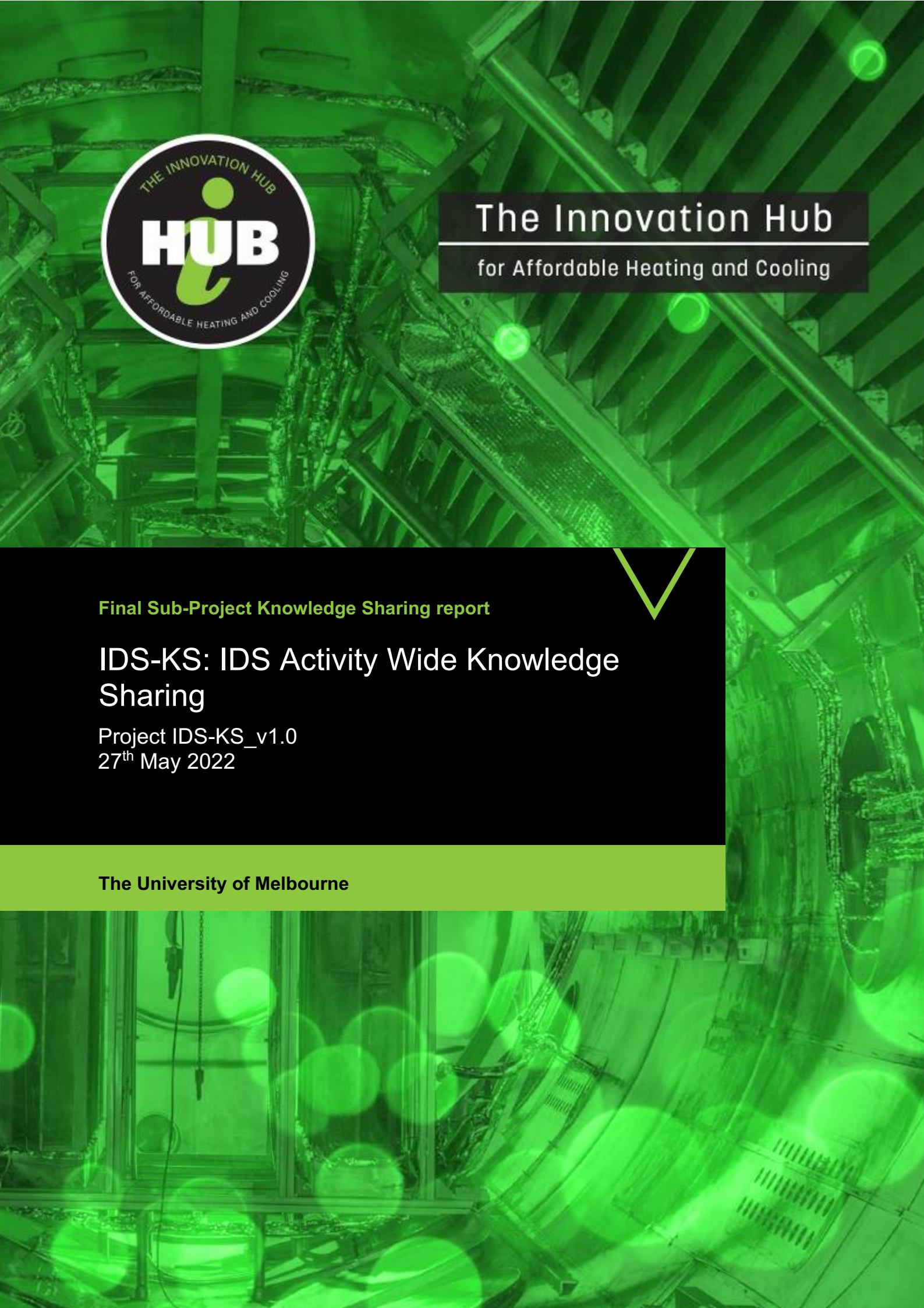


The Innovation Hub

for Affordable Heating and Cooling

Final Sub-Project Knowledge Sharing report

IDS-KS: IDS Activity Wide Knowledge Sharing

Project IDS-KS_v1.0
27th May 2022

The University of Melbourne

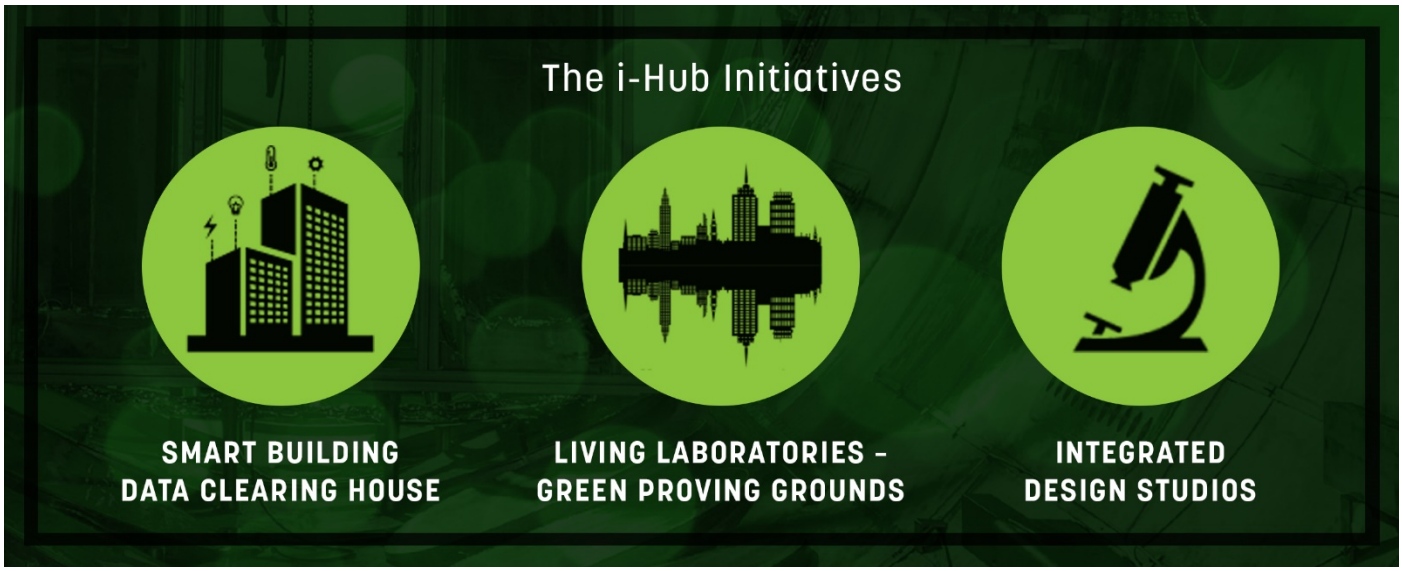
About i-Hub

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.

Primary Project Partner



Final Sub-Project Knowledge Sharing Report

This report is produced at the completion of each IDS sub-project and captures the breadth of activities and information produced in the sub-project including studio logistics. It makes use of cross referencing the individual reports produced in each sub-project rather than repeating information wholesale.

The 'i-Hub IDS-03 Design Studio outcomes report_100%_inc_Appendices' is intended to be the main technical learnings and outcomes report of interest to industry when shared publicly.

Lead organisation	The University of Melbourne		
Sub-Project number	IDS-06		
Sub-Project commencement date	1st July 2021	Completion date	27th May 2022
Report date	27th May 2022		
Contact name	Dr Dominik Holzer		
Position in organisation	Associate Professor in Digital Architectural Design		
Phone	0416 214 165	Email	dominik.holzer@unimelb.edu.au

Table of Contents

1. Report Context

This report is intended to summarise the full; i-Hub Integrated Design Studios (IDS) Activity Stream.

It is intended to be a first/main point of contact with the overall IDS activity stream providing high level summaries of outcomes etc., and importantly acting as a knowledge sharing road map providing links to the key reports and documents produced across the 14 studios undertaken.

2. Sub-Project overview, objectives and importance to market/industry

The overall objective of the integrated design studio activity is to examine how integrated design occurs on case study projects with outcomes on two fronts:

Enabling of Integrated Design

Significant cultural barriers exist in the design of sustainable buildings in relation to achieving the high technical performance required in tandem with the architectural building amenity desired. The root cause of many of these barriers is the relationship of the engineering and architectural disciplines in the design environment. The integrated design studio programme has been designed to study how to best overcome these barriers.

Much has been written on how to achieve integrated design and yet its realisation in practice is often ad-hoc or poorly executed. The integrated design studio programme tested best practice integrated design theory in practice by employing it in working design studios on case study projects. The process was refined through subsequent studios reflecting lessons learnt.

The focus of the studios was on mobilising both engineering and architectural input into the conceptual ideation stages of project formation. Net Zero design sits at the nexus of architecture and engineering and also fits well with AIRAH interests in affordable HVAC that reduces energy use and environmental impact, and ARENAs agenda of renewable energy. As such it provided the ideal studio focus with which to study how integrated design might best be facilitated. Concentrating on good design in the front-end design of projects creates maximum downstream impact:

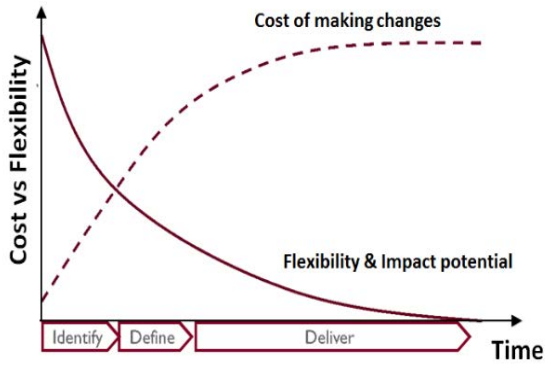


Figure 1: Decision value: opportunity with time.

The final refined integrated design process, incorporating learnings on implementation gathered through the studios, is outlined in the 'i-Hub IDS-KS Catalyst for Integrated Design' document (refer link in Section 6).

Building Typology Analysis around renewables and net zero carbon design

As the studios use case study projects to study integrated design, they also provide an ideal opportunity for building specific research. In line with the primary design focus building specific research on net zero carbon outcomes was generated.

Whilst not a complete or exhaustive industry wide study of different building typologies, the typologies examined (nine in total over fourteen different studios), contributes to a useful wider picture of net zero design. Net Zero design lessons on building typology groupings were able to be ascertained (simple buildings, complex building, and specialist buildings). These lessons and cross comparisons provide a useful starting point for clients and designers wishing to embark on net zero design. These lessons have been encapsulated in the more detailed reporting contained in 'Report on Combined Outcomes' link provided in Section 6.

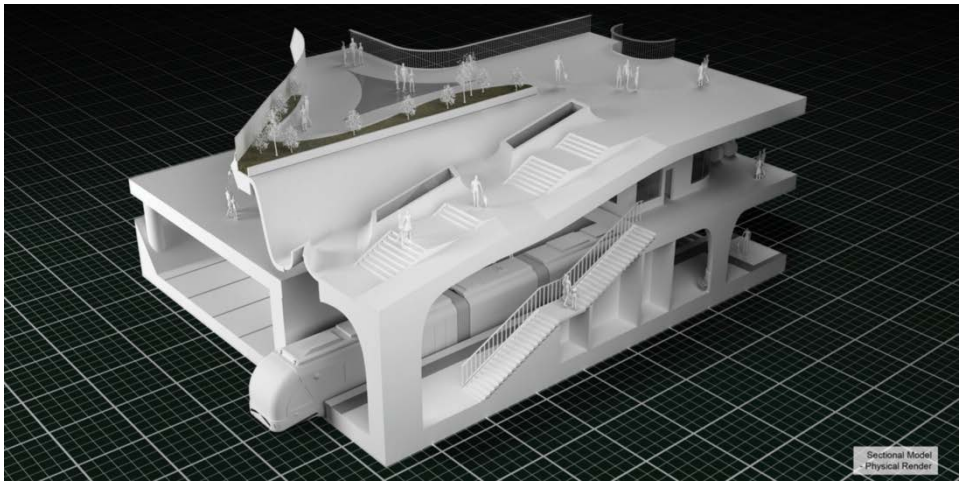


Figure 2: Example student designer work from IDS-06 Transport Buildings (Stations) – sectional modelling on Edithvale station, by Zhe Li, Fangyi Miao, Qi Zhang.

The following is a list of the individual sub-project studios that were undertaken along with the institution leading:

- IDS-01 Data Centres (UoM).
- IDS-02 Schools I (UoM).
- IDS-03 Schools II (UoM).
- IDS-04 Emergency Response Centres (UoM).
- IDS-05 Aquatic Centres (UoM).
- IDS-06 Transport Buildings LXRP (UoM).
- IDS-07 Aged Care I (UoM).
- IDS-08 Laboratories CSIRO (UoM).
- IDS-09 Multi-Purpose Buildings, (UoW).
- IDS-10 Aged Care II (UoW).
- IDS-11 Community Centres (UoW).
- IDS-12 Mixed Use II, (UoW).
- IDSs 13 & 14 Subtropical & Tropical Mixed Use (QUT).

- IDS-KS Cross Programme coordination and knowledge sharing (UoM).

3. Challenges/Limitations experienced and how these were overcome

The delivery of the IDS activity occurred largely in line with the original planning. Challenges/Limitations were experienced on two main fronts:

1) **Logistical delivery of the studios.** The main logistics issues related to COVID-19 restrictions. Impacts such as the need to instigate remote delivery and limitations on the number of engineering students that were able to be enlisted were encountered. The final impact of these factors was felt to be minimal and in fact resulted in additional learnings around the value of face-to-face delivery in comparison to remote.

2) **Differences between 'academic' and 'real world' design environments.** There were many advantages to carrying out the study on integrated design in an academic environment:

   - All participants were willing to be involved.
   - Participants were open in their assessment of the experiences.
   - Academics and research assistants were able to attend the large majority of the studios and were able to interact with the studio leader to analyse design progress and quality resulting in a deep level of learning.
   - The potential changes to program common in industry were able to be avoided.

   The main limitation of conducting the exercise in an academic environment was the relative inexperience of the student designers taking part. The technical inexperience of students was not considered to be a primary issue as it was reflective of designers in industry relative inexperience in the disciplines other than their own. Students' relative inexperience in design however along with softer collaboration skills may have had more of an impact. This effect was ameliorated through the support provided by the industry consultants and studio leaders taking part in the studios. A number of interesting learnings relating to the need to allow time for designers (student or industry), to gain a base level of understanding of 'others' disciplines before being able to design Integratively were gained.

Overall the studios ran well and the level of learnings gained from them are considered to be of high quality and to have direct applicability to design in industry.

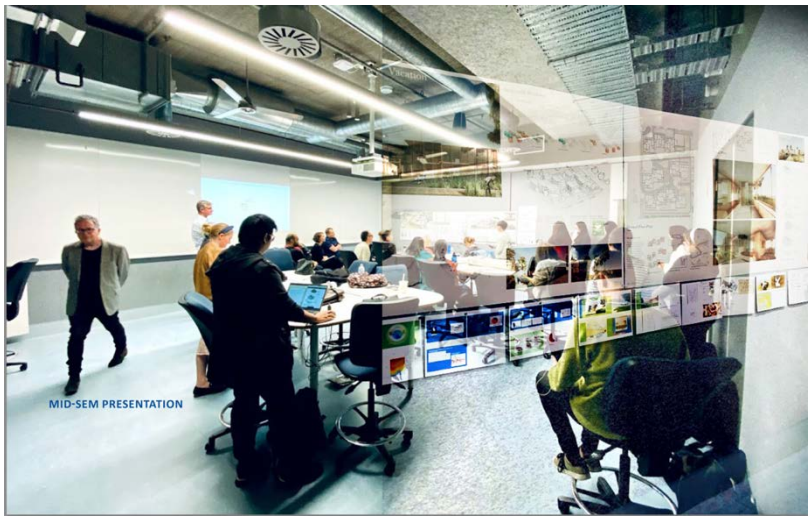


Figure 3: Integrated Design Studio IDS-07 Aged Care at work

4. Summary of lessons learnt and Main Conclusions

Valuable learnings occurred in both objective areas of the studios, on how to implement integrated design in industry, and also on evaluation of potential net zero technology solutions appropriate to the building typology used as a case study. Headline summary learnings are provided below:

Integrated Design Process

Known Theory in Integrated Design (initial process tested)

- Setting of common high level goals.
- Establishment of an environment and culture designed to foster creativity and innovation.
- Instil a design mindset that prioritises vision, intent, strategy and culture first.
- Balance individual and integrated approaches.
- Embrace design as open ended.
- Avoid focusing on detail too early.
- Maintain a flexible structure.

Additional learnings (enhancing and/or facilitating integrated design).

- Integrated design requires a 'design co-author' mindset in all participant designers.
- Integrated design ideation happens in a limited time window after designers reach a level of base understanding of the disciplines to be integrated.
- Integrated design benefits from active third-party curation.
- There is a high level of excitement and buy in to the concept of integrated design meaning simply articulating this as a project goal achieves some gains.
- Integrated Design Process - one size does not fit all.
- Establishing Integrated Design extremes (or discipline goal posts) helps.
- Precedent disparities exist in the working frameworks architects and engineers bring to projects.
- Experience levels of designers is an important consideration in integrated design.
- Architects and engineers have different preferences in communicating and engaging. Visual communication is the best universal language and is useful both for communication and as an analysis/collaborative thinking tool.
- Base level of understanding required in disciplines to be integrated before integration can happen effectively.
- Visual communication is the best universal language and is useful both for communication and as an analysis/collaborative thinking tool.
- An informed process of interrogation and iteration can assist in the process of integration
- Time pressures on delivery often negatively impact integration.
- An integrated design team is most effective in a comfortable space, encouraging innovation and experimentation, built on strong social connections.
- Materiality is a nexus of integration, drawing together architecture, structure/ construction, and sustainability.
- Face-Face interaction is an important factor in facilitating integrated design.
- Easily accessible software tools for interrogating technical performance is important to early design/integration process.
- Reminders of how the common goals established at the start of the process translate to outcomes throughout the design was beneficial.
- Multi-discipline design critiquing found to be important in facilitating integrated collaborative outcomes.
- Existing structural form restricts integrated design opportunities.
- Co-design is a terminology that needs clarification.

- Procurement methods can inhibit or support integrated design.
- Adopting integrated design principles from literature important.

For detail on the final iteration of the integrated design process refer to the Catalyst for Integrated Design document (link in Section 6).

Net Zero Carbon design of laboratory buildings

Significant potential energy reductions in demand from grid over BAU were identified across all of the building typologies with the exception of the data centres typology (due to the extremely large base loads involved in servicing core operations).

Reductions consisted of a combination of reductions in demand made through gains in operational efficiencies, and increases in generation through the use of on-site renewables.

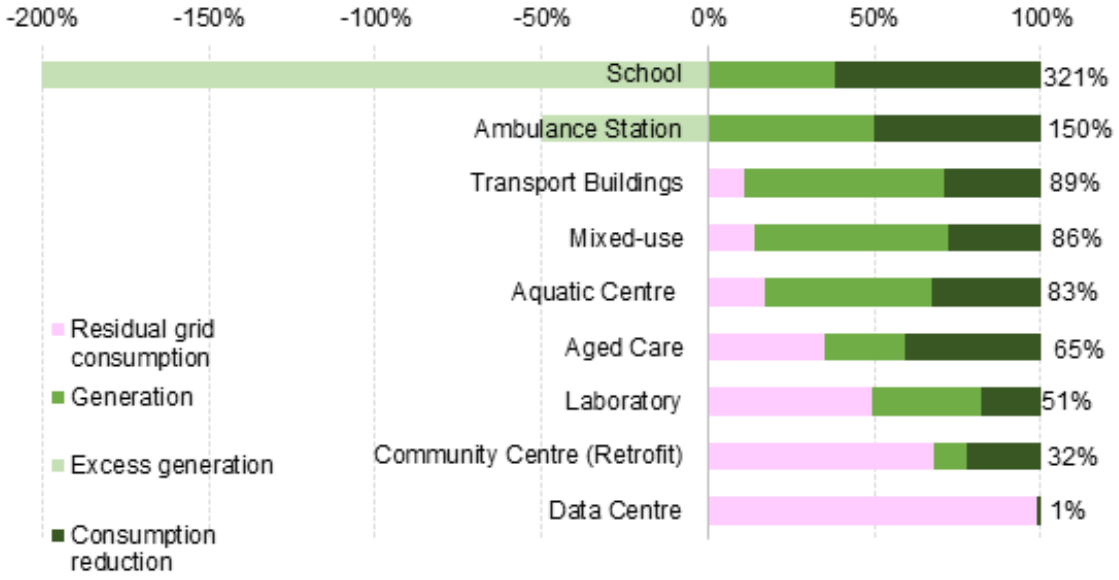


Figure 4: Summary of building typology' percentage grid demand reductions made through 'consumption reduction' and 'on-site generation' where (-) indicates more energy is generated than consumed by the typology. The total energy reduction (including energy use reduction and energy generation) is labelled on the right.

For the detail on the design methods and interventions made refer to the IDS-KS Report on Combine Outcomes (link in Section 8)

Embodied Energy/Carbon

Extending the scope of 'net-zero' further from operational energy to embodied energy, various studios interrogated embodied carbon against BAU. While not exhaustive across all studios, the studies carried out showed approximately on average 35% reductions. The currently broadly accepted ratio in buildings of a 50:50 split between embodied and operational carbon means that the savings are significant and worthy of attention.

Well-Being & Productivity

In addition to the energy and carbon savings identified through the studios, it was found that many of the design interventions made had positive impacts on occupant well-being and productivity. This was due both to the passive nature of some of systems adopted as well as consideration/response to stakeholders nature of integrated design overall.

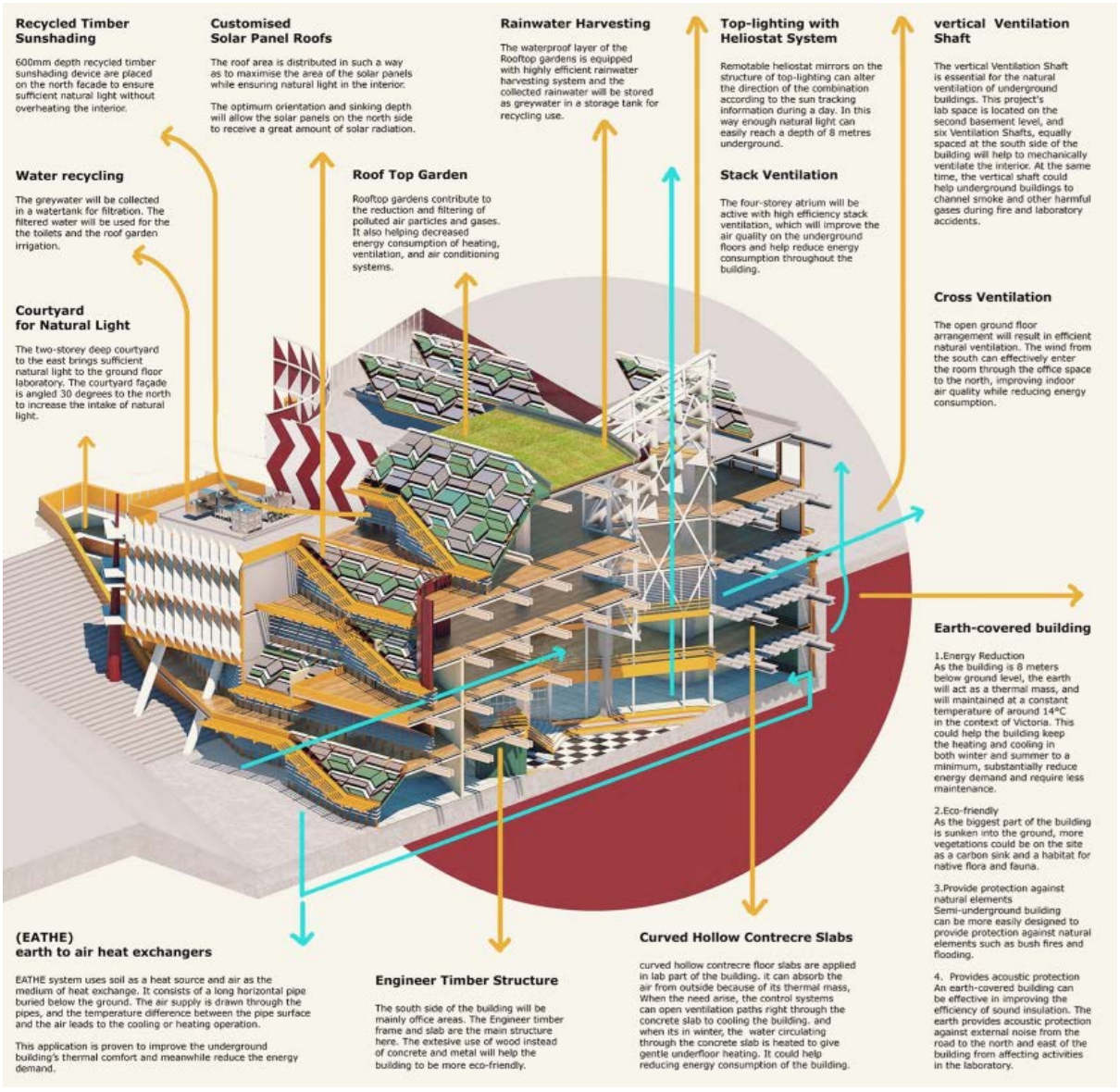


Figure 5: Example student designer work showing sustainability initiatives employed across the building (by Zirui Wang)

5. Evaluation of IDS program against envisaged activity and i-Hub wide outcomes and KPI's.

The following summarises the IDS activity stream performance against outcomes and KPI's envisaged at commencement of the i-Hub program of work.

IDS envisaged outcomes

Establish a standardised IDS facilitation process used to co-create new ideas for better integration of HVAC and renewable energy generation in building designs & Demonstrate technical and commercial value of the IDS process.

The IDS framework set up and proven suitable as a standard for implementation of further IDS's. All three institutions involved in the IDS activity are planning to continue the studios in a self-funded form demonstrating the inherent value they represent.

Conduct integrated design studio processes in relation to 14 buildings across a range of non-residential building types covering 7 sectors (or building typologies), with a focus on developing innovative whole-of-building approaches for reducing the cost of deploying renewable energy technologies and increasing the value of renewable energy produced. Facilitation of design charrettes, modelling exploration of alternative design strategies.

Fourteen IDSs were undertaken across nine different non-residential building typologies. The studios were led by a studio leader who convened establishment of design briefs and design development through charrettes across 14 week semesters. In line with the philosophy of integrated design, as many stakeholder opinions as possible were bought to the design table for input and participation in developing the designs. Systems thinking was employed in incorporating renewable energy into the building design and promoting its technical enablers, I.e. reducing the operational energy consumption of the building through both passive and active design measures, and then further reducing reliance on grid energy by introducing on-site generation through renewables, Design teams (including clients and consultants), were encourage to challenge norms and develop innovative solutions. Solutions were then vetted for feasibility by the engineering consultants (after completion of in-semester design work), to identify ideas worthy of being taken further, and the scale of the practical energy reductions that could be made to reach net zero.

Demonstrate technical and commercial value of the integrated design studio process such that it becomes adopted by industry and practitioners

Clients and consultants have seen value in studios. ACT Schools for example have commissioned further work using some of the studio analysis as a base, Ambulance Victoria have used it to inform internal policy and processes and it has helped initiate their first net zero prototype station under planning in Mallacoota. All three institutions have indicated intention to continue IDSs as a part of curriculum with industry prepared to provide support. The program will continue to identify clients who can benefit from the process and will also influence the way design happens in industry both through continued consultant involvement and also through student designers involved making their way into industry.

Match making to bring building owners together with a diverse mix of i-Hub member consultants, academics and graduate/undergraduate students

Different owner organisations involved in the studios were bought together with a diverse mix of consultants and academics including architects, engineers, and specialist technical subject experts. The diverse nature of the participants involved aided in studio ideation and many of the relationships formed have outlasted the duration of the studios in which they were formed.

i-Hub KPI's

The capability to reduce onsite energy use by at least 25% (compared to BAU), by improving the control of HVAC&R and renewable energy, is demonstrated within a selection of three building types, &,

The IDSs demonstrated significant grid demand reductions through combinations of consumption reduction as well as the provision of generation on-site through renewables. Reductions ranged from approximately 30% to 320% for the majority of typologies considered. The exception was the data centres typology which rated lowly (1-2%) on the basis of the extremely high BAU energy base loads required for core IT operations.

The capability of integrating HVAC load control with onsite renewable energy to significantly reduce peak demand (and demand charges) as well as increasing the hosting capacity of solar PV within the building or precinct is demonstrated within a selection of three building types.

On-Site generation through the incorporation of renewable energy technologies was a core focus for all the integrated design studios for all nine building typologies examined. Many renewable technologies were considered with photovoltaics and heat pumps being the two most feasible/practical solutions. Whilst not interrogated in detail (designs were to a conceptual level), many of the designs considered the daily energy demand cycle and the provision of battery storage technologies to smooth demand.

A pathway to 100 MW of available demand response potential (proven and demonstrated through iHub sub-projects) is identified within the broader iHub portfolio (including the broader portfolio of partners).

The BAU demand reductions and on-site generation opportunities identified across the various building typologies will contribute to achieving 100 MW of demand response if applied in scale across a large number of buildings. The IDS activity did not undertake detailed calculations in this respect due to the high level conceptual nature of the designs produced.

X number of industry professionals, Y number of building owners and Z number of university students have been encouraged and provided the tools to make integrated co-design a mainstream approach to deliver lower cost and higher performance buildings.

Each of the 14 integrated design studios involved an average of 16 masters level students, 1-2 representatives from building owner's organisations, and 5-6 industry professionals (architects and engineers). This equates to between three and four hundred individuals indoctrinated into the philosophy of integrated design.

The value of early assessment design software in facilitating integrated design was one of the learnings of the studios. Technical plugins to Rhino and other spreadsheet based or standalone platforms allowed designers from any discipline to interrogate and analyse the design to inform changes.

In a sign of the success of the studios a number of students have gone on to be employed by the consultants in the studios in which they partook and have been active in the integrated design space.

The benefits of early stage integrated design have been communicated to industry across 14 building projects

The benefits of integrated design approaches in improving energy and carbon outcomes while at the same time producing better designs overall was evident in the designs produced. Designs were generally well received by clients and in cases have already led to on the ground change (in ACT schools deciding to refurbish Forrest PS on the basis of low energy considerations, and Ambulance Victoria planning for their first net zero proto-type Ambulance station to be built in Mallacoota).

Presentations to industry have communicated the universal applicability of integrated design across any building typology, even data centres where the possibility of alternative community/council partnerships with synergistic facilities such as glass houses or aquatic centres was identified.

The Integrated design process is developed, documented, tested, released and refined for different building topologies.

The integrated design process was developed (tested & refined), through 5 successive tranches of integrated design studios. The process morphed from an academic paper format to a practical catalyst for integrated design document throughout the duration of the IDS activity.

The catalyst provides a generic design philosophy applicable to all building typologies (not just those examined in the studios).

Additional i-Hub envisaged Outcomes

Improve developer and building owner decision making capabilities by demonstrating the value of non-monetary benefits of energy productivity measures

The central idea in integrated design is the design that meets satisfies many functions at the same time. Responsible design in terms of the technical (energy reduction being a primary measure), is one outcome considered. Others include indoor air quality, user experience etc. Clients are involved in the studios with one of

the end goals being to demonstrate that technical benefits of reduced energy consumption can coexist with good architecture and user experience.

Identify new technologies that are able to contribute to the decarbonisation of commercial buildings over the next decade

The IDSs explore novel and new ways of integrating existing technologies into architecture, i.e. new ways of realising energy saving benefits of existing technologies. Using solar photovoltaics for shading in various configurations is a simple example of this, the many design solutions explored through the studios contain others.

Change the industry paradigm to make co-design a mainstream approach to deliver lower cost and higher performance buildings

This is a core tenet of the IDSs. The IDSs have been received well by industry and will continue in a self-funded form in all three institutions. The IDSs have demonstrated value in design outcomes (both in cost and performance), and have contributed to a growing industry wide discussion in this and related areas (such as regenerative design). A biennial symposium on integrated design has been mooted in Melbourne and is hopefully indicative of the changing mindsets around the value of integrated design approaches in the construction industry.

Industry professionals, building owners and university students actively participating in IDS subprojects

The IDSs were received well by students, clients (owners), and consultants alike. All three institutions involved in the IDS activity are planning to continue the studios in a self-funded form demonstrating the inherent value they represent.

Evidence to support the removal of risk-management barriers that prevent design consultants from providing innovative designs for their clients

The IDSs generated design ideas for clients that were able to able to move towards net zero that in many cases had proven problematic beforehand. Ambulance Victoria is a good example where demonstrated net zero feasibility led to the organisation's first net zero prototype facility currently planned for construction in Mallacoota.

Results from integrated design studios analysed and shared with industry

Material generated in the studios have been written up in reports that are now publicly available. In addition to the material produced as a part of the fourteen building specific studios, three journal papers, twelve magazine articles, three webinars, an industry symposium and seven speaking slot presentations as a part of industry conferences were undertaken.

Financial performance against budget

The IDS activity planning and operation was assisted by the fact that the studios had to be run in line with key semester dates. The overall activity revenues and costs were within 2% of budget.

The most significant delivery impacts to the studios resulted from Covid-19 restrictions. These necessitated delays in some instances (not material), and required delivery via remote technology rather than face-to-face means. Travel restrictions represented the largest of the impacts with the result that site visits were unable to be made. The corresponding reduction in planned travel expenses represented the majority of the financial underspend observed.

6. Links to Key reports

The following reports were produced for public sharing as a part of or in relation to IDS-KS and the wider IDS activity stream. Click on documents to be linked to publicly available copy.

Key Activity wide key documents of interest:

- **i-Hub IDS-KS Catalyst for Integrated Design :** Live integrated design methodology document (updated with learnings from each successive IDS).
- **IDS-KS Report on Combined Outcomes** : Detailed report on IDS activity wide outcomes. Summarises findings from each of the fourteen IDSs and incorporates **'The Carbon Catalogue'** which provides comparisons and guidance on current best practice net zero design for the different building typologies, and their groupings (simple buildings, complex buildings, and specialist buildings).

Other activity wide documents:

- **i-Hub IDS-KS Lessons Learnt Report :** Consolidated report of lessons learnt across all studios (Technical and logistical).

Other activity wide material of interest:

- **IDS-KS JP01-CREATING INTEGRATED DESIGN IN AN ACADEMIC ENVIRONMENT: PROCESS AND A METHOD** : Journal paper manuscript – note: not accessible publicly until published due to Journal IP restrictions. Link available on request once published.
- **IDS-KS JP02- IDS: An integrated design approach for architect/engineer education using Zero Carbon targets** : Journal paper manuscript – note: not accessible publicly until published due to Journal IP restrictions. Link available on request once published.
- **IDS-KS JP03- Lessons from Integrated Design Studios focusing on Zero Carbon** : Journal paper manuscript – note: not accessible publicly until published due to Journal IP restrictions. Link available on request once published.
- **IDS-KS MA01 What are we doing about integrated design:** PDF of published article in Ecolibrium August Issue.
- **IDS-KS MA02 Building Performance Attributes:** Article content (pending publishing).
- IDS-KS MA03 Urge to Merge PDF published article in Ecolibrium May 2020 issue.
- IDS-KS MA04 Interesting Tension PDF published article in Ecolibrium Jun-July 2021 issue.
- IDS-KS i-hub summit recordings : Recordings of the four integrated design webinars (I-IV), undertaken over the course of the IDS activity stream.
- IDS-KS Integrated design Symposium : Recordings of the symposium that took place over three days October 25-27th 2021.
- "Architects and Engineers Declare" Integrated Design Symposium panel participation held December 2021.
- I-Hub Outcomes Symposium: 17th May 2021 (note: link to symposium flyer, full transcription still to be uploaded)

Individual IDS studio materials:

Following links to studio home pages on i-Hub website containing the following detailed individual studio reports for each of the fourteen studios:

- **Design Studio outcomes report_100%**: Main detailed technical learning/outcomes report produced for each studio. Includes selected student work, consultant feasibility vetting report etc.

- **Studio Lessons Learnt Report :** Detailed lessons learnt (Technical and logistical), for each studio.
- **Studio Final Sub-Project Knowledge Sharing Reports :** Individual knowledge sharing reports produced for each studio.

  IDS-01 Data Centres (UoM).
  IDS-02 Schools I (UoM).
  IDS-03 Schools II (UoM).
  IDS-04 Emergency Response Centres (UoM).
  IDS-05 Aquatic Centres (UoM).
  IDS-06 Transport Buildings LXRP (UoM).
  IDS-07 Aged Care I (UoM).
  IDS-08 Laboratories CSIRO (UoM).
  IDS-09 Multi-Purpose Buildings, (UoW).
  IDS-10 Aged Care II (UoW).
  IDS-11 Community Centres (UoW).
  IDS-12 Mixed Use II, (UoW).
  IDSs 13 & 14 Subtropical & Tropical Mixed Use (QUT).

  IDS-KS Cross Programme coordination and knowledge sharing (UoM).

Magazine Articles for each building typology:

- **Data Centres - Union Specific** published Spring 2020 edition Ecolibrium.
- **Aged Care - Low Energy Design** PDF published article in Ageing Agenda Nov-Dec 2021 issue
- **Schools - Zero Carbon, Maximum Learning** submitted for publication to Ecolibrium.
- **Emergency Response Facilities – Emergency** submitted for publication to Ecolibrium.
- **Aquatic Centres – The Challenge of Zero Carbon for Aquatic Centres** submitted for publication to Ecolibrium.
- **Laboratories – Researching Sustainably** submitted for publication to Ecolibrium.
- **Transport Buildings – Sustainable Stations** submitted for publication to Ecolibrium.
- **Community Centres - Helping to build a greener future, together.** Published in Wollongong City Council Newsletter 7/Jan/2022.
- **Mixed Use - Applying an integrated design approach to improve the match between renewable energy supply and building energy demand**. Article to be published in July/Aug 2022 edition of Green Review magazine.

Figure 6: Students conducting site visit and energy audit of ACT schools IDS-02.

7. Conclusions and What Comes Next

A significant volume of material and knowledge was produced across the fourteen integrated design studios that were undertaken. Valuable lessons in how to facilitate integrated design theory in practice in industry were gained and now exist in the 'Catalyst for Integrated Design' document produced.

In addition to this an array of net zero technical design learnings were amassed across a number of building typologies (nine in total), and were then distilled to practical best practice guidance across three typology groupings (simple building, complex buildings, and specialist buildings). These have articulated in the 'Carbon Catalogue' produced as a part of the 'Report on Combined Outcomes').

The IDSs largely achieved what they set out to do. While they cannot claim to have instigated the current ground swell of discussion and activity being observed around integrated design and its related fields, in industry, it has definitely given it a large push and has also contributed significantly to the amount of guidance material available on the subject.

What's next?

A strong degree of knowledge sharing also occurred as a part of the IDS activities. The three institutions are keen to see the work produced continue to be disseminated amongst industry, and for the knowledge gained to be employed in assisting integrated design to gain traction. In this light the IDS proponents will:

- Continue to publicise the 'Catalyst for Integrated Design' document encouraging building owners and industry groups to adopt principles of integrated design in the procurement of projects.
- Further articulate and publicise the 'Carbon Catalogue'. This document has the potential to be a stand-alone document providing guidance on where to start with net zero design.
- Continue to take part in industry discussion around integrated design and its related areas (regenerative design etc). As a part of this further integrated design symposiums have been mooted perhaps on a biennial basis in Melbourne.
- Continue to support the development of an 'inner circle' of integrated design interested people in Melbourne and potentially nationally. Interest in being a part of this industry group has already been shown by Swinburne, Monash, Victoria and Deakin universities as well as by a number of passionate integrated design individuals from various architectural and engineering consultants. The ultimate realisation of this may be the formation of an integrated design industry body.
- All three institutions involved in i-Hub (The University of Melbourne, The University of Wollongong, and Queensland University of Technology), have indicated forward plans to continue the integrated design studios in a self-funded form.
- Further dissemination through involvement in IEA Annex 80, an international energy research programme in the buildings and communities field with the objective of providing resilient cooling of building.

It is envisaged that opportunities for further work in the net zero field to be carried out will continue to arise as government and private industry grapple with meeting zero carbon targets. The work produced in the integrated design studios places those involved in it in a strong position to partake in these opportunities to further the net zero cause.

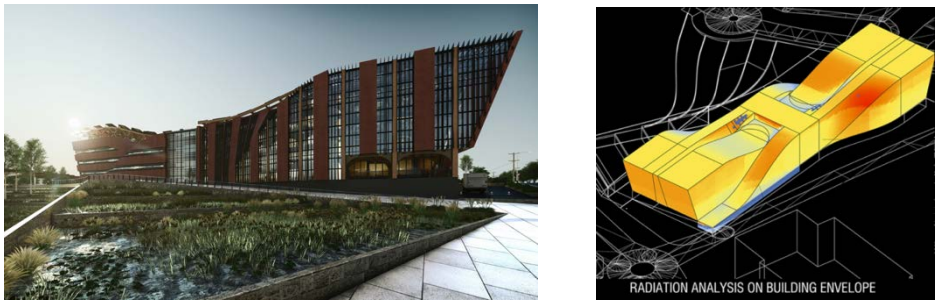


Figure 7: Example student designer work from IDS-08 Laboratories (by Frank Guo)