

Re-thinking Local Timber



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Teaching assistant
and PhD student



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MSc. engineer architect

Teaching assistant
and PhD student



Andrea Settini
MSc. architect

Teaching assistant
and PhD student



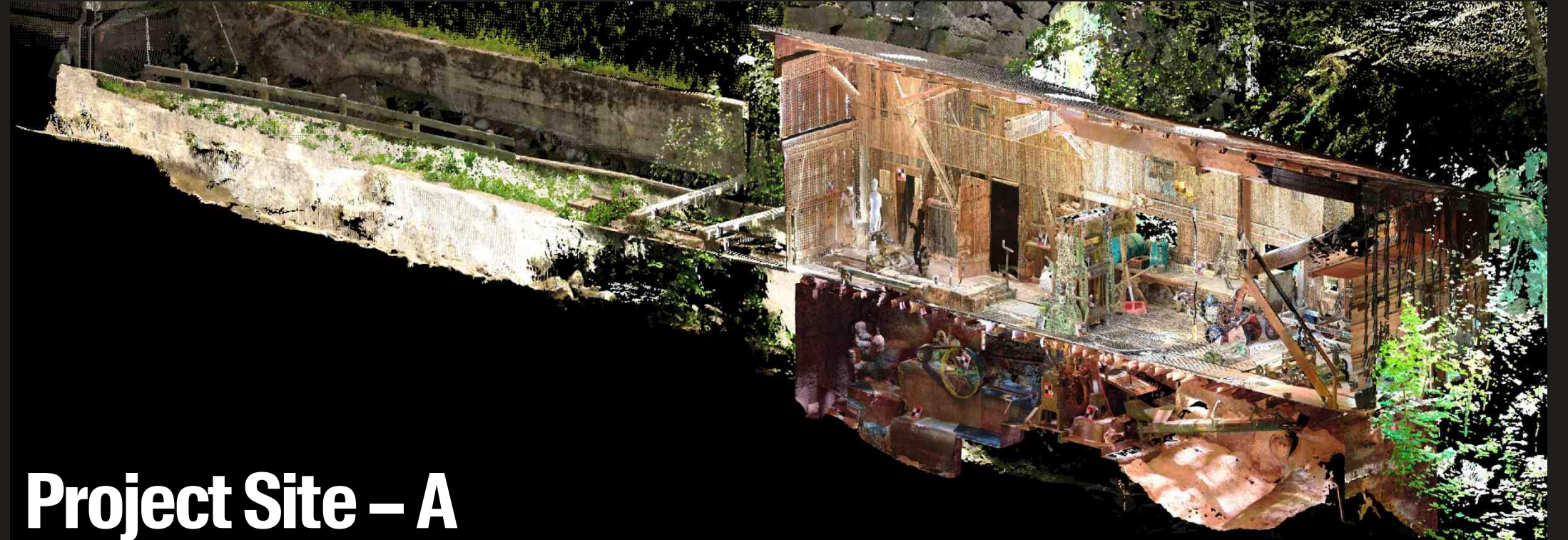
François Perrin
carpenter

Technical advisor
and security coordinator





Site – Saw-mill Campus



Program

The program shows the current saw-mill organization that has to be extended 10 meters to accommodate an industrial robot arm on a 5 meter rail. The timbers that are delivered to this saw-mill are sized to mountain trucks that are the maximum of 5 meters in length. The timber production follows mountain forest harvesting process resulting in regular beam and timber boards products. The robotic facility will bring a 3rd product – raw timber fabrication. This minor extension requires rethinking the whole building. Meaning the current structure must be dismantled and a new building has to be constructed. The relatively small program turns the focus to a structural system you are going to design in order to accommodate the needed facilities. Be aware that the current building is constructed as one continuous rail system, when freshly cut trees are deposited first in the outside storage area, processed in the saw-mill and taken from the delivery part. The overall program and organization can be changed depending on your design decisions and larger size analysis or remain as is.

PROGRAM

Outdoor Storage – 154.75 m²

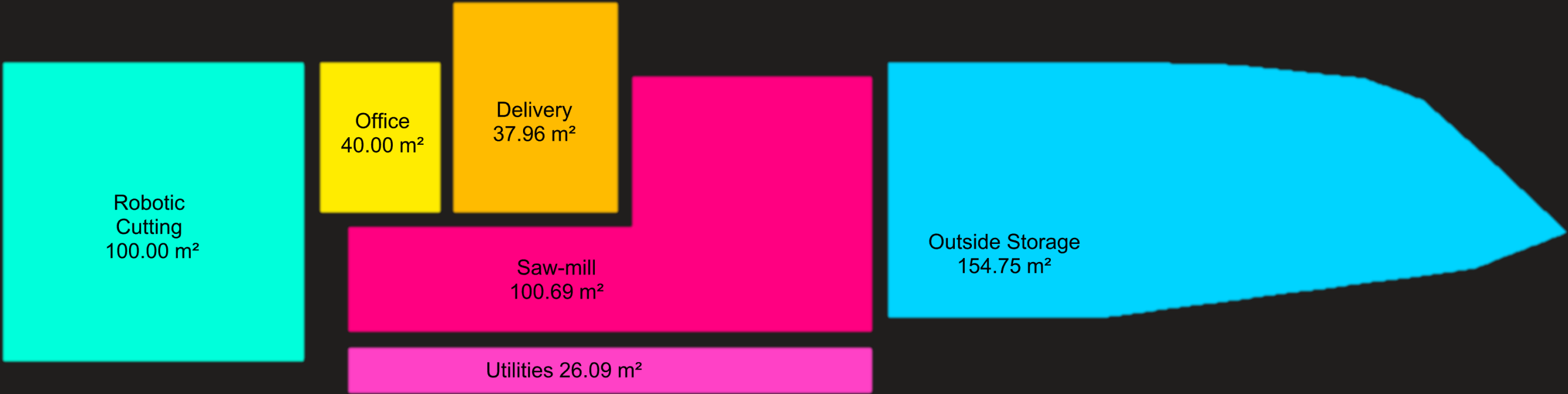
Saw-mill – 100.69 m²

Office – 40 m²

Robotic Facility with 10 m track – 100 m²

Delivery – 37.96 m²

Utilities – 26.09 m²



Planning

Program subject to modifications

Week	Day	Plan	Student's deliverables	
W1	Tu 21/09	[9:00] Intro + Lecture on timber construction [13:00] Workshop on inquiry skills	PHASE I : CONCEPT	
W2	Mo 27/09 Tu 28/09	[9:00] Site visit + visit of local sawmill and timber construction company [9:00] Autonomous work: concept proposal		
W3	Mo 04/10 Tu 05/10	[9:00] Students review [9:00] Auton. work: program integration [13:00] Roundtable personal investigation		Compile and read documents for your investigation
W4	Mo 11/10 Tu 12/10	[9:00] Professor review: concept proposal and program integration [9:00] Autonomous work: developing an efficient construction system		
W5	Mo 18/10 Tu 19/10	[9:00] Students review [9:00] Auton. work: assessing project performance [13:00] Workshop LCA		Submit a first version of the essay
W6	Mo 25/10 Tu 26/10	[9:00] Students review [9:00] Auton. work: refining the integration of the different aspects of the project		
W7	Mo 01/11 Tu 02/11	[9:00] Intermediary Critic [9:00] Autonomous work: react to the comments of the critic		Presentation of the concept, the construction process and its integration within the context (site + program)
W8	Mo 08/11 Tu 09/11	[9:00] Workshop Digital Integrated Design (Rhino-Grasshopper workflows) [9:00] Autonomous work: application of parametric tools	PHASE II : DETAILS	Download Rhino 7 for Windows Submit parametric exercise
W9	Mo 15/11 Tu 16/11	[9:00] Students review [9:00] Autonomous work: assembly sequence and construction principles		Submit a final version of the essay
W10	Mo 22/11 Tu 23/11	[9:00] Professor review: assembly sequence and construction principles [9:00] Autonomous work: development of constructive details		
W11	Mo 29/11 Tu 30/11	[9:00] Students review [9:00] Autonomous work: assessing project performance		
W12	Mo 06/12 Tu 07/12	[9:00] Students review [9:00] Autonomous work: refining architectural plans		
W13	Mo 13/12 Tu 14/12	[9:00] Autonomous work: presentation preparation [9:00] Structure of the presentation and the discourse		
W14	Mo 20/12 Tu 21/12	[9:00] Oral preparation [9:00] Final Critic		Submission of the final documents (Monday at 6pm)
Group activity - Autonomous activity - Master students activity				

1

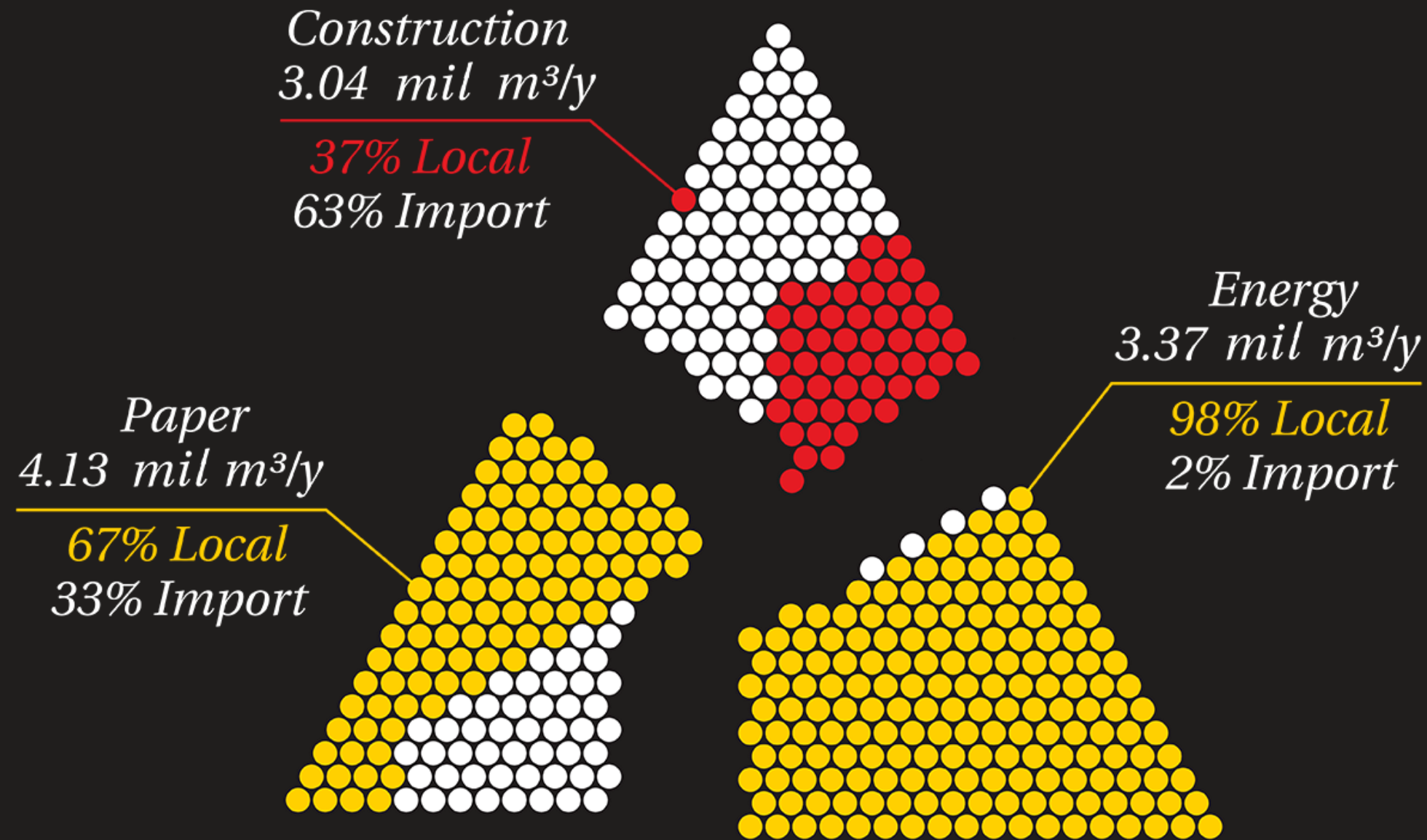
Site Analysis + Economic Model

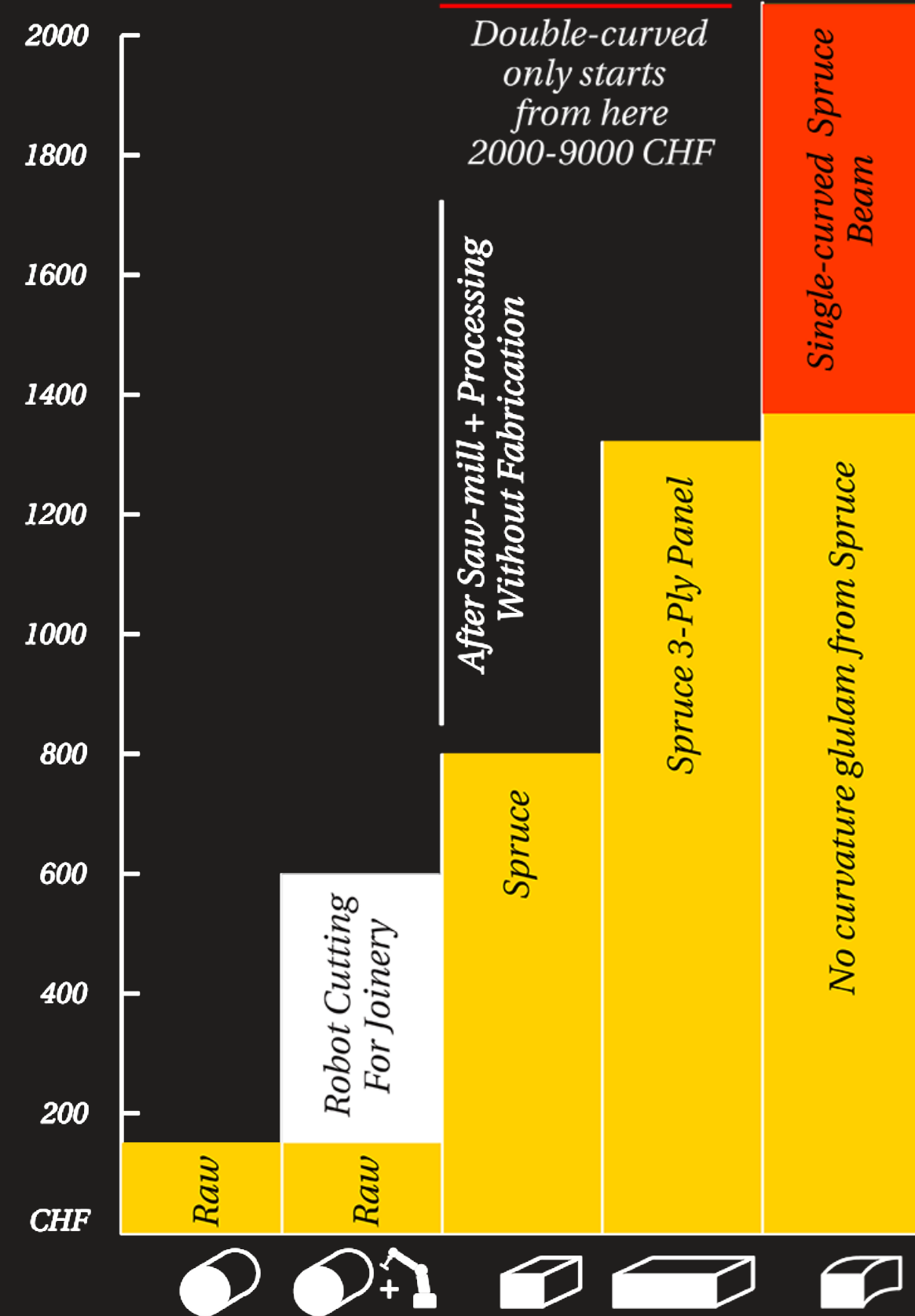
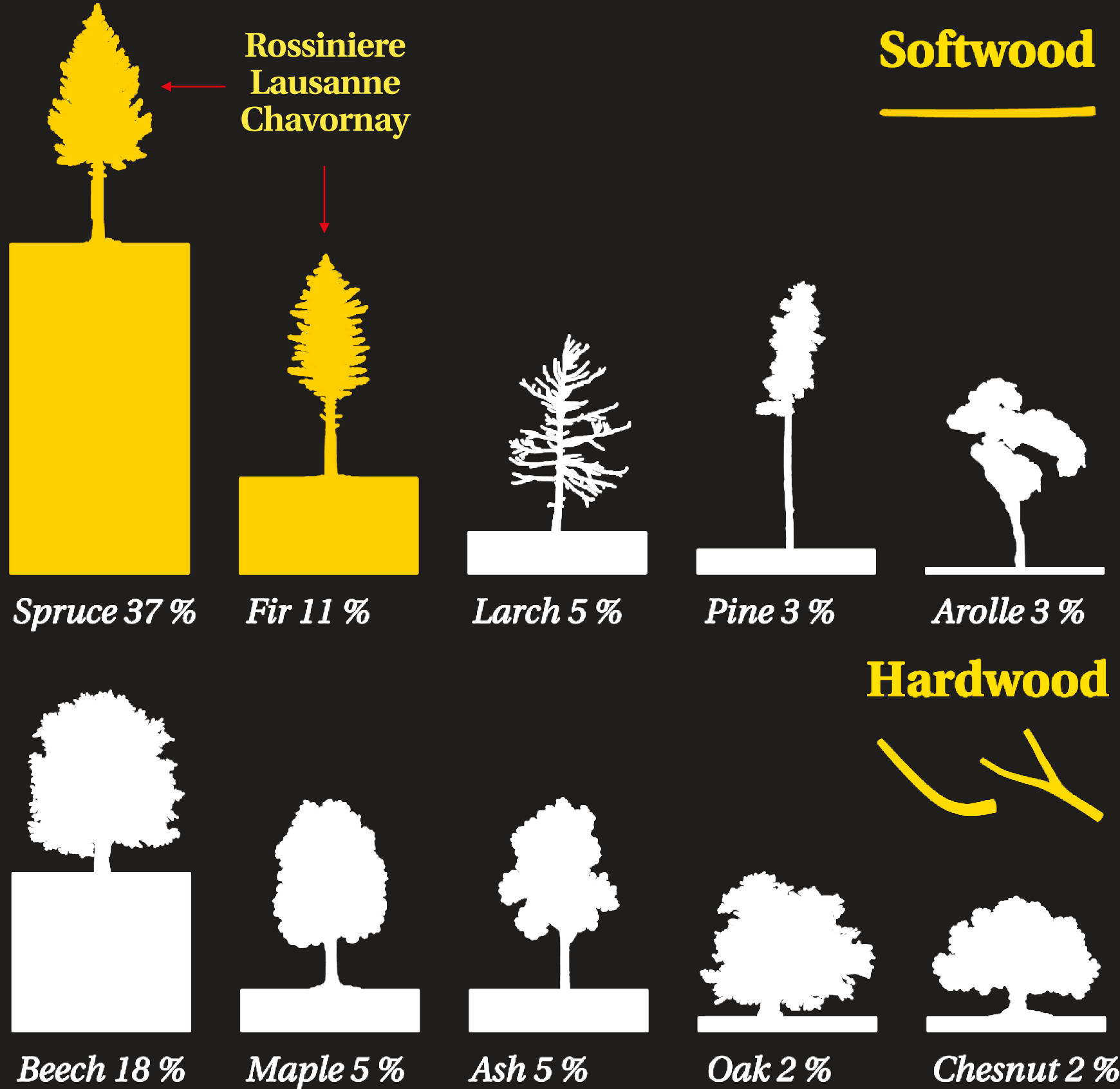
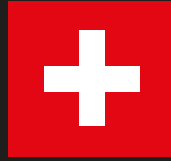
Both come together

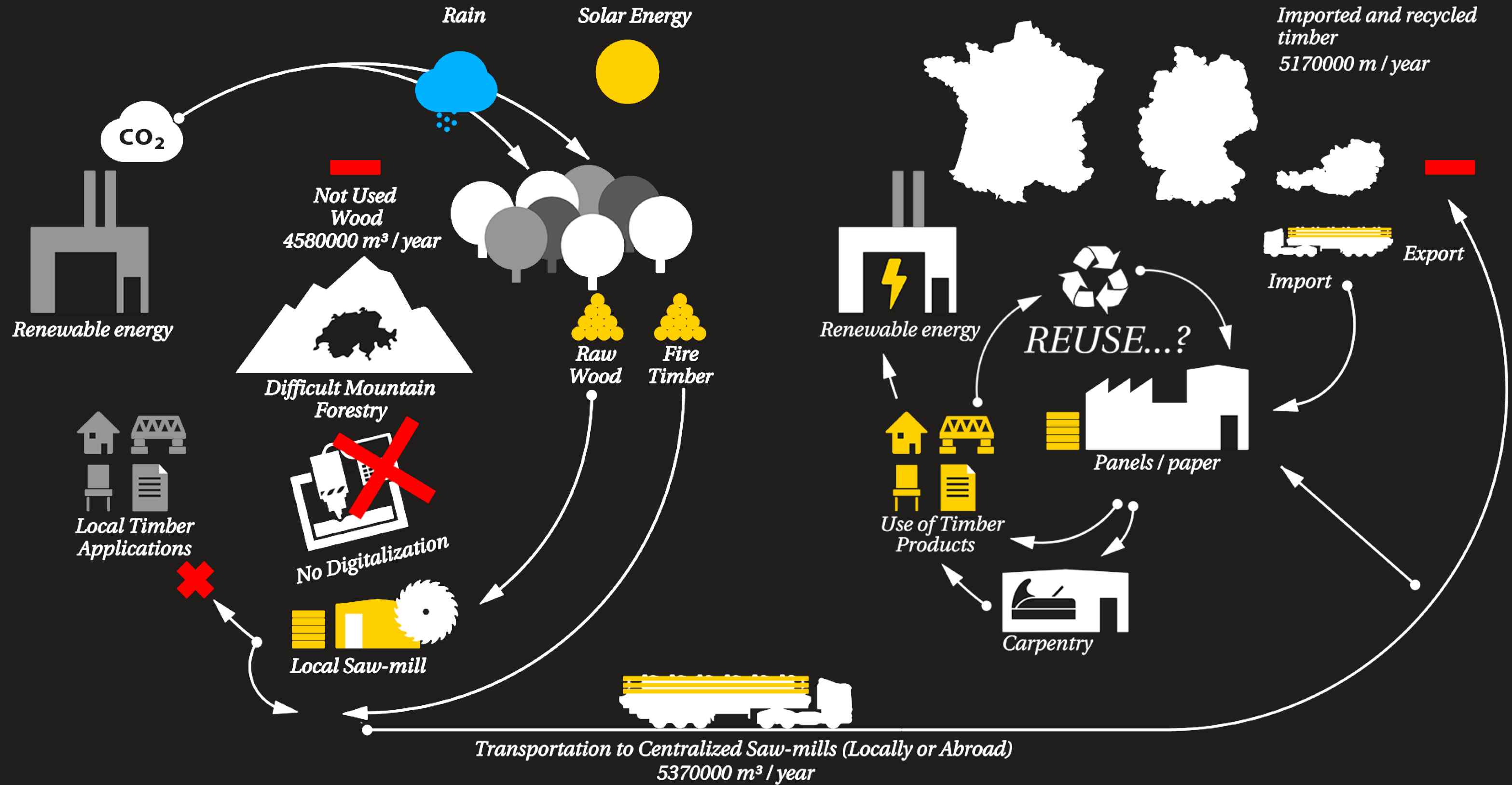
Swiss context

Swiss Timber Use
10.54 million m³ / year

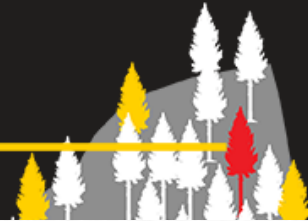
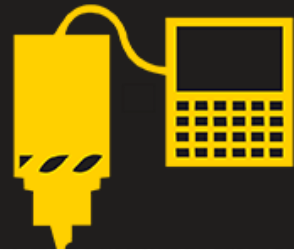
Swiss Wood
51 %







Local Trees
Local Application



MDF

*Medium-density
Fibre-board*

OSB

*Laminated-strand
Board*

LSI

Source: «24 heures»

«Si l'on n'innove pas en prenant des risques, on n'aura plus que les yeux pour pleurer»

"If we do not innovate by taking risks, we will only have the eyes to cry on"

LUM

*Lumber
Boards, Beams*

Timber

GLT

*Glue-laminated
Timber*

Veneer

CLT

*Cross-laminated
Timber*

PLY

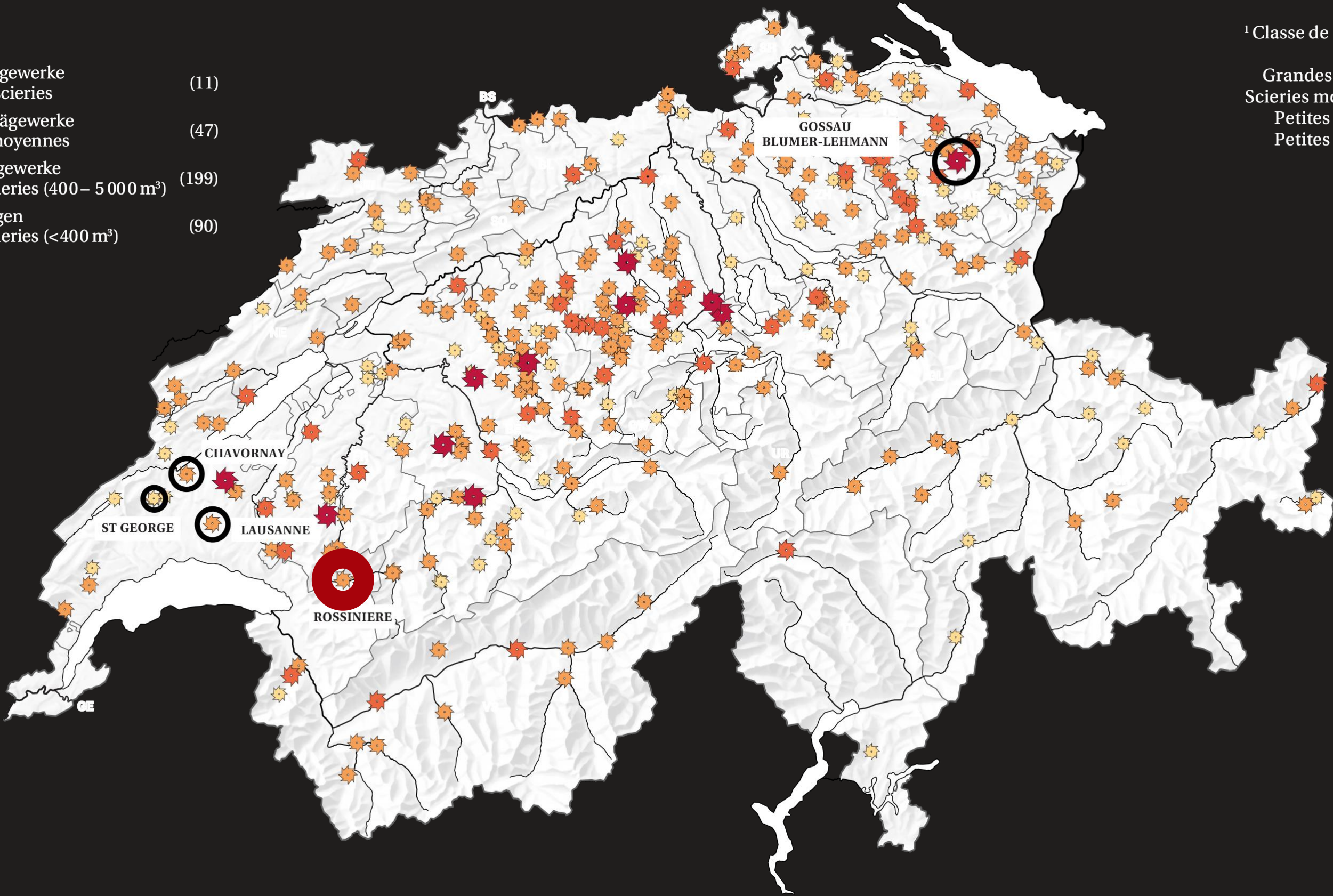
Plywood



Scieries

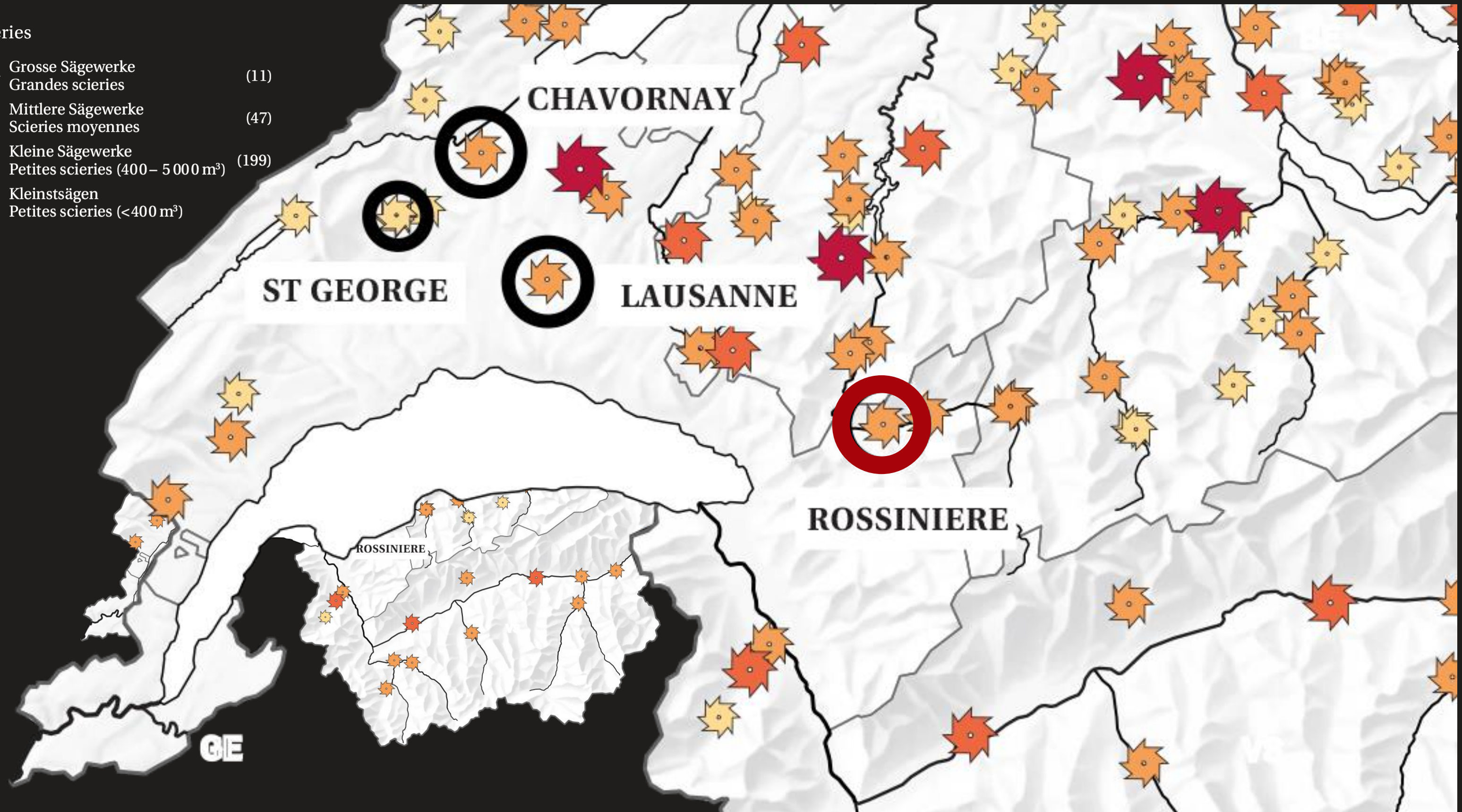
- Grosse Sägewerke
Grandes scieries (11)
- Mittlere Sägewerke
Scieries moyennes (47)
- Kleine Sägewerke
Petites scieries (400 – 5 000 m³) (199)
- Kleinstsägen
Petites scieries (<400 m³) (90)

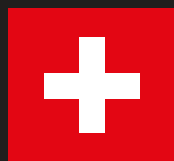
¹ Classe de grandeur des scieries selon
débitage par année en m³
Grandes scieries > 25 000 m³
Scieries moyennes 5 001 – 25 000 m³
Petites scieries 400 – 5 000 m³
Petites scieries < 400 m³

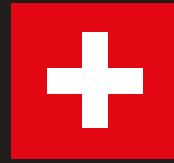


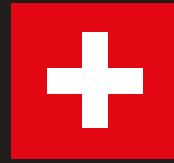
Scieries

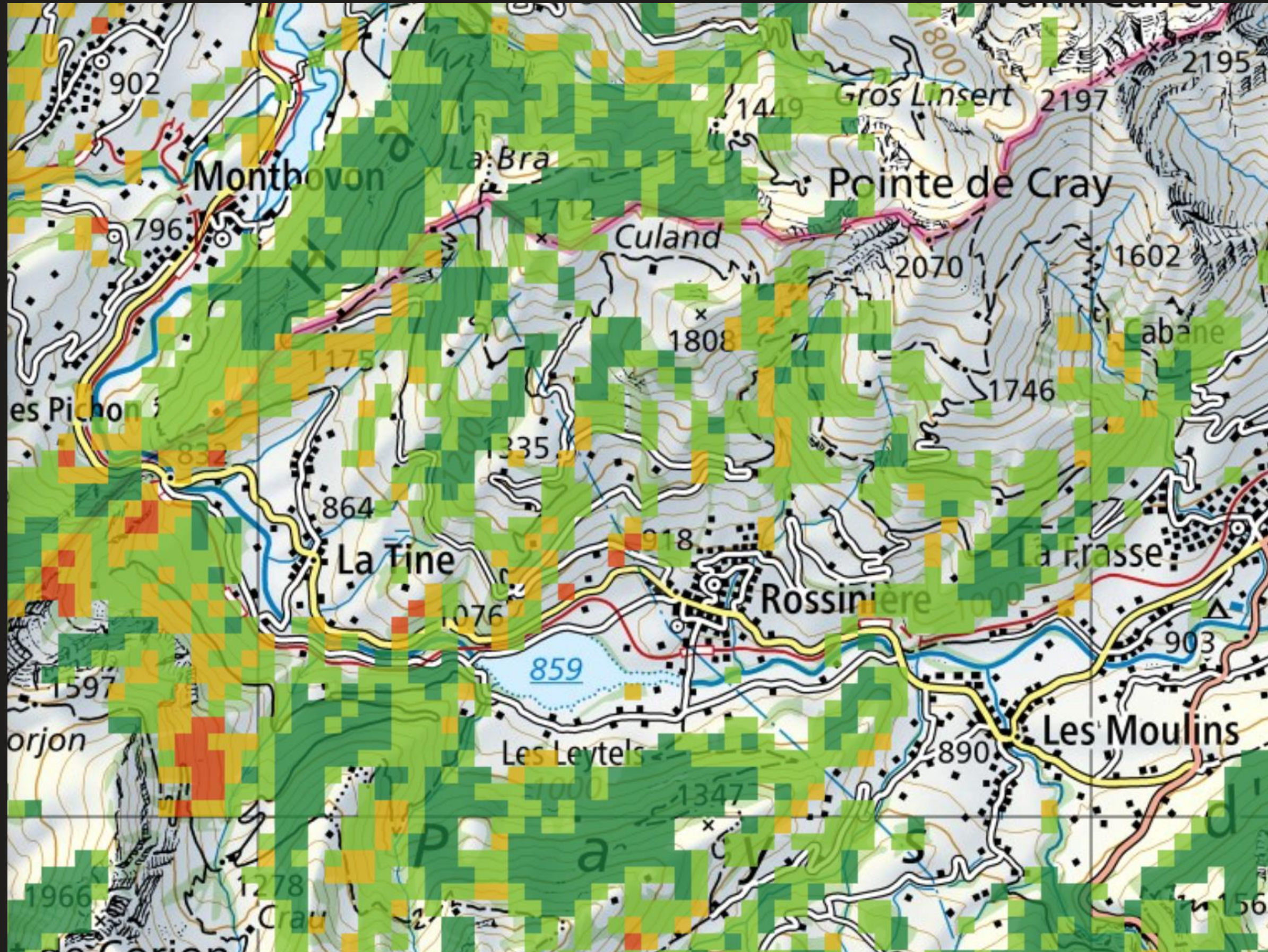
-  Grosse Sägewerke
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Scieries moyennes (47)
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Petites scieries (400 – 5 000 m³) (199)
-  Kleinstsägen
Petites scieries (<400 m³)





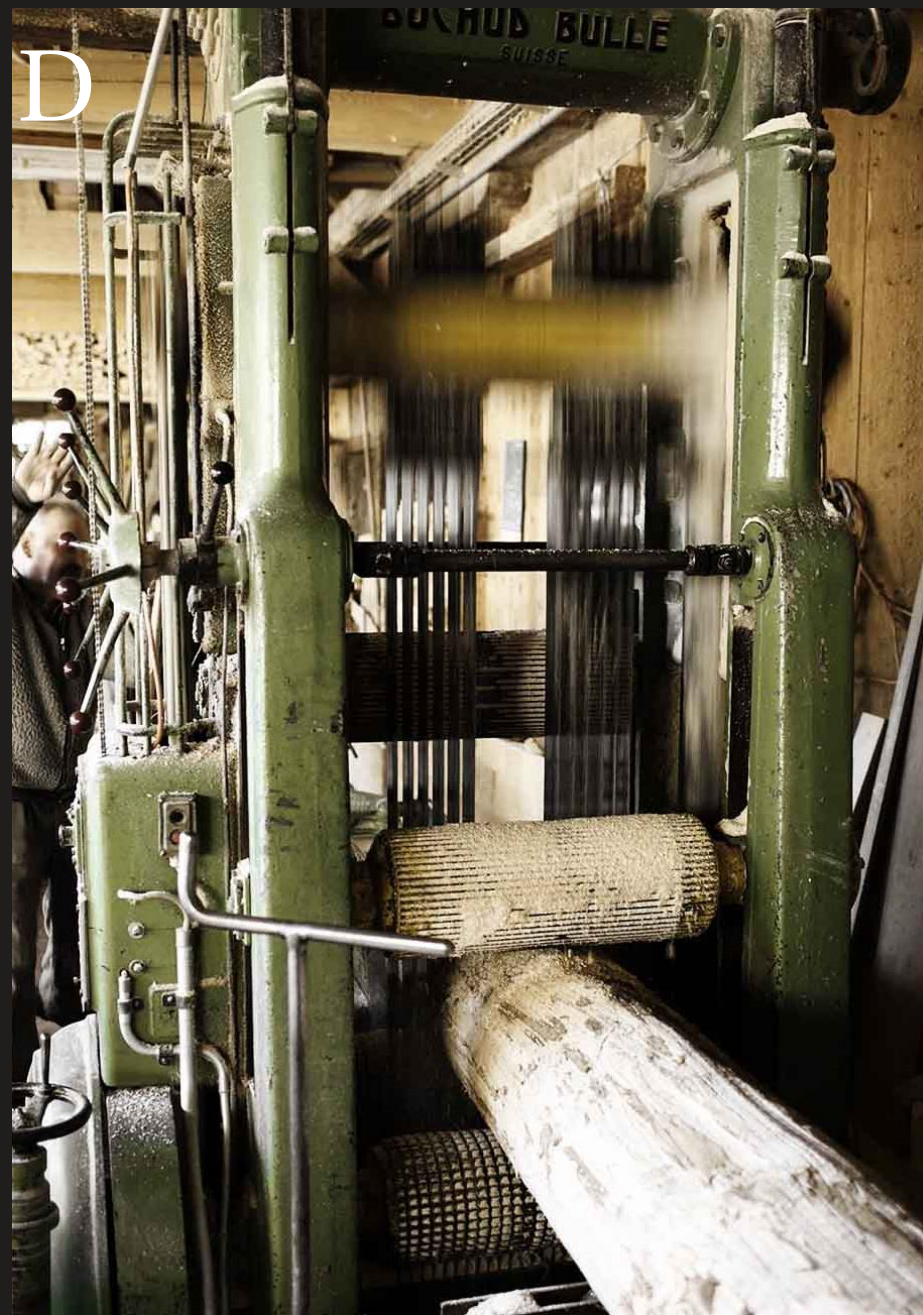
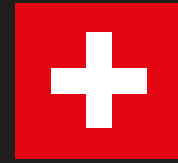


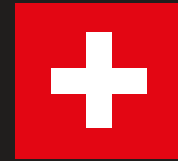




-  coniferous forest
-  mixed coniferous forest
-  mixed deciduous forest
-  deciduous forest

In 1996, as part of the project "Forest differentiation using digital satellite imagery", two datasets covering the whole of Switzerland were created on the basis of Landsat TM satellite images, which divide the forests into coniferous, mixed coniferous, mixed deciduous and deciduous categories. The aim of this project was, on the one hand, to help to develop reliable experience and knowledge of digital remote sensing and of using satellite data for statistical purposes and, on the other hand, to add a statistically verified and geographically differentiated distinction between deciduous, mixed and coniferous forests to the Swiss land use statistics. After the satellite images used had been geographically and radiometrically corrected, the first step involved distinguishing between forest and non-forest areas. After this the forest was divided into four mixture ratios.



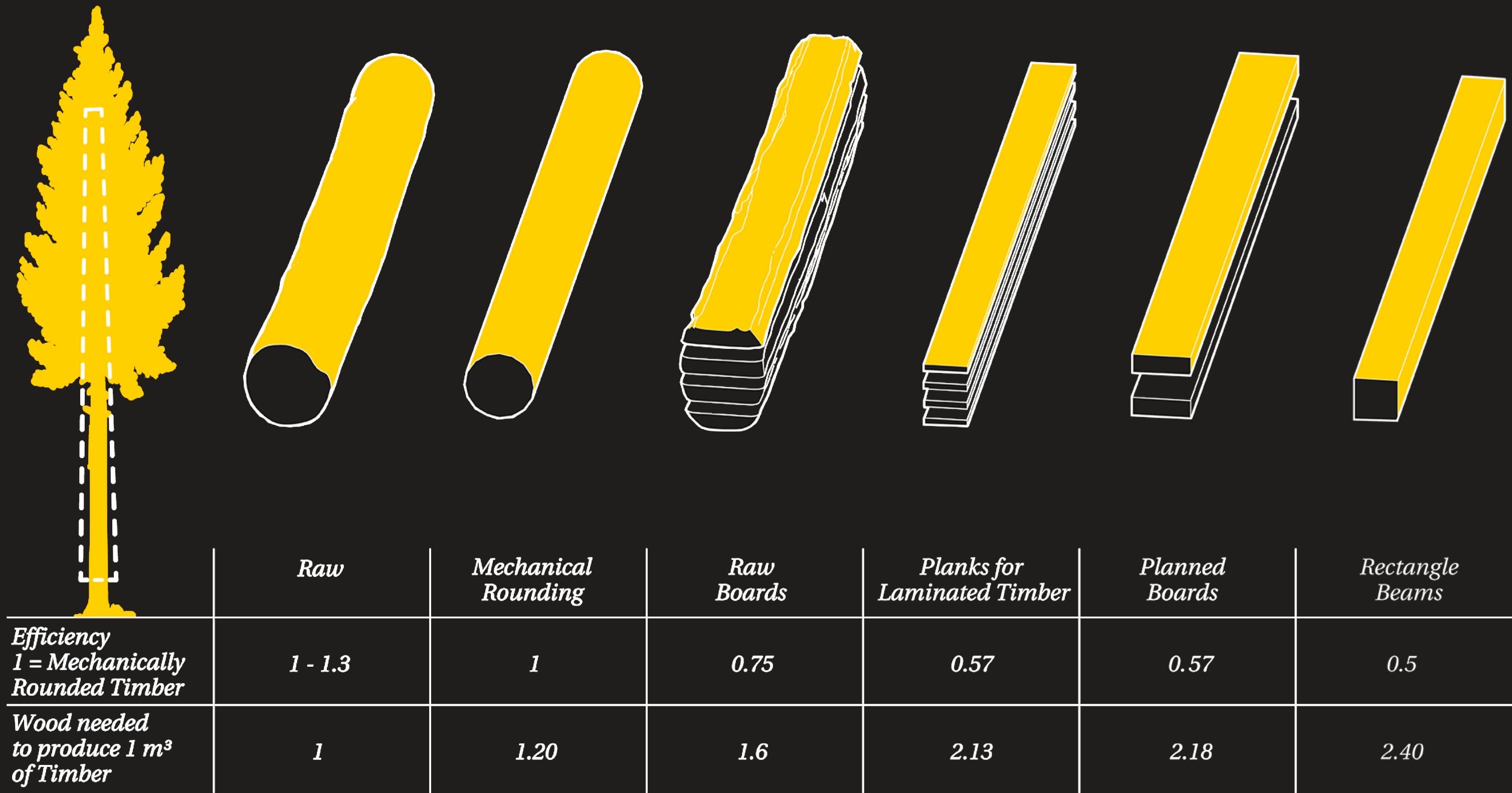


Forestry + Low-tech saw mills

This is what limits local construction or you import timber products from abroad or large centralized sawmills.



Raw-wood Properties



Swiss context Alpage de la Cierne



Experiments in strong **natural** surroundings



Raw-wood Design Methods

*I have had a teacher, famous german wooden engineer, who always asked his students:
What is the biggest enemy of wood? And he wanted the students to answer: The saw.*

*It is always good that you are using round-wood that is not cut by a saw.
But there is a difficulty to use round-wood without a saw.*

Frei Otto 2015 - AA Hooke Park

Design Methods

IBOIS, EPFL
Non-destructive
Testing
1993

PhD Thesis
Yann Benoit
2004



The New Non
Standard
Jonathan Enns
Princeton University
2010



Bandsawn Curved
Lumber
Ryan Luke Johns,
Nicholas Foley
IaaC
2012-14



Robotic SawMill
Timber Joinery
IaaC
2013



7x stool and
7x cabin
Tom Pawlofsky
ETHZ
2013-14



New Structural
Systems
In Small-Diameter
Round Timber
Aurimas Bukauskas
2015



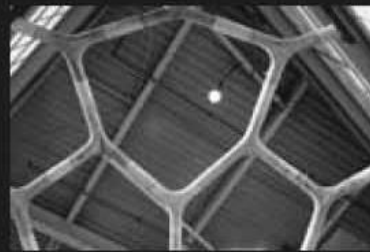
Biomass Boiler
House
Sahu & Wang
AA Design & Make
2015



Wood Chip Barn
Zachary Mollica
AA Design & Make
2016



Developing a
Fabrication Workflow
for Irregular Saw logs
Niels Martin Larsen,
Anders Kruse Aagaard
Aarhus School of
Architecture
2017



Combining
Parametric Form
Generation and
Design Exploration to
Produce a Wooden
Reticulated Shell using
Natural Tree Crotches
2018



A New Approach to
Free-form Wooden
Shell Structures using
Helical Cuts.
Peer Hallerm,
Marzia Calvarese,
ImaxPro,
TU Dresden
IASS
2019



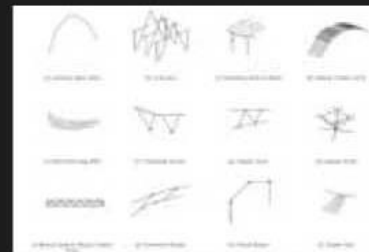
Prototype Cabin
Wyatt Armstrong
AA Design & Make
2019



David Marshall
Unmaking
Architecture
2019



Human-in-the-loop
Fabrication of 3D
Surfaces with Natural
Tree Branches
2019



Whole Timber
Construction:
A State of the Art Review
2019



Conceptual Joining
Lukas Allner, Daniela
Kröhnert,
collaboration with
Philipp Hornung
Angewandte
2019

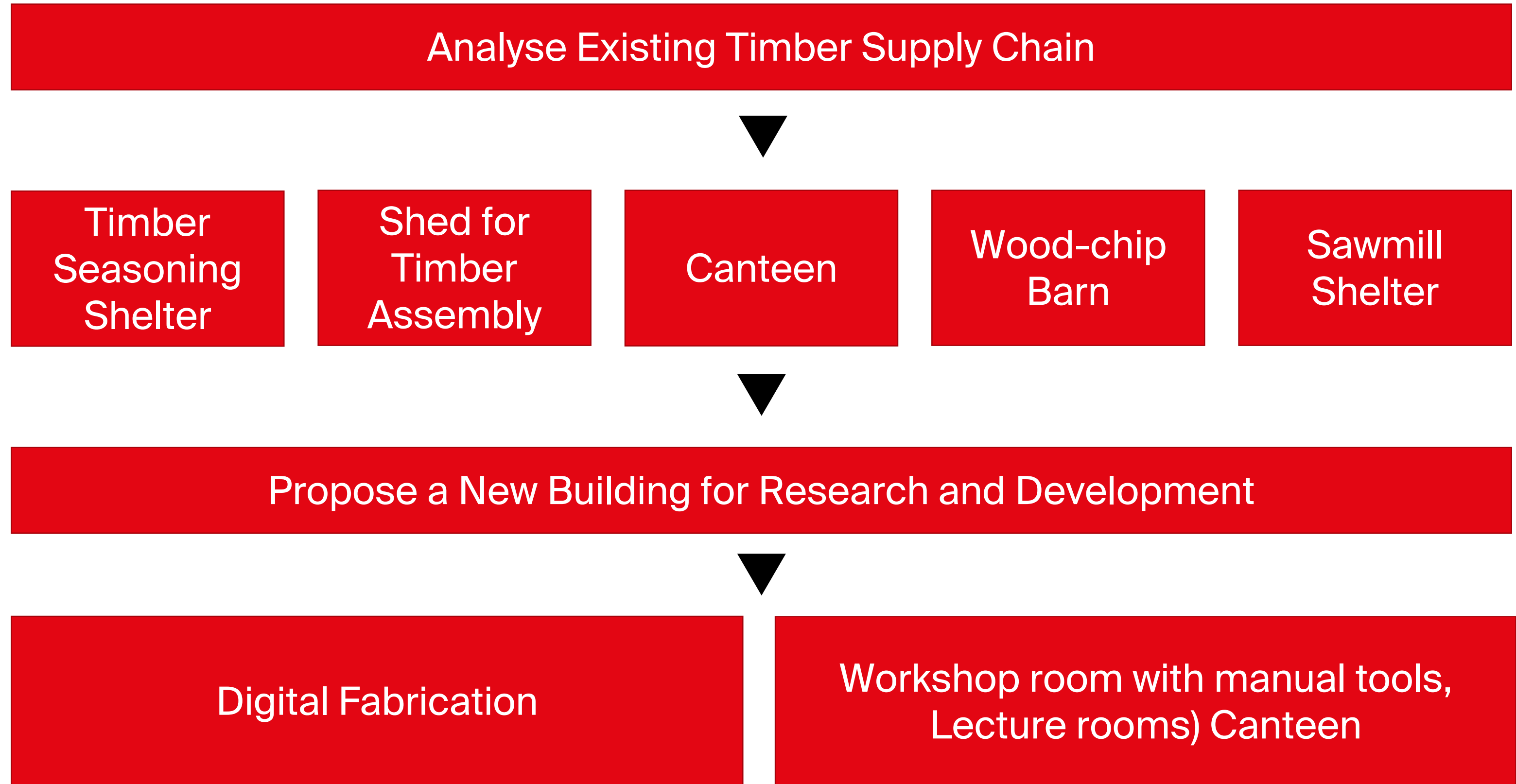


Making Form-work
Experiments Along
the Grain of
Concrete and
Timber,
Sasa Zivkovic,
Leslie Lok
Cornell University
Farbicate
2020

2

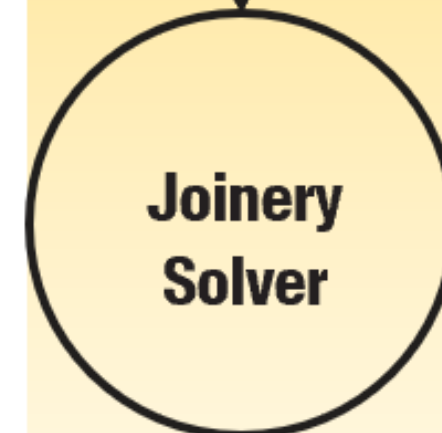
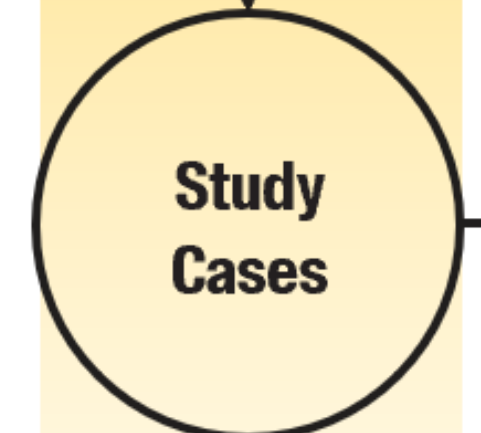
Software support (CAD + Fabrication)

Function – Saw-mill Cooperative



3

Software support (CAD + Fabrication)

*Physical**Micro**Meso**Macro* $W = 0.1$  $W = 0.6$  $W = 0.3$ 

?

State-of-the-Art
Review

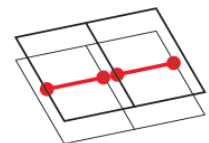
Design Target

Point-cloud Processing

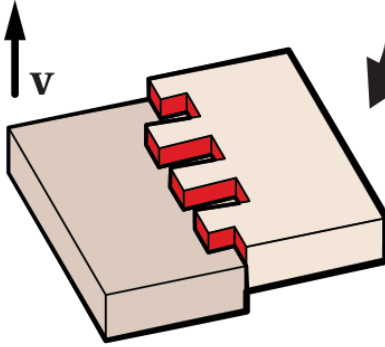
Assignment of Linear
Elements From a Stock

Joinery – From Regular to Irregular

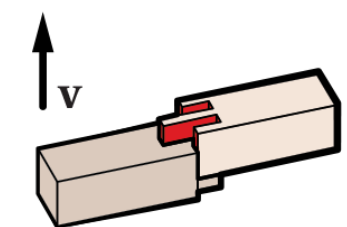
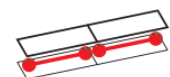
CurveAxis + Two Outlines



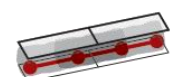
Computed Joint



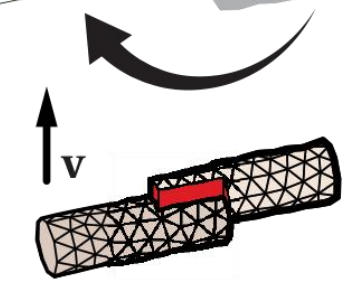
Plates



Beams



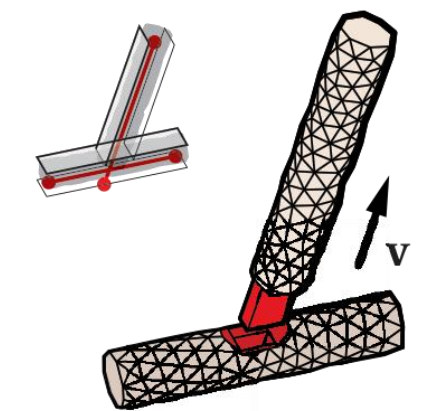
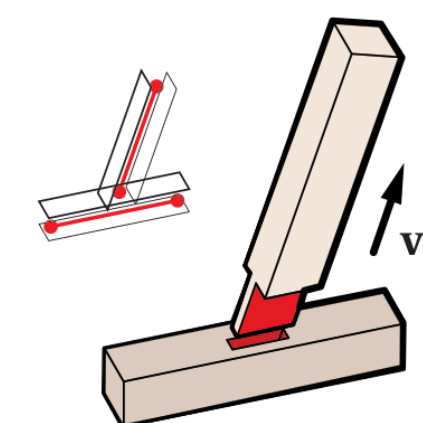
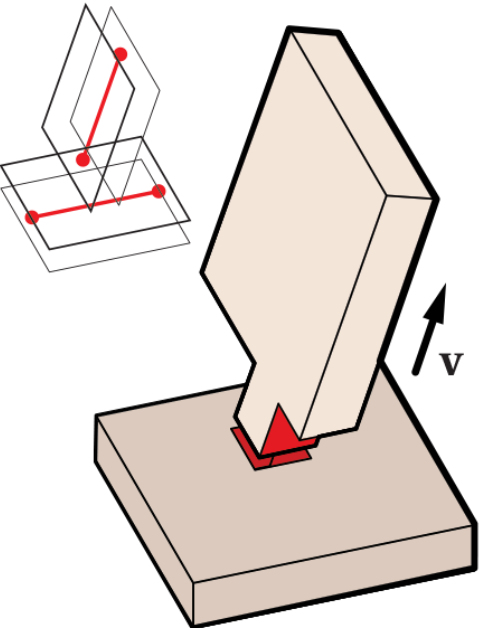
Reference



Raw-wood

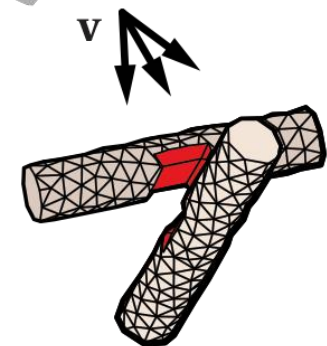
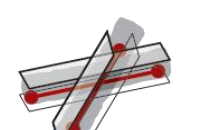
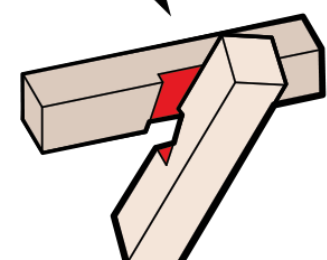
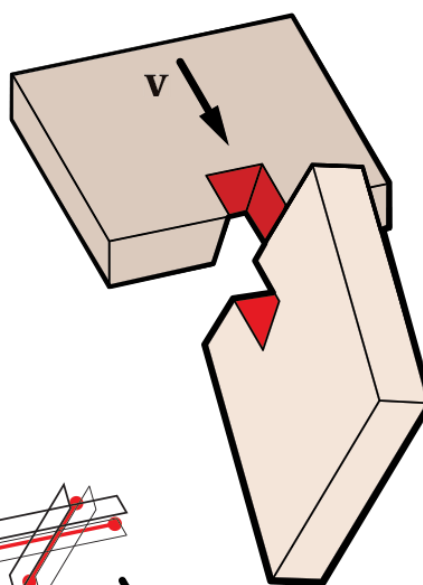
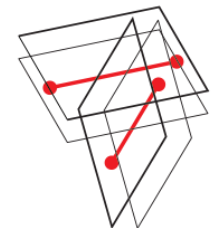
A

Side-Side



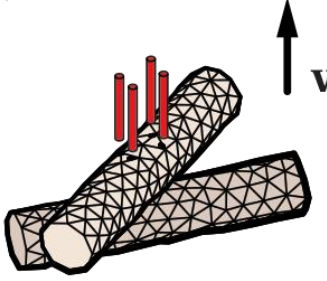
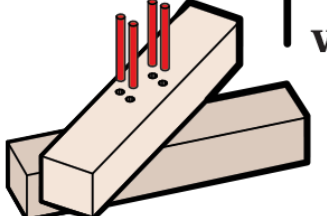
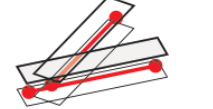
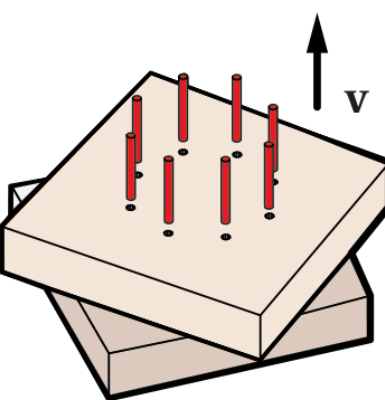
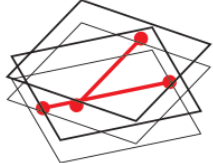
Top-Side

B



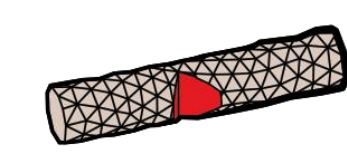
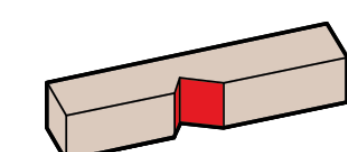
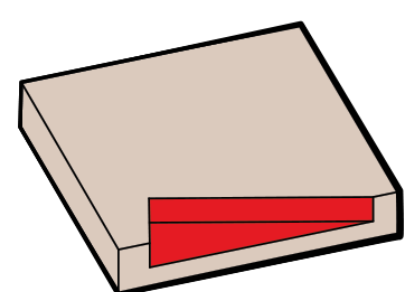
Cross

C



Top-Top

D



Custom

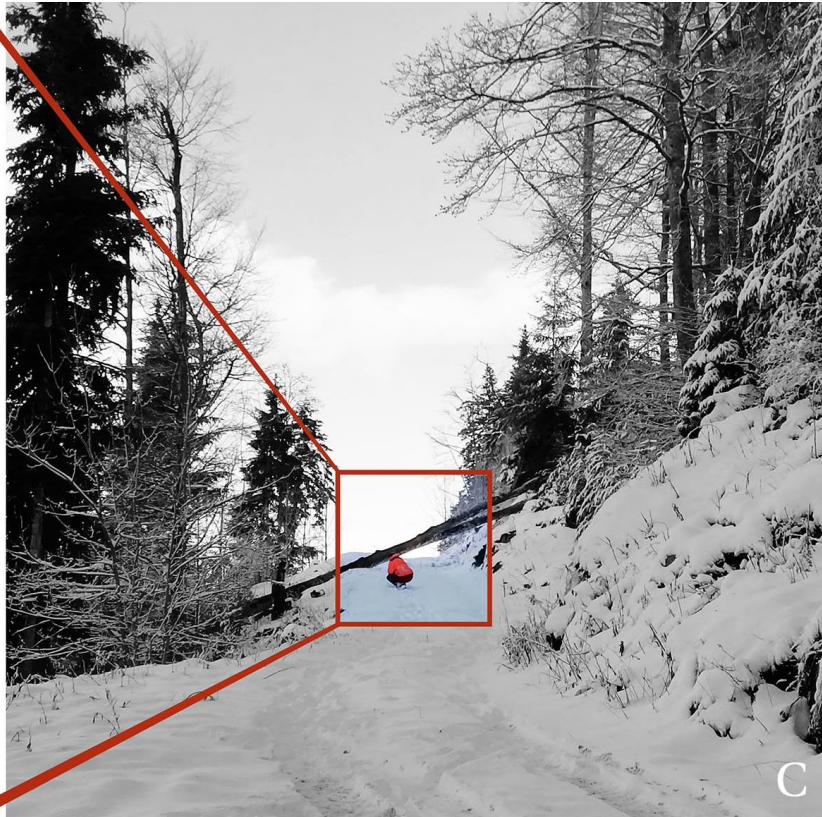
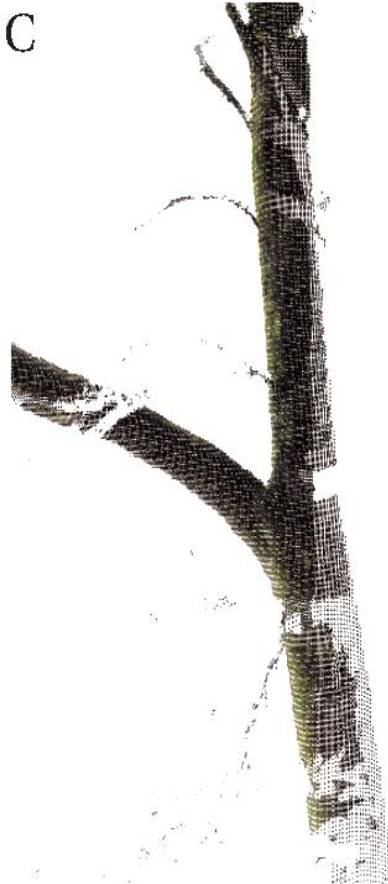
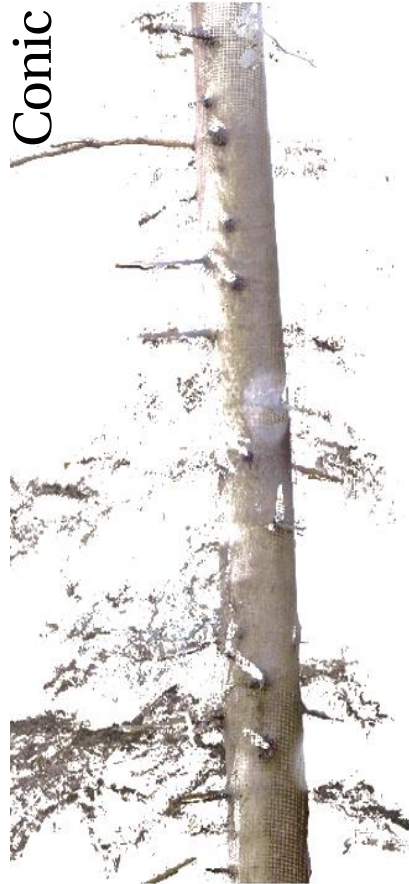
E

4

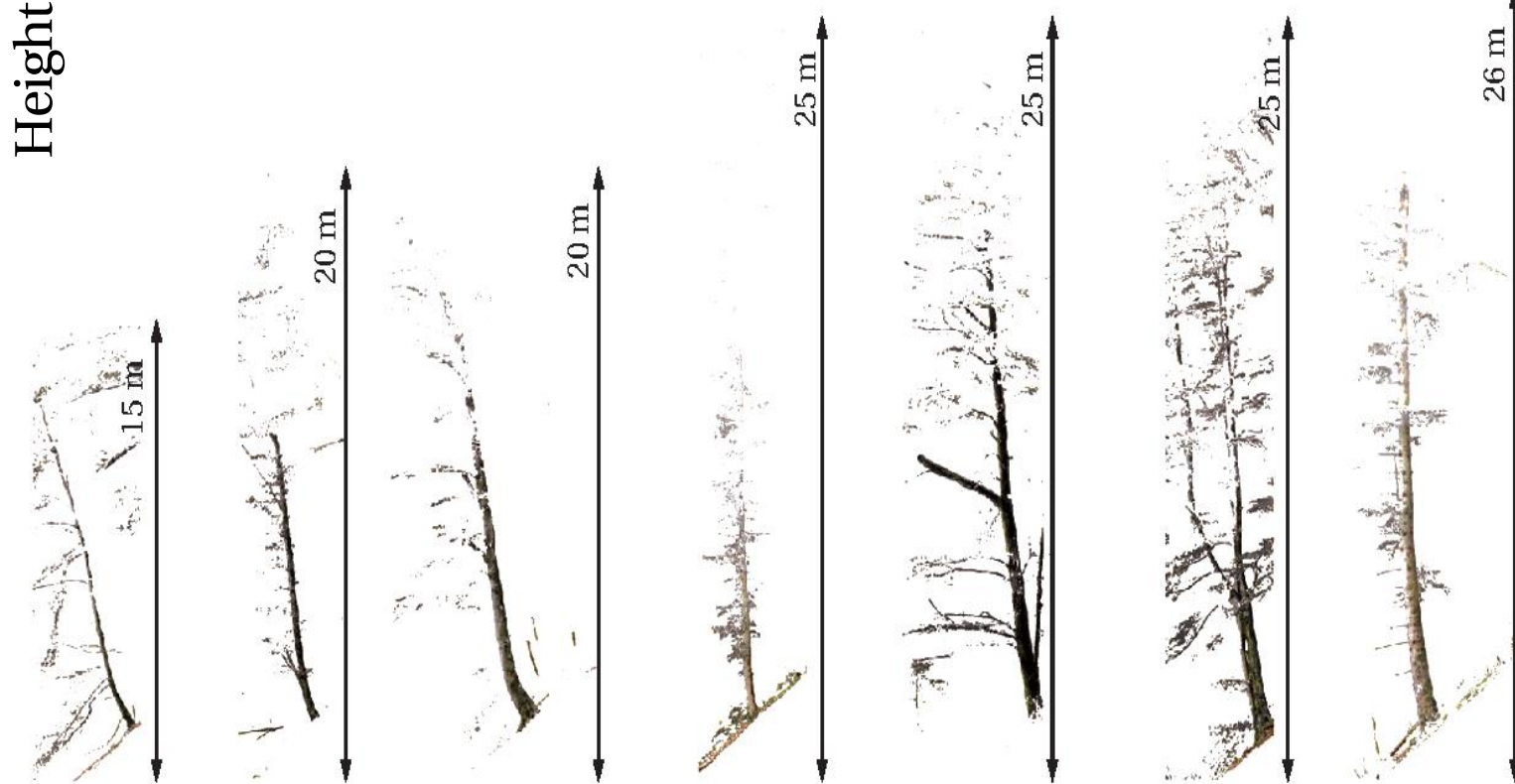
Library - Tree Topology*

* Prefabricated Elements Can be Used too.

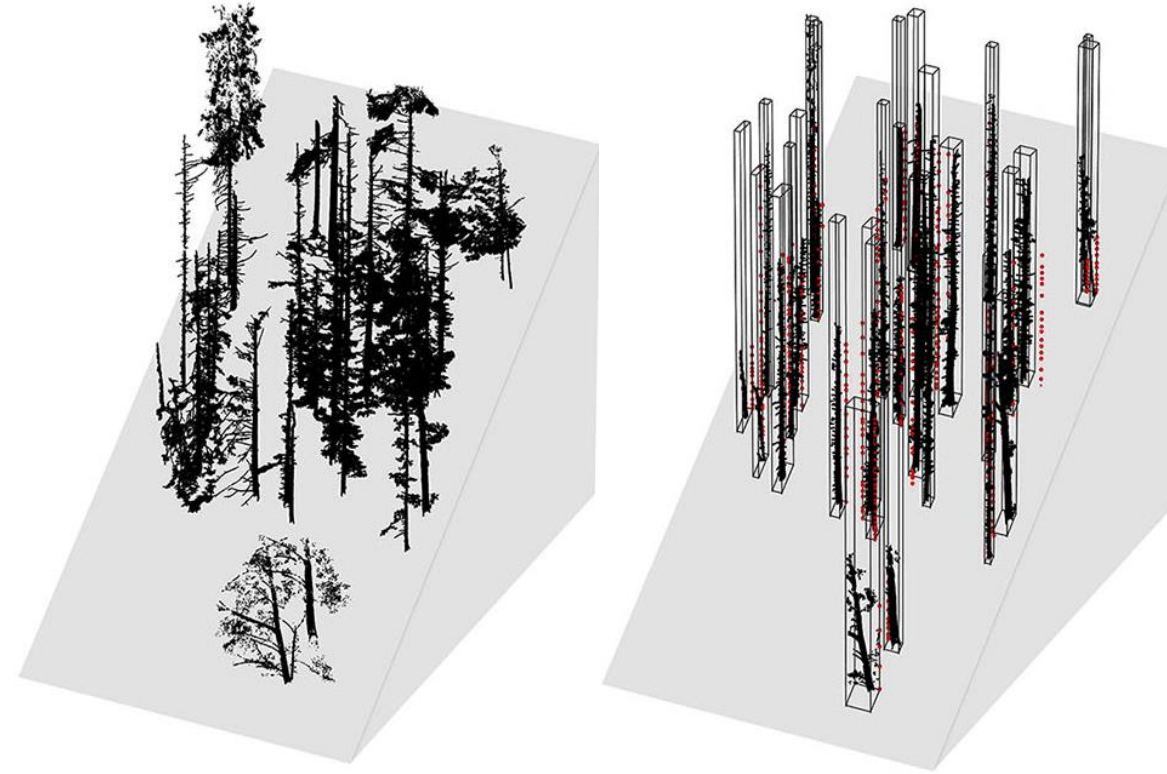
Swiss Context – Forest Visit



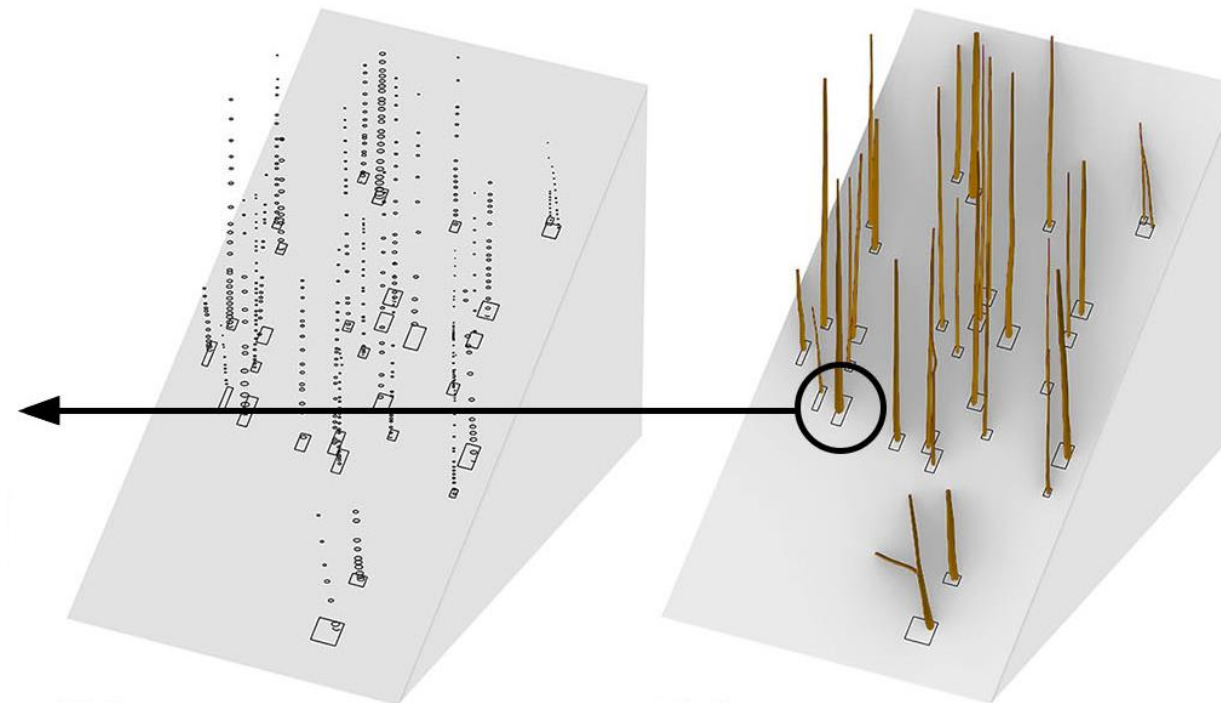
Height



Swiss Context – Multiple Scan Studies

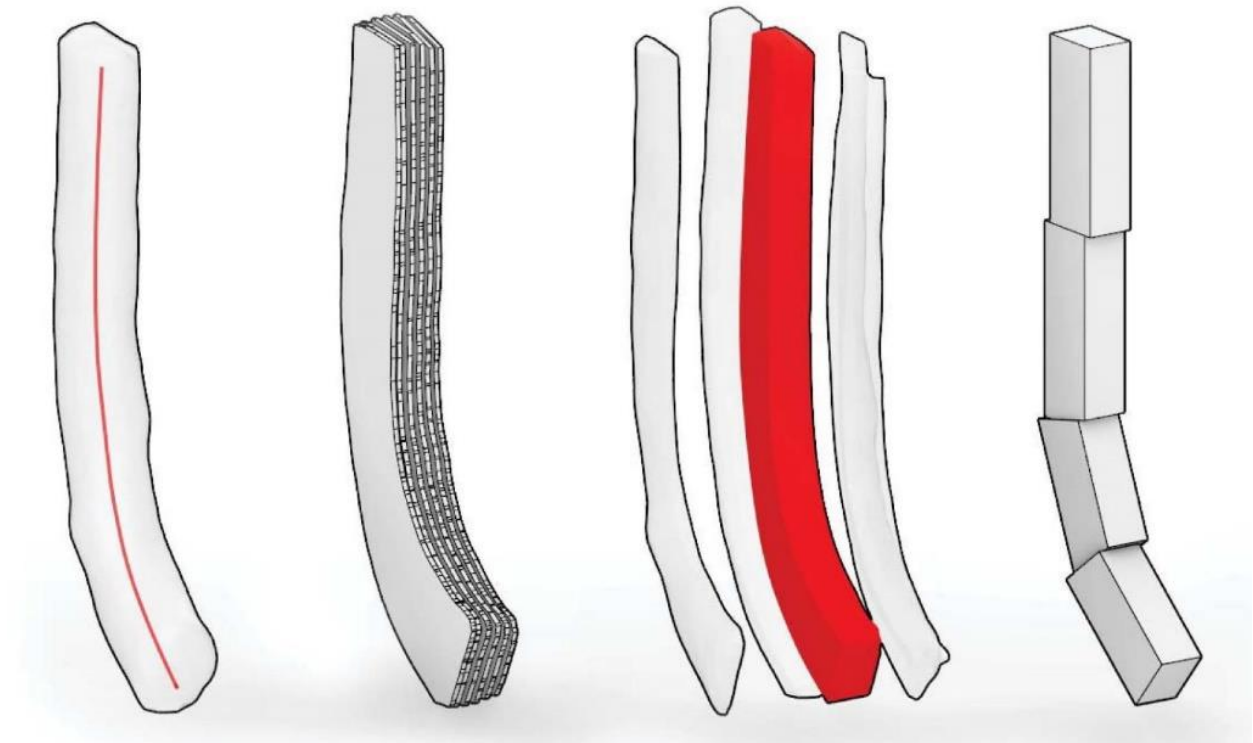


Forest Scan Mostly straight Spruce



Scan Visit 1

Scan Visit 2



Thank you