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On Differences and Connections between EGSS, Bioeconomy, Circular Economy and Clean Tech

1 Introduction

The terminology among economic activities connected to environmental aspects is diverse. One that is well defined is statistics on Environmental goods and services sector (EGSS). However, there are plenty of different expressions of activities which underline the environment-friendliness of the actions carried out under the concept at stake. These concepts include for example bioeconomy, circular economy and clean tech. Whether the terminology for these concepts is launched by governments or corporations, they are after all used miscellaneously. In this paper, we intend to put the concepts in the context by enlightening their definitions and comparing them with each other and with EGSS. How do they differ from each other and from EGSS and what do they have in common?

2 Definitions for the concepts

We concentrate on three commonly used terms in the field of environmental economics. All these three, bioeconomy, circular economy and clean tech, can be seen as a part of wider complex of green economy. All these three are partly covered by EGSS statistics. None of them have a widely established definition.

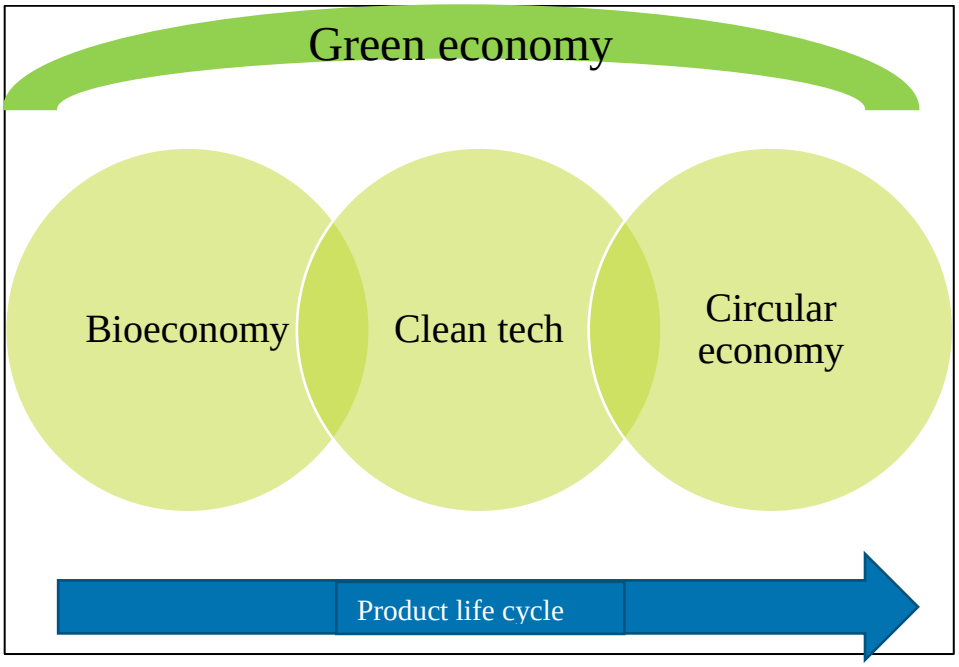

Figure 1. Concepts in green economy.

2.1 Bioeconomy

In general in the definitions of bioeconomy the main point is the use of renewable resources in order to replace non-renewable resources. This goal is often encouraged to be achieved with the new innovations and development of technologies.

Bioeconomy includes the processes over the whole range of life cycles of goods and services. However, the basis of bioeconomy is renewable materials used sustainably and effectively although bioeconomy strategies often include recycling as one component. Roughly, bioeconomy concentrates more on raw materials and production than at the end of the life cycle.

Bioeconomy strategies emphasize economic issues such as firms turnover or employment related to bioeconomic action. While these strategies do not take notice of consumer behavior they expect the efficient operation of bioeconomy lead to not only economic growth but also to positive environmental impacts.

According to OECD (2009) the three main elements of bioeconomy are: the development of biotechnology, effective use of natural resources and

integration between sectors. However, European Commission (2012) defines bioeconomy as the production of renewable biological resources and using them to produce food, biobased products and bioenergy. The industries included are agriculture, forestry, fishing, and manufacturing of food, pulp and paper as well as parts of chemical, biotechnology and energy industries.

According to The Finnish Government (2014a) bioeconomy is an economy which uses renewable natural resources to produce food, energy and other goods and services. It aims to reduce the dependence on fossil resources, prevent the impoverishment of ecosystems and promote economic development and to create new jobs under the principles of sustainable development.

2.2 Clean tech

Firms often use expression clean tech to market their environment-friendliness. Clean tech may refer to various solutions but usually clean technologies are thought as integrated in the production process contrary to end-of-pipe technologies. Mainly the focus is on using the materials in the process as efficiently as possible to promote the sustainable use of natural resources and to prevent emissions into the environment. However, the sustainable use of natural resources may also mean replacing non-renewable materials with renewable materials.

According to The Finnish Innovation Fund Sitra (2016a) clean tech contains all technologies, products, services and processes which promote the sustainable use of natural resources and prevent the negative environmental impacts of business activities. On the other hand, The Finnish Government (2014b) widens the scope of clean tech to solutions including material and energy efficiency, renewable energy, new materials, recycling and developing transportation systems.

2.3 Circular economy

Circular economy aims at reducing the amount of waste by maximizing the material circulation in economy. This would require long-lasting products

as well as developing recycling systems. Also, this requires to design products at early stage to maximize their recyclability.

An essential concept in circular economy is so called “cascade” use. In other words, to prioritize the use of raw material, e.g. using wood primarily to industrial products and recycling instead of to the production of energy. The goal is to generate more value with less input. Circular economy aims at using new technology and recycling to minimize the amount of waste and, on the other hand, to optimize the reclamation of recycled material.

According to European Environment Agency (EEA) (2016) circular economy aims at maintaining material usability. It minimizes the need for new material and energy inputs to reduce the burden to the environment from both raw material and waste viewpoints. As its purest, circular economy would mean a full alternative to take-produce-consume-dispose – model. The idea is to minimize waste and the use of raw material by ecological planning, recycling and reusing goods.

The Finnish Innovation Fund Sitra (2016b) define circular economy as a system where the consumption is based on sharing, renting and recycling in order to minimize the possession of goods. This definition also touches on sharing economy, that is, another popular concept in the field. Circular economy aims at maximizing the circulation of products, components and materials as well as their value in the economy to minimize the waste generated in production and consumption. These are seen to promote sustainable economic growth.

According to European Commission (2015) in circular economy the values of products, material and resources are maintained in the economy as long as possible. This way it minimizes the amount of waste while it encourages to new business ideas and innovations in the field. European Commission (2017) along with the member countries have been working on a list of indicators for the monitoring framework for the circular economy.

3 Comparison of the concepts

The concepts described above are linked to each other one way or another. One option to observe their connections is to choose clearly defined factors to examine. Figure 1 shows the overlapping between the three concepts when concentrating on their focal points arisen in this paper. The viewpoint is a life cycle of a product. On the left side in the diagram, the life cycle of, for example, a wood begins with logging and goes through the production phase to the end where some of the products are recycled and some disposed of or used for energy production. The picture is a simplified illustration but gives a rough view for the circumstances.

As the names of the concepts reveal they are mostly developed from an economic viewpoint. Thus, economic growth is an important target in all of them. Another key point in all the concepts is eco-efficiency which promotes the more efficient use of natural resources and environment-friendly economic activities. Third point is the use of renewable materials instead of non-renewable materials. Green economy is often seen as an umbrella concept for these and other related concepts.

Bioeconomy emphasizes mainly on raw material and production phases although this may include recycled material as well. Clean tech, on the other hand, focuses on environment-friendly production technologies. Circular economy aims at reducing the use of natural resources which in turn separates it from bioeconomy which sees the use of renewable natural resources as a means to promote economic growth. One main point in circular economy is to design products to last long and be recyclable. This target also overlaps with clean tech.

To sum up and to keep it simple, bioeconomy brings renewable resources to the green economy while clean tech maximizes their material efficiency and value and circular economy recycles the material back to a new production process.

4 EGSS and the concepts

The three concepts described in Section 2 are more or less inaccurately defined. One that is well defined while describing the same phenomenon is statistics on Environmental goods and services sector EGSS. Table 1 shows the output of bioeconomy and EGSS in Finland in 2015. It reveals that bioeconomy is somewhat larger in Finland than EGSS in total. While the contents of these statistics differ from each other, in most cases if there is activity in one there is also in another. Industry A (Agriculture, forestry and fishing) is pure bioeconomy as it is based totally on renewable materials. On the other hand, EGSS covers one fourth of the industry. Almost all of it is management of forest areas. However, in industry D (Electricity, gas, steam and air conditioning) both statistics describe quite much the same activities. Mostly, they both illustrate the use of renewable resources in energy production. In addition to that, EGSS also includes energy saving and management. Third industry we want to highlight is E (Water supply: sewerage, waste management and remediation activities) as 90 % of it belongs to EGSS while only 20 % is included in bioeconomy. This is due to the fact that management of water is the only part of industry E that is included in bioeconomy, whereas EGSS consists also for example of waste and wastewater management.

Table 1. EGSS and bioeconomy output in Finland in 2015 industry-wise.

2015	Million €			Proportion of the whole economy	
Industry	Whole economy	Bioeconomy	EGSS	Bioeconomy	EGSS
A Agriculture, forestry and fishing	9 288	9 288	2 426	100 %	26 %
B Mining and quarrying	1 858	0	4	0 %	0 %
C Manufacturing	105 586	37 563	10 713	36 %	10 %
D Electricity, gas, steam and air conditioning supply	8 645	3 617	4 668	42 %	54 %
E Water supply: sewerage, waste management and remediation activities	3 724	725	3 353	19 %	90 %
F Construction	29 800	8 568	10 755	29 %	36 %
G Wholesale and retail trade: repair of motor vehicles and motorcycles	32 034	0	131	0 %	0 %
H Transportation and storage	22 734	0	0	0 %	0 %
I Accommodation and food service activities	7 412	1 853	1 838	25 %	25 %
J Information and communication	20 179	0	0	0 %	0 %
K Financial and insurance activities	11 110	0	2	0 %	0 %
L Real estate activities	33 462	0	0	0 %	0 %
M Professional, scientific and technical activities	16 348	0	1 215	0 %	7 %
N Administrative and support service activities	10 014	181	521	2 %	5 %
O Public administration and defence: compulsory social security	20 994	0	0	0 %	0 %
P Education	14 160	0	0	0 %	0 %
Q Human health and social work activities	27 442	0	0	0 %	0 %
R Arts, entertainment and recreation	5 096	1 097	0	22 %	0 %
S Other service activities	6 010	0	12	0 %	0 %
T Activities of households as employers: undifferentiated goods- and services-producing activities of households for own use	245	0	0	0 %	0 %
TOTAL	**386 141**	**62 893**	**35 638**	**16 %**	**9 %**

In Table 2 we roughly illustrate bioeconomy, clean tech and circular economy in the context of environmental goods and services class. X-marks describe in which class each concept would potentially show in EGSS. We think that somehow every goods and services class catches at least one of these concepts yet none of these are fully included in EGSS.

Table 2. EGSS, bioeconomy, clean tech and circular economy EGS class-wise.

Environmental goods and services class	Bioeconomy	Clean tech	Circular economy
1-9 Environmental protection total			
1 Protection of ambient air and climate		x	
2 Wastewater management		x	x
3 Waste management		x	x
4 Protection and remediation of soil, groundwater and surface water		x	
5 Noise and vibration abatement		x	
6 Protection of biodiversity and landscapes			
7 Protection against radiation		x	
8 Environmental research and development		x	
9 Other environmental protection activities	?	?	?
10-16 Management of natural resources total			
10 Management of water	x	x	x
11A Management of forest areas	x	x	
11B Minimization of the intake of forest resources	x	x	x
12 Management of wild flora and fauna	x		
13A Production of energy from renewable resources	x	x	x
13B Heat/energy saving and management		x	x
13C Minimization of the use of fossil energy as raw materials	x	x	x
14 Management of minerals		x	x
15 Research and development activities for resource management		x	x
16 Other resource management activities	?	?	?

5 Conclusion

Bioeconomy, clean tech and circular economy are widely used concepts but still do not have widely accepted definitions. There are, though, some extensively used specifications for all of these. In this paper, we have put together some definitions we have found in order to formulate short descriptions to put the concepts in the context. We also compared the three

concepts with EGSS to widen the point of view through an existing defined statistics. Different concepts within environmental economy come and go. There are plenty of them at the moment in use. Some of them survive some of them don’t. From the statistics point of view the concepts which have clear definitions, available data, are measurable and useful will survive.

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