

From Transition to Practice: The Role of Education in Biobased Construction

INSPIRATION CATALOGUE



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1. Introduction

The construction sector is undergoing a significant transformation. Increasing focus on climate impact, resource use, and building performance is driving the adoption of biobased materials such as hemp, straw, flax, cattail, and other renewable resources. Biobased materials can reduce embodied climate impacts, depending on cultivation, processing, transport, construction, service life and end-of-life assumptions. They can also support circular construction and contribute to healthier indoor environments.

This development is not only changing what we build with—it is also changing how we build, how projects are organised, and which competencies are required across the construction sector.

For Vocational Education and Training (VET) and Technical Upper Secondary Education (TUS) this creates both a challenge and an opportunity. Educational programmes must reflect new materials, methods, and collaborations, while continuing to deliver reliable, practice-oriented teaching. At the same time, biobased construction opens new ways of combining technical skills, sustainability, and hands-on learning.

This inspiration catalogue is developed to support that transition. It is aimed at managers, programme leaders, and teachers who are working to integrate biobased construction into education. The catalogue combines strategic perspectives with concrete teaching approaches and real cases from practice.

Rather than presenting a single model, it shows different ways to begin—ranging from small pilot activities to more integrated approaches across programmes and educational levels.

This inspiration catalogue forms part of the BBoBB training module on biobased value-chain development. While *The Hemp Value Chain – The Orchestrator’s Challenge* provides a practical simulation for training stakeholder coordination, negotiation and the identification of blockages in a value chain, this catalogue supports the implementation and follow-up of that learning. It shows how educational institutions can act as partners and connectors in biobased construction value chains and provides examples of how cooperation, competence development and biobased construction activities can be embedded in practice.

1.1. From Transition to Practice: The Role of Education in Biobased Construction

The shift toward biobased construction is not only a material transition—it is a systemic change in how buildings are designed, produced, and assembled.

New materials such as hemp, flax and cattail are entering the construction sector. At the same time, value chains are being reorganised—from raw material sources now integrating agriculture and processing to design and construction. This affects not only what we build with, but also how different professions collaborate.

This creates a gap.

In many cases, the knowledge, roles, and workflows connected to biobased construction are still emerging. Traditional divisions between trades are shifting, new materials require new competencies, and practical experience is still limited. As a result, education does not yet fully reflect current and future practice.

At the same time, education holds a unique position.

VET and TUS are not only preparing students for the labour market—they are also part of the ecosystem that shapes it. Schools can act as testing environments, demonstration sites, and connectors between companies, municipalities,

and material producers. In this way, education becomes an active contributor to the development of biobased value chains.

This catalogue builds on that perspective.

It shows how education can move from awareness to implementation—starting with small initiatives and growing into integrated practice. It provides both strategic guidance for managers and concrete teaching approaches for educators, supported by real cases.

Together, these examples demonstrate that the transition to biobased construction is not a distant future scenario. It is already happening—and education can play a key role in making it work.

2. Managers and programme leaders (VET and TUS)

To translate this transition into practice, educational institutions need to make strategic choices. This involves balancing innovation with reliability, aligning with labour market developments, and creating the organisational conditions for new types of teaching and collaboration.

The following section outlines how managers and programme leaders can approach this task.

2.1. Why this matters.

As mentioned above, the construction sector is undergoing a structural shift. Climate targets, regulation, and market demand are accelerating the use of biobased materials such as hemp, flax, cattail, straw and other renewable resources. These materials contribute to CO₂ reduction, circular construction, and healthier buildings.

For VET and TUS, this development is already affecting practice. Schools that engage with biobased construction can:

- Strengthen the relevance of their programmes
- Align with labour market developments
- Position themselves as active contributors to the green transition

At the same time, the field is evolving. Not all solutions are equally established or widely accepted within the construction sector. A key task for management is therefore to balance innovation with reliability in teaching.

2.2. How to get started: three practical entry points

Start small (pilot approach)

- Introduce biobased construction through:
- A single module or project (e.g. Green Week)
- One programme or subject
- A collaboration with a local company

Integrate into existing subjects, for example:

Embed biobased materials into:

- Building physics
- Materials science
- Construction methods
- Design and technology

Develop a strategic focus area

Position biobased construction as:

- A profile area for the school
- A cross-disciplinary theme
- A basis for partnerships and funding

Important:

Start at a level that matches both organisational capacity and the maturity of the solutions you plan to use and be aware that the teachers may be co-learning along with students in getting the practical experience.

2.3. Working with innovation: using maturity as a decision tool

Because the Danish BBoBB pilot focuses on a hemp value chain and a Hemp House, the following maturity framework uses hemp-based products as its primary example.

Hemp-based construction products are developing rapidly and are becoming increasingly relevant within sustainable construction. At the same time, the field includes solutions with different levels of maturity—from well-documented insulation products to more experimental construction systems. For VET and TUS institutions, understanding these differences is important when integrating hemp-based materials into teaching.

A maturity-based approach can help schools balance innovation with reliable teaching practice.

Mature hemp-based solutions

Some hemp-based products are already relatively established and supported by technical documentation and practical experience. Examples include:

- hemp insulation mats,
- hemp fibre insulation,
- and certain prefabricated hemp-based boards.

These solutions are suitable for:

- standard workshop activities,
- compulsory teaching,
- and introduction to biobased materials and construction methods.

Emerging hemp-based solutions

Other solutions are still developing and are not yet widely used across the construction sector. Examples include:

- hemp-lime (hempcrete) wall systems,
- cast in-situ hemp-lime construction,
- and prefab hemp-based building elements.

These are well suited for:

- project-based learning,
- comparative analysis,
- full-scale mock-ups,
- and interdisciplinary collaboration.

Experimental hemp-based solutions

Some hemp-based materials and binders remain experimental and may have limited documentation or practical experience.

These are best used for:

- pilot projects,
- innovation activities,
- and exploratory teaching focused on experimentation and future construction methods.

Importantly, maturity is not only about the material itself. It also concerns educational readiness. Even promising hemp-based solutions may be difficult to implement if access to suppliers, workshop facilities, technical documentation, or teacher experience is limited.

Using a maturity perspective helps institutions:

- introduce hemp-based construction gradually,
- combine reliable teaching with innovation,
- and prepare students for a construction sector where biobased materials are becoming increasingly important.
- In this way, students learn not only how hemp-based materials are used in construction, but also how professionals evaluate new solutions in practice.



Use as a teaching–decision tool, not as a single global market ranking

Hemp-based building products: education maturity map

Mapping the maturity and adoption journey of hemp-based building products in education and practice



2.4. Key decisions for management

Define the level of ambition

Decide how biobased construction should be positioned:

- Introductory level: Basic understanding of materials and sustainability
- Integrated level: Embedded across subjects and programmes
- Specialisation level: Dedicated modules or flagship projects

The level of ambition should reflect:

- available teaching capacity
- facilities and resources
- the maturity of the solutions used

Recommendation:

Start with integration of mature solutions and expand into projects with emerging ones.

B. Align with labour market and policy

Biobased construction is driven by:

- Climate targets and CO₂ reduction requirements
- Increasing use of EPDs and LCA
- Growing interest from construction companies and public clients

Key question:

Which competencies will your graduates need in 3–5 years?

Examples:

- VET: material handling, correct detailing, safe execution
- TUS: analysis, documentation, systems thinking

C. Select materials and systems

Material selection should be guided by both relevance and maturity.

Use mature solutions for:

- compulsory teaching
- exams and certification
- standard workshop activities

Use emerging solutions for:

- project-based learning
- innovation modules
- interdisciplinary collaboration

Use early-stage solutions for:

- pilot projects

- partnerships with companies
- limited experimental activities

This ensures both:

- stable teaching quality
- exposure to current developments

D. Ensure organisational readiness

Introducing biobased construction affects:

Facilities and equipment

- Storage (dry conditions)
- Ventilation and dust extraction
- Workshop or lab adjustments including appropriate tools

Teaching capacity

- Knowledge of materials and building physics
- Familiarity with sustainability tools

Safety

- Dust, fibres, additives
- Handling and ergonomics

Less mature solutions may require:

- closer supervision
- smaller-scale implementation
- collaboration with external experts

Recommendation:

Start with simple mock-ups and test setups before scaling up.

E. Build partnerships

Collaboration is essential, especially in a developing field.

Relevant partners:

- Construction companies
- Material producers
- Municipalities and housing organisations
- Knowledge institutions

Partnerships are particularly important when working with:

- emerging solutions
- new materials or methods
- pilot activities

They provide:

- access to real cases

- updated knowledge
- opportunities for student involvement

F. Secure funding and resources

Costs may include:

- Teacher training
- Materials and equipment
- Development of teaching modules
- Facility adjustments

Funding can often be linked to:

- climate and innovation programmes
- regional development initiatives
- industry collaboration

Pilot projects using emerging solutions are often well suited for external funding.

G. Plan implementation and logistics

Consider:

- How biobased construction is placed in the timetable
- Whether it is:
 - a module
 - integrated teaching
 - cross-disciplinary projects

Also consider:

- Because these are biological materials, procurement and storage procedures should address moisture exposure and the potential risk of fungal growth.
- coordination across programmes

H. Ensure quality and learning outcomes

Define clear expectations:

VET

- Workmanship quality
- Safe processes
- Correct sequencing
- Documentation

TUS

- Design and analysis
- Comparative reasoning
- Reporting and presentation

Using a maturity-based approach helps ensure that core competencies are built on reliable solutions, and innovation is introduced in a controlled and meaningful way

Common pitfalls and challenges

While biobased construction offers significant opportunities, institutions often encounter practical challenges when moving from inspiration to implementation. A common barrier is limited teacher experience with new materials and methods, which can make it difficult to translate concepts into confident, hands-on teaching. In addition, access to biobased materials is not always stable, especially for emerging solutions, which can complicate planning and continuity in teaching activities. Another challenge is alignment with existing curricula, where learning objectives and assessment frameworks may still be oriented toward conventional construction practices. Finally, safety and regulatory conditions are not always fully defined for newer materials, requiring extra attention to risk assessment, documentation, and supervision. Being aware of these challenges makes it easier to plan realistic starting points and to combine innovation with reliable teaching.

What success looks like

A well-integrated approach to biobased construction will:

- Combine proven practices with emerging knowledge
- Strengthen alignment with industry and policy
- Enable hands-on, practice-oriented learning
- Support both stability and innovation in education

Summary

Introducing biobased construction is not about adding a new topic—it is about updating construction education to reflect current and future practice.

A successful approach:

- starts small and scales
- uses maturity to guide decisions
- combines reliability with innovation
- involves teachers and industry early

This ensures that biobased construction becomes a coherent and practice-oriented part of education—preparing students for a changing construction sector.

The decisions outlined above are not theoretical. In practice, institutions often start with small initiatives that gradually evolve into broader educational approaches.

The following case illustrates how this development can unfold over time.

Case A: UCE – From Project-based Experimentation to Integrated educational Practice

Context

At UCE, formerly CELF, biobased construction did not begin as a fully developed institutional strategy. It emerged gradually through externally funded projects, cooperation with Guldborgsund Municipality, and strong interest among teachers.

The municipality was working to develop a local value chain for hemp-based construction materials. This created a direct connection between regional development and education. Activities in classrooms and workshops were therefore linked to practical questions concerning cultivation, materials, construction methods, skills and future employment.

Teachers began by exploring three fundamental questions:

- What knowledge and experience already exist?
- How are other institutions teaching sustainable and biobased construction?
- How can this knowledge be translated into meaningful learning activities for students?

Some teachers participated in courses on biobased and biogenic construction and brought this knowledge back into the organisation. At the same time, an important professional question emerged:

Which trades should work with these materials, and how should responsibilities be divided?

There was no simple answer. Biobased construction affects several trades and often changes the sequence in which work is carried out.

Development process

1. Starting with a limited educational activity

The first practical step was taken in vocational education and training.

Biobased materials were introduced within the Technology subject as part of a broader focus on sustainable construction. The purpose was not initially to create a specialist programme, but to give students and teachers an accessible entry point.

This made it possible to begin within an existing curriculum and to build experience without requiring major organisational changes.

2. Expanding across educational levels

As teachers and students gained experience, biobased construction became more than an isolated topic.

The work was gradually extended to Technical Upper Secondary Education. Here, students could engage with the subject through:

- material comparison;
- design and analysis;
- environmental assessment;
- technical documentation;
- and systems thinking.

The connection between VET and TUS strengthened the overall educational approach. Practical construction experience from VET could be combined with the analytical and design-oriented perspectives used in TUS.

3. Moving from theory to hands-on learning

A major turning point came when teachers began constructing mock-ups using different sustainable and biobased materials.

The mock-ups allowed students to:

- handle and compare materials;
- examine construction layers and details;
- understand sequencing and workmanship;
- discuss moisture, insulation and durability;
- and evaluate the difference between conventional and biobased solutions.

This changed the character of the teaching. Materials were no longer abstract examples described in textbooks. They became tangible components that students could test, question and apply.

The practical work also revealed important implementation requirements. Effective hands-on teaching depended on:

- reliable access to materials;
- suitable tools and equipment;
- workshop space;
- teacher preparation;
- technical documentation;
- and sufficient time for experimentation.

Because biobased materials and specialised equipment can be more expensive than conventional teaching materials, external funding and partnerships played an important enabling role.

4. Understanding changing professional roles

Practical work with biobased construction also showed that established divisions between trades do not always apply.

In conventional construction, one trade may complete its work before another begins. In biobased systems, the order may change. For example, a timber frame may be constructed before hemp-lime infill or other biobased layers are installed.

This affects:

- task sequencing;
- coordination between trades;
- responsibility for detailing;
- moisture management;
- and quality assurance.

The experience demonstrated that biobased construction should not be treated as the responsibility of one profession alone. Carpenters, bricklayers, electricians, plumbers and other trades all interact with the building envelope and must understand how new materials affect their work.

Biobased construction therefore became a natural basis for interdisciplinary teaching.



5. Developing a clearer focus on hemp

Over time, UCE placed greater emphasis on hemp-based construction.

This focus was closely connected to:

- the municipality's ambition to develop a local hemp value chain;
- the Danish BBoBB pilot and Hemp House;
- access to practical demonstration activities;
- and growing teacher experience.

Teaching became increasingly material-based, practical and connected to real construction processes.

Students did not only learn why hemp might be relevant. They also investigated how hemp-based materials behave, how they are installed and what limitations must be considered.

6. Combining theory and practice

Teachers found that no single teaching sequence worked in every situation.

In some activities, students benefited from receiving theoretical instruction before entering the workshop. In other activities, practical experimentation created questions that made the subsequent theory more meaningful.

The strongest learning process was therefore iterative:

theory → practice → reflection → revised understanding → improved practice

This approach enabled students to connect technical concepts with their own observations and experiences.

7. Using demonstration activities beyond the classroom

The mock-up was also used at the Danish construction-sector SkillsChallenge in 2025.

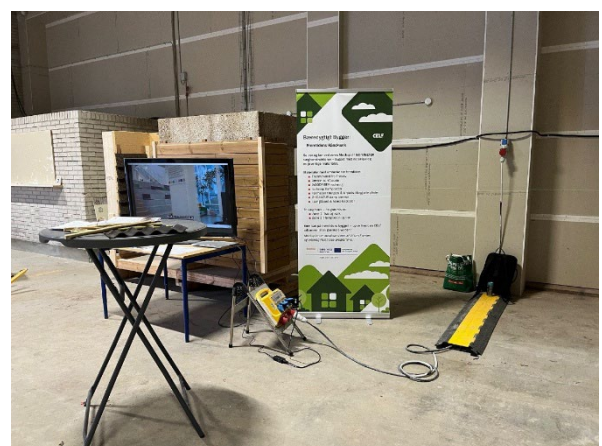
The exhibition created a visible platform for discussing biobased construction with:

- students;
- vocational teachers from other institutions;
- construction professionals;
- visitors;
- and the national Knowledge Centre for Craftsmanship and Sustainability.

Because the discussions were centred on a physical construction element, they moved beyond general statements about sustainability. Participants could discuss specific issues such as:

- material selection;
- construction detailing;
- sequencing;
- workmanship;
- and teaching methods.

The activity helped position UCE as an institution with practical experience in biobased construction and strengthened knowledge exchange with other educational actors.



Management perspective

The development did not follow a fixed linear plan. Management supported a gradual process driven by teacher engagement, project opportunities and external partnerships.

Important management contributions included:

- allowing teachers to experiment;
- supporting professional development;
- recognising the need for materials and equipment;
- facilitating cooperation across programmes and trades;
- and maintaining partnerships with external organisations.

Management also had to address several practical challenges:

- higher material and equipment costs;
- dependence on external funding;
- coordination across departments;
- uncertainty connected to emerging materials;
- and difficulties fitting experimental work into fixed teaching plans.

The role of management was therefore not to define every step in advance, but to create conditions in which promising activities could be tested, evaluated and expanded.



Results

Biobased construction at UCE has developed from a limited project activity into a broader educational practice.

It is now characterised by:

- integration across VET and TUS;
- hands-on and material-based learning;
- interdisciplinary cooperation;
- links to regional development and value chains;
- and growing teacher competence.

What began as an externally supported initiative has gradually become embedded in everyday teaching.

Lessons for other institutions

UCE's experience suggests that successful implementation can begin without a complete long-term plan.

Institutions can start by:

- using one existing subject or module;
- supporting interested teachers;
- building a small mock-up;
- cooperating with a local company or municipality;
- and expanding activities after evaluating what works.

The case also shows that:

- innovation often begins through projects and partnerships;
- teacher ownership is essential;
- practical learning requires investments;
- regional value chains can make teaching more relevant;
- and experimental construction does not always fit neatly into predetermined schedules.

The central lesson is that educational change can be built gradually.

A school does not need to begin with a complete specialist programme. It needs a realistic first activity, organisational support and a willingness to develop successful practices over time.

Source: Kristine Zeuthen Jeppesen, Project Manager, UCE

3. Inspiration for teachers

While management sets the direction and creates the conditions, the transition becomes real in teaching practice.

The following section shows how biobased construction can be integrated into teaching—through concrete assignments, learning formats, and hands-on activities.

3.1. Teaching biobased construction in construction VET

Case B: Biobased Construction in Carpentry Practice

Programme: Vocational Education and Training (Carpentry – Foundation course, Technology F)

Format: Project-based module combining theory, calculation, documentation, and hands-on construction (mock-up)

Context

Biobased construction is introduced as part of the core Technology subject, not as an add-on but as a natural extension of existing vocational competencies. The approach integrates sustainability into fundamental carpentry skills such as material understanding, measurement, planning, and execution.

The course is structured around a central project: designing, analysing, and constructing a biobased ground deck as a full-scale mock-up.

Students work with both biobased and conventional solutions, allowing them to compare performance, cost, and environmental impact in a practical and profession-oriented way.

At the same time, the course reflects the broader purpose of the Technology subject: to combine craft skills with product development, documentation, and user-oriented thinking

Case B presents a focused vocational construction module, while Case C presents an extended Technology F programme integrating science, innovation and product development

Assignment

Students must develop, document, and construct a biobased alternative to a traditional ground deck.

The assignment includes:

- Understanding why biobased materials are relevant (CO₂, sustainability, indoor climate)
- Comparing a traditional and a biobased construction solution
- Producing technical documentation and calculations
- Building a 1 m² physical mock-up
- Presenting both process and results

All work is documented in a documentation portfolio and a presentation.

Work Process (Student Activities)

1. Introduction and framing

- Introduction to biobased construction and sustainability
- Discussion: why materials matter (CO₂, resource use, building performance)

2. Material understanding

- Research and describe biobased materials:
 - Origin (where it comes from)
 - Properties
 - Applications
- Compile material descriptions in structured documentation

3. Environmental assessment

- Calculate CO₂ impact of:
 - A biobased ground deck
 - A traditional ground deck
- Compare results and interpret findings

4. Technical planning and calculation

- Perform material take-off and price calculation:
 - Quantify material use
 - Investigate market prices
- Reflect on cost differences between conventional and biobased solutions

5. Workflow planning

- Plan the construction process:
 - Who does what and when
 - Sequence of tasks
- Document workflow (e.g. flowcharts or written plan)

6. Practical construction

- Build a 1 m² mock-up of the selected ground deck
- Apply carpentry skills in a real construction scenario
- Work in teams with defined roles

7. Documentation and presentation

- Maintain a documentation portfolio
- Prepare a presentation (e.g. PowerPoint)
- Present process, choices, and results

Learning Outcomes

Students are able to:

- Explain why biobased materials are relevant in construction
- Describe and compare material properties and applications
- Perform basic CO₂ assessments and interpret results
- Carry out material take-off and price calculations
- Plan and execute a construction workflow

- Build and evaluate a construction component in practice
- Document and communicate technical work professionally

These outcomes directly connect sustainability with core vocational competencies, rather than treating it as separate theory.

Minimum Deliverables

- Documentation portfolio including:
 - Material descriptions (biobased materials)
 - CO₂ calculations (biobased vs conventional)
 - Material take-off and price calculation
 - Workflow plan
- One physical mock-up (1 m² ground deck)
- Presentation (process + results)

Teaching Perspective

This case demonstrates how biobased construction can be integrated into existing subjects without restructuring the curriculum.

Key strengths of the approach:

- Direct alignment with vocational practice
Sustainability is embedded in tasks students already recognise (measuring, building, pricing)
- Combination of theory and practice
Students move from abstract concepts (CO₂, materials) to tangible construction
- Strong focus on documentation
Reflects real industry requirements and strengthens professional competencies
- Clear progression
From understanding → analysing → planning → building → reflecting

The case also highlights an important insight:

Hands-on experience is essential—biobased construction only becomes meaningful when students can work physically with materials, compare solutions, and see the consequences of their choices in practice.

Source: Kasper Pouli Engel Hansen, Technology Teacher, UCE

Case C: Technology Subject – From Climate Understanding to Biobased Construction Practice

Programme: Vocational Education and Training (Carpentry – Foundation course, Technology F)

Format: Project-based module combining scientific understanding, material studies, analysis, and hands-on construction (mock-up + prototype)

Context

In this course, biobased construction is introduced through the Technology subject as a combination of craft, product development, and societal understanding. The subject integrates practical skills with knowledge about materials, users, and technological development.

The module is designed to move students from basic climate literacy (e.g. greenhouse effect, photosynthesis) to applied construction practice, where they must make and justify material choices.

Students work project-based with the theme *Biobased Construction*, combining:

- Scientific understanding (CO₂, climate impact)
- Material knowledge
- Technical calculations
- Practical construction
- Product development and testing

The course culminates in building a full-scale mock-up of a ground deck and presenting the entire process.

Assignment

Students must investigate, develop, and apply knowledge about biobased construction through a structured project.

The assignment includes:

- Understanding climate challenges and the role of construction
- Analysing and comparing materials (biobased vs conventional)
- Developing and testing a prototype material (sawdust-based)
- Designing and building a 1 m² construction mock-up
- Documenting all steps in a portfolio and final presentation

The project is both analytical and practical, reflecting real construction workflows.

Work Process (Student Activities)

1. Scientific foundation

- Learn key concepts:
 - Greenhouse effect
 - Photosynthesis
- Understand how biobased materials store CO₂ and reduce emissions
- Reflect on construction's role in climate challenges

2. Sustainability framing and problem analysis

- Work with UN Sustainable Development Goals
- Identify relevant goals for construction
- Develop a problem tree:
 - Core problem: construction contributes to climate and environmental challenges
- Analyse causes, effects, and possible interventions

3. Life cycle thinking (LCA)

- Introduction to LCA as a professional framework
- Develop simplified lifecycle sketches (reuse vs linear systems)
- Understand how environmental impact is assessed across a product lifecycle

4. Material understanding and comparison

- Research biobased materials:
 - Origin
 - Properties
 - Applications
- Compare to conventional materials
- Work with tools such as:
 - Material Pyramid (CO₂ impact)
 - Certification systems (FSC, PEFC)

5. CO₂ calculation and comparison

- Calculate CO₂ impact of:
 - A biobased ground deck
 - A traditional ground deck
- Compare results and interpret differences

6. Product development: prototype material

- Develop a building material from sawdust
- Plan production (materials, process, feasibility)
- Produce and test prototype:
 - Strength, durability, behaviour
- **Document and evaluate:**
 - Product description
 - Market comparison
 - SWOT analysis
- Reflect on real-world applicability

7. Technical planning and construction

- Perform:
 - Material take-off
 - Price calculation
- Plan workflow:
 - Roles and sequencing
- Build a 1 m² ground deck mock-up

8. Documentation and presentation

- Maintain a documentation portfolio
- Prepare a final presentation covering:

- Climate relevance
- LCA understanding
- Material choices
- Construction process
- Reflections on planning vs execution

Learning Outcomes

Students are able to:

- Explain key climate concepts relevant to construction
- Understand how biobased materials contribute to CO₂ reduction
- Apply life cycle thinking at the principle level
- Analyse and compare construction materials
- Develop and test simple material prototypes
- Perform basic CO₂ calculations and material estimations
- Plan and execute a construction process
- Document and communicate technical work
- Reflect on sustainability in practical construction contexts

These outcomes connect sustainability directly to trade competencies, rather than treating it as abstract theory.

Minimum Deliverables

- Documentation portfolio including:
 - Problem tree analysis
 - LCA sketches
 - Material descriptions
 - CO₂ calculations
 - Prototype development and testing report
 - Workflow and cost calculations
- One prototype material (sawdust-based)
- One 1 m² construction mock-up
- Final presentation (15 min + discussion)

Teaching Perspective

This case illustrates a fully integrated approach where sustainability, technology, and craftsmanship are combined into one coherent learning process.

Key strengths:

- Strong progression
From theory (climate science) → analysis → material understanding → making → building
- Dual learning track
Students work both with:
 - Construction systems (mock-up)
 - Material innovation (prototype)
- High level of student engagement
Hands-on activities (building + prototyping) make abstract concepts tangible
- Alignment with real practice
Includes core professional tasks:
 - Documentation
 - Pricing
 - Planning
 - Material evaluation

- Bridges science and trade
Connects concepts like photosynthesis and CO₂ directly to construction decisions

Source: Kasper Pouli Engel Hansen, Technology Teacher, UCE

Case D: Green Week – From Conventional to Biobased Construction

Programme: Vocational Education and Training (Carpentry / Construction – GF2 level)

Format: Intensive one-week interdisciplinary module combining theory, analysis, and hands-on construction

Context

The construction sector is undergoing a green transition, requiring future craftsmen to understand not only how to build, but how to build sustainably. During *Green Week*, students are introduced to the evolution of construction practices—past, present, and future—and explore how material choices and building methods impact climate, resources, and waste.

The course combines theoretical input with practical workshop activities. Students work with real construction elements and are challenged to rethink conventional solutions by integrating biobased materials and circular thinking.

The week is structured around three key perspectives:

1. **Understanding the past** – how traditional and industrialised construction methods developed
2. **Analysing the present** – current materials, waste streams, and climate impact
3. **Building the future** – applying biobased solutions in practice

This aligns with the learning focus on sustainability, material properties, climate impact, and resource use.

Assignment

Students must investigate, compare, and construct two versions of a building element:

1. A **conventional construction solution** (based on standard materials such as mineral wool and gypsum)
2. A **biobased alternative solution** (using materials such as wood fibre, cellulose, or clay-based boards)

The goal is to understand how construction choices influence:

- Climate impact (CO₂ emissions)
- Resource consumption
- Waste generation
- Building performance (e.g. moisture, durability)

Students are required to document and reflect on both solutions and evaluate their differences.

Work Process (Student Activities)

1. Introduction and theory

- Introduction to sustainability concepts: resources, climate impact, and material properties
- Understanding waste management and circular principles in construction
- Basic introduction to EPD and LCA as tools for assessing environmental impact

2. Analysis of current construction

- Build a **mock-up of a conventional wall structure**
- Identify materials, layers, and functions (e.g. insulation, vapour barrier)
- Reflect on how current building practices developed

3. Transition to biobased construction

- Investigate alternative materials (e.g. biobased insulation, natural boards)
- Compare material properties and environmental impact

- Recalculate or rethink the construction using biobased solutions

4. Practical construction

- Build a **second mock-up using biobased materials**
- Follow a structured workflow: planning, frame construction, insulation, interior layers
- Work in teams with defined roles and time constraints

5. Environmental assessment

- Analyse selected materials using EPDs
- Understand life cycle thinking and how CO₂ impact is calculated across a building's lifespan

6. Reflection and discussion

- Compare the two constructions (conventional vs biobased)
- Discuss advantages, limitations, and feasibility
- Reflect on how the carpenter's role is changing in the green transition

Learning Outcomes

By the end of the case, students should be able to:

- Explain key concepts related to sustainability and green transition in construction
- Identify and compare conventional and biobased building materials
- Understand basic building physics principles (e.g. moisture, material behaviour)
- Apply materials in practice with minimal waste
- Describe how construction contributes to climate impact and how it can be reduced
- Collaborate across roles and understand interdisciplinary aspects of building

These outcomes reflect the intended competencies of gaining knowledge about sustainability, material use, and collaboration in construction.

Minimum Deliverables

- Two physical mock-ups (conventional and biobased)
- Documentation of construction process (photos + notes)
- Material comparison (properties, use, environmental aspects)
- Short explanation of EPD/LCA findings
- Group reflection:
 - What are the key differences?
 - What would you choose in practice—and why?

Source: Knud Erik Ellemose Jørgensen, Carpentry Teacher, UCE

Case E: Biobased Material Library – From Sample Collection to Active Learning Tool

Programme: VET (Carpentry, Masonry, Construction) and Continuing Education

Format: Ongoing learning environment integrated across courses and modules

Context

As biobased construction becomes increasingly relevant, students need more than theoretical knowledge—they need **direct, hands-on familiarity with materials**. A biobased material library provides a structured way to integrate material understanding into everyday teaching across programmes.

The material library is not a passive collection, but an active teaching tool. It supports multiple educational levels and connects directly to ongoing initiatives in sustainability and green transition within construction education.

It also creates continuity between:

- Introductory training (material understanding)
- Main courses (construction and building physics)
- Advanced work (documentation and sustainability assessment)

Assignment

Students work with the material library to:

- Select and justify material choices
- Analyse technical and building-physics properties
- Compare conventional and biobased materials
- Document decisions using technical data
- Reflect on sustainability and resource use

The material library is used across different assignments rather than as a standalone activity.

Work Process (Student Activities)

1. Material exploration (foundation level)

- Handle and compare materials (weight, structure, texture)
- Test basic properties through simple exercises
- Discuss possible applications in construction
- Examples of materials:
 - Wood fibre insulation
 - Cellulose (paper-based insulation)
 - Hemp and flax products
 - Solid wood
 - Biobased boards

2. Building physics and construction (intermediate level)

- Use materials in relation to building components (e.g. wall systems)
- Analyse moisture behaviour, insulation performance, and detailing
- Identify risks such as condensation or thermal bridges

- Focus areas include:
 - Moisture transport and diffusion
 - Insulation thickness and performance
 - Climate screen design

3. Documentation and Quality Assurance (advanced level)

- Work with real documentation:
 - EPDs
 - CE marking
 - Fire documentation
 - Installation guides
- Justify material choices using technical data
- Produce written documentation and simple reports

Students learn to connect material choice with professional standards and requirements

4. Sustainability and Resource Perspective

- Analyse materials in relation to:
 - CO₂ storage
 - Renewable resources
 - Waste handling
 - Environmental impact
- Compare biobased and conventional materials

This supports the development of resource-conscious and sustainable work practices

Learning Outcomes

Students are able to:

- Select and apply materials correctly in construction
- Understand key material properties and building physics
- Document and justify material choices
- Work with technical documentation and standards
- Integrate sustainability into practical decision-making

These competencies are directly linked to core vocational learning objectives and embed sustainability into everyday practice

Minimum Deliverables

Depending on course level:

- Material comparison (biobased vs conventional)
- Short technical documentation (based on EPDs or similar)
- Application proposal (where and how to use the material)
- Reflection on sustainability and performance

Teaching Perspective

The material library demonstrates how biobased construction can be integrated continuously rather than as isolated projects. It supports both theoretical understanding and practical application and can be used across multiple subjects and programmes.

It also strengthens collaboration between education and industry, as materials, documentation, and updates can be sourced through suppliers and partners.

Implementation Note (for institutions)

To function effectively, the material library requires:

- Continuous updating of materials
- Integration into teaching plans
- Clear responsibility for maintenance
- Collaboration with suppliers and external partners

When implemented successfully, the material library becomes a permanent learning infrastructure that supports the transition toward biobased construction in education.

Source: Knud Erik Ellemose Jørgensen & Daniel Dalbom Hansen, Carpentry Teachers at UCE.

3.2. Teaching Biobased construction in Technical Upper Secondary Education

Case F: The Hemp House – Design of Physical Environments

Programme: Architecture & Design (TUS)

Format: Project-based design module combining analysis, concept development, and spatial representation

Context

The Hemp House is conceived as a biobased demonstration building, constructed using hemp-based materials and timber. It functions both as a learning laboratory and a visible landmark, showcasing how biobased construction can be integrated into real architectural contexts.

The project introduces students to designing with emerging materials, where environmental performance, user needs, and spatial quality must be considered together. Students are challenged to adapt the Hemp House to their own school context—functionally, aesthetically, and in terms of user experience.

Assignment

Students must develop a design proposal for how the Hemp House can be adapted to their organisation.

The assignment includes:

- Analysing user needs and context
- Developing design concepts using different architectural approaches
- Integrating hemp as a material in design decisions
- Translating concepts into drawings or models
- Presenting both process and final proposal

Work process:

1. **User and context analysis**
 - Define target groups (students, teachers, visitors)
 - Identify needs, functions, and user scenarios
2. **Needs and values mapping**
 - Develop a **PV chart** (needs/values/priorities)
 - Translate user insights into design criteria
3. **Concept development**
 - Select three architects or design approaches
 - Create initial sketches using different methods
4. **Material exploration**
 - Work with hemp material samples
 - Develop a material palette supporting the design concept
5. **Midterm evaluation**
 - Present concepts for peer and teacher feedback
 - Reflect and select one direction
6. **Design development**
 - Develop the selected concept further
 - Translate into:
 - 3D model/drawing, or
 - scaled drawings (plans, sections, elevations)
7. **Final presentation**
 - Present the full design proposal
 - Document the process from analysis to final concept

Core vs optional

Core (must do):

- Target group analysis
- PV chart (needs/values)
- Concept sketches (multiple approaches)
- One developed design proposal
- Final presentation

Optional (if time/resources allow):

- Physical model
- Advanced 3D modelling
- Detailed material or construction analysis
- Integration of indoor climate strategies (e.g. pond concept)

Learning outcomes

Students are able to:

- Analyse user needs and translate them into spatial design
- Apply different architectural methods and approaches
- Integrate material considerations into design decisions
- Develop and communicate design concepts through drawings or models
- Reflect on how biobased materials influence architecture and user experience
- Present and justify design proposals

Minimum deliverables

- Defined target groups + short needs description (personas acceptable)
- PV chart documenting needs, values, and priorities
- Set of concept sketches (minimum three approaches)
- Material board (hemp-based materials)
- One developed design proposal:
 - 3D model, or
 - scaled drawings (plans/sections/elevations)
- Final presentation (process + final proposal)

Teacher notes

- **Student challenge:** Students may focus on form over function—ensure strong link to user needs
- **Design support:** Provide examples of architectural methods to guide sketching
- **Material understanding:** Hemp is often unfamiliar—use samples or references where possible
- **Time management:** Concept development can expand—set clear milestones
- **Tip:** Use midterm critique actively to improve quality and direction

Implementation note (optional)

- **Cost level:** Low–Medium (depending on model-making and materials)
- **Scalability:** Can be run as a standalone design project or integrated into larger architecture modules
- **Partnership potential:** Local projects, municipalities, or demonstration buildings

Source: Janus Tange Ravn Wald, Teacher Technical Upper Secondary Education, UCE

Case G: Hempcrete (Hemp-Lime) Blocks – Comparative Wall Design + Full-Scale Mock-Up

Programme: Construction & Energy (TUS/ Engineering subject)

Format: Group project (3–4 students) with drawings, analysis, and a 1:1 Mock-up

Context

Biobased construction systems are increasingly relevant because they can reduce embodied emissions, support circularity, and require robust building-physics understanding (moisture, durability, fire, detailing, and workmanship). This case uses hempcrete blocks as the focal material and frames the work as *project development from concept to documented solution*, including environmental and technical justification.

Assignment

Develop and document a wall solution based on hempcrete blocks and compare it to a conventional reference wall. You must justify material and component choices in relation to economy, service life, and environmental impact, and you must present your work together with a full-scale mock-up.

Work process (student activities)

1. **Select a reference wall** (typical conventional wall build-up) and define performance criteria (function, durability, buildability).
2. **Design an “ecological” alternative wall** using hempcrete blocks (system logic, layers, detailing principles).
3. **Construction analysis (comparative):** analyse advantages/limitations of both walls (e.g., robustness, moisture risk points, maintainability, expected service life, buildability on site).
4. **Environmental framing:** include a simple life-cycle perspective in the comparison (principle-level LCA reasoning is sufficient; focus on what drives impact and what assumptions matter).
5. **AutoCAD production drawing:** create a production drawing for casting hempcrete blocks, i.e., drawings for your mould/formwork (dimensions, assembly logic, tolerances).
6. **3D documentation:** create 3D drawings/models of both wall solutions (or the chosen key details) to show build-up and interfaces clearly.
7. **Plan the build:** produce a **time schedule** for the theme process (sequencing, roles, dependencies, drying/curing considerations).
8. **Full-scale mock-up:** build and document one selected construction (e.g., a representative wall section/detail at 1:1).
9. **Evaluate and iterate:** evaluate your finished solutions and propose improvements or alternative proposals (what you would change and why).

Minimum deliverables (recommended formatting)

- **Comparative wall construction analysis:** conventional vs hempcrete-based wall (clear criteria + conclusions).
- **AutoCAD set:** production drawing for the hempcrete block mould/formwork + key wall/detail drawings.
- **Pros/cons analysis of hempcrete block solution** (technical + practical + environmental + economic considerations).
- **Principle-level life-cycle comparison** (what impacts are counted, what assumptions drive results).
- **Process schedule** for the theme project.
- **3D drawings/models** of the wall solutions (or minimum: scaled sections/details).
- **Reflection and improvement proposals** (including at least one alternative suggestion).
- **Presentation boards (posters/plancher)** compiling written material + oral presentation alongside the mock-up.

Assessment focus (teacher lens)

- Quality and clarity of drawings (production logic, dimensions, constructability).
- Strength of argumentation: material/component choice linked to economy, service life, and environmental impact.
- Sound comparative reasoning (what you compared, why it matters, what trade-offs you identified).
- Professional reflection: evaluation of the finished design and concrete improvement proposals.

Source: Carsten Fold, Teacher Technical Upper Secondary Education, UCE

Case H: ILab – Biobased Materials as a Starting Point for Youth Innovation and Entrepreneurship

Programme: Innovation education, Building and Construction, Technology, Architecture & Design, Entrepreneurship

Educational level: VET and Technical Upper Secondary Education

Format: Informal incubation and learning environment combining material exploration, idea development, prototyping and business thinking

Context

ILab functions as an informal incubation and learning environment where young people can work with ideas for new products, services and businesses.

Unlike a traditional classroom or workshop, ILab gives students a more open setting for experimentation. The focus is not only on completing an assignment, but on developing ideas, testing possibilities, receiving feedback and improving concepts over time.

To support this work, biobased materials have been purchased for ILab. These materials create a concrete starting point for innovation education. Students are not only introduced to biobased construction as a sustainability topic; they are invited to use the materials as resources for product development, service design and business ideas.

The purchased materials may include physical material samples, construction-related biobased products and materials suitable for prototyping, for example biobased materials for 3D printing or model-making. In this way, ILab becomes a bridge between material understanding, digital fabrication and entrepreneurship.

The case supports a central learning point: biobased materials are not only alternatives to conventional construction products. They can also become the basis for new ideas, new services, new value chains and new business opportunities.

Assignment

Students must develop an idea for a product, service or business concept based on one or more of the biobased materials available in ILab.

The assignment includes:

- Exploring selected biobased materials
- Identifying a user need, market opportunity or practical problem
- Developing an idea for a product, service or business
- Producing a simple prototype, model, mock-up or visual concept
- Testing the idea with users, peers or teachers
- Explaining the sustainability value of the material choice
- Presenting the concept as an innovation pitch

The final concept does not need to be a finished commercial product. The purpose is to help students move from material curiosity to concrete innovation.

Possible student concepts include:

- A 3D-printed biobased product component
- A construction detail or model using biobased materials
- A display system for communicating biobased materials to other students
- A sample box or teaching kit for sustainable construction
- A service concept helping companies or schools select biobased materials
- A business idea based on local renewable resources
- A circular product concept using leftover biobased materials
- A digital guide, platform or communication tool for material comparison

Work Process

1. Introduction to ILab as an innovation environment

Students are introduced to ILab as a place for experimentation, entrepreneurship and idea development.

The teacher or ILab facilitator explains that the purpose in this case is to use biobased materials as a starting point for innovation. Students are encouraged to think beyond traditional construction tasks and ask:

- What can this material be used for?
- Who could benefit from it?
- What problem could it help solve?
- Could it become part of a product, service or business?
- How can we communicate its value?

2. Material exploration

Students work hands-on with the purchased biobased materials.

They investigate:

- What the material is made from
- Where it comes from
- How it feels, looks and behaves
- Whether it can be cut, shaped, printed, assembled or combined with other materials
- What advantages and limitations it has
- How it compares with conventional materials
- Whether it is mature, emerging or experimental

The aim is to make the material tangible. Students should not only read about biobased materials; they should handle them, test them and discuss their possible applications.

3. Opportunity spotting

Students identify a possible need or opportunity.

This can be based on:

- Problems in construction practice
- Challenges in education or communication
- Sustainable product development
- Local resources and value chains
- Waste reduction or reuse
- Indoor climate and healthy materials
- New ways of making biobased materials understandable to others

Students formulate a short problem statement, for example:

“How can we make biobased materials easier for construction students to understand?”

“How can a biobased 3D-printed component be used in a building model?”

“How can ILab help young people develop business ideas based on sustainable materials?”

“How can leftover biobased materials become part of a circular product concept?”

4. Idea development

Students generate several ideas and select one concept for further development.

They use simple innovation methods such as:

- Brainstorming

- Sketching
- User scenarios
- Material mapping
- Value proposition development
- “How might we” questions
- Simple business model thinking

The selected idea must clearly connect:

- A biobased material
- A user or target group
- A problem or opportunity
- A possible product, service or business model

5. Prototyping

Students develop a simple prototype or representation of the idea.

Depending on the concept and available equipment, this may include:

- 3D printing
- Laser cutting
- Model-making
- Material samples
- Mock-ups
- Diagrams
- Service blueprints
- Digital drawings
- Pitch boards
- Short videos or visual explanations

The prototype should make the idea understandable enough to receive feedback. It does not need to be technically perfect.

The key learning point is that prototyping helps students discover what works, what does not work and what needs to be changed.

6. Testing and feedback

Students test their idea with others.

Feedback may come from:

- Other students
- Teachers
- ILab facilitators
- Local companies
- Construction professionals
- Potential users
- Visitors to ILab

Students collect feedback on questions such as:

- Is the idea understandable?
- Is the material choice relevant?
- Does the concept solve a real problem?
- What is unclear?

- What should be improved?
- Could the idea become useful in education, construction or business?

7. Sustainability and value proposition

Students explain the value of their concept.

They must describe:

- Why the selected biobased material is relevant
- How the idea supports sustainability
- What problem the concept addresses
- Who would use or buy it
- What makes it different from a conventional solution
- What further development would be needed

At this stage, the work moves from “we made something” to “we understand why this could matter”.

8. Pitch and reflection

The case ends with a short pitch presentation.

Each group presents:

- The selected material
- The problem or opportunity
- The product, service or business idea
- The prototype or visual concept
- Feedback received
- Improvements made
- Sustainability argument
- Next steps
- The pitch can be organised as an informal ILab event, a class presentation or a mini-innovation fair.

Learning Outcomes

Students are able to:

- Explore and describe biobased materials through hands-on investigation
- Identify user needs and innovation opportunities
- Develop ideas for products, services or businesses based on material properties
- Use prototyping as a method for testing and improving ideas
- Connect sustainability with entrepreneurship and value creation
- Communicate the relevance of biobased materials to others
- Reflect on the difference between mature, emerging and experimental materials
- Work iteratively from idea to prototype to feedback
- Present a concept clearly through pitch, model or visual material

These outcomes connect biobased construction education with innovation competence. Students learn that new materials require not only technical knowledge, but also creativity, communication, collaboration and business understanding.

Minimum Deliverables

- Material card for one selected biobased material
- Problem statement or opportunity description
- Concept sketches or idea board
- Simple prototype, model, mock-up or service concept
- User feedback or peer feedback notes

- Short sustainability reflection
- Value proposition or mini business model
- Final pitch presentation

Teaching Perspective

This case shows how ILab can support biobased construction education in a different way than a traditional workshop assignment.

In the workshop, students often learn how to use a material correctly in a defined construction task. In ILab, students explore what a material could become. The setting invites experimentation, uncertainty and idea development.

The purchased biobased materials therefore become more than teaching materials. They become innovation resources.

This gives students the opportunity to work with questions such as:

- How can sustainable materials create new value?
- How can young people contribute to the green transition through entrepreneurship?
- How can materials be transformed into products, services or business concepts?
- How can education become a place where future construction practices are tested?

The case can be used as a short innovation sprint, a project week, an entrepreneurship module or a cross-disciplinary collaboration between VET and TUS.

Implementation Note

To run the case successfully, ILab should have:

- A visible and accessible collection of biobased materials
- A simple registration system for the purchased materials
- Clear information about material origin, properties and possible use
- Access to prototyping tools such as 3D printers, laser cutter or model-making equipment
- Space for informal group work and idea development
- Teacher or facilitator support during prototyping
- Time for feedback and iteration
- A simple pitch format for final presentations

Because some biobased materials may be experimental or unfamiliar, the focus should be on safe exploration, learning and concept development rather than full technical certification.

4. From Inspiration to Implementation

Biobased construction in education does not begin with a complete system or a finished curriculum. It often begins with a manageable first step: a teaching activity, a material sample, a mock-up, a partnership or a pilot project that gradually builds experience and confidence.

As the cases in this catalogue demonstrate, there is no single model for implementation. Different institutions and educational programmes can begin in different places, depending on their resources, partnerships, facilities, teacher competence and level of ambition.

A useful starting point is to identify one activity that is both relevant and realistic.

For managers and programme leaders, this may involve:

- defining the institution's level of ambition;

- selecting a suitable programme, subject or pilot activity;
- providing time, resources and professional development for teachers;
- establishing cooperation with companies, municipalities or material suppliers;
- and clarifying responsibility for coordination and follow-up.

For teachers, this may involve:

- integrating one biobased material into an existing assignment;
- using a material comparison or small mock-up;
- linking practical work with documentation, building physics or environmental assessment;
- working together with another subject or trade;
- and evaluating the activity with students before repeating or expanding it.

Implementation should be treated as a gradual learning process. New materials and methods may require experimentation, external expertise and adjustment. It is therefore useful to begin at a scale where risks can be managed and learning can be documented.

After the first activity, institutions should reflect on:

- What worked well?
- What knowledge or resources were missing?
- What did students and teachers learn?
- Which partners should be involved next time?
- Can the activity be repeated, improved or integrated into ordinary teaching?

Over time, small initiatives can develop into something more:

From isolated projects to integrated teaching
 From individual teachers to organisational strategies
 From experimentation to established practice
 From temporary partnerships to lasting learning environments

In this way, education does not only respond to the transition in construction—it helps shape it.

The most important next step is not to design the complete solution, but to select a realistic starting point, assign responsibility and begin building experience.