



让我们共同打造气候中和的未来
Building a climate-neutral future together.

ZEB China Sino-Swiss Cooperation 中瑞零碳建筑示范项目



浙江大学
ZHEJIANG UNIVERSITY



重庆大学
CHONGQING UNIVERSITY



哈尔滨理工大学
Harbin University of Science and Technology



中华人民共和国
住房和城乡建设部



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



中国建筑节能协会
CHINA ASSOCIATION OF BUILDING ENERGY EFFICIENCY

intep

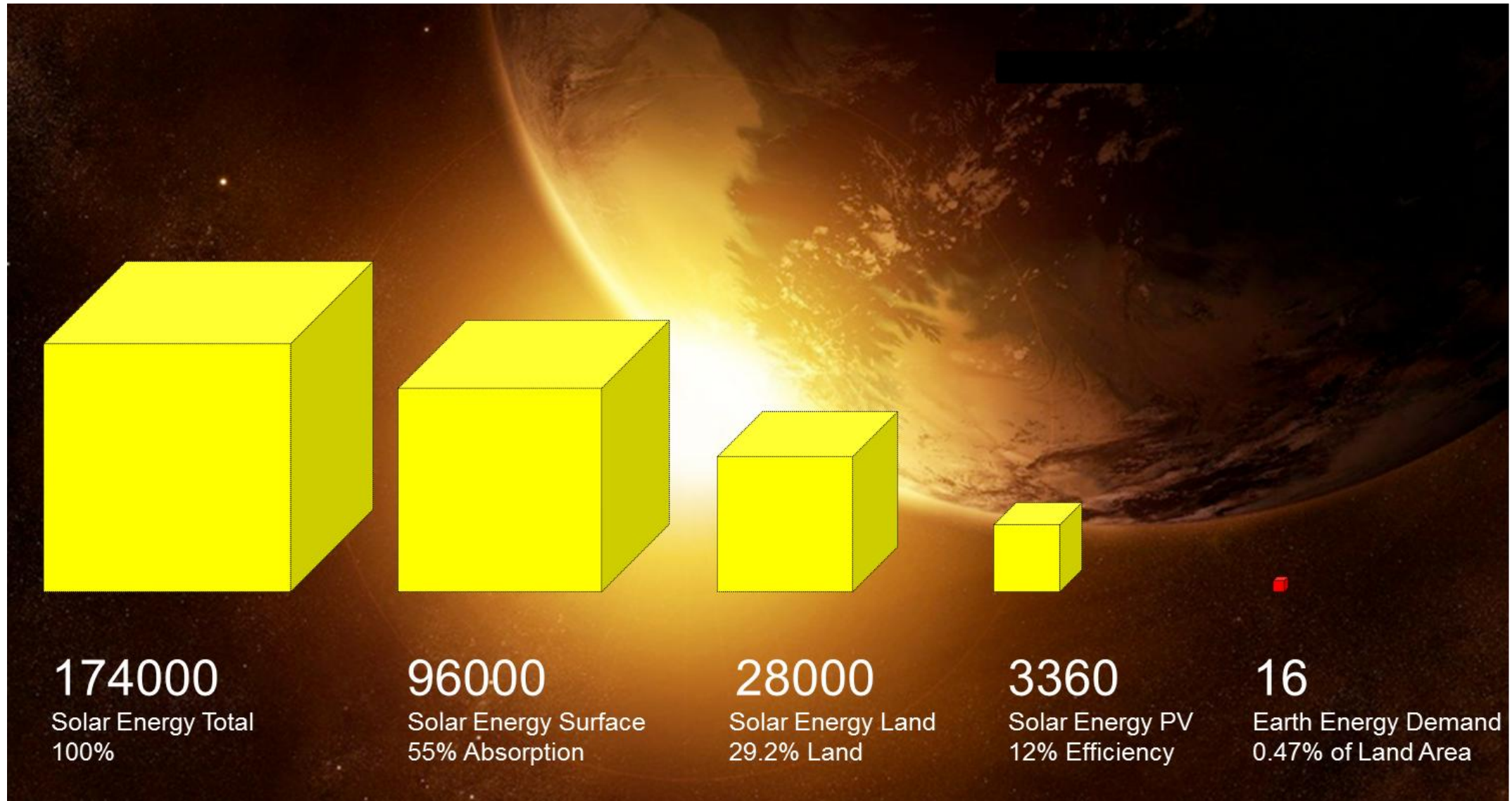
skat Swiss Resource Centre and
Consultancies for Development



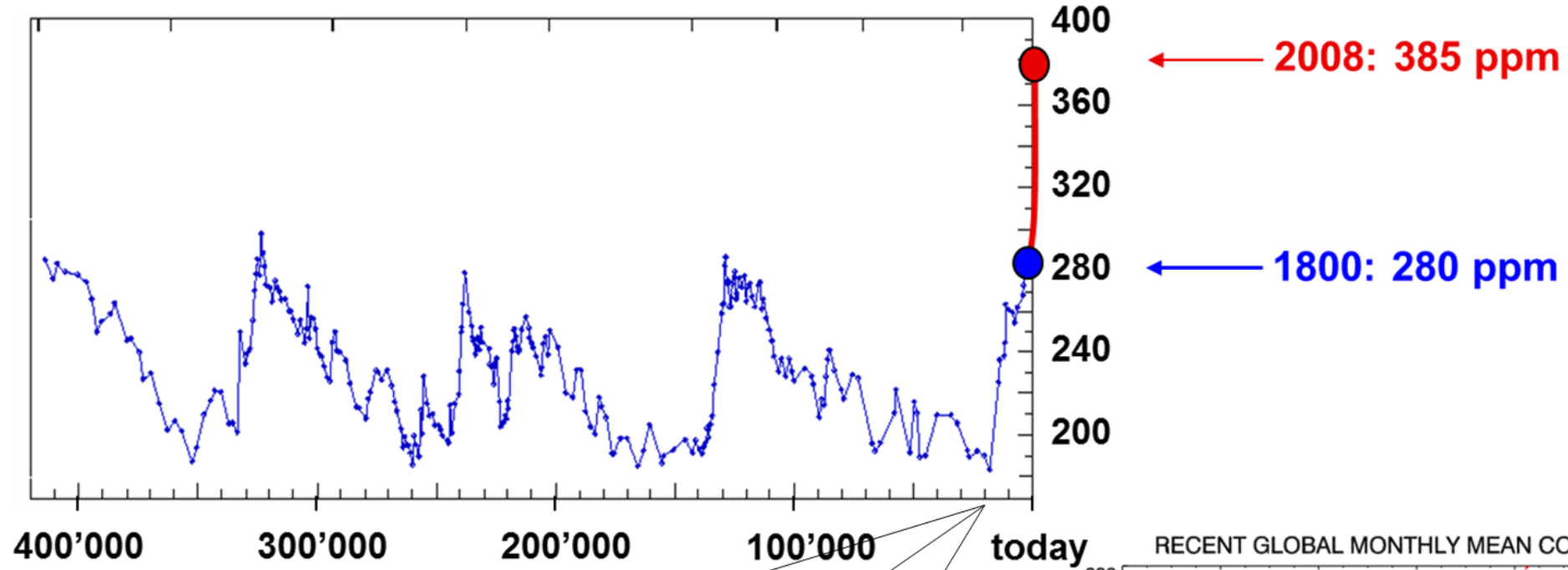
HSLU Lucerne University
of Applied Sciences
and Arts

Prof. Adrian Altenburger

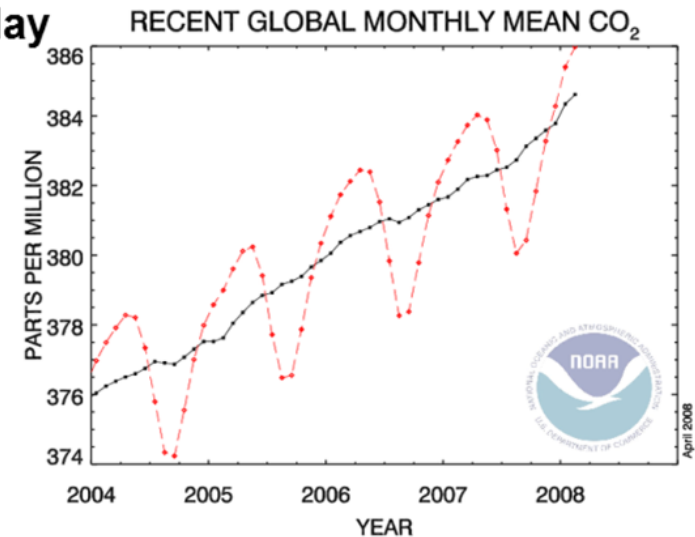
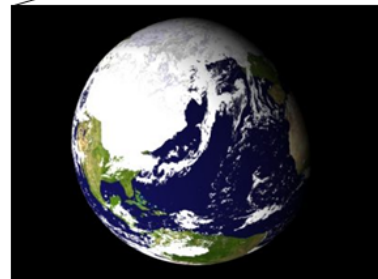
Lucerne, Switzerland
6th March 2024



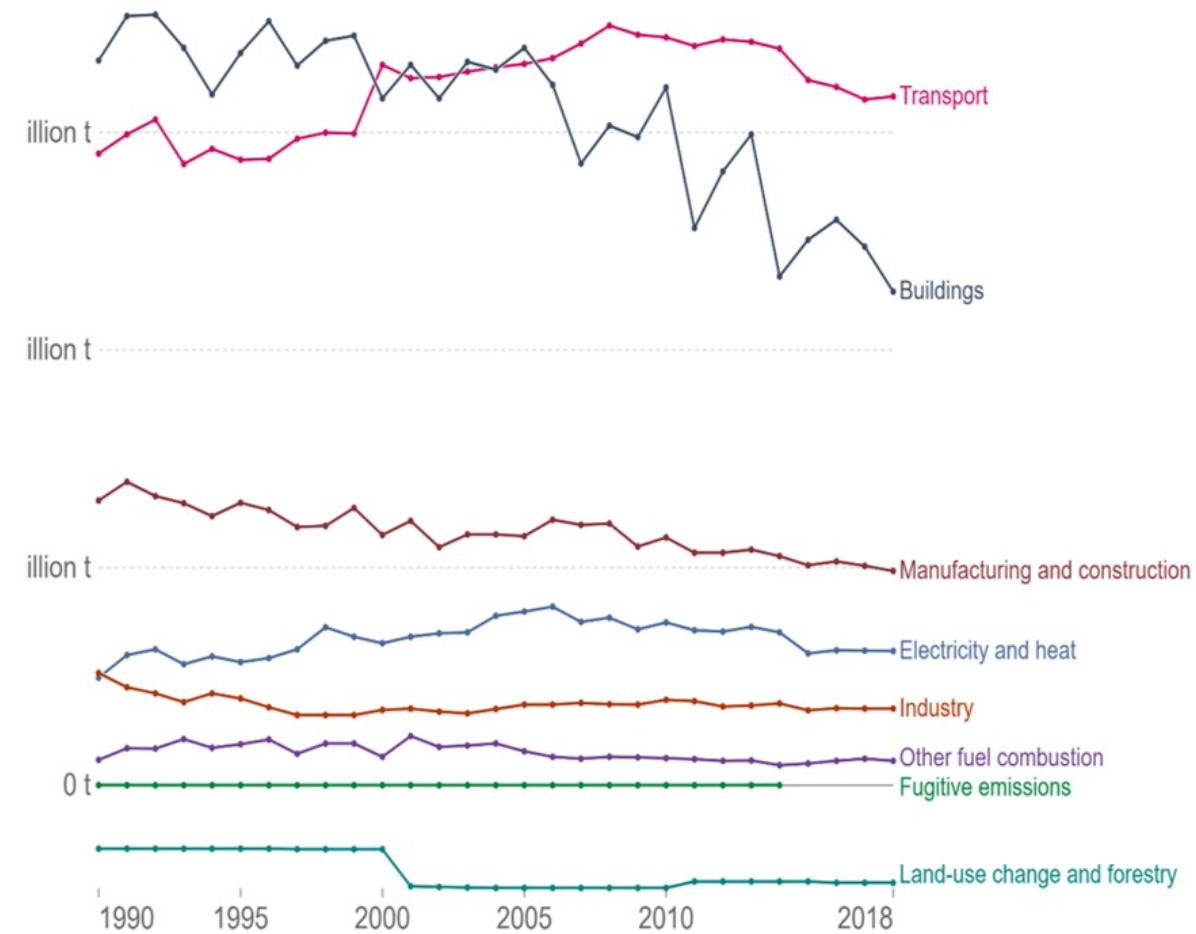
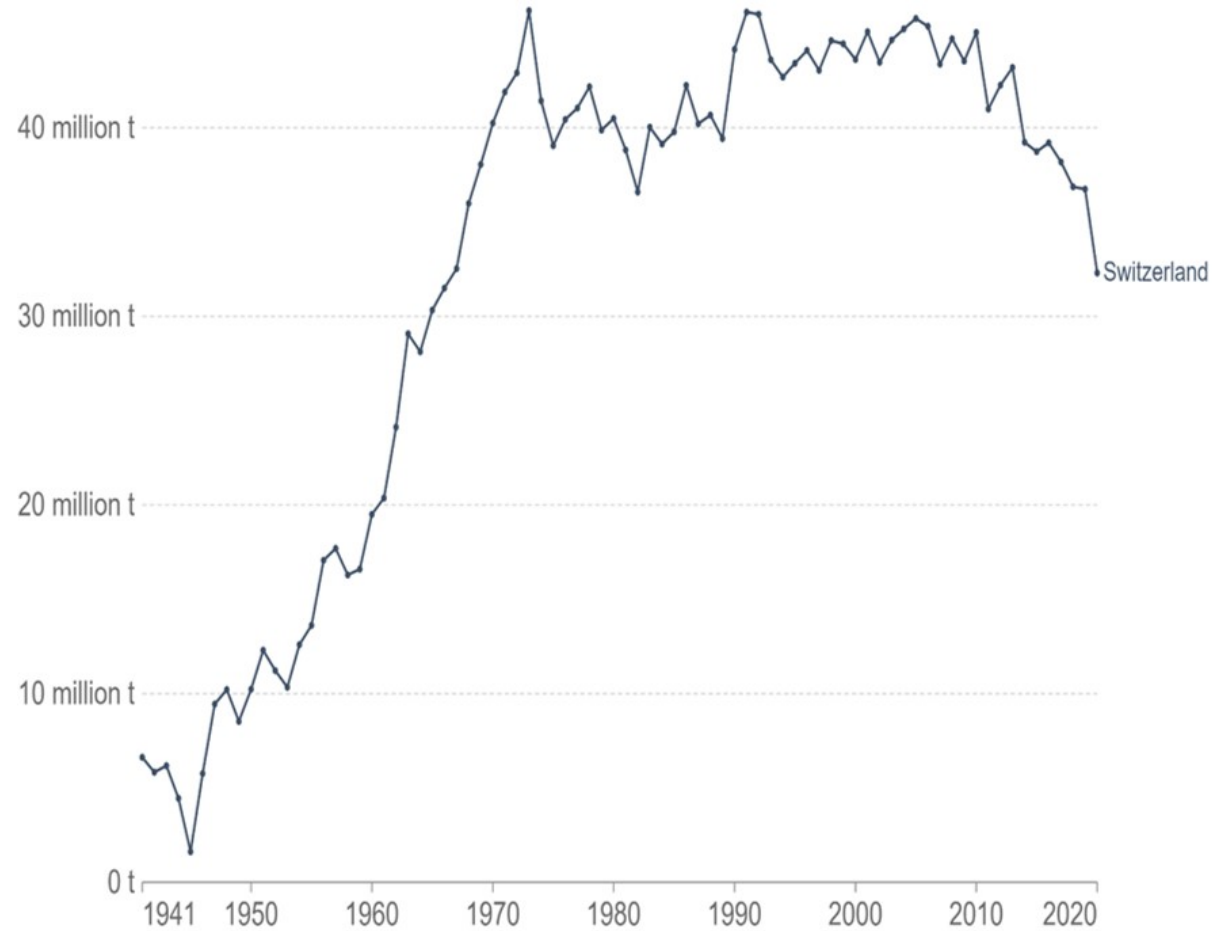
INTRO – ENERGY IS NOT THE PROBLEM (SOLAR ENERGY FACTOR 10000)



Last Ice Age Peak:
- Sea Level = -120m
- Temperature = -8K



INTRO – PROBLEM #1: CO₂ EMISSIONS (RISK OF CLIMATE CHANGE)



INTRO – PROBLEM #1: CO₂ EMISSIONS (DEVELOPMENT SWITZERLAND)

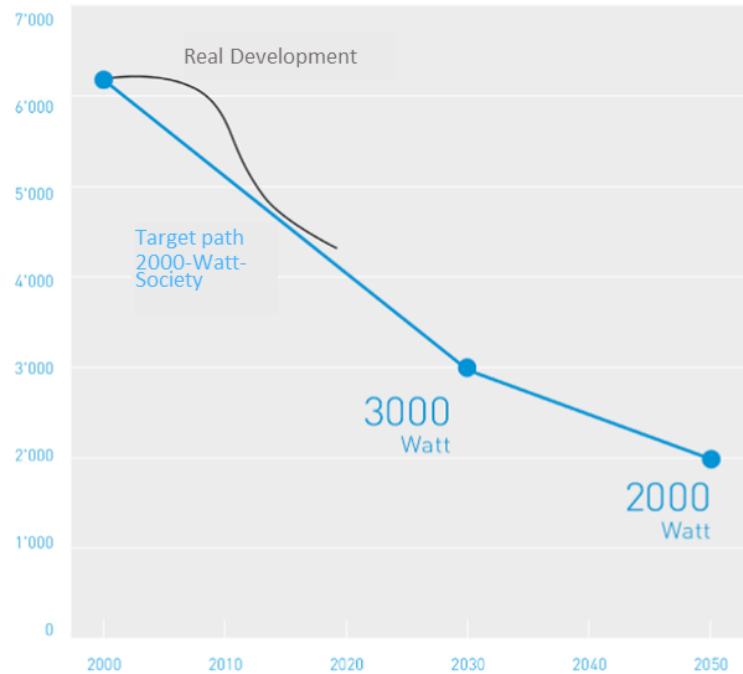
目标1：能效

Objective 1: Energy Efficiency

2000 Watt primary energy

Continuous output

2000瓦一次能源持续输出

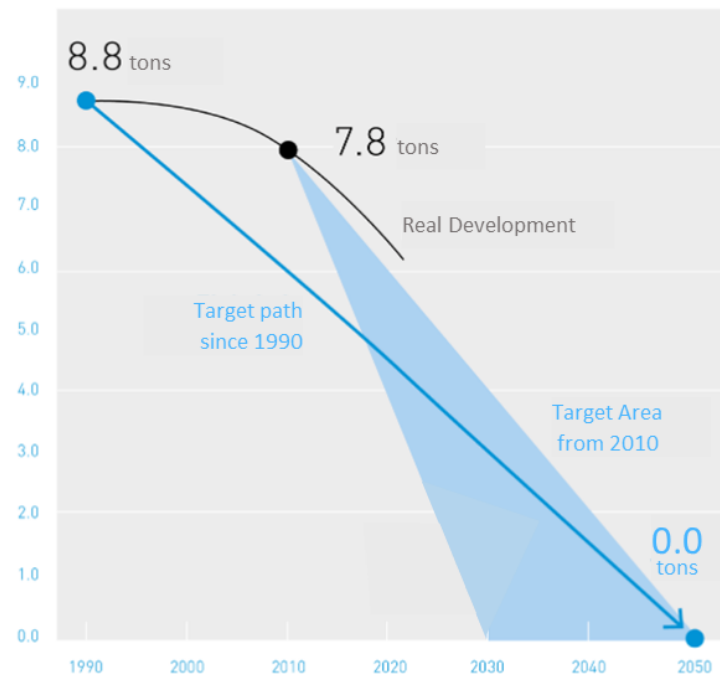


目标2：气候中和

Objective 2: Climate neutrality

Zero energy-related greenhouse gas emissions

与能耗相关的温室气体零排放

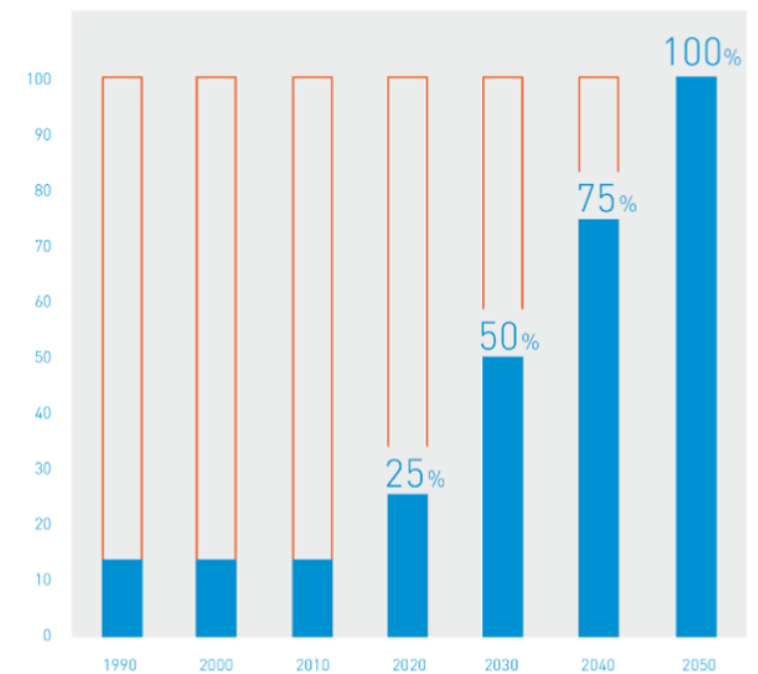


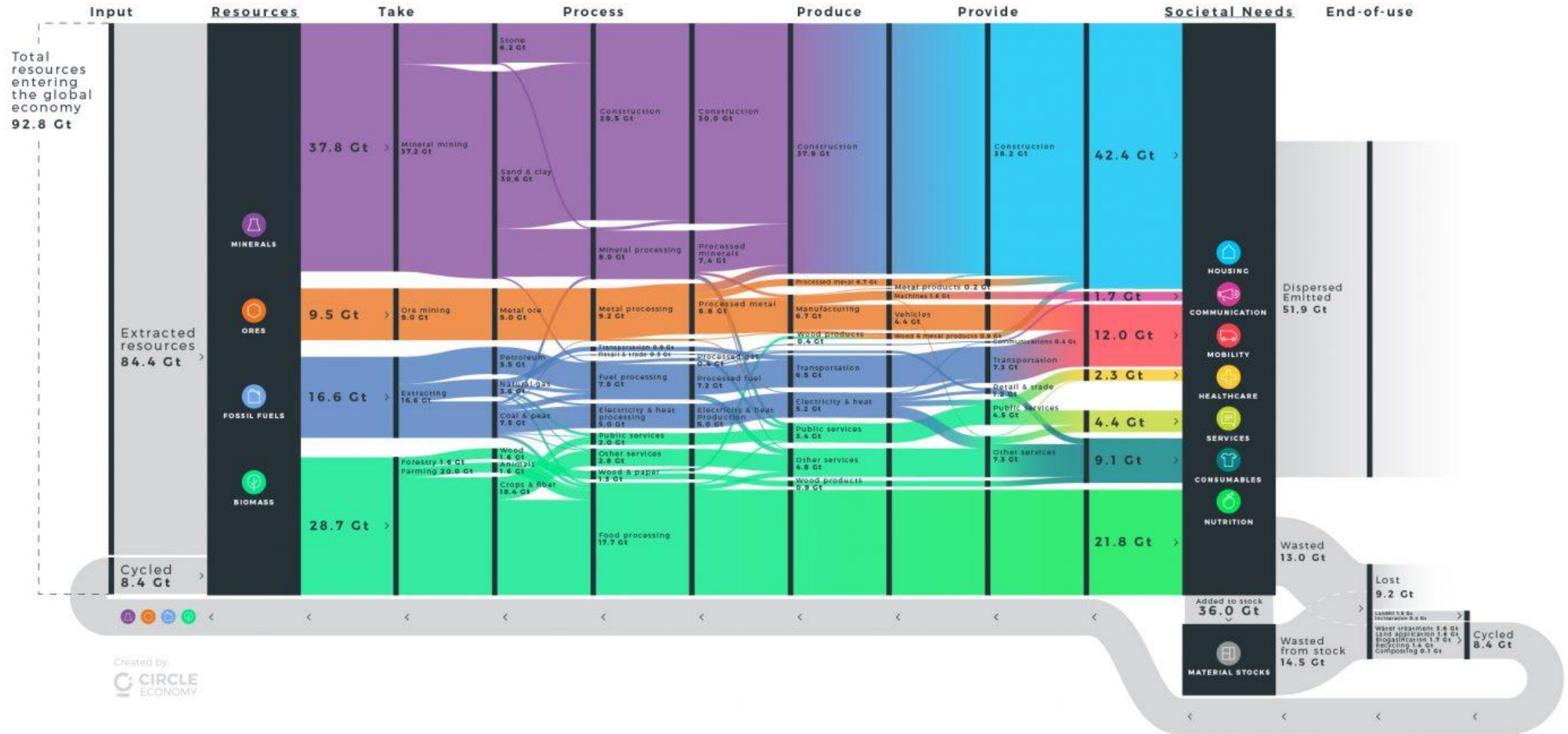
目标3：可持续性

Objective 3: Sustainability

100% renewable energy

100%可再生能源





INTRO – PROBLEM #2: RESOURCE CONSUMPTION (GLOBAL CONSTRUCTION: 46%)

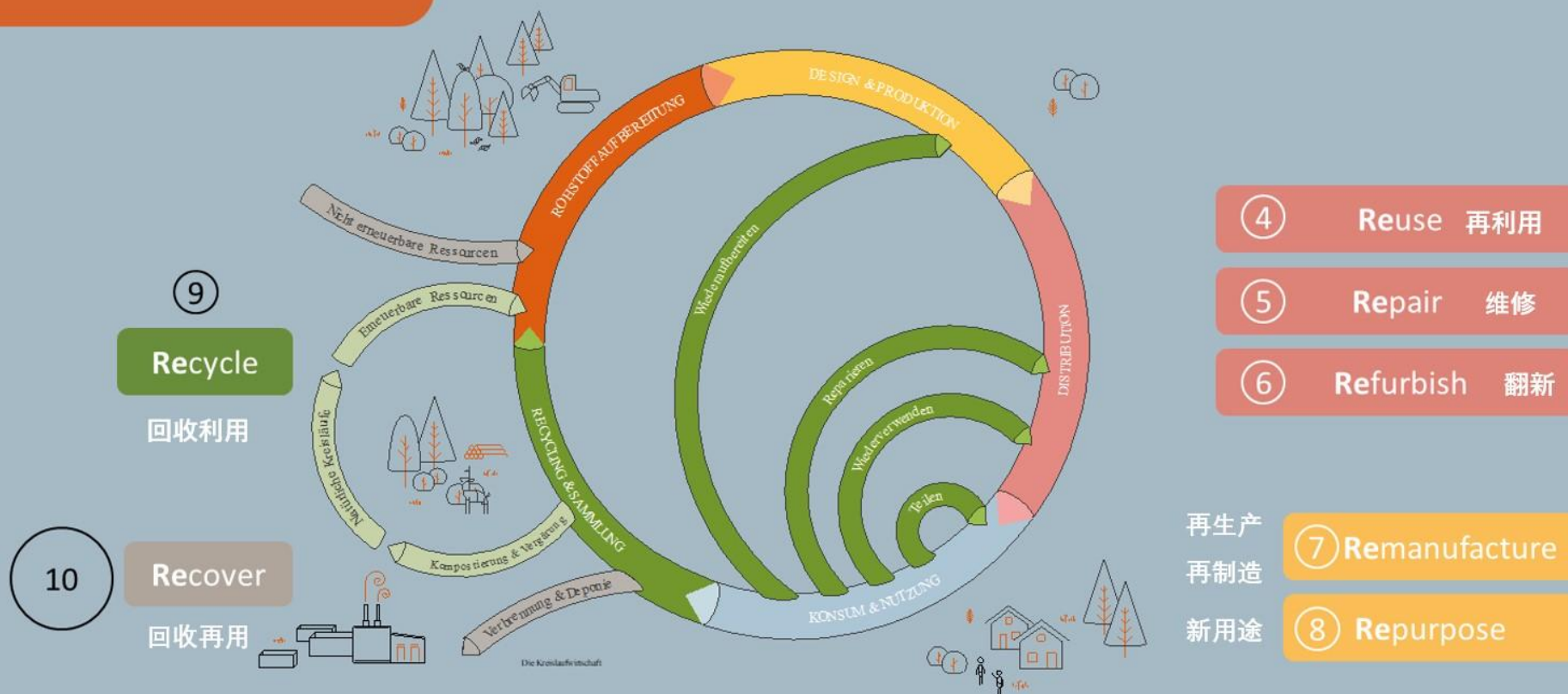
1 Refuse 拒用

2 Rethink 反思

3 Reduce 减少

The 10 R's of circular construction

10 个循环建造的规则





让我们共同打造气候中和的未来
Building a climate-neutral future together.

- 1: What is ZEB and its Goal
- 2: The Method and the Way
- 3: Integral Planning



让我们共同打造气候中和的未来
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ZEB IS...

...

- ...a sino swiss cooperation
- ...based on science, experience and communication
- ...a standard and the benchmark for sustainable building in China and around the world
- ...the future of construction today

WHAT IS ZEB



让我们共同打造气候中和的未来
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THE ZEB GOAL IS...

...

- ...to transform the way of planning and construction
- ...to decarbonize the building sector
- ...to increase energy efficiency
- ...to reduce the material resources in a circular construction economy

THE GOAL



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China has defined its mitigation path towards a carbon neutral country until 2060 and has acknowledged the building sector as one of the main pillars of a zero emission society and economy.

The ZEB China project team has the unique chance and privilege to support Chinese partners on its ambition to reach this long-term objective.

On the one hand, ZEB Demonstration Projects (DPs) will proof that Zero Emission Buildings are indeed possible – already today and in different building types. To gain that proof, solid and transparent calculations as well as CO2 balances are critical.

Only if the project can evaluate improvements from baseline concept to the built project, successful ZEB measures become visible and can be implemented in the industry and market on scale.

THE METHOD



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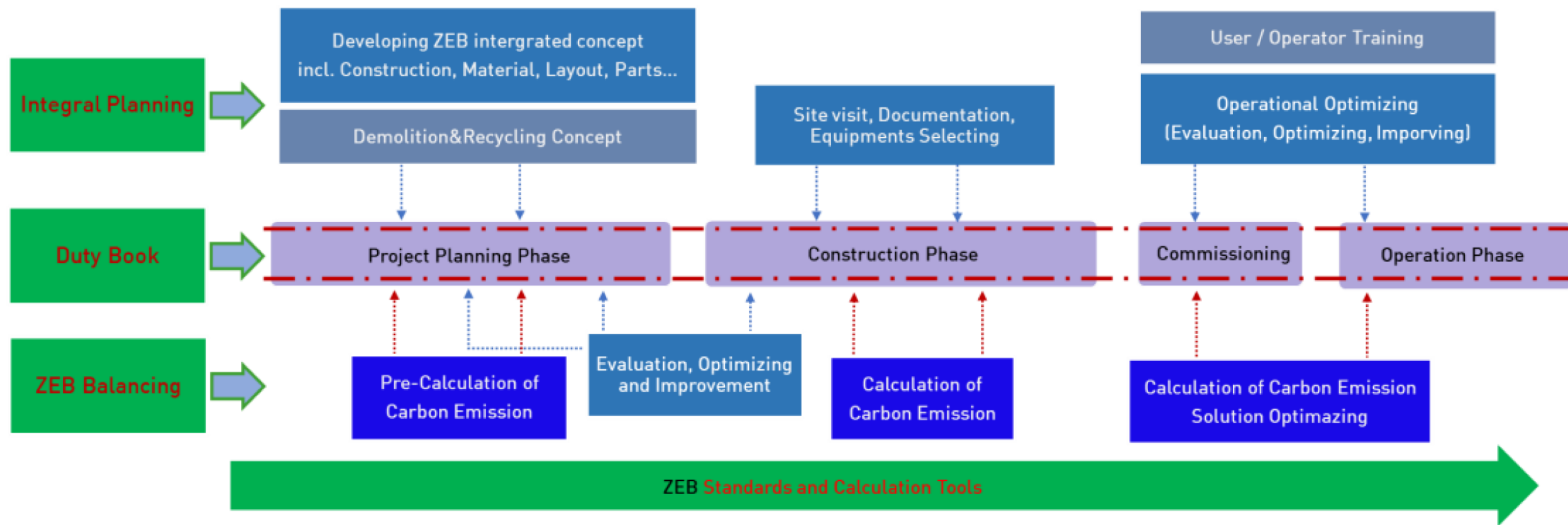
ZEB INNOVATIONS ARE...

- ...in the nexus climate, energy efficiency and resource efficiency
- ...integrated in all outcomes
- ...part of research, technical studies and special expertise for DPs
- ...to be presented on www.chinapb.org.cn

THE WAY



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ZEB PROCESS OVERVIEW

TABLE OF CONTENT 目录

Integral planning - fundamentals and prerequisites 综合规划 - 基本原理及先决条件

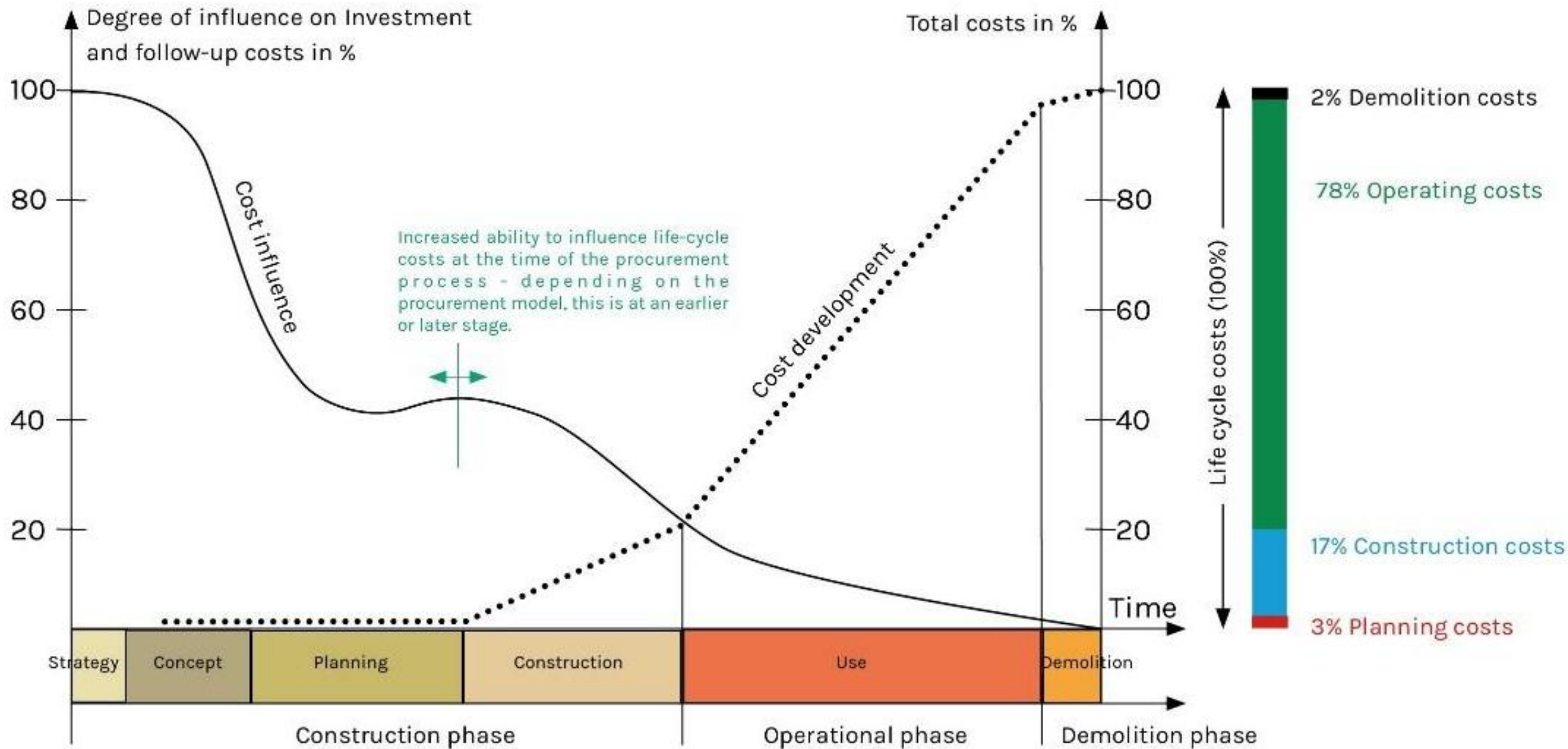
Example Zurich Airport – New Dock E Terminal 案例：苏黎世机场 - 新的航站楼 E

综合规划助力零碳建筑



综合规划 - 基本原理及先决条件

Integral planning -
fundamentals and prerequisites



团队 TEAM 1

团队：基于任务和能力组建团队，包括资深建筑师、土木工程师、建筑服务工程师以及建筑物理、幕墙规划等领域的专家。

Team Composition: Depending on task and competences (core disciplines architecture, civil engineer, building services engineer and specialists such as building physicists, facade planners, etc.)

要求 PREMISES 2

要求：必须为所有人所知，并如实声明。要求必须全面合理（也针对客户）。

Premises: Must be known to all and declared as such. No premises without comprehensible justification (also vis-à-vis the customer).

规则 RULES 3

规则：必须明确能力和责任。最佳的解决方案需要过程中的灵活性（反复寻找最优解决方案）。

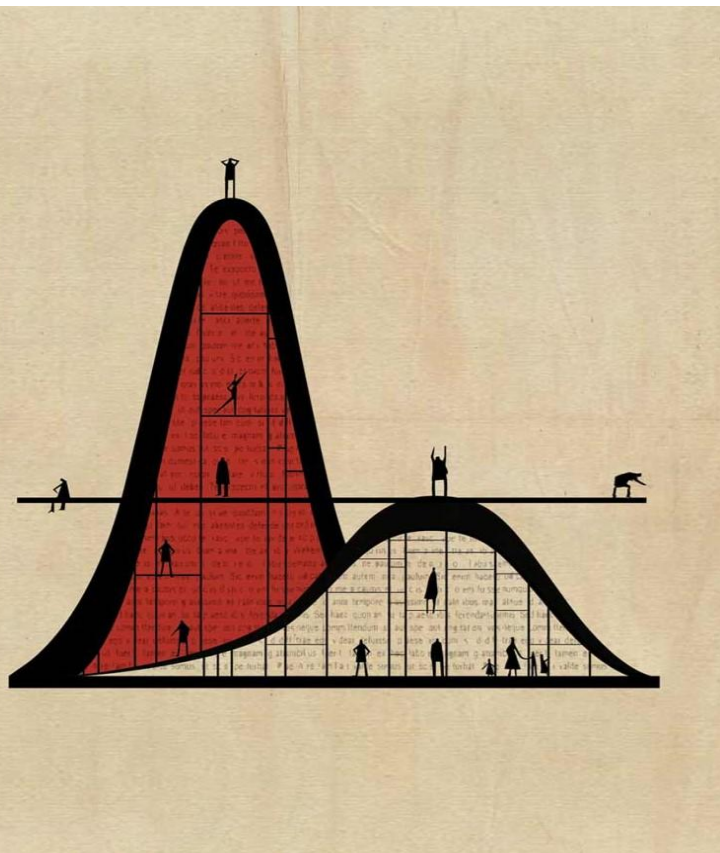
Rules: Competencies and responsibilities must be clear. Optimal solutions require flexibility in the process (iterative solution finding).

基于专业学科能力的跨学科解决方案

Interdisciplinary solutions are based on
disciplinary competences

1 团队构成

TEAM COMPOSITION



零碳建筑涉及到以下任务

INVOLVEMENT FOLLOWS TASKS FOR ZEB

建筑 - 基于零碳理念的建筑设计 and 建材选用

Architecture – ZEB mainly related to design and materials

结构工程 - 基于零碳理念的材料和结构

Structural Engineering – ZEB mainly related to materials and structure

建筑技术工程 - 基于零碳理念的能量来源和系统效率

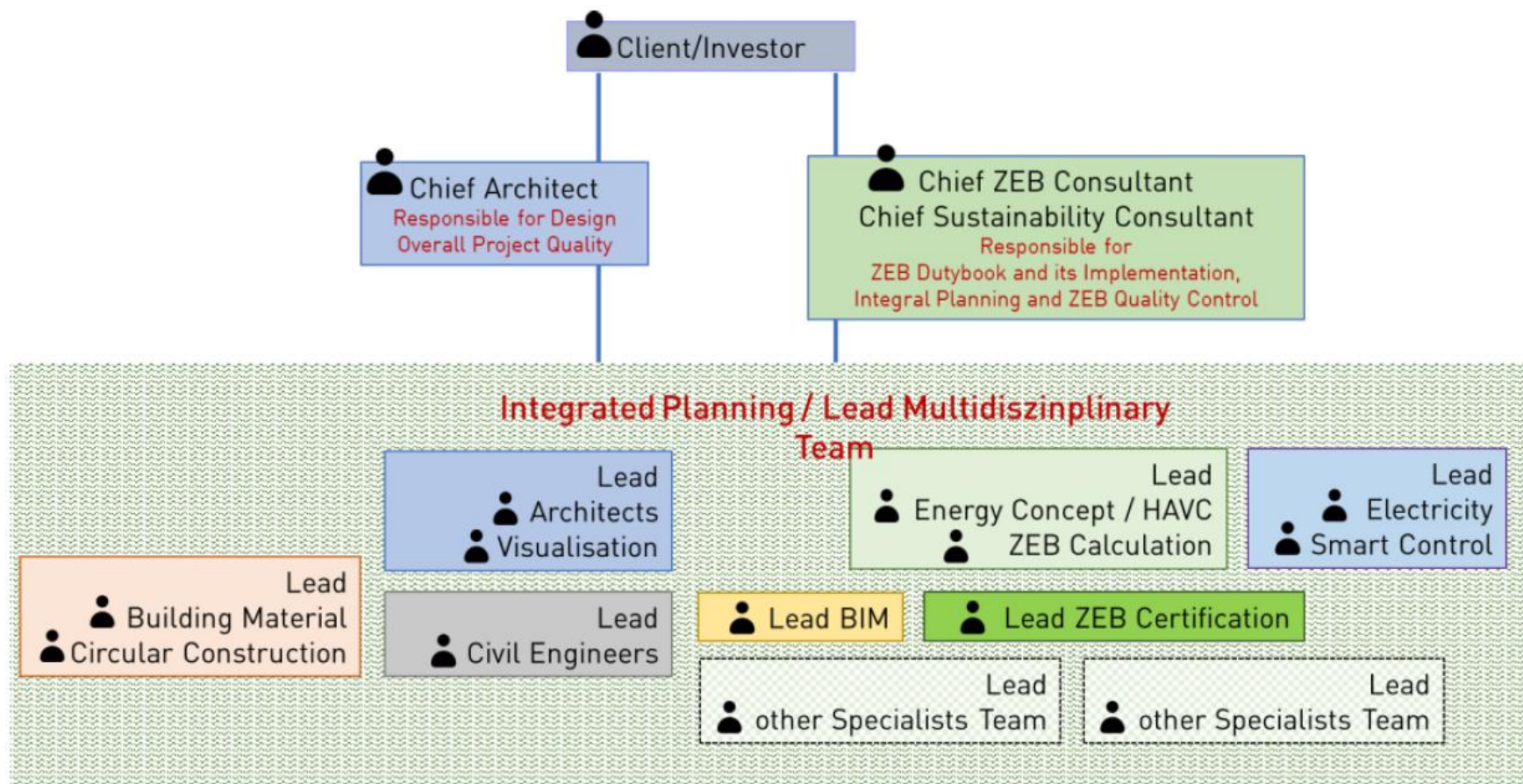
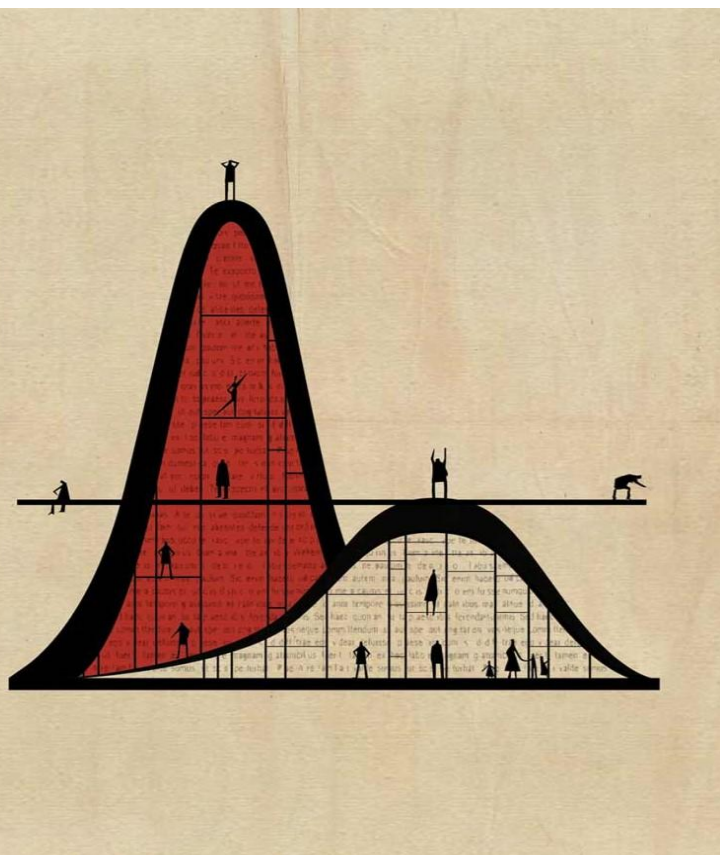
Building Technology Engineering (MEP) – ZEB mainly related to energy sources and efficiency of systems needed

团队构成 - 合作文化

TEAM COMPOSITION – CULTURE OF COOPERATION

1 团队构成

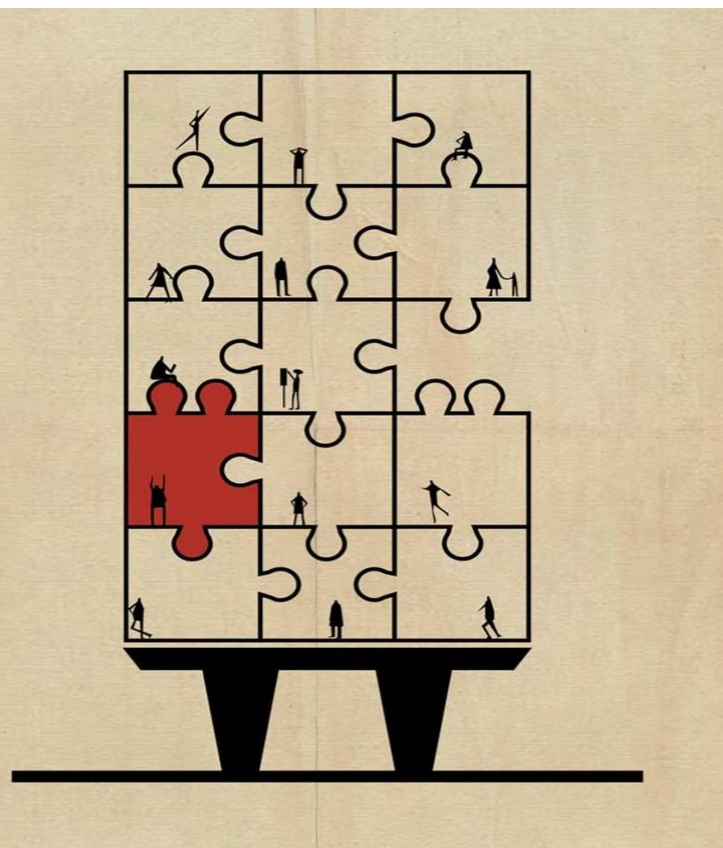
TEAM COMPOSITION



团队构成 - 合作文化

TEAM COMPOSITION – CULTURE OF COOPERATION

2 要求 PREMISES



明确并符合零碳建筑目标 - 责任手册

CLEAR AND IN LINE WITH ZEB OBJECTIVES – DUTY BOOK

零碳建筑设计阶段 - 比如能源效率、舒适度参数、自给自足程度等目标值

ZEB design phase - e.g. target values for energy efficiency, comfort parameters, degree of self-sufficiency, etc.

零碳建筑施工阶段 - 比如材料和部件再利用百分比的目标值，预制和现场施工的质量控制等

ZEB construction phase - e.g. target values for percentage of re use for materials and components, ongoing quality controls in prefabrication and on site etc.

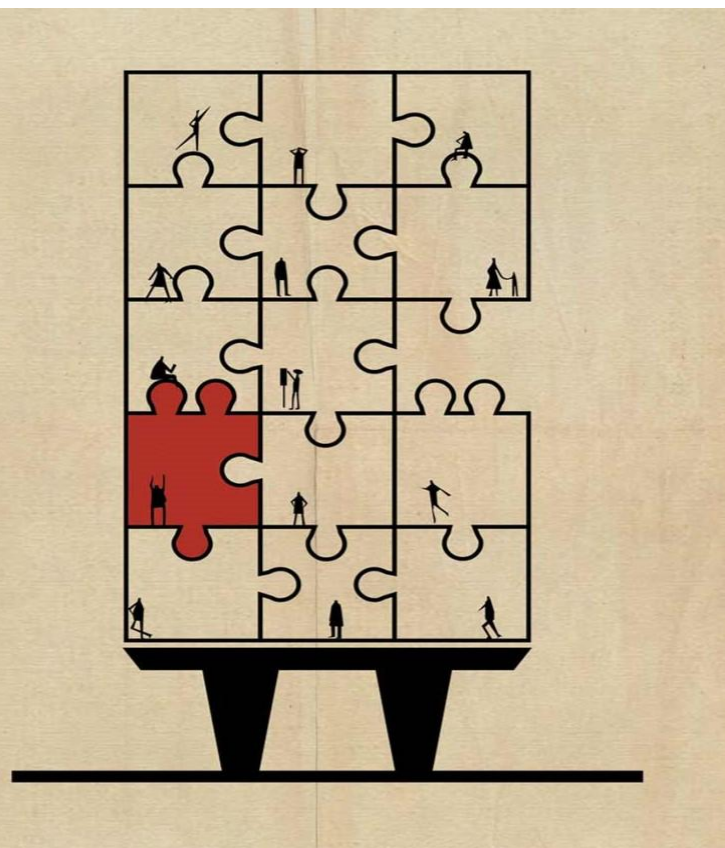
零碳建筑运行阶段 - 比如与规划、监测数据和优化阶段相比的允许偏差等

ZEB operational phase - e.g. tolerance values compared to planning, monitoring data, periodicity of optimizations, etc.

要求 - 少即是多

PREMISES – LESS IS MORE

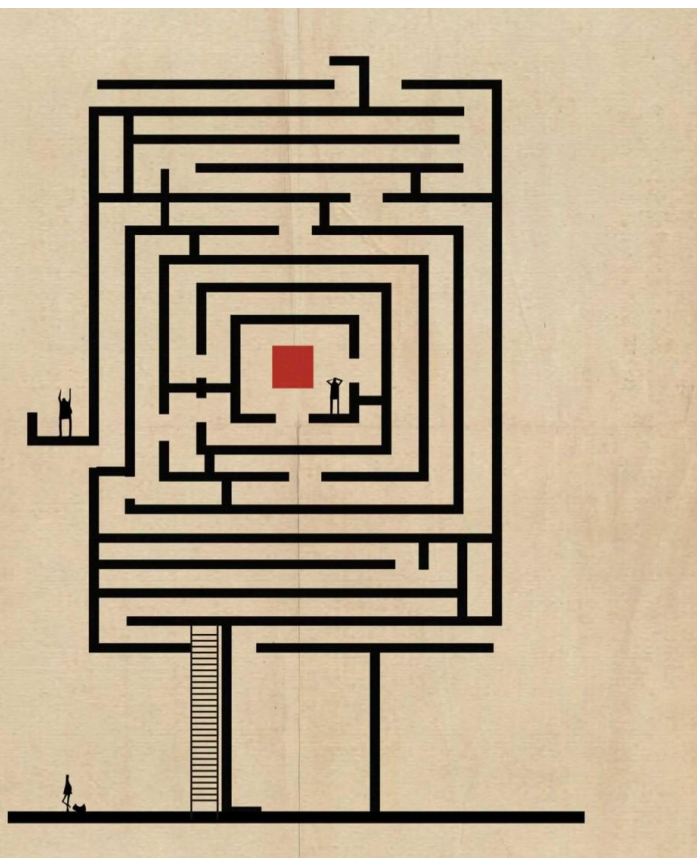
2 要求 PREMISES



要求 - 少即是多

PREMISES – LESS IS MORE

3 规则 RULES



规则服务于流程效率

RULES SERVE PROCESS EFFICIENCY

第一步：规范规则，背景分析，团队确认

Step 1: Disciplinary order and context analysis and confirmation in the team

第二步：定义零碳建筑目标及权重（责任手册）

Step 2: Definition of ZEB objectives and their weighting (Duty Book)

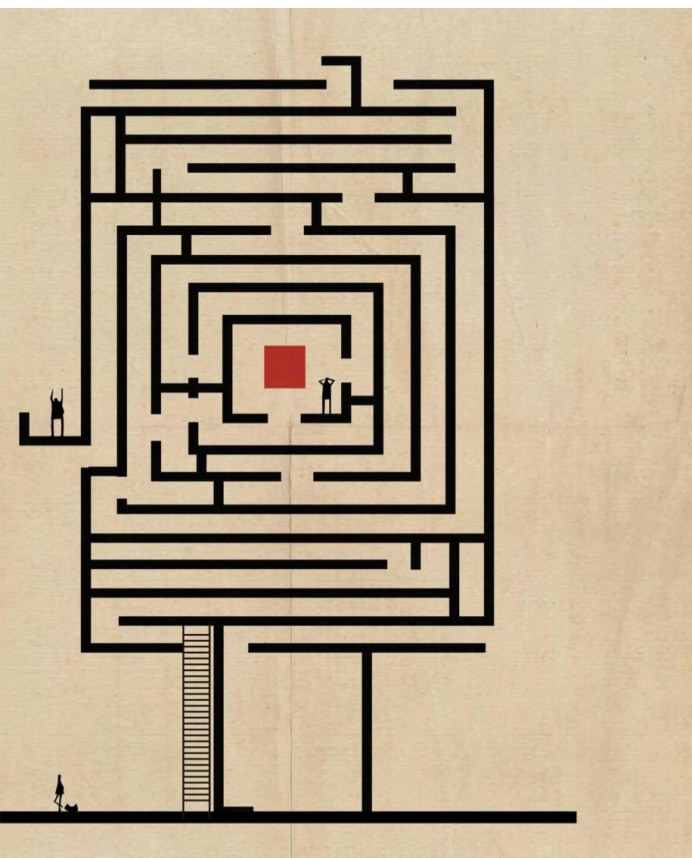
第三步：定义可能变量，并进行效用分析，包括敏感性分析，如能源价格、资本利息等

Step 3: Definition of possible variants and utility analysis including sensitivity analysis (e.g. energy prices, capital interest, etc.)

规则 - 基于协定的信息作出的决定

RULES – DECISIONS BASED ON AGREED
INFORMATION

3 RULES



Calculator SIA 2040: Preliminary study / preliminary project						construction	
Project information		Test Project for CABR				Legend	
Object input		Gross Floor Area	GFA	m ²	12'500	Input fields	
		Energy Reference Area	ERA	m ²	10'000	Selection fields	
						transferred values	
						CES Component area	
	Designation	Reference	Unit	Quantity	Design variant	Primary energy non-renewable kWh/m ²	Greenhouse gas emissions kg/m ²
						amortized over one year, based on EBF	
Building below ground	Excavation	Volumen	m ³	4500	without groundwater	0.3	0.07
	Foundation, base plate	CES	m ²	1500	uninsulated	0.7	0.26
	Exterior wall	CES	m ²	1800	uninsulated	0.8	0.28
	Roof	CES	m ²		uninsulated	0.0	0.00
Building above ground	Outer wall: supporting structure (reserve)	CES	m ²	2600	Insulating concrete	3.5	0.86
	Exterior wall Supporting structure:	CES	m ²			0.0	0.00
	Exterior wall: superstructure (reserve)	CES	m ²	2500	Cladding light, ventilated	1.3	0.25
	Medium cladding, ventilated	CES	m ²	0		0.0	0.00
	Windows incl. sun protection	CES	m ²	1300		2.8	0.69
	Interior walls	CES	m ²	10000		3.9	1.30
	Ceiling: supporting structure (reserve)	CES	m ²	8000	Wooden element ceiling	2.4	0.53
	Concrete ceiling (25 cm)	CES	m ²	1500		0.6	0.20
	Ceiling: superstructure (reserve)	CES	m ²	8500	Underlayment and floor covering	3.8	0.85
	Ceiling structure:	CES	m ²	0		0.0	0.00
	Balcony	CES	m ²	0		0.0	0.00
	Roof: supporting structure (reserve)	CES	m ²	1500	wooden element ceiling	0.5	0.10
	roof, supporting structure:	CES	m ²	0		0.0	0.00
	Roof: superstructure (reserve)	CES	m ²	1500	insulated (flat roof)	1.4	0.30
	Roof structure:	CES	m ²	0		0.0	0.00
Building services	Electrical system	ERA	m ²	10000	Electrical system including distribution	2.9	0.63
	Photovoltaic system	max. performance	kWp	210	(input in the sheet "Operation")	5.1	1.37
	Thermal plant	ERA	m ²	10000	Heating system including distribution	2.3	0.53
	Thermal solar collectors	CES	m ²	0	(input in the sheet "Operation")	0.0	0.00
	Ventilation system	ERA	m ²	10000	(input in the sheet "Operation")	1.9	0.45
	Water plant	ERA	m ²	10000	Sanitary system incl. distribution	1.3	0.30
Project value						35	9.0
Standard value						35	9.0
Parameters		Compactness factor (SIA 380)	0.7	(total building envelope below and above ground level/floor area)			
		Window proportion on facade	33%	(window area/facade area above terrain)			

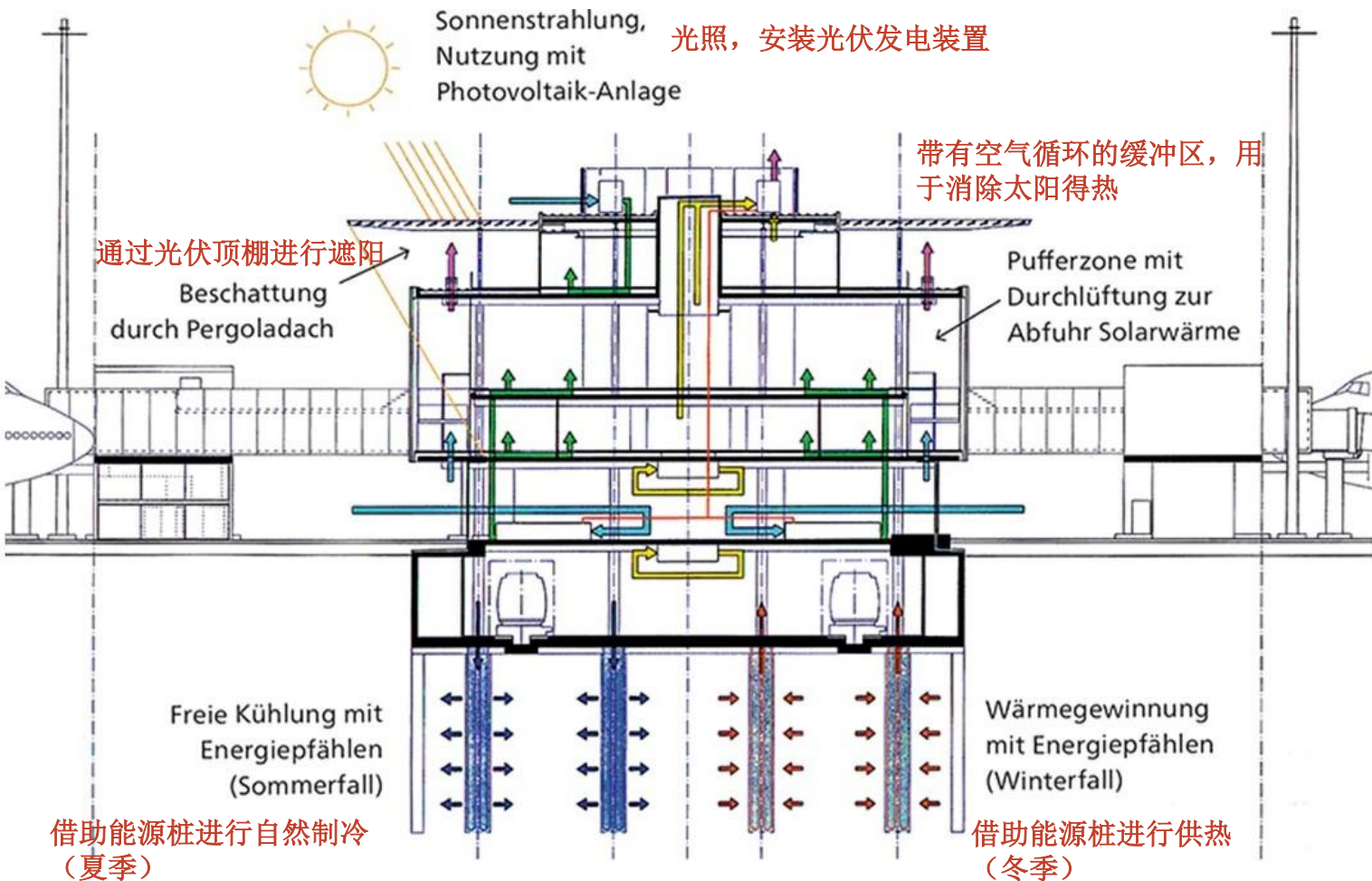
规则 - 基于协定的信息作出的决定

RULES – DECISIONS BASED ON AGREED INFORMATION



案例：苏黎世机场 - 新的航站楼E

EXAMPLE – ZURICH AIRPORT
NEW DOCK E TERMINAL



规划/建设周期: 1996-2003

成本: 3.5亿瑞士法郎

建筑面积: 8万平方米 (500米长)

Planing/Construction Period: 1996-2003

Cost: 350 Mio. CHF

Floor Area: 80'000 m² (500 m long)

能量来源: 300个能源桩用于供暖和制冷, 屋顶集成了300kWp的光伏发电系统

Energy Sources: 300 Energy Piles for heating and cooling, 300 kWp PV with integrated pergola roof

协同效应: 登机通道的幕墙缓冲区, 结构桩, 光伏遮阳, 家居一体化的新风供应

Synergies: Façade Buffer for boarding ramps, Structural Piling, Shading with PV, supply air integrated in the furniture

建筑技术工程 - 基于零碳理念的能源来源和系统效率

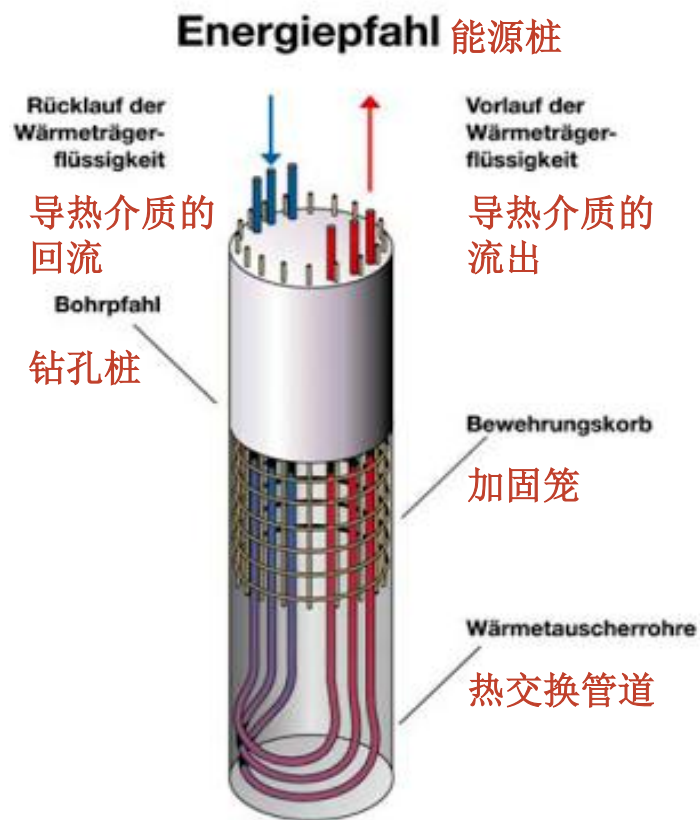
Building Technology Engineering (MEP) - ZEB mainly related to energy sources and efficiency of systems needed

案例: 苏黎世机场 - 新的航站楼E

EXAMPLE - ZURICH AIRPORT
NEW DOCK E TERMINAL

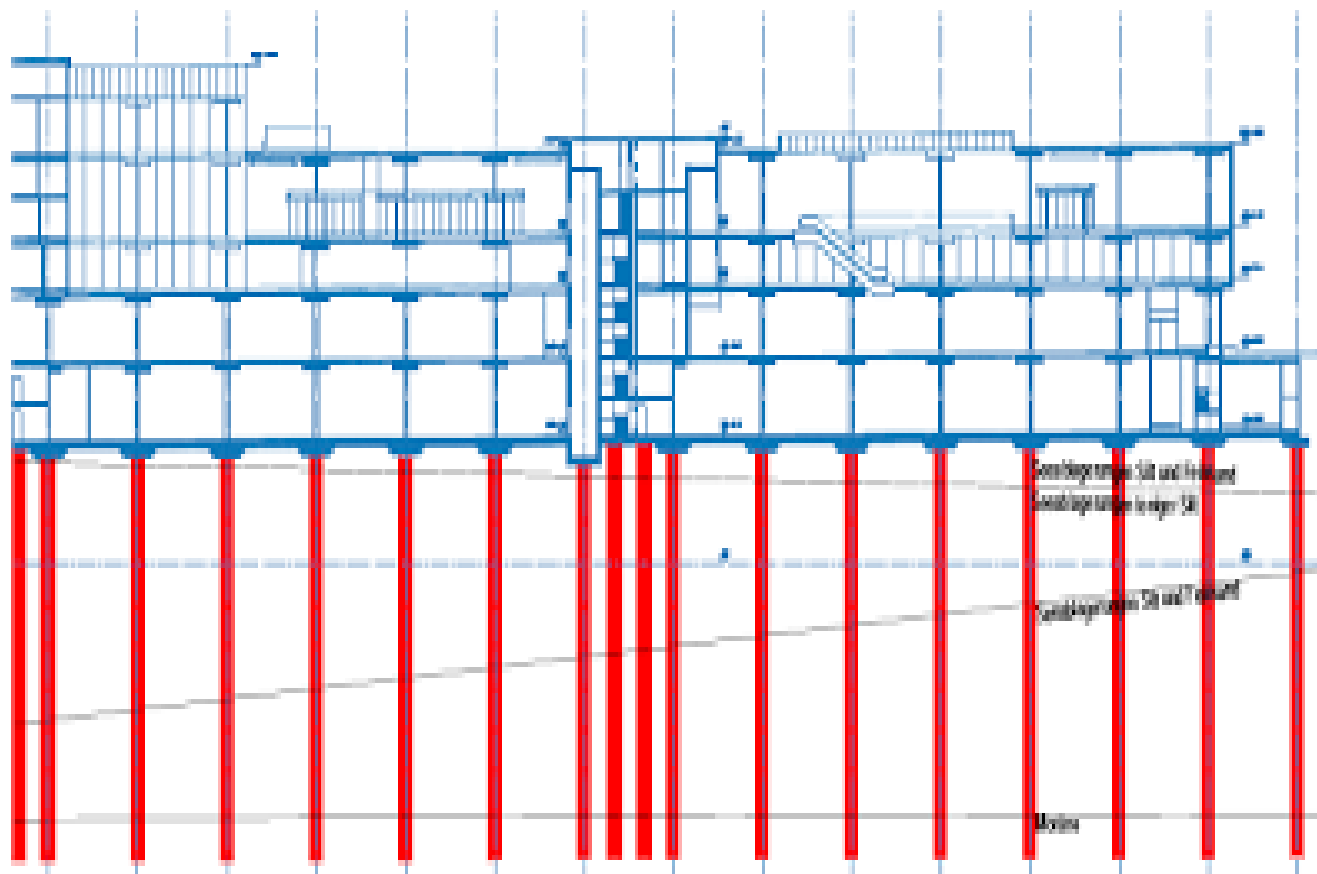
能源桩（40米长，带集成管道）

Energy Piles (40 m length with integrated piping)



建筑剖面：300根能源桩（红色）

Building Section with 300 Energy Piles (red)



案例：苏黎世机场 - 新的航站楼E

EXAMPLE – ZURICH AIRPORT
NEW DOCK E TERMINAL

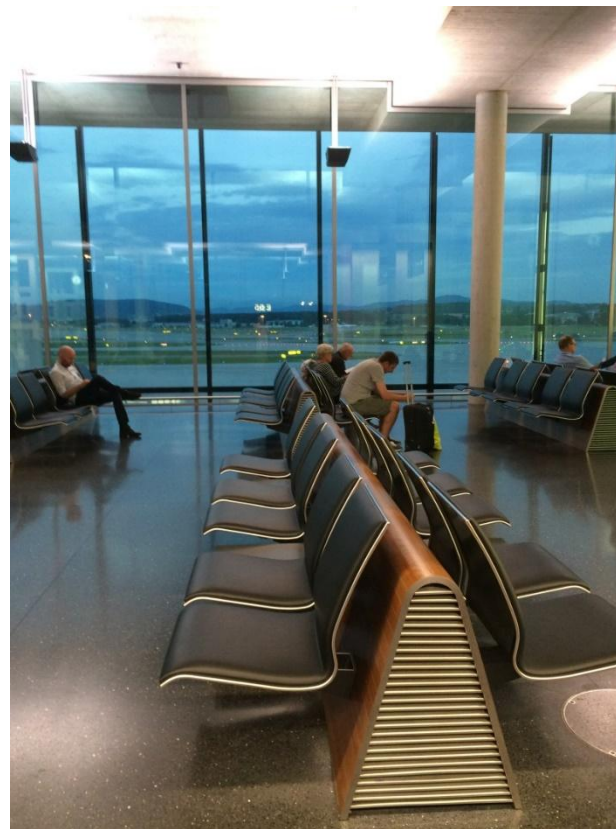
光伏屋顶（300kWp，集成遮阳）

PV Roof (300 kWp, integrated shading)



家居一体化的新风供应

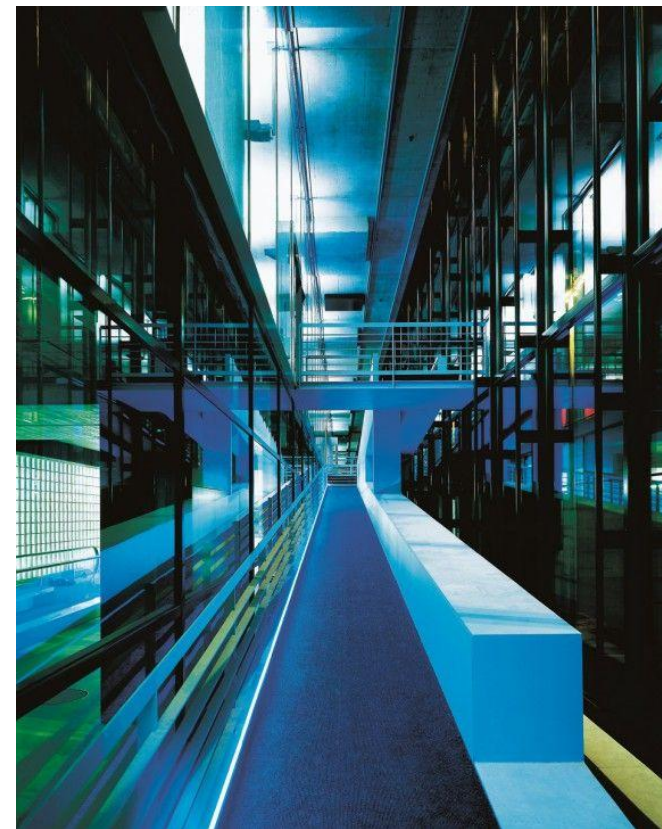
Supply Air integrated furniture



集成登机通道的双层幕墙

（气候缓冲区）

Double facade (climate buffer)
with integrated boarding ramps



案例：苏黎世机场 - 新的航站楼E

EXAMPLE – ZURICH AIRPORT
NEW DOCK E TERMINAL



方法来源于挑战 - 综合规划助力零碳建筑及可持续解决方案

THE METHOD FOLLOWS THE CHALLENGE – INTEGRATED PLANNING FOR ZEB AND SUSTAINABLE SOLUTIONS

“电灯并不是来自于对蜡烛的不断改进”
奥伦·哈拉里（1949–2010）

"The electric light did not come from the continuous improvement of candles"

Oren Harari (1949-2010)

创新&可持续 - 零碳建筑需要新的方法

INNOVATION & SUSTAINABILITY –
NEW METHODS NEEDED FOR ZEB



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THANK YOU

感谢您的关注



中华人民共和国
住房和城乡建设部



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



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skat Swiss Resource Centre and
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