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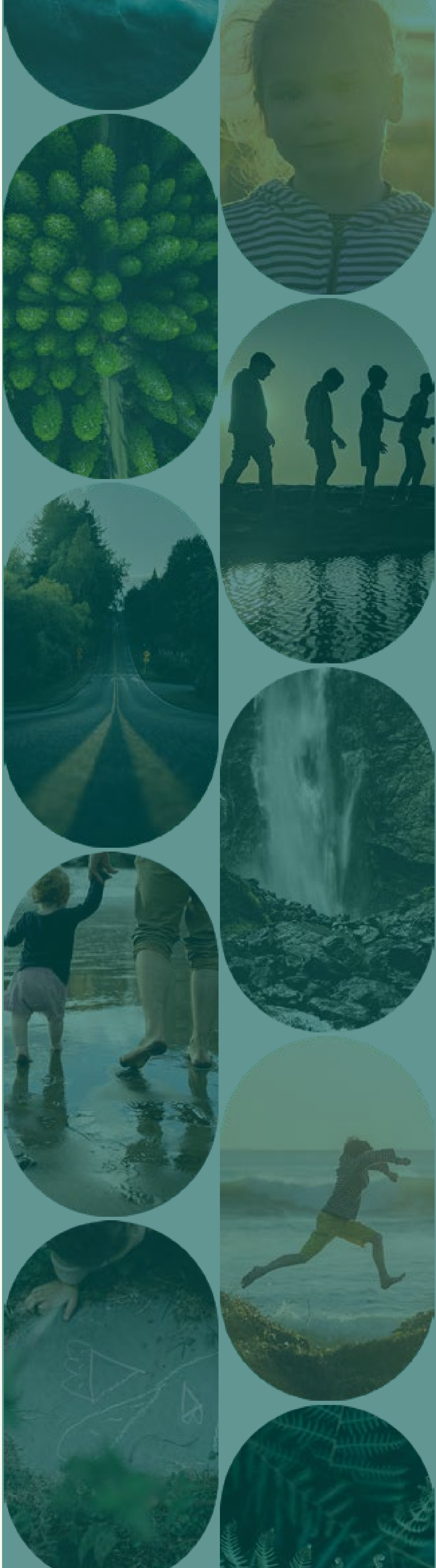
Climate Change Commission

Non-Cost Decarbonisation Barriers for Process Heat

13 April 2023



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Executive Summary

Decarbonisation of process heat for sites seeking to reduce carbon emissions is hindered by a range of barriers – much information is available regarding cost barriers, but there is less available regarding non-cost barriers.

This study has canvassed a range of process heat decarbonisation stakeholders, and has identified some key non-cost barriers:

- Electricity Distribution Business (EDB) processes and setup.
- The biomass market setup.
- Future uncertainties regarding pricing and technology.
- Unexpectedly onerous consenting.
- Insufficient information regarding technology.

Lack of equipment availability, poor data availability and subsequent system design, labour constraints, site characteristics, and overall company direction not prioritising decarbonisation are obstacles that varied in scale among sectors.

Addressing the major non-cost barriers requires a multi-faceted approach that includes establishing:

- **Decarbonisation Resource Centre:** A central hub of information and resources to inform sites on decarbonisation technology and challenges and serve as a bridging point between experts and sites.
- **EDB Support Organisation:** An organisation that acts as a support to all 29 electricity distribution businesses. This organisation will provide guidance to align all EDB processes and reduce the delays associated with these processes, staffing to help alleviate resourcing issues within EDBs during peak periods, and pre-purchasing of common equipment to help with delays and internal EDB capital cost mechanisms.
- **Cohesive biomass market:** Providing a central hub for purchasing biomass through regional pricing nodes. These nodes will provide valuable information regarding market trends and pricing, therefore reducing future uncertainties.

Such an approach will be critical to accelerating the transition to low-carbon process heat, reducing emissions, and achieving a net-zero future.

In order to summarise and convey the findings of this report more easily, DETA has prepared an Info-graphic which is included in Appendix A.

1. Introduction

Process heat refers to thermal energy used in industrial manufacturing processes for heating, drying, or sterilising, often in the form of steam or hot water. In New Zealand, process heat is primarily sourced from the combustion of fossil fuels, such as coal or natural gas and emissions amount to 6 $MtCO_2e$ or nearly 8% of gross emissions[1].

Decarbonising process heat is a critical step towards reducing greenhouse gas emissions and mitigating the impacts of climate change. The process of decarbonisation can be particularly challenging, with numerous barriers and obstacles that can impede progress.

The ease of decarbonisation of process heat varies greatly between sectors. Site-specific factors also play a large role, with electricity supply, local biomass supply and physical site characteristics affecting the feasibility to decarbonise.

EECA's Accelerating the Decarbonisation of Process Heat report[2] highlights a few of these barriers and the corresponding issues that arise with them. While there is a wealth of knowledge in the EECA report, there is a large focus on cost barriers. This present report will instead focus on non-cost barriers encountered by sites that wish to transition away from fossil fuel-powered boilers.

In this report, non-cost barriers are considered to be barriers not directly associated with the cost of transition. For example, the price of electricity is a cost barrier, but uncertainty around the future cost of electricity is considered to be a non-cost barrier.

To gain a comprehensive understanding of the barriers to process heat decarbonisation, several decarbonisation partners and industry experts were contacted regarding this topic and potential interventions. The following industry experts were engaged:

- Lyttleton Engineering
- Powernet
- Active Refrigeration
- BANZ
- CEP
- EA Networks

Further to conversations with industry experts, DETA also held an internal workshop and subsequent interviews to understand what non-cost barriers have impacted decarbonisation projects DETA has been involved with, and how these barriers have been

[1] https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/evidence/advice-report-DRAFT-1ST-FEB/Evidence-CH-04a-Reducing-emissions-HIP-20-Jan-2021.pdf
[2] https://www.eeca.govt.nz/insights/eeca-insights/accelerating-the-decarbonisation-of-process-heat/

overcome. This internal knowledge is unique as it follows projects from feasibility studies all the way to actual project implementation. Industries covered by these interviews cover:

- Dairy processing
- Meat processing
- Food processing
- Drinks manufacturing
- Wood processing
- General industrial

The staff interviewed have been involved with decarbonisation projects at over 100 sites, encompassing 1,000 MW of installed process heat. This correlates to approximately 20% of New Zealand's total process heat capacity. Additionally, a review of our internal boiler and decarbonisation database was performed to further inform the barriers – this database covers approximately 70% of process heat capacity in the country.

The following sections of this report outline the generalised barriers identified during this project, followed by potential mitigation actions in Section 11. These barriers are split into two categories: key non-cost barriers, and ancillary non-cost barriers.

Key non-cost barriers, which are barriers which have been noticed to significantly influence project timing and initiation, are as follows:

- Electricity Distribution Business (EDB) processes and setup.
- The biomass market setup.
- Future uncertainties regarding pricing and technology.
- Unexpectedly onerous consenting.
- Insufficient information regarding technology.

Ancillary non-cost barriers, which are barriers that have influenced project timing and initiation, but are only prominent to specific industries, company dependent, or are a flow on barrier from a key non-cost barrier. These are as follows:

- Site/Process characteristics
- Equipment availability
- Labour constraints
- Poor data availability
- Overall company directions and systems

It should be noted that this report is partly based on interviews held with industry experts. Where possible we have confirmed their commentary through comparison to similar projects, but there are some items where this could not be done.

2. EDB Processes

2.1 Barrier Description

In the past, Electricity Distribution Businesses (EDBs) have largely been tasked with the ongoing maintenance and improvement of their networks, along with small incremental upgrades. Large upgrades also occur, but these are typically planned over a long period (such as new subdivisions and industrial factories which might have 3-5 year planning windows).

Further, given that EDBs are primarily monopolies that cover a relatively small area each, there are stringent regulations around the amount of spending and cost allocations within their networks. While these EDBs may have the capital and the desire to implement upgrades necessary for site electrification, they are often unable to meet the clients' internal investment parameters i.e. projects that are too expensive to justify implementation.

Given the above, the fundamental setup of the EDBs clashes with the current decarbonisation push:

- Decarbonisation projects occur on a much shorter timeline than EDBs are used to - GIDI applications incentivise a <6-month plan/design for decarbonisation, with implementation as soon as possible after that, typically within 12 months.
- EDBs cannot invest proactively in the network without the ability to recover those costs fairly due to the default price paths allowed by the Commerce Commission.
- EDB resources and systems vary significantly around the country, creating staffing and process barriers to decarbonisation projects.
- EDBs are generally committed to supplying N-1 electricity, but this may not be required for specific site decarbonisation.

The above results in the following:

- EDBs being understaffed to facilitate peaky, large decarbonisation projects – the further impact of this includes:
    - Difficult and slow communication regarding the feasibility of increasing site electrical capacity.
    - Limited capacity to design and quote for possible upgrades required, in particular where designs are iterative to try and minimise costs and maximise benefits.
- EDBs have developed their own processes and pricing mechanisms, therefore, organisations with sites across multiple EDB regions have to engage multiple times with different requirements and rules on each occasion.
- There can be a first-mover advantage/disadvantage if the project doesn't/does trigger a network upgrade. This sees the costs and benefits of the upgrades spread unevenly, purely dependent on the time of implementation. Even with EECA's

proposed GIDI Support for lines upgrades, the time and effort disproportionally impact the first mover.

The above means that time spent in the feasibility stage is higher than ideal and can discourage further action due to the slow-moving and time-consuming nature of engagement. The flow on effects from above can include:

- Project delays through the feasibility phase.
- Project delays due to the time taken for network upgrades.
- Projects not proceeding because the network upgrade cost is too great to justify the decarbonisation project, where a lower-cost solution could potentially be available.
- Risk of inefficient upgrade sequence.

2.2 Scale and Importance

EDB engagement is encountered on most decarbonisation projects with an increased electrical supply to site, but the issues are location and site specific. Where they do occur, they can create moderate issues for the project.

Specific examples which have impacted decarbonisation projects include:

- A processing plant installing an electrode boiler to decarbonise. However, there is insufficient N-1 network capacity to operate the boiler at full load, so a diesel boiler has been added to provide peak heating. When a solution can be found to upgrade the site capacity (through an upgrade or facilitating an acceptable N supply), the electrode boiler will operate at full capacity, maximising decarbonisation potential.
- A project upgrade for a facility was delayed due to slow design and contracting with the EDB. This meant that the transformer was ordered later than required, and the delayed delivery date resulted in the project missing the required plant shut period for initiation. There has been a 6-month delay to wait for the next plant shutdown to complete the installation.
- A facility was investigating an electrode boiler and was told that there is 2 MW of spare capacity in the township where it is located. This 2 MW has multiple users interested in it – the first was told that there was a relatively low upgrade cost and once the capacity has been reached a significantly larger network is required to provide additional power. Users who want additional capacity after the spare 2 MW is taken will have to invest time, money, and resources into the required upgrades.

2.3 Potential Interventions

- EBDs could provide long-term investment road maps incorporating potential electrification demand.
- Government-funded and resourced design team to help EDBs with peaky workloads.
- Central guidance on systems, processes and pricing.
- Combining small EDBs.

3. Biomass Market

3.1 Barrier Description

While biomass has been grown, processed, and sold in New Zealand for generations, the trading of biomass for use as a boiler fuel is a relatively recent occurrence. Thus, the industry is very immature when compared to others, such as coal, electricity, and gas – this is true both for wood suppliers and users.

Further, the biomass market is quite different to other fuel markets that many users are familiar with, including:

- The time from tree planting to harvest is long (~30 years), therefore there needs to be long-term planning regarding demand (including plans for site growth) and supply to ensure a functioning and effective market.
- Biomass as a boiler fuel has historically been a secondary market, with the export log market driving the overall direction of the industry. This is changing, but the log market acts as an expensive cap to the boiler fuel market.
- Multiple markets are competing for most types biomass e.g., MDF and pulp/paper purchase large amounts of low-grade wood. Other decarbonisation programmes (such as liquid biofuels) are expected to use biomass supplies also.
- Biomass purchasing requires a bespoke approach (when compared to electricity, gas or even coal) to ensure the suitability for a site (e.g., moisture content, size, low calorific value, storage constraints, feed system issues etc).
- There is limited availability of biomass due to the cost of transporting it long distances and the limited availability of forest residues. This is particularly true for cost-effective biomass in the short term.
- There are many different types of suppliers of biomass (including forest owners, sawmills and specialist companies), who operate in different ways and have different drivers.

The items above have resulted in actual and perceived market issues which are hindering decarbonisation:

- Uncertainty regarding the quantity of biomass available in the future, in particular with the potential for other large users in the same region to convert to biomass, competing for available supply (and increasing the price).
- Some biomass suppliers are reticent to enter into long-term contracts with a fixed price of wood (we understand this is primarily in the residues and chip market), rather longer-term contracts are for the supply of a certain quantity, but at an unspecified price (or a price linked to biomass index values).
- Potential users and suppliers of wood are not able to adequately address the continuity of supply, supply quality and overall project requirements.

- Large scale biomass users will typically have to establish long term relationships with suppliers to ensure continuity of supply.

3.2 Scale and Importance

The above issues have been identified primarily in those areas early to decarbonisation with unprocessed forms (i.e. not pellets) of biomass (e.g. Southland), and are slowly being rectified. It is anticipated that they will also be an issue in other areas soon. Specific examples include:

- A user only being able to obtain a fixed price of wood for a short-term contract from the nearby sawmill. A longer-term contract was at a price that was not fixed.
- An organisation choosing to opt for another method of decarbonisation (i.e. electrode boiler) because they were able to source a long-term (10-year) electricity contract at a known price, even when the business case showed it was a significantly lower cost to convert to biomass for the short term.
- An organisation struggling to decarbonise with wood as there was no single supplier in the region who could supply all their requirements, resulting in complicated split contracts.
- An organisation that would be ideal for biomass conversion, but they are too far from a large enough supply to enable the transition.
- A processing site investigating the possibility of using biomass, however, the future uncertainty around the supply and price of biomass makes the investment too risky for them.

3.3 Potential Interventions

- Centralised support to facilitate the supply of biomass from a range of forest owners and sawmills to users.
- Creation of a formal biomass trading market.
- Support to encourage the movement of biomass (as a fuel) on trains, helping to alleviate distance limitations.

4. Future Uncertainties

4.1 Barrier Description

The energy sector in New Zealand is undergoing a change in terms of fuel inputs, supply levels, demand levels and types of energy availability. Further, many of our fuel markets are impacted by overseas factors. This has created a high level of uncertainty regarding decarbonisation options and pricing in the future. In particular:

- Uncertainty around the future price of electricity.
- The current changes to transmission charges (Transmission Pricing Methodology (TPM)) and how these will be passed through to individual users.
- Uncertainty regarding the volume of electricity being available with New Zealand's overall plans for electrification.
- Uncertainty regarding the volume of biomass available in the future.
- Uncertainty around the future price of biomass.
- Volatile pricing as seen with natural gas.
- The variable nature of the ETS.
- Potential new decarbonisation options are being developed (such as biomethane being introduced into the North Island gas network, hydrogen etc), with unknown timeframes for implementation and pricing, once they are available.
- Variability in electricity emissions factor.
- Uncertainty around energy emissions factors (hydrogen, biomethane).

By nature, most organisations are risk-averse when developing and approving projects, and future uncertainties regarding energy pricing and decarbonisation options are a major barrier to decision-making. Further, the lowest cost option is not always clear, and if organisations happen to choose the wrong option (with the benefit of hindsight), then difficult questions can be asked of those involved in the project.

Follow-on effects:

- Too many options to choose from, making decision-making unclear.
- Hesitance to commit to a particular decarbonisation pathway when the best solution is uncertain.
- Holding out for future potential decarbonisation options when their availability and pricing are uncertain.
- Hesitance to continue with decarbonisation once a historic project has not been as economically beneficial as predicted.

4.2 Scale and Importance

Future uncertainty is a problem that impacts every decarbonisation project. However, some of these impacts can be mitigated through various actions, such as long-term pricing contracts, fuel diversification, retaining existing process heat infrastructure and comprehensive upfront analysis.

The impact of the uncertainty varies, however, but some specific examples that have negatively impacted site decarbonisation plans:

- A site is in the process of replacing a concentration system relying on energy from steam, with a new more efficient concentration system relying on energy from electricity. When the business case was undertaken, the price of electricity was such that the economics were beneficial. Implementation is approaching completion and electricity pricing has risen to the level that the cost of the new system will likely be (at best) similar to the thermal system. It is expected that the electric system will still be used given it has other co-benefits, but the site is likely to be far more cautious regarding decarbonising via fuel-switching projects in the future.
- A site that is expanding in the future will need production upgrades and its current default energy source is diesel. It is not clear what the best solution (in terms of cost) is when comparing electricity, wood, tallow or business as usual. This is delaying the implementation as work is having to be performed on each fuel source to try to improve the future projections for the site.
- A site is looking at a range of decarbonisation options for its gas boilers, but these are all capital-intensive, with significant ongoing costs. They have heard about the potential for renewable gas and hydrogen to be injected into the North Island gas network and then the purchase of these with renewable gas certificates. Despite the higher expected operating costs of these, they are waiting to see what happens in the future with the low-carbon gas streams, as they could avoid the need for expensive capital expenditure.
- Some projects that received GIDI funding were cancelled due to uncertainty regarding how the TPM would affect their pricing and overall economics.

4.3 Potential Interventions

Dealing with future uncertainty is challenging, but there are approaches that can help organisations navigate this uncertainty and make informed decisions, such as:

- Sensitivity analysis on potential future outcomes and the prospective impact of each.
- Collaboration and engagement with the industry to build consensus and support for future decisions.
- A nationwide hub for experts/information to be shared.
- A changed approach, prioritising short term decarbonisation to stop perfection getting in the way of progress.

5. Unexpectedly Onerous Consenting

5.1 Barrier Description

Large decarbonisation projects typically require site upgrades, new equipment or new facilities on an existing site, which in turn must comply with resource consents and the rules of the day - this can result in increased cost, complexity, and implementation time for projects. Specific issues include:

- Base systems (such as an ammonia refrigeration system) not being compliant with today's rules and any integration of a HTHP would require the upgrade of the existing system.
- An upgrade to one building onsite requires all the buildings on site that don't meet current standards to be upgraded.
- Different councils having different consenting requirements, resulting in increased complexity for multi-site organisations.
- Consent differences between industrial/rural/residential zoned land and the historical inclusion/rezoning of industrial plants into rural areas.
- Input is required from regional council/district plans where specific conditions are met.
- A change from burning coal to wood requiring a new resource consent, even when emissions are still within the consented limits.

The above means that the requirements of the project often move past that required for decarbonisation alone, and in general, the consenting conditions cannot be addressed at the early stages of the process (e.g., scoping studies) and therefore increase complexity once the business cases/implementation progresses.

The follow-on effects from the above include:

- Project cost increasing to cater for the additional requirements.
- Projects are being delayed while consenting conditions are addressed.
- Non-optimal solutions being pursued to avoid consenting requirements (such as utilising an existing building, rather than constructing a new one).
- Projects not proceeding because the cost of compliance is too great to justify the decarbonisation project.

5.2 Scale and Importance

Consenting is encountered on many large decarbonisation projects, but the issues are location and site-specific. Where they do occur, they can create significant issues for the project.

Specific examples which have severely impacted a decarbonisation project include:

- A facility that was going to install a HTHP on an existing ammonia system, but the base system was non-compliant due to updated requirements. This meant that the project was cancelled at the time as the cost was too high and a full system upgrade needed to be designed and planned for. This is in the process of being designed currently, and the issues have delayed the project by 3-5 years.
- A project installing a HTHP in a new plant room became a discretionary activity as it was within 20m of a river and that part of the site was zoned rural. This triggered a far more onerous consenting requirement which is currently being worked through but will likely add at least 3 months to the project, along with significant costs.
- A processing plant replacing its coal boiler required a new plant room and the council said that to add a new building onsite, all the other buildings would have to be brought up to the current code. A workaround has been to include the boiler in an existing building which needs to be strengthened and undergo an asbestos removal project. This has added ~3-6 months to the project timeline and increased overall costs by ~$500,000 (20%).

5.3 Potential Interventions

- Rezoning of “rural” land, which is clearly industrial, and has been for a long time.
- A common application of consenting requirements across regions.
- Common sense application of consent laws.
- Engaging with consenting specialists early in the process.
- Applications for GIDI to require discussions with resource consenting officers.
- Change to consenting rules allowing biomass to replace coal, so long as all the existing consent conditions are met.

6. Site/Process Characteristics

6.1 Barrier Description

The physical characteristics of a site play a significant role in determining the decarbonisation approach. The size and age of the site, the processes involved, and the location of the site all influence the feasibility of transitioning. Some of the more common barriers that sites face based on their characteristics are as follows:

- Insufficient room to accommodate a larger biomass boiler.
- Limited accessibility for biomass deliveries.
- Equipment size limitations due to space constraints.
- Sites that use natural gas may not be accustomed to handling solid fuels and the associated challenges, such as maintaining feed systems and biomass stores needing to remain dry and being homes for rodents.
- Short or restrictive shutdown periods for installation can delay or limit timing, or result in plant downtime outside of standard shutdown windows.
- Not owning the land or building can limit how much the business wants to invest.
- Point-of-use energy systems (such as gas dryers) require a different decarbonisation approach to a boiler system.
- Sites operating on a district energy scheme, or receiving energy as a service, have less control over fuel used than a site with boilers onsite.

These barriers vary from site to site, but some general trends apply:

- Rural sites have more space available than those in built-up areas.
- Sites that consume coal currently are more readily set up to convert to biomass.
- Meat and milk processing sites have very limited/rigid shutdown windows.
- North Island milk drying sites using natural gas commonly have point-of-use gas dryers, which have significant decarbonisation challenges.

6.2 Scale and Importance

In some cases, site characteristics may be the primary limiting factor in achieving significant reductions in carbon emissions, while in other sites it may play a less significant role. It should be noted that in many cases a barrier to one decarbonisation method results in a different method being pursued.

Some examples that demonstrate the scale of this are:

- North Island milk drying facilities often have gas-fired air heaters at point of use. These are sometimes relatively new, efficient and challenging to decarbonise – electric options are very expensive, renewable gas is not currently available (and expected to be expensive) and running high-pressure steam throughout the facility to new steam air heaters is not economically feasible. Many of these sites will likely wait until renewable gas is available for injection into the gas network, and then potentially not be able to source it due to lack of supply quantity.

- Numerous sites have natural gas/LPG-fired boilers and are located in industrial zones. However, they have insufficient space on their site for biomass boilers and no space for delivery trucks to operate. They would need to purchase adjoining properties to do this.
- A range of sites being on leased land with a relatively short time left on the leases, and the owner potentially not renewing the leases when they fall due.

6.3 Potential Interventions

It needs to be generally recognised that understanding the unique site characteristics of each site is crucial to developing effective decarbonisation projects. Where a particular characteristic prevents a decarbonisation option from occurring, there is likely other avenues to pursue (i.e. electric rather than biomass).

7. Equipment Availability

7.1 Barrier Description

As more and more decarbonisation projects are implemented both globally and nationally, key components can be constrained by supply chain issues. Some of which involve:

- Suppliers not having sufficient equipment on hand.
- Long delivery times for ordered equipment.
- Equipment delays and shortages.

When suppliers do not have sufficient equipment on hand, it can be troublesome for project developers to obtain the necessary components to complete installation. This will often cause project delays.

Even if the equipment is available, long delivery times can be a major challenge. In some cases, lead times can stretch out to several months or even years, particularly for custom equipment. Again, this can make it incredibly challenging for decarbonisation projects to be planned and executed on a predictable timeline.

Lastly, equipment delays or shortages, often from supply chain disruptions, manufacturing issues, or unexpected demand, can leave sites scrambling for alternative solutions that may be sub-optimal.

7.2 Scale and Importance

Equipment availability is a problem that is encountered at almost every site – typically there is a lead time of several months for at least one piece of equipment, but this is beginning to be accepted going into projects, and timelines can be adjusted accordingly.

The impact on decarbonisation varies from site to site and organisation to organisation depending on the project equipment, but specific examples include:

- A HTHP taking 12 months to arrive from order, significantly extending the implementation time.
- A transformer taking 12 months to arrive from order, significantly extending the implementation timeframe.

7.3 Potential Interventions

- Upfront understanding of equipment shortages and delays.
- Pre-order major equipment ahead of tendering the installation contract and then free issuing the major equipment to the chosen contractor
- A central company with key components (such as transformers) in stock and available for purchase.

8. Labour Constraints

8.1 Barrier Description

Labour constraints can have a significant impact on decarbonising process heat, particularly in cases where specialised skills or training are required to implement low-carbon technologies or to retrofit existing boiler systems. With the current decarbonisation push, resources are becoming more constrained, and have become a significant barrier to project implementation, both in New Zealand and overseas.

Organisations have outlined various shortages:

- Insufficient people to engineer and oversee projects.
- Infeasibility of decarbonising all sites simultaneously (capital, labour and timing shortage).
- Short shutdown windows limit the amount of work that can be performed at one time, both due to internal and external labour constraints.
- Competition for contractors capable of performing the decarbonisation work.
- Sites are preoccupied with other projects and lacking the capacity for decarbonisation.
- Shortage of experienced consultants available to guide decarbonisation projects.
- Difficulty in attracting staff to work permanently in the regions (where many of the large carbon emitters are based).

From the factors listed, some possible flow-on effects to decarbonisation projects may be:

- Delays or difficulties in the design, construction, and implementation phases.
- Required prioritisation or phased approach to decarbonisation efforts from larger companies.
- Increased costs, longer project timelines, and suboptimal outcomes.

8.2 Scale and Importance

For the majority of sites, issues with labour constraints are common. The following examples indicate how labour constraints have impacted site decarbonisation.

- A distillery has an internal goal to be carbon neutral by 2025 but has insufficient in-house ability or expertise to execute this and was unsure how to start.
- A meat processing plant is trying to progress with a biogas plant, but there is limited New Zealand expertise available, making progress slow.
- Boiler manufacturing companies not being able to get qualified staff, so are undertaking their own apprenticeship scheme to train employees.
- Industrial sites located in rural areas struggle to get professional staff to design and implement projects..

8.3 Potential Interventions

- New Zealand generally, and organisations specifically, addressing the shortage of qualified professionals by investing in training and education programs and expanding recruitment efforts.
- For companies with multiple sites, prioritising projects based on emissions reduced and ease of the project.
- Organisations working with other companies, suppliers, and stakeholders to share resources, reduce costs, and improve efficiency and effectiveness.
- Organisations engaging experts to provide guidance and advice on decarbonisation projects and leveraging their expertise to identify and mitigate potential challenges. This could be in the form of an easily accessible list on EECA that show experts in the decarbonisation field.

9. Poor Data Availability

9.1 Barrier Description

Decarbonisation projects are often complicated and site-specific and must consider current sources of heat, heat requirements of specific equipment and potential sources of heat recovery to design an effective system. As such, accurate site data is imperative for a successful outcome.

Data regarding site usage is normally gathered through a SCADA system, but often:

- There is insufficient monitoring of key items to provide the information required e.g. major pieces of equipment are not monitored for energy use.
- Data is available, but not recorded for specific periods.
- The monitoring of equipment has been set up incorrectly which provides misleading information.
- No one is directly in charge of data management.

The above means that there is often insufficient data regarding these items to make a confident decarbonisation system design and business case. Further, in some cases when the initial information gathered is wrong, additional design/study to progress the project highlights that the proposed project is not feasible, or not optimal. In other cases, the mistakes are not recognised until the installed project is not operating as designed/initially intended.

Follow on effects from the above include:

- Design conservatism leads to oversized equipment and inefficient operation.
- Projects not proceeding in any form as management lose faith in decarbonisation.
- Multi-site organisations stopping/slowing decarbonisation due to poor results.
- An inaccurate pathway leads to too many options and management is afraid to make decisions without a clear best solution.
- Investment in sensors needs to occur before the decarbonisation project feasibility can be assessed and before there is a capital project to assign costs to. Investment in sensors must occur before decarbonisation projects can be designed.

9.2 Scale and Importance

Poor data availability is a problem that is encountered at almost every site – typically there is good data monitoring for items important to process control, but this often does not align with that needed for energy efficiency and decarbonisation.

The impact on decarbonisation varies from site to site and organisation to organisation depending on the accuracy of estimation in lieu of good information, but specific examples include:

- A beverage processing facility that had an initial study performed indicated a HTHP would be ideal, but the concept design in turn highlighted significant errors in data capture that rendered the project uneconomic. Decarbonisation has since been put on hold at that site.
- A meat processing facility installed a HTHP and post installation it was found that the design temperatures were not being met and the energy savings were therefore lower than predicted. Further study found that SCADA data was labelled incorrectly, resulting in the HTHP system being oversized causing operating issues and poor project outcomes.
- A HTHP study assessed available heat load from a condenser system in five different ways and the scenarios varied by over 100% of each other. Three of the five scenarios were relatively close so the project is proceeding on that basis, but the actual operation will only be determined once it is installed.

Overall, we believe this barrier will slow the uptake of decarbonisation as poor data least to the project feasibility becoming unclear and muddled and will likely result in projects which waste capital resources due to over-specification, which could have been avoided with additional information.

9.3 Potential Interventions

- Case studies to highlight the importance of metered data.
- Consultant support for initial specifications.
- Client education around the accuracy of initial investigations.
- EECA run a project to improve data collection onsite.

10. Overall Company Direction & Systems

10.1 Barrier Description

Overall company direction can create barriers to the full decarbonisation of boiler systems and industrial sites. Some of the key barriers include:

- Short-term thinking leads to inadequate planning for decarbonisation efforts.
- Reliance on a single internal champion for project success.
- Lack of commitment to emission reduction goals or sustainability initiatives.
- Overseas owners dictate the direction of the company's actions.
- Decarbonisation is viewed as a lower priority than business as usual.
- Shortage of staff to champion and implement projects.
- Focus on energy efficiency projects delaying full decarbonisation projects.
- South Island sites are prioritised over North Island as decarbonising from coal is viewed as easier and more impactful.

Follow on effects from the above include:

- Missed opportunities for cost savings, reduced environmental impact and missed emission reduction targets.
- Projects flounder if a project champion leaves.

10.2 Scale and Importance

Overall company direction is often a problem, but the impact on decarbonisation varies from site to site and organisation to organisation. Specific examples include:

- A non-technical site director for a processing plant did not believe the benefits of a high-temperature heat pump would materialise, so the project was cancelled.
- A global parent company has outsourced worldwide decarbonisation to a particular overseas-based firm. This means that the larger overseas factories will have a decarbonisation focus and the New Zealand factories will have to wait until progress has been made elsewhere.
- A site has made a significant effort to reduce emissions through project identification and scoping, but the convoluted and stringent approval process from the corporate level has added years to the associated projects.
- A wood processing site has a corporate structure which means no one on-site makes decisions around capital. This has resulted in innovative site-specific projects not being funded, significantly reducing decarbonisation.
- The decarbonisation effort for a particular organisation was largely driven by a single sustainability champion. Once he left the company, the projects in development were halted and have not since progressed.
- A site is in the process of implementing a range of energy (and carbon) efficiency projects and will address full decarbonisation once the implementation is complete

and the operation is settled. While this is the ideal scenario in terms of site energy costs and minimised capital (through reducing heat demand), implementation of energy efficiency projects onsite is complicated and time-consuming, and is expected to delay the final, full decarbonisation of the site by 2-3 years. However, once decarbonisation is achieved, capital and renewable energy consumption will be minimised due to the previous work performed.

Issues, such as the above, can delay projects significantly.

10.3 Potential Interventions

- Clear goals and objectives within companies.
- Organisations develop baseline carbon inventory to understand the current site emissions.
- Organisations develop a decarbonisation roadmap that outlines the specific steps necessary.
- Report and measure progress made to build trust with stakeholders.

11. Potential Mitigation Actions

There are a range of potential mitigation actions included at the end of each barrier. We believe there are some over arching actions that could be undertaken to help mitigate a wide range of barriers and these are outlined in this section.

11.1 Decarbonisation Resource Centre

A centralised information hub, such as a decarbonisation resource centre, would help guide organisations through the barriers mentioned earlier in this report. Many sites face these barriers but are unsure of how to overcome them and what challenges they may encounter. A centralised hub of information and resources will equip sites with knowledge on how to navigate specific issues in a way that provides transparency around the challenges of decarbonisation.

One component of a decarbonisation resource centre could be a team of people who can answer general enquiries around decarbonisation, and direct more complex issues to an appropriate specialist. This team could be the first point of contact for businesses developing plans of how they will decarbonise their sites. Communications could occur through phone or email and would be free. It would be important that this advice be free of attached conditions and agendas and focus on helping sites decarbonise.

Secondly, it is recommended that the decarbonisation centre includes realistic case studies to increase transparency around the barriers to decarbonisation and to illustrate real-life solutions to these issues. This is intended to create realistic expectations around decarbonisation, and the importance of resilience and flexibility with solutions. It has been observed that case studies that are currently presented to the public tend to not include the journey from the very start, the timeline of the project, any delays that occurred, barriers faced and how they were navigated, and how concerns were addressed. Realistic case studies would provide the industry with an accurate idea of how decarbonisation projects are implemented and give sites inspiration for how possible barriers may be navigated.

The organisation could also facilitate training and provide courses free of charge to enhance the uptake. There are a wide variety of courses currently available (through organisations such as CEP/EECA), and these could be funded by the organisation to help educate representatives from industrial businesses.

The set-up of a decarbonisation resource centre is expected to alleviate the following barriers:

- Insufficient information regarding technology
    - Providing a first point of contact will help direct organisations to the right information, resulting in tailored solutions for sites that may not have previously been explored.
    - Realistic case studies could include feasibility, potential benefits, and barriers encountered and overcome. This would help organisations make a more informed decision about which technologies to pursue and guide them to experts who can help implement the best technology effectively.
- Unexpectedly onerous consenting
    - Realistic case studies can discuss the onerous consenting process and provide commentary on how it has been previously navigated so companies can anticipate and prepare for consenting challenges. There is also an opportunity for this centre to provide additional guidance and best practices for navigating the regulatory and consenting process experienced with decarbonisation efforts. This will help save time and costs.
    - Councils could undergo decarbonisation training and work with the centre to streamline consenting for decarbonisation projects, thus helping to cut red tape.
- Future uncertainties
    - A centralised hub will provide a connection point for businesses having concerns about future uncertainties to contact experts within the field to reduce the impacts of this barrier.

Initially, it is recommended for the centre to consist of one to two full-time staff, where in periods of downtime case studies could be developed. These staff could be located in an EECA or MBIE office to ensure the staff are continuously engaged with the most up-to-date information.

Some possible extensions to this program could include development of educational materials, webinars, and updates relevant to decarbonisation.

11.2 EDB Support

In New Zealand, there are 29 EDBs, all with different ownership structures, capital allocation mechanisms, resources, and capacity to evaluate the electrification of process heat from individual sites. The issues that arise from the variation between EDBs have proven to be a decarbonisation barrier for sites. There is an apparent need for further guidance and support to EDBs to help address these barriers and their flow-on effects. It is recommended for this to be done in a three-stage approach from an organisation that sits as a support to all EDBs.

Firstly, it is recommended that a guideline document be developed that details a standard process for EDBs regarding capital cost/recovery mechanisms, pricing mechanisms, flexibility around N-1, contracts, and health and safety, to help align all EDBs to a standard way of handling decarbonisation projects. The guidelines can be optional for EBDs but would be encouraged as best practice. A workshop with key stakeholders before the development of the guidelines is necessary to facilitate buy-in and support from EDBs and provide a forum for clarifying any questions or concerns about the guidelines. Subsequently, a set of guidelines can be developed by the support organisation and reviewed further by stakeholders before issue. Standardising the process will reduce complications for organisations and provide clarification on regulations and rules that need to be followed for both sites and EDBs alike.

Upon the completion of guidelines, the second step is to hire professionals within the support organisation who are familiar with the guidelines and are trained in assessing the feasibility of electrification on the industrial supply side. These professionals will be accessible to EDBs to utilise during times of high workload. Staff would supply sites with information regarding what upgrades may be required and indicative costing, as this was noted to be where bottlenecks for sites occurred. This would be particularly beneficial for smaller EDBs that are less able to cater to swings in workload.. Consideration would need to be given to how this is funded and how staff resourcing is allocated amongst EDBs.

Lastly, it is recommended for the support organisation to prepurchase common electrical equipment, such as transformers, to help speed up project times and to help mitigate issues around EDB capital cost mechanisms. This equipment could then be bought from the organisation by the EDB on an as-needed basis. Pre-purchasing common equipment in bulk will also help drive costs down while also reducing wait times. If EDBs are unable to buy the equipment directly due to internal capital cost mechanisms, there may be an opportunity for EDBs to pre-emptively build using equipment form the support organisation, thus circumvent regulatory requirements of return. The EDBs could then charge users when sites are commissioned and repay the support organisation.

Implementing a support organisation with the above outline is expected to address and alleviate the following barriers:

- EDB processes:
    - A guideline that details processes for pricing mechanisms, capital cost mechanisms, flexibility around N-1, and contracts not only provides clarity for sites investigating electrification, it also provides clarity for EDBs on how to tackle these big challenges. This could help with wait times as sites will be aware of what information is required so can come to conversations with EDBs prepared, and a standardised procedure will mean EDBs have a clear pathway for navigating these queries.
    - Implementing a support organisation with staff available for EDBs during peak periods will increase capacity to design and price future upgrades and improve communication regarding the feasibility of increasing site capacity. This will reduce wait times for sites and ensure applications for funding, such as GIDI, can be submitted on time.
- Equipment availability
    - Bulk purchasing common electrical equipment is an easy way to mitigate delays that may be experienced if individual EDBs purchase equipment on an as-need basis. This can reduce delays in projects and speed up decarbonisation efforts.

The organisation could be set up similarly to NZGIF and act like a financing agency with government grants. The cost is difficult to quantify due to the level of uncertainty involved and is dependent on the stages implemented and the equipment pre-purchased. It is likely this arrangement would be a stepping stone to an eventual restructure of the EDBs to permanently overcome the majority of the outlined barriers.

It should be noted that there is currently collaboration between EDBs occurring. The South Island EDBs meet on a regular basis and are in the process of creating a framework of common documents for use around their networks.

11.3 Cohesive Biomass Market

The creation of a cohesive biomass market could play an important role in mitigating non-cost barriers to decarbonisation. By providing a standardised and efficient way for buyers and sellers to interact, a market could help streamline the process of purchasing and distributing biomass. This could avoid ad-hoc interactions between buyers and sellers, which has historically been a barrier for sites. Further, it would create the base to enable future planning for biomass needs, thus helping stimulate further investment in biomass stocks in the future.

The market could comprise 10-15 pricing nodes around the country where suppliers can provide available quantities of biomass at a set price or through bidding. Alternatively, buyers could put in requests for quantities and allow suppliers to bid. These nodes would be located near major industrial centres, or where large quantities of biomass are produced. Buyers could then use the pricing nodes as a central hub for purchasing biomass, which would help establish a more cohesive and efficient market. These nodes would also provide valuable information regarding market trends and pricing, helping buyers and sellers make informed decisions about the purchase and distribution of biomass.

Transportation could be a possible issue for a biomass market, particularly if stock needs to be transported over long distances. The cost of transportation can increase the overall cost of biomass, as well as increase the carbon emissions released. However, this challenge could potentially be addressed through regional biomass markets, which would provide clarity around local resources and reduce the distance that biomass needs to be transported. Another approach could be to invest in more efficient transportation, such as rail transport. Many sites are located on, or close to, a train line, so this could potentially be used to mitigate transport costs.

Standardised contracts should also be encouraged for biomass traded through the market (note that BANZ already have templated contracts, but are unsure of how widespread their use is).

Implementing a cohesive biomass market is expected to address and alleviate the following barriers:

- Biomass market
  - A cohesive market with a well-functioning supply chain can help encourage resources and infrastructure to produce and transport biomass, which could improve further enhance supply security.
  - Transparency around pricing may help stabilise pricing and encourage a competitive market.
  - Transparency around quantities of biomass supplied and purchased regionally can provide a clear indication of current biomass demand. This can ensure

policies are put in place to support the development of the long-term biomass industry.

- Future uncertainties
    - Transparent pricing and clear market signals can reduce uncertainty around the pricing of biomass. Reduced uncertainties will allow sites to make an informed decision regarding the best decarbonisation option for their facility.

12. Conclusions

This study has canvassed a range of process heat decarbonisation stakeholders, and has identified some key non-cost barriers:

- Electricity Distribution Business (EDB) processes and setup.
- The biomass market setup.
- Future uncertainties regarding pricing and technology.
- Unexpectedly onerous consenting.
- Insufficient information regarding technology.

Lack of equipment availability, poor data availability and subsequent system design, labour constraints, site characteristics, and overall company direction not prioritising decarbonisation are obstacles that varied in scale among sectors.

Addressing non-cost barriers requires a multi-faceted approach that includes establishing:

- **Decarbonisation Resource Centre:** A central hub of information and resources to inform sites on decarbonisation technology and challenges and serve as a bridging point between experts and sites.
- **EDB Support Organisation:** An organisation that acts as a support to all 29 electricity distribution businesses. This organisation will provide guidance to align all EDB processes and reduce the delays associated with these processes, staffing to help alleviate resourcing issues within EDBs during peak periods, and pre-purchasing of common equipment to help with delays and internal EDB capital cost mechanisms.
- **Cohesive biomass market:** Providing a central hub for purchasing biomass through regional pricing nodes. These nodes will provide valuable information regarding market trends and pricing, therefore reducing future uncertainties.

In order to summarise and convey the findings of this report more easily, DETA has prepared an Info-graphic which is included in Appendix A.

Appendix A – Barrier Info-Graphic