15 October 2021

Submission: National Construction Code 2022 public comment draft (stage 2) consultation

The Australian Pipelines and Gas Association (APGA) represents the owners, operators, designers, constructors and service providers of Australia's pipeline infrastructure, with a focus on high-pressure gas transmission. APGA's members build, own and operate the gas transmission infrastructure connecting the disparate gas supply basins and demand centres of Australia, offering a wide range of services to gas producers, retailers and users.

APGA welcomes the opportunity to contribute to the ABCB consultation on the National Construction Code (NCC) 2022 public comment draft (stage 2) (the **Draft NCC**).

APGA supports the NCC intention to achieve lower home greenhouse gas emissions by mandating energy efficient homes. AGPA is concerned however that the approach currently taken by the Draft NCC does not achieve the desired objective. Table 1 demonstrates that some homes with gas appliances will have lower emissions profiles than electric homes but receive a higher Energy Efficiency factor (EE) under the Draft NCC. A higher EE is undesirable for a home as higher EE requires additional expense in installing solar to offset the EE. This means homes will be incentivised to choose electric appliance options despite the fact that, in some circumstances, this will lead to higher overall emissions for the home.

Table 1: Comparison of <6 Star Gas Home and <2.5 Star Heat Pump Home (VIC6, EF = 2.320)[1]

Home Appliance Composition	Draft NCC EE Rating	Average Efficiency	kgCO2e per kWh Input (2019[2])	kgCO2e per kWh Heat Output
Heat Pump <2.5 Star	2.057	300%	1.02	0.340
Gas <6 Star	3.223	88%	0.186	0.211

The lower emission gas home in Table 1 will be financially penalised through a solar installation mandate as EE is greater than the regional Energy Factor (EF), while the higher emission electric heat pump home will be financially incentivised through no solar mandate as EE is less than EF.

This is an unintended outcome and should be cause for the Australian Building Codes Board (ABCB) to review the current methodologies in the current Draft NCC.

APGA propose two features of the Draft NCC are likely to be responsible for this outcome:

- Using energy capacity as a proxy for emissions intensity. The amount of energy used by an appliance must be related to the emission intensity of the energy used.
- The undisclosed calculations behind the Energy Efficiency factors (EE)

[1] Comparison details including references can be found in the Detailed Feedback – Example Details
[2] 2019 emissions data is used in this submission consistent with Draft NCC use of 2019 data.

This is not a one-off outcome of the Draft NCC. Examples from most states can be found in Table 2 in the *Detailed Feedback* section below, which contains an explanation of why using energy capacity as a proxy for emissions intensity fails to achieve the desired outcome, as well as APGA's concerns around the lack of detail provided for how EE is derived.

APGA further suspects that the Draft NCC methodology may not only have a negative impact on homes that use gas appliances. Appendix 1 explores suspicions that the Draft NCC may impact the lowest emissions energy source – that is to say, the Draft NCC will negatively impact electricity use once the emissions intensity of electricity is lower than the emissions intensity of gas. The lack of transparency in EE factors makes this very difficult to assess.

Based on these observations, APGA recommends the ABCB take the following measures:

- Develop a measure of home emissions intensity that achieves the desired ABCB's stated goal of *reduce[ing] greenhouse gas emissions from buildings* which considers emissions intensity rather than a proxy for emissions; and
- Publicly disclose the calculations and variables used to derive EE and publicly consult with energy industry experts on the applicability of these calculations.
- Failing these, remove H6P2 from Draft NCC Volume 1, and J3D14 & J3D15 from Draft NCC Volume 2 based on their financial penalisation of lower emission homes.

While not a topic for this submission, APGA further questions whether the NCC should contain energy efficiency policy beyond building fabric standards, and whether penalising homes by mandating solar PV installation truly addresses the problems which it Draft NCC seeks to solve. Effective appliance standards and economy-wide (or state-driven) emissions reductions targets are more effective avenues to drive emissions reduction.

Finally, APGA highlights that the gas industry is actively developing options for gas use decarbonisation through renewable gas. APGA are the largest industry contributor to the Future Fuels CRC and signatory to Gas Vision 2050. Through uptake of renewable gases such as hydrogen and biomethane, homes with gas appliances Australia wide will have the opportunity to decarbonise their gas use without the need or expense of an all-electric home – in fact, some homes have already been able to take up this opportunity today. There is increasing evidence that renewable gases offer Australia, and countries around the world, a lower cost decarbonisation pathway than electrification.

It is vital that the NCC is developed with an understanding of the decarbonisation of gas alongside the relative merits of electricity and gas appliances today to ensure the best decisions are made.

APGA welcome further discussion on these topics. Should you have any questions about this submission, please contact me on +61 422 057 856 or jmccollum@apga.org.au.

Yours Sincerely,

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Australian Pipelines and Gas Association

Detailed Feedback

The following detailed feedback provides the basis of APGA's concerns relating to the Draft NCC. An explanation of the examples included in Table 1 can be found in the *Table 1 Example Details* section below.

APGA supports the NCC objective of achieving lower home emissions intensity by targeting more energy efficient homes. Unfortunately, AGPA anticipates that the approach currently taken by the Draft NCC will achieve the opposite objective, penalising lower emissions homes, and in turn, actively incentivising higher emissions intensity homes.

There are two primary factors which APGA considers will contribute to this unintended consequence:

1. Using energy capacity as a proxy for emissions intensity. The amount of energy used by an appliance must be related to the emission intensity of the energy used.
2. The undisclosed calculations behind the Energy Efficiency factors (EE)

These are elaborated upon in the sections below, alongside additional points of concern.

Table 1 Example Details

APGA provides an example of Draft NCC outcomes in Table 1 which is reproduced with references below.

Table 1: Comparison of <6 Star Gas Home and <2.5 Star Heat Pump Home (VIC6, EF = 2.320)

Home Appliance Composition	Draft NCC EE Rating[3]	Average Efficiency	kgCO2e per kWh Input (2019[4])	kgCO2e per kWh Heat Output
Heat Pump <2.5 Star	2.057	300% [5]	1.02[6]	0.340
Gas <6 Star	3.223	88% [7]	0.186[6]	0.211

The example purposely compares a low efficiency sub-2.5-star heat pump home to a high efficiency sub-6-star gas home. The heat pump home includes 2.5-star ducted heat pump heating and heat pump hot water (standard), while the gas home includes 6-star ducted gas heating and instant hot water. The City of Melbourne region (Victoria Climate Zone 6) was

[3] ABCB Standard: Whole-of-home efficiency factors Public Comment Draft 2021
https://consultation.abcb.gov.au/engagement/ncc-2022-public-comment-draft-stage-2/supporting_documents/ABCB%20Standard%20%20WholeofHome%20Efficiency%20Factos.pdf
[4] 2019 emissions data used to be consistent with Draft NCC use of 2019 emissions data
[5] Greenhouse and Energy Minimum Standards (Air Conditioners up to 65kW) Determination 2019
https://www.legislation.gov.au/Details/F2019L00490
*Assuming Heat Pump Hot Water star ratings are equivalent
[6] National Greenhouse Accounts Factors, Australian Department of Industry, Science, Energy & Resources 2019
https://www.industry.gov.au/sites/default/files/2020-07/national-greenhouse-accounts-factors-august-2019.pdf
[7] Star Ratings for Gas Heaters, Elgas 2021
https://www.elgas.com.au/blog/449-star-ratings-for-gas-heaters-gas-wall-furnaces-a-gas-fireplaces/
*Assuming Gas Hot Water Heater star ratings are equivalent

chosen to highlight the unintended emissions consequences of the current Draft NCC to Victorian regulators as cooler climates are negatively impacted the most.

The 'no cooling' option has been chosen for each home so that the examples could include known emissions intensity of energy and energy efficiency factors. It is currently not possible to undertake such analysis for mixed gas – electricity homes considering the lack of transparency in EE calculation methodology. This lack of transparency means that the ratio of gas and electricity use that go into EE, as well as any other factors, are unknown. This is elaborated on in the *Undisclosed Whole-of-Home Energy Efficiency rating calculation* section below.

Energy capacity as a proxy for emissions intensity

Energy use does not equal emissions intensity. By assuming energy use does equal emissions intensity, it is possible to label lower emissions homes as higher emissions homes. Incorrectly labelling lower emission homes as higher emission homes while financially penalising higher emission homes through solar PV purchase mandates can lead to the financial penalisation of lower emission homes.

Energy capacity is only directly proportional to emissions intensity if only one source of energy is considered. Once a second energy source is considered, there is a middle ground where the use of more of a lower emissions energy source can result in lower overall emissions. This is what APGA submits the Draft NCC fails to consider. In doing so, the Draft NCC financially penalises lower emission homes and incentivises higher emission homes.

A non-exhaustive set of examples of the above failure can be seen in Table 2. These examples demonstrate the differences in EE factor between homes with gas appliances and homes with electric heat pump appliances, alongside the resultant emissions intensity per unit of heat generated in these homes. These show that gas homes are lower emitting than electric homes, and that gas homes are financially penalised through mandated solar PV installation.

Each unit of gas used by appliances (kgCO2e per kWh Heat Input) clearly produces less emissions than each unit of electricity used by electric appliances. Despite this, each unit of energy input is related to the exact same EF limit. APGA expect this relationship to be at the heart of the perverse penalisation of lower emission homes seen in Table 2.

A few quick notes on the approach taken for these examples:

- Home appliance combinations without cooling were used so that a comparison of appliance efficiency and emissions intensity of energy sources could be undertaken.
- Although we anticipate similar outcomes, this analysis cannot be done for homes with a mixture of appliances due to the lack of EE calculation transparency detailed in the *Undisclosed Whole-of-Home Energy Efficiency rating calculation* section below.
- For simplicity, the same efficiency for both hot water and space heating is assumed.

While it is currently homes using gas appliances which are incorrectly penalised for producing lower emissions, APGA suspects that any lower emission energy source will be negatively impacted by this approach. This includes electricity once it is less emissions intensive than gas. Further elaboration on this suspicion can be found in the Appendix 1.

Table 2: Comparisons of Ducted Gas Appliance Homes with lower emissions than Ducted Heat Pump Appliance Homes (no cooling)

City	Home Appliance Configuration	Draft NCC Home EE (kW/Area)	Avg Appliance Efficiency	kgCO2e per kWh Input (2019)	kgCO2e per kWh Heat Output	Draft NCC Region EF (kW/Area)	Solar Mandate (kW/Area)
Melb (VIC6) EF = 2.32	Heat Pump <3.00 Star	1.965	450%	1.020	0.227	2.320	0.000
	Heat Pump <2.25 Star	2.057	300%	1.020	0.340	2.320	0.000
	Gas <3.0 Star	3.717	73%	0.186	0.255	2.320	1.397
	Gas <4.5 Star	3.520	79%	0.186	0.235	2.320	1.200
	Gas <6.0 Star	3.223	88%	0.186	0.211	2.320	0.903
	Gas >6.0 Star	2.927	91%	0.186	0.204	2.320	0.607
Canb (ACT7) EF = 3.66	Heat Pump <2.25 Star	2.259	300%	0.810	0.270	3.660	0.000
	Gas <3.0 Star	7.916	73%	0.186	0.255	3.660	4.256
	Gas <4.5 Star	7.437	79%	0.186	0.235	3.660	3.777
	Gas <6.0 Star	6.718	88%	0.186	0.211	3.660	3.058
	Gas >6.0 Star	5.999	91%	0.186	0.204	3.660	2.339
Syd (NSW6) EF = 3.43	Heat Pump <2.25 Star	2.146	300%	0.810	0.270	3.430	0.000
	Gas <3.0 Star	6.433	73%	0.186	0.255	3.430	3.003
	Gas <4.5 Star	6.067	79%	0.186	0.235	3.430	2.637
	Gas <6.0 Star	5.517	88%	0.186	0.211	3.430	2.087
	Gas >6.0 Star	4.967	91%	0.186	0.204	3.430	1.537
Perth (WA5) EF = 3.36	Heat Pump <2.25 Star	1.761	300%	0.690	0.230	3.360	0.000
	Gas <6.0 Star	4.932	88%	0.186	0.211	3.360	1.572
	Gas >6.0 Star	4.598	91%	0.186	0.204	3.360	1.238
Bris (QLD2) EF = 2.54	Heat Pump <2.25 Star	0.919	300%	0.810	0.270	2.540	0.000
	Gas <3.0 Star	3.031	73%	0.186	0.255	2.540	0.491
	Gas <4.5 Star	2.991	79%	0.186	0.235	2.540	0.451
	Gas <6.0 Star	2.932	88%	0.186	0.211	2.540	0.392
	Gas >6.0 Star	2.874	91%	0.186	0.204	2.540	0.334

Undisclosed Whole-of-Home Energy Efficiency rating calculation

Having explored the problems with using *Energy capacity as a proxy for emissions intensity*, this section will query observations around Energy Efficiency (EE) factors. Comparing EE across various appliance combinations displays unexpected outcomes which raise questions about EE calculation methodology. Unfortunately, EE calculation methodology is not disclosed within the Draft NCC.

Table 3: Comparison of <6 Star Gas Home and <3 Star Heat Pump Home (VIC6)

Home Appliance Configuration	Draft NCC EE Rating[8]	Average Efficiency	kgCO2e per kWh Input (2019)[9]	kgCO2e per kWh Heat Output
Heat Pump <3 Star	1.965	450% 10	1.0211	0.227
Gas <6 Star	3.223	81% 12	0.186[11]	0.227

Comparing the resultant EE of different appliance combinations with equal actual emissions outcomes as in Table 3 results in significant differences in EE. EE for the gas home in Table 3 is 64% higher than the heat pump home despite both having the exact same emissions outcomes.

This difference can start to be understood in reading the NCC 2022 Update Whole-of-Home Component (August 2021) report which recommends applying a "Social Cost of Energy" (SCoE) factor on top of actual energy use in calculating EE. There is no indication if or how SCoE was applied within the EE calculation methodology – a concerning cap noting that SCoE is stated in dollars in the aforementioned report. If some version of the SCoE method has been used in deriving EE then there are serious questions around the appropriateness of this approach considering that it results in such large differences in EE relative to emissions intensity.

Noting that an EE value above the regional EF results in financial penalties in the form of mandated Solar PV installation, the example in Table 2 demonstrates that those who have

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[8] ABCB Standard: Whole-of-home efficiency factors Public Comment Draft 2021
https://consultation.abcb.gov.au/engagement/ncc-2022-public-comment-draft-stage-2/supporting_documents/ABCB%20Standard%20%20WholeofHome%20Efficiency%20Factos.pdf
[9] 2019 figures used in line with figures used by Draft NCC
[10] Greenhouse and Energy Minimum Standards (Air Conditioners up to 65kW) Determination 2019
https://www.legislation.gov.au/Details/F2019L00490
*Assuming Heat Pump Hot Water star ratings are equivalent
[11] National Greenhouse Accounts Factors, Australian Department of Industry, Science, Energy & Resources 2019
https://www.industry.gov.au/sites/default/files/2020-07/national-greenhouse-accounts-factors-august-2019.pdf
[12] Star Ratings for Gas Heaters, Elgas 2021
https://www.elgas.com.au/blog/449-star-ratings-for-gas-heaters-gas-wall-furnaces-a-gas-fireplaces/
*Assuming Gas Hot Water Heater star ratings are equivalent

chosen to achieve an emission outcome will seemingly be penalised solely for having chosen to achieve the emissions outcome using gas appliances.

If the Draft NCC is truly interested in delivering emissions outcomes. There should be no financial penalty applied to homes that can achieve the same emissions outcome simply because they choose to do so with gas appliances.

This result brings into question the very premise of applying SCoE in its current form to home energy efficiency. Assuming that the approach documented in the aforementioned report was indeed what was used, this fails to consider a wide range of societal impacts, some of which are included in the *Further Points of Concern* section below.

APGA requests that ACBC publicly disclose the calculations and variables used to derive EE and publicly consult with energy industry experts on the applicability of these calculations. Once again, the financial burden of any mathematical flaw within the NCC ultimately lands on Australian homeowners who are already facing record house price inflation nation-wide.

Further Points of Concern

Alongside the more detailed concerns raised within this submission, APGA also note a number of concerning features within the Draft NCC:

- Gas too is starting its decarbonisation journey
  Renewable gases like hydrogen and biomethane are expected to start bringing down average gas use emissions across the coming decade[13]. Penalising gas homes on the basis that the electricity system is decarbonising ignores the reality that gas appliances in some suburbs already have access to reduced emission intensity gas[14]. This will expand in the foreseeable future with more lower and zero emission gas being made available nation-wide. APGA expect the National Greenhouse Accounts Factors to display this across coming years, and for the NCC to incorporate such developments.

- Emission avoidance matters today
  A comparison between the Victorian Energy Efficiency Target Amendment (Prescribed Customers and Targets) Regulations 2020 Regulatory Impact Statement and the National Greenhouse Accounts Factors 2021 quickly demonstrates that it is difficult to accurately estimate electricity emissions intensity reduction across the coming decade. A recent Future Fuels CRC report warns that the use of electricity in place of gas will likely increase emission intensity across the coming decade rather than decrease it. The comparison seen in Table 1 is an example of how the Draft NCC will help increase emission intensity across the coming decade.

[13] AEMC to review how rules can accommodate hydrogen and renewable gases, AEMC 2021
https://www.aemc.gov.au/news-centre/media-releases/aemc-review-how-rules-can-accommodate-hydrogen-and-renewable-gases
[14] Hydrogen Park South Australia, AGIG 2021
https://www.agig.com.au/hydrogen-park-south-australia

- Cost of housing matters today
  The cost burden of mandated yet unwarranted Solar PV installations and more costly heat pump appliances will fall on Australian homeowners who are already facing record house price inflation nation-wide. APGA is aware of industry research into the relative costs of heat pump and gas appliances to better inform consumer choice around the overall lowest cost approach to home emissions reduction.

- Underrepresented Social Costs
  There are a range of social costs not represented within the report describing SCoE:
  - The social cost of Solar PV feed into electricity distribution networks, resulting in the need for AEMO to acquire and use the power to switch off Home Solar PV in periods of low electricity demand[15]
  - The societal cost of reducing network efficiencies which keep gas prices low for those who can't afford the higher cost of new 6-star all electric housing
  - The societal cost of increasing electricity network capacity. In the example of Victorian energy infrastructure, the electricity infrastructure makes 3.6 times more revenue off of its customers than gas infrastructure while delivering two thirds the energy at peak demand of less than half of that achievable by gas infrastructure. Its no wonder considering electricity infrastructure is valued at over three times that of gas infrastructure. This concern is based upon data found in Table 4, which can be found below this list.

- Outdated Heat Pump GEMS methodology
  The Whole of Home Component document appears to use assumptions for heat pump CoP based on GEMS 2013 methodology which significantly underestimates the energy used for heating by not considering regional temperature impact on heat pump performance.

  Even the most recent GEMS methodology for heat pumps does not consider the hour to hour transient changes to CoP due to cold side and hot side temperatures which can each vary CoP by a factor of 0.5 to 1.5 and can combine[16].

- Outdated National Greenhouse Accounts Factors
  The assumed greenhouse factors are based on 2019 greenhouse factors and energy tariffs on March 2020 data. By the time NCC 2022 is published (September 2022) these figures will be out of date by 3 years and locked in for a further 3 years.

  The National Greenhouse Accounts Factors series of documents is yet to consider renewable gas uptake in gas networks. While this is still very small, this is not of

[15] Solar panels switched off by energy authorities to stabilise South Australian electricity grid, ABC 2021
https://www.abc.net.au/news/2021-03-17/solar-panels-switched-off-in-sa-to-stabilise-grid/13256572
[16] Product Profile: Heat Pump Water Heaters, Commonwealth of Australia 2012
https://www.energyrating.gov.au/sites/default/files/documents/Heat-Pump-Water-Heater-ProductProfile-June-2012-1_0.pdf

great concern. APGA and other gas industry participants will work to ensure that National Greenhouse Accounts Factors accurately reflect changes to gas emissions intensity as time progresses.

Table 4: Costs and deliveries of Victoria's energy infrastructure (2019) [17,18,19,20,21,22,23]

Transmission and Distribution Infrastructure	Regulated Asset Base ($m)	Actual Annual Revenues ($m)	Actual Energy Delivered (GWh)	Max Demand Capacity (MW)
Electricity	17,329	2,825	41,480	8,684
Gas	5,631	774	64,722	23,250

[17] Electricity DNSP - Operational performance data - 2006-2019, The Australian Energy Regulator 2020 https://www.aer.gov.au/system/files/Electricity%20DNSP%20-%20Operational%20performance%20data%20-%202006-2019.xlsm

[18] Victorian Gas Planning Report Update, AEMO 2020 https://aemo.com.au/-/media/files/gas/national_planning_and_forecasting/vgpr/2020/2020-vgpr-update.pdf?la=en

[19] AER Annual Reporting – APA GasNet Australia (Operations) Pty Ltd, Australian Energy Regulator 2021 https://www.aer.gov.au/system/files/VTS%20%28APA%20GasNet%29%202020%20-%20Annual%20-%20RIN%20Response%20-%20Consolidated%20-%2030%20April%202021%20-%20PUBLIC%20%2312%2C211%2C975.xlsx

[20] APA Victorian Transmission System pipeline information - RIN responses, Australian Energy Regulator 2021 https://www.aer.gov.au/networks-pipelines/performance-reporting/apa-victorian-transmission-system-pipeline-information-rin-responses

[21] Multinet Gas pipeline information - RIN responses, Australian Energy Regulator 2021 https://www.aer.gov.au/networks-pipelines/performance-reporting/multinet-gas-pipeline-information-rin-responses

[22] AusNet Services Gas pipeline information - RIN responses, Australian Energy Regulator 2021 https://www.aer.gov.au/networks-pipelines/performance-reporting/ausnet-services-gas-pipeline-information-rin-responses

[23] Australian Gas Networks (Victoria/Albury) Gas pipeline information - RIN responses, Australian Energy Regulator 2021 https://www.aer.gov.au/networks-pipelines/performance-reporting/australian-gas-networks-victoria-albury-gas-pipeline-information-rin-responses

Appendix 1: Negative impact on lowest emission energy source

Energy capacity does not equal emissions intensity. By assuming energy capacity does equal emissions intensity, it is possible to label lower emissions homes as higher emissions. Incorrectly labelling lower emission homes as higher emission homes and financially penalising higher emission homes through solar PV purchase mandates can lead to the financial penalisation of lower emission homes.

When only one energy source is in use, it is reasonable to use energy capacity as a proxy for emissions intensity. This changes however when more than one energy source is used, and more specifically, when more than one energy source with different emissions intensities is used. Homes have access to more than one energy source with different emissions intensities, and this is recognised by the Draft NCC inclusion of gas and electric appliances in the whole of home equation.

In its most simple form, the Whole of Home equation boils down to a comparison between a home's EE and the regions EF. EE and EF are energy capacity factors being used as proxies for emissions intensity. The emissions intensity which EE and EF represent could reasonable be considered equal to these energy capacity factors multiplied by the emissions intensity of the energy used by the home.

The problem that arises can be explained by considering the situation where a home being assessed under the NCC has an energy capacity factor EE equivalent to the regional energy capacity factor EF, but does so using gas appliances. As EF is calculated using one gas appliance and two electric appliances, the unweighted average emissions intensity for EF if the home is being built in Victoria would be (1.02 + 0.186 + 1.02)/3 = 0.742kgCO2 per kWh. The home being assessed however could be using two gas appliances and one electric appliances, resulting in an unweighted average emissions intensity for EE of (0.186 + 0.186 + 1.02)/3 = 0.464kgCO2 per kWh.

If the home under assessment has the same energy capacity factor EE as the regional energy capacity factor EF, but a lower emissions intensity of energy, then the emissions intensity of the home is likely to be less than that of the base home used to calculate EF. This is not a problem when EE equals EF as this does not result in a mandate to purchase solar PV.

Consider, however, the circumstance where the energy capacity factor EE for the home under assessment is 1% higher than the regional energy capacity factor EF. Arguably, with such a large difference between average emissions intensity of energy, and such a small increase in the energy used by the home, the home being assessed can only be expected to have lower emissions intensity than the base home used to calculate EF.

The difference being the home under assessment with 1% higher energy capacity factor EE than the regional energy capacity factor EF receives a financial penalty in a mandated requirement to purchase solar PV. This is despite having an arguably lower emissions intensity than would result from a home built to the exact specifications used to calculate the regional energy capacity factor EF. A home being financially penalised despite having lower emissions.

This result of lower emissions homes being penalised with solar PV mandate will extend up until the point where the home uses so much energy that even its lower emissions energy use does not result in lower overall emission. Between the lower limit of homes where EE equals EF, and the upper limit where the emissions intensity of the home equals the emissions intensity of the base home, a range of lower emissions homes will be financially penalised for achieving lower emission through the use of gas appliances.