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Renewables and energy efficiency

Comment on MBIE discussion paper

NZIER report to MEUG

28 February 2020

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Key points

MBIE has proposed a suite of options to accelerate investment in renewable energy and energy efficiency. The discussion paper is a compilation of standalone problem definitions each with a set of intervention options. This report comments on the selection of problem definitions and the proposed options on the basis of the following criteria:

- Potential contribution to GHG emission reduction
- Effectiveness and efficiency of proposed options

Both the Productivity Commission and the Interim Climate Change Committee (ICCC) have completed detailed modelling of scenarios for both electrification of process heat and the increasing the proportion of electricity generated by renewable energy sources.

The objective of the analysis is to suggest how this modelling might be used to:

- Narrow the list of 'problems' in the MBIE discussion paper to a subset where specific government intervention might address a market failure that is not already adequately addressed by government climate change policy.
- Shift the rating from a qualitative assessment for each option on a standalone basis towards a quantitative assessment of potential benefits and costs that allows comparison of the contribution of each of the options to GHG emission reduction.

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1 Discussion document structure

1.1 Objective of the discussion document

The objective of the discussion document is to identify options to accelerate energy transition that complement the New Zealand Emissions Trading Scheme (ETS):[1]

> *The options represent a comprehensive policy package for the energy transition. They are intended to be complementary to the New Zealand Emissions Trading Scheme (NZ-ETS), and work alongside initiatives in the Climate Change, Economic Development, and Research, Science and Innovation portfolios, and the Just Transitions work programme.*
>
> *The options and analysis in this discussion paper build on the Productivity Commission's Low-Emissions Economy report, the Interim Climate Change Committee's Accelerated Electrification report, and the Ministry of Business, Innovation and Employment and the Energy Efficiency and Conservation Authority's technical paper Process Heat in New Zealand: Opportunities and barriers to lowering emissions.*

1.2 Renewables and energy efficiency

The discussion paper argues that 'market failure' (mainly for renewable energy sources/energy efficiency) and regulatory constraints (mainly for investment in renewable generation) is inhibiting reduction in GHG emissions from energy use.

The 'problem definitions' are considered as standalone issues with only a description of the problem and no quantification of the impact of the problem on the abatement of GHG emissions. The option descriptions do not provide evidence that they remove a binding constraint and are a sufficient condition for transition to energy uses and sources with lower GHG emissions let alone that the transition is efficient.

The key questions considered by this report are:

- What is the expected GHG emission path if none of the proposed options are adopted?
- How can the comparison of the options be refined from the simple rating of costs and benefits into an assessment of potential impact that considers:
  - How much the option could advance the adoption of low emissions energy sources (compared to when they would be adopted without intervention)?
  - Is the option necessary or sufficient to achieve the advance?
  - How large is the energy use to which the change can be applied and over what time frame?
- How can the size of the problem and the impact of the option be quantified or compared to the other problems listed in the document?

[1] 'Discussion Document, Accelerating renewable energy and energy efficiency, December 2019' Ministry of Business Innovation and Employment, p5.

2 Electrification and energy efficiency

2.1 Introduction

In 'Part A; Encouraging energy efficiency and the uptake of renewable fuels in industry', the discussion paper identifies potential 'market failures' in the form of lack of information, lack of access to capital and risk aversion as general impediments to investments in projects to reduce use of fossil fuels in process heat. The discussion paper also identifies the phase-down of coal-fired process heat and the limited use of geothermal and biomass for process heat as specific fuel switching issues..

The evidence for the size and drivers of the market failure is not quantified in the discussion paper. The rationale for the term 'market failure' seems to be that investment in the transition away from fossil fuel use that would have a positive net present value based on estimated marginal abatement cost is not being made.

The reduction in the use of fossil fuels to deliver process heat through electrification has a much more direct effect on lowering green-house gas (GHG) emissions than improving energy efficiency (which may or may not be specifically related to fossil fuel plant).

2.2 What would happen without intervention

The core theme of the paper is to identify opportunities to speed up the reduction in GHG emissions attributable to energy use either by removing barriers to change or encouraging faster adoption of low GHG emission energy sources.

The path without the proposed complementary intervention options is not specifically defined in the discussion paper. However, as the MBIE paper builds on the work by the Productivity Commission we suggest that the modelling by Concept Consulting of emissions for 'manufacturing process heat'[2] used in the 'Low-emissions economy' report[3] should be used as an indication of the expected GHG emission reduction path without further intervention[4] (other than the effect of the emissions trading scheme (ETS) and the change in policy and technology assumed in the modelling scenarios[5]).

Concept Consulting modelled changes in energy uses and associated emissions in two stages. The first stage used three core scenarios[6]:

- Policy driven (PD) - technologies are slow to develop and reductions in emissions must rely on strong policy such as high emissions prices

[2] The manufacturing process heat group does not include emissions from 'Fuel production Refining' which has emissions of 1.0 Mt CO_2e in 2017.

[3] 'Low-emissions economy, Final report, August 2018', 'Modelling the transition to a lower net emissions New Zealand, Uncertainty analysis, July 2018' and 'Final results workbook - Concept, Motu, Vivid.xlsx' all available from https://www.productivity.govt.nz/inquiries/lowemissions/ .

[4] The Concept Consulting modelling also includes 'industrial processes and product use' (IPPU) which are the non-energy related emissions from industrial processes (such as aluminium, steel and cement production) and product use (such as refrigerant gases). Four of the named IPPU industries: urea, methanol, cement and steel accounted for 2.2 Mt CO_2e (44 percent) of IPPU emissions in 2017 and also accounted for 2.4 Mt CO_2e (35 percent) of manufacturing process heat related emissions.

[5] This is a limited perspective on the drivers of GHG emission change. (The Concept Consulting model documentation describes the high-level assumptions about rates of change and the spreadsheets only include the key assumptions results of the model runs but not the formulae that would indicate how the input and output variables are related.)

[6] 'Low-emissions economy, Final report, August 2018', page 10.

- Disruptive decarbonisation (DD) - technological change is fast, and it disrupts existing industries
- Stabilising decarbonisation (TO) - technological change is also fast, but it reduces emissions in existing industries.

The second stage (uncertainty analysis) combined the core scenarios with four sets of assumptions to produce 12 forecast paths over the period 2030 to 2050. The four sets of assumptions were: 'moderate technological change', 'innovation disrupting existing industries', 'innovation stabilising existing industries' and 'slow international response'.

Our initial analysis focuses on the first stage modelling as this is the most relevant to a qualitative discussion about which groups could accelerate use of renewable energy to reduce emissions from process heat. However, those options that are selected for further analysis should be evaluated against the second stage modelling once there is more detail on how they are expected to work.

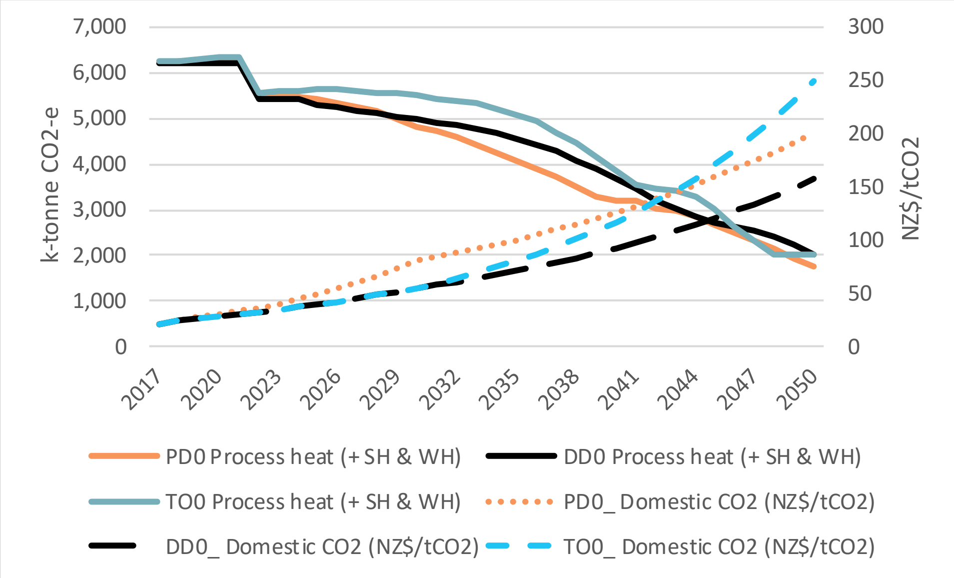
2.2.1 First stage: scenarios 2015 to 2030 extended to 2050

The Concept Consulting modelling provides an indication of the relative size of manufacturing process heat GHG emissions includes four groups of energy users:

- heavy industrial users with material IPPU emissions - a decline in GHG emissions is probably related to lower production levels in the future
- pulp and paper – which has a gradual decline in emissions until 2040 and then falls by at least half by 2050
- Other industrial uses and liquid fuelled motors used by industry which both steady declines over the modelling period
- food processing the largest group - forecast decline in emissions probably based on the electrification of low and medium temperature process heat.

Figure 1 shows the modelled reduction in manufacturing process heat emissions over the period 2020 to 2050 (including space heating (SH) and water heating (WH)). The PD scenario with the highest carbon prices over the period 2025 to about 2042 delivers the fastest reduction in emission closely followed by the DD scenario. The "0" at the end of each of PD, DD and TO refers to a target of zero net emissions by 2050.

Figure 1 Manufacturing process heat emission reductions and carbon price



Source: NZIER

Table 1 shows the manufacturing process heat emissions under PD0 are at least 1.0 million tonnes of CO_2 equivalent (Mt CO_2e) below the TO0 scenario over 2035 to 2045 but that annual emissions converge by 2050. This difference in paths is a rough indication of the potential of different mixes of policy and technology assumptions to accelerate GHG emission reductions.

Table 1 Total manufacturing process heat emissions

Annual GHG emissions Mt CO_2e from process heat including space heating (SH) and water heating (WH)

Scenario	2020	2025	2030	2035	2040	2045	2050
PD0	6.28	5.42	4.83	4.08	3.22	2.67	1.75
DD0	6.24	5.30	4.98	4.57	3.67	2.71	2.01
TO0	6.33	5.64	5.50	5.07	3.87	3.02	2.02

Source: NZIER

Table 2 below lists modelled emissions for the industry groups that are not likely to be affected by the measures proposed in Part A of the MBIE discussion paper (heavy industrial users with material IPPU emissions and pulp and paper) because they are large scale producers with highly integrated energy and production processes.

Table 2 Manufacturing process heat emissions by group

Annual GHG emissions Mt CO_2e from process heat including space heating (SH) and water heating (WH)

Scenario	2020	2025	2030	2035	2040	2045	2050
Material IPPU							
PD0	2.40	1.58	1.58	1.58	1.58	1.46	1.46
DD0	2.40	1.46	1.46	1.46	1.46	1.46	1.46
TO0	2.40	1.58	1.58	1.58	1.58	1.58	1.46
Pulp and Paper							
PD0	0.53	0.50	0.44	0.42	0.40	0.29	0.07
DD0	0.53	0.52	0.48	0.44	0.42	0.39	0.22
TO0	0.53	0.52	0.49	0.44	0.41	0.27	0.06
Total IPPU and Pulp							
PD0	2.93	2.09	2.02	2.00	1.98	1.75	1.53
DD0	2.93	1.98	1.94	1.90	1.88	1.84	1.68
TO0	2.93	2.10	2.07	2.02	1.99	1.86	1.51
Process heat share							
PD0	47%	38%	42%	49%	62%	66%	87%
DD0	47%	37%	39%	42%	51%	68%	83%
TO0	46%	37%	38%	40%	51%	61%	75%

Source: NZIER

Error! Not a valid bookmark self-reference. below shows the modelled emissions for process heat from other industries and liquid-fuel motors. The businesses responsible for these emissions may be affected by information asymmetries if either they are either medium of small businesses, or the processes are not a core part of their business.

Table 3 Other industry liquid-fuel motors process heat emissions

Annual GHG emissions Mt CO_2e from process heat including space heating (SH) and water heating (WH)

Scenario	2020	2025	2030	2035	2040	2045	2050
Other industries							
PD0	0.28	0.27	0.22	0.18	0.14	0.12	0.06
DD0	0.28	0.29	0.27	0.23	0.19	0.15	0.11
TO0	0.28	0.29	0.27	0.23	0.17	0.12	0.06
Liquid-fuel motors							
PD0	0.72	0.74	0.70	0.60	0.48	0.36	0.27
DD0	0.72	0.69	0.56	0.41	0.30	0.21	0.15
TO0	0.72	0.76	0.77	0.75	0.70	0.61	0.50
Total other & motors							
PD0	1.00	1.01	0.92	0.79	0.62	0.48	0.32
DD0	1.00	0.98	0.83	0.65	0.49	0.36	0.25
TO0	1.00	1.05	1.04	0.98	0.86	0.72	0.56
Process heat share							
PD0	16%	19%	19%	19%	19%	18%	18%
DD0	16%	19%	17%	14%	13%	13%	13%
TO0	16%	19%	19%	19%	22%	24%	27%

Source: NZIER

Table 4 lists modelled emissions from process heat for food processing and beverages. The reduction path for a substantial proportion of these emissions will be determined by dairy processors replacing coal with other fuels.

Table 4 Food process heat emissions

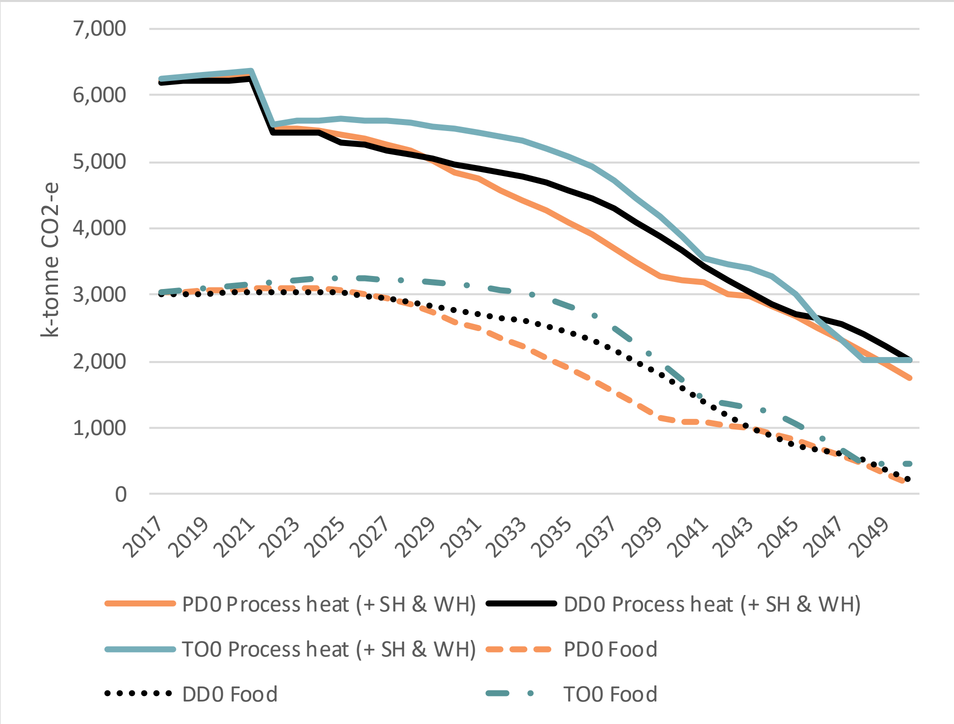
Annual GHG emissions Mt CO_2e from process heat including space heating (SH) and water heating (WH)

Scenario	2020	2025	2030	2035	2040	2045	2050
Food & beverages							
PD0	3.08	3.06	2.59	1.90	1.09	0.80	0.17
DD0	3.03	3.03	2.77	2.44	1.60	0.72	0.23
TO0	3.13	3.25	3.16	2.83	1.71	1.05	0.45
Process heat share							
PD0	49%	56%	54%	46%	34%	30%	10%
DD0	49%	57%	56%	53%	44%	27%	11%
TO0	49%	58%	57%	56%	44%	35%	22%

Source: NZIER

The modelled food process heat reduction paths determines the shape for the process heat reductions

Figure 2 Total and food process heat emission reductions and carbon price



Source: NZIER

2.3 Sizing the acceleration opportunity

The Concept modelling of the GHG reductions under different scenarios already considers a general market response to both rising carbon prices and the change in the cost of alternative agency sources. This framework could be used to consider the potential impact of the policy options suggested in the discussion paper. They could encourage process heat users to either:

- behave as if they were on a faster rather than a slower emission reduction path (for example PD0 rather than TO0) or they could encourage
- bring forward the GHG reductions on a given scenario by a set period (for example five years).

The analysis of the Concept models suggests that the process heat emissions most likely to be affected by the initiatives proposed in the discussion paper are process heat emissions from:

- Other industry and liquid-fuel motors which are forecast to be 1.0 Mt CO_2e in 2020 and are forecast to decline at best to about 0.83 Mt CO_2e in 2030 (on the DD0 scenario)
- Food process heat which are forecast to be 3.08 Mt CO_2e in 2020 and are forecast to decline at best to about 2.59 Mt CO_2e in 2030.

At best the measures in the discussion paper only allow emissions reductions modelled over 2020 to 2040 to be achieved earlier, but they do not lower the 2040 to 2050 modelled path. Therefore the maximum benefit that could be attributed to the measures in the discussion paper is limited to the additional reductions in emissions over 2020 to 2040.

2.4 ICCC modelling

The ICCC models an increase in electricity use for process heat of 0.6 TWh by 2035 under business as usual or 100% renewable electricity generation scenarios and 5.6 TWh under an accelerated electrification scenario. The ICCC model is focused on the impact on emissions of 100% renewable electricity generation and is discussed in section 3.3.2.

2.5 Verifying the potential to electrify process heat

The detailed assumptions about the feasibility, cost and benefits of electrification of that underpinned the Concept modelling in sections 2.2 and 2.3 above were not published. Therefore the extent to which these assumptions were verified with major users of process heat is unclear. This creates a risk that the modelling overstates the potential to electrify process heat.

Following the Concept modelling both MBIE and the Ministry for Environment (MfE) have attempted to analyse the relative cost of reducing emissions through electrification, energy efficiency and phasing out fossil fuels in electricity generation. Appendix 2[7] of the MBIE discussion paper contains estimated marginal abatement costs of emission reductions based on more detailed work by MfE[8].

Verification of the estimated potential and costs and benefits to further electrify process heat with businesses is a key next step for the consideration of the problem definition and options in section A of the MBIE discussion paper. Comments from large energy users indicate some of the opportunities have already been implemented while the costs and time required to implement of others have been understated.

7 'Appendix 2: Stationary energy opportunities to reduce emissions' page 125 -126 of the MBIE discussion paper.

8 MfE published 'Marginal abatement cost curves analysis for New Zealand, POTENTIAL GREENHOUSE GAS MITIGATION OPTIONS AND THEIR COSTS' in January 2020 and the supporting MAACs spreadsheet tools on 20 February 2020.

3 Accelerating renewable energy generation

3.1 Introduction

The discussion paper identifies potential barriers to investment in renewable electricity generation arising from:

- Resource Management Act (RMA) consenting barriers for new renewable energy project and continued operation of existing hydro schemes
- Cost of connection to the grid.

3.2 What problem are the options trying to fix?

These options can be analysed by assessing the impact of the barrier relative to other conditions that affect the decision to invest in renewable energy generation and assessing whether the option passes the test of delivering a more efficient outcome and then whether the allocation of costs and benefits is acceptable to stakeholders. A starting point for the assessment of the impact of the options is the Concept Consulting and Interim Climate Change Committee (ICCC) forecast of electricity generation (quantity, method of generation) and wholesale price.

The discussion paper also identifies potential to influence how the energy market operates through:

- Attempting to shift market power between buyers and sellers through:
  - Introducing purchase power agreements
  - Encourage demand side participation
  - Ask retailers and distributors to promote energy efficiency programmes
  - Facilitating community engagement/investment in generation projects
- Changing what the market can buy and sell through:
  - Phasing down base-load generation
  - Introducing renewable energy certificates and portfolio standards

These options have elements of administrative solutions to market problems. From an economic perspective they have a high risk of inefficiency because they bypass prices signals, require market participants to take on ancillary roles for which they have limited capability and tend to hide the cost of the intervention. The discussion paper assessment of these options does not describe in what sense the outcome expected by the option would be better than the expected outcome without intervention and how benefits of this difference could be valued.

3.3 Outlook for generation without intervention

3.3.1 Concept Consulting

The Concept Consulting modelling for electricity generation over the period 2020 to 2050 projects an increase in electricity generation of 50 to 60 percent with most of the increase in generation coming from wind-farms. Geothermal generation is not increased. Emissions from thermal and co-generation fall below 20 percent of current levels by 2050. This is partially offset by increased emissions from thermal peakers.

Table 5 Electricity generation and prices

Generation tera-watt hours (TWh) for selected plant and wholesale prices in $/MWh

Scenario	2020	2025	2030	2035	2040	2045	2050
Wind							
PD0	4.02	7.47	12.53	18.58	25.65	33.88	39.57
DD0	3.67	5.99	8.91	13.78	21.80	33.11	38.48
TO0	3.68	6.20	10.20	13.20	20.29	29.33	37.85
Hydro							
PD0	24.51	23.88	22.68	20.85	18.62	15.22	13.01
DD0	24.57	22.32	22.63	21.92	18.87	13.39	11.66
TO0	24.56	24.15	22.92	22.20	19.48	15.43	12.39
Solar							
PD0	0.58	1.19	1.83	2.51	3.23	3.37	5.76
DD0	0.58	1.19	1.83	2.51	3.24	3.37	4.75
TO0	0.58	1.19	1.84	2.51	3.23	3.37	3.94
Geothermal							
PD0	7.53	7.53	7.53	7.53	7.53	7.53	7.53
DD0	7.53	8.06	8.06	8.06	8.06	8.06	8.06
TO0	7.53	7.53	7.53	7.53	7.53	7.53	7.53
Thermal & CoGen							
PD0	3.97	2.69	1.42	1.13	1.09	0.99	0.70
DD0	4.73	0.81	1.12	1.09	0.86	0.62	0.66
TO0	4.17	3.12	1.63	1.45	0.92	0.72	0.52
Peaker							
PD0	0.48	0.21	0.27	0.44	0.75	0.98	1.82
DD0	0.10	0.23	0.72	1.24	1.44	1.33	1.78
TO0	0.54	0.32	0.29	0.30	0.33	0.41	0.92
All generation							
PD0	**43.32**	**45.21**	**48.51**	**53.28**	**59.10**	**63.62**	**70.04**
DD0	**43.42**	**40.25**	**44.91**	**50.24**	**55.91**	**61.53**	**67.03**
TO0	**43.30**	**44.73**	**46.64**	**49.43**	**54.02**	**59.01**	**64.80**
Wholesale price							
PD0	76.13	72.52	70.05	68.77	68.38	70.52	70.74
DD0	76.01	74.74	69.74	66.45	66.67	71.40	70.18
TO0	76.03	72.04	69.50	66.34	66.41	69.17	70.74

Source: NZIER

This mix of generation delivers wholesale electricity prices around $70 per MWh – a key driver of the model assumptions about the financial viability of the electrification of process heat.

3.3.2 ICCC modelling

The ICCC modelling compared the reduction in GHG emissions from scenarios for increased use of electricity in transport and process heat with the reduction in GHG emissions if all of New Zealand's electricity was generated from renewable sources by 2035. The key conclusion is that a drive to renewable energy by 2035 will deliver a smaller reduction in emissions than accelerated electrification of vehicles and process heat because it drives electricity prices to the point where accelerated electrification is not likely to occur. The ICCC modelling results are summarised in Table 6.

Table 6 Electricity generation, prices and GHG emissions[9]

Generation tera-watt hours (TWh) for selected plant and wholesale prices in $/MWh

Description	2019	2035 Business as usual	2035 100% renewable	2035 Accelerated electrification
Generation by type (TWh)				
Wind	2.09	7.53	9.16	11.15
Hydro	24.5	24.79	23.82	25.81
Solar	0.15	1.18	2.18	1.96
Geothermal	7.95	11.92	13.56	13.36
Thermal &CoGen	7.67	3.85	0.56	4.99
Total[10]	**44.42**	**49.27**	**49.28**	**57.27**
Wholesale prices ($/MWh)		78.00	113.00	85.00
Change in emissions ($MtCO_2e$)				
Electricity system		2.8	1.7	3.6
Vehicle & process heat		-3.3	-3.3	-9.0
Net impact		**-0.5**	**-1.6**	**-5.4**

Source: NZIER

9 Adapted from 'Accelerated electrification. Evidence, analysis and recommendations, 30 APRIL 2019' Table 4.2 on page 47 for generation, Figure 4.5 on page 55 for electricity prices and Figure 4.7 on page 58 for net emission impacts.

10 Total generation reported for 2019 in Table 4.2 is 2.0 TWh higher than the sum of the components. We have not been able to find an explanation of the difference.

Appendix A Electrification and energy efficiency

A.1 Introduction

The comments in section 2 of the report focused on suggesting how existing modelling could be used to both:

- Identify the industry emissions to which the options in Part A of the MBIE discussion paper could apply
- Indicate that the benefit of the options is to bring forward emissions reductions that have been modelled as an economic response to the increasing cost of emissions and the falling cost of electrification.

The tables in this appendix include brief comment on the individual problem definitions and options.

Table 7 Barriers to use of renewable energy for industry process heat and investment in energy efficiency

Summary of the problem

Section	Potential barrier/issue	Comment
Addressing information failures	Lack of accurate information on the emissions performance of firms or products.	Problem definition does not state what additional information is required and how this could be used to change policy settings.
	Information gap on the issues, costs, reliability, and process for the electrification of industrial sites.	The accuracy of information used by Government to assess the potential to reduce emissions for setting policy on GHG reduction needs to be tested with businesses to ensure the estimates are credible and policy settings efficient
	Some entities have poor information about their energy use and emissions.	Needs to be supported by evidence of which firms have information gaps and their impact on emissions. Large process heat users already have strong incentives to optimise energy use
Developing markets for bioenergy and geothermal heat	Under-developed supply chains for bioenergy and the availability of bioenergy and geothermal resources regionally.	Reflects constraints (reliability of supply, technical, transport costs, location etc.) on the suitability of these types of energy for meeting industry need for process heat.
Process heat; Innovating and building process heat capability	Firms tend to be risk averse to technologies that change or could delay their production process, and process engineers may not be familiar with new technologies.	Need to translate 'risk aversion' into adoption lags for different groups of firms. This will help to identify the root cause of the slower adoption than expected by 'government' and clarify whether it is due to a 'market failure'.
Phasing out fossil fuels in process heat	Risk of locking in new long-lived emissions intensive heat plant. Reluctance to replace legacy fossil fuel facilities before the end of their technical lives (both power plants and industrial facilities).	Mixes two issues – the choice of new process heat sources where the risk of reinvestment in coal is unlikely and an economic decision about when to retire existing coal-fired boilers.
Investment in energy efficiency and renewable energy technologies	Competition for capital leading to prioritisation of core business spending and an underinvestment in energy efficiency and renewable energy technologies in the industrial sector.	Need to restate this as an assessment of how long energy efficiency gain is delayed by lack of capital. Adoption of new technologies is embedded in the replacement of equipment.
Cost recovery mechanisms levy on coal	In order to mobilise private-sector investment and scale up efforts to achieve the Government's process heat outcomes, additional funds will be required to resource implementation of some of the policy proposals.	Needs a clearer statement of who needs to do what so that the public and private costs and benefits can be compared.

Source: NZIER

Table 8 Options for reducing use of fossil fuels for industry process heat

Comment on options[11]

Section	Option	Comment
Addressing information failures	1.1 Require large energy users to publish Corporate Energy Transition Plans (including reporting emissions) and conduct energy audits. .	Large energy users already have strong incentives to use energy efficiently and already provide information on energy use.
	1.2 Develop an electrification information package for businesses looking to electrify process heat, and offer co-funded low-emissions heating feasibility studies for EECA's Large Energy User partners.	Not clear how this would differ from the advice and funding offered by EECA and why a parallel initiative is required though MBIE
	1.3 Provide benchmarking information for food processing industries	No evidence that either food processing businesses would benefit from benchmarking any more than other industries or that multi-site businesses are not aware of the differences between sites.
Bioenergy markets	2.1 Development of a users' guide on the application of the National Environmental Standards for Air Quality to wood energy.	Potentially assists with one impediment to use of biomass. Not clear that this removes a binding constraint.
Innovating and building capability	3.1 Expand EECA's grants for technology diffusion and capability-building.	More efficient and effective to set general polices to encourage lower emissions and let businesses determine the approach that suits their markets and processes.
	3.2 Collaborate with EIHI industry to foster knowledge sharing, develop sectoral low-carbon roadmaps and build capability for the future using a Just Transitions approach.	Industry-led collaborative approach may enhance trust with Government in information exchange that could assist the Government to gather information for compliance with international climate change requirements.
Phase out fossil fuels in process heat	4.1 Introduce a ban on new coal-fired boilers for low and medium temperature requirements.	ETS pricing and the availability of other technologies create strong incentives for reduced use of coal in process heat. The paper does not make a case that these instruments will not be effective or a case for accelerating the phase-out of coal ahead of the timetable indicated by major users. The paper lacks analysis of the feasibility and costs of alternative sources of process heat and the cost of faster transition.
	4.2 Require existing coal-fired process heat equipment supplying end-use temperature requirements below 100°C to be phased out by 2030	
Cost recovery mechanism	6.1 Introduce a levy on consumers of coal to fund process heat activities.	The paper does not make a case for singling out coal for a punitive tax in addition to the ETS GHG cost and does not consider the deadweight loss associated with taxes.

Source: NZIER

[11] 'Investment in energy efficiency' section 5.1 is omitted from the table as no new options are proposed at this time

Appendix B Investment in renewable energy generation

B.1 Introduction

The comments in section 3 of the report focused on suggesting how existing modelling could be used to identify the paths that investment in renewable energy would follow given the expected change in generation and storage costs and potential demand. The Concept Consulting and ICCC models both indicated that the increase in electricity demand over their respective modelling periods could be met by increased use of renewable energy[12] and wholesale electricity prices would be around 2017 levels.

The ICCC report on accelerated electrification made a strong case that there was a much greater potential to lower emissions by increasing electricity use in transport and process heat than through replacing generation that uses fossil fuels.

The tables in this appendix include brief comment on the individual problem definitions and options.

12 Admittedly the two models reported very different combinations of renewable generation with the Concept scenarios showing much higher use of wind and solar and less use of hydro and geothermal than the ICC models.

Table 9 Options for removing consenting barriers to investment in renewable generation

Section 7

Section	Option	Comment
Section 7	7.1 Amend the NPSREG to provide stronger direction on the national importance of renewables	These suggestions need more analysis and discussion as they are part of a complex debate local and national decision processes on the use of natural resources. The ICCC comments[13] on this area highlighted unresolved conflicts between two national policy statements on the priority that should be given to renewable energy as well as concerns about the access to water for hydro schemes.
	7.2 Scope National Environmental Standards or National Planning Standards specific to renewable energy	
	7.3 Other options including: • Pre-approval of new renewable developments: Planning approaches including relatively permissive consenting rules in defined areas • Pre-approval of new renewable developments: Crown acquiring consents for transfer to developers • Pre-approval of new renewable developments: new statutory allocation process • Amending NPSET and NESETA	The ‘problem’ seems to be that consenting processes are slower, more expensive and less predictable than would be ideal to meet the expected long term need for increased renewable generation capacity. The degree of improvement in the process and how to measure the improvement are not defined. The paper does not make a case for inserting central government into the process for gaining consent for renewable development is a proportionate response let alone the most effective or efficient solution to this problem.

Source: NZIER

[13] See ‘Accelerated electrification’ Chapter 6 pages 73 to 83

Table 10 Options for encouraging demand for renewable energy generation investment and demand response

Section 8

Section	Option	Comment
Section 8	8.1 Introduce a Power Purchase Agreement (PPA) Platform	Unlikely to be practicable to build a purchase agreement around a group requirement for process heat. Need examples to explore this properly
	8.2 Encourage greater demand-side participation and develop the demand response market	Should be left to market specialists.
	8.3 Deploy energy efficiency resources via retailer/distributor obligations	Energy retailers and distributors do not have a competitive advantage in this role and should not be given preferential assistance to compete in the market for energy efficiency solutions.
	8.4 Develop offshore wind assets	Does not appear to be needed in the medium term and there is no evidence of market failure preventing this type of development if investors considered it the most attractive option. .
	8.5 Introduce renewable electricity certification and portfolio standards	Most electricity is already generated from 'renewable' sources.
	8.6 Phase down thermal baseload and place in strategic reserve	Premature phase-out of thermal generation risks higher and more volatile wholesale electricity prices. This would delay or prevent replacement of fossil fuel energy sources with electricity.
	8.7 Other options including: • Government-sponsored storage facility for firming hedge products • State-owned enterprise for renewables investments • Co-ordinated procurement of new generation (single market buyer) • Tax incentives for renewable electricity generation • Provision of subsidies via auction (one-off or in rounds i.e. biennially	The paper does not provide any evidence that a market failure will lead to under-supply of generation or that taxes and subsidies will be the most efficient method of correcting such a 'market failure'.

Source: NZIER

Table 11 Options for encouraging community investment in renewable energy

Section 9

Section	Option	Comment
Section 9	9.1 Ensuring a clear and consistent government position on community energy issues, aligned across different policies and work programmes	Communities generally do not have natural advantages as the owners or funders of electricity generation assets. The paper does not explain how community ownership would enable more efficient and effective delivery of renewable energy than would be delivered by specialist generation investors with a diversified portfolio of plant and options for further development.
	9.2 Government supports development of a small number of community energy pilot projects, through options including financial support, 'handholding' and facilitating of projects, or assisting with regulatory approvals and access to land	

Source: NZIER

Table 12 Options to reduce cost of connection to the grid

Section 10

<table>
<tr><th>Section</th><th>Option</th><th>Comment</th></tr>
<tr><td></td><td>10.1 Encourage Transpower to include the economic benefits of climate change mitigation in applications for Commerce Commission approval of projects expected to cost over $20m</td><td>Transpower can already consider these benefits.</td></tr>
<tr><td></td><td>10.2 Put in place additional mechanisms for, or encourage, Transpower, first movers and subsequent customers to agree to alternative forms of cost sharing arrangements by contract</td><td rowspan="4">For options 10.2 to 10.3.2:
• The discussion paper does not provide any evidence that the cost of connecting to the grid is preventing the construction of new generating plant.
• Unlikely to be practicable. The transmission pricing methodology is already challenged by identifying the beneficiaries of selected assets and considering how these charges should be changed in response to closure of consumers.</td></tr>
<tr><td></td><td>10.3 Shift some of the cost and risk allocation for new and upgraded connections from the first mover through mechanisms within the Commerce Commission’s regulatory scope, with the Crown accepting some of the financial risk. Two identified ways to achieve this are:</td></tr>
<tr><td></td><td>10.3.1 Optimise asset valuations under the Commerce Commission’s regime in circumstances where demand is lower than originally anticipated because expected (subsequent) customers do not eventuate</td></tr>
<tr><td></td><td>10.3.2 Provide for Transpower to build larger capacity connection asset or a configuration that allows for growth, but only recover full costs once asset is fully utilised, with the Crown covering risk of revenue shortfall.</td></tr>
</table>

Source: NZIER

Table 13 Options to provide information on generation investment opportunities

Section 10

Section	Option	Comment
Section 10	10.4 Provide independent geospatial data on potential generation and electrification sites (e.g. wind speeds for sites, information on relative economics and feasibility of investment locations given available transmission capacity)	Leave to market. The paper does not provide evidence that a market failure is preventing access to this information or that the cost of accessing information is a binding constraint on identifying sites. Developers may also have different approaches to modelling and assessing generation prospects which would reduce the benefit to them of generic data.
	10.5 Extend the data and information provided in MBIE's EDGS and increase the frequency of publication, and potentially recover the cost through the existing levy on electricity industry participants.	More important to have regular updates of energy supply/demand of all forms of energy (rather than only electricity) over the economy.
	10.6 Produce a user's guide on the current regulations and approval processes relating to getting an upgraded or new connections to the grid	Transpower to develop if needed.
	10.7 Provide a "map" or database of potential renewable generation and demand sources, location and potential size (e.g. wind, geothermal, milk plant).	Similar to 10.4 Leave to market. The paper does not provide evidence that a market failure is preventing access to this information or that the cost of accessing information is a binding constraint on identifying sites.
	10.8 Introduce measures to enable coordination regarding the placement of wind farms to ensure they are more likely to be better distributed around the country	Leave to market. Owners of generation plant have much stronger incentives and greater capability to co-ordinate generation so that it meets requirements than the Government (as well as more tools than just 'location')

Source: NZIER