Green growth indicators for biogas production in the villages of Lapland

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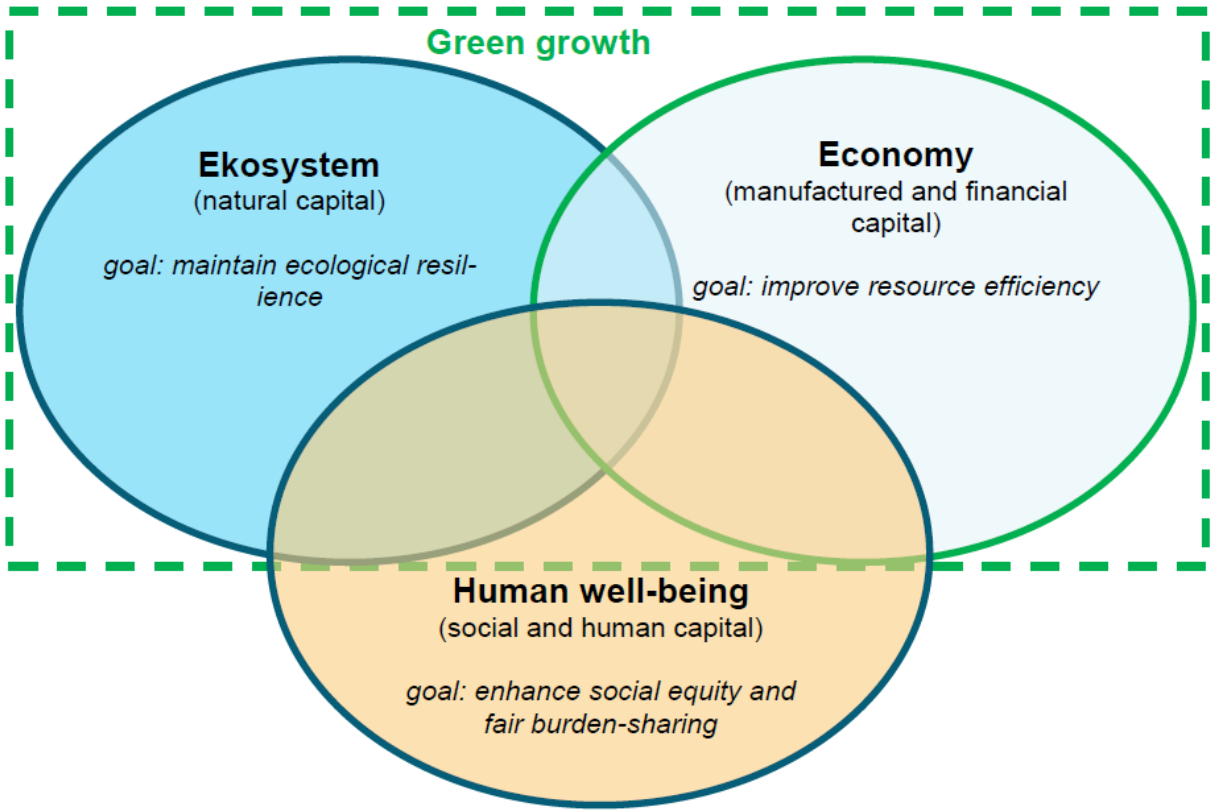
Green economy project in Lapland

- **t**o develop small three villages in Lapland for green economy transition
- **to develop an approach model** for this green economy transition from area's perspective
- As a part of this aim was to **choose and develop green economy indicators** for these villages
  - **Indicators are development tools** for the assessment of green growth of the area (assessing the state at this moment, the potential for renewable resources, energy production and also assessing the effectiveness of green economy transition process in the future)
  - ➢ the first step was for bioenergy and particularly biogas production

Green economy and growth

- Taking into account more comprehensive sustainability perspective than bioeconomy
- Ensuring **ecosystem resilience**, improving **resource efficiency** and enhancing **social equity** (Speck & Zoboli 2017)
- Objectives are maintaining economical growth of area and at the same time:
  1. Maintaining performance of ecosystem services
  2. Shift towards a low carbon economy
  3. Resource efficient action
  4. Develop an overall life style and well-being in society

Green growth emphasises the interaction between the environment and the economy, which is also connected to human well-being (Source: COM 571/2011, EEA 2012).



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Ecosystem services:

Arrows describe the indirect effects of socioeconomical factors between ecosystem services and human well-being (Millennium Ecosystem Assessment (2005).

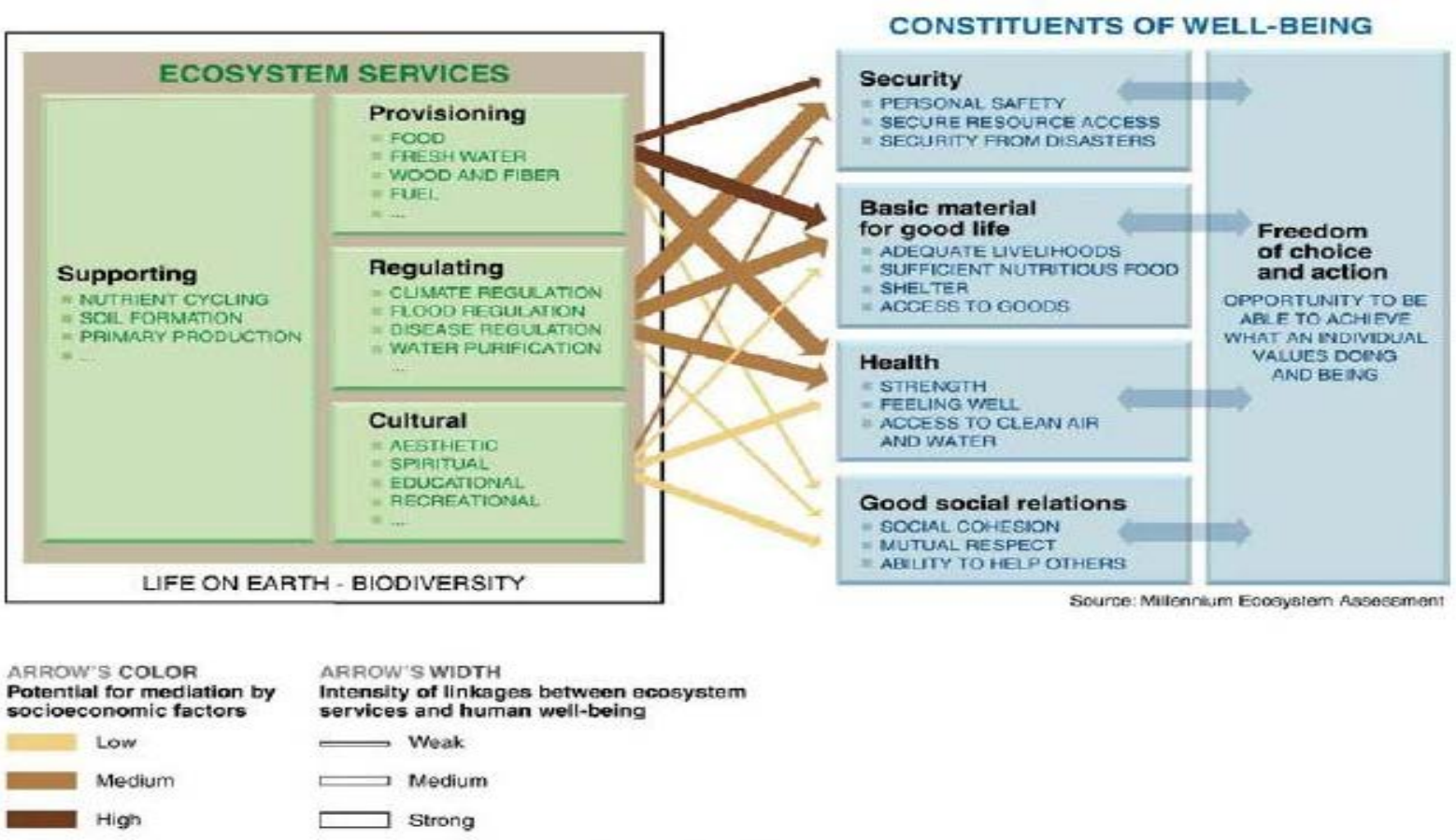

Figure SDM - A - The MA framework

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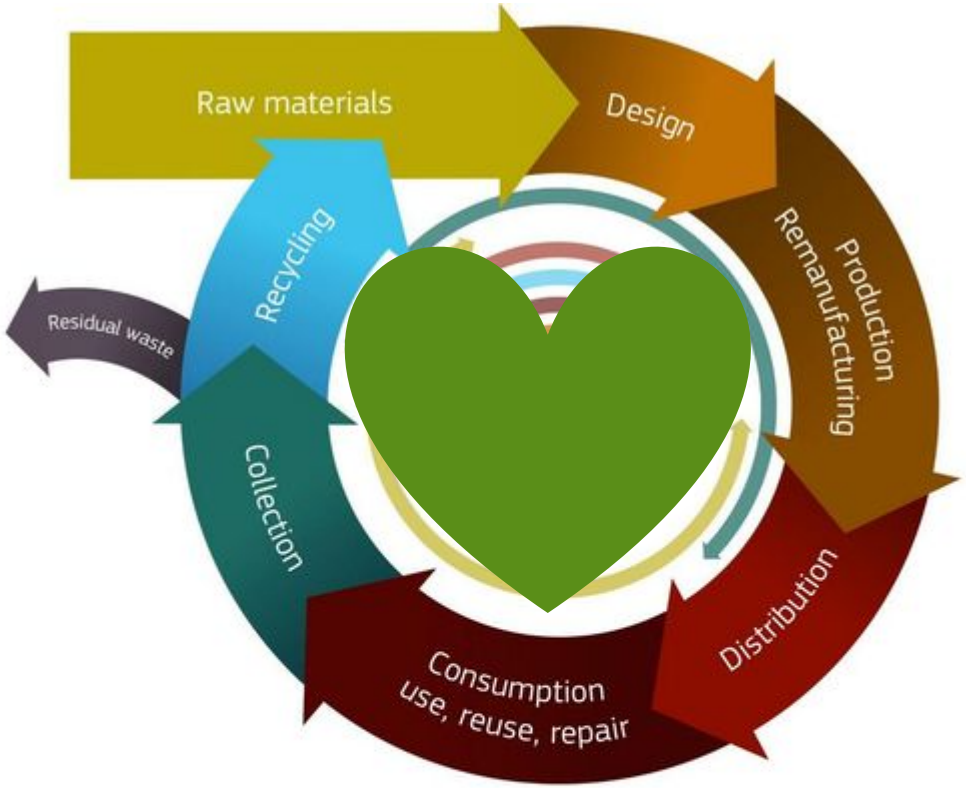
Circular economy and resource efficiency



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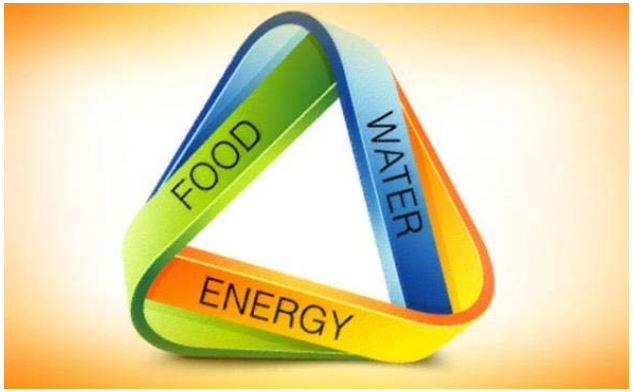

Linear economy

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Why green economy indicators?

- needed to verify total sustainability of economic growth in different systems
- used in system's development activities and decision-making activities
  - e.g. policy monitoring, follow-up control, economic development, social development and prosperity and sustainable use of natural resources
  - ➢ meeting the UN Agenda 2030 goals of sustainability
    - ➢ E.g. Social sustainability goals and a need for measurement alongside with economical and ecological goals
  - ➢ EU and national level climate and energy strategies and bioeconomy strategies
    - e.g. In Finland renewable energy accounts for more than 50% of final energy consumption in 2020.
  - ➢ EU and national level Bioeconomy strategies

Scalability: Village/Local/Regional level indicators

- Decentralized system indicators should be built data hierarchically, from corporate and local level to regional and national and international level (not vice versa)
- some reports are published already but they are more of a national and international level indicators
  - Green Growth Indicators (OECD 2014); EU set of indicators
  - Finland's national level green economy indicators (Seppälä ym. 2016)
- the excessive condensation of information, which can lead to simplification of things is a problem
  - National or international scale indicators are too general and information summarizing at the local and regional level
  - Indicators may ignore the special features of the local level, where decision-making lacks relevant information (Rosenström & Palosaari 2000, Failing & Gregory 2003).

➢ There is a need for more specific area and village level information in order to note real changes and benefits of green economy and growth

  - Changes in enterprise levels are known to affect the indicators to be monitored at village, regional and ultimately provincial levels, and vice versa
  - Indicators support village, regional and finally national decision-making processes and development activities
    - ➢ Indicators enable evaluation of the present state of villages' sustainability level and reveal the critical points and potentials when moving towards green economy

This project

- The aim was to create a village-level, decentralized, sustainable and competitive approach to the green economy transition in Lapland

1. Starting from the village meetings and interviews with local residents
2. Building a vision for the villages in cooperation with the village residents and actors
3. Creating green economy indicators for the green economy transition
   - Based on their evaluation criteria (relevance, viability, acceptance and availability of data)

➢ Biogas production was assessed to be the main driver for this transition

Why bioenergy indicators?

In this study we start the utilization of side flows for energy production as a starting point towards green economy development of areas, because:

1. Energy is the facilitator and factor of many things
   - Energy creates possibilities for many things towards production of more high added value products
2. Energy is the main source for capital flight:
   - Energy is bought from abroad as fossil energy and there is no production of energy in the area
3. Bioenergy could be produced inside the village as an own decentralized energy from its own local raw materials
   - habitants are living in the middle of the renewable resources needed
     - 98% of Lapland's land area is Forests (9.1 million ha)
4. In sparsely populated rural areas:
   - following a strict cascading principle could problematically limit the use of biomass energy use (Rytteri & Lukkarinen 2015)
     - Cascading theory is favouring industrial utilization and recycling of the material (utilizing side flows) *over energy use*
   - the energy use of wood creates a basic first infrastructure for more sustainable forms of power (e.g. wind and solar) to be adopted.
     - Wood has been deemed unsustainable from the viewpoint of material and resource efficiency

Case Lapland and challenges

Lapland areas need its own green economy indicators, both in the company, village and provincial level:

- Lapland consists of regions that are very different from the ecosystem perspective
- The climate varies a lot in northern parts compared to the southern parts
- The specialization and enterprise structure is micro-entrepreneurial
  - Village-level indicators provide important information for companies
  - They tell companies about the overall situation in their local area.
- Population density is low and it varies greatly within Lapland
  - migration and employment challenges
  - a variety of commodities is needed so that life is sufficient for modern humans in Lapland
- energy must be produced by combining different forms of production and not from individual raw materials
- There is also a danger of ending the resource if energy production is maximized and attention is focused only on maximizing the strategic raw material reform
  - the ecological system will be unilateral and the management of the whole production and of all ecosystem services will be compromised

Ecological indicators

The volume of raw materials that do not compete with already utilized usage, but are processed into land and forestry side flows:

- Potential for raw materials:
  - Total and sustainable forest logging potential: Increment and drain of growing stock (for example wood, this reflects securing ecosystems for productivity for future generations)
  - Chips from forestry measures
  - Manure
- Renewable energy production
- Energy surplus
  - Production meeting demand and surplus for new business opportunities and export
- Consumption of local renewable energy / total energy consumption
  - (This reflects transition towards more sustainable and low carbon energy production and consumption in the region). E.g. meeting climate and energy strategies

Results: Case Saija

Total potential for energy production produced from side-streams in agriculture and forestry

15 070 MWh

Energy surplus

8 505 KWh

Energy total demand

6 565 MWh

(traffic gas, electricity, heat)

Economic perspective

1. Capital flight (€) (Regional perspective)
   - The demand (€) for fossil energy produced and bought from somewhere else but can be produced from area's own renewable resources
2. Alternative calculation (Regional perspective)
   - With the proviso that the region's capital flight is completely cut off and the area becomes fully energy-selfsufficient
3. Profitability assessment (Company's Perspective)
   - Assuming demand and net sales for bioenergy is the same than for fossil energy bought from elsewhere

Results: Case Saija

Purchasing power intake (2012)

6565 MWh (total) > 4952MWh (export)

Energy capital flight per year

-688 236 €
75%

Investment vs Saija village energy market

Optional calculation for regional economy
Annual costs vs investments for regional energy production

Hydrid plant investment
1 279 000 €

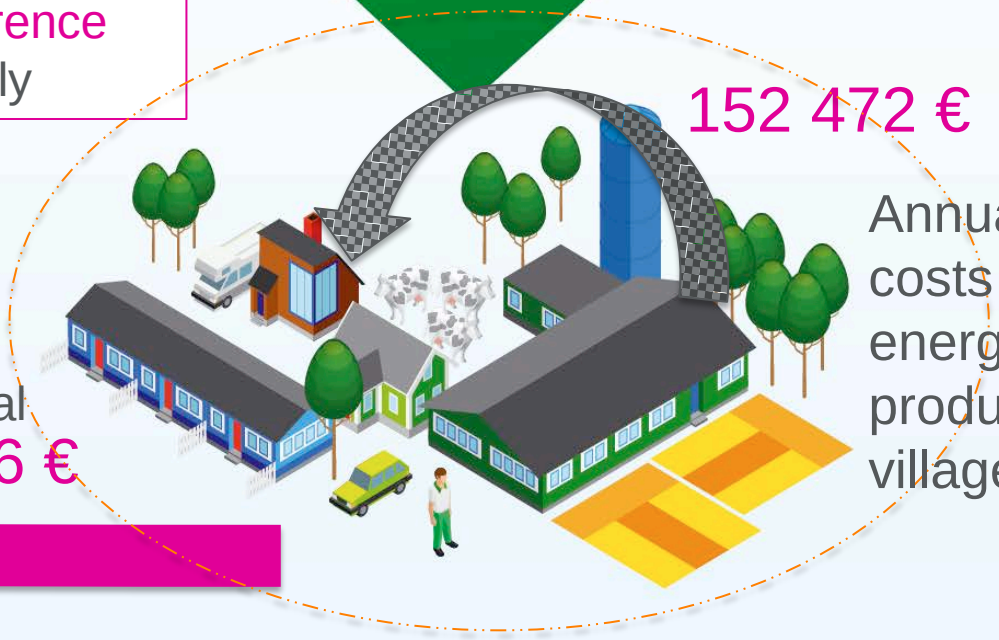
152 500 €
Annual operating costs for own energy production produced by villagers

Annual energy net sales for cutting capital flight
688 236 €

After 5 year of Investment

Annual Capital leave
328 292 €

	Balance
	152 472 € operating
-	688 236 € reference
=	328 292 € yearly surplus



152 472 €

Annual operating costs for own energy production produced by villagers

Annual energy net sales for cutting capital flight

688 236 €

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Case Saija: Energy production investment

Planned financing

Capital requirements	€	Financing	€
Machinery and equipment	1 279 000	Bank loans	575 550
Working capital	22 100	Other long term loans	575 550
Company development	0	Self-financing	150 000
Total	1 301 100	Total	1 301 100

Sales = Annual energy costs before investment

	Year 1	Year 2	Year 3
Net sales	688 236	688 236	688 236
Material and supplies	-101 498	-101 498	-101 498
Personnel costs	-41 400	-41 400	-41 400
Other expenses	-41 108	-41 108	-41 108
Gross margin	504 230	504 230	504 230
Financing costs	-54 677	-45 325	-32 375
Taxes 20 %	-72 005	-73 875	-76 465
Profit after financial items	377 548	385 030	395 390
Depreciation	-89 530	-89 530	-89 530
Net profit	288 018	295 500	305 860
Other income/expenses	0	0	0
Overall financial performance	288 018	295 500	305 860

Social indicators

- Socioeconomical indicators

To reflect the characteristics of the region and potential for transition towards green economy

  - e.g population structure**, employment rate**, human capital (education)
  - Data was collected from statistics and assessed by utilized ecological and economical indicators
    - E.g. Saija-case result: Employment rate is 3 personnel workers per year

- Social

To reflect the social and human capital of the region and potential for transition towards green economy

- E.g. Experienced motivation, will power, know how state of local residents or wellbeing achieved by utilizing outdoor and recreational services
- Data was collected during village meetings and with a survey
- ➢ There are still a challenge to measure these impacts
- ➢ The indirect effects of socioeconomical factors between ecosystem services and human well-being (Millennium Ecosystem Assessment, 2005).

What next

- Further development of green economy indicators
- Exploring missing factors in profitability calculations
  - Energy surplus, growing business opportunities, export possibilities
  - Sustainability and green economy goals and intepretation challenges
- Develope village indicators into a centered - distributed energy network model
  - ➢ Connections between different companies and villages
- Symbiosis between energy and food systems/indicators
- Develop social indicators

Thank you!


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