Report commissioned by Trustpower

A lack of joined up thinking on energy, water and climate change objectives

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14 November 2017

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Glossary

EA	Electricity Authority
EECA	Energy Efficiency and Conservation Authority
ETS	Emissions Trading Scheme
E-W-E	Energy-Water-Environment [nexus]
LGA	Local Government Act
MBIE	Ministry of Business, Innovation and Employment
MfE	Ministry for the Environment
NES	National Environmental Standard
NPS-FM	National Policy Statement on Freshwater Management
NPS-REG	National Policy Statement on Renewable Electricity Generation
NZCPS	New Zealand Coastal Policy Statement
PCE	Parliamentary Commissioner for the Environment
RMA	Resource Management Act
SOSPA	System Operator Service Provider Agreement
WCO	Water Conservation Order

Executive summary

Hydro plays a pivotal role in meeting three national objectives

Hydroelectricity has long been the backbone of the energy supply mix in New Zealand and looks set to continue to meet a high proportion of electricity demand. Hydro schemes can provide the operational flexibility needed to sustain a changing electricity supply mix and to respond to short-term changes in demand. Because of these characteristics existing hydro schemes will play a significant role in New Zealand's transition to a lower-emissions economy and as more renewable generation is introduced into the New Zealand electricity system. Renewable generation forms such as wind and solar are non-dispatchable, which means that their output levels are not able to be varied in response to demand, so hydro's flexibility will become more important for system stability.

Given its operational flexibility and low-emissions profile, New Zealand hydro generation can help meet three national objectives: **energy security, system reliability and emissions reduction**. However, the effect of disjointed thinking between these objectives at the national and local decision-making levels is that the role of existing hydro schemes in meeting these objectives may be undermined.

There are issues at the local and national levels that may undermine hydro's role in meeting the national objectives

At the local level, decisions that impact on hydro operations relate to water management in particular (water allocation, operational flexibility, and preservation of water quality and ecosystem health). In New Zealand, these decisions are managed through resource consents under the Resource Management Act 1991, and include provisions on minimum river flows, rates of change of downstream flow levels, minimum and maximum lake levels, flushing flows for water quality downstream, and access to water by other water users, among others.

Any reduction in water allocation to hydro reduces its contribution to electricity supply, which must be offset by some other form of generation. In the short term, the only discretionary fuel that could increase output is thermal (coal, gas). In the medium term, some investment in new generation may be expected; this could be renewable, but not necessarily emissions free (e.g., geothermal) and may not have the flexibility that hydro offers. In both cases, any decisions made that have the potential to reduce hydro generation have the potential to increase sector emissions. Operational flexibility is a further issue that can be affected through RMA policy and rule changes. Enforced changes to operating lake level ranges, downstream discharge flow rates and frequencies, and ability to utilise lake storage, will affect operational flexibility, and can have a significant impact on hydro's role in coordinating energy security and system reliability.

At the national level, decisions that may impact on hydro's contribution to meeting the three national objectives relate to the regulatory framework governing the New Zealand electricity market. Specifically, although the Electricity Authority's statutory objective concerns reliable supply, this is de-coupled from a low-emissions objective. If the sector were to be allocated an emissions budget the provisions of the market may have to take into account the impact of less thermal generation being available in its design e.g. the long-standing practice of meeting seasonal shortfalls in hydro inflows with fossil fuelled generation would have to be addressed.

Disjointed thinking manifests across the energy-water-environment (E-W-E) nexus

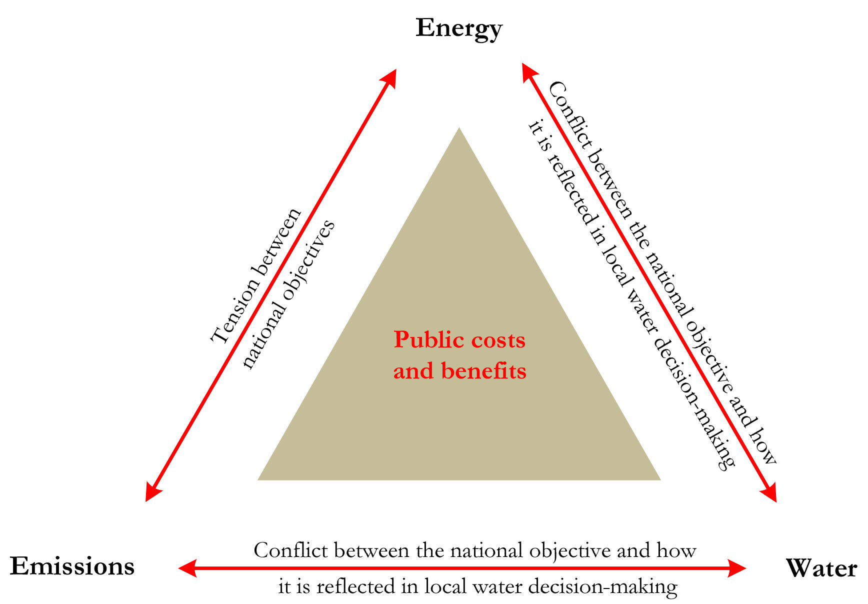
These observations lead us to conclude that achieving national policy objectives is at risk to the extent that there is a lack of joined-up thinking across decisions relating to energy, water and the environment (in this context we are referring mainly to emissions and climate change). We understand there is a lack of coordination of these decisions from a cost and benefits perspective. Ignoring the cost and benefits perspective amplifies the disjointed thinking within the E-W-E nexus because it can lead to sub-optimal outcomes from an economy-wide view over the medium and longer time horizons.

We find evidence of disjointed thinking within the E-W-E nexus across multiple delivery mechanisms that include: official documents, policies and targets; organisational mandates; stakeholder engagement processes, and the resource management framework. A careful analysis across the mechanisms identifies:

- A tension between national energy security and system reliability objectives on the one hand, and emissions reduction objectives on the other, and
- A conflict between each national objective and the way it is accounted for in water decisions at local levels.

This is summarised in the figure below:

Disjointed thinking across the E-W-E nexus



Our analysis concludes that the lack of joined-up thinking arises due to the following factors:

- Within the RMA framework, the language translating the national objectives into local water decision-making is not well-defined and is not forceful;
- Within the electricity market the Electricity Authority regards carbon emissions as an externality. By this the Authority means that while carbon emissions are a product of generation, the workings of the ETS deal with all emitters (including generators), and all the impacts of emissions. Hence they appear to argue that the electricity market does not have any further role to factor emissions outcomes into its workings. In contrast, the market gives a strong imperative to ensuring energy security and system reliability.
- At the national level, there is no mechanism that would provide direction on how decisions with impacts on energy security, system reliability, emissions and electricity cost should be synchronised.
- At the local level, there is no mechanism that would provide directive guidance to local authorities over how to translate the three national objectives into local water decision-making, whilst accounting for the costs and benefits of their decisions.

Consequences of disjointed thinking

The lack of joined up thinking may reduce and restrict the contribution hydro makes to meeting energy security and reliability. On the one hand, limiting hydro's flexibility may require an increased contribution from existing discretionary plant, which is thermal and with higher variable costs. On the other, limiting hydro's absolute contribution to supply (through water reallocation) may require investment in new generation plant, with cost consequences for electricity consumers.

Overall, the cost consequences of any restraints on hydro operation will manifest through increased wholesale and retail tariffs. This may exacerbate issues of affordability.

Furthermore, if the contribution of new supply required to compensate for any impairment of hydro operation (from either existing thermal, or new investment) has associated emissions, New Zealand will find it more difficult (and/or expensive) to meet its emissions and electricity sector public policy objectives. We note that the incoming Government has indicated it will provide greater force to a target of a low net emissions economy by 2050 and 100% renewable energy (in a normal hydrology year) by 2035.

Finally, the consequences of disjointed thinking will become more pronounced over time and with climate change, as a result of greater pressure on decisions around water allocation, water quality and ecosystem health. In this case, the risk of inefficient decisions, and unintended consequences, will be that much greater.

1. Introduction and objectives

New Zealand has committed to reducing its greenhouse gas (GHG) emissions, and is currently investigating options for maximising the opportunities and minimising the costs and risks associated with transitioning to a lower net-emissions economy.[1] New Zealand aims to increase its emissions reduction from 5% below 1990 levels by 2020 to 50% below 1990 levels by 2050 (MfE, 2017).

The incoming coalition government has released its Coalition Agreement (New Zealand Labour Party & New Zealand First) and Confidence and Supply Agreement (New Zealand Labour Party & Green Party of Aotearoa New Zealand) that set out positions that are likely to be given force by the new government. Specifically the Coalition Agreement states government will:

> *Introduce a Zero Carbon Act and an independent Climate Commission, based on the recommendations of the Parliamentary Commissioner for the Environment.*

The Confidence and Supply Agreement states the government will:

> *Adopt and make progress towards the goal of a Net Zero Emissions Economy by 2050*
>
> *Introduce a Zero Carbon Act and establish an independent Climate Commission*
>
> *Request the Climate Commission to plan the transition to 100% renewable electricity by 2035 (which includes geothermal) in a normal hydrological year.*
>
> *Provide assistance to the agricultural sector to reduce biological emissions, improve water quality, and shift to more diverse and sustainable land use including more forestry.*

One of the implications of New Zealand's transition to a low-emissions economy with 100% renewable electricity production is that increasing the supply of electricity generation will almost certainly require leveraging more off the country's hydro generation role. Hydro generation has played a key role in ensuring the high renewables profile of current electricity generation. In 2016, 85% of New Zealand's electricity was produced from renewable sources, most of which was hydro (MBIE, 2016). Going forward, existing hydro generation will continue to play a significant role in the country's drive to lower emissions, as its inherent flexibility will help support the integration of inflexible and non-dispatchable generation into the electricity system.

The operation of hydro schemes cuts across the energy, water and environmental sectors (the E-W-E nexus), which are governed by numerous policy, regulatory and institutional settings. Each of these sectors is underpinned by a set of objectives and decision-making drivers. When these objectives and drivers lack a framework of prioritisation and are

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1 See NZ Productivity Commission's inquiry into a low-emissions economy https://www.productivity.govt.nz/sites/default/files/Low%20emissions%20economy%20issues%20paper%20FINAL%20WEB.pdf.

inconsistently applied across the sectors, disjointed thinking occurs, which can undermine the role that hydro plays in meeting those objectives.

- This paper provides an analysis of how this disjointed thinking manifests itself in the context of New Zealand hydro's operation within the E-W-E nexus. For the purpose of our work, we interpret joined-up thinking as relating to decisions that concern the interaction between New Zealand national objectives on energy and the environment: [2] and
- We also consider the relative weighting applied to decisions that relate to New Zealand hydro generation and water management decisions.[3]

This is a conceptual paper that assesses whether and how joined-up thinking within the E-W-E nexus manifests at national and local levels, within and outside the Resource Management Act (RMA) framework. Water management decisions in New Zealand take place within the RMA framework, whereas national objectives on energy and carbon emissions are set outside the framework but cut across RMA issues. In our analysis, the issue of joined-up thinking thus takes a broad view.

Joined-up thinking would have the benefit of guiding future policy and decision-making across environmental, water use and energy specific goals, especially given that any tensions amongst water users today will be exacerbated by climate change. The pressure on our water resources, the imperative of climate change, and the expectations on the energy sector to contribute to reducing emissions in an affordable and reliable way put existing hydroelectric generation squarely at the centre of the debates now underway.

Objective

The objective of this paper is to clearly articulate

(i) the lack of joined-up thinking in the energy-water-environment nexus in New Zealand across national and local decision-making, and

(ii) the consequences of the lack of joined-up thinking on the ability of existing hydro generation to enable key national objectives to be met.

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2 Although not explicitly stated, the analysis also covers the regional differences with regards to how national objectives are reflected in local decision-making. Establishing joined-up thinking between the national and local levels generally should address these regional differences.

3 These decisions include those that relate to preserving 'outstanding' natural features and landscapes, and which have impact on hydro catchments. It also includes iwi co-governance and a whole range of other decision making functions that can impact on hydro operations.

2. The national significance of hydro

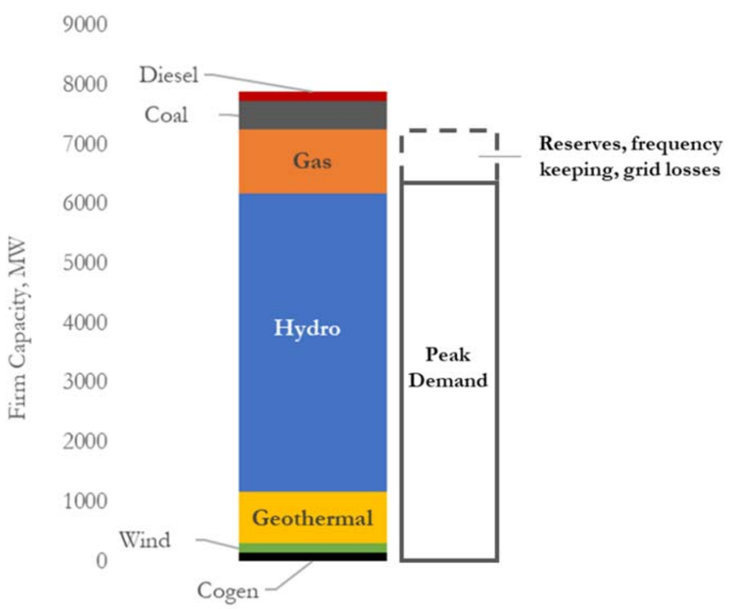
2.1 The role of hydro in the New Zealand electricity market

Hydroelectricity has long been the backbone of the energy supply mix in New Zealand. Depending on rainfall, hydro generation typically accounts for 55% - 65 % of New Zealand's generation. In periods of high rainfall, the figure can exceed 70% (NZX, 2017).

In 2015, 38 hydro power plants had an operating capacity of 10MW or greater; together, these stations accounted for over 95% of operating capacity. Half of these were in the North Island, seven of which were in the Waikato region. In the South Island, the large hydro plants predominantly are in the Canterbury, Otago and Southland regions (Stats NZ, 2017).

One major service that hydro provides to the operation of the electricity system is the ability to respond quickly, over short time frames, to changing conditions of supply and demand. These changes arise from short term variability in demand, intermittent generation (e.g., wind and solar) or unexpected outages of other generation plant. This is especially true at peak demand, which tends to only last for a very short time (minutes). Hydro plays a significant role in meeting peak demand and instantaneous reserves[4] (see figure below).

Figure 1 The role of hydro in meeting peak demand



[4] An instantaneous reserve is generating capacity that is available to operate automatically in case of a sudden failure of a large generating plant or the HVDC link between the North and South Islands. For example, some hydro stations are able to increase their output from their minimum generation levels to full output in under six seconds, supplying a service to the grid known as "fast instantaneous reserves".

Source: Sapere, based on Transpower (2017) data

In order to provide the operational flexibility needed to sustain electricity supply and to respond to short-term changes in demand, hydro schemes require storage. This provides them with greater flexibility and peaking capacity than so-called "run-of-river" hydro (alongside operating requirements like environmental considerations, which allow low-generation periods). The bulk of New Zealand hydro schemes have been built with these criteria in mind. As a result, the large New Zealand schemes have a significant capacity to readily alter output in response to changing demand, especially at peak use times. Some stations were built specifically to provide peaking capacity in the North Island (e.g. Maraetai 2).

Because of these characteristics existing hydro will play a significant role in New Zealand's transition to a lower-emissions economy. As more intermittent and inflexible renewable generation is introduced into the grid (e.g. wind, solar), hydro will be relied on more and more to support system security. The alternative is investment in more thermal peaking plant, which runs counter to government's aspirations for higher levels of renewables and lower emissions. Any erosion of hydro's ability to fill this role will make the task harder or drive the need for more thermal peaking plant.

2.2 Hydro is pivotal for meeting three national objectives

Due to its operational flexibility and low-emissions profile, New Zealand hydro generation plays a pivotal role meeting three national objectives:

- **Energy security** – providing appropriate generation capacity and storable fuel supplies to maintain normal supply to consumers;
- **System reliability** – providing fast response to short-term changes in electricity demand, and
- **Emissions reduction** – the New Zealand Government has committed to a 5% reduction in GHG emissions below 1990 by 2020 (under the UNFCCC framework), 11% reduction in GHG emissions below 1990 by 2030 (under the Paris Accord)[5], and by 50% below 1990 levels by 2050.

These objectives are reflected in the following documents, policies and targets, and organisational mandates.

5 New Zealand committed to this target under the Paris Agreement New Zealand's "Nationally Determined Contribution" (NDC). The target is equivalent to 30% below 2005 levels). The United Nations Framework Convention on Climate Change "Paris Agreement" came into force on 4th November 2016.

Table 1 New Zealand national energy and low-emissions objectives

<table>
<tr><th>National objective</th><th>Documents, policies, targets</th><th>Organisational mandates</th></tr>
<tr><td>Energy security</td><td rowspan="2">Achieving the renewables target in New Zealand electricity generation “must not be at the expense of the security and reliability” of New Zealand electricity supply (Energy Strategy 2011-2021)
New Zealand energy systems must have the resilience to cope with changes and shocks. Energy must be obtained from a diversity of sources in order to enhance energy security and resilience to shocks (Energy Strategy 2011-2021)
The (i) development, operation, maintenance, and upgrade of renewable electricity generation, and (ii) the benefits of renewable electricity generation are “matters of national significance” (NPS-REG)</td><td rowspan="2">EA’s strategic directions include promoting flexibility and resilience in the electricity market (EA, 2013)
EA has a statutory obligation under the Electricity industry Act 2010 “to promote reliable supply by the electricity industry for the long term benefit of consumers”
In the energy sector, MBIE has a policy making role – e.g. it is responsible for elaborating the New Zealand Energy Strategy</td></tr>
<tr><td>System reliability</td></tr>
<tr><td>Low emissions</td><td>The (i) development, operation, maintenance, and upgrade of renewable electricity generation, and (ii) the benefits of renewable electricity generation are “matters of national significance” (NPS-REG)
The New Zealand government has currently got a target of achieving 90% of electricity generation from renewable sources by 2025 (in an average hydrological year) (Energy Strategy 20110-2021)
The New Zealand government has set out the following unconditional targets[6] for GHG emissions reductions (MfE, 2017):
5% below 1990 levels by</td><td>MfE is responsible for leading the development and implementation of “whole-of-government” climate change policy, including policy development for the New Zealand ETS (MfE, 2017b)
MBIE is responsible for energy policy and has a role in promoting innovation in low-emissions technologies (MfE, 2017b)
The Productivity Commission’s tasks include identifying options</td></tr>
</table>

6 An ‘unconditional’ target means that the government has committed to meeting that target regardless of what other countries or international agreements have committed to do.

National objective	Documents, policies, targets	Organisational mandates
	2020 – 30% below 2005 levels by 2030 (equivalent to 11% below 1990 by 2030) – 50% below 1990 by 2050 Based on the incoming government's Coalition Agreement[7] and Confidence and Supply Agreement[8] it is likely to: • Establish an independent Climate Commission. • Set a goal of a Net Zero Emissions Economy by 2050. • Introduce a Zero Carbon Act • Have target emissions milestones set by the Climate Commission. • Require all new legislation to have a climate impact assessment analysis. • Have the Climate Commission work towards a target of 100% renewable electricity by 2035 (which includes geothermal) in a normal hydrological year. • Provide assistance to the agricultural sector to reduce biological emissions, improve water quality, and shift to more diverse and sustainable land use including more forestry.	for how New Zealand could reduce domestic emissions and transition to a low-emissions future (Productivity Commission, 2017) • PCE's functions include investigating matters where the environment may be or has been adversely affected (Environment Guide, 2014) • EECA supports and promotes energy efficiency and conservation, and the use of renewable sources in New Zealand (MfE, 2017b)

7 New Zealand Labour Party & New Zealand First Coalition Agreement

8 New Zealand Labour Party & Green Party of Aotearoa New Zealand Confidence and Supply Agreement

3. Issues that affect hydro's ability to meet national objectives

3.1 Local decisions regarding water allocation, water quality and ecosystem health

Hydro's contribution to meeting the energy security and system reliability objectives primarily relies on the ability of hydro schemes to store water, and manage the level of the head pond and consequential downstream flows. Hydro schemes with storage and control of the head pond are able to vary outflows relative to inflows over time, which means that they have a role to play in coordinating energy security (by supplying energy) and system reliability (by being able to respond fast to short-term fluctuations in electricity demand and supply).

There are a number of water management decisions that can impact on the use of hydro storage and power stations' operational flexibility. In New Zealand, these decisions are managed through resource consents under the Resource Management Act (RMA) 1991 and include: ramp rate changes (e.g. to control erosion), minimum river flows, minimum and maximum lake levels (for recreational users), flushing flows downstream (for sediment removal or periphyton flushing), flood management, and access to water by other water users (e.g. irrigation and recreational users).

As stated previously, one major service that hydro provides to the operation of the electricity system is the ability to respond quickly to short-term changes in the electricity supply and demand balance. As the supply and demand for electricity must be exactly matched in real-time, having plant with the ability to respond quickly to these changes is vital to managing reliability of supply. Changes to allowable ramp rates may reduce the speed with which hydro can respond to these variations, and further limit its contribution to system security management.

Any reduction in water allocated to hydro obviously reduces its contribution to supply, which must therefore be met by some other form of generation. In the short term, the only discretionary fuel that could increase output would be discretionary thermal (coal, gas). In the medium term, we might expect investment in new plant, which may be renewable, but not necessarily emissions free (e.g., geothermal).[9] In both situations, there is potential for the reduction in hydro to result in an increase in sector emissions.

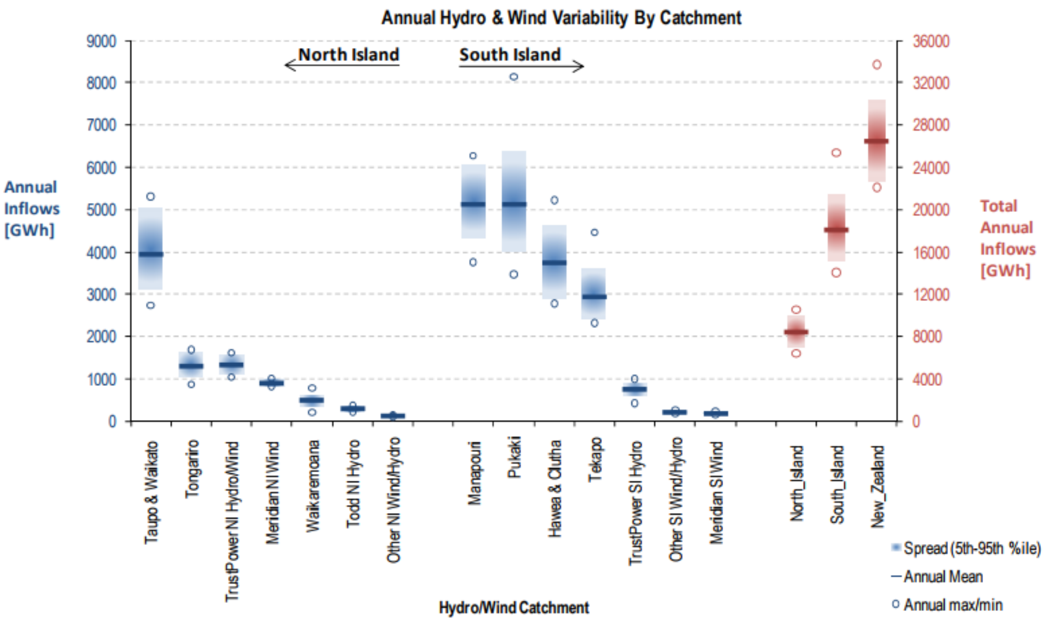
Measures aimed at remedying water quality, such as increased minimum flows and addition of flushing flows, risk undermining operational flexibility not only in catchments where water quality is poor, but also in catchments where a hydro scheme's operation has some hydrological influence, either via the control of flow or diversion of water. Flushing flow

9 In the long-term, the electricity supply and demand balance will be increasingly provided for by battery storage and demand-side response solutions.

requirements can limit the discretion of hydro operators to utilise longer-term storage and to respond to security and reliability issues, which can undermine the security and reliability of electricity supply (and especially to specific regions). The relationship between water and hydro generation is particularly sensitive in New Zealand given that New Zealand's hydro schemes do not have large storage reservoir capacities compared to the variability in inflows[10], and are vulnerable to annual and seasonal fluctuations in rainfall and snow melt. Because of the high variability of inflows in New Zealand (as can be seen in the Figure 2 below), any potential further water management constraints on hydro storage and operational flexibility can have a significant impact on hydro's role in coordinating energy security and system reliability.

Lastly, water management decisions that impact on hydro operational flexibility may result in other types of fuel being used to meet supply when inflows are low and storage is limited. Typically, thermal capacity (based on coal or natural gas) is used in these circumstances (often referred to as "hydro firming"). As thermal generation is emissions-intensive, the degree to which this occurs is a determinant in the emissions profile of the electricity sector.

Figure 2 New Zealand inflow variability



Source: Meridian (2011)

3.2 Electricity market regulations

The Electricity Industry Act 2010 (the "Act"), the Electricity Industry (Enforcement) Regulations 2010 made under section 112 of the Act (the "enforcement regulations") and the

[10] Unlike a number of hydro systems in other countries, such as Norway and Brazil, New Zealand does not have storage capable of sustaining multi-year dry periods.

Electricity Industry Participation Code 2010 made under section 36 of the Act (the "Code") govern the electricity industry.

The Act establishes the Electricity Authority as the market regulator. Critically, the Authority is guided by an objective embedded in the Act (i.e. its statutory objective):[11]

> *The objective of the Authority is to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers.*

The statutory objective captures security of supply and reliability. However, there is nothing in the statutory objective, or in the Authority's interpretation of the statutory objective, that causes the Authority to favour hydro or other low-emissions generation over any other generation type. What the Authority's interpretation says is:[12]

> ***2.3 Reliable supply limb***
>
> *2.3.1 In regard to reliable supply the Authority notes that:*
>
> *(a) both continuity of supply and quality of supply are of interest to the Authority, subject to the jurisdiction of the Commerce Act;*

Hydro-electric output is based on dispatch under the Code. Dispatch is carried out by Transpower under the System Operator Service Provider Agreement (SOSPA) between Transpower and the Electricity Authority. The SOSPA is formulated under the Act and provides for delivery of system operation services that must meet the provisions of the Act, i.e. decisions relating to dispatch are made with reference to the statutory objective and should deliver outcomes that align with the statutory objective.

This leads to the observation that the level of emissions from the electricity sector is an outcome of the market rules and the workings of the ETS but the emissions profile is not a feature of the optimisation of the market or the approach taken to security of supply.

All of the economic signals relating to the cost of carbon in investment decision come from the ETS. A "properly designed" ETS would be calibrated to deliver national emissions targets, and for the electricity sector those signals would be reflected in electricity market outcomes but not be attributable to electricity market design or governance.

Any initiative in electricity market design or governance that restrained hydro output or flexibility would implicitly restrict hydro's contribution to the sector's emissions profile. For example, in 2017 the Authority found a hydro operator in breach of the high standard of trading conduct provisions.[13] In their decision, the Authority compared price outcomes during a certain market conditions with what they saw as the price outcomes that they would expect. The decision did not explicitly account for the possibility that the generation called could have been generation capacity made available at very high prices for reliability

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11 s 15 Electricity Industry Act 2010

12 See EA (2011)

13 Clause 13.5A of the Code. See: https://www.ea.govt.nz/code-and-compliance/compliance/decisions/investigations-closed-no-settlement-reached/

purposes but that the generator would otherwise prefer not to run. This is often referred to as "last resort" generation.[14] By ignoring this possibility the Authority risks sending a message to hydro generators to not make this capability available to the market. Reliability is one limb of the Authority's statutory objective, and it is surprising for them not to explicitly deal with this in practice. There is a risk that this finding results in a change of practice on the part of the hydro operator and it may be fossil-fuelled generation that steps in to take its place, which would run counter to a low emissions goal.

Another example is the case of season by season energy security. If the market were designed giving regards to national emissions objectives, it would consider how to address the long-standing practice of meeting seasonal shortfalls in hydro inflows with fossil fuelled generation. It is not doing this because the security objective is de-coupled from a low-emissions objective.

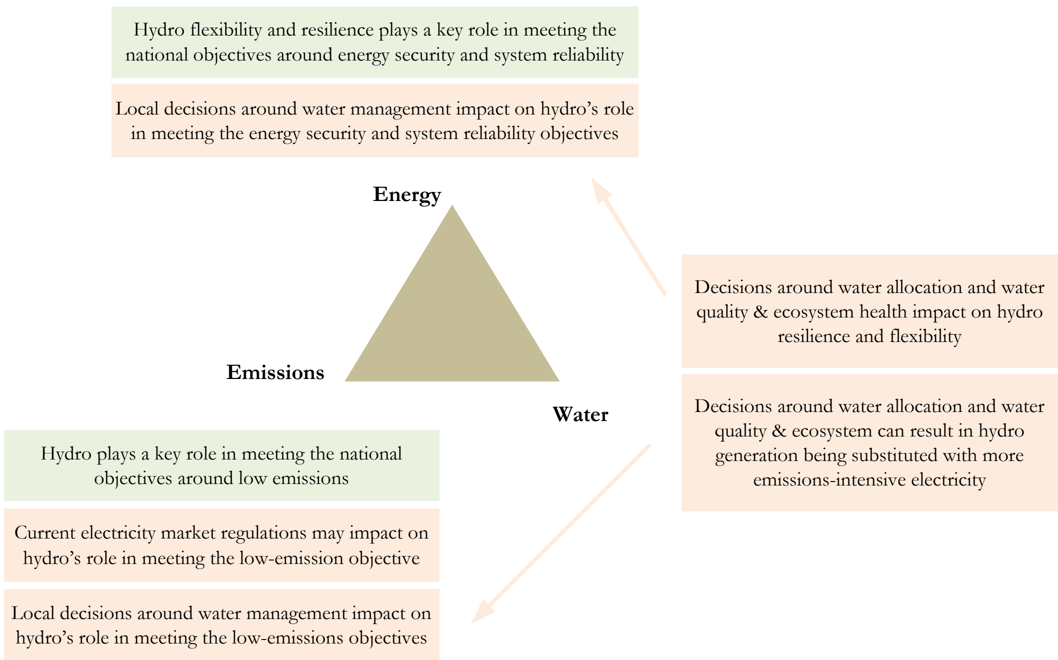
14 Often this situation is described as the "missing money" problem. That is where a market fails to reward generators for making last resort generation available. It is relatively straight forward to place a value on it with peaking thermal generation but is more contentious when the generation capacity comes from hydro.

4. Placing hydro in the E-W-E nexus

The discussions from the previous two chapters clearly point to the fact that hydro operation lies at the confluence of decisions in the energy, water and the environmental sectors (the E-W-E nexus). Within the environmental sector, we focus on the sector's emission profile because it relates to the national objective of emissions reduction.

The figure below illustrates the E-W-E nexus, by highlighting (i) the national energy and low-emissions objectives that hydro can contribute to (green rectangles), and (ii) the issues relating to water management decisions and electricity market regulation that may impact on hydro's ability to play its part in delivering the national objectives (orange rectangles).

Figure 3 Hydro in the E-W-E nexus



Source: Sapere

Five key themes emerge from the E-W-E nexus with relevance to hydro operation:[15]

- Energy security
- System reliability
- Emissions
- Water allocation, and
- Water quality and ecosystem health.

In the next chapter, we explore how disjointed thinking arises across these five themes.

15 Another important theme with relevance to the role of hydro within the E-W-E nexus is energy affordability. In this report, we discuss affordability as a *consequence* of disjointed thinking (see section 6).

5. Disjointed thinking

5.1 Disjointed thinking occurs across multiple delivery mechanisms within the E-W-E nexus

We define 'delivery mechanisms' as the mechanisms that support or undermine the role that hydro can play in delivering the national objectives on energy security, system reliability and emissions. These mechanisms include:

- Official documents, policies and targets
- Organisational mandates
- Stakeholder engagement processes, and
- The rights to appeal (recourse against decisions).

For our purposes, we establish a list of delivery mechanisms by identifying those that have relevance to the five themes within the E-W-E nexus: energy security, system reliability, emissions, water allocation, and water quality and ecosystem health.

To locate the disjointed thinking, our task is to identify whether a delivery mechanism associated with a theme supports or undermines the role that hydro can play in meeting one of the three national objectives. We base this analysis on a number of hydro-scheme case studies, and on the language used in official documents with respect to the significance of energy security, system reliability and emissions reduction. If we took water conservation orders for example (which are associated with decisions on water allocation and water quality & ecosystem health decisions), we would look at how they may impact on any of the three objectives based on some recent WCO decisions.

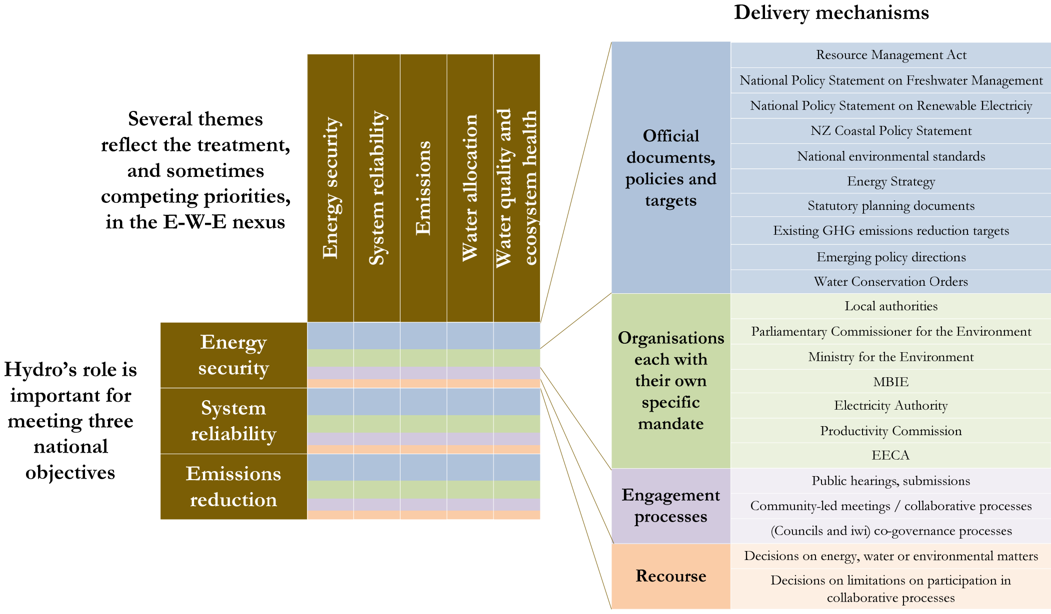
The figure further below illustrates this thought process. As can be seen, there is a wide array of delivery mechanisms that cut across energy, water and the environment. We investigated all delivery mechanisms listed on the right-hand side.

A careful analysis across the mechanisms identifies:

- A tension between national energy security and system reliability objectives on the one hand, and emissions reduction objectives on the other, and
- A conflict between each national objective and the way it is accounted for in water decisions at local levels.

We discuss this in more detail in the next two sections.

Figure 4 Delivery mechanisms within the E-W-E nexus



Source: Sapere

5.2 Disjointed thinking occurs between national objectives and local water decision-making

Water management decisions at the local level are governed by the RMA framework, which includes the RMA 1991, national policy statements and national environmental standards (among others). Of particular relevance within this framework is how well-defined and forceful the language regarding the importance of energy security, system reliability and low emissions is. We found that the relevant wording is weak, which has consequences on the way decisions are made at the local level with respect to conflicting uses of water.

The forcefulness of the language used is particularly important given the Supreme Court's decisions in the *Environmental Defence Society Inc v The New Zealand King Salmon Co Ltd [2014]*. Accordingly, the Supreme Court asserted that the directive policies of the New Zealand Coastal Policy Statement should be given greater weight than those that are less prescriptive. The implication of this is that local decisions concerning conflicting uses of water may be biased towards those uses that are governed by a more prescriptive (or forceful) set of policy documents.

Our analysis uncovered a number of instances within the RMA framework where the wording concerning the three national objectives with relevance to hydro is weak. In addition to the RMA itself, of particular relevance also is the language used in the National Policy

Statements (NPSs), which set out the objectives and policies for matters of national significance that must be taken into account for the purpose of achieving the objectives of the RMA.[16]

For example, whereas the preservation of outstanding natural features and landscapes must be "recognised and provided for" (as per RMA Art. 6 and the New Zealand Coastal Policy Statement), the effects of climate change must be given "particular regard to" (RMA Art. 7), which is less forceful. Furthermore, although the national significance of renewable generation is explicitly recognised under the NPS-REG, under the RMA the language used with regards to the benefits from renewable generation is that these benefits must be given "particular regard to" (Art. 7). This weaker language under the RMA, coupled with the lack of guidance on *how* to have "regard" for renewable generation particularly when conflicting interests arise (e.g. water use, or preservation of "outstanding" natural features), has resulted in the current situation where provisions concerning the importance of renewable energy do not have teeth at the local decision-making level.

The table below summarises the main instances of a lack of a well-defined and forceful language within the RMA framework, with relevance to hydro's role in meeting the energy security, system reliability and emissions reduction objectives. These issues apply to all three objectives because they refer to the benefits of renewable electricity generation; hydro has a great share in this, and has a role to play across all three objectives.

16 Appendix 2 illustrates the hierarchy of documents within the RMA framework.

Table 2 Lack of well-defined and forceful language within the RMA framework

Document	Issue description
RMA	The RMA does not explicitly recognise achieving energy security, system reliability or emissions reduction as a matter of national importance. Instead "the benefits derived from the use and development of renewable energy" is reflected as "other matters" (as opposed to "matters of national significance") that must be given "particular regard to".
NPS-REG	The language concerning the national significance of renewable electricity generation is forceful in some parts but not in others. *Decision-makers shall recognise and provide for [highlight added] the national significance of renewable electricity generation activities, including the national, regional and local benefits relevant to renewable electricity generation activities" (Policy A); versus* *Decision-makers shall have particular regard to [highlight added] the following matters, including maintenance of renewable generation output, and meeting or exceeding NZ's national renewable electricity targets (Policy B)* This inconsistency in the use of language may lead to the interpretation that although the NPS-REG recognises renewable electricity as being of national significance, it does not require renewable generation activities per se. Critically; the NPS-FM doesn't capture the primary issue of access to water for hydro generation. It states: *This national policy statement does not apply to the allocation and prioritisation of freshwater as these are matters for regional councils to address in a catchment or regional context* As a result, when decisions are being made regarding access to water ways for renewable generation there is no need to give regard to the NPS-REG at all.
NPS-FM	Overall, the language of the NPS-FM is more forceful than that of the NPS-REG and is having significant influence on water allocation policy and rules. This means that local decisions with regards to freshwater management may be made without due consideration of the benefits from renewable energy generation, as evidenced by the following: • What constitutes "significant" infrastructure is not defined. This creates issues for smaller hydro schemes that are critical for providing secure and reliable electricity supply to regions, and, in aggregate, are just as critical to meeting national objectives as individual large schemes • Implementation of water quality and quantity objectives is not explicitly stated to account for the benefits of significant infrastructure • Although the NPS-FM states that an integrated freshwater management framework is a matter of national significance, it focuses on the overall health of water resources, and does not specifically recognise the national significance of renewable electricity

The lack of well-defined and forceful language as described above can lead to the three national objectives not being adequately translated into local water decision-making. Another reason why this translation might be broken is the lack of a delivery mechanism that would provide directive guidance to local authorities over how to account for the three objectives in their water decisions. The issues arising within the E-W-E nexus are very complex, and local authorities may lack the knowledge, capacity and measurable impact methods to account for these in an adequate manner.

Furthermore, there is an expectation that some responsibilities should reside with the central government in order to avoid double regulation. For example, the Resource Management Amendment Act 2004 put the legal responsibility for regulating emissions in central government's hands in order to avoid emissions regulation at both central and local levels, and to enable emissions reductions to be addressed centrally through the NZ ETS (GWRC, 2014).

To summarise, the lack of two elements has contributed to the fact that various water-related delivery mechanisms have been applied locally in a way that can undermine hydro's role in meeting the energy security, system reliability and emissions reduction objectives. The two missing elements are:

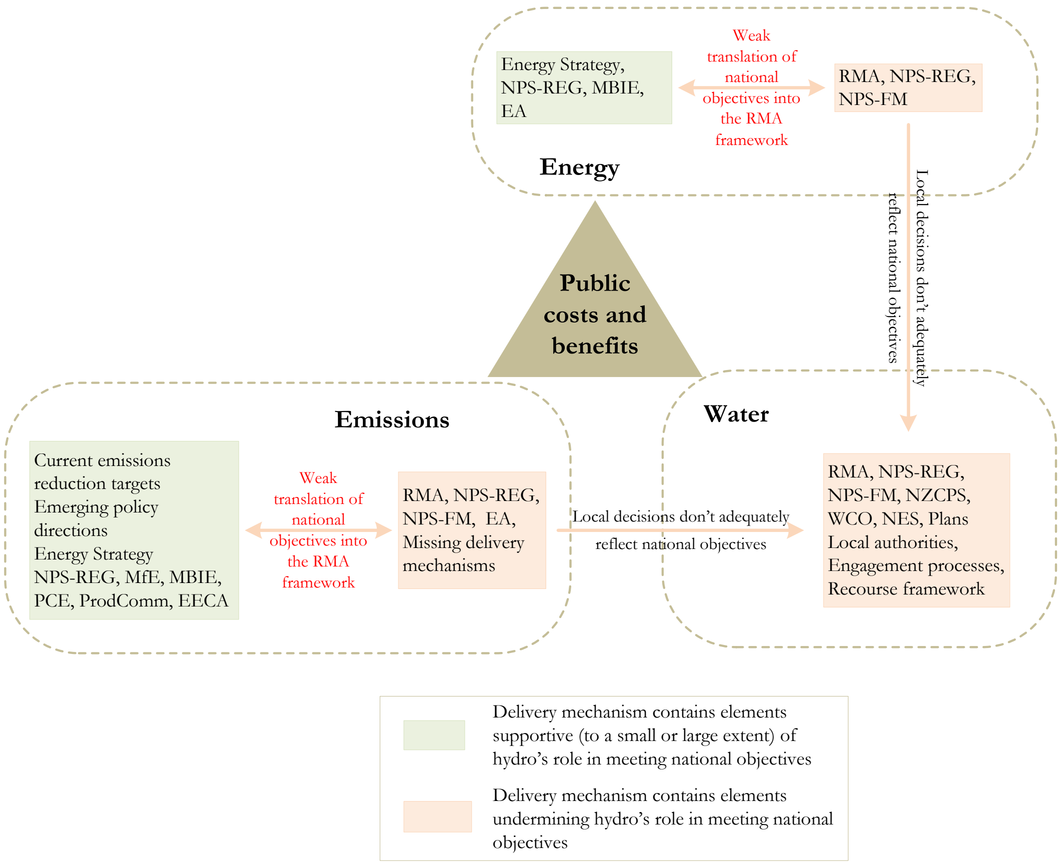
- well-defined and forceful language concerning the national significance of renewable sources of energy,[17] and
- a delivery mechanism to provide directive guidance to local authorities over how to translate the three national objectives into local water decision-making and how to prioritise these in relation to other national objectives

A relevant example is the explicit exclusion of water allocation matters from the scope of the NPS-REG: the Statement's preamble states that such matters are to be left for decisions at regional levels, which can create a potential disconnect between national objectives and the local decisions which impact on how these objectives can be met. Regional councils operate community based collaborative processes; these processes are not necessarily well equipped to deal with the national climate change targets and the consequence on those targets of decisions that impact on hydro operation. Appendix 1 provides further examples.

This points to disjointed thinking between the three national objectives and local water decision-making, as illustrated in the figure below. In the figure, disjointed thinking occurs due to the issue highlighted in red.

[17] We focus on the national significance as defined by the role that these sources can play in meeting the energy security, system reliability and low-emissions objectives.

Figure 5 Disjointed thinking between national objectives and local water decisions



Source: Sapere

5.3 Disjointed thinking can occur between national objectives

Disjointed thinking can occur between the national objectives of energy security and system reliability on the one hand, and low emissions on the other, due to a lack of coordination and prioritisation between the regulatory and policy frameworks surrounding these objectives. In particular, this can be seen in the lack of coordination between the renewables-related objective in the Energy Strategy and the mandate of the electricity market regulator (EA). As described previously, the EA is primarily responsible for the reliability of electricity supply, and its objectives are silent on issues of renewable generation or emissions reduction. The language of the Electricity Act and the EA's current statutory obligations thus creates weak imperatives to prioritise the contribution of the electricity system to national low-emissions objectives. In turn, the lack of coordination and prioritisation across national objectives means that local decision-making may occur ad-hoc and without due consideration of national imperatives.

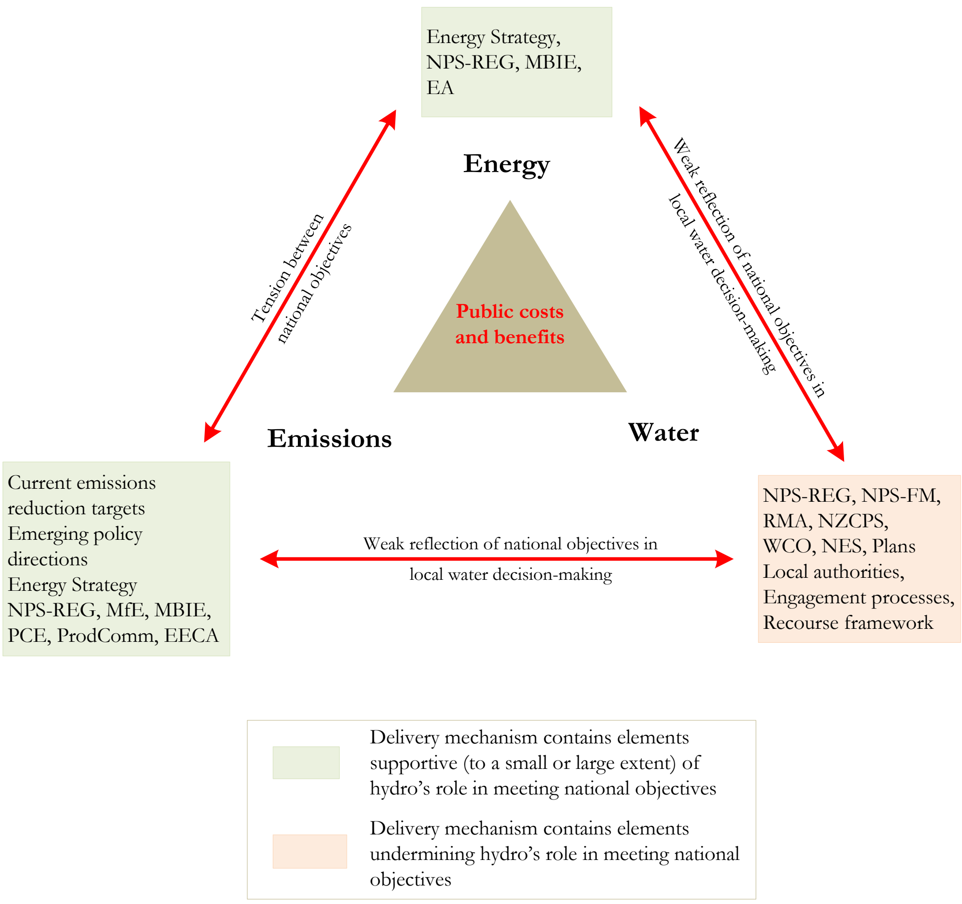
5.4 Putting it all together

In the previous two sections, we showed that there is disjointed thinking between the national objectives, and between each national objective and local water decision-making.

Another dimension that must be addressed when assessing joined-up thinking relates to the costs and benefits associated with a particular decision that may impact on hydro's role in delivering the three national objectives. Ignoring the cost and benefits perspective amplifies the disjointed thinking within the E-W-E nexus because it can lead to sub-optimal outcomes from an economy-wide view over the medium and longer time horizons. For example, the focus on the energy security objective in isolation from the emissions reduction objective could result in weak signals to investors with regards to the trade-offs between investing in low-carbon and emissions-intensive solutions in a world where the imperative of emissions reduction is likely to only get stronger. In the water sector, water management decisions that are made without considering the implications on the final cost of goods (or services) at the end of the water supply chain, which may lead to sub-optimal water management decisions that favour local interests at the expense of national priorities (e.g. affordability of electricity).

The following figure summarises all these points and illustrates how disjointed thinking occurs across the four dimensions. In the figure, the manifestation of disjointed thinking is highlighted in red (arrows and text).

Figure 6 Disjointed thinking across the E-W-E nexus



Source: Sapere

To summarise, within the E-W-E nexus with relevance for hydro generation, there is a lack of joined-up thinking between

- National energy-related objectives (security and reliability) and local water decision making
- National emissions reduction objectives and local water decision making
- National emissions reduction objectives and electricity sector objectives, and
- The three parts of the E-W-E nexus from an overall costs and benefits perspective.

The lack of joined-up thinking arises due to the fact that

- Within the RMA framework, the language translating the national objectives into local water decision-making is not well-defined and is not forceful;
- The electricity market does not have a focus on a low emissions electricity system as a goal in itself. The market regards the carbon price emanating from the NZ ETS as the sole vehicle for signalling the value of reducing emissions to emitters, including participants in the electricity market. This contrasts with the strong imperatives given to ensuring energy security and system reliability;

- At the local level, there is no mechanism that would provide directive guidance to local authorities over how to translate the three national objectives into local water decision-making, whilst accounting for the costs and benefits of their decisions. The consequence is ad-hoc local decision-making that is disjointed from national imperatives:
  - Although the RMA makes provisions for some level of renewable electricity generation, these need to be weighed against a multitude of other matters of local importance.
  - The outcome of this decision-making is significantly influenced by the way the language concerning these matters is framed. The fact that National Policy Statements seem to carry different weightings (e.g. as evidenced in the language used) creates the risk that local decisions are made in a way that reflect local interests at the expense of national objectives.
  - Finally, the lack of a directive framework that would support decision-making on potentially conflicting matters can also create an issue when such decisions are appealed, as court rulings are likely to reflect statutory provisions that are more prescriptive;
- At the national level, there is no mechanism that would provide direction on how decisions with impact on energy security, system reliability, emissions and electricity cost should be synchronised.

6. Consequences for New Zealand

Energy market

As discussed above, a lack of joined up thinking may reduce the contribution existing hydro makes to meeting energy security and reliability and emissions reduction objectives. Assuming that we would not contemplate a reduction in security or reliability, this role must be replaced with other forms of generation. This may result in the following consequences:

- Limiting hydro's flexibility may require an increased contribution from existing discretionary plant, to offset the reduction in the contribution existing hydro makes. Discretionary plant is thermal, and likely to be higher cost than the lost hydro. This has a direct cost consequence for consumers.
- Limiting hydro's absolute contribution to supply (through water allocation) may require investment in new generation plant. This additional investment, compared to the counterfactual where hydro's current contribution is maintained, has a cost consequence for consumers.
- If this new supply contribution (from existing thermal, or new investment) has associated emissions, New Zealand will find it more difficult (and/or expensive) to meet its emissions and electricity sector public policy objectives.
- Overall, the cost consequences, which will manifest through increased wholesale and retail tariffs, may exacerbate issues of affordability, sometimes referred to as energy poverty or energy hardship[18].
- Reducing ability to best support further integration of non-dispatchable renewable generation, thereby impeding the transition to a low emissions future.

Climate change

New Zealand's current policy framework with regards to climate change does not enable decision-makers to address the dynamics of climate change risks over long time frames. At the organisational level, considerations of changing risks do not seem to have permeated institutional response. According to Lawrence (2016), some councils are still operating within a static framing of climate change risks, largely driven by fear of court contest. Generally, risk aversion and single-purpose policy decision-making seem to be characteristic across central and local governments, often in response to climate events (Lawrence, 2015).

With climate change, flood and storm management will require more scope on how to manage river flows. Regional droughts and changing rainfall patterns will result in water shortages that will put greater strain on conflicting uses of water. Increased temperatures

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18 Energy poverty is generally defined by the proportion of the population whose required energy costs exceed a threshold proportion of their disposable income. Other indicators may also measure energy affordability/poverty/hardship and Stats New Zealand is currently considering measures that would be appropriate for New Zealand. See: http://www.stats.govt.nz/browse_for_stats/people_and_communities/Households/energy-hardship-report.aspx

may shift peak demand for electricity in some regions towards summer rather than winter, and will increase demand for irrigation in the summer. This will impact on the ability of hydro to provide discretionary supply and could result in reduced hydro power in the future. As discussed above, a constrained hydro supply can have implications for electricity affordability and the country's emissions profile as more expensive and emissions-intensive thermal generation may need to be brought in to offset the constrained hydro supply.

In this context, the consequences of disjointed thinking will become more pronounced as a result of greater pressure on decisions around water allocation, water quality and ecosystem health. The risk of inefficient decisions, and unintended consequences, will be that much greater.

All of these effects can exacerbate the conflict between national and local priorities. Without doubt, balancing these interests will need to account for the specifics of a local situation, particularly when matters of safety are involved. However, this balancing should be guided by a holistic view of the impact that water decisions may have both locally and nationally. As discussed previously, however, the delivery mechanisms needed to provide that holistic view are currently missing.

Local authorities' mandates

Finally, disjointed thinking across the E-W-E nexus can also undermine the ability of local authorities to fulfil their mandates. According to the Local Government Act 2002, the purpose of local government is

> *to meet the current and future needs of communities for good-quality local infrastructure, local public services, and performance of regulatory functions in way that is most cost-effective for households and businesses (Art 10(1)(b))*

As discussed above, failing to account for the impact that local water decisions may have on national priorities can have energy cost implications. This will jeopardize the ability of local authorities to fulfil their functions in a "most cost-effective" way.

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Appendix 1 Delivery mechanisms concerning local water decision-making: issues with impact on hydro

Delivery mechanism	Issue description
NPS-REG	• Water allocation is treated separately from generation: although matters of national significance include renewable electricity generation, freshwater allocation matters are left for decisions at regional level. *This national policy statement does not apply to the allocation and prioritisation of freshwater as these are matters for regional councils to address in a catchment or regional context and may be subject to the development of national guidance in the future" (Preamble)*
NPS-FM	• The requirement for hydro plants to meet water quality objectives does not account for energy security implications at either the local/regional or national level • Water allocation objectives are stated in terms of community impact, and not also national impact • Exemptions from national bottom lines do not take into account the national significance of infrastructure (also, what constitutes nationally significant infrastructure is not defined)
RMA	• Preservation of water quality and "outstanding" natural features is of national significance, which may impact on hydro resource development
NZCPS	• In the absence of forceful language around the national significance of energy security, the directive nature of the NZCPS creates the risk that renewable electricity opportunities may be foreclosed in many coastal areas
NES	• There are no national environmental standards specifying nationally consistent rules, standards and assessment criteria to be applied to the consenting and re-consenting of renewable generation activities
WCO	• Water conservation orders may be issued without taking into account the impact on (local) energy security
Local authorities	• The regional council's mandate is specifically focused on matters of regional significance, without an explicit acknowledgement of matters of national significance

Delivery mechanism	Issue description
Statutory planning documents	• The lack of forceful language concerning the national significance of renewables can result in local authorities failing to recognise that a plan is of particular relevance to renewable generation activities. For example, instead of a proactive planning framework that would enable renewables development, planning documents may simply apply NPS-REG objectives as a 'checklist' when assessing resource consent applications • The activity status of hydro is typically classified as either a "discretionary" or "non-complying activity", as opposed to "controlled" (as defined in the RMA). Controlled activities provide more certainty around resource consent continuity.
Engagement processes (mostly regulated under the RMA)	• The provision for limited public notification may exclude relevant parties from the planning process. The issue is largely due to how the definition of "affected person" (RMA Art. 95E) is applied in practice • Inclusion in collaborative processes can in practice be refused on grounds of the party not being locally based • There is no statutory requirement for collaborative planning processes (in RMA Part 4 of Schedule 1) to be inclusive, so there is no guaranteed participation. There are a number of examples of how affected parties were left out of collaborative processes • Restrictions on the number of participants involved in a process may leave relevant interests out (e.g. Environment Canterbury Water zone committees) • The inclusion of specific processes relating to iwi participation can be seen as inconsistent with a transparent and inclusive public process. For example, whereas RMA Art. 3 of Schedule 1 provides that local authorities should "consult" iwi authorities, Art. 47(1)(b) Part 4 of Schedule 1 requires local authorities to "have particular regard to any advice received on the draft policy statement or draft plan from the iwi authorities"
Recourse	• Exclusion from engagement processes often implies that there is no basis to seek appeal against a decision made at the local level, given that the party was not involved in deliberations in the first place • There are also no means for appealing against decisions of being excluded from an engagement process

Source: Sapere analysis

Appendix 2 The RMA framework