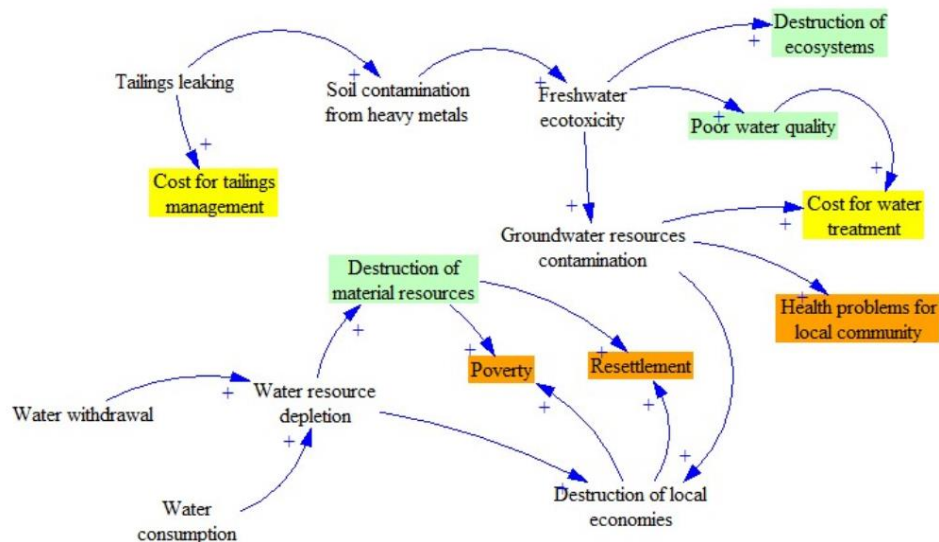
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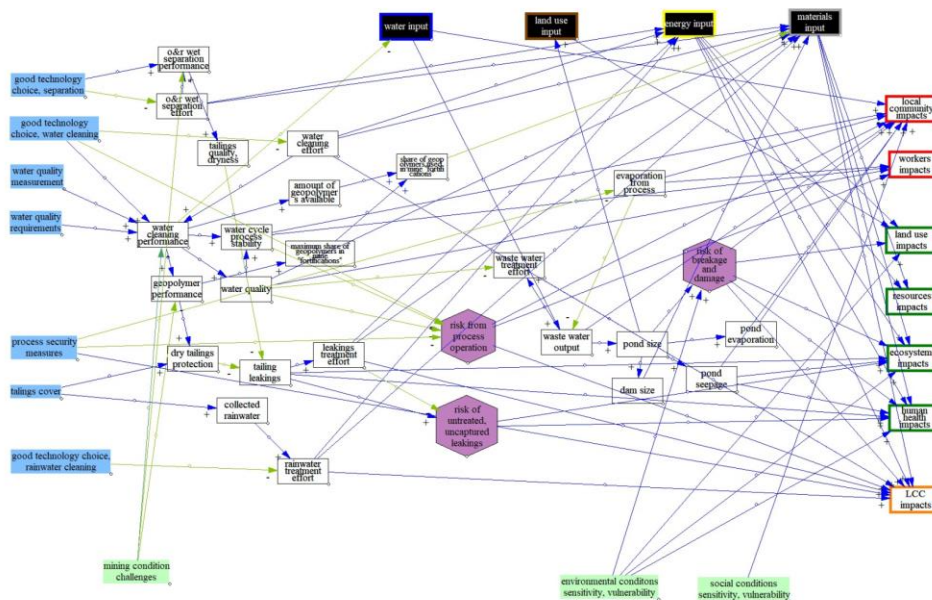


Di Noi, C., Ciroth, A. (2018): Environmental and Social Pressures in Mining. Results from a Sustainability Hotspots Screening. Resources 2018, 7, 80 <https://doi.org/10.3390/resources7040080>

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## What can we take from these observations?

### 1) it is very useful to detect linearity

- make a causal loop overview diagram to get a feeling for the system under study first
- identify main drivers and structures
- identify “linear areas” in the model (f(amounts and ratios); and structural checks)
- then make linear LCA-like models for them, but with risk/probabilities and also qualitative impacts

**What can we take from these observations?**

**This is really complicated. Are there low hanging fruits?**

**Are there actions that can already now be determined as being clearly sustainable?  
“safe spots” (i.e. actions which are clearly sustainable)?**

## Sustainability Safe Spots?

- collecting and returning deposit bottles?





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- collecting and returning deposit bottles
- producing bio-honey



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- collecting and returning deposit bottles
- producing bio-honey
- adding a solar-powered water treatment plant to a hotel that did not have one before



# Sustainability Safe Spots?

## Issues (maybe):

- rebound effects (many more similar hotels)
- wrong focus (recycling paper in nuclear power plant)
- positive action supports a bad system and prevents a needed correction (deposit collection – people survive – therefore no increase of social support)
- ...

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- ...

**..but on the other side, promise for a shortcut in a complicated assessment procedure that seems to work for quite some cases**

**→ these potential issues should be kept in mind when making the Causal Loop diagram**

## So, steps in a Full Sustainability Assessment (FSA)

- make a Causal Loop Diagram of the system under study, considering structural effects
- investigate for sustainability safe spots
- for identified linear areas: add linear models
- for key issues: extend the analysis (better data, refine, ...)

**FSA in short is thus “just”:**

- **Causal modeling, with quantification, for screening and for setting the scope & focus**
- **Life Cycle Sustainability Assessment, with consideration of**
  - **probabilities**
  - **background situation**
  - **in per-impact and inventory appropriate regional resolution**

**?**

## -> next steps?

- **test positive cases /safe spots**
- **develop “test and assessment kit” (maybe for different application cases, similar to PCR in EPDs) for small and quick cases, for due diligence, for ...**
- **this will require an extension of LCIA (for environment but especially social – regional background impacts, ...)**
- **show benefits of FSA compared to both circular economy and LCA alone**

## Short summary

- The presentation tries to present elements of a Full Sustainability Assessment.
- While being demanding for data and methodology, the principles link to the existing LCA and other approaches..
- ..this is not too far away from current approaches, and promises to fully consider sustainability
- Reliability, correctness needs to be investigated
- Sustainability Safe Spots promise to directly take decisions without a lot of method overhead



# GreenDELTA

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## *Thank you very much!*

Contact:

Dr. Andreas Ciroth

GreenDelta GmbH

Kaiserdamm 13, 14057 Berlin, Germany

[ciroth@greendelta.com](mailto:ciroth@greendelta.com)

[www.greendelta.com](http://www.greendelta.com)