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WHITE PAPER

THE IMPORTANCE OF DATA IN TRANSITION TO CIRCULAR ECONOMY

ALKEM OY, HELSINKI, FINLAND

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WHY SHOULD YOU GET INVOLVED IN CIRCULAR ECONOMY?

Forewords from the authors,

While reaching for ways of achieving a sustainable world, areas of design thinking, product life extension, systems thinking and recycling have together given us means of creating economically and environmentally sustainable business models. Over the past years the terms 'circular economy' and 'sustainability' have became mainstream and are gradually taking on various forms within the fields of policy making, industry and academia. The latest IPCC 2018 report on climate change underlined the urge to work in more hurried pace towards a sustainable economy and to take immediate and somewhat radical steps towards lowering the economy's impacts towards climate change. Circular economy might be one tool in the toolbox to fix the problem and we have seen the first steps on a journey towards a circular economy. However, much still needs to be done and the day to start this transition is now.

According to the Global Footprint network, a non-profit organisation dedicated to analysing ecological overshoot limits, 'humanity's demand for renewable resources remains 68 percent higher than what the planet can renew.' In addition, the economic challenges especially in sectors of agricultural production and material flows associated with such sectors present us with a complicated puzzle of many moving parts, in which we have to try and connect humanity's intense ecological footprint value chains, while exploring the potential socio-economic and environmental gains in the reuse of waste streams on an industrial scale. Nevertheless, we remain optimistic that societies and in particularly companies, can raise to this challenge by bringing into their business strategies concepts from the circular economy literature, such as product life extension or resource looping, that can bring competitive advantages to their value chains.

In a report by the WBCSD, their study highlighted that eight materials are responsible for 20% of global greenhouse gas (GHG) emissions, 95% of water use and 88% of land-use. These material flows are prevalent, for example, in the value chains of primary crop production and animal husbandry. Furthermore, large carbon, water and land footprint impacts are found in the construction and manufacturing industries.

On the other hand, the impacts of these material flows associated with fulfilling our everyday needs, be it in our food supply, housing, goods, transport and public infrastructure, presents an exciting opportunity for applying circular economy standards in the value chain. The important question now remains, 'How do we intend to go about doing this?'.

Before expanding on the question further, we might need to define what we mean by Circular Economy. The Ellen MacArthur Foundation define a circular economy as ”an industrial system that is restorative or regenerative by intention and design” (2013). Furthermore, ”it replaces the ’end-of-life’ concept with restoration shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which prevent reuse and aims for the elimination of waste through the superior design of materials, products, systems and within this business models” (IBID).

Circular economy principles have gone through several iteration but an important takeaway from this is, that companies now have a framework to build on, giving them a roadmap towards making their bottom line reflect regenerative or restorative principles. So given the goals of the circular economy, what sort of important tools are at our disposal, to assist companies who are ready to unlock competitive advantage channels through regenerative designs in their value chain?

At Alkem Oy, we have realised that although circular economy benefits are widely acknowledged, many companies, be it a small-medium sized enterprise or large corporates, are finding it challenging to implement, because it is not entirely clear how…their value chain could recognise the wasted value (P.Lacy and J.Rutqvist, 2016). In the next few sections we would like to highlight how we can help companies realise these benefits.

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THE CONNECTION BETWEEN SUSTAINABILITY AND CIRCULAR ECONOMY

Awareness for Sustainability was first raised by The Club of Rome, on their alarmist report “The Limits to Growth” (Meadows, D.H. et al. 1972), that demonstrated, how certain economic and population growth trends would adversely affect resource availability and food production on a global level. It was in this period, where the world took note that the exponential growth of development and the prosperity it brought also came with adverse environmental and ecological consequences.

From the debates on “The Limits to Growth” to the well known “Our Common Future” report created by the Brundtland Commission in 1987, the Sustainable Development movement gave the world a new importance in emphasising that “ the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change” should be mindful, with both the future as well as present needs.

The report established a base for the UN Programme on Sustainable Development which has also been a product of several multilateral environmental commitments in the past - including the Kyoto protocol, the Sustainable Development Goals and the Paris Agreement of 2016. Much has been done in the past, but we also need to find practical tools to fulfil these commitments, so as to reach the ambitious targets represented over the years by international environmental treaties.

The Circular Economy approach presents us with a design philosophy on how to address today’s environmental challenges. What is particularly exciting about the circular approach is that it looks far beyond the traditional factory limits. It does this by directing us to take action on an industrial scale and how best to think about the adverse impacts generated by the interconnected areas in services, design, production and consumption of goods towards the environment.

The idea to utilise side streams in other manufactured goods production is not new (see P.L Simmonds,1862) and lots of recycling companies make a business out of it, but methodologies and analysis tools are only now emerging in order to take the closing of material loops to the next level.

This means that the whole product life cycle and side streams that are associated to a product or a service, should be included to the design of the entire system. This approach enables optimal ways for organising resource and energy

use in order to provide the highest level of added value and similarly close the material loops within the economy. These value added business opportunities, that we see within the circular economy framework include: improved utilisation of side streams and waste, maintenance, longevity-of-products-principles, reutilisation, and sharing of resources, amongst others.

At Alkem Oy, we have started by examining the potential to create closed resource loops so as to increase the utilisation of resources in industries. By collecting data from various sources it was possible to build a database containing information on material and waste streams with their approximate amounts and respective locations. In addition, it is also possible to verify the quality of these streams. So far, we have collected material and waste data for around 4,700 industrial facilities, municipalities and farms in Finland containing up to some 40,000 - 50,000 material streams, based on our latest estimate.

WHAT ROLE DOES DATA PLAY IN CIRCULAR ECONOMY?

The implementation of the circular economy in practice has been a lengthy process. However, the literature in circular business models has developed strong arguments for supporting better waste management practices, thus creating a path for companies to look into such models.

The biggest problem for closing the resource loop altogether, is that resource use and waste management data have not been developed from a collaborative standpoint. The limited willingness and ability to share such data and the lack of incentive structure to make data sharing inviting, present some explanations for these missed collaborative opportunities.

The sensitivity of the material's data leads us to conclude that in order to make the circular economy work, the logic of not sharing limited
amount of specific data needs to be broken, as this plays a critical role for developing further circular business approaches and practical applications (see S.Gupta et al., 2018). These trends lead to the conclusion that the use of data is essential. As many of the companies holding the data turn out to be competitors, there might be certain limitations that need to be taken into account. The most significant recognised limitation is the need for the data to be either partially non-specific or completely anonymous.

It is clear that these limitations can lead to a situation where no cooperation with data sharing takes place, even if the underlying added value could be significant for all the market participants. As economic advantages rising from

data sharing are rarely considered for the game-theoretic reasons in companies, we have taken as our mission to speed up the realization of this economic potential through our database which enables its part to change the game.

How to gain access to material data?

There are two alternative ways to get access to the materials data.

It is possible to go for the non-specific material data and analyse this data for its most consistent parts and fill the gaps later. Alternatively, we can choose to gather more specific material data and disconnect this data from its owner enabling certain level of anonymity. In such case we might be able to find ways to share material data from producer to eventual end-user, thus creating a anonymized marketplace.

At Alkem we have chosen to start with non-specific material data first, as the gathering of this data has enabled us to establish a database that has critical mass that makes it possible to analyse vast amounts of waste and side streams in a quick and easy way. We have started the analysis by recognising most relevant side streams and all the players that are involved in these streams. This enables aggregation of material data and recognition of added value within the material streams. Furthermore, there is potential to unlock interesting local business opportunities within these streams.

Another option is an anonymized marketplace that would enable presenting data without connecting it to the material source. The marketplace could be realized either through a closed system where sidestream suppliers could declare their materials through mediators' platform or through openly accessible distributed blockchain technology that could be means to hide the source of materials. Both of these approaches have currently some issues, mainly the challenge to gather enough market participants to have critical mass for functional markets, but also verification of the materials quality might be an issue. Possibly the greatest challenge might eventually be the current trust in blockchain technology, Bitcoin has had its issues. Nonetheless it is worth mentioning that the blockchain technology can actually allow trade of side streams that is both anonymous and verifiable. We are excited to see blockchain eventually turning into real platforms for trade.

Combining non-specific and anonymized specific material streams together into a global marketplace might ultimately provide the greatest possibilities for sidestream utilization, making the material looping part of the circular economy a reality.

How to turn material data into business opportunities?

The necessary information (data) for the circular economy to get going requires several variables. For analytical purposes information on the location of the facilities and the quantity and quality of corporate and public material streams (both inputs and outputs) are required. For advanced logistics optimization, price data could be collected, to improve the quality of the analysis. Over all, in order to utilize the material stream data for analysis, the data needs to be on an adequate level.

The aggregated material streams data represented by our database present a good estimation of the side streams of a company. This data, we believe, provides a good foundation understanding existing material availability as well as for potential business opportunities. Such opportunities can be best realized through the data and establishing certain economic and co-operative schemes.

CASE: DATA IN CONTEXT OF LOCAL BIOGAS PRODUCTION

We have established a example case by analyzing data from the database to demonstrate business potential. We started by recognizing the most interesting material streams within the database. According to our analysis, the most promising streams in mass terms seemed to be the sidestream biomasses from industries and farms. For practical reasons we limited our analysis to waste and sidestream masses totalling 1,900,000 t/a, or around 4% of Finland's direct input requirement (statistics of Finland, 2016) for biobased natural resources.

The most significant problem with reuse might be in many instances, that the logistical costs, or lack of data, prevents these streams to be used in an economically sensible way. Our database has for this reason connected material streams with location data. This allows us to analyse local mass streams in detail so as to recognise economically and ecologically viable unused business opportunities.

One such well recognised opportunity is local production of biogas from industrial and municipal side streams as well as manure and field biomasses from farms, making it possible for producers to benefit economically from these low value waste and side streams. Currently in Finland, some biogas production is connected to municipal waste, but not so much to industrial sources or farms due to low profitability of small scale production. (See figure 1 for the scheme material flows and process units).

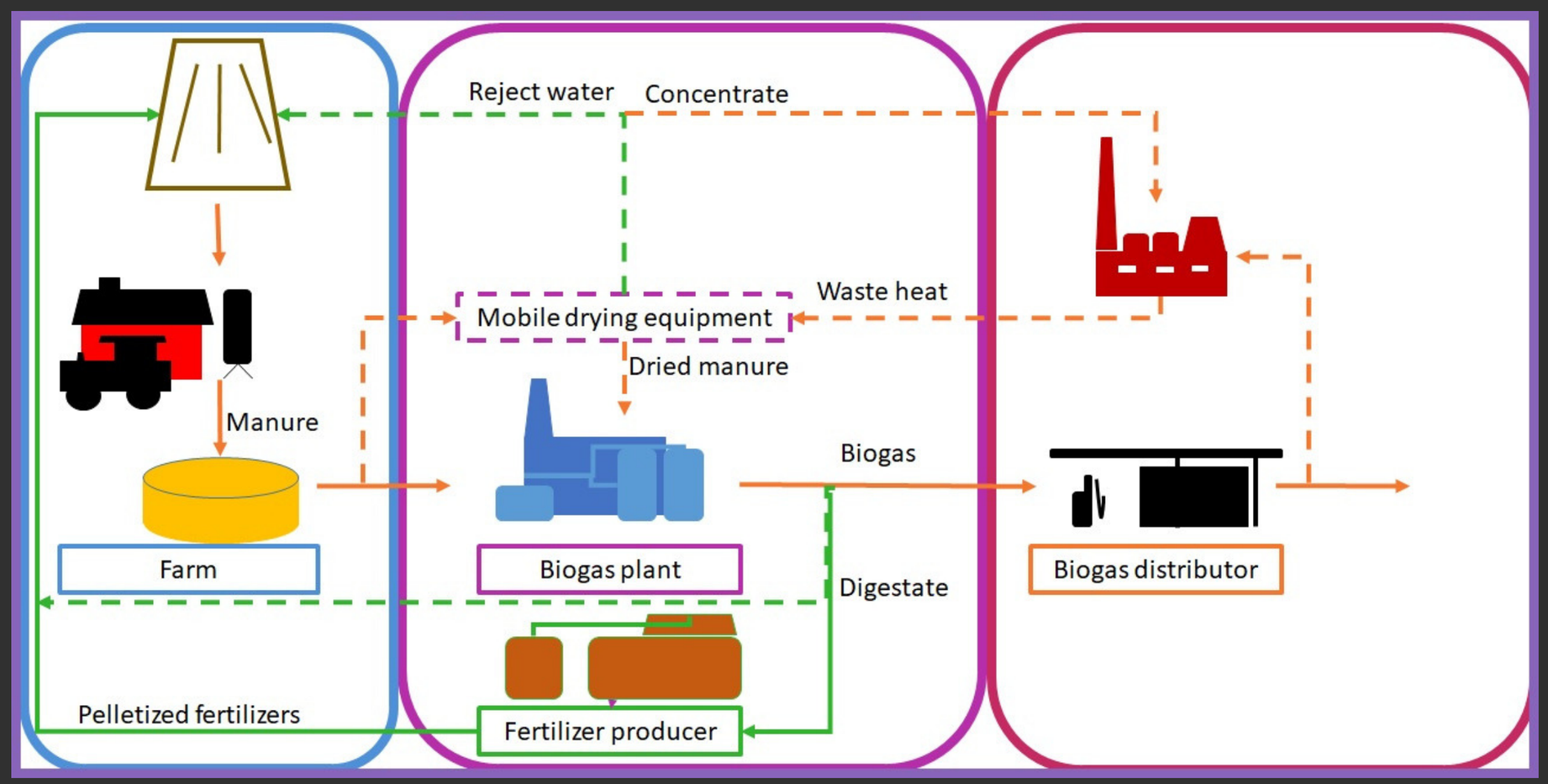

Figure 1. Potential biogas and fertilizer production scheme utilizing material stream and location data

Economics of scale play a big role in determining the capital expenses of the project, while logistics and maintenance take significant part of operational costs. Our database allows recognising those local biogas production opportunities that have enough material available to guarantee economies of scale while the logistics can be optimised to minimize the costs. Optimally the farms have existing storage facilities that might further reduce the overall investment.

Such plants might become inviting for a local fertilizer production, that could monetize on the nutrient-rich digestate. The main users of the fertilizers would be close to the production site, which would make this kind of co-production economically more interesting and it would similarly improve the profitability of the plant.

In order to sell the produced biogas, location data is relevant, as there could be local gas stations, having most of the relevant distribution infrastructure in place, that might be interested in distributing the biogas for methane-based transportation. Alternatively some local chemicals production might be interested in utilizing biogas (or even synthesis gas) as a raw material for their production.

The excess gas could be sold through gas stations or chemicals producers or it could be used for local heating purposes in the close-by farms or factories lowering their operating costs and allowing a steadier income stream to the biogas plant.

The database additionally allows recognising local low cost waste heat sources that could be directed for drying some of the side streams, while allowing lower logistics costs and higher capacities for the biogas plant. Most importantly the

database makes systems analysis possible, enabling economic modelling and optimization of the whole production system, instead of just concentrating on plant level planning.

ABOUT US

Alkem Oy has a purpose to decrease the barrier for companies to participate in the Circular Economy (CE) movement, so as to realise the potential benefits of the CE movement for industrial companies. We do this by actively searching for business and investment opportunities embedded beneath the material data. Furthermore, by recognising local uses for sidestreams and utilising public and private data, we aim to provide analysis and tools for improving materials efficiency and for promoting new business opportunities related to Circular Economy.

We are similarly searching for industrial partners wanting to get a hold on Circular Economy and willing to explore the unleashed business potentials of it.

Feel free to contact our consultant Karri Lehtonen (+358 400 749 042, karri@alkem.fi) for further questions and inquiries!

About the authors:

Karri Lehtonen is a Circular Economy and Sustainability professional and consultant who has established the database for Alkem Oy. He holds Masters degrees in Economics and Process Chemistry from Aalto University and is specialized in resource economics, life cycle assessment, industrial symbiosis and circular economy themes.

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References:

[1] IPCC Raport 2018, "Global Warming of 1.5 °C", http://www.ipcc.ch/report/sr15/

[2] Global Footprint network, (09/04/2018). “Has humanity’s Ecological footprint reached its peak?” (blog), https://www.footprintnetwork.org/2018/04/09/has_humanitys_ecological_footprint_reached_its_peak/

[3] WBCSD, (05/06/2017). “Circular Economy Potential and Environmental Priorities for Business” https://www.ecofys.com/files/files/ecofys-wbscd-2017-circular-economy-environm-prio-for-business.pdf

[4] The Ellen MacArthur Foundation, 2013. “Towards the Circular Economy: Economic and business rationale for an accelerated transition”. https://www.ellenmacarthurfoundation.org/circular-economy

[5] P.Lacy and J.Rutqvist, 2016.“Waste to wealth: The circular economy advantage”. ISBN 978-1-137-53070-7

[6] Meadows, D.H. et al. 1972. “The Limits to Growth” , http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf

[7] Brundtland Commission for WCDE, UN, 1987.“Our Common Future, From one Earth to one World”, http://www.un-documents.net/our-common-future.pdf

[8] Gupta, S. et al., 2018, “Circular economy and big data analytics: A stakeholder perspective” (access required) https://www.sciencedirect.com/science/article/pii/S0040162517314488

Further readings:

[9] Sitra, 2016. “Leading the Cycle, Finnish Roadmap to Circular Economy 2016-2025”. https://media.sitra.fi/2017/02/28142644/Selvityksia121.pdf

[10] M. Lewandowski, 2015. “Designing the Business Models for Circular Economy - Towards the Conceptual Framework” https://pdfs.semanticscholar.org/78c1/025b21e46bb2ff0a3e668b8853ba148829e4.pdf

[11] Virtanen et al., 2018. “Circular Material Library. An innovative tool to Design Circular Economy” https://www.tandfonline.com/doi/pdf/10.1080/14606925.2017.1352685

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