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final report

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Development of an energy conservation and cost reduction tool for the Australian red meat industry

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Executive summary

It is estimated that the Australian red meat industry (RMI) spends approximately $1.6 billion per annum on fossil fuel derived heating and power[1] (adjusted to 2019 energy market pricing). This issue is further compounded by the 'knowledge gap' that has been observed in the industry to be able to confidently make technical and financial decisions for rapid uptake of lower cost renewable options: an estimated 93% of the energy for Australia's red meat industry is obtained from fossil fuels hence the "Business as Usual" scenario is continued use of fossil derived energy. Energy literacy is important for businesses to understand where they are and the lower cost options that are available; some entry level questions to define energy literacy are:

- What do I pay per kWh of electricity?
- What do I pay per kW or kVA of capacity from the electricity grid?
- What do I pay per GJ of thermal energy?

This knowledge enables businesses to compare their options on a "like for like" basis. Historically, grid power and fossil fuels have been convenient and cheap. Operators have a strong commitment to core business activities with limited resources allocated to continually re-assessing energy strategies and options. The above factors have resulted in businesses in the Australian red meat industry paying more for energy than necessary.

All Energy Pty Ltd has attempted to bridge this knowledge gap and increase energy literacy by developing www.myenergy.tech, a digital tool for producers, feedlots, and processors to quickly and easily assess proven, low risk, and viable renewable energy technologies for their business. This reduces the time and cost of concept level feasibility studies: from several months and thousands of dollars of effort to less than a minute at no cost.

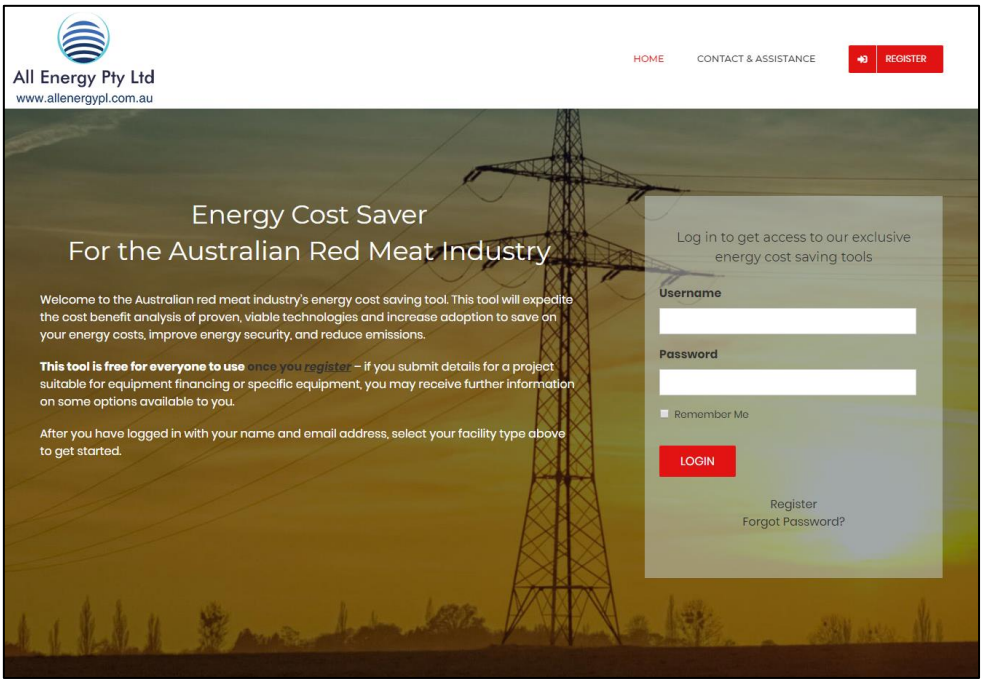

Figure 1: www.myenergy.tech homepage

[1] MLA V.SCS.0003 *Review of renewable energy technology adoption within the Australian red meat industry,* All Energy Pty Ltd, 2017

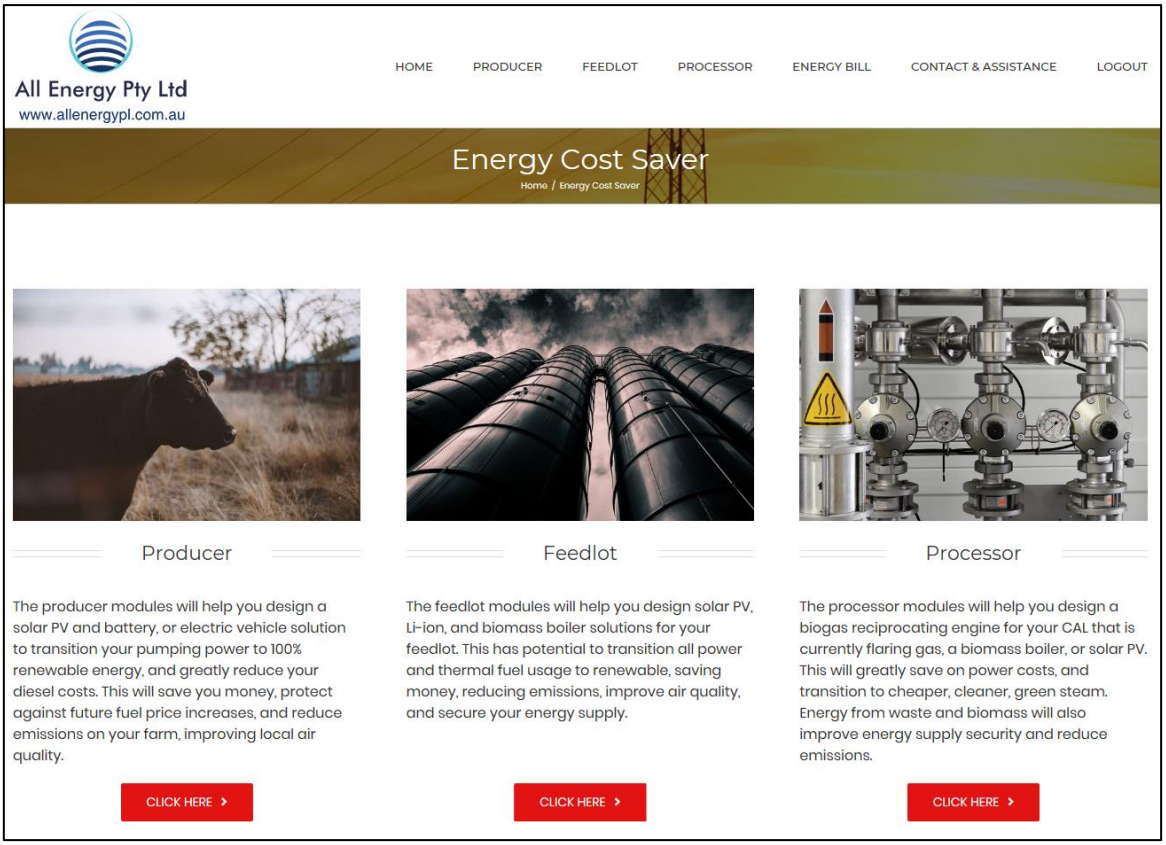

Figure 2: www.myenergy.tech contains energy cost reduction modules for producers, feedlots, and processors

The practical implications of using this tool and investing in the above renewable energy technologies for the Australian red meat industry are:

- **Reduced power costs:** Renewable energy technologies generally deliver power cheaper than conventional grid tariffs or diesel/petrol generators. As an example, sub-100 kW solar arrays where the small scale technology credits are claimed upfront can provide power for between 4 – 6 c/kWh.

- **Reduced thermal energy costs:** Biomass can be produced for less than $5 /GJ, approximately similar to high LHV bituminous coal as available in Queensland; and significantly cheaper than east coast pipeline natural gas at $15 - $20 /GJ and regional LPG at $30 /GJ and more.

- **Reduced waste disposal costs:** Biogas to energy may be the component of the plant to make an investment in an anaerobic lagoon or intensified tank-style digester viable, saving on liquid trade waste and solid landfilling costs.

- **Improved environmental outcomes and social license to operate:** There is growing pressure in the industry to maintain the clean and green image of Australian red meat; renewables can aid in progressing towards the broad CN30 goal and specific business targets.

- **Increased use of domestically and locally generated energy:** Australia is on trend for importing 100% of its liquid fuels by 2030[2]. This is a huge business continuity risk given that a third of RMI energy comes from liquid fuels. PV solar and biogas energy can be generated on-site to provide

[2] https://reneweconomy.com.au/running-on-empty-australias-dependence-on-imported-fossil-fuels-92310/

power and/or thermal energy. The use of biomass provides the opportunity to use locally grown or created fuels rather than fuels that are transported over long distances via pipelines, trucks and/or are imported (such as LPG).

- **Reduction in scope 1 and scope 2 greenhouse gas emissions:** Businesses can reduce their scope 1 emissions by offsetting fossil fuels such as coal, natural gas, LPG, and diesel used for thermal energy or on-site power generation with biomass and biogas, both of which contribute no scope 1 emissions due to their biogenic nature, according to Clean Energy Regulator reporting guidelines. Scope 2 emissions can be reduced by offsetting grid electricity with biogas generation and solar PV.

- **Improved relationships with local councils and businesses:** Local councils and businesses can be cooperated with to provide sources of biomass for boilers or additional digestible organic material to boost biogas production in existing digesters. The installation and commissioning of these plants will employ local skilled workers with a small full-time equivalent (FTE) requirement during operation.

- **Mitigate the effect of future price increases in power and heat:** ABS data shows that in the last 2 years, power prices are up 14.5%, natural gas prices are up 11.2%, versus an economy wide CPI increase of 3.7%. Over the last 10 years, CPI is up 23% versus power at 110%. This kind of exponential growth in power and thermal energy cost can be mitigated by investing in embedded generation and renewable energy that can provide more predictable costs.

- **Avoided capital costs of new/expanded plant:** A key obstacle in renewable energy uptake are the large upfront capital costs. Sources of low cost funding are available to help Australia businesses uptake clean technology solutions. For example, groups such as the Clean Energy Finance Corporation and Verdia. To provide additional risk assessment of clean technologies, funding groups complete their own due diligence before financing projects.

- **Buffer against future insecurity of energy supply:** Businesses should take their energy supply into their own hands, bringing power and heat “behind the meter” or within the fence line to protect against security issues of grid stability and quality, proximity to fuel sources, increasing demand and, in some areas, limited access to energy infrastructure and/or no available capacity in existing infrastructure.

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1 Background

It was estimated by All Energy Pty Ltd in the MLA project V.SCS.0003[3] that the Australian red meat industry spends approximately $1.6 billion (adjusted to 2019 values) per annum on fossil fuel heat and power, with the split between fuels and operators in the supply chain (producers, feedlots, and processors) shown below in Figure 3. Based upon available data and the Australian Federal Government's Clean Energy Regulator's 2019 published renewable power percentage (RPP) of 18.60%[4], it is estimated that approximately 93% of the energy for Australia's red meat industry is currently obtained from fossil fuels.

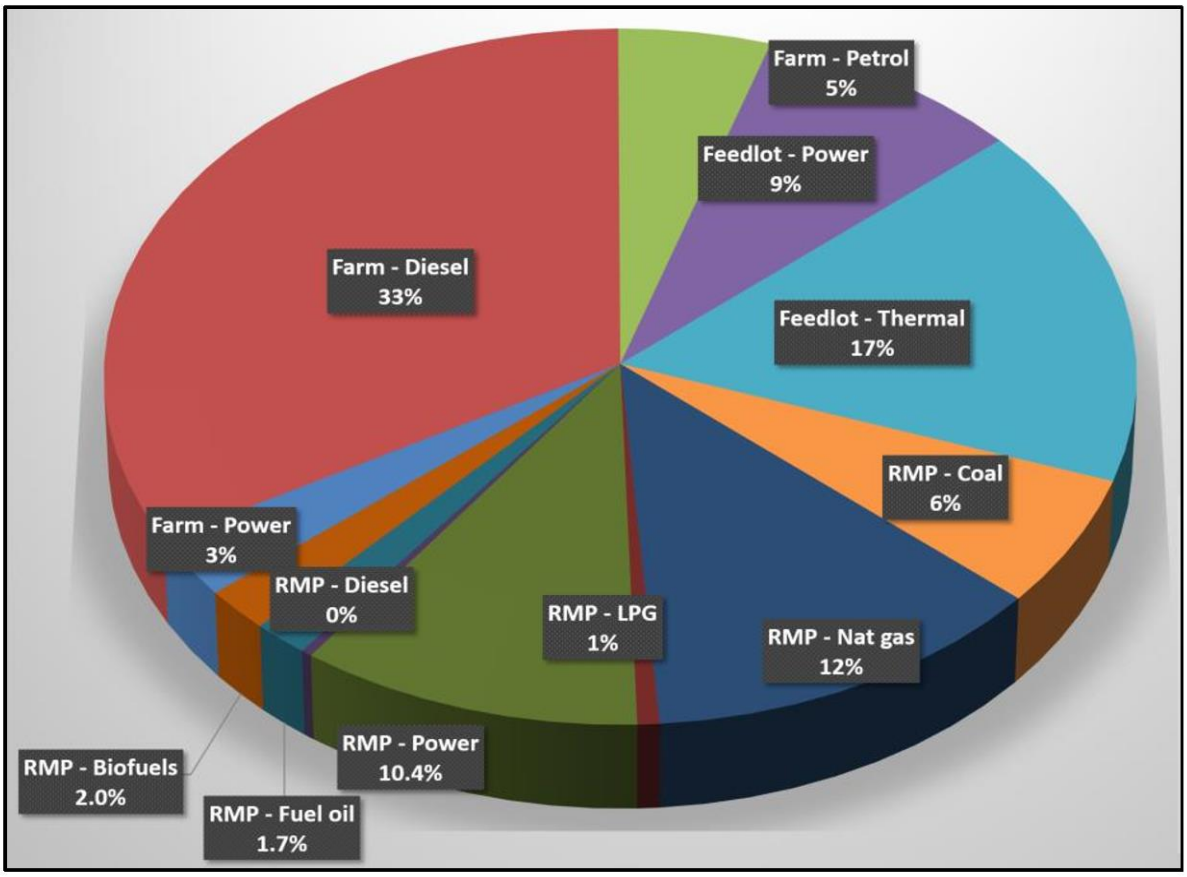


Figure 3: Split of 47.2 PJ annual energy demand between producers, feedlots, and processors, and power and thermal

The above is for RMI operations through to the end of red meat processing (i.e. does not include off site cold storage, transport and retail energy). The above also excludes the embodied energy of products used throughout the RMI such as fertilizer, chemicals, packaging and other materials. Where embodied energy is included, 61 PJ per annum is used throughout the RMI.

The energy literacy of key decision makers is critical for understanding options that are available and to respond quickly to opportunities. The sorts of questions that RMI businesses should be continually asking is:

- What do I pay per unit of energy? kWh for power; GJ Lower Heat Value for fuel.

[3] MLA V.SCS.0003 *Review of renewable energy technology adoption within the Australian red meat industry,* All Energy Pty Ltd, 2017

[4] http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/the-renewable-power-percentage

- What do I pay to access this energy? kW or kVA charges for power; trucking and storage for fuel.
- What other options exist?
- What is the capital cost?
- What would I pay per unit of energy and to access this energy over the life of plant? e.g. 10 to 20 years.
- What is an acceptable hurdle rate for energy investment? e.g. simple payback period in years.

With the grid and liquid/gaseous fuels being historically cheap and technical resources of businesses often being engaged in core business activities, businesses in the Australian red meat industry are, in the main, paying more for energy than necessary.

All Energy Pty Ltd has developed a Software as a Service (SaaS) digital tool to bridge this knowledge gap so that producers, feedlots, and processors can assess the viability of a selection of proven, low risk, and viable technologies. The digital tool was developed as a stand-alone platform: by developing www.myenergy.tech

The overarching aims of this project for MLA's membership were as follows:

- Provide free and instantaneous feasibility level analysis of renewable energy options, as opposed to taking months and several thousand dollars to complete.
- Upskill the industry in the area of renewable energy and its feasibility in the Australian red meat industry;
- Shorten the "knowledge gap" between where people are and what they can utilise;
- Increase the adoption of these technologies in the industry;
- Reduce operating costs and emissions with no negative impact on animal welfare in an economically viable way;
- Minimise (targeting zero) capital outlay by operators;
- Disseminate the economic viability of the selected technologies throughout the industry, as well as information on financing and funding assistance.

2 Project objectives

The objective of this project was to develop an energy cost reduction tool from the prototype stage, through proof of concept (PoC), to final viable product for a suite of energy cost saving options most suited to the Australian red meat industry, including biogas, PV solar, batteries, and biomass boilers.

- M1: Proof of Concept followed by a Go/No Go decision point:
  - show results of design-led thinking and/or lean start-up and/or equivalent venture development process, - approve commercialisation plan.
- M2: Launch and instructional video
  - Launch of the tool to the Australian RMI through MLA with associated All Energy Support.
  - Initial platform setup & model; Platform Agent/tenancy model and permission (licensing) setup.
- M3: Further build out

    - Minimal Viable Product for energy bill/document scanner with data recognition capability; scenarios and case studies.
- M4: Refinement and further build-out
    - Based on data historian analytics, feedback, successes and failures, refinement of tool and further build-out for additional technologies and scale as required; Analytics and user experience (UX) tracking automation.
- M5: Automation.
    - Outputs of lead automation and filtering activities.
- M6: Final Milestone and Industry Presentation/Demonstration of fully functional product
    - Final report approved by MLA detailing:
        - outputs and outcomes of all milestones
        - cost/benefit analysis of project
        - recommended next steps including further R&D plus commercialisation arrangements.

3 Methodology

The project methodology was as follows:

1. Review the adoption of renewable energy in the Australian RMI and previous feasibility studies, selecting the most proven, viable, and lowest risk technologies
2. Design heat and mass balances and thermodynamic models for a typical red meat producer, feedlot, and processor, normalising back to a minimum of input variables
3. Compile cost correlations for the selected equipment able to be sized according to the input variable of point 2
4. Build out a proof of concept tool to be soft launched to a shortlist of producers, feedlots, and processors
5. Develop the tool to a minimum viable product after implementing the revisions and suggestions from the soft launch
6. Launch the tool to the industry on a dedicated domain www.myenergy.tech

The above is summarised in the user experience, data flow, analytics and lead generation diagram in Figures 4 and 5.

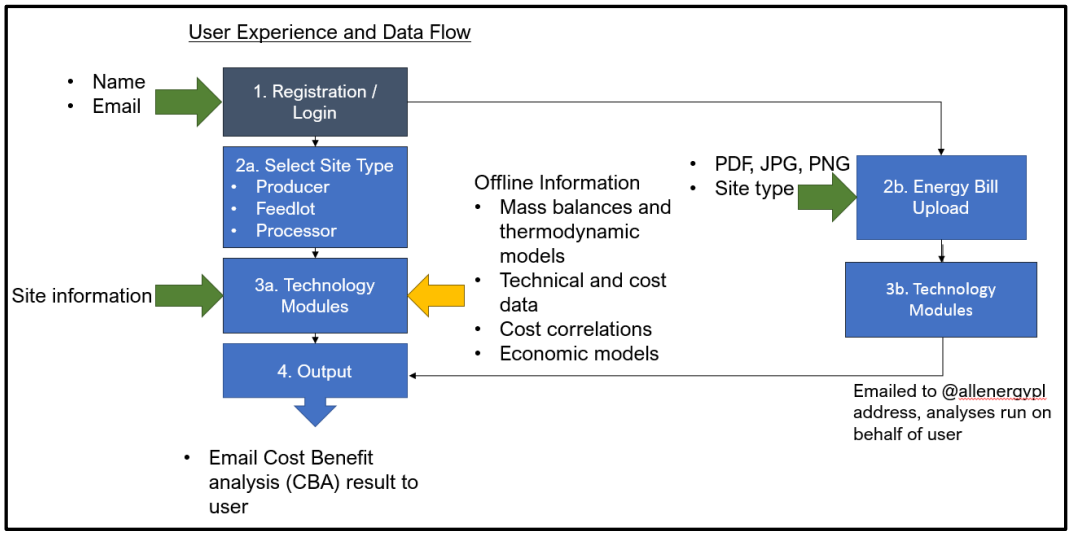


Figure 4: Schematic of myenergy.tech user experience and data flow

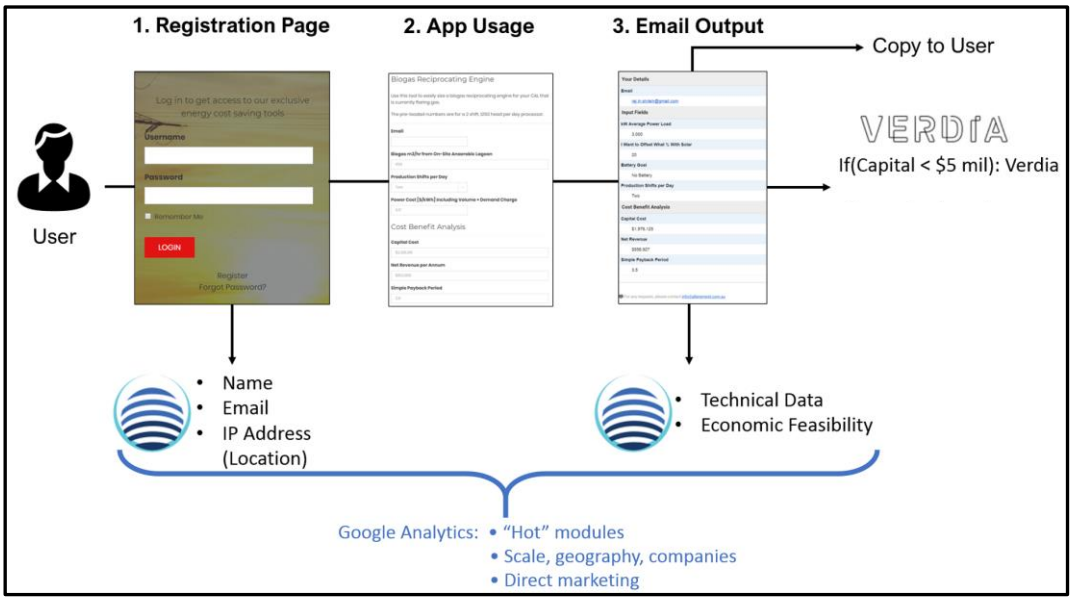


Figure 5: User analytics and lead generation flow diagram for equipment financing.

4 Results

4.1 Final Tool myenergy.tech

4.1.1 Homepage and Registration

Upon accessing www.myenergy.tech, below is the homepage where returning users can log in to access the energy cost saving modules for free.

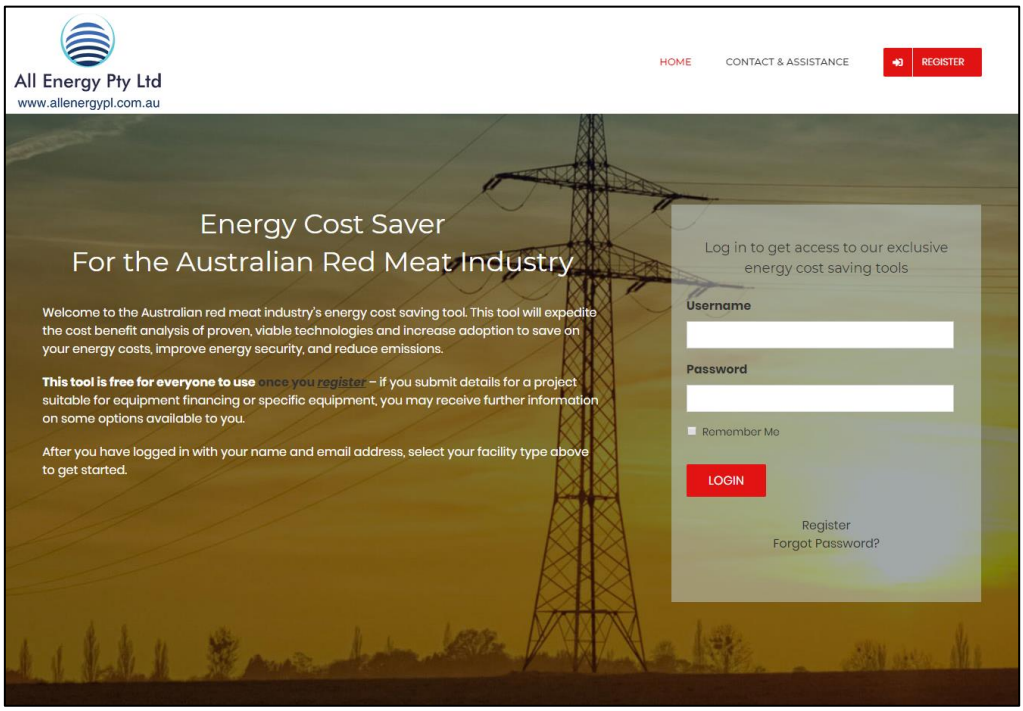


Figure 6: www.myenergy.tech homepage

First time users of myenergy.tech will be prompted to register with their name, email, and phone number, choosing a username and password.

It is free for anyone to register and use this tool.

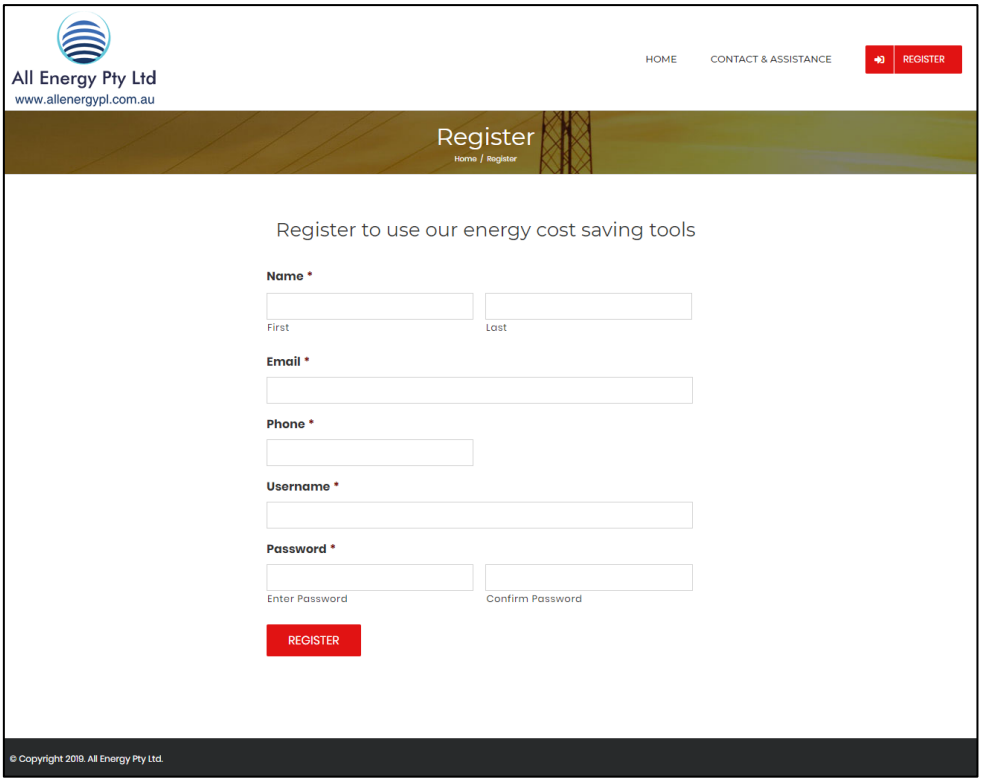


Figure 7: www.myenergy.tech registration page

After registering, select facility type from producer, feedlot, and processor to get started.

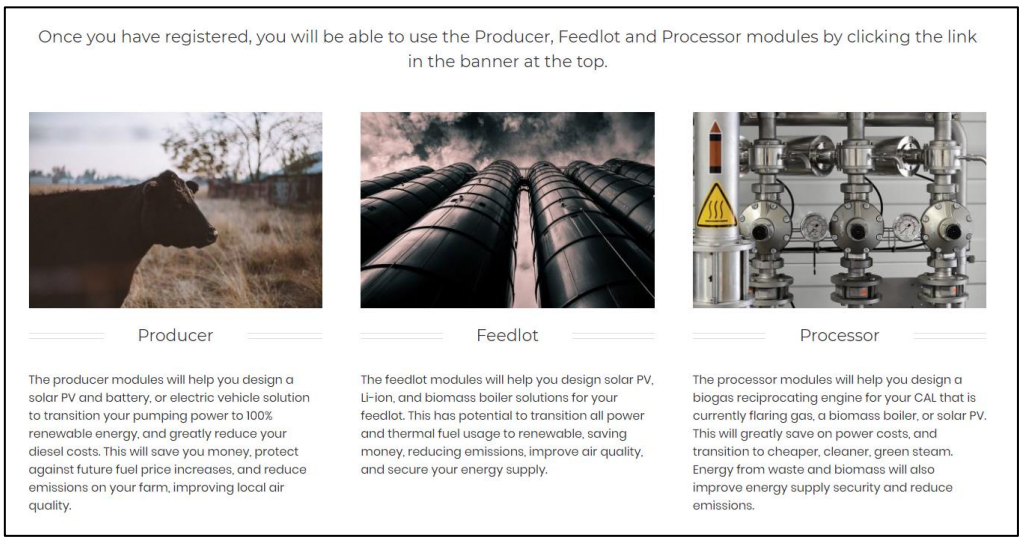


Figure 8: Links to producer, feedlot, and processor pages

4.1.2 Producer Page

The energy cost saving modules contained on the producer page are electric farm vehicles (quad bikes and all-terrain vehicles (ATVs)) and solar PV and batteries. To use the electric vehicle calculator, input the approximate distance covered per day in kilometres, and price paid per litre of fuel factoring the ATO off road rebate. Click submit and you will receive a cost benefit analysis report via email containing the cost of a new electric vehicle, amount saved per annum on fuel, and estimated simple payback.

To use the solar PV module, input your farm pumping data of number of pumps, rating, and hours per day each pump is run for; current power source; and interest in batteries. Submit and you will receive a cost benefit analysis report via email of the estimated capital cost of your solar PV system, amount saved per annum on power, and estimated simple payback. Note that for a typical farm, solar arrays under 100 kW are an economic optimum as small scale technology credits may be claimed upfront; it is recommended to investigate this scale if capital is limited or to offset a good portion of your kWh with the best economic viability.

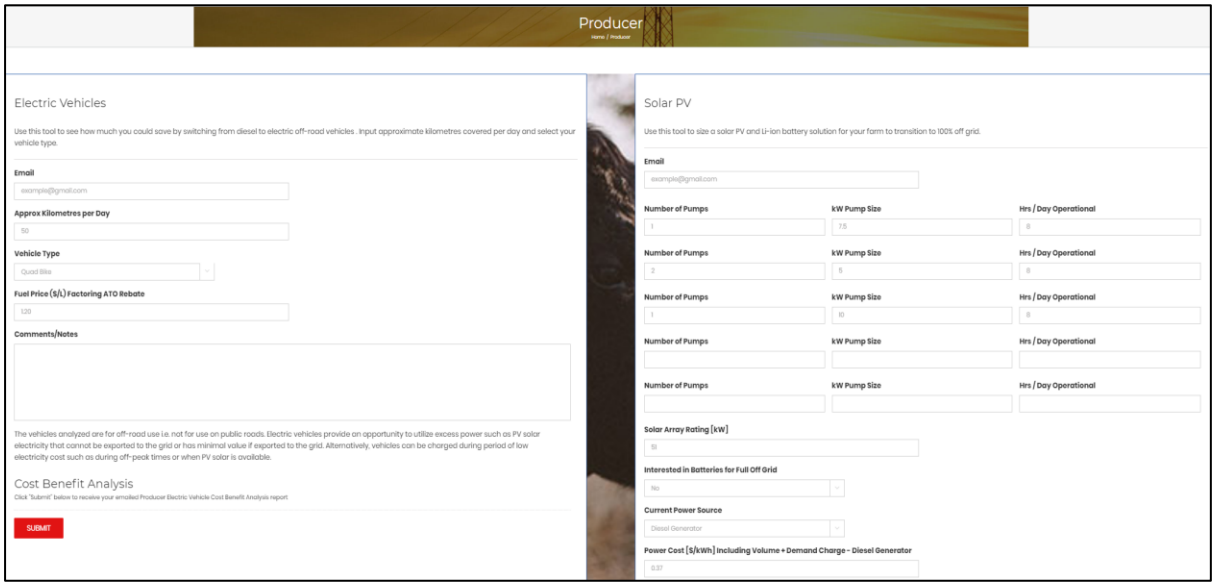


Figure 9: www.myenergy.tech producer page

4.1.3 Feedlot Page

The feedlot energy cost reduction modules of myenergy.tech are biomass (woodchip) boilers and solar PV and batteries. To use the biomass boiler module, input the number of SCUs[5] on feed, hours per day milling while the boiler is run, and current fuel. Click submit and a cost benefit analysis report will be emailed to you with the additional capital cost of a woodchip boiler, savings on fuel, and estimated simple payback. This tool is best used when your current boiler is at end of life and a new plant must be procured.

To use the solar PV module, input the number of SCUs on feed, desired kWh offset with solar, interest in batteries, and current power source. Submit and you will be emailed a cost benefit analysis report with the solar array rating, capital cost, savings on power, and simple payback period. As above, solar arrays under 100 kW are an economic optimum as small scale technology credits may be claimed upfront to reduce the upfront capital cost; for a 20,000 SCU feedlot, a 100 kW solar array can offset around 30% of kWh with the highest economic viability.

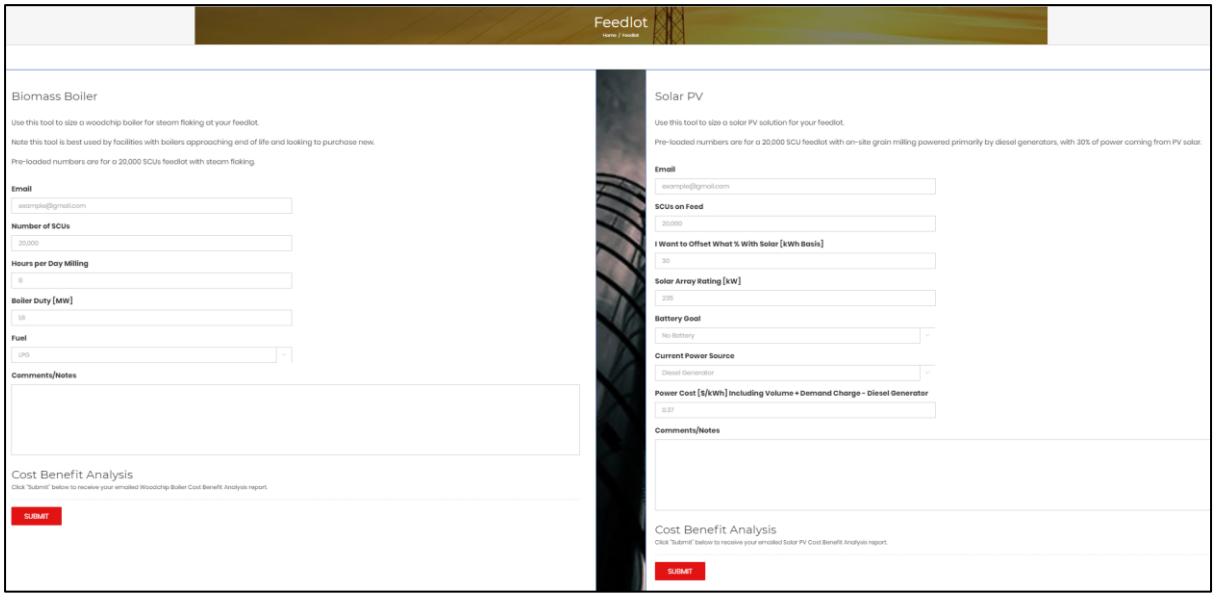


Figure 10: www.myenergy.tech feedlot page

[5] 1.0 Standard Cattle Unit (SCU) = 600 kg live weight.

4.1.4 Processor Page

The processor cost reduction modules are biogas reciprocating engines, biomass (woodchip) boilers, and solar PV and batteries. To use the biogas reciprocating engine calculator, input the approximate generation of biogas from your CAL in m^3/hr and power cost in $/kWh including volume and demand charges. Click submit and you will be emailed a cost benefit report of the engine size in kW, capital cost, savings on power, and simple payback.

To use the biomass boiler tool, select your current fuel and the quantity burned per day, and the hours per day rendering while the boiler is run. A cost benefit analysis report will be emailed to you with the boiler duty in MW, additional cost for a new woodchip boiler, fuel savings, and simple payback. This tool is best used when your current boiler is at end of life and a new plant must be procured.

For the solar PV and battery tool, input the average plant load in kW, desired kWh offset percentage, interest in batteries, and current power cost in $/kWh including volume and demand charges. Click submit and you will receive an emailed cost benefit analysis report of the array and battery rating, capital cost, savings on power, and simple payback.

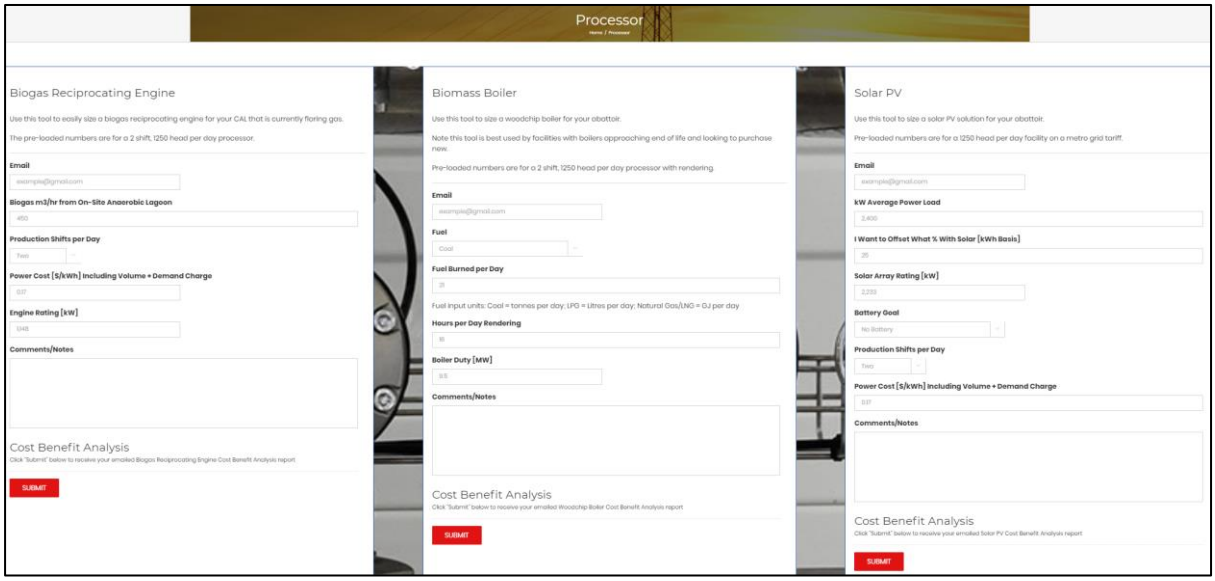


Figure 11: www.myenergy.tech processor page

4.1.5 Energy Bill Upload

In addition to the pre-loaded scenarios in each module, users have the option to simply upload an image of their current power or thermal energy bill, select their facility type, and submit on the "Energy Bill" page. This will then be emailed to All Energy Pty Ltd and we will be in contact with a brief report on your energy cost reduction options.

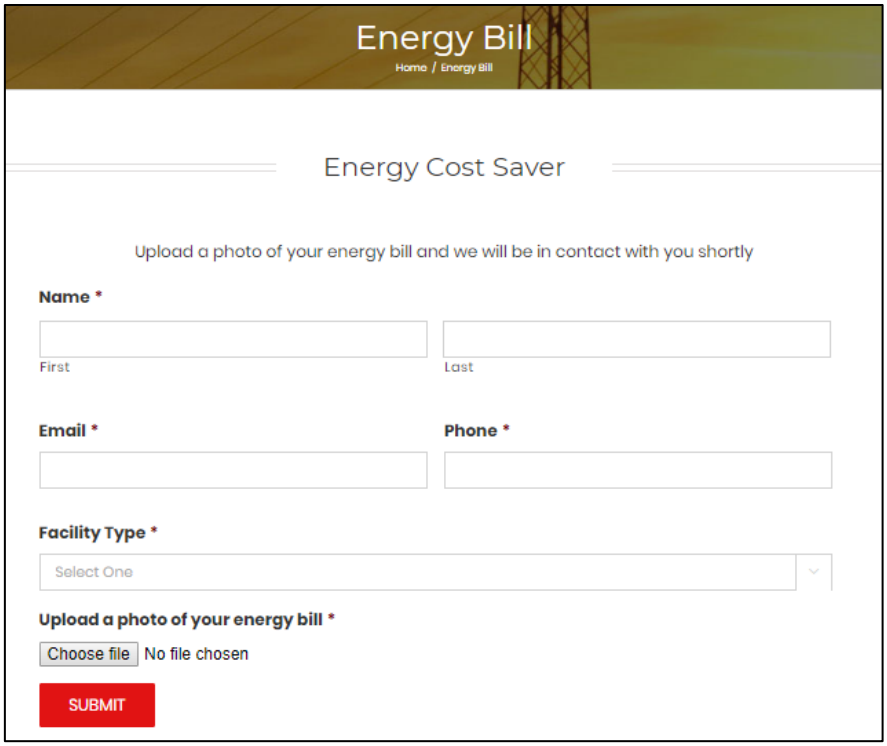


Figure 12: www.myenergy.tech energy bill upload page

4.1.6 Contact & Assistance

If users require assistance with any of the calculator modules, registration, login or would like to discuss a personalised detailed analysis for their operations, the contact page enables individuals to contact All Energy Pty Ltd via the web based form.

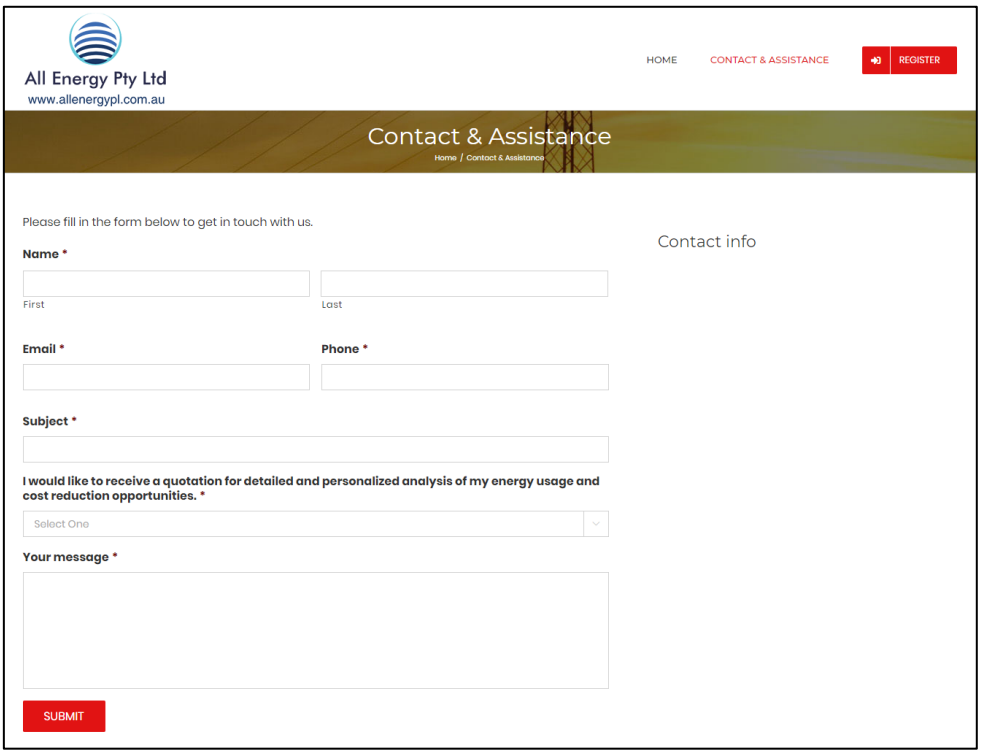


Figure 13: www.myenergy.tech contact & assistance form

4.2 Cost Benefit Analysis of Project

The following analysis is a cost benefit for implementation of renewable energy throughout the RMI supply chain. This level of disruption is not claimed to be due solely to myenergy.tech, however this analysis shows a feasible transition from where the RMI is today and where it could reasonably be in the short to medium term with the assistance of a tool such as myenergy.tech.

The assumptions when estimating the cost benefit analysis of this project are as follows:

1. 47,200,000 GJ per annum energy consumption among producers, feedlots, and processors, split according to Figure 1
2. No consideration of embodied energy (fertiliser), or biofuels (e.g. state based mandates of biodiesel / bioethanol content of liquid fuels)
3. Assumed prices of power
    a. Feedlot $0.32 / kWh = $88.9 / GJ
    b. Producer $0.32 / kWh from grid or $0.34 / kWh from diesel generators
    c. Processor $0.17 / kWh = $47.2 / GJ
4. Assumed prices of thermal energy
    a. Feedlot LPG $22 / GJ
    b. Processor LPG $20 / GJ, natural gas $15 / GJ, coal $5 / GJ
5. Assumed liquid fuel prices
    a. Petrol $1.25 / L = $39 / GJ;
    b. Diesel $1.00 / L = $27.8 / GJ; factoring ATO fuel tax rebates.
6. Estimated 48% of feedlots viable to use myenergy.tech[6] from top fifteen feedlot operators above 15,000 SCU feeding 48% of 1,147,000 head on feed (553,707 SCU) in 26 feedlots in June 2019[7]
7. Assuming 30% of feedlot kWh able to be offset by 99 kW of solar and 100% of feedlot thermal energy (GJt) offset with biomass
8. Assumed that 20% of producers cover enough kilometres per day to make electric ATVs or quad bikes viable; 30% of farm petrol use for these vehicles (70% in regular cars, utes, etc)
9. Assumed 80% of producers at sufficient electrical scale for solar viability; 100% use of diesel in power generation assumed; 30% offset of kWh from solar array.
10. Estimated top 25 processors representing 78% of the kill share[8] consume 70% of respective heat and power, factoring in an assumed economy of scale in larger plants. Assumed over 51 plants[9]
11. Estimate 40% of processor kWh able to be offset with biogas if run during staffed hours only (16 hrs per day), and 10% offset with on-site solar PV. If biogas generation run 24 hrs per day, kWh offset up to 60% can be achieved.
12. Assume 100% offset of processor natural gas, LPG, and coal with woodchip

Table 1: Estimated savings as a result of implementing technologies designed with www.myenergy.tech

Industry total	GJ per annum	Price $/GJ	Cost per annum	Estimated % of facilities viable to save with myenergy.tech	Estimated Savings

[6] https://www.beefcentral.com/top-25-lotfeeders-list/
[7] https://www.beefcentral.com/lotfeeding/june-cattle-on-feed-numbers-hit-new-record-1-147m-head/
[8] https://www.mla.com.au/download/finalreports?itemId=2734

Feedlot Power	4,248,000	$88.9	$377,603,021	48%	$44,179,553
Feedlot LPG	8,024,000	$22	$176,528,000	48%	$65,475,840
Producer Petrol	2,360,000	$39	$92,187,500	20%	$3,171,231
Producer Diesel	15,576,000	$27.8	$432,666,667	80%	$18,324,706
Producer Power	1,416,000	$88.9	$125,867,674	80%	$24,544,196
Processor Power	4,908,000	$47.2	$231,806,299	70%	$63,951,267
Processor LPG	472,000	$20	$9,440,000	70%	$4,956,000
Processor Natural Gas	5,664,000	$15	$84,960,000	70%	$39,648,000
Processor Coal	2,832,000	$5	$14,160,000	70%	-
		Total	$1,545,219,160	**Total Savings**	$264,250,794
				% of Current Spend	17.1%

Quantifying a "typical" producer scale, with a standard number of kilometres covered per day and number and rating of pumps cannot be done accurately at this stage without extensive additional surveys. This piece of work would prove a very valuable asset for future MLA producer energy strategy works.

As in assumption 6 above, the "typical" size of a top 26 feedlot is 21,296 SCUs; running this scale through the feedlot modules in myenergy.tech produces the following two cost benefit analysis reports.

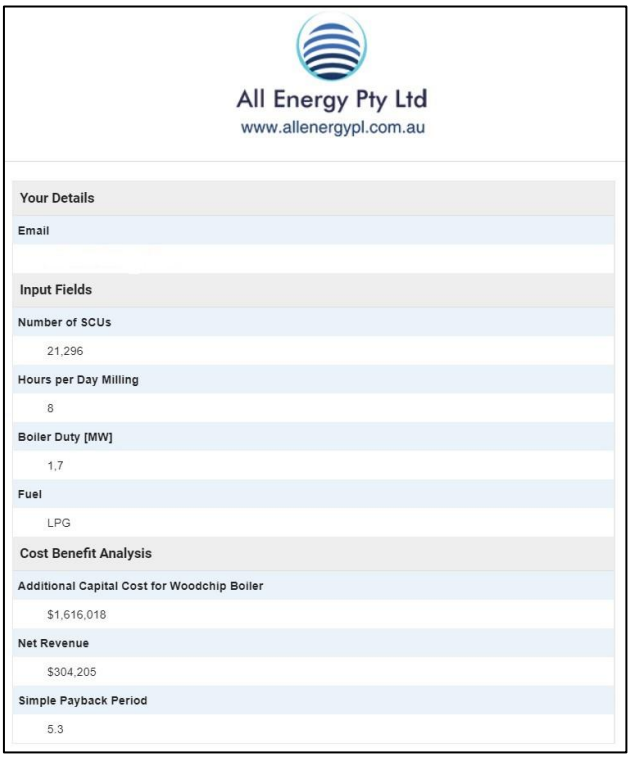
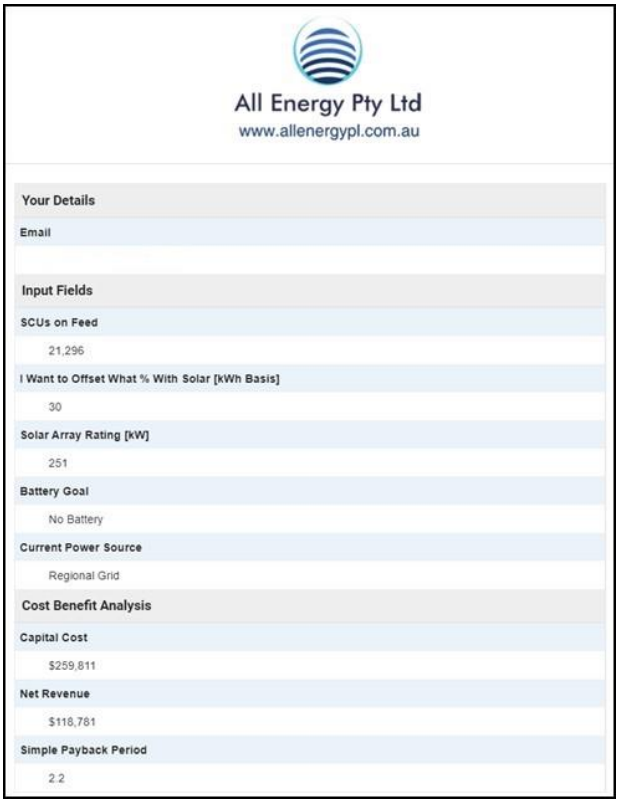


Figure 14: Typical feedlot biomass boiler cost benefit analysis, offsetting 100% of GJ with biomass



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Your Details	
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SCUs on Feed	
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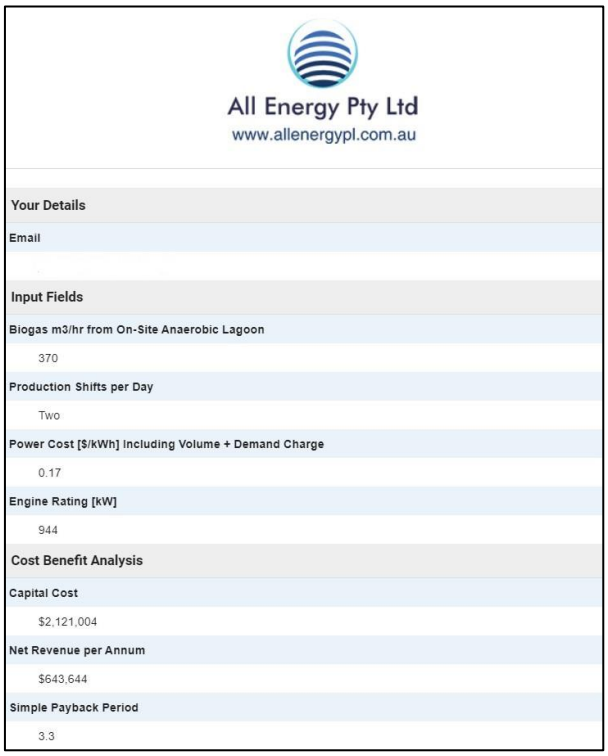
I Want to Offset What % With Solar [kWh Basis]	
30	
Solar Array Rating [kW]	
251	
Battery Goal	
No Battery	
Current Power Source	
Regional Grid	
Cost Benefit Analysis	
Capital Cost	
$259,811	
Net Revenue	
$116,761	
Simple Payback Period	
2.2	

Figure 15: Typical feedlot solar PV cost benefit analysis, offsetting 30% of kWh with solar

As in assumption 10 above, the "typical" size of a top 25 processor is 1024 head per day, equivalent to approximately 370 m^3/hr of biogas generation capability, 450 GJ per day of natural gas burned, and an average power demand of 1966 kW.



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Biogas m3/hr from On-Site Anaerobic Lagoon	
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Two	
Power Cost [$/kWh] Including Volume + Demand Charge	
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Engine Rating [kW]	
944	
Cost Benefit Analysis	
Capital Cost	
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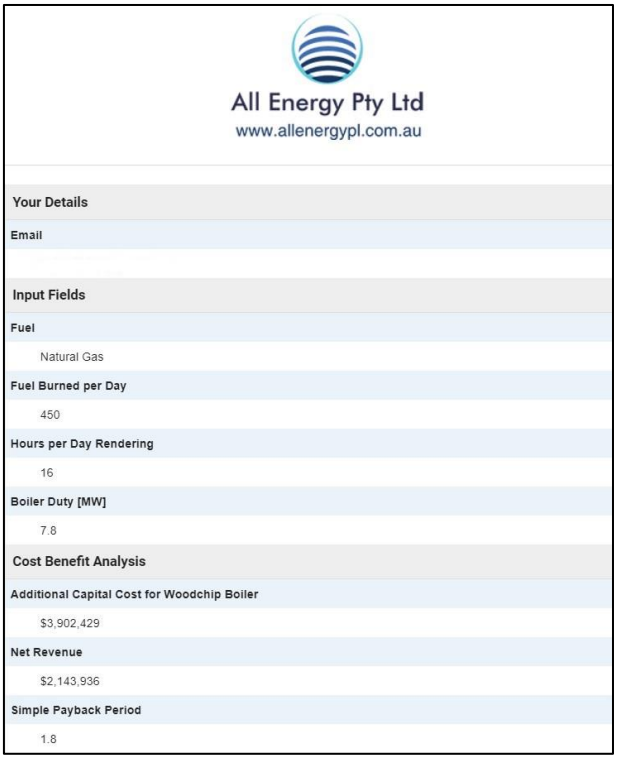
Net Revenue per Annum	
$643,644	
Simple Payback Period	
3.3	

Figure 16: Typical processor biogas reciprocating engine cost benefit analysis



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Your Details	
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Fuel Burned per Day	
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Hours per Day Rendering	
	16
Boiler Duty [MW]	
	7.8
Cost Benefit Analysis	
Additional Capital Cost for Woodchip Boiler	
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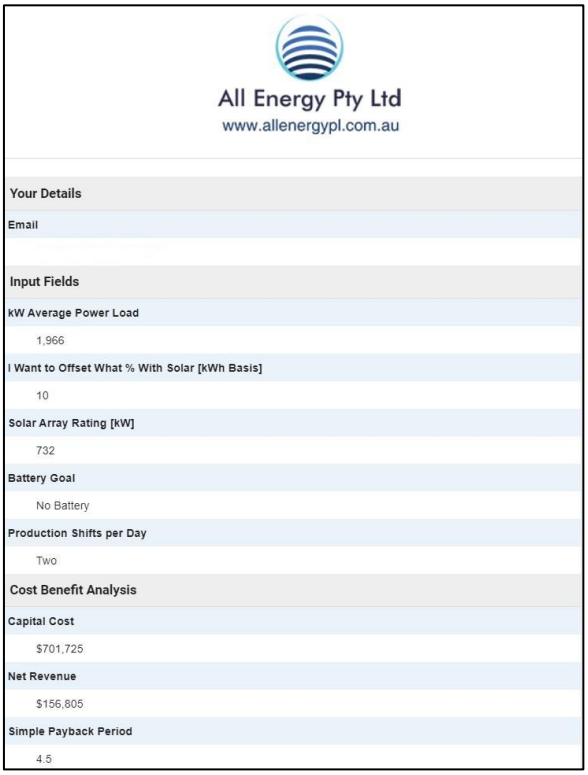
Net Revenue	
	$2,143,936
Simple Payback Period	
	1.8

Figure 17: Typical processor biomass boiler cost benefit analysis, offsetting natural gas



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Your Details	
Email	
Input Fields	
kW Average Power Load	
	1,966
I Want to Offset What % With Solar [kWh Basis]	
	10
Solar Array Rating [kW]	
	732
Battery Goal	
	No Battery
Production Shifts per Day	
	Two
Cost Benefit Analysis	
Capital Cost	
	$701,725
Net Revenue	
	$156,805
Simple Payback Period	
	4.5

Figure 18: Typical processor solar PV cost benefit analysis, offsetting 10% of kWh

5 Discussion

All Energy Pty Ltd has been travelling around Australia informing the Red Meat Industry and associated businesses of the existence of myenergy.tech, how to use it and its advantages. Presentations / workshops and information sessions included:

- Beef Week Industry Day, Casino, May 2019.
- Innovating energy for food, presented by Food Innovation Australia Limited and Australian Alliance for Energy Productivity, July 2019.
- Australian Agriculture Immersive Technology Conference, July 2019.
- Australian Renderer's Association Symposium, Hobart, July 2019.
- Institute of Chemical Engineers – Digital Disruption, QUT, Aug 2019.
- AMPC Network Collective meetings in Brisbane, Aug 2019; Adelaide, Aug 2019; Wagga, September 2019; Perth, October 2019; and Tamworth, November 2019
- Energy Cost Saving workshop, Brisbane, Sept 2019.
- Verdia, Sydney, April 2019.
- AMPC, Sydney, April 2019.
- QUT AMPC Networking Evening, Brisbane, September 2019.
- MINTRAC RMP Industry Presentation [upcoming; Oct 2019].
- All Energy Conference, Melbourne [upcoming; Oct 2019].

One key learning was how to make it as easy as possible for individuals to be directed to the web site. The method found was to provide a QR code during a presentation then invite delegates to "take a photo and click the link". A dedicated QR code was generated and provided during presentations as shown below as part of the slide deck (Figure 20).

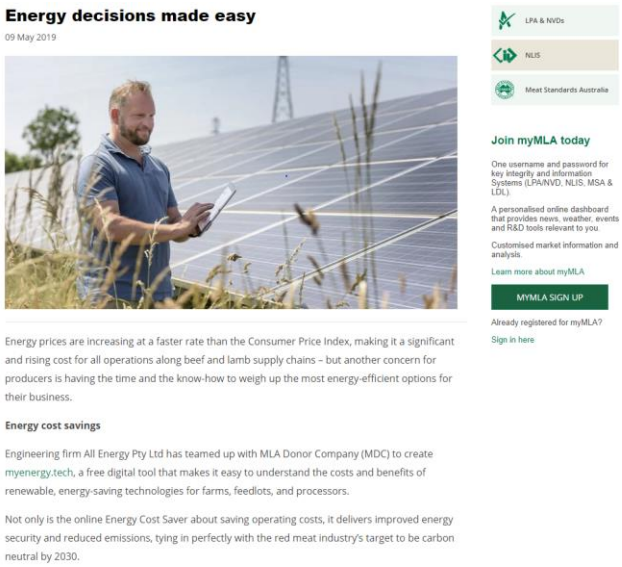
Figure 19: Slide with a QR code for myenergy.tech

Other PR activities that All Energy have been engaged in to promote myenergy.tech include:

- Article in Queensland Country Life (QCL) published online March 2019 available at https://www.queenslandcountrylife.com.au/story/5956369/app-aids-red-meat-industry-cut-costs/
- Radio interview on Rural Queensland Today with Ben Dobbin aired March 2019 available at https://player.whooshkaa.com/episode/350902
- Article on MLA website published May 2019 available at https://www.mla.com.au/news-and-events/industry-news/energy-decisions-made-easy/#
- LinkedIn, Facebook, and All Energy website posts. Search for "All Energy Pty Ltd" on LinkedIn or Facebook, or refer to www.allenergypl.com.au

Figure 20: LinkedIn post announcing the hard launch of myenergy.tech

Figure 21: Article in QCL available at https://www.queenslandcountrylife.com.au/story/5956369/app-aids-red-meat-industry-cut-costs/



Energy decisions made easy

09 May 2019

Energy prices are increasing at a faster rate than the Consumer Price Index, making it a significant and rising cost for all operations along beef and lamb supply chains – but another concern for producers is having the time and the know-how to weigh up the most energy-efficient options for their business.

Energy cost savings

Engineering firm All Energy Pty Ltd has teamed up with MLA Donor Company (MDC) to create myenergy.tech, a free digital tool that makes it easy to understand the costs and benefits of renewable, energy-saving technologies for farms, feedlots, and processors.

Not only is the online Energy Cost Saver about saving operating costs, it delivers improved energy security and reduced emissions, tying in perfectly with the red meat industry's target to be carbon neutral by 2030.

Figure 22: Article on MLA website available at https://www.mla.com.au/news-and-events/industry-news/energy-decisions-made-easy/#

Domain data analytics provides insights to the number of users and the technology class of highest interest. As displayed in Table 2 below, it can be seen that the most popular module is solar PV for producers, with strong interest in the processor modules.

Table 2: Views of myenergy.tech modules

Module	Views
Producer Electric Vehicle	411
Producer Solar PV	424
Feedlot Biomass Boiler	316
Feedlot Solar PV	325
Processor Biogas Generation	406
Processor Biomass Boiler	404
Processor Solar PV	382

As of publishing, there have been 490 uses of the tool, over 817 sessions and 3,207 page views. Plotting these users with major events is shown below in Figure 24.

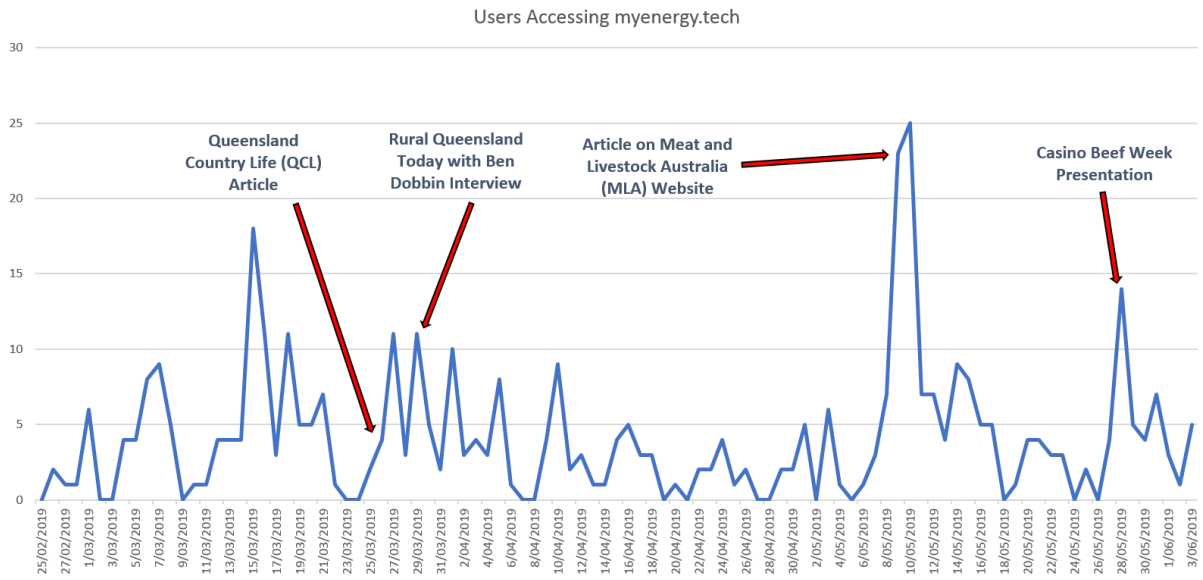


Figure 23: Extract from Google Analytics of myenergy.tech

The practical implications of using this tool and investing in the above renewable energy technologies for the Australian red meat industry are:

- **Reduced power costs:** Renewable energy technologies generally deliver power cheaper than conventional grid tariffs or diesel/petrol generators. As an example, sub-100 kW solar arrays where the small scale technology credits are claimed upfront can provide power for between 4 – 6 c/kWh.

- **Reduced thermal energy costs:** Biomass can be produced for less than $5 /GJ, approximately similar to high LHV bituminous coal as available in Queensland; and significantly cheaper than east coast pipeline natural gas at $15 - $20 /GJ and regional LPG at $30 /GJ and more.

- **Reduced waste disposal costs: Biogas** to energy may be the component of the plant to make an investment in an anaerobic lagoon or intensified tank-style digester viable, saving on liquid trade waste and solid landfilling costs.

- **Improved environmental outcomes and social license to operate:** There is growing pressure in the industry to maintain the clean and green image of Australian red meat; renewables can aid in progressing towards the broad CN30 goal and specific business targets.

- **Reduction in scope 1 and scope 2 greenhouse gas emissions:** Businesses can reduce their scope 1 emissions by offsetting fossil fuels such as coal, natural gas, LPG, and diesel used for thermal energy or on-site power generation with biomass and biogas, both of which contribute no scope 1 emissions due to their biogenic nature, according to Clean Energy Regulator reporting guidelines. Scope 2 emissions can be reduced by offsetting grid electricity with biogas generation and solar PV.

- **Improved relationships with local councils and businesses:** Local councils and businesses can be cooperated with to provide sources of biomass for boilers or additional digestible organic material to boost biogas production in existing digesters. The installation and commissioning of these

plants will employ local skilled workers with a small full-time equivalent (FTE) requirement during operation.

- **Mitigate the effect of future price increases in power and heat:** The above renewable energy technologies allow businesses to take greater control of their thermal and electrical energy supply, for a relatively fixed price over the life of plant. ABS data shows that in the last 2 years, power prices are up 14.5%, natural gas price up 11.2%, versus an economy wide CPI increase of 3.7%. Over the last 10 years, CPI is up 23% versus power at 110%. This kind of exponential growth in power and thermal energy cost can be mitigated by investing in renewable energy.

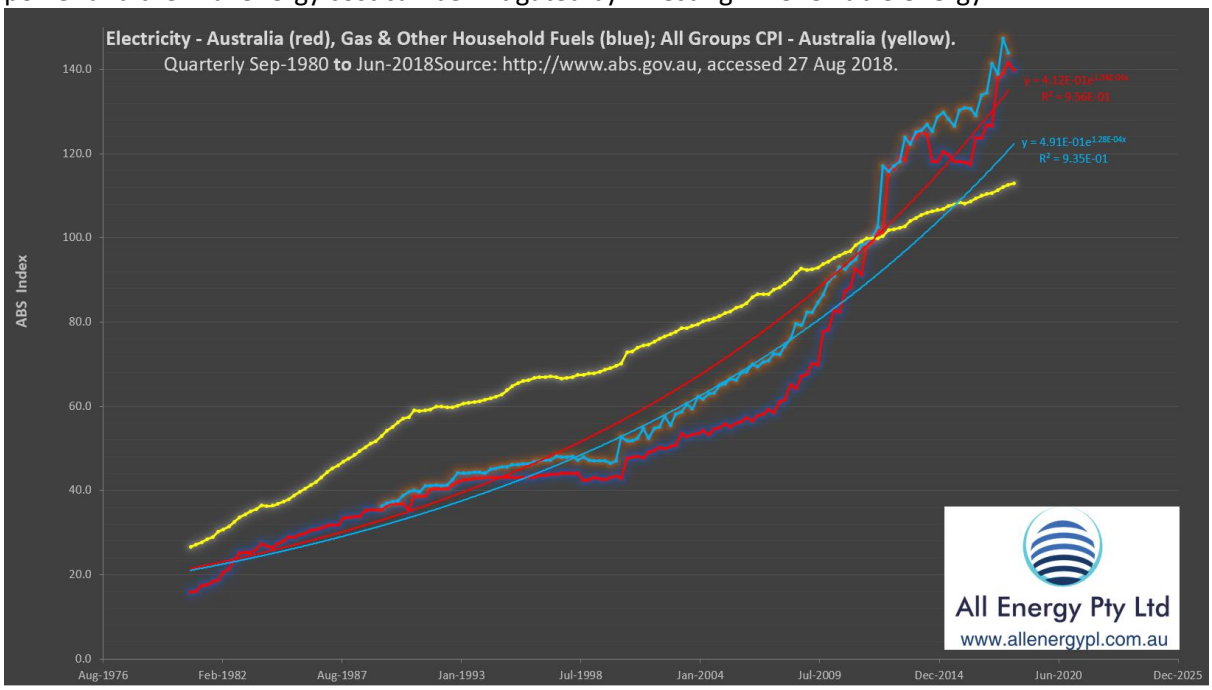


Figure 24: Electricity and gas price versus CPI from 1980 - 2018

- **Buffer against future insecurity of energy supply:** Businesses should take their energy supply into their own hands, bringing power and heat "behind the meter" or within the fence line to protect against security issues of grid stability and quality, proximity to fuel sources, and increasing demand.

- **Avoided capital costs of new/expanded plant:** Viable submissions will be automatically offered financing deals through Verdia; this will remove the greatest obstacle to renewable energy adoption of capital availability and give another level of risk avoidance as Verdia and the Clean Energy Finance Corporation (CEFC) complete their own due diligence before financing projects.

The objective of this project was to develop and energy cost reduction tool from the prototype stage to proof of concept (PoC), to final viable product for a suite of energy cost saving options most suited to the Australian red meat industry, including biogas, PV solar, batteries, and biomass boilers.

6 Conclusions and recommendations for further R&D

It is not recommended for this project to be the end of www.myenergy.tech; this tool was designed to be continually revisited as a facility's circumstances change, e.g. the number of SCUs on feed, power tariff or fuel costs, and biogas generation rate. All Energy Pty Ltd will update the capital cost correlations and economic metrics to keep the tool current to users, this effect will be best observed in the solar PV and battery modules: with a key message being, if a large solar array or battery system is not currently viable for your facility, check back in a few months as the price point and technical performance of these technologies is improving rapidly.

There exists the opportunity for creating and releasing additional modules on this platform such as:

- Use of fuel created within the RMI supply chain, with one specific exciting opportunity being renewable boiler fuel from tree plantations that can also create carbon credits, provide visual / odour screens and enable co-grazing.
- Covered Anaerobic Lagoons (CALs)
- Continuously Stirred Tank Reactor (CSTR) style anaerobic digestion
- Paunch / organics palletisation and use as boiler fuel.
- Modular gasification of organics and use as boiler fuel or for electricity generation
- Hydrogen for transport fuel and as a method of valorising wastewater.
- This platform could be extended in energy related areas such as sterilization water recycling for boiler make up water. It is of a high purity and elevated temperature which lends itself well to this use.
- Energy efficiency measures that have been identified as suitable for feedlots and producers including voltage optimisation (VO), power factor correction (PFC), supercapacitors, and energy management systems (EMS)
- Thermal energy efficiency at feedlots and processors

-

The SaaS format could be a "clearing house" for taking innovative or proven ideas from a static report into a dynamic digital tool so that larger numbers of people can comprehend. As a specific example:

> An innovative, low capex low energy technology is available for:
>
> [1] drying and pelletizing of paunch into a solid boiler fuel for use in RMPS, feedlots, or sale to the market,
> [2] the same technology can be used for drying and sterilizing sludges and other organics to reduce transport costs and improve spreadability of fertilizer,
> [3] the same technology can be used by feedlots for pelletising flaked grains and to produce in-house pellets for other parts of the business / sale to the market.
>
> A module can be built to define the major parameters of the capex for the technology: starting moisture, end moisture, tonnage throughputs, odour management, etc. The module can then be built out by groups inputting their own key parameters to model the above technologies:
>
> [1] current fuel costs; new or re-purposed boiler; current waste management costs; current power costs.
> [2] current fertilizer costs; current waste management costs; current power costs; distance to point of use; use of fertilizer in carbon farming.
> [3] current pellet / feed costs; current power costs; distance to point of use.

Correlations on how key parameters impact the capex of different plant configurations will be important. If a vendor is not able to provide this key capex information, then the technology may be too early for commercial utilization. The opex / cost savings / revenue for each plant configuration will need to be defined.

As mentioned earlier, the producer mass and energy balances and modules could be refined with further study into how a "typical" producer procures and consumes fuel and electricity, and relating this back to a single input variable of head, similar to the feedlot input variable of SCUs on feed. This will further simplify the use of this tool for producers and increase adoption in this key area of the supply chain (~49,000 members).

7 Key messages

General messages from red meat industry energy strategies and associated action items are

- **The red meat industry must urgently decouple from imported fuels (i.e. diesel and LPG)**
  - Imported fuels are subject to high price volatility from international politics (e.g. OPEC and Middle East politics). This also threatens the fuel security of these fuels. Local biofuels are lower cost and higher security as there are multiple available supply streams within a short radius of feedlot locations.
  - Where a producer is significantly reliant on diesel for power generation, this can be offset by solar PV. Reliance on LPG at feedlots can be mitigated by biomass.

- **The red meat industry must decouple from fuels exposed to international pricing mechanisms (i.e. natural gas)**
  - Domestic natural gas pricing is being driven upwards from demand in Japan, China, and Korea, where high LHV Australian gas that was historically available domestically for a comparatively low price is being locked up into long-term export contracts with Queensland LNG export projects. This is bringing wholesale gas prices in Australia closer to parity with the Asian markets, resulting in significant year on year increases in the price of natural gas to consumers in the Australian red meat industry.
  - This can be mitigated by signing longer-term supply contracts; however the general trend of natural gas pricing remains, hence processors and feedlots could consider biomass and/or biogas as a replacement.

- **The red meat industry must decouple from emissions intensive fuels (i.e. fossil fuels) within 5 years**
  - When (not if) emissions pricing mechanisms are reintroduced into the Australian market, whether these take the form of broad based emissions pricing, narrower scope pricing, or emissions trading schemes, larger emitters of GHGs in the Australian RMI may be liable and vulnerable to a significant annual cost increase. All biological fuels or sources of energy, including woodchip, manure, biogas, straw etc are counted by the Clean Energy Regulator as "zero emission" as any carbon emitted via combustion is not being added to the atmosphere, only recycled.

- **The red meat industry must decouple from the conventional power grid (where connected) as soon as is viable**
  - The effects of emissions pricing can be dramatically seen in the wholesale and retail spikes in power during 2011/2012 where some states observed an over 100% increase

in prices over a single year. With a precedent for such increases and continued extortionate practices of time-of-use tariffs in regional areas charging as much as 50 c/kWh, with these transient tariffs expiring before 2020 where consumers will then be charged 60 c/kWh, it can be seen why medium-large consumers in the Australian supply chain must disconnect as soon as is possible and viable and generate their own power within their boundary. At the very least, it is in the interest of all red meat producers, feedlots, and processors to investigate renegotiating their tariff class.

- Solar PV and reciprocating engines are suitable technologies to generate up to 100% of electrical energy within a site's boundary. Other options such as concentrated solar exist, however without significant funding assistance and long term delivery models, are not currently viable.