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SYSTEMIC
Circular solutions for biowaste

Development and Application of Economic Key Performance Indicators (KPIs), Final Report

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History of changes

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15th May 2020	Draft Version		
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5th December 2020	Reviewed version	List of abbreviations	6

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List of abbreviations

AD	Anaerobic digestion
CNG	Compressed natural gas
CSTR	Continuous stirred-tank reactor
DAF	Dissolved air flotation
EBIT	Earnings before interest and tax
EBITA	Earnings before interest, tax, and amortisation
IEC	Installed electric capacity
KPI	Key performance indicator
LNG	Liquefied natural gas / liquid natural gas
NRR	Nutrient recovery and recycling
OPEX	Operations costs
P&L	Profit and loss
WP	Work package

Preface

The SYSTEMIC WP2 (Work package 2) milestone to achieve at about halfway of project roll-out was understanding the individual business models and having analysed the business cases of the demonstration plants. Apart from the narrative analysis in the *Business Case Analysis Report,* the development and implementation of Key Performance Indicators (KPIs) was proposed and performed. The present report "Development and application of economic Key Performance Indicators" in its final and publishable version is the corresponding deliverable 2.4.

The five SYSTEMIC demonstration plants and the participating outreach plants process different substrate mixes in compliance with the national framework conditions and have considered, planned or yet installed different NRR technologies: N-recovery to ammonium sulphate, P-recovery to struvite, N-(P)-K-recovery to a mineral concentrate, the nutrient rich or nutrient depleted (depending on the region of application) solid fraction of digestate to organic fertilisers or soil improvers, the fibrous mass fraction of the digestate to fibre-products and the aqueous fraction to discharge- and/or reusable water. The delay of commissioning the British Fridays plant – due to delayed adoption of feed-in tariff legislation, extended permitting processes, some technical issues and not least the COVID-19 pandemic – made it necessary to add a new, fully operational demonstration plant – Waterleau in Ypres, West-Flanders and assign the role of an additional outreach plant to Fridays. However, this organisational change does not have a relevant impact on the KPIs.

Processing of organic wastes plus nutrient recovery and recycling (NRR) can only exceptionally sustain operations of a large scale anaerobic digestion plant. This rare exception is demonstrated by the Italian SYSTEMIC partner Acqua e Sole generating most of its revenues from a gate-fee for processing selected municipal sewage sludge. Economic results of all other partners depend on relevant returns from energy supplies. Hence, measuring the performance of NRR is currently only relevant for comparing the cost of handling and disposal of untreated digestate and technical treatment options.

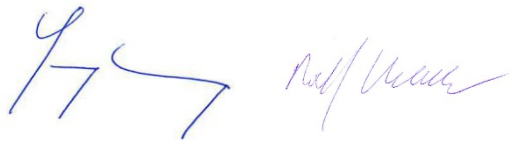
The balance sheets including the profit and loss (P&L) statements inform about the overall economic performance of a company. Albeit it is difficult to derive strategic options for the development of a business from interpreting the P&L statement. Well defined key performance indicators are valuable tools for supporting the selection of strategic process options. KPIs may also contribute to project development and investment decisions.

Most commonly used KPIs are not convincing for identifying business areas of an AD (anaerobic digestion) plant that may need improvement or that offer great opportunities. The KPIs selected for this report have shown their usefulness as a tool for measuring the financial performance. They allow distinction between the activity areas (cost centres) performing below median and those performing outstandingly well. Usually, both areas deserve a closer evaluation for opportunities.

Owners and operators of anaerobic digestion plants participating in SYSTEMIC stand out from the crowd by their innovative and entrepreneurial spirit, reflected in profitable business cases. Yet, the identified options and pathways for additional NRR look exciting and promising. They will be further laid out by developing business models (deliverable 2.7) for profitable anaerobic digestion plants operating in a Circular Economy.

The authors owe to the highly committed practitioners and scientists of the SYSTEMIC team, particularly to the owners and operators of demonstration and outreach plants, highly relevant facts and insights to innovative businesses serving as a role model for the potential contribution of municipal and agricultural organic waste and by-product flows to a sustainable, material efficient, low-emission, Circular economy.

31st May 2020



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More information on the SYSTEMIC business cases can be found in the *Business Case Evaluation Report* published by Wageningen Environmental Research, Wageningen, September 2019.

Summary

For the development of Key Performance Indicators (KPIs), business cases of five demonstration and two outreach plants were evaluated and reported in D2.2 *Business Case Evaluation Report*, September 2019. Delays not least due to the COVID-19 pandemic made it necessary to invite a new AD plant to SYSTEMIC and replace the Fridays AD Plant by an AD plant operated by Waterleau New Energy in Ypres, Belgium. Due to the timeline for reporting, the KPI analysis of Waterleau has been performed before the business case analysis in the corresponding report is updated. However, the corresponding business case analysis will follow in a couple of months and the *Business Case Evaluation Report* will be updated and published.

Acqua e Sole S.r.l., a thermophilic anaerobic digestion plant in Vellezzo Bellini (30 km south of Milan), Pavia, Lombardy, Italy, in operation since 2016 with a total annual substrate processing capacity of 85,000 t. Processing municipal sewage sludge and source separated domestic food waste.

AM-Power BVBA, a thermophilic anaerobic digestion plant in Pittem (40 km west of Ghent), West-Flanders, Belgium, in operation since 2011 with a total annual substrate processing capacity of 180,000 t. Processing biowaste and manure.

BENAS GmbH, a thermophilic anaerobic digestion plant in Ottersberg (40 km east of Bremen), Lower Saxony, Germany, in operation since 2006 with a total annual substrate processing capacity of 174,000 t. Processing corn silage, plant residues and poultry litter.

Groot Zevert Vergisting B.V., a mesophilic anaerobic digester plant in Beltrum (35 km southwest of Enschede), Achterhoek Region, Province Gelderland, The Netherlands, in operation since 2004 with a total annual substrate treatment capacity of 135,000 t. Processing manure and biowaste.

Waterleau BV, a mesophilic anaerobic digestion plant in Ypres (80 km west of Ghent), West-Flanders, Belgium, in operation since 2012 with a total annual substrate treatment capacity of 120,000 t. Processing manure and biowaste.

Fridays Ltd., a mesophilic anaerobic digester at Knoxbridge Farm, Frittenden, Cranbrook, Kent, United Kingdom, currently under construction with a total annual substrate treatment capacity of 60,000 t. Planned to process poultry litter and straw (photo of an existing DVO plant in USA).

Nurmon Bioenergia Ltd., a mesophilic anaerobic digester in Seinäjoki (80 km southeast of Vaasa), South Ostrobothnia, Finland currently under construction with a total annual substrate treatment capacity of 240,000 t. Planned to process manure, industry by-products and plant biomass.

The business cases represent large-scale biogas activities owned and, typically operated by small and medium enterprises (4-9 M€ sales, 10-30 employees) servicing the farming and food industry sector. Plants are located in high livestock density regions (Flanders/Belgium, The Netherlands), in regions with moderate livestock density (Finland, Germany, UK) and low livestock density (Italy). A variety of feedstock is used including manure, poultry litter, agricultural waste, food industry waste, source separated domestic food waste and sewage sludge. By far the most important source of revenues is energy supplies paid by feed-in tariffs, feed-in premiums, and green certificates. In contrast to the other plants, Acqua e Sole in Italy generates most of its revenues from gate-fees for processing municipal sewage sludge.

The report explains the nature and function of KPIs in general and their intended function in business cases present in SYSTEMIC.

In the second chapter the approach and KPI development is explained. SYSTEMIC aspires to develop model business cases for anaerobic digestion and nutrient recovery and recycling in a Circular Economy

(European Commission, 2018). The relevant policy (European Commission, 2017) and legislative (European Union, Parliament and Council, 2018) framework as well as the energy mix options in a low or net-zero carbon emission EU-2050 (European Commission, 2018) have been analysed and exhibited in the *Business Case Evaluation Report*, published in September 2019[1].

Apart from the apparent use of EBITA- (earnings before interest, tax and amortisation) and EBIT- (earnings before interest and tax) margins measuring the overall profitability of a business, three case specific KPIs have been derived from the main material and energy flows of the anaerobic digestion plants providing indicators for

- Overall substrate financial productivity measuring the overall financial productivity of substrates, i.e. total revenues per ton of substrate processed in EUR/t.
- Energy related financial productivity measuring the energy related financial productivity of biogas, i.e. the net revenues from energy supplies per m³ of biogas in EUR/m³.
- Digestate related financial productivity measuring the digestate related financial productivity of substrates, i.e. net costs (revenues) of products (digestate, recycled products) per ton of feedstock processed in EUR/t.

Because of irrelevance for the purpose of developing business models, KPIs related to the internal cost centres of the companies are not considered but they may be added at a later stage of the project.

In chapter 3 the financial performance of SYSTEMIC partner plants is analysed by application of the five KPIs. Every plant (except Fridays) is compared to the median of all seven SYSTEMIC partner plants for every indicator, plainly exhibiting the differences in terms of approaches and performances. KPIs have proven to be useful highlighting the areas of activity that contribute to the profitability and those that do not. Furthermore, KPIs can help the management identify the areas that should be further assessed for improvement options. All plants have relevant costs related to the handling and disposal of digestate, even after implementation of NRR systems.

As another direct result from the performed KPI development, recommendations for strategic options to be pursued during the remaining project life, about 18 months, have been included. As all plants may improve their overall profitability by productisation and marketing of recycled products, this will become a common project task. Yet, most business cases are already quite profitable and the improvements are not urgently needed. Actually, the business cases can alrieady be used as a role model for anaerobic digestion plants due to mostly using organic waste based feedstock and having implemented the equipment for effective product recycling. NRR systems are in all cases contributing to the profitability, clearly exhibited by the two cases that have operated conventional digesters until recently.

In chapter 4 all seven plants are compared and the overall results are evaluated. The direct comparison of the measured results facilitates positioning of the own business vis-à-vis the "competitors", albeit operating under different framework conditions. The comparison of AM-Power and Groot Zevert, before and after NRR implementation is also exhibited in chapter 4.

Chapter 5 draws the conclusions.

[1] Hermann, L. and Hermann, R., 2019, Business Case Evaluation Report. Ed.: Wageningen Environmental Research 2019, in press

1 What is a Key Performance Indicator?

Literature offers various definitions of KPIs and you can find a Web-Site called www.kpi.org managed by the Balanced Score Card Institute, located in North Carolina and offices in several countries outside the US. The approach proposed by KPI.org is starting by formulating the objectives and strategy. The web-site offers a guideline on how to develop and use KPIs for an individual organisation. Other definitions are:

- KPI is "A quantifiable measure used to evaluate the success of an organization, employee, etc. in meeting objectives for performance" (Oxford Dictionary).
- KPI is a tool to understand how an organisation is performing. It must be quantifiable and essential for achieving goals. Frequently KPIs are associated with targets and aim at quantifying their achievement. In the context of the SYSTEMIC project, KPIs are understood as a pillar of the organisations performance management system and are intended to find out which targets the organisations should set and pursue (Boston Consulting Group, 2017).
- The British Companies Act 2006, section 417/6 requires KPIs to be reported in the annual reporting of medium-sized companies: "Key performance indicators" means factors by reference to which the development, performance or position of the business of the company can be measured effectively" (PriceWaterhouseCoopers, 2007).

KPIs may be designed to measure all kind of aspects in a business like sustainability, materials efficiency, customer satisfaction, employee performance, etc. For this report, the focus is on KPIs measuring the financial performance of the business answering a few simple questions:

- Is the business profitable
- Which business activities (cost centres) are significantly contributing to the profitability of the company
- Which business activities are underperforming and undermining the profitability of the company and
- What are the best metrics to measure the performance.

KPIs depend on business types and priorities. Different organisations will select different KPIs and even within one organisation business areas, departments and projects may choose different KPIs. The choice fully depends on individual targets. Hence, every project or department will measure its performance against its own financial, marketing, sales, service, supply or manufacturing KPIs. Meaningful KPIs allow leaders to evaluate how well the business is doing and which changes may improve the performance. They can also provide early warnings about sectors critically underperforming.

Literature distinguishes between lagging KPIs that are tracking the past performance and leading indicators dealing with future outcomes. In addition, organisations can use quantitative indicators measuring results by numbers and qualitative indicators leaving more room for interpretation. Attention must be paid to select relevant KPIs that are measuring business critical parameters and selectig the right number – too many KPIs can distract the management from the processes having a real impact on the business performance. Once KPIs are introduced they should be continously evaluated to remain aligned with the priorities of the organisation.

Commonly used KPIs are measuring expenses and profit, gross and net profit margins, material and financial productivity, return on investment, total costs of products sold, annual uptime of facilities and equipment, specific energy and/or material consumption, material use efficiency, recovery and recycling rates, emissions to air, soil and water, cost of acquiring new customers, turnover of inventory, turnover per employee, turnover per square meter shop area, rate of defective products, rate of returns, customer satisfaction, employee satisfaction, number of accidents per working hour and many others. Everything that can be measured or at least interpreted with common sense can be used as a KPI.

SYSTEMIC, at least at this stage of the project, aims at providing tools for self-assessment of the businesses of partners including assessment of the installation of NRR systems and benchmarking the own performance in comparison to others.

The aspiration to KPIs developed for SYSTEMIC partners and future anaerobic digestion business cases, including the use as an assessment tool for investors, is having indicators that help to identify the cost centres and/or activities that perform well and those that perform below median. After having identified these activity areas, they can be tackled and strategic options for improvement can be developed. Once the strategies are implemented, the function of KPIs is to measure the achievment of objectives.

2 Anaerobic Digestion Business Cases and KPI Development

The anaerobic digestion business depends on regional and national framework conditions that distinguish one case from another. It is essentially a service business, has elements of a utility (supplying energy) and may handle large quantities of materials containing high mass fractions of water.

Essentially, anaerobic digestion (biogas) plants deal with processing three relevant in- and output flows (feedstock, energy, digestate) that may generate revenues or costs:

(1) Organic waste flow (substrate) processing – a service to farmers, industries, municipalities, wastewater treatment plants and others. The corresponding revenue is typically a gate-fee. The gate-fee depends on multiple factors (regional market, legislation, type of substrate, content of volatile, conversable organic matter, water content). However, the substrate can also have a price (if delivered by third parties and regardless of being a waste or by-products) or a cost (in case of energy or cover crops grown by the owner/operator of the anaerobic digestion plant). Regardless of the substrate having a price or an internal cost, the initial value is negative. Availability and characteristics of the substrate can have a significant influence on the P&L accounts of the operating company and is therefore a meaningful KPI reference value. In addition, availability of substrates, i.e. feedstock for digesters, is key to developing a digester business. Hence, biogas business development usually starts with the search for digestible organic feedstock.

(2) Conversion of substrate to energy – a service to the public at large or to specific sectors like the industry (e.g. dairy plants) or transport (e.g. heavy good vehicles) sector. Energy supplies are usually the most important sources of revenues of biogas plants and they are frequently fixed in a multiannual contract in form of feed-in tariffs, feed-in premiums, or green certificates. Regardless of these characteristics, the operator still has instruments to improve the energy revenues, e.g. by adapting their business case to available bonuses by increasing the conversion efficiency (making best use of secondary energy flows like heat), increasing the supply flexibility to better adapt the business to its role as stabilising factor in an environment of highly volatile energy supplies by solar energy and wind and selecting the type of energy the biogas plant is selling – biogas, electricity, biomethane, bio-LNG (liquid natural gas) or bio-CNG (compressed natural gas). Energy supplies always generate revenues, albeit, in absence of support schemes, quite small ones that do not cover operations of a biogas plant.

(3) Processing the digester effluents and selling them as a re- or upcycled product – the focus area of SYSTEMIC. Currently, the management of digester effluents typically causes operations costs (OPEX), sometimes very relevant ones. Some SYSTEMIC business cases have the advantage of cropland under the company's management. When using the fertilising by-products for the own production of agricultural products, operators save the equivalent amount of nutrients supplied by third parties and the corresponding costs. In this case, the cost of the nutrients in the market (if any) can be accounted as a benefit in the P&L account. When operators have to sell the by-products at the free market, they currently receive only a fraction of the typical market value of nutrients. In every SYSTEMIC business case, processing the nutrients saves costs and has a relevant impact on the P&L account.

For the purpose of the SYSTEMIC business case evaluation and for providing suitable tools for self-assessment of the owners/operators, deriving finance related KPIs from the revenue and/or cost streams described above was considered most appropriate. In addition, the simple KPIs EBITA margin and EBIT margin were selected to measure the overall business performance. The EBITA margin makes the OPEX of biogas-based business cases comparable as it does not include the arbitrarily set factor amortisation time and the interest rate. Amortisation time in accounting usually differs a lot, depending on prevailing accounting rules and on management decisions – in case of SYSTEMIC the range goes from 3 years (for peripheral nutrient recovery systems) to 20 years (for the whole biogas plant).

After identifying business areas which may be considered cost centres common to all AD plants, Key Performance Indicators can be developed. KPIs should be measurable and reportable without many additional efforts by operators and the management.

2.1 Definition of "SYSTEMIC" KPIs

The two KPIs defining the overall financial performance of anaerobic digestion plants are key indicators reported in every profit and loss (P&L) statement: EBIT- margin and EBITA- margin, the ratios of a company's operating income to net revenues, presented in percent. The EBITA margin measures only operating cash-flows while the EBIT margin takes the effect of amortisation into account. Both indicators exclude the interest and tax rates and facilitate the overall comparison of the financial results of seven investigated plants. In addition, they facilitate to assess the overall business performance of the activity in comparison to other activities for managers, investors, and bankers in case of loan financing. However, EBITA and EBIT margins and EBIT do not help the management to identify the levers to pull to improve the business performance. For this purpose, other indicators need to be determined.

Following the approach of deriving metrics from the main revenue/cost items of an anaerobic digestion plant, the task is to identify relevant and quantifiable indicators that are key to the financial performance of the businesses.

As KPI related to organic substrate processed by the plant the "*financial substrate productivity"* per mass unit – tonne - is proposed. The financial substrate productivity is calculated as revenues in Euro per tonne of substrate whereby revenues can be generated by gate-fees, energy supplies and products.

As KPI related to energy conversion "*financial productivity of biogas*" per volume unit – cubic meter – has been determined. This indicator allows the assessment of the different potential types of energy outputs of a biogas plant: biogas, electricity and biomethane including bio-LNG and bio-CNG. Heat is an accountable energy output but usually consumed internally.

As KPI related to digestate *"financial digestate productivity"* per mass unit – tonne – has been selected. This indicator facilitates the assessment of costs (in most cases) or revenues (the long-term objective of NRR systems) of the financial flows associated to the handling and disposal of digestate or derived products. It allows a comparison of the financial flows before and after installing an NRR system.

The five selected KPIs allow assessment and comparison of different strategies and options of managing and operating an anaerobic digestion plant. Each revenue or cost carrier – substrate, energy, digestate – is represented by one individual KPI by which the specific "carrier" performance can be measured.

Both, substrate and digestate financial productivity are related to the total mass of substrate processed. If digestate financial productivity were measured by tonne of digestate, changing the mass/volume flows could produce deceptive results. Substrate financial productivity can be affected by changes in substrate management (e.g. other types, other suppliers), changes in energy supplies (e.g. biomethane instead of electricity, biogas storage for higher flexibility) and changes in digestate management (e.g. by NRR). However, if both individual values remain unchanged, one can clearly discern the effect of a substrate related measure.

By calculating a median KPI value for each of the selected indicators, a benchmark is set to compare the performance of one AD plant to the other AD plants of a selected group – for this report the median of partner plants. Owners/operators realise in which sector their plant performs better or worse than the peer group and can analyse the reasons. This instrument is a valuable metrics for all AD plants dealing with this report. The sector specific performance of AD businesses can be calculated and compared.

Selected KPIs only refer to external relations with suppliers and customers. In general, KPIs could also measure internal targets but for the purpose of evaluating SYSTEMIC business cases we do not consider internal plant processes and issues for obvious reasons of confidentiality of related information.

Nonetheless, indicators discussed in this report can still be used for analysing internal costs an individual business case. If the selected KPIs for substrate, digestate and biogas financial productivities are at or above median of SYSTEMIC participants and EBIT or EBITA are far below and even negative, it is an

indicator of excessive internal costs. In this case, businesses should dive deeper into their internal structures and expenses for maintenance, repair, personnel, travel, representation, and whatever other cost position may stand out in comparison to the peer group.

Table 2.1.1 KPIs, metrics and related business relevant information

KPI #	Name	Unit	Explanation
1	EBITA margin	€ EBITA / € revenues in %	Overall operational financial performance of businesses (excl. interests and amortisation) in percent of revenues
2	EBIT margin	€ EBIT / € revenues in %	Overall operational and capital expenses related financial performance of businesses (excl. interests) in percent of revenues
3	Substrate financial productivity EUR total revenues / tonnes substrate	€ / t	Measures the overall substrate related financial productivity, i.e. total revenues (turnover) of the plant per ton of feedstock processed. Indicator of the overall financial productivity of processed substrates regardless from which activity (cost centre) of the digestion plant.
4	Digestate financial productivity EUR digestate costs (revenues) / tonnes substrate	€ / t	Measures the digestate related financial productivity of substrates, i.e. net costs (revenues) of effluents or products (digestate, recycled products) per ton of feedstock processed. Indicator for the costs or revenues of handling/disposing of or selling the solid and liquid materials coming out of the digester which are affected by NRR systems and use/sale of recycled products.
5	Biogas financial productivity EUR energy revenues / cubic meters biogas	€ / m³	Measures the energy related financial productivity of biogas, i.e. the net revenues from energy supplies per m³ of biogas supplied. Indicator for the revenues generated from a given biogas output and affected by the type of final energy carrier supply (electricity, bio-methane, bio-LNG or bio-CNG) and support schemes (feed-in tariff, feed-in premium and other energy supply related revenues).

3 KPIs of SYSTEMIC Partner Plants

3.1 Demonstration Plants

3.1.1 Acqua e Sole S.r.l.

A thermophilic AD plant in Vellezzo Bellini (30 km south of Milan), Pavia, Italy, in operation since 2016 with a total annual substrate processing capacity of 85,000 t. Processing municipal sewage sludge and source separated domestic food waste.

Table 3.1.1.1 Acqua e Sole Plant characteristics

Date of commissioning	2016
Annual substrate processing capacity / processed	120,000 t / 72,000 t (62 kt sludge / 10 kt food waste)
Installed electric capacity (IEC)	1.6 MW
Installed biomethane capacity	none
Digester volume	13,500 m³
Annual biogas output / biogas per t of feedstock	4.0 Mm³ / 56 m³/t
Annual electricity net-output (fed to the grid)	5,547 MWh
Annual bio-methane output	None
Digester type	Thermophilic Continuous Stirred-Tank Reactor (CSTR)
Nutrient recovery & recycling (NRR) facilities	Ammonium recovery system (stripper, scrubber, ancillary equipment)
NRR Products	Hygienised digestate, ammonium sulphate
Framework conditions relevant to the business case	Owners cultivate 1,400 ha agricultural land Low livestock density in the region, dominant crop is rice.

The KPIs are derived from the plant characteristics shown in table 3.1.1.1 above and the P&L summary shown in table 3.1.1.2 below.

Table 3.1.1.2 Acqua e Sole P&L summary in EUR

Acqua e Sole	**Revenues**	**Expenses**	**Balance**
Substrates (biowaste, manure, energy crops)	4,536,000		4,536,000
Energy and Green Certificates	306,604		306,604
Product sales / savings *)	0		0
Consumables (chemicals, spare parts)		17,202	-17,202
Digestate & NRR product handling (storage, application)		650,000	-650,000
Operations (personnel, overhead, maintenance, repair)		2,210,000	-2,210,000
Amortisation (15 years)		1,210,569	-1,210,569
	4,842,604	4,087,771	754,833
EBITA		**1,965,402**	**EBITA Margin 41%**
EBIT		**754,833**	**EBIT Margin 16%**

* *Savings of mineral fertilisers*: *Acqua & Sole in order to valorise nutrients in digestate has agreements with local farmers for mutual exchange of organic fertilisers; so Acqua & Sole does not have accountable savings from chemical fertilizers replacement.*

The KPI analysis of Acqua e Sole demonstrates that the business case generates a medium profitability with regard to the KPIs EBITA and EBIT. The financial substrate profitability is above median, mainly because of far above median substrate related revenues due to substantial gate-fees for sewage sludge. In contrast, Acqua e Sole has a low energy related performance due to selling electricity at market price without targeted support schemes.

The negative fertilising product related KPI would turn around to a positive value if Acqua e Sole would account fertiliser savings in its P&L statement.

Table 3.1.1.3 Acqua e Sole KPIs

KPI #	Type / Description	Unit	Reference value	Perfor-mance	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	1,965,402 €	41%	41%	Median EBITA margin
2	EBIT margin	€ EBIT / € revenues in %	754,833 €	16%	12%	Much above median EBIT margin
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	72,000 t	67.26 €	53.38 €	High financial productivity of substrates
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	72,000 t	-9.03 €	-5.35 €	Negative digestate related results – no financial benefits accounted from use as fertilisers
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	4,000,000 m³	0.08 €	0.33 €	Much below median biogas productivity

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

The apparent strategy of Acqua e Sole would be to improve the performance of those indicators that are far below the median of SYSTEMIC plants. Improving the energy related revenues of substrate would imply changing the business model and producing biomethane instead of electricity. A new support scheme for bio-LNG or bio-CNG for the transport sector is enacted for 2019 (Decreto 2 marzo 2018, Promozione dell'uso del biometano e degli altri biocarburanti avanzati nel settore dei trasporti, (RES LEGAL EU, 2019)) which apparently does not exlude the use of sewage sludge as feedstock.

Alternatively, the company could seek to improve the performance of the substrate indicator – getting even higher revenues from the feed. However, this may be offset by accepting lower quality sludges and hampering the fertilising product quality. This would not have financial implications but could have a negative impact on soil and crop quality.

3.1.2 AM-Power BVBA

A thermophilic AD plant in Pittem (40 km west of Ghent), West-Flanders, Belgium, in operation since 2011 with a total annual substrate processing capacity of 180,000 t. Processing biowaste and manure.

Table 3.1.2.1 AM-Power Plant characteristics

Date of commissioning	2016
Annual substrate processing capacity / processed	180,000 t / 171,000 t (150 kt biowaste/21 kt manure)
IEC	7.5 MW
Installed biomethane capacity	None
Digester volume	20,000 m³
Digester type	Thermophilic CSTR
Annual biogas output / biogas per t of feedstock	30 Mm³ / 170 m³/t
Annual electricity net-output (fed to the grid)	34,645 MWh (39,407 MWh_{eltot} + 64,694 MWh_{heat})
Annual bio-methane output	None
Nutrient recovery & recycling (NRR) facilities	Solid/liquid separation by centrifuge; dryer for solid fraction; evaporator and reverse osmosis for liquid fraction
NRR Products	Hygienised, dry, P-rich digestate Hygienised, NK concentrate from liquid fraction Dischargeable (possibly reusable) water
Framework conditions relevant to the business case	High livestock density in the region Products need to be transported to other regions or treated

The KPIs are derived from the plant characteristics shown in table 3.1.2.1 above and the P&L summary shown in table 3.1.2.2 below.

Table 3.1.2.2 AM-Power P&L summary in EUR

AM-Power	Revenues	Expenses	Balance
Substrates (biowaste, manure, energy crops)	446,103	2,192,531	-1,746,428
Energy and Green Certificates	7,163,986		7,163,986
Product sales / savings			0
Consumables (chemicals, spare parts)		400,285	-400,285
Digestate & NRR product handling (storage, application)		1,238,984	-1,238,984
Operations (personnel, overhead, maintenance, repair)		1,885,000	-1,885,000
Amortisation (12 years)		1,691,797	-1,691,797
	7,610,089	7,408,597	201,492
EBITA		**1,893,289**	**EBITA Margin 25%**
EBIT		**201,492**	**EBIT Margin 3%**

The KPIs of AM-Power show critically low EBITA and EBIT margins, even after implementation of the new NRR system. The KPI for substrate related revenues shows that the performance is below median, the high substrate costs reflected in this KPI are not offset by a high energy related productivity which is also below median. If the feedstock related revenues are low or negative as in the case of AM-Power, the energy related productivity should be high to compensate for the overall business result. Like in all SYSTEMIC business cases, the negative digestate/product related KPI indicates room for improvement.

Table 3.1.2.3 AM-Power KPIs

KPI #	Type / Description	Unit	Reference value	KPI Result	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	1,893,289 €	25%	41%	Much below median EBITA margin
2	EBIT margin	€ EBIT / € revenues in %	201,492 €	3%	12%	Much below median EBIT margin
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	171,000 t	44.50 €	53.38 €	Medium low financial substrate productivity
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	171,000 t	-7.25 €	-5.35 €	Medium low negative digestate related results
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	30,000,000m³	0.24 €	0.33 €	Below median energy related results

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

The suggested strategy for AM-Power is reviewing the substrate purchasing contracts and trying to improve the feedstock related KPI. Reducing the cost of feedstock would have an impact on the KPIs financial substrate productivity, EBIT and EBITA and make the business case much more resilient. In addition, it may have an immediate effect. The improvement of the digestate/product related KPI is another area for improvement but is supposed to take longer until the business case will become more robust.

3.1.3 BENAS GmbH

A thermophilic AD plant in Ottersberg (40 km east of Bremen), Lower Saxony, Germany, in operation since 2006 with a total annual substrate processing capacity of 174,000 t. Processing corn silage, plant residues and poultry litter.

Table 3.1.3.1 BENAS Plant characteristics

Date of commissioning	2006
Annual substrate processing capacity / processed	174,000 t / 102,000 t (82 kt corn & plant residues / 20 kt poultry litter)
IEC	11.3 MW
Installed biomethane capacity	1,200 m³/h
Digester volume	26,000 m³
Annual biogas output / biogas per t of feedstock	20 Mm³ / 194 m³/t
Annual electricity net-output (fed to the grid)	26,972 MWh (23,610 MWh_{eltot} + 25,580 Mwh_{heat})
Annual bio-methane output	8.78 Mm³ (1,200 m³/h)
Digester type	Thermophilic CSTR
Nutrient recovery & recycling (NRR) facilities	FiberPlus ammonium stripping system Screw press for solid/liquid separation Rotary drum dryer for digestate
NRR Products	Hygienised dewatered / dry digestate Ammonium sulphate (3,700 t/a) Calcium carbonate (1,000 t/a) Hygienised, dry digestate / fibres
Framework conditions relevant to the business case	Biogas storage capacity 39,000 m³ Owners cultivate 3,500 ha agricultural land, 2,000 ha about 200 km distant from biogas plant Double IEC for full flexibility Desulphurisation gypsum used for ammonium sulphate production FibrePlus system for future production of fibres

The KPIs are derived from the plant characteristics shown in table 3.1.3.1 above and the P&L summary shown in table 3.1.3.2 below.

Table 3.1.3.2 BENAS P&L summary in EUR

BENAS	**Revenues**	**Expenses**	**Balance**
Substrates (biowaste, manure, energy crops)		3,016,626	-3,016,626
Energy and Green Certificates	7,920,373	398,400	7,521,973
Product sales / savings	277,160		277,160
Consumables (chemicals, spare parts)		17,604	-17,604
Digestate & NRR product handling (storage, application)		374,430	-374,430
Operations (personnel, overhead, maintenance, repair)		1,450,000	-1,450,000
Amortisation (12 years)		1,850,000	-1,850,000
	8,197,533	7,107,060	1,090,473
EBITA		**2,940,473**	**EBITA Margin 36%**
EBIT		**1,090,473**	**EBIT Margin 13%**

BENAS gives a good example for how a very low substrate related performance is totally off-set by a very high energy productivity leading to the highest financial substrate productivity in the SYSTEMIC group. BENAS' KPIs are all above median except the EBITA and EBIT. However, this may be due to

relatively high costs of consumables and personnel. Since the business case is profitable and highly resilient due to the flexibility in terms energy conversion and use of products (KPI also much above median), mainly gradual improvements along the same strategy line are suggested.

Table 3.1.3.3 BENAS KPIs

KPI #	Type / Description	Unit	Reference value	KPI Result	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	2,940,473 €	36%	41%	Below median EBITA
2	EBIT margin	€ EBIT / € revenues in %	1,090,473 €	13%	12%	Slightly above median EBIT
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	102,000 t	80.37 €	53.38 €	Very high financial substrate productivity
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	102,000 t	-0.95 €	-5.35 €	Slightly negative digestate related results – the best among the operational AD plants
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	20,000,000 m³	0.38 €	0.33 €	Above median biogas productivity

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

The suggested strategy for BENAS is to continue with gradual improvements, for instance in trying to reduce the feedstock cost which may be a consequence of replacing energy crops by waste materials. However, attention must be paid on keeping the high energy related performance and the very high substrate financial productivity.

As to the product strategy, continued efforts to productise the fibrous fraction of digestate that would not even impact the use as fertilising product – fibres will be nutrient free – should be a very promising pathway, in particular if the use of fibres in bio-degradable pots materialises.

3.1.4 Groot Zevert Vergisting B.V.

A mesophilic AD plant in Beltrum (35 km southwest of Enschede), Achterhoek Region, Province Gelderland, The Netherlands, in operation since 2004 with a total annual substrate treatment capacity of 135,000 t. Processing manure and biowaste.

Table 3.1.4.1 Groot Zevert Vergisting Plant characteristics

Date of commissioning	2004
Annual substrate processing capacity / processed	135,000 t / 120,000 t (90 kt manure / 30 kt biowaste)
IEC	6.5 MW
Installed biomethane capacity	None, biogas is directly sold to FrieslandCampina
Digester volume	15,000 m³
Annual biogas output / biogas per t of feedstock	10 Mm³ / 75 m³/t
Annual electricity net-output (fed to the grid)	3,200 MWh (5,000 MWh_{eltot})
Annual biogas supplies (to FrieslandCampina)	6.5 Mm³
Digester type	Mesophilic CSTR
Nutrient recovery & recycling (NRR) facilities	GENIAAL – flotation, microfiltration, reverse osmosis RePeat – acidification and struvite reactors
NRR Products	Mineral NK concentrate Struvite, P-depleted organic product
Framework conditions relevant to the business case	High livestock density in the region Products need to be transported to other regions or treated

The KPIs are derived from the plant characteristics shown in table 3.1.4.1 above and the P&L summary shown in table 3.1.4.2 below.

Table 3.1.4.2 Groot Zevert P&L summary in EUR

Groot Zevert Vergisting (GZV)	Revenues	Expenses	Balance
Substrates (biowaste, manure, energy crops)	780,000		780,000
Energy and Green Certificates	3,348,000	108,000	3,240,000
Product sales / savings	14,400		14,400
Consumables (chemicals, spare parts)		992,000	-992,000
Digestate & NRR product handling (storage, application)		449,800	-449,800
Operations (personnel, overhead, maintenance, repair)		546,000	-546,000
Amortisation (12 years biogas plant / 5 years NRR)		1,560,000	-1,560,000
	4,142,400	3,655,800	486,600
EBITA		**2,046,600**	**EBITA Margin 49%**
EBIT		**486,600**	**EBIT Margin 12%**

The EBITA margin KPI of Groot Zevert is above median and proves that the decision to invest in the NRR system was correct. The EBIT margin is comparatively not as good, mainly due to Groot Zevert's decision to amortise the new equipment in a very short time – no reason for concern.

The slightly below median performance of the energy related revenues and the overall financial substrate productivity may be interpreted as an indicator for the low specific biogas output of manure that is only partly compensated by the dairy waste products. In turn, the feedstock related KPI is positive and partly offsets the low specific energy productivity.

The very high biogas related KPI is an indicator for a very good energy carrier sales mix, the agreement with FrieslandCampina proves its value. In addition, the new NRR system is reflected in above median results related to the digestate KPI.

Table 3.1.4.3 Groot Zevert KPIs

KPI #	Type / Description	Unit	Reference value	KPI Result	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	2,046,600 €	49%	41%	Much above median EBITA margin
2	EBIT margin	€ EBIT / € revenues in %	486,600 €	12%	12%	Median EBIT margin
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	120,000 t	34.52 €	53.38 €	Low financial substrate productivity
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	120,000 t	-3.63 €	-5.35 €	Negative digestate related results – limited benefits from use as fertiliser
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	10,000,000 m³	0.32 €	0.33 €	Close to median biogas productivity

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

The preferred strategic option for Groot Zevert should focus on productising and marketing the recycled products produced from digestate. The idea of producing potting soils as outlined in the business case analysis should be pursued during the remaining project period. With potting soils marketed at market value to the gardening sector, the business case could become outstanding and a role model for anaerobic digesters processing manure due to overcoming the inherent low energy productivity of this substrate.

3.1.5 Waterleau New Energy BV

Waterleau BV, a mesophilic AD plant in Ypres (80 km west of Ghent), West-Flanders, Belgium, in operation since 2012 with a total annual substrate treatment capacity of 120,000 t. Processing manure and biowaste.

Table 3.1.5.1 Waterleau plant characteristics

Date of commissioning	2012
Annual substrate processing capacity / processed	120,000 t / 66,000 t (25 kt manure / 41 kt biowaste)
IEC	3.2 MW
Installed biomethane capacity	None
Digester volume	12,000 m³
Annual biogas output / biogas per t of feedstock	10 Mm³ / 155 m³/t
Annual electricity net-output (fed to the grid)	3,200 MWh (5,000 MWh_{eltot})
Annual biomethane output	none
Digester type	Mesophilic CSTR
Nutrient recovery & recycling (NRR) facilities	Hygienisation (70°C, 1 hour), solid/liquid separation, drying of the solid fraction; aerobic liquid phase treatment, evaporator
NRR Products	Dry solid fraction for export to France K-rich liquid concentrate; ammonium water for gas treatment
Framework conditions relevant to the business case	High livestock density in the region Products need to be transported to other regions or treated

The KPIs are derived from the plant characteristics shown in table 3.1.5.1 above and the P&L summary shown in table 3.1.5.2 below.

Table 3.1.5.2 Waterleau P&L summary in EUR

Waterleau New Energy	Revenues	Expenses	Balance
Substrates (biowaste, manure, energy crops)	719,000	760,000	-41,000
Energy and Green Certificates	3,377,000	48,000	3,329,000
Product sales / savings	12,000		12,000
Consumables (chemicals, spare parts)		334,000	-334,000
Digestate & NRR product handling (storage, application)		478,000	-478,000
Operations (personnel, overhead, maintenance, repair)		1,709,000	-1.709,000
Amortisation		470,000	-470,000
	4,108,000	3,799,000	309,000
EBITA		779,000	**EBITA Margin 19%**
EBIT		309,000	**EBIT Margin 8%**

Waterleau's EBITA and EBIT margins are the lowest among SYSTEMIC partner plants whereas KPIs for substrate financial productivity are significantly above median, biogas financial productivity corresponds to the mean value of the group and only digestate financial productivity is below median but still in the range of other plants not having own land for direct use und being in a nitrate vulnerable zone with high livestock density.

The profit and loss statement shows that more than half of the annual turnover is spent on operational expenses (personnel, overhead, maintenance and repair) excluding consumables, significantly more than plants with comparable sales in comparable regions in Flanders and the Netherlands. The question is, to

which extent these expenses are due to the technical NRR installations and how the relationship between operational expenses and digestate financial productivity can be improved.

Before a more thorough analysis can provide deeper insights into the Waterleau business case – to be further explored in the updated business case analysis following soon – KPIs already show that revenues related to the material and energy flows cannot fully explain the low overall financial returns of the AD plant.

Table 3.1.5.3 Waterleau KPIs

KPI #	Type / Description	Unit	Reference value	KPI Result	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	783,000 €	19%	41%	Below median EBITA margin
2	EBIT margin	€ EBIT / € revenues in %	309.000 €	8%	12%	Below median EBIT margin
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	66,000 t	62.25 €	53.38 €	High, above median substrate financial productivity
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	66,000 t	-7.06 €	-5.35 €	Low, negative digestate related digestate productivity despite some products sold for low market prices
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	10,000,000 m³	0.33 €	0.33 €	Median biogas related financial productivity

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

The KPI related recommendation to Waterleau is to further analyse the relationship between operational expenses and the digestate productivity. Regarding external, NRR related factors the cost of disposing of the K-rich liquid fraction reflected in the low KPI value for the digestate financial productivity needs more scrutiny. It is recommended to check, if for instance vacuum evaporation using low temperature saturated steam could improve the cost/benefit relation without too much of additional effort.

3.2 Outreach Plants

3.2.1 Fridays Ltd.

A mesophilic AD at Knoxbridge Farm, Frittenden, Cranbrook, Kent, United Kingdom, currently under construction with a total annual substrate treatment capacity of 60,000 t. Planned to process poultry litter and straw.

Table 3.2.1.1 Rika Biofuels / Green Create W2V Plant characteristics

Date of commissioning	2019
Annual substrate processing capacity / to process	60,000 t / 57,500 t (55 kt poultry litter / 2,5 kt straw)
IEC	1.8 MW
Installed biomethane capacity	450 m³
Digester volume	16,000 m³
Annual biogas output / biogas per t of feedstock	7.2 Mm³ / 125 m³/t
Annual electricity net-output (fed to the grid)	3,750 MWh (4,125 MWh_{heat})
Annual bio-methane output	2.8 Mm³
Digester type	Mesophilic mixed plug-flow digester (system DVO)
Nutrient recovery & recycling (NRR) facilities	N-stripper and reactor Modified dissolved air flotation (DAF) Screw press for solid/liquid separation
NRR Products	Ammonium sulphate Hygienised P-rich digestate
Framework conditions relevant to the business case	Moderate livestock density in the region Products can be used in the region Plug-flow digester

The KPIs are derived from the plant characteristics shown in table 3.2.1.1 above and the P&L summary is based on Friday's business plan calculation. Eventually Friday's main investor Green Create W2V refused publishing the details of its business plan. Consequently, the values are considered in the calculations of median indicators but are not published.

The Green Create W2V business case is outstanding in terms of EBIT margin, EBITA margin and overall financial substrate productivity which is remarkable due to its characteristic as a new and fully waste based business venture.

All KPIs except the digestate/product related performance are above median. However, the analysis is based on the business plan and the results need to be proven by the actual business results in 2021, when the plant will be operating at its design capacity.

Apart from focusing on implementing the digester and proving the already outstanding business plan, the strategic options could focus on productising and marketing the digestate based products – the idea of producing potting soils following the model of Magic Dirt potting soils seems to be promising.

3.2.2 A-Farmers / Nurmon Bioenergia Ltd.

A mesophilic AD in Seinäjoki (80 km southeast of Vaasa), South Ostrobothnia, Finland currently under construction with a total annual substrate treatment capacity of 240,000 t. Planned to process manure, industry by-products and plant biomass.

Table 3.2.2.1 A-Farmers / Nurmon Bioenergia Plant characteristics

Date of commissioning	2021
Annual substrate processing capacity / to process	240,000 t / 210,000 t (90 kt manure, 100 kt industry by products and 20 kt plant biomass)
IEC	None
Installed biomethane capacity	~20 t of bio-LNG/d
Digester volume	~20,000 m³
Annual biogas output / biogas per t of feedstock	15 Mm³ / 70 m³/t
Annual electricity net-output (fed to the grid)	None
Annual bio-methane output	9 Mm³ (90,000 MWh) bio-LNG
Digester type	Mesophilic CSTR
Nutrient recovery & recycling (NRR) facilities	Centrifuges for solid/liquid separation, N-stripper and evaporator
NRR Products	Separated solid fraction of digestate, NPK- (or PK-concentrate and ammonium sulphate)
Framework conditions relevant to the business case	Moderate livestock density in the region All feedstock converted to bio-LNG as a transport fuel

The KPIs are derived from the plant characteristics shown in table 3.2.2.1 above and the business plan based P&L summary shown in table 3.2.1.2 below.

Table 3.2.1.2 Nurmon Bioenergia P&L summary (2022, full operation) in EUR

A-Farmers / Nurmon Bioenergia	Revenues	Expenses	Balance
Substrates (biowaste, manure, energy crops)	1,010,000	652,400	357,600
Energy and Green Certificates	8,100,000	1,372,080	6,727,920
Product sales / savings			0
Consumables (chemicals, spare parts)		1,035,326	-1,035,326
Digestate & NRR product handling (storage, application)			0
Operations (personnel, overhead, maintenance, repair)		1,575,000	-1,575,000
Amortisation (10 years)		3,450,000	-3,450,000
	9,110,000	8,084,806	1,025,194
EBITA		**4,475,194**	**EBITA Margin 49%**
EBIT		**1,025,194**	**EBIT Margin 11%**

The Nurmon Bioenergia business case is characterised by a very high EBITA margin and a medium low EBIT margin, the latter due to the very short amortisation period selected by the investors – no reason for concern. The business case is another example of a new, fully waste based business venture and it shows that conversion of agricultural and industrial waste flows to biogas/biomethane can be a very profitable business.

The high share of manure in the feedstock mix hampers the overall financial substrate productivity and the energy related performance of the substrate which is unavoidable. However, the feedstock

contributes to the cash flow, even if the performance is below median and may have room for improvement.

The biogas related revenues are very high and prove that producing bio-LNG is a good choice.

Table 3.2.2.3 Nurmon Bioenergia KPIs

KPI #	Type / Description	Unit	Reference value	KPI Result	Median values*)	Comment
1	EBITA margin	€ EBITA / € revenues in %	4,475,194 €	49%	41%	Much above median EBITA margin
2	EBIT margin	€ EBIT / € revenues in %	1,025,194 €	11%	12%	Slightly below median EBIT margin
3	Substrate financial productivity EUR total revenues / tonnes feedstock	€ / t	210,000 t	43.38 €	53.38 €	Medium low financial substrate productivity
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	€ / t	210,000 t	0.00 €	-5.35 €	Neutral effluent related results – benefits from use as fertiliser
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	€ / m³	15,000,000 m³	0.45 €	0.33 €	Very high biogas productivity

*) Median values refer to seven SYSTEMIC partner anaerobic digestion plants

Like the business case of Green Create, Nurmon Bioenergia's results need to be confirmed in 2022 when the plant will operate at its design capacity. Consequently, the short-term goal will be on building and commissioning the plant and achieving the planned results that are very promising. The good news is that Nurmon Bioenergia (similar to Fridays) invest and operate under support schemes that have been adapted to be financially sustainable.

Like all plants, Nurmon Bioenergia could improve the digestate/product related KPI by productising and marketing some of the products produced by the NRR system.

4 KPI analysis and comparison of AD plants

The selected KPIs prove to be relevant indicators for measuring the financial productivity of the SYSTEMIC business cases. The comparison aims at serving owners and operators to identify the areas where their plants perform below or above median and where particular attention may be needed.

Table 4.1.1 below shows the comparative performance of SYSTEMIC business cases with EBITA margins from 19% to 49% and EBIT margins from -4% to 16%. Some EBIT margins are comparatively low due to owners/investors having chosen very short amortisation periods, but this just means higher profits in later operating periods. The outreach cases have yet to confirm that the forecast values will be achieved when operating at full scale in 2021 or 2022. Most business cases demonstrate solid margins – many large industry businesses would be happy if they achieved EBIT margins above 10%.

The substrate related financial productivity is comparatively high for all plants with values ranging from 34.52 to 80.37 € per tonne of substrate processed. For this KPI the best value is achieved by a plant in operation, processing a mix of energy crops and some organic waste including poultry litter. Its trade-off are high costs for the feedstock, the highest in the group not reflected in the KPIs. The table also shows that digestate handling has a cost in all but the two outreach cases (Acqua e Sole not published), albeit with a value close to zero for one operating plant. In this case, the low cost is achieved by saving and accounting for mineral fertilisers on own or leased cropland.

Table 4.1.1 KPIs for each SYSTEMIC partner and median KPI values

Co	Name	Median values	Acqua e Sole	AM-Power	BENAS	Groot Zevert	Waterleau	Nurmon Bioenergia
1	EBITA margin	41%	41%	25%	36%	49%	19%	49%
2	EBIT margin	12%	16%	3%	13%	12%	8%	11%
3	Substrate financial productivity	53.38 €	67.26 €	44.50 €	80.37 €	34.52 €	62.25 €	43.38 €
4	Digestate financial productivity	-5.35 €	-9.03 €	-7.25 €	-0.95 €	-3.63 €	-7.06 €	0.00 €
5	Biogas financial productivity	0.33 €	0.08 €	0.24 €	0.38 €	0.32 €	0.33 €	0.45 €

Reviewing the KPIs, the conclusions of the business case analysis reported in Deliverable 2.2, can be confirmed. Most SYSTEMIC anaerobic digestion plants produce presentable financial results but the KPI related to digestate disposal and use of recycled products has much room for improvement. The related recommendations are laid out below the individual KPI analyses in the corresponding chapters of the report.

4.1 Comparison of Results with and without Nutrient Recovery and Recycling (NRR)

Comparing the KPIs of the two business cases that have operated the plant without NRR until 2017 and only installed effective NRR systems during the SYSTEMIC project it can clearly be seen – besides the positive effect of the newly installed systems - the benefit of KPIs. While some KPIs remain unchanged, KPIs for EBITA, EBIT, substrate related and particularly the digestate related financial productivity (due to reduced digestate handling costs) improve substantially after implementation of the NRR systems. From the high negative digestate related indicators operators could realise that this activity was causing the problem.

Consequently, both partners have taken the right decision to tackle the high effluent handling and disposal costs by installing a new and effective NRR system. Both systems have been successfully commissioned and are now on their way to achieve the design performance.

Table 4.1.2 KPIs for SYSTEMIC partners AM-Power and Groot Zevert, with and without NRR

KPI #	Name	AM-Power	AM-Power without NRR	Groot Zevert	Groot Zevert without NRR
1	EBITA margin	25 %	-2% €	49%	25%
2	EBIT margin	3 %	-23% €	12%	3%
3	Substrate financial productivity EUR total revenues / tonnes feedstock	44.50 €	41.89 €	34.52 €	34.40 €
4	Digestate financial productivity EUR digestate handling / tonnes feedstock	-7.25 €	-17.04 €	-3.63 €	-19.80 €
5	Biogas financial productivity EUR energy supplies / cubic meters biogas	0.24 €	0.24 €	0.32 €	0.32 €

Particularly AM-Power, one of two financially critical SYSTEMIC business cases, exhibits a turnaround from a negative overall business result to a modest positive one. Whereas the KPIs for substrate related financial productivity and for the energy related financial productivity remain largely unchanged, EBITA and EBIT margins significantly improve. Both cases show a substantial improvement for the digestate related metrics.

5 KPI Development Conclusions

After an intensive screening of options for meaningful key performance indicators the decision was made to derive them from the main material flows of the anaerobic digestion business: feedstock for processing, energy converted from the feedstock and digestate or recovered materials produced. Whereas the function of EBITA and EBIT margins as KPIs is evident, other indicators, if intended to be practicable and meaningful, needed analyses of business cases and testing if their application produces additional insight in the strengths and weaknesses of the different AD businesses.

In contrast to the usual function of KPIs, measuring the achievement of targets, the development of KPIs that work for the identification of strategic options, objectives and simultaneously for controlling the achievements was required. In addition, and again in contrast to the usual approach, the task in SYSTEMIC is not only demonstrating profitable business cases but developing role models for anaerobic digestion businesses. Hence, typical KPIs such as the productivity of consumables and the productivity of employees are not helpful. These are valid indicators but certainly not key for the purpose of developing new business models and particularly not for developing products that are in demand in selected niche markets or in growing non-agricultural markets like gardening.

Applying the finally selected KPIs to the seven SYSTEMIC business cases has demonstrated that they are meaningful tools to measure the financial performance of the different activity sectors (cost centres) of digestion plants participating in SYSTEMIC. The five KPIs clearly highlight the well performing activity areas and the critical ones likewise.

Testing the KPIs has shown that their function is coherent with the non-KPI-based business case analysis performed in 2019. In addition, selected KPIs provide metrics for the performance difference between normal digestate handling and advanced NRR systems and point at the financially underdeveloped areas of the business. Some of the performance deficits are explainable and cannot be removed, for instance the low energy productivity of manure. Others may be tackled by corresponding strategies, like replacing power as an energy carrier when biomethane promises a higher financial productivity and a more modest need for support schemes.

However, deliberately limiting this work package to KPIs referring to material and energy flows, the full picture of certain weaknesses is not given. Nonetheless these weaknesses can be indirectly derived from the selected KPIs: if an AD business shows reasonably good metrics for the three material and energy flow related KPIs but low or even negative overall financial results, operators should look for potential weaknesses internally. Too short pay-back periods, too high maintenance, personnel, or overhead costs could prevent the business from producing better returns.

An important feature of this report is the calculation of five median KPIs for the seven participating plants. The mean value can be used as a benchmark for large AD plants and stakeholders far beyond the SYSTEMIC project can calculate their own KPIs and compare them to the mean values given in this report.

The good news is that operating an AD plant in regions of high livestock density with very limited use of digestate based fertilisers in the region or even country where the business is located does not mean that quite satisfying financial results cannot be achieved with an appropriate substrate mix, nutrient recovery and recycling and an effective support scheme.

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SYSTEMIC
Circular solutions for biowaste

Systemic large-scale eco-innovation to advance circular economy and mineral recovery from organic waste in Europe

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