SUTAINABLE BUSINESS MODEL CANVAS WORKSHOP-

Limnos

Introduction and Business idea:

Sewage sludge is a side product of any wastewater treatment plant/process (WWTP). It is usually dehydrated and transported to incineration (major practice of Slovenia, 70%), it is composted or used for biogas plants. All treatment and disposal practices are linked to high costs that can normally accumulate in 30-70% of entire WWTP operating costs. Currently already produced Kandstone (lightweight rock), which is industrially produced from ash, cement and water in a mixing and pelletizing process. It is intended to change the raw material composition in the new project to increase the increase the insulating properties of the product and improve its sustainability (Reuse of wood ash instead of fly ash).

There is a natural alternative to mechanical sludge treatment that offers biosolids generation and nutrient reuse.

Technology description:

Limnosolids® is a passive approach technology of reed beds enabling dehydration, mineralization and stabilization of sludge from wastewater treatment plants. The processes are natural. The technology enables long-term and sustainable storage of sludge with low operating and maintenance costs. It can completely replace dehydration which currently represents significant cost on existing wastewater treatment plants.

With this technology different types of sewage and industrial sludge can be treated. It is stored in the reed beds normally between 8 to 10 years. Due to parallel operation of physical (drying) and biological processes (mineralization) the treatment results in significant sludge volume reduction. The sludge no longer contains pathogen organisms and is therefore stabilized. The system operates without using chemicals, such as polymers or flocculants. Reed beds are constructed in rectangular concrete basins or soil excavated basins. The bottom of basins is impermeabilized with a waterproof membrane to protect ground water and/or to prevent water gains. The drained water from the sludge is collected through perforated pipes, placed on the bottom of beds, and returned to a wastewater treatment plant. The bed hosts a filter with layers of gravel and sand. In the top layer of sand, reeds (Phragmites australis) are planted.

The end result of the process is a compost-like soil that can be reused as fertilizer in agriculture, cover layer for landfills or construction material. Start Circles also proved it can be used in biopolymer materials.It is expected that a reed beds system can be in operation for more than 30 years. After approximately 8 to 10 years of operation individual beds are emptied sequentially. Before harvesting the biosoilids, the bed to be emptied will not be loaded for about 3 to 4 months to allow further stabilization of the top layer. Once the bed is emptied, a resting period is recommended to allow the regrowth of the plants and the microbial community before the new cycle of loading.

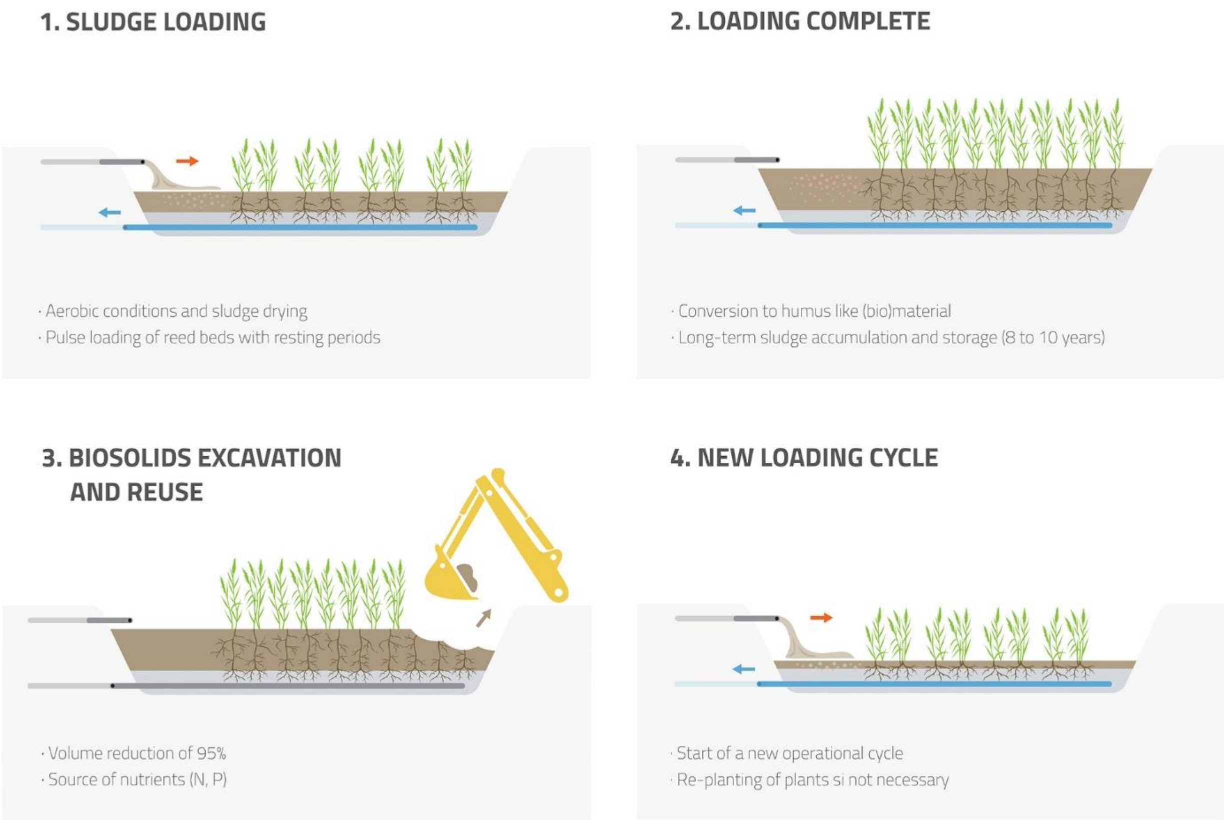

Figure 1. Sludge phases on the reed beds

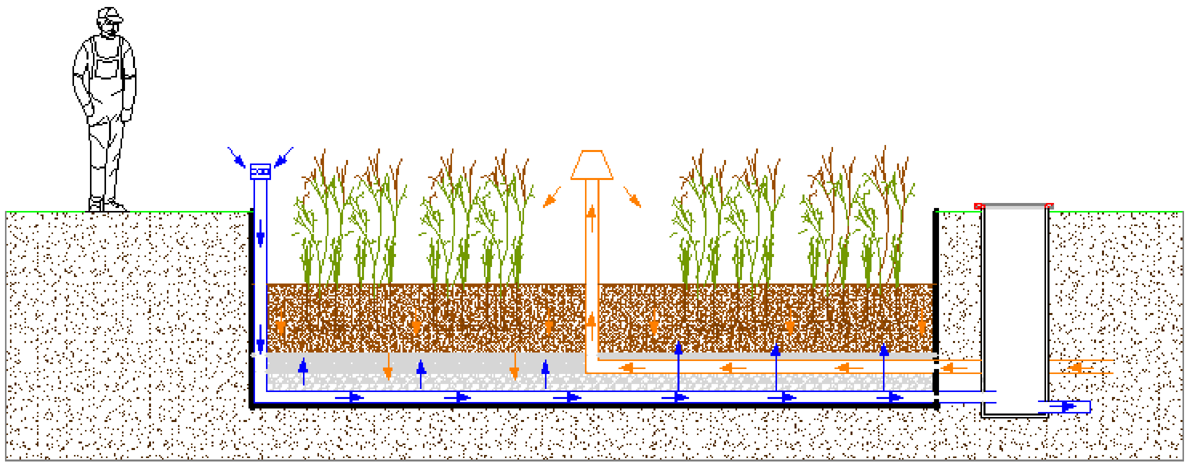

Figure 2. Scheme of reed beds

Current market obstacles for the technology (and final material):

- Technology requires surface area next to the WWTP
- The area must be located in local planning documents and suitable for investment
- Legislation: mineralised materials (biosolids) is considered as waste (not suitable for application in agriculture) – our analyses proove otherwise, but mainly from minor WWTP sludge (our main target).
- Nutrients (N,P) should be recovered: if not agriculture then … (construction, landscaping; other).

However, in Croatia the technology has been widely adopted and available material will be abundant in app. 6-8 years time. The main reason of the application is the lack of national strategy of sewage sludge disposal, and reed beds are convenient for „buying time”. The material will be available and the need to smart and affordable disposal considerable (see Figure 3 below).

Figure 3. Planned WWTP location with RBs in Croatia: total capacity of 350.000 PE

There are two options for a business model:

1. the use of sewage sludge as fertilizer

Opportunities:

- nutrient recovery (P, N)
- circular economy (Phosphorus being a global critical resource)
- product development potential (agriculture, greening of degraded surfaces; construction material)
- availability of biosolids in app. 6 years from now – need for final disposal/use paths (legal)

Barriers:

- pollutants in the biosolids (depends of the quality of wastewater)
- legislation
- certification process

2. the use of sewage sludge as a composite material (solution of FTPO)

Opportunities:

- back-up if biosolids is too polluted (to be used as fertilizer)
- product development potential (sewage pipes and other similar)

Barriers:

- product development only for underground use - smell remains (yet to be tested)
- certification process
- need to dry up the vast quantities of material before composite production - price?
- uncontinuous availability of biosolids (planning necessary to align several locations and their disposal timing; every app. 8 years)

During the workshop two business model canvases for both business ideas were created. Firstly, the canvas focusing on composites will be discussed, followed by the canvas focusing on fertilizer.

1. **The use of sewage sludge as a composite material (solution of FTPO)**

Key partners:

The key partners are the owners of the sludge, designers of new products from bioplastics, regional compounders, product manufacturers, permitting authorities as well as transportation companies.

Key activities:

The following key activities were identified: creation of a business plan and the finding of investors, collection of sewage sludge, research and development, producing of pipes and containers, marketing as well as the selling of pipes and containers.

Key resources:

Sludge, drying facilities, compounding facilities as well as knowledge were identified as key resources.

Value proposition:

The created value was especially seen in the context of the possibility of creating value out of waste and thereby closing the loop.

Customer relationships:

Regarding customer relationships, especially value chain relationships were identified as important.

Channels:

Especially B2B was identified as important channel.

Customer segments:

The following customer segments were identified: producers of pipes and containers, compounders, community and state, multipurpose container makers, users of biopolymers for product development and plastics producers.

Cost structure:

The following costs were identified: compounding of the polymer matrix and the sludge as the filler, costs associated with the drying of the sludge, costs regarding the transportation of the sludge and final disposal costs.

Revenue streams:

The following possibilities to create revenue were discovered: Income from the companies who have issues with sludge (just for taking it from them), selling service of drying or reusing, and municipality project financial streams.

Social/environmental impacts:

Land use, space intensiveness as well as energy consumption were mentioned as potential social or environmental impacts.

Social/environmental benefits:

The following social and environmental benefits were identified: prevention of degradation of the environment with unsuitable sludge disposal, resource efficiency, reuse of sludge instead of it becoming waste or incinerated, reduction of use of fossil materials for polymer production, reduction of air pollution and a reduction of landfilling.

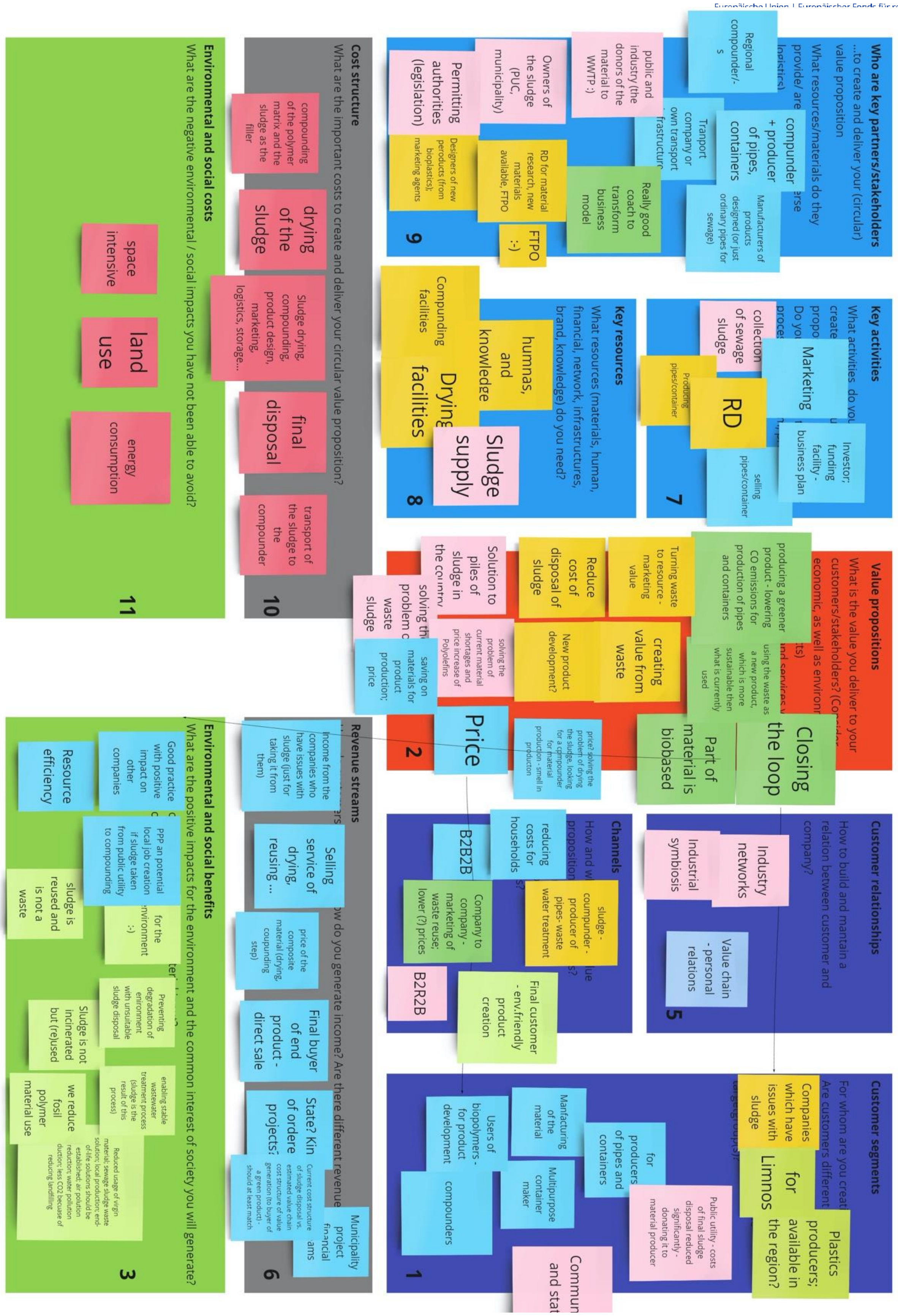

Figure 4. Business model canvas composite

2. The use of sewage sludge as fertilizer

Key partners:

The key partners are public authorities, WWTP owners and operators and experts.

Key activities:

Consulting and the support of the process were identified as key activities.

Key resources:

Technology experts, knowledge, land space and wastewater treatment plants were identified as key sources.

Value proposition:

The created value was especially seen in the context of the possibility to create a natural alternative to other fertilizers.

Customer relationships:

In the context of customer relationships, the building of a community and the providing of education and information were seen as important.

Channels:

Regarding channels, the following elements were identified as important: word of mouth (building of reputation), advertising, PR activities, social media, general awareness rising activities and online channels were identified as important.

Customer segments:

The following customer segments were identified: forestry sector, farmers, distributors, public sector and city gardens.

Cost structure:

The following costs were identified: staff costs, WWTP investments and operational costs, logistics costs, costs to obtain permits, excavation costs of material, costs for analysis and public relations and costs for consulting in order to support the process.

Revenue streams:

The following possibilities to create revenue were discovered: selling of biosolids, fees for training, % from sold solid and the selling in shops.

Social/environmental impacts:

Land use, CO_2 emissions corresponding with excavation and transport and residuals of heavy metals were identified as impacts.

Social/environmental benefits:

The following social and environmental benefits were identified: CO_2 sink, contribution to a circular economy, the recycling of phosphorus, low energy requirements in production, no packaging, local use and environmental friendliness.

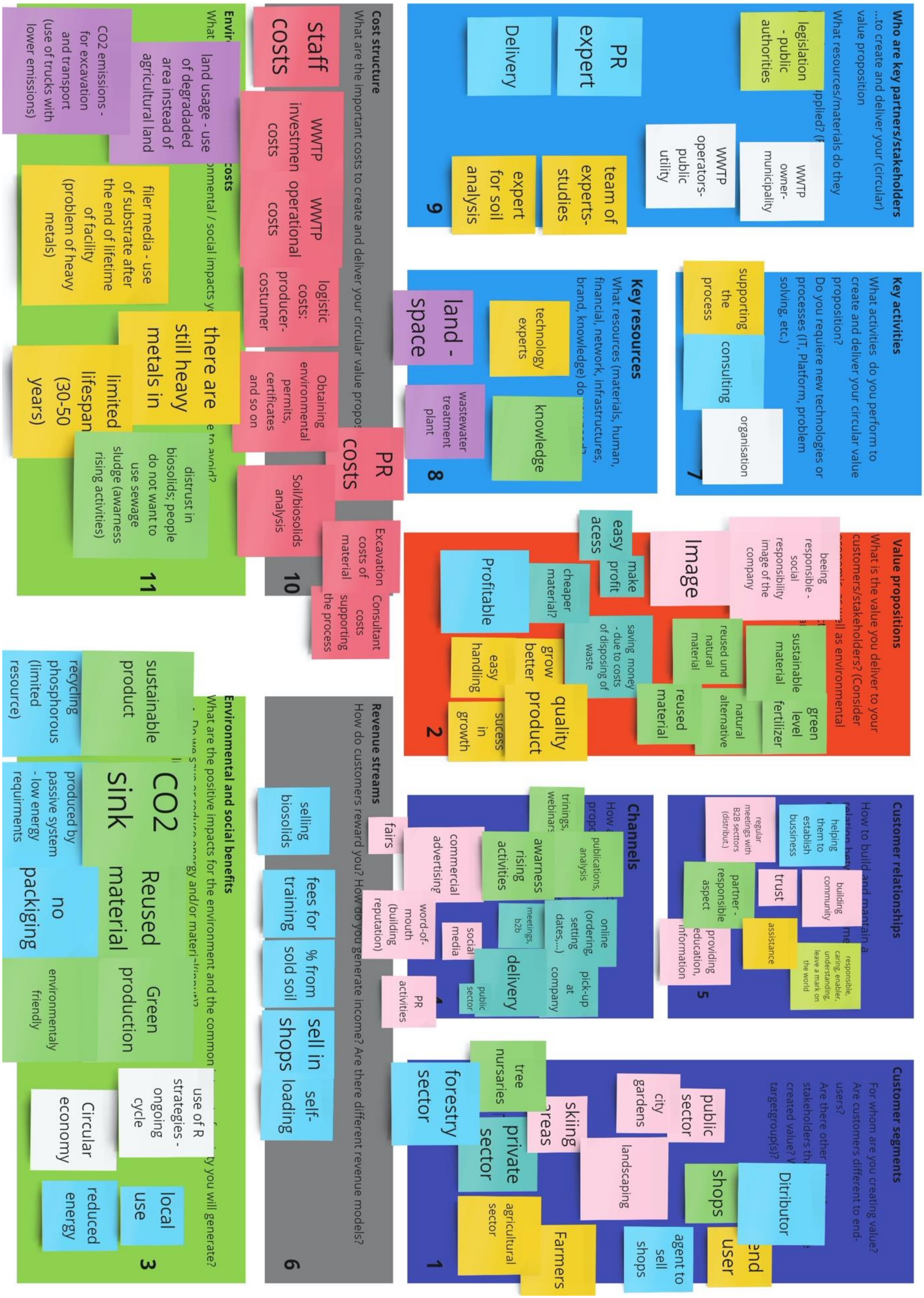

Figure 5. Business model canvas fertilizer

Next steps and challenges:

- Development of prototype and testing of properties
- Analysis of legislation
- Calculation of price
- Finding of compounders
- Value chain creation
- Legislation as a challenge
- Costs of compounded materials