NCC 2025 Energy Efficiency - Advice on the technical basis

Final Stringency Analysis Report

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Prepared for: Erica Kenna, Michael Dodd
The Australian Building Codes Board (ABCB)

Author: DeltaQ
Reviewer: Paul Bannister
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Executive Summary

This report presents the results of the technical analysis completed for the Australian Building Codes Board (ABCB) to develop updates to Section J of the 2025 National Construction Code (NCC). The report presents the results of the application of a defined set of energy efficiency and renewable energy measures on ten distinct commercial building archetypes across the 8 NCC climate zones[1] (CZs). It represents the last of the three major stages of DeltaQ's investigation of proposed revisions to Section J. The three major stages of DeltaQ's investigation are described below. Separately to this investigation, the proposed changes will be subject to impact analysis, consultation, and approvals before the next edition of the NCC is finalised.

Background and context

The technical analysis supporting revisions to Section J of the NCC consists of three major stages, being:

1. **Initial measures development.** In this stage, efficiency measures were assessed on an individual, standalone basis. Measures were subject to benefit-cost analysis and stakeholder consultation. Measures with a benefit-cost ratio (BCR) of greater than 1 that were deemed to be buildable and not unacceptably limiting to product selection were selected as initial measures for NCC 2025 Section J. Major measures arising from this stage were as follows:
    a. Increased stringency for solar admittance of window/wall structures
    b. Increased efficiency requirements for chillers and unitary air-conditioning
    c. Electrification and/or preparation for electrification for space heating and domestic hot water
    d. Mandatory use of rooftop solar Photovoltaic (PV) panels in some situations

    Additional measures of lesser impact/importance included:
    a. Adjustments to wall and roof insulation requirements
    b. Higher roof solar reflectance requirement in the presence of roof-mounted plant
    c. Revised compliance methodology for Heating, Ventilation and Air-Conditioning (HVAC) fans
    d. New minimum efficiency requirements for 4 pipe chillers and heat pumps
    e. Minor adjustments to economy cycle requirements for air handlers
    f. Increased requirements for the provision of Variable Speed Drives (VSD) for pumps and fans
    g. Increased requirements for the use of demand-driven (e.g. occupancy sensed) lighting controls.
2. **Whole building stringency analysis.** In this stage, the proposed measures from the initial measures stage were applied to four core archetype buildings (medium and large office, small and large hospital). Benefit-cost analyses for the integrated application of the measures were calculated on a whole-of-building basis. Where possible, additional measures were added to maximise energy savings while maintaining a favourable benefit-cost ratio on a whole-of-building basis. The impacts of electrification were also examined in detail in this phase.

3. **Final stringency analysis** (the current phase)**.** The final phase of the project involves the application of the expanded set of measures arising from Stage 2 to the six remaining archetypes under consideration for the project, including performance and benefit-cost analyses in each case.

[1] Visit https://www.abcb.gov.au/resources/climate-zone-map for further description of the 8 NCC climate zones

This report provides summary results for each of these stages.

Stringency Levels

This project includes the evaluation of three possible levels of overall stringency, defined as follows:

a. **Stringency level 1**: **Cost-effective energy efficiency without mandated PV.** Societally cost-effective energy efficiency stringency not including onsite solar (PV), other than Business As Usual (BAU)[2], to maximise energy reduction, while maintaining a BCR of at least 1 at the building level.

b. **Stringency level 2: Cost-effective energy efficiency with mandated PV.** Societally cost-effective energy efficiency stringency including onsite PV, in addition to BAU, to maximise energy reduction, while maintaining a BCR of at least 1 at the building level.

c. **Stringency level 3: Least cost, zero carbon ready buildings.** This option covers least cost zero carbon provisions that achieve net zero GHG emissions-ready buildings (when the grid decarbonises), with respect to regulated energy. This option extends Stringency Level 2 to provide full electrification readiness and to require additional PV to balance emissions from gas appliances compared with an all-electric equivalent. This means that under Stringency level 3, a building's operational carbon emissions[3] allowing for the additional avoided electricity generation associated with the additional PV should be no higher than an equivalent all-electric building.

Economic Analysis Parameters

Benefit-cost ratios for each archetype were calculated on a societal basis, allowing for the following factors:

a. Incremental capital cost of measures, covering any changes to the costs of equipment and construction required to meet the new measures.

b. Incremental operating/maintenance costs associated with the new plant are required to meet the new measures.

c. For each archetype, the base case used for comparison was the archetype using NCC 2022 measures. In most instances, this was achieved by modelling exact compliance with the minimum permitted efficiency under NCC 2022. However, for chillers, variable refrigerant flow (VRF) systems, and unitary air-conditioning systems, the base case was designed to reflect normal selection practice in the context of the NCC 2022 minimum requirements and available equipment on the market. As a result, these selections were moderately to significantly more efficient than the minimum requirement in NCC 2022.

Other key parameters of the analysis are as recommended by the independent economic advisor[4], including:

a. The cost of electricity (demand/usage and feed-in tariffs) and gas (usage) and the associated social cost of carbon. Note that each of these items and the carbon intensity of electricity were modelled using projected time-variant profiles across the economic assessment period.

b. Analysis performed on a 50-year basis as detailed in Appendix C of the main body of the report, including allowance for like-for-like plant replacement at the end of its life (typically 20-25 years) and the residual value of the plant at the end of the 50-year analysis period.

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[2] BAU PV is not considered in the building-level analysis presented in this report.

[3] Assessed across 14 years of operation. In the analyses, gas appliances were assumed to be replaced in year 15.

[4] Hutley, N. 2023, Economic Parameters for technical work (NCC), Rovingstone Advisory Pty Ltd, April 2023

It is to be noted that EV charging was only evaluated on a standalone, single-measure basis as detailed in the Electrical Services Report prepared by DeltaQ for ABCB, issued in September 2023. The current report does not make any assessment in relation to the proposed electric vehicle charging requirements for NCC 2025. No allowance for additional costs, benefits, or regulated energy consumption arising from electric vehicle charging has been included in the analyses.

Simulation Modelling

Energy use calculations for this work were conducted using the simulation package IES <VE>, which meets the relevant major international standards including ASHRAE 140, BEST TEST, CIBSE TM33, EU EN13791, ANSI/ASHRAE/ACCA Standard 183 and ISO 52000. This software has been used worldwide and it has acquired widespread international acceptance.

Stringency 1 Results

The analysis for Stringency 1 involved the development of the four core archetype models (medium and large office, small and large hospital) into notional NCC 2025 compliant models adopting all the individual measures found economic in the Initial Measures Analysis phase of the project (labelled as Iteration 1 in the following tables). The BCR of these integrated models was calculated, and if the whole building BCR was greater than 1, additional individually uneconomic measures were selected that improved energy savings while maintaining a whole building BCR greater than 1, leading to the optimised scenarios reported in the tables below.

The results of this optimisation process for Stringency 1 led to updates to the economy cycle and outside air control measures, above and beyond changes recommended in the Initial Measures reports, as listed in 1.7.2 of the body of the report. The resulting savings achieved for the core archetypes are listed in Table 1 to Table 4.

The optimised Stringency 1 measures thus derived were then applied to the remaining six archetypes, providing savings as listed in Table 5 to Table 10 below.

All results are reported on a regulated energy basis (i.e. building electricity consumption that is affected by NCC provisions), excluding lifts and domestic hot water. Gas and electricity savings are reported based on Year 1 (Y1) savings, and greenhouse gas (GHG) savings are calculated across 50 years. The NCC 2025 model and base case are assumed to maintain the same plant types for the full 50 years. No allowance was made for any PV installation.

Table 1. Summary results with % savings and BCR for Stringency 1 optimised case for the large office archetype (C5OL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	17%	17%	17%	**2.41**
2	4%	23%	22%	22%	**1.84**
3	16%	23%	22%	22%	**1.96**
4	2%	19%	15%	14%	**4.00**
5	-4%	21%	20%	20%	**2.75**
6	-4%	19%	15%	14%	**2.71**
7	3%	19%	13%	13%	**2.44**
8	-9%	18%	2%	1%	**2.50**

Note: The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use.

Table 2. Summary results for % savings and BCR for Stringency 1 optimised case for the medium office archetype (C5OM).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	29%	29%	29%	**5.36**
2	0%	29%	29%	29%	**4.85**
3	0%	37%	37%	37%	**68342**
4	0%	31%	31%	31%	**15.19**
5	0%	31%	31%	31%	**11.15**
6	0%	28%	28%	28%	**3.38**
7	0%	24%	24%	24%	**5.25**
8	0%	18%	18%	18%	**2.16**

Note: 1.) The BCR cell showing negative sign (-) indicates a negative capital cost. 2.) The very high BCR recorded in the table reflects a case where the net capital costs were very small.

Table 3. Summary results for % savings and BCR for Stringency 1 optimised case for the large hospital archetype (C9A).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	16%	16%	16%	**33.76**
2	2%	7%	7%	7%	**-**
3	37%	14%	17%	18%	**-**
4	-14%	5%	1%	0%	**-**
5	-43%	10%	9%	9%	**-**
6	-25%	3%	-1%	-1%	**-**
7	-4%	4%	1%	1%	**-**
8	-10%	2%	-5%	-5%	**-0.19**

Note: 1.) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use, 2.) The BCR cells showing negative signs (-) indicate negative capital costs, 3.) The large change in gas consumption for climate zone 3 is caused by the introduction of heat recovery as part of the indirect evaporative cooling measures added in the optimisation process, 4.) The negative BCR reflects negative savings and a positive capital cost.

Table 4. Summary results for % savings and BCR for Stringency 1 optimised case for the small hospital archetype (C9AS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	16%	16%	16%	**-**
2	0%	27%	27%	27%	**-**
3	0%	18%	18%	18%	**-**
4	0%	18%	18%	18%	**-**
5	0%	23%	23%	23%	**-**
6	0%	27%	27%	27%	**-**
7	0%	16%	16%	16%	**-**
8	0%	17%	17%	17%	**2.92**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 5. Summary results for % savings and BCR for Stringency 1 optimised case for the small office archetype (C5OS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	21%	21%	21%	-
2	0%	11%	11%	11%	-
3	0%	25%	25%	25%	-
4	0%	20%	20%	20%	-
5	0%	23%	23%	23%	-
6	0%	22%	22%	22%	-
7	0%	18%	18%	18%	-
8	0%	22%	22%	22%	-

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 6. Summary results for % savings and BCR for Stringency 1 optimised case for the small retail archetype (C6RS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	32%	32%	32%	-
2	0%	32%	32%	32%	-
3	0%	38%	38%	38%	-
4	0%	30%	30%	30%	-
5	0%	31%	31%	31%	-
6	0%	24%	24%	24%	**15.76**
7	0%	22%	22%	22%	**11.49**
8	0%	17%	17%	17%	**6.41**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 7. Summary results for % savings and BCR for Stringency 1 optimised case for the large retail archetype (C6RL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	24%	24%	24%	**8.91**
2	0%	28%	28%	28%	**-**
3	0%	32%	32%	32%	**809.42**
4	0%	20%	20%	20%	**3.35**
5	0%	25%	25%	25%	**81.59**
6	0%	13%	13%	13%	**2.18**
7	0%	21%	21%	21%	**5.63**
8	0%	16%	16%	16%	**1.68**

Note: 1.) The BCR cell showing negative sign (-) indicates a negative capital cost, 2.) The very high BCR recorded in the table reflects a case where the net capital costs were very small.

Table 8. Summary results for % savings and BCR for Stringency 1 optimised case for the motel archetype (C3HS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	25%	25%	25%	-
2	0%	18%	18%	18%	-
3	0%	18%	18%	18%	-
4	0%	16%	16%	16%	-
5	0%	23%	23%	23%	-
6	0%	14%	14%	14%	-
7	0%	16%	16%	16%	-
8	0%	11%	11%	11%	-

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 9. Summary results for % savings and BCR for Stringency 1 optimised case for the large hotel archetype (C3HL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	14%	14%	14%	-
2	-44%	20%	17%	16%	-
3	-12%	17%	12%	12%	-
4	-8%	13%	3%	3%	-
5	-33%	19%	12%	11%	-
6	-23%	14%	0%	-1%	-
7	-12%	15%	0%	0%	-
8	-11%	7%	-6%	-6%	**-0.16**

Note: 1.) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use. 2.) The BCR cells showing negative signs (-) indicate negative capital costs, 3.) The negative BCR reflects a negative saving and a positive capital cost.

Table 10. Summary results for % savings and BCR for Stringency 1 optimised case for the school archetype (C9B).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	18%	18%	18%	-
2	0%	23%	23%	23%	-
3	0%	22%	22%	22%	-
4	0%	19%	19%	19%	-
5	0%	22%	22%	22%	-
6	0%	20%	20%	20%	-
7	0%	18%	18%	18%	-
8	0%	14%	14%	14%	-

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Stringency 1 Commentary

The results for the Stringency 1 optimisation process show a minor improvement in stringency relative to the unoptimized (Iteration 1) results. Benefit-cost ratios are reduced in a number of cases but remain above the threshold of a BCR of 1, except for the large hospital (C9A) and large hotel (C3HL) in Climate Zone 8. These latter results have been ignored as not being material to results on a national level.

Negative capital costs arise in a few cases. Two key factors were found to be driving reductions in capital costs, being:

a. The reduction in cooling plant size caused by the increased solar admittance stringency.

b. Reductions in insulation costs, primarily driven by the removal of some existing insulation requirements that were found either not to be delivering energy benefits or indeed to be driving increased energy use.

The large hospital and large hotel have significantly lower overall savings than the other archetypes. This is caused by the following effects:

1. The overall range and scale of measures applied to these archetypes were more limited than in other archetypes.
2. The solar admittance measure is better optimised for unitary air-conditioning systems than for gas heating systems. This leads to an increase in gas consumption and the cases of increased emissions.
3. It was found in general that a better performing building is good for reducing cooling, but not heating.

The increases in gas consumption recorded for the large office archetype are due to the solar admittance effects described above, although for climate zones 5 and 6 the gas consumption comprises only a small component of the total emissions.

Stringency 2 Results

Under Stringency 2, the optimised results from Stringency 1 were supplemented by the addition of roof-top PV. Roof-top PV designs were completed according to the draft NCC 2025 Deemed-to-Satisfy Provisions which maximises the use of rooftop PV within the limitations of area exclusions required for access and transit and any shaded areas. An upper limit based on Watts per m² (W/m²) of conditioned space is also applied, reflecting the intention that energy generated by the PV installation should be primarily used onsite, rather than exported. No allowance was made in the analysis for shade from other buildings or local topography. The base case for analysis was the same as for Stringency 1. No allowance was made for any business-as-usual (i.e. base case) level of PV installation.

The economic analysis parameters were expanded to include revenue from a feed-in tariff, sourced from the Table 399 in the main body of the report.

The results of the Stringency 2 whole building analysis are listed in Table 11 to Table 20.

All results are expressed on a regulated energy basis excluding lifts and domestic hot water (DHW). Gas and electricity savings are reported based on Y1 savings, and GHG savings are calculated across 50 years. The NCC 2025 model and base case are assumed to maintain the same plant types for the full 50 years.

Table 11. Summary table of % savings relative to base case for Stringency 2 with BCRs for the large office archetype (C5OL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	29%	29%	29%	**2.87**
2	4%	38%	38%	38%	**2.30**
3	16%	41%	39%	39%	**2.52**
4	2%	43%	32%	31%	**3.96**
5	-4%	40%	38%	38%	**3.01**
6	-4%	40%	32%	31%	**2.95**
7	3%	41%	26%	25%	**2.91**
8	-9%	44%	12%	11%	**2.97**

Note: The "Gas (%)" cells showing negative sign (-) indicate an increase in gas use.

Table 12. Summary table of % savings relative to base case for Stringency 2 with BCRs for the medium office archetype (C5OM).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	72%	72%	72%	**4.10**
2	0%	95%	95%	95%	**3.78**
3	0%	94%	94%	94%	**6.58**
4	0%	100%	100%	100%	**4.37**
5	0%	100%	100%	100%	**3.82**
6	0%	105%	105%	105%	**2.81**
7	0%	102%	102%	102%	**3.35**
8	0%	79%	79%	79%	**2.53**

Note: The very high BCR recorded in the table reflects a case where the net capital costs were very small.

Table 13. Summary table of % savings relative to base case for Stringency 2 with BCRs for large hospital archetype (C9A).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	25%	25%	25%	**10.37**
2	2%	26%	25%	25%	**-**
3	37%	30%	31%	31%	**10.58**
4	-14%	25%	16%	15%	**-**
5	-43%	29%	28%	28%	**-**
6	-25%	22%	15%	14%	**-**
7	-4%	24%	14%	14%	**-**
8	-10%	22%	5%	4%	**-**

Note: 1.) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use. 2.) The BCR cells showing negative signs (-) indicate negative capital costs. 3.) The negative BCR reflects a negative savings and positive capital cost.

Table 14. Summary table of % savings relative to base case for Stringency 2 with BCRs for small hospital archetype (C9AS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	62%	62%	62%	**4.08**
2	0%	76%	76%	76%	**6.80**
3	0%	66%	66%	66%	**8.38**
4	0%	64%	64%	64%	**5.92**
5	0%	77%	77%	77%	**3.88**
6	0%	77%	77%	77%	**-**
7	0%	60%	60%	60%	**3.54**
8	0%	46%	46%	46%	**2.43**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 15. Summary table of % savings relative to base case for Stringency 2 with BCRs for small office archetype (C5OS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	65%	65%	65%	**6.19**
2	0%	85%	85%	85%	**5.05**
3	0%	87%	87%	87%	**7.23**
4	0%	90%	90%	90%	**5.44**
5	0%	100%	100%	100%	**4.35**
6	0%	99%	99%	99%	**5.01**
7	0%	89%	89%	89%	**3.74**
8	0%	72%	72%	72%	**3.76**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 16. Summary table of % savings relative to base case for Stringency 2 with BCRs for small retail archetype (C6RS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	65%	65%	65%	**10.54**
2	0%	72%	72%	72%	**8.43**
3	0%	73%	73%	73%	**17.31**
4	0%	70%	70%	70%	**8.67**
5	0%	72%	72%	72%	**7.09**
6	0%	66%	66%	66%	**4.55**
7	0%	65%	65%	65%	**4.71**
8	0%	48%	48%	48%	**4.05**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 17. Summary table of % savings relative to base case for Stringency 2 with BCRs for large retail archetype (C6RL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	49%	49%	49%	**5.86**
2	0%	66%	66%	66%	**8.35**
3	0%	65%	65%	65%	**10.04**
4	0%	58%	58%	58%	**3.64**
5	0%	63%	63%	63%	**5.87**
6	0%	52%	52%	52%	**2.79**
7	0%	57%	57%	57%	**4.25**
8	0%	44%	44%	44%	**2.38**

Note: 1.) The BCR cell showing negative sign (-) indicates a negative capital cost. 2.) The very high BCR recorded in the table reflects a case where the net capital costs were very small.

Table 18. Summary table of % savings relative to base case for Stringency 2 with BCRs for motel archetype (C3HS).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	44%	44%	44%	**-**
2	0%	46%	46%	46%	**7.66**
3	0%	43%	43%	43%	**7.04**
4	0%	39%	39%	39%	**5.73**
5	0%	49%	49%	49%	**12.36**
6	0%	43%	43%	43%	**4.34**
7	0%	38%	38%	38%	**4.60**
8	0%	29%	29%	29%	**6.22**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Table 19. Summary table of % savings relative to base case for Stringency 2 with BCRs for large hotel archetype (C3HL).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	18%	18%	18%	**-**
2	-44%	27%	23%	23%	**-**
3	-12%	23%	17%	17%	**-**
4	-8%	21%	8%	7%	**-**
5	-33%	27%	19%	18%	**-**
6	-23%	23%	5%	4%	**-**
7	-12%	23%	4%	3%	**-**
8	-11%	16%	-3%	-4%	**-**

Note: 1.) The "Gas (%)" cells showing negative sign (-) indicate an increase in gas use. 2.) The BCR cells showing negative signs (-) indicate negative capital costs. 3.) The negative BCR reflects a negative saving and a positive capital cost.

Table 20. Summary table of % savings relative to base case for Stringency 2 with BCRs for school archetype (C9B).

CZ	Gas (%)	Elec (%)	Total Energy (%)	GHG (%)	BCR
1	0%	51%	51%	51%	**6.72**
2	0%	77%	77%	77%	**9.28**
3	0%	71%	71%	71%	**6.84**
4	0%	73%	73%	73%	**4.82**
5	0%	78%	78%	78%	**4.66**
6	0%	79%	79%	79%	**3.41**
7	0%	72%	72%	72%	**3.83**
8	0%	48%	48%	48%	**3.35**

Note: The BCR cells showing negative signs (-) indicate negative capital costs.

Stringency 2 Commentary

The results show that the additional requirement of rooftop PV generates a significant further reduction in electricity use and greenhouse gas emissions in all cases. The impact is particularly pronounced for the low-rise archetypes, due to the high amount of roof area available per unit conditioned floor area but is significant nonetheless for the high-rise archetypes. This includes creating a positive greenhouse gas saving and financial outcomes in all cases bar the large hotel in Climate Zone 8.

It is noted that in all of the archetypes (core and extended) other than the small hospital (C9AS), the size of the PV array was limited by the available roof space rather than the export limitation.

Stringency 3 Results

The objective of Stringency 3 is to achieve least cost, zero carbon ready buildings. To achieve this, it is assumed that electrification is not a requirement, but that for buildings with fossil fuel use, the Code should deliver an equivalent greenhouse gas position outcome to an all-electric building across the first 14 years.

The base case is an NCC 2022 compliant building that does not change its fuel mix in the 50-year analysis period, reflecting the definition of Stringency 3. Analyses against this base case are covered under Scenarios 1-4 (described below).

As an alternative, if we assume that electrification is inevitable at some point in the lifetime of the buliding (regardless of the NCC), then the base case becomes an NCC 2022 compliant building that will electrify at some stage in the future. For the purposes of the analysis, this is taken to be 15 years, as a notional midpoint between market-driven electrification at 10 years and end-of-life electrification at 20 years. This alternative base case is covered under Scenarios 5-8 of the analysis.

Note that as Stringency 3 tests electrification scenarios, the NCC 2025 versions of buildings all assume electrification at either year 15 (Scenarios 1-3, 5-7) or year zero (Scenarios 4, 8). For the case where no change in fuel mix occurs in the NCC 2025 scenarios, refer to the stringency 1 and 2 results.

Scenario definitions are provided below. Note that Scenario 1 is effectively the central analysis case reflecting the definition of Stringency 3. Other scenarios are subcases used to understand the broader context of the Stringency 3 definition.

a. Scenarios 1 and 5: Additional costs are incurred for initial construction to ready the building for future electrification. This increases initial capital costs but lowers future electrification costs.

Additionally, for buildings using gas, additional PV (beyond that specified in Stringency 2, modelled as ground mounted) is specified in order to displace grid-sourced electricity emissions approximately equal to the difference in emissions between a dual-fuel building and its all-electric equivalent (across the first 14 years). Grid electricity emissions are displaced by a combination of self-consumption of on-site generation and export of the PV generated on-site.

b. Scenarios 2 and 6: No preparation is made in initial construction to ready the building for future electrification. This defers electrification costs wholly to the future, at the expense of higher costs at that time relative to Scenarios 1 and 5. As with Scenarios 1 and 5, additional PV (beyond that specified in Stringency 2, modelled as ground mounted) is specified in order to create a reduction in national electricity demand with an emissions value that approximates the difference in emissions between the dual fuel building and its all-electric equivalent across the first 14 years.
c. Scenarios 3 and 7: As per Scenarios 1 and 5 but with no additional PV beyond that specified in Stringency 2. These cases test the impact and materiality of the additional PV relative to Scenarios 1 and 5.
d. Scenarios 4 and 8: Building electrified from day one, with no additional PV beyond that specified in Stringency 2. These cases test the impact of an immediate code requirement for electrification.

The assessment for Stringency 3 has an expanded energy scope relative to Stringency 2, in that calculations also include energy use of domestic hot water plant. As a simplifying assumption, only the three archetypes with gas space heating: large hotel (C3HL), large office (C5OL), and large hospital (C9A) were assessed, effectively assuming that the remaining archetypes would use electric domestic hot water. Lift energy use was not modelled in any scenarios but is a constant between NCC 2022 and NCC 2025.

Feed-in tariff revenue has been included in the analysis for exported electricity. Emissions reductions have been calculated on a 50-year basis. Results are listed in Table 21 to Table 26.

Table 21. Large Office (C5OL) Stringency 3 BCR Results Summary.

C5OL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	**BCR**	**BCR**	**BCR**	**BCR**	**BCR**	**BCR**	**BCR**	**BCR**
1	**3.23 (3.24)**	3.22 (3.23)	3.23 (3.24)	2.79 (2.79)	4.76 (4.77)	4.76 (4.77)	4.76 (4.77)	4.68 (4.69)
2	**3.32 (3.32)**	2.19 (2.20)	3.32 (3.32)	2.48 (2.49)	- (-)	6.54 (6.54)	- (-)	23.29 (23.32)
3	**1.87 (1.87)**	1.42 (1.42)	1.87 (1.87)	1.78 (1.78)	- (-)	7.76 (7.77)	- (-)	- (-)
4	**2.02 (2.04)**	1.47 (1.49)	1.87 (1.88)	1.64 (1.65)	- (-)	18.96 (19.13)	- (-)	- (-)
5	**4.89 (4.91)**	2.67 (2.68)	4.89 (4.91)	2.93 (2.94)	- (-)	36.86 (36.98)	- (-)	- (-)
6	**1.44 (1.45)**	1.07 (1.07)	1.31 (1.31)	1.07 (1.08)	- (-)	10.97 (11.02)	- (-)	158.73 (158.94)
7	**1.70 (1.71)**	1.25 (1.26)	1.46 (1.46)	1.23 (1.23)	- (-)	- (-)	- (-)	- (-)
8	**1.61 (1.66)**	1.24 (1.27)	1.08 (1.08)	0.47 (0.47)	- (-)	- (-)	- (-)	4.37 (4.39)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 22. Large Hospital (C9A) Stringency 3 BCR Results Summary.

C9A	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	BCR	BCR	BCR	BCR	BCR	BCR	BCR	BCR
1	**6.47 (6.47)**	3.90 (3.90)	5.68 (5.68)	6.57 (6.57)	- (-)	- (-)	- (-)	- (-)
2	**2.47 (2.47)**	1.17 (1.17)	2.28 (2.28)	0.77 (0.77)	- (-)	- (-)	- (-)	6.10 (6.10)
3	**11.72 (11.73)**	3.77 (3.77)	9.85 (9.85)	- (-)	- (-)	- (-)	- (-)	- (-)
4	**2.97 (2.98)**	1.63 (1.63)	2.37 (2.37)	1.87 (1.87)	- (-)	- (-)	- (-)	- (-)
5	**2.42 (2.42)**	1.20 (1.20)	2.27 (2.27)	0.89 (0.89)	- (-)	- (-)	- (-)	- (-)
6	**2.64 (2.65)**	1.41 (1.42)	2.12 (2.12)	1.45 (1.45)	- (-)	- (-)	- (-)	- (-)
7	**2.93 (2.93)**	1.39 (1.39)	2.67 (2.67)	1.10 (1.10)	- (-)	- (-)	- (-)	- (-)
8	**1.76 (1.76)**	0.63 (0.63)	1.76 (1.76)	-0.87 (-0.87)	- (-)	- (-)	- (-)	-0.15 (-0.15)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 23. Large Hotel (C3HL) Stringency 3 BCR Results Summary.

C3HL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	BCR	BCR	BCR	BCR	BCR	BCR	BCR	BCR
1	**- (-)**	12.03 (12.03)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
2	**95.97 (95.97)**	6.20 (6.20)	91.64 (91.64)	3.37 (3.37)	- (-)	- (-)	- (-)	- (-)
3	**- (-)**	27.32 (27.33)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
4	**6.63 (6.64)**	3.07 (3.08)	5.78 (5.78)	5.45 (5.45)	- (-)	- (-)	- (-)	- (-)
5	**11.38 (11.38)**	3.85 (3.85)	10.91 (10.91)	2.36 (2.36)	- (-)	- (-)	- (-)	- (-)
6	**5.98 (5.99)**	2.82 (2.83)	5.30 (5.30)	3.73 (3.73)	- (-)	- (-)	- (-)	- (-)
7	**11.49 (11.49)**	3.74 (3.74)	10.95 (10.95)	9.43 (9.43)	- (-)	- (-)	- (-)	- (-)
8	**- (-)**	3.26 (3.26)	- (-)	1.90 (1.90)	- (-)	- (-)	- (-)	- (-)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 24. Large Office (C5OL) Stringency 3 GHG % savings relative to base case.

C5OL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**29% (30%)**	29% (30%)	29% (30%)	29% (30%)	29% (29%)	29% (29%)	29% (29%)	29% (29%)
2	**38% (39%)**	38% (39%)	38% (39%)	38% (38%)	38% (38%)	38% (38%)	38% (38%)	38% (38%)
3	**41% (42%)**	41% (42%)	41% (42%)	40% (40%)	39% (39%)	39% (39%)	39% (39%)	37% (37%)
4	**50% (51%)**	50% (51%)	47% (48%)	49% (50%)	40% (41%)	40% (41%)	37% (37%)	39% (40%)
5	**40% (40%)**	40% (40%)	40% (40%)	38% (39%)	38% (39%)	38% (39%)	38% (39%)	38% (38%)
6	**47% (47%)**	47% (47%)	43% (44%)	44% (44%)	39% (40%)	39% (40%)	35% (35%)	37% (37%)
7	**52% (53%)**	52% (53%)	48% (48%)	50% (50%)	38% (39%)	38% (39%)	32% (32%)	36% (36%)
8	**57% (59%)**	57% (59%)	50% (50%)	55% (55%)	34% (37%)	34% (37%)	22% (23%)	31% (31%)

Note: 1.) Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 25. Large Hospital (C9A) Stringency 3 GHG % savings relative to base case.

C9A	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**32% (32%)**	32% (32%)	28% (28%)	29% (29%)	29% (29%)	29% (29%)	25% (25%)	25% (25%)
2	**34% (34%)**	34% (34%)	32% (32%)	27% (27%)	29% (29%)	29% (29%)	26% (26%)	23% (23%)
3	**47% (47%)**	47% (47%)	41% (41%)	43% (43%)	37% (37%)	37% (37%)	30% (30%)	30% (30%)
4	**39% (39%)**	39% (39%)	34% (34%)	33% (33%)	27% (27%)	27% (27%)	19% (19%)	21% (21%)
5	**36% (36%)**	36% (36%)	34% (34%)	29% (29%)	31% (31%)	31% (31%)	28% (28%)	26% (26%)
6	**37% (37%)**	37% (37%)	31% (31%)	30% (30%)	26% (27%)	26% (27%)	18% (18%)	21% (21%)
7	**36% (36%)**	36% (36%)	34% (34%)	28% (28%)	21% (21%)	21% (21%)	18% (18%)	19% (19%)
8	**36% (36%)**	36% (36%)	36% (36%)	30% (30%)	10% (10%)	10% (10%)	10% (10%)	11% (11%)

Note: 1). Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 26. Large Hotel (C3HL) Stringency 3 GHG % savings relative to base case.

C3HL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**27% (27%)**	27% (27%)	25% (25%)	26% (26%)	21% (21%)	21% (21%)	18% (18%)	18% (18%)
2	**35% (35%)**	35% (35%)	34% (34%)	31% (31%)	26% (26%)	26% (26%)	24% (24%)	26% (26%)
3	**40% (40%)**	40% (40%)	36% (36%)	39% (39%)	25% (25%)	25% (25%)	19% (19%)	21% (21%)
4	**42% (42%)**	42% (42%)	39% (39%)	40% (40%)	18% (18%)	18% (18%)	13% (13%)	19% (19%)
5	**37% (37%)**	37% (37%)	36% (36%)	34% (34%)	25% (25%)	25% (25%)	22% (22%)	27% (27%)
6	**41% (41%)**	41% (41%)	38% (38%)	39% (39%)	18% (18%)	18% (18%)	13% (13%)	22% (22%)
7	**39% (39%)**	39% (39%)	38% (38%)	33% (33%)	12% (12%)	12% (12%)	10% (10%)	17% (17%)
8	**40% (40%)**	40% (40%)	40% (40%)	36% (36%)	3% (3%)	3% (3%)	3% (3%)	8% (8%)

Note: 1.) Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Stringency 3 Commentary

Scenarios 1-4: no electrification in base case

Assessments in these scenarios can be characterised as answering the question as to whether the total package of measures including electrification provisions is economic. This in effect uses the efficiency and onsite electricity generation measures to help pay for electrification measures.

A number of features can be seen in the data tables:

1. The strongest economic result is generally achieved from the inclusion of planned electrification in NCC 2025 along with expanded PV (Scenario 1, the core scenario).
2. The exclusion of planned electrification from NCC 2025 (Scenario 2) leads to poorer results than Scenario 1.
3. The limiting of PV to that required under Stringency 2 (Scenario 3) results in poorer but still positive economic results than Scenario 1, which has additional PV. This reflects the loss of avoided electricity costs and potential feed-in tariff revenue arising from the additional PV in Scenario 1. However, the Stringency 2 level of PV may be considered more physically realistic. The climate zone 8 result for this scenario fails the BCR>1 test for the large hospital archetype. As noted previously, this is of limited materiality.
4. Overall greenhouse gas savings are considerably higher than for Stringency 2 for these archetypes for climates with significant heating load. While the inclusion of DHW in the calculations for this stringency limits the comparability of these figures, the dominant effect is the inclusion of electrification at Y15 in Scenarios 1-3 and at Year 1 in Scenario 4. The absence of emissions from gas use in Y15-50 is particularly important given the low electricity emissions intensity in this period.
5. While not a requirement of Stringency 3, immediate[5] electrification is economic in all cases other than the large hospital and large office in Climate zone 8.
6. Emissions savings for Scenario 1 are greater than for Scenario 4 for two reasons:
    a. Scenario 1 often has a greater amount of PV. The impact of this can be assessed by comparing emissions reductions for Scenario 1 to Scenario 3.
    b. In a number of cases, the dual fuel building has lower emissions in Y1-14 than the all-electric building. This can be seen by comparing the emissions reductions between scenario 3 and 4.
7. Inclusion or exclusion of assumed greenhouse benefits from PV export has a limited impact on results, indicating that the major benefits arise from on-site use.

Scenarios 5-8: base case electrification in 15 years

The economic results for these scenarios are similar but inevitably better than for the previous scenarios as the base case now includes the costs of future unprepared electrification. Only the large hospital in Climate Zone 8 does not produce BCR greater than 1.

However, the emissions reduction results are lower due to the removal of emissions from gas use in the base case in Y15-50; this also affects the relativity of emissions savings between scenarios, with scenario 8

[5] The term 'immediate' is interchangeable with 'Day one'

(immediate electrification) being more favourable. This highlights the importance of the emissions in this later period in determining the higher emissions reductions identified for Scenarios 1-4.

Overall

Overall, the stringency 3 results indicate:

1. The core scenario (Scenario 1, planning for electrification and adding on-site generation to equalise Y1-14 emissions relative to an all-electric alternative) is economic in all cases.
2. Planned future electrification is economically beneficial relative to unplanned future electrification and no electrification.
3. The proposed requirement for dual-fuel buildings to provide additional on-site renewable energy generation (or equivalent) is cost-beneficial, albeit with practical limitations.
4. Immediate electrification (scenarios 4, 8) is also economically beneficial in almost all cases tested although this is not a requirement of Stringency 3.

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Table of Contents

Introduction

This report presents results of the whole building analysis of proposed energy efficiency measures for NCC 2025 for the all ten archetypes considered in the analysis, namely: Class 3 Motel (C3HS), Class 3 Large Hotel (C3HL), Class 5 Large Office (C5OL), Class 5 Medium Office (C5OM), Class 5 Small Office (C5OS), Class 6 Retail Strip (C6RS), Class 6 Large Retail (C6RL), Class 9A Hospital Ward (C9A), Class 9AS Small Hospital (C9AS) and Class 9B School Classroom (C9B).

Section 2 of this report outlines the optimisation process used to develop the package of measures and describes the building models and the cost-benefit analysis. Sections 3 to 5 present the cost-benefit analysis for each of the three stringency levels investigated.

The stringency levels are:

- **Stringency level 1: Cost-effective energy efficiency without mandated PV.** Societally cost-effective energy efficiency stringency not including onsite solar (PV), other than BAU, to maximise energy reduction, while maintaining a BCR of at least 1 at the building level.
- **Stringency level 2: Cost-effective energy efficiency with mandated PV.** Societally cost-effective energy efficiency stringency including onsite PV, in addition to BAU, to maximise energy reduction, while maintaining a BCR of at least 1 at the building level.
- **Stringency level 3: Least cost, zero carbon ready buildings.** This option extends Stringency Level 2 to provide full electrification readiness and to require additional PV to balance emissions from gas appliances compared with an all-electric equivalent. Under this stringency, the building's operational carbon emissions allowing for the additional avoided electricity generation associated with the additional PV should be no higher than an equivalent all-electric building. All-electric and dual-fuel options were investigated.

Methodology and Results Summary

1.1 Overview

The general methodology for the analysis was as follows:

1. NCC 2022 base case models were defined for each building archetype and dynamic thermal simulations were run to determine the annual energy consumption and plant sizing.
2. For the Stringency 1 analysis, previously evaluated individual measures where BCR of at least 1 was achievable were applied to the base case models of the four core archetypes (C5L, C5M, C9A and C9AS) to generate new 2025 test case models. Dynamic thermal simulations were run using these 2025 test case models to determine the annual energy consumption.
3. Plant and architectural costs were calculated for each case based primarily on cost data gathered during the initial measures phase of the project for each archetype using plant sizes determined via simulation. These costs were used to calculate the associated overall capital expenditure for each base case and test case. Similarly, energy pricing and other economic parameters were used along with the simulation energy consumption outputs to calculate operating expenditure over the building lifespan for each base case and test case.

4. BCRs were calculated for each test case using the capital and operational expenditure data mentioned above.
5. Where BCRs were found to be greater than 1, additional measures with useful energy savings but individual BCRs less than 1 were applied to maximise energy savings while maintaining a BCR of greater than 1 for the building overall.
6. The optimised Stringency 1 case was defined as the "best option" result from the optimisation analysis. Changes to the energy efficiency recommendations were documented. The recommended measures were then applied across the remaining 6 archetypes to identify BCRs in each case.
7. The Stringency 2 analysis applied roof-top PV to the optimised Stringency 1 models, using a PV design in compliance with the code text developed for the initial measures analysis. A rooftop PV system was specified for each archetype, and each test case was altered to account for the associated capital cost expenditure and energy generation (including revenue from a feed-in tariff). BCRs were recalculated using the updated capital and operating costs.
8. Stringency 3 started with the Stringency 2 models and examined the impact of building electrification (replacing gas DHW and HVAC plant with electric plant) and PV balancing (the addition of supplementary PV such that the Y1-14 emissions of a dual fuel building are no more than that of the equivalent all-electric building).

The methodology for each stringency is described in more detail in Sections 0 to 0.

1.2 Simulation and Archetype Specification

The IES <VE> software package was used to simulate building energy performance and determine necessary HVAC plant sizing for each building archetype. IES <VE> meets the relevant major international standards including ASHRAE 140, BEST TEST, CIBSE TM33, EU EN13791, ANSI/ASHRAE/ACCA Standard 183 and ISO 52000. This software has been used worldwide and it has acquired widespread international acceptance.

Each archetype was simulated across 8 different NCC climate zones using TMY 2050 RCP 8.5 weather files for Darwin (CZ1), Brisbane (CZ2), Alice Springs (CZ3), Wagga Wagga (CZ4), Sydney (CZ5), Melbourne (CZ6), Canberra (CZ7), and Thredbo (CZ8). Plant was sized based on current (AIRAH) design conditions but was checked for adequacy of temperature control under the RCP8.5 climate[6]. The key data simulation outputs were:

- Monthly energy consumption across one year.
- Hourly energy consumption across one year.
- Required HVAC plant capacity to meet internal comfort conditions.

The general archetype parameters used for each simulation are presented below from Section 1.2.1 to 1.2.10. Additional detail including oversizing factors and design parameters specific to each base/test case (for example glazing, insulation, roof solar reflectance and lighting) are provided in Appendix A.

1.2.1 C5OL – Large Office Building

- Basic Geometry Information
  - Area: 12,250m^2

[6] It was found that no adjustment of plant sizing was required above and beyond the standard industry oversizing parameters used in the analysis.

- Storey: 10
- 2 levels of underground car park and 1 rooftop plant room
- Level Height: 3.6m
- Floor to Ceiling Height: 2.7m
- Ceiling Space Height: 0.9m
- Floor Plate: Square, 35m x 35m
- Window size: 35m x 2.16m
- Window to wall ratio (WWR): 56%
- Orientation: Faces to north, south, east and west.

- Geometry View

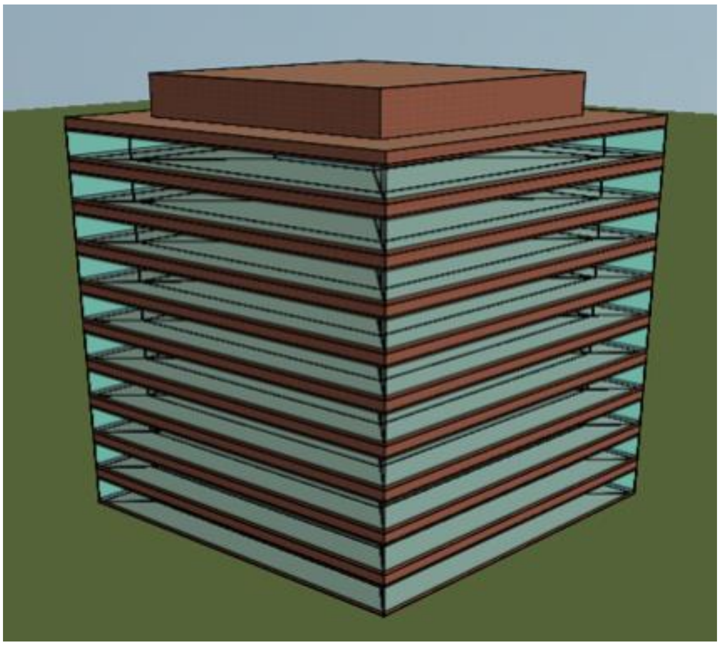

Figure 1. Geometric view of C5OL

- Construction Details -
  - External wall – Lightweight frame wall
  - Roof – Concrete roof with underside insulation; uninsulated plant room rooftop
  - Floor - suspended floor with underground car park
  - Glazing - modelled as per Appendix A.I.I
- Internal load and operation profiles –
  - Occupancy – 10m²/person in office area; zero in the core area, underground car park and rooftop plant room. 75W sensible heat gain and 55W latent heat gain per person.
  - Lighting – 4.5W/m² in office area; 3 W/m² in core area (toilet/lift); 2W/m² in underground carpark; zero in rooftop plant room. Note that these lighting power density values were adjusted based on the Room Aspect Ratio in NCC 2019 Section J6. For the office area, we measured the office zones on one floor in the model as a combined zone rather than one by one as we assume it is an open space office.
  - Equipment – 11W/m² in office area; zero in the core area, underground car park and rooftop plant room

- Operation profiles – NCC 2019 Specification JVc Table 2c and Table 2d for office. Core area and underground car park lighting operation profiles will be set to operate 100% whenever the office schedule > 25% otherwise same as the office schedule.
- Infiltration – 0.7 Air Changes per Hour (ACH) when HVAC is not operating and 0.35ACH when HVAC is operating in the office area and return air plenum (ceiling space). Infiltration in the core area is modelled the same as the office area. 2ACH for 24/7 in the underground car park. 0.7ACH for 24/7 in the rooftop plant room.

- HVAC –
  - Major plant –
    - Air-conditioning for this archetype is provided by a water-cooled chiller system with primary-secondary pumping and gas boiler heating hot water system with primary-secondary pumping.
    - Chilled water plant consists of two identical chillers each selected at 60% of design load. Chiller efficiencies are modelled as per Appendix A.
    - Heating hot water plant consists of two identical boilers each selected at 60% of design load. Boiler efficiency is set to be 90%.
    - Air-conditioning is provided by centre, north, south, east and west air-handlers each serving all 10 floors. Variable Air Volume (VAV) turndowns are to 30% and 50% of maximum flow in perimeter and centre zones respectively. Fan efficiencies are calculated as per Section J6D5 in NCC 2022.
    - Air handler cooling and heating coils are sized with an oversizing factor of 1.1.
  - Control –
    - The VAV zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
    - The perimeter zone Air Handling Unit (AHU) supply air temperature was controlled by high-select. The centre zone AHU supply air temperature was controlled by the average zone temperature.
    - The dry bulb economy cycle and the CO_2 control to the minimum outside air was modelled when required as per NCC 2022.
  - HVAC Zoning –

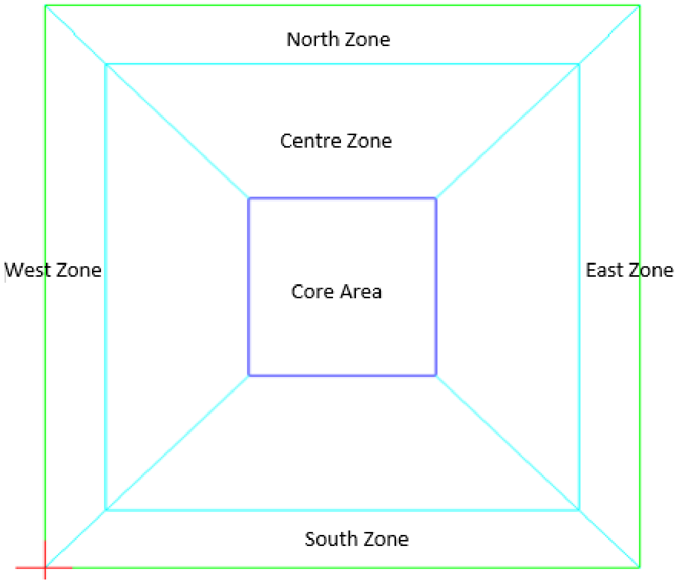

Figure 2. HVAC zone markings for C5OL

1.2.2 C5OM – Medium Office Building

- Basic Geometry Information –
  - Area: 2,304m^2
  - Storey: 2
  - Level Height: 3.6m
  - Floor to Ceiling Height: 2.7m
  - Ceiling Space Height: 0.9m
  - Floor Plate: Rectangle, 48m x 24m
  - Window size: 48m x 1.26m; 24m x 1.26m
  - WWR: 35%
  - Orientation: Long sides north/south
- Geometry View

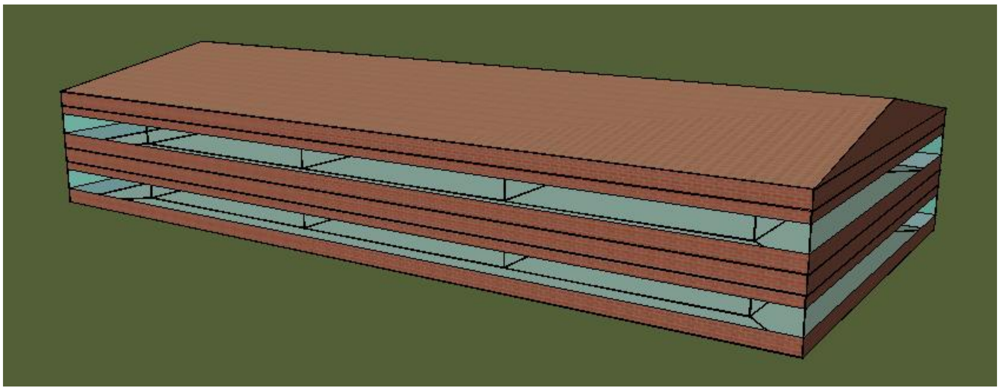

Figure 3. Geometric view of C5OM

- Construction Details
  - External wall – Lightweight frame wall

- Roof – Insulated metal roof (reflective underside) with uninsulated suspended ceiling. We allowed for one long edge to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
- Floor - Slab on grade
- Glazing - modelled as per Appendix A.I.II

- Internal load and operation profiles
  - Occupancy – 10m²/person in the office area, zero in the core area, 75 W sensible heat gain and 55 W latent heat gain per person
  - Lighting – 4.5W/m² in the office area. 3 W/m² in core area (toilet/lift). Note that these lighting power density values are adjusted based on the Room Aspect Ratio in NCC 2019 Section J6. For the office area, we measured the office zones on one floor as a combined zone rather than one by one as we assume it is an open space office.
  - Equipment – 11W/m².
  - Operation profiles – NCC 2019 Specification JVc Table 2c and Table 2d for office. The core area lighting operation profile is modelled the same as an office area.
  - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in the office area and return air plenum (ceiling space). Infiltration in the core area is modelled the same as the office area.
- HVAC
  - Major plant – Air-conditioning for this archetype is provided by Packaged Air Conditioning (PAC) systems.
    The systems were modelled as one PAC unit per zone. The supply airflow was modelled as constant flow system. The PAC units are sized with an oversizing factor of 1.2.
  - Control –
    - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
    - The dry bulb economy cycle and the CO_2 control to the minimum outside air was modelled when required as per NCC 2022.
  - HVAC Zoning –

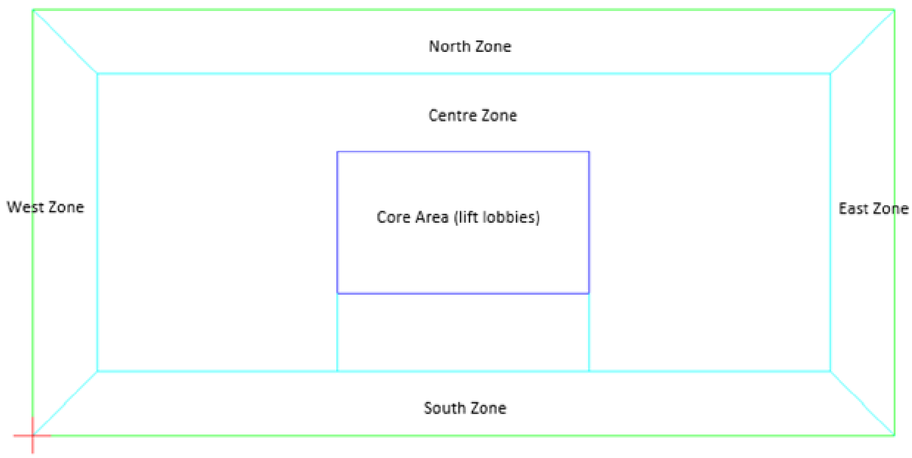

Figure 4. HVAC zone markings for C5OM

1.2.3 C9A – Large Hospital Ward Building

- Basic Geometry Information –
  - Area: 10,368m²
  - Storey: 8 storeys. Note that Level 3 to Level 8 are to be modelled as hospital ward floors. The geometry of the Ground Floor and Level 2 is modelled but treated as adiabatic in the thermal model.
  - 2 levels of underground car park and 1 rooftop plant room
  - Level Height: 4.2m
  - Floor to Ceiling Height: 3.3m
  - Ceiling Space Height: 0.9m
  - Floor Plate: Square, 36m x 36m
  - WWR: 24% for wardroom floors
  - Orientation: Faces to north, south, east and west.
- Geometry View

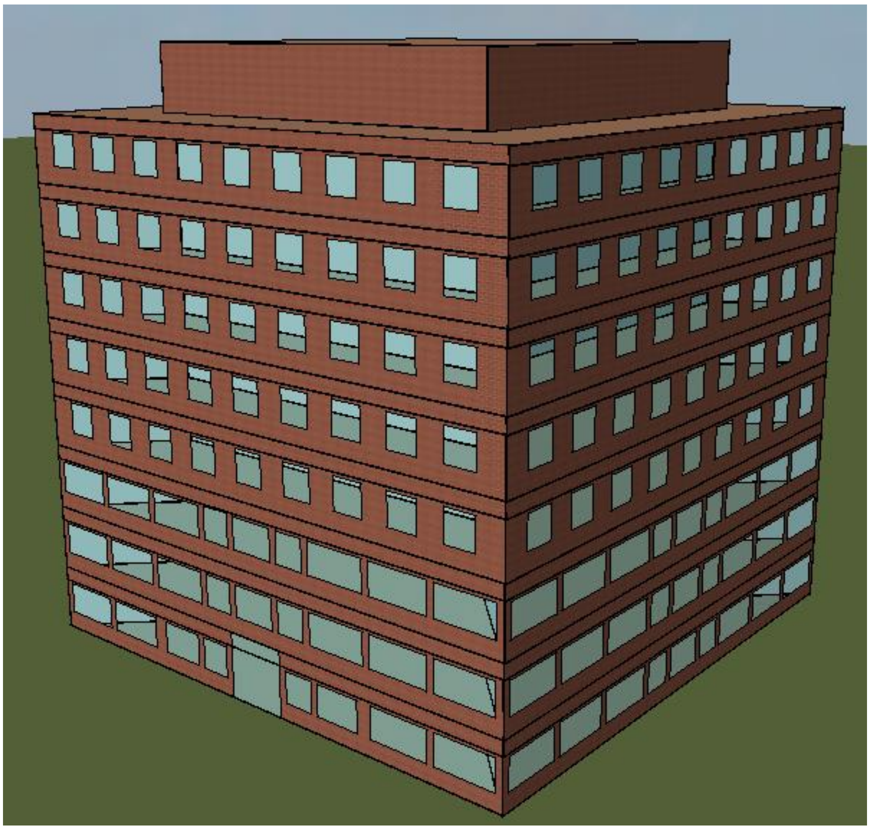

Figure 5. Geometric view of C9A

- Construction Details
  - External wall – Lightweight frame wall
  - Roof – Concrete roof with underside insulation; uninsulated plant room rooftop
  - Floor - suspended floor with underground car park
  - Glazing - modelled as per Appendix A.I.III
- Internal load and operation profiles –
  - Occupancy – 10m²/person in ward area, 2 persons in corridor representing the staff in nurse station, zero in core area, underground carpark and rooftop plant room. 75 W sensible heat gain and 55 W latent heat gain

- Lighting – 2.5W/m² in ward area and corridor; 3 W/m² in core area (toilet/lift); 2W/m² in underground carpark; zero in rooftop plant room. Note that these lighting power density values are to be adjusted based on the Room Aspect Ratio in NCC 2019 Section J6. For the corridor, core area and underground car park, we measured the dimensions in the model. For the wardroom, we cannot measure the dimensions from the model directly as we modelled the ward rooms as combined zones. We assume the wardroom is 5m x 4m (20m²) with 3.3m of the height.
- Equipment – 5W/m² for 24/7 in ward area; zero in corridor, core area, underground car park and rooftop plant room
- Operation profiles – NCC 2019 Specification JVc Table 2g for ward area. 100% occupancy for 24/7 in the corridor; 100% lighting operation for 24/7 in the corridor, core area and underground car park.
- Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in ward area, corridor and return air plenum (ceiling space). Infiltration in the core area are modelled the same as the corridor area. 2ACH for 24/7 in the underground car park. 0.7ACH for 24/7 in the rooftop plant room.

- HVAC
  - Major plant –
    - Air-conditioning for this archetype is provided by an air-cooled chiller system with primary-secondary pumping and gas boiler heating hot water system with primary-secondary pumping.
    - Chilled water plant consists of two identical chillers each selected at 60% of design load. Chiller efficiencies are applied based on the base case efficiencies listed in Table 5.
    - Heating hot water plant consists of two identical boilers each selected at 60% of design load. Boiler efficiency is set to be 90%.
    - Air-conditioning is provided by Fan Coil Units (FCUs) serving the wardrooms and one constant flow AHU serving all corridors. Fan efficiencies are calculated as per Section J6D5 in NCC 2022.
    - FCU and AHU cooling and heating coils are sized with an oversizing factor of 1.1.
  - Control –
    - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
    - The corridor zone AHU supply air temperature was controlled by the average zone temperature.
    - The heat exchanger used to precondition the minimum outside air was modelled when required as per NCC 2022.
    - Chilled water temperature and heating hot water temperature was modelled to be reset based on the outside air temperature. The chillers and boilers were staged up and down at 50% of the design load.
  - HVAC Zoning –

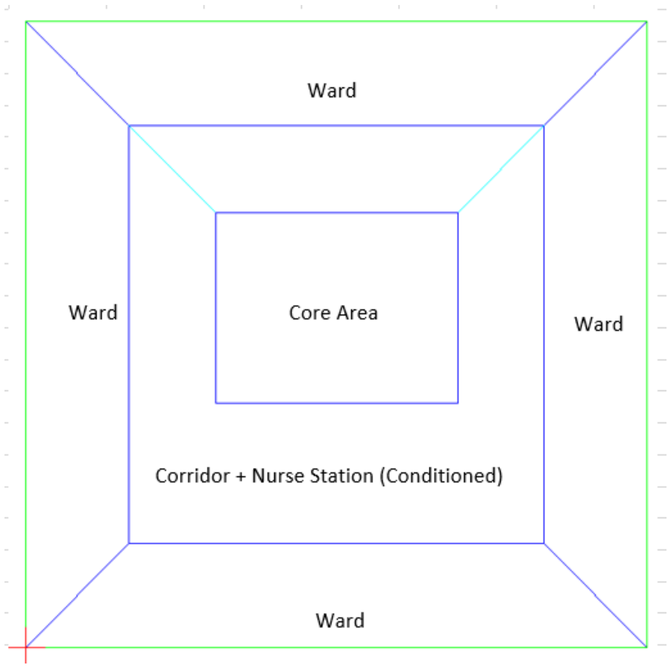

Figure 6. HVAC zone markings for C9A

1.2.4 C9AS - Small Hospital Ward Building

- Basic Geometry Information –
  - Area: 2,048m²
  - Storey: 1
  - Level Height: 3.5m
  - Floor to Ceiling Height: 2.7m
  - Ceiling Space Height: 0.8m
  - Floor Plate: Donut shape, 48m x 48m – 16m x 16m
  - Window size: 2.5m x 2m
  - WWR: 35%
  - Orientation: Faces to north, south, east and west.
- Geometry View

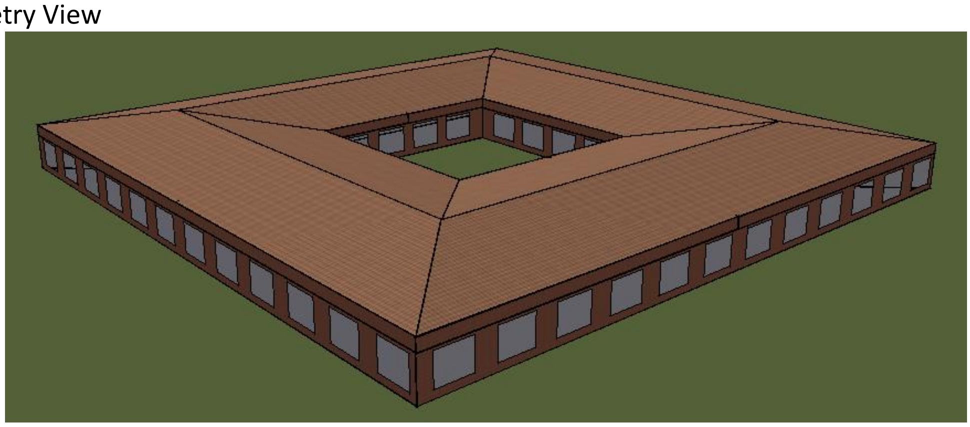

Figure 7. Geometric view of C9AS

- Construction Details
  - External wall – Lightweight frame wall
  - Roof – Metal roof with reflective sarking over insulated fixed plaster ceiling

- Floor - Slab on grade
- Glazing - modelled as per Appendix A.I.IV

- Internal load and operation profiles –
  - Occupancy – 10m²/person in ward area, 2 persons in corridor representing the staff in nurse station. 75 W sensible heat gain and 55 W latent heat gain per person.
  - Lighting – 2.5W/m² in ward area and corridor. Note that these lighting power density values were adjusted based on the Room Aspect Ratio in NCC 2019 Section J6. For the corridor, the dimensions were measured in the model. For the wardroom, we cannot measure the dimensions from the model directly as we modelled the ward rooms as combined zones. We assume the wardroom is 5m x 4m (20m²) with 3.3m of the height.
  - Equipment – 5W/m² for 24/7 in ward area; zero in corridor
  - Operation profiles – NCC 2019 Specification JVc Table 2g for ward area. 100% occupancy for 24/7 in the corridor; 100% lighting operation for 24/7 in the corridor, core area and underground car park.
- HVAC
  - Major plant –
    - Air-conditioning for this archetype is provided by VRF systems. The supply air was delivered to the zones by constant flow FCUs. The FCU cooling coils and heating coils were served by outdoor VRF unit. The coils and VRF unit are sized with an oversizing factor of 1.1.
  - Control –
    - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
    - The heat exchanger used to precondition the minimum outside air was modelled when required as per NCC 2022.
  - HVAC Zoning

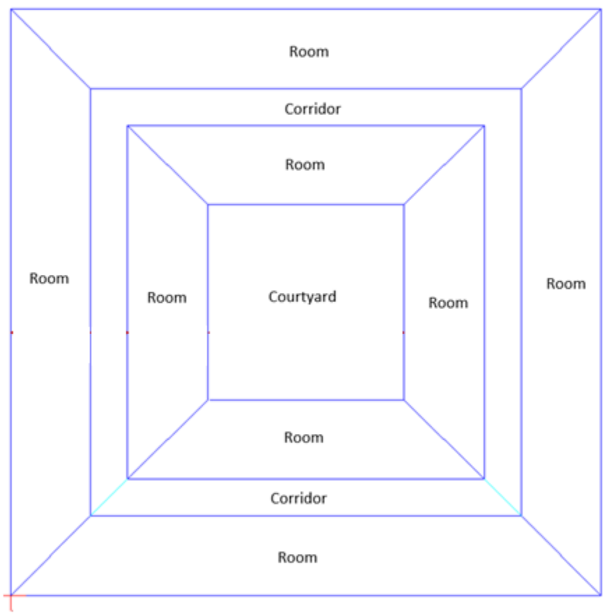

Figure 8. HVAC Zone marking for C9AS

1.2.5 C5OS – Small Office Building

- Basic Geometry Information –
  - Area: 578m²

- Storey: 2
- Level Height: 3.6m
- Floor to Ceiling Height: 2.7m
- Ceiling Space Height: 0.6m
- Floor Plate: Square, 17m x 17m
- Window size: 17m x 1.26m
- WWR: 38%

- Geometry View –

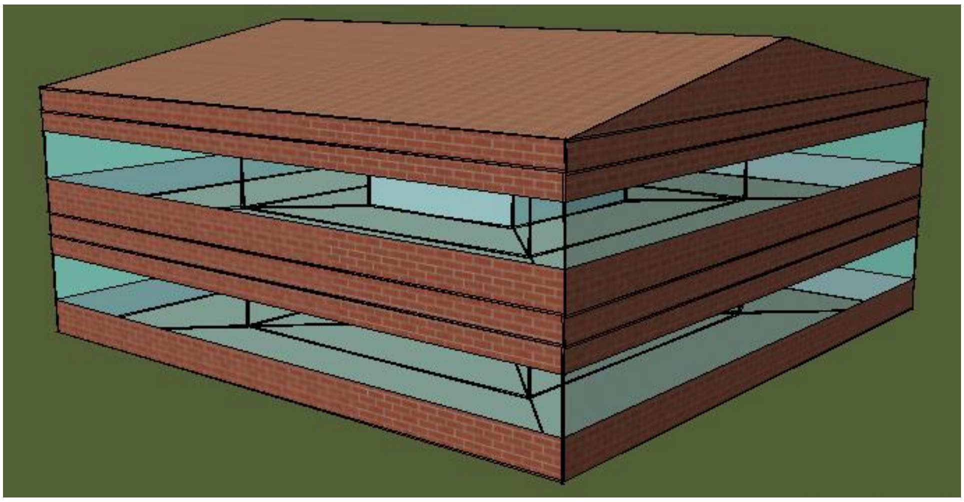

Figure 9. Geometric view of C5OS

- Construction Details –
  - External wall – Brick veneer wall
  - Roof – 10-degree gabled Metal roof with reflective sarking over insulated fixed plaster ceiling. We allowed for one long edge to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
  - Floor - Slab on grade
- Internal load and operation profiles –
  - Occupancy – 10m²/person in office area, zero in core area, 75 W sensible heat gain and 55 W latent heat gain
  - Lighting – 4.5W/m² in office area. 3 W/m² in core area (toilet/lift). Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. For the office area, the dimensions were measured as a combined zone on each floor rather than one by one as we assume it is an open space office.
  - Equipment – 11W/m².
  - Operation profiles – NCC 2019 Specification JVc Table 2c and Table 2d for office. Core area lighting operation profile to be modelled the same as office area.
  - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in office area and return air plenum (ceiling space). Infiltration in core area to be modelled the same as the office area. 7.68 ACH was modelled to represent the door infiltration in the perimeter zones on Ground Floor. This figure was calculated based on PNNL-20026 which in turn is based on ASHRAE.
- HVAC –

- Major plant –
  - Air-conditioning for this archetype is provided by VRF systems. The supply air was delivered to the zones by constant flow FCUs. The FCU cooling coils and heating coils were served by outdoor VRF unit. The system was modelled as one VRF outdoor units per floor.
- Control –
  - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
  - The CO_2 control to the minimum outside air was modelled when required as per NCC 2022.
- HVAC Zoning

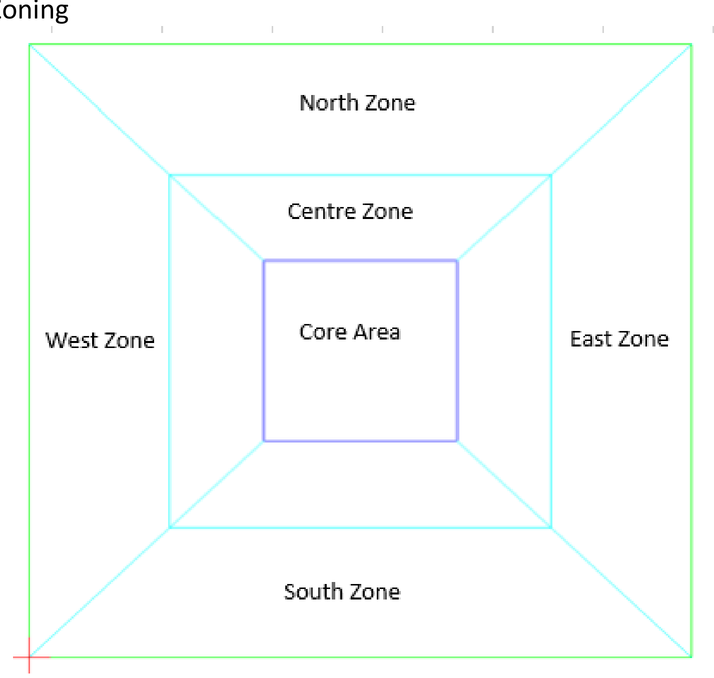

Figure 10. HVAC Zone marking for C5OS

1.2.6 C6RS – Small Retail Strip

- Basic Geometry Information –
  - Area: 1,000m^2
  - Storey: Ground floor was modelled as small retails. The geometry of upper floors was modelled but treated as adiabatic in the thermal model.
  - Level Height: 4.5m
  - Floor to Ceiling Height: 6m
  - Ceiling Space Height: 0.9m
  - Floor Plate: Square, 50m x 20m
  - Windows: windows on the front view and the side views modelled as shown in Figure 11. No windows modelled on the rear view.
- Geometry View –

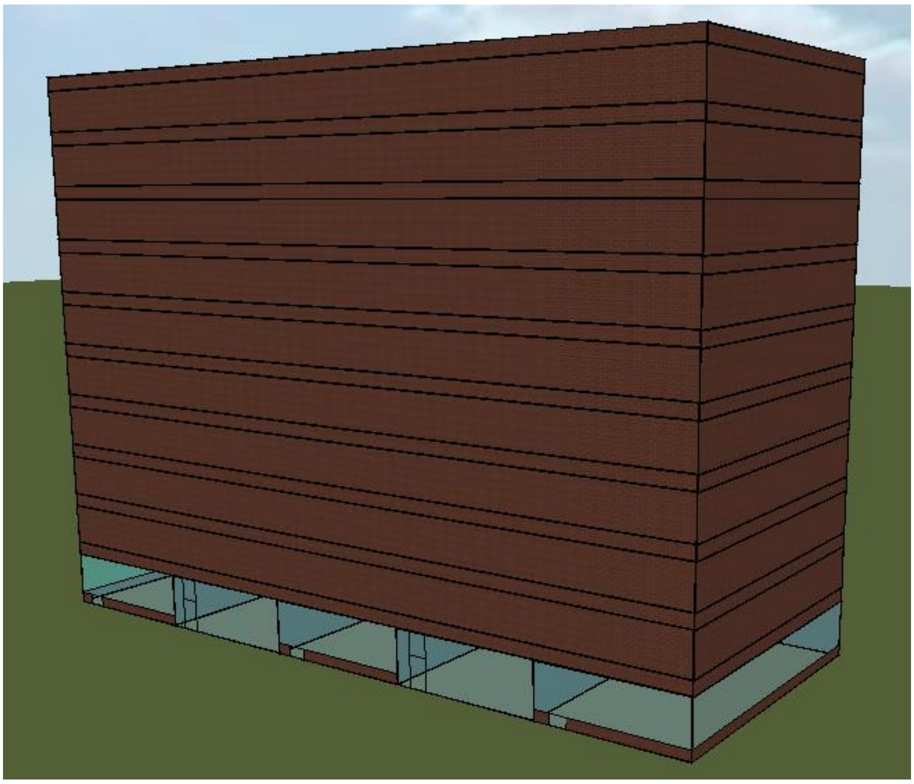

Figure 11. Geometric View of C6RS

- Construction Details –
  - External wall – Lightweight frame wall
  - Roof – Adiabatic roof
  - Floor - Slab on grade
  - Glazing - modelled as per Appendix A.I.VI
- Internal load and operation profiles –
  - Occupancy – 3m²/person in office area. 75 W sensible heat gain and 55 W latent heat gain
  - Lighting – 14W/m². Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. The dimensions of the shops were measured in the model.
  - Equipment – 5W/m²
  - Operation profiles – modelled as per NCC 2019 Specification JVc Table 2e
  - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in retail and return air plenum (ceiling space). 2.64 ACH was modelled to represent the door infiltration. This figure was calculated based on PNNL-20026 which in turn is based on ASHRAE.
- HVAC –
  - Major plant – Air-conditioning for this archetype is provided by PAC systems.
    The systems were modelled as one PAC unit per shop. The supply airflow was modelled as constant flow system.
  - Control –
    - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.

        - The dry bulb economy cycle and the CO_2 control to the minimum outside air was modelled when required as per NCC 2022.
    - HVAC Zoning –

Figure 12. HVAC Zone marking for C6RS

1.2.7 C6RL – Large Retail Building

- Basic Geometry Information –
    - Area: 1,000m^2
    - Storey: 1
    - Level Height: 7m
    - Floor Plate: Square, 31.6m x 31.6m
    - Window size: 12m x 3.5m
    - WWR: 19% for the side with glazed door; zero for other sides.
- Geometry View

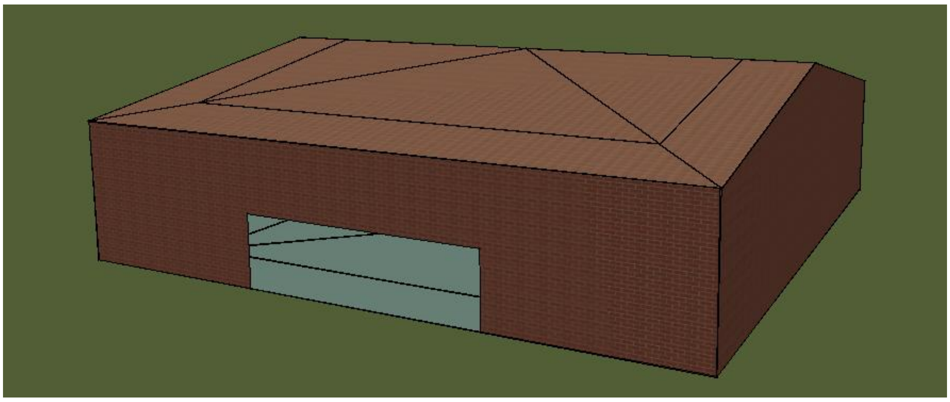

Figure 13. Geometric view of C6RL

- Construction Details
    - External wall – concrete wall with insulation
    - Roof – 10-degree gable Insulated metal roof (reflective underside), no suspended ceiling
    - Floor - Slab on grade
    - Glazing - modelled as per Appendix A.I.VII
- Internal load and operation profiles –

- Occupancy – 3m²/person in office area. 75 W sensible heat gain and 55 W latent heat gain
    - Lighting – 14W/m². Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. For the retail area, the dimensions were measured as a combined zone rather than one by one as we assume it is an open space retail.
    - Equipment – 5W/m²
    - Operation profiles – NCC 2019 Specification JVc Table 2e
    - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in retail area. 1.33 ACH was modelled to represent the door infiltration. This figure was calculated based on PNNL-20026 which in turn is based on ASHRAE.
- HVAC –
    - Major plant - Four PAC units were modelled. Each serves perimeter zone and centre zone for one aspect. HVAC operation hours to be modelled as per NCC 2019 Specification JVc Table 2e.
    - Control –
        - The zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side.
        - The dry bulb economy cycle and the CO_2 control to the minimum outside air was modelled when required as per NCC 2022.
    - HVAC Zoning

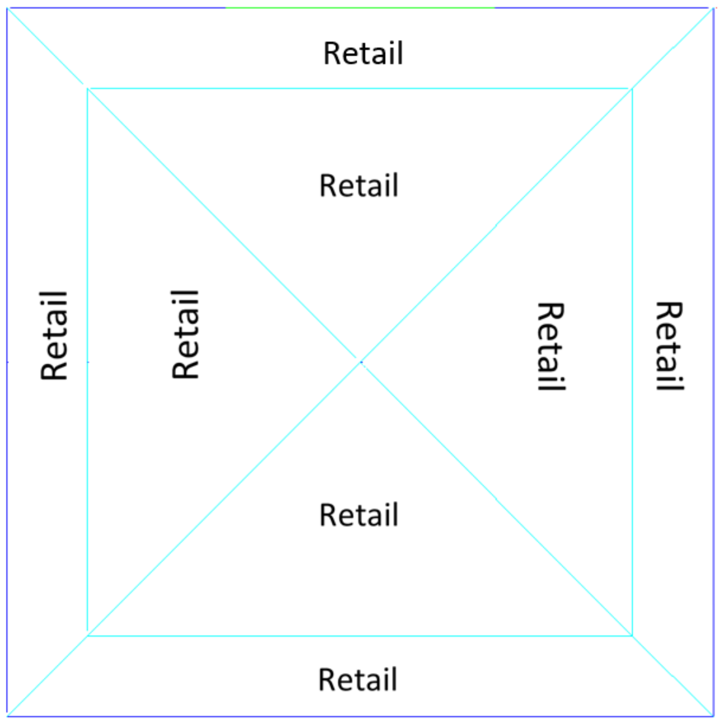

Figure 14. HVAC Zone marking for C6RL

1.2.8 C3HS – Small Motel Building

- Basic Geometry Information –
    - Area: 1,296m²

- Storey: 2
- Level Height: 3.6m
- Floor to Ceiling Height: 2.7m
- Ceiling Space Height: 0.9m
- Floor Plate: Rectangle, 36m x 18m
- Window size: 2m x 2m; 1.8m x 1.8m
- WWR: 25% for front view and rear view; zero for side views

- Geometry View -

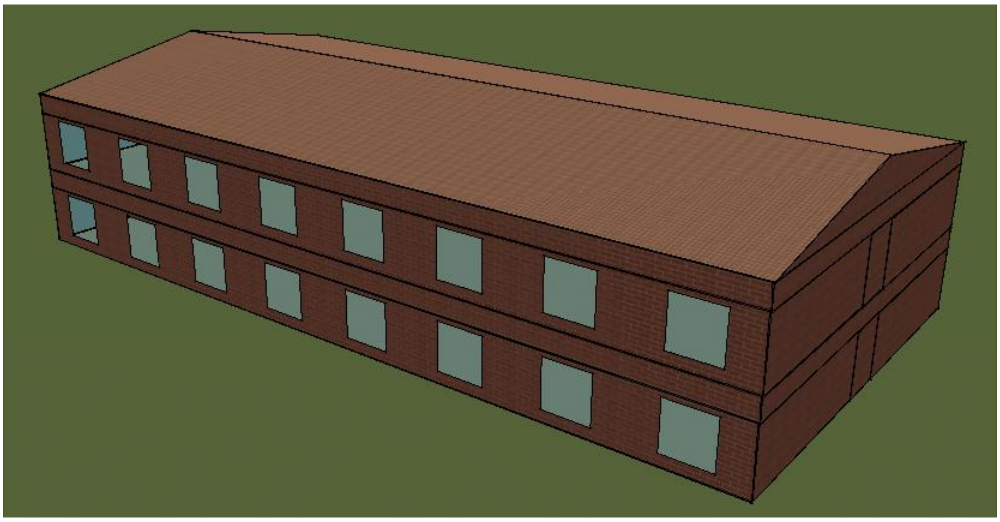

Figure 15. Geometric view of C3HS

- Construction Details –
  - External wall – Lightweight frame wall
  - Roof – 10-degree gabled Insulated metal roof (reflective underside) with uninsulated suspended ceiling. We also allowed for both long edges to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
  - Floor - Slab on grade
  - Glazing - modelled as per Appendix A.I.VIII
- Internal load and operation profiles –
  - Occupancy – 15m²/person in hotel rooms, zero in corridor, 75 W sensible heat gain and 55 W latent heat gain
  - Lighting – 5W/m² in hotel rooms and corridors. 3 W/m² in core area (toilet/lift). Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. For corridor and core area, the dimensions were measured in the model. For the motel room, we cannot measure the dimensions from the model directly as we modelled the hotel rooms as combined zones. Assume the room is 6m x 4m (24m²) with 2.7m of the height.
  - Equipment – 160W/room, assuming the motel room size is 24m². So the equipment load is calculated to be 6.7W/m².
  - Operation profiles – NCC 2019 Specification JVc Table 2b for hotel rooms. 100% lighting for 24/7 for corridors and core area as per NABERS handbook hotel common area schedule.

- Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in hotel rooms and return air plenum (ceiling space). Infiltration in Leve 1 corridor and core area to be modelled the same as the hotel rooms. 20.06 ACH of door infiltration applies to the ground floor corridor. This figure was calculated based on PNNL-20026 which in turn is based on ASHRAE.

- HVAC –
    - Major plant –
        - Air-conditioning for this archetype is provided by VRF systems. The supply air was delivered to the zones by constant flow FCUs. The FCU cooling coils and heating coils were served by outdoor VRF unit. The system was modelled as one VRF outdoor units per floor.
    - Control –
        - The classroom zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side. The corridor zone temperature control was modelled with a 6°C dead band from 18.5°C to 24.5°C with 0.5°C proportional band on either side.
        - The heat exchanger to precondition the minimum outside air was modelled when required as per NCC 2022.
    - HVAC Zoning

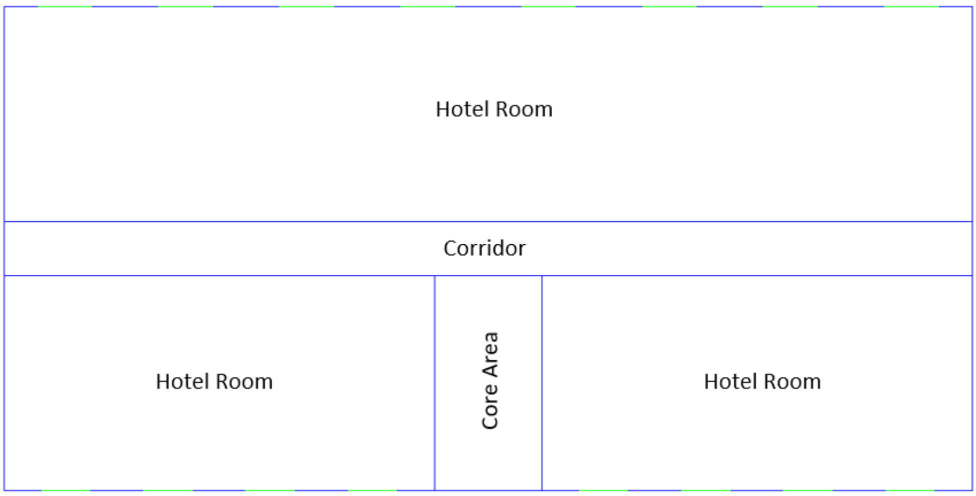

Figure 16. HVAC Zone marking for C3HS

1.2.9 C3HL – Large Hotel Building

- Basic Geometry Information –
    - Area: 10,240 m².
    - Storey: 10 storeys. Note that L2 to L9 are to be modelled as hotel room floors. Geometry of Ground Floor and L1 will be modelled but treated as adiabatic in thermal model.
    - 1 level of underground carpark and 1 rooftop plant room
    - Level Height: 3.6m
    - Floor to Ceiling Height: 2.7m
    - Ceiling Space Height: 0.9m
    - Floor Plate: Square, 32m x 32m
    - Window size: 2m x 2m in hotel room floors

  - WWR: 28% for hotel room floors
- Geometry View

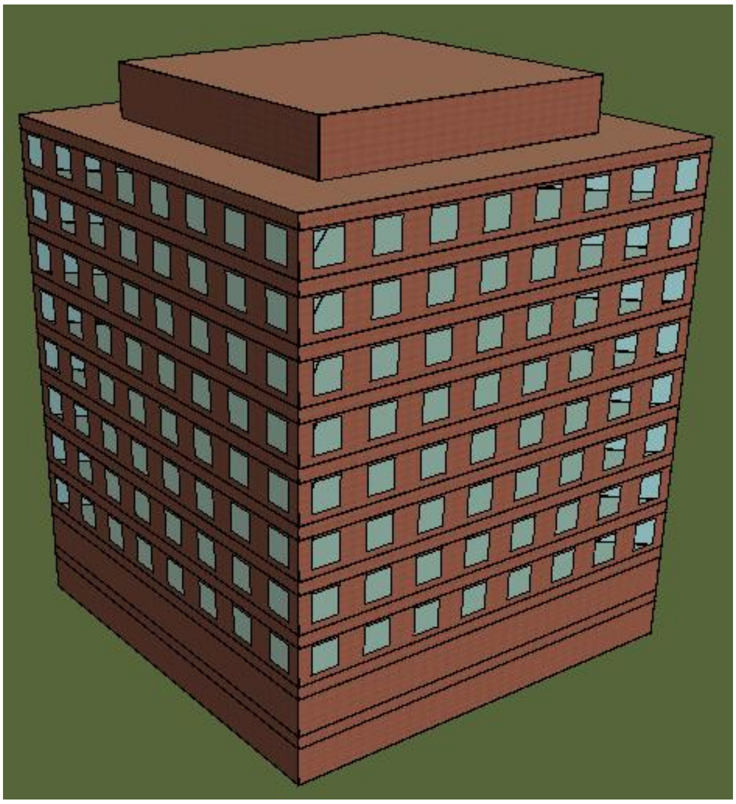

Figure 17. Geometric view of View of C3HL

- Construction Details –
  - External wall – Lightweight frame wall
  - Roof - Concrete roof with underside insulation; uninsulated plant room rooftop
  - Floor – suspended floor with underground car park
  - Glazing - modelled as per Appendix A.I.IX
- Internal load and operation profiles –
  - Occupancy – 15m²/person in hotel rooms, zero in corridor, 75 W sensible heat gain and 55 W latent heat gain
  - Lighting – 5W/m² in hotel rooms and corridors; 3 W/m² in core area (toilet/lift); 2W/m² in underground carpark; zero in rooftop plant room. Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. For corridor, core area and underground carpark, the dimensions were measured in the model. For the hotel room, we cannot measure the dimensions from the model directly as we modelled the hotel rooms as combined zones. We assume the room is 6m x 4m (24m²) with 2.7m of the ceiling height.
  - Equipment – 160W/room, assuming the motel room size is 24m². So the equipment load is calculated to be 6.7W/m².

  - Operation profiles – NCC 2019 Specification JVc Table 2b for hotel rooms. 100% lighting for 24/7 for corridors and core area as per NABERS handbook hotel common area schedule. 100% lighting for 24/7 in underground carpark.
  - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in hotel rooms and return air plenum (ceiling space). 0.35ACH in corridor and core area for 24/7. 2ACH for 24/7 in underground carpark. 0.7ACH for 24/7 in rooftop plant room.
- HVAC –
  - Major plant –
    - Air-conditioning for this archetype is provided by an air-cooled chiller system with primary-secondary pumping and gas boiler heating hot water system with primary-secondary pumping.
    - Chilled water plant consists of two identical chillers each selected at 60% of design load. Chiller efficiencies are modelled as per Appendix A.
    - Heating hot water plant consists of two identical boilers each selected at 60% of design load. Boiler efficiency is set to be 90%.
    - Constant flow FCUs plus DOAS were modelled to serve the hotel rooms and corridors. The same DOAS also serves corridor for 24/7. No HVAC serves core area. FCU fan efficiencies are calculated as per Section J6D5 in NCC 2022.
    - FCU cooling and heating coils are sized with an oversizing factor of 1.1.
  - Control –
    - The hotel room zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side. The corridor zone temperature control was modelled with a 6°C dead band from 18.5°C to 24.5°C with 0.5°C proportional band on either side.
    - The heat exchanger to the minimum outside air was modelled when required as per NCC 2022.
  - HVAC Zoning -

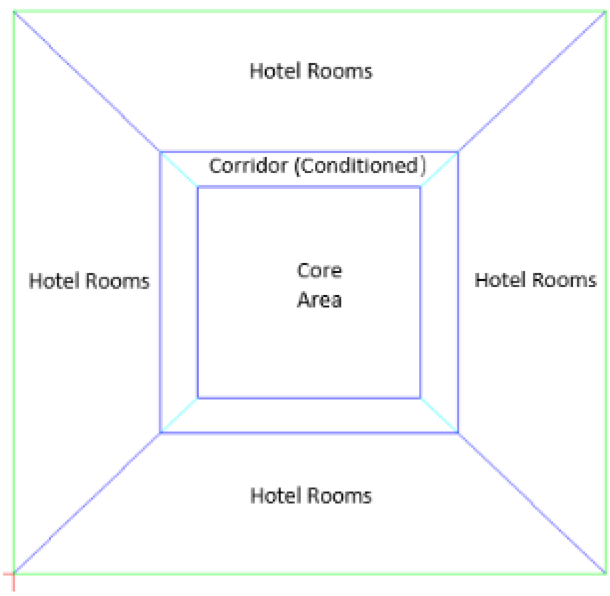

Figure 18. HVAC Zone marking for C3HL

1.2.10 C9B –School Classroom Building

- Basic Geometry Information –
    - Area: 2,304m^2
    - Storey: 2
    - Level Height: 4.2m
    - Floor to Ceiling Height: 3.3m
    - Ceiling Space Height: 0.9m
    - Floor Plate: Rectangle, 48m x 24m
    - Window size: 48m x 1.5m; 2m x 1.5m
    - WWR: 36% for front view and rear view; 24% for side views
- Geometry View –

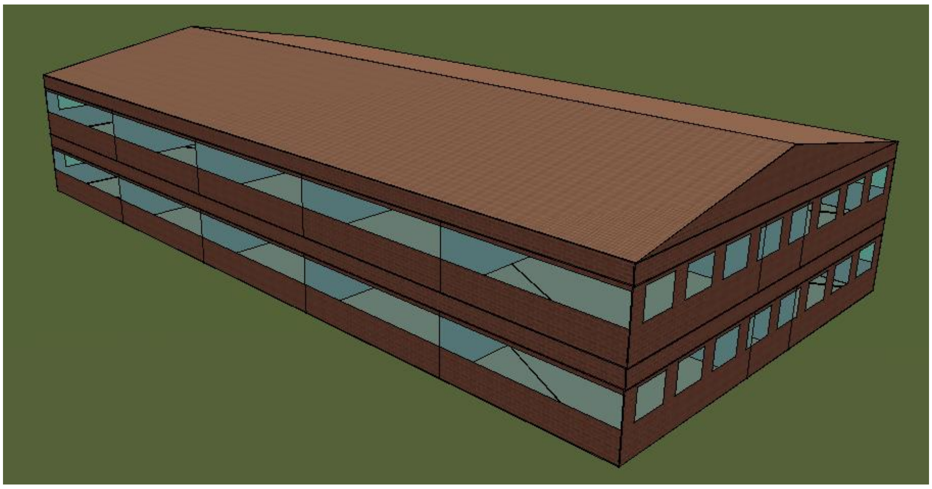

Figure 19. Geometric view of C9B

- Construction Details –
    - External wall – Brick veneer
    - Roof – 10-degree gable metal roof with reflective sarking over insulated fixed plaster ceiling
    - Floor - Slab on grade
    - Glazing - modelled as per Appendix A.I.X
- Internal load and operation profiles –
    - Occupancy – 2m^2/person in classrooms; zero in core area and corridor. Note that core area and corridor are modelled as a combined zone.
    - Lighting – 4.5W/m^2 in classrooms; 3 W/m^2 (toilet) in corridor. Note that these lighting power density values are to be adjusted based on Room Aspect Ratio in NCC 2019 Section J6. For corridor, the dimensions were measured in the model. For the classroom, we cannot measure the dimensions from the model directly as we modelled the classrooms as combined zones. Assume the classroom is 7.1m x 7.1m (50m^2) with 3.3m of the height.
    - Equipment – 5W/m^2 in classrooms; zero in corridor.
    - Operation profiles – NCC 2019 Specification JVc Table 2j for classrooms. Lighting operation in corridor and core area to be modelled the same as the classrooms.
    - Infiltration – 0.7ACH when HVAC is not operating and 0.35ACH when HVAC is operating in classrooms and return air plenum (ceiling space). Infiltration in corridor was modelled the

same as the classrooms. 10.57 ACH of door infiltration applies to the ground floor corridor. This figure was calculated based on PNNL-20026 which in turn is based on ASHRAE.

- HVAC –
    - Major plant –
        - Air-conditioning for this archetype is provided by VRF systems. The supply air was delivered to the zones by constant flow FCUs. The FCU cooling coils and heating coils were served by outdoor VRF unit. The system was modelled as one VRF outdoor units per floor.
    - Control –
        - The classroom zone temperature control was modelled with a 2°C dead band from 21.5°C to 23.5°C with 0.5°C proportional band on either side. The corridor zone temperature control was modelled with a 6°C dead band from 18.5°C to 24.5°C with 0.5°C proportional band on either side.
        - The CO2 control to the minimum outside air was modelled when required as per NCC 2022.
    - HVAC Zoning

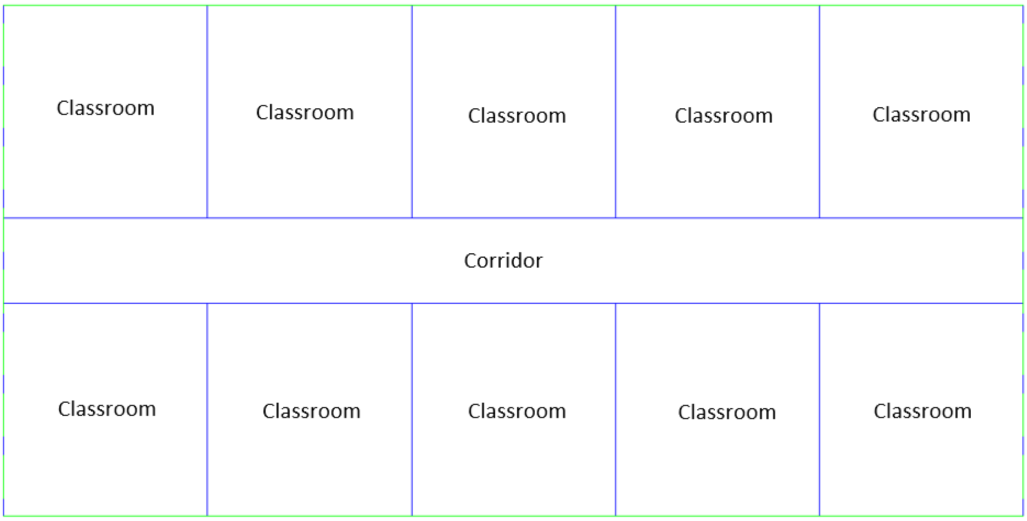

Figure 20. HVAC Zone marking for C9B

1.3 Out-of-scope services

Non-regulated services outside of the scope of the thermal simulation that had no changes in cost or consumption between base case and test case for a given scenario (archetype, climate zone or stringency) were excluded from all calculations for that scenario.

Service	Stringency 1	Stringency 2	Stringency3
DHW	Excluded	Excluded	Included for C5OL, C9A & C3HL
Lifts	Excluded	Excluded	Excluded
Cooking	Excluded	Excluded	Excluded
EV charging	Excluded	Excluded	Excluded

1.4 Benefit Cost Analysis

For each scenario, consisting of a base case/test case pair, BCRs were calculated using the formula:

$$BCR = -\frac{\Delta\ NPV\ Operating\ Expenses}{\Delta\ NPV\ Capital\ Expenditure}$$

where Δ refers to the change in expense/expenditure between the two cases. A Benefit Cost Ratio (BCR) above 1 indicates total savings in operating expenses were greater than total increases in capital expenditure. Where capital expenditure decreased while producing energy savings, a "negative capital cost" was calculated, instead of a numerical BCR.

1.4.1 Economic Assumptions

To undertake the benefit cost analysis, various economic assumptions were made (Table 27). Projected energy and carbon prices and intensities for the 50 year analysis period are presented in Table 399 in Appendix C.I.

Table 27. Economic Assumptions used for Benefit Cost Analysis

Parameter	Value	Description
Discount Rate	5% per annum	Discount rate applied to calculate Net Present Values (NPVs).
Carbon Cost Inclusion	100%	Proportion of carbon costs included pricing model.
Plant Lifespan	20 years	Plant lifespan before replacement is necessary, used to calculate total plant expenditure over building lifespan.
Analysis Timeframe	50 years	Building lifespan used to calculate overall capital and operating expenditures.
Assumed Power Factor	90%	Used to calculate building peak demand.
Year of Electrification	15 years	Delay between building construction and electrification of plant equipment (used for Stringency 3 analysis).

No performance or cost learning rates were applied.

1.4.2 Operating Expense Calculations

For each base case and test case, operating expenses were calculated across a 50-year building lifespan. Net Present Values were calculated by summing costs for each future year using the standard NPV formula:

$$NPV = \sum_{t=1}^{N} \frac{C_t}{(1+i)^t}$$

Where N is the total lifespan or time horizon, t is the year in which the cost is incurred, C_t is the cost, and i is the discount rate.

1.4.3 Capital Expenditure Calculations

For each base case and test case, two capital cost components were calculated:

- One-off costs incurred at initial construction
- Replacement costs

The total NPV of all capital expenditure over the 50-year building lifespan was calculated for each scenario similarly to the operating expenses, using the standard NPV formula.

HVAC plant was assumed to have some economic value available at the end of the analysis timeframe, based on a power law-based depreciation curve:

$$V(n) = C(1 - (1 - d)^{N-n})$$

Where *V(n)* is the residual plant economic value, *C* is the plant replacement cost, *d* is the discount rate, *N* is the expected economic life of a plant item (in years) and *n* is the number of years since the plant was replaced. For the analysis conducted here, *V(n)* was calculated in year 50, 15 years after the last plant replacement. The net present value of *V(n)* was calculated and subtracted from the capital expenditure cost.

Stringency 1 – Cost Benefit Optimisation Without PV

For the Stringency 1 analysis, groups of measures were applied to each archetype to specify new 2025 test cases. These measure groups consisted of previously evaluated individual measures where a Benefit Cost Ratio (BCR) of 1 (or higher, if there was no BCR=1 case for the measure) was achievable, as documented in the initial measures analysis reports[7]. For each of the four building archetype models, performance was simulated for a 2022 base case and a 2025 test case. No use of PV was included in any Stringency 1 model.

Where a whole building BCR greater than 1 was achieved, additional previously unadopted measures with the highest energy impact per dollar capital cost was identified and added to the model. This resulted in several modelling iterations for some archetypes/climate zones to maximise energy savings whilst still achieving a BCR higher than 1. The additional measures selected for the optimisation process were:

- Lower airflow threshold for economy cycle requirement;
- Lower airflow threshold for use of CO_2 control; and
- Addition of indirect evaporative cooling to minimum outside air supply.

This list of potential optimisation measures was based on results from the Initial Measures Analysis stage. In that stage it was found that the investigated measures tended either to be economic and therefore included already or found not to generate worthwhile energy savings (and therefore of no value to the optimisation process), leaving a very short list of possible optimisation measures[8]. Increased stringency in solar admittance was not considered as this is limited more by industry acceptability than benefits and costs. Economy cycle and indirect evaporative cooling were the only unadopted items showing significant energy savings. The addition of CO_2 control to the optimisation process (not analysed in the initial measures stage) was based on positive results for this technology from previous analyses.

1.5 Simulations

The measures used for each archetype and iteration during the Stringency 1 analysis are summarized below. For some archetypes and climate zones, several iterations were run for the analysis to optimise the measure selection. The details of the iteration 1 measures are listed in Appendix A.I.

1.5.1 C5OL 2025 Test Case Measures

- Iteration 1
  - Glazing update
  - External wall insulation update
  - Mitigate the external wall thermal slab edge bridging
  - Remove internal wall insulation between occupied zone and the unconditioned building core.
  - Roof insulation update

[7] REP01080-B-003 Building Envelope Measures Report, REP01080-B-004 HVAC Services Report, REP01080-B-005 Electrical Services Report

[8] For technologies such as chillers, VRF and unitary air-conditioning, the initial measures were also constrained by the need to maintain a good range of available and compliant equipment. As a result, not further increase in stringency was attempted for these measures.

- Chillers with adjusted[9] sizing and higher EER & IPLV
- Better control for AHU fans, chilled water pumps, heating hot water pumps and cooling tower fans
- Lighting control update

- Iteration 2
  - Iteration 1 + CO_2 control used in all AHUs that don't have in Iteration 1
- Iteration 3
  - Iteration 2 + Economy cycle used in all AHUs in CZ2-8 that don't have it in Iteration 2

1.5.2 C5OM 2025 Test Case Measures

- Iteration 1
  - Glazing update
  - External wall insulation update
  - Mitigate the external wall thermal bridging
  - Remove internal wall insulation
  - Roof insulation update
  - Insulate box gutter
  - Cool roof used in CZ1, 2, 3, 5 & 6
  - Variable speed PACs with standard sizing and higher EER
  - Lighting control update
- Iteration 2
  - Iteration 1 + CO_2 control used in all centre zone PACs
- Iteration 3
  - Iteration 2 + CO_2 control used in all N&S PACs
- Iteration 4
  - Iteration 3 + CO_2 control used in all E&W PACs
- Iteration 5
  - Iteration 4 + Economy cycle used in all PACs over 1000l/s
- Iteration 6 (This iteration only applies to C5OM CZ6 modelling)
  - Iteration 1 + Economy cycle used in all PACs over 1000l/s

1.5.3 C9A 2025 Test Case Measures

- Iteration 1
  - Glazing update
  - External wall insulation update
  - Mitigate the external wall thermal bridging
  - Remove internal wall insulation
  - Roof insulation update
  - Chillers with standard sizing and higher EER & IPLV
  - Better control for AHU fans, chilled water pumps and heating hot water pumps

[9] The term adjusted sizing refers to the fact that NCC 2022 base case used a 5% additional oversizing factor (on top of normal (20%) oversizing factors) which was removed for NCC 2025 cases. This is intended to represent the impact of the design of NCC 2025 chiller and unitary AC measures on sizing decisions.

- Iteration 2
  - Iteration 1 + Indirect evaporative cooling used in CZ1 and CZ3 (the only climate zones in which savings of greater than 5% were predicted in the initial measures analysis)

1.5.4 C9AS 2025 Test Case Measures

- Iteration 1
  - Glazing update
  - External wall insulation update
  - Roof insulation update
  - Cool roof used in CZ1, 2, 3, 5 & 6
  - VRFs with standard sizing and higher EER
  - Better control for outside air fans
- Iteration 2
  - Iteration 1 + Indirect evaporative cooling used in CZ1 and CZ3

Refer Table 28 for the summary of optimum iteration scenario used for the 4 core archetypes for Stringency 1 results.

1.5.5 C5OS 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Mitigate thermal bridging around slab edge
- Remove internal wall insulation
- Roof insulation update
- Insulate box gutter
- VRFs with standard sizing and higher EER
- Better control for outside air fans
- Updated CO_2 control to the minimum outside air
- Lighting control update

1.5.6 C6RS 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Cool roof used in CZ1, 2, 3, 5 & 6
- PACs with standard sizing and higher EER
- Updated CO_2 control to the minimum outside air
- Updated economy cycle requirement
- Lighting control update

1.5.7 C6RL 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Roof insulation update
- Cool roof used in CZ1, 2, 3, 5 & 6
- PACs with standard sizing and higher EER
- Updated CO_2 control to the minimum outside air
- Updated economy cycle requirement
- Lighting control update

1.5.8 C3HS 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Mitigate the external wall thermal bridging
- Remove internal wall insulation
- Roof insulation update
- Insulate box gutters
- VRFs with standard sizing and higher EER
- Better control for outside air fans
- Updated the heat exchanger requirement to the minimum outside air
- Corridor lighting control update

1.5.9 C3HL 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Mitigate the external wall thermal bridging
- Remove internal wall insulation
- Roof insulation update
- Chillers with standard sizing and higher EER & IPLV
- Better control for AHU fans, chilled water pumps and heating hot water pumps
- Updated the heat exchanger requirement to the minimum outside air
- Corridor lighting control update

1.5.10 C9B 2025 Test Case Measures

The measures listed below were derived from a single iteration. They were chosen based on optimised package of measures developed based on day use building types (C5OM and C5OL) for each climate zone.

- Glazing update
- External wall insulation update
- Mitigate the external wall thermal bridging
- Roof insulation update
- VRFs with standard sizing and higher EER
- Better control for outside air fans
- Updated CO_2 control to the minimum outside air
- Lighting control update

1.6 Benefit Cost-Analysis

Benefit Cost-Analysis was carried out according to the general methodology outlined in Section 1.3.

For the Stringency 1 analysis, the following capital expenditure components were calculated for each scenario:

- One-off costs incurred at initial construction:
    - Building envelope
    - Relevant HVAC pipework and ductwork
- Replacement costs:
    - HVAC cooling and heating plant (excluding pipework and ductwork)
    - Pumps
    - Fans
    - VSDs

These costs covered only the building components and systems that varied between the base and test cases, and the overall HVAC plant size differences between the base and test cases:

- Differences in code requirements from NCC 2022 to NCC 2025
    - HVAC: Increased stringency for chillers, PACs, VRF, VSDs on pumps & fans
    - Building envelope: external and internal wall insulation, roof insulation, glazing
    - Electrical: lighting control
- Differences in overall plant size:
    - Overall system cost differences based on (typically) $/kW as a result of stringency increases, to give total capital costs for each base and test case.

Detailed pricing assumptions and methodologies for individual building components and plant items are provided in Appendix C.

1.7 Optimised Scenarios

1.7.1 Optimised scenario selection and results

The optimised Stringency 1 models were selected based on analysis of the results from the simulations outlined in Section 1.5. The following criteria were used in the acceptance of additional measures into the optimised model:

1. The total BCR for the building after optimisation must be >1
2. The additional HVAC energy saving of an economy cycle measure must be at least 2%
3. The additional HVAC energy saving of a CO_2 control measure must be at least 1%
4. The additional HVAC energy saving of an indirect evaporative cooling measure must be at least 5%

These minimum energy saving thresholds were set based on ensuring a positive return allowing for both the scale of the capital outlay and the novelty of the measure.

The final optimised scenarios for Core 4 Archetypes selected from the Stringency 1 analysis are listed in Table 28.

Table 28. Optimised Iteration Scenarios for Stringency 1 for 4 Core Archetypes

	C5OL	C5OM	C9A	C9AS
CZ1	Iteration 1	Iteration 3	Iteration 2	Iteration 1
CZ2	Iteration 2	Iteration 2	Iteration 1	Iteration 1
CZ3	Iteration 2	Iteration 2	Iteration 2	Iteration 1
CZ4	Iteration 1	Iteration 2	Iteration 1	Iteration 1
CZ5	Iteration 2	Iteration 2	Iteration 1	Iteration 1
CZ6	Iteration 1	Iteration 6	Iteration 1	Iteration 1
CZ7	Iteration 1	Iteration 1	Iteration 1	Iteration 1
CZ8	Iteration 1	Iteration 3	Iteration 1	Iteration 1

For the remaining 6 archetypes there is only single iteration for optimised results.

The Stringency 1 results and savings achieved as a result of the optimisation process are summarised in Table 29 to Table 38 below.

Table 29. Large Office Archetype (C5OL) Stringency 1 final optimised results

CZ	NCC 2022Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	899	0	746	0%	17%	17%	2.41
2	7	558	7	432	4%	23%	22%	1.84
3	39	559	33	431	16%	23%	22%	1.96
4	152	412	149	332	2%	19%	14%	4.00
5	22	500	23	395	-4%	21%	20%	2.75
6	83	343	86	277	-4%	19%	14%	2.71
7	228	353	221	285	3%	19%	13%	2.44
8	480	316	525	258	-9%	18%	1%	2.50

Note: 1.)) The "Gas (%)" cells showing negative sign (-) indicate an increase in gas use. 2.) Energy use is annual. 3.)*2)* GHG emissions are for the 50-year operational lifetime of the building.

Table 30. Medium Office Archetype (C5OM) Stringency optimised results

CZ	NCC 2022Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	230	0	162	0%	29%	29%	5.36
2	0	146	0	103	0%	29%	29%	4.85
3	0	184	0	117	0%	37%	37%	68342.02
4	0	129	0	89	0%	31%	31%	15.19
5	0	117	0	81	0%	31%	31%	11.15
6	0	98	0	70	0%	28%	28%	3.38
7	0	107	0	82	0%	24%	24%	5.25
8	0	128	0	104	0%	18%	18%	2.16

Note: 1.) The BCR cell showing negative sign (-) indicates a negative capital cost. 2.) The very high BCR recorded in the table reflects a case where the net capital costs were very small. Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 31. Large Hospital Archetype (C9A) Stringency 1 optimised results

CZ	NCC 2022Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	1,039	0	872	0%	16%	16%	33.76
2	25	491	24	455	2%	7%	7%	-
3	109	571	68	494	37%	14%	18%	-
4	136	448	155	426	-14%	5%	0%	-
5	12	479	17	430	-43%	10%	9%	-
6	67	381	84	368	-25%	3%	-1%	-
7	204	396	213	381	-4%	4%	1%	-
8	400	358	441	352	-10%	2%	-5%	-0.19

Note: 1.) The "Gas (%)" cells showing negative sign (-) indicate an increase in gas use, 2.) The BCR cells showing negative signs (-) indicate negative capital costs, 3.) The large change in gas consumption for climate zone 3 is caused by the introduction of heat recovery as part of the indirect evaporative cooling measures added in the optimisation process, 4.) The negative BCR reflects negative saving and a positive capital cost. 5.) Energy use is annual. 5) GHG emissions are for the 50-year operational lifetime of the building.

Table 32. Small Hospital Archetype (C9AS) Stringency 1 final optimised results

CZ	NCC 2022Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	276	0	233	0%	16%	16%	-
2	0	155	0	114	0%	27%	27%	-
3	0	178	0	145	0%	18%	18%	-
4	0	141	0	116	0%	18%	18%	-
5	0	116	0	89	0%	23%	23%	-
6	0	114	0	83	0%	27%	27%	-
7	0	146	0	123	0%	16%	16%	-
8	0	192	0	159	0%	17%	17%	2.92

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50 year operational lifetime of the building.

Table 33. Small Motel Archetype (C5OS) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	63	0	50	0%	21%	21%	-
2	0	37	0	33	0%	11%	11%	-
3	0	48	0	36	0%	25%	25%	-
4	0	35	0	28	0%	20%	20%	-
5	0	29	0	22	0%	23%	23%	-
6	0	27	0	21	0%	22%	22%	-
7	0	32	0	27	0%	18%	18%	-
8	0	40	0	31	0%	22%	22%	-

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 2) GHG emissions are for the 50 year operational lifetime of the building.

Table 34. School Classroom Archetype (C6RS) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	392	0	267	0%	32%	32%	-
2	0	260	0	177	0%	32%	32%	-
3	0	320	0	200	0%	38%	38%	-
4	0	234	0	162	0%	30%	30%	-
5	0	207	0	143	0%	31%	31%	-
6	0	182	0	138	0%	24%	24%	15.76
7	0	199	0	156	0%	22%	22%	11.49
8	0	228	0	189	0%	17%	17%	6.41

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 2) GHG emissions are for the 50 year operational lifetime of the building.

Table 35. Large Retail Archetype (C6RL) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	364	0	275	0%	24%	24%	8.91
2	0	232	0	167	0%	28%	28%	-
3	0	303	0	205	0%	32%	32%	809.42
4	0	217	0	174	0%	20%	20%	3.35
5	0	189	0	143	0%	25%	25%	81.59
6	0	171	0	148	0%	13%	13%	2.18
7	0	212	0	167	0%	21%	21%	5.63
8	0	254	0	213	0%	16%	16%	1.68

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs, 2.) The very high BCR recorded in the table reflects a case where the net capital costs were very small. 3) Energy use is annual. 4) GHG emissions are for the 50 year operational lifetime of the building.

Table 36. Small Motel Archetype (C3HS) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	214	0	162	0%	25%	25%	-
2	0	108	0	88	0%	18%	18%	-
3	0	139	0	114	0%	18%	18%	-
4	0	117	0	98	0%	16%	16%	-
5	0	92	0	71	0%	23%	23%	-
6	0	81	0	69	0%	14%	14%	-
7	0	109	0	91	0%	16%	16%	-
8	0	135	0	120	0%	11%	11%	-

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50 year operational lifetime of the building.

Table 37. Large Hotel Archetype (C3HL) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	1,100	0	951	0%	14%	14%	-
2	30	578	43	465	-44%	20%	16%	-
3	134	657	150	543	-12%	17%	12%	-
4	368	453	398	396	-8%	13%	3%	-
5	76	472	101	384	-33%	19%	11%	-
6	242	386	297	333	-23%	14%	-1%	-
7	488	397	548	336	-12%	15%	0%	-
8	882	328	975	303	-11%	7%	-6%	-0.16

Note: 1.) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use, 2.) The BCR cells showing negative signs (-) indicate negative capital costs. 3) Energy use is annual. 4) GHG emissions are for the 50 year operational lifetime of the building.

Table 38. School Classroom Archetype (C9B) Stringency 1 final optimised results

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Optimised Gas (MWh)	Optimised Elec (MWh)	Optimised Gas (%)	Optimised Elec (%)	Optimised GHG (%)	Optimised BCR
1	0	297	0	244	0%	18%	18%	-
2	0	176	0	135	0%	23%	23%	-
3	0	201	0	158	0%	22%	22%	-
4	0	147	0	120	0%	19%	19%	-
5	0	130	0	101	0%	22%	22%	-
6	0	106	0	85	0%	20%	20%	-
7	0	132	0	109	0%	18%	18%	-
8	0	178	0	153	0%	14%	14%	-

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50 year operational lifetime of the building.

1.7.2 Stringency 1 Commentary

The results for the Stringency 1 optimisation process show a minor improvement in stringency relative to the unoptimized (Iteration 1) results. Only moderate additional savings were achieved because, in most cases, the measures accepted from the initial measures analysis already captured all the available savings allowing for the availability of product in the market. Benefit-cost ratios are reduced in a number of cases but remain above the threshold of a BCR of 1, except for the large hospital (C9A) and large hotel (C3HL) in Climate Zone 8. These latter results have been ignored as not being material to results on a national level.

Negative capital costs arise in a number of cases. Two key factors were found to be driving reductions in capital costs, being:

a. The reduction in cooling plant size caused by the increased solar admittance stringency.
b. Reductions in insulation costs, primarily driven by the removal of some existing insulation requirements that were found either not to be delivering energy benefits or indeed to be driving increased energy use.

The large hospital and large hotel have significantly lower overall savings than the other archetypes. This is caused by the following effects:

1. The overall range and scale of measures applied to these archetypes were more limited than in other archetypes.
2. The solar admittance measure is better optimised for unitary air-conditioning systems than for gas heating systems. This leads to an increase in gas consumption and the cases of increased emissions.

The increases in gas consumption recorded for the large office archetype are due to the solar admittance effects described above, although for climate zones 5 and 6 the gas consumption comprises only a small component of the total emissions.

1.7.3 Stringency 1 Updated Measures

Based on the results of the Stringency 1 optimisation, the following changes are recommended to the originally proposed Stringency 1 measures from the Initial Measures stage of the project.

Based on the results above the modifications required to reflect the Stringency 1 optimisation process are as follows:

Table 39. Table J6 D3 modified to reflect the outcomes of the optimisation process (CZ6) and the initial measures (CZ8)

Climate zone	Total air flow rate *requiring* an economy cycle (L/s)
2	9000
3	7500
4	3500
5	3000
6	~~2000~~ 1200
7	2500
8	~~4000~~ 2000

Table 40. Table J6D4 modified to reflect the outcomes of the optimisation process.

Climate zone	*Outdoor air* flow (L/s)	*Required* measure – variable flow outside air systems	Required measure – constant flow outside air systems
1	~~>500~~ >120	Modulating control	**n/a**
	>2000	Modulating control	**Indirect evaporative cooling system**
2	~~Not applicable~~ >400	Modulating control	**n/a**
3	~~>1000~~ >400	Modulating control	**n/a**
	>2000	Modulating control	**Indirect evaporative cooling system**
4 ~~**and 6**~~	~~>500~~ >400	Modulating control ~~or energy reclaiming system~~	**n/a**
4	>500	Modulating control	**Energy reclaiming system**
5	~~>1000~~ >400	Modulating control ~~or energy reclaiming system~~	**n/a**
5	>1000	Modulating control	**Energy reclaiming system**
6	>500	Modulating control	**Energy reclaiming system**
7 ~~**and 8**~~	>250	Modulating control ~~or energy reclaiming system~~	**Energy reclaiming system**
8	>100	Modulating control	**n/a**
8	**>250**	**Modulating control**	**Energy reclaiming system**

Stringency 2 – Cost Benefit Optimisation with PV

1.8 Simulations

For the Stringency 2 scenarios, PV was added to the building rooftop in each NCC 2025 test case, in addition to the NCC 2025 stringency changes modelled under the Stringency 1 optimised scenarios. The thermal simulation results from Stringency 1 were reused for this analysis. PV systems were sized according to the draft NCC 2025 Deemed-to-Satisfy Provisions. That is, effectively the entire available roof space for each archetype was installed with PV up to a limit prescribed by the W_p/m^2 figure, which was a simplification developed to approximate a 50% export to total energy generated as per the draft provisions. See Appendix A.II for a detailed description on methodology and calculation. To carry out this modelling, the following methodology was followed:

- A 100 kW PV array was simulated across 8 climate zones in IES<VE> to obtain one year of hourly PV generation data.
- The simulated generation data was scaled based on the final initial measures recommendations (which was tabulated for use in code) to obtain a generation profile specific to each archetype and climate zone.
- PV generation profiles were overlaid against NCC 2025 total building electricity consumption profiles (hourly basis) to determine self-consumption and export quantities for operational expenditure calculations for each assessment case.
- The total building electricity includes all regulated energy plus the non-regulated equipment end use.
    - Regulated:
        - All HVAC cooling, heating (if electric), pumping and fan energy (the mix is dependent on the archetype's HVAC system type)
        - Lighting
        - Equipment
    - Non-regulated: It consists of mix of equipment based on each archetype

1.9 Cost Benefit Analysis

The cost-benefit analysis for Stringency 2 followed the same process as for Stringency 1, with only the following changes to each final optimised test case scenario (base case unchanged):

- PV system production was mapped to building simulation hourly output to calculate revised electricity use (gas remained unchanged):
    - Resultant grid electricity consumption and associated operating expense were reduced due to onsite generation.
    - Electricity export was added as a (negative) operating expense using the decreasing feed-in tariff pricing presented in Table 399.
    - Exported electricity was excluded from the main GHG savings calculations.
- PV system capital costs were added to the replacement capital expenditure, with the same assumed 20-year lifespan as for the HVAC plant.
- Yearly PV maintenance costs were added to operational expenses.

The results of the Stringency 2 analysis for all ten archetypes are summarised in Table 41 to Table 50 below. Electricity values shown in these tables are regulated grid electricity excluding lifts and domestic hot water (DHW). Gas and electricity savings are reported based on Y1 savings, and GHG savings are calculated across 50 years. Both the NCC 2022 base case and NCC 2025tst cases are assumed to maintain the same plant types for the full 50 years. Refer Table 105. Stringency 2 and 3 Rooftop PV System Sizes and Generation for further details on solar generation, export and on-site use of electricity.

1.10 Results

Table 41. Large Office Archetype (C5OL) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	899	0	640	0%	29%	29%	2.87
2	7	558	7	345	4%	38%	38%	2.30
3	39	559	33	330	16%	41%	39%	2.52
4	152	412	149	234	2%	43%	31%	3.96
5	22	500	23	301	-4%	40%	38%	3.01
6	83	343	86	204	-4%	40%	31%	2.95
7	228	353	221	208	3%	41%	25%	2.91
8	480	316	525	177	-9%	44%	11%	2.97

Note: 1) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 42. Medium Office Archetype (C5OM) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	230	0	64	0%	72%	72%	4.10
2	0	146	0	7	0%	95%	95%	3.78
3	0	184	0	11	0%	94%	94%	6.58
4	0	129	0	0	0%	100%	100%	4.37
5	0	117	0	0	0%	100%	100%	3.82
6	0	98	0	-5	0%	105%	105%	2.81
7	0	107	0	-2	0%	102%	102%	3.35
8	0	128	0	27	0%	79%	79%	2.53

Note: 1) The BCR cells showing negative signs (-) indicates negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 43. Large Hospital Archetype (C9A) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	1,039	0	780	0%	25%	25%	10.37
2	25	491	24	364	2%	26%	25%	-
3	109	571	68	400	37%	30%	31%	10.58
4	136	448	155	338	-14%	25%	15%	-
5	12	479	17	338	-43%	29%	28%	-
6	67	381	84	298	-25%	22%	14%	-
7	204	396	213	301	-4%	24%	14%	-
8	400	358	441	279	-10%	22%	4%	-

Note: 1.) The “Gas (%)” cells showing negative sign (-) indicate an increase in gas use. 2.) The BCR cells showing negative signs (-) indicates negative capital costs. 3.) The negative BCR reflects a negative savings and positive capital cost. 4) Energy use is annual. 5) GHG emissions are for the 50-year operational lifetime of the building.

Table 44. Small Hospital Archetype (C9AS) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR

1	0	276	0	105	0%	62%	62%	4.08
2	0	155	0	37	0%	76%	76%	6.80
3	0	178	0	61	0%	66%	66%	8.38
4	0	141	0	50	0%	64%	64%	5.92
5	0	116	0	26	0%	77%	77%	3.88
6	0	114	0	26	0%	77%	77%	-
7	0	146	0	58	0%	60%	60%	3.54
8	0	192	0	103	0%	46%	46%	2.43

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 45. Small Office Archetype (C5OS) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	63	0	22	0%	65%	65%	6.19
2	0	37	0	6	0%	85%	85%	5.05
3	0	48	0	6	0%	87%	87%	7.23
4	0	35	0	3	0%	90%	90%	5.4
5	0	29	0	0	0%	100%	100%	4.4
6	0	27	0	0	0%	99%	99%	5.0
7	0	32	0	3	0%	89%	89%	3.7
8	0	40	0	11	0%	72%	72%	3.8

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 46. Retail Strip Archetype (C6RS) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	392	0	138	0%	65%	65%	10.54
2	0	260	0	73	0%	72%	72%	8.43
3	0	320	0	85	0%	73%	73%	17.31
4	0	234	0	69	0%	70%	70%	8.67
5	0	207	0	59	0%	72%	72%	7.09
6	0	182	0	63	0%	66%	66%	4.55
7	0	199	0	70	0%	65%	65%	4.71
8	0	228	0	120	0%	48%	48%	4.05

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50 year operational lifetime of the building. 4) Energy use is annual. 4) GHG emissions are for the 50-year operational lifetime of the building.

Table 47. Large Retail Archetype (C6RL) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	364	0	186	0%	49%	49%	5.86
2	0	232	0	79	0%	66%	66%	8.35
3	0	303	0	107	0%	65%	65%	10.04
4	0	217	0	92	0%	58%	58%	3.64
5	0	189	0	70	0%	63%	63%	5.87
6	0	171	0	81	0%	52%	52%	2.79
7	0	212	0	91	0%	57%	57%	4.25
8	0	254	0	142	0%	44%	44%	2.38

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 48. Small Motel Archetype (C3HS) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	214	0	120	0%	44%	44%	-
2	0	108	0	58	0%	46%	46%	7.66
3	0	139	0	80	0%	43%	43%	7.04
4	0	117	0	72	0%	39%	39%	5.73
5	0	92	0	47	0%	49%	49%	12.36
6	0	81	0	47	0%	43%	43%	4.34
7	0	109	0	67	0%	38%	38%	4.60
8	0	135	0	96	0%	29%	29%	6.22

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

Table 49. Large Hotel Archetype (C3HL) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	1,100	0	905	0%	18%	18%	-
2	30	578	43	423	-44%	27%	23%	-
3	134	657	150	503	-12%	23%	17%	-
4	368	453	398	357	-8%	21%	7%	-
5	76	472	101	344	-33%	27%	18%	-
6	242	386	297	299	-23%	23%	4%	-
7	488	397	548	305	-12%	23%	3%	-
8	882	328	975	275	-11%	16%	-4%	-

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50 year operational lifetime of the building.

Table 50. School Classroom Archetype (C9B) Stringency 2 Results Summary

CZ	NCC 2022 Gas (MWh)	NCC 2022 Elec (MWh)	Stringency 2 Gas (MWh)	Stringency 2 Elec (MWh)	Stringency 2 Gas (%)	Stringency 2 Elec (%)	Stringency 2 GHG (%)	Stringency 2 BCR
1	0	297	0	146	0%	51%	51%	6.72
2	0	176	0	41	0%	77%	77%	9.28
3	0	201	0	57	0%	71%	71%	6.84
4	0	147	0	40	0%	73%	73%	4.82
5	0	130	0	28	0%	78%	78%	4.66
6	0	106	0	23	0%	79%	79%	3.41
7	0	132	0	37	0%	72%	72%	3.83
8	0	178	0	93	0%	48%	48%	3.35

Note: 1) The BCR cells showing negative signs (-) indicate negative capital costs. 2) Energy use is annual. 3) GHG emissions are for the 50-year operational lifetime of the building.

1.11 Stringency 2 Interpretation

The results show that the additional requirement of rooftop PV generates a significant further reduction in electricity use and greenhouse gas emissions in all cases. The impact is particularly pronounced for the low-rise archetypes, due to the high amount of roof area available per unit floor area, but is significant nonetheless for the high-rise archetypes. This includes creating a positive greenhouse gas saving and financial outcomes in all cases bar the large hotel in Climate Zone 8, reversing almost all of the negative stringency 1 results.

It is noted that in all cases other than the small hospital (C9AS), the size of the PV array was limited by the available roof space rather than the export limitation.

Stringency 3 – Cost Benefit Optimisation with Electrification

The objective of Stringency 3 is to achieve least cost, zero carbon ready buildings. To achieve this, it is assumed that electrification is not a requirement, but that for buildings with fossil fuel use, the Code should deliver an equivalent greenhouse gas position outcome to an all-electric building across the first 14 years.

The base case is an NCC 2022 compliant building that does not change its fuel mix in the 50-year analysis period, reflecting the definition of Stringency 3. Analyses against this case are covered under Scenarios 1-4 (described below).

As an alternative, if we assume that electrification is inevitable (regardless of the NCC), then the base case becomes an NCC 2022 compliant building that at some stage in the future (taken to be 15 years, as a notional midpoint between market-driven electrification at 10 years and end-of-life electrification at 20 years) will be forced to electrify. This is covered under Scenarios 5-8 of the analysis.

Note that as Stringency 3 is testing electrification and electrification equivalence scenarios, the NCC 2025 versions of buildings all assume electrification at either year 15 (Scenarios 1-3, 5-7) or year zero (Scenarios 4, 8). For the case where no change in fuel mix occurs in the NCC 2025 scenarios, refer to the stringency 1 and 2 results.

Scenario definitions are provided below. Note that Scenario 1 is effectively the central analysis case reflecting the definition of Stringency 3. Other scenarios are subcases used to understand the broader context of the Stringency 3 definition.

- Scenarios 1 and 5: Additional costs are incurred for initial construction to ready the building for future electrification. This increases initial capital costs but lowers future electrification costs. Additionally, for buildings using gas, additional PV (beyond that specified in Stringency 2, modelled as ground mounted) is specified in order to displace grid-sourced electricity emissions approximately equal to the difference in emissions between a dual-fuel building and its all-electric equivalent (across the first 14 years). Grid electricity emissions are displaced by a combination of self-consumption of on-site generation and export of the PV generated on-site.
- Scenarios 2 and 6: No preparation is made in initial construction to ready the building for future electrification. This defers electrification costs wholly to the future, at the expense of higher costs at that time relative to Scenarios 1 and 5. As with Scenarios 1 and 5, additional PV (beyond that specified in Stringency 2, modelled as ground mounted) is specified in order to create a reduction in national electricity demand with an emissions value that approximates the difference in emissions between the dual fuel building and its all-electric equivalent across the first 14 years.
- Scenarios 3 and 7: As per Scenarios 1 and 5 but with no additional PV beyond that specified in Stringency 2. These cases test the impact and materiality of the additional PV relative to Scenarios 1 and 5.
- Scenarios 4 and 8: Building electrified from day one, with no additional PV beyond that specified in Stringency 2. These cases test the impact of an immediate code requirement for electrification.

The assessment for Stringency 3 has an expanded energy scope relative to Stringency 2, in that calculations also include energy use of domestic hot water plant. As a simplifying assumption, only the three archetypes with gas space heating (large hotel (C3HL), large office (C5OL), and large hospital (C9A)) were assessed, effectively assuming that the remaining archetypes would use electric domestic hot water. Lift energy use was not modelled in any scenarios but is a constant between NCC 2022 and NCC 2025.

1.12 Simulations

For the Stringency 3 scenarios, electrification measures were applied to each 2025 test case, in addition to the 2025 stringency changes modelled under the Stringency 1 optimised scenarios. Base case C5OL, C9A and C3HL models were otherwise as described in Section 1.2.

Electrification measures that were considered within this scope only covers HVAC and domestic hot water systems. In reality, some buildings such as hotels or retail may have cooking that is gas-based. As cooking appliances are not regulated under Section J, we have not considered the cooking electrification measures for this analysis.

1.12.1 HVAC Electrification Measures

The electrification measures for the HVAC services of C5OL, C9A and C3HL were dependent on archetype and are described in this subsection. Generally, the assessment that leads to the design decision of selecting direct electric vs hydronic heating types is one of balancing capital cost vs operational lifecycle costs. While direct electric heating is generally lower in up front cost, the operational costs can be much higher if any moderate to high annual heating intensity is required (due to location specific weather patterns). As a result, the preferred design approach is split depending on heating intensity for the climate zone. Climate zones 1, 2 and 5 use direct electric heating with the remainder using hydronic (air-sourced heat pumps). This approach stands for all new builds and most retrofit applications, except where the retrofit scenario consists of sufficient complexity to not justify the conversion of hydronic to direct electric heating (noting that all climate zones use gas-fired heating in the base case models, for C5OL, C9A and C3HL). This is particularly applicable to the C9A and C3HL archetypes, where hydronic heating is via distributed fan coil units. The retrofit and new build cases are distinct for these cases because the complexity involved in reality means the retrofit solution would lead to different outcomes. C9A has predominantly distributed FCUs for heating - if the building already has this hydronic (heating water pipework and coil) infrastructure, then it's most likely that a retrofit solution would use this and upgrade to a heat pump rather than carry out more extensive works on site to add electric duct heaters. For a new build, it's much easier to add electric duct heaters within the building.

C5OL

- CZ1, CZ2 & CZ5
    - Cooling: 2-off water-cooled chillers
    - Heating: electric duct heaters
- CZ3, CZ4 & CZ6
    - Cooling: 2-off water-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
- CZ7:

  - Cooling: 1-off water-cooled chillers and 2-off air-sourced heat pumps
  - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
- CZ8:
  - Cooling: 2-off air-sourced heat pumps
  - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)

C9A

- CZ1 & CZ2
  - Retrofit (planned and unplanned)
    - Cooling: 2-off air-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
  - New Build (day 1 electrification)
    - Cooling: 2-off air-cooled chillers
    - Heating: electric duct heaters
- CZ5
  - Retrofit (planned and unplanned)
    - Cooling: 1-off air-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
  - New Build (day 1 electrification)
    - Cooling: 2-off air-cooled chillers
    - Heating: electric heaters
- CZ3, CZ4 & CZ6:
    - Cooling: 1-off air-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
- CZ7 & CZ8:
    - Cooling: 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)

C3HL

- CZ1, CZ2 & CZ5
  - Retrofit (planned and unplanned)
    - Cooling: 2-off air-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
  - New Build (day 1 electrification)
    - Cooling: 2-off air-cooled chillers
    - Heating: electric heaters
- CZ3, CZ4, CZ6 & CZ7:
    - Cooling: 1-off air-cooled chillers and 2-off air-sourced heat pumps
    - Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)
- CZ8:

- Cooling: 2-off air-sourced heat pumps
- Heating: 2-off air-sourced heat pumps (the same heat pumps which provide cooling)

1.12.2 DHW Electrification Measures

The systems selected for the electrification of DHW systems were carried out using methods described by CIBSE Guide G to obtain demand requirements for the different archetypes. As noted previously, the DHW electrification analysis only applied to archetypes C5OL, C9A and C3HL as DHW systems were assumed to be electric if there are no other gas consuming appliances on site. The maximum hot water demand figures in combination with the anticipated demand duration/profile shapes and ambient climatic conditions were applied to generate a DHW plant with varying capacities and combination of the following equipment:

- Air-sourced heat pump – primary heat source for DHW.
- Electric element storage tanks – to provide consumption buffer and additional boost at times of high demand and/or low ambient temperatures.
- Additional storage – to provide additional consumption buffer.

Energy consumption for DHW systems was calculated by estimating hot water consumption using the Green Building Council of Australia's Potable Water Calculator (v16_r6). The water consumption estimates were then input to the energy consumption model which used the ambient and average water temperatures specified by AS/NZS 4234 and applied to a combination of heat pump (efficiency/ Cofficient of Performance (COP) modified dependent on average ambient temperatures) and direct electric systems to obtain an average plant efficiency. The direct electric system is external to the heat pump and these systems control in coordination to give preference to the heat pump but use direct electric heating when heat pump capacity is insufficient. This is especially relevant in colder climates where ambient air and inlet cold water temperatures reduce heat pump capacity and efficiency. In these cases, more direct electric heating capacity is required to boost and supplement the heat pumps to manage peak DHW demands at the coldest times of the year. The system designs describing these separate components are detailed under the archetype sub-headings below. Calculated DHW energy use for both gas and electric systems is shown in Table 51 below. Gas heating was assumed to be 80% efficient. Heat pump COPs are as show in the table.

Table 51. DHW Energy Consumption Results

Arche-type	CZ	AS/NZS 4234 CZ	kL/year (per GBCA Calculator)	CW makeup temp (°C)	Gas Energy (MJ/year)	Heat Pump COP	Heat pump proportion	Electric Energy (kWh/yr)
C5OL	**1**	**1**	339	24.8	53,577	4.2	100%	2,835
C5OL	**2**	**3**	339	17.7	68,834	3.5	75%	7,102
C5OL	**3**	**2**	339	20.1	63,690	4.2	100%	3,370
C5OL	**4**	**3**	339	17.7	68,834	3.5	75%	7,102
C5OL	**5**	**3**	339	17.7	68,834	3.5	75%	7,102
C5OL	**6**	**4**	339	14.5	75,576	3.5	75%	7,798
C5OL	**7**	**5**	339	12.1	80,721	3.2	50%	11,772
C5OL	**8**	**5**	339	12.1	80,721	3.2	50%	11,772
C9A	**1**	**1**	2952	24.8	373,848	4.2	100%	19,780
C9A	**2**	**3**	2952	17.7	506,703	3.5	75%	52,279
C9A	**3**	**2**	2952	20.1	461,903	4.2	100%	24,439

Arche-type	CZ	AS/NZS 4234 CZ	kL/year (per GBCA Calculator)	CW makeup temp (°C)	Gas Energy (MJ/year)	Heat Pump COP	Heat pump proportion	Electric Energy (kWh/yr)
C9A	**4**	**3**	2952	17.7	506,703	3.5	75%	52,279
C9A	**5**	**3**	2952	17.7	506,703	3.5	75%	52,279
C9A	**6**	**4**	2952	14.5	565,406	3.5	75%	58,336
C9A	**7**	**5**	2952	12.1	610,206	3.2	50%	88,988
C9A	**8**	**5**	2952	12.1	610,206	3.2	50%	88,988
C3HL	**1**	**1**	4846	24.8	766,003	4.2	100%	40,529
C3HL	**2**	**3**	4846	17.7	984,136	3.5	75%	101,538
C3HL	**3**	**2**	4846	20.1	910,579	4.2	100%	48,179
C3HL	**4**	**3**	4846	17.7	984,136	3.5	75%	101,538
C3HL	**5**	**3**	4846	17.7	984,136	3.5	75%	101,538
C3HL	**6**	**4**	4846	14.5	1,080,520	3.5	75%	111,482
C3HL	**7**	**5**	4846	12.1	1,154,077	3.2	50%	168,303
C3HL	**8**	**5**	4846	12.1	1,154,077	3.2	50%	168,303

The electrification measures for the DHW services of C5OL, C9A and C3HL were as follows:

C5OL

- CZ1, CZ3
  - 2-off 35 kW air-sourced heat pumps
  - 2,000 L insulated storage tank
- CZ2, CZ4, CZ5 & CZ6
  - 2-off 35 kW air-sourced heat pumps
  - 1-off 315 L 6-element storage tank
  - 2,000 L insulated storage tank
- CZ7 & CZ8:
  - 2-off 35 kW air-sourced heat pumps
  - 2-off 315 L 6-element storage tank
  - 2,000 L insulated storage tank

C9A

- CZ1, CZ3
  - 3-off 35 kW air-sourced heat pumps
  - 3-off 315 L 6-element storage tank
  - 4-off 2,000 L insulated storage tank
- CZ2, CZ4, CZ5 & CZ6
  - 4-off 35 kW air-sourced heat pumps
  - 3-off 315 L 6-element storage tank
  - 4-off 2,000 L insulated storage tank
- CZ7 & CZ8:
  - 4-off 35 kW air-sourced heat pumps
  - 4-off 315 L 6-element storage tank

-
  - 4-off 2,000 L insulated storage tank

C3HL

- CZ1, CZ3
  - 3-off 35 kW air-sourced heat pumps
  - 2-off 315 L 6-element storage tank
  - 2-off 2,000 L insulated storage tank
- CZ2, CZ4, CZ5 & CZ6
  - 4-off 35 kW air-sourced heat pumps
  - 2-off 315 L 6-element storage tank
  - 2-off 2,000 L insulated storage tank
- CZ7 & CZ8:
  - 4-off 35 kW air-sourced heat pumps
  - 3-off 315 L 6-element storage tank
  - 3-off 2,000 L insulated storage tank

1.13 Cost Benefit Analysis

The cost benefit analysis for stringency 3 followed the same process as for Stringency 1 & 2, with adjustments to the existing pricing models (described under the Stringency 1 and 2 methodologies) comprised of:

- Ground-based PV (in addition to rooftop PV specified under Stringency 2) sized to offset gas emissions. The calculations only include the cost of PV, not the cost of land.
- Use of revised energy simulation results defining different periods of building operation (prior to and following electrification).
- Manual calculation of energy consumption for gas and electric DHW systems.
- Calculation of the following capital expenditure in addition to costs calculated under Stringencies 1 and 2.
  - Calculation of electrical works including substation upgrades (which was combined across HVAC and DHW uses).
  - Calculation of new cost of electric heat pump space heating plant, where applicable, to be replaced every 20 years following installation.
  - Calculation of new cost of smaller chilled water plant (due to provision of some CHW by heat pump plant), to be installed every 20 years post retrofit (following its own replacement schedule).
  - Retaining existing costs of one-off HVAC equipment (specific pipework ductwork etc assumed to be compatible with new system).
  - Calculating new gas and electric DHW systems, to be replaced every 20 years following installation.

Stringency 3 pricing assumptions and methodology are presented in Appendix C.V and Appendix C.VI.

Assumptions:

- Electrification took place in year 15, with gas plant assumed to have no economic value following the retrofit.

- Following a retrofit at year 15, replacement of heating and cooling HVAC systems was assumed to be replaced at different times, following the same 20-year plant life established in Stringencies 1 & 2.

1.14 Stringency 3 results

Summarised results for Stringency 3 are presented in Table 52 to Table 57 below. In each case, GHG savings and BCRs are calculated across the whole analysis timeframe. Refer to Appendix B for detailed Stringency 3 simulation and modelling results and Appendix D.III for detailed BCR results. In the tables, the bracketed figures include an offset GHG and carbon cost allowance for exported electricity, which is excluded from all other calculations. Greenhouse gas savings are calculated on a 50-year basis.

Table 52. Large Office (C5OL) Stringency 3 BCR Results Summary.

C5OL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	BCR	BCR	BCR	BCR	BCR	BCR	BCR	BCR
1	**3.23 (3.24)**	3.22 (3.23)	3.23 (3.24)	2.79 (2.79)	4.76 (4.77)	4.76 (4.77)	4.76 (4.77)	4.68 (4.69)
2	**3.32 (3.32)**	2.19 (2.20)	3.32 (3.32)	2.48 (2.49)	- (-)	6.54 (6.54)	- (-)	23.29 (23.32)
3	**1.87 (1.87)**	1.42 (1.42)	1.87 (1.87)	1.78 (1.78)	- (-)	7.76 (7.77)	- (-)	- (-)
4	**2.02 (2.04)**	1.47 (1.49)	1.87 (1.88)	1.64 (1.65)	- (-)	18.96 (19.13)	- (-)	- (-)
5	**4.89 (4.91)**	2.67 (2.68)	4.89 (4.91)	2.93 (2.94)	- (-)	36.86 (36.98)	- (-)	- (-)
6	**1.44 (1.45)**	1.07 (1.07)	1.31 (1.31)	1.07 (1.08)	- (-)	10.97 (11.02)	- (-)	158.73 (158.94)
7	**1.70 (1.71)**	1.25 (1.26)	1.46 (1.46)	1.23 (1.23)	- (-)	- (-)	- (-)	- (-)
8	**1.61 (1.66)**	1.24 (1.27)	1.08 (1.08)	0.47 (0.47)	- (-)	- (-)	- (-)	4.37 (4.39)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 53. Large Hospital (C9A) Stringency 3 BCR Results Summary.

C9A	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	BCR	BCR	BCR	BCR	BCR	BCR	BCR	BCR
1	**6.47 (6.47)**	3.90 (3.90)	5.68 (5.68)	6.57 (6.57)	- (-)	- (-)	- (-)	- (-)
2	**2.47 (2.47)**	1.17 (1.17)	2.28 (2.28)	0.77 (0.77)	- (-)	- (-)	- (-)	6.10 (6.10)
3	**11.72 (11.73)**	3.77 (3.77)	9.85 (9.85)	- (-)	- (-)	- (-)	- (-)	- (-)
4	**2.97 (2.98)**	1.63 (1.63)	2.37 (2.37)	1.87 (1.87)	- (-)	- (-)	- (-)	- (-)
5	**2.42 (2.42)**	1.20 (1.20)	2.27 (2.27)	0.89 (0.89)	- (-)	- (-)	- (-)	- (-)
6	**2.64 (2.65)**	1.41 (1.42)	2.12 (2.12)	1.45 (1.45)	- (-)	- (-)	- (-)	- (-)
7	**2.93 (2.93)**	1.39 (1.39)	2.67 (2.67)	1.10 (1.10)	- (-)	- (-)	- (-)	- (-)
8	**1.76 (1.76)**	0.63 (0.63)	1.76 (1.76)	-0.87 (-0.87)	- (-)	- (-)	- (-)	-0.15 (-0.15)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 54. Large Hotel (C3HL) Stringency 3 BCR Results Summary.

C3HL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	BCR	BCR	BCR	BCR	BCR	BCR	BCR	BCR
1	**- (-)**	12.03 (12.03)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
2	**95.97 (95.97)**	6.20 (6.20)	91.64 (91.64)	3.37 (3.37)	- (-)	- (-)	- (-)	- (-)
3	**- (-)**	27.32 (27.33)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
4	**6.63 (6.64)**	3.07 (3.08)	5.78 (5.78)	5.45 (5.45)	- (-)	- (-)	- (-)	- (-)
5	**11.38 (11.38)**	3.85 (3.85)	10.91 (10.91)	2.36 (2.36)	- (-)	- (-)	- (-)	- (-)
6	**5.98 (5.99)**	2.82 (2.83)	5.30 (5.30)	3.73 (3.73)	- (-)	- (-)	- (-)	- (-)
7	**11.49 (11.49)**	3.74 (3.74)	10.95 (10.95)	9.43 (9.43)	- (-)	- (-)	- (-)	- (-)
8	**- (-)**	3.26 (3.26)	- (-)	1.90 (1.90)	- (-)	- (-)	- (-)	- (-)

Note: 1.) values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) The BCR cells showing negative sign (-) indicate a negative capital cost. 3.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 55. Large Office (C5OL) Stringency 3 GHG % savings relative to base case.

C5OL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**29% (30%)**	29% (30%)	29% (30%)	29% (30%)	29% (29%)	29% (29%)	29% (29%)	29% (29%)
2	**38% (39%)**	38% (39%)	38% (39%)	38% (38%)	38% (38%)	38% (38%)	38% (38%)	38% (38%)
3	**41% (42%)**	41% (42%)	41% (42%)	40% (40%)	39% (39%)	39% (39%)	39% (39%)	37% (37%)
4	**50% (51%)**	50% (51%)	47% (48%)	49% (50%)	40% (41%)	40% (41%)	37% (37%)	39% (40%)
5	**40% (40%)**	40% (40%)	40% (40%)	38% (39%)	38% (39%)	38% (39%)	38% (39%)	38% (38%)
6	**47% (47%)**	47% (47%)	43% (44%)	44% (44%)	39% (40%)	39% (40%)	35% (35%)	37% (37%)
7	**52% (53%)**	52% (53%)	48% (48%)	50% (50%)	38% (39%)	38% (39%)	32% (32%)	36% (36%)
8	**57% (59%)**	57% (59%)	50% (50%)	55% (55%)	34% (37%)	34% (37%)	22% (23%)	31% (31%)

Note: 1.) Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 56. Large Hospital (C9A) Stringency 3 GHG % savings relative to base case.

C9A	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**32% (32%)**	32% (32%)	28% (28%)	29% (29%)	29% (29%)	29% (29%)	25% (25%)	25% (25%)
2	**34% (34%)**	34% (34%)	32% (32%)	27% (27%)	29% (29%)	29% (29%)	26% (26%)	23% (23%)
3	**47% (47%)**	47% (47%)	41% (41%)	43% (43%)	37% (37%)	37% (37%)	30% (30%)	30% (30%)
4	**39% (39%)**	39% (39%)	34% (34%)	33% (33%)	27% (27%)	27% (27%)	19% (19%)	21% (21%)
5	**36% (36%)**	36% (36%)	34% (34%)	29% (29%)	31% (31%)	31% (31%)	28% (28%)	26% (26%)
6	**37% (37%)**	37% (37%)	31% (31%)	30% (30%)	26% (27%)	26% (27%)	18% (18%)	21% (21%)
7	**36% (36%)**	36% (36%)	34% (34%)	28% (28%)	21% (21%)	21% (21%)	18% (18%)	19% (19%)
8	**36% (36%)**	36% (36%)	36% (36%)	30% (30%)	10% (10%)	10% (10%)	10% (10%)	11% (11%)

Note: 1). Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

Table 57. Large Hotel (C3HL) Stringency 3 GHG % savings relative to base case.

C3HL	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Base Case	**Original**	Original	Original	Original	Y15 Electrified	Y15 Electrified	Y15 Electrified	Y15 Electrified
Test Case Electrification	**Planned**	Unplanned	Planned	Day one	Planned	Unplanned	Planned	Day one
Test Case Electrification Date	**After 15 Years**	After 15 Years	After 15 Years	Day One	After 15 Years	After 15 Years	After 15 Years	Day one
PV	**Expanded**	Expanded	Rooftop Only	Rooftop Only	Expanded	Expanded	Rooftop Only	Rooftop Only
CZ	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)	GHG (%)
1	**27% (27%)**	27% (27%)	25% (25%)	26% (26%)	21% (21%)	21% (21%)	18% (18%)	18% (18%)
2	**35% (35%)**	35% (35%)	34% (34%)	31% (31%)	26% (26%)	26% (26%)	24% (24%)	26% (26%)
3	**40% (40%)**	40% (40%)	36% (36%)	39% (39%)	25% (25%)	25% (25%)	19% (19%)	21% (21%)
4	**42% (42%)**	42% (42%)	39% (39%)	40% (40%)	18% (18%)	18% (18%)	13% (13%)	19% (19%)
5	**37% (37%)**	37% (37%)	36% (36%)	34% (34%)	25% (25%)	25% (25%)	22% (22%)	27% (27%)
6	**41% (41%)**	41% (41%)	38% (38%)	39% (39%)	18% (18%)	18% (18%)	13% (13%)	22% (22%)
7	**39% (39%)**	39% (39%)	38% (38%)	33% (33%)	12% (12%)	12% (12%)	10% (10%)	17% (17%)
8	**40% (40%)**	40% (40%)	40% (40%)	36% (36%)	3% (3%)	3% (3%)	3% (3%)	8% (8%)

Note: 1.) Values in ( ) indicate results with PV export treated as having negative emissions and a consequent carbon value saving, 2.) Scenario 1 is the core scenario with respect to the Stringency 3 definition.

1.14.1 Stringency 3 interpretation

Scenarios 1-4: no electrification in base case

Assessments in these scenarios can be characterised as answering the question as to whether the total package of measures including provisions that facilitate electrification is economic. This in effect uses the efficiency measures to help pay for electrification measures.

A number of features can be seen in the data tables:

1. The strongest economic result is generally achieved from the inclusion of planned electrification in NCC 2025 along with expanded PV (Scenario 1, the core scenario).
2. The exclusion of planned electrification from NCC 2025 (Scenario 2) leads to poorer results than Scenario 1.
3. The limiting of PV to that required under Stringency 2 (Scenario 3) results in poorer but still positive economic result than for Scenario 1, which has additional PV. This reflects the loss of avoided electricity costs and potential feed-in tariff revenue arising from the additional PV in Scenario 1. However, the Stringency 2 level of PV may be considered more physically realistic. The climate zone 8 result for this scenario fails the BCR>1 test for the large hospital archetype. As noted previously, this is of limited materiality.
4. Overall greenhouse gas savings are considerably higher than for Stringency 2 for these archetypes for climates with significant heating load. While the inclusion of DHW in the calculations for this stringency limits the comparability of these figures, the dominant effect is the inclusion of electrification at Y15 in Scenarios 1-3 and at Year 1 in Scenario 4. The absence of emissions from gas use in Y15-50 is particularly important given the low electricity emissions intensity in this period.
5. While not a requirement of Stringency 3, immediate electrification is economic in all cases other than the large hospital and large office in Climate zone 8.
6. Emissions savings for Scenario 1 are greater than for Scenario 4 for two reasons:
    a. Scenario 1 often has a greater amount of PV. The impact of this can be assessed by comparing emissions reductions for Scenario 1 to Scenario 3.
    b. In a number of cases, the dual fuel building has lower emissions in Y1-14 than the all-electric building. This can be seen by comparing the emissions reductions between scenario 3 and 4.
7. Inclusion or exclusion of assumed greenhouse benefits from PV export has a limited impact on results, indicating that the major benefits arise from on-site use.

Scenarios 5-8: base case electrification in 15 years

The economic results for these scenarios are similar but inevitably better than for the previous scenarios as the base case now includes the costs of future unprepared electrification. Only the large hospital in Climate Zone 8 does not produce BCR greater than 1.

However, the emissions reduction results are lower due to the removal of emissions from gas use in the base case in Y15-50; this also affects the relativity of emissions savings between scenarios, with scenario 8 (immediate electrification) being more favourable. This highlights the importance of the emissions in this later period in determining the higher emissions reductions identified for Scenarios 1-4.

Overall

Overall, the stringency 3 results indicate:

1. The core scenario (Scenario 1, planning for electrification and adding on-site generation to equalise Y1-14 emissions relative to an all-electric alternative) is economic in all cases.
2. Planned future electrification is economically beneficial relative to unplanned future electrification and no electrification.
3. The proposed requirement for dual-fuel buildings to provide additional on-site renewable energy generation (or equivalent) is cost-beneficial, albeit with practical limitations.
4. Immediate electrification (scenarios 4, 8) is also economically beneficial in almost all cases tested, although this is not a requirement of Stringency 3.

Appendix A Detailed Simulation Parameters

Appendix A.I Stringency 1 Simulation Parameters

Appendix A.I.I C5OL

- **WWR**: 56%
- **Glazing**:

Table 58. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
2	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
3	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
4	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
5	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
6	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
7	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
8	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17

Thermal bridging:

- NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with University of Wollongong (UoW) method[10] and then modelled as thermal bridge doors[11].
- NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.

- **Core area internal wall:**
  - NCC 2022 – Insulated
  - NCC 2025 – uninsulated

- **Wall**: R-Value modelled as per the table below.

Table 59. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	1	2.8
2	1	1
3	1	1.7
4	1	1.7
5	1	1
6	1	1.2
7	1	1.7
8	1	1

- **Roof:**
  Concrete roof with insulation on underside.
  Rooftop plant room: uninsulated

Table 60. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	3.7 (down)
2	3.7 (down)	3.7 (down)
3	3.7 (down)	3.7 (down)
4	3.7 (down)	3.7 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	3.2 (down)
7	3.7 (up)	3.7 (up)
8	4.8 (up)	4.8 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%

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[10] *Green, A, Kempton, L, Beltrame, S, Pickup, C, Kokogiannakis, G, Heffernan, E & Cooper, P, 2021, Thermal bridging energy impacts modelling, Sustainable Buildings Research Centre, University of Wollongong, Australia*

[11] The UoW method creates a dedicated wall section that represents the thermal bridge components being modelled and suggest this can be modelled as a door in some building performance simulation software. In IES, this is implemented by inserting a door component of appropriate properties into the wall.

- NCC 2025: 75% for plantroom roof and 55% for the balance
- **Floor:** as per NCC 2022
- **Internal load profiles:** as per NCC 2022 JV3 modelling profiles except lighting
- **Lighting profiles:**

Table 61. Lighting Operation Profile for C5OL

Hour	Class 5-Lighting-2022 Weekday	Class 5-Lighting-2022 Weekend	Class 5-Lighting-2025 Weekday	Class 5-Lighting-2025 Weekend
1	15%	15%	0%	0%
2	15%	15%	0%	0%
3	15%	15%	0%	0%
4	15%	15%	0%	0%
5	15%	15%	0%	0%
6	15%	15%	0%	0%
7	15%	15%	0%	0%
8	40%	15%	40%	0%
9	90%	25%	90%	15%
10	100%	25%	100%	15%
11	100%	25%	100%	15%
12	100%	25%	100%	15%
13	100%	25%	100%	15%
14	100%	25%	100%	15%
15	100%	25%	100%	15%
16	100%	25%	100%	15%
17	100%	25%	100%	15%
18	80%	15%	80%	0%
19	60%	15%	60%	0%
20	60%	15%	60%	0%
21	50%	15%	50%	0%
22	15%	15%	0%	0%
23	15%	15%	0%	0%
24	15%	15%	0%	0%

- **HVAC system**: Water cooled chillers, boilers, AHU and VAV on roof
- **AHU cooling and heating coil oversizing factor:** 1.1
- **Reheat oversizing factor:** 1.1
- **Chilled water loop oversizing factor**:
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- **Heating hot water loop oversizing factor**
  - NCC 2022 – 1.2
  - NCC 2025 – 1.2

- **Chiller EER and IPLV:**

Table 62. Water cooled Chillers EER and IPLV values for NCC 2022 and NCC 2025 C5OL Modelling

Range(kW_th)[12]	Code	CZ	EER	IPLV	Type
0 - 264	NCC 2022	-	4.95	6.14	WC Screw
265 - 528	NCC 2022	-	5.526	6.59	WC Screw
529 - 1055	NCC 2022	-	5.5	7.48	WC Screw
1056 - 1407	NCC 2022	-	5.773	9.322	WC Screw
>1407	NCC 2022	-	6.4	11.5	WC Cent
0 - 264	NCC 2025	1	4.95	6.14	WC Screw
265 - 528	NCC 2025	1	5.69	8.73	WC Cent
529 - 1055	NCC 2025	1	5.99	10.42	WC Cent
1056 - 1407	NCC 2025	1	6.01	10.3	WC Cent
>1407	NCC 2025	1	6.13	10.82	WC Cent
0 - 264	NCC 2025	2	4.95	6.14	WC Screw
265 - 528	NCC 2025	2	5.69	8.73	WC Cent
529 - 1055	NCC 2025	2	5.99	10.42	WC Cent
1056 - 1407	NCC 2025	2	6.01	10.3	WC Cent
>1407	NCC 2025	2	6.13	10.82	WC Cent
0 - 264	NCC 2025	3	4.95	6.14	WC Screw
265 - 528	NCC 2025	3	5.69	8.73	WC Cent
529 - 1055	NCC 2025	3	5.99	10.42	WC Cent
1056 - 1407	NCC 2025	3	6.01	10.3	WC Cent
>1407	NCC 2025	3	6.13	10.82	WC Cent
0 - 264	NCC 2025	4	4.95	6.14	WC Screw
265 - 528	NCC 2025	4	5.49	7.88	WC Screw
529 - 1055	NCC 2025	4	5.63	9.57	WC Screw

[12] kW_th is the thermal capacity (kW) of the chiller

1056 - 1407	NCC 2025	4	5.77	9.32	WC Screw
>1407	NCC 2025	4	6.13	10.82	WC Cent
0 - 264	NCC 2025	5	4.95	6.14	WC Screw
265 - 528	NCC 2025	5	5.49	7.88	WC Screw
529 - 1055	NCC 2025	5	5.63	9.57	WC Screw
1056 - 1407	NCC 2025	5	5.77	9.32	WC Screw
>1407	NCC 2025	5	6.13	10.82	WC Cent
0 - 264	NCC 2025	6	4.95	6.14	WC Screw
265 - 528	NCC 2025	6	5.49	7.88	WC Screw
529 - 1055	NCC 2025	6	5.63	9.57	WC Screw
1056 - 1407	NCC 2025	6	5.77	9.32	WC Screw
>1407	NCC 2025	6	6.13	10.82	WC Cent
0 - 264	NCC 2025	7	4.95	6.14	WC Screw
265 - 528	NCC 2025	7	5.49	7.88	WC Screw
529 - 1055	NCC 2025	7	5.63	9.57	WC Screw
1056 - 1407	NCC 2025	7	5.77	9.32	WC Screw
>1407	NCC 2025	7	6.13	10.82	WC Cent
0 - 264	NCC 2025	8	4.95	6.14	WC Screw
265 - 528	NCC 2025	8	5.49	7.88	WC Screw
529 - 1055	NCC 2025	8	5.63	9.57	WC Screw
1056 - 1407	NCC 2025	8	5.77	9.32	WC Screw
>1407	NCC 2025	8	6.13	10.82	WC Cent

- **Fan selection**: as per NCC 2022
- **AHU supply fan control:**
  - NCC 2022: VSD fixed pressure
  - NCC 2025: VSD variable pressure
- **Minimum OA CO_2 control**: as per NCC 2022
- **Economy cycle**: as per NCC 2022 (except for optimised scenario)

- **Pump system**: Fixed primary/variable secondary
- **Primary Chilled Water Pump (CHWP)and primary Heating Hot Water Pump (HHWP):**
    - NCC 2022: Constant flow based on 85% flow with balancing valve
    - NCC 2025: Constant flow based on 85% flow with VSD
- **Secondary CHWP and secondary HHWP:**
    - NCC 2022: VSD fixed pressure
    - NCC 2025: VSD variable pressure
- **Cooling tower fan:**
    - NCC 2022: fixed speed
    - NCC 2025: VSD

Appendix A.I.II C5OM

- **WWR**: 35%
- **Glazing:**

Table 63. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
2	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
3	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
4	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
5	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
6	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
7	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
8	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 6-12-6 air	2.778	0.32

- **Thermal bridging:**
  - NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
- **Core area internal wall:**
  - NCC 2022 – Insulated
  - NCC 2025 – uninsulated
- **Wall R-Value:** modelled as per table below.

Table 64. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1

- **Roof:** Insulated metal roof with uninsulated suspended ceiling

Table 65. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	3.7 (down)
2	3.7 (down)	3.7 (down)
3	3.7 (down)	3.7 (down)
4	3.7 (down)	3.7 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	3.2 (down)
7	3.7 (up)	3.7 (up)
8	4.8 (up)	4.8 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 75%
- **Roof emissivity:** 0.9
- **Roof thermal bridging:**
  - NCC 2022: Allow for one long edge to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
  - NCC 2025: Allow for box gutter to have underside insulation of bulk R-value 2, reflective underside.
  - Floor – as per NCC 2022
- **Internal load profiles:** as per NCC 2022 JV3 modelling profiles except lighting

- **Lighting profiles:**

Table 66. Lighting Operation Profile for C5OM

Hour	Class 5-Lighting-2022 Weekday	Class 5-Lighting-2022 Weekend	Class 5-Lighting-2022 Weekday	Class 5-Lighting-2022 Weekend
1	15%	15%	0%	0%
2	15%	15%	0%	0%
3	15%	15%	0%	0%
4	15%	15%	0%	0%
5	15%	15%	0%	0%
6	15%	15%	0%	0%
7	15%	15%	0%	0%
8	40%	15%	40%	0%
9	90%	25%	90%	15%
10	100%	25%	100%	15%
11	100%	25%	100%	15%
12	100%	25%	100%	15%
13	100%	25%	100%	15%
14	100%	25%	100%	15%
15	100%	25%	100%	15%
16	100%	25%	100%	15%
17	100%	25%	100%	15%
18	80%	15%	80%	0%
19	60%	15%	60%	0%
20	60%	15%	60%	0%
21	50%	15%	50%	0%
22	15%	15%	0%	0%
23	15%	15%	0%	0%
24	15%	15%	0%	0%

- **HVAC system** –PAC system on roof
- **Outside air:**
  - NCC 2022: 2°C temperature increase in the outside airflow due to the roof microclimate.
  - NCC 2025: 0°C temperature increase in the outside airflow due to the use of cool roof paint.
- **PAC oversizing factor:**
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- **PAC COP**
  - NCC 2022 – 3.2 below 39kW, 3 above
  - NCC 2025 – 3.3 below 39kW, 3.1 above
- **Minimum OA CO_2 control** - as per NCC 2022
- **Economy cycle** - as per NCC 2022 (except for optimised scenario)

Appendix A.I.III C9A

- **WWR:** 24% from L3 to L7. Note that Only L3 to L7 are included in the energy simulation.
- **Glazing:**

Table 67. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.25
2	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
3	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
4	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.25
5	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
6	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
7	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
8	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.25

- **Thermal bridging:**
  - NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
- **Core area internal wall:**
  - NCC 2022 – Insulated
  - NCC 2025 – uninsulated

- **Wall R-Value:** modelled as per table below.

Table 68. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	1.6	1.6
2	1	1
3	1.7	1.3
4	1.7	1.1
5	1	1
6	1.7	1
7	1.7	1.3
8	3.3	1.6

- **Roof:**
  - Concrete roof with insulation on underside.
  - Rooftop plant room: uninsulated

Table 69. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	4.8 (down)
2	3.7 (down)	4.4 (down)
3	3.7 (down)	4.8 (down)
4	3.7 (down)	4.8 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	4.8 (down)
7	3.7 (up)	5.3 (up)
8	4.8 (up)	5.3 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 75% for plantroom roof and 55% for the balance
- **Floor:** as per NCC 2022
- **Internal load profiles:** as per NCC 2022 JV3 modelling profiles
- **HVAC system**: Air-cooled chillers, boilers, FCU serving wardrooms and 100% outside air constant volume AHU serving corridors on roof.
- **AHU & FCU cooling and heating coil oversizing factor:** 1.1
- **Chilled water loop oversizing factor:**
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- **Heating hot water loop oversizing factor:**
  - NCC 2022 – 1.2
  - NCC 2025 – 1.2

- **Chiller EER and IPLV:**

Table 70. Air Cooled Chillers EER and IPLV Values for NCC 2022 and NCC 2025 C5OM Modelling

Range(kW_th)[13]	Code	CZ	EER	IPLV	Type
0 - 528	NCC 2022	-	2.885	4.7	AC Scroll
>528	NCC 2022	-	3.167	5.03	AC Scroll
0 - 528	NCC 2025	1	3.25	5.42	AC Scroll
>528	NCC 2025	1	3.39	5.25	AC Screw
0 - 528	NCC 2025	2	3.25	5.42	AC Scroll
>528	NCC 2025	2	3.39	5.25	AC Screw
0 - 528	NCC 2025	3	3.25	5.42	AC Scroll
>528	NCC 2025	3	3.39	5.25	AC Screw
0 - 528	NCC 2025	4	3.25	5.42	AC Scroll
>528	NCC 2025	4	3.39	5.25	AC Screw
0 - 528	NCC 2025	5	3.25	5.42	AC Scroll
>528	NCC 2025	5	3.39	5.25	AC Screw
0 - 528	NCC 2025	6	3.25	5.42	AC Scroll
>528	NCC 2025	6	3.39	5.25	AC Screw
0 - 528	NCC 2025	7	3.25	5.42	AC Scroll
>528	NCC 2025	7	3.39	5.25	AC Screw
0 - 528	NCC 2025	8	3.2	5.42	AC Scroll
>528	NCC 2025	8	3.31	5.25	AC Screw

- **Fan selection** – as per NCC 2022
- **Heat exchanger** - as per NCC 2022
- **Economy cycle** - as per NCC 2022
- **Pump system:** Fixed primary/variable secondary
- **Primary CHWP and primary HHWP:**
  - NCC 2022: Constant flow based on 85% flow with balancing valve
  - NCC 2025: Constant flow based on 85% flow with VSD
- **Secondary CHWP and secondary HHWP:**
  - NCC 2022: VSD fixed pressure

[13] kW_th is the thermal capacity (kW) of the chiller

    - NCC 2025: VSD variable pressure
- **Cooling tower fan:**
    - NCC 2022: fixed speed
    - NCC 2025: VSD

Appendix A.I.IV C9AS

- **WWR:** 35%
- **Glazing:**

Table 71. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
2	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
3	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
4	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
5	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
6	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
7	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
8	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17

- **Wall**: R-Value modelled as per table below.

Table 72. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	3.3	3.3
2	1	1
3	3.3	2.2
4	3.3	1.6
5	1	1
6	3.3	1
7	3.3	2.2
8	1	3.3

- **Roof/Ceiling**: Metal roof with reflective sarking over insulated fixed plaster ceiling.

Table 73. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	4.8 (down)
2	3.7 (down)	4.4 (down)
3	3.7 (down)	4.8 (down)
4	3.7 (down)	4.8 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	4.8 (down)
7	3.7 (up)	5.3 (up)
8	4.8 (up)	5.3 (up)

Roof solar reflectance:
  - NCC 2022: 55%
  - NCC 2025: 75%
- **Floor** – as per NCC 2022
- **Internal load profiles:** as per NCC 2022 JV3 modelling profiles
- **HVAC system** – VRF system on roof
- **Outside air:**
  - NCC 2022: 2°C temperature increase in the outside airflow due to the roof microclimate
  - NCC 2025: 0°C temperature increase in the outside airflow due to the use of cool roof paint.
- **VRF oversizing factor:**
  - NCC 2022 – 1.155
  - NCC 2025 – 1.1
- **VRF COP**
  - NCC 2022 – 3.48 below 39kW, 3.17 above
  - NCC 2025 – 4.1 below 39kW, 3.7 above
- **OA Fan selection:**
  - NCC 2022: constant flow based on 85% flow with balancing damper
  - NCC 2025: constant flow with 85% using VSD
- **Heat exchanger:** as per NCC 2022

Appendix A.I.V C5OS

- **WWR**: 38%
- **Glazing**:

Table 74. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253
2	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
3	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
4	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
5	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
6	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
7	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22
8	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3

- **Thermal bridging:**
  - NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
- **Internal wall:**
  - NCC 2022 – insulated
  - NCC 2025 – uninsulated

- **Wall**: Brick veneer wall, R-Value modelled as per table below

Table 75. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1

- **Roof:** Insulated metal roof with uninsulated suspended ceiling

Table 76. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	3.7 (down)
2	3.7 (down)	3.7 (down)
3	3.7 (down)	3.7 (down)
4	3.7 (down)	3.7 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	3.2 (down)
7	3.7 (up)	3.7 (up)
8	4.8 (up)	4.8 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 55%
- **Roof thermal bridging:**
  - NCC 2022: Allow for one edge to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
  - NCC 2025: Allow for box gutter to have underside insulation of bulk R value 2, reflective underside
- **Floor:** as per NCC 2022
- **Internal load profile**: as per NCC 2022 except lighting

- **Lighting operation profile:**

Table 77. Lighting Operation Profile for C5OS

Hour	C5 Lighting Shed-22 Weekday	C5 Lighting Shed-22 Weekend	C5 Lighting Shed-25 Weekday	C5 Lighting Shed-25 Weekend
1	15%	15%	0%	0%
2	15%	15%	0%	0%
3	15%	15%	0%	0%
4	15%	15%	0%	0%
5	15%	15%	0%	0%
6	15%	15%	0%	0%
7	15%	15%	0%	0%
8	40%	15%	40%	0%
9	90%	25%	90%	15%
10	100%	25%	100%	15%
11	100%	25%	100%	15%
12	100%	25%	100%	15%
13	100%	25%	100%	15%
14	100%	25%	100%	15%
15	100%	25%	100%	15%
16	100%	25%	100%	15%
17	100%	25%	100%	15%
18	80%	15%	80%	0%
19	60%	15%	60%	0%
20	60%	15%	60%	0%
21	50%	15%	50%	0%
22	15%	15%	0%	0%
23	15%	15%	0%	0%
24	15%	15%	0%	0%

- **HVAC system**: VRF system on roof
- **VRF oversizing factor:**
    - NCC 2022: 1.155
    - NCC 2025: 1.1
- **VRF COP:**
    - NCC 2022: 3.48 below 39kW, 3.17 above
    - NCC 2025: 4.1 below 39kW, 3.7 above
- **Outside air fan:**
    - NCC 2022: constant flow based on 85% flow with balancing damper
    - NCC 2025: constant flow with 85% using VSD

Appendix A.I.VI C6RS

- **Glazing:**

Table 78. Standard Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	Standard Glazing - NCC 2022 Selection	Standard Glazing - NCC 2022 System U-value	Standard Glazing - NCC 2022 System SHGC	Standard Glazing - NCC 2025 Selection	Standard Glazing - NCC 2025 System U-value	Standard Glazing - NCC 2025 System SHGC
1	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
2	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3
3	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3
4	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3
5	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 6-12-6 air	2.778	0.32
6	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 + Grey 6-12-6 90% Argon	2.573	0.3
7	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 6-12-6 air	2.778	0.32
8	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 6-12-6 air	2.778	0.32

Table 79. Display Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	Display Glazing - NCC 2022 Selection	Display Glazing - NCC 2022 System U-value	Display Glazing - NCC 2022 System SHGC	Display Glazing - NCC 2025 Selection	Display Glazing - NCC 2025 System U-value	Display Glazing - NCC 2025 System SHGC
1	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
2	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
3	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
4	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
5	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
6	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
7	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61
8	6mm Planibel on clear	4.106	0.61	6mm Planibel on clear	4.106	0.61

Note that the glazed doors in the shops with standard glazing were modelled as standard glazing. The glazed doors in the shops with display glazing were modelled as display glazing.

- **Wall:** R-Value modelled as per table below.

Table 80. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Front/Rear Total Wall R-Value	NCC 2022 Side Total Wall R-Value	NCC 2025 Front/Rear Total Wall R-Value	NCC 2025 Side Total Wall R-Value
1	1.6	3.3	1.8	4
2	1	1.4	1	1
3	1.6	3.3	1.5	2.4
4	1.6	2.8	1.2	1.9
5	1	1.4	1	1
6	1.6	2.8	1	1
7	1.6	2.8	1.5	2.2
8	2.9	3.8	1.8	3.6

- **Floor:** as per NCC 2022
  Internal load profile: as per NCC 2022 except lighting
- **Lighting operation profile:**

Table 81. Lighting Operation Profile for C6RS

Hour	C6Shed-22 Lighting	C6Shed-25 Lighting
1	25%	0%
2	25%	0%
3	25%	0%
4	25%	0%
5	25%	0%
6	25%	0%
7	25%	0%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%
17	100%	100%
18	100%	100%
19	100%	100%
20	10%	0%
21	10%	0%
22	10%	0%
23	10%	0%
24	10%	0%

- **HVAC system:** One PAC per shop on roof
- **Outside air:**
  - NCC 2022: 2°C temperature increase in the outside airflow due to the roof microclimate.
  - NCC 2025: 0°C temperature increase in the outside airflow due to the use of cool roof paint.
- **PAC oversizing factor:**
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- **PAC COP**
  - NCC 2022 – 3.84 below 39kW, 3.6 above
  - NCC 2025 – 3.96 below 39kW, 3.72 above
- **Economy cycle**
  - NCC 2022:

Table J5.2 Requirement for an outdoor air economy cycle

Climate zone	Total air flow rate *requiring* an economy cycle (L/s)
2	9000
3	7500
4	3500
5	3000
6	2000
7	2500
8	4000

  - NCC 2025

Table 82. NCC 2025 economy cycle for C6RL

Climate zone	Total air flow rate requiring an economy cycle (L/s)
2	9000
3	7500
4	3500
5	3000
6	1200
7	2500
8	2000

Appendix A.I.VII C6RL

- **Window**: 12m x 3.5m glazed door
- **Glazing:**

Table 83. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 6-12-6 90% Argon	2.67	0.49
2	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
3	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
4	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
5	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
6	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
7	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54
8	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54

- **Wall:** R-Value modelled as per table below.

Table 84. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Front Total Wall R-Value	NCC 2022 Side & Rear Total Wall R-Value	NCC 2025 Front/Rear Total Wall R-Value	NCC 2025 Side & Rear Total Wall R-Value
1	2.4	2.4	3	3
2	1.4	1.4	1	1
3	1.4	1.4	2.2	2.2
4	1.4	1.4	2	2
5	1.4	1.4	1	1
6	1.4	1.4	1.2	1.2
7	1.4	1.4	2.2	2.2
8	1.4	1.4	3.6	3.6

- **Roof:** Insulated metal roof (reflective underside), no suspended ceiling

Table 85. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

Climate zone	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	3.7 (down)
2	3.7 (down)	3.7 (down)
3	3.7 (down)	3.7 (down)
4	3.7 (down)	3.7 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	3.2 (down)
7	3.7 (up)	3.7 (up)
8	4.8 (up)	4.8 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 75% (CZ1,2,3,5,6) 55% (CZ4,7,8)
- **Floor:** as per NCC 2022
- **Internal load profile:** as per NCC 2022 except lighting

- **Lighting operation profile:**

Table 86. Lighting Operation Profile for C6RL

Hour	C6Shed-22 Lighting	C6Shed-25 Lighting
1	25%	0%
2	25%	0%
3	25%	0%
4	25%	0%
5	25%	0%
6	25%	0%
7	25%	0%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%
17	100%	100%
18	100%	100%
19	100%	100%
20	10%	0%
21	10%	0%
22	10%	0%
23	10%	0%
24	10%	0%

- **HVAC system:** 4 roof mounted PAC units (Each serves perimeter zone and centre zone for one aspect).
- **PAC oversizing factor:**
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- **PAC COP:**
  - NCC 2022 – 3.84 below 39kW, 3.6 above
  - NCC 2025 – 3.96 below 39kW, 3.72 above
- **Economy cycle**
  - NCC 2022:

Table J5.2 Requirement for an outdoor air economy cycle

Climate zone	Total air flow rate *requiring* an economy cycle (L/s)
2	9000
3	7500
4	3500
5	3000
6	2000
7	2500
8	4000

- NCC 2025

Table 87. NCC 2025 economy cycle for C6RL

Climate zone	Total air flow rate requiring an economy cycle (L/s)
2	9000
3	7500
4	3500
5	3000
6	1200
7	2500
8	2000

Appendix A.I.VIII C3HS

- **WWR**: 25% front and rear, 0% sides. Long sides N/S.
- **Glazing**:

Table 88. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 - Selection	NCC 2022 - System U-value	NCC 2022 - System SHGC	NCC 2025 - Selection	NCC 2025 - System U-value	NCC 2025 - System SHGC
1	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 6-12-6 air	2.778	0.32
2	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 6-12-6 air	2.778	0.32
3	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 67-1 6-12-6 air	2.778	0.32
4	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 67-1 6-12-6 air	2.778	0.32
5	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 6-12-6 air	2.778	0.32
6	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 67-1 6-12-6 air	2.778	0.32
7	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 67-1 6-12-6 air	2.778	0.32
8	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 67-1 6-12-6 air	2.778	0.32

- **Thermal bridging**
  - NCC 2022: For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025: The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.

- **Internal wall**
  - NCC 2022: Insulated
  - NCC 2025: uninsulated

- **Wall:** R-Value modelled as per table below.

Table 89. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Front/Rear Total Wall R-Value	NCC 2022 Side Total Wall R-Value	NCC 2025 Front/Rear Total Wall R-Value	NCC 2025 Side Total Wall R-Value
1	1.6	3.3	1.8	4
2	1	1.4	1	1
3	1.6	3.3	1.5	2.4
4	1.6	2.8	1.2	1.9
5	1	1.4	1	1
6	1.6	2.8	1	1
7	1.6	2.8	1.5	2.2
8	2.9	3.8	1.8	3.6

- **Roof:** Insulated metal roof

Table 90. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	4.8 (down)
2	3.7 (down)	4.4 (down)
3	3.7 (down)	4.8 (down)
4	3.7 (down)	4.8 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	4.8 (down)
7	3.7 (up)	5.3 (up)
8	4.8 (up)	5.3 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 55%
- **Roof thermal bridging:**
  - NCC 2022: Allow for one long edge to have an uninsulated box gutter equivalent to an uninsulated (but reflective sarked) section 450mm wide.
  - NCC 2025: Allow for box gutter to have underside insulation of bulk R value 2, reflective underside
- **Floor:** as per NCC 2022
- **Internal load profile:** as per NCC 2022 except corridor lighting

- **Corridor lighting operation profile:**

Table 91. Lighting Operation Profile for C3HS

Hour	C3Shed-22 Lighting	C3Shed-25 Lighting
1	100%	10%
2	100%	10%
3	100%	10%
4	100%	10%
5	100%	10%
6	100%	10%
7	100%	60%
8	100%	60%
9	100%	60%
10	100%	60%
11	100%	60%
12	100%	60%
13	100%	60%
14	100%	60%
15	100%	60%
16	100%	60%
17	100%	60%
18	100%	60%
19	100%	60%
20	100%	60%
21	100%	60%
22	100%	60%
23	100%	10%
24	100%	10%

- **HVAC system:** VRF system on roof
- **VRF oversizing factor:**
  - NCC 2022 – 1.155
  - NCC 2025 – 1.1
- **VRF COP:**
  - NCC 2022 – 3.48 below 39kW, 3.17 above
  - NCC 2025 – 4.1 below 39kW, 3.7 above
- **Outside air fan:**
  - NCC 2022 – constant flow based on 85% flow with balancing damper
  - NCC 2025 – constant flow with 85% using VSD

Appendix A.I.IX C3HL

- **WWR:** 28%
- **Glazing:**

Table 92. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 - Selection	NCC 2022 - System U-value	NCC 2022 - System SHGC	NCC 2025 - Selection	NCC 2025 - System U-value	NCC 2025 - System SHGC
1	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
2	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
3	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
4	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
5	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
6	ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	2.588	0.22	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
7	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17
8	ASG Visualite 70S-1 6-12-6 air	2.771	0.27	ASG CoolShade 30 crystal grey 6-12-6 90% Argon	2.581	0.17

- **Thermal bridging**
  - NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
- **Core area internal wall**
  - NCC 2022 – Insulated
  - NCC 2025 – uninsulated

- **Wall:** R-Value modelled as per table below.

Table 93. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	2.2	1.9
2	1	1
3	1.9	1.5
4	1.9	1.2
5	1	1
6	1.9	1
7	1.9	1.5
8	5.8	1.9

- **Roof:** Concrete roof with insulation on underside;
- **Rooftop plant room:** uninsulated

Table 94. . Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	4.8 (down)
2	3.7 (down)	4.4 (down)
3	3.7 (down)	4.8 (down)
4	3.7 (down)	4.8 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	4.8 (down)
7	3.7 (up)	5.3 (up)
8	4.8 (up)	5.3 (up)

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 55%

- **Internal load profile:** as per NCC 2022 except corridor lighting

- **Corridor lighting operation profile:**

Table 95. Lighting Operation Profile for C3HL

Hour	C3Shed-22 Lighting	C3Shed-25 Lighting
1	100%	10%
2	100%	10%
3	100%	10%
4	100%	10%
5	100%	10%
6	100%	10%
7	100%	60%
8	100%	60%
9	100%	60%
10	100%	60%
11	100%	60%
12	100%	60%
13	100%	60%
14	100%	60%
15	100%	60%
16	100%	60%
17	100%	60%
18	100%	60%
19	100%	60%
20	100%	60%
21	100%	60%
22	100%	60%
23	100%	10%
24	100%	10%

- HVAC system – Roof mounter air cooled chillers, central plant heat pumps/electric heaters, FCU serving hotel rooms and corridors.
- **FCU cooling and heating coil oversizing factor:** 1.1
- Chilled water loop oversizing factor:
  - NCC 2022 – 1.26
  - NCC 2025 – 1.2
- Heating hot water loop oversizing factor
  - NCC 2022 – 1.2
  - NCC 2025 – 1.2

- **Chiller EER and IPLV:**

Table 96. Air cooled Chillers EER and IPLV values for NCC 2022 and NCC 2025 C3HL Modelling

Range(kW_th)[14]	Code	CZ	EER	IPLV	Type
0 - 528	NCC 2022	-	2.89	4.7	AC Scroll
>528	NCC 2022	-	3.17	5.03	AC Scroll
0 - 528	NCC 2025	1	3.25	5.42	AC Scroll
>528	NCC 2025	1	3.39	5.25	AC Screw
0 - 528	NCC 2025	2	3.25	5.42	AC Scroll
>528	NCC 2025	2	3.39	5.25	AC Screw
0 - 528	NCC 2025	3	3.25	5.42	AC Scroll
>528	NCC 2025	3	3.39	5.25	AC Screw
0 - 528	NCC 2025	4	3.25	5.42	AC Scroll
>528	NCC 2025	4	3.39	5.25	AC Screw
0 - 528	NCC 2025	5	3.25	5.42	AC Scroll
>528	NCC 2025	5	3.39	5.25	AC Screw
0 - 528	NCC 2025	6	3.25	5.42	AC Scroll
>528	NCC 2025	6	3.39	5.25	AC Screw
0 - 528	NCC 2025	7	3.25	5.42	AC Scroll
>528	NCC 2025	7	3.39	5.25	AC Screw
0 - 528	NCC 2025	8	3.2	5.42	AC Scroll
>528	NCC 2025	8	3.31	5.25	AC Screw

- **Central plant heat pump cooling: EER:** 3; **Heating COP**:3.25
- **Fan selection:** as per NCC 2022
- **Outside air fan:**
    - NCC 2022: constant flow based on 85% flow with balancing damper
    - NCC 2025: constant flow with 85% using VSD
- **Pump system:** Fixed primary/variable secondary
- **Primary CHWP and primary HHWP:**
    - NCC 2022: Constant flow based on 85% flow with balancing valve
    - NCC 2025: Constant flow based on 85% flow with VSD

[14] kW_th is the thermal capacity (kW) of the chiller

- **Secondary CHWP and secondary HHWP:**
    - NCC 2022: VSD fixed pressure
    - NCC 2025: VSD variable pressure

Appendix A.I.X C9B

- **WWR**: 1.5m x 48m front and rear, 1.5m x 2m sides. Long sides N/S.
- **Glazing**:

Table 97. Glazing Values for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Selection	NCC 2022 System U-value	NCC 2022 System SHGC	NCC 2025 Selection	NCC 2025 System U-value	NCC 2025 System SHGC
1	ASG Visualite 67-1 6-12-6 air	2.778	0.32	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
2	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253
3	ASG Clear Visualite 67-1 #3 6-12-6 Argon	2.578	0.43	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253
4	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253
5	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
6	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 6-12-6 air	2.771	0.27
7	ASG Clear Visualite 70S-1 #3 6-12-6 Argon	2.57	0.36	ASG Visualite 70S-1 + Grey 6-12-6 Argon	2.573	0.253
8	ASG Super S1-1 #3 6-12-6 Argon	2.668	0.54	ASG Visualite 67-1 6-12-6 air	2.778	0.32

- **Thermal bridging**
  - NCC 2022 - For each intermediate floor slab, 200mm exposed concrete slab edge. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.
  - NCC 2025 – The exposed slab edge is mitigated. This is calculated in accordance with UoW method and then modelled as thermal bridge doors.

- **Internal wall**
  - NCC 2022 – uninsulated
  - NCC 2025 – uninsulated

- **Wall:** R-Value modelled as per table below.

Table 98. Wall R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Wall R-Value	NCC 2025 Total Wall R-Value
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1

- **Roof:** Metal roof with reflective sarking over insulated fixed plaster ceiling

Table 99. Roof R-value for NCC 2022 and NCC 2025 for Climate Zone 1-8

CZ	NCC 2022 Total Roof R-Value	NCC 2025 Total Roof R-Value
1	3.7 (down)	3.7 (down)
2	3.7 (down)	3.7 (down)
3	3.7 (down)	3.7 (down)
4	3.7 (down)	3.7 (down)
5	3.7 (down)	3.7 (down)
6	3.2 (down)	3.2 (down)
7	3.7 (up)	3.7 (up)
8	4.8 (up)	4.8 (up)

Note that in this archetype, the roof, the ceiling and the air space between them was treated as a roof construction component. The above roof total R-Value is for the whole roof construction component. The R-Value of the air space was assumed to be 0.56 (up) and 1.09 (down) for different climate zones.

- **Roof solar reflectance:**
  - NCC 2022: 55%
  - NCC 2025: 55%

- **Floor:** as per NCC 2022
- **Internal load profile:** as per NCC 2022 except lighting

- **Lighting operation profile**
  - Classroom:

Table 100. Classroom Lighting Operation Profile for C9B

Hour	C9bShed-22 Classroom Lighting	C9bShed-25 Classroom Lighting
1	5%	0%
2	5%	0%
3	5%	0%
4	5%	0%
5	5%	0%
6	5%	0%
7	5%	0%
8	30%	20%
9	85%	85%
10	95%	95%
11	95%	95%
12	95%	95%
13	80%	60%
14	80%	60%
15	95%	95%
16	90%	90%
17	70%	70%
18	20%	20%
19	20%	20%
20	20%	20%
21	10%	5%
22	5%	0%
23	5%	0%
24	5%	0%

  - Corridor:

Table 101. Corridor Lighting Operation Profile for C9B

Hour	C9bShed-22 Corridor Lighting	C9bShed-25 Corridor Lighting
1	5%	5%
2	5%	5%
3	5%	5%
4	5%	5%
5	5%	5%
6	5%	5%
7	5%	5%
8	100%	60%
9	100%	60%
10	100%	60%
11	100%	60%

Hour	C9bShed-22 Corridor Lighting	C9bShed-25 Corridor Lighting
12	100%	60%
13	100%	60%
14	100%	60%
15	100%	60%
16	100%	60%
17	100%	60%
18	20%	20%
19	20%	20%
20	20%	20%
21	10%	10%
22	5%	5%
23	5%	5%
24	5%	5%

- **HVAC system:** VRF system on roof
- **VRF oversizing factor:**
    - NCC 2022 – 1.155
    - NCC 2025 – 1.1

- **VRF COP:**
    - NCC 2022 – 3.48 below 39kW, 3.17 above
    - NCC 2025 – 4.1 below 39kW, 3.7 above

- **Outside air fan:**
    - NCC 2022 – constant flow based on 85% flow with balancing damper
    - NCC 2025 – constant flow with 85% using VSD

Appendix A.II Stringency 2 Simulation and PV Modelling Parameters

Building simulation parameters were the same as those used for Stringency 1. The only difference between the two stringencies is the addition of rooftop PV. PV Modelling input parameters are summarised in Table 102 below. For information, Table 103 and Table 104 also present a summary of the simulation results that were used to develop the initial measures results for the PV draft NCC 2025 Deemed-to-Satisfy Provisions, which forms the basis of the designs used in Stringency 2 modelling.

Table 102. PV Modelling Parameters

Modelling Parameter	Selection / Value
PV Cell Type	Monocrystalline Silicon
Panel Height (mm)	2187
Panel Width (mm)	1102
Modular Nominal Efficiency (%)	20.7
Nominal Operating Cell Temperature (NOCT) (°C)	43
Reference Irradiance for NOCT (W/m^2)	800
Temperature Coefficient for Module Efficiency (%/°C)	-0.34
Degradation Factor (%)	1%
Electrical Conversion Efficiency (%)	98.5

Appendix A.II.I PV Design Deemed-to-Satisfy Provisions

Table 103 provides the results from the initial measures analysis which determines the PV system capacities for each of the core archetypes at which 50% export is achieved. The PV output was applied to consumption for each climate zone and, adjusted until the resulting 50% export is achieved.

Table 103: PV system capacity (Wp/m^2) as a function of building conditioned area at which 50% export is achieved

CZ	C5OL	C5OM	C5 Average	C9A	C9AS	C9 Average
1	89	98	95	55	81	70
2	63	67	65	32	49	40
3	58	65	60	32	49	40
4	58	61	60	31	44	35
5	72	69	70	35	49	40
6	62	65	65	32	44	40
7	57	59	60	29	46	40
8	55	56	55	28	46	35

Averaging and rounding the results from each archetype group (day and night archetypes) results in, on average, a Wp/m2 within 10% of the results for each specific archetype. Further, this also results in a number of climate zones with equivalent minimum PV system capacities, making implementation in code more streamlined and simpler. For clarity, the summarised Wp/m2 limits recommended for Code are provided in Table 104.

Table 104: Limit of required solar photovoltaic system installed peak output Wp per m2 of conditioned space

Building Class	Climate Zone 1	Climate zone 2 to 7	Climate Zone 8
5, 6, 7 and 8	95	65	55
2, 3, 4 and 9	70	40	35

While the above describes the upper limit requirements for PV system designs, the provisions developed also needed to take account for differences in building geometries and roof layout characteristics. The lower limit PV system designs are required to maximise the roof space available, allowing for areas needing to be reserved for maintenance access, other roof mounted building services elements, and south facing roofs at ≤10° pitch.

Appendix A.II.II Stringency 2 PV Design

The draft Deemed-to-Satisfy provisions described above were used to develop the PV design for each archetype and climate zone combination. . For Stringency 2 rooftop PV system size and generation data is presented in Table 105.

Table 105. Stringency 2 and 3 Rooftop PV System Sizes and Generation

Archetype	Climate Zone	PV System size (kW)	Total Generation (kWh)	Total Export (kWh)	Onsite use[15] (kWh)
C5OL	1	65.6	107,356	1,967	105,389
C5OL	2	53.1	87,643	801	86,842
C5OL	3	56.7	102,171	1,416	100,755
C5OL	4	65.1	100,218	2,575	97,643
C5OL	5	70.1	95,871	2,085	93,786
C5OL	6	56.2	72,941	576	72,365
C5OL	7	52.5	77,465	369	77,096
C5OL	8	61.5	83,514	1,615	81,899
C5OM	1	77.7	127,158	28,282	98,877
C5OM	2	77.7	128,246	32,117	96,129
C5OM	3	77.7	140,012	34,466	105,545
C5OM	4	77.7	119,615	30,514	89,101
C5OM	5	77.7	106,265	25,623	80,642
C5OM	6	77.7	100,846	25,942	74,904
C5OM	7	77.7	114,648	30,651	83,997
C5OM	8	77.7	105,513	28,398	77,115
C9A	1	56.2	91,973	-	91,973
C9A	2	55.2	91,109	-	91,109
C9A	3	52.2	94,062	-	94,062
C9A	4	57.2	88,056	-	88,056
C9A	5	67.3	92,041	12	92,030
C9A	6	53.6	69,567	-	69,567
C9A	7	54	79,678	-	79,678
C9A	8	54.1	73,466	-	73,466
C9AS	1	143	234,024	105,803	128,220
C9AS	2	82	135,343	58,737	76,607
C9AS	3	82	147,760	63,390	84,370

[15] Please refer Appendix B.I.IV for detailed information on regulated, unregular energy and onsite PV use

Archetype	Climate Zone	PV System size (kW)	Total Generation (kWh)	Total Export (kWh)	Onsite use[15] (kWh)
C9AS	4	82	126,234	60,594	65,640
C9AS	5	82	112,146	49,129	63,017
C9AS	6	82	106,427	49,669	56,757
C9AS	7	82	120,993	55,656	65,336
C9AS	8	72	97,773	41,618	56,155
C5OS	1	22.1	36,167	8,221	27,946
C5OS	2	22.1	36,477	9,172	27,305
C5OS	3	22.1	39,823	10,645	29,178
C5OS	4	22.1	34,022	9,220	24,802
C5OS	5	22.1	30,225	7,829	22,396
C5OS	6	22.1	28,683	7,804	20,880
C5OS	7	22.1	32,609	9,376	23,233
C5OS	8	22.1	30,011	10,000	20,011
C6RS	1	79	129,286	391	128,895
C6RS	2	65	107,284	3,841	103,444
C6RS	3	65	117,127	2,543	114,584
C6RS	4	65	100,064	7,064	93,000
C6RS	5	65	88,896	5,080	83,816
C6RS	6	65	84,363	9,010	75,353
C6RS	7	65	95,909	9,363	86,545
C6RS	8	55	74,688	5,106	69,581
C6RL	1	54.6	89,354	48	89,306
C6RL	2	54.6	90,119	1,768	88,351
C6RL	3	54.6	98,387	598	97,789
C6RL	4	54.6	84,054	2,402	81,652
C6RL	5	54.6	74,673	2,210	72,463
C6RL	6	54.6	70,865	4,248	66,617
C6RL	7	54.6	80,563	3,816	76,747
C6RL	8	54.6	74,144	3,411	70,733
C3HS	1	47.3	77,408	35,429	41,979
C3HS	2	47.3	78,070	48,271	29,799
C3HS	3	47.3	85,232	50,591	34,641
C3HS	4	47.3	72,816	46,129	26,686
C3HS	5	47.3	64,689	40,194	24,494
C3HS	6	47.3	61,390	38,684	22,706
C3HS	7	47.3	69,792	45,757	24,035
C3HS	8	45.5	61,787	37,852	23,935
C3HL	1	28	45,823	-	45,823
C3HL	2	25	41,263	-	41,263
C3HL	3	22	39,643	-	39,643
C3HL	4	25	38,486	-	38,486
C3HL	5	29	39,661	-	39,661
C3HL	6	26	33,745	-	33,745
C3HL	7	21	30,986	-	30,986
C3HL	8	21	28,517	-	28,517
C9B	1	86.1	140,905	42,861	98,044

Archetype	Climate Zone	PV System size (kW)	Total Generation (kWh)	Total Export (kWh)	Onsite use[15] (kWh)
C9B	2	86.1	142,111	47,886	94,225
C9B	3	86.1	155,148	54,877	100,271
C9B	4	86.1	132,546	52,599	79,947
C9B	5	86.1	117,753	45,586	72,166
C9B	6	86.1	111,748	49,850	61,899
C9B	7	86.1	127,042	55,402	71,641
C9B	8	81	109,995	50,332	59,663

Appendix A.III Stringency 3 Simulation and PV Modelling Parameters

An additional PV modelling analysis has been carried out for Stringency 3 whereby an expanded PV system is added (assumed to be ground-mounted due to roof space limitations) and sized to offset the additional emissions for the building that is constructed as dual fuel (gas fired space heating and domestic hot water) then converted to all-electric. The analysis is intended to explore impacts of a building reaching electrification through different pathways, but ultimately achieving equivalent lifecycle operational emissions.

Building simulation parameters were the same as those used for Stringency 1, apart from the electrification of heating and cooling plant. Details of electrified plant equipment are provided in Section 1.12.1. Energy consumption associated with domestic hot water plant was calculated separately, as detailed in Section 1.12.2. Hourly energy consumption was not modelled for DHW; as such, the exported electricity generation does not consider the DHW demand on an hourly basis.

Rooftop PV modelling parameters were the same as those specified for the Stringency 2 analysis

The result of this process is illustrated in Table 106.

The result of this process is illustrated in Table 106.

Table 106. Expanded PV system sizes to offset additional emissions for dual fuel archetypes

Archetype	Climate Zone	NCC Dual-Fuel Building Emissions Yrs 1-14 (kg CO2/yr)	NCC All Electric Building Emissions Yrs 1-14 (kg CO2/yr)	Equivalent Electrical offset (kWh/yr)	Equivalent PV required (kW)	Equivalent PV Required Wp/m²
C5OL	1	3,498,622.8	3,472,205.5	4,893.3	3.0	0.2
C5OL	2	1,935,799.6	1,933,945.7	343.4	0.2	0.0
C5OL	3	1,925,812.6	2,004,078.5	0.0	0.0	0.0
C5OL	4	1,741,641.3	1,610,622.2	24,269.0	15.8	1.3
C5OL	5	1,744,947.7	1,773,294.5	0.0	0.0	0.0
C5OL	6	1,404,715.0	1,344,160.6	11,216.6	8.6	0.7
C5OL	7	1,808,674.6	1,643,833.9	30,533.8	20.7	1.7
C5OL	8	2,497,382.4	2,072,296.0	78,739.8	58.0	4.7
C9A	1	4,502,803.5	4,316,493.4	34,510.7	21.1	2.0
C9A	2	2,430,805.5	2,364,018.2	12,371.2	7.5	0.7
C9A	3	2,712,383.4	2,450,145.1	48,575.0	27.0	2.6
C9A	4	2,655,904.6	2,441,056.2	39,796.9	25.9	2.5
C9A	5	2,269,197.2	2,188,142.0	15,014.1	11.0	1.1
C9A	6	2,289,293.9	2,056,754.4	43,073.8	33.2	3.2
C9A	7	2,705,274.8	2,641,005.3	11,904.8	8.1	0.8
C9A	8	3,227,867.8	3,221,659.2	1,150.0	0.8	0.1
C3HL	1	5,485,945.9	5,097,157.4	72,016.2	44.0	5.4
C3HL	2	3,178,546.1	2,851,458.3	60,587.3	36.7	4.5
C3HL	3	3,854,820.0	3,283,254.7	105,872.4	58.8	7.2
C3HL	4	3,823,697.8	3,226,402.1	110,638.5	71.9	8.8
C3HL	5	2,913,850.1	2,498,627.5	76,912.7	56.2	6.9

Archetype	Climate Zone	NCC Dual-Fuel Building Emissions Yrs 1-14 (kg CO2/yr)	NCC All Electric Building Emissions Yrs 1-14 (kg CO2/yr)	Equivalent Electrical offset (kWh/yr)	Equivalent PV required (kW)	Equivalent PV Required Wp/m²
C3HL	6	3,298,686.1	2,646,131.1	120,874.3	93.1	11.4
C3HL	7	4,096,983.0	3,720,735.6	69,693.2	47.2	5.8
C3HL	8	5,141,267.5	4,760,310.3	70,565.6	52.0	6.3

The required equivalent PV systems sizes, expressed as Wp/m^2, were then simplified in to groups to minimise factional differences in system sizes, and the C9A archetype (representing the night time archetype) was applied to C3HL, as presented in Table 107.

Table 107: Simplified Wp/m2 PV System Design

Climate Zone	Wp/m^2 - C5OL	Wp/m^2 - C9A & C3HL
1	0	2.6
2	0	0.9
3	0	2.6
4	1	2.6
5	0	0.9
6	1	2.6
7	1.7	0.9
8	4.7	0

The resulting ground mount (expanded) PV system sizes and associated *total* PV generation (including roof mounted system) was calculated and is presented in Table 108.

Table 108: Expanded PV System Sizes and Total PV Generation across 14 years

Archetype	Climate Zone	Ground PV System Size (kW)	Total Generation (kWh) (from roof and ground mounted PV)	Total Export (kWh) (from roof and ground mounted PV)	Onsite Use (kWh) (from roof and ground mounted PV)
C5OL	1	0.0	107,356	1,967	105,389
C5OL	2	0.0	87,643	801	86,842
C5OL	3	0.0	102,171	1,416	100,755
C5OL	4	12.3	119,153	5,570	113,583
C5OL	5	0.0	95,871	2,085	93,786
C5OL	6	12.3	88,905	2,019	86,886
C5OL	7	20.8	108,156	3,360	104,796
C5OL	8	57.6	161,733	15,314	146,419
C9A	1	27.0	136,159	0	136,159
C9A	2	9.3	106,459	0	106,459
C9A	3	27.0	142,715	981	141,734
C9A	4	27.0	129,621	1,319	128,302
C9A	5	9.3	104,760	118	104,642
C9A	6	27.0	104,610	1,429	103,181
C9A	7	9.3	93,400	54	93,346
C9A	8	0.0	73,466	0	73,466
C3HL	1	21.3	80,681	4	80,677
C3HL	2	7.4	53,477	0	53,477
C3HL	3	21.3	78,025	271	77,754
C3HL	4	21.3	71,276	1,375	69,901
C3HL	5	7.4	49,782	11	49,771
C3HL	6	21.3	61,390	1,848	59,542
C3HL	7	7.4	41,905	0	41,905
C3HL	8	0.0	28,517	0	28,517

Appendix B Simulation Results (Detailed)

Appendix B.I NCC 2022 Base Case

Appendix B.I.I C5OL

Detailed simulation results for NCC 2022 C5OL base case modelling are presented in Table 109 to Table 116 below.

Table 109. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ1

	Boilers energy (MWh gas)	EHC[16] heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	42.5146	6.2353	5.4406	8.3622	19.5275
Feb	0	0	41.0456	6.003	5.3004	8.1538	18.1938
Mar	0	0	45.2466	6.9048	5.7269	8.8878	20.6048
Apr	0	0	38.3839	6.3268	4.8959	7.7124	19.2625
May	0	0	34.6237	6.1866	4.2387	7.2799	20.0662
Jun	0	0	22.7181	4.8274	2.4301	5.5882	19.8011
Jul	0	0	21.2467	4.3866	2.1883	5.1605	19.5275
Aug	0	0	24.4707	5.2061	2.4826	5.8374	20.6048
Sep	0	0	37.0488	6.3806	4.4648	7.4063	19.8011
Oct	0	0	41.9951	7.1369	5.5882	8.1456	19.5275
Nov	0	0	46.4046	7.7446	6.2426	8.8613	19.8011
Dec	0	0	46.8142	7.1652	6.1567	9.1194	20.0662
Total	0	0	442.5126	74.5039	55.1558	90.5148	236.784

Table 110. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ2

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	31.4968	5.0542	3.7153	6.1638	19.5275
Feb	0	0	31.7243	5.0343	3.7806	5.9973	18.1938
Mar	0	0	30.51	5.1511	3.5281	6.4092	20.6048
Apr	0	0	17.3165	3.4215	1.9846	4.3209	19.2625
May	0.1766	0.0365	8.6147	2.492	1.2393	2.8833	20.0662
Jun	1.7219	0.597	3.0081	2.4636	0.6877	1.1916	19.8011
Jul	3.2718	1.1973	2.5174	2.5454	0.5572	0.9641	19.5275
Aug	2.0055	0.7118	3.8526	2.6237	0.8215	1.5818	20.6048
Sep	0.1273	0.0293	8.6996	2.5706	1.1999	2.8134	19.8011
Oct	0	0	11.7205	2.8928	1.4234	3.5343	19.5275
Nov	0	0	22.701	4.2815	2.5656	5.3475	19.8011
Dec	0	0	29.6999	5.2271	3.5553	6.3319	20.0662
Total	7.3032	2.572	201.8612	43.7578	25.0586	47.539	236.784

[16] EHC stands for Electric Heating Coil

Table 111. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ3

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	32.4763	7.1893	4.077	6.6534	19.5275
Feb	0	0	23.9946	6.046	2.9447	5.7502	18.1938
Mar	0	0.0007	23.839	6.0542	2.9128	5.8626	20.6048
Apr	0.0384	0.038	10.2705	3.4165	1.3289	3.2663	19.2625
May	4.3742	1.723	3.634	3.4094	0.8033	1.3113	20.0662
Jun	8.2608	3.3031	1.9447	4.0079	0.5088	0.6596	19.8011
Jul	18.0324	5.6606	0.9893	4.7608	0.4086	0.3123	19.5275
Aug	8.5008	3.4044	3.0439	4.0029	0.7622	1.053	20.6048
Sep	0.2073	0.0537	12.393	3.9888	1.5304	3.6402	19.8011
Oct	0.023	0.0307	13.4898	4.1594	1.6964	3.7549	19.5275
Nov	0	0.015	26.0734	6.6909	3.262	6.0858	19.8011
Dec	0	0	27.643	6.7129	3.3008	6.0778	20.0662
Total	39.4369	14.2292	179.7913	60.439	23.536	44.4273	236.784

Table 112. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ4

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1168	0.0004	18.1402	4.6656	2.2851	4.3037	19.5275
Feb	0.0802	0.0028	15.25	4.1959	1.7634	3.5656	18.1938
Mar	1.1552	0.0656	9.6165	3.376	1.2107	2.4288	20.6048
Apr	5.674	0.5033	3.377	2.6328	0.7585	1.2264	19.2625
May	19.8271	2.3609	0.6601	3.3736	0.381	0.2367	20.0662
Jun	33.3594	3.9441	0.1496	4.0354	0.367	0.0402	19.8011
Jul	38.744	4.8041	0.0101	4.2569	0.3653	0.002	19.5275
Aug	32.4039	4.277	0.2409	4.1241	0.3782	0.0717	20.6048
Sep	13.6742	1.4841	1.7788	3.0861	0.5491	0.6331	19.8011
Oct	6.1698	0.5522	3.8222	2.7194	0.7925	1.2607	19.5275
Nov	0.3639	0.0247	11.6763	3.5319	1.5957	2.9729	19.8011
Dec	0.227	0.0059	15.604	4.3193	1.7524	3.7028	20.0662
Total	151.7956	18.025	80.3256	44.317	12.1989	20.4449	236.784

Table 113. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ5

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0103	0	23.492	4.931	3.0177	7.0808	19.5275
Feb	0	0	24.9728	4.7514	3.2601	7.0737	18.1938
Mar	0.0168	0	22.153	4.6199	2.8381	7.2083	20.6048
Apr	0.0472	0.0004	13.6138	3.3272	1.7692	5.0377	19.2625
May	1.2695	0.0786	5.2514	2.4489	0.8221	2.4127	20.0662
Jun	5.4716	0.2836	1.6764	2.3098	0.4203	0.8198	19.8011
Jul	7.9539	0.4659	1.1451	2.3403	0.3312	0.4681	19.5275
Aug	5.8653	0.3548	2.0709	2.5312	0.5094	0.9683	20.6048
Sep	1.0669	0.066	6.1116	2.8587	0.9629	3.0022	19.8011
Oct	0.0199	0	12.0179	3.5367	1.5678	4.6617	19.5275
Nov	0.051	0.0015	15.311	4.2146	2.0949	5.4727	19.8011
Dec	0	0	20.3339	4.6102	2.5878	6.7385	20.0662
Total	21.7723	1.2509	148.1501	42.4798	20.1816	50.9446	236.784

Table 114. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ6

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0331	0	12.9817	3.4871	1.5746	2.9138	19.5275
Feb	0.0144	0	11.3029	3.2029	1.4051	2.5319	18.1938
Mar	0.2522	0	6.0397	2.481	0.8563	1.642	20.6048
Apr	2.4803	0	2.5181	2.1621	0.4646	0.7495	19.2625
May	11.0735	0	0.3911	2.634	0.2119	0.0697	20.0662
Jun	20.2353	0	0.1226	2.9804	0.2557	0.0204	19.8011
Jul	19.9294	0	0.0019	2.8433	0.2285	0.0003	19.5275
Aug	17.3715	0	0.127	2.9875	0.233	0.0183	20.6048
Sep	7.9754	0	1.5865	2.512	0.3661	0.4329	19.8011
Oct	2.3519	0	2.2673	2.1815	0.3898	0.5885	19.5275
Nov	0.6714	0	6.6696	2.708	0.9362	1.5492	19.8011
Dec	0.2027	0	8.4523	2.901	1.1117	2.1382	20.0662
Total	82.5911	0	52.4607	33.0809	8.0336	12.6546	236.784

Table 115. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ7

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1356	0	11.1707	3.0374	1.3396	2.6027	19.5275
Feb	0.1026	0	13.3961	3.443	1.6796	3.003	18.1938
Mar	0.7666	0	5.8429	2.6627	0.9112	1.6324	20.6048
Apr	10.8017	0	2.2298	2.7782	0.5781	0.6255	19.2625
May	31.277	0	0.3885	3.7922	0.6768	0.092	20.0662
Jun	51.4911	0	0.0217	4.8878	0.9801	0.0035	19.8011
Jul	51.8933	0	0	4.9547	1.0179	0	19.5275
Aug	48.8862	0	0	4.8102	0.9442	0	20.6048
Sep	19.3483	0	0.9548	3.2925	0.567	0.2873	19.8011
Oct	9.8716	0	1.9183	2.7535	0.522	0.5373	19.5275
Nov	3.1194	0	4.8174	2.7173	0.71	1.2483	19.8011
Dec	0.3036	0	9.6287	3.0573	1.2721	2.2988	20.0662
Total	227.997	0	50.3688	42.1867	11.1985	12.3309	236.784

Table 116. Detailed Simulation Results for NCC 2022 C5OL Base Case Modelling in CZ8

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	2.3403	0	4.5489	2.6665	0.4527	0.765	19.5275
Feb	1.95	0	3.3637	2.5218	0.3441	0.6159	18.1938
Mar	9.5473	0	1.3877	3.1719	0.2699	0.3246	20.6048
Apr	29.0274	0	0.1546	3.7254	0.3153	0.0378	19.2625
May	58.4653	0	0.0001	5.1395	0.58	0	20.0662
Jun	94.1245	0	0.0002	7.1694	0.9502	0	19.8011
Jul	96.9175	0	0	7.3634	1.0041	0	19.5275
Aug	89.0677	0	0	6.9725	0.929	0	20.6048
Sep	54.1393	0	0.0293	5.0339	0.5352	0.0061	19.8011
Oct	28.1837	0	0.9458	3.7043	0.3663	0.188	19.5275
Nov	12.98	0	2.0379	3.178	0.3384	0.4257	19.8011
Dec	3.1774	0	3.4975	3.4276	0.5549	0.6579	20.0662
Total	479.9203	0	15.9657	54.0741	6.6401	3.0211	236.784

Appendix B.I.II C5OM

Detailed simulation results for NCC 2022 C5OM base case modelling are presented in Table 117 to Table 124 below.

Table 117. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ1

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	12.171	0	3.9222	3.3409
Feb	0	12.0522	0	3.7355	3.112
Mar	0	13.4852	0	4.2958	3.5238
Apr	0	11.7717	0	3.9222	3.2951
May	0	11.8322	0	4.109	3.4324
Jun	0	8.8597	0	4.109	3.3866
Jul	0	7.7663	0	3.9222	3.3409
Aug	0	9.0817	0	4.2958	3.5238
Sep	0	11.7479	0	4.109	3.3866
Oct	0	12.8374	0	3.9222	3.3409
Nov	0	14.7514	0	4.109	3.3866
Dec	0	14.4179	0	4.109	3.4324
Total	0	140.7748	0	48.5611	40.502

Table 118. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ2

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	8.4813	0	3.1554	3.3409
Feb	0	8.7726	0	3.0051	3.112
Mar	0	9.2581	0	3.4559	3.5238
Apr	0	5.776	0	3.1554	3.2951
May	0.0029	3.8892	0	3.3057	3.4324
Jun	0.045	2.1294	0	3.3057	3.3866
Jul	0.1096	1.953	0	3.1554	3.3409
Aug	0.0553	2.6378	0	3.4559	3.5238
Sep	0.003	3.6608	0	3.3057	3.3866
Oct	0	4.1961	0	3.1554	3.3409
Nov	0	6.9719	0	3.3057	3.3866
Dec	0	8.869	0	3.3057	3.4324
Total	0.2159	66.5951	0	39.0669	40.502

Table 119. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ3

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	12.5228	0	4.0309	3.3409
Feb	0	10.8217	0	3.839	3.112
Mar	0	11.0081	0	4.4148	3.5238
Apr	0.002	6.8232	0	4.0309	3.2951
May	0.1253	3.2183	0.2444	4.2229	3.4324
Jun	0.2606	2.2315	0.3408	4.2229	3.3866
Jul	0.874	1.3211	0.7017	4.0309	3.3409
Aug	0.3846	2.9349	0.1731	4.4148	3.5238
Sep	0.0077	7.589	0.0062	4.2229	3.3866
Oct	0.0022	7.4739	0	4.0309	3.3409
Nov	0	12.0728	0	4.2229	3.3866
Dec	0	12.2546	0	4.2229	3.4324
Total	1.6563	90.2718	1.4662	49.9068	40.502

Table 120. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ4

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.6164	0	2.9239	3.3409
Feb	0	7.1213	0	2.7846	3.112
Mar	0.0162	5.2141	0	3.2023	3.5238
Apr	0.1191	2.6152	0.0909	2.9239	3.2951
May	0.7189	0.8155	0.5801	3.0631	3.4324
Jun	1.7358	0.2459	1.0542	3.0631	3.3866
Jul	2.1096	0.0895	1.2282	2.9239	3.3409
Aug	1.7196	0.3775	0.7475	3.2023	3.5238
Sep	0.4915	1.5832	0.3084	3.0631	3.3866
Oct	0.1697	2.5856	0.091	2.9239	3.3409
Nov	0.0077	5.7814	0.0022	3.0631	3.3866
Dec	0.0012	7.2589	0	3.0631	3.4324
Total	7.0894	41.3045	4.1025	36.2001	40.502

Table 121. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ5

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	5.9373	0	2.5404	3.3409
Feb	0	6.1632	0	2.4194	3.112
Mar	0	5.999	0	2.7823	3.5238
Apr	0.001	3.8595	0	2.5404	3.2951
May	0.032	2.1639	0	2.6613	3.4324
Jun	0.1146	1.0662	0	2.6613	3.3866
Jul	0.2457	0.8819	0	2.5404	3.3409
Aug	0.17	1.4017	0	2.7823	3.5238
Sep	0.0229	2.7348	0	2.6613	3.3866
Oct	0.0007	4.0346	0	2.5404	3.3409
Nov	0.0022	4.8865	0	2.6613	3.3866
Dec	0	5.7642	0	2.6613	3.4324
Total	0.589	44.8927	0	31.4523	40.502

Table 122. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0007	4.7182	0	2.2791	3.3409
Feb	0.0003	4.4656	0	2.1706	3.112
Mar	0.0029	3.1299	0	2.4962	3.5238
Apr	0.067	1.6187	0	2.2791	3.2951
May	0.4021	0.5342	0.1606	2.3876	3.4324
Jun	0.9214	0.1819	0.1658	2.3876	3.3866
Jul	0.922	0.0478	0.0456	2.2791	3.3409
Aug	0.8237	0.2937	0.3496	2.4962	3.5238
Sep	0.3202	1.0427	0.0877	2.3876	3.3866
Oct	0.0816	1.5881	0	2.2791	3.3409
Nov	0.0158	3.1786	0	2.3876	3.3866
Dec	0.0064	3.8421	0	2.3876	3.4324
Total	3.5642	24.6416	0.8093	28.2176	40.502

Table 123. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ7

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0027	4.1144	0	2.3885	3.3409
Feb	0.0013	5.048	0	2.2747	3.112
Mar	0.0262	3.1427	0	2.6159	3.5238
Apr	0.3847	1.2058	0.3411	2.3885	3.2951
May	1.2674	0.3431	0.984	2.5022	3.4324
Jun	2.4353	0.0486	1.3069	2.5022	3.3866
Jul	2.3741	0	0.8933	2.3885	3.3409
Aug	2.1892	0.0523	0.8427	2.6159	3.5238
Sep	0.9216	0.634	0.5055	2.5022	3.3866
Oct	0.4133	1.1398	0.3414	2.3885	3.3409
Nov	0.088	2.3259	0.0771	2.5022	3.3866
Dec	0.0089	3.8552	0.0005	2.5022	3.4324
Total	10.1128	21.9098	5.2926	29.5715	40.502

Table 124. Detailed Simulation Results for NCC 2022 C5OM Base Case Modelling in CZ8

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0465	2.3299	0.0245	3.0794	3.3409
Feb	0.0366	2.2982	0	2.9328	3.112
Mar	0.2273	1.6749	0.1821	3.3727	3.5238
Apr	0.9246	0.614	0.8952	3.0794	3.2951
May	2.3958	0.0696	1.2642	3.2261	3.4324
Jun	4.8458	0	3.592	3.2261	3.3866
Jul	4.9285	0	4.1097	3.0794	3.3409
Aug	4.3659	0.0233	2.6217	3.3727	3.5238
Sep	2.3844	0.2014	1.7175	3.2261	3.3866
Oct	1.0331	0.7119	0.7658	3.0794	3.3409
Nov	0.4624	1.4356	0.5218	3.2261	3.3866
Dec	0.0691	2.2624	0.0761	3.2261	3.4324
Total	21.7199	11.6212	15.7705	38.1261	40.502

Appendix B.I.III C9A

Detailed simulation results for NCC 2022 C9A base case modelling are presented in Table 125 to Table 132 below.

Table 125. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ1

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	73.0327	7.8974	6.2187	0	14.2383
Feb	0	0	67.6239	7.1331	5.9188	0	12.8604
Mar	0	0	71.6911	7.8974	6.2111	0	14.2383
Apr	0	0	65.3822	7.6426	5.4944	0	13.779
May	0	0	53.826	7.8974	4.3318	0	14.2383
Jun	0	0	33.2917	7.6426	2.5299	0	13.779
Jul	0	0	31.523	7.8974	2.4971	0	14.2383
Aug	0	0	32.9029	7.8974	2.4358	0	14.2383
Sep	0	0	55.4666	7.6426	4.4963	0	13.779
Oct	0	0	72.1879	7.8974	6.0868	0	14.2383
Nov	0	0	80.0991	7.6426	6.6172	0	13.779
Dec	0	0	81.746	7.8974	6.9628	0	14.2383
Total	0	0	718.7732	92.9852	59.8005	0	167.6443

Table 126. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ2

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	40.9091	7.1606	3.5454	0	14.2383
Feb	0	0	40.8769	6.4676	3.5214	0	12.8604
Mar	0	0	32.5925	7.1606	2.7042	0	14.2383
Apr	0	0	18.0503	6.9296	1.6473	0	13.779
May	0.5013	0	5.988	7.1606	0.7501	0	14.2383
Jun	5.0983	0	1.2729	6.9296	0.3251	0	13.779
Jul	11.3065	0	1.4533	7.1606	0.408	0	14.2383
Aug	7.503	0	2.1142	7.1606	0.463	0	14.2383
Sep	0.4111	0	6.1009	6.9296	0.7426	0	13.779
Oct	0.0165	0	10.6953	7.1606	1.153	0	14.2383
Nov	0	0	24.1499	6.9296	2.095	0	13.779
Dec	0	0	34.9709	7.1606	2.9434	0	14.2383
Total	24.8367	0	219.1743	84.3098	20.2985	0	167.6443

Table 127. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ3

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	51.7662	8.787	3.7605	0	14.2383
Feb	0	0	37.1286	7.9366	2.6749	0	12.8604
Mar	0	0	35.5767	8.787	2.5891	0	14.2383
Apr	0.5419	0	16.0765	8.5035	1.338	0	13.779
May	13.9693	0	3.321	8.787	0.5726	0	14.2383
Jun	24.3589	0	2.2427	8.5035	0.5202	0	13.779
Jul	43.2094	0	1.0117	8.787	0.5141	0	14.2383
Aug	23.694	0	3.3843	8.787	0.6287	0	14.2383
Sep	1.566	0	19.5188	8.5035	1.5333	0	13.779
Oct	1.1757	0	22.2261	8.787	1.753	0	14.2383
Nov	0	0	40.5695	8.5035	2.8685	0	13.779
Dec	0	0	45.4953	8.787	3.2167	0	14.2383
Total	108.5152	0	278.3174	103.4596	21.9695	0	167.6447

Table 128. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ4

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	27.9793	13.0169	2.2452	0	14.2383
Feb	0	0	22.1738	11.7572	1.8018	0	12.8604
Mar	0.1455	0	11.7872	13.0169	1.0984	0	14.2383
Apr	4.3022	0	5.0767	12.597	0.5897	0	13.779
May	16.2377	0	0.5414	13.0169	0.2531	0	14.2383
Jun	31.107	0	0.0797	12.597	0.273	0	13.779
Jul	40.8405	0	0.0254	13.0169	0.3208	0	14.2383
Aug	30.2417	0	0.2506	13.0169	0.3053	0	14.2383
Sep	10.0063	0	2.2239	12.597	0.3812	0	13.779
Oct	2.8018	0	4.93	13.0169	0.5688	0	14.2383
Nov	0.0564	0	17.5443	12.597	1.4978	0	13.779
Dec	0	0	23.1117	13.0169	1.9007	0	14.2383
Total	135.739	0	115.7241	153.2637	11.2358	0	167.6443

Table 129. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ5

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	28.9674	11.763	2.5662	0	14.2383
Feb	0	0	26.8842	10.6246	2.4415	0	12.8604
Mar	0	0	23.1642	11.763	2.1014	0	14.2383
Apr	0	0	12.1826	11.3835	1.2218	0	13.779
May	0.2873	0	4.1032	11.763	0.5652	0	14.2383
Jun	2.8248	0	0.9544	11.3835	0.249	0	13.779
Jul	5.5899	0	0.9597	11.763	0.2845	0	14.2383
Aug	2.7777	0	2.0172	11.763	0.3668	0	14.2383
Sep	0.1116	0	6.8836	11.3835	0.7747	0	13.779
Oct	0	0	12.9434	11.763	1.2628	0	14.2383
Nov	0	0	17.1619	11.3835	1.6086	0	13.779
Dec	0	0	21.6786	11.763	2.0112	0	14.2383
Total	11.5913	0	157.9003	138.4996	15.4536	0	167.6443

Table 130. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ6

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	15.9273	11.8147	1.4644	0	14.2383
Feb	0	0	15.1348	10.6713	1.3381	0	12.8604
Mar	0.0344	0	6.8482	11.8147	0.7281	0	14.2383
Apr	0.6792	0	2.747	11.4336	0.3712	0	13.779
May	7.6237	0	0.2548	11.8147	0.1397	0	14.2383
Jun	18.136	0	0.0941	11.4336	0.1796	0	13.779
Jul	19.612	0	0.0364	11.8147	0.1954	0	14.2383
Aug	14.0034	0	0.1433	11.8147	0.1693	0	14.2383
Sep	6.0248	0	1.4401	11.4336	0.2709	0	13.779
Oct	1.0099	0	3.7078	11.8147	0.4187	0	14.2383
Nov	0.0575	0	9.6296	11.4336	0.9226	0	13.779
Dec	0.0505	0	10.6927	11.8147	1.0246	0	14.2383
Total	67.2313	0	66.6559	139.1085	7.2226	0	167.6443

Table 131. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ7

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	14.9768	13.3186	1.3744	0	14.2383
Feb	0	0	16.8304	12.0297	1.516	0	12.8604
Mar	0.1094	0	7.3724	13.3186	0.7522	0	14.2383
Apr	10.6358	0	1.8252	12.889	0.3431	0	13.779
May	28.3246	0	0.337	13.3186	0.3192	0	14.2383
Jun	45.2609	0	0.0343	12.889	0.3454	0	13.779
Jul	51.0079	0	0.0048	13.3186	0.3849	0	14.2383
Aug	40.9699	0	0.0478	13.3186	0.3354	0	14.2383
Sep	17.9406	0	0.7053	12.889	0.2719	0	13.779
Oct	7.8872	0	2.7586	13.3186	0.3858	0	14.2383
Nov	2.2655	0	6.2649	12.889	0.6317	0	13.779
Dec	0.0673	0	12.4492	13.3186	1.1522	0	14.2383
Total	204.4691	0	63.6067	156.8161	7.812	0	167.6443

Table 132. Detailed Simulation Results for NCC 2022 C9A Base Case Modelling in CZ8

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	1.47	0	4.3503	14.3193	0.4926	0	14.2383
Feb	1.0862	0	3.4884	12.9336	0.4084	0	12.8604
Mar	6.2318	0	1.306	14.3193	0.2608	0	14.2383
Apr	25.713	0	0.2359	13.8574	0.2857	0	13.779
May	46.9588	0	0.0249	14.3193	0.3831	0	14.2383
Jun	78.115	0	0.0001	13.8574	0.4812	0	13.779
Jul	86.3442	0	0	14.3193	0.5203	0	14.2383
Aug	70.5863	0	0.0094	14.3193	0.4732	0	14.2383
Sep	45.284	0	0.0717	13.8574	0.355	0	13.779
Oct	24.6313	0	0.8215	14.3193	0.3278	0	14.2383
Nov	11.3227	0	2.2459	13.8574	0.3717	0	13.779
Dec	1.7766	0	4.1393	14.3193	0.4964	0	14.2383
Total	399.5199	0	16.6936	168.5982	4.8562	0	167.6443

Appendix B.I.IV C9AS

Detailed simulation results for NCC 2022 C9AS base case modelling are presented in Table 133 to Table 140 below.

Table 133. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ1

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	21.3243	0	1.0319	2.5088
Feb	0	20.4146	0	0.932	2.266
Mar	0	21.9505	0	1.0319	2.5088
Apr	0	19.706	0	0.9986	2.4279
May	0	18.4385	0	1.0319	2.5088
Jun	0	14.3975	0	0.9986	2.4279
Jul	0	14.2998	0	1.0319	2.5088
Aug	0	14.5973	0	1.0319	2.5088
Sep	0	18.1716	0	0.9986	2.4279
Oct	0	21.6644	0	1.0319	2.5088
Nov	0	24.5384	0	0.9986	2.4279
Dec	0	24.7467	0	1.0319	2.5088
Total	0	234.2496	0	12.1497	29.539

Table 134. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ2

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	15.7099	0	1.0319	2.5088
Feb	0	15.4215	0	0.932	2.266
Mar	0	14.8485	0	1.0319	2.5088
Apr	0	10.3854	0	0.9986	2.4279
May	0.0011	6.2213	0	1.0319	2.5088
Jun	0.4331	2.0681	0	0.9986	2.4279
Jul	1.5636	1.6314	0.2215	1.0319	2.5088
Aug	0.7994	2.5629	0	1.0319	2.5088
Sep	0.0017	5.3783	0	0.9986	2.4279
Oct	0	8.5425	0	1.0319	2.5088
Nov	0	12.3116	0	0.9986	2.4279
Dec	0	14.9775	0	1.0319	2.5088
Total	2.7989	110.059	0.2215	12.1497	29.539

Table 135. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ3

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	17.9498	0	1.0319	2.5088
Feb	0	14.9132	0	0.932	2.266
Mar	0	15.4143	0	1.0319	2.5088
Apr	0	9.1084	0	0.9986	2.4279
May	1.1063	2.6604	0.999	1.0319	2.5088
Jun	3.2835	1.1146	1.2203	0.9986	2.4279
Jul	5.9358	0.3277	2.2368	1.0319	2.5088
Aug	2.9522	1.7692	0.6408	1.0319	2.5088
Sep	0.05	9.5467	0.0221	0.9986	2.4279
Oct	0.0046	11.0942	0	1.0319	2.5088
Nov	0	15.9871	0	0.9986	2.4279
Dec	0	17.5774	0	1.0319	2.5088
Total	13.3325	117.4629	5.1189	12.1497	29.539

Table 136. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ4

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	10.9001	0	1.0319	2.5088
Feb	0	9.6026	0	0.932	2.266
Mar	0.0492	6.5096	0	1.0319	2.5088
Apr	1.3607	2.2944	0.359	0.9986	2.4279
May	5.129	0.122	1.8463	1.0319	2.5088
Jun	7.786	0	2.8151	0.9986	2.4279
Jul	9.5849	0	3.9616	1.0319	2.5088
Aug	8.1378	0.0103	2.5439	1.0319	2.5088
Sep	3.6821	0.6227	1.2835	0.9986	2.4279
Oct	1.4389	1.7418	0.3946	1.0319	2.5088
Nov	0.0333	7.1988	0.0303	0.9986	2.4279
Dec	0	9.9356	0	1.0319	2.5088
Total	37.2018	48.9378	13.2343	12.1497	29.539

Table 137. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ5

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	10.4433	0	1.0319	2.5088
Feb	0	9.9294	0	0.932	2.266
Mar	0	9.7509	0	1.0319	2.5088
Apr	0	6.2344	0	0.9986	2.4279
May	0.2791	2.5451	0	1.0319	2.5088
Jun	1.7744	0.3594	0	0.9986	2.4279
Jul	2.9753	0.437	0	1.0319	2.5088
Aug	2.036	0.9148	0	1.0319	2.5088
Sep	0.2845	3.1365	0	0.9986	2.4279
Oct	0	6.0288	0	1.0319	2.5088
Nov	0.0011	7.5785	0	0.9986	2.4279
Dec	0	9.7365	0	1.0319	2.5088
Total	7.3505	67.0945	0	12.1497	29.539

Table 138. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ6

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	8.7465	0	1.0319	2.5088
Feb	0	8.5894	0	0.932	2.266
Mar	0.0241	5.1829	0	1.0319	2.5088
Apr	0.8805	1.4777	0	0.9986	2.4279
May	4.1609	0.0883	0.5067	1.0319	2.5088
Jun	6.7931	0.0155	0.624	0.9986	2.4279
Jul	7.531	0.002	0.1736	1.0319	2.5088
Aug	5.9515	0.0597	0.7523	1.0319	2.5088
Sep	3.1315	0.7081	0.1887	0.9986	2.4279
Oct	1.2491	2.3224	0	1.0319	2.5088
Nov	0.1452	6.0197	0	0.9986	2.4279
Dec	0.0358	6.8332	0	1.0319	2.5088
Total	29.9032	40.0455	2.2454	12.1497	29.539

Table 139. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ7

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	6.7645	0	2.8614	2.5088
Feb	0	7.5022	0	2.5845	2.266
Mar	0	4.5769	0	2.8614	2.5088
Apr	1.6347	0.7532	1.3485	2.7691	2.4279
May	4.8521	0.0686	2.9124	2.8614	2.5088
Jun	7.2946	0	3.8909	2.7691	2.4279
Jul	8.1224	0	4.1093	2.8614	2.5088
Aug	7.3306	0	3.0882	2.8614	2.5088
Sep	3.6669	0.145	2.0849	2.7691	2.4279
Oct	1.4727	0.9663	1.1256	2.8614	2.5088
Nov	0.277	2.6479	0.2971	2.7691	2.4279
Dec	0	5.8242	0	2.8614	2.5088
Total	34.6509	29.2488	18.8569	33.6912	29.539

Table 140. Detailed Simulation Results for NCC 2022 C9AS Base Case Modelling in CZ8

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0.3985	2.3082	0.1326	2.8614	2.5088
Feb	0.1658	2.1667	0.0484	2.5845	2.266
Mar	1.591	0.4534	0.5177	2.8614	2.5088
Apr	5.5125	0.0464	3.5682	2.7691	2.4279
May	8.9504	0	5.4024	2.8614	2.5088
Jun	12.1583	0	10.1753	2.7691	2.4279
Jul	13.0739	0	11.3736	2.8614	2.5088
Aug	11.991	0	8.5275	2.8614	2.5088
Sep	8.6971	0.0051	6.2278	2.7691	2.4279
Oct	5.2891	0.2256	2.767	2.8614	2.5088
Nov	2.5647	0.8732	1.3208	2.7691	2.4279
Dec	0.4805	1.9881	0.2511	2.8614	2.5088
Total	70.8728	8.0667	50.3123	33.6912	29.539

Appendix B.I.V C5OS

Detailed simulation results for NCC 2022 C5OS base case modelling are presented in Table 141 to Table 148 below.

Table 141. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	4.4256	0	0.0689	0.9701
Feb	0	4.3019	0	0.0656	0.9036
Mar	0	4.8019	0	0.0755	1.0232
Apr	0	4.194	0	0.0689	0.9568
May	0	4.0722	0	0.0722	0.9967
Jun	0	3.1563	0	0.0722	0.9833
Jul	0	2.9536	0	0.0689	0.9701
Aug	0	3.2958	0	0.0755	1.0232
Sep	0	4.0844	0	0.0722	0.9833
Oct	0	4.6689	0	0.0689	0.9701
Nov	0	5.3794	0	0.0722	0.9833
Dec	0	5.2529	0	0.0722	0.9967
Total	0	50.5869	0	0.8531	11.7606

Table 142. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	2.8869	0	0.0689	0.9701
Feb	0	2.9651	0	0.0656	0.9036
Mar	0	2.9575	0	0.0755	1.0232
Apr	0.0002	2.0873	0	0.0689	0.9568
May	0.0053	1.6011	0	0.0722	0.9967
Jun	0.1258	0.8069	0	0.0722	0.9833
Jul	0.2244	0.832	0	0.0689	0.9701
Aug	0.1441	1.1619	0	0.0755	1.0232
Sep	0.0087	1.5504	0	0.0722	0.9833
Oct	0.0001	1.8719	0	0.0689	0.9701
Nov	0	2.4096	0	0.0722	0.9833
Dec	0	2.943	0	0.0722	0.9967
Total	0.5085	24.0736	0	0.8531	11.7606

Table 143. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	4.3992	0	0.0689	0.9701
Feb	0	3.6046	0	0.0656	0.9036
Mar	0	3.7012	0	0.0755	1.0232
Apr	0.0033	2.4695	0	0.0689	0.9568
May	0.2396	1.3199	0.2138	0.0722	0.9967
Jun	0.5125	0.8455	0.2057	0.0722	0.9833
Jul	0.9456	0.4809	0.34	0.0689	0.9701
Aug	0.467	1.2747	0.0968	0.0755	1.0232
Sep	0.0111	2.7245	0.0053	0.0722	0.9833
Oct	0.0013	2.8313	0	0.0689	0.9701
Nov	0	4.1907	0	0.0722	0.9833
Dec	0	4.1702	0	0.0722	0.9967
Total	2.1805	32.0122	0.8616	0.8531	11.7606

Table 144. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0001	2.5411	0	0.0689	0.9701
Feb	0	2.3133	0	0.0656	0.9036
Mar	0.0362	1.8063	0	0.0755	1.0232
Apr	0.2708	0.9831	0.0412	0.0689	0.9568
May	0.9255	0.1661	0.2519	0.0722	0.9967
Jun	1.6148	0.0174	0.4479	0.0722	0.9833
Jul	1.8161	0.0019	0.5208	0.0689	0.9701
Aug	1.5513	0.073	0.3181	0.0755	1.0232
Sep	0.5983	0.5182	0.1389	0.0722	0.9833
Oct	0.2133	0.9599	0.0476	0.0689	0.9701
Nov	0.0114	2.0724	0.0012	0.0722	0.9833
Dec	0.0008	2.4624	0	0.0722	0.9967
Total	7.0387	13.9152	1.7676	0.8531	11.7606

Table 145. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	1.947	0	0.0689	0.9701
Feb	0	1.9662	0	0.0656	0.9036
Mar	0	1.9082	0	0.0755	1.0232
Apr	0.0015	1.37	0	0.0689	0.9568
May	0.0918	0.7534	0	0.0722	0.9967
Jun	0.2961	0.256	0	0.0722	0.9833
Jul	0.4576	0.2544	0	0.0689	0.9701
Aug	0.3438	0.4823	0	0.0755	1.0232
Sep	0.0478	1.0649	0	0.0722	0.9833
Oct	0.0005	1.5566	0	0.0689	0.9701
Nov	0.0069	1.7449	0	0.0722	0.9833
Dec	0	1.9161	0	0.0722	0.9967
Total	1.246	15.2199	0	0.8531	11.7606

Table 146. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0019	1.8282	0	0.0689	0.9701
Feb	0.0004	1.705	0	0.0656	0.9036
Mar	0.02	1.274	0	0.0755	1.0232
Apr	0.1466	0.6145	0	0.0689	0.9568
May	0.5962	0.1054	0.0673	0.0722	0.9967
Jun	1.088	0.038	0.0671	0.0722	0.9833
Jul	1.1598	0	0.0183	0.0689	0.9701
Aug	0.9507	0.0584	0.1454	0.0755	1.0232
Sep	0.4196	0.3701	0.0369	0.0722	0.9833
Oct	0.1784	0.5733	0	0.0689	0.9701
Nov	0.0485	1.3117	0	0.0722	0.9833
Dec	0.0096	1.6154	0	0.0722	0.9967
Total	4.6198	9.4938	0.3351	0.8531	11.7606

Table 147. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0023	1.681	0	0.0689	0.9701
Feb	0.0031	1.8498	0	0.0656	0.9036
Mar	0.0788	1.2279	0	0.0755	1.0232
Apr	0.4658	0.4323	0.1472	0.0689	0.9568
May	1.3088	0.0871	0.4209	0.0722	0.9967
Jun	1.9575	0.012	0.5551	0.0722	0.9833
Jul	1.9953	0	0.3787	0.0689	0.9701
Aug	1.9309	0.0023	0.3574	0.0755	1.0232
Sep	0.8525	0.243	0.2141	0.0722	0.9833
Oct	0.495	0.391	0.1546	0.0689	0.9701
Nov	0.1656	0.869	0.0405	0.0722	0.9833
Dec	0.0147	1.5364	0.0003	0.0722	0.9967
Total	9.2703	8.3318	2.2688	0.8531	11.7606

Table 148. Detailed Simulation Results for NCC 2022 C5OS Base Case Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.074	1.1595	0.0224	0.0689	0.9701
Feb	0.0749	1.1887	0	0.0656	0.9036
Mar	0.33	0.9045	0.0829	0.0755	1.0232
Apr	0.9421	0.3545	0.3767	0.0689	0.9568
May	1.8964	0.0176	0.485	0.0722	0.9967
Jun	2.973	0	1.3818	0.0722	0.9833
Jul	2.9808	0	1.5817	0.0689	0.9701
Aug	2.7121	0.0126	0.9838	0.0755	1.0232
Sep	1.6959	0.121	0.7427	0.0722	0.9833
Oct	0.9362	0.4015	0.3276	0.0689	0.9701
Nov	0.5363	0.8377	0.2838	0.0722	0.9833
Dec	0.1348	1.2417	0.0569	0.0722	0.9967
Total	15.2865	6.2393	6.3254	0.8531	11.7606

Appendix B.I.VI C6RS

Detailed simulation results for NCC 2022 C6RS base case modelling are presented in Table 149 to Table 156 below.

Table 149. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ1

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	20.6763	0	6.5066	7.6454
Feb	0	19.227	0	5.8769	6.9055
Mar	0	20.8553	0	6.5066	7.6454
Apr	0	19.9794	0	6.2967	7.3987
May	0	19.056	0	6.5066	7.6454
Jun	0	13.5252	0	6.2967	7.3987
Jul	0	13.2486	0	6.5066	7.6454
Aug	0	13.3579	0	6.5066	7.6454
Sep	0	17.7589	0	6.2967	7.3987
Oct	0	21.2691	0	6.5066	7.6454
Nov	0	23.0016	0	6.2967	7.3987
Dec	0	22.922	0	6.5066	7.6454
Total	0	224.8773	0	76.6099	90.0181

Table 150. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ2

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	13.9264	0	5.7852	7.6454
Feb	0	13.7923	0	5.2253	6.9055
Mar	0	13.4331	0	5.7852	7.6454
Apr	0	8.9956	0	5.5985	7.3987
May	0.0009	5.7839	0	5.7852	7.6454
Jun	0.1019	3.0324	0	5.5985	7.3987
Jul	0.3144	3.6224	0.0409	5.7852	7.6454
Aug	0.1767	3.9648	0	5.7852	7.6454
Sep	0	5.1869	0	5.5985	7.3987
Oct	0	6.3287	0	5.7852	7.6454
Nov	0	10.3769	0	5.5985	7.3987
Dec	0	13.0611	0	5.7852	7.6454
Total	0.5938	101.5044	0.0409	68.1156	90.0181

Table 151. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ3

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	19.784	0	7.237	7.6454
Feb	0	15.5025	0	6.5367	6.9055
Mar	0	16.1247	0	7.237	7.6454
Apr	0	10.6466	0	7.0036	7.3987
May	0.5164	4.692	0.5933	7.237	7.6454
Jun	1.0744	3.6703	0.6962	7.0036	7.3987
Jul	2.249	2.7609	1.1992	7.237	7.6454
Aug	1.2251	4.4412	0.361	7.237	7.6454
Sep	0.03	11.0606	0.0213	7.0036	7.3987
Oct	0.0018	11.3787	0	7.237	7.6454
Nov	0	18.2377	0	7.0036	7.3987
Dec	0	18.9892	0	7.237	7.6454
Total	5.0967	137.2883	2.871	85.2103	90.0181

Table 152. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ4

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	11.0414	0	5.5967	7.6454
Feb	0	9.5167	0	5.0551	6.9055
Mar	0.0444	6.1916	0	5.5967	7.6454
Apr	0.5008	3.9952	0.2234	5.4161	7.3987
May	1.7228	1.0629	0.9497	5.5967	7.6454
Jun	3.4773	0.2617	1.4722	5.4161	7.3987
Jul	4.5177	0.0901	1.9884	5.5967	7.6454
Aug	3.3375	0.5666	1.2005	5.5967	7.6454
Sep	1.2312	2.2745	0.3961	5.4161	7.3987
Oct	0.5635	3.262	0.2058	5.5967	7.6454
Nov	0.0181	7.8673	0.0047	5.4161	7.3987
Dec	0	9.7873	0	5.5967	7.6454
Total	15.4133	55.9173	6.4407	65.8964	90.0181

Table 153. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ5

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	8.9712	0	4.5413	7.6454
Feb	0	8.3781	0	4.1018	6.9055
Mar	0	8.3879	0	4.5413	7.6454
Apr	0.0001	5.5485	0	4.3948	7.3987
May	0.09	2.8422	0	4.5413	7.6454
Jun	0.4559	1.1261	0	4.3948	7.3987
Jul	0.7966	1.2708	0	4.5413	7.6454
Aug	0.5908	2.0291	0	4.5413	7.6454
Sep	0.0527	3.7798	0	4.3948	7.3987
Oct	0	5.4727	0	4.5413	7.6454
Nov	0.0089	6.2891	0	4.3948	7.3987
Dec	0	7.7715	0	4.5413	7.6454
Total	1.9949	61.867	0	53.47	90.0181

Table 154. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ6

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	5.9994	0	4.3419	7.6454
Feb	0	6.0055	0	3.9218	6.9055
Mar	0.0224	3.5123	0	4.3419	7.6454
Apr	0.2345	1.875	0	4.2019	7.3987
May	1.2611	0.5212	0.2881	4.3419	7.6454
Jun	2.4446	0.2043	0.4632	4.2019	7.3987
Jul	2.6753	0.0977	0.0802	4.3419	7.6454
Aug	1.8673	0.2841	0.4383	4.3419	7.6454
Sep	0.8797	1.0196	0.1033	4.2019	7.3987
Oct	0.4165	1.9205	0	4.3419	7.6454
Nov	0.0612	3.9202	0	4.2019	7.3987
Dec	0.0163	4.496	0	4.3419	7.6454
Total	9.8788	29.8557	1.3731	51.1228	90.0181

Table 155. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ7

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	5.6954	0	4.5472	7.6454
Feb	0	6.5754	0	4.1071	6.9055
Mar	0.0538	4.0128	0	4.5472	7.6454
Apr	0.909	1.6973	0.5436	4.4005	7.3987
May	2.4888	0.7428	1.4978	4.5472	7.6454
Jun	3.9135	0.0606	2.0159	4.4005	7.3987
Jul	4.1704	0.0021	1.9372	4.5472	7.6454
Aug	3.3621	0.1051	1.3011	4.5472	7.6454
Sep	1.5262	0.8394	0.6847	4.4005	7.3987
Oct	0.9685	1.7468	0.5021	4.5472	7.6454
Nov	0.2799	2.9061	0.1353	4.4005	7.3987
Dec	0.0128	5.0398	0.001	4.5472	7.6454
Total	17.6851	29.4235	8.6187	53.5392	90.0181

Table 156. Detailed Simulation Results for NCC 2022 C6RS Base Case Modelling in CZ8

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.2502	2.5182	0.1011	4.9006	7.6454
Feb	0.2593	2.3175	0.042	4.4264	6.9055
Mar	0.9369	1.711	0.4209	4.9006	7.6454
Apr	2.4087	0.8317	1.475	4.7425	7.3987
May	4.5555	0.081	1.8407	4.9006	7.6454
Jun	8.4924	0	5.5343	4.7425	7.3987
Jul	9.2404	0	6.4628	4.9006	7.6454
Aug	7.2732	0.0401	3.9415	4.9006	7.6454
Sep	4.6334	0.2398	2.6921	4.7425	7.3987
Oct	2.6953	0.9583	1.3027	4.9006	7.6454
Nov	1.4961	1.7366	0.816	4.7425	7.3987
Dec	0.3691	2.562	0.1823	4.9006	7.6454
Total	42.6106	12.9962	24.8114	57.7008	90.0181

Appendix B.I.VII C6RL

Detailed simulation results for NCC 2022 C6RL base case modelling are presented in Table 157 to Table 164 below.

Table 157. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ1

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	18.6414	0	6.2141	8.0269
Feb	0	17.4097	0	5.6127	7.2501
Mar	0	18.6719	0	6.2141	8.0269
Apr	0	17.3025	0	6.0136	7.768
May	0	16.068	0	6.2141	8.0269
Jun	0	10.7839	0	6.0136	7.768
Jul	0	10.2749	0	6.2141	8.0269
Aug	0	10.8357	0	6.2141	8.0269
Sep	0	15.6185	0	6.0136	7.768
Oct	0	19.2654	0	6.2141	8.0269
Nov	0	21.0419	0	6.0136	7.768
Dec	0	20.8706	0	6.2141	8.0269
Total	0	196.7843	0	73.1658	94.5106

Table 158. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ2

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	12.5391	0	4.9112	8.0269
Feb	0	12.4162	0	4.4359	7.2501
Mar	0	11.3537	0	4.9112	8.0269
Apr	0.0007	6.4928	0	4.7528	7.768
May	0.057	3.2468	0	4.9112	8.0269
Jun	0.4932	1.0866	0	4.7528	7.768
Jul	0.9721	1.2262	0.041	4.9112	8.0269
Aug	0.7442	1.6202	0	4.9112	8.0269
Sep	0.0597	2.8648	0	4.7528	7.768
Oct	0.0034	4.2241	0	4.9112	8.0269
Nov	0	8.521	0	4.7528	7.768
Dec	0	11.4916	0	4.9112	8.0269
Total	2.3303	77.0831	0.041	57.8256	94.5106

Table 159. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ3

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	18.5079	0	6.994	8.0269
Feb	0	14.1996	0	6.3172	7.2501
Mar	0	14.2077	0	6.994	8.0269
Apr	0.0373	7.58	0	6.7684	7.768
May	1.3593	2.1233	0.6089	6.994	8.0269
Jun	2.3506	1.3112	0.7204	6.7684	7.768
Jul	4.2791	0.6111	1.3395	6.994	8.0269
Aug	2.5484	1.7295	0.3808	6.994	8.0269
Sep	0.1425	8.5252	0.0273	6.7684	7.768
Oct	0.0941	9.3622	0	6.994	8.0269
Nov	0	16.8072	0	6.7684	7.768
Dec	0	17.5645	0	6.994	8.0269
Total	10.8114	112.5295	3.0768	82.3492	94.5106

Table 160. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ4

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0005	8.2672	0	4.7689	8.0269
Feb	0.0049	6.8626	0	4.3074	7.2501
Mar	0.2203	3.6713	0	4.7689	8.0269
Apr	1.1651	1.8751	0.2171	4.615	7.768
May	3.2512	0.2187	0.9127	4.7689	8.0269
Jun	5.1234	0.0073	1.3694	4.615	7.768
Jul	6.4306	0	1.8485	4.7689	8.0269
Aug	5.1371	0.0444	1.1204	4.7689	8.0269
Sep	2.3751	0.7806	0.3987	4.615	7.768
Oct	1.3062	1.4182	0.2045	4.7689	8.0269
Nov	0.126	5.3318	0.0058	4.615	7.768
Dec	0.0166	7.0979	0	4.7689	8.0269
Total	25.157	35.5752	6.0772	56.1495	94.5106

Table 161. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ5

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	7.1315	0	3.9922	8.0269
Feb	0	6.575	0	3.6059	7.2501
Mar	0	6.3286	0	3.9922	8.0269
Apr	0.0374	3.2448	0	3.8635	7.768
May	0.5041	1.0754	0	3.9922	8.0269
Jun	1.6211	0.1115	0	3.8635	7.768
Jul	2.3117	0.1354	0	3.9922	8.0269
Aug	1.8113	0.4034	0	3.9922	8.0269
Sep	0.3819	1.8721	0	3.8635	7.768
Oct	0.0811	3.4785	0	3.9922	8.0269
Nov	0.0939	4.479	0	3.8635	7.768
Dec	0	5.8808	0	3.9922	8.0269
Total	6.8425	40.716	0	47.0054	94.5106

Table 162. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ6

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.032	3.6483	0	3.4418	8.0269
Feb	0.0049	3.7741	0	3.1087	7.2501
Mar	0.1914	1.4718	0	3.4418	8.0269
Apr	0.8116	0.515	0	3.3308	7.768
May	2.4928	0.0219	0.2363	3.4418	8.0269
Jun	3.9377	0	0.3736	3.3308	7.768
Jul	4.3897	0	0.0634	3.4418	8.0269
Aug	3.5239	0	0.3579	3.4418	8.0269
Sep	2.1021	0.2238	0.0858	3.3308	7.768
Oct	1.2666	0.799	0	3.4418	8.0269
Nov	0.4293	2.0587	0	3.3308	7.768
Dec	0.1215	2.5347	0	3.4418	8.0269
Total	19.3032	15.0472	1.117	40.5247	94.5106

Table 163. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ7

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0468	4.2327	0	4.6877	8.0269
Feb	0.0235	4.9204	0	4.234	7.2501
Mar	0.3915	2.2134	0	4.6877	8.0269
Apr	2.0702	0.5735	0.5893	4.5365	7.768
May	4.6697	0.0996	1.6029	4.6877	8.0269
Jun	6.6355	0	2.133	4.5365	7.768
Jul	7.312	0	2.0551	4.6877	8.0269
Aug	6.4325	0	1.3903	4.6877	8.0269
Sep	3.2583	0.1975	0.7382	4.5365	7.768
Oct	2.2042	0.7782	0.5329	4.6877	8.0269
Nov	1.0387	1.7749	0.1546	4.5365	7.768
Dec	0.1715	3.5693	0.0015	4.6877	8.0269
Total	34.2547	18.3594	9.1978	55.1938	94.5106

Table 164. Detailed Simulation Results for NCC 2022 C6RL Base Case Modelling in CZ8

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.9897	1.0665	0.1172	5.4035	8.0269
Feb	1.0052	0.7718	0.0438	4.8806	7.2501
Mar	2.422	0.2243	0.403	5.4035	8.0269
Apr	4.5699	0.0052	1.5218	5.2292	7.768
May	7.4522	0	1.8946	5.4035	8.0269
Jun	11.1253	0	5.5414	5.2292	7.768
Jul	11.8534	0	6.4865	5.4035	8.0269
Aug	10.3456	0	4.0846	5.4035	8.0269
Sep	7.5798	0	2.7684	5.2292	7.768
Oct	5.0191	0.1532	1.3424	5.4035	8.0269
Nov	2.9632	0.5073	0.8185	5.2292	7.768
Dec	1.2392	0.9916	0.1911	5.4035	8.0269
Total	66.5647	3.7199	25.2132	63.6217	94.5106

Appendix B.I.VIII C3HS

Detailed simulation results for NCC 2022 C3HS base case modelling are presented in Table 165 to Table 172 below.

Table 165. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	11.3449	0	0.5213	2.5951
Feb	0	10.4565	0	0.4709	2.3439
Mar	0	11.2859	0	0.5213	2.5951
Apr	0	10.6152	0	0.5045	2.5114
May	0	10.2029	0	0.5213	2.5951
Jun	0	8.4774	0	0.5045	2.5114
Jul	0	8.0669	0	0.5213	2.5951
Aug	0	8.5842	0	0.5213	2.5951
Sep	0	9.855	0	0.5045	2.5114
Oct	0	11.2739	0	0.5213	2.5951
Nov	0	12.2509	0	0.5045	2.5114
Dec	0	12.4898	0	0.5213	2.5951
Total	0	124.9036	0	6.1381	30.5549

Table 166. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	7.9635	0	0.5213	2.5951
Feb	0	7.6717	0	0.4709	2.3439
Mar	0	7.4938	0	0.5213	2.5951
Apr	0.0016	4.7615	0	0.5045	2.5114
May	0.0634	1.5424	0	0.5213	2.5951
Jun	0.847	0.0481	0	0.5045	2.5114
Jul	1.8141	0.0569	0.1853	0.5213	2.5951
Aug	1.1933	0.0978	0	0.5213	2.5951
Sep	0.1274	1.2049	0	0.5045	2.5114
Oct	0.0092	3.0242	0	0.5213	2.5951
Nov	0	5.8144	0	0.5045	2.5114
Dec	0	7.5484	0	0.5213	2.5951
Total	4.056	47.2277	0.1853	6.1381	30.5549

Table 167. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	10.2135	0	0.5213	2.5951
Feb	0	8.5761	0	0.4709	2.3439
Mar	0	8.6601	0	0.5213	2.5951
Apr	0.0372	4.05	0	0.5045	2.5114
May	1.4312	0.6751	0.8574	0.5213	2.5951
Jun	2.7404	0.3193	1.0435	0.5045	2.5114
Jul	4.4463	0.072	1.9086	0.5213	2.5951
Aug	2.683	0.5357	0.5482	0.5213	2.5951
Sep	0.1346	4.6103	0.02	0.5045	2.5114
Oct	0.1149	5.2395	0	0.5213	2.5951
Nov	0	8.7906	0	0.5045	2.5114
Dec	0	9.8035	0	0.5213	2.5951
Total	11.5875	61.5458	4.3776	6.1381	30.5549

Table 168. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0019	5.7995	0	0.5213	2.5951
Feb	0.0107	5.1149	0	0.4709	2.3439
Mar	0.2402	2.734	0	0.5213	2.5951
Apr	1.4723	0.6049	0.3009	0.5045	2.5114
May	4.0515	0.0164	1.5473	0.5213	2.5951
Jun	5.3227	0	2.2643	0.5045	2.5114
Jul	6.2465	0	3.1474	0.5213	2.5951
Aug	5.6521	0.0058	2.1122	0.5213	2.5951
Sep	3.1394	0.1452	1.0819	0.5045	2.5114
Oct	1.7347	0.4434	0.3307	0.5213	2.5951
Nov	0.138	3.2061	0.0283	0.5045	2.5114
Dec	0.031	4.8402	0	0.5213	2.5951
Total	28.041	22.9103	10.8132	6.1381	30.5549

Table 169. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	5.1001	0	0.5213	2.5951
Feb	0	4.7392	0	0.4709	2.3439
Mar	0	4.4234	0	0.5213	2.5951
Apr	0.0355	2.1367	0	0.5045	2.5114
May	0.6405	0.2702	0	0.5213	2.5951
Jun	2.0335	0.0003	0	0.5045	2.5114
Jul	2.7332	0.0109	0	0.5213	2.5951
Aug	2.0693	0.0389	0	0.5213	2.5951
Sep	0.559	0.5645	0	0.5045	2.5114
Oct	0.0597	1.8698	0	0.5213	2.5951
Nov	0.0561	2.9208	0	0.5045	2.5114
Dec	0	4.276	0	0.5213	2.5951
Total	8.1868	26.3507	0	6.1381	30.5549

Table 170. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0214	2.8054	0	0.5213	2.5951
Feb	0.0082	2.8866	0	0.4709	2.3439
Mar	0.1819	1.1464	0	0.5213	2.5951
Apr	1.0442	0.1581	0	0.5045	2.5114
May	2.9039	0.0003	0.2872	0.5213	2.5951
Jun	3.9294	0	0.364	0.5045	2.5114
Jul	4.235	0	0.1024	0.5213	2.5951
Aug	3.8649	0	0.4429	0.5213	2.5951
Sep	2.5251	0.0919	0.1114	0.5045	2.5114
Oct	1.5305	0.3302	0	0.5213	2.5951
Nov	0.4815	1.3784	0	0.5045	2.5114
Dec	0.1322	1.6171	0	0.5213	2.5951
Total	20.8581	10.4143	1.3078	6.1381	30.5549

Table 171. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0417	2.1969	0	0.5313	2.5951
Feb	0.0326	2.8832	0	0.4883	2.3439
Mar	0.2504	0.9021	0	0.5235	2.5951
Apr	2.4499	0.0756	0.992	0.5131	2.5114
May	4.4516	0.0007	2.0303	0.5625	2.5951
Jun	5.6738	0	2.6584	0.6045	2.5114
Jul	6.2008	0	2.8091	0.6292	2.5951
Aug	5.6808	0	2.1482	0.6141	2.5951
Sep	3.7396	0.0155	1.4701	0.5327	2.5114
Oct	2.358	0.1502	0.8353	0.531	2.5951
Nov	1.1639	0.5533	0.2252	0.5087	2.5114
Dec	0.1469	1.6622	0.0032	0.526	2.5951
Total	32.1899	8.4397	13.1719	6.5648	30.5549

Table 172. Detailed Simulation Results for NCC 2022 C3HS Base Case Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	1.1525	0.1559	0.0747	0.5244	2.5951
Feb	1.0305	0.1198	0.0273	0.4727	2.3439
Mar	2.4909	0.0033	0.2863	0.5351	2.5951
Apr	4.4316	0	1.9671	0.5738	2.5114
May	5.9695	0	2.9847	0.6674	2.5951
Jun	8.1028	0	5.425	0.7152	2.5114
Jul	8.6255	0	6.0631	0.7412	2.5951
Aug	7.8714	0	4.6376	0.7249	2.5951
Sep	6.0546	0	3.3652	0.6431	2.5114
Oct	4.3884	0.0043	1.5165	0.5988	2.5951
Nov	2.869	0.0459	0.7138	0.5423	2.5114
Dec	1.5181	0.1846	0.1631	0.527	2.5951
Total	54.5049	0.5139	27.2243	7.2659	30.5549

Appendix B.I.IX C3HL

Detailed simulation results for NCC 2022 C3HL base case modelling are presented in Table 173 to Table 180 below.

Table 173. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ1

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	71.374	9.3191	5.4161	0	19.6213
Feb	0	0	67.2944	8.4173	4.9362	0	17.7224
Mar	0	0	70.872	9.3191	5.3216	0	19.6213
Apr	0	0	64.855	9.0185	4.8906	0	18.9883
May	0	0	52.4752	9.3191	4.183	0	19.6213
Jun	0	0	30.5929	9.0185	3.0682	0	18.9883
Jul	0	0	28.3233	9.3191	2.9656	0	19.6213
Aug	0	0	28.944	9.3191	3.1028	0	19.6213
Sep	0	0	54.1952	9.0185	4.2287	0	18.9883
Oct	0	0	73.1198	9.3191	5.2071	0	19.6213
Nov	0	0	80.4753	9.0185	5.8008	0	18.9883
Dec	0	0	81.4607	9.3191	5.9951	0	19.6213
Total	0	0	703.9819	109.7253	55.1159	0	231.0247

Table 174. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ2

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	42.9796	9.039	3.5385	0	19.6213
Feb	0	0	42.9075	8.1643	3.4927	0	17.7224
Mar	0	0	32.8956	9.039	2.9804	0	19.6213
Apr	0.0321	0	17.7089	8.7474	1.8896	0	18.9883
May	0.3667	0	4.7491	9.039	0.7979	0	19.6213
Jun	6.2346	0	0.4866	8.7474	0.269	0	18.9883
Jul	13.8021	0	0.5659	9.039	0.3771	0	19.6213
Aug	8.7927	0	1.1664	9.039	0.4457	0	19.6213
Sep	0.454	0	5.2967	8.7474	0.8191	0	18.9883
Oct	0.0248	0	10.0601	9.039	1.3969	0	19.6213
Nov	0	0	24.2414	8.7474	2.4061	0	18.9883
Dec	0	0	36.4118	9.039	3.1577	0	19.6213
Total	29.7069	0	219.4696	106.4272	21.5708	0	231.0247

Table 175. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ3

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	55.6673	9.8925	3.7216	0	19.6213
Feb	0	0	39.94	8.9352	2.8693	0	17.7224
Mar	0	0	37.8419	9.8925	2.8228	0	19.6213
Apr	0.2687	0	14.9689	9.5734	1.4902	0	18.9883
May	16.5058	0	2.0691	9.8925	0.562	0	19.6213
Jun	31.2301	0	1.353	9.5734	0.5746	0	18.9883
Jul	54.7271	0	0.3818	9.8925	0.6438	0	19.6213
Aug	29.2366	0	2.2218	9.8925	0.6515	0	19.6213
Sep	1.5201	0	19.1184	9.5734	1.7118	0	18.9883
Oct	0.9411	0	22.2088	9.8925	1.9067	0	19.6213
Nov	0	0	42.444	9.5734	3.0304	0	18.9883
Dec	0	0	48.2926	9.8925	3.3745	0	19.6213
Total	134.4295	0	286.5076	116.4763	23.3593	0	231.0247

Table 176. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ4

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0057	0	26.9281	9.4429	2.1578	0	19.6213
Feb	0.0502	0	21.2488	8.4559	1.7647	0	17.7224
Mar	2.3655	0	9.4372	9.1971	0.9966	0	19.6213
Apr	16.782	0	2.6391	8.9004	0.5685	0	18.9883
May	51.2738	0	0.0906	9.1971	0.5934	0	19.6213
Jun	75.6193	0	0	8.9038	0.6895	0	18.9883
Jul	93.1414	0	0	9.2031	0.8035	0	19.6213
Aug	76.2675	0	0.0247	9.1989	0.7085	0	19.6213
Sep	34.9937	0	0.8376	8.9004	0.5149	0	18.9883
Oct	16.2938	0	2.7077	9.1975	0.5524	0	19.6213
Nov	1.0709	0	15.1262	9.0241	1.377	0	18.9883
Dec	0.2643	0	21.4448	9.3392	1.7997	0	19.6213
Total	368.128	0	100.4847	108.9604	12.5265	0	231.0247

Table 177. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ5

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	26.9984	8.4254	2.4276	0	19.6213
Feb	0	0	25.0762	7.6048	2.2801	0	17.7224
Mar	0	0	20.1267	8.4196	1.9841	0	19.6213
Apr	0.1863	0	8.4339	8.148	1.0416	0	18.9883
May	5.4663	0	1.3651	8.4196	0.365	0	19.6213
Jun	19.1701	0	0.0218	8.148	0.2872	0	18.9883
Jul	27.9123	0	0.0927	8.4196	0.3777	0	19.6213
Aug	18.7527	0	0.3887	8.4196	0.3465	0	19.6213
Sep	3.6113	0	3.5925	8.1616	0.5606	0	18.9883
Oct	0.2318	0	9.2804	8.4358	1.0383	0	19.6213
Nov	0.3238	0	14.0608	8.167	1.4247	0	18.9883
Dec	0	0	18.4522	8.4424	1.8682	0	19.6213
Total	75.6546	0	127.8894	99.2114	14.0017	0	231.0247

Table 178. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ6

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0617	0	13.437	8.4014	1.2741	0	19.6213
Feb	0.0268	0	13.0698	7.6049	1.1677	0	17.7224
Mar	1.5827	0	4.1373	8.3019	0.5004	0	19.6213
Apr	8.6802	0	0.8991	8.0341	0.2869	0	18.9883
May	33.1615	0	0.0053	8.3022	0.4029	0	19.6213
Jun	51.8387	0	0	8.0348	0.518	0	18.9883
Jul	56.3611	0	0	8.3024	0.5501	0	19.6213
Aug	46.3158	0	0	8.3019	0.487	0	19.6213
Sep	26.979	0	0.5158	8.0341	0.3874	0	18.9883
Oct	12.6328	0	1.9861	8.3019	0.4316	0	19.6213
Nov	3.0046	0	7.3919	8.0676	0.7544	0	18.9883
Dec	0.9483	0	7.8082	8.3397	0.7903	0	19.6213
Total	241.5932	0	49.2505	98.0267	7.5506	0	231.0247

Table 179. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ7

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.2112	0	12.9556	9.1197	1.2067	0	19.6213
Feb	0.2403	0	15.2387	8.2998	1.3414	0	17.7224
Mar	2.9803	0	4.7529	9.0553	0.6193	0	19.6213
Apr	32.8349	0	0.5865	8.7519	0.5023	0	18.9883
May	69.179	0	0.0266	9.0441	0.7202	0	19.6213
Jun	94.9131	0	0	8.7555	0.8503	0	18.9883
Jul	105.7392	0	0	9.0453	0.9144	0	19.6213
Aug	89.9854	0	0	9.0473	0.8407	0	19.6213
Sep	50.1742	0	0.1646	8.7519	0.6029	0	18.9883
Oct	28.6703	0	1.4965	9.0437	0.57	0	19.6213
Nov	12.1282	0	4.3353	8.7559	0.6589	0	18.9883
Dec	1.2008	0	9.9587	9.0802	0.9929	0	19.6213
Total	488.2569	0	49.5152	106.7507	9.82	0	231.0247

Table 180. Detailed Simulation Results for NCC 2022 C3HL Base Case Modelling in CZ8

	Boilers energy (MWh gas)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	10.1974	0	1.0235	8.8717	0.3471	0	19.6213
Feb	9.6998	0	0.7729	8.0132	0.3087	0	17.7224
Mar	29.1004	0	0.0776	8.8717	0.4811	0	19.6213
Apr	68.9667	0	0	8.5908	0.7677	0	18.9883
May	103.7666	0	0	8.882	0.9564	0	19.6213
Jun	149.7013	0	0	8.6194	1.1843	0	18.9883
Jul	162.3987	0	0	8.9128	1.2822	0	19.6213
Aug	140.7766	0	0	8.8974	1.1543	0	19.6213
Sep	100.9934	0	0	8.5994	0.9314	0	18.9883
Oct	64.5961	0	0.0992	8.8749	0.7106	0	19.6213
Nov	35.6296	0	0.3914	8.5873	0.5076	0	18.9883
Dec	5.6977	0	0.1452	2.8618	0.1274	0	6.3294
Total	881.5245	0	2.5099	98.5827	8.7587	0	217.7328

Appendix B.I.X C9B

Detailed simulation results for NCC 2022 C9B base case modelling are presented in Table 181 to Table 188 below.

Table 181. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	23.6532	0	0.4884	2.8229
Feb	0	23.0768	0	0.4651	2.6643
Mar	0	24.9168	0	0.5349	3.0449
Apr	0	20.911	0	0.4884	2.807
May	0	20.2749	0	0.5117	2.9339
Jun	0	15.1494	0	0.5117	2.918
Jul	0	14.1985	0	0.4884	2.8229
Aug	0	15.7024	0	0.5349	3.0449
Sep	0	20.3379	0	0.5117	2.918
Oct	0	23.141	0	0.4884	2.8229
Nov	0	27.2686	0	0.5117	2.918
Dec	0	27.6409	0	0.5117	2.9339
Total	0	256.2714	0	6.0469	34.6517

Table 182. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	16.2484	0	0.4884	2.8229
Feb	0	16.6102	0	0.4651	2.6643
Mar	0	16.8094	0	0.5349	3.0449
Apr	0.0011	11.3504	0	0.4884	2.807
May	0.0169	9.0832	0	0.5117	2.9339
Jun	0.3991	4.9824	0	0.5117	2.918
Jul	0.7731	5.2828	0	0.4884	2.8229
Aug	0.4696	7.0301	0	0.5349	3.0449
Sep	0.0236	8.2552	0	0.5117	2.918
Oct	0.001	9.4899	0	0.4884	2.8229
Nov	0	12.8012	0	0.5117	2.918
Dec	0	16.0876	0	0.5117	2.9339
Total	1.6844	134.0308	0	6.0469	34.6517

Table 183. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	19.2644	0	0.4884	2.8229
Feb	0	15.7644	0	0.4651	2.6643
Mar	0	16.8338	0	0.5349	3.0449
Apr	0.0207	11.7357	0	0.4884	2.807
May	1.0653	6.5934	1.2203	0.5117	2.9339
Jun	2.4229	4.0721	1.1907	0.5117	2.918
Jul	4.5574	2.4365	1.9965	0.4884	2.8229
Aug	2.2807	6.0415	0.5555	0.5349	3.0449
Sep	0.0523	12.7339	0.0159	0.5117	2.918
Oct	0.0112	12.7157	0	0.4884	2.8229
Nov	0	18.5907	0	0.5117	2.918
Dec	0	18.462	0	0.5117	2.9339
Total	10.4106	145.244	4.979	6.0469	34.6517

Table 184. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0008	11.8414	0	0.4884	2.8229
Feb	0	10.6922	0	0.4651	2.6643
Mar	0.1265	8.4168	0	0.5349	3.0449
Apr	1.0944	5.1311	0.2241	0.4884	2.807
May	3.7921	1.1269	1.3668	0.5117	2.9339
Jun	7.0317	0.164	2.4346	0.5117	2.918
Jul	8.0122	0.0261	2.8316	0.4884	2.8229
Aug	6.8998	0.4121	1.7278	0.5349	3.0449
Sep	2.8176	2.6879	0.7433	0.5117	2.918
Oct	0.9563	4.4892	0.2522	0.4884	2.8229
Nov	0.0396	9.8202	0.0053	0.5117	2.918
Dec	0.0039	11.4552	0	0.5117	2.9339
Total	30.7748	66.263	9.5857	6.0469	34.6517

Table 185. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	10.6578	0	0.4884	2.8229
Feb	0	10.9664	0	0.4651	2.6643
Mar	0	10.8782	0	0.5349	3.0449
Apr	0.0075	7.6206	0	0.4884	2.807
May	0.2833	4.6185	0	0.5117	2.9339
Jun	1.0391	1.8215	0	0.5117	2.918
Jul	1.8511	1.6605	0	0.4884	2.8229
Aug	1.4386	2.8608	0	0.5349	3.0449
Sep	0.1535	5.7755	0	0.5117	2.918
Oct	0.0051	7.9584	0	0.4884	2.8229
Nov	0.0211	8.9333	0	0.5117	2.918
Dec	0	10.383	0	0.5117	2.9339
Total	4.7994	84.1346	0	6.0469	34.6517

Table 186. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0043	8.6133	0	0.4884	2.8229
Feb	0.0032	8.138	0	0.4651	2.6643
Mar	0.0403	6.0506	0	0.5349	3.0449
Apr	0.5661	3.2636	0	0.4884	2.807
May	2.4351	0.5694	0.3606	0.5117	2.9339
Jun	4.5354	0.1886	0.3603	0.5117	2.918
Jul	5.066	0.0001	0.0984	0.4884	2.8229
Aug	4.1461	0.2127	0.7816	0.5349	3.0449
Sep	1.8327	1.9023	0.1983	0.5117	2.918
Oct	0.7976	1.9603	0	0.4884	2.8229
Nov	0.1654	5.9084	0	0.5117	2.918
Dec	0.0405	7.2367	0	0.5117	2.9339
Total	19.6325	44.044	1.7992	6.0469	34.6517

Table 187. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0125	7.7797	0	0.4884	2.8229
Feb	0.0085	8.549	0	0.4651	2.6643
Mar	0.2334	5.7419	0	0.5349	3.0449
Apr	1.8518	2.6058	0.7832	0.4884	2.807
May	5.6462	0.8501	2.2367	0.5117	2.9339
Jun	8.5169	0.0745	2.9474	0.5117	2.918
Jul	8.747	0	2.0112	0.4884	2.8229
Aug	8.4307	0.0198	1.8979	0.5349	3.0449
Sep	3.7334	1.3619	1.1374	0.5117	2.918
Oct	2.2357	1.6884	0.8219	0.4884	2.8229
Nov	0.8368	3.6484	0.216	0.5117	2.918
Dec	0.0481	7.1131	0.0019	0.5117	2.9339
Total	40.3011	39.4325	12.0537	6.0469	34.6517

Table 188. Detailed Simulation Results for NCC 2022 C9B Base Case Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.6945	4.7187	0.1516	0.4884	2.8229
Feb	0.5605	4.561	0	0.4651	2.6643
Mar	2.2041	2.8958	0.5235	0.5349	3.0449
Apr	4.8977	1.1347	2.2974	0.4884	2.807
May	9.3132	0.0084	2.9504	0.5117	2.9339
Jun	14.2308	0	7.8177	0.5117	2.918
Jul	14.1348	0	8.9413	0.4884	2.8229
Aug	13.5686	0.0168	5.8173	0.5349	3.0449
Sep	8.9187	0.2496	4.3628	0.5117	2.918
Oct	5.6353	1.4217	2.0583	0.4884	2.8229
Nov	3.4	2.9705	1.8233	0.5117	2.918
Dec	0.9841	4.0145	0.4571	0.5117	2.9339
Total	78.5421	21.9917	37.2006	6.0469	34.6517

Appendix B.II Stringency 1

The dynamic thermal simulations performed in the software IES <VE> show that a significant reduction in annual energy consumption can be attributed to a tightening in NCC provisions. The degree of reduction in energy consumption is dependent on building type, building construction and climate zone. The energy and GHG savings are presented in the section.

In the results tables below, electricity and gas values represent annual consumption. Electricity consumption values shown are regulated electricity i.e. building electricity consumption that is affected by NCC provisions. Percentage savings were calculated using these regulated electricity values. Greenhouse gas emissions (GHG) were calculated using 2023 carbon intensity factors (0.70 kg/kWh for electricity and 56 kg/GJ for gas).

Appendix B.II.I C5OL

The summarised annual energy consumption and savings for C5OL Stringency 1 modelling are presented in Table 189 to Table 191.

Table 189. Energy and GHG Savings for C5OL Stringency 1 Iteration 1 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving -Gas (%)	Saving -Elec (%)	Saving - GHG (%)
1	0	899	0	746	0%	17%	17%
2	7	558	8	446	-14%	20%	19%
3	39	559	36	435	9%	22%	21%
4	152	412	149	332	2%	19%	14%
5	22	500	25	398	-15%	20%	19%
6	83	343	86	277	-4%	19%	14%
7	228	353	221	285	3%	19%	13%
8	480	316	525	258	-9%	18%	1%

Table 190. Energy and GHG Savings for C5OL Stringency 1 Iteration 2 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 2 - Gas (MWh)	NCC 2025 Iteration 2 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	899	0	746	0%	17%	17%
2	7	558	7	432	4%	23%	22%
3	39	559	33	431	16%	23%	22%
4	152	412	149	332	2%	19%	14%
5	22	500	23	395	-4%	21%	20%
6	83	343	86	277	-4%	19%	14%
7	228	353	221	285	3%	19%	12%
8	480	316	525	258	-9%	18%	1%

Table 191. Energy and GHG Savings for C5OL Stringency 1 Iteration 3 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 3 - Gas (MWh)	NCC 2025 Iteration 3 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	899	0	746	0%	17%	17%
2	7	558	7	431	3%	23%	22%
3	39	559	33	429	16%	23%	23%
4	152	412	149	332	2%	19%	14%
5	22	500	23	395	-4%	21%	20%
6	83	343	86	277	-4%	19%	14%
7	228	353	221	285	3%	19%	12%
8	480	316	525	258	-9%	18%	1%

Detailed simulation results for Iteration 1 to Iteration 3 of NCC 2025 C5OL Stringency 1 modelling are presented in Table 192 to Table 215 below.

Table 192. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ1

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	38.5037	5.1061	4.0337	6.0225	16.1072
Feb	0	0	37.1828	4.9185	3.9851	6.1346	15.219
Mar	0	0	40.4713	5.6315	4.2731	6.2554	17.4064
Apr	0	0	33.9469	5.1023	3.5266	4.8434	16.0277
May	0	0	29.8086	4.939	3.005	4.2873	16.7568
Jun	0	0	18.4398	3.6905	1.5872	2.5815	16.6773
Jul	0	0	17.3593	3.3196	1.4367	2.3412	16.1072
Aug	0	0	19.8585	3.9899	1.5975	2.6317	17.4064
Sep	0	0	32.3227	5.1183	3.2013	4.3328	16.6773
Oct	0	0	37.4742	5.91	4.1481	5.3572	16.1072
Nov	0	0	41.7463	6.4925	4.72	6.226	16.6773
Dec	0	0	42.3518	5.9541	4.6573	6.917	16.7568
Total	0	0	389.4658	60.1722	40.1716	57.9306	197.9266

Table 193. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ1

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	38.5037	5.1061	4.0337	6.0225	16.1072
Feb	0	0	37.1828	4.9185	3.9851	6.1346	15.219
Mar	0	0	40.4713	5.6315	4.2731	6.2554	17.4064
Apr	0	0	33.9469	5.1023	3.5266	4.8434	16.0277
May	0	0	29.8086	4.939	3.005	4.2873	16.7568
Jun	0	0	18.4398	3.6905	1.5872	2.5815	16.6773
Jul	0	0	17.3593	3.3196	1.4367	2.3412	16.1072
Aug	0	0	19.8585	3.9899	1.5975	2.6317	17.4064
Sep	0	0	32.3227	5.1183	3.2013	4.3328	16.6773
Oct	0	0	37.4742	5.91	4.1481	5.3572	16.1072
Nov	0	0	41.7463	6.4925	4.72	6.226	16.6773
Dec	0	0	42.3518	5.9541	4.6573	6.917	16.7568
Total	0	0	389.4658	60.1722	40.1716	57.9306	197.9266

Table 194. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ1

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	38.5037	5.1061	4.0337	6.0225	16.1072
Feb	0	0	37.1828	4.9185	3.9851	6.1346	15.219
Mar	0	0	40.4713	5.6315	4.2731	6.2554	17.4064
Apr	0	0	33.9469	5.1023	3.5266	4.8434	16.0277
May	0	0	29.8086	4.939	3.005	4.2873	16.7568
Jun	0	0	18.4398	3.6905	1.5872	2.5815	16.6773
Jul	0	0	17.3593	3.3196	1.4367	2.3412	16.1072
Aug	0	0	19.8585	3.9899	1.5975	2.6317	17.4064
Sep	0	0	32.3227	5.1183	3.2013	4.3328	16.6773
Oct	0	0	37.4742	5.91	4.1481	5.3572	16.1072
Nov	0	0	41.7463	6.4925	4.72	6.226	16.6773
Dec	0	0	42.3518	5.9541	4.6573	6.917	16.7568
Total	0	0	389.4658	60.1722	40.1716	57.9306	197.9266

Table 195. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ2

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	27.5159	3.9233	2.696	3.8973	16.1072
Feb	0	0	27.789	3.989	2.8378	3.9714	15.219
Mar	0	0	25.9063	3.9368	2.494	3.9257	17.4064
Apr	0	0	14.1006	2.447	1.3259	2.1748	16.0277
May	0.2232	0.0544	6.4612	1.6268	0.8531	1.3098	16.7568
Jun	1.9327	0.8314	2.16	1.6268	0.5895	0.7603	16.6773
Jul	3.6248	1.5858	1.7924	1.7145	0.5428	0.7215	16.1072
Aug	2.3264	1.0836	2.7154	1.75	0.697	0.9599	17.4064
Sep	0.1988	0.0774	6.5095	1.7084	0.8326	1.2811	16.6773
Oct	0	0.0004	8.8744	1.9611	0.941	1.5797	16.1072
Nov	0	0	18.5364	3.1519	1.713	2.9227	16.6773
Dec	0	0	25.1117	4.0021	2.4964	3.9436	16.7568
Total	8.3059	3.633	167.4729	31.8375	18.0189	27.4478	197.9266

Table 196. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ2

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	25.138	3.8961	2.4042	3.5415	16.1072
Feb	0	0	25.4771	3.9205	2.4912	3.58	15.219
Mar	0	0	24.0627	3.9354	2.1834	3.4366	17.4064
Apr	0	0	13.2255	2.4472	1.2434	2.0249	16.0277
May	0.2231	0.0542	6.3074	1.6271	0.8667	1.3179	16.7568
Jun	1.6879	0.7398	2.2971	1.6002	0.6241	0.815	16.6773
Jul	2.9441	1.4996	1.85	1.677	0.5564	0.7502	16.1072
Aug	1.9889	0.9449	2.7669	1.7242	0.7144	0.9864	17.4064
Sep	0.1927	0.0554	6.3259	1.7017	0.8419	1.2873	16.6773
Oct	0	0.0004	8.5991	1.9613	0.9244	1.5412	16.1072
Nov	0	0	17.43	3.1496	1.5639	2.6411	16.6773
Dec	0	0	23.2785	3.9991	2.2252	3.5599	16.7568
Total	7.0367	3.2943	156.7583	31.6394	16.6392	25.482	197.9266

Table 197. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ2

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	25.1528	3.8955	2.4037	3.5376	16.1072
Feb	0	0	25.4615	3.9195	2.4959	3.5905	15.219
Mar	0	0	24.0419	3.9384	2.1865	3.445	17.4064
Apr	0	0	13.1715	2.4461	1.2415	2.0054	16.0277
May	0.2231	0.0542	6.2406	1.6273	0.8572	1.2945	16.7568
Jun	1.6918	0.7395	2.1739	1.5983	0.6102	0.7644	16.6773
Jul	2.9615	1.4878	1.7336	1.6748	0.5437	0.6967	16.1072
Aug	1.9887	0.9345	2.6771	1.7217	0.7061	0.951	17.4064
Sep	0.1927	0.0554	6.2268	1.7022	0.8277	1.2522	16.6773
Oct	0	0.0004	8.5188	1.9612	0.9185	1.5196	16.1072
Nov	0	0	17.4093	3.1515	1.5654	2.6412	16.6773
Dec	0	0	23.2831	4	2.2232	3.5568	16.7568
Total	7.0578	3.2719	156.0908	31.6365	16.5796	25.2549	197.9266

Table 198. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ3

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	25.5703	5.7738	2.8292	4.1912	16.1072
Feb	0	0	17.7395	4.7355	1.9546	3.3936	15.219
Mar	0	0	17.5838	4.6616	1.9928	3.3457	17.4064
Apr	0.0512	0.0569	6.9929	2.3506	0.8715	1.4361	16.0277
May	4.0475	2.2068	2.5158	2.283	0.6421	0.7722	16.7568
Jun	7.3644	3.9727	1.3012	2.7601	0.4296	0.4642	16.6773
Jul	16.3714	6.6803	0.6744	3.4729	0.3447	0.2748	16.1072
Aug	7.8594	4.1689	1.9982	2.731	0.631	0.7104	17.4064
Sep	0.2016	0.0644	8.43	2.8278	1.0443	1.8062	16.6773
Oct	0.027	0.028	9.3581	2.9924	1.1698	1.9941	16.1072
Nov	0	0.0116	19.4487	5.2586	2.2092	3.6726	16.6773
Dec	0	0	20.8603	5.2995	2.3379	3.7827	16.7568
Total	35.9224	17.1895	132.4732	45.1469	16.4567	25.8441	197.9266

Table 199. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ3

Optimised	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	25.0388	5.7833	2.7672	4.1251	16.1072
Feb	0	0	17.5241	4.7354	1.9259	3.3282	15.219
Mar	0	0	17.3391	4.669	1.9536	3.289	17.4064
Apr	0.0509	0.0511	6.9375	2.3503	0.8746	1.434	16.0277
May	3.6128	1.9893	2.5438	2.2331	0.655	0.7931	16.7568
Jun	6.6932	3.6451	1.3211	2.6668	0.4445	0.4824	16.6773
Jul	15.3813	6.0833	0.6836	3.3197	0.3446	0.2807	16.1072
Aug	7.1964	3.8709	2.0189	2.6621	0.6386	0.7283	17.4064
Sep	0.182	0.0589	8.3505	2.8276	1.0366	1.7832	16.6773
Oct	0.0289	0.028	9.2696	2.9931	1.1575	1.9614	16.1072
Nov	0	0.0112	19.1367	5.2649	2.1538	3.594	16.6773
Dec	0	0	20.5412	5.3036	2.2805	3.6902	16.7568
Total	33.1454	15.7379	130.7049	44.8088	16.2324	25.4896	197.9266

Table 200. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ3

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	25.0025	5.779	2.7543	4.1113	16.1072
Feb	0	0	17.4728	4.7307	1.9172	3.3097	15.219
Mar	0	0	17.2217	4.6657	1.9266	3.2552	17.4064
Apr	0.0509	0.0511	6.7911	2.3496	0.8854	1.3653	16.0277
May	3.6302	1.9772	2.4385	2.2352	0.6488	0.7457	16.7568
Jun	6.6832	3.6501	1.235	2.6747	0.4256	0.431	16.6773
Jul	15.3679	6.0869	0.6506	3.3326	0.3457	0.2619	16.1072
Aug	7.1972	3.8583	1.9098	2.6704	0.6345	0.6769	17.4064
Sep	0.182	0.0585	8.1985	2.8223	1.031	1.735	16.6773
Oct	0.0289	0.028	9.1491	2.9923	1.1498	1.905	16.1072
Nov	0	0.0124	19.0194	5.2759	2.1419	3.5618	16.6773
Dec	0	0	20.4882	5.3018	2.2768	3.6903	16.7568
Total	33.1402	15.7225	129.5771	44.83	16.1376	25.0491	197.9266

Table 201. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ4

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0666	0	15.2672	3.5702	1.5099	2.3755	16.1072
Feb	0.0192	0	12.6811	3.1695	1.1468	1.7909	15.219
Mar	1.3433	0.0856	7.9307	2.3572	0.788	1.0968	17.4064
Apr	5.8354	0.5271	2.4447	1.7534	0.5102	0.5433	16.0277
May	19.8468	2.4119	0.4443	2.3933	0.2889	0.1206	16.7568
Jun	32.2285	3.9117	0.0978	2.9649	0.2933	0.0268	16.6773
Jul	37.1876	4.7764	0.0035	3.2233	0.2989	0.0015	16.1072
Aug	31.7903	4.2816	0.146	3.0564	0.3035	0.0408	17.4064
Sep	13.9976	1.6032	1.1963	2.1273	0.3863	0.3048	16.6773
Oct	6.6478	0.6177	2.8888	1.8325	0.5335	0.5576	16.1072
Nov	0.3597	0.0262	9.4957	2.5228	1.0613	1.4298	16.6773
Dec	0.1458	0.0041	12.8757	3.2029	1.1244	1.7621	16.7568
Total	149.4686	18.2453	65.4719	32.1737	8.2449	10.0506	197.9266

Table 202. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ4

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0666	0	15.2672	3.5702	1.5099	2.3755	16.1072
Feb	0.0192	0	12.6811	3.1695	1.1468	1.7909	15.219
Mar	1.3433	0.0856	7.9307	2.3572	0.788	1.0968	17.4064
Apr	5.8354	0.5271	2.4447	1.7534	0.5102	0.5433	16.0277
May	19.8468	2.4119	0.4443	2.3933	0.2889	0.1206	16.7568
Jun	32.2285	3.9117	0.0978	2.9649	0.2933	0.0268	16.6773
Jul	37.1876	4.7764	0.0035	3.2233	0.2989	0.0015	16.1072
Aug	31.7903	4.2816	0.146	3.0564	0.3035	0.0408	17.4064
Sep	13.9976	1.6032	1.1963	2.1273	0.3863	0.3048	16.6773
Oct	6.6478	0.6177	2.8888	1.8325	0.5335	0.5576	16.1072
Nov	0.3597	0.0262	9.4957	2.5228	1.0613	1.4298	16.6773
Dec	0.1458	0.0041	12.8757	3.2029	1.1244	1.7621	16.7568
Total	149.4686	18.2453	65.4719	32.1737	8.2449	10.0506	197.9266

Table 203. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ4

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0666	0	15.2672	3.5702	1.5099	2.3755	16.1072
Feb	0.0192	0	12.6811	3.1695	1.1468	1.7909	15.219
Mar	1.3433	0.0856	7.9307	2.3572	0.788	1.0968	17.4064
Apr	5.8354	0.5271	2.4447	1.7534	0.5102	0.5433	16.0277
May	19.8468	2.4119	0.4443	2.3933	0.2889	0.1206	16.7568
Jun	32.2285	3.9117	0.0978	2.9649	0.2933	0.0268	16.6773
Jul	37.1876	4.7764	0.0035	3.2233	0.2989	0.0015	16.1072
Aug	31.7903	4.2816	0.146	3.0564	0.3035	0.0408	17.4064
Sep	13.9976	1.6032	1.1963	2.1273	0.3863	0.3048	16.6773
Oct	6.6478	0.6177	2.8888	1.8325	0.5335	0.5576	16.1072
Nov	0.3597	0.0262	9.4957	2.5228	1.0613	1.4298	16.6773
Dec	0.1458	0.0041	12.8757	3.2029	1.1244	1.7621	16.7568
Total	149.4686	18.2453	65.4719	32.1737	8.2449	10.0506	197.9266

Table 204. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ5

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	21.8083	3.7848	2.1238	2.9359	16.1072
Feb	0	0	23.4419	3.7046	2.3585	3.013	15.219
Mar	0	0	20.4955	3.4512	1.9291	2.7639	17.4064
Apr	0.0965	0.0044	12.2744	2.3445	1.1241	1.7432	16.0277
May	1.786	0.1323	4.4779	1.6266	0.5088	0.6739	16.7568
Jun	6.078	0.5257	1.3255	1.5344	0.2738	0.2678	16.6773
Jul	8.5497	0.7906	0.8514	1.5751	0.2264	0.168	16.1072
Aug	7.1013	0.5938	1.6215	1.702	0.3283	0.3227	17.4064
Sep	1.3277	0.1137	5.1676	1.9301	0.5984	0.8945	16.6773
Oct	0.0325	0.0012	10.6893	2.5167	0.9847	1.5833	16.1072
Nov	0.0887	0.0071	13.8	3.1116	1.391	2.0496	16.6773
Dec	0	0	18.6308	3.4367	1.7315	2.5421	16.7568
Total	25.0604	2.1688	134.5842	30.7181	13.5784	18.9581	197.9266

Table 205. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ5

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	21.3564	3.7813	2.0718	2.8779	16.1072
Feb	0	0	22.8528	3.6972	2.2785	2.9343	15.219
Mar	0	0	20.1049	3.4488	1.8828	2.7094	17.4064
Apr	0.0964	0.0044	12.1173	2.3443	1.1027	1.7102	16.0277
May	1.5819	0.132	4.4983	1.627	0.5115	0.6773	16.7568
Jun	5.5149	0.5254	1.3513	1.534	0.2782	0.2729	16.6773
Jul	7.7198	0.7867	0.862	1.5741	0.2254	0.1703	16.1072
Aug	6.4406	0.5952	1.6288	1.7027	0.333	0.3243	17.4064
Sep	1.2573	0.1136	5.1537	1.9307	0.5986	0.8912	16.6773
Oct	0.0325	0.0012	10.5665	2.5171	0.9712	1.561	16.1072
Nov	0.0883	0.0071	13.6184	3.1108	1.3603	2.0073	16.6773
Dec	0	0	18.2916	3.4344	1.6888	2.491	16.7568
Total	22.7319	2.1657	132.402	30.7023	13.3028	18.6271	197.9266

Table 206. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ5

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	21.3564	3.7813	2.0718	2.8779	16.1072
Feb	0	0	22.8528	3.6972	2.2785	2.9343	15.219
Mar	0	0	20.1049	3.4488	1.8828	2.7094	17.4064
Apr	0.0964	0.0044	12.1173	2.3443	1.1027	1.7102	16.0277
May	1.5819	0.132	4.4983	1.627	0.5115	0.6773	16.7568
Jun	5.5149	0.5254	1.3513	1.534	0.2782	0.2729	16.6773
Jul	7.7198	0.7867	0.862	1.5741	0.2254	0.1703	16.1072
Aug	6.4406	0.5952	1.6288	1.7027	0.333	0.3243	17.4064
Sep	1.2573	0.1136	5.1537	1.9307	0.5986	0.8912	16.6773
Oct	0.0325	0.0012	10.5665	2.5171	0.9712	1.561	16.1072
Nov	0.0883	0.0071	13.6184	3.1108	1.3603	2.0073	16.6773
Dec	0	0	18.2916	3.4344	1.6888	2.491	16.7568
Total	22.7319	2.1657	132.402	30.7023	13.3028	18.6271	197.9266

Table 207. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ6

Optimised	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0382	0	11.2768	2.6086	1.0424	1.5451	16.1072
Feb	0.0183	0	9.7162	2.3994	0.939	1.3158	15.219
Mar	0.3311	0	4.8867	1.6694	0.5602	0.7341	17.4064
Apr	2.7669	0	1.9214	1.4324	0.3157	0.3391	16.0277
May	11.5208	0	0.2391	1.819	0.1762	0.0438	16.7568
Jun	20.5139	0	0.0707	2.1259	0.2084	0.0128	16.6773
Jul	20.2572	0	0	2.0178	0.1892	0	16.1072
Aug	18.0395	0	0.0618	2.1288	0.1958	0.0108	17.4064
Sep	8.5228	0	1.1833	1.7231	0.2664	0.2033	16.6773
Oct	2.6362	0	1.7393	1.4428	0.2703	0.2727	16.1072
Nov	0.8043	0	5.6243	1.8879	0.6453	0.7694	16.6773
Dec	0.2402	0	6.9824	2.0644	0.7294	1.057	16.7568
Total	85.6895	0	43.7019	23.3196	5.5383	6.3038	197.9266

Table 208. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ6

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0382	0	11.2768	2.6086	1.0424	1.5451	16.1072
Feb	0.0183	0	9.7162	2.3994	0.939	1.3158	15.219
Mar	0.3311	0	4.8867	1.6694	0.5602	0.7341	17.4064
Apr	2.7669	0	1.9214	1.4324	0.3157	0.3391	16.0277
May	11.5208	0	0.2391	1.819	0.1762	0.0438	16.7568
Jun	20.5139	0	0.0707	2.1259	0.2084	0.0128	16.6773
Jul	20.2572	0	0	2.0178	0.1892	0	16.1072
Aug	18.0395	0	0.0618	2.1288	0.1958	0.0108	17.4064
Sep	8.5228	0	1.1833	1.7231	0.2664	0.2033	16.6773
Oct	2.6362	0	1.7393	1.4428	0.2703	0.2727	16.1072
Nov	0.8043	0	5.6243	1.8879	0.6453	0.7694	16.6773
Dec	0.2402	0	6.9824	2.0644	0.7294	1.057	16.7568
Total	85.6895	0	43.7019	23.3196	5.5383	6.3038	197.9266

Table 209. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ6

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0382	0	11.2768	2.6086	1.0424	1.5451	16.1072
Feb	0.0183	0	9.7162	2.3994	0.939	1.3158	15.219
Mar	0.3311	0	4.8867	1.6694	0.5602	0.7341	17.4064
Apr	2.7669	0	1.9214	1.4324	0.3157	0.3391	16.0277
May	11.5208	0	0.2391	1.819	0.1762	0.0438	16.7568

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jun	20.5139	0	0.0707	2.1259	0.2084	0.0128	16.6773
Jul	20.2572	0	0	2.0178	0.1892	0	16.1072
Aug	18.0395	0	0.0618	2.1288	0.1958	0.0108	17.4064
Sep	8.5228	0	1.1833	1.7231	0.2664	0.2033	16.6773
Oct	2.6362	0	1.7393	1.4428	0.2703	0.2727	16.1072
Nov	0.8043	0	5.6243	1.8879	0.6453	0.7694	16.6773
Dec	0.2402	0	6.9824	2.0644	0.7294	1.057	16.7568
Total	85.6895	0	43.7019	23.3196	5.5383	6.3038	197.9266

Table 210. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ7

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1213	0	9.4878	2.1243	0.8724	1.2279	16.1072
Feb	0.0991	0	11.5939	2.5026	1.0986	1.5542	15.219
Mar	0.8008	0	4.7288	1.7666	0.602	0.6887	17.4064
Apr	10.7053	0	1.7851	1.9146	0.4206	0.2886	16.0277
May	30.2902	0	0.2682	2.8344	0.5468	0.0517	16.7568
Jun	49.2606	0	0.0122	3.8771	0.8628	0.0021	16.6773
Jul	49.6863	0	0	3.8593	0.8839	0	16.1072
Aug	47.5162	0	0	3.7312	0.8205	0	17.4064
Sep	19.2083	0	0.6895	2.3643	0.4558	0.1351	16.6773
Oct	10.0174	0	1.4374	1.92	0.3785	0.2379	16.1072
Nov	3.329	0	3.8491	1.8323	0.4723	0.5249	16.6773
Dec	0.3082	0	7.9946	2.1433	0.8349	1.0772	16.7568
Total	221.3426	0	41.8466	30.87	8.249	5.7884	197.9266

Table 211. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ7

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1213	0	9.4878	2.1243	0.8724	1.2279	16.1072
Feb	0.0991	0	11.5939	2.5026	1.0986	1.5542	15.219
Mar	0.8008	0	4.7288	1.7666	0.602	0.6887	17.4064
Apr	10.7053	0	1.7851	1.9146	0.4206	0.2886	16.0277
May	30.2902	0	0.2682	2.8344	0.5468	0.0517	16.7568
Jun	49.2606	0	0.0122	3.8771	0.8628	0.0021	16.6773
Jul	49.6863	0	0	3.8593	0.8839	0	16.1072
Aug	47.5162	0	0	3.7312	0.8205	0	17.4064
Sep	19.2083	0	0.6895	2.3643	0.4558	0.1351	16.6773
Oct	10.0174	0	1.4374	1.92	0.3785	0.2379	16.1072

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Nov	3.329	0	3.8491	1.8323	0.4723	0.5249	16.6773
Dec	0.3082	0	7.9946	2.1433	0.8349	1.0772	16.7568
Total	221.3426	0	41.8466	30.87	8.249	5.7884	197.9266

Table 212. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ7

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1213	0	9.4878	2.1243	0.8724	1.2279	16.1072
Feb	0.0991	0	11.5939	2.5026	1.0986	1.5542	15.219
Mar	0.8008	0	4.7288	1.7666	0.602	0.6887	17.4064
Apr	10.7053	0	1.7851	1.9146	0.4206	0.2886	16.0277
May	30.2902	0	0.2682	2.8344	0.5468	0.0517	16.7568
Jun	49.2606	0	0.0122	3.8771	0.8628	0.0021	16.6773
Jul	49.6863	0	0	3.8593	0.8839	0	16.1072
Aug	47.5162	0	0	3.7312	0.8205	0	17.4064
Sep	19.2083	0	0.6895	2.3643	0.4558	0.1351	16.6773
Oct	10.0174	0	1.4374	1.92	0.3785	0.2379	16.1072
Nov	3.329	0	3.8491	1.8323	0.4723	0.5249	16.6773
Dec	0.3082	0	7.9946	2.1433	0.8349	1.0772	16.7568
Total	221.3426	0	41.8466	30.87	8.249	5.7884	197.9266

Table 213. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 1 Modelling in CZ8

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	4.0699	0	3.3943	2.0161	0.3598	0.3211	16.1072
Feb	3.6136	0	2.5305	1.7985	0.2617	0.2486	15.219
Mar	13.1915	0	0.9883	2.2769	0.1964	0.1096	17.4064
Apr	33.7331	0	0.0846	2.7962	0.2876	0.0121	16.0277
May	63.0628	0	0	3.9785	0.5407	0	16.7568
Jun	96.8076	0	0	5.8042	0.8983	0	16.6773
Jul	99.2458	0	0	5.9375	0.9347	0	16.1072
Aug	93.4122	0	0	5.6382	0.877	0	17.4064
Sep	60.1011	0	0.0061	3.9798	0.5169	0.0008	16.6773
Oct	34.7902	0	0.6938	2.8554	0.3161	0.0715	16.1072
Nov	17.163	0	1.4088	2.2969	0.2347	0.1486	16.6773
Dec	5.4488	0	2.4626	2.6703	0.3508	0.2606	16.7568
Total	524.6394	0	11.5689	42.0485	5.7746	1.1729	197.9266

Table 214. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 2 Modelling in CZ8

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	4.0699	0	3.3943	2.0161	0.3598	0.3211	16.1072
Feb	3.6136	0	2.5305	1.7985	0.2617	0.2486	15.219
Mar	13.1915	0	0.9883	2.2769	0.1964	0.1096	17.4064
Apr	33.7331	0	0.0846	2.7962	0.2876	0.0121	16.0277
May	63.0628	0	0	3.9785	0.5407	0	16.7568
Jun	96.8076	0	0	5.8042	0.8983	0	16.6773
Jul	99.2458	0	0	5.9375	0.9347	0	16.1072
Aug	93.4122	0	0	5.6382	0.877	0	17.4064
Sep	60.1011	0	0.0061	3.9798	0.5169	0.0008	16.6773
Oct	34.7902	0	0.6938	2.8554	0.3161	0.0715	16.1072
Nov	17.163	0	1.4088	2.2969	0.2347	0.1486	16.6773
Dec	5.4488	0	2.4626	2.6703	0.3508	0.2606	16.7568
Total	524.6394	0	11.5689	42.0485	5.7746	1.1729	197.9266

Table 215. Detailed Simulation Results for NCC 2025 C5OL Stringency 1 Iteration 3 Modelling in CZ8

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	4.0699	0	3.3943	2.0161	0.3598	0.3211	16.1072
Feb	3.6136	0	2.5305	1.7985	0.2617	0.2486	15.219
Mar	13.1915	0	0.9883	2.2769	0.1964	0.1096	17.4064
Apr	33.7331	0	0.0846	2.7962	0.2876	0.0121	16.0277
May	63.0628	0	0	3.9785	0.5407	0	16.7568
Jun	96.8076	0	0	5.8042	0.8983	0	16.6773
Jul	99.2458	0	0	5.9375	0.9347	0	16.1072
Aug	93.4122	0	0	5.6382	0.877	0	17.4064
Sep	60.1011	0	0.0061	3.9798	0.5169	0.0008	16.6773
Oct	34.7902	0	0.6938	2.8554	0.3161	0.0715	16.1072
Nov	17.163	0	1.4088	2.2969	0.2347	0.1486	16.6773
Dec	5.4488	0	2.4626	2.6703	0.3508	0.2606	16.7568
Total	524.6394	0	11.5689	42.0485	5.7746	1.1729	197.9266

Appendix B.II.II C5OM

The summarised annual energy consumption and savings for C5OM Stringency 1 modelling are presented in Table 216 to Table 221.

Table 216. Energy and GHG Savings for C5OM Stringency 1 Iteration 1 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	230	0	171	0%	26%	26%
2	0	146	0	105	0%	29%	29%
3	0	184	0	118	0%	36%	36%
4	0	129	0	90	0%	31%	31%
5	0	117	0	82	0%	30%	30%
6	0	98	0	71	0%	27%	27%
7	0	107	0	82	0%	24%	24%
8	0	128	0	105	0%	18%	18%

Table 217. Energy and GHG Savings for C5OM Stringency 1 Iteration 2 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 2 - Gas (MWh)	NCC 2025 Iteration 2 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	230	0	165	0%	28%	28%
2	0	146	0	103	0%	29%	29%
3	0	184	0	117	0%	37%	37%
4	0	129	0	89	0%	31%	31%
5	0	117	0	81	0%	31%	31%
6	0	98	0	71	0%	28%	28%
7	0	107	0	82	0%	24%	24%
8	0	128	0	105	0%	18%	18%

Table 218. Energy and GHG Savings for C5OM Stringency 1 Iteration 3 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 3 - Gas (MWh)	NCC 2025 Iteration 3 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	230	0	162	0%	29%	29%
2	0	146	0	103	0%	30%	30%
3	0	184	0	116	0%	37%	37%
4	0	129	0	88	0%	32%	32%
5	0	117	0	81	0%	31%	31%
6	0	98	0	71	0%	28%	28%
7	0	107	0	81	0%	24%	24%
8	0	128	0	104	0%	18%	18%

Table 219. Energy and GHG Savings for C5OM Stringency 1 Iteration 4 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 4 - Gas (MWh)	NCC 2025 Iteration 4 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	230	0	162	0%	30%	30%
2	0	146	0	102	0%	30%	30%
3	0	184	0	116	0%	37%	37%
4	0	129	0	88	0%	32%	32%
5	0	117	0	81	0%	31%	31%
6	0	98	0	71	0%	28%	28%
7	0	107	0	81	0%	24%	24%
8	0	128	0	104	0%	19%	19%

Table 220. Energy and GHG Savings for C5OM Stringency 1 Iteration 5 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 5 - Gas (MWh)	NCC 2025 Iteration 5 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	230	0	162	0%	30%	30%
2	0	146	0	102	0%	30%	30%
3	0	184	0	115	0%	38%	38%
4	0	129	0	88	0%	32%	32%
5	0	117	0	80	0%	32%	32%
6	0	98	0	70	0%	29%	29%
7	0	107	0	81	0%	25%	25%
8	0	128	0	103	0%	19%	19%

Table 221. Energy and GHG Savings for C5OM Stringency 1 Iteration 6 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 6 - Gas (MWh)	NCC 2025 Iteration 6 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
6	0	98	0	70	0%	28%	28%

Detailed simulation results for Iteration 1 to Iteration 6 of NCC 2025 C5OM Stringency 1 modelling are presented in Table 222 to

Table 262 below.

Table 222. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ1

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	8.7015	0	3.452	2.7253
Feb	0	8.8446	0	3.2876	2.5746
Mar	0	9.5967	0	3.7807	2.9443

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Apr	0	7.8419	0	3.452	2.7115
May	0	7.593	0	3.6164	2.8348
Jun	0	4.7759	0	3.6164	2.821
Jul	0	4.0639	0	3.452	2.7253
Aug	0	4.8101	0	3.7807	2.9443
Sep	0	7.554	0	3.6164	2.821
Oct	0	8.986	0	3.452	2.7253
Nov	0	10.9908	0	3.6164	2.821
Dec	0	10.9551	0	3.6164	2.8348
Total	0	94.7135	0	42.7389	33.4832

Table 223. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ1

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	8.0294	0	3.452	2.7253
Feb	0	8.1317	0	3.2876	2.5746
Mar	0	8.8823	0	3.7807	2.9443
Apr	0	7.3388	0	3.452	2.7115
May	0	7.1678	0	3.6164	2.8348
Jun	0	4.6313	0	3.6164	2.821
Jul	0	3.9423	0	3.452	2.7253
Aug	0	4.6751	0	3.7807	2.9443
Sep	0	7.1066	0	3.6164	2.821
Oct	0	8.3625	0	3.452	2.7253
Nov	0	10.2042	0	3.6164	2.821
Dec	0	10.1166	0	3.6164	2.8348
Total	0	88.5885	0	42.7389	33.4832

Table 224. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ1

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.7614	0	3.452	2.7253
Feb	0	7.8607	0	3.2876	2.5746
Mar	0	8.6052	0	3.7807	2.9443
Apr	0	7.1406	0	3.452	2.7115
May	0	6.9993	0	3.6164	2.8348
Jun	0	4.5757	0	3.6164	2.821
Jul	0	3.8945	0	3.452	2.7253
Aug	0	4.6237	0	3.7807	2.9443
Sep	0	6.9361	0	3.6164	2.821
Oct	0	8.1205	0	3.452	2.7253
Nov	0	9.8955	0	3.6164	2.821

Dec	0	9.7744	0	3.6164	2.8348
Total	0	86.1875	0	42.7389	33.4832

Table 225. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ1

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.6675	0	3.452	2.7253
Feb	0	7.764	0	3.2876	2.5746
Mar	0	8.5039	0	3.7807	2.9443
Apr	0	7.0715	0	3.452	2.7115
May	0	6.9426	0	3.6164	2.8348
Jun	0	4.5574	0	3.6164	2.821
Jul	0	3.8781	0	3.452	2.7253
Aug	0	4.6042	0	3.7807	2.9443
Sep	0	6.8733	0	3.6164	2.821
Oct	0	8.0307	0	3.452	2.7253
Nov	0	9.7821	0	3.6164	2.821
Dec	0	9.6517	0	3.6164	2.8348
Total	0	85.3271	0	42.7389	33.4832

Table 226. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ1

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.6675	0	3.452	2.7253
Feb	0	7.764	0	3.2876	2.5746
Mar	0	8.5039	0	3.7807	2.9443
Apr	0	7.0715	0	3.452	2.7115
May	0	6.9295	0	3.6164	2.8348
Jun	0	4.5481	0	3.6164	2.821
Jul	0	3.8645	0	3.452	2.7253
Aug	0	4.5959	0	3.7807	2.9443
Sep	0	6.8732	0	3.6164	2.821
Oct	0	8.0308	0	3.452	2.7253
Nov	0	9.7821	0	3.6164	2.821
Dec	0	9.6517	0	3.6164	2.8348
Total	0	85.2826	0	42.7389	33.4832

Table 227. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ2

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	5.4405	0	2.7809	2.7253
Feb	0	5.985	0	2.6485	2.5746
Mar	0	5.7154	0	3.0458	2.9443
Apr	0.0005	2.916	0	2.7809	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.0049	1.6577	0	2.9133	2.8348
Jun	0.0476	0.7119	0	2.9133	2.821
Jul	0.1182	0.5905	0	2.7809	2.7253
Aug	0.0648	0.8687	0	3.0458	2.9443
Sep	0.0057	1.4997	0	2.9133	2.821
Oct	0.0002	1.8594	0	2.7809	2.7253
Nov	0	3.7519	0	2.9133	2.821
Dec	0	5.4541	0	2.9133	2.8348
Total	0.2419	36.4508	0	34.4303	33.4832

Table 228. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ2

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	5.1294	0	2.7809	2.7253
Feb	0	5.6421	0	2.6485	2.5746
Mar	0	5.4147	0	3.0458	2.9443
Apr	0.0005	2.8324	0	2.7809	2.7115
May	0.0049	1.6599	0	2.9133	2.8348
Jun	0.0449	0.7455	0	2.9133	2.821
Jul	0.1116	0.6142	0	2.7809	2.7253
Aug	0.0618	0.8901	0	3.0458	2.9443
Sep	0.0057	1.503	0	2.9133	2.821
Oct	0.0002	1.8499	0	2.7809	2.7253
Nov	0	3.6182	0	2.9133	2.821
Dec	0	5.1738	0	2.9133	2.8348
Total	0.2295	35.0732	0	34.4303	33.4832

Table 229. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ2

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	5.0029	0	2.7809	2.7253
Feb	0	5.4958	0	2.6485	2.5746
Mar	0	5.2916	0	3.0458	2.9443
Apr	0.0005	2.7988	0	2.7809	2.7115
May	0.0049	1.6627	0	2.9133	2.8348
Jun	0.0433	0.7612	0	2.9133	2.821
Jul	0.108	0.6255	0	2.7809	2.7253
Aug	0.0603	0.9009	0	3.0458	2.9443
Sep	0.0057	1.5065	0	2.9133	2.821
Oct	0.0002	1.8471	0	2.7809	2.7253
Nov	0	3.5662	0	2.9133	2.821

Dec	0	5.0614	0	2.9133	2.8348
Total	0.2229	34.5205	0	34.4303	33.4832

Table 230. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ2

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	4.9634	0	2.7809	2.7253
Feb	0	5.4482	0	2.6485	2.5746
Mar	0	5.2548	0	3.0458	2.9443
Apr	0.0005	2.7896	0	2.7809	2.7115
May	0.0049	1.6644	0	2.9133	2.8348
Jun	0.0426	0.7675	0	2.9133	2.821
Jul	0.1064	0.63	0	2.7809	2.7253
Aug	0.0597	0.9054	0	3.0458	2.9443
Sep	0.0057	1.5079	0	2.9133	2.821
Oct	0.0002	1.8463	0	2.7809	2.7253
Nov	0	3.5486	0	2.9133	2.821
Dec	0	5.0263	0	2.9133	2.8348
Total	0.22	34.3524	0	34.4303	33.4832

Table 231. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ2

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	4.9634	0	2.7809	2.7253
Feb	0	5.4481	0	2.6485	2.5746
Mar	0	5.2548	0	3.0458	2.9443
Apr	0.0005	2.7588	0	2.7809	2.7115
May	0.005	1.6144	0	2.9133	2.8348
Jun	0.0434	0.6751	0	2.9133	2.821
Jul	0.108	0.5518	0	2.7809	2.7253
Aug	0.0605	0.8392	0	3.0458	2.9443
Sep	0.0057	1.4514	0	2.9133	2.821
Oct	0.0002	1.8125	0	2.7809	2.7253
Nov	0	3.5427	0	2.9133	2.821
Dec	0	5.0248	0	2.9133	2.8348
Total	0.2233	33.9369	0	34.4303	33.4832

Table 232. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ3

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.6753	0	2.9847	2.7253
Feb	0	6.0439	0	2.8426	2.5746
Mar	0	5.8408	0	3.269	2.9443
Apr	0.0025	2.6503	0	2.9847	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.1409	0.9077	0.1784	3.1268	2.8348
Jun	0.3113	0.4965	0.2495	3.1268	2.821
Jul	0.9374	0.2198	0.5495	2.9847	2.7253
Aug	0.4508	0.7109	0.1249	3.269	2.9443
Sep	0.0091	3.0722	0.0023	3.1268	2.821
Oct	0.0035	3.3135	0	2.9847	2.7253
Nov	0	6.7676	0	3.1268	2.821
Dec	0	7.1932	0	3.1268	2.8348
Total	1.8556	44.8917	1.1046	36.9535	33.4832

Table 233. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ3

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.3477	0	2.9847	2.7253
Feb	0	5.8365	0	2.8426	2.5746
Mar	0	5.6607	0	3.269	2.9443
Apr	0.0024	2.6042	0	2.9847	2.7115
May	0.1244	0.9328	0.1573	3.1268	2.8348
Jun	0.274	0.5177	0.2217	3.1268	2.821
Jul	0.8439	0.233	0.5142	2.9847	2.7253
Aug	0.4054	0.7266	0.115	3.269	2.9443
Sep	0.0082	2.9937	0.0019	3.1268	2.821
Oct	0.0035	3.2218	0	2.9847	2.7253
Nov	0	6.4962	0	3.1268	2.821
Dec	0	6.9209	0	3.1268	2.8348
Total	1.6619	43.4917	1.01	36.9535	33.4832

Table 234. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ3

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.2188	0	2.9847	2.7253
Feb	0	5.7572	0	2.8426	2.5746
Mar	0	5.592	0	3.269	2.9443
Apr	0.0024	2.5868	0	2.9847	2.7115
May	0.1161	0.9459	0.1466	3.1268	2.8348
Jun	0.2555	0.5279	0.2073	3.1268	2.821
Jul	0.7983	0.2391	0.4952	2.9847	2.7253
Aug	0.3822	0.7352	0.1092	3.269	2.9443
Sep	0.0078	2.9651	0.0017	3.1268	2.821
Oct	0.0035	3.1878	0	2.9847	2.7253
Nov	0	6.3906	0	3.1268	2.821

Dec	0	6.8167	0	3.1268	2.8348
Total	1.5657	42.9631	0.96	36.9535	33.4832

Table 235. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ3

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.1715	0	2.9847	2.7253
Feb	0	5.729	0	2.8426	2.5746
Mar	0	5.5702	0	3.269	2.9443
Apr	0.0024	2.5832	0	2.9847	2.7115
May	0.1124	0.9518	0.1419	3.1268	2.8348
Jun	0.2475	0.5325	0.2007	3.1268	2.821
Jul	0.7782	0.2417	0.4856	2.9847	2.7253
Aug	0.372	0.7391	0.1064	3.269	2.9443
Sep	0.0076	2.9552	0.0016	3.1268	2.821
Oct	0.0035	3.1755	0	2.9847	2.7253
Nov	0	6.354	0	3.1268	2.821
Dec	0	6.7778	0	3.1268	2.8348
Total	1.5236	42.7814	0.9361	36.9535	33.4832

Table 236. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ3

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.163	0	2.9847	2.7253
Feb	0	5.7109	0	2.8426	2.5746
Mar	0	5.5068	0	3.269	2.9443
Apr	0.0025	2.4387	0	2.9847	2.7115
May	0.1145	0.815	0.1444	3.1268	2.8348
Jun	0.2577	0.441	0.2076	3.1268	2.821
Jul	0.7858	0.2003	0.4892	2.9847	2.7253
Aug	0.3758	0.6392	0.1075	3.269	2.9443
Sep	0.0076	2.8347	0.0016	3.1268	2.821
Oct	0.0035	3.0571	0	2.9847	2.7253
Nov	0	6.2949	0	3.1268	2.821
Dec	0	6.752	0	3.1268	2.8348
Total	1.5474	41.8537	0.9503	36.9535	33.4832

Table 237. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ4

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	4.0003	0	2.2945	2.7253
Feb	0	3.6499	0	2.1853	2.5746
Mar	0.0166	2.1565	0	2.5131	2.9443
Apr	0.1331	0.7659	0.0717	2.2945	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.7262	0.1287	0.4632	2.4038	2.8348
Jun	1.5848	0.0221	0.8471	2.4038	2.821
Jul	1.8738	0.0037	0.9793	2.2945	2.7253
Aug	1.6227	0.0436	0.596	2.5131	2.9443
Sep	0.5267	0.3548	0.2477	2.4038	2.821
Oct	0.1852	0.7499	0.0719	2.2945	2.7253
Nov	0.0092	2.5775	0.0016	2.4038	2.821
Dec	0.0019	3.4695	0	2.4038	2.8348
Total	6.6806	17.9224	3.2785	28.4087	33.4832

Table 238. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ4

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	3.8771	0	2.2945	2.7253
Feb	0	3.579	0	2.1853	2.5746
Mar	0.0153	2.1515	0	2.5131	2.9443
Apr	0.1163	0.7794	0.0673	2.2945	2.7115
May	0.6591	0.1387	0.4491	2.4038	2.8348
Jun	1.4503	0.0262	0.8217	2.4038	2.821
Jul	1.7258	0.0053	0.9508	2.2945	2.7253
Aug	1.497	0.0492	0.5822	2.5131	2.9443
Sep	0.4774	0.3644	0.242	2.4038	2.821
Oct	0.1719	0.7601	0.0705	2.2945	2.7253
Nov	0.0088	2.5126	0.0016	2.4038	2.821
Dec	0.0019	3.3759	0	2.4038	2.8348
Total	6.1243	17.6194	3.1852	28.4087	33.4832

Table 239. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ4

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	3.832	0	2.2945	2.7253
Feb	0	3.5526	0	2.1853	2.5746
Mar	0.0147	2.1525	0	2.5131	2.9443
Apr	0.1084	0.7872	0.0652	2.2945	2.7115
May	0.6266	0.1436	0.4409	2.4038	2.8348
Jun	1.3882	0.0281	0.808	2.4038	2.821
Jul	1.659	0.0059	0.9363	2.2945	2.7253
Aug	1.439	0.0516	0.5734	2.5131	2.9443
Sep	0.4539	0.3693	0.2383	2.4038	2.821
Oct	0.1649	0.7657	0.0698	2.2945	2.7253
Nov	0.0086	2.4907	0.0016	2.4038	2.821

Dec	0.0019	3.3428	0	2.4038	2.8348
Total	5.8656	17.522	3.1335	28.4087	33.4832

Table 240. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ4

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	3.8162	0	2.2945	2.7253
Feb	0	3.5429	0	2.1853	2.5746
Mar	0.0145	2.1539	0	2.5131	2.9443
Apr	0.105	0.7906	0.0642	2.2945	2.7115
May	0.6125	0.1456	0.4362	2.4038	2.8348
Jun	1.3615	0.0288	0.8007	2.4038	2.821
Jul	1.6308	0.0061	0.9279	2.2945	2.7253
Aug	1.4145	0.0525	0.5683	2.5131	2.9443
Sep	0.4437	0.3715	0.2358	2.4038	2.821
Oct	0.1618	0.7684	0.0694	2.2945	2.7253
Nov	0.0085	2.4835	0.0016	2.4038	2.821
Dec	0.0019	3.331	0	2.4038	2.8348
Total	5.7552	17.4912	3.1041	28.4087	33.4832

Table 241. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ4

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0004	3.7607	0	2.2945	2.7253
Feb	0	3.4617	0	2.1853	2.5746
Mar	0.0147	2.0062	0	2.5131	2.9443
Apr	0.1079	0.7246	0.0656	2.2945	2.7115
May	0.6198	0.1157	0.4379	2.4038	2.8348
Jun	1.3663	0.0135	0.8008	2.4038	2.821
Jul	1.633	0.0014	0.9281	2.2945	2.7253
Aug	1.418	0.0324	0.5689	2.5131	2.9443
Sep	0.4488	0.3177	0.2365	2.4038	2.821
Oct	0.1633	0.691	0.0699	2.2945	2.7253
Nov	0.0086	2.4022	0.0016	2.4038	2.821
Dec	0.0019	3.2566	0	2.4038	2.8348
Total	5.7828	16.7837	3.1094	28.4087	33.4832

Table 242. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ5

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	3.6013	0	1.9523	2.7253
Feb	0	4.098	0	1.8593	2.5746
Mar	0	3.506	0	2.1382	2.9443
Apr	0.0024	1.8126	0	1.9523	2.7115

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.0362	0.7344	0	2.0452	2.8348
Jun	0.1432	0.2207	0	2.0452	2.821
Jul	0.2818	0.1631	0	1.9523	2.7253
Aug	0.2123	0.3077	0	2.1382	2.9443
Sep	0.032	0.9974	0	2.0452	2.821
Oct	0.0017	1.9327	0	1.9523	2.7253
Nov	0.0038	2.6204	0	2.0452	2.821
Dec	0	3.2771	0	2.0452	2.8348
Total	0.7134	23.2714	0	24.1711	33.4832

Table 243. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ5

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	3.4589	0	1.9523	2.7253
Feb	0	3.9239	0	1.8593	2.5746
Mar	0	3.3787	0	2.1382	2.9443
Apr	0.0024	1.7907	0	1.9523	2.7115
May	0.0331	0.7662	0	2.0452	2.8348
Jun	0.1286	0.2517	0	2.0452	2.821
Jul	0.2514	0.1856	0	1.9523	2.7253
Aug	0.19	0.3364	0	2.1382	2.9443
Sep	0.0303	1.012	0	2.0452	2.821
Oct	0.0017	1.9036	0	1.9523	2.7253
Nov	0.0035	2.5544	0	2.0452	2.821
Dec	0	3.1578	0	2.0452	2.8348
Total	0.641	22.72	0	24.1711	33.4832

Table 244. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ5

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	3.4028	0	1.9523	2.7253
Feb	0	3.8456	0	1.8593	2.5746
Mar	0	3.3298	0	2.1382	2.9443
Apr	0.0024	1.7843	0	1.9523	2.7115
May	0.0315	0.7816	0	2.0452	2.8348
Jun	0.1211	0.2659	0	2.0452	2.821
Jul	0.2364	0.1962	0	1.9523	2.7253
Aug	0.1786	0.3499	0	2.1382	2.9443
Sep	0.0295	1.0197	0	2.0452	2.821
Oct	0.0017	1.8936	0	1.9523	2.7253
Nov	0.0033	2.5301	0	2.0452	2.821

Dec	0	3.1133	0	2.0452	2.8348
Total	0.6046	22.5126	0	24.1711	33.4832

Table 245. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ5

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	3.3838	0	1.9523	2.7253
Feb	0	3.8181	0	1.8593	2.5746
Mar	0	3.315	0	2.1382	2.9443
Apr	0.0024	1.7837	0	1.9523	2.7115
May	0.0308	0.788	0	2.0452	2.8348
Jun	0.1178	0.2716	0	2.0452	2.821
Jul	0.23	0.2005	0	1.9523	2.7253
Aug	0.1736	0.3555	0	2.1382	2.9443
Sep	0.0292	1.0233	0	2.0452	2.821
Oct	0.0017	1.8912	0	1.9523	2.7253
Nov	0.0033	2.5217	0	2.0452	2.821
Dec	0	3.0988	0	2.0452	2.8348
Total	0.5887	22.4511	0	24.1711	33.4832

Table 246. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ5

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0	3.3732	0	1.9523	2.7253
Feb	0	3.8181	0	1.8593	2.5746
Mar	0	3.3077	0	2.1382	2.9443
Apr	0.0024	1.7408	0	1.9523	2.7115
May	0.0314	0.7017	0	2.0452	2.8348
Jun	0.1222	0.1929	0	2.0452	2.821
Jul	0.2362	0.1362	0	1.9523	2.7253
Aug	0.1793	0.2704	0	2.1382	2.9443
Sep	0.03	0.9225	0	2.0452	2.821
Oct	0.0017	1.8099	0	1.9523	2.7253
Nov	0.0033	2.4498	0	2.0452	2.821
Dec	0	3.0723	0	2.0452	2.8348
Total	0.6065	21.7955	0	24.1711	33.4832

Table 247. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.5258	0	1.8231	2.7253
Feb	0.0007	2.4617	0	1.7363	2.5746
Mar	0.0056	1.2216	0	1.9967	2.9443
Apr	0.0813	0.4759	0	1.8231	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.4382	0.069	0.1299	1.9099	2.8348
Jun	0.9141	0.0201	0.132	1.9099	2.821
Jul	0.9298	0	0.036	1.8231	2.7253
Aug	0.8747	0.0276	0.2782	1.9967	2.9443
Sep	0.3716	0.2413	0.0698	1.9099	2.821
Oct	0.094	0.4483	0	1.8231	2.7253
Nov	0.0193	1.4296	0	1.9099	2.821
Dec	0.0076	1.7657	0	1.9099	2.8348
Total	3.7382	10.6867	0.6457	22.5715	33.4832

Table 248. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.4712	0	1.8231	2.7253
Feb	0.0007	2.4342	0	1.7363	2.5746
Mar	0.0053	1.2507	0	1.9967	2.9443
Apr	0.0739	0.5041	0	1.8231	2.7115
May	0.3922	0.0859	0.1264	1.9099	2.8348
Jun	0.8277	0.0252	0.1296	1.9099	2.821
Jul	0.8351	0.0007	0.0352	1.8231	2.7253
Aug	0.7941	0.0355	0.2695	1.9967	2.9443
Sep	0.3377	0.2599	0.0671	1.9099	2.821
Oct	0.0844	0.4763	0	1.8231	2.7253
Nov	0.0177	1.4304	0	1.9099	2.821
Dec	0.0072	1.7492	0	1.9099	2.8348
Total	3.3772	10.7233	0.6279	22.5715	33.4832

Table 249. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.4503	0	1.8231	2.7253
Feb	0.0007	2.4224	0	1.7363	2.5746
Mar	0.0052	1.2652	0	1.9967	2.9443
Apr	0.07	0.5175	0	1.8231	2.7115
May	0.3693	0.0936	0.1242	1.9099	2.8348
Jun	0.787	0.0277	0.1282	1.9099	2.821
Jul	0.7913	0.0013	0.0347	1.8231	2.7253
Aug	0.7552	0.0391	0.2643	1.9967	2.9443
Sep	0.321	0.2685	0.0658	1.9099	2.821
Oct	0.0791	0.4897	0	1.8231	2.7253
Nov	0.0169	1.4312	0	1.9099	2.821

Dec	0.007	1.746	0	1.9099	2.8348
Total	3.2038	10.7525	0.6172	22.5715	33.4832

Table 250. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.4435	0	1.8231	2.7253
Feb	0.0007	2.4181	0	1.7363	2.5746
Mar	0.0052	1.2716	0	1.9967	2.9443
Apr	0.0683	0.5231	0	1.8231	2.7115
May	0.3593	0.0967	0.1229	1.9099	2.8348
Jun	0.7697	0.0287	0.1274	1.9099	2.821
Jul	0.7727	0.0015	0.0344	1.8231	2.7253
Aug	0.7388	0.0406	0.2613	1.9967	2.9443
Sep	0.3139	0.272	0.065	1.9099	2.821
Oct	0.0769	0.4953	0	1.8231	2.7253
Nov	0.0165	1.432	0	1.9099	2.821
Dec	0.0069	1.7454	0	1.9099	2.8348
Total	3.1301	10.7685	0.611	22.5715	33.4832

Table 251. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ6

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.3677	0	1.8231	2.7253
Feb	0.0007	2.3279	0	1.7363	2.5746
Mar	0.0054	1.1221	0	1.9967	2.9443
Apr	0.0708	0.4186	0	1.8231	2.7115
May	0.3674	0.0445	0.1231	1.9099	2.8348
Jun	0.7754	0.0115	0.1275	1.9099	2.821
Jul	0.7772	0	0.0344	1.8231	2.7253
Aug	0.7442	0.014	0.2619	1.9967	2.9443
Sep	0.319	0.213	0.0656	1.9099	2.821
Oct	0.0808	0.3783	0	1.8231	2.7253
Nov	0.0172	1.2894	0	1.9099	2.821
Dec	0.007	1.6123	0	1.9099	2.8348
Total	3.1663	9.7993	0.6125	22.5715	33.4832

Table 252. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 6 Modelling in CZ6

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0013	2.4617	0	1.8231	2.7253
Feb	0.0007	2.3845	0	1.7363	2.5746
Mar	0.0059	1.0973	0	1.9967	2.9443
Apr	0.0837	0.3952	0	1.8231	2.7115

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	0.4446	0.0329	0.1299	1.9099	2.8348
Jun	0.9175	0.0088	0.132	1.9099	2.821
Jul	0.932	0	0.036	1.8231	2.7253
Aug	0.8777	0.0096	0.2783	1.9967	2.9443
Sep	0.375	0.1982	0.0699	1.9099	2.821
Oct	0.0982	0.3614	0	1.8231	2.7253
Nov	0.02	1.3145	0	1.9099	2.821
Dec	0.0077	1.6533	0	1.9099	2.8348
Total	3.7642	9.9174	0.6461	22.5715	33.4832

Table 253. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ7

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0041	1.9426	0	1.9855	2.7253
Feb	0.0023	2.7044	0	1.891	2.5746
Mar	0.0269	1.2358	0	2.1746	2.9443
Apr	0.3843	0.3704	0.2972	1.9855	2.7115
May	1.2264	0.0692	0.8401	2.08	2.8348
Jun	2.2396	0.0085	1.128	2.08	2.821
Jul	2.2025	0	0.7738	1.9855	2.7253
Aug	2.1066	0.0042	0.7234	2.1746	2.9443
Sep	0.9432	0.1594	0.4408	2.08	2.821
Oct	0.4299	0.3266	0.2954	1.9855	2.7253
Nov	0.0982	0.8499	0.0667	2.08	2.821
Dec	0.0103	1.7578	0.0005	2.08	2.8348
Total	9.6742	9.4287	4.5658	24.5824	33.4832

Table 254. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ7

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0041	1.9426	0	1.9855	2.7253
Feb	0.0023	2.7044	0	1.891	2.5746
Mar	0.0269	1.2358	0	2.1746	2.9443
Apr	0.3843	0.3704	0.2972	1.9855	2.7115
May	1.2264	0.0692	0.8401	2.08	2.8348
Jun	2.2396	0.0085	1.128	2.08	2.821
Jul	2.2025	0	0.7738	1.9855	2.7253
Aug	2.1066	0.0042	0.7234	2.1746	2.9443
Sep	0.9432	0.1594	0.4408	2.08	2.821
Oct	0.4299	0.3266	0.2954	1.9855	2.7253
Nov	0.0982	0.8499	0.0667	2.08	2.821

Dec	0.0103	1.7578	0.0005	2.08	2.8348
Total	9.6742	9.4287	4.5658	24.5824	33.4832

Table 255. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ7

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.004	1.9361	0	1.9855	2.7253
Feb	0.0023	2.6864	0	1.891	2.5746
Mar	0.025	1.2491	0	2.1746	2.9443
Apr	0.3677	0.3785	0.2935	1.9855	2.7115
May	1.1736	0.0718	0.8274	2.08	2.8348
Jun	2.1638	0.0091	1.1196	2.08	2.821
Jul	2.1283	0	0.7682	1.9855	2.7253
Aug	2.033	0.005	0.7163	2.1746	2.9443
Sep	0.9115	0.1632	0.4394	2.08	2.821
Oct	0.4102	0.3331	0.2923	1.9855	2.7253
Nov	0.0922	0.8578	0.0639	2.08	2.821
Dec	0.0101	1.7576	0.0005	2.08	2.8348
Total	9.3218	9.4477	4.521	24.5824	33.4832

Table 256. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ7

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.004	1.9339	0	1.9855	2.7253
Feb	0.0023	2.6802	0	1.891	2.5746
Mar	0.0243	1.2549	0	2.1746	2.9443
Apr	0.3605	0.3818	0.2912	1.9855	2.7115
May	1.1506	0.0729	0.8204	2.08	2.8348
Jun	2.1314	0.0093	1.1159	2.08	2.821
Jul	2.0965	0	0.7653	1.9855	2.7253
Aug	2.0021	0.0053	0.7123	2.1746	2.9443
Sep	0.8978	0.1648	0.4382	2.08	2.821
Oct	0.4019	0.3359	0.29	1.9855	2.7253
Nov	0.0898	0.8612	0.0628	2.08	2.821
Dec	0.01	1.758	0.0005	2.08	2.8348
Total	9.1712	9.4583	4.4967	24.5824	33.4832

Table 257. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ7

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0041	1.8569	0	1.9855	2.7253
Feb	0.0023	2.604	0	1.891	2.5746
Mar	0.0246	1.126	0	2.1746	2.9443
Apr	0.3636	0.3325	0.2919	1.9855	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	1.1552	0.0582	0.8211	2.08	2.8348
Jun	2.1326	0.005	1.1156	2.08	2.821
Jul	2.0965	0	0.7655	1.9855	2.7253
Aug	2.0039	0.0015	0.7124	2.1746	2.9443
Sep	0.9007	0.1354	0.4385	2.08	2.821
Oct	0.4057	0.289	0.2906	1.9855	2.7253
Nov	0.0924	0.7814	0.0641	2.08	2.821
Dec	0.0102	1.6599	0.0005	2.08	2.8348
Total	9.1919	8.8499	4.5	24.5824	33.4832

Table 258. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 1 Modelling in CZ8

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0817	0.6818	0.0249	2.7516	2.7253
Feb	0.0636	0.6489	0	2.6206	2.5746
Mar	0.315	0.3449	0.1606	3.0137	2.9443
Apr	1.0384	0.0705	0.8006	2.7516	2.7115
May	2.3658	0.0001	1.1388	2.8827	2.8348
Jun	4.3517	0	3.0981	2.8827	2.821
Jul	4.3975	0	3.4848	2.7516	2.7253
Aug	4.1077	0.0003	2.3509	3.0137	2.9443
Sep	2.4338	0.0126	1.5026	2.8827	2.821
Oct	1.2091	0.1436	0.6823	2.7516	2.7253
Nov	0.5597	0.3127	0.4843	2.8827	2.821
Dec	0.1129	0.6095	0.0814	2.8827	2.8348
Total	21.0369	2.8249	13.8092	34.0679	33.4832

Table 259. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 2 Modelling in CZ8

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0817	0.6818	0.0249	2.7516	2.7253
Feb	0.0636	0.6489	0	2.6206	2.5746
Mar	0.315	0.3449	0.1606	3.0137	2.9443
Apr	1.0384	0.0705	0.8006	2.7516	2.7115
May	2.3658	0.0001	1.1388	2.8827	2.8348
Jun	4.3517	0	3.0981	2.8827	2.821
Jul	4.3975	0	3.4848	2.7516	2.7253
Aug	4.1077	0.0003	2.3509	3.0137	2.9443
Sep	2.4338	0.0126	1.5026	2.8827	2.821
Oct	1.2091	0.1436	0.6823	2.7516	2.7253
Nov	0.5597	0.3127	0.4843	2.8827	2.821

Dec	0.1129	0.6095	0.0814	2.8827	2.8348
Total	21.0369	2.8249	13.8092	34.0679	33.4832

Table 260. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 3 Modelling in CZ8

OPTIMISED	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0767	0.6933	0.0232	2.7516	2.7253
Feb	0.0603	0.6646	0	2.6206	2.5746
Mar	0.2958	0.3601	0.154	3.0137	2.9443
Apr	0.9927	0.0755	0.7823	2.7516	2.7115
May	2.2859	0.0003	1.1226	2.8827	2.8348
Jun	4.2261	0	3.0532	2.8827	2.821
Jul	4.2762	0	3.4335	2.7516	2.7253
Aug	3.9969	0.0004	2.3299	3.0137	2.9443
Sep	2.3518	0.0141	1.4679	2.8827	2.821
Oct	1.1522	0.1465	0.6624	2.7516	2.7253
Nov	0.5268	0.3198	0.4561	2.8827	2.821
Dec	0.105	0.6233	0.0774	2.8827	2.8348
Total	20.3465	2.898	13.5626	34.0679	33.4832

Table 261. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 4 Modelling in CZ8

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.0748	0.698	0.0226	2.7516	2.7253
Feb	0.0589	0.6714	0	2.6206	2.5746
Mar	0.2876	0.3665	0.1505	3.0137	2.9443
Apr	0.9738	0.0775	0.7721	2.7516	2.7115
May	2.2528	0.0005	1.1155	2.8827	2.8348
Jun	4.1746	0	3.0384	2.8827	2.821
Jul	4.2263	0	3.4193	2.7516	2.7253
Aug	3.9514	0.0004	2.322	3.0137	2.9443
Sep	2.3177	0.0147	1.4555	2.8827	2.821
Oct	1.1287	0.1478	0.6536	2.7516	2.7253
Nov	0.5133	0.3228	0.4429	2.8827	2.821
Dec	0.1017	0.6294	0.0754	2.8827	2.8348
Total	20.0613	2.929	13.4678	34.0679	33.4832

Table 262. Detailed Simulation Results for NCC 2025 C5OM Stringency 1 Iteration 5 Modelling in CZ8

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
Jan	0.078	0.6132	0.0248	2.7516	2.7253
Feb	0.0609	0.5377	0	2.6206	2.5746
Mar	0.2927	0.2612	0.1522	3.0137	2.9443
Apr	0.9825	0.0393	0.7766	2.7516	2.7115

	PAC heating energy (MWh)	PAC cooling energy (MWh)	PAC defrost energy (MWh)	PAC fan energy (MWh)	Total lights energy (MWh)
May	2.2539	0	1.1159	2.8827	2.8348
Jun	4.175	0	3.0391	2.8827	2.821
Jul	4.2274	0	3.4184	2.7516	2.7253
Aug	3.9515	0	2.3226	3.0137	2.9443
Sep	2.3213	0.0048	1.4553	2.8827	2.821
Oct	1.1315	0.1253	0.6547	2.7516	2.7253
Nov	0.5196	0.2657	0.4507	2.8827	2.821
Dec	0.1043	0.5115	0.076	2.8827	2.8348
Total	20.0986	2.3588	13.4864	34.0679	33.4832

Appendix B.II.III C9A

The annual energy consumption and savings for C9A Stringency 1 modelling are presented in Table 263 and Table 264.

Table 263. Energy and GHG Savings for C9A Stringency 1 Iteration 1 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	1,039	0	910	0%	12%	12%
2	25	491	24	455	2%	7%	7%
3	109	571	115	522	-6%	9%	6%
4	136	448	155	426	-14%	5%	0%
5	12	479	17	430	-43%	10%	9%
6	67	381	84	368	-25%	3%	-1%
7	204	396	213	381	-4%	4%	1%
8	400	358	441	352	-10%	2%	-5%

Table 264. Energy and GHG Savings for C9A Stringency 1 Iteration 2 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 2 - Gas (MWh)	NCC 2025 Iteration 2 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	1,039	0	872	0%	16%	16%
3	109	571	68	494	37%	14%	18%

Detailed simulation results for Iteration 1 and Iteration 2 of NCC 2025 C9A Stringency 1 modelling are presented in Table 265 to Table 274 below.

Table 265. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ1

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	62.9099	7.2586	4.5552	0	14.2383
Feb	0	0	58.3595	6.5562	4.3196	0	12.8604
Mar	0	0	61.5567	7.2586	4.5111	0	14.2383
Apr	0	0	55.7954	7.0245	3.8916	0	13.779
May	0	0	45.5956	7.2586	2.9241	0	14.2383
Jun	0	0	27.8274	7.0245	1.5677	0	13.779
Jul	0	0	26.1522	7.2586	1.5477	0	14.2383
Aug	0	0	27.3414	7.2586	1.4762	0	14.2383
Sep	0	0	47.137	7.0245	3.0723	0	13.779
Oct	0	0	62.0657	7.2586	4.3327	0	14.2383
Nov	0	0	69.2223	7.0245	4.9163	0	13.779
Dec	0	0	70.5504	7.2586	5.2118	0	14.2383
Total	0	0	614.5134	85.4644	42.3263	0	167.6443

Table 266. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 2 Modelling in CZ1

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.00	0	58.2454	8.8805	4.1077	0	14.2383
Feb	0.00	0	54.374	7.9708	3.9495	0	12.8604
Mar	0.00	0	57.448	8.6351	4.1234	0	14.2383
Apr	0.00	0	51.3466	8.5793	3.4778	0	13.779
May	0.00	0	41.8965	8.7766	2.5618	0	14.2383
Jun	0.00	0	25.0128	8.4055	1.39	0	13.779
Jul	0.00	0	23.4759	8.5258	1.3958	0	14.2383
Aug	0.00	0	24.4645	8.5451	1.3642	0	14.2383
Sep	0.00	0	43.2382	8.6211	2.7278	0	13.779
Oct	0.00	0	55.9168	9.5154	3.7427	0	14.2383
Nov	0.00	0	61.6592	9.3284	4.2345	0	13.779
Dec	0.00	0	64.3911	9.1433	4.6315	0	14.2383
Total	0.00	0	561.4691	104.9268	37.7067	0	167.6443

Table 267. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ2

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	35.4664	7.0985	2.5199	0	14.2383
Feb	0	0	35.4245	6.4116	2.5626	0	12.8604
Mar	0	0	28.1309	7.0985	1.8383	0	14.2383
Apr	0	0	15.5997	6.8695	1.0873	0	13.779
May	0.5183	0	5.2425	7.0985	0.4957	0	14.2383
Jun	4.9125	0	1.1497	6.8695	0.2305	0	13.779

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jul	11.0943	0	1.3	7.0985	0.2854	0	14.2383
Aug	7.3786	0	1.883	7.0985	0.3229	0	14.2383
Sep	0.4127	0	5.322	6.8695	0.4856	0	13.779
Oct	0.022	0	9.2649	7.0985	0.7464	0	14.2383
Nov	0	0	20.8759	6.8695	1.4011	0	13.779
Dec	0	0	30.1719	7.0985	2.0336	0	14.2383
Total	24.3383	0	189.8314	83.5794	14.0095	0	167.6443

Table 268. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ3

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	44.4826	8.6665	2.5399	0	14.2383
Feb	0	0	31.7528	7.8278	1.7692	0	12.8604
Mar	0	0	30.4129	8.6665	1.6897	0	14.2383
Apr	0.6779	0	13.5289	8.387	0.8328	0	13.779
May	15.0727	0	2.671	8.6665	0.3698	0	14.2383
Jun	25.7084	0	1.8054	8.387	0.343	0	13.779
Jul	45.1085	0	0.7789	8.6665	0.3528	0	14.2383
Aug	25.2519	0	2.708	8.6665	0.4113	0	14.2383
Sep	1.767	0	16.5647	8.387	0.9798	0	13.779
Oct	1.3603	0	18.9666	8.6665	1.1304	0	14.2383
Nov	0.0021	0	34.9359	8.387	1.9121	0	13.779
Dec	0	0	39.134	8.6665	2.1512	0	14.2383
Total	114.949	0	237.7416	102.0413	14.4821	0	167.6447

Table 269. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 2 Modelling in CZ3

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	37.2286	11.1492	1.8539	0	14.2383
Feb	0	0	25.9226	10.0474	1.313	0	12.8604
Mar	0	0	24.7171	10.893	1.2519	0	14.2383
Apr	0.4029	0	9.7362	10.114	0.7098	0	13.779
May	8.4164	0	2.2046	10.0066	0.3354	0	14.2383
Jun	14.8483	0	1.2572	10.3075	0.2882	0	13.779
Jul	27.5911	0	0.5631	10.9744	0.2821	0	14.2383
Aug	14.9491	0	1.8193	10.6453	0.3405	0	14.2383
Sep	0.9597	0	11.8457	10.4305	0.759	0	13.779
Oct	0.782	0	14.098	10.6432	0.8594	0	14.2383
Nov	0.0029	0	27.5966	10.7115	1.3696	0	13.779
Dec	0	0	31.2005	11.1671	1.5924	0	14.2383
Total	67.9524	0	188.1894	127.0898	10.9552	0	167.6447

Table 270. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ4

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	23.8334	13.0832	1.4757	0	14.2383
Feb	0	0	18.754	11.8171	1.1664	0	12.8604
Mar	0.2656	0	9.6477	13.0832	0.6842	0	14.2383
Apr	5.2676	0	3.9673	12.6612	0.3739	0	13.779
May	19.1869	0	0.3752	13.0832	0.1827	0	14.2383
Jun	34.5896	0	0.0415	12.6612	0.1949	0	13.779
Jul	44.9454	0	0.0104	13.0832	0.2335	0	14.2383
Aug	34.1123	0	0.1645	13.0832	0.2215	0	14.2383
Sep	12.2765	0	1.6629	12.6612	0.2499	0	13.779
Oct	3.9189	0	3.8347	13.0832	0.3584	0	14.2383
Nov	0.109	0	14.724	12.6612	0.9804	0	13.779
Dec	0.0117	0	19.5093	13.0832	1.228	0	14.2383
Total	154.6836	0	96.5248	154.0442	7.3494	0	167.6443

Table 271. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ5

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	22.6149	11.3811	1.6338	0	14.2383
Feb	0	0	21.2314	10.2798	1.5957	0	12.8604
Mar	0	0	18.0248	11.3811	1.305	0	14.2383
Apr	0	0	8.9367	11.014	0.6924	0	13.779
May	0.5568	0	2.6657	11.3811	0.3109	0	14.2383
Jun	4.0128	0	0.4524	11.014	0.1427	0	13.779
Jul	7.429	0	0.4529	11.3811	0.1752	0	14.2383
Aug	4.2783	0	1.0718	11.3811	0.2094	0	14.2383
Sep	0.3059	0	4.6623	11.014	0.4261	0	13.779
Oct	0	0	9.4888	11.3811	0.7308	0	14.2383
Nov	0	0	12.874	11.014	0.956	0	13.779
Dec	0	0	16.584	11.3811	1.2188	0	14.2383
Total	16.5829	0	119.0597	134.0037	9.3968	0	167.6443

Table 272. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ6

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	13.4058	11.9338	0.984	0	14.2383
Feb	0	0	12.8068	10.7789	0.9042	0	12.8604
Mar	0.0644	0	5.4411	11.9338	0.4465	0	14.2383
Apr	1.1901	0	2.0382	11.5488	0.228	0	13.779
May	10.0696	0	0.1583	11.9338	0.1004	0	14.2383
Jun	21.6539	0	0.0634	11.5488	0.1376	0	13.779

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jul	23.3552	0	0.0229	11.9338	0.1505	0	14.2383
Aug	17.4082	0	0.088	11.9338	0.1291	0	14.2383
Sep	8.1646	0	1.0508	11.5488	0.172	0	13.779
Oct	1.8222	0	2.862	11.9338	0.2612	0	14.2383
Nov	0.1666	0	7.8995	11.5488	0.6089	0	13.779
Dec	0.1011	0	8.8152	11.9338	0.6661	0	14.2383
Total	83.996	0	54.6521	140.5108	4.7884	0	167.6443

Table 273. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ7

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	12.5211	13.206	0.901	0	14.2383
Feb	0	0	14.1453	11.928	1.0176	0	12.8604
Mar	0.185	0	5.986	13.206	0.4694	0	14.2383
Apr	11.4498	0	1.429	12.78	0.2208	0	13.779
May	29.6081	0	0.2522	13.206	0.219	0	14.2383
Jun	46.3151	0	0.0233	12.78	0.2384	0	13.779
Jul	52.2713	0	0.0025	13.206	0.2694	0	14.2383
Aug	42.4683	0	0.0314	13.206	0.2335	0	14.2383
Sep	19.2418	0	0.5295	12.78	0.1844	0	13.779
Oct	8.77	0	2.1864	13.206	0.2485	0	14.2383
Nov	2.6792	0	5.0825	12.78	0.4014	0	13.779
Dec	0.102	0	10.2922	13.206	0.7435	0	14.2383
Total	213.0906	0	52.4815	155.4905	5.147	0	167.6443

Table 274. Detailed Simulation Results for NCC 2025 C9A Stringency 1 Iteration 1 Modelling in CZ8

OPTIMISED	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	2.2383	0	3.0785	14.4535	0.273	0	14.2383
Feb	1.8711	0	2.3909	13.0548	0.2228	0	12.8604
Mar	8.5779	0	0.7368	14.4535	0.1657	0	14.2383
Apr	30.1123	0	0.1044	13.9873	0.2059	0	13.779
May	51.6886	0	0.0052	14.4535	0.2784	0	14.2383
Jun	83.0287	0	0	13.9873	0.3389	0	13.779
Jul	90.9417	0	0	14.4535	0.3649	0	14.2383
Aug	76.1422	0	0.0026	14.4535	0.3378	0	14.2383
Sep	50.5293	0	0.0303	13.9873	0.2594	0	13.779
Oct	29.0067	0	0.5015	14.4535	0.2264	0	14.2383
Nov	13.895	0	1.492	13.9873	0.2287	0	13.779
Dec	2.8344	0	2.9211	14.4535	0.2829	0	14.2383
Total	440.8662	0	11.2633	170.1784	3.1849	0	167.6443

Appendix B.II.IV C9AS

The summarised annual energy consumption and savings for C9AS Stringency 1 modelling are presented in Table 275 to Table 276.

Table 275. Energy and GHG Savings for C9AS Stringency 1 Iteration 1 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	276	0	233	0%	16%	16%
2	0	155	0	114	0%	27%	27%
3	0	178	0	145	0%	18%	18%
4	0	141	0	116	0%	18%	18%
5	0	116	0	89	0%	23%	23%
6	0	114	0	83	0%	27%	27%
7	0	146	0	123	0%	16%	16%
8	0	192	0	159	0%	17%	17%

Table 276. Energy and GHG Savings for C9AS Stringency 1 Iteration 2 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	276	0	223	0%	19%	19%
3	0	178	0	140	0%	21%	21%

Detailed simulation results for Iteration 1 and Iteration 2 of NCC 2025 C9AS Stringency 1 modelling are presented in Table 277 to Table 286 below.

Table 277. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ1

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	17.8188	0	0.9191	2.5088
Feb	0	17.3161	0	0.8301	2.266
Mar	0	18.4674	0	0.9191	2.5088
Apr	0	16.1928	0	0.8894	2.4279
May	0	14.9137	0	0.9191	2.5088
Jun	0	10.9604	0	0.8894	2.4279
Jul	0	10.8558	0	0.9191	2.5088
Aug	0	10.9795	0	0.9191	2.5088
Sep	0	14.6812	0	0.8894	2.4279
Oct	0	17.9972	0	0.9191	2.5088
Nov	0	20.9725	0	0.8894	2.4279
Dec	0	21.2553	0	0.9191	2.5088
Total	0	192.4109	0	10.8211	29.539

Table 278. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 2 Modelling in CZ1

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	16.301	0	1.4936	2.5088
Feb	0	15.7071	0	1.4466	2.266
Mar	0	16.9906	0	1.427	2.5088
Apr	0	14.8067	0	1.4111	2.4279
May	0	13.7551	0	1.4148	2.5088
Jun	0	10.5235	0	1.3109	2.4279
Jul	0	10.4741	0	1.2942	2.5088
Aug	0	10.5737	0	1.303	2.5088
Sep	0	13.4729	0	1.4419	2.4279
Oct	0	16.0736	0	1.6518	2.5088
Nov	0	18.4629	0	1.6576	2.4279
Dec	0	19.0579	0	1.6068	2.5088
Total	0	176.199	0	17.4594	29.539

Table 279. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ2

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	10.6464	0	0.9191	2.5088
Feb	0	10.5933	0	0.8301	2.266
Mar	0	9.8334	0	0.9191	2.5088
Apr	0	6.8401	0	0.8894	2.4279
May	0.0003	3.8999	0	0.9191	2.5088
Jun	0.4013	0.7254	0	0.8894	2.4279
Jul	1.406	0.3668	0.1767	0.9191	2.5088
Aug	0.7312	0.8182	0	0.9191	2.5088
Sep	0.0077	3.1768	0	0.8894	2.4279
Oct	0	5.5498	0	0.9191	2.5088
Nov	0	8.0779	0	0.8894	2.4279
Dec	0	9.9025	0	0.9191	2.5088
Total	2.5464	70.4306	0.1767	10.8211	29.539

Table 280. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ3

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	13.9466	0	0.9191	2.5088
Feb	0	11.4019	0	0.8301	2.266
Mar	0	11.7474	0	0.9191	2.5088
Apr	0	6.8862	0	0.8894	2.4279
May	0.9444	1.7566	0.8466	0.9191	2.5088
Jun	2.8471	0.6599	1.0318	0.8894	2.4279
Jul	5.0525	0.1572	1.8876	0.9191	2.5088
Aug	2.5593	1.0434	0.5417	0.9191	2.5088
Sep	0.0327	7.1723	0.0156	0.8894	2.4279
Oct	0.0039	8.29	0	0.9191	2.5088
Nov	0	12.3895	0	0.8894	2.4279
Dec	0	13.6815	0	0.9191	2.5088

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Total	11.4399	89.1324	4.3233	10.8211	29.539

Table 281. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 2 Modelling in CZ3

	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	12.0743	0	1.6618	2.5088
Feb	0	10.0905	0	1.4942	2.266
Mar	0	10.5306	0	1.5778	2.5088
Apr	0.0001	6.5365	0	1.3821	2.4279
May	1.0165	1.5186	0.8471	1.0481	2.5088
Jun	2.9957	0.352	1.0318	1.0472	2.4279
Jul	5.2552	0.0506	1.8923	1.0287	2.5088
Aug	2.8568	0.6025	0.5423	1.1745	2.5088
Sep	0.0419	6.3842	0.0183	1.4575	2.4279
Oct	0.0063	7.3879	0	1.4702	2.5088
Nov	0	10.5734	0	1.5807	2.4279
Dec	0	11.6889	0	1.6643	2.5088
Total	12.1725	77.79	4.3318	16.587	29.539

Table 282. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ4

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	7.823	0	0.9191	2.5088
Feb	0	6.8182	0	0.8301	2.266
Mar	0.0453	4.4624	0	0.9191	2.5088
Apr	1.155	1.4309	0.3034	0.8894	2.4279
May	4.2674	0.0533	1.5607	0.9191	2.5088
Jun	6.2167	0	2.3796	0.8894	2.4279
Jul	7.5764	0	3.3487	0.9191	2.5088
Aug	6.5232	0.0035	2.1503	0.9191	2.5088
Sep	3.0924	0.3055	1.088	0.8894	2.4279
Oct	1.2689	0.9881	0.3336	0.9191	2.5088
Nov	0.0258	5.0355	0.0254	0.8894	2.4279
Dec	0	7.1019	0	0.9191	2.5088
Total	30.1711	34.0223	11.1898	10.8211	29.539

Table 283. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ5

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	6.8496	0	0.9191	2.5088
Feb	0	6.6653	0	0.8301	2.266
Mar	0	6.4456	0	0.9191	2.5088
Apr	0	3.8607	0	0.8894	2.4279
May	0.3653	1.2299	0	0.9191	2.5088
Jun	1.8303	0.0342	0	0.8894	2.4279
Jul	2.8242	0.061	0	0.9191	2.5088
Aug	2.0112	0.1675	0	0.9191	2.5088

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Sep	0.3794	1.5435	0	0.8894	2.4279
Oct	0.0002	3.5463	0	0.9191	2.5088
Nov	0.0059	4.7939	0	0.8894	2.4279
Dec	0	6.4469	0	0.9191	2.5088
Total	7.4165	41.6444	0	10.8211	29.539

Table 284. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ6

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	4.7794	0	0.9191	2.5088
Feb	0	4.7862	0	0.8301	2.266
Mar	0.0237	2.7046	0	0.9191	2.5088
Apr	0.6486	0.5906	0	0.8894	2.4279
May	2.8828	0.0103	0.3271	0.9191	2.5088
Jun	4.6324	0	0.4029	0.8894	2.4279
Jul	5.1679	0	0.1121	0.9191	2.5088
Aug	4.3636	0	0.4857	0.9191	2.5088
Sep	2.5131	0.1979	0.1218	0.8894	2.4279
Oct	1.1363	0.736	0	0.9191	2.5088
Nov	0.1941	2.449	0	0.8894	2.4279
Dec	0.0339	3.4541	0	0.9191	2.5088
Total	21.5964	19.7081	1.4496	10.8211	29.539

Table 285. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ7

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0	5.3257	0	2.1521	2.5088
Feb	0	5.8815	0	1.9438	2.266
Mar	0	3.6505	0	2.1521	2.5088
Apr	1.37	0.4893	1.2226	2.0826	2.4279
May	4.0358	0.0282	2.6386	2.1521	2.5088
Jun	5.9704	0	3.5161	2.0826	2.4279
Jul	6.6305	0	3.7135	2.1521	2.5088
Aug	6.0414	0	2.7907	2.1521	2.5088
Sep	3.1279	0.0554	1.8855	2.0826	2.4279
Oct	1.2651	0.5887	1.0166	2.1521	2.5088
Nov	0.2409	1.9041	0.2741	2.0826	2.4279
Dec	0	4.5711	0	2.1521	2.5088
Total	28.682	22.4946	17.0577	25.3388	29.539

Table 286. Detailed Simulation Results for NCC 2025 C9AS Stringency 1 Iteration 1 Modelling in CZ8

OPTIMISED	VRF heating energy (MWh)	VRF cooling energy (MWh)	VRF defrost energy (MWh)	Fan energy (MWh)	Total lights energy (MWh)
Jan	0.3468	1.3944	0.117	2.1521	2.5088
Feb	0.1283	1.392	0.0425	1.9438	2.266
Mar	1.3458	0.1006	0.4546	2.1521	2.5088
Apr	4.4209	0.0023	3.1311	2.0826	2.4279
May	7.006	0	4.7407	2.1521	2.5088
Jun	9.3577	0	8.9289	2.0826	2.4279
Jul	10.0837	0	9.9804	2.1521	2.5088
Aug	9.3342	0	7.483	2.1521	2.5088
Sep	6.9052	0	5.4649	2.0826	2.4279
Oct	4.3327	0.0521	2.4281	2.1521	2.5088
Nov	2.1199	0.3765	1.1591	2.0826	2.4279
Dec	0.4122	1.1186	0.1907	2.1521	2.5088
Total	55.7932	4.4365	44.1211	25.3388	29.539

Appendix B.II.V C5OS

The summarised annual energy consumption and savings for C5OS Stringency 1 modelling are presented in Table 287.

Table 287. Energy and GHG Savings for C5OS Stringency 1 Iteration 1 Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	63	0	50	0%	21%	21%
2	0	37	0	33	0%	11%	11%
3	0	48	0	36	0%	25%	25%
4	0	35	0	28	0%	20%	20%
5	0	29	0	22	0%	23%	23%
6	0	27	0	21	0%	22%	22%
7	0	32	0	27	0%	18%	18%
8	0	40	0	31	0%	22%	22%

Detailed simulation results for Iteration 1(also optimised) NCC 2025 C5OS Stringency 1 modelling are presented in

Table 288 to Table 295 below.

Table 288. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	3.4239	0	0.0612	0.7909
Feb	0	3.3319	0	0.0583	0.7472
Mar	0	3.7208	0	0.067	0.8545
Apr	0	3.2606	0	0.0612	0.7869

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
May	0	3.1711	0	0.0641	0.8227
Jun	0	2.4613	0	0.0641	0.8187
Jul	0	2.3061	0	0.0612	0.7909
Aug	0	2.5682	0	0.067	0.8545
Sep	0	3.1878	0	0.0641	0.8187
Oct	0	3.6482	0	0.0612	0.7909
Nov	0	4.1922	0	0.0641	0.8187
Dec	0	4.0632	0	0.0641	0.8227
Total	0	39.3353	0	0.7574	9.7173

Table 289. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	2.6623	0	0.0689	0.7909
Feb	0	2.7153	0	0.0656	0.7472
Mar	0	2.7246	0	0.0755	0.8545
Apr	0.0002	2.001	0	0.0689	0.7869
May	0.0087	1.4389	0	0.0722	0.8227
Jun	0.1603	0.5873	0	0.0722	0.8187
Jul	0.2612	0.5579	0	0.0689	0.7909
Aug	0.1866	0.9019	0	0.0755	0.8545
Sep	0.0145	1.3973	0	0.0722	0.8187
Oct	0.0001	1.7639	0	0.0689	0.7909
Nov	0	2.2864	0	0.0722	0.8187
Dec	0	2.6914	0	0.0722	0.8227
Total	0.6318	21.7281	0	0.8531	9.7173

Table 290. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	3.2434	0	0.0612	0.7909
Feb	0	2.6242	0	0.0583	0.7472
Mar	0	2.6678	0	0.067	0.8545
Apr	0.0092	1.6655	0	0.0612	0.7869
May	0.2722	0.6655	0.201	0.0641	0.8227
Jun	0.5679	0.3502	0.1837	0.0641	0.8187
Jul	0.9621	0.1718	0.3066	0.0612	0.7909
Aug	0.521	0.579	0.0892	0.067	0.8545
Sep	0.0186	1.8564	0.0055	0.0641	0.8187
Oct	0.0038	1.9619	0	0.0612	0.7909
Nov	0	3.078	0	0.0641	0.8187
Dec	0	3.0648	0	0.0641	0.8227
Total	2.3548	21.9284	0.7859	0.7574	9.7173

Table 291. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0001	1.9209	0	0.0612	0.7909
Feb	0	1.7331	0	0.0583	0.7472
Mar	0.0402	1.252	0	0.067	0.8545
Apr	0.266	0.6245	0.0359	0.0612	0.7869
May	0.8644	0.081	0.2196	0.0641	0.8227
Jun	1.3906	0.0077	0.3904	0.0641	0.8187
Jul	1.5615	0	0.4541	0.0612	0.7909
Aug	1.4071	0.0274	0.2773	0.067	0.8545
Sep	0.5931	0.2888	0.1228	0.0641	0.8187
Oct	0.2183	0.5666	0.0423	0.0612	0.7909
Nov	0.0144	1.4853	0.0018	0.0641	0.8187
Dec	0.0009	1.8384	0	0.0641	0.8227
Total	6.3567	9.8258	1.5442	0.7574	9.7173

Table 292. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	1.4533	0	0.0612	0.7909
Feb	0	1.4846	0	0.0583	0.7472
Mar	0	1.423	0	0.067	0.8545
Apr	0.0025	0.9599	0	0.0612	0.7869
May	0.0937	0.4524	0	0.0641	0.8227
Jun	0.3015	0.1243	0	0.0641	0.8187
Jul	0.4513	0.125	0	0.0612	0.7909
Aug	0.3557	0.2337	0	0.067	0.8545
Sep	0.057	0.6782	0	0.0641	0.8187
Oct	0.0013	1.0975	0	0.0612	0.7909
Nov	0.0078	1.243	0	0.0641	0.8187
Dec	0	1.4227	0	0.0641	0.8227
Total	1.2708	10.6976	0	0.7574	9.7173

Table 293. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0026	1.2991	0	0.0612	0.7909
Feb	0.0006	1.2145	0	0.0583	0.7472
Mar	0.023	0.8253	0	0.067	0.8545
Apr	0.149	0.3539	0	0.0612	0.7869
May	0.5587	0.0543	0.0561	0.0641	0.8227
Jun	0.9607	0.0193	0.056	0.0641	0.8187
Jul	1.0265	0	0.0153	0.0612	0.7909
Aug	0.881	0.0223	0.1215	0.067	0.8545
Sep	0.4278	0.1892	0.0308	0.0641	0.8187
Oct	0.1863	0.3112	0	0.0612	0.7909
Nov	0.0572	0.8222	0	0.0641	0.8187
Dec	0.01	1.0719	0	0.0641	0.8227

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Total	4.2835	6.1832	0.2797	0.7574	9.7173

Table 294. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0044	1.2315	0	0.0612	0.7909
Feb	0.0037	1.3756	0	0.0583	0.7472
Mar	0.074	0.8151	0	0.067	0.8545
Apr	0.452	0.2539	0.134	0.0612	0.7869
May	1.1852	0.0494	0.3827	0.0641	0.8227
Jun	1.7069	0.004	0.5045	0.0641	0.8187
Jul	1.7339	0	0.3442	0.0612	0.7909
Aug	1.7441	0	0.3249	0.067	0.8545
Sep	0.8134	0.123	0.1947	0.0641	0.8187
Oct	0.4924	0.2241	0.1407	0.0612	0.7909
Nov	0.1838	0.5635	0.0369	0.0641	0.8187
Dec	0.0207	1.0872	0.0003	0.0641	0.8227
Total	8.4145	5.7274	2.0629	0.7574	9.7173

Table 295. Detailed Simulation Results for NCC 2025 C5OS Stringency 1 Optimised Iteration Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.1226	0.3042	0.0221	0.0612	0.7909
Feb	0.1059	0.2999	0	0.0583	0.7472
Mar	0.3913	0.1592	0.0759	0.067	0.8545
Apr	0.9438	0.0468	0.346	0.0612	0.7869
May	1.7007	0.0002	0.4437	0.0641	0.8227
Jun	2.4546	0	1.2644	0.0641	0.8187
Jul	2.4431	0	1.4444	0.0612	0.7909
Aug	2.3335	0.0019	0.9003	0.067	0.8545
Sep	1.5853	0.0178	0.6871	0.0641	0.8187
Oct	0.9768	0.0784	0.3102	0.0612	0.7909
Nov	0.5701	0.1725	0.2631	0.0641	0.8187
Dec	0.1842	0.2932	0.07	0.0641	0.8227
Total	13.8119	1.3742	5.8273	0.7574	9.7173

Appendix B.II.VI C6RS

The summarised annual energy consumption and savings for C5OS Stringency 1 modelling are presented in Table 296.

Table 296. Energy and GHG Savings for C6RS Stringency 1 Optimised Iteration Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	392	0	267	0%	32%	32%
2	0	260	0	177	0%	32%	32%
3	0	320	0	200	0%	38%	38%
4	0	234	0	162	0%	30%	30%
5	0	207	0	143	0%	31%	31%
6	0	182	0	138	0%	24%	24%
7	0	199	0	156	0%	22%	22%
8	0	228	0	189	0%	17%	17%

Detailed simulation results for NCC 2025 C6RS Stringency 1 optimised modelling are presented in Table 297 to Table 304 below.

Table 297. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ1

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	12.8544	0	4.9392	6.4393
Feb	0	12.2845	0	4.4612	5.8162
Mar	0	13.0098	0	4.9392	6.4393
Apr	0	12.0229	0	4.7798	6.2316
May	0	10.8797	0	4.9392	6.4393
Jun	0	6.466	0	4.7798	6.2316
Jul	0	6.199	0	4.9392	6.4393
Aug	0	6.1335	0	4.9392	6.4393
Sep	0	9.7328	0	4.7798	6.2316
Oct	0	12.7931	0	4.9392	6.4393
Nov	0	15.2137	0	4.7798	6.2316
Dec	0	15.2765	0	4.9392	6.4393
Total	0	132.8659	0	58.1546	75.818

Table 298. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ2

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	7.3814	0	4.4805	6.4393
Feb	0	7.8071	0	4.0469	5.8162
Mar	0	6.8377	0	4.4805	6.4393
Apr	0	3.9736	0	4.336	6.2316
May	0.0065	2.1963	0	4.4805	6.4393
Jun	0.1112	0.9909	0	4.336	6.2316
Jul	0.3083	1.1773	0.0365	4.4805	6.4393
Aug	0.1945	1.3174	0	4.4805	6.4393
Sep	0.0044	1.8682	0	4.336	6.2316
Oct	0	2.4145	0	4.4805	6.4393
Nov	0	4.7768	0	4.336	6.2316
Dec	0	6.5733	0	4.4805	6.4393

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Total	0.6249	47.3145	0.0365	52.7546	75.818

Table 299. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ3

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	9.5684	0	5.0275	6.4393
Feb	0	6.967	0	4.541	5.8162
Mar	0	7.1599	0	5.0275	6.4393
Apr	0.0005	4.0656	0	4.8654	6.2316
May	0.4137	1.4388	0.429	5.0275	6.4393
Jun	0.8248	1.0513	0.5672	4.8654	6.2316
Jul	1.7127	0.6951	1.032	5.0275	6.4393
Aug	0.9594	1.2834	0.2946	5.0275	6.4393
Sep	0.0303	4.3054	0.0117	4.8654	6.2316
Oct	0.0067	4.5694	0	5.0275	6.4393
Nov	0	8.4606	0	4.8654	6.2316
Dec	0	8.8968	0	5.0275	6.4393
Total	3.9481	58.4618	2.3346	59.1951	75.818

Table 300. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ4

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	4.9902	0	4.0279	6.4393
Feb	0	4.2031	0	3.6381	5.8162
Mar	0.0379	2.4427	0	4.0279	6.4393
Apr	0.3995	1.4176	0.1886	3.898	6.2316
May	1.3151	0.2908	0.7955	4.0279	6.4393
Jun	2.491	0.0305	1.1877	3.898	6.2316
Jul	3.1959	0.0113	1.5996	4.0279	6.4393
Aug	2.4095	0.1253	0.9834	4.0279	6.4393
Sep	0.9482	0.69	0.3376	3.898	6.2316
Oct	0.4693	1.0734	0.1754	4.0279	6.4393
Nov	0.0207	3.25	0.0039	3.898	6.2316
Dec	0.0001	4.1565	0	4.0279	6.4393
Total	11.2872	22.6815	5.2717	47.4253	75.818

Table 301. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ5

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	4.2414	0	3.2911	6.4393
Feb	0	4.1202	0	2.9726	5.8162
Mar	0	3.9701	0	3.2911	6.4393
Apr	0.0026	2.2173	0	3.1849	6.2316
May	0.1023	0.9257	0	3.2911	6.4393
Jun	0.4172	0.2862	0	3.1849	6.2316
Jul	0.6677	0.3375	0	3.2911	6.4393
Aug	0.5012	0.5702	0	3.2911	6.4393
Sep	0.0727	1.3207	0	3.1849	6.2316
Oct	0.0016	2.294	0	3.2911	6.4393
Nov	0.0108	2.7695	0	3.1849	6.2316
Dec	0	3.4673	0	3.2911	6.4393
Total	1.7762	26.5202	0	38.7495	75.818

Table 302. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ6

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0022	2.541	0	3.4293	6.4393
Feb	0	2.7618	0	3.0974	5.8162
Mar	0.0601	0.9794	0	3.4293	6.4393
Apr	0.3245	0.3783	0	3.3187	6.2316
May	1.3136	0.0258	0.2528	3.4293	6.4393
Jun	2.2496	0	0.402	3.3187	6.2316
Jul	2.4537	0	0.0684	3.4293	6.4393
Aug	1.8628	0.0037	0.3848	3.4293	6.4393
Sep	0.9533	0.1402	0.0918	3.3187	6.2316
Oct	0.5437	0.5695	0	3.4293	6.4393
Nov	0.124	1.4899	0	3.3187	6.2316
Dec	0.0244	1.7114	0	3.4293	6.4393
Total	9.9118	10.6011	1.1998	40.3772	75.818

Table 303. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ7

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0018	2.4523	0	3.7764	6.4393
Feb	0.0003	3.1433	0	3.411	5.8162
Mar	0.0954	1.5269	0	3.7764	6.4393
Apr	0.8706	0.4959	0.5009	3.6546	6.2316
May	2.2588	0.1721	1.3389	3.7764	6.4393
Jun	3.5226	0.0073	1.7891	3.6546	6.2316
Jul	3.8202	0	1.7156	3.7764	6.4393
Aug	3.1019	0.0125	1.1574	3.7764	6.4393
Sep	1.4428	0.192	0.6199	3.6546	6.2316
Oct	0.9425	0.5489	0.4599	3.7764	6.4393
Nov	0.3283	1.0864	0.1268	3.6546	6.2316
Dec	0.0249	2.0856	0.0012	3.7764	6.4393

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Total	16.4099	11.7233	7.7097	44.4642	75.818

Table 304. Detailed Simulation Results for NCC 2025 C6RS Stringency 1 Optimised Iteration Modelling in CZ8

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.3408	0.5074	0.1074	4.2952	6.4393
Feb	0.3394	0.3701	0.0422	3.8795	5.8162
Mar	1.0115	0.0969	0.3936	4.2952	6.4393
Apr	2.2797	0.0006	1.3563	4.1566	6.2316
May	4.0342	0	1.662	4.2952	6.4393
Jun	7.325	0	4.9795	4.1566	6.2316
Jul	7.9414	0	5.8303	4.2952	6.4393
Aug	6.4286	0	3.5722	4.2952	6.4393
Sep	4.225	0	2.4429	4.1566	6.2316
Oct	2.5823	0.0767	1.1922	4.2952	6.4393
Nov	1.4533	0.2608	0.752	4.1566	6.2316
Dec	0.4629	0.4848	0.1863	4.2952	6.4393
Total	38.4241	1.7974	22.5169	50.5719	75.818

Appendix B.II.VII C6RL

The summarised annual energy consumption and savings for C6RL Stringency 1 modelling are presented in Table 305.

Table 305. Energy and GHG Savings for C6RL Stringency 1 Optimised Iteration Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	364	0	275	0%	24%	24%
2	0	232	0	167	0%	28%	28%
3	0	303	0	205	0%	32%	32%
4	0	217	0	174	0%	20%	20%
5	0	189	0	143	0%	25%	25%
6	0	171	0	148	0%	13%	13%
7	0	212	0	167	0%	21%	21%
8	0	254	0	213	0%	16%	16%

Detailed simulation results for NCC 2025 C6RL Stringency 1 Optimised Iteration modelling are presented in Table 306 to Table 313 below.

Table 306. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ1

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	13.2683	0	5.3893	6.7607
Feb	0	12.7007	0	4.8678	6.1065
Mar	0	13.1638	0	5.3893	6.7607
Apr	0	11.4969	0	5.2155	6.5426
May	0	10.0192	0	5.3893	6.7607
Jun	0	5.6703	0	5.2155	6.5426
Jul	0	5.3485	0	5.3893	6.7607
Aug	0	5.6434	0	5.3893	6.7607
Sep	0	9.7685	0	5.2155	6.5426
Oct	0	13.2695	0	5.3893	6.7607
Nov	0	15.9002	0	5.2155	6.5426
Dec	0	15.8642	0	5.3893	6.7607
Total	0	132.1134	0	63.4551	79.602

Table 307. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ2

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	7.4119	0	3.9214	6.7607
Feb	0	7.7956	0	3.5419	6.1065
Mar	0	6.0605	0	3.9214	6.7607
Apr	0.0056	2.9012	0	3.7949	6.5426
May	0.0764	1.1212	0	3.9214	6.7607
Jun	0.47	0.2418	0	3.7949	6.5426
Jul	0.8418	0.2559	0.0347	3.9214	6.7607
Aug	0.6403	0.3989	0	3.9214	6.7607
Sep	0.0965	0.964	0	3.7949	6.5426
Oct	0.0094	1.5802	0	3.9214	6.7607
Nov	0	4.1139	0	3.7949	6.5426
Dec	0	6.2604	0	3.9214	6.7607
Total	2.14	39.1056	0.0347	46.1713	79.602

Table 308. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ3

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	9.681	0	5.0636	6.7607
Feb	0	7.1265	0	4.5735	6.1065
Mar	0	7.0089	0	5.0636	6.7607
Apr	0.0315	3.2567	0	4.9002	6.5426
May	0.9905	0.6876	0.5071	5.0636	6.7607
Jun	1.7005	0.4225	0.6101	4.9002	6.5426
Jul	3.1006	0.16	1.1321	5.0636	6.7607
Aug	1.9078	0.5173	0.3195	5.0636	6.7607
Sep	0.1137	3.8594	0.0229	4.9002	6.5426

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Oct	0.0869	4.3876	0	5.0636	6.7607
Nov	0	8.6591	0	4.9002	6.5426
Dec	0	9.2586	0	5.0636	6.7607
Total	7.9315	55.0252	2.5917	59.6194	79.602

Table 309. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ4

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0046	4.3412	0	4.3407	6.7607
Feb	0.0068	3.5012	0	3.9206	6.1065
Mar	0.1907	1.6789	0	4.3407	6.7607
Apr	0.9253	0.7723	0.2056	4.2006	6.5426
May	2.528	0.0753	0.8701	4.3407	6.7607
Jun	3.9809	0	1.2957	4.2006	6.5426
Jul	4.963	0	1.7477	4.3407	6.7607
Aug	3.9778	0.0138	1.0699	4.3407	6.7607
Sep	1.89	0.2974	0.3772	4.2006	6.5426
Oct	1.0565	0.5753	0.1984	4.3407	6.7607
Nov	0.123	2.6334	0.0058	4.2006	6.5426
Dec	0.0183	3.5638	0	4.3407	6.7607
Total	19.6648	17.4527	5.7705	51.1077	79.602

Table 310. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ5

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0	3.5496	0	3.3256	6.7607
Feb	0	3.383	0	3.0038	6.1065
Mar	0	3.0236	0	3.3256	6.7607
Apr	0.0445	1.2773	0	3.2183	6.5426
May	0.4274	0.3006	0	3.3256	6.7607
Jun	1.2534	0.0046	0	3.2183	6.5426
Jul	1.7554	0.0264	0	3.3256	6.7607
Aug	1.3799	0.0765	0	3.3256	6.7607
Sep	0.3555	0.6461	0	3.2183	6.5426
Oct	0.0781	1.4648	0	3.3256	6.7607
Nov	0.0733	2.0419	0	3.2183	6.5426
Dec	0	2.6815	0	3.3256	6.7607
Total	5.3676	18.476	0	39.1563	79.602

Table 311. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ6

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.044	2.3014	0	3.4541	6.7607
Feb	0.0174	2.4511	0	3.1198	6.1065
Mar	0.2306	0.7263	0	3.4541	6.7607
Apr	0.8103	0.2188	0	3.3426	6.5426
May	2.2942	0.0008	0.2433	3.4541	6.7607
Jun	3.4666	0	0.3863	3.3426	6.5426
Jul	3.8253	0	0.0654	3.4541	6.7607
Aug	3.1591	0	0.3703	3.4541	6.7607
Sep	1.9338	0.0854	0.0887	3.3426	6.5426
Oct	1.2105	0.4252	0	3.4541	6.7607
Nov	0.4489	1.2623	0	3.3426	6.5426
Dec	0.1576	1.4762	0	3.4541	6.7607
Total	17.5985	8.9476	1.154	40.6688	79.602

Table 312. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ7

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.0622	1.8625	0	3.816	6.7607
Feb	0.0288	2.3577	0	3.4467	6.1065
Mar	0.3503	0.832	0	3.816	6.7607
Apr	1.6855	0.1571	0.509	3.6929	6.5426
May	3.6535	0.0069	1.3634	3.816	6.7607
Jun	5.208	0	1.8176	3.6929	6.5426
Jul	5.7443	0	1.7361	3.816	6.7607
Aug	5.0307	0	1.1745	3.816	6.7607
Sep	2.603	0.0582	0.6218	3.6929	6.5426
Oct	1.7813	0.2853	0.4708	3.816	6.7607
Nov	0.8751	0.7209	0.1344	3.6929	6.5426
Dec	0.165	1.5519	0.0012	3.816	6.7607
Total	27.1876	7.8325	7.8289	44.9305	79.602

Table 313. Detailed Simulation Results for NCC 2025 C6RL Stringency 1 Optimised Iteration Modelling in CZ8

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Jan	0.7765	0.3091	0.1108	4.8402	6.7607
Feb	0.7737	0.2016	0.0424	4.3718	6.1065
Mar	1.8419	0.0205	0.3834	4.8402	6.7607
Apr	3.422	0	1.4366	4.6841	6.5426
May	5.6004	0	1.765	4.8402	6.7607
Jun	9.0171	0	5.0363	4.6841	6.5426
Jul	9.6427	0	5.9142	4.8402	6.7607
Aug	8.2439	0	3.7656	4.8402	6.7607
Sep	5.8719	0	2.5239	4.6841	6.5426

	PAC Heating (MWh)	PAC Cooling (MWh)	Defrost energy (MWh)	Distr Fans energy (MWh)	Total lights (MWh)
Oct	3.8594	0.03	1.2604	4.8402	6.7607
Nov	2.2849	0.1438	0.7686	4.6841	6.5426
Dec	0.9717	0.3241	0.1798	4.8402	6.7607
Total	52.3061	1.029	23.1871	56.9896	79.602

Appendix B.II.VIII C3HS

The summarised annual energy consumption and savings for C3HS Stringency 1 modelling are presented in Table 314.

Table 314. Energy and GHG Savings for C3HS Stringency 1 Optimised Iteration Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	214	0	162	0%	25%	25%
2	0	108	0	88	0%	18%	18%
3	0	139	0	114	0%	18%	18%
4	0	117	0	98	0%	16%	16%
5	0	92	0	71	0%	23%	23%
6	0	81	0	69	0%	14%	14%
7	0	109	0	91	0%	16%	16%
8	0	135	0	120	0%	11%	11%

Detailed simulation results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling are presented in Table 315 to Table 322 below.

Table 315. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	11.3449	0	0.5213	2.5951
Feb	0	10.4565	0	0.4709	2.3439
Mar	0	11.2859	0	0.5213	2.5951
Apr	0	10.6152	0	0.5045	2.5114
May	0	10.2029	0	0.5213	2.5951
Jun	0	8.4774	0	0.5045	2.5114
Jul	0	8.0669	0	0.5213	2.5951
Aug	0	8.5842	0	0.5213	2.5951
Sep	0	9.855	0	0.5045	2.5114
Oct	0	11.2739	0	0.5213	2.5951
Nov	0	12.2509	0	0.5045	2.5114
Dec	0	12.4898	0	0.5213	2.5951
Total	0	124.9036	0	6.1381	30.5549

Table 316. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	7.9635	0	0.5213	2.5951
Feb	0	7.6717	0	0.4709	2.3439
Mar	0	7.4938	0	0.5213	2.5951
Apr	0.0016	4.7615	0	0.5045	2.5114
May	0.0634	1.5424	0	0.5213	2.5951
Jun	0.847	0.0481	0	0.5045	2.5114
Jul	1.8141	0.0569	0.1853	0.5213	2.5951
Aug	1.1933	0.0978	0	0.5213	2.5951
Sep	0.1274	1.2049	0	0.5045	2.5114
Oct	0.0092	3.0242	0	0.5213	2.5951
Nov	0	5.8144	0	0.5045	2.5114
Dec	0	7.5484	0	0.5213	2.5951
Total	4.056	47.2277	0.1853	6.1381	30.5549

Table 317. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	10.2135	0	0.5213	2.5951
Feb	0	8.5761	0	0.4709	2.3439
Mar	0	8.6601	0	0.5213	2.5951
Apr	0.0372	4.05	0	0.5045	2.5114
May	1.4312	0.6751	0.8574	0.5213	2.5951
Jun	2.7404	0.3193	1.0435	0.5045	2.5114
Jul	4.4463	0.072	1.9086	0.5213	2.5951
Aug	2.683	0.5357	0.5482	0.5213	2.5951
Sep	0.1346	4.6103	0.02	0.5045	2.5114
Oct	0.1149	5.2395	0	0.5213	2.5951
Nov	0	8.7906	0	0.5045	2.5114
Dec	0	9.8035	0	0.5213	2.5951
Total	11.5875	61.5458	4.3776	6.1381	30.5549

Table 318. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0019	5.7995	0	0.5213	2.5951
Feb	0.0107	5.1149	0	0.4709	2.3439
Mar	0.2402	2.734	0	0.5213	2.5951
Apr	1.4723	0.6049	0.3009	0.5045	2.5114
May	4.0515	0.0164	1.5473	0.5213	2.5951
Jun	5.3227	0	2.2643	0.5045	2.5114
Jul	6.2465	0	3.1474	0.5213	2.5951
Aug	5.6521	0.0058	2.1122	0.5213	2.5951
Sep	3.1394	0.1452	1.0819	0.5045	2.5114
Oct	1.7347	0.4434	0.3307	0.5213	2.5951

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Nov	0.138	3.2061	0.0283	0.5045	2.5114
Dec	0.031	4.8402	0	0.5213	2.5951
Total	28.041	22.9103	10.8132	6.1381	30.5549

Table 319. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0	5.1001	0	0.5213	2.5951
Feb	0	4.7392	0	0.4709	2.3439
Mar	0	4.4234	0	0.5213	2.5951
Apr	0.0355	2.1367	0	0.5045	2.5114
May	0.6405	0.2702	0	0.5213	2.5951
Jun	2.0335	0.0003	0	0.5045	2.5114
Jul	2.7332	0.0109	0	0.5213	2.5951
Aug	2.0693	0.0389	0	0.5213	2.5951
Sep	0.559	0.5645	0	0.5045	2.5114
Oct	0.0597	1.8698	0	0.5213	2.5951
Nov	0.0561	2.9208	0	0.5045	2.5114
Dec	0	4.276	0	0.5213	2.5951
Total	8.1868	26.3507	0	6.1381	30.5549

Table 320. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0214	2.8054	0	0.5213	2.5951
Feb	0.0082	2.8866	0	0.4709	2.3439
Mar	0.1819	1.1464	0	0.5213	2.5951
Apr	1.0442	0.1581	0	0.5045	2.5114
May	2.9039	0.0003	0.2872	0.5213	2.5951
Jun	3.9294	0	0.364	0.5045	2.5114
Jul	4.235	0	0.1024	0.5213	2.5951
Aug	3.8649	0	0.4429	0.5213	2.5951
Sep	2.5251	0.0919	0.1114	0.5045	2.5114
Oct	1.5305	0.3302	0	0.5213	2.5951
Nov	0.4815	1.3784	0	0.5045	2.5114
Dec	0.1322	1.6171	0	0.5213	2.5951
Total	20.8581	10.4143	1.3078	6.1381	30.5549

Table 321. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	0.0417	2.1969	0	0.5313	2.5951
Feb	0.0326	2.8832	0	0.4883	2.3439
Mar	0.2504	0.9021	0	0.5235	2.5951
Apr	2.4499	0.0756	0.992	0.5131	2.5114
May	4.4516	0.0007	2.0303	0.5625	2.5951
Jun	5.6738	0	2.6584	0.6045	2.5114

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jul	6.2008	0	2.8091	0.6292	2.5951
Aug	5.6808	0	2.1482	0.6141	2.5951
Sep	3.7396	0.0155	1.4701	0.5327	2.5114
Oct	2.358	0.1502	0.8353	0.531	2.5951
Nov	1.1639	0.5533	0.2252	0.5087	2.5114
Dec	0.1469	1.6622	0.0032	0.526	2.5951
Total	32.1899	8.4397	13.1719	6.5648	30.5549

Table 322. Detailed Simulation Results for NCC 2025 C3HS Stringency 1 Optimised Iteration Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	VRF Defrost (MWh)	VRF Fans (MWh)	Total lights (MWh)
Jan	1.1525	0.1559	0.0747	0.5244	2.5951
Feb	1.0305	0.1198	0.0273	0.4727	2.3439
Mar	2.4909	0.0033	0.2863	0.5351	2.5951
Apr	4.4316	0	1.9671	0.5738	2.5114
May	5.9695	0	2.9847	0.6674	2.5951
Jun	8.1028	0	5.425	0.7152	2.5114
Jul	8.6255	0	6.0631	0.7412	2.5951
Aug	7.8714	0	4.6376	0.7249	2.5951
Sep	6.0546	0	3.3652	0.6431	2.5114
Oct	4.3884	0.0043	1.5165	0.5988	2.5951
Nov	2.869	0.0459	0.7138	0.5423	2.5114
Dec	1.5181	0.1846	0.1631	0.527	2.5951
Total	54.5049	0.5139	27.2243	7.2659	30.5549

Appendix B.II.IX C3HL

The summarised annual energy consumption and savings for C3HL Stringency 1 modelling are presented in Table 323.

Table 323. Energy and GHG Savings for C3HL Stringency 1 Optimised Iteration Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	1,100	0	951	0%	14%	14%
2	30	578	43	465	-44%	20%	16%
3	134	657	150	543	-12%	17%	12%
4	368	453	398	396	-8%	13%	3%
5	76	472	101	384	-33%	19%	11%
6	242	386	297	333	-23%	14%	-1%
7	488	397	548	336	-12%	15%	0%
8	882	328	975	303	-11%	7%	-6%

Detailed simulation results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling are presented in Table 324 to

Table 331 below.

Table 324. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ1

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	63.2236	9.0511	3.361	0	16.5919
Feb	0	0	60.4019	8.0333	3.0575	0	14.9862
Mar	0	0	63.1077	8.8908	3.279	0	16.5919
Apr	0	0	56.9568	8.7985	2.9292	0	16.0566
May	0	0	45.6231	8.9155	2.4382	0	16.5919
Jun	0	0	25.6393	8.4379	1.766	0	16.0566
Jul	0	0	23.3734	8.6794	1.7018	0	16.5919
Aug	0	0	23.8762	8.7459	1.7819	0	16.5919
Sep	0	0	47.3939	8.7601	2.4775	0	16.0566
Oct	0	0	64.2862	9.4947	3.0963	0	16.5919
Nov	0	0	70.095	9.4087	3.6201	0	16.0566
Dec	0	0	71.5362	9.3653	3.7983	0	16.5919
Total	0	0	615.5132	106.5811	33.3069	0	195.3558

Table 325. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ2

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	33.5683	7.8968	2.1453	0	16.5919
Feb	0	0	33.7524	7.1326	2.1539	0	14.9862
Mar	0	0	25.2449	7.8968	1.7083	0	16.5919
Apr	0.0381	0	12.8522	7.6421	1.0372	0	16.0566
May	0.8115	0	2.6805	7.8968	0.3902	0	16.5919
Jun	9.4137	0	0.1017	7.6421	0.1352	0	16.0566
Jul	18.8591	0	0.1361	7.8968	0.2065	0	16.5919
Aug	12.4886	0	0.3326	7.8968	0.2042	0	16.5919
Sep	1.0937	0	3.0349	7.6421	0.3978	0	16.0566
Oct	0.0868	0	6.5497	7.8968	0.7304	0	16.5919
Nov	0	0	17.9136	7.6421	1.3514	0	16.0566
Dec	0	0	27.9406	7.8968	1.8407	0	16.5919
Total	42.7916	0	164.1077	92.9786	12.301	0	195.3558

Table 326. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ3

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	42.8719	10.6176	2.1498	0	16.5919
Feb	0	0	30.6542	9.2938	1.6529	0	14.9862
Mar	0	0	28.9668	10.0966	1.6211	0	16.5919
Apr	0.4503	0	11.4223	9.0955	0.8624	0	16.0566
May	19.4756	0	1.4393	9.2468	0.3571	0	16.5919

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jun	34.8916	0	0.964	8.9484	0.3764	0	16.0566
Jul	59.3414	0	0.2325	9.2461	0.4373	0	16.5919
Aug	32.9443	0	1.5604	9.247	0.422	0	16.5919
Sep	1.8883	0	14.5672	9.2297	0.979	0	16.0566
Oct	1.3541	0	16.9389	9.607	1.0905	0	16.5919
Nov	0	0	32.3494	9.9738	1.7387	0	16.0566
Dec	0	0	36.8805	10.4	1.951	0	16.5919
Total	150.3455	0	218.8474	115.0021	13.6382	0	195.3558

Table 327. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ4

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0146	0	22.2687	9.2604	2.0244	0	16.5919
Feb	0.104	0	17.4226	8.2868	1.6469	0	14.9862
Mar	3.5652	0	7.4356	9.007	0.9134	0	16.5919
Apr	19.2907	0	1.9168	8.7167	0.5266	0	16.0566
May	55.8431	0	0.0559	9.007	0.6131	0	16.5919
Jun	79.866	0	0	8.7207	0.7123	0	16.0566
Jul	97.7832	0	0	9.0147	0.8241	0	16.5919
Aug	81.1008	0	0.0152	9.0098	0.7287	0	16.5919
Sep	39.1846	0	0.6067	8.7164	0.5198	0	16.0566
Oct	19.495	0	2.0054	9.0073	0.5368	0	16.5919
Nov	1.5708	0	12.3219	8.8361	1.2603	0	16.0566
Dec	0.4093	0	17.5302	9.1516	1.6716	0	16.5919
Total	398.2275	0	81.5788	106.7344	11.9781	0	195.3558

Table 328. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ5

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	20.8342	7.3679	1.431	0	16.5919
Feb	0	0	19.4743	6.6497	1.3937	0	14.9862
Mar	0	0	15.137	7.3621	1.136	0	16.5919
Apr	0.4097	0	5.7116	7.1246	0.5327	0	16.0566
May	8.1952	0	0.5575	7.3621	0.1669	0	16.5919
Jun	25.201	0	0.0006	7.1246	0.2246	0	16.0566
Jul	34.9595	0	0.0198	7.3621	0.2789	0	16.5919
Aug	25.0114	0	0.1127	7.3621	0.2207	0	16.5919
Sep	5.9063	0	2.0095	7.1394	0.2638	0	16.0566
Oct	0.5732	0	6.1621	7.3791	0.5386	0	16.5919
Nov	0.6786	0	10.1122	7.1439	0.789	0	16.0566
Dec	0	0	13.4385	7.3875	1.0464	0	16.5919

Total	100.9349	0	93.57	86.7654	8.0223	0	195.3558

Table 329. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ6

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1982	0	10.8395	8.0004	0.8047	0	16.5919
Feb	0.0871	0	10.682	7.2443	0.7357	0	14.9862
Mar	2.7827	0	2.9474	7.9018	0.2964	0	16.5919
Apr	12.6676	0	0.5309	7.6469	0.2032	0	16.0566
May	41.279	0	0.0004	7.9025	0.3267	0	16.5919
Jun	60.8601	0	0	7.6492	0.3982	0	16.0566
Jul	65.7181	0	0	7.9041	0.4133	0	16.5919
Aug	55.4984	0	0	7.9023	0.3783	0	16.5919
Sep	33.7159	0	0.3426	7.6469	0.2971	0	16.0566
Oct	17.5911	0	1.4466	7.9018	0.3014	0	16.5919
Nov	5.1078	0	5.8922	7.6765	0.4916	0	16.0566
Dec	1.5621	0	6.0695	7.9398	0.4757	0	16.5919
Total	297.0681	0	38.7512	93.3165	5.1224	0	195.3558

Table 330. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ7

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	0.4544	0	9.7366	8.3592	0.7042	0	16.5919
Feb	0.5121	0	11.8176	7.624	0.806	0	14.9862
Mar	4.3763	0	3.1053	8.3001	0.3295	0	16.5919
Apr	38.6467	0	0.3003	8.0282	0.3534	0	16.0566
May	76.9557	0	0.0031	8.2978	0.5127	0	16.5919
Jun	103.1209	0	0	8.0353	0.6319	0	16.0566
Jul	114.7156	0	0	8.3022	0.6787	0	16.5919
Aug	99.4678	0	0	8.302	0.6212	0	16.5919
Sep	57.8653	0	0.0735	8.0282	0.4421	0	16.0566
Oct	34.2597	0	0.9069	8.2958	0.3871	0	16.5919
Nov	15.6658	0	2.9493	8.0302	0.3989	0	16.0566
Dec	1.8308	0	7.235	8.3336	0.5694	0	16.5919
Total	547.8709	0	36.1277	97.9367	6.4352	0	195.3558

Table 331. Detailed Simulation Results for NCC 2025 C3HL Stringency 1 Optimised Iteration Modelling in CZ8

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
Jan	14.3166	0	0.2478	8.5123	0.231	0	16.5919
Feb	14.052	0	0.1816	7.6885	0.2209	0	14.9862
Mar	36.9095	0	0.0192	8.5125	0.3886	0	16.5919
Apr	77.4004	0	0	8.244	0.5653	0	16.0566

	Boilers energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans/pumps energy (MWh)	Total lights energy (MWh)
May	111.6426	0	0	8.5256	0.6972	0	16.5919
Jun	157.6085	0	0	8.2753	0.9111	0	16.0566
Jul	170.0382	0	0	8.5577	0.9911	0	16.5919
Aug	149.6418	0	0	8.5411	0.8802	0	16.5919
Sep	109.7632	0	0	8.2538	0.6982	0	16.0566
Oct	73.2256	0	0.0288	8.5175	0.5399	0	16.5919
Nov	42.4933	0	0.1002	8.2402	0.3756	0	16.0566
Dec	18.3252	0	0.2181	8.5123	0.27	0	16.5919
Total	975.4168	0	0.7956	100.3806	6.769	0	195.3558

Appendix B.II.X C9B

The summarised annual energy consumption and savings for C9B Stringency 1 modelling are presented in Table 332.

Table 332. Energy and GHG Savings for C9B Stringency 1 Optimised Iteration Model

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Saving - Gas (%)	Saving - Elec (%)	Saving - GHG (%)
1	0	297	0	244	0%	18%	18%
2	0	176	0	135	0%	23%	23%
3	0	201	0	158	0%	22%	22%
4	0	147	0	120	0%	19%	19%
5	0	130	0	101	0%	22%	22%
6	0	106	0	85	0%	20%	20%
7	0	132	0	109	0%	18%	18%
8	0	178	0	153	0%	14%	14%

Detailed simulation results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling are presented in Table 333 to Table 340 below.

Table 333. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ1

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	19.7592	0	0.3552	2.2683
Feb	0	19.3162	0	0.3383	2.1603
Mar	0	20.7564	0	0.389	2.4843
Apr	0	17.2664	0	0.3552	2.2683
May	0	16.6064	0	0.3721	2.3763
Jun	0	12.1566	0	0.3721	2.3763
Jul	0	11.3822	0	0.3552	2.2683
Aug	0	12.6062	0	0.389	2.4843

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Sep	0	16.7353	0	0.3721	2.3763
Oct	0	19.2436	0	0.3552	2.2683
Nov	0	22.7646	0	0.3721	2.3763
Dec	0	23.1351	0	0.3721	2.3763
Total	0	211.7281	0	4.3977	28.0834

Table 334. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ2

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	12.6237	0	0.3552	2.2683
Feb	0	12.9146	0	0.3383	2.1603
Mar	0	13.0361	0	0.389	2.4843
Apr	0.0014	8.6051	0	0.3552	2.2683
May	0.0238	6.6831	0	0.3721	2.3763
Jun	0.3894	3.3858	0	0.3721	2.3763
Jul	0.7261	3.4348	0	0.3552	2.2683
Aug	0.4718	4.8121	0	0.389	2.4843
Sep	0.0397	6.1199	0	0.3721	2.3763
Oct	0.0019	7.1194	0	0.3552	2.2683
Nov	0	9.822	0	0.3721	2.3763
Dec	0	12.4738	0	0.3721	2.3763
Total	1.6541	101.0304	0	4.3977	28.0834

Table 335. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ3

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	15.3517	0	0.3552	2.2683
Feb	0	12.5478	0	0.3383	2.1603
Mar	0	13.2541	0	0.389	2.4843
Apr	0.0304	8.7966	0	0.3552	2.2683
May	1.2007	4.0802	1.2058	0.3721	2.3763
Jun	2.6205	2.1129	1.1121	0.3721	2.3763
Jul	4.5105	1.1743	1.8709	0.3552	2.2683
Aug	2.4254	3.4429	0.5371	0.389	2.4843
Sep	0.0687	9.6423	0.0179	0.3721	2.3763
Oct	0.0196	9.7068	0	0.3552	2.2683
Nov	0	14.8307	0	0.3721	2.3763
Dec	0	14.6527	0	0.3721	2.3763
Total	10.8757	109.593	4.744	4.3977	28.0834

Table 336. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ4

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0011	9.3921	0	0.3552	2.2683
Feb	0.0003	8.3984	0	0.3383	2.1603
Mar	0.1663	6.207	0	0.389	2.4843

Apr	1.1435	3.6366	0.2057	0.3552	2.2683
May	3.6608	0.6904	1.2588	0.3721	2.3763
Jun	6.2915	0.0844	2.2386	0.3721	2.3763
Jul	7.1279	0.004	2.6031	0.3552	2.2683
Aug	6.2968	0.2209	1.5905	0.389	2.4843
Sep	2.7469	1.7739	0.6963	0.3721	2.3763
Oct	1.0001	3.015	0.2389	0.3552	2.2683
Nov	0.0525	7.5024	0.009	0.3721	2.3763
Dec	0.0069	8.972	0	0.3721	2.3763
Total	28.4944	49.8972	8.8408	4.3977	28.0834

Table 337. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ5

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0	8.4594	0	0.3552	2.2683
Feb	0	8.763	0	0.3383	2.1603
Mar	0	8.5689	0	0.389	2.4843
Apr	0.0136	5.7126	0	0.3552	2.2683
May	0.3477	3.016	0	0.3721	2.3763
Jun	1.1551	0.9598	0	0.3721	2.3763
Jul	1.8888	0.8439	0	0.3552	2.2683
Aug	1.5327	1.5664	0	0.389	2.4843
Sep	0.2152	3.9964	0	0.3721	2.3763
Oct	0.0115	5.9842	0	0.3552	2.2683
Nov	0.03	6.8323	0	0.3721	2.3763
Dec	0	8.1523	0	0.3721	2.3763
Total	5.1945	62.8552	0	4.3977	28.0834

Table 338. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ6

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0096	6.5986	0	0.3552	2.2683
Feb	0.0062	6.2278	0	0.3383	2.1603
Mar	0.0652	4.2253	0	0.389	2.4843
Apr	0.6339	2.104	0	0.3552	2.2683
May	2.3603	0.2444	0.3302	0.3721	2.3763
Jun	4.2208	0.0822	0.3299	0.3721	2.3763
Jul	4.7325	0	0.0901	0.3552	2.2683
Aug	4.0351	0.0698	0.7156	0.389	2.4843
Sep	1.8835	1.1555	0.1816	0.3721	2.3763
Oct	0.921	1.2547	0	0.3552	2.2683
Nov	0.2502	4.0294	0	0.3721	2.3763
Dec	0.0619	5.2625	0	0.3721	2.3763
Total	19.1802	31.2542	1.6474	4.3977	28.0834

Table 339. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ7

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.0225	5.8275	0	0.3552	2.2683
Feb	0.0151	6.5479	0	0.3383	2.1603
Mar	0.2756	3.9899	0	0.389	2.4843
Apr	1.8067	1.7002	0.7213	0.3552	2.2683
May	5.1444	0.4505	2.0599	0.3721	2.3763
Jun	7.4477	0.0371	2.7145	0.3721	2.3763
Jul	7.6621	0	1.8522	0.3552	2.2683
Aug	7.5763	0.0031	1.7479	0.389	2.4843
Sep	3.5109	0.8217	1.0478	0.3721	2.3763
Oct	2.2118	1.1297	0.7577	0.3552	2.2683
Nov	0.9106	2.6315	0.199	0.3721	2.3763
Dec	0.082	5.2061	0.0018	0.3721	2.3763
Total	36.6658	28.3453	11.1021	4.3977	28.0834

Table 340. Detailed Simulation Results for NCC 2025 C9B Stringency 1 Optimised Iteration Modelling in CZ8

	VRF Heating (MWh)	VRF Cooling (MWh)	Defrost Energy (MWh)	Distr fans energy (MWh)	Total lights (MWh)
Jan	0.971	2.8592	0.1425	0.3552	2.2683
Feb	0.8264	2.5767	0	0.3383	2.1603
Mar	2.5988	1.1473	0.4917	0.389	2.4843
Apr	4.9155	0.2138	2.158	0.3552	2.2683
May	8.7574	0	2.7713	0.3721	2.3763
Jun	12.5351	0	7.3431	0.3721	2.3763
Jul	12.3729	0	8.3985	0.3552	2.2683
Aug	12.1649	0	5.4641	0.389	2.4843
Sep	8.407	0.0246	4.0981	0.3721	2.3763
Oct	5.6375	0.7269	1.9333	0.3552	2.2683
Nov	3.5665	1.4856	1.7129	0.3721	2.3763
Dec	1.3017	2.0505	0.4732	0.3721	2.3763
Total	74.0546	11.0845	34.9867	4.3977	28.0834

Appendix B.III Stringency 2

The Stringency 2 results shown in the tables below are based on optimised scenarios developed during the Stringency 1 analysis (see Table 28), with the addition of rooftop PV. Energy values in the tables represent annual energy consumption. "Total electricity" includes both regulated and non-regulated end-uses, and does not distinguish between electricity generated onsite and grid electricity. Non-regulated loads are included because the on-site PV serves both regulated and non-regulated loads, with any excess exported. "Grid electricity" refers only to regulated electricity consumption from the electricity grid. Electricity saving percentages were calculated using regulated electricity for the NCC 2022 cases and grid electricity for the 2025 cases. Greenhouse gas emissions (GHG) were calculated for the 50-year life span of the building using carbon intensity trajectories based on the 2025 factors (0.70 kg/kWh for electricity and 56 $kgCO_2/GJ$ for gas).

Detailed siwamulation results for each energy using system are as per Stringency Level 1 and are not repeated here.

- ~~*Detailed Simulation Result: Detailed system parameters and simulation results for PV systems (rooftop only) in NCC 2025 Stringency 2.*~~

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Appendix B.III.I C5OL

Table 341. Energy and GHG Savings for C5OL Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	899	0	1,271	746	640	107	2	0%	29%	29%
2	7	558	7	957	432	345	88	1	4%	38%	38%
3	39	559	33	956	431	330	102	1	16%	41%	39%
4	152	412	149	857	332	234	100	3	2%	43%	31%
5	22	500	23	920	395	301	96	2	-4%	40%	38%
6	83	343	86	802	277	204	73	1	-4%	40%	31%
7	228	353	221	810	285	208	77	0	3%	41%	25%
8	480	316	525	783	258	177	84	2	-9%	44%	10%

Appendix B.III.II C5OM

Table 342. Energy and GHG Savings for C5OM Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	230	0	261	162	64	127	28	0%	72%	72%
2	0	146	0	202	103	7	128	32	0%	95%	95%
3	0	184	0	215	117	11	140	34	0%	94%	94%
4	0	129	0	188	89	0	120	31	0%	100%	100%
5	0	117	0	180	81	0	106	26	0%	100%	100%
6	0	98	0	169	70	-5	101	26	0%	105%	105%
7	0	107	0	181	82	-2	115	31	0%	102%	102%
8	0	128	0	203	104	27	106	28	0%	79%	79%

Appendix B.III.III C9A

Table 343. Energy and GHG Savings for C9A Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	1,039	0	1,034	872	780	92	0	0%	25%	25%
2	25	491	24	613	455	364	91	0	2%	26%	25%
3	109	571	68	656	494	400	94	0	37%	30%	31%
4	136	448	155	583	426	338	88	0	-14%	25%	15%
5	12	479	17	588	430	338	92	0	-43%	29%	28%
6	67	381	84	525	368	298	70	0	-25%	22%	14%
7	204	396	213	538	381	301	80	0	-4%	24%	14%
8	400	358	441	510	352	279	73	0	-10%	22%	4%

Appendix B.III.IV C9AS

Table 344. Energy and GHG Savings for C9AS Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	276	0	306	233	105	234	106	0%	62%	62%
2	0	155	0	186	114	37	135	59	0%	76%	76%
3	0	178	0	218	145	61	148	63	0%	66%	66%
4	0	141	0	189	116	50	126	61	0%	64%	64%
5	0	116	0	162	89	26	112	49	0%	77%	77%
6	0	114	0	156	83	26	106	50	0%	77%	77%
7	0	146	0	196	123	58	121	56	0%	60%	60%
8	0	192	0	232	159	103	98	42	0%	46%	46%

Appendix B.III.V C5OS

Table 345. Energy and GHG Savings for C5OS Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	63	0	75	50	22	36	8	0%	65%	65%
2	0	37	0	58	33	6	36	9	0%	85%	85%
3	0	48	0	61	36	6	40	11	0%	87%	87%
4	0	35	0	53	28	3	34	9	0%	90%	90%
5	0	29	0	48	22	0	30	8	0%	100%	100%
6	0	27	0	46	21	0	29	8	0%	99%	99%
7	0	32	0	52	27	3	33	9	0%	89%	89%
8	0	40	0	57	31	11	30	10	0%	72%	72%

Appendix B.III.VI C6RS

Table 346. Energy and GHG Savings for C6RS Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	392	0	286	267	138	129	0	0%	65%	65%
2	0	260	0	196	177	73	107	4	0%	72%	72%
3	0	320	0	219	200	85	117	3	0%	73%	73%
4	0	234	0	182	162	69	100	7	0%	70%	70%
5	0	207	0	162	143	59	89	5	0%	72%	72%
6	0	182	0	157	138	63	84	9	0%	66%	66%
7	0	199	0	176	156	70	96	9	0%	65%	65%
8	0	228	0	209	189	120	75	5	0%	48%	48%

Appendix B.III.VII C6RL

Table 347. Energy and GHG Savings for C6RL Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	364	0	295	275	186	89	0	0%	49%	49%
2	0	232	0	186	167	79	90	2	0%	66%	66%
3	0	303	0	224	205	107	98	1	0%	65%	65%
4	0	217	0	193	174	92	84	2	0%	58%	58%
5	0	189	0	162	143	70	75	2	0%	63%	63%
6	0	171	0	167	148	81	71	4	0%	52%	52%
7	0	212	0	187	167	91	81	4	0%	57%	57%
8	0	254	0	233	213	142	74	3	0%	44%	44%

Appendix B.III.VIII C3HS

Table 348. Energy and GHG Savings for C3HS Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	214	0	182	162	120	77	35	0%	44%	44%
2	0	108	0	108	88	58	78	48	0%	46%	46%
3	0	139	0	134	114	80	85	51	0%	43%	43%
4	0	117	0	118	98	72	73	46	0%	39%	39%
5	0	92	0	91	71	47	65	40	0%	49%	49%
6	0	81	0	89	69	47	61	39	0%	43%	43%
7	0	109	0	111	91	67	70	46	0%	38%	38%
8	0	135	0	140	120	96	62	38	0%	29%	29%

Appendix B.III.IX C3HL

Table 349. Energy and GHG Savings for C3HL Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	1,100	0	1,065	951	905	46	0	0%	18%	18%
2	30	578	43	577	465	423	41	0	-44%	27%	23%
3	134	657	150	657	543	503	40	0	-12%	23%	17%
4	368	453	398	508	396	357	38	0	-8%	21%	7%
5	76	472	101	496	384	344	40	0	-33%	27%	18%
6	242	386	297	445	333	299	34	0	-23%	23%	4%
7	488	397	548	449	336	305	31	0	-12%	23%	3%
8	882	328	975	416	303	275	29	0	-11%	16%	-4%

Appendix B.III.X C9B

Table 350. Energy and GHG Savings for C9B Stringency 2 Model

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)
1	0	297	0	268	244	146	141	43	0%	51%	51%
2	0	176	0	159	135	41	142	48	0%	77%	77%
3	0	201	0	181	158	57	155	55	0%	71%	71%
4	0	147	0	143	120	40	133	53	0%	73%	73%
5	0	130	0	124	101	28	118	46	0%	78%	78%
6	0	106	0	108	85	23	112	50	0%	79%	79%
7	0	132	0	132	109	37	127	55	0%	72%	72%
8	0	178	0	176	153	93	110	50	0%	48%	48%

Appendix B.IV Stringency 3

The Stringency 3 results shown in the tables include:

- Energy Savings: Energy values in the tables represent annual energy consumption. As with Stringency 2, “total electricity” includes regulated components and non-regulated components and does not distinguish between electricity generated on-site and grid electricity. Non-regulated loads are included because the on-site PV serves both regulated and non-regulated loads, with any excess exported. “Grid electricity” refers only to regulated electricity consumption from the electricity grid. Electricity saving percentages were calculated using regulated electricity for the NCC 2022 cases and grid electricity for the 2025 cases. The savings include domestic hot water, which was not included in Stringency 1 and 2 because there was no change between the base case and test cases.

  Electricity and gas savings are based on all-electric versions of the NCC 2025 archetypes and are calculated compared with a dual-fuel base-case (where applicable). That is to say, the annual energy savings reported here only represent the post-electrification period.

- Greenhouse gas emissions (GHG): Calculated for the 50-year life span of the building using carbon intensity trajectories based on the 2025 factors (0.70 kg/kWh for electricity and 56 $kgCO_2/GJ$ for gas).
- Detailed simulation results: The monthly energy results for each energy using system are shown for the all-electric versions of the NCC 2025 archetypes. The results for new-build electrification (i.e. Day 1) and retrofit electrification (Planned or unplanned) are reported separately where the timing impacts plant configuration. Contribution of PV to individual end-uses is not reported.

Appendix B.IV.I C5OL

Table 351. Energy and GHG Savings for C5OL Stringency 3 Model, Scenarios 1 and 2 (Planned Electrification with Expanded PV, Unplanned Electrification with Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	15	899	0	1,271	746	643	107	2	100%	28%	29%
2	26	558	0	963	438	358	88	1	100%	36%	38%
3	57	559	0	993	469	371	102	1	100%	34%	41%
4	171	412	0	914	389	282	119	6	100%	31%	50%
5	41	500	0	940	415	328	96	2	100%	34%	40%
6	104	343	0	838	314	234	89	2	100%	32%	47%
7	250	353	0	895	370	277	108	3	100%	22%	52%
8	502	316	0	979	454	319	162	15	100%	-1%	57%

Table 352. Energy and GHG Savings for C5OL Stringency 3 Model, Scenario 3 (Planned Electrification without Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	15	899	0	1,271	746	643	107	2	100%	28%	29%
2	26	558	0	963	438	358	88	1	100%	36%	38%
3	57	559	0	993	469	371	102	1	100%	34%	41%
4	171	412	0	914	389	298	100	3	100%	28%	47%
5	41	500	0	940	415	328	96	2	100%	34%	40%
6	104	343	0	838	314	249	73	1	100%	27%	43%
7	250	353	0	895	370	304	77	0	100%	14%	48%
8	502	316	0	979	454	384	84	2	100%	-21%	50%

Table 353. Energy and GHG Savings for C5OL Stringency 3 Model, Scenario 4 (Day One Electrification without Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	15	899	0	1,271	746	643	107	2	100%	28%	29%
2	26	558	0	963	438	358	88	1	100%	36%	38%
3	57	559	0	993	469	371	102	1	100%	34%	40%
4	171	412	0	914	389	298	100	3	100%	28%	49%
5	41	500	0	940	415	328	96	2	100%	34%	38%
6	104	343	0	838	314	249	73	1	100%	27%	44%
7	250	353	0	895	370	304	77	0	100%	14%	50%
8	502	316	0	979	454	384	84	2	100%	-21%	55%

Table 354. Energy and GHG Savings for C5OL Stringency 3 Model, Scenarios 5 and 6 (Planned Electrification with expanded PV, Unplanned Electrification with Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	899	0	1,271	746	640	107	2	0%	29%	29%
2	0	564	0	963	438	351	88	1	0%	38%	38%
3	0	587	0	993	469	368	102	1	0%	37%	39%
4	0	466	0	914	389	275	119	6	0%	41%	40%
5	0	519	0	940	415	321	96	2	0%	38%	38%
6	0	371	0	838	314	227	89	2	0%	39%	39%
7	0	432	0	895	370	265	108	3	0%	39%	38%
8	0	500	0	979	454	308	162	15	0%	38%	34%

Table 355. Energy and GHG Savings for C5OL Stringency 3 Model, Scenario 7 (Planned Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	899	0	1,271	746	640	107	2	0%	29%	29%
2	0	564	0	963	438	351	88	1	0%	38%	38%
3	0	587	0	993	469	368	102	1	0%	37%	39%
4	0	466	0	914	389	291	100	3	0%	38%	37%
5	0	519	0	940	415	321	96	2	0%	38%	38%
6	0	371	0	838	314	241	73	1	0%	35%	35%
7	0	432	0	895	370	293	77	0	0%	32%	32%
8	0	500	0	979	454	372	84	2	0%	26%	22%

Table 356. Energy and GHG Savings for C5OL Stringency 3 Model, Scenario 8 (Day One Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	899	0	1,271	746	640	107	2	0%	29%	29%
2	0	564	0	963	438	351	88	1	0%	38%	38%
3	0	587	0	993	469	368	102	1	0%	37%	37%
4	0	466	0	914	389	291	100	3	0%	38%	39%
5	0	519	0	940	415	321	96	2	0%	38%	38%
6	0	371	0	838	314	241	73	1	0%	35%	37%
7	0	432	0	895	370	293	77	0	0%	32%	36%
8	0	500	0	979	454	372	84	2	0%	26%	31%

Table 357. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ1 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	38.4913	5.1098	4.0322	6.0285	16.1072
Feb	0	0	0	0	37.181	4.9189	3.9859	6.1372	15.219
Mar	0	0	0	0	40.4909	5.6259	4.267	6.2458	17.4064
Apr	0	0	0	0	33.9233	5.1055	3.5191	4.8396	16.0277
May	0	0	0	0	29.8743	4.9276	3.0122	4.2821	16.7568
Jun	0	0	0	0	18.4279	3.6935	1.5896	2.5884	16.6773
Jul	0	0	0	0	17.3478	3.3206	1.44	2.349	16.1072
Aug	0	0	0	0	19.8475	3.9927	1.6024	2.6428	17.4064
Sep	0	0	0	0	32.3235	5.1202	3.2095	4.3372	16.6773
Oct	0	0	0	0	37.473	5.9117	4.1465	5.3582	16.1072
Nov	0	0	0	0	41.7492	6.4902	4.7219	6.2283	16.6773
Dec	0	0	0	0	42.3528	5.9615	4.653	6.9158	16.7568
Total	0	0	0	0	389.4824	60.1779	40.1795	57.9529	197.9266

Table 358. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ2 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	25.1393	3.8959	2.4031	3.5396	16.1072
Feb	0	0	0	0	25.47	3.9183	2.4925	3.5823	15.219
Mar	0	0	0	0	24.0311	3.9348	2.1895	3.4495	17.4064
Apr	0	0	0	0	13.2261	2.4452	1.2443	2.0259	16.0277
May	0	0	0	0.2492	6.3089	1.6279	0.8675	1.3186	16.7568
Jun	0	0	0	2.2571	2.2986	1.5945	0.6157	0.8157	16.6773
Jul	0	0	0	4.1245	1.853	1.6733	0.537	0.7512	16.1072
Aug	0	0	0	2.7176	2.7678	1.7242	0.7021	0.9868	17.4064

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Sep	0	0	0	0.2409	6.3268	1.7027	0.8416	1.2878	16.6773
Oct	0	0	0	0.0004	8.6042	1.9619	0.9229	1.5379	16.1072
Nov	0	0	0	0	17.4258	3.1513	1.56	2.6341	16.6773
Dec	0	0	0	0	23.2892	4.0011	2.2221	3.5533	16.7568
Total	0	0	0	9.5897	156.7408	31.6312	16.5983	25.4829	197.9266

Table 359. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ3 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	5.0428	0	0	25.5583	5.778	2.4399	3.9429	16.1072
Feb	0	0.7609	0	0	20.0456	4.7403	1.659	3.5811	15.219
Mar	0	1.0517	0	0	19.3072	4.6761	1.7462	3.6773	17.4064
Apr	0.0081	0.0034	0	0.0495	8.1822	2.3515	0.8353	1.8749	16.0277
May	1.0106	0	0.5113	1.9697	3.0563	2.218	0.4817	0.6403	16.7568
Jun	1.8276	0	0.4819	3.5294	1.6504	2.6411	0.3409	0.3986	16.6773
Jul	4.2055	0	0.9082	6.0081	0.8303	3.3152	0.2767	0.229	16.1072
Aug	2.1097	0	0.2332	3.8045	2.4625	2.6527	0.482	0.5843	17.4064
Sep	0.0393	0.0382	0.0023	0.0553	9.7684	2.8233	0.9717	2.2395	16.6773
Oct	0.0158	0.5036	0	0.027	10.5675	2.9879	1.0535	2.2739	16.1072
Nov	0	2.9549	0	0.0112	20.7198	5.2665	1.9355	3.808	16.6773
Dec	0	4.078	0	0	21.0735	5.3012	2.0957	3.8954	16.7568
Total	9.2167	14.4333	2.1369	15.4546	143.2221	44.7519	14.3181	27.1451	197.9266

Table 360. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ4 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0205	2.3592	0	0	15.8703	3.5744	1.2741	2.5226	16.1072
Feb	0.0064	1.1172	0	0	13.5153	3.1669	1.0402	2.2619	15.219
Mar	0.3511	0.0629	0	0.0714	8.8088	2.3496	0.6937	1.3962	17.4064
Apr	1.5202	0	0.1431	0.481	3.0672	1.7339	0.3561	0.4661	16.0277
May	5.1268	0	0.9905	2.3279	0.5733	2.3394	0.2089	0.1069	16.7568
Jun	8.4709	0	1.7875	3.8142	0.1396	2.9966	0.217	0.0282	16.6773
Jul	9.8509	0	2.132	4.3845	0.008	3.1978	0.2182	0.0014	16.1072
Aug	8.3579	0	1.2782	4.0074	0.2117	3.0234	0.2274	0.0402	17.4064
Sep	3.6729	0	0.5223	1.5074	1.5964	2.0884	0.2851	0.2792	16.6773
Oct	1.6391	0	0.1729	0.5611	3.4481	1.7995	0.3873	0.5286	16.1072
Nov	0.0883	1.7982	0.0095	0.0225	9.7973	2.5252	0.9114	1.6131	16.6773
Dec	0.0429	0.9925	0	0.0034	13.7052	3.2031	1.0664	2.39	16.7568
Total	39.148	6.33	7.0359	17.1808	70.741	31.9982	6.8856	11.6344	197.9266

Table 361. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ5 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	21.342	3.7827	2.0674	2.8788	16.1072
Feb	0	0	0	0	22.8522	3.6977	2.279	2.9368	15.219
Mar	0	0	0	0	20.1097	3.4482	1.8829	2.7074	17.4064
Apr	0	0	0	0.0573	12.1187	2.3444	1.1019	1.7097	16.0277
May	0	0	0	1.5314	4.4995	1.6209	0.5007	0.6776	16.7568
Jun	0	0	0	5.5059	1.3557	1.5297	0.2415	0.2737	16.6773
Jul	0	0	0	7.7135	0.8647	1.5581	0.1761	0.1708	16.1072

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Aug	0	0	0	6.2029	1.6297	1.6857	0.2915	0.3245	17.4064
Sep	0	0	0	1.2511	5.1569	1.9293	0.5903	0.891	16.6773
Oct	0	0	0	0.0323	10.5661	2.5161	0.973	1.5633	16.1072
Nov	0	0	0	0.0786	13.6214	3.1109	1.3659	2.0136	16.6773
Dec	0	0	0	0	18.2823	3.4325	1.6888	2.4948	16.7568
Total	0	0	0	22.3729	132.399	30.6561	13.1591	18.6421	197.9266

Table 362. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ6 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0108	3.9407	0	0	10.9952	2.6072	0.8931	1.4165	16.1072
Feb	0.0052	3.3527	0	0	9.5353	2.3984	0.8216	1.248	15.219
Mar	0.0923	0.3519	0	0	5.8946	1.6674	0.4316	0.7776	17.4064
Apr	0.7047	0	0	0	2.558	1.4201	0.2211	0.3225	16.0277
May	2.9642	0	0.3241	0	0.3648	1.8335	0.1572	0.0484	16.7568
Jun	5.3254	0	0.3124	0	0.1097	2.0834	0.198	0.014	16.6773
Jul	5.2492	0	0.0826	0	0.0003	1.9852	0.1736	0	16.1072
Aug	4.738	0	0.6789	0	0.109	2.1061	0.1958	0.0122	17.4064
Sep	2.1966	0	0.1652	0	1.56	1.6865	0.2169	0.2175	16.6773
Oct	0.6785	0.0847	0	0	2.2129	1.434	0.1875	0.2729	16.1072
Nov	0.2122	1.785	0	0	5.6855	1.8837	0.5253	0.6972	16.6773
Dec	0.0664	1.7523	0	0	7.7015	2.0643	0.5767	1.0273	16.7568
Total	22.2435	11.2673	1.563	0	46.7268	23.17	4.5985	6.0541	197.9266

Table 363. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ7 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.038	3.2272	0	0	9.0288	2.1254	0.7911	1.4459	16.1072
Feb	0.0307	5.8523	0	0	9.7004	2.5025	0.9649	1.6404	15.219
Mar	0.2285	0.2178	0	0	5.8035	1.7633	0.5456	0.9345	17.4064
Apr	2.8559	0	0.8234	0	2.2712	1.8801	0.3636	0.3468	16.0277
May	8.0476	0	2.3881	0	0.3757	2.8686	0.4477	0.0564	16.7568
Jun	13.0481	0	3.2695	0	0.0197	4.1494	0.6703	0.0025	16.6773
Jul	13.1206	0	2.2398	0	0	4.0865	0.6648	0	16.1072
Aug	12.5929	0	2.0645	0	0	3.8714	0.6101	0	17.4064
Sep	5.053	0	1.2607	0	0.9304	2.3881	0.384	0.159	16.6773
Oct	2.6824	0	0.843	0	1.8929	1.904	0.3354	0.311	16.1072
Nov	0.9002	0.3236	0.2107	0	4.5841	1.8176	0.4246	0.7288	16.6773
Dec	0.0857	2.3919	0	0	8.0887	2.1409	0.7551	1.3168	16.7568
Total	58.6836	12.0128	13.0998	0	42.6954	31.4978	6.9572	6.9421	197.9266

Table 364. Detailed Simulation Results for NCC 2025 C5OL Stringency 3 Modelling in CZ8 - Retrofit & New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	1.1191	3.9141	0.1114	0	0	1.8241	0.3572	0	16.1072
Feb	0.9873	3.1004	0	0	0	1.7187	0.279	0	15.219
Mar	3.5541	1.554	0.4389	0	0	2.2519	0.2338	0	17.4064
Apr	9.1587	0.3846	2.2238	0	0	2.8893	0.3509	0	16.0277
May	17.3326	0	3.029	0	0	4.3033	0.6905	0	16.7568
Jun	27.4485	0	8.6598	0	0	7.1381	1.4757	0	16.6773

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jul	28.0897	0	9.8781	0	0	7.4847	1.5511	0	16.1072
Aug	26.2491	0	6.3946	0	0	6.8893	1.3591	0	17.4064
Sep	16.916	0.1443	4.4255	0	0	4.3687	0.7362	0	16.6773
Oct	9.9761	1.3056	1.9594	0	0	2.9186	0.4377	0	16.1072
Nov	4.895	1.8419	1.4167	0	0	2.295	0.2974	0	16.6773
Dec	1.5097	3.5893	0.3274	0	0	1.9524	0.3196	0	16.7568
Total	147.2359	15.8343	38.8646	0	0	46.0341	8.0883	0	197.9266

Appendix B.IV.II C9A

Table 365. Energy and GHG Savings for C9A Stringency 3 Model, Scenarios 1 and 2 (Planned Electrification with Expanded PV, Unplanned Electrification with Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	104	1,039	0	1,033	875	759	136	0	100%	27%	32%
2	166	491	0	612	454	400	106	0	100%	19%	34%
3	237	571	0	686	523	406	143	1	100%	29%	47%
4	276	448	0	646	488	412	130	1	100%	8%	39%
5	152	479	0	584	426	373	105	0	100%	22%	36%
6	224	381	0	550	392	347	105	1	100%	9%	37%
7	374	396	0	638	480	476	93	0	100%	-20%	36%
8	569	358	0	739	581	597	73	0	100%	-67%	36%

Table 366. Energy and GHG Savings for C9A Stringency 3 Model, Scenarios 3 (Planned Electrification without Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	104	1,039	0	1,033	875	803	92	0	100%	23%	28%
2	166	491	0	612	454	415	91	0	100%	16%	32%
3	237	571	0	686	523	454	94	0	100%	21%	41%
4	276	448	0	646	488	452	88	0	100%	-1%	34%
5	152	479	0	584	426	386	92	0	100%	19%	34%
6	224	381	0	550	392	381	70	0	100%	0%	31%
7	374	396	0	638	480	489	80	0	100%	-24%	34%
8	569	358	0	739	581	597	73	0	100%	-67%	36%

* In the Day One electrification scenario, for archetype C9A in climate zones 1,2 and 5, gas boiler plant is replaced by electric duct heating rather than heat pumps.

Table 367. Energy and GHG Savings for C9A Stringency 3 Model, Scenarios 4 (Planned Electrification without Expanded PV)

CZ	NCC 2022 Gas (MWh)	NCC 2022 Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	104	1,039	0	1,034	872	800	92	0	100%	23%	29%
2	166	491	0	634	477	438	91	0	100%	11%	27%
3	237	571	0	686	523	454	94	0	100%	21%	43%
4	276	448	0	646	488	452	88	0	100%	-1%	33%
5	152	479	0	603	445	405	92	0	100%	15%	29%
6	224	381	0	550	392	381	70	0	100%	0%	30%
7	374	396	0	638	480	489	80	0	100%	-24%	28%
8	569	358	0	739	581	597	73	0	100%	-67%	30%

Table 368. Energy and GHG Savings for C9A Stringency 3 Model, Scenarios 5 and 6 (Planned Electrification with Expanded PV, Unplanned Electrification with Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,029	0	1,033	875	739	136	0	0%	28%	29%
2	0	497	0	612	454	347	106	0	0%	30%	29%
3	0	595	0	686	523	382	143	1	0%	36%	37%
4	0	490	0	646	488	360	130	1	0%	27%	27%
5	0	463	0	584	426	321	105	0	0%	31%	31%
6	0	398	0	550	392	289	105	1	0%	27%	26%
7	0	485	0	638	480	387	93	0	0%	20%	21%
8	0	568	0	739	581	508	73	0	0%	11%	10%

Table 369. Energy and GHG Savings for C9A Stringency 3 Model, Scenario 7 (Planned Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,029	0	1,033	875	783	92	0	0%	24%	25%
2	0	497	0	612	454	363	91	0	0%	27%	26%
3	0	595	0	686	523	429	94	0	0%	28%	30%
4	0	490	0	646	488	400	88	0	0%	18%	19%
5	0	463	0	584	426	334	92	0	0%	28%	28%
6	0	398	0	550	392	323	70	0	0%	19%	18%
7	0	485	0	638	480	400	80	0	0%	17%	18%
8	0	568	0	739	581	508	73	0	0%	11%	10%

Table 370. Energy and GHG Savings for C9A Stringency 3 Model, Scenario 8 (Day One Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,039	0	1,034	872	780	92	0	0%	25%	25%
2	0	491	0	634	477	386	91	0	0%	22%	23%
3	0	571	0	686	523	429	94	0	0%	25%	30%
4	0	448	0	646	488	400	88	0	0%	11%	21%
5	0	479	0	603	445	353	92	0	0%	26%	26%
6	0	381	0	550	392	323	70	0	0%	15%	21%
7	0	396	0	638	480	400	80	0	0%	-1%	19%
8	0	358	0	739	581	508	73	0	0%	-42%	11%

Table 371. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ1 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	8.1603	0	0	50.4991	8.8805	4.0121	0	14.2383
Feb	0	6.8946	0	0	47.6335	7.9708	3.914	0	12.8604
Mar	0	8.2086	0	0	49.9872	8.6351	3.9635	0	14.2383
Apr	0	8.1398	0	0	44.1381	8.5793	3.2876	0	13.779
May	0	8.168	0	0	34.4775	8.7766	2.3846	0	14.2383
Jun	0	5.4952	0	0	18.9739	8.4055	1.4321	0	13.779
Jul	0	5.2259	0	0	17.7392	8.5258	1.4007	0	14.2383
Aug	0	5.2151	0	0	18.7407	8.5451	1.4505	0	14.2383
Sep	0	8.1172	0	0	36.138	8.6211	2.5156	0	13.779
Oct	0	8.7448	0	0	48.3299	9.5154	3.5281	0	14.2383
Nov	0	8.2501	0	0	53.9334	9.3284	4.1502	0	13.779
Dec	0	8.2527	0	0	56.5225	9.1433	4.5579	0	14.2383

Total	0	88.8724	0	0	477.113	104.9268	36.597	0	167.6443

Table 372. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ1 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	58.2454	8.8805	4.1077	0	14.2383
Feb	0	0	0	0	54.374	7.9708	3.9495	0	12.8604
Mar	0	0	0	0	57.448	8.6351	4.1234	0	14.2383
Apr	0	0	0	0	51.3466	8.5793	3.4778	0	13.779
May	0	0	0	0	41.8965	8.7766	2.5618	0	14.2383
Jun	0	0	0	0	25.0128	8.4055	1.39	0	13.779
Jul	0	0	0	0	23.4759	8.5258	1.3958	0	14.2383
Aug	0	0	0	0	24.4645	8.5451	1.3642	0	14.2383
Sep	0	0	0	0	43.2382	8.6211	2.7278	0	13.779
Oct	0	0	0	0	55.9168	9.5154	3.7427	0	14.2383
Nov	0	0	0	0	61.6592	9.3284	4.2345	0	13.779
Dec	0	0	0	0	64.3911	9.1433	4.6315	0	14.2383
Total	0	0	0	0	561.4691	104.9268	37.7067	0	167.6443

Table 373. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ2 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	22.1204	0	0	13.222	7.0985	2.3224	0	14.2383
Feb	0	20.8472	0	0	14.4097	6.4116	2.3986	0	12.8604
Mar	0	19.6159	0	0	7.9213	7.0985	1.6594	0	14.2383
Apr	0	12.2279	0	0	2.5481	6.8695	0.8938	0	13.779
May	0.1266	4.61	0	0	0.0033	7.0985	0.3178	0	14.2383

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jun	1.2659	0.8515	0	0	0	6.8695	0.1379	0	13.779
Jul	2.9589	1.015	0.1989	0	0	7.0985	0.192	0	14.2383
Aug	1.9117	1.475	0	0	0	7.0985	0.2005	0	14.2383
Sep	0.1048	4.6737	0	0	0.0274	6.8695	0.3121	0	13.779
Oct	0.0057	8.0559	0	0	0.2259	7.0985	0.5223	0	14.2383
Nov	0	15.6756	0	0	4.6076	6.8695	1.2011	0	13.779
Dec	0	20.4458	0	0	9.465	7.0985	1.8441	0	14.2383
Total	6.3735	131.6138	0.1989	0	52.4302	83.5794	12.0019	0	167.6443

Table 374. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ2 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	35.4664	7.0985	2.5199	0	14.2383
Feb	0	0	0	0	35.4245	6.4116	2.5626	0	12.8604
Mar	0	0	0	0	28.1309	7.0985	1.8383	0	14.2383
Apr	0	0	0	0	15.5997	6.8695	1.0873	0	13.779
May	0	0	0	0.4451	5.2425	7.0985	0.4892	0	14.2383
Jun	0	0	0	4.4484	1.1497	6.8695	0.1756	0	13.779
Jul	0	0	0	9.959	1.3001	7.0985	0.1855	0	14.2383
Aug	0	0	0	6.645	1.8823	7.0985	0.2471	0	14.2383
Sep	0	0	0	0.3804	5.3257	6.8695	0.4803	0	13.779
Oct	0	0	0	0.0205	9.2649	7.0985	0.746	0	14.2383
Nov	0	0	0	0	20.8759	6.8695	1.4011	0	13.779
Dec	0	0	0	0	30.1719	7.0985	2.0336	0	14.2383

Total	0	0	0	21.8984	189.8344	83.5794	13.7666	0	167.6443

Table 375. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ3

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	17.7664	0	0	20.5415	11.1492	1.807	0	14.2383
Feb	0	10.2056	0	0	16.2259	10.0474	1.2492	0	12.8604
Mar	0	8.721	0	0	16.3751	10.893	1.1874	0	14.2383
Apr	0.1082	0.7883	0	0	9.245	10.114	0.5538	0	13.779
May	2.4702	0	0.8213	0	2.2236	10.0066	0.2695	0	14.2383
Jun	4.3514	0	1.0059	0	1.267	10.3075	0.2292	0	13.779
Jul	8.5123	0	2.1642	0	0.5569	10.9744	0.2428	0	14.2383
Aug	4.7009	0	0.56	0	1.8258	10.6453	0.2803	0	14.2383
Sep	0.2797	2.1445	0.024	0	9.9925	10.4305	0.6364	0	13.779
Oct	0.2175	3.6044	0	0	10.8875	10.6432	0.7419	0	14.2383
Nov	0.0004	11.2173	0	0	17.5792	10.7115	1.2662	0	13.779
Dec	0	13.4358	0	0	18.9523	11.1671	1.4987	0	14.2383
Total	20.6407	67.8835	4.5754	0	125.6724	127.0898	9.9623	0	167.6447

Table 376. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ4

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	10.4773	0	0	14.1475	13.0832	1.3463	0	14.2383
Feb	0	7.3089	0	0	11.9325	11.8171	1.0534	0	12.8604
Mar	0.0739	2.3819	0	0	7.3689	13.0832	0.6044	0	14.2383
Apr	1.5161	0.5041	0.2861	0	3.5295	12.6612	0.3107	0	13.779
May	5.6299	0	1.7327	0	0.378	13.0832	0.1532	0	14.2383
Jun	10.2764	0	3.4957	0	0.0403	12.6612	0.1965	0	13.779

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jul	13.4074	0	4.9817	0	0.0106	13.0832	0.2409	0	14.2383
Aug	10.1399	0	2.8511	0	0.1634	13.0832	0.209	0	14.2383
Sep	3.6732	0.1877	1.0903	0	1.4897	12.6612	0.2116	0	13.779
Oct	1.1509	0.6747	0.2991	0	3.2062	13.0832	0.3052	0	14.2383
Nov	0.0312	5.6285	0.017	0	9.5429	12.6612	0.8732	0	13.779
Dec	0.0034	7.7561	0	0	12.2375	13.0832	1.1249	0	14.2383
Total	45.9022	34.9191	14.7538	0	64.0469	154.0442	6.6295	0	167.6443

Table 377. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ5 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	10.5596	0	0	11.3198	11.3811	1.5705	0	14.2383
Feb	0	9.9035	0	0	10.4337	10.2798	1.5352	0	12.8604
Mar	0	8.6118	0	0	8.3291	11.3811	1.2341	0	14.2383
Apr	0	4.7658	0	0	3.1176	11.014	0.5904	0	13.779
May	0.1413	1.9395	0	0	0.2921	11.3811	0.2124	0	14.2383
Jun	1.068	0.3964	0	0	0.002	11.014	0.097	0	13.779
Jul	1.977	0.4074	0	0	0.019	11.3811	0.13	0	14.2383
Aug	1.1468	0.8657	0	0	0.0569	11.3811	0.1432	0	14.2383
Sep	0.0815	3.0402	0	0	1.1269	11.014	0.3195	0	13.779
Oct	0	5.4432	0	0	3.4115	11.3811	0.6259	0	14.2383
Nov	0	6.5652	0	0	5.3635	11.014	0.8543	0	13.779
Dec	0	8.2081	0	0	7.1761	11.3811	1.1051	0	14.2383
Total	4.4146	60.7065	0	0	50.6482	134.0037	8.4175	0	167.6443

Table 378. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ5 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	22.6149	11.3811	1.6338	0	14.2383
Feb	0	0	0	0	21.2314	10.2798	1.5957	0	12.8604
Mar	0	0	0	0	18.0248	11.3811	1.305	0	14.2383
Apr	0	0	0	0	8.9367	11.014	0.6924	0	13.779
May	0	0	0	0.4914	2.6657	11.3811	0.3015	0	14.2383
Jun	0	0	0	3.694	0.4524	11.014	0.0872	0	13.779
Jul	0	0	0	6.7818	0.4529	11.3811	0.0841	0	14.2383
Aug	0	0	0	3.9294	1.0718	11.3811	0.1493	0	14.2383
Sep	0	0	0	0.2864	4.6623	11.014	0.4204	0	13.779
Oct	0	0	0	0	9.4888	11.3811	0.7308	0	14.2383
Nov	0	0	0	0	12.874	11.014	0.956	0	13.779
Dec	0	0	0	0	16.584	11.3811	1.2188	0	14.2383
Total	0	0	0	15.1829	119.0597	134.0037	9.175	0	167.6443

Table 379. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ6

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	6.5352	0	0	6.9907	11.9338	0.8963	0	14.2383
Feb	0	6.348	0	0	6.4366	10.7789	0.8385	0	12.8604
Mar	0.0146	1.5198	0	0	3.9717	11.9338	0.3777	0	14.2383
Apr	0.3226	0.2478	0	0	1.8171	11.5488	0.1802	0	13.779
May	2.8154	0	0.5362	0	0.1574	11.9338	0.0837	0	14.2383

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jun	5.921	0	0.607	0	0.0625	11.5488	0.1223	0	13.779
Jul	6.3065	0	0.1729	0	0.0229	11.9338	0.1283	0	14.2383
Aug	4.8451	0	0.6875	0	0.0867	11.9338	0.1092	0	14.2383
Sep	2.2527	0.1235	0.1154	0	0.9413	11.5488	0.1399	0	13.779
Oct	0.4972	0.8672	0	0	2.0322	11.9338	0.2214	0	14.2383
Nov	0.0438	3.3748	0	0	4.3785	11.5488	0.5469	0	13.779
Dec	0.0288	3.5685	0	0	5.1673	11.9338	0.5929	0	14.2383
Total	23.0478	22.5848	2.119	0	32.0649	140.5108	4.2372	0	167.6443

Table 380. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ7

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	12.1131	0	0	0	13.206	0.8468	0	14.2383
Feb	0	14.0314	0	0	0	11.928	0.9724	0	12.8604
Mar	0.0527	5.6752	0	0	0	13.206	0.415	0	14.2383
Apr	3.5045	1.6697	1.5489	0	0	12.78	0.1872	0	13.779
May	9.1063	1.1107	3.7958	0	0	13.206	0.2086	0	14.2383
Jun	14.8368	0.9203	6.3347	0	0	12.78	0.273	0	13.779
Jul	16.8893	0.8497	7.0771	0	0	13.206	0.3026	0	14.2383
Aug	13.479	1.5629	4.7217	0	0	13.206	0.2645	0	14.2383
Sep	6.0017	0.9475	2.7458	0	0	12.78	0.1732	0	13.779
Oct	2.7173	2.3301	1.356	0	0	13.206	0.2165	0	14.2383

Nov	0.8138	5.2366	0.3457	0	0	12.78	0.3652	0	13.779
Dec	0.029	10.0343	0.0003	0	0	13.206	0.6914	0	14.2383
Total	67.4305	56.4815	27.926	0	0	155.4905	4.9165	0	167.6443

Table 381. Detailed Simulation Results for NCC 2025 C9A Stringency 3 Modelling in CZ8

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.6519	2.8172	0.1263	0	0	14.4535	0.271	0	14.2383
Feb	0.5388	2.2849	0.0426	0	0	13.0548	0.2194	0	12.8604
Mar	2.5549	1.4448	0.5313	0	0	14.4535	0.148	0	14.2383
Apr	9.3943	1.3133	4.0707	0	0	13.9873	0.2098	0	13.779
May	16.5553	1.1336	6.5682	0	0	14.4535	0.2962	0	14.2383
Jun	28.5368	0	17.1992	0	0	13.9873	0.4591	0	13.779
Jul	31.4117	0	20.1045	0	0	14.4535	0.503	0	14.2383
Aug	26.0249	0.2066	13.8175	0	0	14.4535	0.4237	0	14.2383
Sep	16.7058	0.9023	8.9022	0	0	13.9873	0.3027	0	13.779
Oct	9.2916	1.7191	3.1882	0	0	14.4535	0.2269	0	14.2383
Nov	4.3545	2.0136	1.4284	0	0	13.9873	0.2188	0	13.779
Dec	0.836	2.946	0.2371	0	0	14.4535	0.277	0	14.2383
Total	146.8565	16.7816	76.2163	0	0	170.1784	3.5556	0	167.6443

Appendix B.IV.III C3HL

Table 382. Energy and GHG Savings for C3HL Stringency 3 Model, Scenarios 1 and 2 (Planned Electrification with Expanded PV, Unplanned Electrification with Expanded PV)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	213	1,100	0	1,062	949	909	81	0	100%	17%	27%
2	303	578	0	581	468	516	53	0	100%	11%	35%
3	387	657	0	712	600	570	78	0	100%	13%	40%
4	641	453	0	647	535	566	71	1	100%	-25%	42%
5	349	472	0	514	401	453	50	0	100%	4%	37%
6	542	386	0	525	412	464	61	2	100%	-20%	41%
7	809	397	0	665	552	678	42	0	100%	-71%	39%
8	1,202	328	0	855	742	882	29	0	100%	-169%	40%

Table 383. Energy and GHG Savings for C3HL Stringency 3 Model, Scenarios 3 (Planned Electrification without Expanded PV)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	213	1,100	0	1,062	949	944	46	0	100%	14%	25%
2	303	578	0	581	468	528	41	0	100%	9%	34%
3	387	657	0	712	600	608	40	0	100%	7%	36%
4	641	453	0	647	535	598	38	0	100%	-32%	39%
5	349	472	0	514	401	463	40	0	100%	2%	36%
6	542	386	0	525	412	490	34	0	100%	-27%	38%
7	809	397	0	665	552	689	31	0	100%	-74%	38%
8	1,202	328	0	855	742	882	29	0	100%	-169%	40%

* In the Day One electrification scenario, for archetype C3HL in climate zones 1,2 and 5, gas boiler plant is replaced by electric duct heating rather than heat pumps.

Table 384. Energy and GHG Savings for C3HL Stringency 3 Model, Scenarios 4 (Planned Electrification without Expanded PV)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	213	1,100	0	1,063	951	945	46	0	100%	14%	26%
2	303	578	0	616	503	563	41	0	100%	3%	31%
3	387	657	0	712	600	608	40	0	100%	7%	39%
4	641	453	0	647	535	598	38	0	100%	-32%	40%
5	349	472	0	586	474	536	40	0	100%	-13%	34%
6	542	386	0	525	412	490	34	0	100%	-27%	39%
7	809	397	0	665	552	689	31	0	100%	-74%	33%
8	1,202	328	0	855	742	882	29	0	100%	-169%	36%

Table 385. Energy and GHG Savings for C3HL Stringency 3 Model, Scenarios 5 and 6 (Planned Electrification with Expanded PV, Unplanned Electrification with Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,094	0	1,062	949	869	81	0	0%	21%	21%
2	0	557	0	581	468	414	53	0	0%	26%	26%
3	0	681	0	712	600	522	78	0	0%	23%	25%
4	0	572	0	647	535	465	71	1	0%	19%	18%
5	0	466	0	514	401	351	50	0	0%	25%	25%
6	0	445	0	525	412	353	61	2	0%	21%	18%
7	0	592	0	665	552	510	42	0	0%	14%	12%
8	0	760	0	855	742	713	29	0	0%	6%	3%

Table 386. Energy and GHG Savings for C3HL Stringency 3 Model, Scenario 7 (Planned Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,094	0	1,062	949	904	46	0	0%	17%	18%
2	0	557	0	581	468	427	41	0	0%	23%	24%
3	0	681	0	712	600	560	40	0	0%	18%	19%
4	0	572	0	647	535	496	38	0	0%	13%	13%
5	0	466	0	514	401	361	40	0	0%	22%	22%
6	0	445	0	525	412	379	34	0	0%	15%	13%
7	0	592	0	665	552	521	31	0	0%	12%	10%
8	0	760	0	855	742	713	29	0	0%	6%	3%

Table 387. Energy and GHG Savings for C3HL Stringency 3 Model, Scenario 8 (Day One Electrification without Expanded PV, Electrified Base Case)

CZ	NCC 2022 (Electrified) Gas (MWh)	NCC 2022 (Electrified) Regulated Elec (MWh)	NCC 2025 Gas (MWh)	NCC 2025 Total Elec (MWh)	NCC 2025 Regulated Elec (MWh)	NCC 2025 Grid Elec (MWh)	NCC 2025 PV Gen (MWh)	NCC 2025 Elec Export (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - Lifetime GHG (%)
1	0	1,094	0	1,062	949	904	46	0	0%	17%	18%
2	0	557	0	581	468	427	41	0	0%	23%	24%
3	0	681	0	712	600	560	40	0	0%	18%	19%
4	0	572	0	647	535	496	38	0	0%	13%	13%
5	0	466	0	514	401	361	40	0	0%	22%	22%
6	0	445	0	525	412	379	34	0	0%	15%	13%
7	0	592	0	665	552	521	31	0	0%	12%	10%
8	0	760	0	855	742	713	29	0	0%	6%	3%

Table 388. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ1 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	10.5172	0	0	52.9051	9.0511	3.2189	0	16.5919
Feb	0	10.0931	0	0	50.1891	8.0333	2.952	0	14.9862
Mar	0	10.6776	0	0	52.5176	8.8908	3.1501	0	16.5919
Apr	0	9.8619	0	0	47.1181	8.7985	2.8397	0	16.0566
May	0	8.2439	0	0	37.137	8.9155	2.4031	0	16.5919
Jun	0	4.7219	0	0	20.654	8.4379	1.7265	0	16.0566
Jul	0	4.6791	0	0	18.2675	8.6794	1.6156	0	16.5919
Aug	0	4.4626	0	0	19.2724	8.7459	1.7464	0	16.5919
Sep	0	8.4006	0	0	38.7564	8.7601	2.4485	0	16.0566
Oct	0	11.0555	0	0	53.0273	9.4947	3.0272	0	16.5919
Nov	0	11.2065	0	0	59.52	9.4087	3.4203	0	16.0566
Dec	0	11.4044	0	0	60.6955	9.3653	3.5825	0	16.5919
Total	0	105.3242	0	0	510.0601	106.5811	32.1309	0	195.3558

Table 389. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ1 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	63.2236	9.0511	3.361	0	16.5919
Feb	0	0	0	0	60.4019	8.0333	3.0575	0	14.9862
Mar	0	0	0	0	63.1077	8.8908	3.279	0	16.5919
Apr	0	0	0	0	56.9568	8.7985	2.9292	0	16.0566
May	0	0	0	0	45.6231	8.9155	2.4382	0	16.5919
Jun	0	0	0	0	25.6393	8.4379	1.766	0	16.0566

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jul	0	0	0	0	23.3734	8.6794	1.7018	0	16.5919
Aug	0	0	0	0	23.8762	8.7459	1.7819	0	16.5919
Sep	0	0	0	0	47.3939	8.7601	2.4775	0	16.0566
Oct	0	0	0	0	64.2862	9.4947	3.0963	0	16.5919
Nov	0	0	0	0	70.095	9.4087	3.6201	0	16.0566
Dec	0	0	0	0	71.5362	9.3653	3.7983	0	16.5919
Total	0	0	0	0	615.5132	106.5811	33.3069	0	195.3558

Table 390. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ2 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	18.5638	0	0	14.4532	7.8968	1.8968	0	16.5919
Feb	0	17.6935	0	0	15.6124	7.1326	1.9223	0	14.9862
Mar	0	16.3956	0	0	8.1702	7.8968	1.3887	0	16.5919
Apr	0.0012	9.1326	0	0	2.9066	7.6421	0.7277	0	16.0566
May	0.2123	2.0829	0	0	0.2033	7.8968	0.1923	0	16.5919
Jun	2.4129	0.0573	0	0	0.0215	7.6421	0.0934	0	16.0566
Jul	4.9587	0.0884	0.2591	0	0.0294	7.8968	0.1602	0	16.5919
Aug	3.2256	0.2172	0	0	0.0569	7.8968	0.1318	0	16.5919
Sep	0.2777	2.3372	0	0	0.2583	7.6421	0.2052	0	16.0566
Oct	0.0237	5.0949	0	0	0.4789	7.8968	0.3932	0	16.5919
Nov	0	12.2531	0	0	4.973	7.6421	1.0035	0	16.0566
Dec	0	17.1374	0	0	10.3177	7.8968	1.5518	0	16.5919
Total	11.1121	101.0538	0.2591	0	57.4815	92.9786	9.6669	0	195.3558

Table 391. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ2 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	33.5683	7.8968	2.1453	0	16.5919
Feb	0	0	0	0	33.7524	7.1326	2.1539	0	14.9862
Mar	0	0	0	0	25.2449	7.8968	1.7083	0	16.5919
Apr	0	0	0	0.0049	12.8522	7.6421	1.0367	0	16.0566
May	0	0	0	0.7499	2.6805	7.8968	0.3781	0	16.5919
Jun	0	0	0	8.5159	0.1017	7.6421	0.0375	0	16.0566
Jul	0	0	0	16.8726	0.1361	7.8968	0.0523	0	16.5919
Aug	0	0	0	11.2219	0.3326	7.8968	0.0921	0	16.5919
Sep	0	0	0	1.0124	3.0349	7.6421	0.3802	0	16.0566
Oct	0	0	0	0.086	6.5497	7.8968	0.729	0	16.5919
Nov	0	0	0	0	17.9136	7.6421	1.3514	0	16.0566
Dec	0	0	0	0	27.9406	7.8968	1.8407	0	16.5919
Total	0	0	0	38.4636	164.1077	92.9786	11.9054	0	195.3558

Table 392. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ3

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	37.6209	0	0	6.4848	10.6176	2.0199	0	16.5919
Feb	0	28.5872	0	0	2.9383	9.2938	1.4176	0	14.9862
Mar	0	26.8956	0	0	2.7072	10.0966	1.3565	0	16.5919
Apr	0.1158	11.0664	0	0	0.378	9.0955	0.6155	0	16.0566
May	5.5913	1.2981	1.3638	0	0.0572	9.2468	0.2697	0	16.5919

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jun	9.9331	0.9068	2.1699	0	0.03	8.9484	0.3302	0	16.0566
Jul	17.9347	0.2129	4.1577	0	0.0078	9.2461	0.4252	0	16.5919
Aug	10.1517	1.4927	1.0051	0	0.0421	9.247	0.3413	0	16.5919
Sep	0.5446	14.3187	0.0344	0	0.5779	9.2297	0.7427	0	16.0566
Oct	0.3736	15.766	0	0	1.4881	9.607	0.8532	0	16.5919
Nov	0	28.8719	0	0	4.5576	9.9738	1.5372	0	16.0566
Dec	0	32.4913	0	0	5.4208	10.4	1.7681	0	16.5919
Total	44.6449	199.5285	8.731	0	24.6898	115.0021	11.6771	0	195.3558

Table 393. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ4

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.0004	19.6806	0	0	2.365	9.2604	1.8754	0	16.5919
Feb	0.0254	16.0979	0	0	1.0864	8.2868	1.4714	0	14.9862
Mar	0.9756	6.8599	0	0	0.2617	9.007	0.7767	0	16.5919
Apr	5.3579	1.6859	0.7057	0	0.0899	8.7167	0.4657	0	16.0566
May	15.859	0.0497	3.9179	0	0.0039	9.007	0.5863	0	16.5919
Jun	23.1438	0	5.7006	0	0	8.7207	0.7227	0	16.0566
Jul	28.1115	0	8.0501	0	0	9.0147	0.8514	0	16.5919
Aug	23.2267	0.0134	5.3602	0	0.0007	9.0098	0.748	0	16.5919
Sep	11.293	0.5463	2.6585	0	0.0356	8.7164	0.4931	0	16.0566
Oct	5.4498	1.8693	0.7453	0	0.0827	9.0073	0.478	0	16.5919
Nov	0.4391	10.5641	0.0366	0	1.6168	8.8361	1.1343	0	16.0566
Dec	0.1107	15.8769	0	0	1.4077	9.1516	1.5273	0	16.5919
Total	113.9928	73.2439	27.1749	0	6.9503	106.7344	11.1303	0	195.3558

Table 394. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ5 - Retrofit

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	16.7345	0	0	3.1099	7.3679	1.1673	0	16.5919
Feb	0	14.7167	0	0	3.7385	6.6497	1.148	0	14.9862
Mar	0	12.1262	0	0	1.7233	7.3621	0.8616	0	16.5919
Apr	0.0982	4.7165	0	0	0.2415	7.1246	0.3492	0	16.0566
May	2.0962	0.3902	0	0	0.0428	7.3621	0.1259	0	16.5919
Jun	6.4381	0.0004	0	0	0	7.1246	0.2072	0	16.0566
Jul	8.9615	0.0177	0	0	0.0017	7.3621	0.261	0	16.5919
Aug	6.4237	0.0889	0	0	0.0108	7.3621	0.205	0	16.5919
Sep	1.5148	1.5911	0	0	0.2376	7.1394	0.1836	0	16.0566
Oct	0.1492	4.9513	0	0	0.8533	7.3791	0.3766	0	16.5919
Nov	0.1784	8.0127	0	0	1.3023	7.1439	0.581	0	16.0566
Dec	0	10.4925	0	0	1.629	7.3875	0.773	0	16.5919
Total	25.86	73.8388	0	0	12.8906	86.7654	6.2395	0	195.3558

Table 395. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ5 - New Build

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0	0	0	0	20.8342	7.3679	1.431	0	16.5919
Feb	0	0	0	0	19.4743	6.6497	1.3937	0	14.9862
Mar	0	0	0	0	15.137	7.3621	1.136	0	16.5919
Apr	0	0	0	0.3547	5.7116	7.1246	0.5258	0	16.0566
May	0	0	0	7.4554	0.5575	7.3621	0.0835	0	16.5919
Jun	0	0	0	22.7989	0.0006	7.1246	0.0005	0	16.0566

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jul	0	0	0	31.3062	0.0198	7.3621	0.0037	0	16.5919
Aug	0	0	0	22.4071	0.1127	7.3621	0.0203	0	16.5919
Sep	0	0	0	5.4053	2.0095	7.1394	0.1967	0	16.0566
Oct	0	0	0	0.5341	6.1621	7.3791	0.5294	0	16.5919
Nov	0	0	0	0.63	10.1122	7.1439	0.779	0	16.0566
Dec	0	0	0	0	13.4385	7.3875	1.0464	0	16.5919
Total	0	0	0	90.8916	93.57	86.7654	7.146	0	195.3558

Table 396. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ6

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.056	8.2611	0	0	2.0799	8.0004	0.7215	0	16.5919
Feb	0.019	8.4764	0	0	1.876	7.2443	0.6718	0	14.9862
Mar	0.7236	2.6587	0	0	0.0845	7.9018	0.25	0	16.5919
Apr	3.2911	0.4333	0	0	0.0252	7.6469	0.1734	0	16.0566
May	10.9255	0.0003	0.7892	0	0	7.9025	0.3092	0	16.5919
Jun	16.1688	0	0.9961	0	0	7.6492	0.3963	0	16.0566
Jul	17.192	0	0.2804	0	0	7.9041	0.4197	0	16.5919
Aug	14.8548	0	1.2125	0	0	7.9023	0.3722	0	16.5919
Sep	8.9253	0.2834	0.3052	0	0.0081	7.6469	0.2753	0	16.0566
Oct	4.5982	1.327	0	0	0.0635	7.9018	0.2688	0	16.5919
Nov	1.3312	4.6163	0	0	0.9941	7.6765	0.4402	0	16.0566
Dec	0.4092	5.0031	0	0	0.7528	7.9398	0.4197	0	16.5919
Total	78.4946	31.0595	3.5833	0	5.8841	93.3165	4.7182	0	195.3558

Table 397. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ7

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	0.1256	4.8502	0	0	4.6619	8.3592	0.7297	0	16.5919
Feb	0.1395	5.9702	0	0	5.7099	7.624	0.8083	0	14.9862
Mar	1.2291	1.5124	0	0	1.49	8.3001	0.3322	0	16.5919
Apr	11.386	0.1466	3.8444	0	0.1436	8.0282	0.3345	0	16.0566
May	23.0971	0.0016	8.1083	0	0.0017	8.2978	0.5178	0	16.5919
Jun	31.2129	0	10.6047	0	0	8.0353	0.65	0	16.0566
Jul	34.6228	0	11.3461	0	0	8.3022	0.7111	0	16.5919
Aug	29.9421	0	8.6357	0	0	8.302	0.6323	0	16.5919
Sep	17.4357	0.0359	5.8056	0	0.0346	8.0282	0.4216	0	16.0566
Oct	10.1238	0.4512	3.1226	0	0.4396	8.2958	0.3771	0	16.5919
Nov	4.4984	1.4544	0.8532	0	1.4169	8.0302	0.4026	0	16.0566
Dec	0.5163	3.6073	0.0065	0	3.4923	8.3336	0.5974	0	16.5919
Total	164.3292	18.0299	52.3271	0	17.3905	97.9367	6.5145	0	195.3558

Table 398. Detailed Simulation Results for NCC 2025 C3HL Stringency 3 Modelling in CZ8

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jan	4.0251	0.5427	0.206	0	0	8.5123	0.2248	0	16.5919
Feb	3.9346	0.3543	0.0673	0	0	7.6885	0.2074	0	14.9862
Mar	10.6251	0.0136	1.291	0	0	8.5125	0.3591	0	16.5919
Apr	23.7743	0	9.4737	0	0	8.244	0.5503	0	16.0566
May	35.5522	0	14.5657	0	0	8.5256	0.7034	0	16.5919
Jun	51.7395	0	25.3151	0	0	8.2753	0.9294	0	16.0566

	CPHP heating energy (MWh)	CPHP cooling energy (MWh)	CPHP defrost energy (MWh)	EHC heating energy (MWh)	Chillers energy (MWh)	Distr fans energy (MWh)	Distr pumps energy (MWh)	Heat rej fans /pumps energy (MWh)	Total lights energy (MWh)
Jul	54.8527	0	28.0839	0	0	8.5577	1.0099	0	16.5919
Aug	48.6707	0	22.1168	0	0	8.5411	0.8949	0	16.5919
Sep	35.7563	0	15.7665	0	0	8.2538	0.6942	0	16.0566
Oct	22.9684	0.0252	7.2034	0	0	8.5175	0.5247	0	16.5919
Nov	12.9093	0.1848	3.3379	0	0	8.2402	0.3683	0	16.0566
Dec	5.2189	0.5192	0.4261	0	0	8.5123	0.2549	0	16.5919
Total	310.027	1.6398	127.8533	0	0	100.3806	6.7213	0	195.3558

Appendix C Economic Assumptions and Pricing

In general, system components were only priced where there was a change between NCC 2022 and NCC 2025 stringencies. This means the system costs below are not indicative of the total cost of each modelled building, but rather used to calculate the change in price associated with changes in stringency. The cost presented in this section accounts for 5% annual discount rate and are in present value (in 2024 terms). No cost learning rates have been applied.

Appendix C.I Energy and Carbon Pricing

The energy and carbon pricing in the table below is as agreed with ABCB.

Table 399. Electricity and Carbon Cost Projections for 50 Year Building Lifespan

Year	Electricity Cost ($/kWh)	Peak Demand Cost ($/kVA)	Gas Cost ($/GJ)	Carbon Cost ($/tonne)	Electricity Carbon Intensity (kg/kWh)	Gas Carbon Intensity (kg/GJ)	PV Electricity feed in tariff ($/kWh)	PV Electricity feed in tariff - decreasing ($/kWh)
1	0.1871	96.98	16.75	281.5	0.7000	56	0.07507	0.07163
2	0.1766	91.53	14.14	286.8	0.6300	56	0.07085	0.06598
3	0.1764	91.46	11.54	292.1	0.5670	56	0.07080	0.06431
4	0.1770	91.76	11.68	297.4	0.5103	56	0.07103	0.06290
5	0.1770	91.73	12.64	302.7	0.4593	56	0.07101	0.06126
6	0.1747	90.54	12.94	308.0	0.4133	56	0.07009	0.05886
7	0.1779	92.23	13.16	313.4	0.3720	56	0.07139	0.05832
8	0.1770	91.74	13.12	318.8	0.3348	56	0.07102	0.05639
9	0.1757	91.09	12.77	324.2	0.3013	56	0.07051	0.05437
10	0.1785	92.52	12.30	329.6	0.2712	56	0.07161	0.05358
11	0.1859	96.38	12.29	335.0	0.2441	56	0.07460	0.05411
12	0.1959	101.55	12.64	340.4	0.2197	56	0.07861	0.05522
13	0.1972	102.21	12.83	345.8	0.1977	56	0.07911	0.05376
14	0.1976	102.41	13.00	351.2	0.1779	56	0.07927	0.05206
15	0.1891	98.02	13.09	356.6	0.1601	56	0.07587	0.04808
16	0.1912	99.12	13.00	362.0	0.1441	56	0.07672	0.04687
17	0.1999	103.59	12.82	367.3	0.1297	56	0.08019	0.04715
18	0.2070	107.27	12.80	372.6	0.1167	56	0.08304	0.04692
19	0.2040	105.76	12.79	377.9	0.1051	56	0.08186	0.04439
20	0.2041	105.78	12.72	383.2	0.1000	56	0.08188	0.04252
21	0.2041	105.80	12.71	388.5	0.1000	56	0.08190	0.04066
22	0.2042	105.82	12.87	393.8	0.1000	56	0.08191	0.03879
23	0.2042	105.84	12.97	399.1	0.1000	56	0.08193	0.03692
24	0.2042	105.87	12.92	404.4	0.1000	56	0.08195	0.03505
25	0.2043	105.89	12.86	409.7	0.1000	56	0.08197	0.03319
26	0.2043	105.91	12.80	415.0	0.1000	56	0.08198	0.03132
27	0.2044	105.94	12.82	420.4	0.1000	56	0.08200	0.02945
28	0.2044	105.94	12.95	425.8	0.1000	56	0.08200	0.02945
29	0.2044	105.94	13.06	431.2	0.1000	56	0.08200	0.02945
30	0.2044	105.94	13.06	436.6	0.1000	56	0.08200	0.02945
31	0.2044	105.94	13.06	442.0	0.1000	56	0.08200	0.02945

Year	Electricity Cost ($/kWh)	Peak Demand Cost ($/kVA)	Gas Cost ($/GJ)	Carbon Cost ($/tonne)	Electricity Carbon Intensity (kg/kWh)	Gas Carbon Intensity (kg/GJ)	PV Electricity feed in tariff ($/kWh)	PV Electricity feed in tariff - decreasing ($/kWh)
32	0.2044	105.94	13.06	447.4	0.1000	56	0.08200	0.02945
33	0.2044	105.94	13.06	452.8	0.1000	56	0.08200	0.02945
34	0.2044	105.94	13.06	458.2	0.1000	56	0.08200	0.02945
35	0.2044	105.94	13.06	463.6	0.1000	56	0.08200	0.02945
36	0.2044	105.94	13.06	469.0	0.1000	56	0.08200	0.02945
37	0.2044	105.94	13.06	473.0	0.1000	56	0.08200	0.02945
38	0.2044	105.94	13.06	477.0	0.1000	56	0.08200	0.02945
39	0.2044	105.94	13.06	481.0	0.1000	56	0.08200	0.02945
40	0.2044	105.94	13.06	485.0	0.1000	56	0.08200	0.02945
41	0.2044	105.94	13.06	489.0	0.1000	56	0.08200	0.02945
42	0.2044	105.94	13.06	493.0	0.1000	56	0.08200	0.02945
43	0.2044	105.94	13.06	497.0	0.1000	56	0.08200	0.02945
44	0.2044	105.94	13.06	501.0	0.1000	56	0.08200	0.02945
45	0.2044	105.94	13.06	505.0	0.1000	56	0.08200	0.02945
46	0.2044	105.94	13.06	509.0	0.1000	56	0.08200	0.02945
47	0.2044	105.94	13.06	513.0	0.1000	56	0.08200	0.02945
48	0.2044	105.94	13.06	517.0	0.1000	56	0.08200	0.02945
49	0.2044	105.94	13.06	521.0	0.1000	56	0.08200	0.02945
50	0.2044	105.94	13.06	525.0	0.1000	56	0.08200	0.02945

Appendix C.II Building Envelope

Table 400. Archetype Dimensions used for Building Envelope Pricing

Archetype	Stringency Case	WWR	External Wall Area (m^2)	Glazing Area (m^2)	Roof/ Insulated Ceiling Area (m^2)	Insulated Internal Wall Area (m^2)
C5OL	2022	56%	2217.6	2822.4	1225	1188
C5OL	2025	56%	2217.6	2822.4	1225	0
C5OM	2022	35%	673.92	362.88	1169.771	237.6
C5OM	2025	35%	673.92	362.88	1169.771	0
C9A	2022	24%	2304	720	1296	825
C9A	2025	24%	2304	720	1296	0
C9AS	2022	35%	582.4	313.6	2048	0
C9AS	2025	35%	582.4	313.6	2048	0
C5OS	2022	38%	277.44	171.36	293.4584	108
C5OS	2025	38%	277.44	171.36	293.4584	0
C6RS	2022	44%	630	205.52	0	
C6RS	2025	44%	630	205.52	0	
C6RL	2022		842.8	42	1013.9648	0
C6RL	2025		842.8	42	1013.9648	0
C3HS	2022	25% front and rear, 0% sides. Long sides N/S	627.2	121.6	657.996	453.6
C3HS	2025	25% front and rear, 0% sides. Long sides N/S	627.2	121.6	657.996	0
C3HL	2022	28%	2662.4	1024	1024	1036.8
C3HL	2025	28%	2662.4	1024	1024	0
C9B	2022	36% North/south, 24% east west. North/south long side	825.6	384	1152	0
C9B	2025	36% North/south, 24% east west. North/south long side	825.6	384	1152	0

Appendix C.II.I Internal and External Wall Insulation Pricing

Archetype internal and external wall insulation costs were calculated using the dimensions shown in Table 400 and the R-value stringencies shown in Appendix A.I. Pricing data for different insulation levels was used to generate a linear regression pricing model, where:

*Wall insulation cost = wall area * (R-value*slope + intercept)*

The parameters used for the pricing model are shown in Table 401.

Table 401. Wall Insulation Pricing Model Parameters

	Slope ($/m^2)	Intercept ($.W/(K.m^2))
Metal Cladding (cavity)	48.87	598.69
Kingspan	47.99	169.36
Average (used for BCR calculations)	48.43	384.02

Appendix C.II.II Roof Insulation Pricing

Archetype roof insulation costs were calculated using the dimensions show in Table 400 and the R-value stringencies shown in Appendix A.I. Pricing for insulation with different thicknesses or R-values was used to calculate an average price per R-value per square meter, which was used to calculate roof insulation costs for each scenario. Costs were calculated by multiplying roof area by required R-value and the average price presented in Table 402.

Table 402. Rooftop Insulation Pricing Values

Insulation Thickness (mm)	R-value (m^2.K°/W)	Price ($/m^2)	$/R-value/m^2 ($.K/W)
140	2.5	6	2.4
165	3	8	2.67
185	3.5	12	3.43
240	5	15	3
Average (used for BCR calculations)			2.87381

Appendix C.II.III Glazing Pricing

Archetype glazing costs were calculated using the glazing selections presented in Table 58, Table 63, Table 67, and Table 71, along with the glazing dimensions in Table 400. Glazing prices were based on high level costing from contractors. Pricing for each glazing selection is shown in Table 403.

Table 403. Glazing Selection Pricing

Glazing Type	Price ($/m^2)
6mm Gray	25
6mm Sunergy (AGC)	25
ASG Visualite 67-1 6-12-6 air	135
ASG Visualite 70S-1 6-12-6 air	156
ASG Clear Visualite 67-1 #3 6-12-6 Argon	144.5
ASG Clear Visualite 70S-1 6-12-6 Argon	165.5
6mm Planibel	100
6mm Crystal Grey XYG	25
ASG Visualite 67-1 + grey 6-12-6 90% Argon	144.5
ASG Visualite 70S-1 + grey 6-12-6 Argon	165.5
ASG Super S1-1 6-12-6 90% Argon	144.5
ASG Coolshade 42-1 crystal grey 6-12-6 %90 Argon	144.5
ASG CoolShade 30 crystal grey 6-12-6 90% Argon	144.5
ASG Clear Visualite 67-1 #3 6-12-6 90% Argon	144.5
ASG Clear Visualite 70S-1 #3 6-12-6 90% Argon	165.5
ASG Super S1-1 #3 6-12-6 90% Argon	144.5
TGU Visualite 67-1 #2 6-12-3-12-6 90% Argon	250.5
TGU Visualite 67-1 #2 6-12-3-12-6 90% Air	237.5
TGU Visualite 70S-1 #2 6-12-3-12-6 90% Argon	275.7
TGU Visualite 70S-1 #2 6-12-3-12-6 90% Air	262.7
TGU Visualite 67-1 #5 6-12-3-12-6 90% Argon	250.5
TGU Visualite 67-1 #5 6-12-3-12-6 90% Air	237.5
TGU Visualite 70S-1 #5 6-12-3-12-6 90% Argon	275.7
TGU Visualite 70S-1 #5 6-12-3-12-6 90% Air	262.7
TGU ASG Cool Shade 30 + Crystal Grey 6-12-3-12-6 90% Argon	250.5
TGU ASG Cool Shade 42-1+ Crystal Grey 6-12-3-12-6 90% Argon	250.5
TGU Visualite 70S-1 #2 and Sunergy #4 90% Argon	275.7
TGU Visualite 70S-1 #2 and Sunergy #6 90% Argon	275.7
TGU Low e Visualite 70S-1 #2 Sunergy #4 and #6 90% Argon	275.7
TGU Low e #2 #4 #5 17961 90% Argon	275.7
ASG Visualite 70S-1 #2 and #3 6-12-6 90% Argon	165.5
ASG Visualite 70S-1 6-12-6 90% Argon low e #2 and #4 Sunergy	165.5
ASG Coolshade 42-1 + clear 6-12-6 %90 Argon	144.5
ASG CoolShade 30 + clear 6-12-6 90% Argon	144.5
ASG Clear Visualite 67-1 #2 and #3 6-12-6 90% Argon	144.5

Appendix C.III HVAC Equipment Pricing

Appendix C.III.I Heating/Cooling Plant Pricing

HVAC plant pricing was determined for each archetype based upon the type of equipment present. For the main plant equipment (i.e. heating/cooling plant) the pricing was separated into two components, one-off plant costs and replacement plant cost. Pricing was not considered for equipment that did not change based on stringency levels. The separation of plant into replacement and one-off items is shown for each system in Table 404.

Table 404. One-off and Replacement Plant Items for each HVAC System Type

System Type	Group	One-off Plant Items	Replacement Plant Items
VRF	Group 1a	• Refrigeration Pipework and Insulation	• VRF indoor units (in-ceiling) • VRF outdoor units
PAC	Group 2a	• N/A	• Rooftop PAC Unit
Heating Hot Water (HHW)	Group 3a	• HHW pipework for plant • HHW pipework for floors • Strainers/valves (motorised, balancing, isolation etc.) for plant and on-floor	• Gas condensing boilers • HHW primary pumps • HHW secondary pumps • HHW expansion tank • Air and dirt separator • Chemical dosing • Mechanical ventilation system for boiler plantroom
Chilled Water (CHW) – Air Cooled	Group 3a	• CHW pipework for plant • CHW pipework for floors • Strainers/valves (motorised, balancing, isolation etc.) for plant and on-floor	• Air-cooled chillers • CHW primary pumps • CHW secondary pumps • CHW expansion tank • Air and dirt separator • Chemical dosing
HHW	Group 4a	• HHW pipework for plant • Strainers/valves (motorised, balancing, isolation etc.) for plant • Condensate pipework (PVC)	• Gas condensing boilers • HHW primary pumps • HHW secondary pumps • HHW expansion tank • Air and dirt separator • Chemical dosing • Mechanical ventilation system for boiler plantroom
CHW – Water Cooled	Group 4a	• CHW pipework for plant • Strainers/valves (motorised, balancing, isolation etc.) for plant • Condensate pipework (PVC)	• Water-cooled chillers • CHW primary pumps • CHW secondary pumps • Cooling towers • CDW pumps • CHW expansion tank • Air and dirt separator • Chemical dosing

Table 405 provides the calculated price per kW (cooling/heating capacity) for each system type, along with the associated archetypes.

Table 405. HVAC Heating/Cooling Plant Pricing

System Type	Group	Archetype	Total ($/kW)	1 off ($/kW)	Replaced ($/kW)
VRF	Group 1a	C9AS	1,600.00	498.64	1,101.39
PAC	Group 2a	C5OM	757.67		757.67
HHW	Group 3a	C9A	952.50	575.83	376.67
CHW	Group 3a	C9A	1,787.83	622.83	1,165.00
HHW	Group 4a	C5OL	245.42	55.42	190.00
CHW	Group 3a	C5OL	719.93	58.27	661.67

For each scenario, heating and cooling plant costs were calculated by multiplying the plant capacities (taken from simulation data) by the $/kW pricing from Table 405, with adjustments made as follows:

- For chillers with a capacity less than 300 kW, an additional loading factor of 30% was applied to the one-off price.

Chiller costs($/kW) for the 2022 base case were calculated using parameters shown in Table 406 and the cost equation:

Chiller cost = a(b+c*capacity)*

Table 406. Chiller Base Case Pricing Parameters

Chiller Capacity (kW)	Type	Compressor	a	b	c
0 – 264	WC Screw	WCS	0.73	73277	249
264 – 528	WC Screw	WCS	0.69	73277	249
528 – 1055	WC Screw	WCS	0.62	73277	249
1055 – 1407	WC Screw	WCS	0.55	73277	249
> 1407	WC Centrifugal	WCC	0.86	73277	249
0 – 528	AC Scroll	ACSL	0.74	44637	235
> 528	AC Scroll	ACSL	0.7	44637	235

For the 2025 scenarios, the price for the chiller itself was recalculated to account for higher efficiency requirements under new stringencies. Chiller costs for the 2025 scenarios were calculated using the 'b' and 'c' pricing parameters from Table 406 and adjusted 'a' parameters from Table 407 below.

Table 407. 2025 scenario chiller pricing adjusted parameters

Archetype	CZ	Base case compressor	Compressor	Cost deviation (%)	Adjusted 'a' parameter
C5OL	1	AC Scroll	AC Scroll	-0.16	0.84
C5OL	1	AC Scroll	AC Screw	-0.262	0.738
C5OL	1	WC Screw	WC Screw	0	1
C5OL	1	WC Screw	WC Cent	0.09	1.09
C5OL	1	WC Screw	WC Cent	0.07	1.07
C5OL	1	WC Screw	WC Cent	-0.038	0.962
C5OL	1	WC Cent	WC Cent	-0.027	0.973
C5OL	2	AC Scroll	AC Scroll	-0.16	0.84
C5OL	2	AC Scroll	AC Scroll	-0.123	0.877
C5OL	2	WC Screw	WC Screw	0	1
C5OL	2	WC Screw	WC Cent	0.09	1.09
C5OL	2	WC Screw	WC Cent	0.07	1.07
C5OL	2	WC Screw	WC Cent	-0.038	0.962
C5OL	2	WC Cent	WC Cent	-0.027	0.973
C5OL	3	AC Scroll	AC Scroll	-0.16	0.84
C5OL	3	AC Scroll	AC Scroll	-0.246	0.754
C5OL	3	WC Screw	WC Screw	0	1
C5OL	3	WC Screw	WC Cent	0.09	1.09
C5OL	3	WC Screw	WC Cent	0.07	1.07
C5OL	3	WC Screw	WC Cent	-0.038	0.962

Archetype	CZ	Base case compressor	Compressor	Cost deviation (%)	Adjusted 'a' parameter
C5OL	3	WC Cent	WC Cent	-0.027	0.973
C5OL	4	AC Scroll	AC Scroll	-0.16	0.84
C5OL	4	AC Scroll	AC Scroll	-0.123	0.877
C5OL	4	WC Screw	WC Screw	0	1
C5OL	4	WC Screw	WC Screw	-0.217	0.783
C5OL	4	WC Screw	WC Screw	-0.368	0.632
C5OL	4	WC Screw	WC Screw	0	1
C5OL	4	WC Cent	WC Cent	-0.027	0.973
C5OL	5	AC Scroll	AC Scroll	-0.16	0.84
C5OL	5	AC Scroll	AC Screw	-0.262	0.738
C5OL	5	WC Screw	WC Screw	0	1
C5OL	5	WC Screw	WC Screw	-0.217	0.783
C5OL	5	WC Screw	WC Screw	-0.368	0.632
C5OL	5	WC Screw	WC Screw	0	1
C5OL	5	WC Cent	WC Cent	-0.027	0.973
C5OL	6	AC Scroll	AC Scroll	-0.16	0.84
C5OL	6	AC Scroll	AC Screw	-0.262	0.738
C5OL	6	WC Screw	WC Screw	0	1
C5OL	6	WC Screw	WC Screw	-0.217	0.783
C5OL	6	WC Screw	WC Screw	-0.368	0.632
C5OL	6	WC Screw	WC Screw	0	1
C5OL	6	WC Cent	WC Cent	-0.027	0.973
C5OL	7	AC Scroll	AC Scroll	-0.16	0.84
C5OL	7	AC Scroll	AC Screw	-0.262	0.738
C5OL	7	WC Screw	WC Screw	0	1
C5OL	7	WC Screw	WC Screw	-0.217	0.783
C5OL	7	WC Screw	WC Screw	-0.368	0.632
C5OL	7	WC Screw	WC Screw	0	1
C5OL	7	WC Cent	WC Cent	-0.027	0.973
C5OL	8	AC Scroll	AC Scroll	-0.16	0.84
C5OL	8	AC Scroll	AC Screw	-0.262	0.738
C5OL	8	WC Screw	WC Screw	0	1
C5OL	8	WC Screw	WC Screw	-0.217	0.783
C5OL	8	WC Screw	WC Screw	-0.368	0.632
C5OL	8	WC Screw	WC Screw	0	1
C5OL	8	WC Cent	WC Cent	-0.027	0.973
C9A	1	AC Scroll	AC Scroll	-0.206	0.794
C9A	1	AC Scroll	AC Screw	-0.305	0.695
C9A	1	WC Screw	WC Screw	-0.008	0.992
C9A	1	WC Screw	WC Cent	0.118	1.118
C9A	1	WC Screw	WC Cent	0.08	1.08
C9A	1	WC Screw	WC Cent	0.059	1.059
C9A	1	WC Cent	WC Cent	-0.027	0.973
C9A	2	AC Scroll	AC Scroll	-0.206	0.794
C9A	2	AC Scroll	AC Screw	-0.305	0.695
C9A	2	WC Screw	WC Screw	-0.008	0.992

Archetype	CZ	Base case compressor	Compressor	Cost deviation (%)	Adjusted 'a' parameter
C9A	2	WC Screw	WC Cent	0.118	1.118
C9A	2	WC Screw	WC Cent	0.08	1.08
C9A	2	WC Screw	WC Cent	0.059	1.059
C9A	2	WC Cent	WC Cent	-0.027	0.973
C9A	3	AC Scroll	AC Scroll	-0.206	0.794
C9A	3	AC Scroll	AC Screw	-0.305	0.695
C9A	3	WC Screw	WC Screw	-0.008	0.992
C9A	3	WC Screw	WC Screw	-0.158	0.842
C9A	3	WC Screw	WC Cent	0.08	1.08
C9A	3	WC Screw	WC Screw	-0.343	0.657
C9A	3	WC Cent	WC Cent	-0.027	0.973
C9A	4	AC Scroll	AC Scroll	-0.206	0.794
C9A	4	AC Scroll	AC Screw	-0.305	0.695
C9A	4	WC Screw	WC Screw	-0.008	0.992
C9A	4	WC Screw	WC Screw	-0.158	0.842
C9A	4	WC Screw	WC Screw	-0.358	0.642
C9A	4	WC Screw	WC Screw	0	1
C9A	4	WC Cent	WC Cent	-0.027	0.973
C9A	5	AC Scroll	AC Scroll	-0.206	0.794
C9A	5	AC Scroll	AC Screw	-0.305	0.695
C9A	5	WC Screw	WC Screw	-0.008	0.992
C9A	5	WC Screw	WC Screw	-0.158	0.842
C9A	5	WC Screw	WC Cent	0.08	1.08
C9A	5	WC Screw	WC Screw	0	1
C9A	5	WC Cent	WC Cent	-0.027	0.973
C9A	6	AC Scroll	AC Scroll	-0.206	0.794
C9A	6	AC Scroll	AC Screw	-0.305	0.695
C9A	6	WC Screw	WC Screw	-0.008	0.992
C9A	6	WC Screw	WC Screw	-0.158	0.842
C9A	6	WC Screw	WC Screw	-0.358	0.642
C9A	6	WC Screw	WC Screw	0	1
C9A	6	WC Cent	WC Cent	-0.027	0.973
C9A	7	AC Scroll	AC Scroll	-0.206	0.794
C9A	7	AC Scroll	AC Screw	-0.305	0.695
C9A	7	WC Screw	WC Screw	-0.008	0.992
C9A	7	WC Screw	WC Screw	-0.158	0.842
C9A	7	WC Screw	WC Screw	-0.358	0.642
C9A	7	WC Screw	WC Screw	0	1
C9A	7	WC Cent	WC Cent	-0.027	0.973
C9A	8	AC Scroll	AC Scroll	-0.259	0.741
C9A	8	AC Scroll	AC Screw	-0.125	0.875
C9A	8	WC Screw	WC Screw	-0.008	0.992
C9A	8	WC Screw	WC Screw	-0.158	0.842
C9A	8	WC Screw	WC Screw	-0.358	0.642
C9A	8	WC Screw	WC Screw	0	1
C9A	8	WC Cent	WC Cent	-0.027	0.973

- For archetypes using PAC units, prices were adjusted in the 2025 scenarios to account for variable speed requirements (Table 408).

Table 408. PAC Unit Pricing (Fixed vs Variable Speed)

PAC pricing	$/kW (thermal)
Fixed Speed	$ 473.79
Variable Speed	$ 615.56

- For archetypes using VRF systems, prices were adjusted in the 2025 scenarios to account for increases in EER stringency (Table 409).

Table 409. VRF Pricing and Energy Efficiency Ratios

	EER Above 39 kW	EER Below 39 kW	VRF costs ($/kW) Above 39 kW	VRF costs ($/kW) Below 39 kW
Base Case Selection	3.17	3.48	$ 432	$ 402
	3.25	3.58	$ 439	$ 406
	3.34	3.67	$ 447	$ 435
	3.43	3.79	$ 445	$ 463
	3.57	3.97	$ 459	$ 488
Test Case Selection	3.67	4.09	$ 466	$ 510
	3.78	4.23	$ 473	$ 543
	3.91	4.42	$ 478	$ 567
	4.11	4.68	$ 516	$ 591

Appendix C.III.II VSD Pricing

VSD costs were calculated using the fan capacities (kW) determined from the simulations. Manufacturer pricing data for different motor sizes was used to generate a linear regression pricing model, with the parameters shown in Table 410. A minimum price was also used in the model (Table 410).

Table 410. VSD Pricing Model Parameters

Minimum Price ($/kW)	Slope	Intercept
$543.02	80.8167	564.6003

Appendix C.III.III CO2 Control Pricing

For test case iterations where CO_2 control was added as a stringency requirement (archetypes C5OM and C5OL), costs were calculated based on the number of additional sensors and cost per sensor unit and installation. This information is summarised in Table 411 and Table 412.

Table 411. Additional Number of CO2 Sensors (vs base case) by Iteration

Archetype	Test Case	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8
C5OM	Iteration 2	2	2	2	2	2	2	0	0
C5OM	Iteration 3	6	6	6	6	6	6	4	4
C5OM	Iteration 4	10	10	10	10	10	10	8	8
C5OM	Iteration 5	10	10	10	10	10	10	8	8
C5OM	Iteration 6	10	10	10	10	10	10	8	8
C5OL	Iteration 2	0	50	40	0	40	0	0	0

Table 412. CO2 Sensor Costs

CO_2 Sensor Unit Cost ($)	CO_2 Sensor Install Cost ($)
1,200	1,300

Appendix C.III.IV Economy Cycle Costing

For test case iterations where PAC economy cycle was added a stringency requirement (archetype C5OM), costs were calculated using a linear regression pricing model. The total economy airflow in the test case was calculated, and the PAC cost was recalculated using the parameters in Table 413 (subtracting the cost of a non-economy cycle PAC unit and adding the cost of an economy cycle capable PAC unit).

Table 413. PAC Unit Economy Cycle Pricing Parameters

Economy Cycle costs - C5OM	Configuration	Slope ($ per L/s)	Intercept ($)
PAC Inverter	No Econ cycle	6.39	1,894.38
PAC Inverter	Econ cycle	6.97	3,860.16

For test case iterations where AHU economy cycle was added as a stringency requirement (archetype C5OL), costs were calculated using a logarithmic model, where:

*Additional economy cycle cost = ln(airflow) * slope + intercept*

The parameters used in the logarithmic model are shown in Table 414.

Table 414. AHU Economy Cycle Cost Parameters

Parameter	Value
Slope (L/s)	3,308.60
Intercept (L/s)	-16,940.00

Appendix C.III.V Heat Exchanger & Evaporative Cooling Pricing

For test case iterations where heat exchanger and evaporative cooling requirements were introduced (archetypes C9A and C9AS), cost differences were calculated using a linear regression pricing model. The total outside air flow in the test case was extracted from the associated thermal model, and the pricing model was used to calculate the additional price associated with these increased requirements. The pricing model parameters are shown in Table 415.

Table 415. Heat Exchanger and Evaporative Cooling Pricing Model Parameters

Parameter	HX only	HX & Evaporative coolers
Slope	11.80	16.04
Intercept	25,744.15	41,469.11

Appendix C.IV Lighting Pricing

The table below (Table 416) includes the cost details of the occupancy sensors. Cost is calculated at $400 for each regular presence/ occupancy sensor and $450 for each waterproof sensor. For the base case, the manual switches are priced at $116 each and the total number of manual switches is the same as the total number of sensors in the test case.

Table 416. Occupancy Sensor Pricing for each archetype

	Number of regular presence/occupancy sensors	Number of waterproof presence/occupancy sensors	Total number of sensors	Manual switch cost	Presence/occupancy sensor cost
C5OL	340	20	360	$41,760	$145,000
C5OM	64	4	68	$7,888	$27,400
C9A	0	0	0	$0	$0
C9AS	0	0	0	$0	$0
C5OS	18	4	22	$2,552	$9,000
C6RS	34	2	36	$4,176	$14,500
C6RL	32	2	34	$3,944	$13,700
C3HS	4	0	4	$464	$1,600
C3HL	64	0	64	$7,424	$25,600
C9B	70	4	74	$8,584	$29,800

Appendix C.V PV (Stringency 2 & 3) Pricing

Photovoltaic panel pricing was calculated based on the system size and the price per W (Table 417). Given price points were not linear, $/W figures and annual maintenance costs for a particular system size were calculated by interpolating between the values shown in Table 417. Ground mount system costs cover equipment and infrastructure requirements (mounting system, electrical infrastructure, PV panels, etc) and exclude any additional land costs.

Table 417. PV System Pricing

System Size (kWp)	Roof mount System Cost ($/W)	Ground Mount System Cost ($/W)	Annual Maintenance Cost ($/kW)
10	1.37	1.92	32
15	1.311	1.83	32
20	1.28	1.79	32
40	1.27	1.77	32
100	1.20	1.69	24
300	1.2	1.68	16

Appendix C.VI Electrification (Stringency 3) Pricing

Appendix C.VI.I DHW Pricing

To evaluate the impact of replacing gas DHW systems with electric, gas DHW costs were added to the base case costs. Gas heater costs apply to the base case. Total system cost for each test case is the sum of the heat pump and direct electric costs.

Table 418. DHW System Costs

Scenario	Gas Heater Cost	Heat pump cost inc. install	Direct electric costs
C5OL CZ1	$26,120	$85,235	NA
C5OL CZ2	$26,120	$85,235	$7,719
C5OL CZ3	$26,120	$85,235	NA
C5OL CZ4	$26,120	$85,235	$7,719
C5OL CZ5	$26,120	$85,235	$7,719
C5OL CZ6	$26,120	$85,235	$7,719
C5OL CZ7	$40,168	$85,235	$15,438
C5OL CZ8	$40,168	$85,235	$15,438
C9A CZ1	$60,064	$127,852	$23,156
C9A CZ2	$60,064	$170,469	$23,156
C9A CZ3	$60,064	$127,852	$23,156
C9A CZ4	$60,064	$170,469	$23,156
C9A CZ5	$60,064	$170,469	$23,156
C9A CZ6	$60,064	$170,469	$23,156
C9A CZ7	$86,092	$170,469	$30,875
C9A CZ8	$86,092	$170,469	$30,875
C3HL CZ1	$42,539	$127,852	$15,438
C3HL CZ2	$42,539	$170,469	$15,438
C3HL CZ3	$42,539	$127,852	$15,438
C3HL CZ4	$42,539	$170,469	$15,438
C3HL CZ5	$42,539	$170,469	$15,438
C3HL CZ6	$42,539	$170,469	$15,438
C3HL CZ7	$40,168	$170,469	$23,156
C3HL CZ8	$40,168	$170,469	$23,156

Appendix C.VI.II Electric Space Heating Plant Pricing

Several linear regression pricing models were used to calculate heating plant and plant room costing for the electrification scenarios. Slope and intercept values for these models are presented in the tables below.

Table 419. Heat Pump Pricing ($/kW) Model Parameters

Scenario	slope	intercept
C5OL Unplanned	$508	$468,570
C5OL Planned	$529	$447,667
C5OL Day One	$838	$111,691
C9A Unplanned	$1,334	$654,192
C9A Planned	$1,317	$395,594
C9A Day One	$925	$188738
C3HL Unplanned	$1334	$654192
C3HL Planned	$1317	$395594
C3HL Day One	$925	$188738

Table 420. Plant Area (m^2/kW) Sizing Model Parameters

Scenario	slope	intercept
C5OL Gas Boiler Plant Room	0.009	24.763
C5OL Heat Pump Plant Room	0.035	31.850
C9A Gas Boiler Plant Room	0.012	28.082
C9A Heat Pump Plant Room	0.041	36.260
C5OL Gas Boiler Louvre	0.027	44.185
C5OL Heat Pump Louvre	0.023	56.496
C9A Gas Boiler Louvre	0.013	55.427
C3HL Heat pump louvre	0.019	64.752

Table 421. Heating Plant room and Louvre Costs

Item	Cost $/m^2
Plant room	$909
Louvre	$699

Table 422. Electric Duct Heating Pricing Parameters ($/kW)

	Slope	Intercept
EDH	$203	$1,286

Table 423. Electric Heating Plant Costs

Scenario	Substation description	Substation cost	MSB	MSB cost	Submain cost
New building	New Substation 1000kVA=1300A	$450,000	New MSB	$70,000	$180
Base case infrastructure	New Substation 800kVA=1000A	$400,000	New MSB	$60,000	$180
Planned & Immediate	Larger Substation	$50,000	Larger MSB	$10,000	$180
Unplanned	Upgrade Substation from 800kVA to 1000 kVA	$300,000	Upgrade MSB	$32,500	$225

Appendix D Benefit Cost Analysis Results

Appendix D.I Stringency 1 BCR Results

Appendix D.I.I Summary Results

C5OL

Table 424. Initial results for C5OL (Large office). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	Iteration 1 - Gas (MWh)	Iteration 1 - Elec (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)	BCR
1	0	899	0	746	0%	17%	17%	2.41
2	7	558	8	446	-14%	20%	19%	2.88
3	39	559	36	435	9%	22%	21%	3.04
4	152	412	149	332	2%	19%	14%	4.00
5	22	500	25	398	-15%	20%	19%	7.20
6	83	343	86	277	-4%	19%	14%	2.71
7	228	353	221	285	3%	19%	13%	2.44
8	480	316	525	258	-9%	18%	1%	2.50

Table 425. Optimised Test Case Results for C5OL (Large Office).

CZ	Iteration 2 (CO2 Control on Perimeter AHUs) – Elec (%)	Iteration 2 (CO2 Control on Perimeter AHUs) – BCR	Iteration 3 (Economy Cycle) - Elec (%)	Iteration 3 (Economy Cycle) - BCR
1	17%	2.4	17%	2.4
2	23%	1.8	23%	1.6
3	23%	2.0	23%	1.8
4	19%	4.0	19%	4.0
5	21%	2.8	21%	2.8
6	19%	2.7	19%	2.7
7	19%	2.4	19%	2.4
8	18%	2.5	18%	2.5

C5OM

Table 426. Initial results for C5OM (Medium office). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 - Gas (MWh)	NCC 2022 - Elec (MWh)	Iteration 1 - Gas (MWh)	Iteration 1 - Elec (MWh)	Savings - Gas (%)	Savings - Elec (%)	Savings - GHG (%)	BCR
1	0	230	0	171	0%	26%	26%	7.02
2	0	146	0	105	0%	29%	29%	5.55
3	0	184	0	118	0%	36%	36%	-
4	0	129	0	90	0%	31%	31%	27.46
5	0	117	0	82	0%	30%	30%	17.62
6	0	98	0	71	0%	27%	27%	18.40
7	0	107	0	82	0%	24%	24%	5.25
8	0	128	0	105	0%	18%	18%	2.71

Table 427. Optimised Test Case Results for C5OM (Medium office).

CZ	Iteration 2 Elec (%)	Iteration 2 BCR	Iteration 3 Elec (%)	Iteration 3 BCR	Iteration 4 Elec (%)	Iteration 4 BCR	Iteration 5 Elec (%)	Iteration 5 BCR	Iteration 6 Elec (%)	Iteration 6 BCR
1	28%	6.6	29%	5.4	30%	4.48	30%	4.27	100%	17.2
2	29%	4.8	30%	3.8	30%	3.11	30%	3.00	100%	12.2
3	37%	68342.0	37%	27.2	37%	13.66	38%	12.10	100%	41.3
4	31%	15.2	32%	8.0	32%	5.42	32%	5.08	100%	19.3
5	31%	11.2	31%	6.4	31%	4.49	32%	4.25	100%	16.4
6	28%	10.3	28%	5.4	28%	3.69	29%	3.53	28%	3.4
7	24%	5.2	24%	3.5	24%	2.67	25%	2.57	100%	12.8
8	18%	2.7	18%	2.2	19%	1.78	19%	1.73	100%	11.6

C9A

Table 428. Initial results for C9A (Large hospital). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	1,039	0	910	0%	12%	12%	-
2	25	491	24	455	2%	7%	7%	-
3	109	571	115	522	-6%	9%	9%	-
4	136	448	155	426	-14%	5%	5%	-
5	12	479	17	430	-43%	10%	10%	-
6	67	381	84	368	-25%	3%	3%	-
7	204	396	213	381	-4%	4%	4%	-
8	400	358	441	352	-10%	2%	2%	-0.19

Table 429. Optimised Test Case Results for C9A (Large Hospital).

CZ	Iteration 2 Elec (%)	Iteration 2 BCR
1	16%	33.8
2	100%	67.3
3	14%	-
4	100%	64.0
5	100%	345.7
6	100%	209.6
7	100%	204.9
8	100%	-

C9AS

Table 430. Initial results for C9AS (Small hospital). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	276	0	233	0%	16%	16%	-
2	0	155	0	114	0%	27%	27%	-
3	0	178	0	145	0%	18%	18%	-
4	0	141	0	116	0%	18%	18%	-
5	0	116	0	89	0%	23%	23%	-
6	0	114	0	83	0%	27%	27%	-
7	0	146	0	123	0%	16%	16%	-
8	0	192	0	159	0%	17%	17%	2.92

Table 431. Optimised Test Case Results for C9AS (Small Hospital).

CZ	Iteration 2 Elec (%)	Iteration 2 BCR
1	19%	5.4
2	100%	-
3	21%	27.2
4	100%	-
5	100%	-
6	100%	-
7	100%	-
8	100%	17.3

C5OS

Table 432. Initial results for C5OS (Small office). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	63	0	50	0%	21%	21%	-
2	0	37	0	33	0%	11%	11%	-
3	0	48	0	36	0%	25%	25%	-
4	0	35	0	28	0%	20%	20%	-
5	0	29	0	22	0%	23%	23%	-
6	0	27	0	21	0%	22%	22%	-
7	0	32	0	27	0%	18%	18%	-
8	0	40	0	31	0%	22%	22%	-

C6RS

Table 433. Initial results for C6RS (Small Retail). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	392	0	267	0%	32%	32%	-
2	0	260	0	177	0%	32%	32%	-
3	0	320	0	200	0%	38%	38%	-
4	0	234	0	162	0%	30%	30%	-
5	0	207	0	143	0%	31%	31%	-
6	0	182	0	138	0%	24%	24%	15.76
7	0	199	0	156	0%	22%	22%	11.49
8	0	228	0	189	0%	17%	17%	6.41

C6RL

Table 434. Initial results for C6RL (Large Retail). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	364	0	275	0%	24%	24%	8.91
2	0	232	0	167	0%	28%	28%	-
3	0	303	0	205	0%	32%	32%	809.42
4	0	217	0	174	0%	20%	20%	3.35
5	0	189	0	143	0%	25%	25%	81.59
6	0	171	0	148	0%	13%	13%	2.18
7	0	212	0	167	0%	21%	21%	5.63
8	0	254	0	213	0%	16%	16%	1.68

C3HS

Table 435. Initial results for C3HS (Small hotel). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	214	0	162	0%	25%	25%	-
2	0	108	0	88	0%	18%	18%	-
3	0	139	0	114	0%	18%	18%	-
4	0	117	0	98	0%	16%	16%	-
5	0	92	0	71	0%	23%	23%	-
6	0	81	0	69	0%	14%	14%	-
7	0	109	0	91	0%	16%	16%	-
8	0	135	0	120	0%	11%	11%	-

C3HL

Table 436. Initial results for C3HL (Large Hotel). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	1,100	0	951	0%	14%	14%	-
2	30	578	43	465	-44%	20%	16%	-
3	134	657	150	543	-12%	17%	12%	-
4	368	453	398	396	-8%	13%	3%	-
5	76	472	101	384	-33%	19%	11%	-
6	242	386	297	333	-23%	14%	-1%	-
7	488	397	548	336	-12%	15%	0%	-
8	882	328	975	303	-11%	7%	-6%	-0.16

C9B

Table 437. Initial results for C9B (School). Percentage savings are expressed relative to NCC 2022.

CZ	NCC 2022 – Gas (MWh)	NCC 2022 – Elec (MWh)	NCC 2025 Iteration 1 - Gas (MWh)	NCC 2025 Iteration 1 - Elec (MWh)	Savings – Gas (%)	Savings – Elec (%)	Savings – GHG (%)	BCR
1	0	297	0	244	0%	18%	18%	-
2	0	176	0	135	0%	23%	23%	-
3	0	201	0	158	0%	22%	22%	-
4	0	147	0	120	0%	19%	19%	-
5	0	130	0	101	0%	22%	22%	-
6	0	106	0	85	0%	20%	20%	-
7	0	132	0	109	0%	18%	18%	-
8	0	178	0	153	0%	14%	14%	-

Appendix D.I.II Detailed Results Stringency 1

Table 438. Stringency 1 Optimised Scenario BCR Results

Archetype	CZ	Iteration	Capex Delta	Opex Delta	BCR
C5OL	1	IT01	$354,957	-$856,008	2.41
C5OL	2	IT02	$413,130	-$761,250	1.84
C5OL	3	IT02	$398,544	-$782,134	1.96
C5OL	4	IT01	$120,558	-$482,758	4.00
C5OL	5	IT02	$229,410	-$631,673	2.75
C5OL	6	IT01	$139,039	-$377,179	2.71
C5OL	7	IT01	$173,418	-$422,519	2.44
C5OL	8	IT01	$106,534	-$266,318	2.50
C5OM	1	IT03	$69,204	-$370,943	5.36
C5OM	2	IT02	$49,702	-$240,915	4.85
C5OM	3	IT02	$6	-$398,418	68342.02
C5OM	4	IT02	$15,996	-$242,930	15.19
C5OM	5	IT02	$19,486	-$217,361	11.15
C5OM	6	IT06	$49,463	-$167,376	3.38
C5OM	7	IT01	$28,674	-$150,538	5.25

C5OM	8	IT03	$62,741	-$135,444	2.16
C9A	1	IT02	$27,370	-$924,132	33.76
C9A	2	IT01	-$132,232	-$221,036	-
C9A	3	IT02	-$184	-$573,561	-
C9A	4	IT01	-$128,971	-$100,869	-
C9A	5	IT01	-$167,764	-$301,167	-
C9A	6	IT01	-$164,310	-$62,394	-
C9A	7	IT01	-$162,306	-$85,997	-
C9A	8	IT01	-$245,732	$47,751	-0.19
C9AS	1	IT01	-$26,262	-$240,370	-
C9AS	2	IT01	-$55,024	-$232,668	-
C9AS	3	IT01	-$73,314	-$183,619	-
C9AS	4	IT01	-$64,904	-$145,658	-
C9AS	5	IT01	-$21,771	-$166,111	-
C9AS	6	IT01	-$159,255	-$216,964	-
C9AS	7	IT01	-$15,019	-$129,332	-
C9AS	8	IT01	$64,136	-$187,000	2.92
C5OS	1	IT01	-$6,027	-$84,711	-
C5OS	2	IT01	-$10,117	-$25,407	-
C5OS	3	IT01	-$10,910	-$78,307	-
C5OS	4	IT01	-$10,481	-$48,643	-
C5OS	5	IT01	-$6,508	-$45,400	-
C5OS	6	IT01	-$13,272	-$42,678	-
C5OS	7	IT01	-$828	-$39,179	-
C5OS	8	IT01	-$826	-$56,062	-
C6RS	1	IT01	-$19,137	-$691,392	-
C6RS	2	IT01	-$4,213	-$474,078	-
C6RS	3	IT01	-$48,182	-$682,829	-
C6RS	4	IT01	-$20,776	-$409,584	-
C6RS	5	IT01	-$9,482	-$381,442	-
C6RS	6	IT01	$16,460	-$259,457	15.76
C6RS	7	IT01	$21,511	-$247,145	11.49
C6RS	8	IT01	$35,221	-$225,616	6.41
C6RL	1	IT01	$54,584	-$486,459	8.91
C6RL	2	IT01	-$7,840	-$357,620	-
C6RL	3	IT01	$685	-$554,170	809.42
C6RL	4	IT01	$71,949	-$241,091	3.35
C6RL	5	IT01	$3,328	-$271,507	81.59
C6RL	6	IT01	$53,507	-$116,625	2.18
C6RL	7	IT01	$46,736	-$262,929	5.63
C6RL	8	IT01	$135,966	-$228,721	1.68
C3HS	1	IT01	-$107,238	-$295,785	-
C3HS	2	IT01	-$51,891	-$110,700	-

C3HS	3	IT01	-$40,387	-$142,531	-
C3HS	4	IT01	-$43,461	-$106,365	-
C3HS	5	IT01	-$67,410	-$125,169	-
C3HS	6	IT01	-$42,950	-$73,250	-
C3HS	7	IT01	-$35,735	-$105,086	-
C3HS	8	IT01	-$50,761	-$83,602	-
C3HL	1	IT01	-$482,334	-$842,820	-
C3HL	2	IT01	-$403,060	-$671,009	-
C3HL	3	IT01	-$414,487	-$577,364	-
C3HL	4	IT01	-$184,704	-$419,130	-
C3HL	5	IT01	-$303,466	-$501,102	-
C3HL	6	IT01	-$225,341	-$153,469	-
C3HL	7	IT01	-$290,716	-$157,488	-
C3HL	8	IT01	-$620,022	$102,158	-0.16
C9B	1	IT01	-$30,274	-$343,608	-
C9B	2	IT01	-$73,871	-$274,942	-
C9B	3	IT01	-$37,958	-$283,904	-
C9B	4	IT01	-$30,364	-$187,830	-
C9B	5	IT01	-$34,087	-$196,591	-
C9B	6	IT01	-$18,667	-$146,956	-
C9B	7	IT01	-$15,384	-$161,477	-
C9B	8	IT01	-$1,461	-$176,783	-

Appendix D.II Stringency 2 BCR Results

Table 439. Stringency 2 Optimised Scenario BCR Results

Archetype	CZ	Iteration	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 2 BCR
C5OL	1	IT01	$475,705	-$1,363,275	2.87
C5OL	2	IT02	$511,911	-$1,177,395	2.30
C5OL	3	IT02	$503,702	-$1,268,590	2.52
C5OL	4	IT01	$240,437	-$951,079	3.96
C5OL	5	IT02	$357,946	-$1,078,041	3.01
C5OL	6	IT01	$243,315	-$717,693	2.95
C5OL	7	IT01	$271,133	-$788,617	2.91
C5OL	8	IT01	$220,131	-$654,494	2.97
C5OM	1	IT03	$210,748	-$864,353	4.10
C5OM	2	IT02	$191,247	-$723,682	3.78
C5OM	3	IT02	$141,550	-$931,510	6.58
C5OM	4	IT02	$157,540	-$688,270	4.37
C5OM	5	IT02	$161,030	-$615,007	3.82
C5OM	6	IT06	$191,007	-$535,921	2.81
C5OM	7	IT01	$170,219	-$569,858	3.35
C5OM	8	IT03	$204,286	-$517,507	2.53
C9A	1	IT02	$131,645	-$1,364,550	10.37
C9A	2	IT01	-$29,726	-$657,441	-
C9A	3	IT02	$96,997	-$1,026,348	10.58
C9A	4	IT01	-$22,930	-$520,822	-
C9A	5	IT01	-$44,066	-$737,657	-
C9A	6	IT01	-$64,641	-$389,138	-
C9A	7	IT01	-$61,926	-$464,357	-
C9A	8	IT01	-$145,175	-$298,750	-
C9AS	1	IT01	$229,049	-$933,457	4.08
C9AS	2	IT01	$93,800	-$637,988	6.80
C9AS	3	IT01	$75,510	-$632,859	8.38
C9AS	4	IT01	$83,920	-$496,476	5.92
C9AS	5	IT01	$127,053	-$493,243	3.88
C9AS	6	IT01	-$10,431	-$512,523	-
C9AS	7	IT01	$133,805	-$474,178	3.54
C9AS	8	IT01	$195,941	-$475,343	2.43
C5OS	1	IT01	$35,900	-$222,275	6.19
C5OS	2	IT01	$31,811	-$160,537	5.05
C5OS	3	IT01	$31,017	-$224,345	7.23
C5OS	4	IT01	$31,446	-$170,993	5.44
C5OS	5	IT01	$35,419	-$154,186	4.35
C5OS	6	IT01	$28,655	-$143,677	5.01
C5OS	7	IT01	$41,100	-$153,634	3.74
C5OS	8	IT01	$41,101	-$154,575	3.76

C6RS	1	IT01	$124,614	-$1,313,218	10.54
C6RS	2	IT01	$115,492	-$973,273	8.43
C6RS	3	IT01	$71,523	-$1,237,919	17.31
C6RS	4	IT01	$98,929	-$858,174	8.67
C6RS	5	IT01	$110,223	-$781,222	7.09
C6RS	6	IT01	$136,165	-$619,409	4.55
C6RS	7	IT01	$141,216	-$664,735	4.71
C6RS	8	IT01	$137,373	-$556,415	4.05
C6RL	1	IT01	$54,584	-$486,459	8.91
C6RL	2	IT01	-$7,840	-$357,620	-
C6RL	3	IT01	$156,028	-$913,922	5.86
C6RL	4	IT01	$93,604	-$781,726	8.35
C6RL	5	IT01	$102,128	-$1,025,567	10.04
C6RL	6	IT01	$173,393	-$631,456	3.64
C6RL	7	IT01	$104,771	-$614,640	5.87
C6RL	8	IT01	$154,950	-$431,639	2.79
C3HS	1	IT01	-$18,815	-$515,656	-
C3HS	2	IT01	$36,532	-$279,672	7.66
C3HS	3	IT01	$48,036	-$338,376	7.04
C3HS	4	IT01	$44,962	-$257,481	5.73
C3HS	5	IT01	$21,013	-$259,754	12.36
C3HS	6	IT01	$45,473	-$197,325	4.34
C3HS	7	IT01	$52,688	-$242,289	4.60
C3HS	8	IT01	$34,426	-$214,048	6.22
C3HL	1	IT01	-$429,363	-$1,061,142	-
C3HL	2	IT01	-$355,697	-$867,732	-
C3HL	3	IT01	-$372,747	-$767,540	-
C3HL	4	IT01	-$137,341	-$601,630	-
C3HL	5	IT01	-$248,630	-$687,283	-
C3HL	6	IT01	-$176,107	-$311,103	-
C3HL	7	IT01	-$250,854	-$303,912	-
C3HL	8	IT01	-$580,161	-$31,622	-
C9B	1	IT01	$125,437	-$843,412	6.72
C9B	2	IT01	$81,840	-$759,676	9.28
C9B	3	IT01	$117,753	-$805,852	6.84
C9B	4	IT01	$125,347	-$603,656	4.82
C9B	5	IT01	$121,624	-$566,299	4.66
C9B	6	IT01	$137,044	-$467,890	3.41
C9B	7	IT01	$140,327	-$537,266	3.83
C9B	8	IT01	$145,676	-$488,098	3.35

Appendix D.III Stringency 3 BCR Detailed Results

Table 440. Stringency 3 Scenario 1 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$418,950	-$1,354,695	3.23
C5OL	2	$343,358	-$1,139,721	3.32
C5OL	3	$586,721	-$1,097,059	1.87
C5OL	4	$493,716	-$999,041	2.02
C5OL	5	$211,546	-$1,034,560	4.89
C5OL	6	$520,707	-$749,380	1.44
C5OL	7	$540,176	-$918,572	1.70
C5OL	8	$580,507	-$937,401	1.61
C9A	1	$265,900	-$1,720,100	6.47
C9A	2	$380,892	-$941,108	2.47
C9A	3	$123,074	-$1,442,049	11.72
C9A	4	$318,016	-$943,999	2.97
C9A	5	$412,023	-$995,762	2.42
C9A	6	$302,194	-$798,332	2.64
C9A	7	$248,684	-$727,408	2.93
C9A	8	$239,079	-$420,836	1.76
C3HL	1	-$43,358	-$1,570,143	-
C3HL	2	$13,461	-$1,291,866	95.97
C3HL	3	-$152,280	-$1,475,035	-
C3HL	4	$177,921	-$1,178,797	6.63
C3HL	5	$100,542	-$1,143,932	11.38
C3HL	6	$178,977	-$1,069,881	5.98
C3HL	7	$95,346	-$1,095,388	11.49
C3HL	8	-$105,217	-$769,241	-

Table 441. Stringency 3 Scenario 2 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$421,025	-$1,354,695	3.22
C5OL	2	$519,780	-$1,139,721	2.19
C5OL	3	$772,806	-$1,097,059	1.42
C5OL	4	$678,152	-$999,041	1.47
C5OL	5	$387,319	-$1,034,560	2.67
C5OL	6	$700,382	-$749,380	1.07
C5OL	7	$733,439	-$918,572	1.25
C5OL	8	$758,435	-$937,401	1.24
C9A	1	$440,808	-$1,720,100	3.90
C9A	2	$802,645	-$941,108	1.17
C9A	3	$382,804	-$1,442,049	3.77
C9A	4	$580,465	-$943,999	1.63
C9A	5	$831,687	-$995,762	1.20
C9A	6	$564,232	-$798,332	1.41
C9A	7	$523,574	-$727,408	1.39
C9A	8	$669,153	-$420,836	0.63

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C3HL	1	$130,528	-$1,570,143	12.03
C3HL	2	$208,402	-$1,291,866	6.20
C3HL	3	$53,987	-$1,475,035	27.32
C3HL	4	$383,908	-$1,178,797	3.07
C3HL	5	$297,157	-$1,143,932	3.85
C3HL	6	$378,988	-$1,069,881	2.82
C3HL	7	$292,567	-$1,095,388	3.74
C3HL	8	$235,811	-$769,241	3.26

Table 442. Stringency 3 Scenario 3 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$418,950	-$1,354,695	3.23
C5OL	2	$343,358	-$1,139,721	3.32
C5OL	3	$586,721	-$1,097,059	1.87
C5OL	4	$493,716	-$921,915	1.87
C5OL	5	$211,546	-$1,034,560	4.89
C5OL	6	$520,707	-$680,908	1.31
C5OL	7	$540,176	-$786,186	1.46
C5OL	8	$580,507	-$625,903	1.08
C9A	1	$265,900	-$1,509,576	5.68
C9A	2	$380,892	-$867,928	2.28
C9A	3	$123,074	-$1,212,798	9.85
C9A	4	$318,016	-$752,478	2.37
C9A	5	$412,023	-$936,504	2.27
C9A	6	$302,194	-$640,675	2.12
C9A	7	$248,684	-$662,791	2.67
C9A	8	$239,079	-$420,836	1.76
C3HL	1	-$43,358	-$1,404,079	-
C3HL	2	$13,461	-$1,233,636	91.64
C3HL	3	-$152,280	-$1,292,055	-
C3HL	4	$177,921	-$1,029,121	5.78
C3HL	5	$100,542	-$1,096,470	10.91
C3HL	6	$178,977	-$948,553	5.30
C3HL	7	$95,346	-$1,043,791	10.95
C3HL	8	-$105,217	-$769,241	-

Table 443. Stringency 3 Scenario 4 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$495,265	-$1,381,054	2.79
C5OL	2	$469,768	-$1,166,756	2.48
C5OL	3	$537,647	-$954,414	1.78
C5OL	4	$518,906	-$852,685	1.64
C5OL	5	$348,603	-$1,022,836	2.93
C5OL	6	$555,178	-$596,008	1.07
C5OL	7	$565,897	-$694,022	1.23
C5OL	8	$851,156	-$397,245	0.47

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C9A	1	$227,048	-$1,490,581	6.57
C9A	2	$828,032	-$637,610	0.77
C9A	3	-$35,589	-$1,151,175	-
C9A	4	$311,019	-$580,140	1.87
C9A	5	$837,844	-$742,692	0.89
C9A	6	$339,631	-$491,837	1.45
C9A	7	$187,977	-$206,268	1.10
C9A	8	$303,915	$264,768	-0.87
C3HL	1	-$247,981	-$1,324,543	-
C3HL	2	$302,345	-$1,018,747	3.37
C3HL	3	-$270,312	-$1,187,318	-
C3HL	4	$149,587	-$814,913	5.45
C3HL	5	$379,594	-$896,699	2.36
C3HL	6	$199,569	-$743,714	3.73
C3HL	7	$72,824	-$686,830	9.43
C3HL	8	$100,922	-$191,799	1.90

Table 444. Stringency 3 Scenario 5 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$279,066	-$1,328,080	4.76
C5OL	2	-$2,710	-$1,117,949	-
C5OL	3	-$32,788	-$1,106,159	-
C5OL	4	-$121,421	-$995,304	-
C5OL	5	-$145,515	-$1,017,044	-
C5OL	6	-$100,100	-$751,095	-
C5OL	7	-$233,440	-$879,661	-
C5OL	8	-$166,352	-$937,698	-
C9A	1	-$229,312	-$1,511,855	-
C9A	2	-$377,012	-$723,137	-
C9A	3	-$443,140	-$1,147,082	-
C9A	4	-$366,374	-$677,899	-
C9A	5	-$513,308	-$739,224	-
C9A	6	-$354,568	-$525,926	-
C9A	7	-$272,085	-$501,586	-
C9A	8	-$581,304	-$287,797	-
C3HL	1	-$523,513	-$1,175,787	-
C3HL	2	-$498,908	-$821,954	-
C3HL	3	-$552,739	-$927,974	-
C3HL	4	-$713,571	-$572,913	-
C3HL	5	-$440,213	-$653,237	-
C3HL	6	-$659,864	-$484,765	-
C3HL	7	-$700,340	-$412,293	-
C3HL	8	-$1,189,479	-$147,749	-

Table 445. Stringency 3 Scenario 6 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$279,066	-$1,328,080	4.76
C5OL	2	$171,049	-$1,117,949	6.54
C5OL	3	$142,617	-$1,106,159	7.76
C5OL	4	$52,506	-$995,304	18.96
C5OL	5	$27,595	-$1,017,044	36.86
C5OL	6	$68,458	-$751,095	10.97
C5OL	7	-$59,596	-$879,661	-
C5OL	8	-$6,630	-$937,698	-
C9A	1	-$234,879	-$1,511,855	-
C9A	2	-$140,409	-$723,137	-
C9A	3	-$366,819	-$1,147,082	-
C9A	4	-$289,873	-$677,899	-
C9A	5	-$278,779	-$739,224	-
C9A	6	-$277,950	-$525,926	-
C9A	7	-$195,716	-$501,586	-
C9A	8	-$350,059	-$287,797	-
C3HL	1	-$528,859	-$1,175,787	-
C3HL	2	-$485,037	-$821,954	-
C3HL	3	-$539,769	-$927,974	-
C3HL	4	-$700,231	-$572,913	-
C3HL	5	-$426,658	-$653,237	-
C3HL	6	-$646,073	-$484,765	-
C3HL	7	-$687,294	-$412,293	-
C3HL	8	-$1,036,319	-$147,749	-

Table 446. Stringency 3 Scenario 7 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$279,066	-$1,328,080	4.76
C5OL	2	-$2,710	-$1,117,949	-
C5OL	3	-$32,788	-$1,106,159	-
C5OL	4	-$121,421	-$918,178	-
C5OL	5	-$145,515	-$1,017,044	-
C5OL	6	-$100,100	-$682,622	-
C5OL	7	-$233,440	-$747,275	-
C5OL	8	-$166,352	-$626,201	-
C9A	1	-$229,312	-$1,301,331	-
C9A	2	-$377,012	-$649,957	-
C9A	3	-$443,140	-$917,831	-
C9A	4	-$366,374	-$486,378	-
C9A	5	-$513,308	-$679,967	-
C9A	6	-$354,568	-$368,269	-
C9A	7	-$272,085	-$436,969	-
C9A	8	-$581,304	-$287,797	-
C3HL	1	-$523,513	-$1,009,723	-
C3HL	2	-$498,908	-$763,724	-

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C3HL	3	-$552,739	-$744,993	-
C3HL	4	-$713,571	-$423,237	-
C3HL	5	-$440,213	-$605,775	-
C3HL	6	-$659,864	-$363,438	-
C3HL	7	-$700,340	-$360,696	-
C3HL	8	-$1,189,479	-$147,749	-

Table 447. Stringency 3 Scenario 8 BCR Results

Archetype	CZ	Lifetime Capex Delta	Lifetime Opex Delta	Stringency 3 BCR
C5OL	1	$291,185	-$1,363,132	4.68
C5OL	2	$50,085	-$1,166,641	23.29
C5OL	3	-$235	-$1,001,655	-
C5OL	4	-$35,213	-$953,827	-
C5OL	5	-$82,072	-$1,020,788	-
C5OL	6	$4,343	-$689,304	158.73
C5OL	7	-$152,967	-$768,581	-
C5OL	8	$141,189	-$616,840	4.37
C9A	1	-$186,852	-$1,341,567	-
C9A	2	$94,311	-$575,640	6.10
C9A	3	-$453,274	-$936,829	-
C9A	4	-$330,925	-$469,538	-
C9A	5	-$63,663	-$634,278	-
C9A	6	-$286,768	-$384,241	-
C9A	7	-$251,597	-$253,759	-
C9A	8	-$435,788	$66,235	-0.15
C3HL	1	-$646,965	-$1,054,324	-
C3HL	2	-$146,227	-$853,798	-
C3HL	3	-$498,121	-$792,038	-
C3HL	4	-$643,628	-$455,782	-
C3HL	5	-$89,929	-$708,387	-
C3HL	6	-$572,390	-$481,037	-
C3HL	7	-$649,409	-$308,213	-
C3HL	8	-$902,030	$123,708	-0.14