Submission on:

"Process Heat in New Zealand: Opportunities and barriers to lowering emissions" Technical paper

from

Ballance Agri-Nutrients Limited

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Commercial Sensitivity

Nothing in this submission is confidential.

1 Introduction

Ballance Agri-Nutrients Limited ("Ballance") would like to thank the Ministry of Business, innovation & Employment and The Energy Efficiency and Conservation Authority for the opportunity to make this submission on the "Process Heat in New Zealand: Opportunities and barriers to lowering emissions" Technical paper, released January 2019.

Ballance has been actively engaged in the low emission economy consultation processes with recent submissions to the Productiveity Commission and Ministry for the Environment.

Company Overview
Ballance is a farmer-owned co-operative with over 18,000 shareholders and approximately 800 staff throughout New Zealand. Ballance owns and operates super-phosphate manufacturing plants located in Tauranga and Invercargill, as well as New Zealand's only ammonia-urea manufacturing plant located at Kapuni, South Taranaki. The Company also owns and operates 'SuperAir', an agricultural aviation company; 'SealesWinslow', a high-performance compound stock food manufacturer. Ballance has a network of fertiliser storage and dispatch facilities across the country.

As well as supporting New Zealand farmers, Ballance also supplies products to a range of domestic industrial businesses including the domestic wood processing sector:

- Urea, is used in the production of formaldehyde based resins, a key ingredient in the manufacture of particleboard and MDF.

- In addition, an extremely high purity urea solution is used to produce GoClear at the Kapuni plant. GoClear is an exhaust system additive and scrubbing agent that reduces harmful nitrogen oxide (NOx) emissions from diesel engines, breaking the NOx down into harmless water vapour and nitrogen gas.

Ballance places a strong emphasis on delivering value to its shareholders and on the use of the best science to inform and deliver sustainable nutrient management.

2 Ballance's interest in Process Heat in New Zealand

2.1 Description of Ballance Process Heat and Fuels Balance

Ballance's operations are energy intensive and in the case of the ammonia urea plant directly impacted by the New Zealand Emissions Trading Scheme (NZ ETS):

- The Kapuni Urea manufacturing facility is an Emissions Intense Trade Exposed (EITE) industry competing against imported Urea. The Kapuni Plant uses natural gas as both a feed stock, fuel for our large engines and to generate high grade process energy;
    - The facility has heavily integrated heat recovery technologies such as pinch technology to minimise process heat requirements.
    - The Kapuni plant production meets approximately one third of New Zealand's demand for urea. Remaining demand is met through imports sourced primarily from the Middle East, Far East and China. Ballance is therefore in direct competition against countries with less stringent international climate change obligations.
    - Please see Attachment 1 for an overview of the Kapuni plant.

- **Energy use at the Kapuni Site:**
    - The Kapuni site uses 7PJ – 7.5PJ of natural gas annually.
    - 53% of natural gas use is as the raw material in the manufacture of Ammonia and Urea. Natural gas provides Hydrogen used in the production of ammonia and carbon used in the production of urea.
    - High grade heat is used in the reformer to crack natural gas at temperatures greater than 600 °C. The reformer accounts for 20% of total site natural gas use. Extensive heat integration, is used to recover waste heat which is used elsewhere in the process.
    - Kapuni operates 3 large compressors which are powered by natural gas; these compressors use 14% of total energy.
    - Only 9% of the natural gas at Kapuni is used for steam raising and electricity generation which is produced from an integrated cogeneration plant.
    - Electricity is used for motive power (for pumps, small compressors, air cooling fans) which is sourced internally from the cogen plant and from the national grid.
- Carbon dioxide produced during the reforming process is recovered and used in the manufacturing of Urea together with additional Carbon Dioxide sourced externally.

Table 1 presents an overview of the fuel switch potential for the Kapuni Site.

Table 1 - Kapuni Ammonia Urea Plant Fuel Switch Potential Overview

Service	Current Fuel	Annual Consumption	Alternatives
Feedstock and Reforming	Natural Gas	5.1PJ	Partial substitution of natural gas for hydrogen manufacture may be possible, e.g. through electrolysis, but this is not yet commercially viable at scale.
Compression	Natural Gas	1PJ	Substitution within the current plant is not possible
Cogeneration	Natural Gas	0.7PJ	Partial substitution is possible. However, grid supply reliability is a key limitation (Taranaki's vulnerability to lightning strikes is a factor).

The Mount Manganui Super phosphate site recovers waste heat from the production of sulphuric acid which is then used to generate electricity for internal use and export to the grid.

2.2 Ballance Energy Management

- Energy management is a foundation activity for the Ballance ammonia urea plant. Energy is the largest cost for the facility and is monitored in real time by our operational staff. Energy performance is reported daily to senior management and monthly within the Kapuni Board papers.
- Energy KPI's include;
    - Process Gas conversion efficiency
    - Fuel gas consumption by all uses (Cogen, reforming, compression)
- Ballance has and continues to actively investigated Energy Efficiency Projects including the replacement of existing ammonia urea plant to realise energy efficiency improvements.
- Ballance regularly benchmarks performance of the Kapuni site versus international ammonia and urea plants.

2.3 Future of Urea and other Products

- Demand for Urea, and Ballance's other product lines, is expected to continue and grow in both agricultural and industrial applications.
- With the right policy settings, domestic manufacture will continue to make a strong economic contribution to New Zealand.

3 Submission Points

3.1 Commentary on Technical Paper

Ballance has some broad comments on the following paragraphs:

- Para 21 "Other factors" should include:
    - Safety considerations & controllability regarding fuel / energy security of supply.
- Para 26 "in built technologies"
    - The statements are endorsed overall but incremental gains are possible:
        - Petrochemical sites are highly complex and require regular replacement of equipment. All replacement projects consider best practice technologies and materials resulting in incremental performance and efficiency gains.
        - 'Internet of Things' and Control systems improvements allow for more consistent monitoring and operation of the plant.
- Para 30 "reducing industrial process emissions…"
    - We disagree that end of life replacement is the main / only means to reduce emissions – refer comments on para 26 above.
- Para 31 – understanding industries
    - Ballance endorses a case-by case analysis, but any analysis should be done in conjunction with the firm.
    - Ballance would welcome the opportunity to discuss our operations with both MBIE and EECA.
- Para 32 – High carbon price
    - We endorse the recognition of the risk of emissions leakage through loss of domestic manufacture.
    - As stated in section 2.3 above, even at very high global carbon prices, the requirement for urea will remain for many decades to come.

3.2 Specific Submission Points

Q1: To what extent has the NZ ETS influenced process heat investments in your business?

- Ballance takes full account of current and future carbon prices when making investment decisions.

Q2: To what extent do you agree that businesses are accounting for the price (and future price) of emissions, but face other barriers to reducing process heat related emissions?

- Ballance strongly agrees that other considerations are required when considering energy supply. Reliability of energy supply as well as plant specific requirements must be considered to ensure the safety of people, protection of equipment and the environment and to maintain reliability of safe operations.

Q3: To what extent do you agree that businesses are accounting for emissions prices but are unresponsive to changes in the emissions price?

- We note that minimal opportunity exists for fuel switching in response to carbon price.

Q4: Does the NZ ETS provide an incentive to significantly reduce emissions beyond current levels for business who receive industrial allocation?

- YES – every tonne of emissions saved retains the full value of the emission price as the opportunity value of being able to sell a unit instead of having to surrender it remains.
    - It is disappointing to see this matter relitigated and being characterised as a "market failure" in para 43. This issue has been discussed at length during the development of the NZ ETS and the decisions on an appropriate EITE sector allocation regime
- To provide context, Ballance's position on allocation, as set out in prior submission to the NZ ETS review is provided below:
    - EITE industries compete with international producers both domestically and intentionally. The NZ ETS only captures locally produced products and therefore requires EITE business' to absorb carbon emission costs rather than passing these through to the end customers.
    - Ballance supports the NZ ETS as the primary greenhouse gas emissions policy instrument. As an EITE industry we seek fairness versus imported products, to achieve this we believe the current industrial allocation methodology is the appropriate tool.
    - We support the industrial allocation approach as it provides an appropriate incentive and recognition for industry to lower carbon emissions and invest in the introduction of alternative low carbon manufacturing techniques where available. The Industrial allocation is important to the development of low carbon manufacturing methods as it allows local production (including those produced via low carbon technologies) to compete with imported products from counties without carbon policies
    - Phase out of the industrial allocation should only commence when a material proportion of competitor trade adopt an auditable carbon price policy comparable to New Zealand's. It would be ethically inappropriate for New Zealand to obviate responsibility for its carbon emissions onto the rest of the world through policy that leads to carbon leakage.
    - Ballance is actively investigating how it can support the development of New Zealand's low emissions economy. In our view uncertainty in carbon policy remains a significant barrier to the NZ ETS functioning as an effective incentive to significantly reduce emissions.

Q5: To what extent does your business ring-fence capital for energy related projects?

- Capital is not ring fenced for energy related projects

Q6: To what extent are objectives such as sustainability incorporated into your organisations investments, i.e. is sustainability included in your KPIs?

- Ballance considers business sustainability to encompass the culture or our workplaces, development of people, the enduring demand for products, the availability and cost of raw materials and the impact of operations on the communities we operate in.
- Ballance top level KPIs include measures for engagement, emissions, energy efficiency, environmental performance and development of new markets and diversification of products from our sites. These KPI's are included in both management and board reporting.

Q7: Are these objectives considered secondary to risk and return?

- No; sustainability is critical to maintaining our social license to operate, stakeholder reputation and in turn enhance profitability.

Q8: Do you agree that energy efficiency or renewable projects are often not implemented as they are not core business investments?

- No.

Q9: Is your business limited by access to capital for energy related investments? Is this due to lender appetite or are these limits self-imposed?

- Gas availability faces an uncertain future in New Zealand now, as a result of the Government's April 2018 decision. This adds a complex dimension for energy intensive businesses considering refurbishing, replacing or investing in greenfield energy efficiency projects. There is significant uncertainty for investment where the risk to gas supply is now greatly elevated.
- As a result of the political process investment strategies favour small incremental development over large investments required to achieve a step change reduction in New Zealand's emission profile.

Q10: To what extent do hidden costs or co-benefits (as described above) hinder or progress process heat investments?

- Urea manufacture is a 24/7 operation where the requirement to carry out maintenance / projects in a planned shutdown period (typically set by statutory inspection intervals or planned maintenance e.g. catalyst replacement) determines the window of opportunity.
- For this reason, projects must be carefully scoped and planned.

Q11: Does your organisation actively monitor its energy use and/or its emissions?

- Yes

Q12: Do you think that there would be benefits from publishing individual emissions data reported by NZ ETS participants and/or large process heat users?

- No – this information is or can be commercially sensitive and would provide international competitors with unwelcome insights into Ballance' business.

Q13: Do any of the informational barriers described above have an impact on your organisation's decision to invest in process heat technologies, and if so, to what extent?

- No – Ballance engages international consultants and regularly compares itself against international benchmarking.

Q14: Could you please rank the three informational barriers as listed directly above this box in order of impact on your organisation?

- Ranking is inappropriate
- Ensuring the safety of staff, the plant and the environment is critical in investment decision making:
    - Ballance would only ever employ proven technology (para 67).
    - As a major hazard facility and significant supplier of nitrogen to New Zealand farmers, Ballance cannot take risk of employing non-proven technology which may place people at risk of harm or lead to disruption to product supply/ quality (para 66).

Q15: Has your organisation considered electrifying part or all of a given site's heating process?

- No – Technology is unavailable at this time however Hydrogen from electrolysis is a potential long-term opportunity

Q16: If so, to what extent do you agree with the barriers I to K listed above?

- Reliability of the electricity network (particularly the national grid) is a barrier to greater use of electricity in complex industrial processes. Short duration disruption events result in long duration plant outages and restarts. In the case of the Ballance Ammonia Urea Plant electricity supply disruption is a leading cause of plant outages and increased process heat consumption.
- Increasingly sophisticated automation technology and control systems are placing greater demand on electricity supply reliability. On current electricity supply performance, potential process efficiencies are not realised.

Q17: What does your organisation consider are the largest barriers to the electrification of its production?

- Technology development pace and costs relative to international producers. As discussed earlier under the current ETS, local low emission producers compete in New Zealand against international producers who are not exposed to carbon pricing.

Q18: Are there any costs or co-benefits of electrification that we have not included that your organisation has identified?

- Grid supplied electricity pricing mechanism builds in a C-price even when the generation is largely renewable (when fossil fuel is on margin) as evidenced by the need to develop the electricity allocation factor for EITE allocation[1].
- This negates New Zealand's "low cost renewable" advantage when evaluating increasing electricity use.
- Increased volatility in electricity prices caused by increased renewable electricity generation is an issue for manufacturing processes, particularly when the nature of their processes are not able to reduce demand or reduce demand quickly.

Q19: Has your organisation considered biomass as a fuel source? If so, what did you conclude and why?

- Biomass is not appropriate due to the nature of the production technology.

Q20: To what extent do you agree with the barriers L to M listed above?

- N/A

Q21: What does your organisation consider to be the largest barrier(s) to the use of biomass for supplying heat?

- N/A

Q22: Has your organisation identified any costs or co-benefits of using biomass that we have not included above?

- N/A

Q23: Has your organisation considered building onsite generation? If so, why did the project go ahead or not go ahead?

- Both the Kapuni and Mount Manganui sites have onsite generation.
- For Kapuni on site generation provides:
    - Security of electricity supply which protects critical equipment against grid outages and increases reliability.
    - Operating cost advantages in conjunction with steam raising.
- At the Mount Manganui site generation utilises waste heat with excess generation exported to the local network.

Q24: Are there any barriers to, or co-benefits from, the use of onsite generation that we have not included that your organisation has encountered?

[1] http://www.mfe.govt.nz/consultation/consultation-setting-electricity-allocation-factor

- True avoidance of carbon cost is possible through onsite generation from waste heat (where energy is produced from exothermic reactions within the process) or where renewables are used.
- Onsite generation allows pricing of electricity to be based on project economics rather than spot pricing methodology allowing for certainty in project returns

Q25: Does your organisation have the potential to use direct heat from geothermal?

- No

Q26: If so, what are the key barriers that hinder your organisation from using direct heat from geothermal?

- N/A

Q27: Has your organisation identified any other barriers to, or co-benefits from, the direct use of geothermal heat that we have not included above?

- N/A

Ballance notes that the Technical Paper does not include questions on switching from coal to natural gas… para 111-118. This is a significant oversight:

- Gas availability faces an uncertain future in New Zealand now, as a result of the Government's April 2018 decision. This adds a complex dimension for energy intensive businesses considering refurbishing, replacing or investing in greenfield energy efficiency projects. There is significant uncertainty for investment where the risk to gas supply is now greatly elevated.
- Government decisions made on gas exploration affect investment decisions to switch from Coal to cleaner burning natural gas. In the long term this will lead to increased reliance on coal

We also note that there are no questions on hydrogen (para 119-121)

- Ballance cautions against placing heavy reliance on the Concept Consulting report "H2 in NZ – A study of the potential economics of hydrogen technology".
- Ballance continues to evaluate and implement measures to improve its energy and emissions performance. For the Kapuni plant this includes evaluation of long-term technologies which may enable "green urea" production through the substitution of natural gas sourced hydrogen with hydrogen produced through hydrolysis using New Zealand's renewable electricity advantage.
- Inappropriate policy settings which lead to high carbon prices on domestic urea manufacture (but not imports) and/or premature phase-down of industrial allocation could jeopardise these opportunities.

Attachment 1 – Kapuni Ammonia–Urea Plant Details

Ballance owns and operates New Zealand's only ammonia-urea plant located on a 32.4 hectare site at Kapuni in South Taranaki.

Using some 7 petajoules (PJ) of natural gas, the plant produces 150,000 tonnes of ammonia per year, over 99% of which is converted to 265,000 tonnes a year of premium grade granular urea. The high quality granular urea product is used as a nitrogen-rich fertiliser in the agricultural, horticultural and forestry sectors, and as a component in the manufacture of other products (primarily resins).

The Kapuni plant production meets approximately one third of New Zealand's demand for urea. Remaining demand is met through imports sourced primarily from the Middle East, Far East and China. Ballance is therefore in direct competition against countries with less stringent international climate change obligations.

The company makes a significant economic contribution to the local economy and employs 130 permanent staff and 17 full time contractors.

The Kapuni Ammonia-Urea Plant

1) The location and scale of Kapuni site is show below (Figure 1).

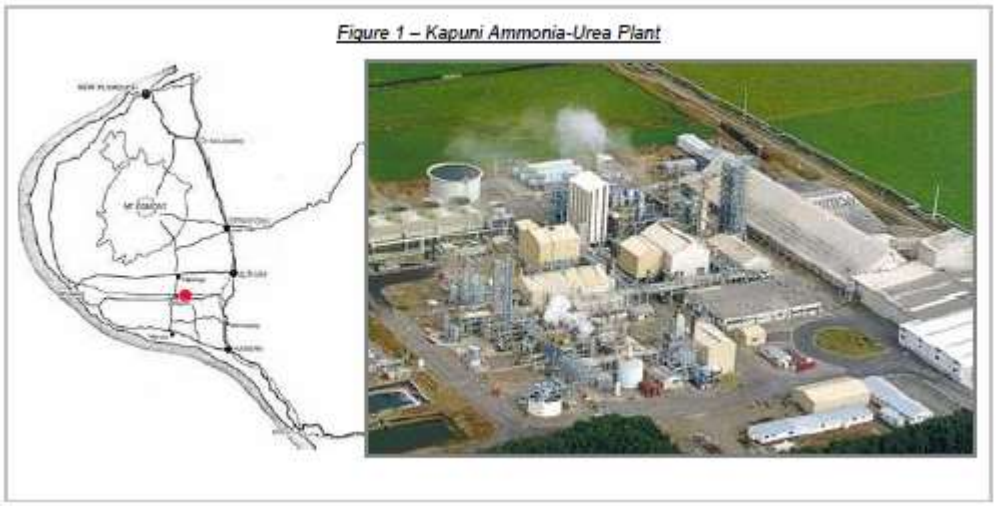


Figure 1 – Kapuni Ammonia-Urea Plant

2) The plant, which commenced operation in 1983, was built to make use of the Government's "take or pay" gas contract arrangements at the nearby gas fields.

3) The plant was designed from the outset as a single site integrated ammonia-urea plant, ammonia being an intermediate product in the conversion of natural gas to urea.

4) The plant was one of a series of "Think Big" projects instigated by the Muldoon led National Government.2 It was envisaged that the plant would help New Zealand's balance of payments by exporting urea, however New Zealand's current demand of 850,000 tonnes now exceeds plant production resulting in all sales being domestic.

5) The plant was revamped in 1996 to increase production and reduce energy use through closer heat integration of the ammonia and urea sections of the plant.

6) The process is described in detail in Attachment 1 and is summarised in Figures 2-3 below, which show the primary chemical reactions and the location in the plant of the activities.

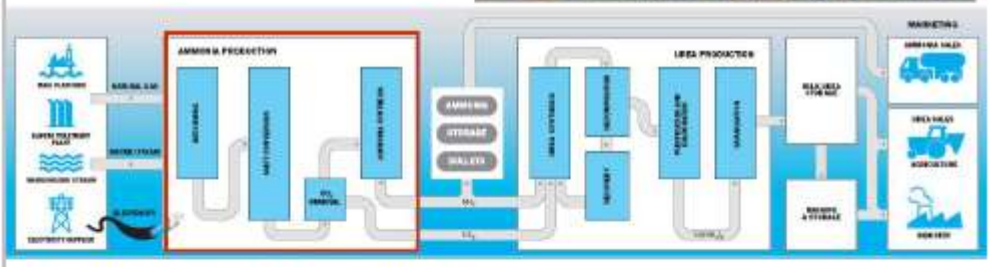
Figure 2 – Ammonia Production Step

$CH_4 + 2H_2O \Leftrightarrow 4H_2 + CO_2$

gas + steam ⇔ hydrogen + carbon dioxide

$N_2 + 3H_2 \Leftrightarrow 2\,NH_3$

nitrogen + hydrogen ⇔ ammonia



Notes (typical production statistics shown):

- *Natural gas feedstock is predominantly specification gas (7PJ).*
- *Ammonia production is 150,000 tonnes per annum.*
  - *There is a small intermediate storage capacity of 450 tonnes ammonia (1 days production if full). This is primarily to allow sequential (ammonia then urea) start up of the plant and to provide a buffer for any minor upsets.*
- *Carbon dioxide production is 195,000 tonnes per annum.*
  - *There is no intermediate storage of carbon dioxide.*

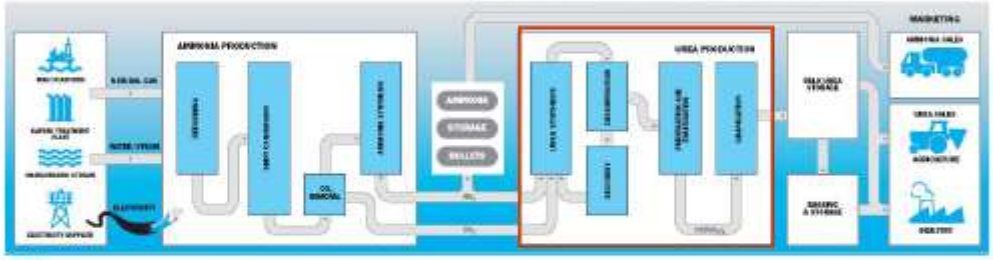
Figure 3 – Urea Production Step

$2\ NH_3 + CO_2 \Leftrightarrow NH_2COONH_4$

ammonia + carbon dioxide ⇔ ammonium carbamate

$NH_2COONH_4 \Leftrightarrow H_2O + NH_2CONH_2$

ammonium carbamate ⇔ water + urea



Notes:

- *All of the ammonia and carbon dioxide from the ammonia production step is converted to 265,000 tonnes of urea per annum.*
- *The urea is produced in granular form allowing easy transportation with no hazardous chemical shipping requirements.*
- *The urea is shipped in bulk and packaged form by road or by rail.*
- *Approximately 5 million litres of GoClear urea solution is produced per annum – GoClear is an exhaust system additive and scrubbing agent that reduces nitrogen oxide emissions from diesel engines, enabling truck operators to run low-emission and efficient vehicle fleets.*

7) As an integrated ammonia-urea plant, there is common infrastructure which yield energy efficiency gains and cost savings:

- Cogen (Electricity and Steam)
- Steam mains + heat integration
- Demineralised water for boilers
- Clarified water + cooling water system
- Control Room & Services
- Effluent Treatment
- Utility air supply