MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

BUILDING PERFORMANCE

Transforming Operational Efficiency

Building for climate change programme

August 2020

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MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

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1. Problem Definition

New Zealand has committed to net zero carbon emissions by 2050. The Building and Construction Sector needs to play its part in meeting this goal as the Sector currently accounts for around 20%[1] of New Zealand's carbon emissions through the energy and materials used in buildings. The Government is developing an Emissions Reduction Plan which will set out the changes needed to allow New Zealand to meet its climate change goals.

The Building System Performance (BSP) Branch of MBIE is leading the Building for Climate Change (BfCC) programme which will deliver the Building and Construction Sector's contribution to the Emissions Reduction Plan.

We are proposing two frameworks to reduce emissions across the Building and Construction Sector:

Mitigation Framework	Scope
Transforming Operational Efficiency	Emissions directly and indirectly attributable to the operation of buildings: eg the use of energy (for heating, cooling, hot water, lighting, ventilation, appliances etc) and water. Water use. Occupant health and wellbeing.
Whole-of-Life Embodied Carbon Emissions Reduction	All emissions attributable to the life cycle of a building, excluding operational emissions. This includes emissions across the full supply chain of construction materials and products, construction processes (and the waste arising), repair and maintenance, and processes at end-of-life of a building.

This document sets out the strategic approach for the first of these frameworks: Transforming Operational Efficiency.

1 This includes emissions from all energy and materials consumed in New Zealand, including imported materials.

2. Context

Emissions produced over the life cycle of a building are generally put into two groups, operational emissions and embodied emissions. **Operational carbon emissions**[2] occur only during the use stage of a building's life and are from the energy and other resources used when operating the building. **Embodied carbon emissions** are from the materials and products that form the building and can occur right across the building's life cycle.

The most significant operational carbon emissions are the indirect carbon emissions from the use of electricity and water when we live and work in buildings. Operating buildings also contribute direct carbon emissions, mainly through burning fossil fuels to provide heating and hot water.

Approximately 20% of all energy in NZ[3] is consumed in the operation of buildings and around 65-70% of the energy consumed in buildings is in the form of electricity. Buildings use slightly more than half of the electricity produced in NZ.

A considerable amount of potable water is used in buildings and a similar amount of wastewater comes from building use. Treatment and transport of potable and waste water, and related activities by water service providers, contribute indirect emissions mainly through the use of electricity[4].

Water supply is already strained in parts of New Zealand and this situation is predicted to worsen[5] through the action of climate change. As well as reducing emissions, improving water efficiency will help keep New Zealanders supplied with water.

Currently many buildings are cold, damp and poorly ventilated which impacts on occupant health and wellbeing[6]. The indoor environmental quality (IEQ) of buildings is primarily related to how much energy is required to maintain suitable indoor conditions throughout the year ie the operational efficiency.

2 The terms emissions, carbon emissions and carbon are used to represent all greenhouse gas emissions.
3 Energy in New Zealand 2019 (Table B.2), MBIE, Markets – Evidence and Insights Branch.
www.mbie.govt.nz/dmsdocument/7040-energy-in-new-zealand-2019
4 Water New Zealand National Performance Review (NPR) 2018-2019.
5 National Climate Change Risk Assessment for Aotearoa New Zealand – Main Report, MfE, Table 1.
6 The 2018 Census results showed 1 in 5 homes are affected by damp.
www.stats.govt.nz/news/one-in-five-homes-damp

3. Objectives

The Transforming Operational Efficiency framework is focussed on how improving the operational efficiency of buildings can reduce emissions, reduce water use and improve occupant health and wellbeing.

3.1 Objective 1: Reduce Operational Emissions

Reducing operational emissions is important for climate change mitigation and an important part of the Building and Construction Sector's contribution to the national Emissions Reduction Plan. Carbon emissions come directly from fossil fuel combustion and indirectly from using electricity and water in buildings. Increasing operational efficiency, and thereby reducing these three components, reduces operational emissions. The emissions are measured in kilograms of CO_2 equivalent per square meter per annum, *kg CO_2-e/(m^2.a)*.

Operational CO_2 emissions
kg CO_2-e/(m^2.a)

=

Fossil fuel combustion	+	**Electricity use**	x	**Grid Emissions Factor**[7]	+	**Water use (potable & wastewater)**	x	**Water Emissions Factor**[8]
Direct Emissions		Indirect Emissions		Electricity generation mix		Indirect Emissions		Water service providers energy use
kg CO_2-e/(m^2.a)		kWh/(m^2.a)		kg CO2-e/kWh		m^3/(m^2.a)		kg CO_2-e/m^3

3.2 Objective 2: Reduce Water Use

While water use contributes to operational emissions, it is also important for climate change adaptation and resilience. The volume of water[9] used in buildings impacts on the capacity of regional water supplies to meet demand.

3.3 Objective 3: Improve Occupant Health and Wellbeing

It is important that operational efficiency is not considered in isolation from indoor environmental quality (IEQ) and that improved efficiency also leads to good occupant health and wellbeing outcomes. Buildings need to be:

› Comfortable temperatures (warm in winter, cool in summer)
› Dry (appropriate humidity)
› Well ventilated

7 The Grid Emissions Factor is the measure of CO2-e emissions per unit of electricity consumed from the national electricity grid.
8 Each cubic meter of potable water supply contributes 0.0313 kg CO_2-e emissions. Each cubic meter of water used for domestic wastewater treatment plants contributes 0.447 kg CO_2-e, each cubic meter of water used in a septic tank contributes 0.202 kg CO_2-e. Ministry for the Environment – Measuring Emissions: A Guide for Organisations – 2019 Summary of Emission Factors.
9 The term "water" is generally used throughout this document to cover potable water and wastewater. Potable water is a proxy for total water use as, for buildings with a reticulated water supply and a wastewater network connection, the volume of potable water supplied and wastewater removed will be very similar.

4. Current Status

Operational efficiency is currently a specialist area within the Building and Construction Sector in New Zealand. This has meant Sector professionals and trades are not routinely taught or trained in operational efficiency. Generally, interested individuals pursue it as an elective subject or look outside their required education or training for specialist training opportunities.

Regulation for operational efficiency is not as robust as it could be. The current New Zealand Building Code (NZBC) does not provide a strong link between operational efficiency and defined health and wellbeing parameters (eg internal temperatures). Other voluntary approaches in the Sector often do not either. In addition, the current approaches to operational efficiency are often fragmented and target individual inputs (eg R-values of insulation) rather than a holistic outcomes approach (eg space heating demand with reference to healthy temperatures.)

The lack of system focus on operational efficiency and wellbeing outcomes is highlighted in the BRANZ surveys[10] and the 2018 census[11]. Both of these record that our buildings can be cold, damp and poorly ventilated which leads to poor occupant health and wellbeing outcomes.

The Sector has been slowly responding to these issues with a growing awareness of the importance of operational efficiency, and occupant comfort and wellbeing. The awareness has been translated into the growth of "high-performance" buildings that focus on operational efficiency, comfort and wellbeing. These higher performing buildings are a growing area within the Sector for professionals, trades and material suppliers.

10 **www.buildmagazine.org.nz/index.php/articles/show/mould-occupants-and-house-condition**
11 **www.stats.govt.nz/news/one-in-five-homes-damp**

5. Vision

Operational efficiency presents an opportunity to move quickly with new buildings and achieve the desired outcomes of this framework earlier than 2050.

Our vision is by 2035, New Zealand's new buildings are using as little energy and water as possible. They are warmer, drier and better ventilated, and provide a healthier place for us all to work and live.

The wellbeing of New Zealanders has improved, they're leading healthier lives, and respiratory illnesses from cold and damp houses are uncommon. People also have more money in their pockets due to lower energy bills.

The Building and Construction Sector can confidently and successfully design and construct energy and water-efficient buildings with low operational carbon emissions. Energy efficiency, water use and operational carbon emissions are core considerations for the Sector and new buildings now meet an emissions cap as well as other regulatory requirements.

Our infrastructure finds it easier to respond to demand for water, due to our lower use. This means we cope better with water shortages than we ever have before.

The efficiencies from the Sector have made it easier for the grid to become more renewable meaning fewer emissions for the energy we do use.

As a result, carbon emissions from building operations will have been significantly reduced compared with 2020 levels, and are making an important contribution to New Zealand's trajectory towards achieving net zero carbon emissions by 2050.

6. Approach

The framework proposes that the new measures for operational efficiency will be implemented in a series of steps for new buildings. Details and limitations of what is included are set out in section seven, the scope section.

The Transforming Operational Efficiency Framework proposes that:

1. There will be a mandatory Operational Emissions Cap setting out the total allowable annual emissions per square meter per annum for all new buildings.
    1.1. The Operational Emissions Cap will have requirements for fossil fuel combustion, electricity use and water use.
    1.2. Electricity use will have requirements for thermal performance, services efficiency and plug loads.
2. There will be a mandatory Water Use Cap setting out the total allowable potable water use per square meter per annum for all new buildings.
3. There will be defined Indoor Environmental Quality parameters for all new buildings to comply with.

- The Operational Emissions Cap and Water Use Cap will tighten in a series of steps, reaching a final cap by 2035.
- MBIE will publish the planned steps at the outset to provide clear signals and guidance to the industry on what they need to deliver in the coming years so the industry plays its part in helping New Zealand become net zero carbon by 2050.
- MBIE will review the planned steps and cap levels at each step and may make adjustments.
- Public sector bodies with building portfolios and council owned buildings are an opportunity for Government leadership by adopting the framework ahead of the private sector.

Step 1	Step 2	Step 3	Step 4
Operational Efficiency Requirements Launched	Initial Operational Efficiency Requirements come into force	Intermediate Operational Efficiency Requirements come into force	Final Operational Efficiency Requirements come into force
All new buildings must report against operational efficiency requirements at consent and code compliance stages.	All new buildings must meet initial operational efficiency requirements at consent and code compliance stages.	All new buildings must meet intermediate operational efficiency requirements at consent and code compliance stages.	All new buildings must meet final operational efficiency requirements at consent and code compliance stages.
	Public sector buildings must meet intermediate operational efficiency requirements at consent and code compliance stages.	Public sector buildings must meet final operational efficiency requirements at consent and code compliance stages.	

	Initial Cap	Intermediate Cap	Final Cap
Operational Emissions Cap CO_2-e/(m^2.a)[12]	The cap will be a reporting mechanism for the total of the operational emissions from the three components		
Fossil Fuel combustion emissions[13] CO_2-e/(m^2.a)	18	9	0
Electricity Use kWh/(m^2.a)[14]	180	90	45
Thermal performance (demand) kWh/(m^2.a)	60	30	15
Services efficiency (delivered) kWh/(m^2.a)	60	30	15
Water use l/p/d[15] (to be converted to m^3/m^2 based on occupancy of the building type)	145	110	75

Throughout the framework implementation, and particularly leading up to each step, MBIE will work closely with businesses and with professional, trade and training bodies in the Sector in order to disseminate the requirements and provide guidance on methods and tools to achieve them.

The framework proposes that MBIE will provide an online modelling tool for use when designing Small Buildings[16] that generates the report required for compliance at building consent application and code of compliance stages.

The framework proposes that MBIE will provide reporting templates for use when designing Large Buildings[17] that generates the report required for compliance at building consent application and code of compliance stages. Modelling for Large Buildings would be undertaken using tools available to the industry that meet MBIE requirements and using modelling parameters defined by MBIE[18].

MBIE will continue to develop ways to work with the Sector on refining the caps and associated processes as well as ways to support the Sector to change the way they work.

12 CO2 equivalent per square meter per annum
13 Fossil Fuel combustion emissions are based on the initial cap being equivalent to meeting the Thermal Performance with coal combustion and transitioning to the final cap being zero. Fuel emission factors from Ministry for the Environment – Measuring Emissions: A Guide for Organisations – 2019 Summary of Emission Factors.
14 Kilowatt hours per square meter per annum.
15 Litres per person per day.
16 See 7.1 for definition.
17 See 7.1 for definition.
18 Comparable to how modelling parameters are defined in NZS 4218.

7. Scope

7.1 Building Type Classifications[19]

The scope of the framework includes: Housing, Communal residential, Communal non-residential, Commercial, and Industrial buildings.

› The scope is broader than that of the current limits on the application of Building Code, Clause H1, in order to include all building types and sizes that need to provide suitable indoor environmental quality (IEQ) for the occupants. The types of buildings included all require heating, cooling, hot water, lighting etc and are an opportunity to meet the objectives of the framework.

› Housing and residential buildings make up a large proportion of the NZ building stock. Although individual houses are smaller buildings, collectively, housing and residential buildings are a significant opportunity to meet the objectives of the framework.

› Non-residential and commercial buildings make up a smaller proportion of the NZ building stock, but are typically larger, more complex and have higher user intensity than housing and residential buildings. Collectively, non-residential and commercial buildings are a significant opportunity to meet the objectives of the framework.

The scope of the framework excludes: Outbuildings and Ancillary buildings, with some possible exceptions.

› By definition these building classifications are not intended for human habitation and therefore very little energy or water is used to operate them.

› In general they have little impact on occupant health and wellbeing outcomes.

› Exceptions that are included in the scope may include buildings such as private swimming pools, where significant amounts of energy and water are used to operate the building and IEQ for occupants is important.

The operational emissions cap for some building classifications may be treated differently in the framework, for example, energy used for industrial processes within an industrial building.

In addition to the current building type classifications, the framework proposes two categories of buildings:

› Small Buildings[20]: those that are 3-storey or less and 300m^2 or less gross external floor area

› Large Buildings: those that are greater than 3-storey or greater than 300m^2 gross external floor area

7.2 New and Existing Buildings

The scope of the framework is limited to new buildings. As they have yet to be built, they present an immediate and urgent opportunity to meet the objectives.

It is also acknowledged that buildings that already exist are projected to make up approximately 65% of NZ's building stock[21] in 2050 and a similar proportion of emissions.[22] Additionally, many existing buildings suffer from poor IEQ.

Retrofitting existing buildings of different types and from different periods presents a multitude of challenges and opportunities. It is proposed that changes to existing buildings will be addressed in future work by the Building for Climate Change programme.

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19 See NZ Building Code, Clause A1 Classified uses.

20 "Small Buildings" and "Large Buildings" are working terms for this document and may not be the final terms used.

21 As calculated by MBIE using pipeline projections and figures from internal sources, BRANZ & Stats NZ.

22 This includes whole of life embodied and operational emissions, assuming business as usual construction and energy use. If emissions from new buildings 2020-2050 reduce, total emissions will reduce but the proportion of emissions from existing buildings will increase.

7.3 Occupant Behaviour

How occupants operate buildings and use fossil fuels, electricity and water in buildings can have an important impact on all of the framework objectives. However, the operational efficiency framework is focussed specifically on how regulating the design and construction of buildings can deliver on the framework objectives. Therefore, occupant behaviour is outside the scope of this framework and is not included in any of the following sections.

7.4 Operational Emissions

Central to the framework is the proposal that buildings must meet an operational emissions cap. However, because operational emissions are dependent on the emissions factor of the national electricity grid and the emissions factor of the water system, essentially it is a reporting mechanism for the total of the operational emissions from the three components as set out in Objective 1.

The framework proposes that all new buildings must comply with an Operational Emissions Cap in CO_2-e/(m^2.a) reported at the consenting stage and re-confirmed at code compliance stage.

The Operational Emissions Cap is a reporting mechanism for the total operational emissions that result from complying with the requirements of the three components: fossil fuel combustion, electricity use, and water use.

7.5 Fossil Fuel Combustion

Reducing fossil fuel combustion can be achieved by:

1. Improving thermal performance (see 7.6.1 Thermal Performance below) thereby reducing the need for space heating
2. Improving hot water system and equipment efficiency (see 7.6.2 Services Efficiency below) thereby reducing the energy needed to heat water
3. Replacing fossil fuels with electricity or other lower-carbon energy sources

The framework proposes that fossil fuel combustion is regulated for all new buildings with a cap on CO_2 emissions from fossil fuel combustion in CO_2-e/(m2.a) calculated at the consenting stage and re-confirmed at code compliance stage. This would form one component of the operational emissions cap.

7.6 Electricity Use

Reducing the amount of electricity used in buildings reduces indirect emissions by reducing demand on the national electricity grid. This allows lower electricity generation which reduces emissions or provides capacity on the grid that can be used to replace fossil fuel use in other Sectors.

Reducing the amount of electricity used in buildings during times of peak demand[23] on the grid is also critical as peak demand plays a large part in determining the emissions from the grid. This can be achieved by reducing the amount of electricity used in buildings at times of peak demand and by shifting the time when the most electricity is used in buildings.

23 Peak Demand on the electricity grid is typically during winter when more heating and lighting is required and, in the evening all year-round, when more heating, lighting, hot water and appliances are used.

The amount of electricity used in buildings is determined by four components: thermal performance, services efficiency, plug loads, and on-site renewable energy generation paired with storage. Water use also impacts on electricity use but is dealt with in a separate section below.

Total Electricity use	=	**Thermal Performance**	+	**Services Efficiency**	+	**Plug Loads**	-	**On-site Renewable Energy Generation and storage**
		Building Efficiency		System & Equipment Efficiency		Occupant behaviour		Useful capacity

Improving or reducing any of these four components, or water use, will reduce the total amount of electricity used.

> The framework proposes that electrical use is regulated for all new buildings with a requirement to comply with an Electricity Use Cap in kWh/(m^2.a) calculated at the consenting stage and re-confirmed at code compliance stage. This forms one component of the operational emissions cap.
>
> The Electricity Use Cap is a reporting mechanism for the total electricity use that results from complying with the requirements of the three components: thermal performance, services efficiency and plug loads.

7.6.1 Thermal Performance

Thermal performance is a key element of the framework because it determines how much heating and cooling will be required (fossil fuel combustion and electricity use) to maintain good indoor environmental quality (IEQ) for occupant health and wellbeing.

Improving thermal performance is high priority because:

- Space heating and cooling accounts for around a third of household and commercial office energy use[24].
- Fossil fuels are used for space heating. Reducing the amount of space heating needed reduces fossil fuel combustion and therefore reduces direct emissions.
- Thermal Performance is primarily determined by passive design measures and the quality of the thermal envelope, which are determined when a building is first designed and constructed and last the majority of the lifetime of a building.
- As a result of this, good thermal performance locks-in low operational emissions for the lifetime of the building, largely independent of the fuel sources and building services or technology used to operate the building.
- With a reduced need for heating and cooling, more energy efficient building services can be used.
- Good thermal performance means less energy is needed to maintain good indoor environmental qualities, promoting good occupant health and wellbeing regardless of their financial means.
- It is effective at reducing and shifting the time of peak electricity use as the whole building can act as a thermal battery.

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24 BRANZ Bulleting 643 Energy Efficiency in New Zealand houses (December 2019) and BRANZ Study Report SR297/1 (2014)

Good thermal performance can be achieved by:

1. A suitable ratio of building surface area to floor area (i.e. a compact ‘form factor’)
2. Good solar orientation so the building receives an appropriate amount of heat from the sun
3. Appropriate insulation for opaque building elements
4. Appropriate thermal performance for transparent building elements
5. Eliminating or reducing thermal bridging so insulation is continuous
6. Eliminating or reducing uncontrolled air leakage through building elements and junctions
7. Appropriate ventilation levels for good IEQ

The framework proposes that thermal performance is regulated for all new buildings with a requirement to comply with a thermal performance energy use intensity in kWh/(m^2.a) for heating and for cooling demand[25] calculated at the consenting stage and re-confirmed at code compliance stage. This would form one component of the electricity use cap.

7.6.2 Services Efficiency

Services efficiency is a key element of the framework because it determines how much electricity will be used to operate the building services in order to maintain good indoor environmental quality (IEQ) for occupant health and wellbeing. Services include the fixed systems and equipment in a building that use electricity (or other fuels) to provide the heating, cooling, ventilation hot water, lighting, potable water supply and disposal of wastewater.

Improving services efficiency is a priority because:

- Building services (hot water, lighting ventilation etc) are the next largest[26] household and commercial office energy use after space heating and cooling demand (thermal performance).
- Services efficiency is largely determined when a building is first designed and constructed and the systems have a long lifespan.
- System design is a priority as it can reduce energy use regardless of which equipment and technology is selected, [27]is much harder to upgrade later and has a longer lifespan than individual items of equipment or technology.
- Equipment and technology can be replaced on maintenance and upgrade cycles, especially if innovation leads to more efficient options becoming available

Good services efficiency can be achieved by:

1. Efficient heating and cooling systems and appliances
2. Efficient hot water systems and appliances
3. Efficient lighting
4. Efficient ventilation systems and appliances
5. Efficient potable water services
6. Efficient wastewater services
7. Post-occupancy monitoring and continuous commissioning. (Especially for Large Buildings.)

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25 Demand = the modelled/calculated amount of heating & cooling energy required to provide a defined level of indoor environmental quality (IEQ) and comfort including air/surface temperature, humidity, ventilation rates etc

26 BRANZ Bullet 643 Energy Efficiency in New Zealand houses (December 2019) and BRANZ Study Report SR297/1 (2014)

27 For example, system design that locates a hot water cylinder so that short lengths of small diameter hot water pipe can be used significantly reduces heat losses and thereby the amount of energy required for the hot water, regardless of how efficient the hot water cylinder itself is.

The framework proposes that services efficiency is regulated for all new buildings with a requirement to comply with a delivered[28] services energy use intensity in kWh/(m^2.a) calculated at the consenting stage and re-confirmed at code compliance stage. This would form one component of the electricity use cap.

7.6.3 Plug Loads

Plug Loads: the electricity used for appliances, electrical and electronic devices that people plug in to use in buildings (including EV charging).

It is proposed that plug loads in Small Buildings are outside the scope of the framework. For Small Buildings:

- Plug loads are not determined by the building design or construction.
- Plug loads are largely about occupant choices, usage behaviour and the appliances and equipment available on the market.

It is proposed that plug loads in Large Buildings are within the scope of the framework as a component of total electrical use. For Large Buildings:

- Plug loads are significant due to the considerable number of electrical appliances and devices in Large Buildings. They provide an opportunity to reduce electricity use based on selecting energy efficient appliances and devices and managed occupant use of them.
- Plug loads can be influenced in the building design and construction process and are often managed by the building owner/landlord.
- Reductions through appliance and device efficiency brought about through means such as EECA programmes are also important.

The framework proposes that plug loads for Small Buildings are not regulated and default values determined by MBIE are used as one component of the electricity use cap.

The framework proposes that plug loads for Large Buildings are regulated for all new buildings with a requirement to comply with an energy use intensity in kWh/(m^2.a) calculated at the consenting stage and re-confirmed at code compliance stage. The requirement may vary according to building classification. This would form one component of the electricity use cap.

28 Delivered = the metered amount of energy modelled/calculated to be supplied to the site to meet the demand. For example, if the heating demand is 15 kWh/(m^2.a) and a heat pump with a COP of 2.5 is used, the delivered electricity will be 15/2.5= 6 kWh/(m2.a). If an electric panel or fan heater is used (COP of 1), the delivered electricity will be 15/1= 15 kWh/(m^2.a).

7.6.4 On-site Renewable Generation and Storage

On-site Renewable Energy generation and storage: hydro, wind, solar photovoltaic (electricity), solar thermal (hot water) installations and batteries on the building or its site.

It is proposed that on-site renewable energy generation and storage is outside the scope of the framework.

- While on-site renewable energy generation and storage may reduce demand on the electricity grid, they are not a measure of efficiency.
- Often there is a mismatch in time of generation and time of use, which on-site electrical storage can resolve in the short term but not across seasons. Consequently, on-site renewable electricity generation and storage should not be considered a means to 'offset' thermal performance or services efficiency. This could result in less efficient buildings inadvertently leading to increased peak demand on the electricity grid and thereby perversely increasing emissions.
- Opportunities for on-site renewable energy generation vary greatly between building types, location and situation.
- While technology costs are reducing, on-site renewable energy generation and storage is still expensive and an additional cost over and above the base construction costs of a building.
- On-site renewable energy generation and storage can be added to a building after it is built and occupied by the building owner, the occupants, an electricity provider or another entity.
- On-site renewable energy generation and storage could be incentivising or supported through other programmes.

The framework proposes that on-site renewable energy generation and storage are not required as part of the Operational Emissions Cap.

However, on-site renewable energy generation and storage systems could be selected in place of fossil fuel systems for heating and/or hot water in order to meet the Operational Emissions Cap requirements.

7.7 Water Use

Water use is a key element of the framework as it impacts on both operational emissions and climate change resilience/adaptation.

- Reducing the total annual amount of potable water used in buildings and wastewater leaving buildings reduces demand on the water services supplier for potable water supply and wastewater treatment. Reducing demand on the water services supplier indirectly reduces emissions by reducing their use of electricity and therefore demand on the national electricity grid. This enables lower electricity generation, which reduces emissions or provides capacity on the grid that can be used to replace fossil fuel use in other industries.
- Reducing the total annual amount of potable water used in buildings also improves availability of regional water supplies. This is important for climate change resilience/adaptation and equitable access to water resources.

It is proposed that the following elements of water use are within the scope of the framework to reduce the amount of potable water required to operate a building:

- Systems efficiency[29]
- Equipment efficiency (eg pumps)
- Fitting efficiency (eg taps, shower heads, toilets)
- Water metering
- Leak detection for [large buildings] to ensure potable water systems are operating as intended

29 Reducing water use also reduces electricity use in many cases, therefore, water services appear in both services efficiency and water use.

It is proposed that the following elements of water use are outside the scope of the framework:

› Appliance efficiency (eg dishwashers, washing machines). These are best regulated through the New Zealand Water Efficiency Labelling Scheme.
› Collecting, storing and treating water on-site for use in the building. While this may reduce water use, opportunities vary greatly between building types, location and situation and it is best regulated through district plans as it currently is.
› On-site wastewater treatment.[30] While this may reduce water use, opportunities vary greatly between building types, location and situation and it would be best regulated through district plans where appropriate.

The framework proposes that potable water use is regulated for all new buildings with a requirement to comply with a Water Use Cap in $m^3/(m^2.a)$ calculated at the consenting stage and re-confirmed at code compliance stage. This forms one component of the operational emissions cap.

7.8 Occupant Health and Wellbeing

Buildings need to provide suitable indoor environmental quality (IEQ) for good occupant health and wellbeing outcomes. These include:

› Comfortable temperatures (warm in winter, cool in summer)
› Dry (appropriate relative humidity)
› Well ventilated
› Good daylight

Without setting clear requirements for IEQ, operational efficiency could result in unintended poor occupant health and wellbeing outcomes. Therefore, thermal performance and services efficiency (particularly ventilation) need to be defined in relation to IEQ parameters. In addition, construction assemblies and junctions need to be considered in relation to IEQ for comfort and avoidance of condensation and mould risk.

It is proposed that the following IEQ parameters are within the scope of the framework:

1. Air temperature range
2. Relative or absolute humidity range
3. Ventilation rates (minimum and maximum)
4. Surface temperature (relative to air temperature)
5. Hygienic surface temperature factor (avoidance of mould)
6. Daylight provision

The framework proposes that the Indoor Environmental Quality (IEQ) is regulated for all new buildings with a requirement that thermal performance and services efficiency are calculated or modelled using IEQ parameters defined by MBIE and that construction assemblies and junctions must meet IEQ parameters defined by MBIE.

30 Reducing demand for wastewater treatment may also directly reduce non-CO_2 GHG emissions at the water services supplier site, however, there may be no net reduction as the emissions may instead occur at the building site where the wastewater is treated (e.g. soak away, septic tank.)

8. Glossary:

In the context of this report, these terms have the following meaning:

Carbon Dioxide equivalent (or CO_2-e): a measure of the global warming caused by all greenhouse gases released by a specific activity. In addition to Carbon Dioxide (CO_2), it includes the impacts of other greenhouse gases, which are typically less significant than the impact of CO_2, but are included for completeness.

Carbon emissions: a shorthand term for emissions of all greenhouse gases including CO_2 and others, which cause global warming.

Delivered energy: the metered amount of energy modelled/calculated to be supplied to the building to meet the demand

Embodied carbon: shorthand term for whole-of-life embodied carbon. See the Whole-of-Life Embodied Carbon Emissions Reduction framework.

Energy Use Intensity: a measure of energy demand or use per square meter of usable floor area within a building per annum.

Greenhouse gases: gases that trap heat in the earth's atmosphere, contributing to global warming. The most prevalent ones are Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), and fluorinated gases (such as CFCs, HCFCs, HFCs etc. found in refrigerants). Of these, CO_2 causes the largest warming impact.

Heating (or cooling) demand: the amount of heating (or cooling) modelled/calculated to be required to maintain a building at a defined comfort level. See Thermal performance also.

Indoor environmental quality (IEQ): indoor comfort and wellbeing qualities including air temperature, surface temperature, air movement, CO_2 concentrations, humidity, daylight etc.

Operational emissions: carbon emissions attributable to the operation of buildings - essentially the use of energy (for heating, cooling, hot water, lighting, ventilation, appliances etc.) and water, that directly and indirectly cause emissions of greenhouse gases.

Retrofitting: renovating an existing building to achieve operational efficiency outcomes.

Thermal performance: the amount of space heating and cooling required to maintain defined IEQs.

Primary energy: the amount of source energy required in order to supply the delivered energy, accounting for transformation (eg from coal to electricity) and distribution losses.

9 Questions for consideration

Below are some questions we would like you to keep in mind when reading this framework and considering your feedback. Your thoughts on these questions will really help us shape the ongoing Building for Climate Change work in a way that is meaningful to you and to others in the Sector.

There is a short survey covering the questions below as well as some extra questions on the MBIE Building for Climate Change website **www.mbie.govt.nz/building-and-energy/building/building-for-climate-change**. You are also welcome to provide feedback directly to the programme team (**bfcc@mbie.govt.nz**).

Content	Questions
Overarching BfCC approach	What support do you think you or your business would need to deliver the changes proposed in the frameworks? What barriers are currently preventing (or discouraging) you, or your business, taking action to reduce emissions? What building classifications should be included in the Building for Climate Change work programme?
General questions	Should the Building for Climate Change programme include measures to improve the operational efficiency of our buildings?
	The Framework proposes that operational efficiency requirements tighten in a series of steps with the requirements for each step published at the outset and reaching the final step by 2035. Do you think that this approach and timeframe is appropriate? How long do you think the Building and Construction Sector will need to prepare before we begin introducing operational efficiency requirements? Should outbuildings and ancillary buildings be exempt from operational emission reduction requirements?
8.4	The Framework proposes that operational efficiency requirements will only apply to new buildings initially with further work to look at requirements for existing buildings being undertaken at a later date. Do you support this approach?
8.5	Would you support a limit on emissions from fossil fuel combustion to operate buildings (i.e. space and water heating)?
8.6.1 – Thermal Performance	Do you think that new Thermal Performance requirements based on heating and cooling demand should be introduced to support increased operational efficiency of buildings?
8.6.1 – Services Efficiency	Requirements for the efficiency of fixed services (such as heating and cooling systems, hot water systems and appliances, ventilation systems etc) are not currently set out in the Building Code. Do you think that Services Efficiency performance requirements should be introduced to support increased operational efficiency of buildings?
8.6.3 Plug loads	The framework proposes that there are requirements for the plug loads for large buildings*, but not small buildings – do you support this approach? (* Large and small buildings as defined in the framework scope section)

8.6.4	The Framework proposes that new buildings will not be required to include onsite renewables/energy generation/ or energy storage capacity. Do you agree with this proposal?
8.7	Do you think the following elements should be excluded from the programme? • Electrical appliance efficiency • On-site collection and storage of water • On-site waste water treatment
8.8	What elements should be considered to provide a suitable indoor environmental quality for good occupant health and wellbeing?

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