

Final Business Case Evaluation Summary

Cooler Classrooms – Tranche 1



September 2020

About this report

The purpose of this document is to summarise the Final Business Case (Business Case) for the Cooler Classrooms Program – Tranche 1 (the Program). The Program has been developed in order to meet the immediate needs of schools (Primary and Secondary) in highly affected, hot climate areas. The need is based on the relationship between the standard of learning facilities (i.e. thermal comfort) and the direct measurable impact that certain aspects of a learning environment can have on student learning outcomes.

The program sets out to improve the learning environment across schools in NSW which include thousands of learning spaces and libraries. This will be achieved through the installation of 'smart systems' that provide cooling, heating and fresh (outside) air.

The Business Case for the Cooler Classrooms Program - Tranche 1 has been initiated by the Department of Education (the Department) and was submitted to Government in October 2018. This Business Case Summary has been prepared by Infrastructure NSW, the Government's independent infrastructure advisory agency.

Strategic context

Improved efficiency and effectiveness of thermal comfort in classrooms and libraries could support better learning outcomes

Generally, government schools have been responsible for installing and maintaining their own air cooling system, which has resulted in existing systems ranging in size, type and quality. ¹As a result, existing air cooling equipment may not be efficiently and effectively supporting quality indoor environments.

Schools Infrastructure NSW (SINSW) estimates that between 30 and 70 per cent of existing air cooling equipment in NSW Government schools has reached (or is approaching) the end of its useful life and/or is not fit for purpose. Typical air cooling systems have an average service life of 10 to 15 years. As these system age, an increasing number of issues arise. These issues include:

- Diminished thermal comfort due to cooling or heating capacity or lack thereof
- Increased operation and maintenance costs.

In addition, around one third of the 40,000 permanent learning spaces²and libraries in NSW Government schools are not air cooled.

The Cooler Classrooms Program can overcome these challenges

The NSW Government announced the Program as part of the NSW 2018-19 Budget. As part of the announcement, it committed \$500 million over five years to install air cooling and mechanical ventilation systems in permanent learning spaces and libraries at up to 1,000 existing NSW Government schools.

The Government stated that the purpose of the investment was to improve learning environments for thousands of permanent learning spaces and libraries through the installation of 'smart systems' that offer heating, cooling, and fresh (outside) air to ensure students have healthy and comfortable environments to learn in³.

The Government committed to prioritising schools with the greatest need (based on mean maximum January temperatures) in metropolitan, regional and remote areas. These schools form Tranche 1 of the overall program.

Environmental sustainability is a key driver of the Program

Sustainability is a key focus of the Program to control energy usage and offset additional energy requirements through the installation of solar photovoltaic (PV) systems⁴. Demand management initiatives and, where feasible, energy storage in the form of batteries will be installed to reduce the extent and cost of electrical infrastructure upgrades and demand on the electricity network.

¹ The Department has installed and maintained air conditioning equipment in certain schools, such as some schools in hotter areas of the State, to support students with disability and for 'sealed schools' which require windows to be closed at all times.

² Permanent learning spaces are defined as built learning spaces (i.e. classrooms) for the purpose of this Business Case. This does not include temporary (i.e. 'demountable') learning spaces as these spaces are already airconditioned.

³ NSW Department of Education 2018, 'NSW Budget: Half a billion to air condition more classrooms'.

⁴ Ibid.

Options considered for Tranche 1 optimise delivery to NSW government schools in the State with high need

This Final Business Case presents the case for change, short listed options, options analysis and implementation for Tranche 1. The Program has been split into two tranches to allow sufficient due diligence to occur, prove the solutions and demonstrate value through de-risking, while balancing delivery to high priority schools as part of Tranche 1.

Due diligence is currently being undertaken across the wider NSW Government school system to determine the specific condition, fitness for purpose and remaining useful life of existing air cooling and heating equipment. The due diligence of schools with a mean maximum January temperature of 30 degrees Celsius or above was completed for priority schools in 2019.

This will effectively de-risk the Program by providing increased transparency and clarity around the state of existing air cooling and electrical infrastructure. This will underpin a prioritisation process and the development of Tranche 2.

A wide range of options were contemplated to address the service needs identified. Options considered all new and existing schools across NSW, a range of different spaces and combinations, and various factors that influenced the need for thermal comfort.

Project need

Improved efficiency and effectiveness of thermal comfort in classrooms and libraries could support better learning outcomes

NSW Government schools cover a large and geographically diverse area with vastly different environmental and thermal conditions. Air cooling systems are recognised as a key way to improve thermal comfort and the quality of indoor environments.

Around one third of the 40,000 permanent learning spaces⁵ and libraries in NSW Government schools are not air cooled. In this context, the need for investment in new air cooling and mechanical ventilation systems in NSW Government schools is underpinned by:

- Inadequate thermal comfort and indoor air quality, which may be limiting learning productivity and performance in NSW schools
- Existing air cooling equipment, which may have reached the end of its useful life and/or is not fit for purpose in many schools
- New opportunities to improve indoor environmental quality in NSW Government schools (in a financially and environmentally sustainable manner) through investment in 'smart' air cooling systems and electrical infrastructure.

International research recognises that the quality of learning environments influences learning outcomes. Numerous studies have found a significant difference in student test scores between high-and low-quality learning environments. In the majority of these studies, high quality learning environments have been shown to improve the academic performance of students by five to 10 percentage points⁶.

Thermal comfort (being temperature, humidity and air movement) and indoor air quality can significantly affect the quality of learning environments. A poor thermal environment can impact a student's ability to engage in activities that promote their understanding of concepts, build their problem-solving abilities and support positive attitudes towards learning⁷. Similarly, research indicates that indoor air quality in schools has a noticeable effect on learning performance and health, and that in a high concentration of airborne pollutants in the learning environment may increase the likelihood of illness and absenteeism in schools⁸.

⁵ Permanent learning spaces are defined as built learning spaces (i.e. classrooms) for the purpose of this Business Case. This does not include temporary (i.e. 'demountable') learning spaces.

⁶ Earthman, G. (2004), Prioritisation of 31 Criteria for School Building Adequacy.

⁷ Earthman (2004); Wargocki et al. (2007); Barret et al. (2015); Haverigen-Shaughnessy et al. (2015); Park (2017).

⁸ Ibid.

Project description

The Cooler Classrooms Program includes a \$500 million, five-year investment to improve thermal comfort and indoor air quality in up to 1,000 existing NSW Government schools. This investment will deliver air conditioning and mechanical ventilation systems in permanent learning spaces and libraries at schools across NSW.

The overall program consists of two tranches in total. Tranche 1 of the program is based on the Business Case referenced in this summary. An additional Business Case will be prepared for Tranche 2. The two tranches have been split up to include:

- Tranche 1. This tranche prioritises government schools in the hottest areas of NSW and applicants under the Cooler Classrooms Fund (for schools below 30 degrees Celsius)
- Tranche 2. SINSW will determine its approach to Tranche 2 in a second Final Business Case for Government consideration in the 2020 calendar year.

The purpose for Tranche 1 of this Program is to:

- Set out the urgent need to improve learning outcomes by improving thermal comfort and indoor air quality in permanent learning spaces and libraries in NSW Government schools, particularly in the hottest areas
- Seek approval for release of capital funding for Tranche 1 of the overall \$500 million five-year program.

Options identification and assessment

A broad range of options were considered

The Base Case or Business as Usual (BAU) was considered as maintenance of the air cooling / conditioning systems in existing schools, referring to a situation where:

- No new NSW Government investment is made in air conditioning or air cooling systems in existing schools in NSW; and
- Only regular maintenance is undertaken that is already in the budget.

Option 1 – New and existing Government schools: this option will maximise learning outcomes by improving the thermal comfort and indoor air quality in all government schools in NSW. New schools are expected to include appropriate measures to maintain thermal comfort and indoor air quality within the desired range therefore, including those schools would cause a duplication in investment (noting that this is already a requirement under the Educational Facilities Standards and Guidelines - which requires air conditioning to be installed in all permanent learning spaces and libraries for new schools and generally in all school buildings for new schools with a long term average mean maximum January temperature of 33 degrees Celsius and above).

Option 2 – All habitable spaces in all existing Government schools: proposed that all habitable spaces in all existing Government schools (approximately 2,200) would maximise thermal comfort and indoor air quality through the provision of air conditioning and mechanical ventilation systems. However, the scope of this option is well beyond the budget commitment (the initial Proof of Concept indicated a potential cost of circa \$5 billion). It may also not deliver value for money.

Option 3a – All habitable spaces in all priority schools: this option would address the service need of schools with a mean maximum January temperature of 30 degrees Celsius and above that require air condition and mechanical ventilation systems. This is estimated to be approximately 600 schools. This option incorporates all habitable areas within the priority schools. However, this may not be the most optimal way to prioritise funding to air-condition schools. Learning outcomes are most impacted by appropriate thermal conditions and indoor air quality in learning spaces, in comparison to other administrative and supporting facilities. Evidence suggests that students in Australia, on average, receive as many as 10,000 hours of compulsory instruction (mostly in permanent learning spaces) during their primary and lower secondary education⁹.

Option 3b – Permanent learning spaces and libraries in priority schools: this option will address the service need of schools with a mean maximum January temperature of 30 degrees Celsius and above that require air cooling and mechanical ventilation systems as outlined by the Policy. However, this option requires delivery of air cooling to 600 schools within the two-year timeframe of Tranche 1. In addition, this option carries deliverability risks as there may not be capacity within the air cooling market to deliver and install on such a scale.

Option 4a – Permanent learning spaces and libraries in priority schools with the highest need: this option will address the service need of schools with the highest need i.e. mean maximum January temperature at 30 degrees Celsius or above. However, it does not provide for a fund to allow schools with mean maximum temperature below 30 degrees Celsius to apply for funding to install air cooling and mechanical ventilation systems. Therefore, it will leave some schools at a disadvantage that do not have appropriate thermal conditions and indoor air quality due to other factors such as building design, humidity or air quality.

⁹ Education at a Glance (2014): OECD Indicators, "How much time do students spend in the classroom?", p.428.

Option 4b – Permanent learning spaces and libraries in priority schools with the highest need plus access to funding for schools with mean maximum January temperatures below 30°C: this option will address the service need of schools with the highest need with a mean maximum January temperature of 30 degrees Celsius and above. In addition, it provides for a fund to allow schools with a mean maximum temperature below 30 degrees Celsius to apply for funding to install air cooling and mechanical ventilation systems. Therefore, it will allow targeting schools that are most in need and at the same time deliver value for money by minimising risk and optimising learning outcomes.

Options were assessed according to budget commitment and criteria to prioritise schools

A number of considerations were assessed in order to short list the options, including:

- **Funding allocation** – the \$500 million program is to be delivered over five years, with a phased rollout in the first two years.
- **School areas to be covered** – the mandate of the Program is to deliver air cooling and mechanical ventilation systems in permanent learning spaces and libraries¹⁰.
- **Availability of fund** – schools with a mean maximum January temperature of below 30 degrees Celsius should have a fund accessible to apply for funding to install air cooling and mechanical ventilation systems where required based on the budget announcement.
- **Priority of need and value for money** – the priority of need will be based on schools that have the highest mean maximum January temperature, availability of existing air cooling systems, equity between regional and metropolitan areas, and the extent of required electrical infrastructure upgrades.
- **Availability of due diligence** – Due diligence is required to understand the current state as well as the extent of investment required in individual schools to ensure that funding is spent efficiently in areas of greatest need.

The underlying premise of the prioritisation criteria was to improve learning outcomes and the quality of the learning environment for as many students as possible in NSW. In alignment with the budget announcement, the following criteria applied resulted in Option 4b as the preferred option:

- The program will only cover existing Government schools in NSW (given that existing government policy provides for air-conditioning in new schools).
- Air cooling and mechanical ventilation systems will be provided in permanent learning spaces¹¹ and libraries.
- Schools with a mean maximum January temperatures at 30 degrees Celsius or above should be prioritised as these schools are well in excess of the optimal thermal conditions for learning¹².
- Access to funding will be made available, as per the budget commitment, for schools with a mean maximum January temperature below 30 degrees Celsius for schools where specific need can be demonstrated.

¹⁰ <https://education.nsw.gov.au/news/media-releases/nsw-budget-half-a-billion-dollars-to-air-condition-more-classrooms>

¹¹ As per the Proof of Concept, all existing demountable learning spaces are air conditioned.

¹² ANSI/ASHRAE (2017), Standard 55 – Thermal Environmental Conditions for Human Occupancy; Richard de Dear, Jungsoo Kim, Christhina Candido & Max Deuble (2015), Adaptive thermal comfort in Australian school classrooms, Building Research & Information, 43:3, 383-398, DOI: 10.1080/09613218.2015.991627

The outcomes of the option analysis

Of the long list of options, the following two options have been considered in further detail:

- Base Case – Business as usual (BAU).
- Option 4b – Permanent learning spaces and libraries in priority schools with the highest need plus access to funding for schools with a mean maximum January temperature below 30 degrees Celsius.

A multi-criteria assessment was undertaken on each of the options, which considered economic, financial, sustainability, risk, legislative and technical factors with results displayed in Table 1 below.

Table 1: Multi-criteria assessment

Criteria	Base Case	Option 4b
Risk Assessment	High	Medium
Social, economic and environmental sustainability	Somewhat meets	Largely meets
Technical standards and legislative requirements	Somewhat meets	Largely meets
BCR (Economic)	-	1.7

Option 4b was assessed to be the preferred option as a result of its ability to:

- Deliver significant economic value to NSW with a benefit cost ratio (BCR) of 1.7 by improving learning outcomes, productivity and earning potential of students through improved learning conditions and thermal comfort.
- Mitigate material risks. The base case risks such as limiting student potential through inadequate thermal and learning conditions was deemed to be higher than the risks of implementing Option 4b.
- Improve social and environmental sustainability by installing smart energy efficient technology and solar PV to minimise energy and emissions impacts.
- Comply with a range of technical and legislative standards.

It should be noted that Project Option 4b forms the basis of this Final Business Case to seek the release of funding to implement the Program's first two years (Tranche 1) to meet the immediate need of schools in the hottest areas only.

Economic evaluation

Cost Benefit Analysis

A cost benefit analysis (CBA) was undertaken in line with NSW Government Guide to Cost-Benefit Analysis (TPP 17-03). The analysis is based on a 15-year appraisal period and the expected life of the asset. In the absence of committed capital funding beyond the \$500 million funding envelope, the analysis only considers the costs and the benefits over the period of the asset life, and as a result terminal values have not been included.

The whole of lifecycle maintenance of the Program will be considered in alignment with the broader school asset planning horizon to ensure an appropriate management of long-term asset planning and budgeting result from the Program. Whilst Cooler Classrooms is a five-year Program, there will need to be ongoing maintenance as well as future capital expenditure as equipment reaches end of life beyond the 15-year asset life. A standard discount rate of seven per cent was used to express all costs and benefits in 2019 values.

Capital costs for Tranche 1

Based on a number of assumed rates and costs, and the target number of schools (around 275) for the first two years of the Program, the associated capital cost is associated with:

- Replacement and installation of reverse cycle air cooling and mechanical ventilation systems, solar PV and electrical infrastructure for schools with a mean maximum January temperature of at least 30 degrees Celsius.
- Replacement and installation of reverse cycle air cooling and mechanical ventilation systems, solar PV and electrical infrastructure for schools with a mean maximum January temperature below 30 degrees Celsius.
- Technical due diligence activities to assist in evaluating the current state of environmental conditions and existing air cooling infrastructure in all NSW Government schools.
- Program management activities.

Operating costs for Tranche 1

The operating costs of the Program relate to the incremental costs for schools with respect to the ongoing maintenance of the new air conditioners and solar PV systems. However, the funding requirement for the Program does not include these costs, which will be separately provided at a later date, through other funding arrangements within the Department.

Benefits analysis

The Program benefits have been assessed incrementally to the base case. The results of this analysis estimate that the Program could deliver economic benefits of increased lifetime earnings for students and avoided energy costs for schools. Overall, the Program will deliver a wide range of benefits, both qualitative and quantitative, to a number of stakeholders, as outlined in Table 2 below:

Table 2: Overview of qualitative and quantitative benefits

Benefit Recipients	Students	Staff	Economy & Community	Department of Education (incl. schools)
Importance	Increased comfort	Increased productivity	Increased uptake of renewable energy	Improved learning outcomes
Benefits	Improved health and wellbeing	Increased comfort	Improved energy efficiency	Increased staff and student satisfaction
	Improved student concentration and morale	Improved health and wellbeing	Increased awareness on energy efficiency and sustainability	Reduction in absenteeism (staff and students)
	Increased human capital formation	Increased job satisfaction	Improved societal outcomes	Avoided energy costs
	Improved learning outcomes	Increased awareness on energy efficiency and sustainability	Increase in Gross Domestic Product (GDP)	
	Increased awareness on energy efficiency and sustainability			
	Increased lifetime earnings			

- Qualitative
- Quantitative (Financial benefits)
- Quantitative (Economic benefits)

Deliverability

A traditional Procurement approach has been recommended for this project.

An outline procurement approach has been developed to shape the delivery of the Tranche 1 of the Program. The procurement approach is tailored to support the delivery of the Program's objectives and appropriately manage the delivery and program risks. A **traditional procurement approach is recommended**, which includes:

- **Early Works Package:** One or more early works packages, with Public Works Advisory (PWA) undertaking design and separate construction contract(s), to support early implementation.
- **Equipment Supply Panels:** The potential establishment of supplier panels to secure cost-effective supply of key equipment e.g. air cooling and solar PV equipment.
- **Managing Contractor (MC):** A Managing Contractor approach to the delivery of the project will be suggested. Further consideration is to be given to whether this will be managed by PWA or through a market appointment(s).
- **Separate Maintenance Arrangements:** All procurement activities will be undertaken in a manner which supports the effective contracting of ongoing maintenance activities. Maintenance contract(s) will be separate arrangements to the construction contracts.

SINSW is undertaking detailed due diligence on all NSW government schools. This includes an assessment of the current condition, fitness for purpose and remaining useful life of existing air cooling equipment. The work is being used to develop a preliminary assessment of scope of activities for the Program. For the purposes of the Early Works Packages, further detailed design development work will be undertaken to a level suitable to award a construction contract.

The Business Case includes a Risk Management Framework and Strategy

Risk management will be a critical factor for the Program's implementation and delivery of the expected benefits. Therefore, a risk management process for the Program has been established in accordance with the NSW Department of Education, Enterprise Risk Management Procedures and SINSW Risk Management Procedure.

The Infrastructure NSW view

Consistent with the NSW Government's Infrastructure Investor Assurance Framework¹³, Infrastructure NSW routinely assesses business cases and provides advice to Government on the efficacy of their findings.

Based on the announced level of funding of \$500 million, an assessment process was developed to identify, analyse and prioritise program options that meet this funding envelope.

Infrastructure NSW has found that the need for investment is well articulated through evidence based scientific studies and demonstrated alignment with Government policies. The options have been well considered and the chosen option is deemed appropriate.

The Final Business Case for Tranche 1 provided a cost benefit analysis (CBA) which demonstrated a positive Benefit Cost Ratio (BCR) of 1.7 for the preferred Option 4b. Sensitivity analysis continued to return a positive BCR at 1.1 for the worst-case scenario.

¹³ Infrastructure NSW (2016), *Infrastructure Investor Assurance Framework*.