22D022

01 April 2022

The Hon Dr Susan Close MP
Deputy Premier
Minister for Climate, Environment and Water
Per email: ptadelaide@parliament.sa.gov.au

Dear Deputy Premier,

Re: Briefing – SADA – Environment and Climate Action

Congratulations upon your re-election and your return to the Ministry in South Australia.

This letter is one of two letters. I am writing to you in your capacity as the Minister for Climate, Environment and Water with the intent of informing you of the work that is being done by the South Australian Dairyfarmers' Association (SADA) in the roll out of our policy to be carbon neutral by 2030 as an industry in South Australia in addition to the industry's position relating to water.

A second letter will be addressed to you attending to your role as the Minister for Industry Innovation and Science to inform you of the work that is being done by the South Australian Dairyfarmers' Association (SADA) in the development of blockchain related technology for the governance of supply chains in the dairy sector.

SADA is the representative voice of dairy farmers in South Australia. We have a proud tradition of representing farmers which, began in 1936, and we continue to remain focussed on outcomes for dairy farmers today with a clear eye into the future.

While we appreciate that you will be very busy in the near future, we nevertheless would appreciate an opportunity to meet with you to discuss some of the work that we are doing as an organisation to advance the dairy industry in South Australia.

We would specifically seek to brief you on elements of the dairy industry that correspond to your portfolio areas, namely:

- The SADA block chain traceability project (covered in a separate letter) and
- SADA's commitment to net zero emissions by 2030, (covered in this letter); and
- The water challenges that face the industry in South Australia today and into the future (also covered in this letter).

South Australian Dairyfarmers' Association Inc
U5 780 – 802 South Road, Glandore SA 5037
Ph: 8293 2399 Fax: 8293 8886 Email: sada@sada.asn.au
ABN: 70 250 523 225

Water

Water is generally prescribed in South Australia and is administered through the nine Landscape Boards which have been established. The Landscape Boards cover the state however, SADA's interest originates from four of the board's areas of influence, namely, The Hills and Fleurieu, the Limestone Coast, Northern and Yorke and Murraylands and Riverland regions.

Each board is responsible for the development and review of a Water Allocation Plan (WAP) for their prospective area ensuring they step through the correct stages:

1. A risk assessment is undertaken to identify risks to the water resource and water users, including the environment.
2. The community is given opportunities to provide input into the content of the water allocation plan, based on the risks it is aiming to manage.
3. Based on the decisions made about the risks to the water resource, the environment and water users, a draft water allocation plan is prepared.
4. A consultation process is undertaken to seek community input and views about the draft water allocation plan.
5. The regional landscape board takes the community feedback into account when making decisions on any changes to the draft before submitting a final water allocation plan to the Minister for Environment and Water for adoption.
6. The adopted water allocation plan is reviewed within 10 years to ensure it is still effectively managing the risks to the water resource, the environment and the community.

Each of the areas are going through or due to be going through their 10 year review process in the near future.

The Hills and Fleurieu

Within the boundaries of this Landscape Board, there are two water allocation plans (WAPs) which are of particular interest to SADA, namely, the Eastern Mount Lofty Ranges WAP and the Western Mount Lofty Ranges WAP.

The Eastern Mount Lofty Ranges WAP was commenced in September 2013 and amended in February 2018. The Eastern Mount Lofty Ranges also fall within the orbit of the Murray Darling Basin Plan as it is within the catchment of the River Murray.

The Western Mount Lofty Ranges WAP was commenced in September 2013 and amended in February 2019.

As part of the upcoming review process, the demands for water should be better known than at the time of the plans' original declarations. Presently, SADA is not concerned regarding water allocation amounts for its members within borders of the two WAPs.

The increasing demands that the government is placing upon water users with requiring farmers to read their own bore meters and test for salinity has raised the question as to what the farmers are gaining from the levies which are paid as part of the Landscape process. Farmers are also expected to meet the costs of installation and maintenance of authorised meters. The fact that the meters

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which are approved by government are not necessarily fit for purpose (i.e. they often are unreadable because of the build-up of condensation inside the meter) is also of concern.

While convenient from a department's point of view, from a primary production point of view the demands of government are becoming intrusive.

Turning to the Eastern Mount Lofty Ranges WAP in particular, the science was well established at the time for the original plans. However, SADA is aware that there is a mindfulness among modelers in some quarters who are concerned that the 2008 models which were originally used for the WAP may potentially have become, because of changes in rainfall patterns, less certain. Consistent with SADA's approach in the rest of this document SADA urges planning which provides commercial certainty built on precise science that supports realistic modelling.

Limestone Coast

The Limestone Coast Landscape Board manages 5 WAPS for their district. These are:

- Padthaway
- Tatiara
- Tintinara-Coonalpyn
- Lower Limestone Coast
- Morambro Creek.

Upon coming to power the previous Government commissioned the "*Independent review of science underpinning reductions to licensed water allocation volumes in the Lower Limestone Coast water allocation plan*", conducted by the Goyder Institute for Water Research (Tech report Series No 19/01), (The Goyder Review).

This report produced mixed findings over the six management areas it reviewed. In its conclusions it identified that there had been widespread water declines and recoveries in the observation bores in the respective areas. In some instances, the recovery had been substantial and in other areas less so. Further the Goyder Review also observed that in some instances there had been a measurable increase in salinity in a number of the observation bores.

Notably the Goyder Review's most consistent finding was that while a substantial amount of science had been done it was still too general and insufficiently granular. Furthermore, the six review areas did not account for the whole of the Limestone Coast area.

While SADA is mindful of the proper management of Groundwater Dependent Ecosystems (GDEs), SADA is concerned that there are some efforts being made by the local officers of the Department or Landscape Board to influence a conservative approach to water allocation moving forward ahead of the required science.

It is clear that the Goyder Review, while comprehensive, cannot amount to a document upon which the water allocations moving into the future should be truncated in any way. There is no doubt that there are concerns for GDEs however, the purpose of the water policy of the South Australian Government is to balance environmental, social and economic outcomes. Relying on thin science to justify greater retardation of water allocations for environmental preservation is, in the opinion of SADA, too onerous to be justifiable, considering the balance.

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The Government should adopt the clear recommendation of the Goyder Review and improve the quality of the information upon which better and more specific planning can occur.

Northern and Yorke

The Northern and Yorke Landscape Board manage three WAPs, namely, Clare Valley, Baroota and Barossa as well as sharing a WAP with the Adelaide Plains.

There are only a small number of dairy farms in the area, the Northern most being located just north of Balaklava.

SADA does not raise any issues of fundamental importance to dairy farmers who are working within the boundaries of the Northern and Yorke Landscape area.

Murraylands and Riverland

As with the Hills and Fleurieu Landscape Board plans, the Murraylands and Riverland board are impacted by the Murray Darling Basin Plan and are subject to the Commonwealth's Water Act.

It governs five WAPs:

- Eastern Mount Lofty (shared with Hills and Fleurieu)
- Mallee
- Marne Saunders
- Peake Roby and Sherlock, and
- Murray River

The position of SADA is that the Murray Darling Basin Plan should be maintained without alteration.

As with the other states within the Plan area SA has been provided with an allocation. In total, South Australia has an annual entitlement of 1,850 gigalitres (GL) under the Murray–Darling Basin Agreement. South Australia does not automatically receive 1,850 GL every year. While access to the full 1,850 GL is available at the start of most water years, it may be reduced when conditions are dry and water availability is limited. In these years, South Australia receives a third share of the available River Murray resources.

Coupled with the conservative settings of water allocations in South Australia, (settings which have enabled SA to return more than required to the environment), farmers have been able to enjoy 100% allocations, even during the recent and pronounced drought.

Nevertheless, the recent drought in Australia saw a number of political assaults on the Plan including the errant notion of the introduction of a "lock zero" at Wellington and arguments for the removal of the barrages. These attacks were misguided and ill-informed but nevertheless resonated with desperate people up stream.

SADA's position is that the Plan must be protected and remain undiluted by pressures from upstream states.

Carbon Neutrality by 2030

SADA has committed itself to creating a carbon neutral dairy industry by 2030. To that end SADA has already committed substantial funds to various areas of research including support for Bio Char research, dung beetle research and research work on methane production in particular.

A focus on Methane

Dairy farms produce greenhouse gasses, the majority of which is methane through the production of enteric methane, (cow burps) and effluent generated methane, from effluent settlement ponds. (Contrary to public perceptions bovine flatulence is not a substantial contributor to methane production).

Methane is of particular interest to SADA as it has an equivalency of 84 kgs of Carbon having the GHG equivalency of 1 kg of Methane.

Much research has been done into enteric methane, and the study of food additives made from seaweed have attracted substantial attention. There are now two sites in SA that are developing this technology and SADA is maintaining a keen interest in that work.

However, SADA has also turned its attention to effluent methane in particular.

Increasing demand for animal products is a consequence of the world's increased capacity to afford animal products such as meat and milk. Dairy cattle are of great importance since milk is an excellent source of protein, high-quality fat, minerals, and vitamins.

To supply the increasing food demand, it is necessary to improve the production efficiency associated with reducing unfavourable effects on the environment, such as greenhouse gas (GHG) emissions.

As stated, SADA has committed itself to a net zero position by the year 2030. SADA has already spent money on researching dung beetles as a vehicle to sequester carbon as well as funding feasibility research into generating electricity from manure.

Useful tools for farms managing measuring baselines already exists and SADA is advising all dairy farmers in South Australia to use those tools to enable them to determine their current on farm emissions.

The major source of greenhouse gas emissions on dairy farms is enteric methane (CH_4) produced by methanogen bacteria in rumen (~55% of emissions). This methane is burped out by cows as part of the rumination process. Methane and nitrous oxide (N_2O) from animal manure are the second largest source of emissions from dairy farms.

Carbon dioxide (CO_2) is emitted from farm diesel consumption and coal-fired power stations used to generate electricity used on dairy farms. There are also emissions associated with production of grain, fodder and fertiliser bought onto the farm (pre-farm embedded emissions).

As methane is a far more assertive emission than carbon (a ratio of 84:1 over a twenty-year period), SADA has chosen to look closely at those emissions as an opportunity to use that methane as a fuel.

The rumen microbiome comprises bacteria, ciliary protozoa, anaerobic fungi and archaea, which are the essential micro-organisms in methane production from by-products and because of the digestion of the other micro-organisms.

As indicated decomposition of herd effluent is also a substantial source of methane production, particularly where that effluent is collected in high concentrations such as primary settling ponds on Total Mixed Rations (TMR) systems or hardstands near dairies where cows accumulate.

Therefore, implementing strategies to reduce emissions in dairy cattle will benefit the environment and the economy. Although most of the variation in methane production is due to non-genetic factors (such as feed and handling), the animal genetics can be notably used to reduce methane production in cattle due to its influences on the ruminal microbiome composition.

Notably:

- Currently in South Australia some growers are selecting breeds with the express intention of limiting methane production.
- Also, the work with seaweeds to eliminate methane from cow burps is advancing with two projects currently under development in South Australia.

However, neither of these approaches offer a solution for methane that is generated from effluent.

SADA has already conducted two preliminary investigations of a farm in South Australia for its suitability for an effluent methane/power generation system.

The Australian dairy sector has been subject to significant changes with automation, milk processing, storage as well as hygiene management.

However, the waste management aspects of dairy operations have not been investigated in SA sufficiently well and therein lie opportunities.

Environmental impact of dairy operations with respect to greenhouse gas emissions and nutrient management are generally high. One of the options to reduce environmental impact is to implement an Anaerobic Digestion (AD) solution to treat waste streams.

Two reports:

- a prefeasibility study on utilisation of dairy waste to generate bioenergy, and
- a feasibility study into the development of a onsite power generation plant,

have been prepared for SADA by Enpro Envirotech Pty Ltd for and a trial farm site near Murray Bridge has been identified. Further details of the work conduct by Enpro Envirotech Pty Ltd are contained in the **Appendix** to this letter below.

These reports covered a grab sample collection and analysis for cow manure from the cow shed floor and its biomethane potential. It was also important to equally assess current treatment processes for the manure at the trial farm site, which is mainly an open lagoon system.

SADA is looking to decarbonise dairy operations by utilising waste streams from dairy to generate bioenergy. The dairy can thus offset the trial farm site’s electricity charges and help to reduce the overall carbon footprint for the sector.

For the feasibility study SADA commissioned Enpro Envirotech Pty Ltd to conduct comprehensive evaluations of waste resources as well as available infrastructure for potential bioenergy generation. With 500 milking cows on site, theoretical and actual manure generation was assessed earlier and was correlated with potential bioenergy generation. A considerable difference in theoretical and actual manure generation was observed which was mainly attributed to improper sampling and waste capture data.

With further discussions with SADA and the trial farm site, a detailed sample collection strategy was discussed and suitably implemented. During the period of work, utilisation of chemicals for washing and cleaning were assessed for quantity used and its potential effect on biogas generation.

Based on the total quantity of waste streams different technology scenarios were assessed considering utilisation of current infrastructure for waste to energy generation.

The study was carried out to investigate the bioenergy generation potential from composite waste streams generated at the trial farm site. The study detailed the composite waste quantification, analysis, potential effect of cleaning chemicals, utilisation of existing infrastructure and potential bioenergy generation with respect to the biomethane potential (BMP) indicating potential for the next steps.

There is no doubt that the preliminary work has made clear that such projects are viable. SADA will continue, hopefully with the assistance of the SA Government to develop this project for the future of the State and the environment.

Conclusion

SADA is proud of the work that we have done thus far and the only elements standing in our way are costs. SADA is currently in the process of raising capital for a $450,000 project that will be used as a facility to demonstrate to other farmers the advantages of the installation of such technology on farm.

The trial site farm has indicated that it would be pleased to be badged by the SA Government as a supported trial site as part of the government's commitment to the environment.

If you have any questions regarding these matters, please don't hesitate to contact SADA's CEO Andrew Curtis on 82932399.

Yours sincerely,

John Hunt
President SADA

APPENDIX

Trial Site – Results of Pre-feasibility and Feasibility studies.

Objectives

The objectives for the feasibility study project included the following:

- Preparation of a sample collection strategy with the trial farm site based on their operations
- Collecting suitably representative samples of waste streams and analyse further for TS, VS, N, P, K and other micronutrients
- Checking the utilisation of chemicals (washing/cleaning) and their contents
- Reviewing existing ponds details and further assessing their suitability as an anaerobic lagoon
- Analysing the potential biogas with combined waste streams from milking shed and cow shed floor to theoretically assess a full-scale commercial bioenergy plant utilising existing infrastructure together with an estimation of capital costs.

Methodology in assessing the trial farm site

Preliminary studies showed that waste stream from the trial site dairy generated bioenergy. Since the sample of waste stream collected was a grab sample the amount of bioenergy generation during BMP testing was low, so in the feasibility study it was proposed to collect composite samples to gain an understanding of the quality in waste streams and bioenergy potential.

Furthermore, a detailed review of existing infrastructure for its suitability considering the biomethane potential testing conducted in an earlier report was assessed.

For further assessment, the following methodology was adopted:

- A strategy composite sample collection was developed after discussions with the trial farm site followed by sample collection of composite waste streams
- Different chemicals used on site for cleaning and sanitising were assessed with technical names and details to work out potential adverse effect on anaerobic digestion processes
- Composite waste stream samples were analysed for organic and inorganic contents mainly to check pH and other inorganics
- Extensive review of existing lagoons was conducted to identify the potentially of the trial farm site to be converted into CAL potential bioenergy generation for the composite sample based on BMP testing
- Possible adverse effects of chemicals used on was assessed on anaerobic digestion with available data

A final report covering evaluation of waste streams, infrastructure availability and potential waste to energy generation will be part of the next development stage.

Sample Collection Strategy

During study the trial farm site generated waste streams from the cow shed floors as well as milking shed.

About 70,000 litres of water was (and still is) used every day in the cow shed floor (twice a day) while 14,000 litres of water was used to flush the milking sheds every day (three times per day).

This frequency and timing for flushing are fixed in the dairy industry.

Cow shed floor flushing is done at 03:30 hrs and 12:00 hrs while milking shed flushing is carried out a 06:30, 14:30 and 21:30 hours. In addition to the flushing water, about 80-100 litres of milk is flushed on an average every day adding an organic load into the combined waste streams.

Considering the operations on site, a sampling protocol was developed for the trial farm site and discussed with them before finalising the sampling date. Accordingly, the sampling was carried out by the trial farm site in accordance with the needs of the feasibility study. The sample was stored in the fridge and collected next day (morning) by Enpro Envirotech for further analysis.

Cleaning Chemicals Information

To attain clean and sterile conditions, various chemicals were used in the milking sheds. These were mainly acid wash, alkaline wash and a sanitizer. After first milking the acid was provided followed by an alkali wash and this washing sequence was repeated until the last milking cycle.

Sanitiser was used after every wash at a minimal quantity of 80 ml per batch. These are routine chemical used in the industry for sanitisation and cleaning purposes.

Waste stream analysis

Waste streams generated from various locations that entered the lagoon were assessed on site.

A composite sample collected by the trial farm site was tested in the laboratory mainly for the parameters important from an anaerobic digestion point of view.

These included pH, Total solids, Volatile solids and N, P, K.

Potential biogas generation

BMP testing was conducted during earlier studies for the trial farm site.

Theoretical biomethane generation was calculated based on the total waste streams generated considering the composite sample analysis of recently collected waste streams.

Review of existing infrastructure

The trial farm site was partially treating the waste streams in three lagoons in series where the waste stream passed by gravity. From the first lagoon, the partially treated water, after solids settlement, entered into a second lagoon and third lagoon subsequently by way of gravity.

The estimated volume of the first lagoon was approximately 2100 m3. Building new infrastructure (AD tank) is costlier hence the project plans have outlined that it is important to assess current infrastructure available at the site including the lagoons.

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Data assessment and evaluation

Evaluation of the current situation, with various streams generated from different locations in the dairy, a suitable sample collection strategy was developed and discussed with the trial farm site for proper collection.

Total waste streams generated at the trial farm site is about 85 kl/d with 70 kl waste stream from the cow shed floors and 14 kl waste stream from the milking shed. In addition to these waste streams, sometimes additional milk was drained into total waste streams, which may vary from 50-100 litres/d.

The cow shed floors were (and are) cleaned twice a day using about 35 kl water every time while the milking shed is cleaned thrice a day generating about 14 kl in waste streams. In addition, there may be 0.1 kl wastewater from milking machine wash as well.

In the milking shed, acid and alkaline washing is carried out regularly using specific chemicals. This wash is administered with an automated system 3 times a day.

After first milking, acid wash is given followed by alkaline wash after second milking and at night third 13 acid wash is given. Sanitiser is used in an optimum quantity (80 ml per batch) after every wash.

The amount of chemicals used, was found not to affect the wastewater quality as the pH was found to be around neutral. Earlier BMP testing carried out on the sample showed significant biogas production indicating no adverse effect of the chemicals used in the processing.

The quantity of chemicals used was found to be minimal as compared to the total waste streams generated and it seems it also did not affect the overall waste characteristics as the pH of the composite waste stream sample was found to be around neutral.

With current waste streams the VS/TS (Volatile Solids and Total Solids) ratio is improved from 66% to 72% with a higher concentration of volatile solids.

Comparison of previous samples and composite sample analysis revealed that higher a concentration of volatile solids in the waste streams generate higher amount of biogas. With the composite sample data and previous biomethane potential value, about 4517GJ energy generation is feasible which generates about 252 MWh electricity in a year with about 290 MWh thermal energy.

Currently the waste streams are treated in a series of lagoons and are separated and emptied out from the lagoons periodically.

Existing infrastructure- lagoons at the trial farm site

The very first lagoon where all waste streams are collected is about 30 x 10 m x 7 m deep (on an average).

Total estimated volume of this lagoon is about 2100 m3. This lagoon can potentially be used to generate biogas by covering it with a HDPE membrane to collect biogas. With the available volume of this lagoon, about 24.7 days HRT is achieved which is suitable for anaerobic digestion with such type of waste streams.

All the settled solids need to be removed from this lagoon before its usage as a Covered Anaerobic Lagoon (CAL) and supplied with a suitable mixing system inside.

Composite sample:

- Total waste generated 85 m3
- Total number of cows 500
- Total solids, 2.86%
- Volatile solids, 2.06%
- Total waste generated annually, 31025 m3

Estimated mass balance and logistics

Considering the total waste streams generation of 31025 m3 /year, a similar amount of digestate is generated in the anaerobic digestion process.

With this quantity of waste stream, about 252 MWe and 290 MW heat energy is generated in a year.

Since the wastewater is recycled back to flush the cow shed floors, it was recommended by Enpro Envirotech that a solid separation system be installed to separate solids that can be used as fertiliser while the liquid portion is recycled back for flushing. 2% solids in the waste streams was found to offer up about 600 t of solid fertiliser over a period of one year.

Estimated mass balance at the trial farm site

Composite sample analysis showed that the estimated energy generation is sufficient to offset the total energy demand for the dairy.

An additional benefit for the trial dairy was found to equate to a reduction in the greenhouse gas emissions equivalent to 1500 t CO2/y.

Two possible technologies were described as being able to be applied on the trial farm, which were, namely a Covered Anaerobic Lagoon or CAL or a Completely Stirred Tank Reactor or CSTR. Efficiency of the CSTR is generally superior to a CAL system, however the capital cost is high.

Input Waste stream manure 31025 m3

Utilising the existing infrastructure was assessed for suitability of converting into CAL. Lagoon no. 1 with an approximate volume of 2100 m3 provides a sufficient retention time for anaerobic bacteria to grow and generate biogas.

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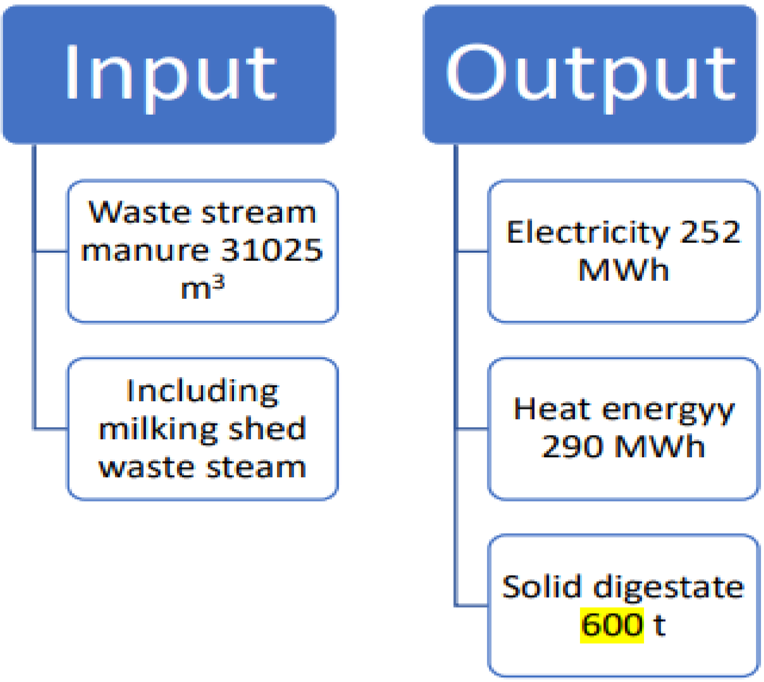
It is proposed that either a single- or double-layer membrane is installed on the existing lagoon with suitable trenches and civil construction.



The overall benefits of a double membrane system include water logging elimination, as well as additional safety.

The author of the feasibility study stated that by employing a typical double layer membrane cover for a CAL system, incorporated with an implementation of potential waste to energy project at the trial farm site, it would be possible to reduce approximately 1500 t CO2 eq of GHG emissions in a year.

Options for implementing waste to energy project

It was concluded by Enpro Envirotech that the available organic material is enough to generate required electricity, however the waste stream quality needs to be monitored on a regular basis. There are chances of variation in solids as well as nitrogen contents as the waste streams are recycled back for flushing.

The Pilot Project

Available infrastructure on site, can be converted into a CAL for biogas generation. The biogas generation is less in a CAL as compared to engineered digesters however the biogas in a CAL can be optimised by providing suitable mixing devices as well as sludge removal arrangements. Enpro Envirotech reported that single or double membranes could be installed on the existing lagoon for biogas collection.

SADA is seeking to move forward by way of implementation of a bioenergy plant using pre-existing infrastructure as a pilot demonstration for industry.

The pilot will assess biogas generation and optimisation of the anaerobic digestion process, and therefore, a pilot demonstration plant will need to be constructed on site.

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Bioenergy generation will be achieved by converting the first lagoon on the pilot site into a Covered Anaerobic Lagoon and generate electricity from the biogas. Implementation of this pathway is less capital intensive as compared to engineered digesters, and through the pilot process the effect of variation in feedstock particularly in terms of ammonia will be assessed further. (Since the wastewater after solid separation is used for flushing, there are chances of higher ammonia concentration which may inhibit the methanogenic bacteria).

Project Phases

In:

- phase 1, biogas generation, organic loading rate and other parameters will be assessed while in transition,
- phase 2, suitable size CHP engine is installed for electricity generation.

As part of the project the heating of CAL needs to be arranged during phase 1 for optimum production of biogas.

The cost for the pilot demonstration plant demonstrating a CAL system is $450,000.

Payback for converting existing infrastructure into a CAL system is in the range of 4-5 years.

Based on the plans and vision of SADA, a decision on implementation of waste to energy project can be undertaken. As such this project fits well in reducing greenhouse gas emissions for the trial farm site and can be implemented in other dairies.

Operational issues can be sorted out while operating the waste to energy plants and this can become a good training site for other dairy owners. An awareness about climate change and greenhouse gas reduction in the dairy sector (not to mention other sectors) is to be advanced by implementing this waste to energy project. Such a project achieves not only economic benefits but also environmental benefits for the dairy sector and the region.

The Enpro Envirotech noted that it was concluded that waste to energy generation is possible at the trial farm site, however the evaluation of options available needed to be done in line with the vision and future plans of SADA and the SA Government.

With the roll out of a commercial scale pilot project plant, further detail steps for implementation of waste to energy projects can be promoted.

After installation of any of these systems, it is important to assess effect of loading rates, variation in quality of waste streams and biogas generation over a period. Exact greenhouse gas reduction for dairy operations at the trial farm site can be calculated with further development of a standard for implementation in other parts of the dairy industry.