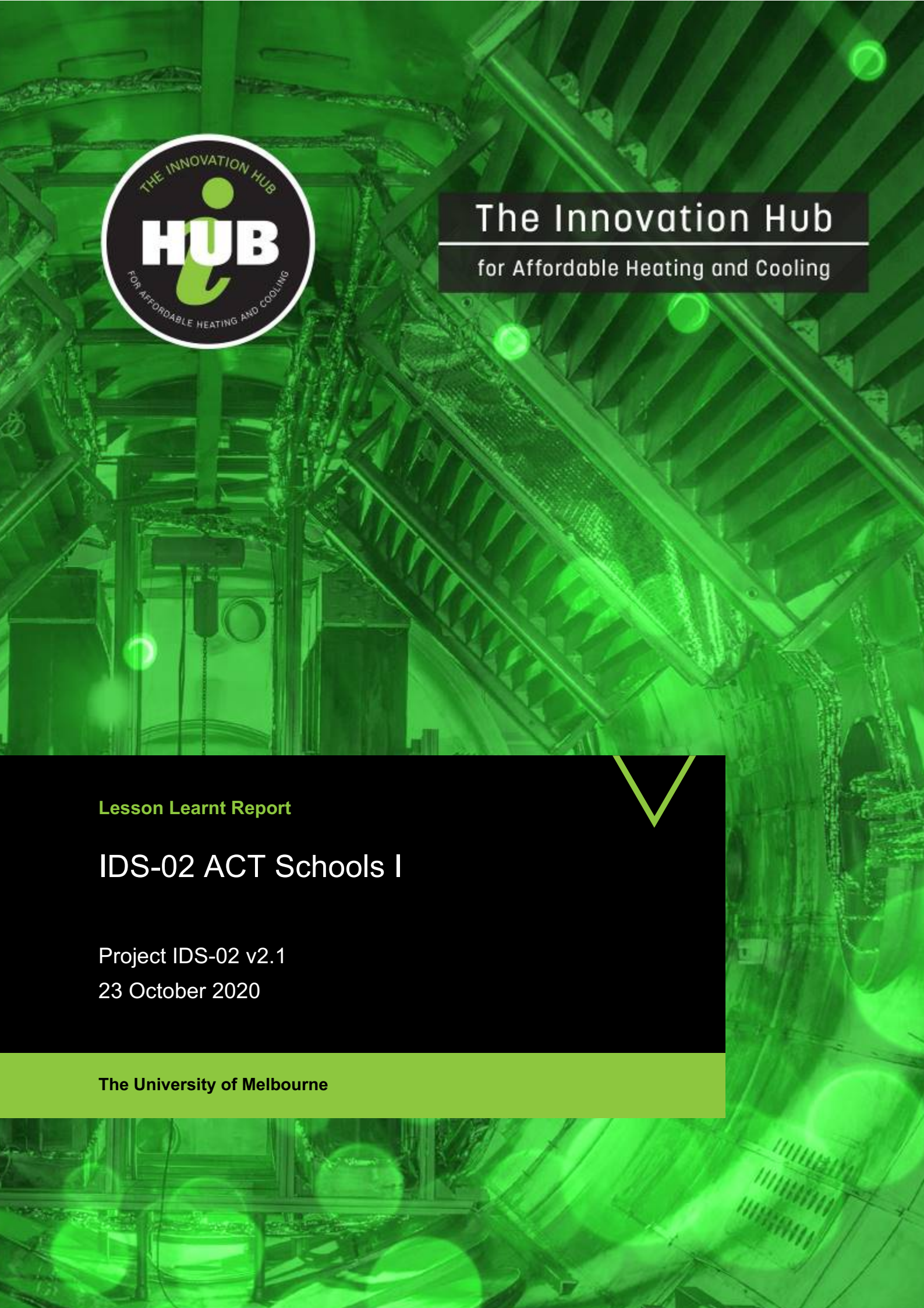


The Innovation Hub

for Affordable Heating and Cooling

Lesson Learnt Report

IDS-02 ACT Schools I

Project IDS-02 v2.1

23 October 2020

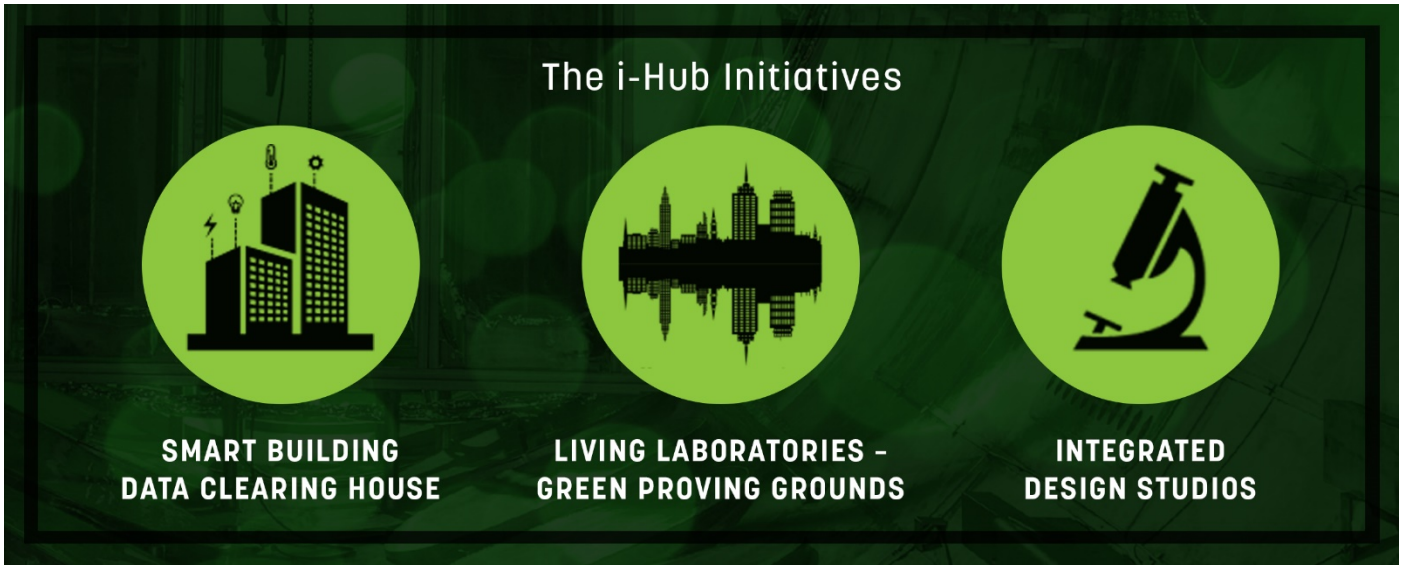
The University of Melbourne

About i-Hub

The Innovation Hub for Affordable Heating and Cooling (i-Hub) is an initiative led by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) in conjunction with CSIRO, Queensland University of Technology (QUT), the University of Melbourne and the University of Wollongong and supported by Australian Renewable Energy Agency (ARENA) to facilitate the heating, ventilation, air conditioning and refrigeration (HVAC&R) industry's transition to a low emissions future, stimulate jobs growth, and showcase HVAC&R innovation in buildings.

The objective of i-Hub is to support the broader HVAC&R industry with knowledge dissemination, skills-development and capacity-building. By facilitating a collaborative approach to innovation, i-Hub brings together leading universities, researchers, consultants, building owners and equipment manufacturers to create a connected research and development community in Australia.

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program.
The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.



i-Hub Lessons Learnt Report

Guidance notes for completion of the Lessons Learnt Report:

- This report is intended to be made public.
- Please use plain English, minimise jargon or unnecessary technical terms.
- Please use your organisation's branding for the report.
- The report should meet your organisation's publishing standards.
- Please use one template per each major lesson learnt and include as many as are relevant for your sub-Project. If what you learnt is more technical, this is the section to include technical information.
- The content of these Lessons Learnt Reports can be compiled (and updated, where necessary) for inclusion in the (public) Project Knowledge Sharing Report, for submission at the completion of your sub-Project.

Lead organisation	The University of Melbourne		
Sub-Project number	IDS-02		
Sub-Project commencement date	20th January 2020	Completion date	30th November 2020
Report date	23 October 2020		
Contact name	Brendon McNiven		
Position in organisation	Enterprise Professor (Architectural Engineering)		
Phone	0409 021 145	Email	brendon.mcniven@unimelb.edu.au

Note: This report builds upon the previous Lessons Learnt report provided at 50% studio completion (Studio Semester work currently 100% complete). Previous lessons have been refined/confirmed where required and further lessons added.

The purpose of the integrated design studios is to progressively learn more with each studio as lessons are incorporate into the studio format and tested. As such Lessons Learnt reports include a summary of applicable lessons learnt in previous studios (in greyed out format), with updates where added included in highlighted text.

Summary of relevant lessons learnt from previous IDSs.

(Refer to the 'Lessons Learnt' reports for studio referenced for more detail).

Category	Technical

IDS-01 #1	Good integrated design requires a 'design co-author' mindset in all participant designers.

Current design paradigms often place engineering as following architecture in the design process. This encourages a consulting type approach to the engineering where engineers are asked to comment on preformed ideas. Design integration can occur in this model however to a reduced potential with the initial ideation missing ideas founded in engineering aspects of the project. The studios found this consulting model to be difficult to break free from. Attention needs to be paid to create a mindset of 'design co-authorship' in all participants (engineers and architects alike). The reasons for this are not immediately clear however we believe may be related to:

- Potential deficiencies in creative thinking education in degree content.
- Established practices in industry (i.e. accepted established role as consultants).
- Early career stage (more experienced engineers were found to be better at ideation that younger engineers).
- Disparity in time available to be dedicated to studio ideation.

Lessons to be incorporated into future studios:

- Emphasise the concept of co-authorship in ideation more heavily.
- Aim for a better balance in numbers between architects and engineers.
- Aim for a better balance of seniority between architects and engineers (to encourage approachability and reduce fear of failure in putting ideas forward).
- Introduce common tasks at a detailed analysis level as well as the high aspirations level to encourage interaction between architects and engineers with common goals. This is anticipated to foster more detailed generation of ideas between the two disciplines.

IDS-01 #2	Integrated design happens over a limited time window.

In a 13-15 week design programme much of the front end is taken up with briefing and bringing design parties up to speed with each other's discipline (in general knowledge terms), the back end is conversely dominated by design development and documentation type activities. In-between these two general phases is a brief period when core design ideas are generated and formed. Once design ideas are formed it is difficult to materially change direction due to the momentum involved. Designers hold preconceptions after this initial ideation and the natural tendency is to adjust direction rather than to discard totally to start again. It is important to recognised when this ideation period is happening ensuring everything and everyone is in place to make it as successful as it can be.

Lessons to be incorporated into future studios:

In future studios more attention will be placed on this important ideation time. We may even give it a name so that the participants are aware of it and treat it with the degree of importance and priority it requires.

IDS-01 #3	Balance between architecture and engineering requires active curation.

IDS-01 took the approach of asking designers to approach the design from the two disciplinary extremes (architecture and engineering), from the beginning producing designs they felt represented each (ignoring the other). This approach emphasised the differences in the two approaches in designer's minds and articulated the prospects of needing to navigate the spectrum in-between the extremes in future design. Once equipped with this perspective it was easier for designers to understand that it is a balance between the two. Observations in the other IDS observed found that designers tended to follow the information in front of them without necessarily understanding the extents of the design spectrum.

This learning is a subset of the larger learning that active curation of the process is beneficial. There were conflicting opinions coming out of the interviews as to where this curation should sit. Some believed this should be the job of the architect, others believed a third party.

Lessons to be incorporated into future studios:
In future studios we will consider adjusting the integrated design process to encourage this exploration of the extremes between the two disciplines views of the project and also discuss where this curation role bests sits.

IDS-01 #4	There is a high level of excitement and buy in to the concept of integrated design.

A high level of excitement and buy in to the concept of integration was observed in all involved (demonstrated by studio popularity with students and keenness to be involved by participants). It is clear that the benefits are recognised. This may suggest that existing failures to follow a design integration path in industry occur as it is simply not an up-front agenda item.

Lessons to be incorporated into future studios:
Further work identifying the gap between practitioners and clients buy in, and the failure to see integrated design realised more in industry is worthy of further research. This will be covered somewhat by discussions in future studios.

Category	Logistics

IDS-01 #5	Extended time required in gaining agreement to contractual terms (due to unfamiliarity with research risk profiles by industry organisations).

Negotiation of terms and conditions took much longer than anticipated due mainly to industry partners being unfamiliar with risk profiles around research orientated projects. The main sticking point was unlimited liability with engineering consultants (architectural consultants were less concerned with this aspect of the contracts).

Lessons to be incorporated into future studios:
Next time around we will be a position to advise of terms previously accepted in other IDS's much earlier and should do this starting as early as possible and focusing on the engineering consultants.

IDS-01 #6	It was more difficult recruiting engineers to the integrated design process than architects.

We found that we had a much higher application rate on the architectural side than the engineering one.

Lessons to be incorporated into future studios:
Next time we would do more advertising with the engineers to articulate the benefits of taking up an integrated design studio. We would also tailor the subject to be a better fit (either a dedicated IDS 'elective', or a one semester design orientated core alternative), and open it up [as an elective to Mechanical engineering.

More up-front effort should also be applied in aligning the assessment criterion between architectural and engineering students as much as is possible.

New lessons learnt this IDS.

Lesson learnt IDS-02 #1	Technical Learnings applicable to Schools
	Note: This lesson is specific to Schools (the building typology used as a case study for IDS-02)

Category	Technical					
Choose from:	*Technical*	*Commercial*	*Social*	*Regulatory*	*Logistical*	*Other (specify)*

Describe what you learnt about this aspect of the Project.

As a part of the studio eleven individual design proposals were developed by architecture students, who advanced their ideas for two different ACT School refurbishment sites, over the course of a semester. These proposals reflect in-depth analysis of 'Net Zero' design approaches for School Refurbishments, and offered an array of solutions, tackling environmental design in different ways. Recognising the speculative and highly experimental nature of the design explorations the design process was coupled with a 6-8-week feasibility vetting process that took place after the studio's completion. Here, the collaborating consultants examined the students' proposals to scrutinise certain 'Net Zero' related technologies analysing bespoke solutions in greater detail and comparing with 'Business As Usual' approaches in School design. The findings of the vetting process have been incorporated into this report, and the full consultant vetting report has been appended.

Summary learnings School Design and Refurbishment Exploration

The eleven design solutions by students highlight the breadth of opportunities in the design and refurbishment of School projects in the ACT climate. Students embraced different aspects of environmental design both indoor, as well as outdoor, and they addressed these on refurbishment elements, as well as newly built components of their design. Selected key ideas that emerged were:

- Passive design measures as a key priority
  - Optimising the building envelope
  - Fixed and dynamic shading
  - Operable façade elements
  - Wintergardens and Green Roofs
- Active design measures as a key priority
  - Introduction of Rooftop Solar Panels
  - LED light fittings
  - Mechanical ventilation with heat recovery
  - Introduction of Heat Pumps (air source/ground coupled)
  - Shift from natural gas consumption to all-electric services strategies.

Consultant vetting of student projects, showed major opportunities for achieving Net Zero Carbon targets. Moving from a standard practice existing building to incorporating best practice initiatives results in Energy Use Intensities less than 40kWh/m^2.yr, with reductions in energy demand ~58% and energy consumption >52%. Further reductions expected to be realised through more effective control strategies such as daylight linking. Electricity generation from **onsite roof-top solar panels** would be predicted to exceed more than four times this amount. This indicates that there is a significant opportunity for the school to not only be net zero carbon in operation, but to be net positive energy in operation, with annual electricity generation exceeding annual consumption.

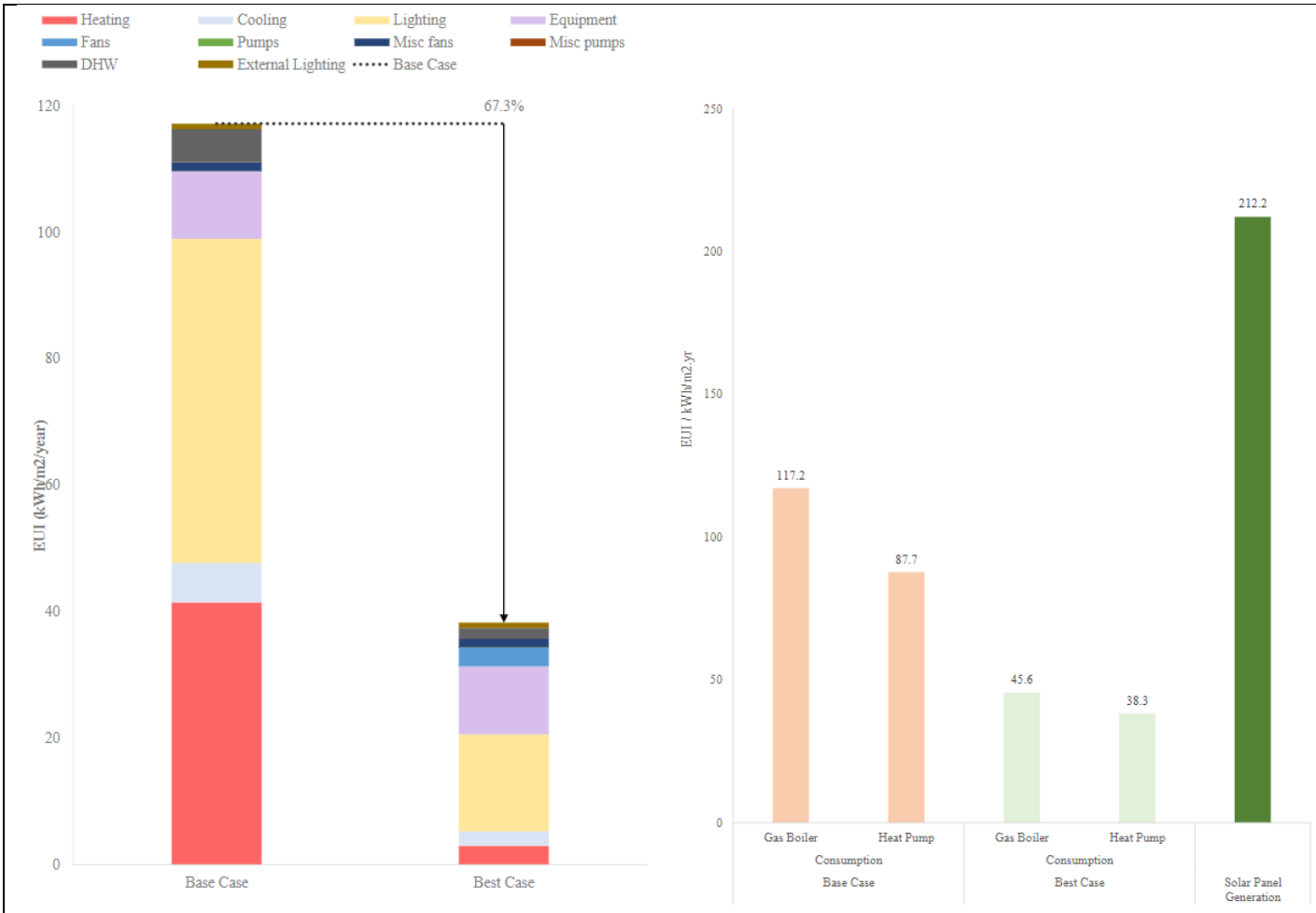


Figure 15 from Studio '100%' report: Energy Usage Intensities (Arup)

Please describe what you would do differently next time and how this would help. What are the implications for future Projects?
Future IDSs involving schools will use the findings of this IDS as a basis to progress from.
If your Project learnings have identified any knowledge gaps that need to be filled, please state it below.
Further refinement of approaches rather than gaps.
Please include any other information you feel is relevant or helpful in sharing the knowledge you learnt through this stage of the Project. This may be qualitative or quantitative and may include a graph, chart, infographic or table as appropriate.
Refer to Studio 100% report and Feasibility Vetting report produced by Arup for further technical detail.