Co-funded by
the European Union

ARCH4CHANGE

Digital climate change curriculum for architectural education: methods towards carbon neutrality ▶▶

ELIZABETH DONOVAN
ED@AARCH.DK

To **co-create an architectural 'climate emergency' curriculum** that is fit for the new decade, in which society faces **unprecedented challenges** related to mitigating and buffering the effects of the climate crisis, underpinning the transition towards a carbon neutral society.

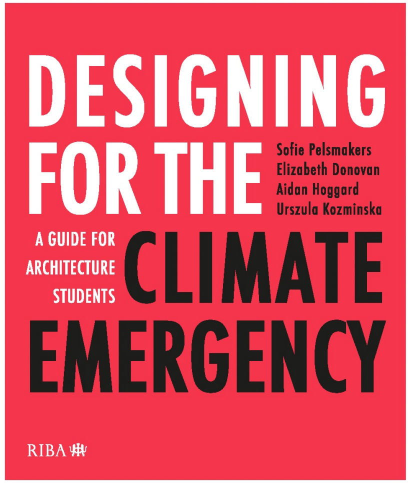
ARCH4CHANGE

- BRINGING CLIMATE CHANGE KNOWLEDGE INTO THE DESIGN STUDIO - focus on integrating sustainability approaches in design-courses.
- HOLISTIC: not JUST about carbon, but about high standards in ALL sustainability aspects.
- INCLUDES climate change ADAPTATION, CLIMATE JUSTICE and GLOBAL RESPONSIBILITY ISSUES as part of architect’s role

CHANGING how we THINK ABOUT and TEACH sustainable architecture

ARCH4CHANGE

1. Going **beyond basic and fragmented sustainability knowledge** in architecture.
2. **TACKLING SKILLS GAPS** for (and with) both architecture students and teachers through a radically changed architecture curriculum, and co-developing a teacher training toolkit.
3. **TESTING NEW AND INNOVATIVE DIGITAL PEDAGOGIES** to strengthen and change teaching and learning approaches.
4. **BROADENING ACCESS TO THE KNOWLEDGE AND TOOLS** via a digital platform.

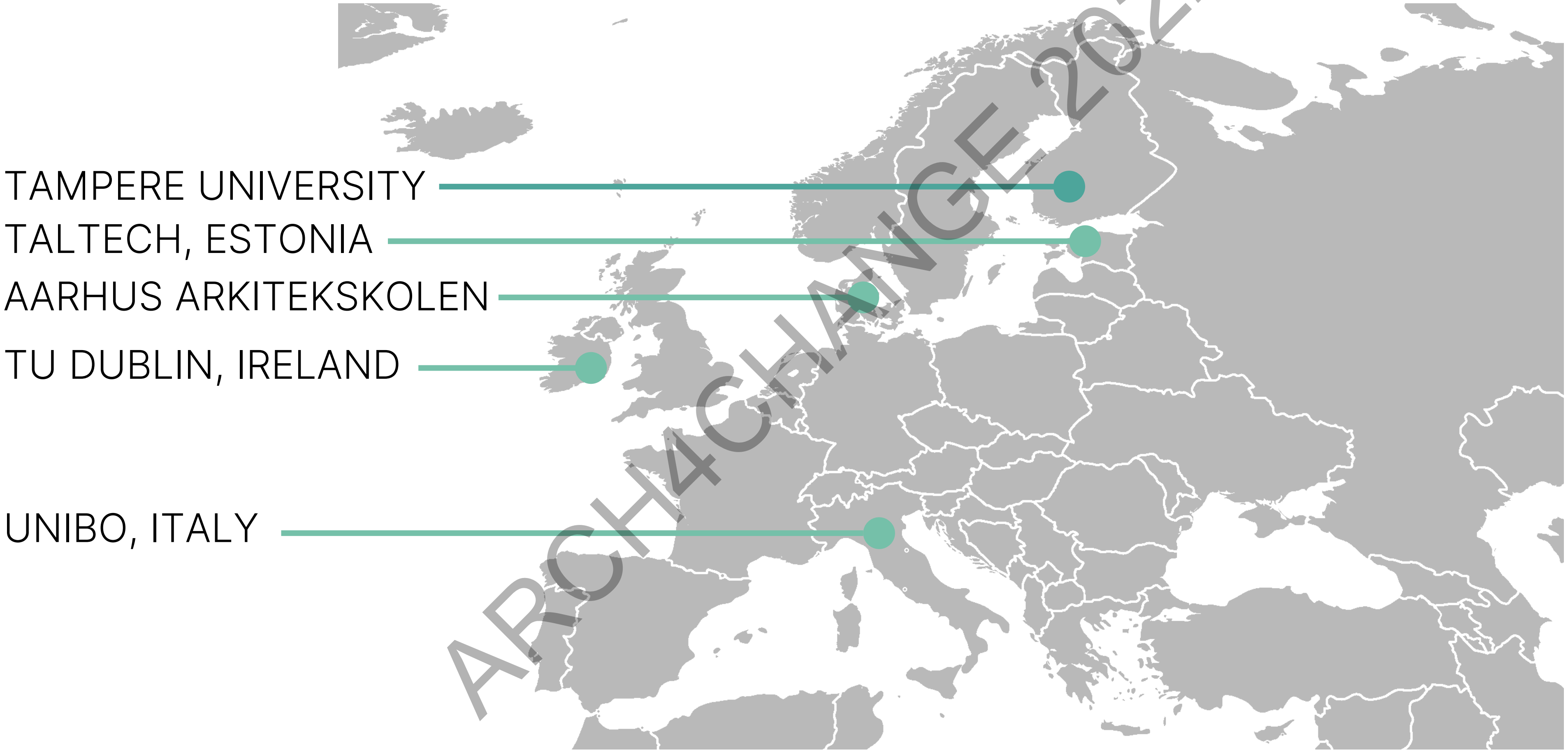


"We must make an urgent shift in the values we hold, and how and why we do things. There is no room for error.

Instead of seeing things as alarmist or an attack on our creative pursuits, it requires determination, conviction and optimism to trust that we are part of the solution, not the problem. **And it requires more, not less, creative thinking**."

ARCH4CHANGE

PARTNERS
EUROPEAN CONSORTIUM



ARCH4CHANGE

ADVISORY BOARD

- ACAN Education (Architects Climate Action Network, UK)
- Sergio Altomonte, UCLouvain La Neuve, Belgium
- Donata Bigazzi, Rimini municipality, Italy
- Selma Harrington, Architects Council Europe, Ireland
- Henna Helander, SAFA (Architects Association Finland)
- Aidan Hoggard, Sheffield University, UK
- Ivan Sergejev, Estonian Ministry of Economic Affairs and Communications, Estonia
- Walter Unterrainer, Chalmers University, Sweden

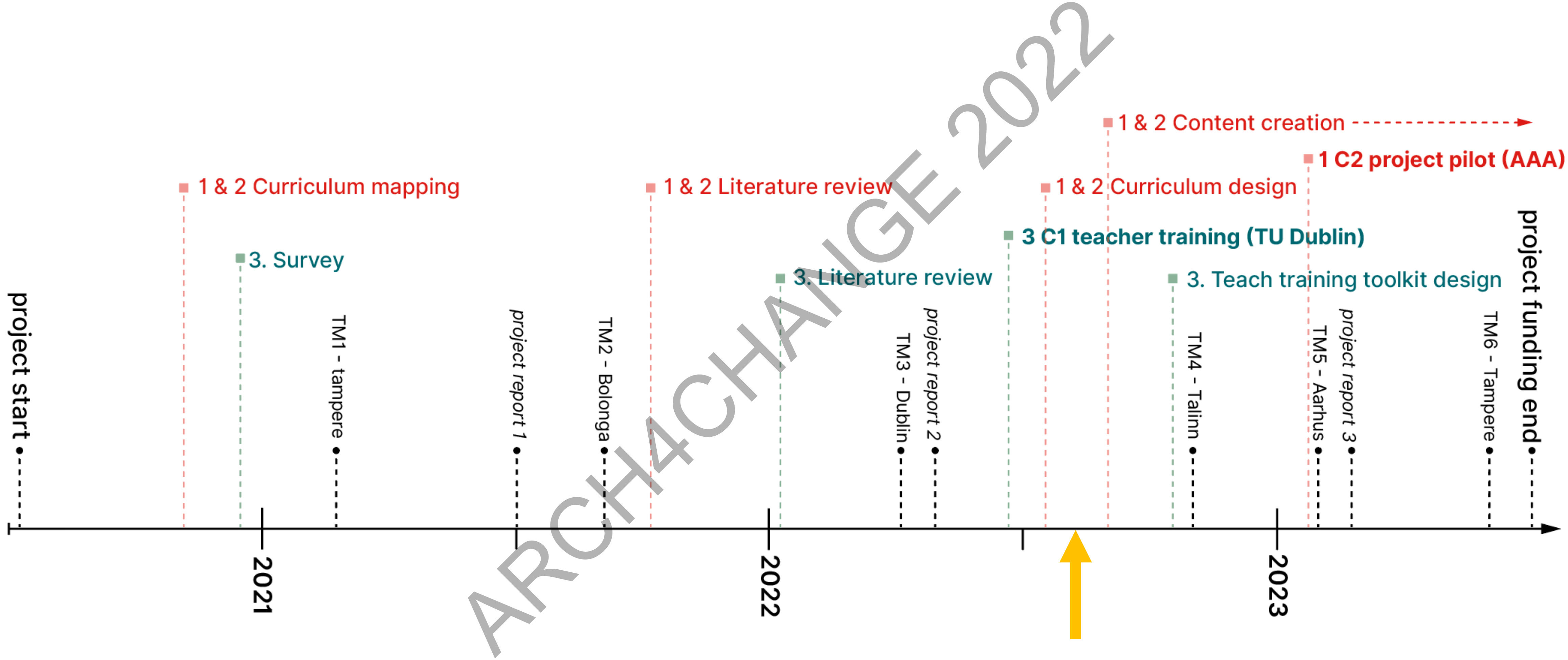
ARCH4CHANGE

PROJECT OUTPUTS & WORK PACKAGES

1	2	3	4	5
CLIMATE CHANGE ARCHITECTURE CURRICULUM *UNDERGRADUATE STUDENTS*	**CLIMATE CHANGE ARCHITECTURE CURRICULUM** *MASTERS STUDENTS*	**TEACHER TRAINING TOOLKIT** *DIDACTIC METHODS*	**STUDENT, EDUCATOR AND STAKEHOLDERS** *FEEDBACK AND PERSPECTIVES*	**DIGITCAL PLATFORM** *FOR ARCHITECTURAL EDUCATION*
AAA, DENMARK	TAMPERE UNIVERSITY, FINLAND	TU DUBLIN, IRELAND	UNIBO, ITALY	TALTECH, ESTONIA

ARCH4CHANGE

PROJECT TIMELINE



ARCH4CHANGE

A.
CURRICULUM
CONTENT (BA/MA)

B.
CLIMATE
EMERGYENCY
BASICS & UNSDGS

C.
TEACHER TRAINING
TOOLKIT

TEACHER TRAINING TOOLKIT

DIDACTIC METHODS

A.
STUDENT / TEACHER SURVEY

B.
LITERATURE REVIEW

C.
TEACHER TRAINING EVENT

D.
PEDAGOGICAL CASE STUDIES

SURVEY AIMS AND OBJECTIVES

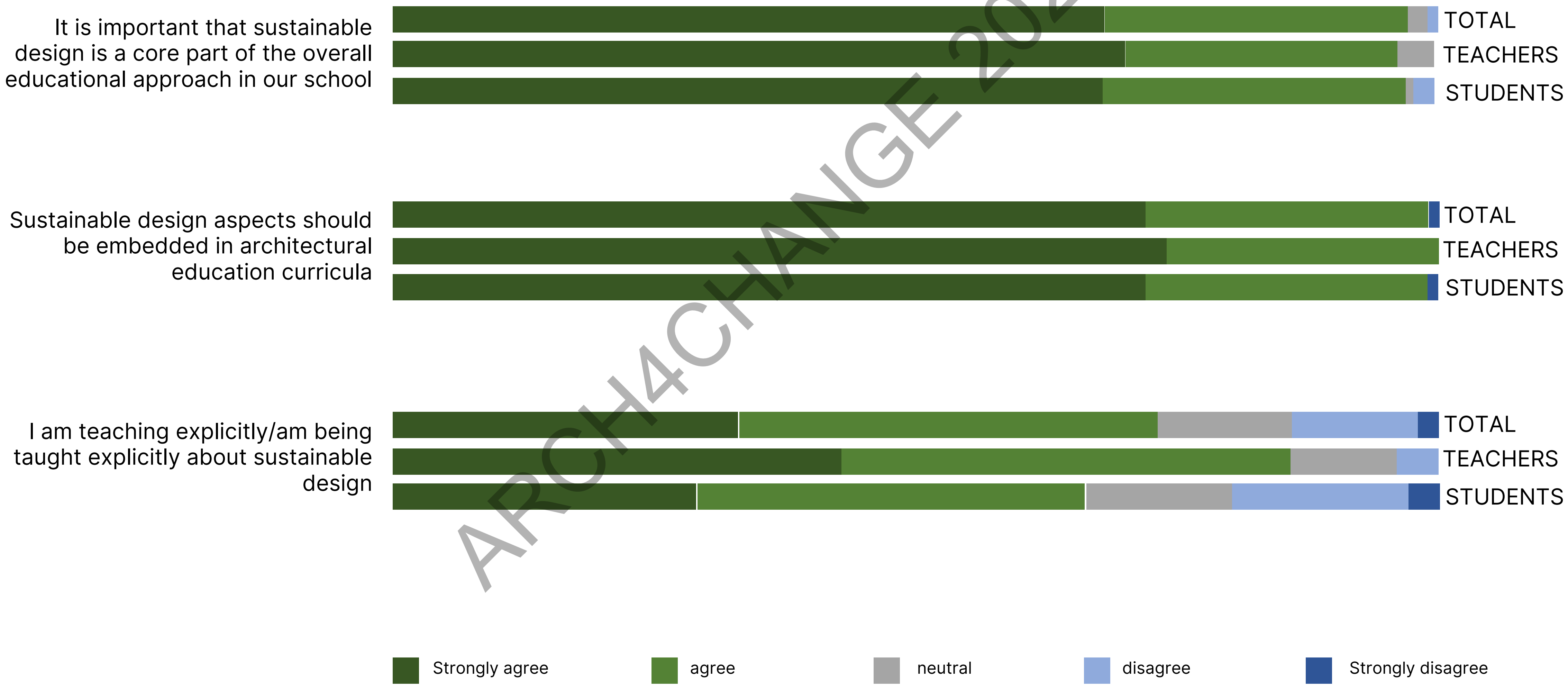
The aim of the survey was to gather an overview of how sustainable architecture is taught at the partner universities, what content is covered and how it could be improved in the future

26 questions gaining insight into the existing experiences and future wishes from students and educators concerning integrating sustainable architecture into education frameworks

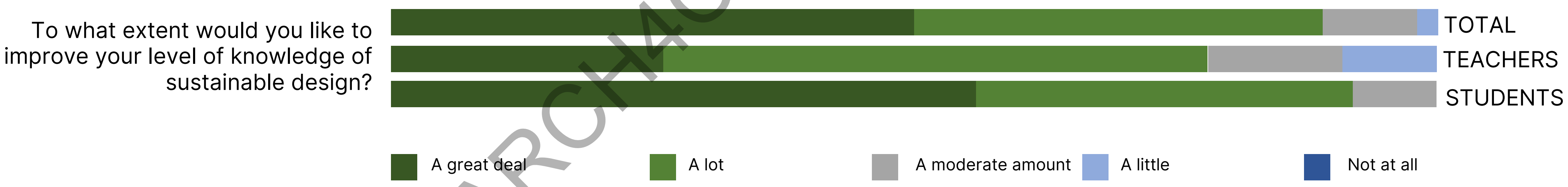
Roughly 530 responses from students and educators from the 5 partner institutions (2021)

Specific for AAA, completed by 101 (78 students and 23 staff)

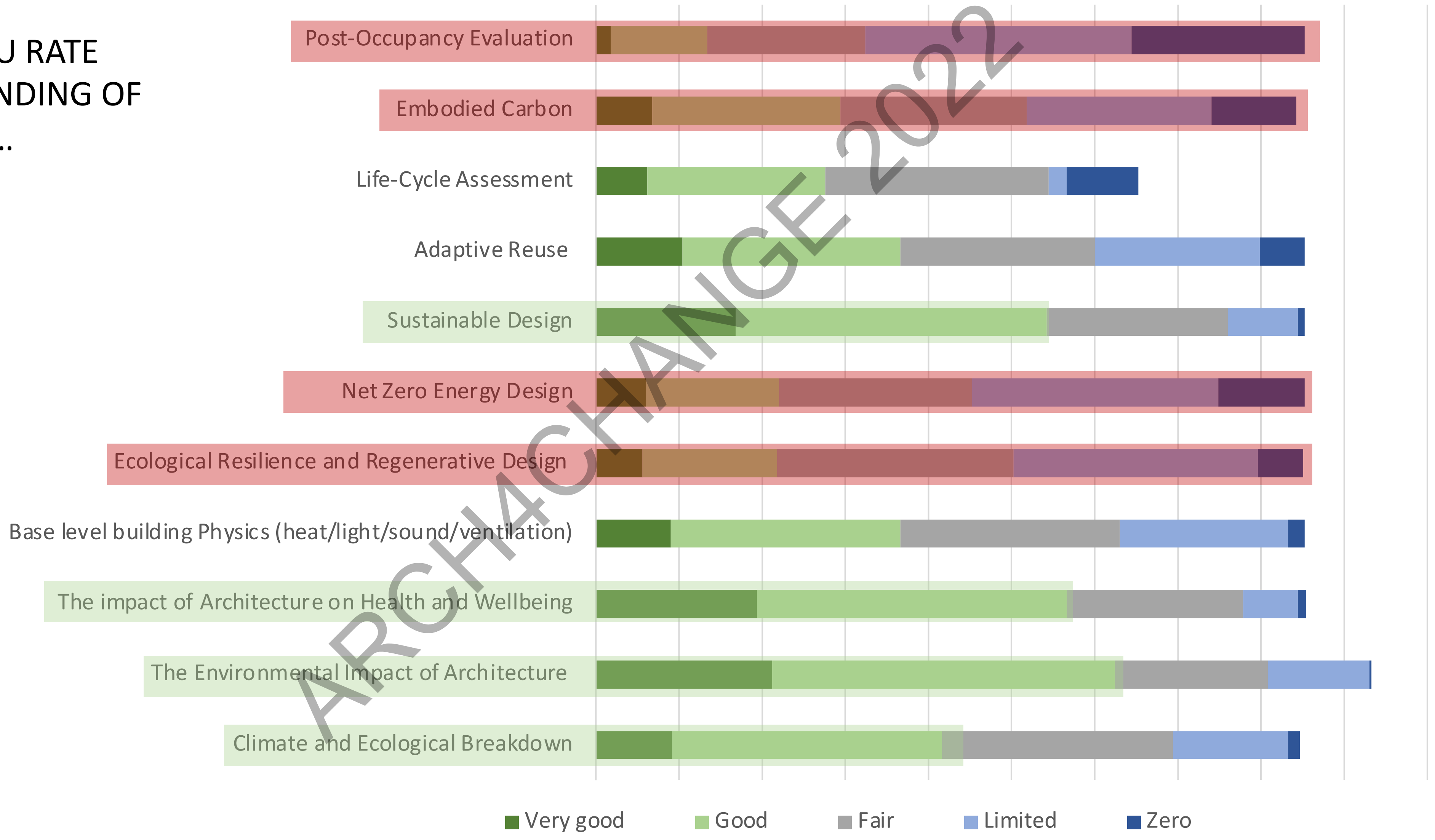
AAA INITIAL RESULTS



AAA INITIAL RESULTS

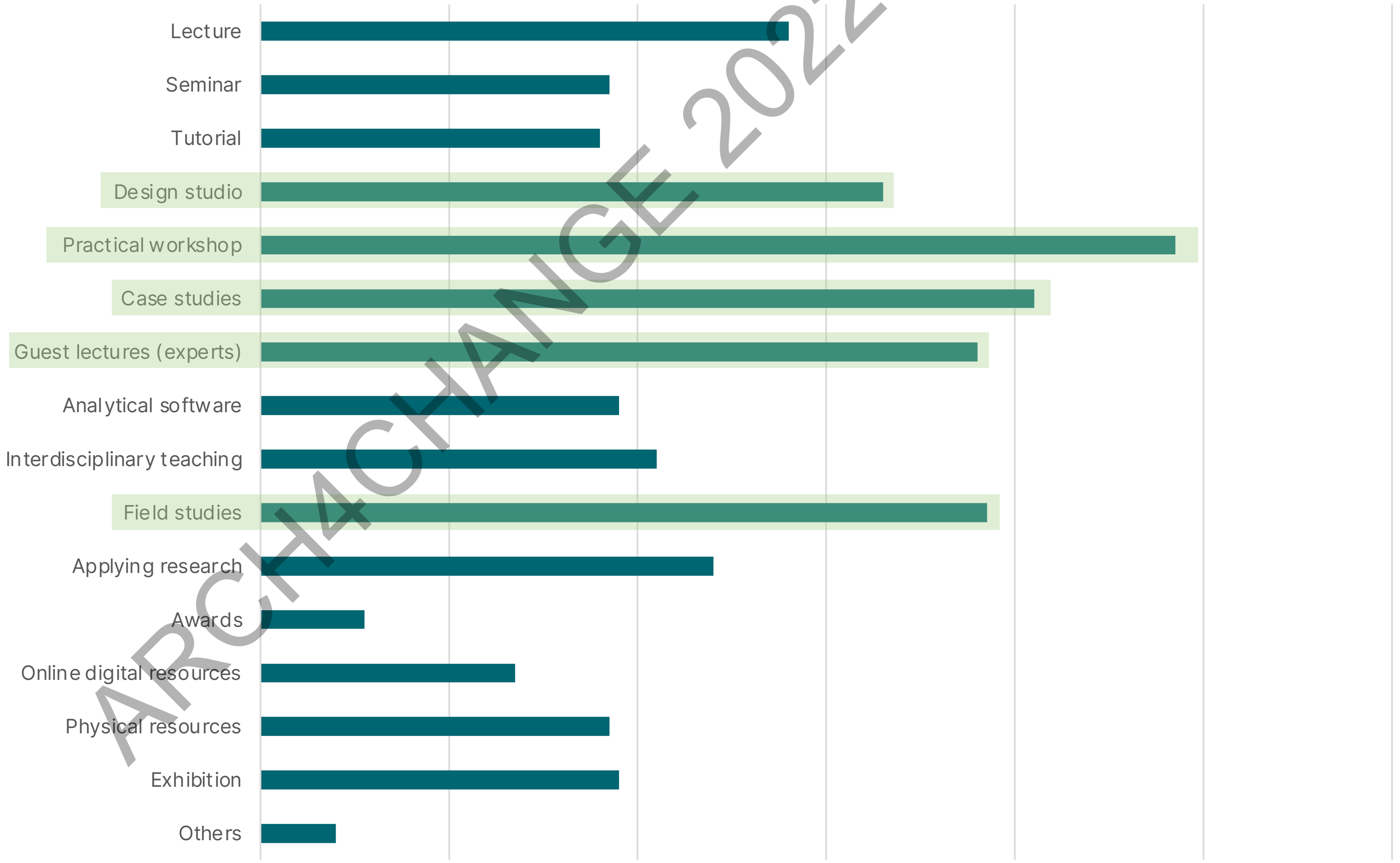


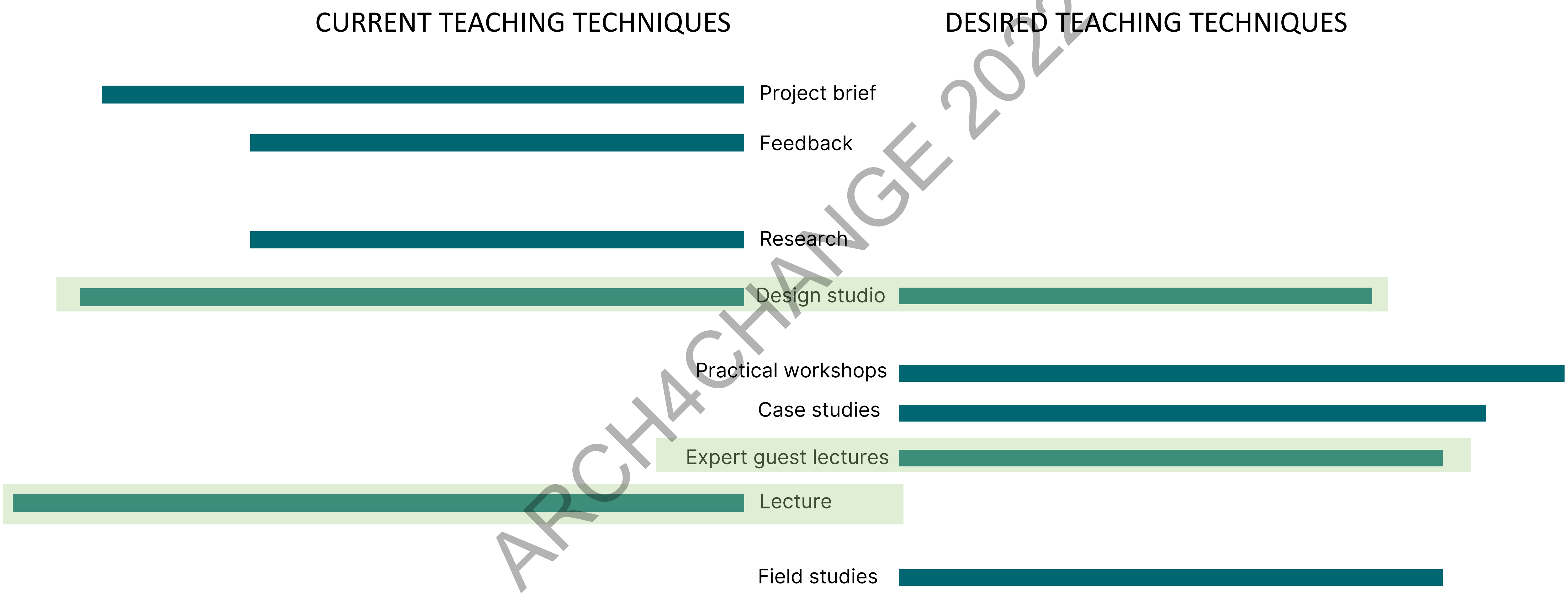
HOW WOULD YOU RATE YOUR UNDERSTANDING OF THE FOLLOWING...

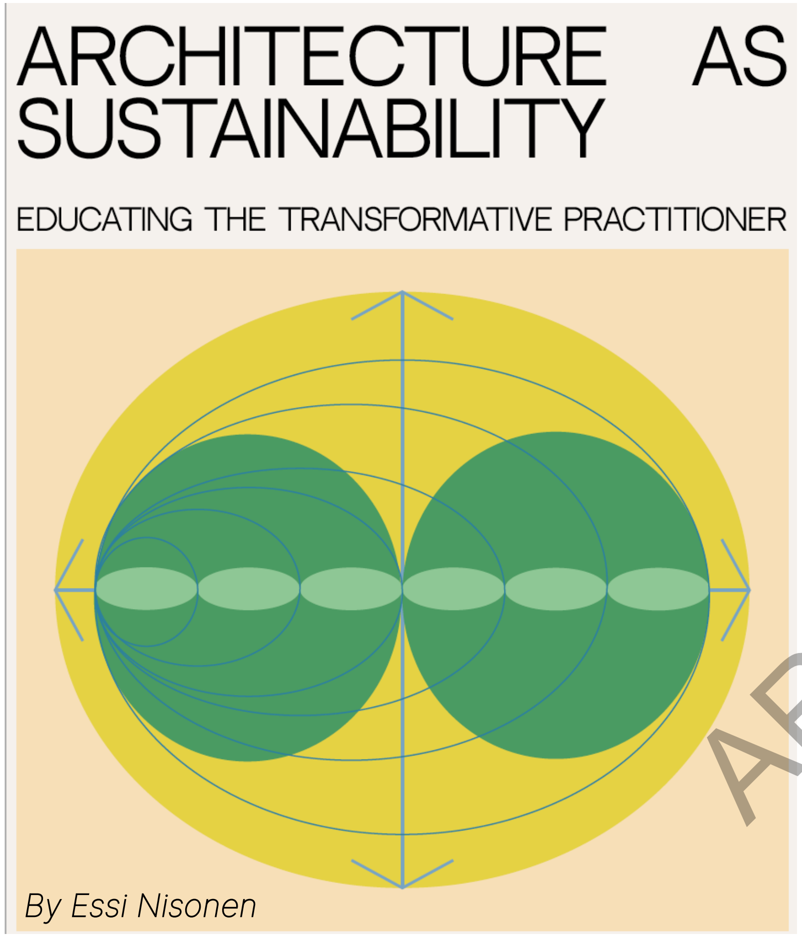


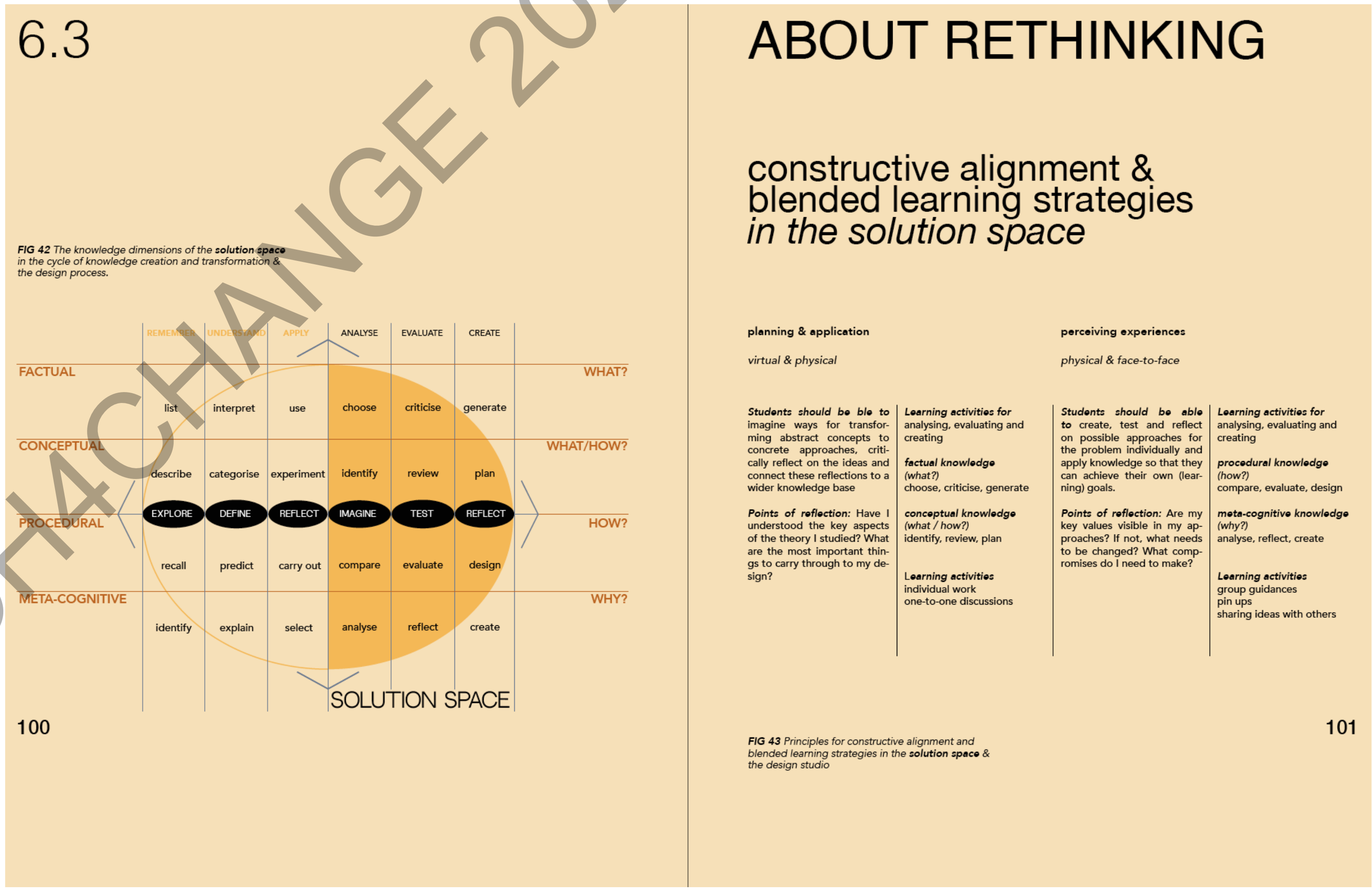
THINKING ABOUT YOUR CURRENT YEAR OF STUDY/TEACHING, WHAT LEARNING ACTIVITIES AND ENVIRONMENTS ARE USED TO TEACH SUSTAINABLE DESIGN IN YOUR SCHOOL?

WHAT WOULD YOUR IDEAL METHOD OF LEARNING/TEACHING BE TO IMPROVE UNDERSTANDING OF SUSTAINABLE DESIGN?




CURRENT TEACHING TECHNIQUES
DESIRED TEACHING TECHNIQUES
Project brief
Feedback
Research
Design studio
Practical workshops
Case studies
Expert guest lectures
Lecture
Field studies





6.3

FIG 42 The knowledge dimensions of the ***solution space*** *in the cycle of knowledge creation and transformation & the design process.*

	REMEMBER	UNDERSTAND	APPLY	ANALYSE	EVALUATE	CREATE	
FACTUAL	list	interpret	use	choose	criticise	generate	WHAT?
CONCEPTUAL	describe	categorise	experiment	identify	review	plan	WHAT/HOW?
	EXPLORE	DEFINE	REFLECT	IMAGINE	TEST	REFLECT	
PROCEDURAL	recall	predict	carry out	compare	evaluate	design	HOW?
META-COGNITIVE	identify	explain	select	analyse	reflect	create	WHY?

SOLUTION SPACE

100

ABOUT RETHINKING

constructive alignment & blended learning strategies *in the solution space*

planning & application

virtual & physical

Students should be ble to imagine ways for transforming abstract concepts to concrete approaches, critically reflect on the ideas and connect these reflections to a wider knowledge base

Points of reflection: Have I understood the key aspects of the theory I studied? What are the most important things to carry through to my design?

Learning activities for analysing, evaluating and creating

factual knowledge
(what?)
choose, criticise, generate

conceptual knowledge
(what / how?)
identify, review, plan

Learning activities
individual work
one-to-one discussions

perceiving experiences

physical & face-to-face

Students should be able to create, test and reflect on possible approaches for the problem individually and apply knowledge so that they can achieve their own (learning) goals.

Points of reflection: Are my key values visible in my approaches? If not, what needs to be changed? What compromises do I need to make?

Learning activities for analysing, evaluating and creating

procedural knowledge
(how?)
compare, evaluate, design

meta-cognitive knowledge
(why?)
analyse, reflect, create

Learning activities
group guidances
pin ups
sharing ideas with others

FIG 43 Principles for constructive alignment and blended learning strategies in the ***solution space*** *& the design studio*

101

ARCHITECTURAL EDUCATION: METHODS FOR INTEGRATING CLIMATE CHANGE DESIGN (CCD) IN THE CURRICULUM
Systematic literature review of 87 publications

What pedagogies and teaching **methods facilitate the successful integration** of sustainable design in architectural education?

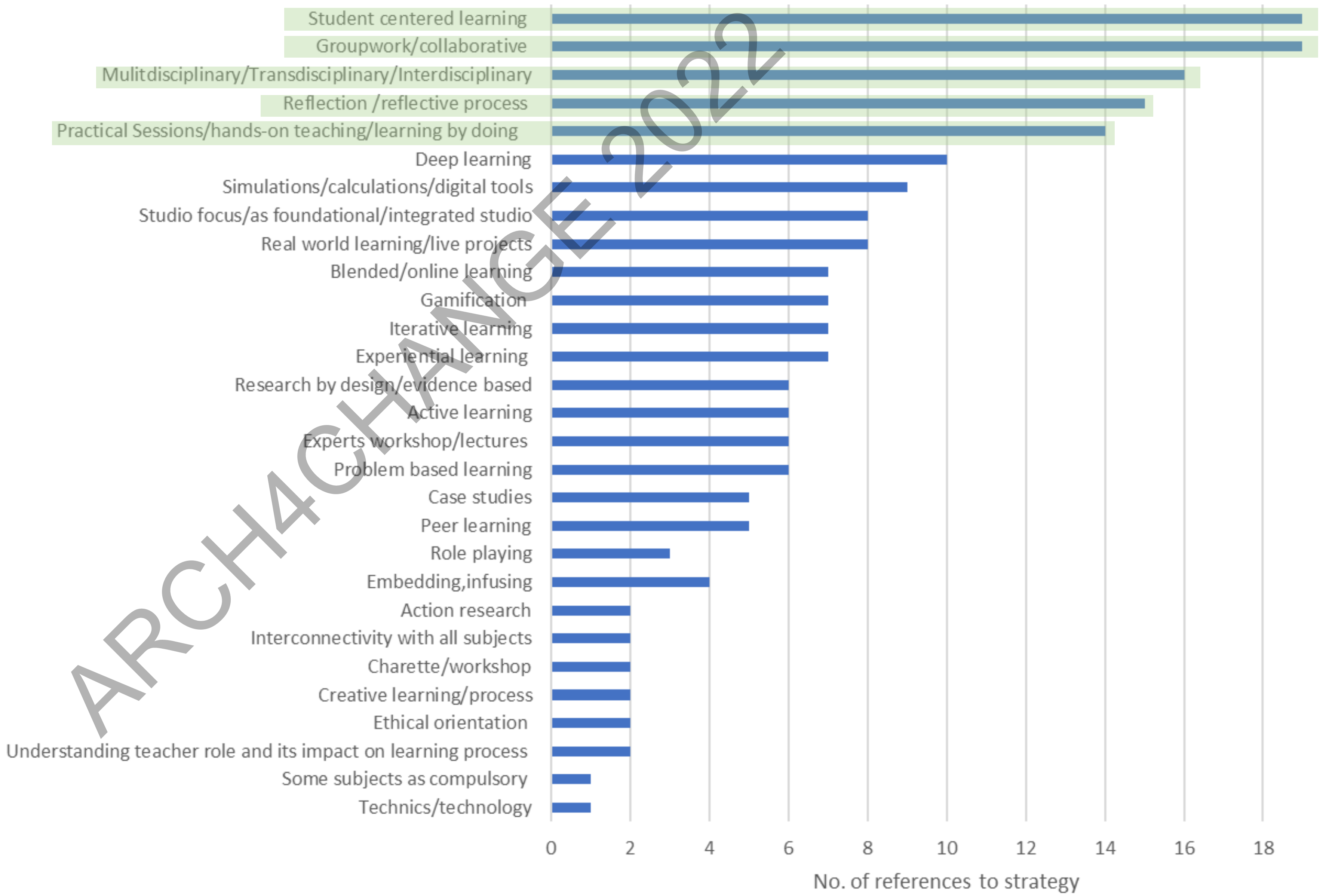
What **skills and competencies are needed** by educators to integrate sustainable design pedagogies and teaching methods?

What are the **barriers and challenges for upskilling** educators to attain these skills and competencies?

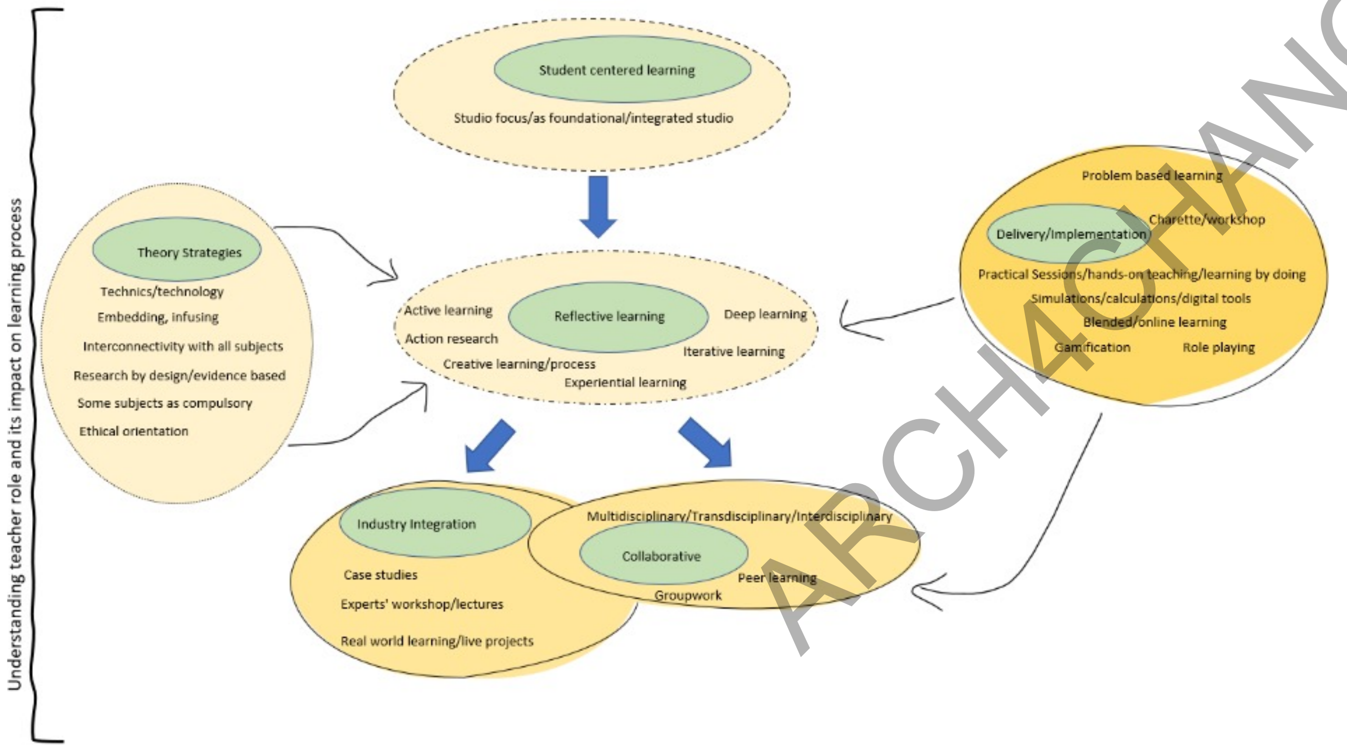
How can these barriers be overcome; as related to teacher competencies, skills and knowledge?

LITERATURE REVIEW RESULTS

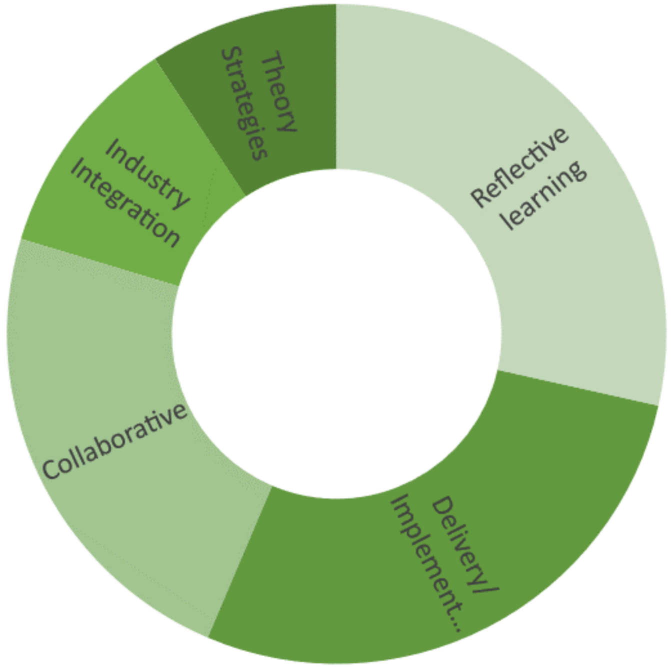
From publication: the most advocated teaching strategies and pedagogies for sustainability integration



Categorisation of teaching approaches and pedagogies for sustainability integration (based on reviewed publications)

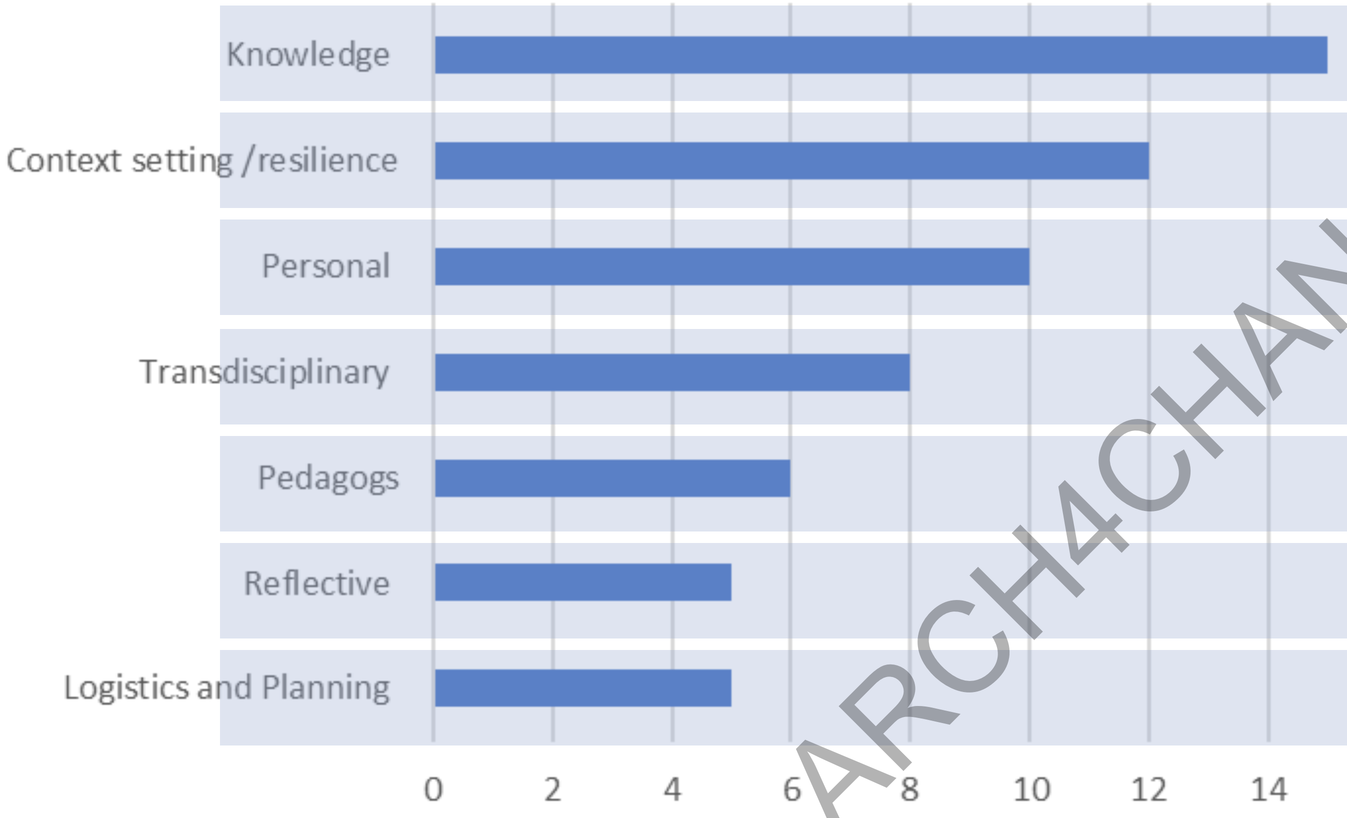


Synthesised strategies based on their prevalence



3 TEACHER TRAINING TOOLKIT

LITERATURE REVIEW RESULTS



knowledge depends on individual educators - highlighting a potential inequity and inconsistency in approach of teaching

to teach a student-centred approaches, educators must be flexible, innovative & able to facilitate the learner's personal development & skills instead of just transmitting professional know-how

teachers' personal 'soft' skills, are needed for a shift in values or ethics and a motivation to pursue a sustainability agenda

the need for transdisciplinary teaching teams to facilitate stepping out of silos

the use of part-time architects as design studio teachers without the necessary pedagogical understanding

the need for educators to be reflective, building and learning on past teaching practices

logistical issues related to having sufficient time, resources, & appropriate student numbers to run the particular student-centred strategies

SKILLS AND ATTRIBUTES NEEDED BY EDUCATORS

WHAT ARE THE BARRIER AND CHANNLLENGES FOR UPSKILLING EDUCATORS TO ATTAIN SKILLS AND COMPETENCIES?

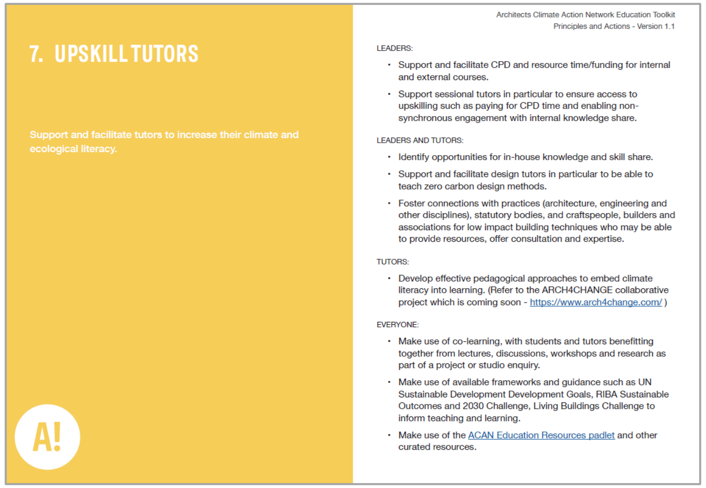
- Lack of knowledge and skills of educators
- Issues with defining and scoping sustainability
- Difficulties in implementing larger scale curriculum change
- Continued use of traditional teaching methods
- ‘Othering’ of sustainability

HOW CAN THESE BARRIER BE OVERCOME, RELATED TO TEACHER COMPETENCIES, SKILLS AND KNOWLEDGE

- Teaching methods need to be reviewed and diversified
- An extensive review of whole schools, courses and curricula
- Educators require teacher training

3 TEACHER TRAINING TOOLKIT

EXISTING TEACHER TRAINING TOOLKITS


Architects Climate Action Network Education Toolkit
Principles and Actions - Version 1.1

7. UPSKILL TUTORS

Support and facilitate tutors to increase their climate and ecological literacy.

LEADERS:

- Support and facilitate CPD and resource time/funding for internal and external courses.
- Support sessional tutors in particular to ensure access to upskilling such as paying for CPD time and enabling non-synchronous engagement with internal knowledge share.

LEADERS AND TUTORS:

- Identify opportunities for in-house knowledge and skill share.
- Support and facilitate design tutors in particular to be able to teach zero carbon design methods.
- Foster connections with practices (architecture, engineering and other disciplines), statutory bodies, and craftspeople, builders and associations for low impact building techniques who may be able to provide resources, offer consultation and expertise.

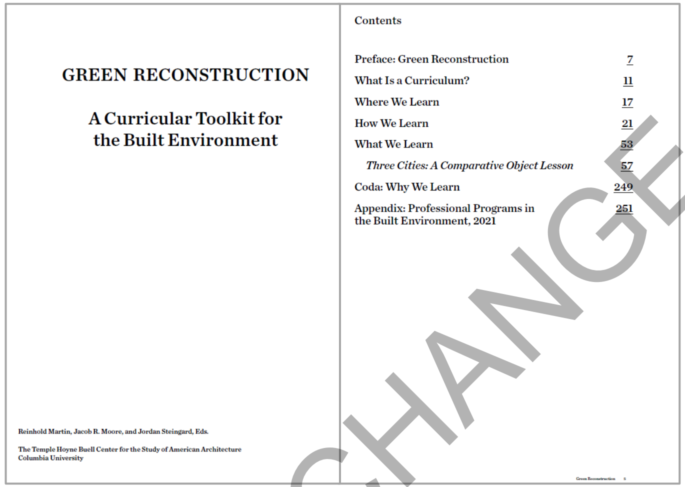
TUTORS:

- Develop effective pedagogical approaches to embed climate literacy into learning. (Refer to the ARCH4CHANGE collaborative project which is coming soon - https://www.arch4change.com/)

EVERYONE:

- Make use of co-learning, with students and tutors benefitting together from lectures, discussions, workshops and research as part of a project or studio enquiry.
- Make use of available frameworks and guidance such as UN Sustainable Development Development Goals, RIBA Sustainable Outcomes and 2030 Challenge, Living Buildings Challenge to inform teaching and learning.
- Make use of the ACAN Education Resources padlet and other curated resources.

A!


GREEN RECONSTRUCTION

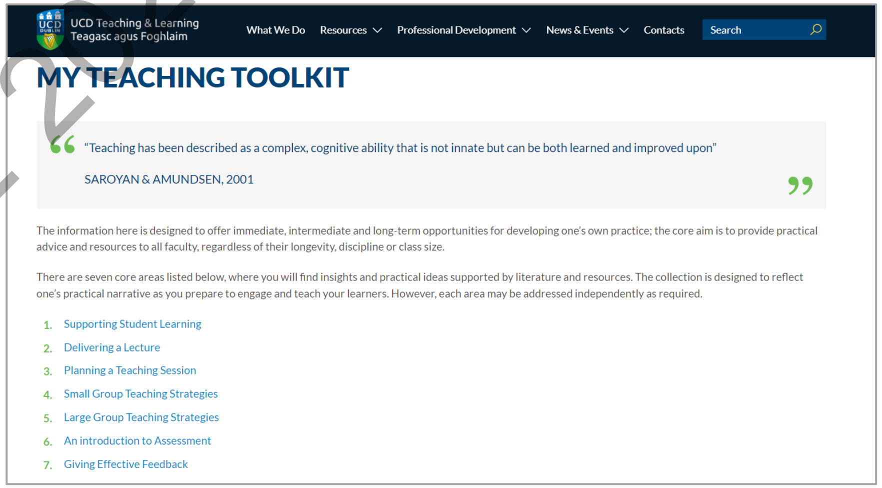
A Curricular Toolkit for the Built Environment

Reinhold Martin, Jacob R. Moore, and Jordan Steingard, Eds.

The Temple Hoyne Buell Center for the Study of American Architecture
Columbia University

Contents

Preface: Green Reconstruction 7
What Is a Curriculum? 11
Where We Learn 17
How We Learn 21
What We Learn 53
Three Cities: A Comparative Object Lesson 57
Coda: Why We Learn 249
Appendix: Professional Programs in the Built Environment, 2021 251


UCD Teaching & Learning
Teagasc agus Foghlaim

What We Do | Resources | Professional Development | News & Events | Contacts | Search

MY TEACHING TOOLKIT

"Teaching has been described as a complex, cognitive ability that is not innate but can be both learned and improved upon"

SAROYAN & AMUNDSEN, 2001

The information here is designed to offer immediate, intermediate and long-term opportunities for developing one's own practice; the core aim is to provide practical advice and resources to all faculty, regardless of their longevity, discipline or class size.

There are seven core areas listed below, where you will find insights and practical ideas supported by literature and resources. The collection is designed to reflect one's practical narrative as you prepare to engage and teach your learners. However, each area may be addressed independently as required.

1. Supporting Student Learning
2. Delivering a Lecture
3. Planning a Teaching Session
4. Small Group Teaching Strategies
5. Large Group Teaching Strategies
6. An introduction to Assessment
7. Giving Effective Feedback


Integrating Sustainability into Design Education: The Toolkit

March 2011

How can we continue to move design education forward?

Mindsets

Design thinking rather than design

Change Agents

A Designers Accord Project

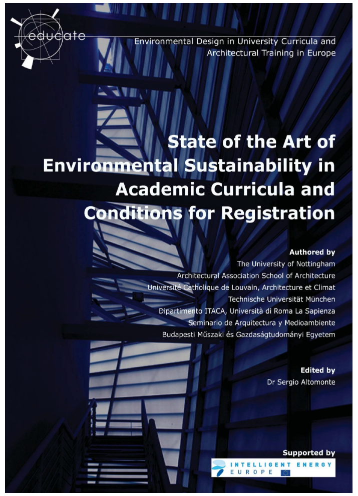

COMBI

Communication competences for migrants and disadvantaged background learners in bilingual work environments

TEACHER TRAINING TOOLKIT

combiproject.eu

Co-funded by the Erasmus+ Programme of the European Union


educate

Environmental Design in University Curricula and Architectural Training in Europe

State of the Art of Environmental Sustainability in Academic Curricula and Conditions for Registration

Authored by
The University of Nottingham
Architectural Association School of Architecture
Université Catholique de Louvain, Architecture et Climat
Technische Universität München
Dipartimento ITACA, Università di Roma La Sapienza
Seminario de Arquitectura y Medioambiente
Budapesti Műszaki és Gazdaságtudományi Egyetem

Edited by
Dr Sergio Altomonte

Supported by
INTELLIGENT ENERGY EUROPE

TEACHER TRAINING EVENT – TU DUBLIN

1. **Objective:**
   - Context of assignment
   - Tools available
   - Specific aims
2. **Method:**
   - Response to previous work
   - Potential improvements.
   - Evaluate and discussion of results
3. **Deliverable:**
   - limitations or assumptions
   - impact of the design changes
   - conclusion
4. **Learning Outcome:**
   - Studio application
   - Future design implications
5. **Reflections:**
   - Teaching issues
   - Positive outcomes
   - Potential improvements

Case Study: Material stewardship one click – **LCA**

Objective:

- Context of assignment: This subject is taught within the ESM [Environment, Services, Materials] module 2 in their second year of architectural studies and is intended to provide both knowledge of the carbon implications of material choice and to assist students in their design projects within Studio.
- Tools available: *One-Click LCA* modified by the IGBC for the Irish construction industry and presented as *Carbon Designer* tool. This is used to assess the embodied carbon of the design and to creatively work on reducing it
- Specific aims: achieve an A rated building design (or as close as you can get)

Method:

- Students are to use a previous design from the first semester to undertake a brief exercise using an Excel sheet or similar, to quantify the areas of their building.
- Use the 'Carbon Designer' tool on one-click LCA to help determine the types of structure and the basic constructional build up; to include, e.g. floor build up and areas, wall build up and areas, areas of glazing, roof, internal finishes. These figures will form the basis for the One-Click LCA inputs.
- Select the materials that most closely fit your material choices.
- Determine embodied energy of the design and its rating; selecting a suitable benchmark for comparison.
- Work towards improving the embodied impact performance of the building design by targeting problem areas. Create a new design in One-Click LCA for each change by copying your design and changing one aspect at a time.
- Evaluate and discuss the results

Deliverable:

- An A4 written report outlining:
  - Details of the initial design inputs and corresponding initial results, using graphics from the OneClick LCA. Diagnose the key impact, the key impact stages and key structures having the most impact
  - Details of subsequent design changes undertaken to the building materials design to improve the embodied impacts and the improved design results, again using graphics from the OneClick LCA
- An A3 design report outlining: the key design changes which have occurred to the design as a result of the move towards an A rated building.

Learning Outcomes:

Understand environmental impacts and characteristics of typical building materials for architecture.

Provide the learner with the necessary knowledge and understanding of environment to inform the development of studio projects.

Analyse and select materials based on embodied carbon for diverse building types, usages, and locations.

Reflections:

This project sits in a series of lectures and assignments termed *Material Stewardship* which introduces the student to the idea of an environmental responsibility in terms of the material choices they make in design. It is a retroactive look at a previous design project so that the student can compare their initial design with one that takes carbon into account. It is followed by a second project using Carbon Designer which proactively assists the studio design of a building. It is a useful method to introduce the idea of carbon accounting to the student; indeed the second part of the exercise – to move the design to an A rated building – allows the student to be quite radical in their material suggestions. There are however, from the tutor's perspective a number of issues:

- Students are not very aware, in their second year of the constructional implications of their designs, thus a student might believe they have achieved an A-rated building but have not understood that their design is for example, problematic to insulate/ requires a brise soleil to protect large expanses of glazing etc.
- Students can feel restricted in their design material choices when asked to reference back to carbon accounting – their range of material design exemplars needs to be expanded.
- Carbon designer is a useful simplified tool but does not look at the carbon implications of operational energy – this is however covered in the One Click LCA and students should 'graduate' to this in year 3.

ARCH4CHANGE

1. CLIMATE CHANGE CURRICULUM

UNDERGRADUATE STUDENTS

ARCH4CHANGE

2 CLIMATE CHANGE CURRICULUM

MASTERS STUDENTS

A.
CURRICULUM
OVERVIEW / ANALYSIS

B.
LITERATURE
REVIEW

C.
CURRICULUM DESIGN
+ BOOK

D.
CURRICULUM
CONTENT

1 2 CLIMATE CHANGE CURRICULUM

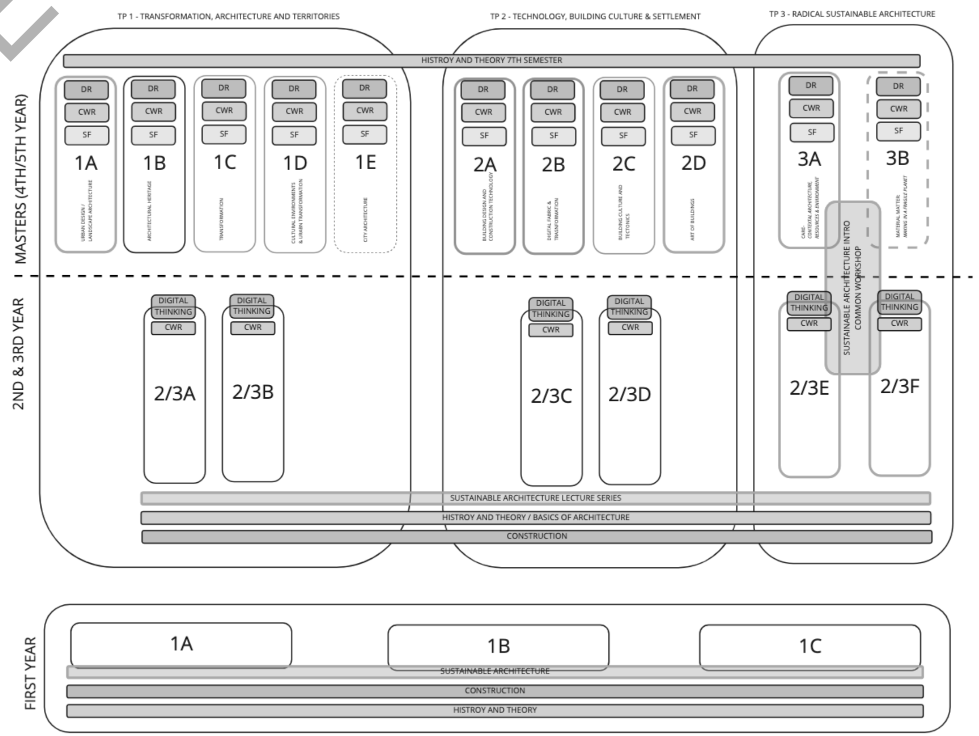
CURRICULUM MAPPING

Mapped 120 courses from the 5 institutions

Aimed to understand where sustainable architecture is taught and what topics

Indicate opportunities and challenges within existing courses and education frameworks

Provide the foundation for the holistic sustainable architecture curriculum

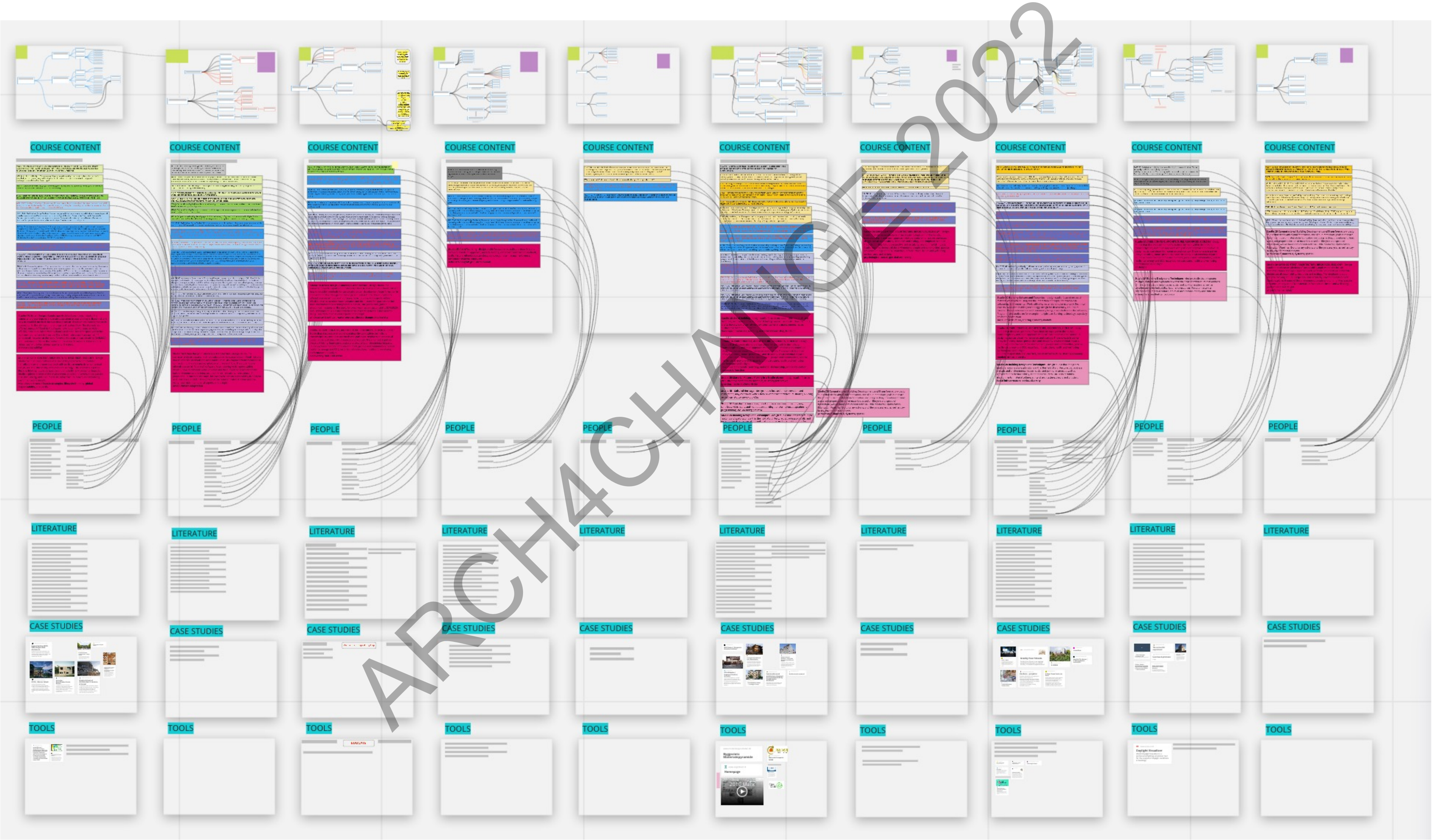


1 2 CLIMATE CHANGE CURRICULUM

General course information													Course content					
Exact course code	Original course name	Translated course name	Language course is taught in	Type of course (studio, elective etc.)	Year level (1st, 2nd, 3rd, 4th, 5th year etc.)	Number of ECTS offered? (assuming 1 ECTS is 27 hrs of study)In TU Dublin 1 ECTS = 20 hours of learning	Duration and frequency of course. (e.g. 6 weeks, once a year)	Mandatory or optional course?	How many hours of contact time?	How many students per course?	(e.g. are all of the students in this year group taking this course or only 10% of total students in the year - estimation is fine)	content related to sustainable architecture differ, for example, semester to semester or year to year.	Estimate what % of course is specifically about sustainable architecture?	In 50 words please describe your course in relation to sustainable architecture	Learning outcomes related to sustainable architecture	List of topics covered in relation to sustainable architecture	List 5-10 specific supporting material in relation to sustainable architecture (e.g. references, material, literature, theory etc.)	What is unique about the course? (If anything)
ARCH 1421	Environment, Science & Materials 1		English	Core Module	1st	5 ECTS	Full semester, once a year	Mandatory	24	Approx 60	All	No?	92% (one lecture on general servicing of building)	Services. Holistic principles of design. Small, simple buildings. History of 'green architecture' design. SEEDING.	systems: natural, manmade, urban and rural and their inter relationships. 4. Introduction to principles of good environmental design	Stewardship Harvesting materials Services and Systems from a historical perspective.	Ponting C. (2007) A New Green History of the World. London UK. Random House	Deliberately nothing unique. In line with other schools. Module Co-Ordinator / Practitioner links to case studies and real projects.
ARCH 1100	Architectural Design Studio 1 & 2		English	Core Module	1st	20 ECTS	Two Semesters	Mandatory	216	Approx 60	All	Yes, subject to project briefs	about sustainable communities. Skills for application.	outlined in theUN's Sustainable Development Goal 11, which focuses on Sustainable Cities and Communities.	characteristics of sustainable communities and buildings and integrate observations into project designs. L05	overlooking / overshadowing, solar gain, microclimates, insulation, comfort and thermal properties, re-use of materials, energy systems	SDGs. Examples of 'unsustainable' ar	Ethical perspective vis a vis climate change at the core of every brief. Module Co-Ordinator / Practitioner links to case studies
ARCH 2421	Environment, Services & Materials 2		English	Core Module	2nd	5 ECTS	Full semester, once a year	Mandatory	24	Approx 55	All	No?	100%	Renewable energies. Embodied Carbon analysis. Material stewardship. Retroactively and proactively embed in studio.	acoustics, light and airflow in buildings and expand on the latter two to incorporate principles of daylighting and natural ventilation into building design.	geo, group systems, CHP. Green Construction Methods DEAP Service strategies for small buildings	CIBSE Guides, BRE, Garstom UK. Perception and Lighting as form givers for Architecture, Lam William M.C., McGraw Hill	Use of Oneclick LCA to assess studio projects and retrospectively improve embodied carbon of projects. Material Stewardship..
ARCH 2000	Architectural Design Studio 3		English	Core Module	2nd	15 ECTS	Full semester, once a year	Mandatory	144	Approx 55	All	Yes, subject to project briefs	principles around material stewardship. SDG 12	uses of materials, efficient use of natural resources and underlying impacts of early stage design decisions.	consequences of material and design choices on small projects and their immediate and wider environmental context.	consequences of such - understanding the issues of bio-regional sourcing of materials, embodied energy and carbon.	Latham I. & Swenarton M., (Ed). Feilden Clegg Bradley: The Environmental Handbook. London, UK:	Use of Oneclick LCA to assess studio projects and retrospectively improve embodied carbon of projects
ARCH 3322	Building Technology & Structures 4		English	Core Module	3rd	5 ECTS	Full semester, once a year	Mandatory	24	Approx 60	All	No	60%	conservation. breathable building materials are showcased and learning from vernacular building technique	manufacture, the construction techniques and the scientific developments in developing new construction techniques.	Conservation, Adaptive Re-use, Traditional and local materials		Focus on re-use of existing building stock
ARCH 3421	Environment Services and Materials 3		English	Core Module	3rd	5 ECTS	Full semester, once a year	Mandatory	24	Approx 60	All	No?	100%	concerns, responses and approaches as generators of pragmatic and resilient architectural design. REFLECTING	7. Have an understanding of the particular nature of various materials their appropriateness to function and their behaviour over time.	structures; conservation, retrofitting, refurbishing, housing Timeless and typical materials in architecture	Cities and Natural Process, Michael Hough, Routledge 1995 Sustainable Settlements, Barton H. University ofWest of England 1995	
ARCH 3000	Architectural Design Studio 5		English	Core Module	3rd	15 ECTS	Full semester, once a year	Mandatory	144	Approx 60	All	Yes, subject to project briefs	*studio. Implicit	deliberately focuses on student led teaching and learning practices, supporting a coordinated model of design process.	architectural, ecological and landscape ideas through an appropriate architectural manifestation.	organisational circulation systems over multiple floors, tectonic approaches, and landscape strategies for climate change.	M. L., Biophilic Design, Wiley. McHarg, I., 1969, Design with Nature, Garden City, N.Y., Natural History Press.	Environment implicit in the design project
ARCH 3001	Architectural Design Studio 6		English	Core Module	3rd	15 ECTS	Full semester, once a year	Mandatory	144	Approx 55	All	Yes, subject to project briefs	*studio. Implicit	Students engage with their own ideas about architecture in a warming world based on a prepared manifesto informed by current ecological	7. Estimate, calculate and prepare a measured approach to consider ecological outputs within a selected response to climate change policy.	management strategies and fresh water ecosystem expansion. Critical reading of critical regionalism in a warming world.	Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development, UN 2018	challenges beyond the building. Temporal considerations - long picture. The here and now and the there and then.
ARCH 4421	Environment Services and Materials 4		English	Core Module	4th	5 ECTS	Full semester, once a year	Mandatory	24	Approx 55* (20/21 83 students)	All	No?	100%	Macro to Micro.	1. Design environmental strategies which establish the aspects of environmental/ ecological/sustainable design which will drive or strengthen the architectural concept	Sustainable design principles for selected buildings History, theory, principles of ecological and sustainable design. Macro and Micro climate modification	Responsive Environments: A manual for designers. Architectural Press. Websites: BRL Website www.environ .ie; SEI website;. E.P.A site;. PHPP site – Passive House.;	Connection to ADS. Intention to make it obsolete - ultimate assimilation of module with ADS.
ARCH 4106	Architectural Design Studio 7		English	Core Module	4th	15 ECTS	Full semester, once a year	Mandatory	144	Approx 55* (20/21 83 students)	All	Yes, subject to project briefs	*studio environment.	Innovation and Infrastructure), SDG 11 (Sustainable Cities & Communities) and SDG 13 (Climate Action)	8.Demonstrate the urban and landscape heritage and/or building conservation principles as relevant to their design project.	Building Conservation and Restoration Energy Retrofit and upgrade of existing buildings	Climate, New Society Publishers. Waldheim, C., Landscape as Urbanism, in Waldheim, C. (ed), The Landscape Urbanism Reader,	dialogue with peers. Recognises design skills of an architect to address climate crisis challenges beyond the building.
ARCH 4107	Architectural Design Studio 8		English	Core Module	4th	15 ECTS	Full semester, once a year	Mandatory	144	Approx 55	All	Yes, subject to project briefs	*studio environment.	ADS 8 builds on semester one, brownfield sites and encourages deep investigation of structure and	1.Develop an innovative and imaginative urban, suburban or rural strategy for future human settlement	UN Sustainable Development Goals Carbon Emissions Reduction in the Built Environment	SDGs.	Focus on assembling a building with care
ARCH 4001	Options Elective 1		English	Core Module	4th	5 ECTS	Full semester, once a year	Mandatory	12-24	Approx 55	All	Yes, subject to project briefs	30% currently 20/21	Depending on the project options available eg Living Building Challenge, Architecture of Trees,		Subject to Project Options available: Acoustics, Building Physics, Living Building Challenge, Architecture of Trees		Project dependent. Specialisation and in depth study. Small classes. Good staff student ratio.
ARCH 4621	Options Elective 2		English	Core Module	4th	5 ECTS	Full semester, once a year	Mandatory	12-24	Approx 35	All	Yes, subject to project briefs	30% currently 20/21	Depending on the project options available eg Living Building Challenge, Architecture of Trees, Human Comfort		Subject to Project Options available: Acoustics, Building Physics, Living Building Challenge, Architecture of Trees		Project dependent. Specialisation and in depth study. Small classes. Good staff student ratio.
ARCH 5501	Thesis Development		English	Core Module	5th	10 ECTS	Full semester, once a year	Mandatory	24	Approx 35	All	Yes, subject to project briefs		This module requires students to take an informed position on the issues surrounding the present and future resilience of a particular place though	Learning Outcomes to be read in association with Project Brief. Make initial projective design propositions that explore the questions raised by the	Architecture & Climate		useful research methods to form a position which is applied to an architectural design thesis project.
ARCH 5101	Architectural Design Studio 9		English	Core Module	5th	20 ECTS	Full semester, once a year	Mandatory	144	Approx 35	All	Yes, subject to project briefs	*studio environment.	This module requires students to be cognisant of the principles of sustainability and resilience in	Learning Outcomes to be read in association with Project Brief. Make initial projective design propositions that explore the questions raised by the	Students participate in a studio guided by a theme or agenda which they interpret through their individual projects. Students pursue their		
ARCH 5102	Architectural Design Studio 10		English	Core Module	5th	30 ECTS	Full semester, once a year	Mandatory	64	Approx 35	All	Yes, subject to project briefs	*studio environment.	This module requires students to be cognisant of the principles of sustainability and resilience in	Learning Outcomes to be read in associatin with Project Brief. Engage the relevant contexts of a developing design proposal as appropriate—these	Students participate in a studio guided by a theme or agenda which they interpret through their individual projects. Students pursue their	Klein, N. 2014. This Changes Everything Morton, T. 2018. Being Ecological	on building design. The module also seeks to actively engage with interest groups and decision-making on the ground.

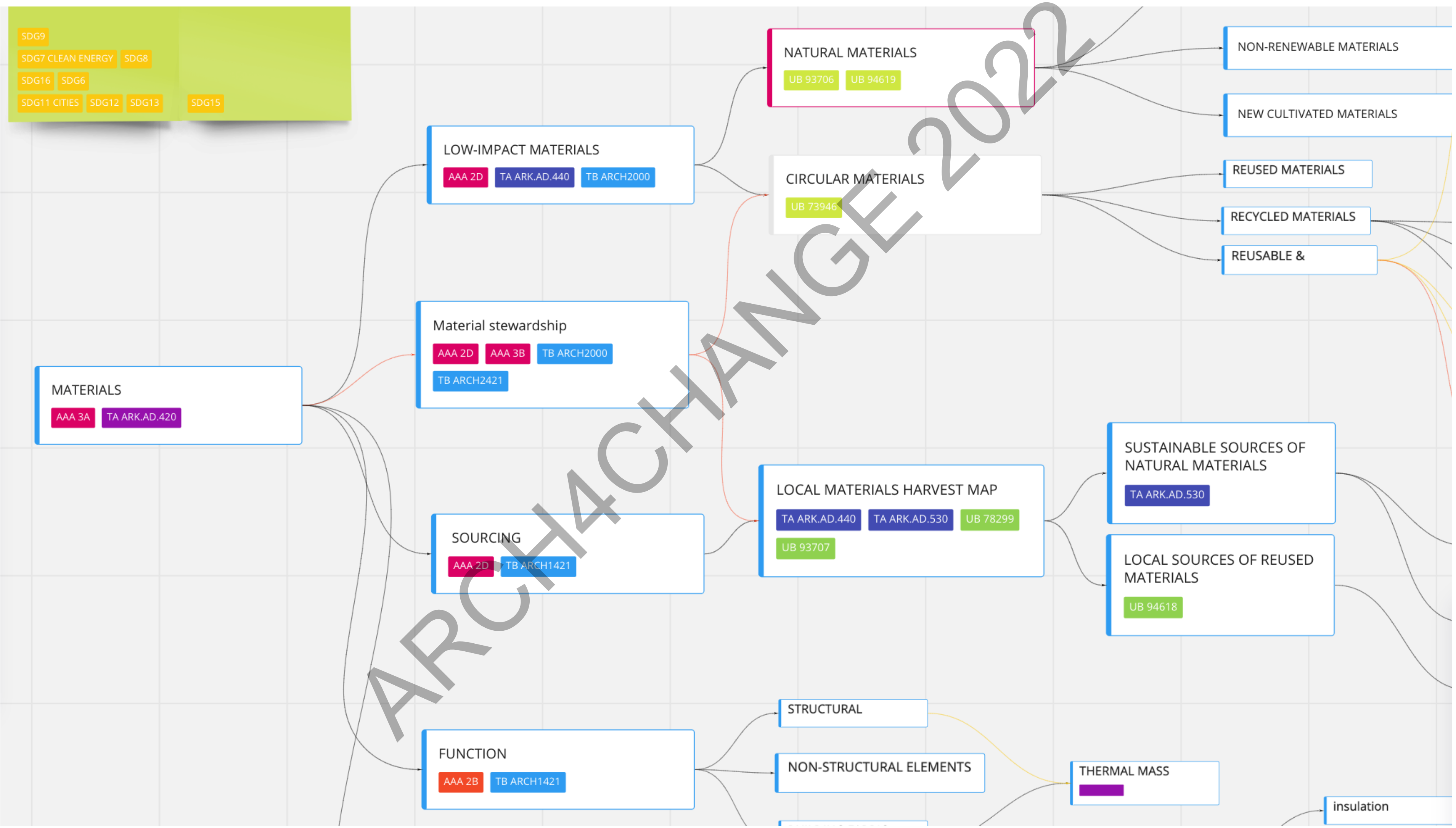
1 2 CLIMATE CHANGE CURRICULUM

CURRICULUM MAPPING



1 2 CLIMATE CHANGE CURRICULUM

CURRICULUM MAPPING

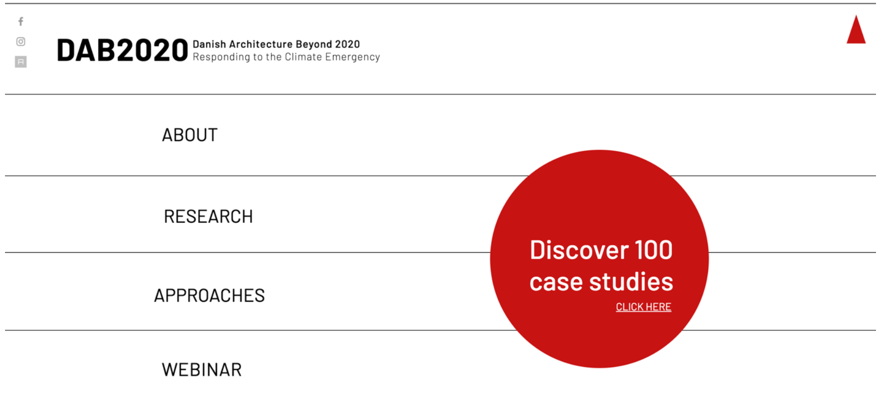


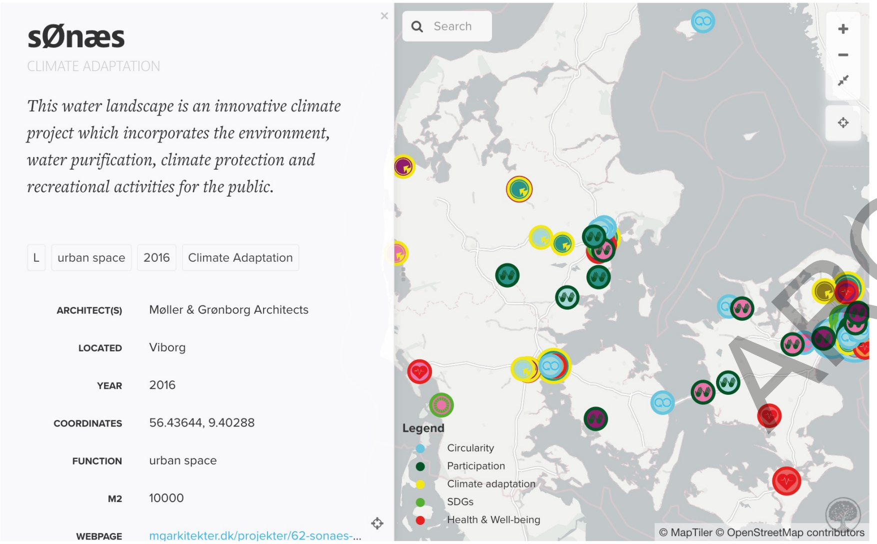
1 2 CLIMATE CHANGE CURRICULUM

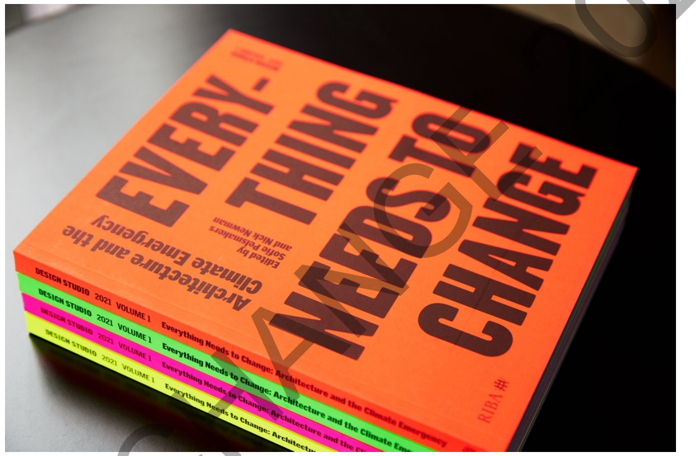
CONTENT LITERATURE REVIEW

1 2 CLIMATE CHANGE CURRICULUM

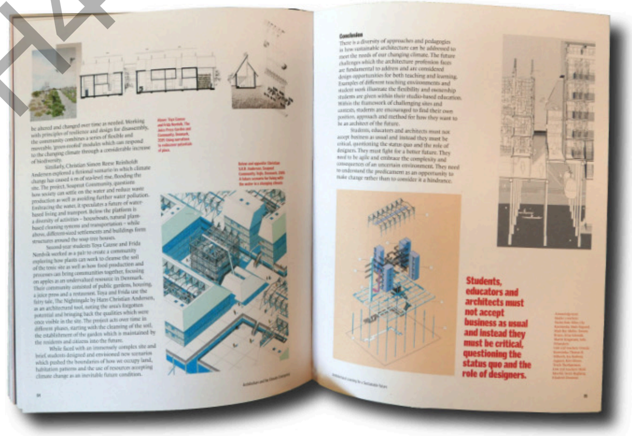
PREVIOUS TEACHING & RESEARCH AT AAA

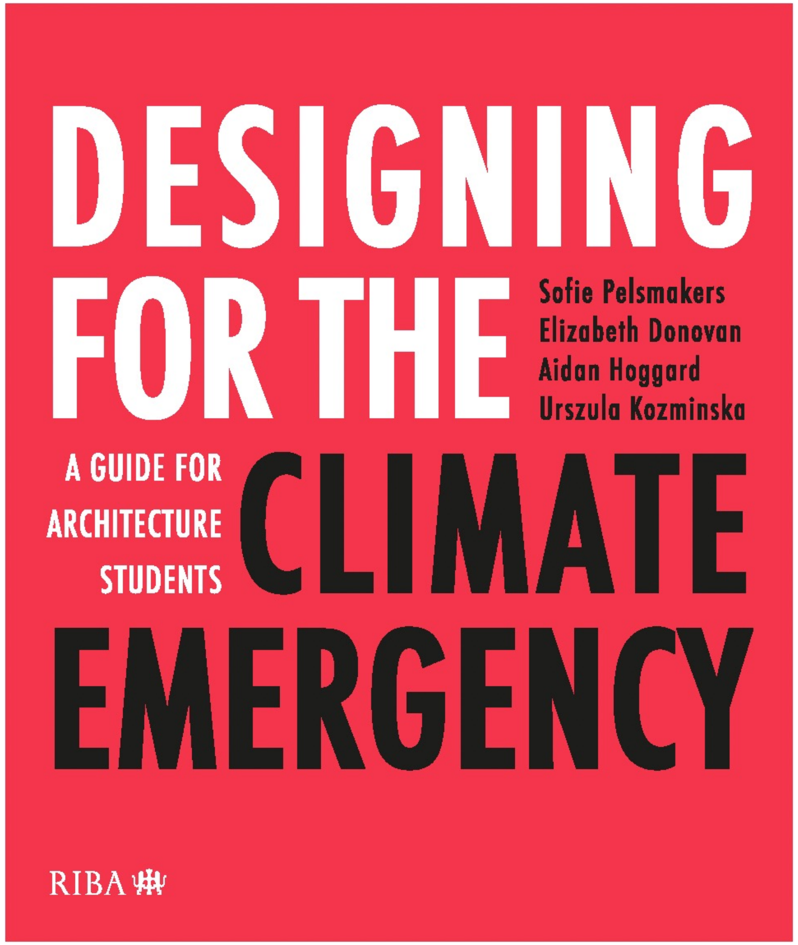




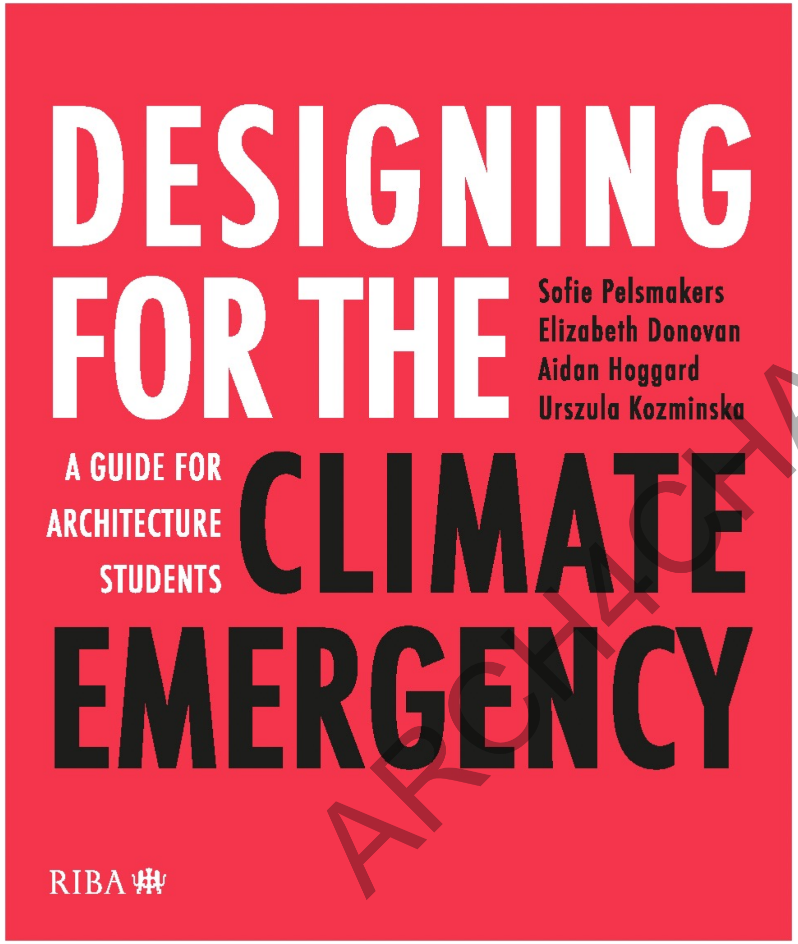


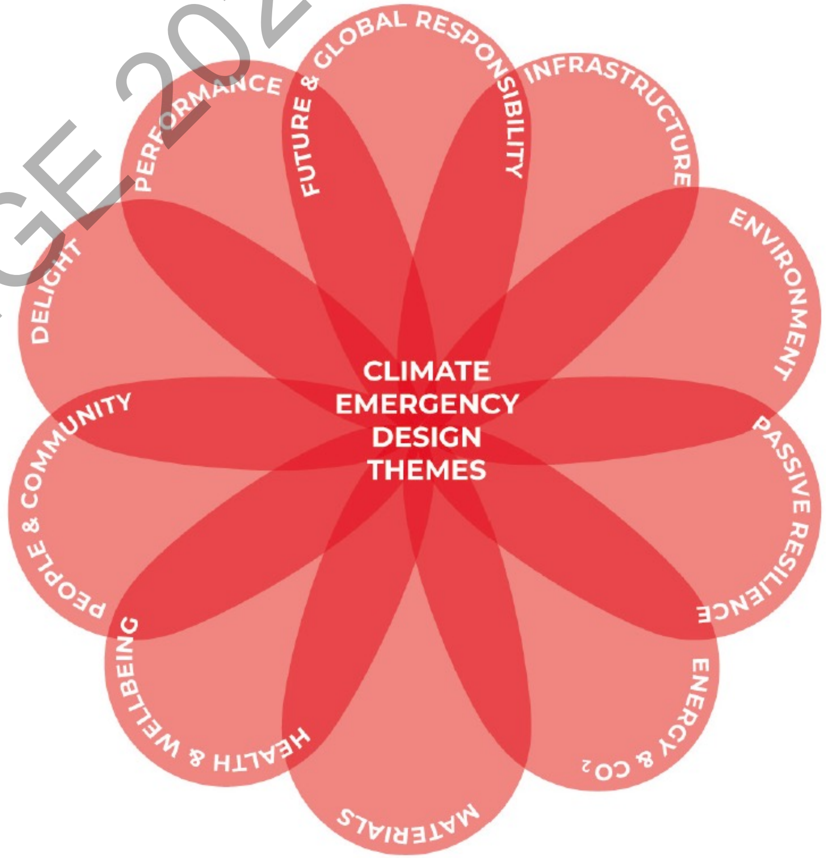
Ed. Sofie Pelsmakers & Nick Newman





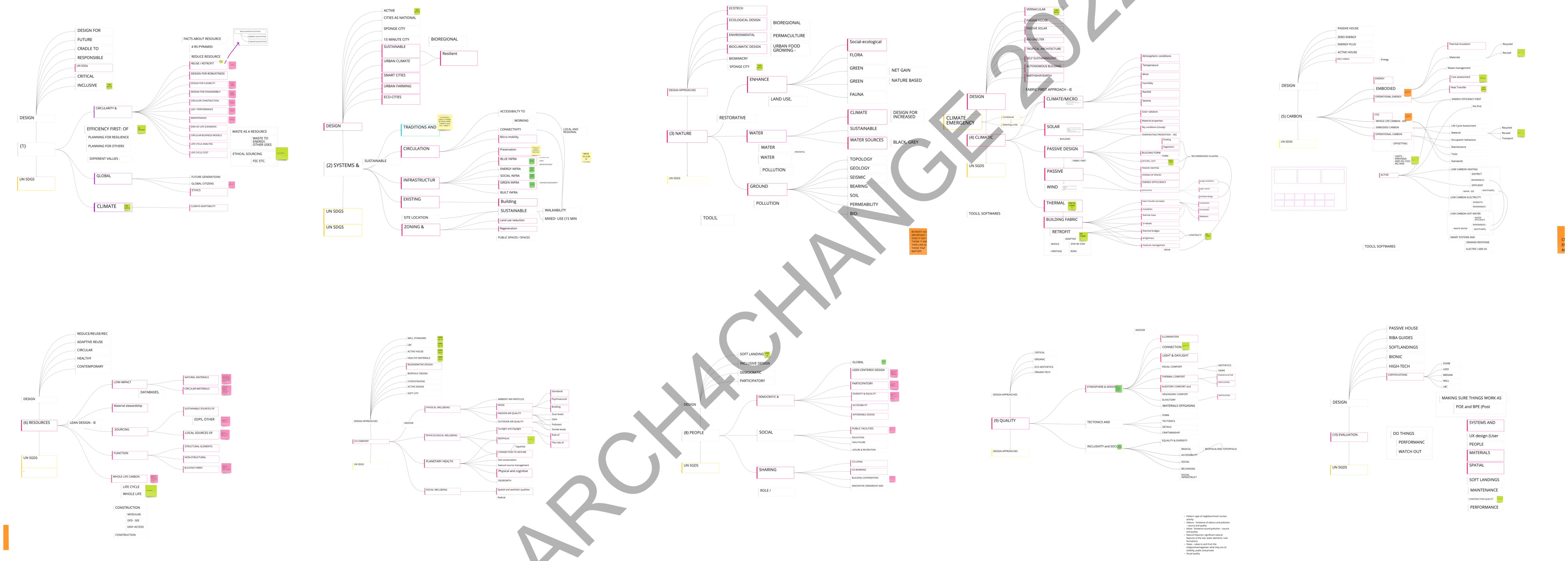
PARALLELL CONTENT





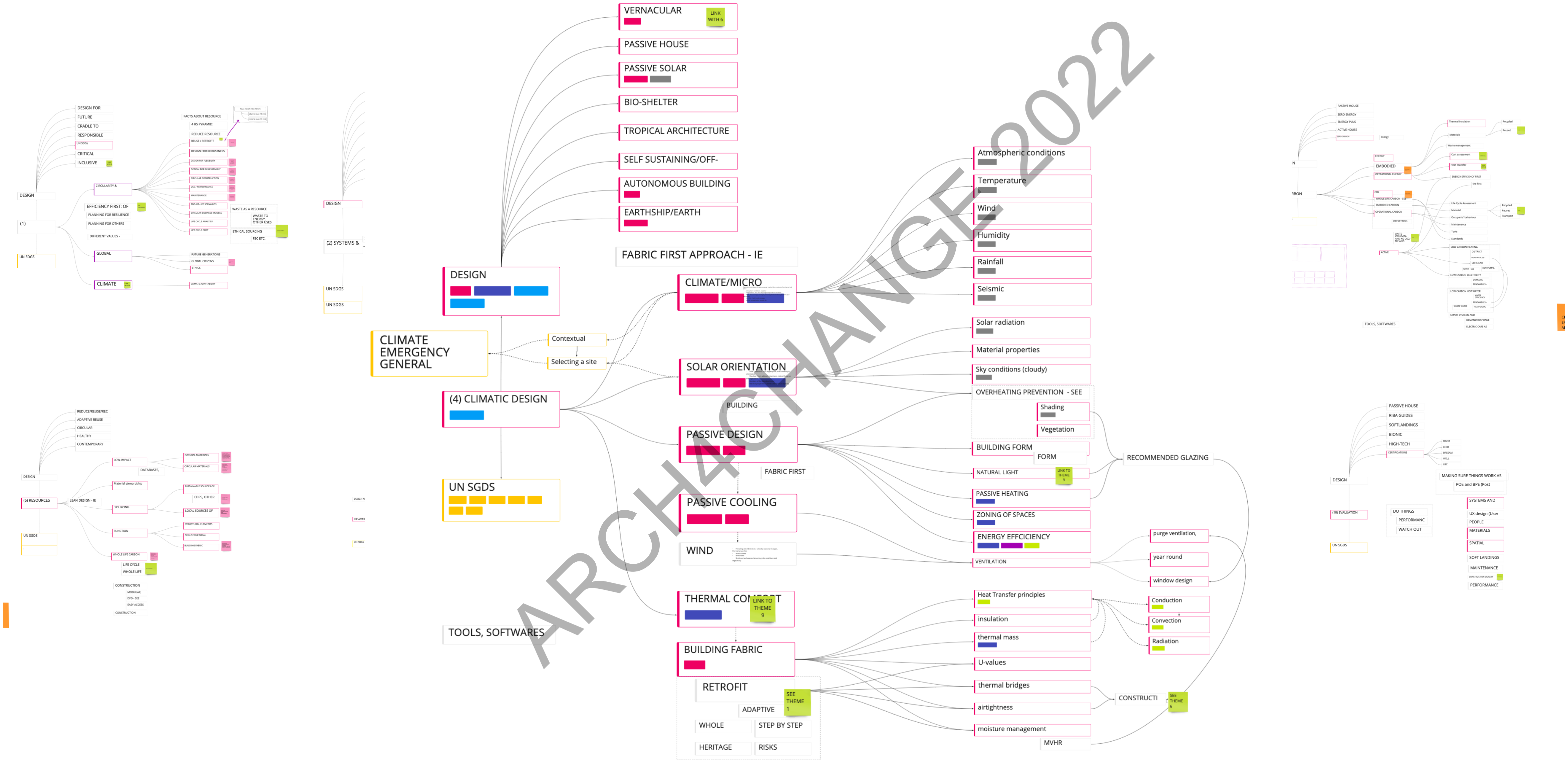
1 2 CLIMATE CHANGE CURRICULUM

CURRICULUM DESIGN



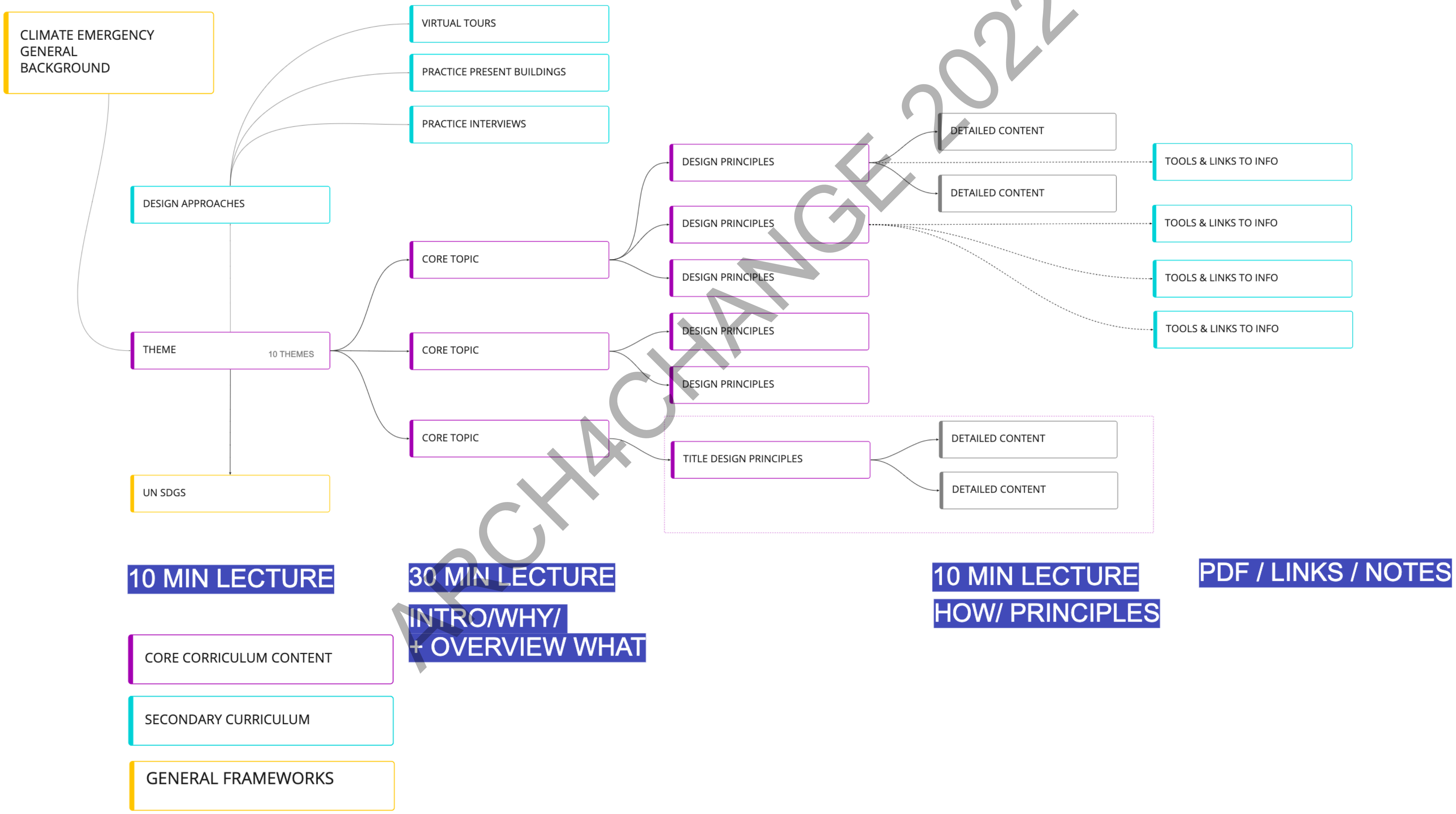
1 2 CLIMATE CHANGE CURRICULUM

CURRICULUM DESIGN



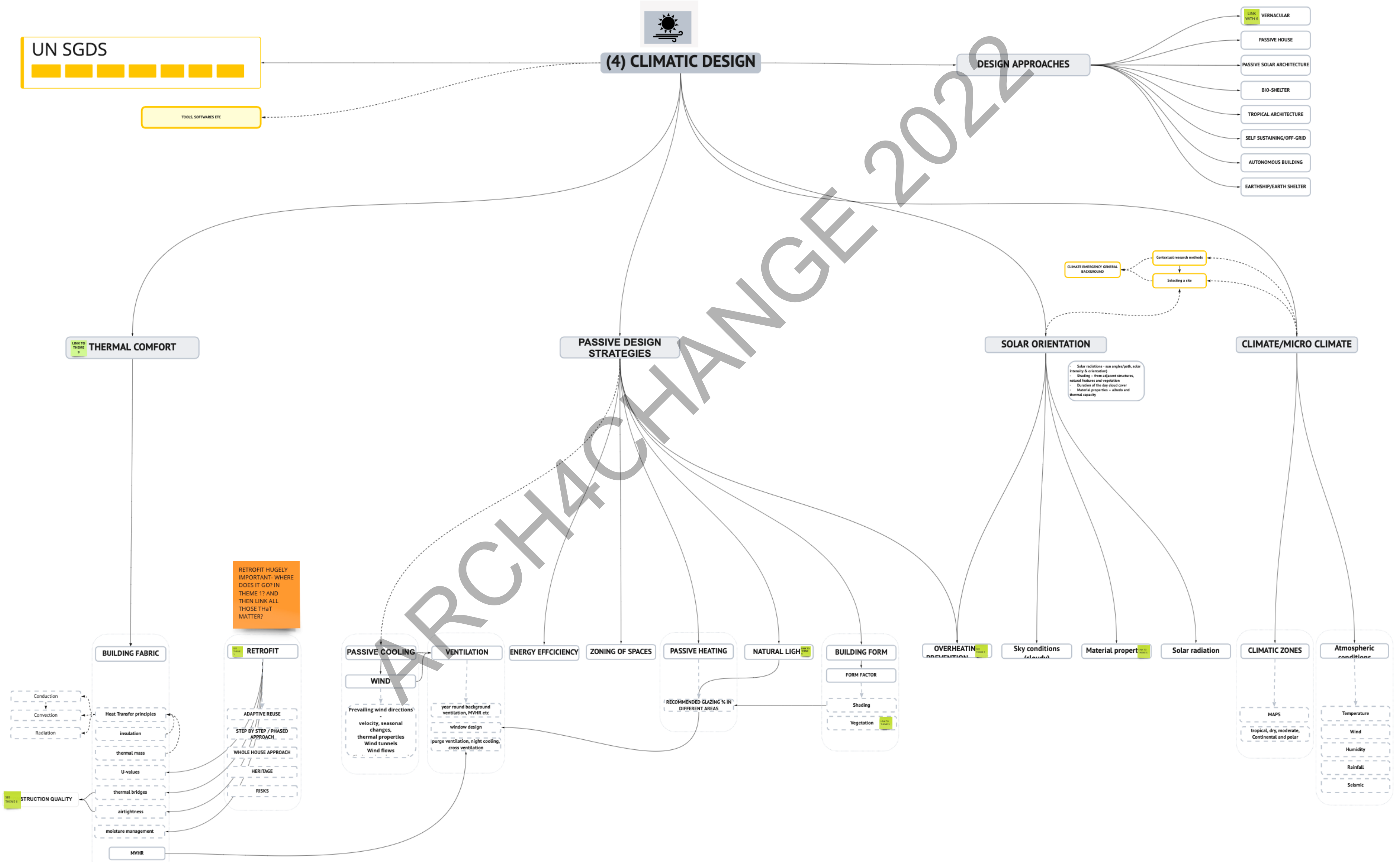
1 2 CLIMATE CHANGE CURRICULUM

CONTENT STRUCTURE



1 2 CLIMATE CHANGE CURRICULUM

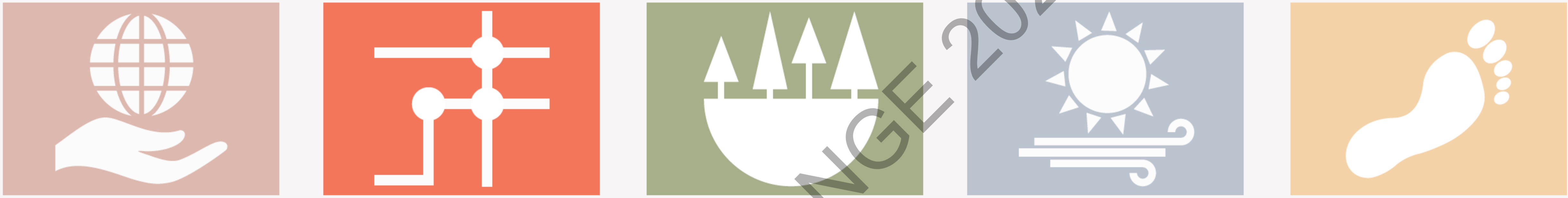
TOPIC CURRICULUM



5 DITIGAL PLATFORM

FOR ARCHITECTURAL EDUCATION

5 DIGITAL PLATFORM



GLOBAL & FUTURE RESPONSIBILITY

INFRASTRUCTURE

ENVIRONMENT

PASSIVE RESILIENCE

ENERGY & CO2

MATERIALS

HEALTH & WELL BEING

PEOPLE &COMMUNITY

DELIGHT

ENERGY & CO2

5 DIGITAL PLATFORM

COHESIVE AND FLEXIBLE SLIDE DESIGN

HEALTH

INDOOR AIR QUALITY

DUST LEVELS IN URBAN ENVIRONMENTS

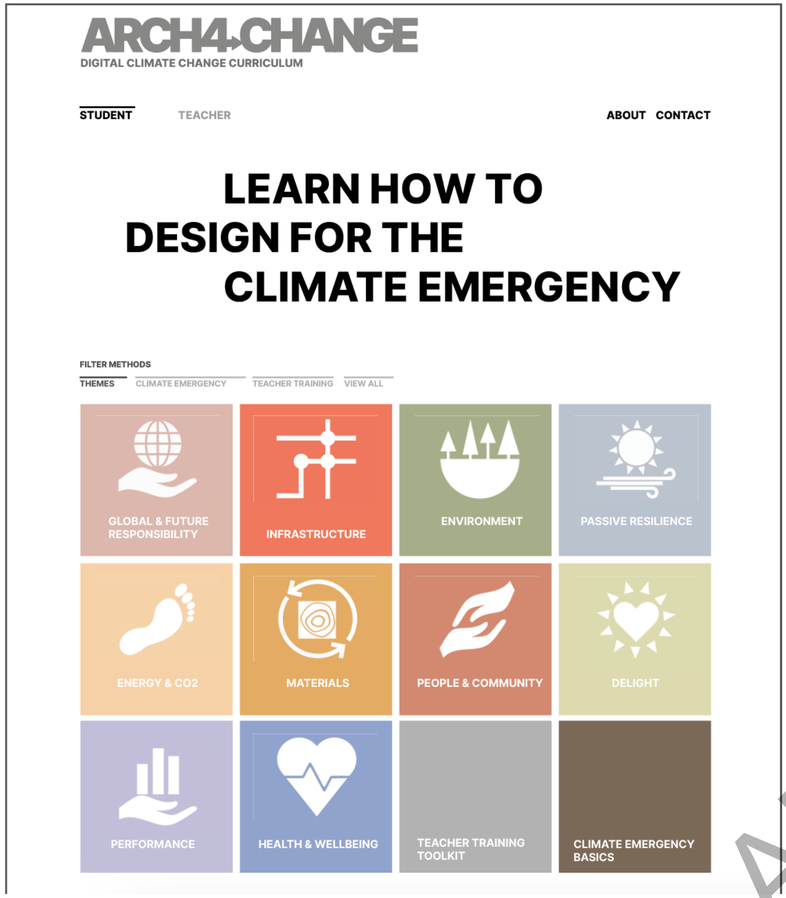
INDOOR AIR QUALITY

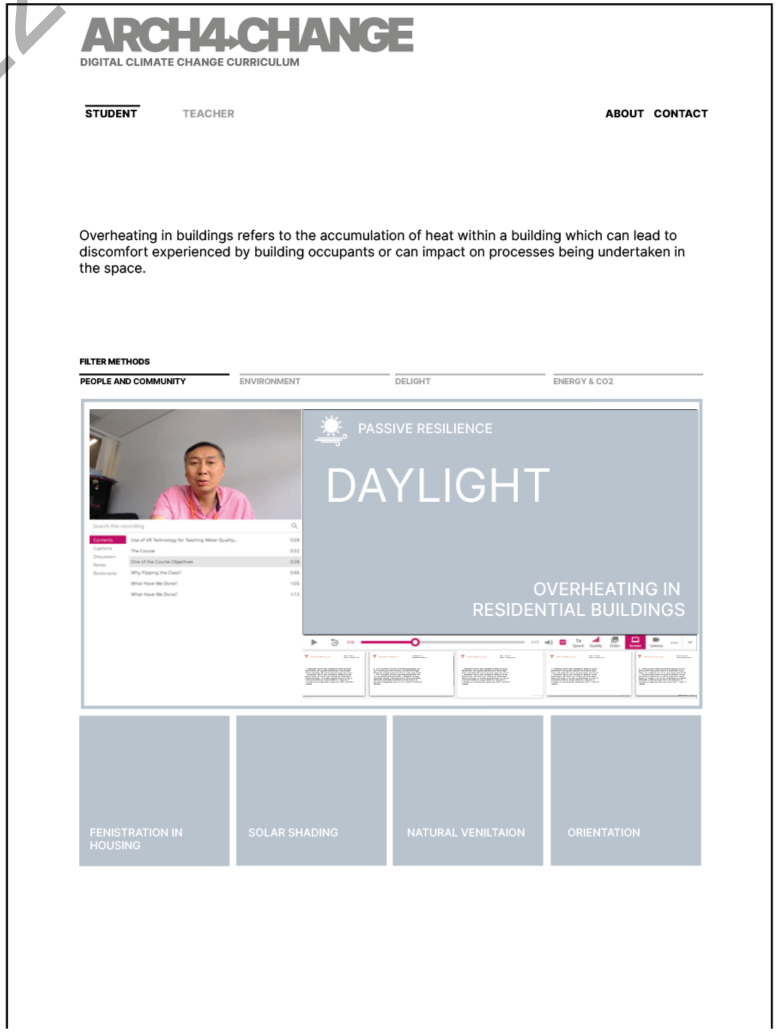
DUST LEVELS IN URBAN ENVIRONMENTS

- Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud
- Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate

5 DIGITAL PLATFORM

WEBSITE DUMMY





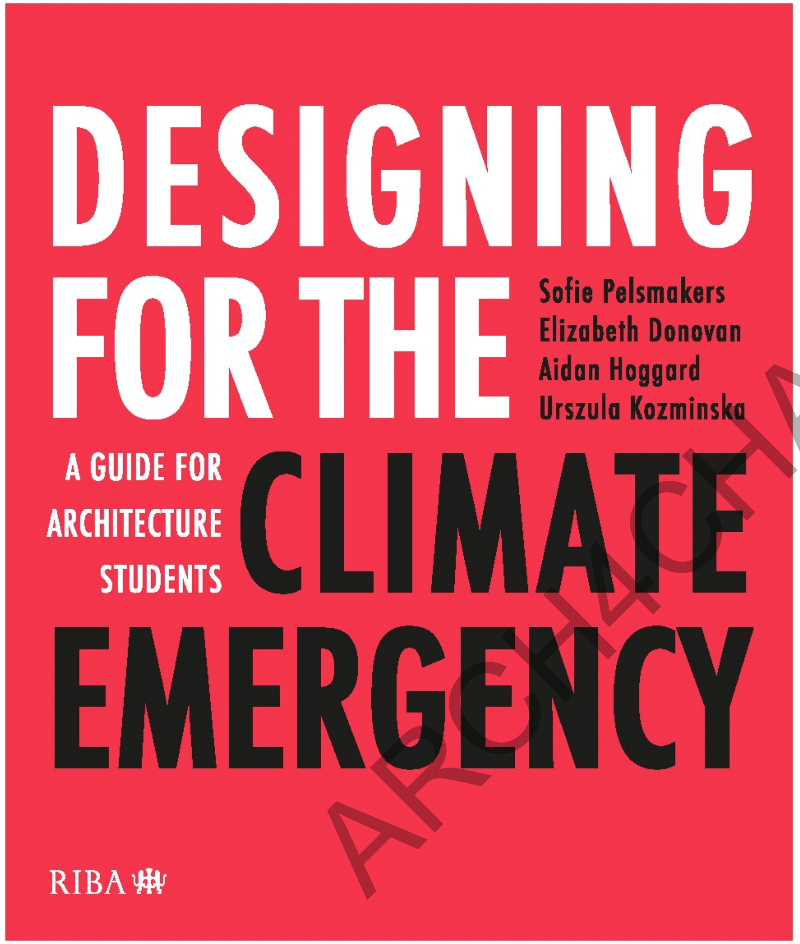
FUTURE FUNDING

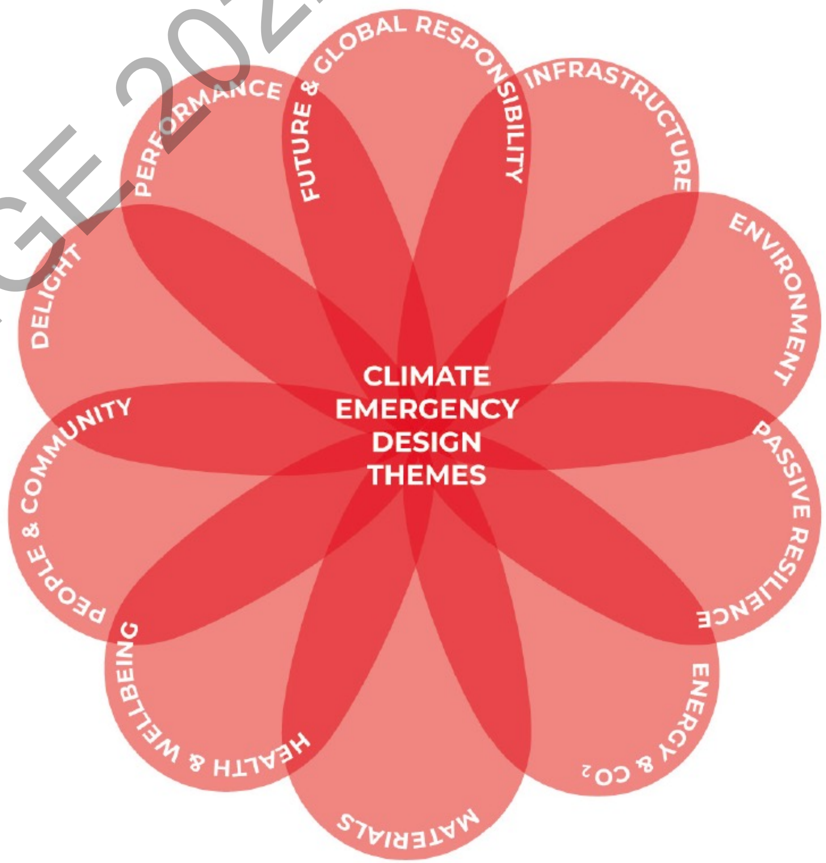
- COST Action Funding (European Cooperation in Science and Technology)

  Follow-on project for a 'Training School', and networking events to capture wider activities to disseminate ARCH4CHANGE but also expand it into transforming architecture education into more inclusive and democratic and collaborative learning environments needed for achieving the green transition (so a focus on teachers, not students).

- Developing partnership and funding with 3 Chinese universities
- Developing partnership and funding with universities in Ghana
- Input from other institutions

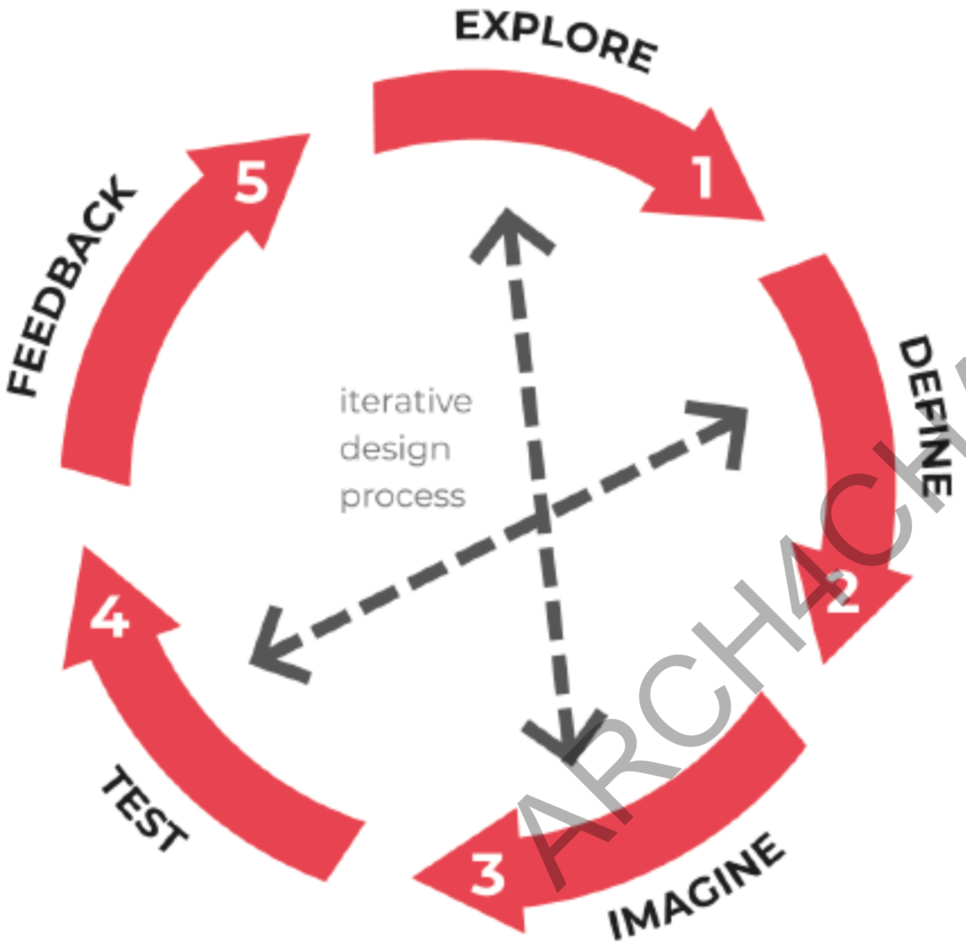
PARALLELL CONTENT





1 2 CLIMATE CHANGE CURRICULUM

PARALLELL CONTENT



V About the Authors
VI Acknowledgements
VII Introduction

1 CHAPTER 0
CLIMATE EMERGENCY FUNDAMENTALS

16 CHAPTER 1
EXPLORING YOUR CONTEXT – RESEARCHING AND ANALYSING YOUR SITE (STEP 1)

65 CHAPTER 2
DEFINING A DESIGN CONCEPT, AND CREATING VALUES AND GOALS (STEP 2)

106 CHAPTER 3
IMAGINING CLIMATE EMERGENCY DESIGN STRATEGIES (STEP 3)

146 CHAPTER 4
TESTING AND DEVELOPING CLIMATE EMERGENCY DESIGN STRATEGIES (STEP 4)

216 CHAPTER 5
VALIDATING AND COMMUNICATING YOUR APPROACH (STEPS 4 AND 5)

266 Afterword
267 Annex I: Technical insulation data table
268 Annex II: Worked example of U-value calculation
269 Glossary
274 Further reading
275 References
278 Index
269 Image credits

Developed by Signe Kongsbro, redeveloped by Aidan Hogaard, Sofie Pelsmakers and refined by Essi Nisonen

1 2 CLIMATE CHANGE CURRICULUM

PARALLELL CONTENT

2.3.2 Theme 2: Infrastructure

Infrastructure encompasses organisational and physical structures and facilities such as mobility and public transport links, density, communication, water and waste services, and energy, as well as the environment and social infrastructures. › It enables communities and cities to function, meeting essential service needs. This is why the safe, inclusive and sustainable provision and performance of infrastructure is the basis of sustainable design. Infrastructure is usually at a relatively large scale and so also encompasses many of the UN SDGs.

› see also Themes 3, 5 and 8

In some countries, urban areas are growing exponentially, creating a need for more sustainable infrastructure and planning. Therefore, there is an opportunity to develop efficient, sustainable and restorative infrastructure for all – including non-human species. Moreover, as this infrastructure is often hard to maintain and replace affordably, it is crucial that developing cities and communities plan for long-term robustness and adaptability ›, especially in the uncertain times of the climate emergency. It is important that we design for future rather than historical climates.

› see Theme 1

2.12 EXAMPLES

Inspiring examples for infrastructure

- 128 Arquitectura y Diseño Urbano – Lineal Gran Canal Park, Mexico City, Mexico
- Atelier d'Architecture Autogérée – R-Urban, Paris, France
- Brooklyn Grange rooftop farming, New York City, USA
- Klas Tham – Bo01, Malmö, Sweden
- Ramboll Studio Dreiseitl – Bishan-Ang Mo Kio Park, Singapore
- Michigan Urban Farming Initiative, Detroit, USA
- Tredje Natur – Enghaveparken, Copenhagen, Denmark
- Turenscape, Mangrove Park sponge city, China
- West 8 – Madrid RIO linear park, Madrid, Spain
- Yori Antar – Kalijodo Park, Jakarta, Indonesia

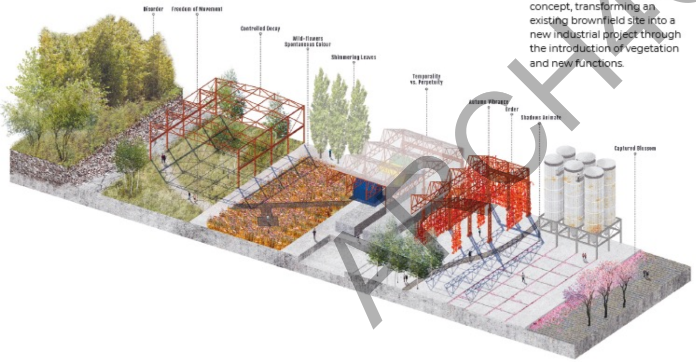


Figure 2.10 Olivia Hellman explored a new infrastructure concept, transforming an existing brownfield site into a new industrial project through the introduction of vegetation and new functions.

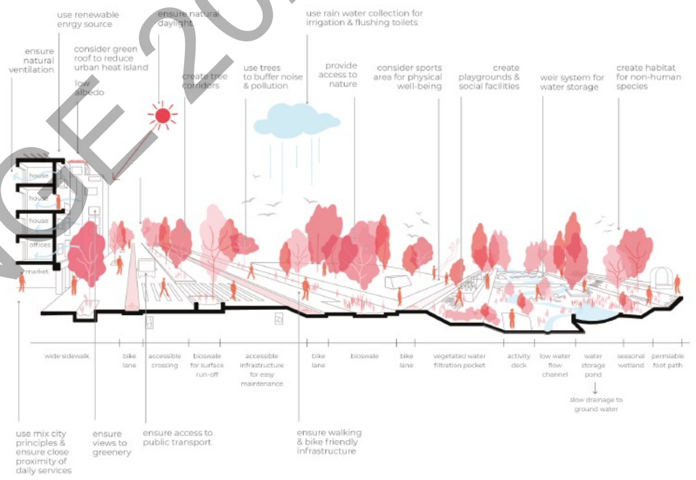


Figure 2.11 Diagram of key principles of possible infrastructure approaches, illustrating some of the key strategies and issues to consider at building and neighbourhood scale to integrate more sustainable infrastructure into a design concept.

Additionally, infrastructure determines the **urban metabolism** ›, so it is important that different types are considered together from end to end to ensure economic, social and environmental sustainability, i.e., **systems thinking**. ›

› see Glossary

› see Glossary

Sustainable infrastructure can, for example, encourage decarbonisation of transport systems, aid a transition towards renewable resources, reduce environmental and carbon footprints, and help rectify inequalities, to name only a few benefits.

Examples of sustainable architecture approaches that focus on sustainable infrastructure provision are summarised in **Table 2.3**.

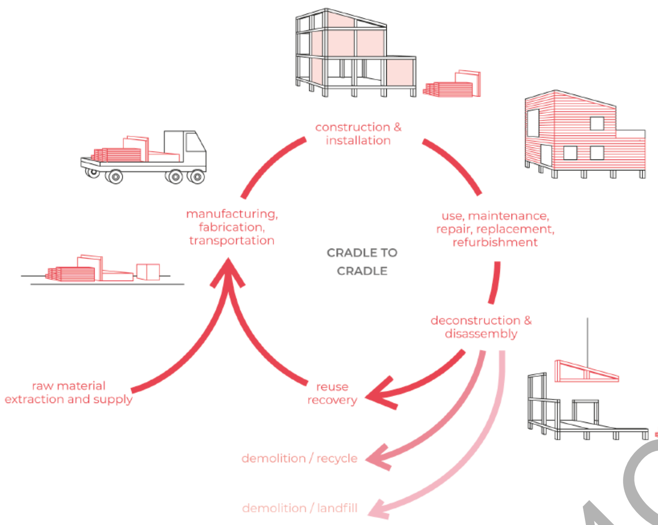
2.13 NOTE

Focusing on the environment to define your project

Make sure the location of your project informs the development of your concept by taking into account critical site features such as current and predicted microclimate, topography, geology, and blue and green infrastructure (**see Chapter 1, Table 1.3 and Note 2.15**).

1 2 CLIMATE CHANGE CURRICULUM

PARALLELL CONTENT



We must also move away from a linear economy to a circular economy. Instead of replacing or removing materials, or demolishing entire buildings that are incinerated or end up in landfill, we must think of materials being stored in buildings as part of a longer cycle of use and reuse, and keep these materials in circulation for as long as possible. This means designing for disassembly (DfD). ›

› see Figure 4.26 and Chapter 2, Table 2.2, Chapter 3, Theme 1

When developing your project, **Table 4.10** offers an overview; however, you can calculate the embodied energy and carbon footprint of different material choices and other impacts. ›

› see Chapter 5

Figure 4.26 Diagram showing cradle to cradle, from raw material extraction to manufacturing, construction, use, deconstruction and reuse or recovery – all part of circular construction principles.

TABLE 4.10 KEY CONSIDERATIONS FOR EMBODIED CARBON IN MATERIALS

Timber frame or structural insulated panels (SIPs)
These can be used for small buildings, offering possible lowered embodied carbon (and locally sourced) solutions.

Solid-mass superstructure
This involves using materials stacked up or cast to form walls that are structural. Reinforced concrete forms walls that are very strong, durable and fire-resistant, but the embodied carbon is high and deconstruction is difficult and only yields aggregate. Solid brick cavity walls are well used in Northern Europe and can provide superstructure, cladding, moisture management and insulation in a single build-up. Bricks have high embodied carbon due to their firing process, but if designed correctly bricks can be reused. › If designing with bricks, always seek to use recycled bricks and always specify lime mortar, which allows the bricks to be reclaimed intact in the future.

› see Table 4.6

Rammed-earth walls
These often use local soils compacted into a formwork, and may provide low embodied-carbon structural walls, though building height is limited. The walls must be protected from rain and water ingress and external walls will require an extra layer of thermal insulation. They have a good thermal mass potential. ›

› see Theme 4

Straw-bale walls
These can provide very low embodied-carbon structural walls, but must be protected from rain and water ingress, and building height is usually limited. Straw-bale walls will be thick, but this may be an advantage in terms of creating deep reveals that shade windows.

Engineered timber products
These can provide excellent, low embodied-carbon alternatives to steel or concrete for larger or more complex buildings. Cross-laminated timber (CLT) provides large slab-based products that can be used for walls, floors and roofs. Glu-lam can provide large columns and beams capable of spans similar to steel. Brettstapel is similar to CLT but uses timber dowels as opposed to glue, and is seen by some as a great option for low-carbon construction.[4] Nowadays it is not unusual to see large and complex buildings such as airports, offices and high-rise residential buildings made from engineered timber.

(Recycled) steel or concrete structures – see **Note 4.39**
Concrete is a high embodied-carbon material and should only be used exceptionally where there are practical reasons for whole-life carbon benefits. Designing partitions and external envelopes from in-situ concrete is no longer appropriate for a design in the climate emergency. If steel or concrete structures are the only options (e.g., in large infrastructure projects such as bridges), aim to offset the embodied carbon by renewable energy production of the materials, offsetting with other biogenic materials[5] and the use of reclaimed components, and always ensure that the structure can be disassembled and reused at the end of life. Where possible, utilise its thermal mass capacity effectively. ›

› see Theme 4

For concrete structures, you should design pre-cast elements for reuse at a later date. Pre-cast concrete soffit systems offer better-quality finishes and speed of construction, and may be designed for disassembly and reuse (provided they are not reliant on an in-situ concrete topping).

Finally, even recycled steel is high in embodied carbon. Reduce its impact with reclaimed steel sections and design for disassembly. ›

› see Chapter 3, Theme 1

PARALLELL CONTENT

Summer benefits

In most temperate climates, thermal mass combined with night-time ventilation can provide an excellent solution to prevent buildings from overheating in summer. This means that with suitable night-time ventilation, use of thermal mass helps to reduce air-conditioning. This is likely to become increasingly important in a warming climate.

The principle is quite simple: as the external air and sunlight warm up spaces during the day, the carefully designed thermal mass will absorb the heat and store it. This stops the internal air temperatures from rising quickly. However, it is crucial that it is combined with night-time cooling so that when the external air temperature drops at night, the stored heat will be released. By the following morning the thermal mass will have lost a good deal of this heat and will once again be ready to store heat during the day. If thermal mass is positioned near a person's body, they will benefit from radiant cooling because the material has a lower surface temperature, increasing thermal comfort.

Winter/spring/autumn benefits

In cooler months there are also benefits to including thermal mass in your design, and passive heating principles utilise this. › Thermal mass can help to keep buildings warm if window and shading design allow for direct winter solar gain to be incident on high thermal mass floors and walls. These elements will store heating energy and release it back into the building once the direct sunlight has passed. Some buildings have specially designed sunspaces that facilitate this, and they can be thermally separated from the rest of the building when there is little solar gain.

› see pages 134 to 135 and 204 to 211

4.13 NOTE

Using thermal mass

Remember that thermal mass requires adequate openings for night-time purge ventilation, and that a large surface of a thermal mass wall or floor is more important than its thickness. Thermal mass is most effective for the first 100 mm of depth. For floors this can be provided by the floor screed. Thermal mass is only effective when it is exposed to the air in rooms and so it should not be fully covered up.

4.14 EXAMPLES

Inspiring examples for passive heating and cooling

- HHS architects/Hélène Jourda and Gilles Perraudin – Mont-Cenis Academy, Herne, Germany
- João Filgueiras Lima – Sarah Kubitschek Hospital, Salvador, Brazil
- Kamal el-Kafrawi – windcatchers in University of Qatar, Doha, Qatar
- Laurie Baker – Centre for Development Studies, Thiruvananthapuram, India
- Haworth Tompkins – Everyman Theatre, Liverpool, UK

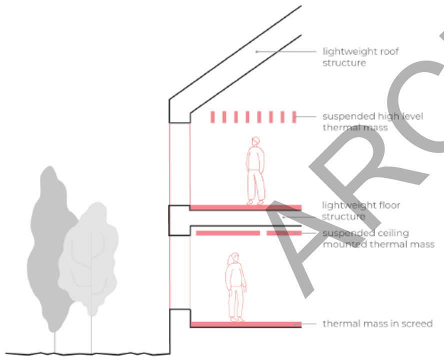


Figure 4.13 Diagram showing that in buildings with lightweight structures and floors effective thermal mass can be provided in the floor screed or in suspended ceiling elements. In the Woodland Trust Headquarters, Feilden Clegg Bradley Studios designed a CLT superstructure with suspended pre-cast concrete thermal mass elements.

Structural thermal mass

In the past, the use of dense structural elements such as concrete and brick has been justified as they have excellent thermal mass properties, if left exposed. However, they are also high in embodied energy and carbon. › In a climate emergency, you need a more holistic approach that considers the impacts and the entire life cycle of the materials you select. › For example, rammed earth and stone also have good thermal mass potential, and while not renewable materials, they are natural, with a lower carbon footprint if locally sourced. › For alternative design strategies, **see Table 4.14**.

› see Themes 5 and 6
› see Theme 6
› see Theme 6, Table 4.13

Non-structural thermal mass

The main benefits from thermal mass are achieved in the first 100 mm nearest to the surface. Therefore, it is possible to include thermal mass in projects with lighter and more sustainable structural systems such as timber. › You can include thermal mass in floor screeds, partition walls or ceiling elements, but make sure the additional weight is taken into account in the structural system. ›

› see Theme 6
› see Figure 4.13

4.4.4 Natural ventilation

In Chapter 3 you learned some key passive resilience principles at the site scale to maximise the potential for natural ventilation through building massing. Ventilation in buildings is normally a combination of natural and mechanical approaches. In this section, natural ventilation approaches are considered, while mechanical or active ventilation systems are in Theme 7 (Health and wellbeing). ›

› see Theme 7

Ventilation strategies enable the exchange of fresh air to the inside and stale, and warm air to the outside. Strategies depend on external air quality and noise, because they impact how much windows can be opened. They also depends on external climate and wind conditions, as well as on occupant activity, function and whether it is winter or summer. For example, ventilation is needed throughout the year to expel stale, humid and polluted air and replace it with fresh air, called **background ventilation**. › In summer, purge ventilation and night-cooling increases the airflow to help cool spaces and provide thermal comfort. ›

› see Glossary and Table 4.4
› see Theme 7

While you can design for active ventilation systems, consider suitable organisation of spaces to enable passive ventilation strategies when developing the plans and sections of your design. This includes the design of dual-aspect shallow spaces and buildings. › Some key recommendations are provided in **Table 4.4.** However, providing year-round good background ventilation to ensure good air quality is difficult to control with natural ventilation (as it depends on external conditions that cannot be influenced). Moreover, in the cooler seasons, opening of windows creates unnecessary heat loss (and therefore increases energy use). This is why, in low-energy and low-carbon buildings, highly efficient mechanical ventilation with heat recovery (MVHR) systems are an excellent low-energy solution if designed well. ›

› see Chapter 3, Theme 4
› see Theme 7

4.15 PRACTICE

Specialist advice for natural ventilation design

In practice it would be normal for a specialist consultant to advise on the design of building ventilation for the provision of fresh air, the extraction of air and to prevent summertime overheating. Usually, dynamic building energy models are created to aid in the design (see **Chapter 5, Table 5.6**).

4.16 NOTE

Difficulties with natural ventilation

The following situations may make it difficult to rely on natural ventilation alone, and typically require some form of mechanical ventilation. It may still be possible to provide natural ventilation at certain times of the day or year, however.

- Bathrooms, kitchens, labs, workshops, clinical rooms.
- Spaces with polluted or very noisy external environments.
- Spaces with specific acoustic requirements such as classrooms or performance rooms.
- Buildings with large differences between internal and external air temperature and humidity.
- Buildings with very low heating or cooling load, e.g., Passivhaus projects.

1 2 CLIMATE CHANGE CURRICULUM

Making an impact

""I'm truly excited about the impact that this book can make. It brings climate emergency to the centre of the design process for architects in a holistic and meaningful way from the context setting, right through to the validation of the design." - Fabia Jeddere-Fisher (UWE Bristol)

"A vital, timely book for the generation of architecture students tasked with tackling buildings' impact on the climate and ecological emergency. It will help them navigate the often-overwhelming challenge of sustainable design and develop the skills they'll need to drive change in practice." - Sian Moxon (London Metropolitan University)

"It's so inspiring to read a book giving practical design advice that goes beyond climate change mitigation to highlight real ways that designers can create a restorative impact... A must read for all architecture students, as well as built environment professionals who need a refresher." - Tom Dollard (PTE)

Scott McAulay • 2nd
Climate Literacy | Climate and Spatial Justice | Whole Life Carbon and Rege...
3mo • Edited •

Whilst this book's title suggests that it's a guide for architecture students, if you're going to be educating students and designing their courses, this is just as - or arguably even more - essential reading before you resume after a summer of climate breakdown-fuelled record high temperatures around the world. Education must be grounded in the reality of a climate and ecological emergency unfolding at pace and that means a radically different kind of architectural education than the one that led to where we are today: one shaped by a normality of overshooting planetary boundaries and separating ourselves from the natural world.

Was humbled to be invited to read through this and offer thoughts and hopefully it's made as accessible as possible at pace.

"Radical change is necessary of the built environment, and this book will support students in envisioning what such change could look like and offer practical guidance on designing for an uncertain future. Ensuring its accessibility to students and staff alike, so that its baselines and processes become everyday practice, could be transformational." - Scott McAulay (founder of the Anthropocene Architecture School)

'Designing for the Climate Emergency is not only timely and valuable, it is an urgent and necessary resource to all those teaching and studying architecture. It will be an essential guide to ensure that architects can address the climate emergency with creativity and success. If architectural education does not tackle this challenge now and equip the next generation with the necessary skills and knowledge to build on the legacy of the environmental movement, it will fail us. Buy this book, recommend it to students and start planning your courses and studios to incorporate designing for the climate emergency. I will.'

A superlative review of Designing for the Climate Emergency by Sofie Pelsmakers, Elizabeth Donovan, Aidan Hoggard and Urszula Kozminska from Koen Steemers for Buildings & Cities.

Amit Anafi • 2nd + Follow
Sustainability Manager presso Il Prisma | LEED AP |...
4d •

#climatechange what can we do about it??

"We must make an urgent shift in the values we hold, and how and why we do things. There is no room for error. Instead of seeing things as alarmist or an attack on our creative pursuits, it requires determination, conviction and optimism to trust that we are part of the solution, not the problem. And it requires more, not less, creative thinking"

couldn't have said it better.

Optimism and determination accompanied by concrete proposals and applications!
starting from education and into real life!

"Comprehensive, contextual, and unafraid of complexity, this guide takes the willing student - and that's all of us - from the climate emergency fundamentals, through to creating values, imagining strategies and thinking about how one might communicate." - Stephen Choi (Architecture for Change)

Pedro Sousa (He/Him) • 1st
MArch Architecture Student at UEL | Nominated for RIBA London Sustainabil...
3mo •

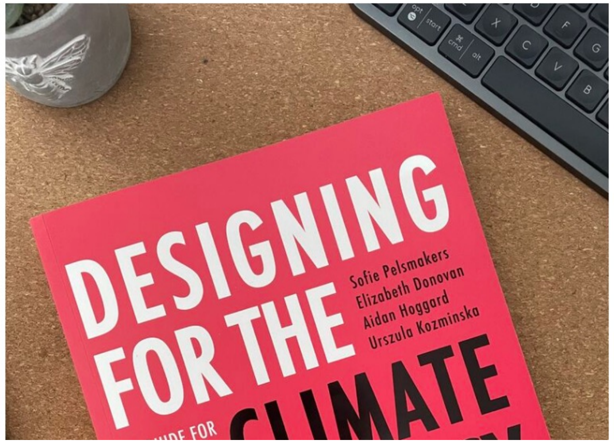
Great book!! Really happy with this purchase.

So good and useful information for architecture students and even for junior architects.

I highly recommend this book, full of research, illustrations, drawings, diagrams etc so we can start and continue to put into practice solutions for climate change.

"Designing for the Climate Emergency" by Sofie Pelsmakers, Elizabeth Donovan, Aidan Hoggard and Urszula Kozminska.

#climatechange #architecture #architects #research #students #sustainability #sustainabledesign



Co-funded by
the European Union

ARCH4CHANGE

Digital climate change curriculum for architectural education: methods towards carbon neutrality

ELIZABETH DONOVAN
ED@AARCH.DK