Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

中华人民共和国
住房和城乡建设部

intep
skat Swiss Resource Centre and Consultancies for Development

HSLU Hochschule Luzern

卢塞恩应用科学和艺术大学
建筑技术和能源研究所

PRESENTATION OF HSLU
SWITZERLAND
22nd AUGUST 2022
GIANRICO SETTEMBRINI

The HSLU Institute for building technology and energy

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HSLU Institute for Building Technology and Energy
HSLU建筑技术和能源研究所

- University and Departmets
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- Institute organizatione and Fields of Activity
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- Research Groups and Lead Researchers
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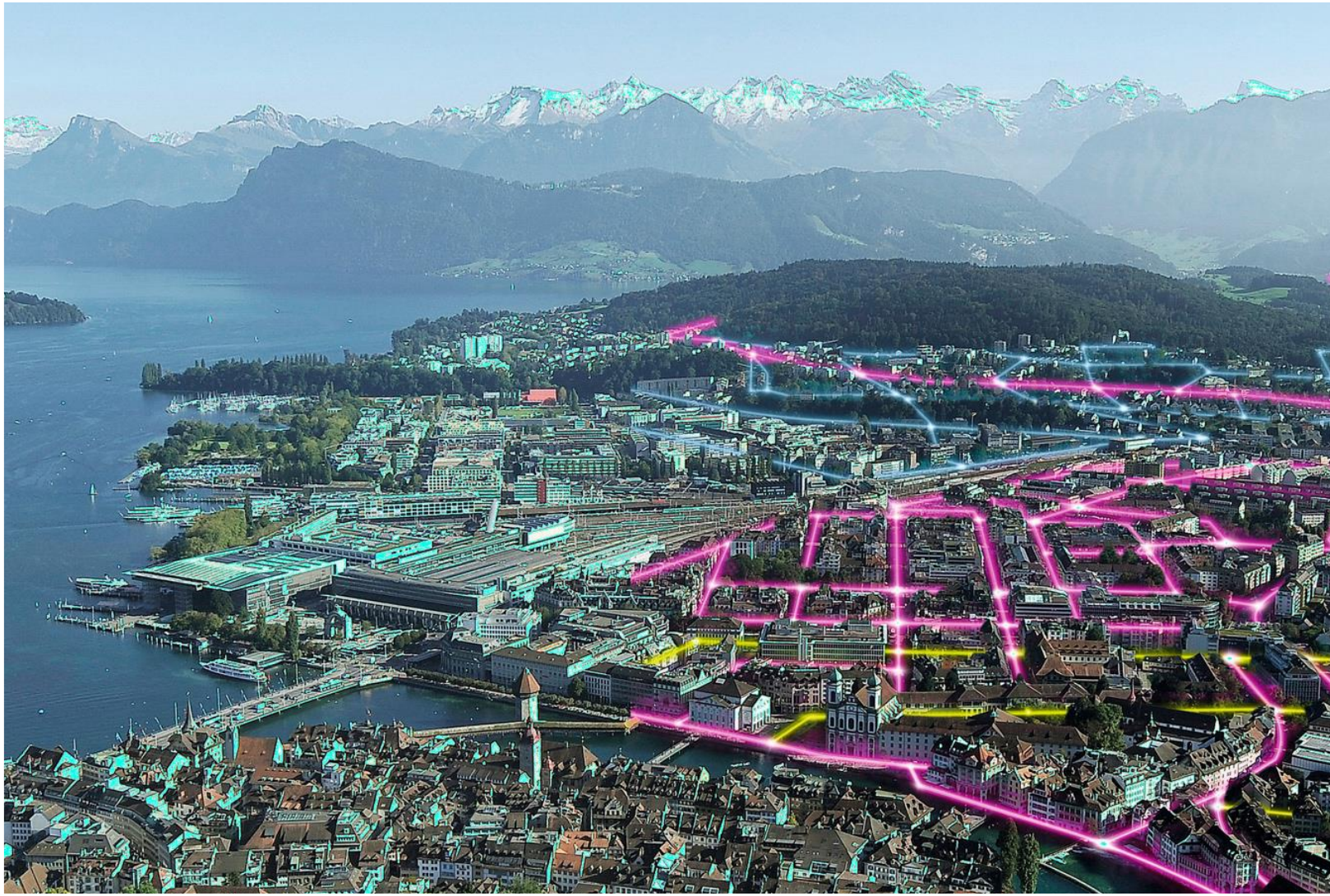
- Examples of Research Projects
  研究项目举例



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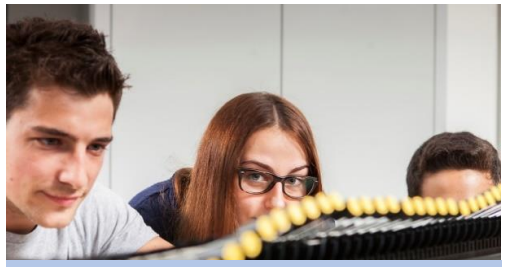
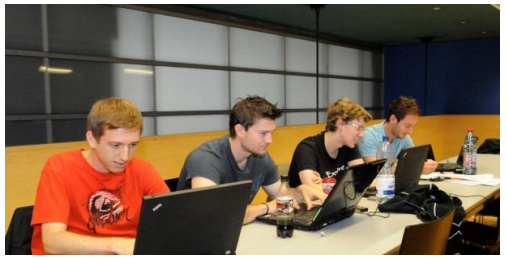
The 6 Departments

6个系



Engineering and Architecture
工程与建筑

Business (Economics)
商业经济学



Computer Science
计算机科学

Social Work
社会科学

Arts & Design
艺术与设计

Music
音乐

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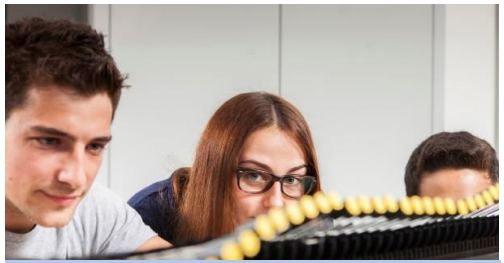
The Department Engineering & Architecture

工程与建筑系



Engineering and Architecture
工程与建筑系

9 Institutes

1. Natural sciences and humanities,
2. Mechanical and power engineering,
3. **Building Technology and Energy**
4. Electrical Engineering
5. Innovation and Technology Management,
6. Medical Technology
7. Architecture
8. Interior Design
9. Civil Engineering

9个研究所

1. 自然科学和人文科学
2. 机械和动力工程
3. **建筑技术和能源**
4. 电气工程
5. 创新与技术，管理
6. 医学技术
7. 建筑学
8. 室内设计
9 土木工程

13 Study Programmes

Bachelor – and Master-Studies
13个课程计划
学士-和硕士课程

15 Competence Centres

Focus Buildings as a System
Solutions for a successful Energy Turnaround
15个技能中心
把建筑作为一个系统来关注
成功的能源转型作为解决方案

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The Institute for Building Technology and Energy
建筑技术与能源研究所

Prof. Adrian Altenburger Prof. Urs-Peter Menti

110 Employees 110名雇员

4 Key Mandates
- Degree Programs
- Continuing education
- Research
- Services

4个主要任务
- 学位课程
- 继续教育
- 研究工作
- 服务

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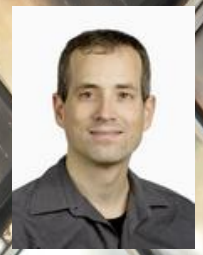
The Institute's Research Groups
研究所的 科研小组

Simulation & Analysis in Buildings & Areas
建筑物和区域模拟与分析



Light, Automation and Electrical Systems in Buildings
建筑物中的照明、自动化和电气系统

Sustainable Construction and Renewal

可持续建造和翻新

Health and Hygiene
健康和 卫生

Quality in Planning and Construction
规划和建造的质量

Building Technology Laboratory
建筑技术 实验室

The Research Group
Sustainable Construction and Renewal
研究小组 - 可持续建造和翻新

Alina Kretschmer
Architect
Ökobilanzierung
New Materials

Heiner Manz
Dozent
Bauphysik
Behaglichkeit

Marvin King
Architekt
Bauökonom
Sanierungstrategien

Sina Büttner
Architektin
Bauingenieurin
Zirkuläres Bauen

Silvia Domingo
Architektin
Simulationen
Klimadaten

Gianrico Settembrini
Head of the Research Group
Architect / MAS Energy and Sustainability
Climate Change and Embodied Energy
Stadards und Labels
Minergie /-P/-A/-ECO, GEAK, 2000-Watt-Areale,
Standard Nachhaltiges Bauen Schweiz SNBS

Oberfeld residential development, car-free settlement Ostermundigen BE
Model processing and construction site, Settembrini @ Halle 58 Architekten Bern

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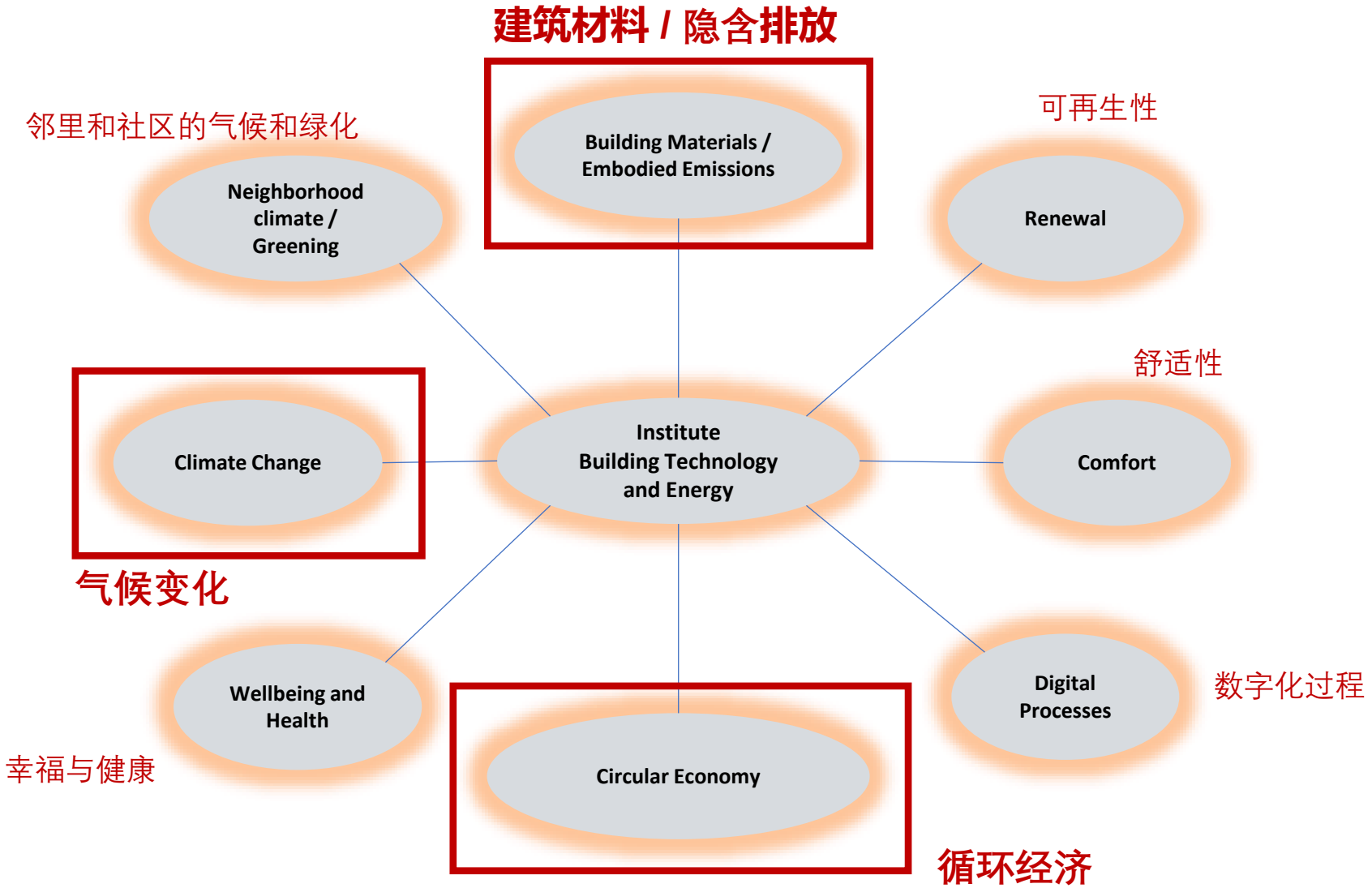
The Institute's Research Topics
研究所的研究课题



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Research Topic 研究主题
Climate Change 气候变化

Projects: 项目

- Residential buildings in climate change – Energy and Comfort
  气候变化中的住宅建筑 – 能耗与舒适性
- Ready for Climate Change? Recommendations for building owners and planners 为气候变化做好准备了吗？给建筑业主和设计人员的建议
- Air conditioning in the context of climate change
  气候变化前提下的空调措施
- Efficient cooling concepts 有效的致冷方案
- Building labels and the climate change
  建筑认证标签和气候变化
- SIA Climate data of the future
  瑞士工程师与建筑师协会SIA的未来数据

Further research topics 更多研究主题

- Climate-friendly planning with low-tech低技术有利气候的设计手法
- Same comfort with less energy demand在能耗减少情况下达到同样的舒适度

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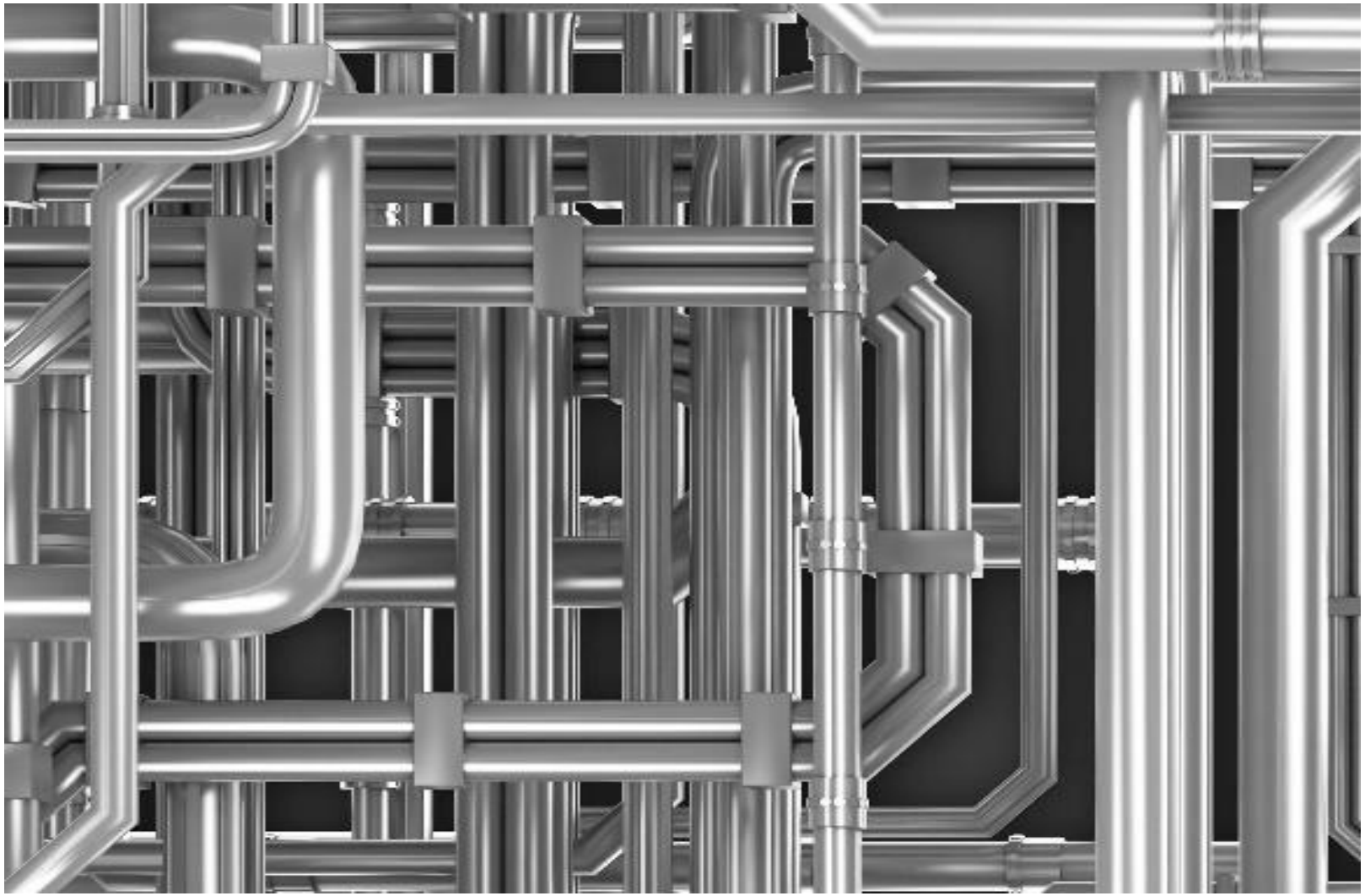
Research Topic 研究主题

Materials and Embodied Emissions

材料和隐含排放



Projects: 项目

- Optimal insulation thicknesses in buildings
- Building envelope of high-rise façades
- Wood hybrid in high-rise buildings
- Homogeneous brick façade
- “GreenPV” – Green and PV in façades

- 建筑物的最佳保温层厚度
- 高层建筑外立面的建筑围护结构
- 高层建筑中的木质混合结构
- 均质砖外墙
- "GreenPV"--绿色和光伏外墙

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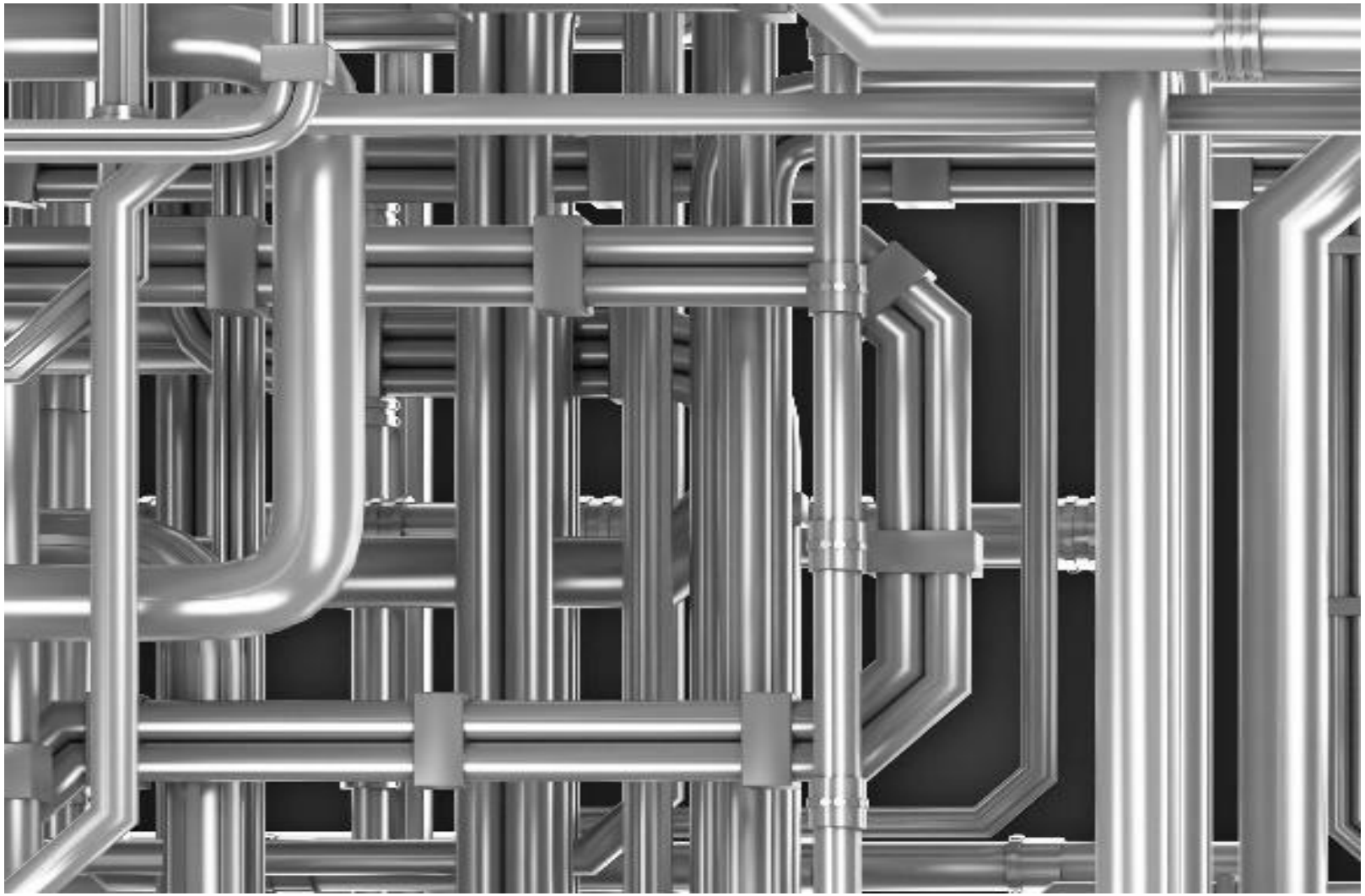
Research Project 研究项目 „Zero Emissions Buildings“ – Minimising Embodied Emissions

“零排放建筑” - 最大限度地减少隐含排放

Projects examples : 项目实例

- Characteristic values for embodied energy of building technologies
- Ventilation systems: Alternative materials and Re-Use potential
- Analysis of low-tech ventilation concepts
- 16cm concrete ceiling is enough –Analysis of visible ventilation ducts in residential buildings

- 建筑技术隐含能耗的特征值
- 通风系统：替代材料和再使用潜力
- 低技术通风方案的分析
- 16厘米的混凝土天花板就足够了 – 住宅楼内可见通风管道的分析



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Research Projects 研究项目
„BEEP Review“ - BEEP回顾

Indo-Swiss Building Energy Efficiency Programm:

- Project Review with
  Federal Department of Foreign Affairs
  Embassy of Switzerland in India and Bhutan

印度-瑞士建筑能效项目

- 与瑞士联邦外交部驻印度和不丹大使馆合作的项目回顾

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THANK YOU FOR YOUR ATTENTION

感 谢 您 的 关 注

THE ZEB-CHINA PROJECT - ZERO-EMISSION BUILDING
中瑞零碳建筑合作项目

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

中华人民共和国
住房和城乡建设部

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低碳建材的ZEB设计

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22nd AUGUST 2022
GIANRICO SETTEMBRINI

ZEB Design with Low Carbon Building Material

EXPERIENCES FROM SWITZERLAND

瑞士经验

1

Greenhous Gas Emissions by 2020:
Total 46.2 Mio. t CO_2-Equivalent

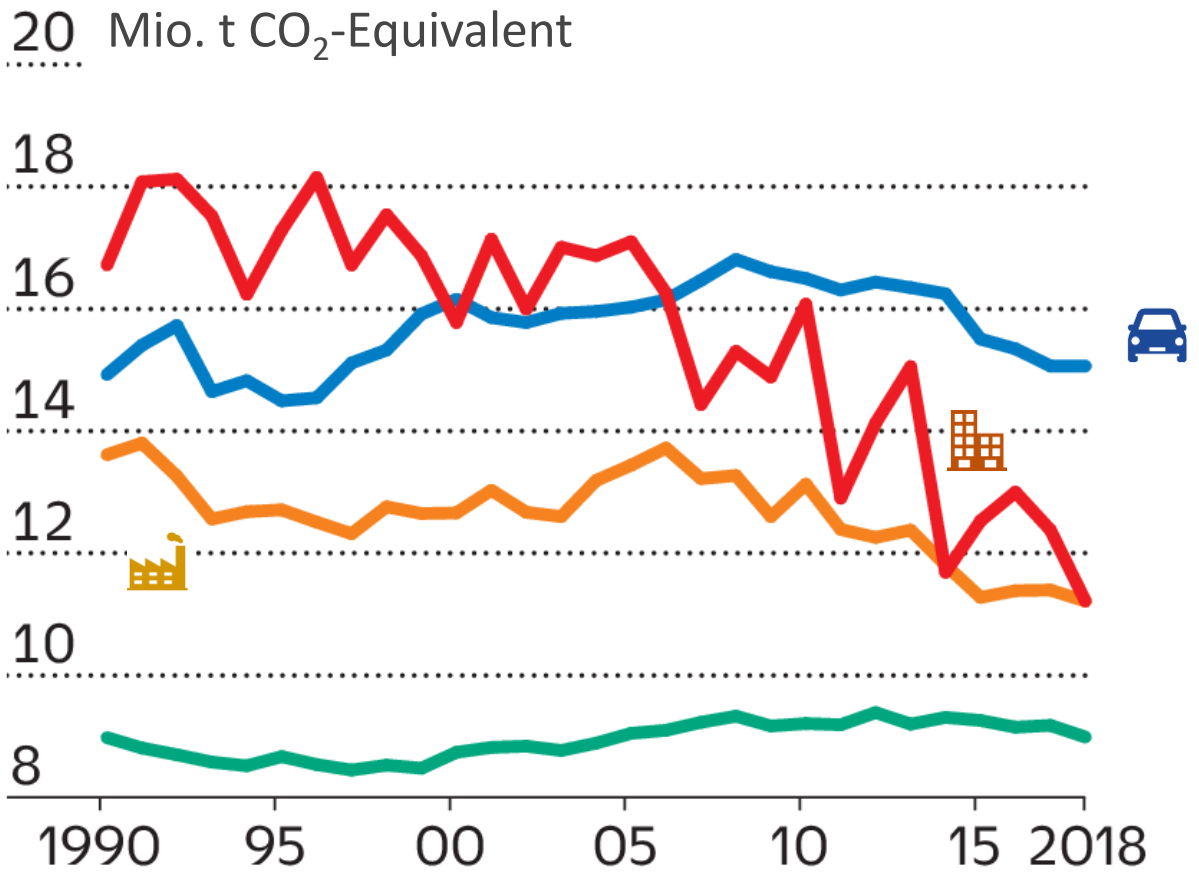
到2020年为止的温室气体排放:
总共46.2百万吨二氧化碳当量

Transport 32% (Trend +1%, 2020-Target -10%)
交通32% （趋势+1%, 2020-目标-10%)）

Building 24% (Trend -34%, 2020-Target-40%)
建筑 24% (趋势 -34%, 2020-目标-40%)

Industry 24% (Trend -14%, 2020-Target -15%)
工业 24% (趋势 -14%, 2020-目标 -15%)

Other 19% (Trend 0%, 2020-Target -10%)
其他 19% (趋势 0%, 2020-目标 -10%)



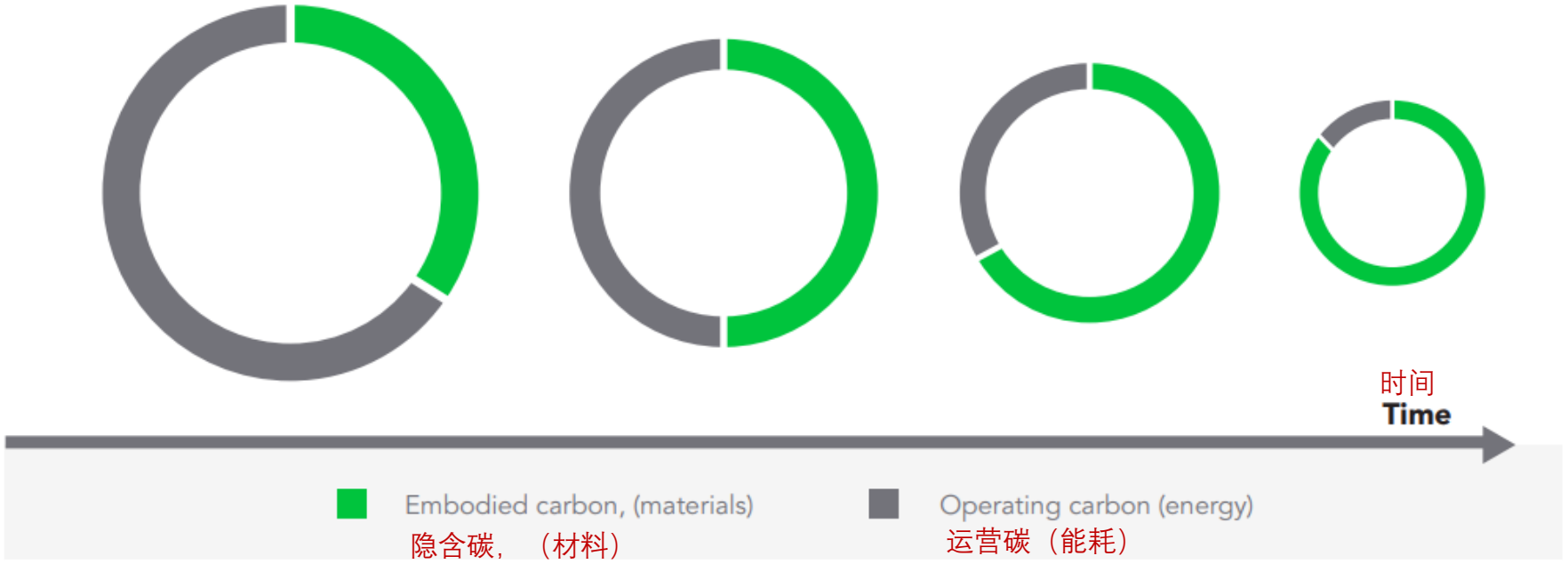
EMBODIED CARBON EMISSIONS IN SWISS BUILDINGS

瑞士建筑
隐含碳排放

1

Greenhouse Gas Emissions: Embodied carbon importance grows constantly

温室气体排放：
隐含碳的重要性不断增长



EMBODIED CARBON EMISSIONS IN SWISS BUILDINGS

瑞士建筑
隐含碳排放

1

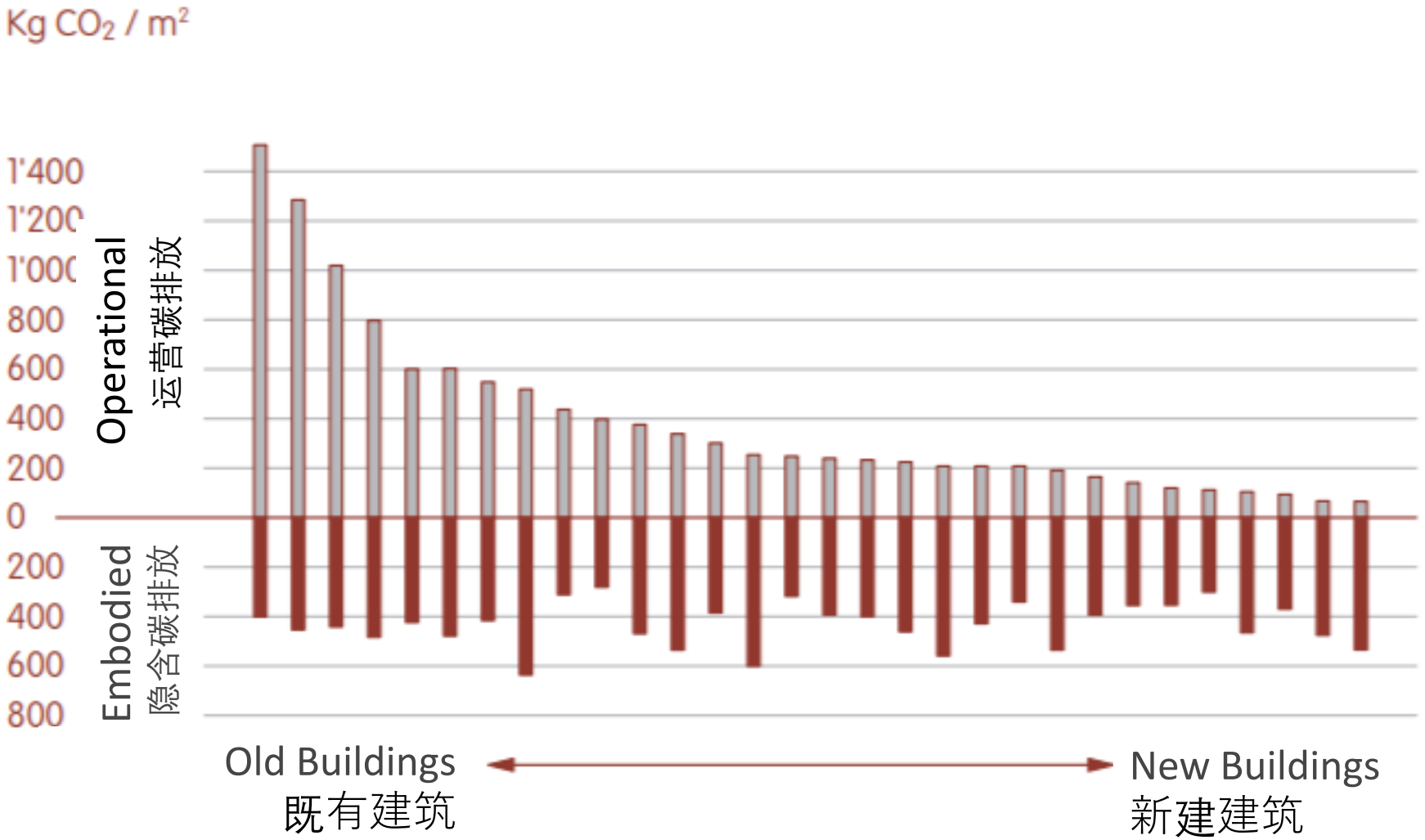
Greenhouse Gas Emissions:

Operating Carbon vs

Embodied Carbon

温室气体排放：

运营碳排放和隐含碳排放的对比



EMBODIED CARBON EMISSIONS IN SWISS BUILDINGS

瑞士建筑
隐含碳排放

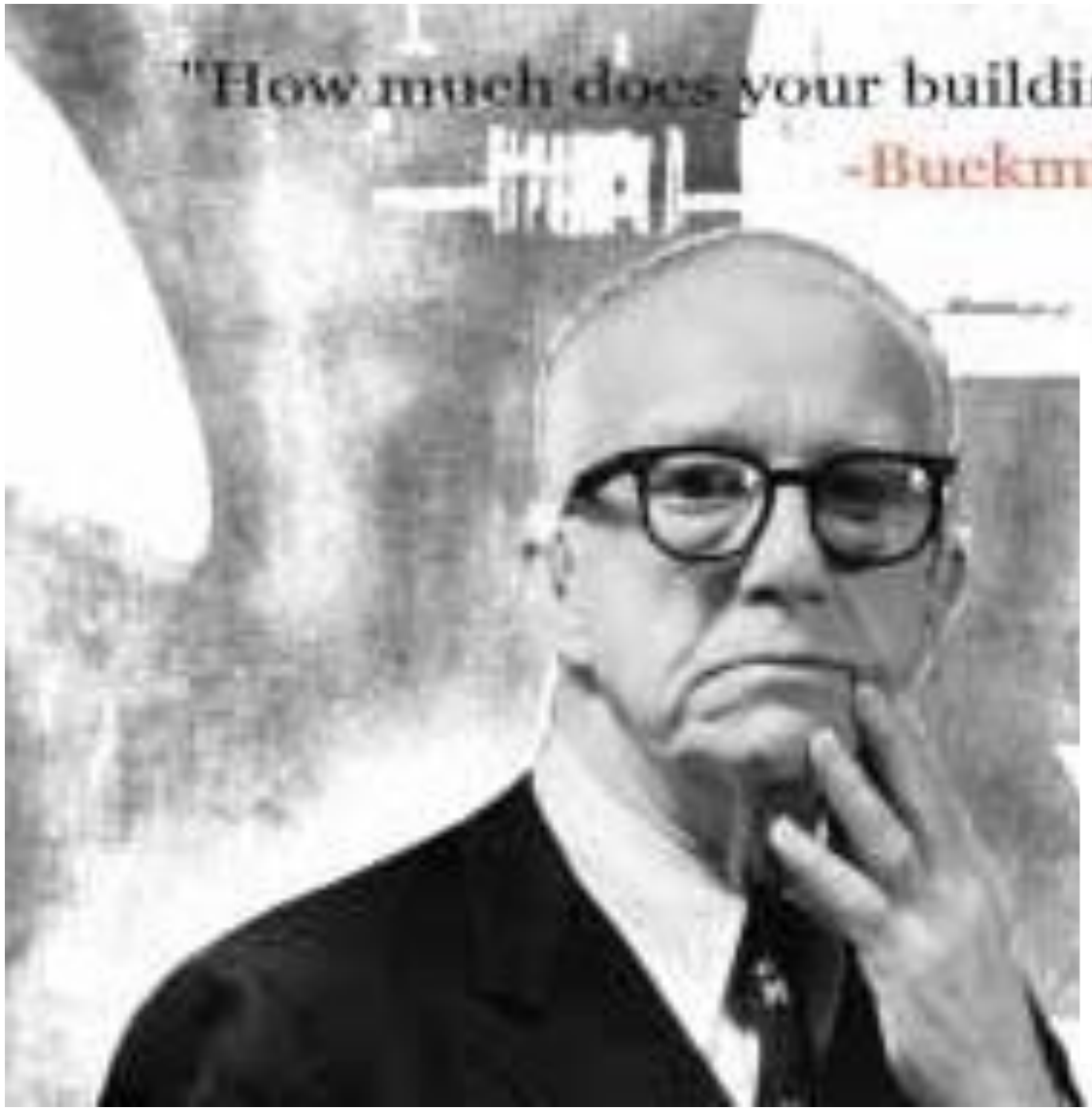
2

Example of materials and manufacturing processes:

材料和生产工艺例子

How can we reduce the manufacturing process for building materials?

我们如何能减少建筑材料的生产过程?



3g Gold requires 20t of Minerals (ore, stones)

3克黄金需要20吨的矿物（矿石、石头）

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

瑞士建筑
隐含碳排放

2

Example of a Building with Low Embodied Carbon Emissions

低隐含碳排放的建筑实例

Residential Building in Schlins (Aut)

by Boltshauser and Rauch

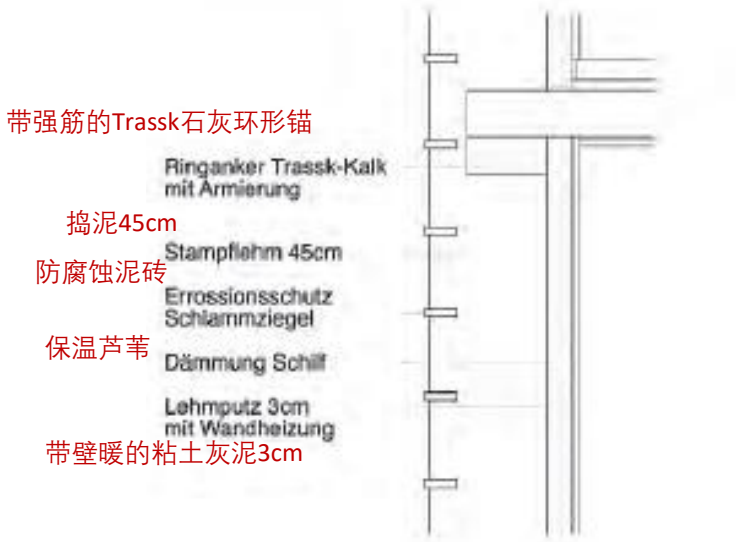
施林斯住宅建筑
（由Boltshauser and Rauch 设计事务所设计）

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

节材设计的重要性

2

Wandaufbau 墙体构造

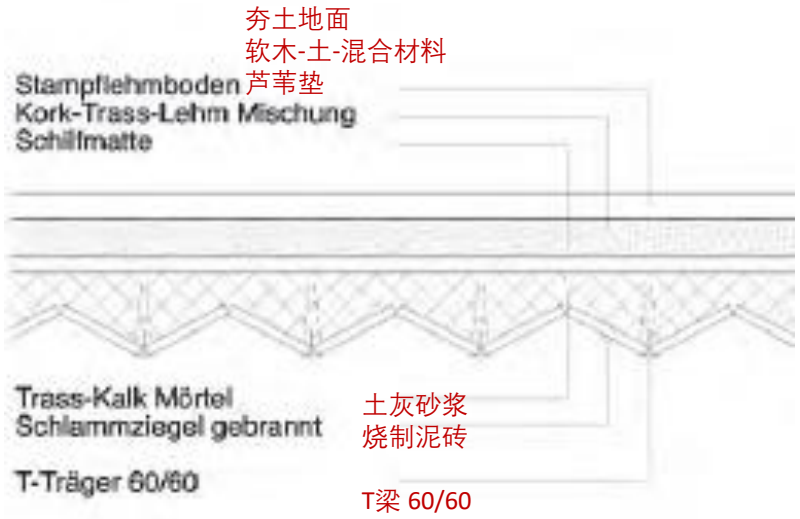


THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

节材设计的重要性

2

Bodenaufbau Küche 厨房地面构造



THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

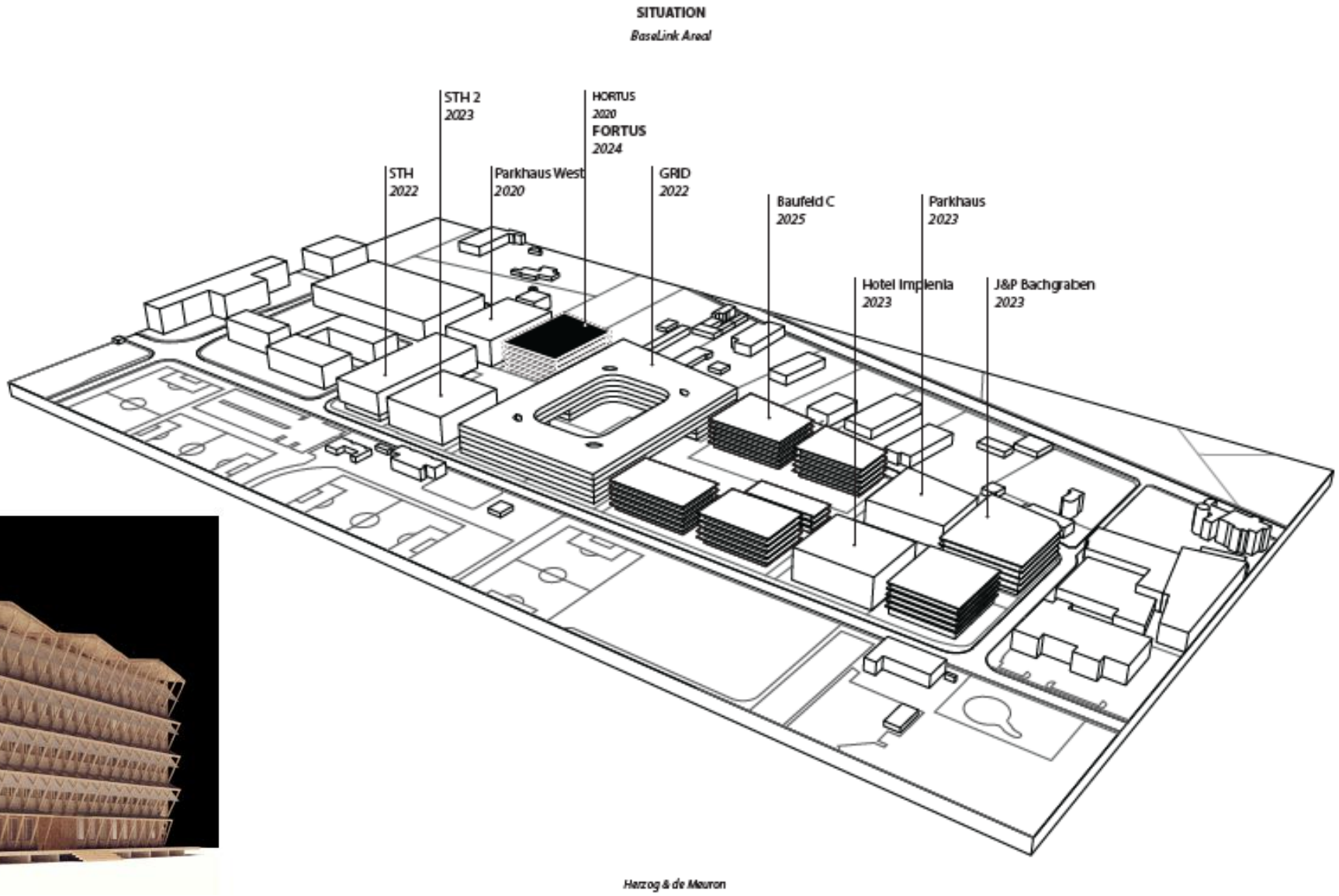
节材设计的重要性

2

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

节材设计的重要性

2



THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

节材设计的重要性

2

Basic rules for reducing embodied carbon emissions

减少隐含碳排放的基本规则

Rating of Key Building Materials 重要建材的评级

★★★	Concrete:	As little and as much as necessary.
	混凝土:	用量多少完全按必须性
★★★★	Wood:	As little glue as possible.
	木头:	尽可能少用胶水
★★	Masonry:	It all depends on the stone.
	砌体：	这完全取决于石材
★★★	Clay:	A niche with potential.
	粘土:	一个有潜力的利基市场
★★★	Recycling /reusing:	A second life without CO_2.
	回收/再利用:	没有二氧化碳的第二次生命
★	Interior fittings:	Little mass, little impact.
	户内装修:	量少，就影响小。

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN

节材设计的重要性

2

Basic rules for reducing embodied carbon emissions

减少隐含碳排放的基本规则

Energy 能耗

★★★★	Building technology: 建筑技术:	Low-Tech versus High-Tech 低技术与高技术的对比
★★★	Thermal mass: 蓄热量:	Equalize heat summer. 平衡酷暑

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN 节材设计的重要性

2

Basic rules for reducing embodied carbon emissions

减少隐含碳排放的基本规则

Order 秩序

★★★★★ Room program: 用房规划 — Question the order! 质疑秩序! Create as little house as possible. 尽可能少地创造用房

★★★★ Renovation: 翻新 — Mantain embodied energy. 保持隐含能耗

Building 建筑

★★★★ Underground: — Every house needs a foundation. The motto, as little as possible

地下部分：每个房子都需要一个地基。原则是，尽可能少

★★★★ Support structure: As slim as possible.

支撑结构: 尽可能的纤细。

★★★★ Compactness: — The efficiency of the box!

紧凑性: 盒子的效应!

★★★ Floor plan: — Every square meter counts.

平面图: 每一平方米都对减碳至关重要

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN 节材设计的重要性

2

Basic rules for reducing embodied carbon emissions

减少隐含碳排放的基本规则

Construction 建筑结构

★★★	Durability:	60 years or more. 60年或更久
	耐用性:	A durable construction! 耐用的结构!
★★★★	Façade:	Light and durable.
	外墙:	轻巧耐用。
★★★★	Windows:	As little and as much glass as necessary.
	窗户:	玻璃用量的多少完全按必要性。
★★	Layers:	Omit and combine. Components that perform several functions save material.
	层数:	省略和组合。可体现多种功能的部件可以一举多得，节省材料。
★	Prefabrication:	Don‘t wander off into the distance.
	预制:	不要想念远距离的供货

THE IMPORTANCE OF MATERIAL-EFFICIENT DESIGN 节材设计的重要性

3

Example of calculation

计算实例

你的建筑有多肥重?

这里我们不统计卡路里,

而是统计碳排放

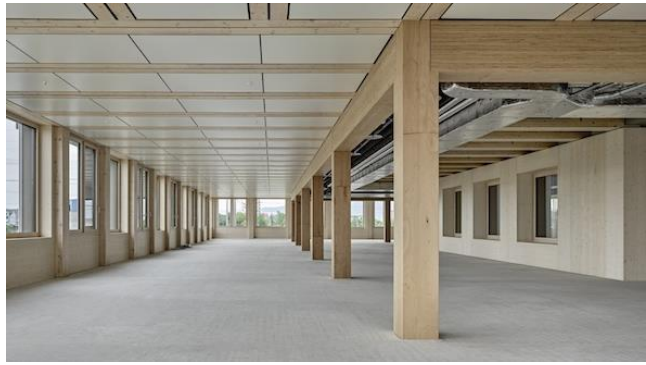
SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳
计算工具

3

Calculating and Comparing Embodied CO2 Emissions
计算和比较隐含二氧化碳排放量

Comparison between 4 modern Hybrid Timber Buildings and conventional construction systems 4种现代木建筑和传统结构体系和对比



SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

3

Calculating and Comparing Embodied CO2 Emissions
计算和比较隐含二氧化碳排放量

Comparison between 4 modern Hybrid Timber Buildings and conventional construction systems 4种现代木建筑和传统结构体系和对比

Suurstoffi 22
Burkard Meyer
36 m tall

SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

3

Calculating and Comparing Embodied CO2 Emissions
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瑞士建筑隐含碳
计算工具

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SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

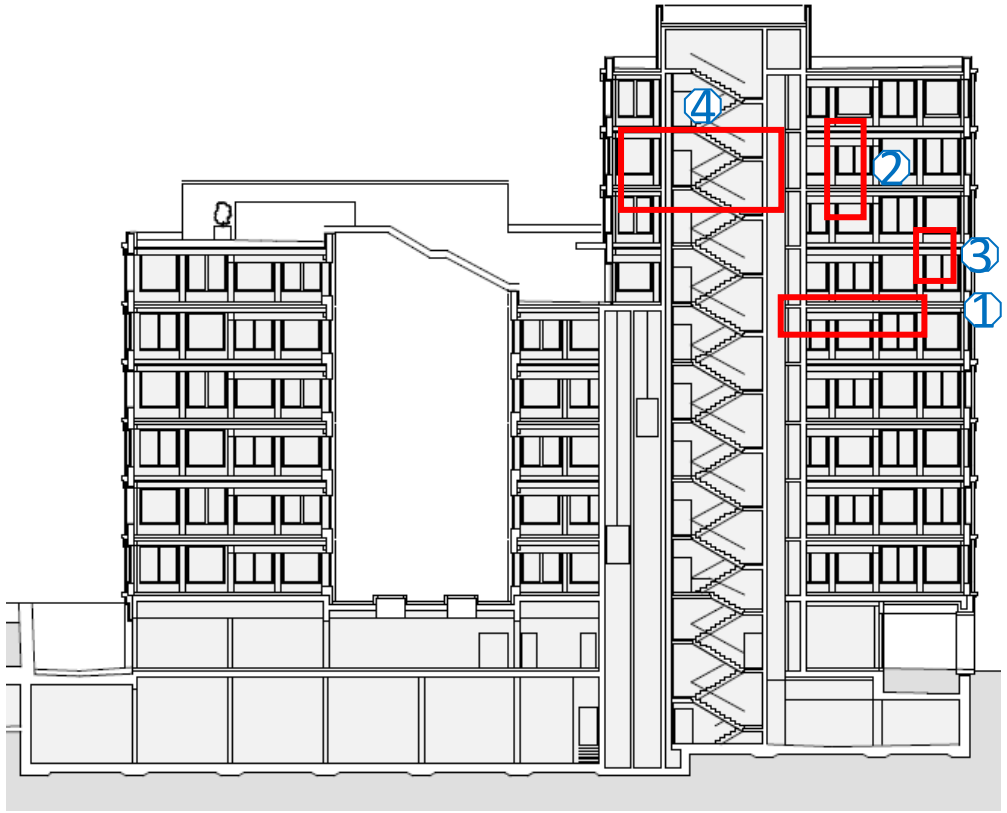
3

Calculating and Comparing Embodied CO2 Emissions
计算和比较隐含·二氧化碳排放量

Comparison between 4 modern Hybrid Timber Buildings and conventional construction systems 4种现代木建筑和传统结构体系和对比

Comparison of the following building components:对下列建筑部件进行比较

1. Ceiling 天花板
2. Primary structure (columns + beams) 主要结构（柱子+横梁）
3. Facade 外立面
4. Cores 核心部分



SWISS CALCULATION TOOLS FOR EMBODIED CO2

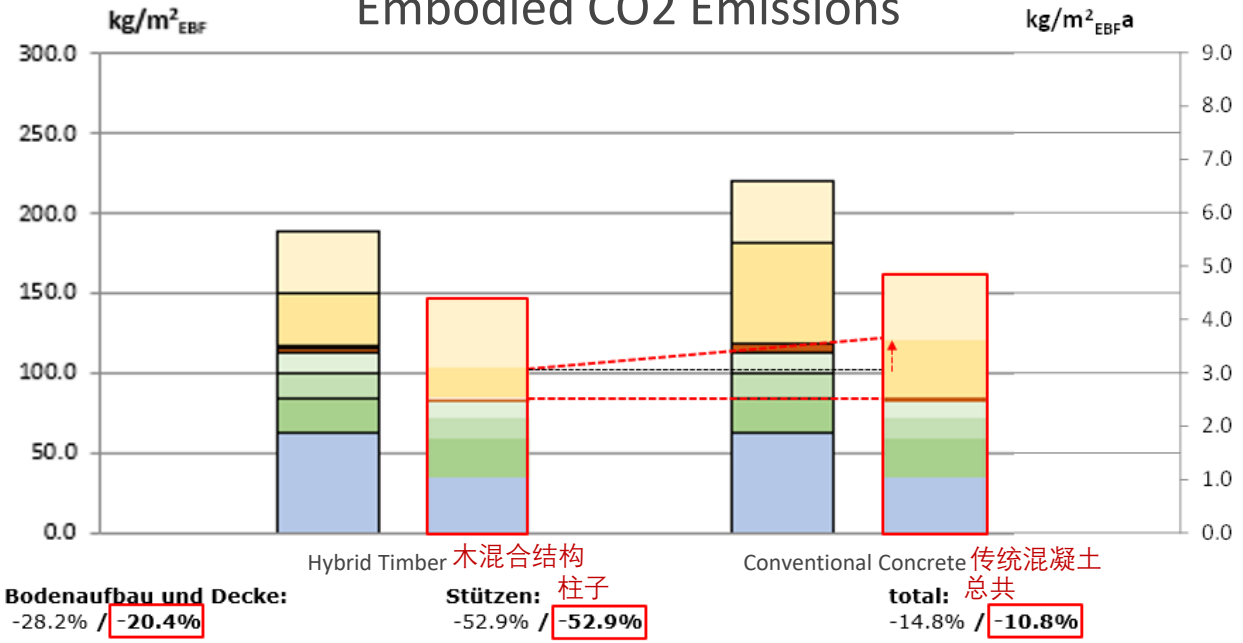
瑞士建筑隐含碳计算工具

3

Calculating and Comparing Embodied CO2 Emissions
计算和比较隐含二氧化碳排放量

Comparison between 4 modern Hybrid Timber Buildings and conventional construction systems 4种现代木建筑和传统结构体系和对比

隐含二氧化碳排放
Embodied CO2 Emissions



楼面构造和楼板 **Bodenaufbau und Decke:** -28.2% / **-20.4%**

柱子 **Stützen:** -52.9% / **-52.9%**

总共 **total:** -14.8% / **-10.8%**

Approximate reduction potential in the buildings by using a Hybrid Timber construction:
-2% bis -5% (Embodied CO2 Emissions)

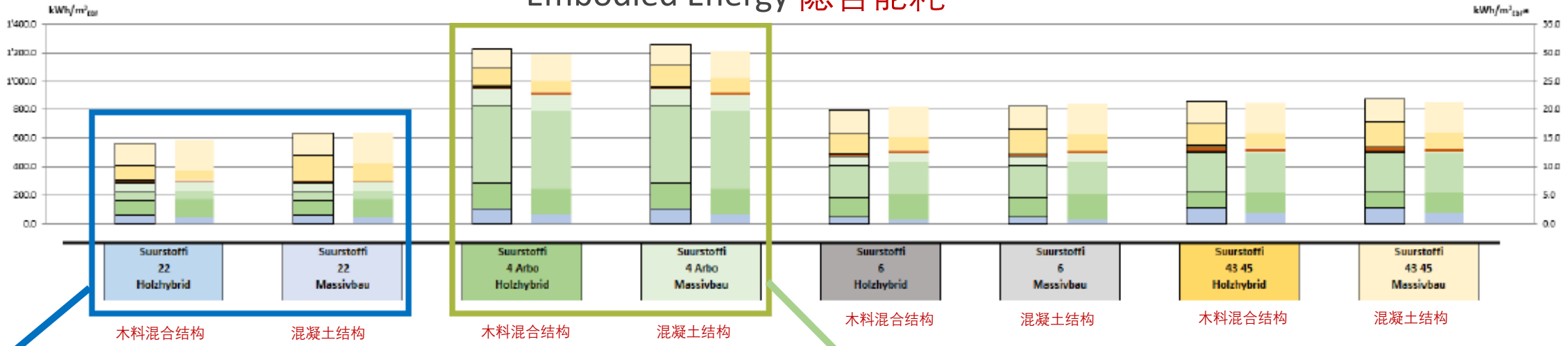
建筑物使用混合木材结构的大约减排潜力
-2% 至-5% （隐含二氧化碳排放量）

SWISS CALCULATION TOOLS FOR EMBODIED CO2

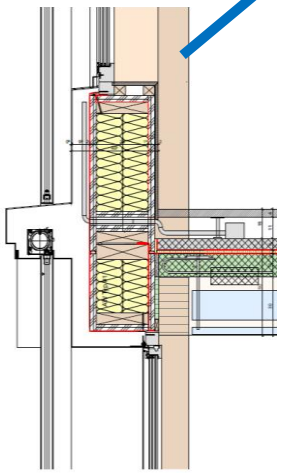
瑞士建筑隐含碳计算工具

3

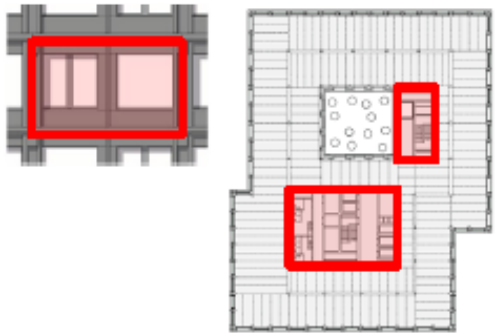
Embodied Energy 隐含能耗



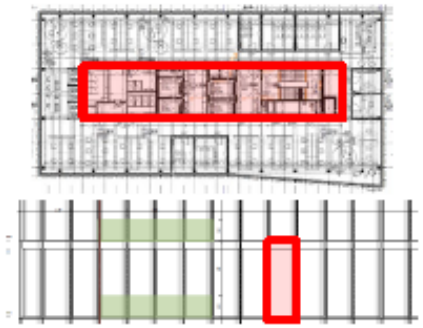
木料混合结构 混凝土结构 木料混合结构 混凝土结构 木料混合结构 混凝土结构 木料混合结构 混凝土结构

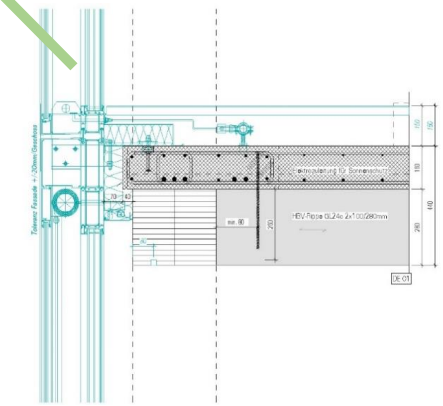


EBF: 1'766 m²

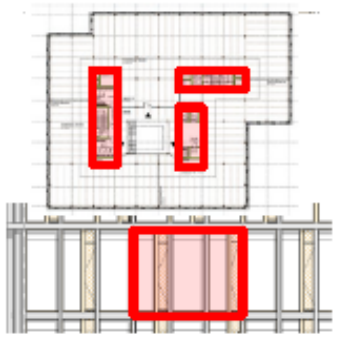


765 m²





1'565 m²



SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

4

Calculating the

Life Cycle Assessment

计算生命周期评估

Principle of calculation
计算原则

Life Cycle Assessment	=	Bill of Quantities	X	Environmental Factor
• Environmental Rating • Embodied Energy • Embodied CO2 emissions		• Material A [kg] • Material B [kg] • Material C [kg]		• UBP / [kg] • kWh oil eq / [kg] • kg CO2e / [kg]
生命周期评估	=	**材料总量**	X	**环境因子**
• 环境评级 • 隐含能耗 • 隐含二氧化碳排放量		• 材料A [kg] • 材料B [kg] • 材料C [kg]		• UBP / [kg] • kWh oil eq / [kg] • kg CO2e / [kg]

THE SWISS CALCULATION TOOL FOR EMBODIED CO2

瑞士建筑隐含碳
计算工具

4

Calculating the Life Cycle Assessment
计算生命周期评估

Early project planning phase:

早期项目规划阶段:

THE SIA 2040 CALCULATOR

瑞士建筑师和工程师协会

SIA2040 计算工具

计算器 SIA 2040: 初步研究/初步项目 **建造**

项目信息 **Test Project for CABR**

项目输入

建筑总面积	建筑总面积	m^2	11'000		
能源参考面积	ERA	m^2	9'000		

图示
输入字段
选择字段
采用值
组件面积 组件面积

	名称	*参考资料*	*单位*	*数量*	*设计变量*	不可再生的一次能源 kWh/m^2	温室气体排放 kg/m^2
						以能源参考面积为基础一年的摊销	
建筑物	挖方	Volumen	m^3	4500	无地下水	0.3	0.08
地下	地基、底板	组件面积	m^2	1500	有保温层	1.1	0.37
	外墙	组件面积	m^2	1800	有保温层	1.4	0.50
	屋顶	组件面积	m^2	2000	有保温层	2.6	0.80
建筑物	外墙：承重结构	组件面积	m^2	2600	混凝土墙	1.0	0.34
地上	(备用)	组件面积	m^2		混凝土墙	0.0	0.00
	外墙：建造	组件面积	m^2	2500	有保温层的外墙抹灰	1.6	0.34
	(备用)	组件面积	m^2	0	有保温层的外墙抹灰	0.0	0.00
	有遮阳功能的窗户	组件面积	m^2	1300		3.1	0.76
	内墙	组件面积	m^2	6967		3.0	1.01
	天花板：支撑结构	组件面积	m^2	8000	混凝土天花板(25厘米)	3.3	1.19
	(备用)	组件面积	m^2	1500	木质天花板	0.5	0.11
	天花板：建造	组件面积	m^2	8500	针对未供暖空间的保温板	1.3	0.28
	(备用)	组件面积	m^2	0	屋顶结构	0.0	0.00
	阳台	组件面积	m^2	0		0.0	0.00
	屋顶：支撑结构	组件面积	m^2	1500	混凝土天花板(25厘米)	0.6	0.22
	(备用)	组件面积	m^2	0	混凝土天花板(25厘米)	0.0	0.00
	屋顶：建造	组件面积	m^2	1500	保温的（平屋顶）	1.5	0.33
	(备用)	组件面积	m^2	0	保温的（平屋顶）	0.0	0.00
建筑设备	电气系统	ERA	m^2	9000	包括配电系统电气系统	3.0	0.65
	光伏系统	最大功率	kWp	210	(在 "运营 "表中输入)	5.7	1.52
	热电厂	ERA	m^2	9000	供暖系统，包括配电系统	2.2	0.51
	太阳能集热器	组件面积	m^2	0	(在 "运营 "表中输入)	0.0	0.00
	通风系统	ERA	m^2	5000	(在 "运营 "表中输入)	2.1	0.51
	水厂	ERA	m^2	9000	卫生系统包括分配网络	1.3	0.32
					项目值	**36**	**9.8**
					标准值	*30*	*7.9*

SWISS CALCULATIONS TOOL FOR EMBODIED CO2

瑞士建筑隐含碳
计算工具

4

Calculating the

Life Cycle Assessment

计算生命周期评估

Later project planning phase:

后期项目规划阶段

THE KBOB DATA SET

KBOB数据库

Ökobilanzdaten im Baubereich — **KBOB / ecobau / IPB 2009/1:2022**

ID-Nummer	BAUMATERIALIEN	Rohdichte/ Flächen-masse	Bezug	UBP'21			Primärenergie Energie primaire										Treibhausgas-emissionen			Biogener Kohlenstoff
							erneuerbar renouvelable					nicht erneuerbar (Graue Energie) non renouvelable (énergie grise)					Emissions de gaz à effet de serre			
	Hinweis: Anzeigen der herstellerspezifischen und herstellerregionenspezifischen Daten durch Anklicken der '+' am linken Rand.	Masse volumique/ surface	Référence	Total	Herstellung	Entsorgung	Total	Herstellung total	Herstellung energetisch genutzt	Herstellung stofflich genutzt	Entsorgung	Total	Herstellung total	Herstellung energetisch genutzt	Herstellung stofflich genutzt	Entsorgung	Total	Herstellung	Entsorgung	im Produkt enthalten
				Total UBP	Fabrication UBP	Elimination UBP	Total kWh oil-eq	kWh oil-eq	kWh oil-eq	kWh oil-eq	Elimination kWh oil-eq	Total kWh oil-eq	kWh oil-eq	kWh oil-eq	kWh oil-eq	Elimination kWh oil-eq	Total kg CO_2-eq	Fabrication kg CO_2-eq	Elimination kg CO_2-eq	kg C
06	**Metallbaustoffe**	kg/m³																		
06.001	Aluminiumblech, blank	2'690	kg	12'500	12'500	19.9	5.22	5.22	5.22	0	0.001	24.8	24.8	24.8	0	0.032	5.59	5.58	0.008	0
06.002	Aluminiumprofil, blank	2'690	kg	11'500	11'400	19.9	5.24	5.24	5.24	0	0.001	25.6	25.6	25.6	0	0.032	5.70	5.69	0.008	0
06.002.01	Aluminiumprofil blank, WICONA, hergestellt mit Hydro CIRCAL 75R	2'690	kg	12'700	12'700	19.9	4.26	4.26	4.26	0	0.001	8.88	8.85	8.85	0	0.032	2.67	2.66	0.008	0
06.003	Armierungsstahl	7'850	kg	2'930	2'910	19.7	0.422	0.420	0.420	0	0.002	4.99	4.94	4.94	0	0.051	1.52	1.50	0.012	0
06.014	Blei	11'340	kg	3'810	3'790	19.9	0.240	0.240	0.240	0	0.001	3.84	3.81	3.81	0	0.032	1.02	1.01	0.008	0
06.004	Chromnickelstahlblech 18/8 blank	7'900	kg	9'710	9'700	11.2	2.39	2.39	2.39	0	0.001	14.6	14.5	14.5	0	0.027	4.12	4.12	0.007	0
06.005	Chromnickelstahlblech 18/8 verzinnt	7'900	kg	13'000	13'000	11.2	2.65	2.65	2.65	0	0.001	22.3	22.3	22.3	0	0.027	5.88	5.88	0.007	0
06.006	Chromstahlblech blank	7'700	kg	7'080	7'070	11.2	0.961	0.960	0.960	0	0.001	8.54	8.51	8.51	0	0.027	2.74	2.73	0.007	0
06.007	Chromstahlblech verzinnt	7'700	kg	10'400	10'400	11.2	1.22	1.22	1.22	0	0.001	16.2	16.2	16.2	0	0.027	4.50	4.49	0.007	0
06.008	Kupferblech, blank	8'900	kg	24'500	24'500	19.9	1.62	1.62	1.62	0	0.001	8.91	8.88	8.88	0	0.032	2.21	2.20	0.008	0
06.009	Messing-/Baubronzeblech	8'300	kg	25'500	25'500	19.9	1.88	1.88	1.88	0	0.001	11.1	11.1	11.1	0	0.032	2.72	2.71	0.008	0
06.010	Stahlblech, blank	7'850	kg	5'270	5'260	11.2	0.613	0.612	0.612	0	0.001	7.80	7.78	7.78	0	0.027	2.80	2.79	0.007	0
06.011	Stahlblech, verzinkt	7'850	kg	15'200	15'200	11.2	1.38	1.37	1.37	0	0.001	15.6	15.6	15.6	0	0.027	4.49	4.49	0.007	0
06.012	Stahlprofil, blank	7'850	kg	1'300	1'280	11.2	0.246	0.245	0.245	0	0.001	3.38	3.36	3.35	0	0.027	0.738	0.731	0.007	0
06.013	Titanzinkblech	7'200	kg	27'800	27'800	19.9	2.60	2.59	2.59	0	0.001	17.5	17.4	17.4	0	0.032	4.03	4.02	0.008	0
07	**Holz und Holzwerkstoffe**	kg/m³																		
07.001	3- und 5-Schicht Massivholzplatte	453	kg	1'020	936	80.7	13.3	13.2	8.30	4.95	0.006	2.18	2.09	1.75	0.337	0.093	0.471	0.415	0.056	0.433
07.021	Balkenschichtholz	439	kg	792	718	74.2	8.59	8.58	3.49	5.09	0.006	1.56	1.47	1.38	0.097	0.091	0.343	0.294	0.049	0.446
07.003	Brettschichtholz	439	kg	772	698	74.2	8.14	8.13	3.07	5.06	0.006	1.54	1.45	1.30	0.142	0.091	0.336	0.287	0.049	0.446
07.003.01	Brettschichtholz, Produktion Schweiz	439	kg	683	609	74.2	8.00	8.00	2.90	5.10	0.006	1.20	1.11	1.03	0.084	0.091	0.254	0.205	0.049	0.447
07.002	Brettschichtholz	439	kg	772	698	74.2	8.14	8.13	3.07	5.06	0.006	1.54	1.45	1.30	0.142	0.091	0.336	0.287	0.049	0.446
07.020	Brettsperrholz	436	kg	884	777	107	8.12	8.11	2.99	5.12	0.006	1.82	1.73	1.64	0.089	0.098	0.397	0.317	0.080	0.449
07.020.01	Brettsperrholz, Produktion Schweiz	424	kg	745	638	107	5.67	5.66	0.549	5.11	0.006	1.61	1.51	1.45	0.054	0.098	0.281	0.201	0.080	0.448
07.022	Furnierspernholz	823	kg	1'980	1'870	107	9.24	9.24	4.72	4.52	0.006	5.08	4.98	4.05	0.933	0.098	1.02	0.944	0.080	0.410
07.004	Hartfaserplatte	955	kg	1'770	1'700	68.8	7.04	7.03	1.85	5.18	0.006	4.13	4.04	3.78	0.260	0.090	1.07	1.03	0.044	0.455
07.005	Holzwolle-Leichtbauplatte, zementgebunden	400	kg	773	687	86.5	2.04	2.03	0.491	1.54	0.010	1.28	1.10	1.10	0	0.171	0.536	0.499	0.036	0.138
07.023	Konstruktionsvollholz	436	kg	691	622	68.8	8.28	8.27	3.13	5.15	0.006	1.25	1.15	1.14	0.011	0.090	0.290	0.245	0.044	0.450
07.008	Massivholz Buche / Eiche, kammergetrocknet, gehobelt	675	kg	438	375	63.3	7.28	7.27	2.32	4.95	0.006	0.664	0.575	0.575	0	0.089	0.153	0.114	0.039	0.451
07.008.01	Massivholz Buche / Eiche, kammergetrocknet, gehobelt, Produktion Schweiz	675	kg	398	334	63.3	7.39	7.39	2.44	4.95	0.006	0.574	0.484	0.484	0	0.089	0.123	0.084	0.039	0.451
07.007	Massivholz Buche / Eiche, kammergetrocknet, rau	675	kg	393	330	63.3	7.11	7.11	2.16	4.95	0.006	0.569	0.480	0.480	0	0.089	0.136	0.097	0.039	0.451
07.007.01	Massivholz Buche / Eiche, kammergetrocknet, rau, Produktion Schweiz	675	kg	357	293	63.3	7.22	7.21	2.27	4.95	0.006	0.486	0.397	0.397	0	0.089	0.110	0.070	0.039	0.451
07.006	Massivholz Buche / Eiche, luftgetrocknet, rau	705	kg	324	261	63.3	6.21	6.20	1.66	4.54	0.006	0.480	0.390	0.390	0	0.089	0.121	0.082	0.039	0.413
07.006.01	Massivholz Buche / Eiche, luftgetrocknet, rau, Produktion Schweiz	705	kg	291	228	63.3	6.30	6.29	1.76	4.54	0.006	0.403	0.314	0.314	0	0.089	0.098	0.059	0.039	0.413
07.011	Massivholz Fichte / Tanne / Lärche, kammergetr., gehobelt	465	kg	478	415	63.3	6.05	6.04	0.889	5.15	0.006	0.779	0.690	0.690	0	0.089	0.174	0.135	0.039	0.451
07.011.01	Massivholz Fichte / Tanne / Lärche, kammergetr., gehobelt, Produktion Schweiz	465	kg	460	397	63.3	5.93	5.93	0.774	5.15	0.006	0.735	0.646	0.646	0	0.089	0.157	0.118	0.039	0.451
07.011.02	Massivholz Fichte / Tanne, kammergetr., Vollholzhaus holzpur	420	kg	434	371	63.3	10.0	10.0	4.67	5.35	0.006	0.471	0.382	0.382	0	0.089	0.135	0.096	0.039	0.451
07.010	Massivholz Fichte / Tanne / Lärche, luftgetr., gehobelt	485	kg	402	339	63.3	5.21	5.21	0.484	4.72	0.006	0.674	0.585	0.585	0	0.089	0.157	0.118	0.039	0.413

SWISS CALCULATIONS TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳
计算工具

4

Calculating the

Life Cycle Assessment

计算生命周期评估

Basic formula for planners

规划者的基本公式

needs to be optimized
需要优化

Life Cycle Assessment

- Environmental Rating
- Embodied Energy
- Embodied emissions

生命周期评估

- 环境评级
- 隐含能耗
- 隐含排放

=

build light, efficient (with little material) and frugal (sufficiency)
建得轻盈，有效（用材少），节省（充足）

planning

Bill of Quantities
材料总量

- Material A [kg] 材料A
- Material B [kg] 材料B
- Material C [kg] 材料C

X

build with ecological, sustainable materials
用生态而可持续的材料来建造

KBOB data set

Environmental Factor
环境因子

- UBP / [kg]
- kWh oil eq / [kg]
- **kg CO2e / [kg]**

Reference Area [m2]
参考面积 （平方米）
Energy reference area / Floor area
供能面积 / 建筑面积

planning

build compact and space-efficient
建得紧凑且空间有效

Lifespan [years]
寿命（年）

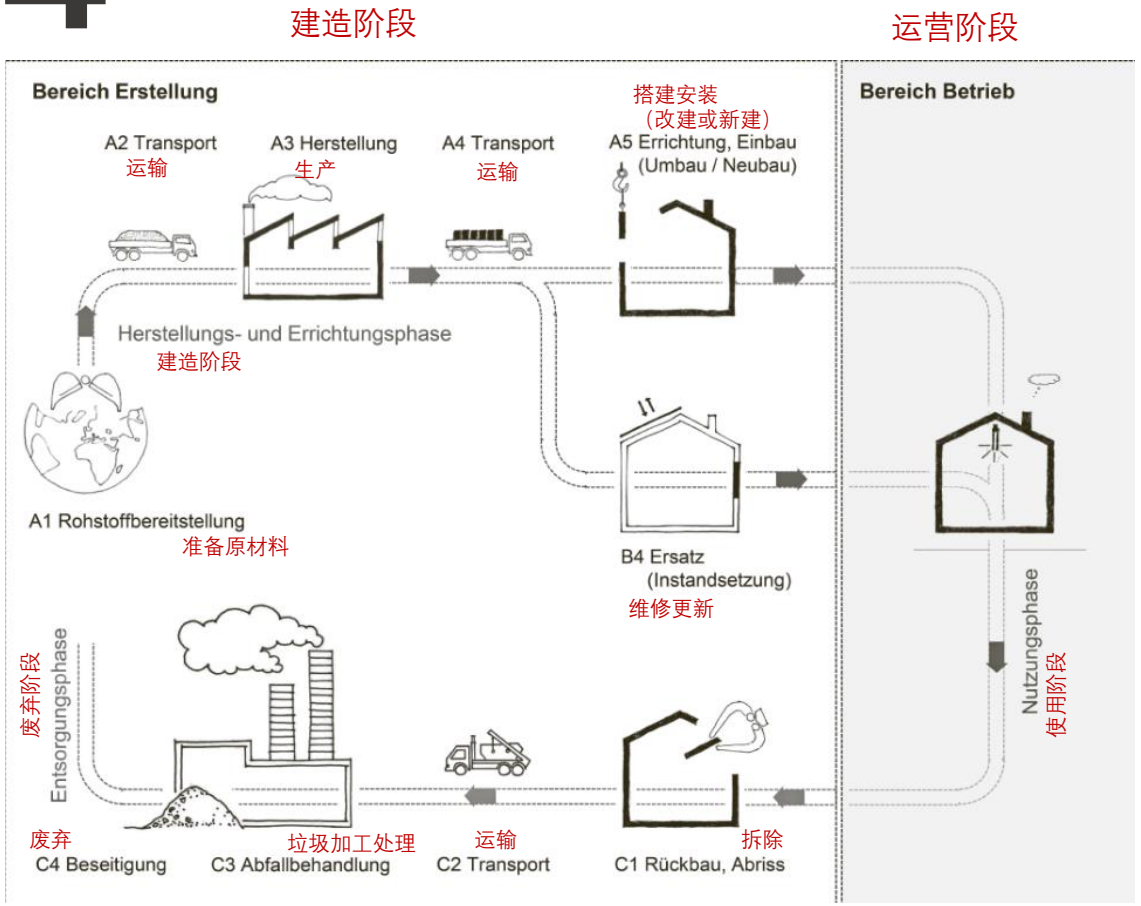
SIA 2032

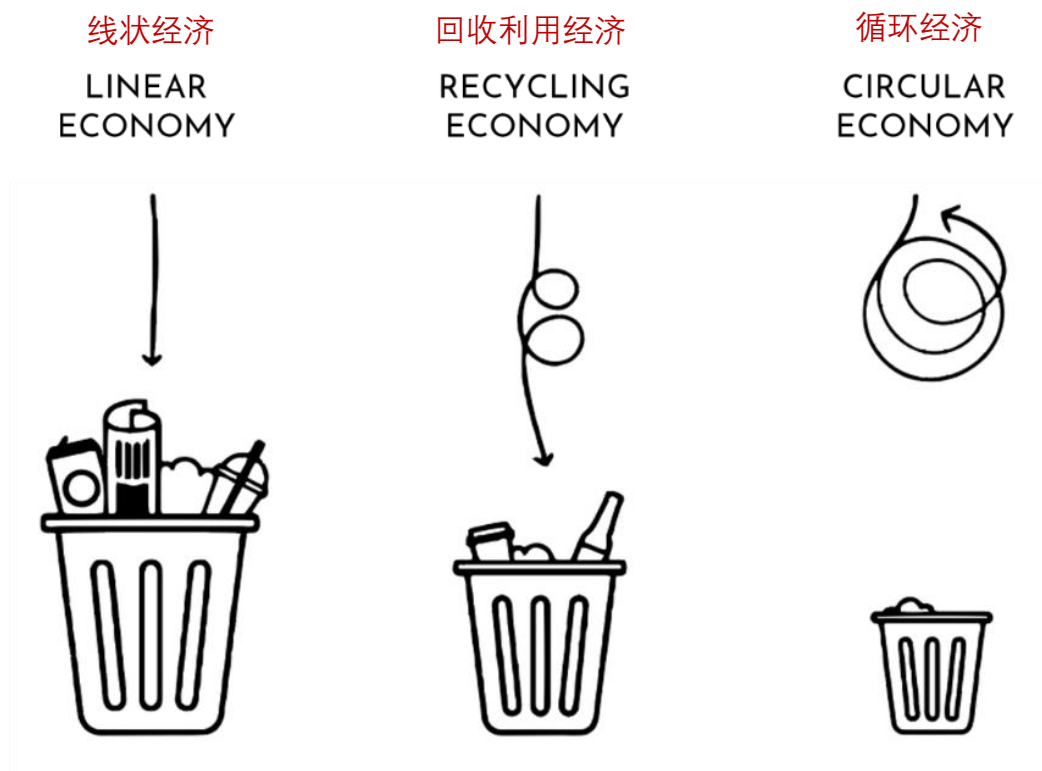
build long lasting (durable)
建得持久耐用

SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

4





SIA 2032:2020

SWISS CALCULATIONS TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

中华人民共和国
住房和城乡建设部

intep
skat Swiss Resource Centre and Consultancies for Development

HSLU Hochschule Luzern

循环建造的简短介绍

PRESENTATION OF HSLU
SWITZERLAND
22nd AUGUST 2022
GIANRICO SETTEMBRINI

A Short Introduction to Circular Construction

EXPERIENCES FROM SWITZERLAND

瑞士经验

5

Circular thinking

循环思维

Principles

原则

WHAT MEANS CIRCULAR CONSTRUCTION

什么是循环建造

5

The 10 R's of circular construction

10 个循环建造的规则

1 Refuse 拒用

2 Rethink 反思

3 Reduce 减少

4 Reuse 重复用

5 Repair 维修

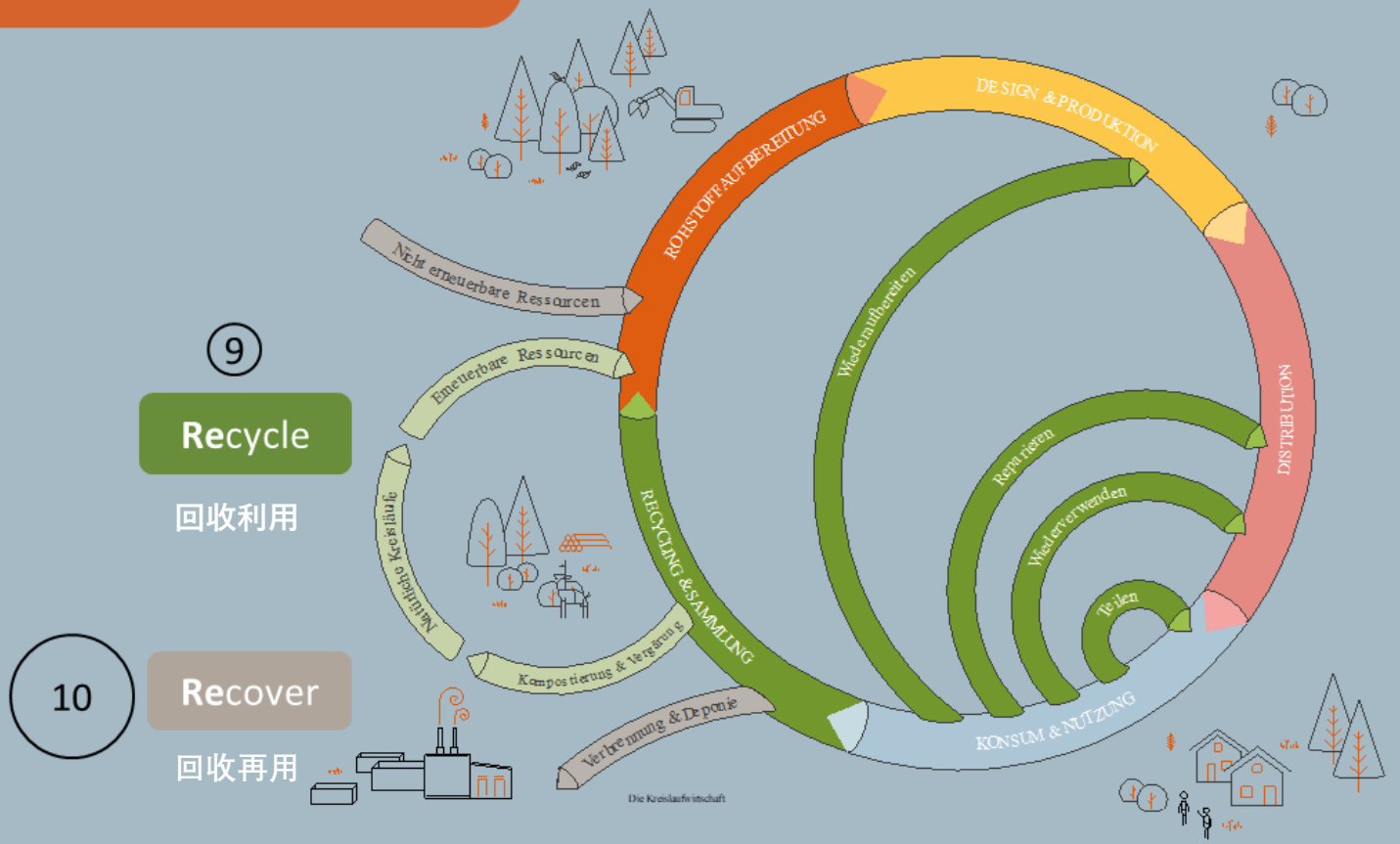
6 Refurbish 翻新

7 Remanufacture 再生产 再制造

8 Repurpose 新用途

9 Recycle 回收利用

10 Recover 回收再用



Quelle: Grundlage BAFU

WHAT MEANS CIRCULAR CONSTRUCTION

什么是循环建造

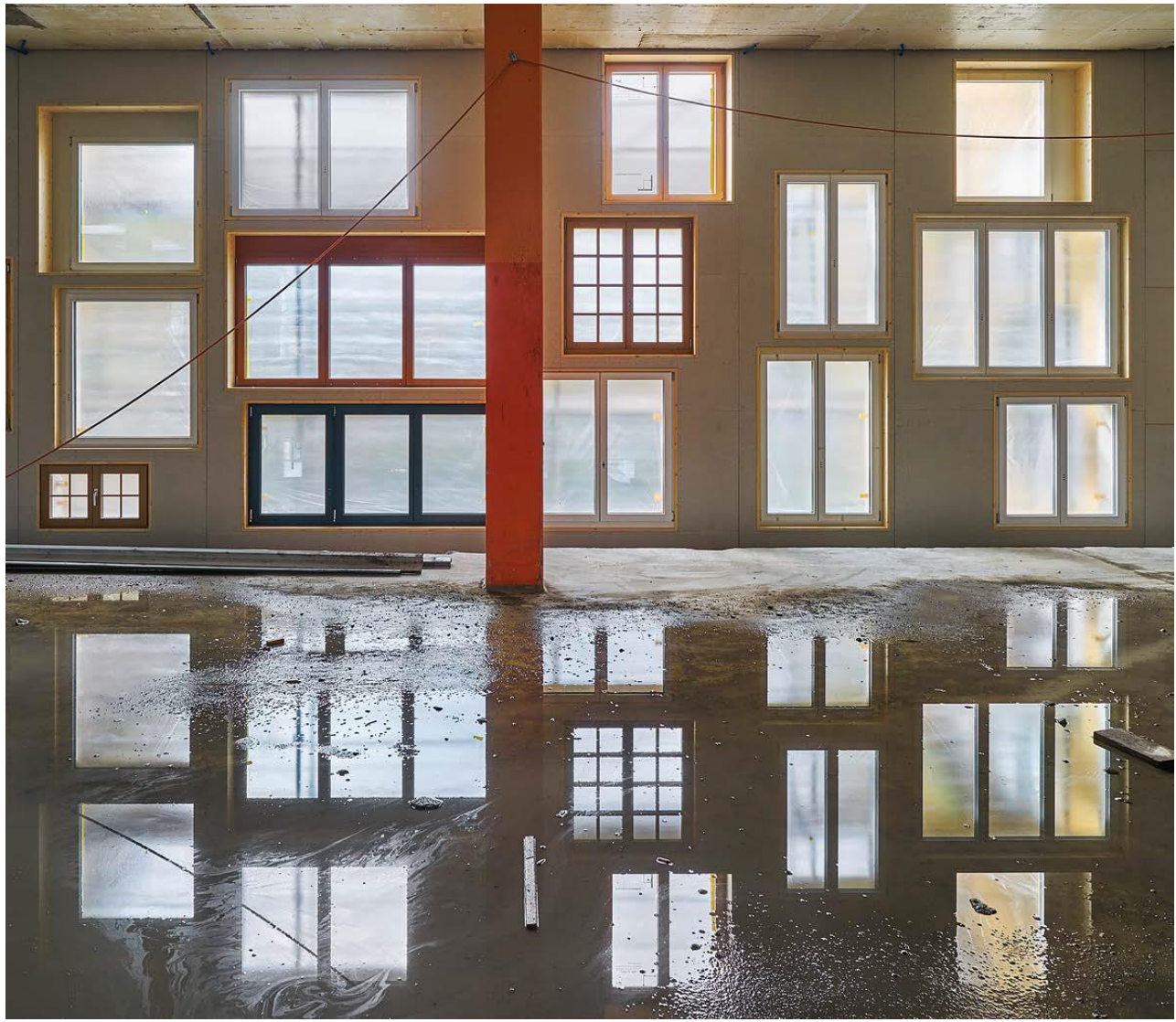
6

Lysbüchelareal, Basel, Switzerland
Baubüro in situ, 2020
→ Reuse
→ 瑞士再利用的例子，2020

The façade of the inner courtyard was constructed by using windows from surplus or reserve stocks from around ten Swiss window manufacturers. 内院立面是使用大约十家瑞士窗户制造商的剩余或储备库存的窗户建造的

If they had not been used here, they would have been disposed. 如果它们不被用在这里，它们就会被丢弃

The thermal insulation mats and the wood for the facade elements are also partly from existing stock. 保温垫和立面组件上的木材也部分来自已有的库存材料



5

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

5

K 118 – Kopfbau Halle 118,
Winterthur, Switzerland
Baubüro in situ, 2021
→ Reuse
→ 瑞士再利用例子，2021

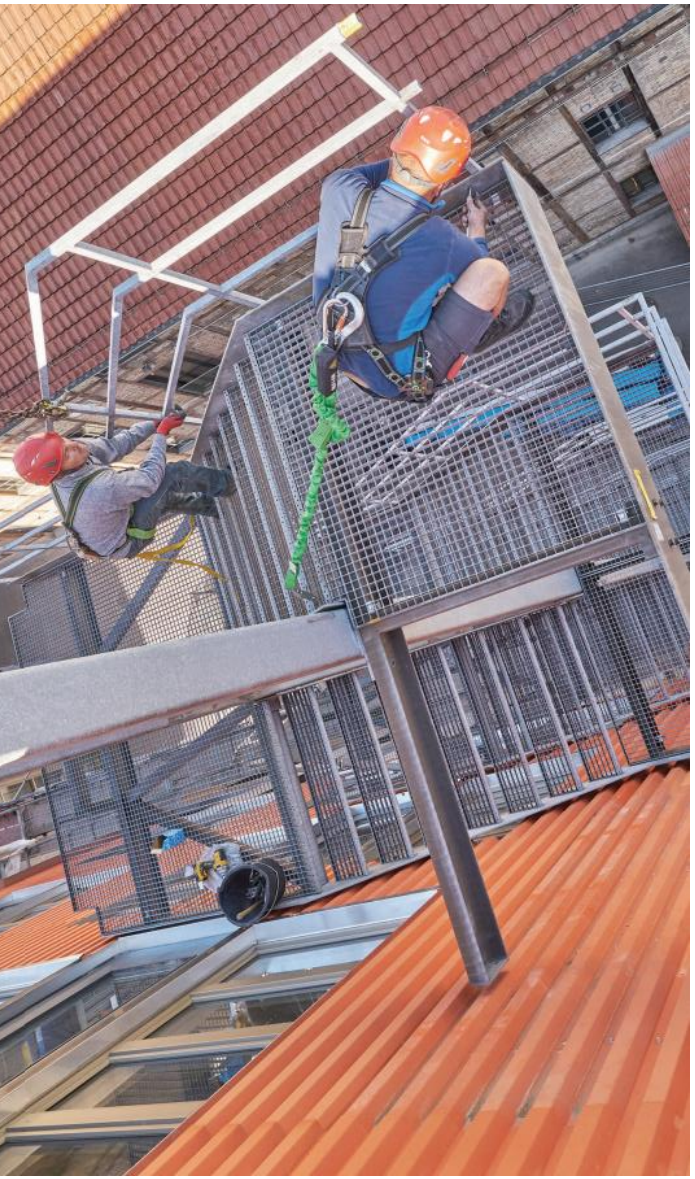
Reuse steel beams and stairs
重复使用的钢梁和楼梯

Façade with insulated aluminum windows and red facade slabs from Winterthur and Zurich, complemented by natural building materials such as wood, straw and clay外墙采用来自温特图尔和苏黎世的隔热铝窗和红色外墙板，辅以木材、稻草和粘土等天然建筑材料

→ Total: 349 tons of greenhouse gases were saved through reuse 通过这样的重复再用总共节省了349吨温室气体排放

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析



CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

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Burohaus 2226, Lustenau, Austria, baumschlager eberle, 2013

→ **Re**fuse, **Re**duce

→ 瑞士拒用和减少的例子

Compact office building without heating, cooling and active ventilation systems 紧凑的办公建筑，没有供暖致冷和主动的通风系统

Every second ventilation sash is running automated
每两个通风风扇是自动运行的

In summer the building is naturally cooled at night
夏天建筑夜间自然冷却

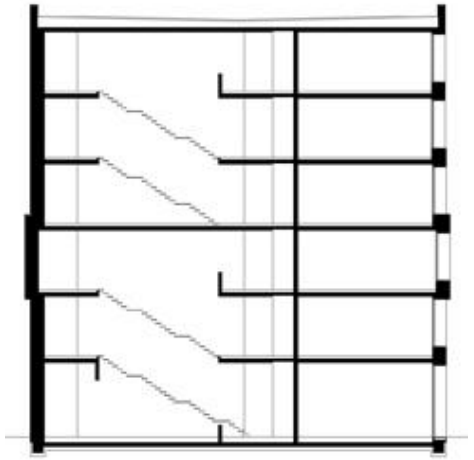
During winter the internal gains through employees and appliances is enough to heat the building
冬季室内人员和设备散热足以给建筑供暖

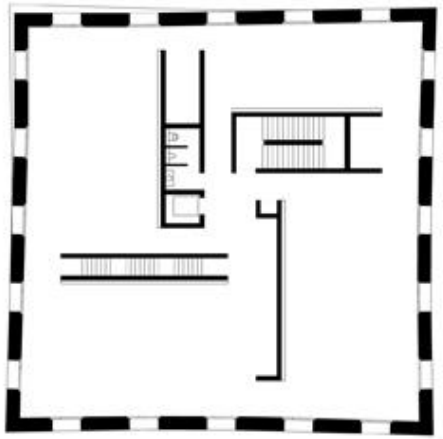
Dispensing building technology* - reducing operational energy, but adding thermal mass 放弃建筑技术 – 通过减少运营能耗，但增加热量

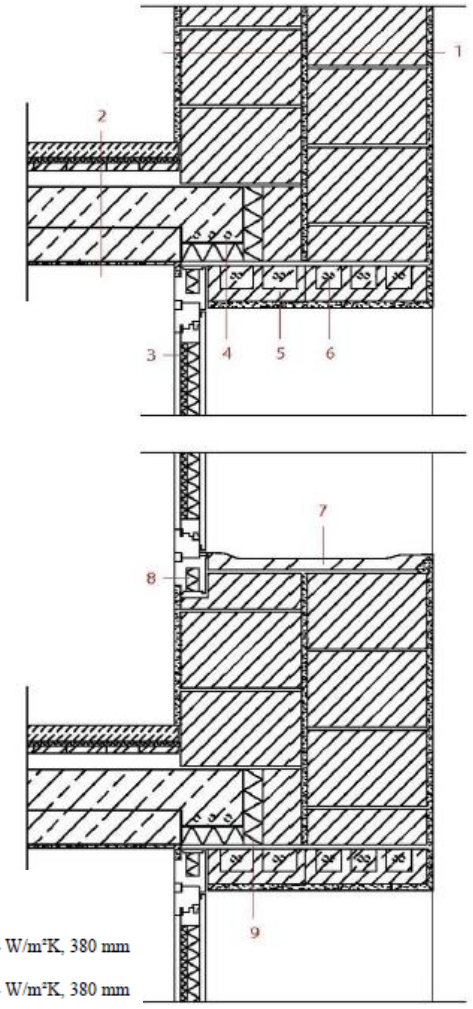
*: usually 20-30% of the embodied CO_2 of buildings
通常20-30%的建筑隐含碳

5

Burohaus 2226, Lustenau, Austria,
baumschlager eberle, 2013
→ **Re**fuse, **Re**duce
→ 瑞士拒用和减少的例子







1 Wandaufbau:
gelöschter Kalkputz, 8 mm
Kalkzement-Grundputz, 12 mm
gelochter Ziegel, U-Wert = 0,24 W/m²K, 380 mm
Mörtelfuge, 18 mm
gelochter Ziegel, U-Wert = 0,34 W/m²K, 380 mm
Kalkzement-Grundputz, 15 mm
Kalkputz-Spachtelung, 5 mm

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

5

Burohaus 2226, Lustenau, Austria,
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→ **Re**fuse, **Re**duce
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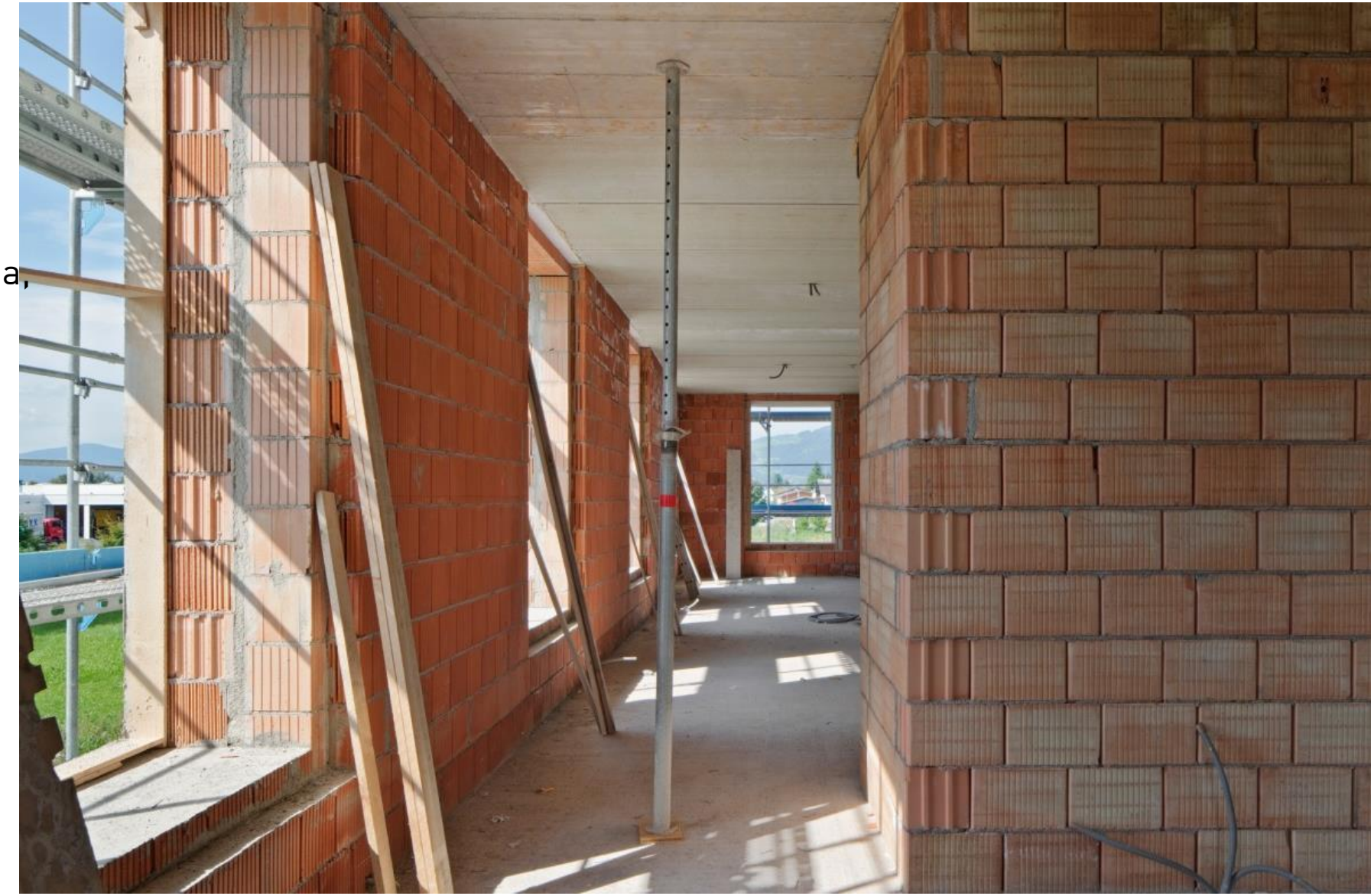

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

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CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

5

Gorlaeus Building Bio Science Park,
Leiden university, Netherlands,
concept
→ **Re**think, **Re**use, **Re**furbisch
→ 反思、重复用和翻新的例子

Reutilization of the existing building structure

Studies on the reutilisation of existing components instead of their disposal

既有建筑结构的再利用

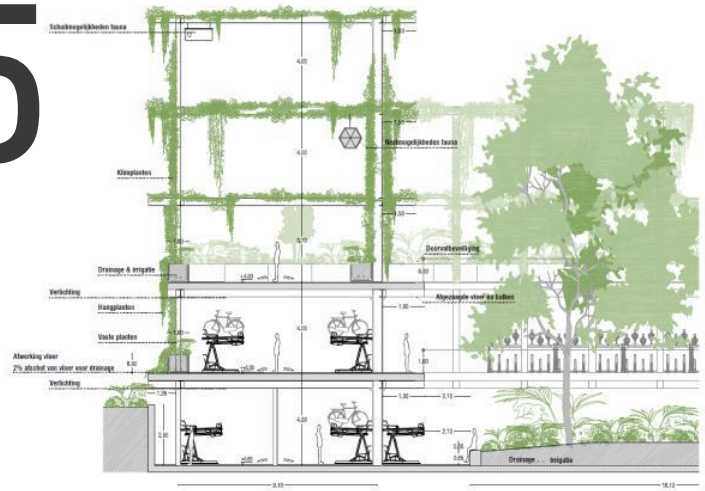
对既有部件的再利用而不是废弃的研究

瑞士低隐含碳的建筑案例研究

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

5



CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

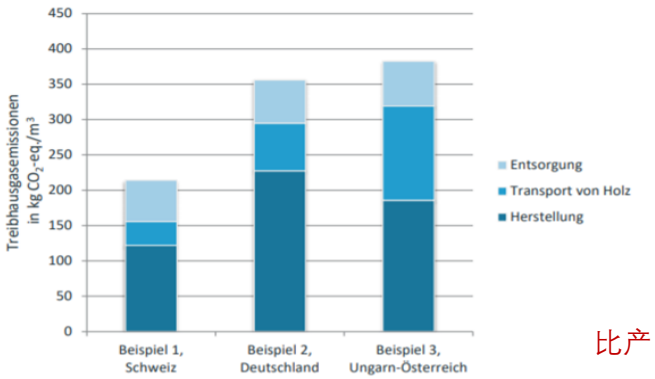
4

Other KBOB Tools

Calculators for concrete and timber

其他KBOB工具

混凝土和木材的计算器



例子: 来自奥地利和匈牙利的木材
比产自瑞士的木材会引发多排放79% 的 CO2

Example: Timber from Austria and Hungary emitts 79% more CO2 than Timber from Switzerland

KBOB
Koordinationskonferenz der Bau- und Liegenschaftsorgane der öffentlichen Bauherren
Conférence de coordination des services de la construction et des immeubles des maîtres d'ouvrage publics
Conferenza di coordinamento degli organi della costruzione e degli immobili dei committenti pubblici
Coordination Group for Construction and Property Services

Schnittholz

	Bereich Latten, Bretter und Balken
Holzprodukt	Balken
Holztyp	Laubholz
Holzverarbeitung	gehobelt, kammergetrocknet (u=10%)

Herkunftsland Rundholz	*Anteil*	*Transport vom Wald zum Sägewerk [km]*	*Anteil LKW [%]*	*Default Distanz Total [km]*
Deutschland	50%	Default	100%	650
Finnland	0%	Default	100%	0
Frankreich	0%	Default	100%	0
Italien	0%	Default	100%	0
Norwegen	0%	Default	100%	0
Österreich	0%	Default	100%	0
Schweden	0%	Default	100%	0
Schweiz	50%	Default	100%	40
Ungarn	0%	Default	100%	0
Total	100%	0		

		Default
Land des Sägewerkes	Schweiz	
Transport des Produkts in die Schweiz [km]	Default	0
Anteil LKW [%]	38%	38%

Umweltindikator

Treibhausgasemissionen (THG-E)

Herstellung	**39**	**kg CO2-eq/m³**	
Transport von Holz	**39**	**kg CO2-eq/m³**	*Zur Berechnung des Transportes wurde mindestens eine Default-Distanz angewendet*
Entsorgung	**7.2**	**kg CO2-eq/m³**	
Total	**146**	**kg CO2-eq/m³**	

SWISS CALCULATION TOOLS FOR EMBODIED CO2

瑞士建筑隐含碳计算工具

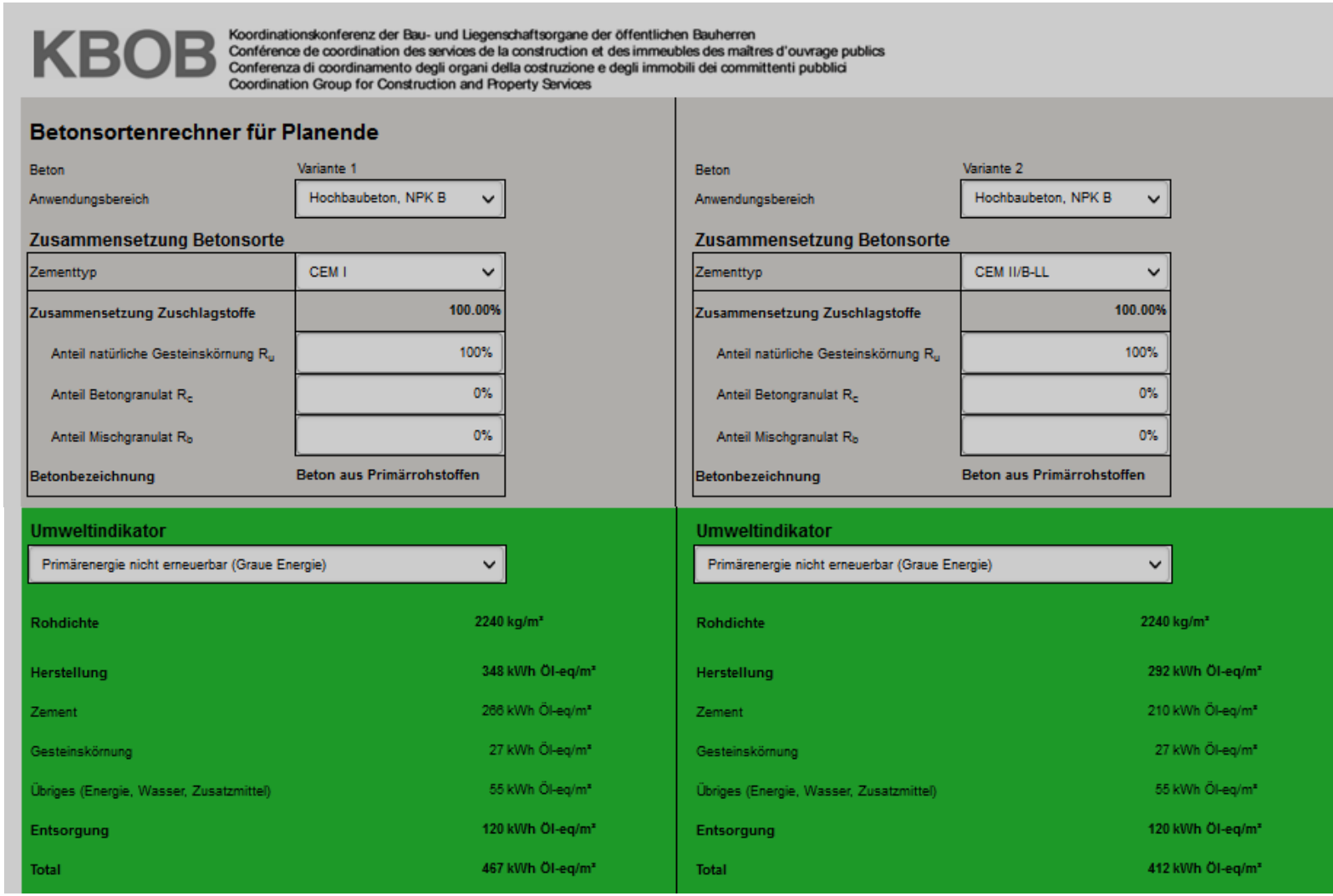
4

Other KBOB Tools

Calculators for concrete and timber

其他KBOB工具

混凝土和木材的计算器



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Betonsortenrechner für Planende

Beton	Variante 1	Variante 2
Anwendungsbereich	Hochbaubeton, NPK B	Hochbaubeton, NPK B
Zusammensetzung Betonsorte		
Zementtyp	CEM I	CEM II/B-LL
Zusammensetzung Zuschlagstoffe	100.00%	100.00%
Anteil natürliche Gesteinskörnung R_u	100%	100%
Anteil Betongranulat R_c	0%	0%
Anteil Mischgranulat R_b	0%	0%
Betonbezeichnung	Beton aus Primärrohstoffen	Beton aus Primärrohstoffen

Umweltindikator

Umweltindikator	Primärenergie nicht erneuerbar (Graue Energie)	Primärenergie nicht erneuerbar (Graue Energie)
Rohdichte	2240 kg/m³	2240 kg/m³
Herstellung	348 kWh Öl-eq/m³	292 kWh Öl-eq/m³
Zement	266 kWh Öl-eq/m³	210 kWh Öl-eq/m³
Gesteinskörnung	27 kWh Öl-eq/m³	27 kWh Öl-eq/m³
Übriges (Energie, Wasser, Zusatzmittel)	55 kWh Öl-eq/m³	55 kWh Öl-eq/m³
Entsorgung	120 kWh Öl-eq/m³	120 kWh Öl-eq/m³
Total	467 kWh Öl-eq/m³	412 kWh Öl-eq/m³

SWISS CALCULATION TOOLS FOR EMBODIED CO2

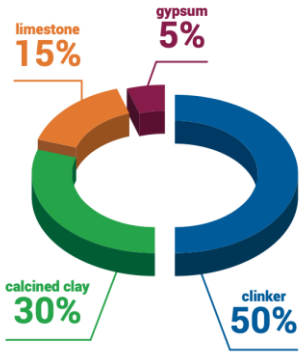
瑞士建筑隐含碳
计算工具

5

Example of a Building with Low Embodied Carbon Emissions

低隐含碳排放的建筑实例

The SDC Office at the Swiss Embassy in New Dehli India
瑞士驻印度新德里大使馆的SDC办公室



EPFL

LC3

CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

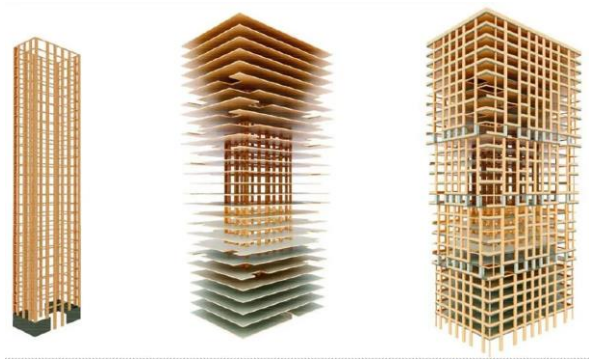
低隐含碳
建筑案例分析

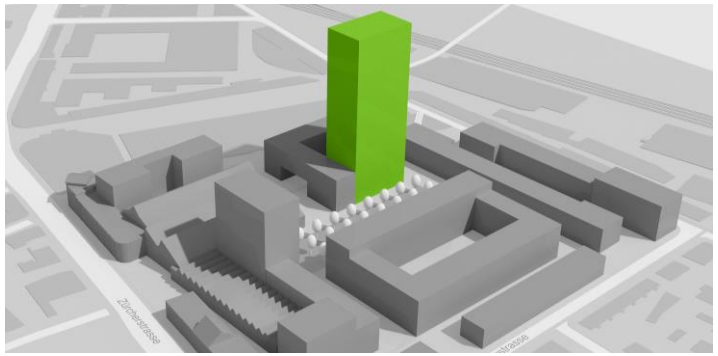
5

Example of a Building with Low Embodied Carbon Emissions

低隐含碳排放的建筑实例

The Rocket Tower in Winterthur Lokstadt by Implenia





CASE STUDIES OF BUILDING WITH LOW EMBODIED CO2

低隐含碳
建筑案例分析

6

Culture

Innovation

Urban layout

Flexibility

Interaction

Clima

Social acceptability

Ecology

Comfort 舒适

Space allocation

Law

Economy

Aesthetics

Creativity

Life cicle

Energie

Energy 能量

Society

61, 22/08/2022

Identification

Urbanism

Operation 运营

Construction 建造

Mobility 交通

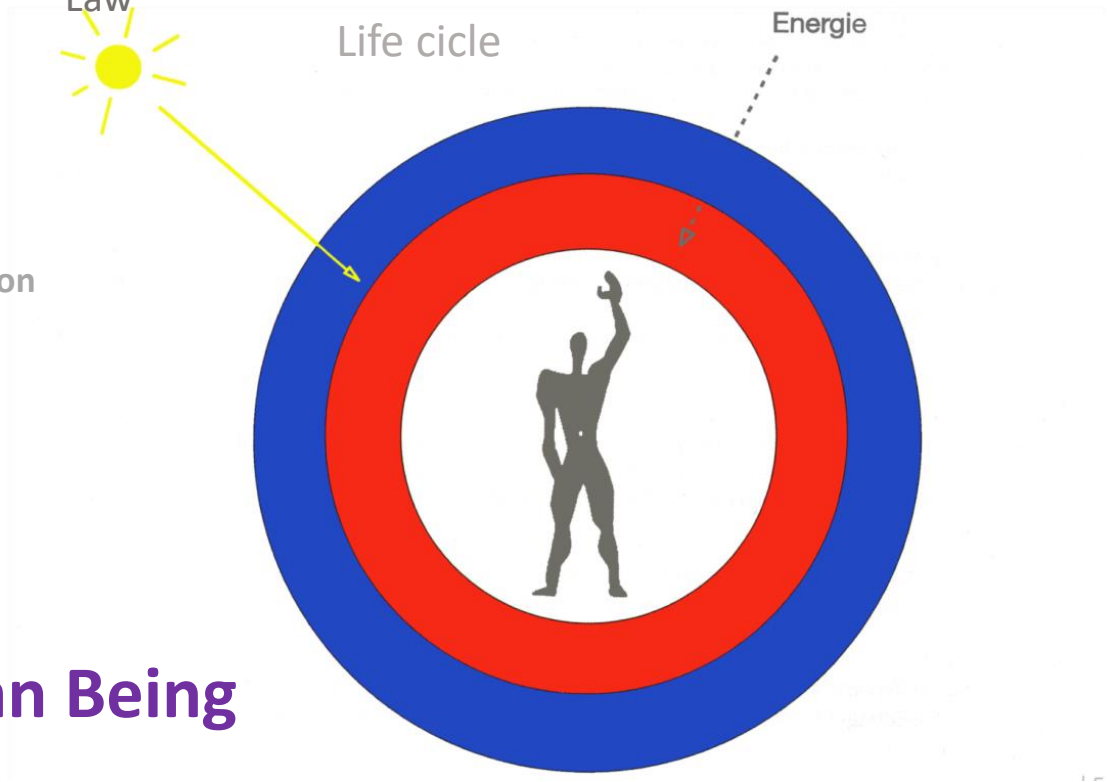
Multidisciplinarity

Compression

Sustainability

Biodiversity

Resource management



Human Being
人类

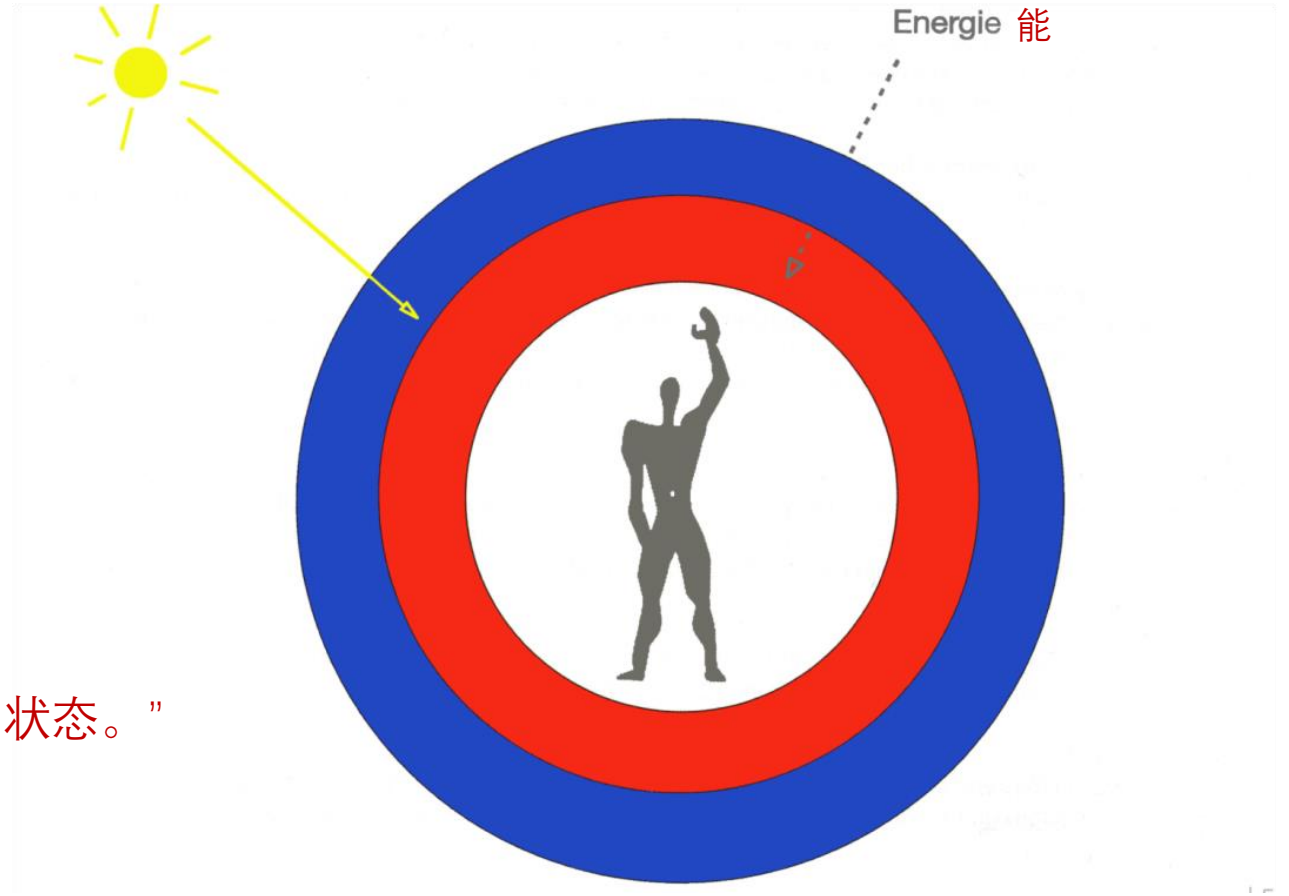
CONCLUSION 总结

6

“Ideally, architecture is always direct confrontation with humans.”

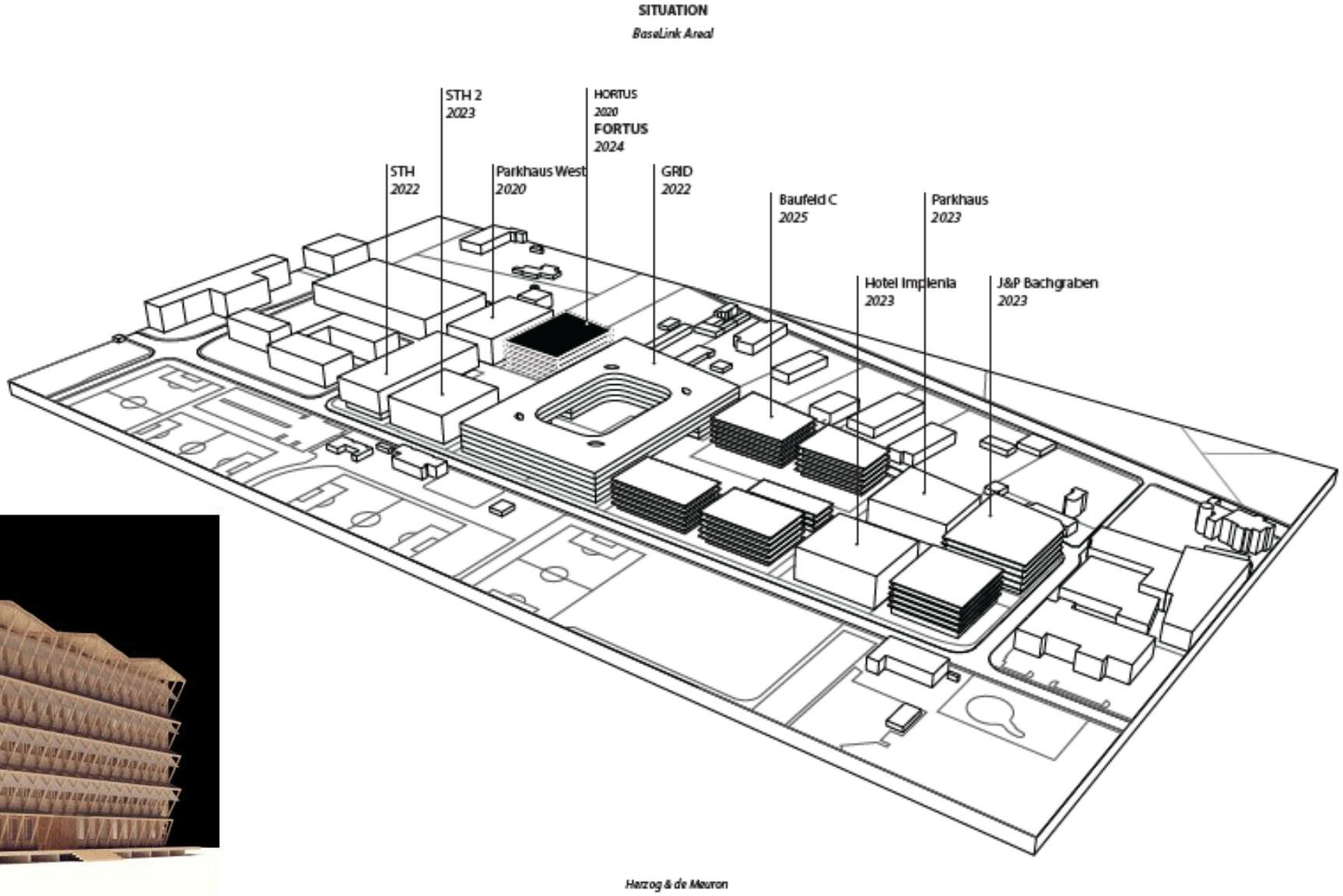
Richard Alan Meier

“理想状况下，建筑总是处于与人类直面相对的状态。”
- Richard Alan Meier



CONCLUSION 总结

6



CONCLUSION 总结

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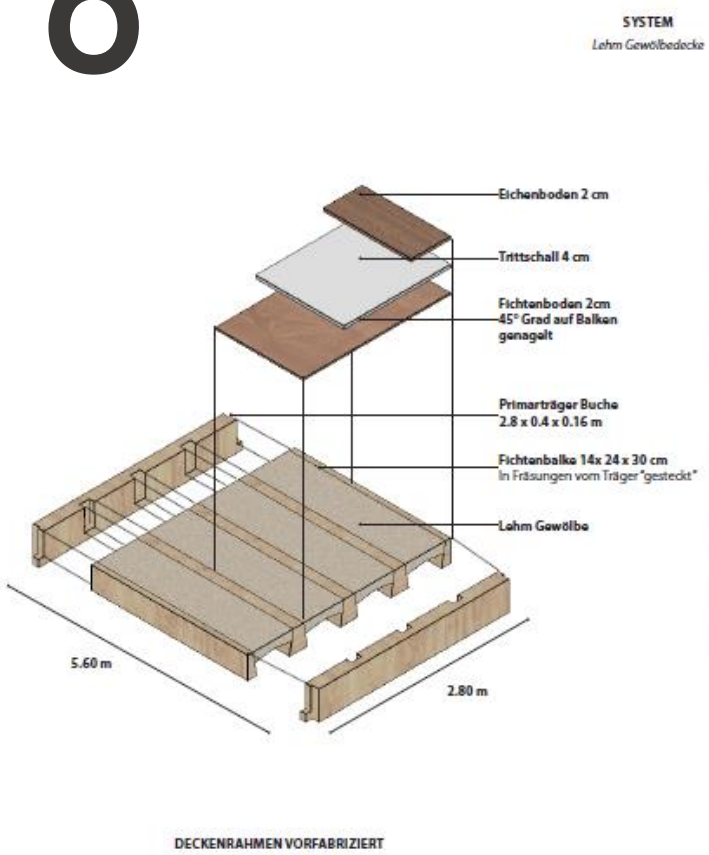
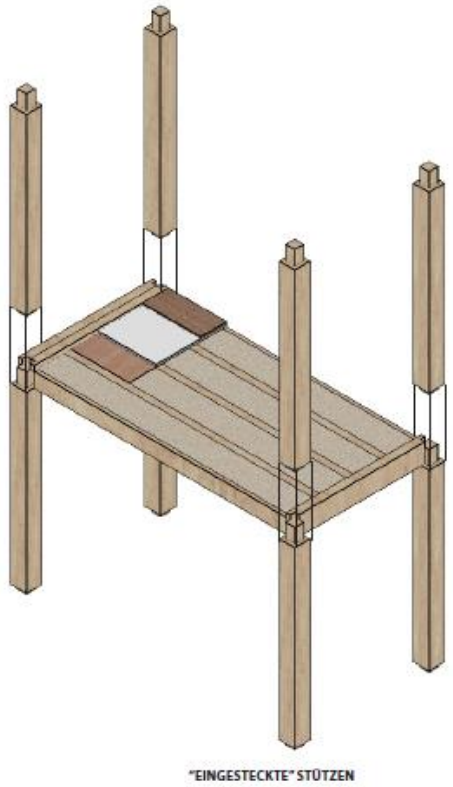
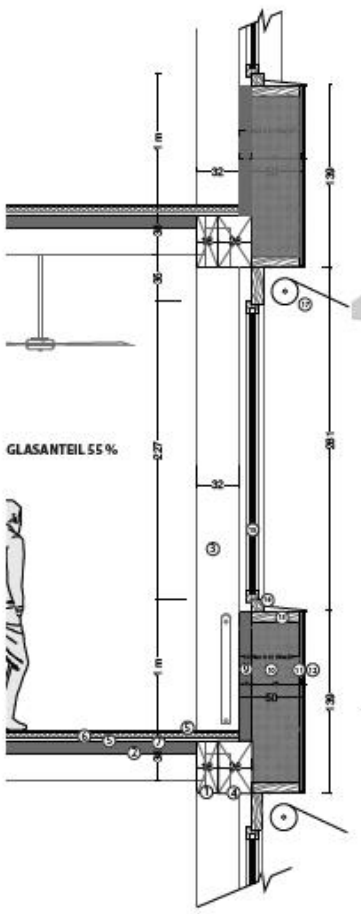
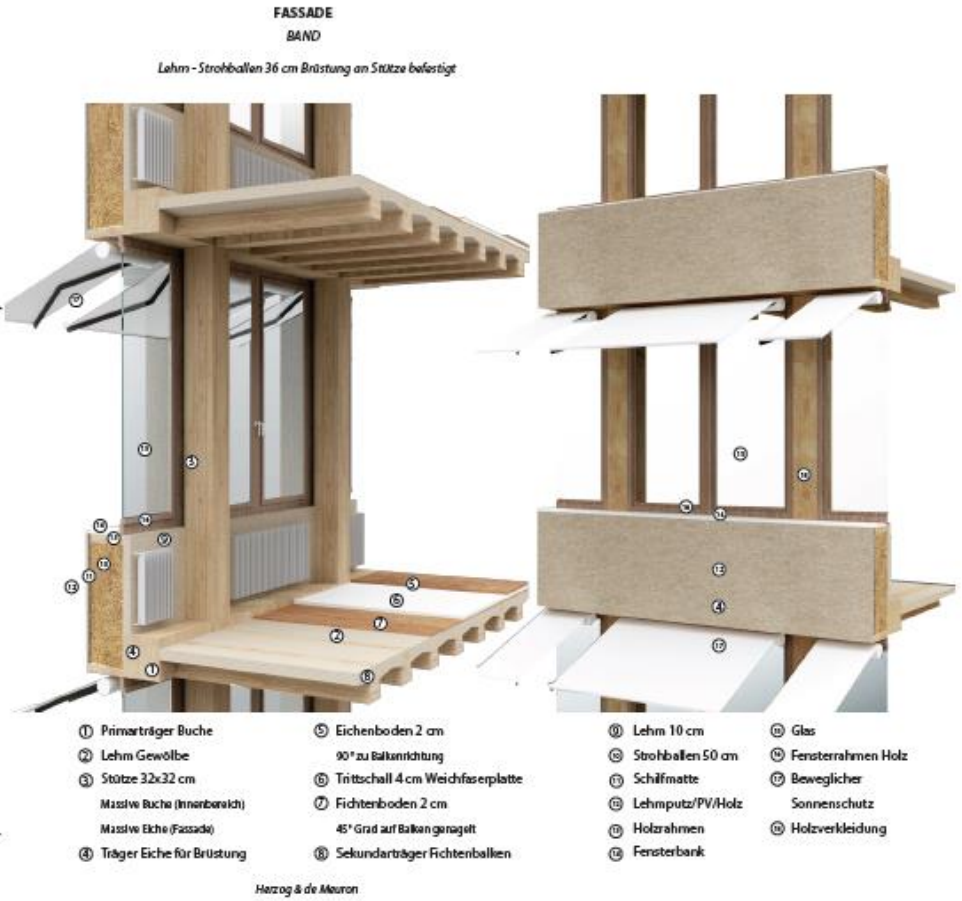




Herzog & de Meuron





Herzog & de Meuron

CONCLUSION 总结

THANK YOU FOR YOUR ATTENTION

感 谢 您 的 关 注