La strategia delle addizioni volumetriche per l'efficienza energetica degli edifici

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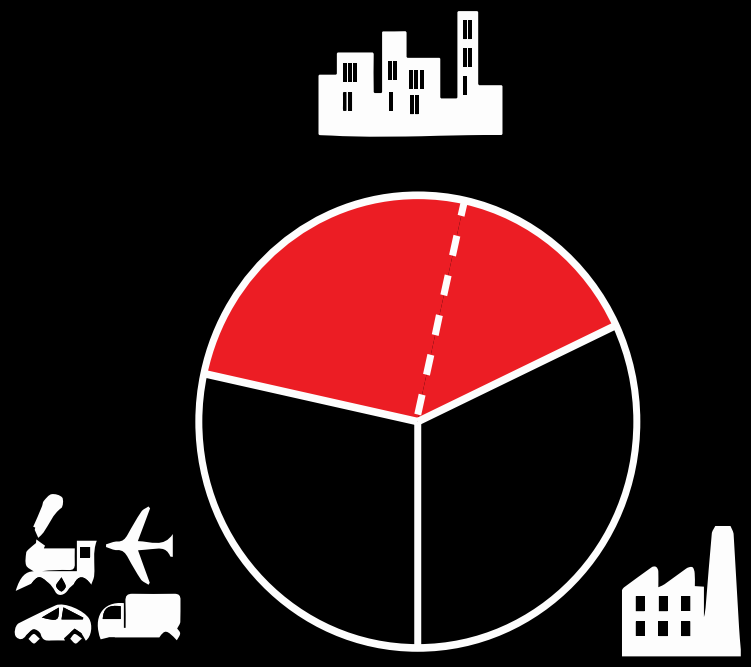
INTRODUZIONE
LA STRATEGIA
CALCOLO E VALIDAZIONE
PROTOTIPAZIONE – ON TOP
CONCLUSIONI

IL PROGETTO ABRACADABRA

CONSUMI ENERGETICI

40 %



DEI CONSUMI COMPLESSIVI
ENERGETICI IN EUROPA
E' DOVUTO
AL SETTORE EDILIZIO.

LA COMPONENTE RESIDENZIALE
COPRE I 2/3
DELL'EDILIZIA COMPLESSIVA

Fonte dati: rapporto europeo BPIE, 2012

RIQUALIFICAZIONE? PREVISIONI 2020

80 %

DEL SETTORE EDILIZIA, SECONDO LE PREVISIONI PER I PROSSIMI 5 ANNI,

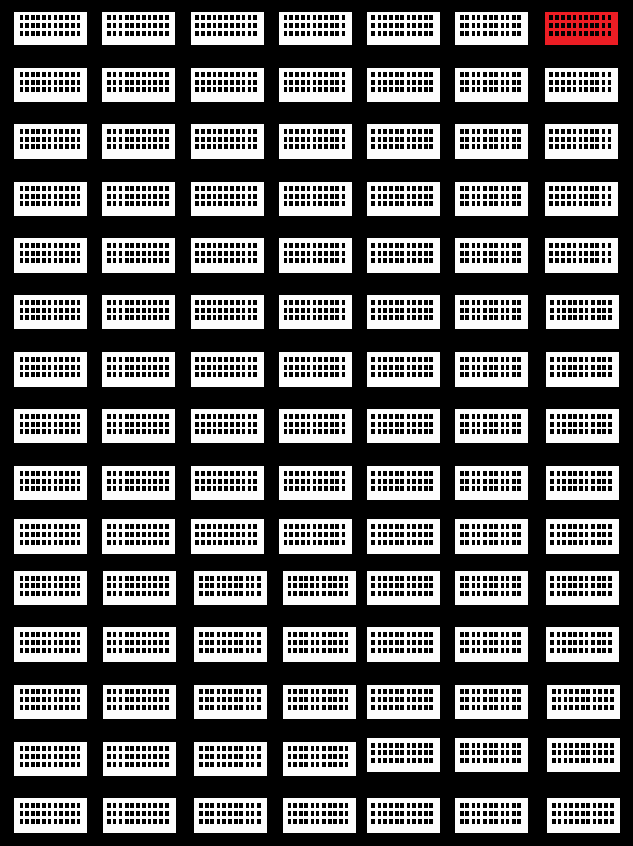
SI INCENTRERA'

SUGLI INTERVENTI DI RECUPERO E RIQUALIFICAZIONE ENERGETICA DEGLI EDIFICI ESISTENTI

Fonte dati: 11 minuti di recuero, 2a+p

OGGI, 2016?

1,4 %



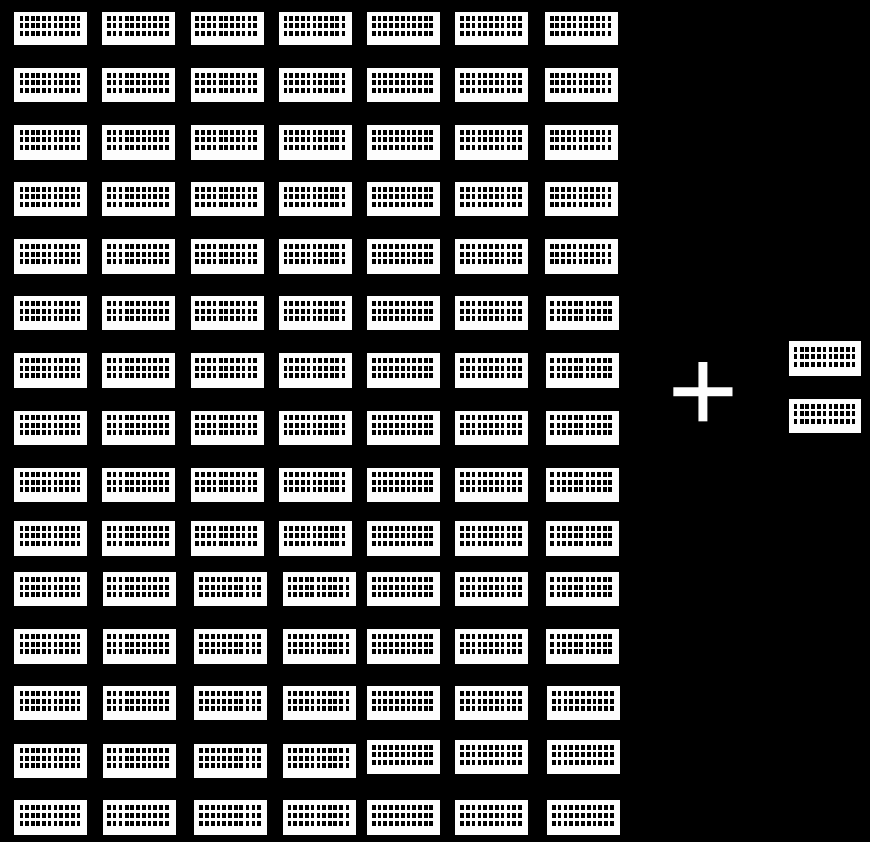
DEL PATRIMONIO IMMOBILIARE VIENE RINNOVATO OGNI ANNO.

SI TRATTA DI UN PROBLEMA GRANDE
11.000.000 IMMOBILI

DI CUI RECUPERIAMO
11.000 ALL'ANNO

NUOVA COSTRUZIONE?

100.000.000 m^3



+ =

NUOVA COSTRUZIONE DI EDIFICI RESIDENZIALI.

CONSIDERANDO CHE UN ABITAZIONE MEDIA HA UNA CUBATURA DI C.A. 225 M^3 ,

IN ITALIA COSTRUIAMO ANNUALMENTE 444.444 UNITA' C.A.
20.000 NUOVI EDIFICI OGNI ANNO

Fonte dati: A. Minero, Architettura Parassita, Università di Torino

IL SUOLO È UNA RISORSA FINITA E IRRIPRODUCIBILE

2.189.000 ha

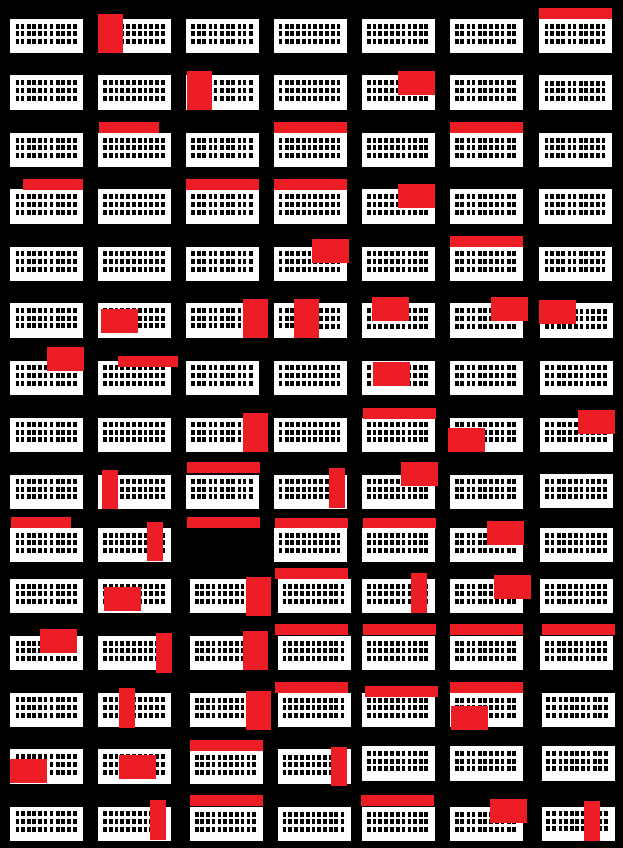
SUPERFICIE AGRICOLA SCOMPARSA
IN ITALIA
DAL 1989 AL 2015

8 M^2 AL SECONDO

SI TRATTA DI UNA SUPERFICIE PARI
ALL'INTERA EMILIA ROMAGNA
(C.A. 20.000 KM^2)

Fonte dati: Il consumo di suolo in Italia, rapporto 2014

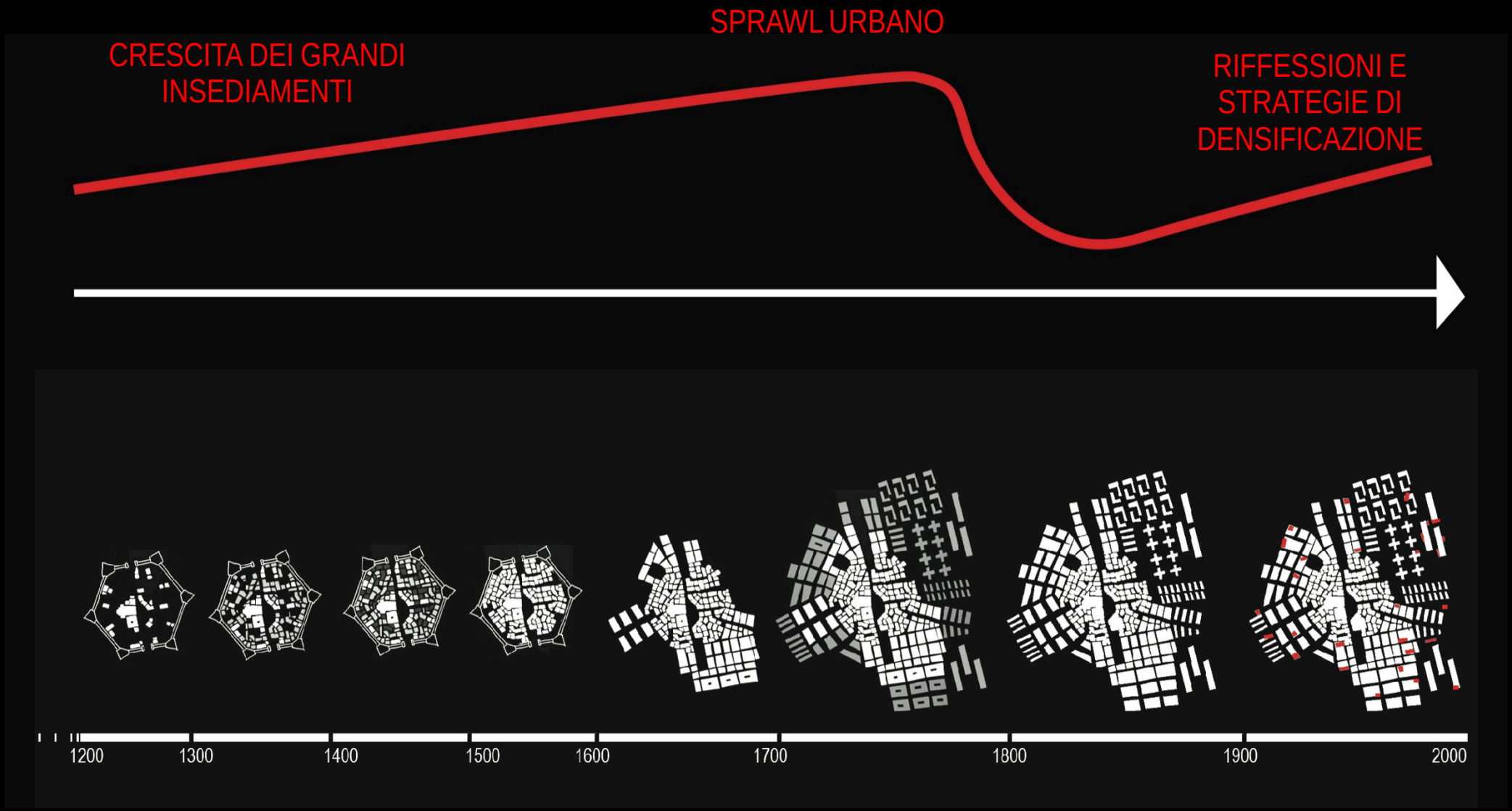
RIQUALIFICAZIONE E DENSIFICAZIONE



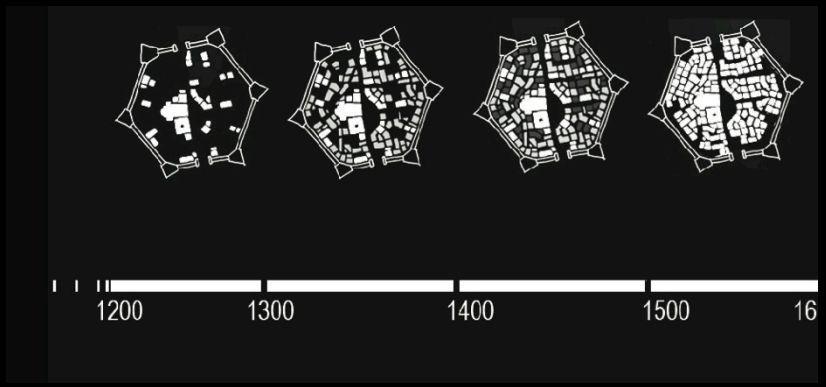
SFRUTTANDO UN AUMENTO DI VOLUMETRIA DEL 20%
SI POTREBBE

- RISPONDERE ALLA DOMANDA DI CUBATURA ANNUA
- NON CONSUMARE NUOVA SUPERFICIE
- RIQUALIFICARE L'ESISTENTE
- DENSIFICARE LE AREE GIA' URBANIZZATE

UNA STRATEGIA ANTICA PER UN PROBLEMA ATTUALE



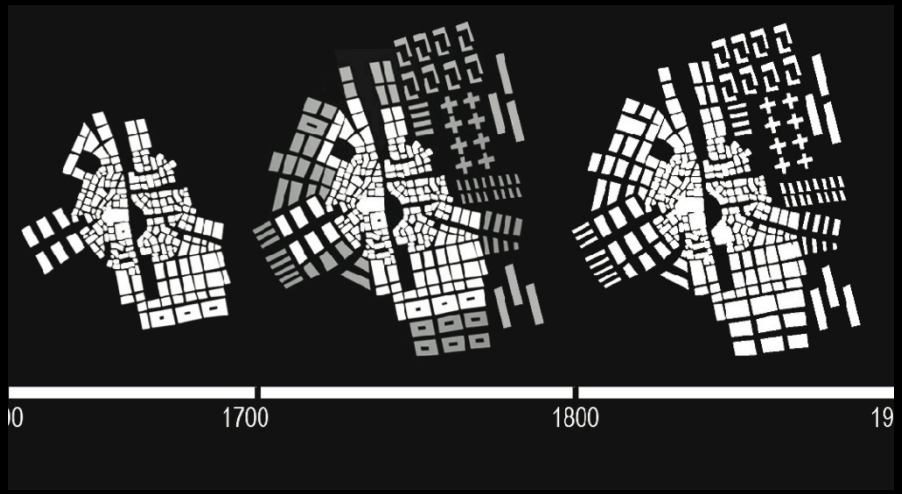
UNA STRATEGIA ANTICA PER UN PROBLEMA ATTUALE



Da sinistra: Ponte Vecchio, Firenze; Teatro Marcello, Roma; Dioclezian Palace, Spalato; Typical English House from the 16th century with 17th wooden frame addition; Arles Colosseum historical reconstruction, Arles.

UNA STRATEGIA ANTICA PER UN PROBLEMA ATTUALE

Da sinistra: Biljlmermeer, Amsterdam; Kanaleneiland, Utrecht; Pilastro, Bologna; GrossSiedelungen Britz, Berlin; Peep Corticella; Bologna; Corviale, Roma

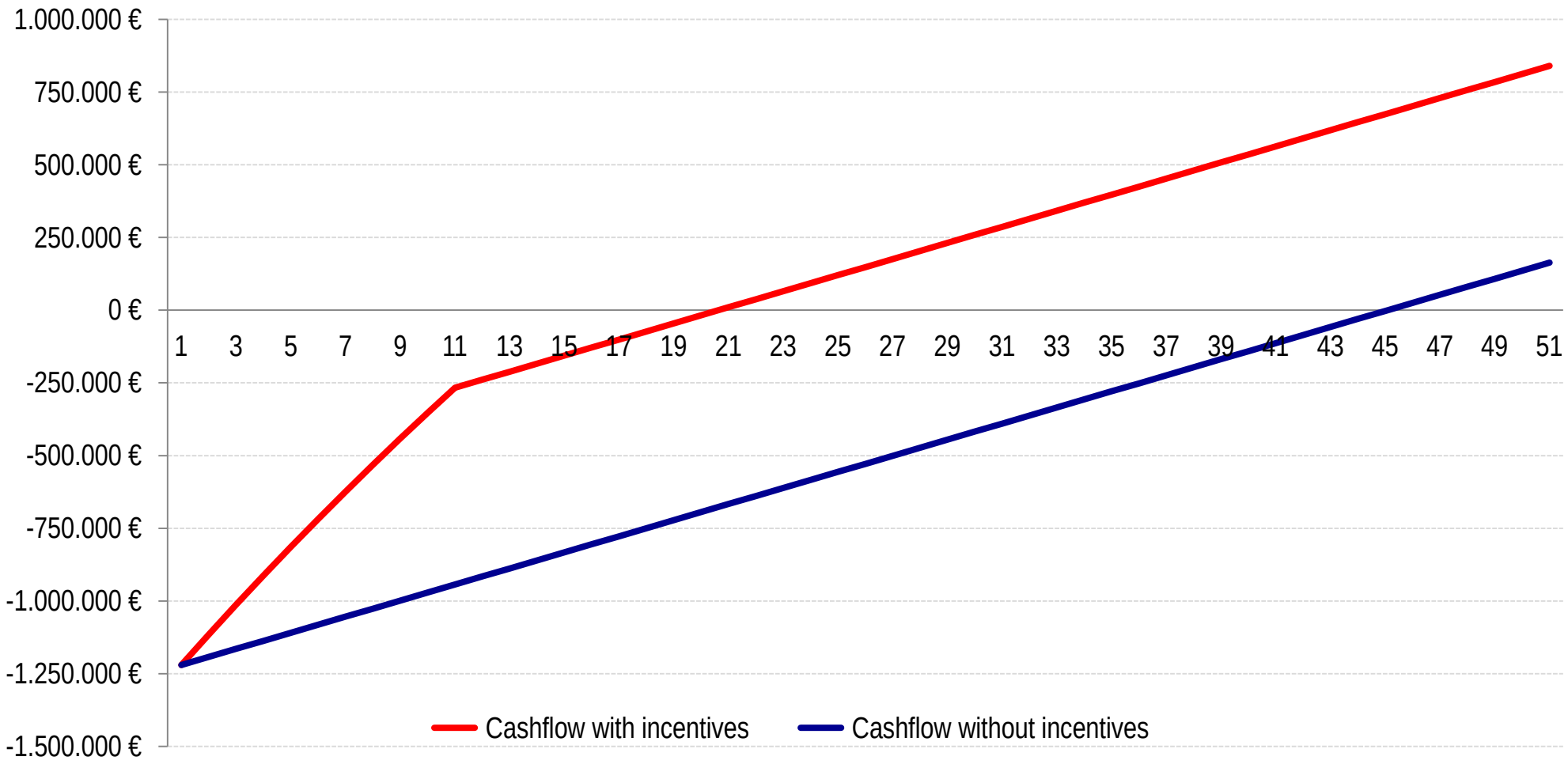


?

E’ POSSIBILE APPLICARE IL
PRINCIPIO DELL’ADDIZIONE
COME STRATEGIA INTEGRATA
PER SUPERARE LE BARRIERE
ESISTENTI ALLA
RIQUALIFICAZIONE
ENERGETICA DEGLI EDIFICI

LA STRATEGIA

BARRIERA ECONOMICA



BARRIERA SOCIALE









BEST PRACTICE

NORRLANDSGATAN, 20
Sweden, 2009
Rooftop Addition

+500 m²

ALBY ETAGE
Sweden, 2010
Facade Addition

+280 m²

FERNPASS STR.
Germany, 2013
Facade Addition

+1300 m²

GRUENTEN STR.
Germany, 2013
Facade Transformation

+180 m²

TREEHOUSE
Germany, 2014
Rooftop + Facade Addition

+2200 m²

MANDALAHOF
Austria, 2008
Rooftop Addition

+600 m²

MANESSE STR.
Switzerland, 2011
Facade Addition

+2800 m²

TOIR BOIS LE PRETRE
France, 2012
Facade Transformation

+600 m²

TORENFLAT
The Netherlands, 2010
Facade and Aside Addition

+2000 m²

DE VALK
The Netherlands, 2008
Facade and Aside Addition

+1200 m²

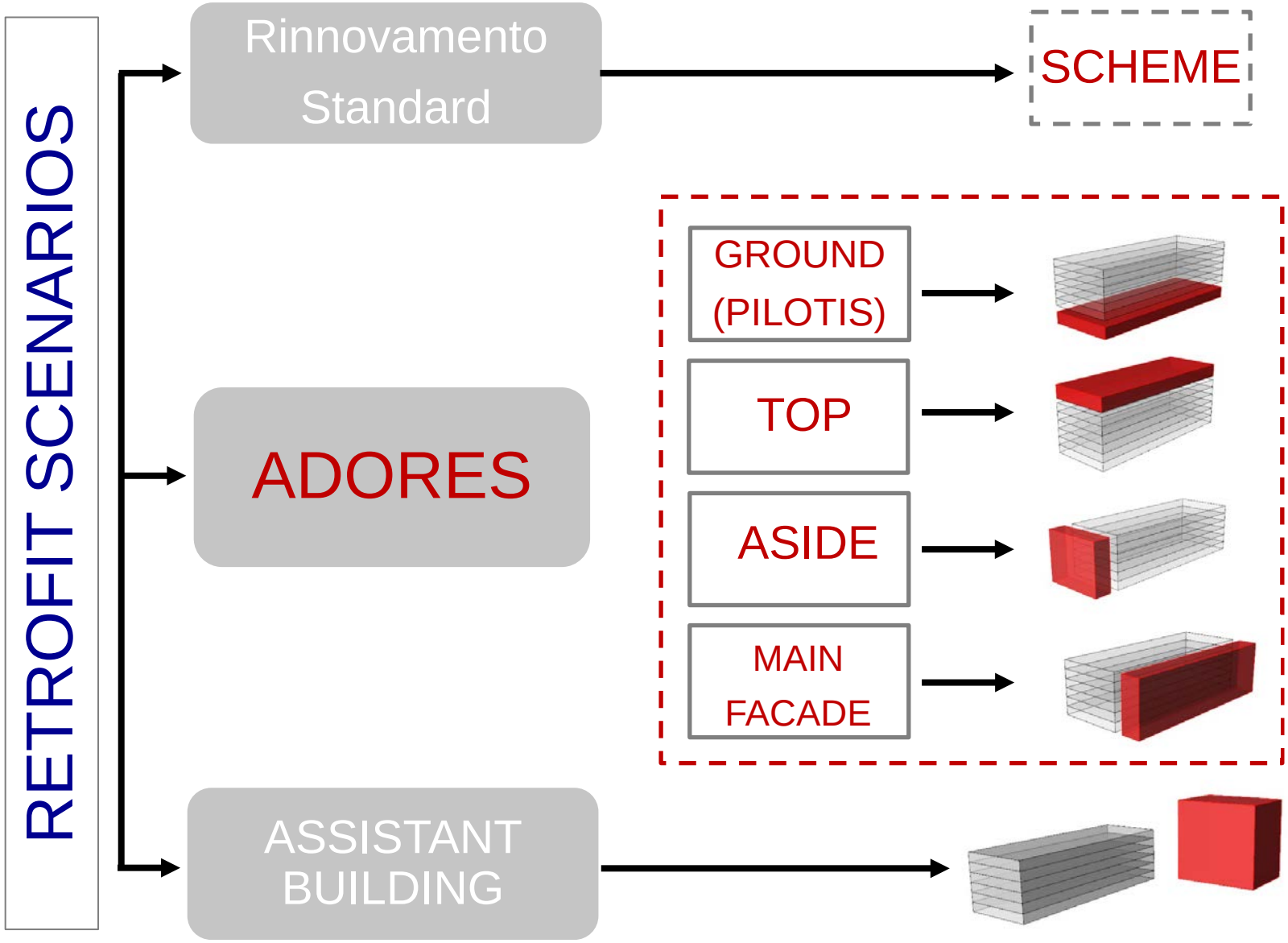
EUCALYPTUSHOF
The Netherlands, 2009
Facade Addition

+300 m²

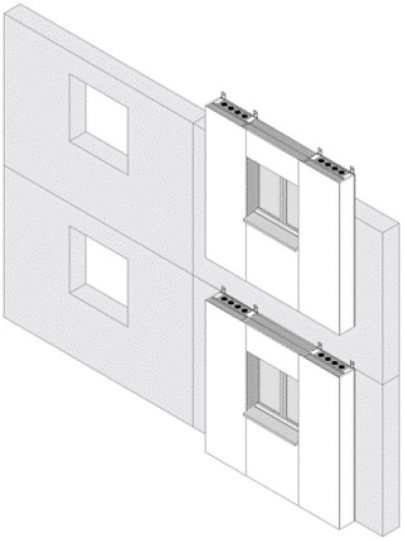
SEGANTIN STR.
Switzerlan, 2010
Rooftop Addition

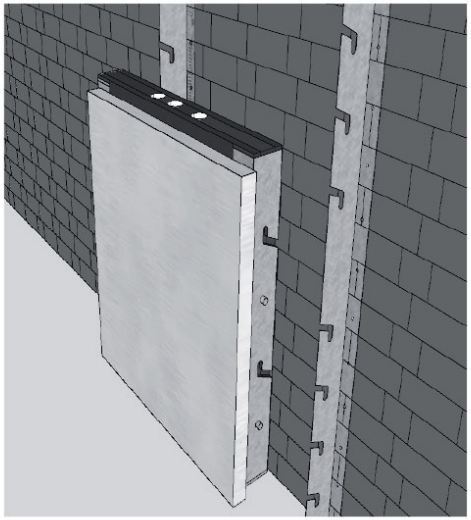
+200 m²

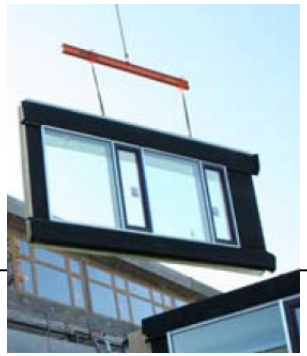
CATEGORIZZAZIONE



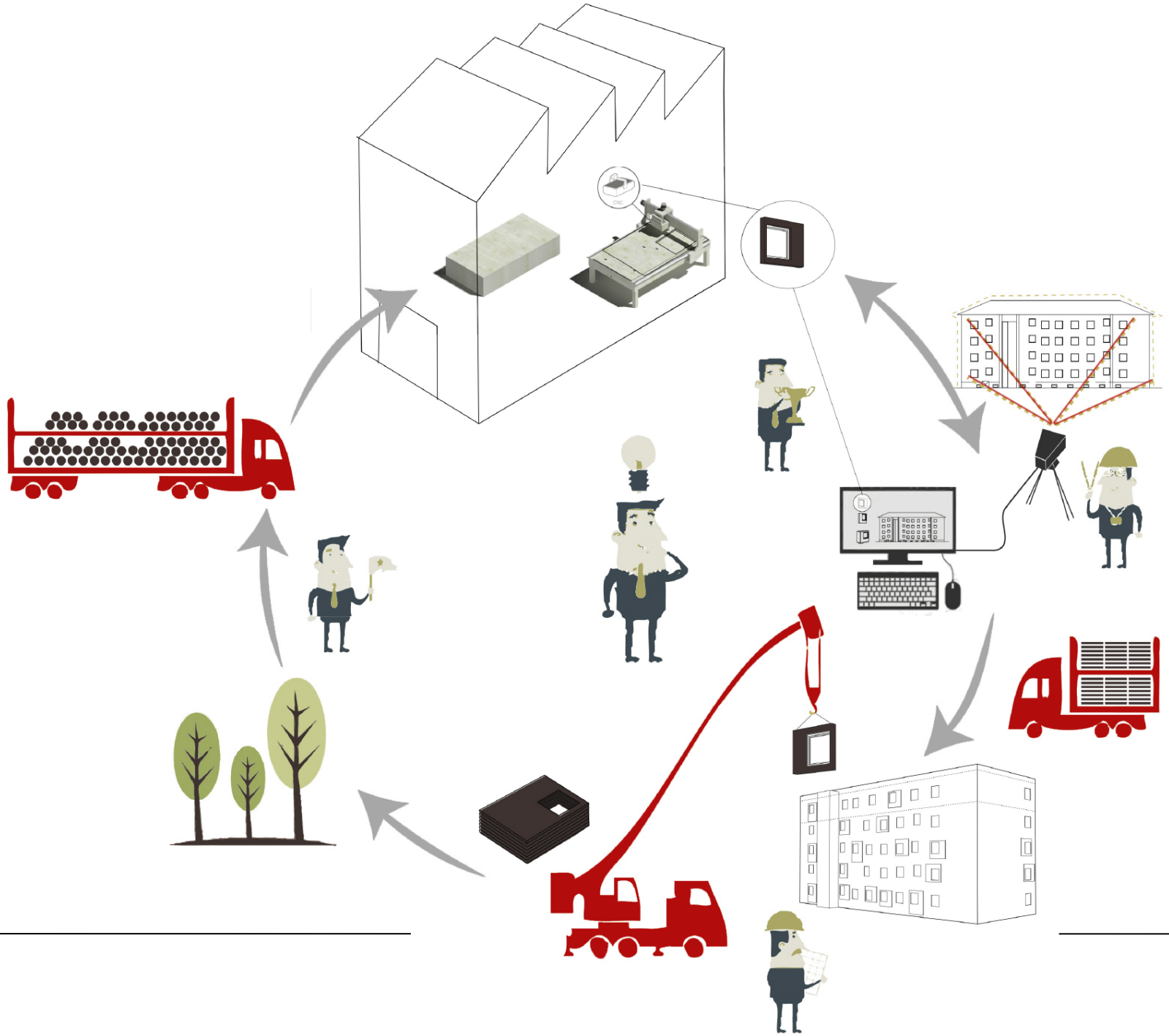
POTENZIALE TECNOLOGICO







LIFE CYCLE



TOUR BOIS LE PRETRE

LOCATION: Paris, France

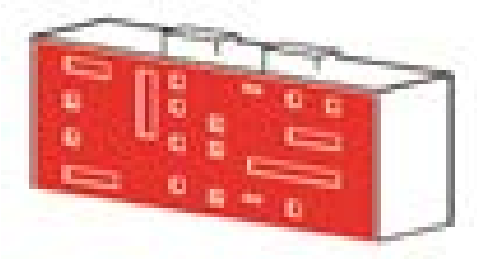
BUILDING TYPE: Apartment building, Tower

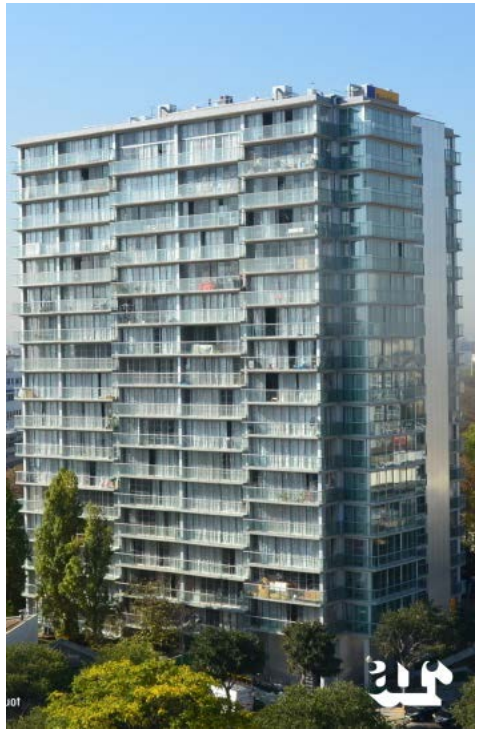
YEAR OF CONSTRUCTION: 1962

FAÇADE : Prefab. Concrete panels

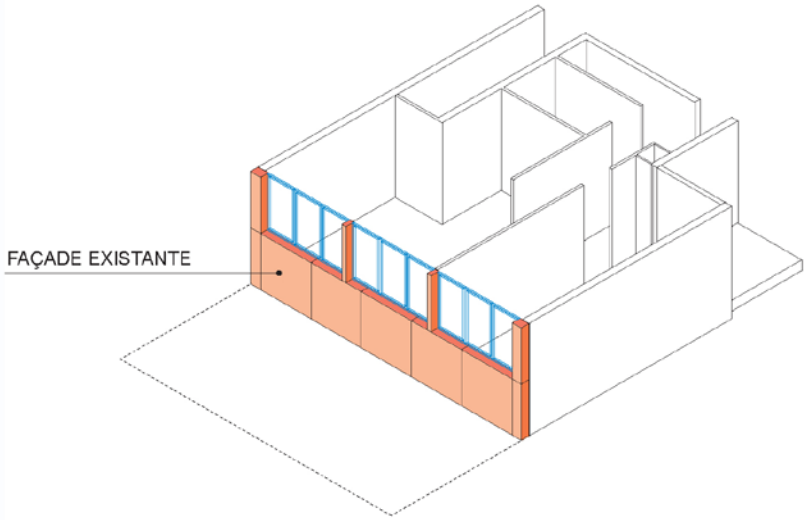
ADDITION TYPE

Façade renovation

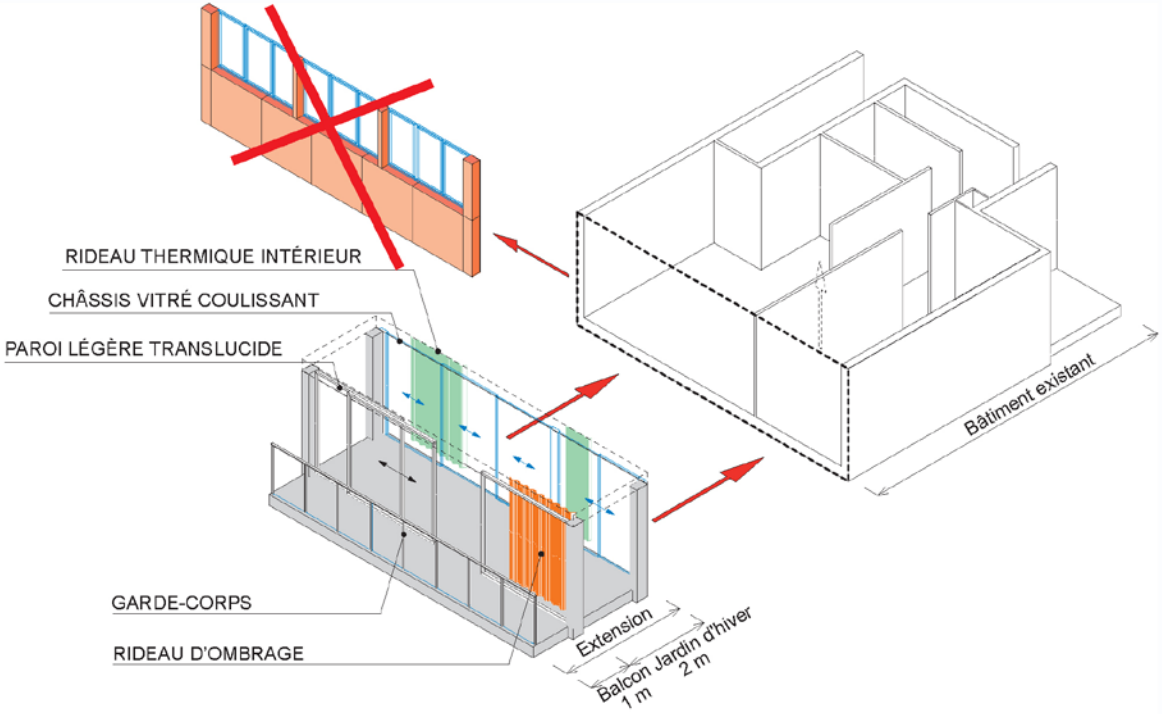




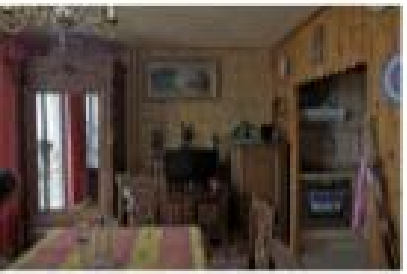
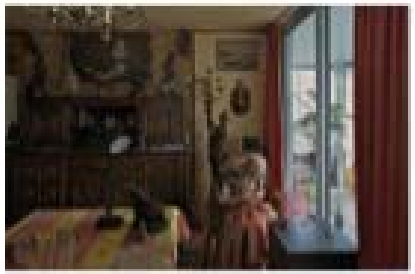
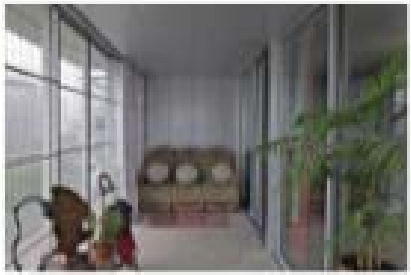
TECNOLOGIA

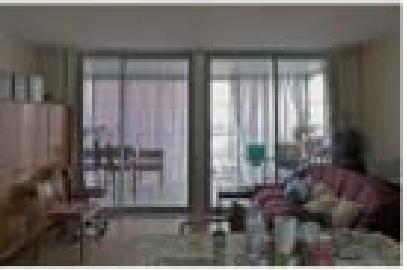
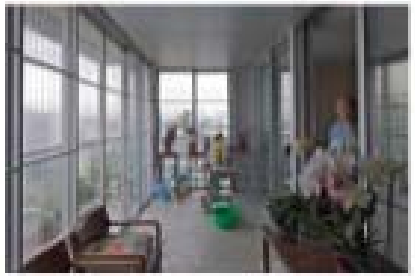
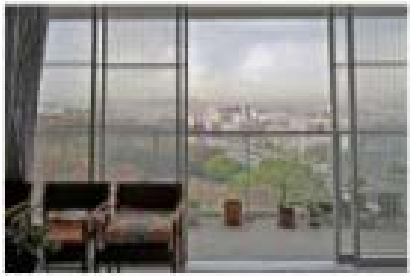


APPARTEMENT T2 EXISTANT

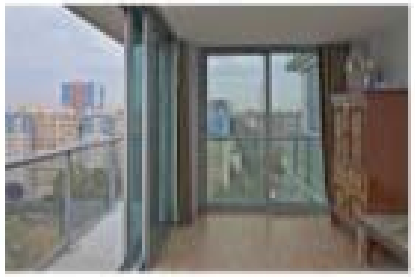


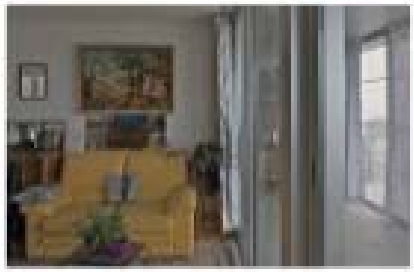
APPARTEMENT T2 + EXTENSION (JARDIN D'HIVER + BALCON)

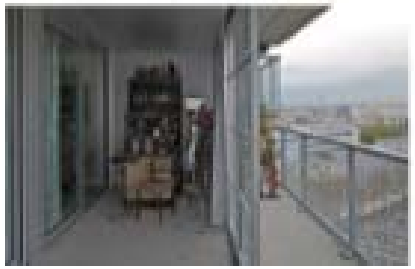
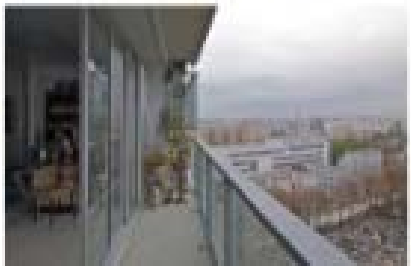










Burkhalter Sumi Architekten

PILE UP

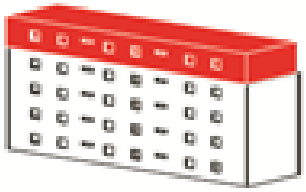
LOCATION: Zurich

BUILDING TYPE: Industrial building

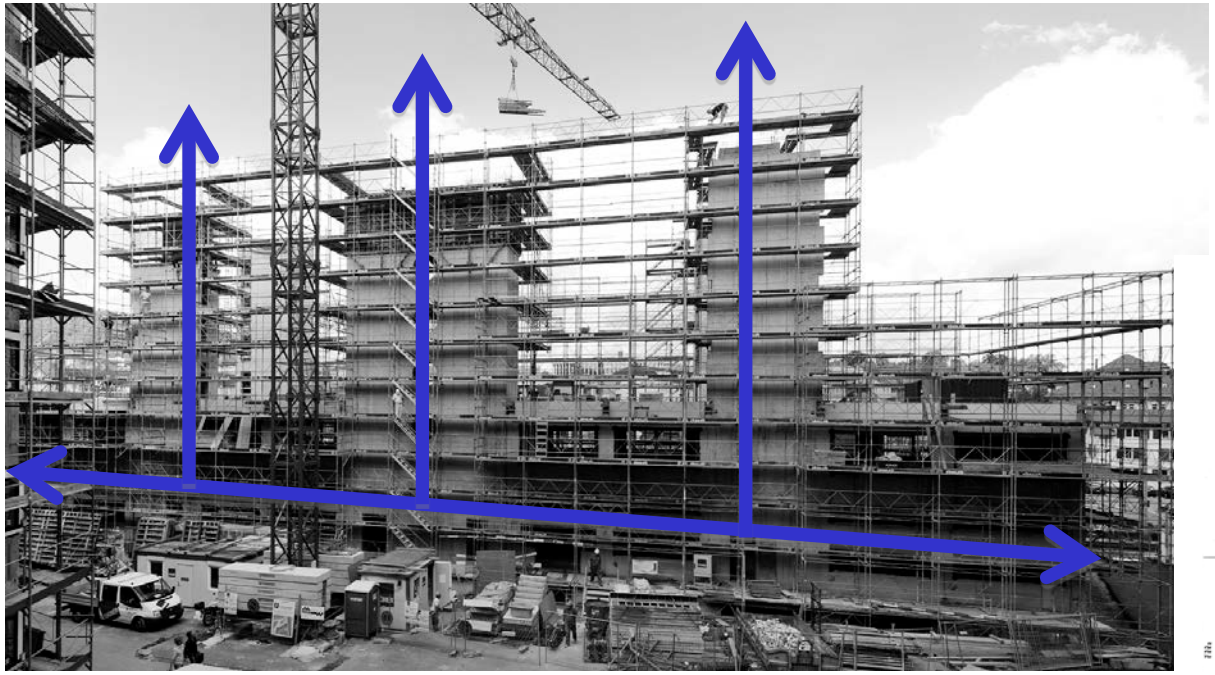
YEAR OF CONSTRUCTION: -

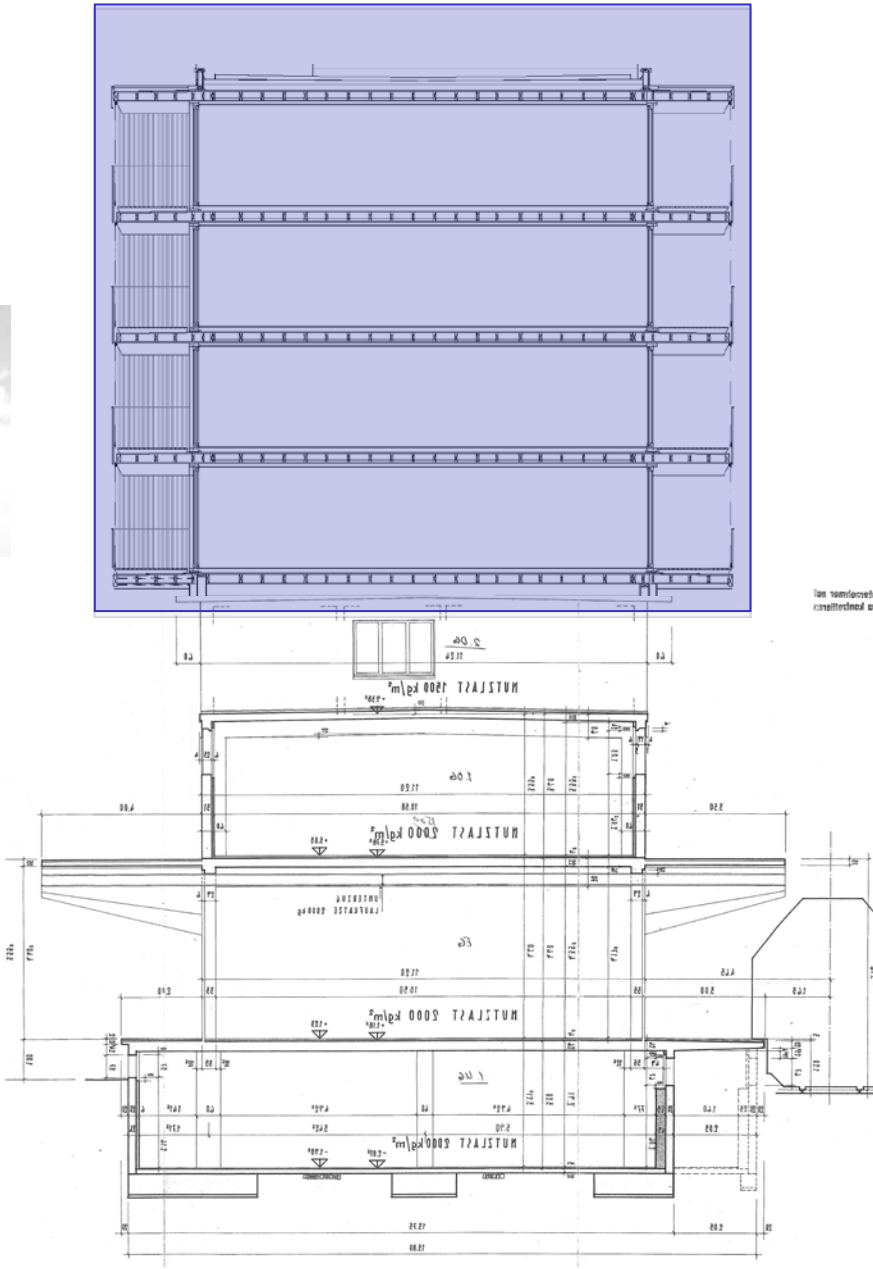
ADDITION TYPE

On the top

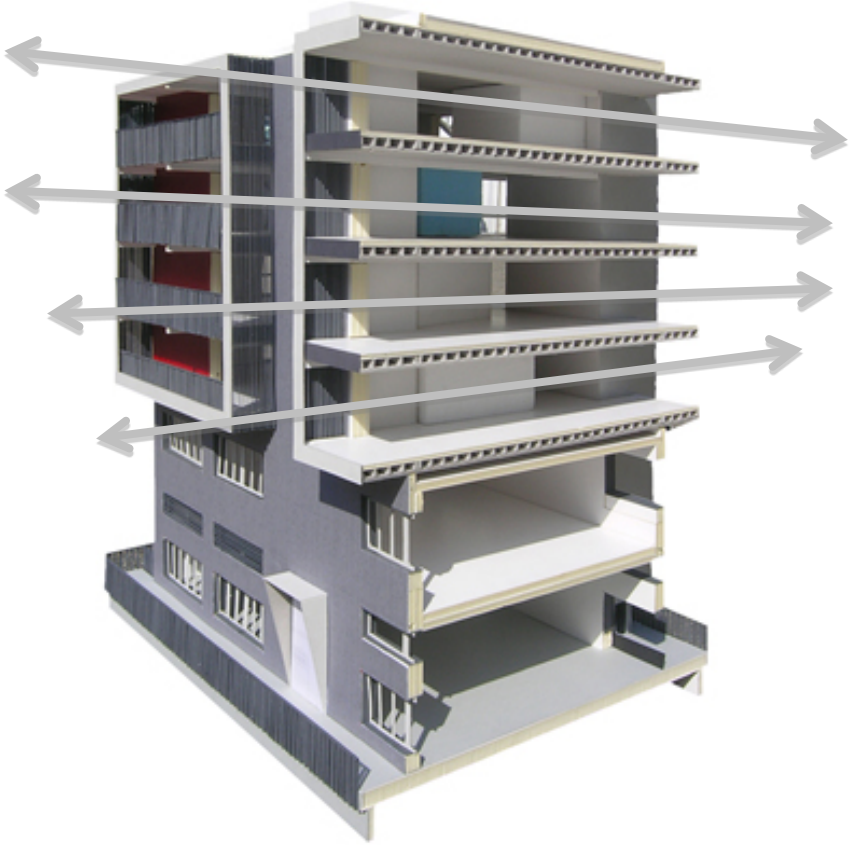


TECNOLOGIA



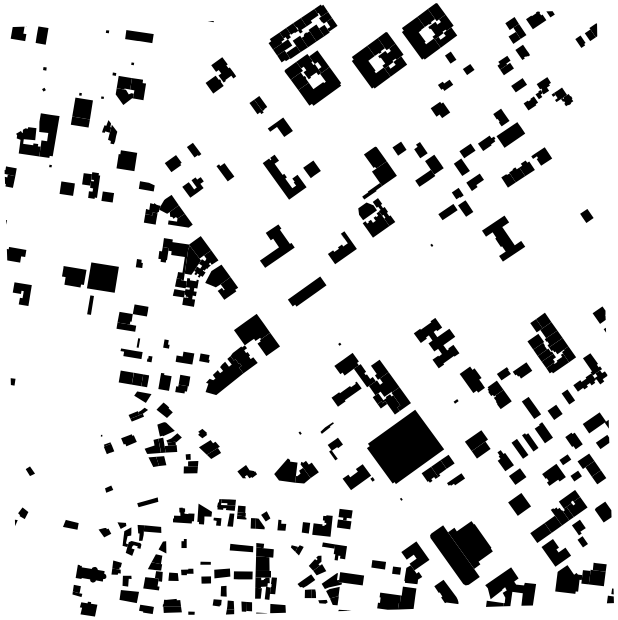



SZU
Sihltal Zürich Uetliberg
Bahn



CALCOLO E VALIDAZIONE

POTENZIALE URBANISTICO



FAR = 0,39
(m^2_h/m^2_l)
DU = 40 per block
(unit size c.a. 100 m^2)
POP= 742
people/km^2

FAR = 1,14
(m^2_h/m^2_l)
DU = 20 per block
(unit size c.a. 70 m^2)
POP= 9.474
ab./km^2

FAR = 1,68
(m^2_h/m^2_l)
DU = 160 per block
(unit size c.a. 90 m^2)
POP= 14.675
ab./km^2

SIMULAZIONE DELLE ADDIZIONI

BEFORE

AFTER

BEFORE

AFTER

BEFORE

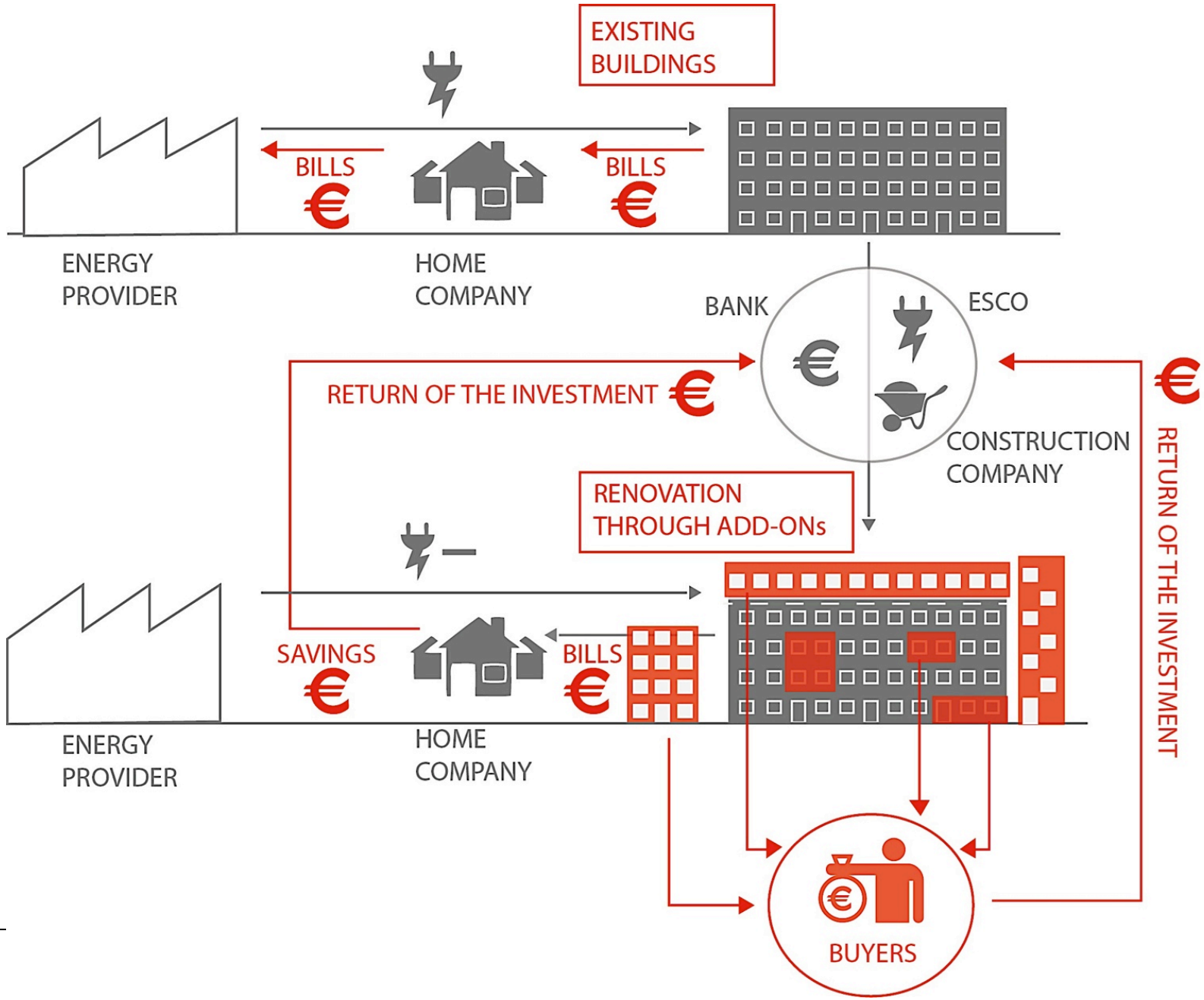
AFTER

ESEMPIO

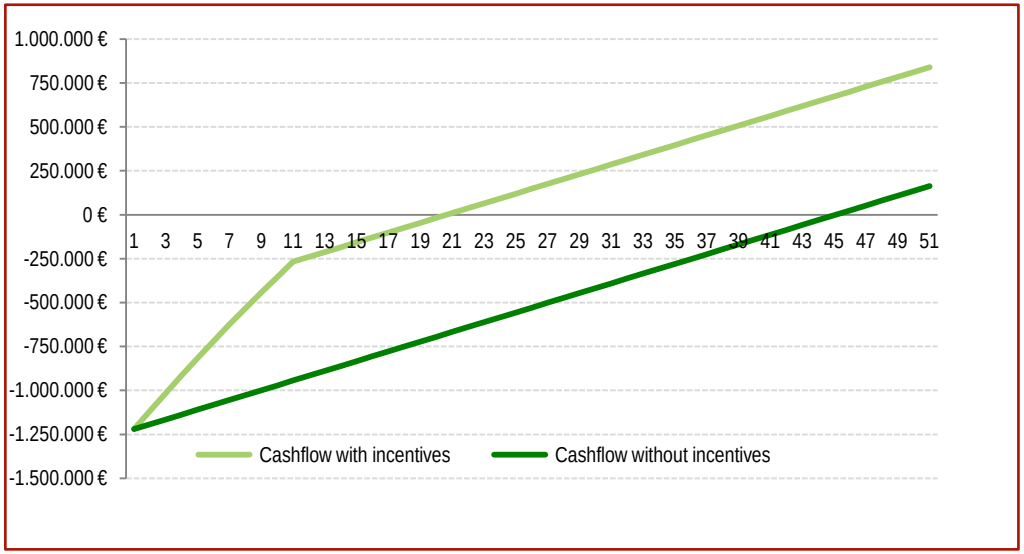
Cr = costo di ristrutturazione
y = mq edificio esistente
Cc = costo di costruzione nuova edificazione/incremento volumetrico al mq
x = mq aggiunti di nuova edificazione/incremento volumetrico
Cv = Prezzo di vendita nuova edificazione/incremento volumetrico al mq
R = risparmio annuale per mq

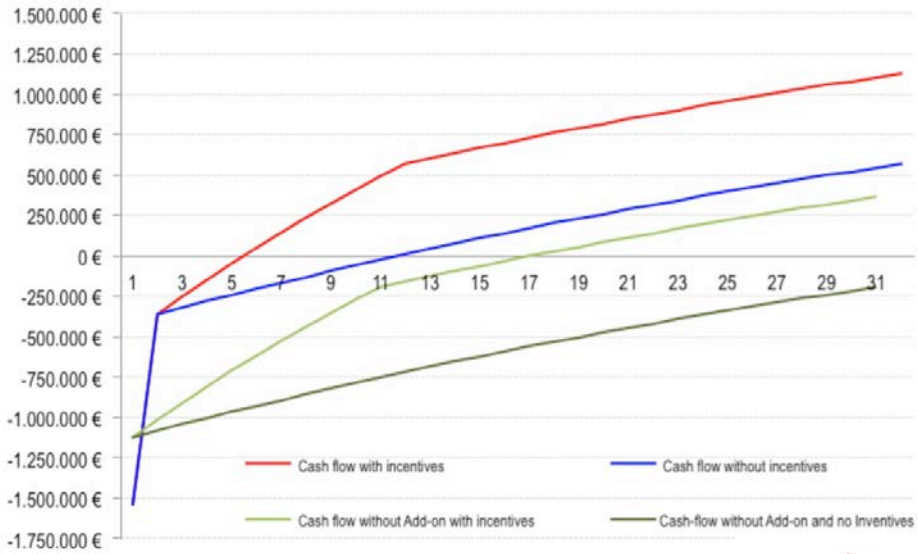
$$\frac{Cr*y+Cc*x-P*x}{R*y} = t$$

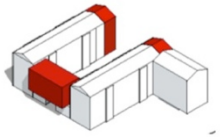
ESEMPIO

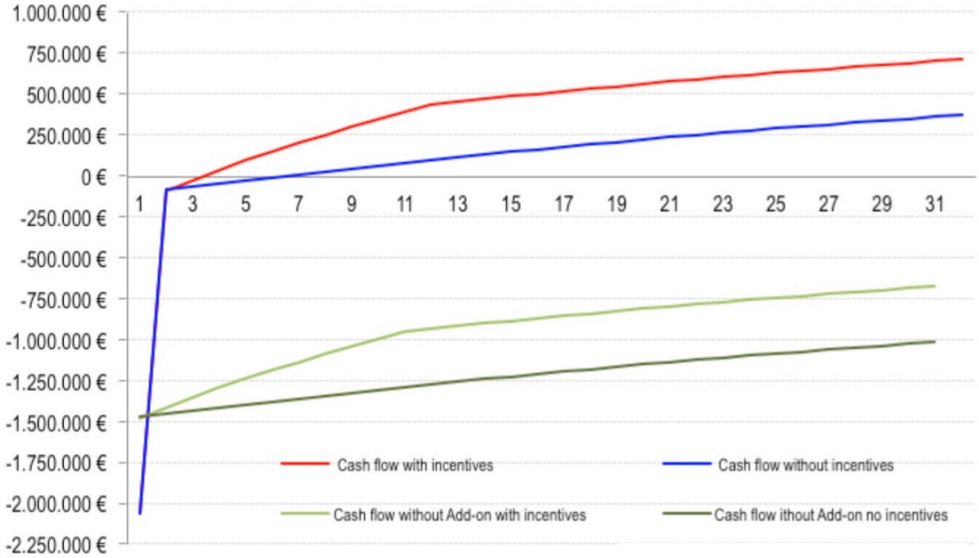

EXISTING BUILDINGS
BILLS
BILLS
ENERGY PROVIDER
HOME COMPANY
BANK
ESCO
CONSTRUCTION COMPANY
RETURN OF THE INVESTMENT
RETURN OF THE INVESTMENT
RENOVATION THROUGH ADD-ONs
SAVINGS
BILLS
ENERGY PROVIDER
HOME COMPANY
BUYERS

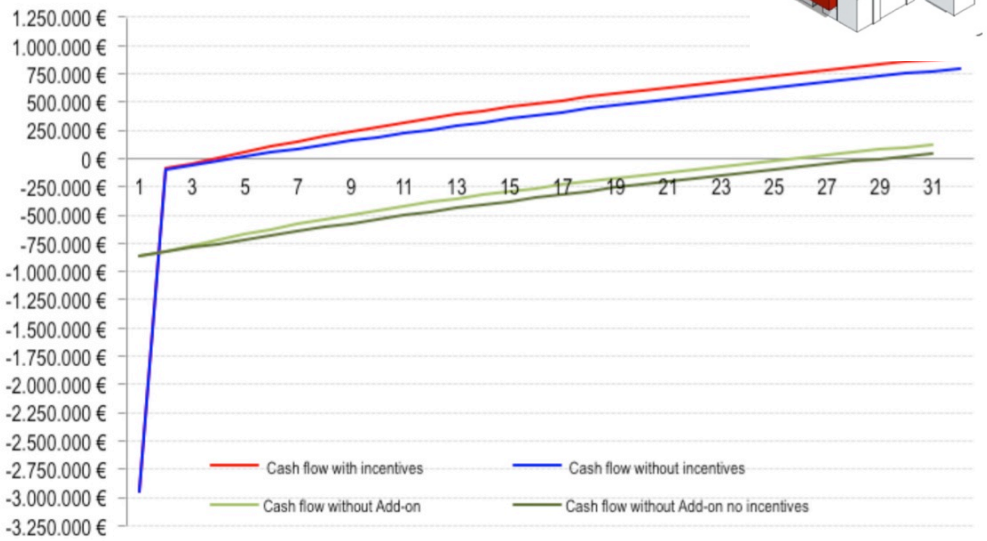
PART 3_Payback comparison

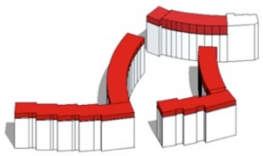


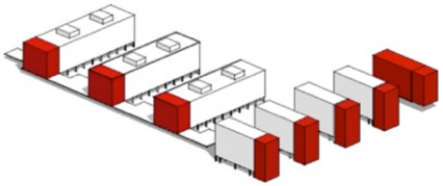












PROTOTIPAZIONE

SOLARDECATHLON (2014)

growing population density

demographic change

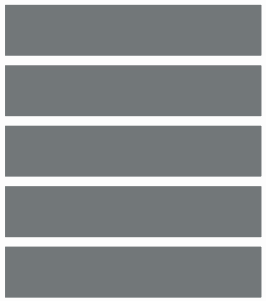
building restoration

energy turnaround

CONCEPT

MOUSON STR. Existing Building

Mouson Str. Frankfurt am Main



ON TOP strategy

Refurbishment + Symbiont SD14 + Plant System

PROTOTIPE Versailles

Energy Effciency

Energy strategy

Existing building
Energy Consumption

Refurnishment
Energy demand Decrease

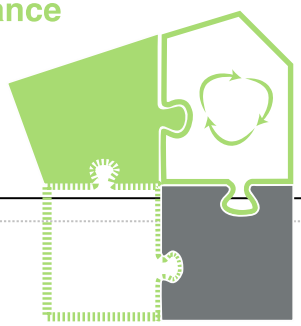
+

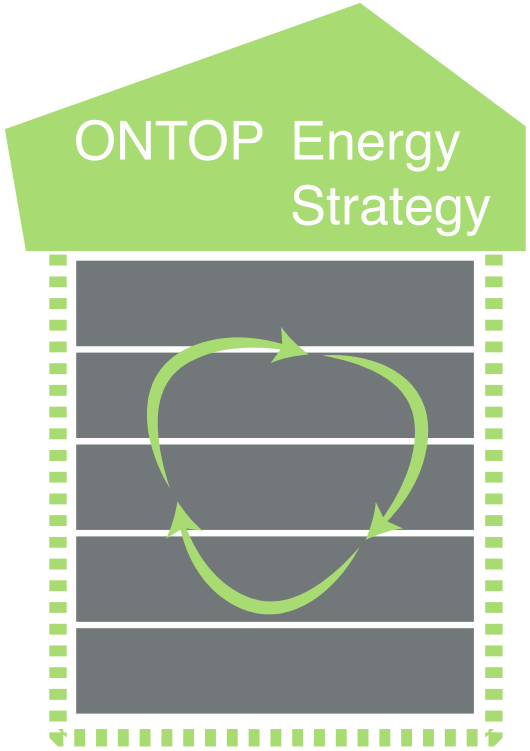
Symbiont SD14
Energy Production

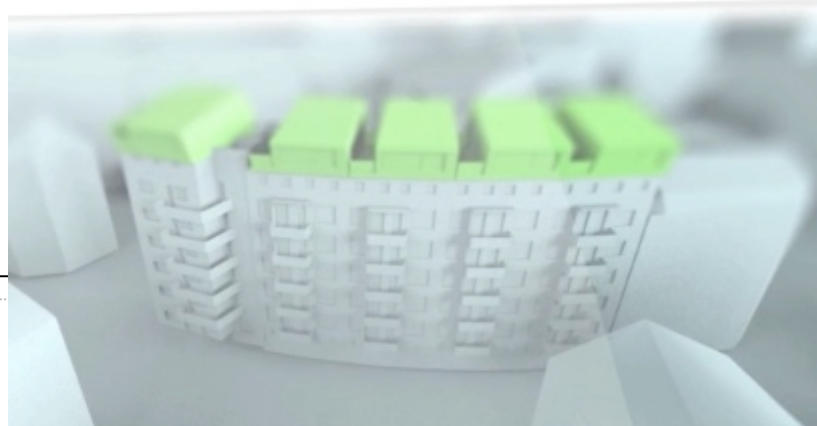
+

Plant System
Energy waste Recycling

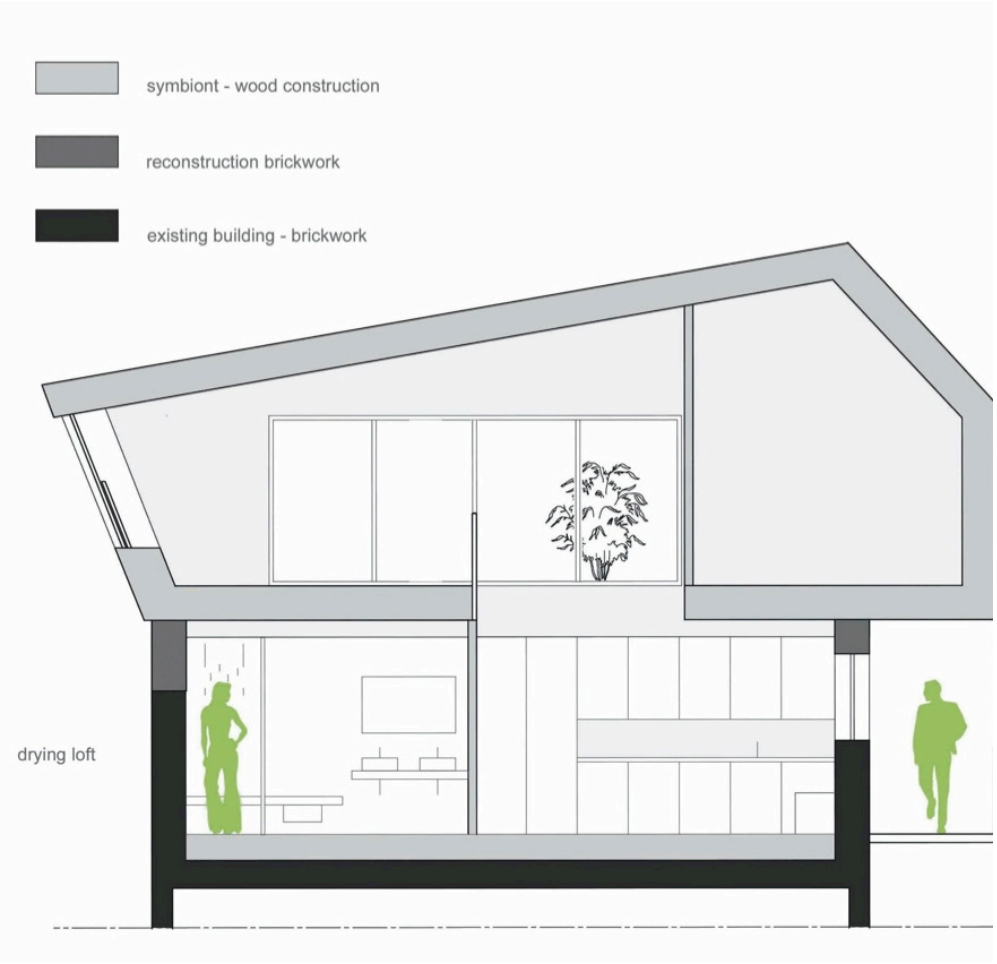
Energy Balance

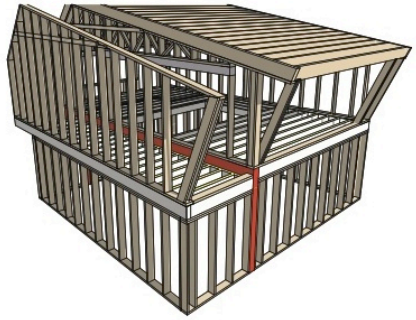


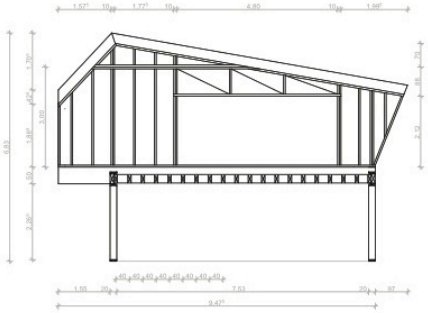




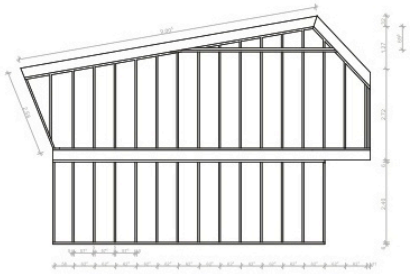
BIEN ZENCKER, SISTEMA COSTRUTTIVO



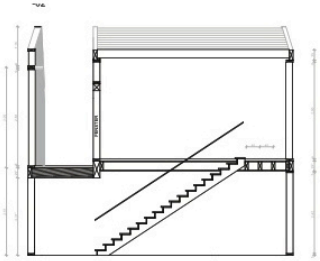




SCHNITT-03



ANSICHT-OST



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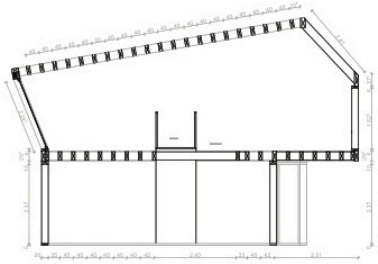

SCHNITT-04

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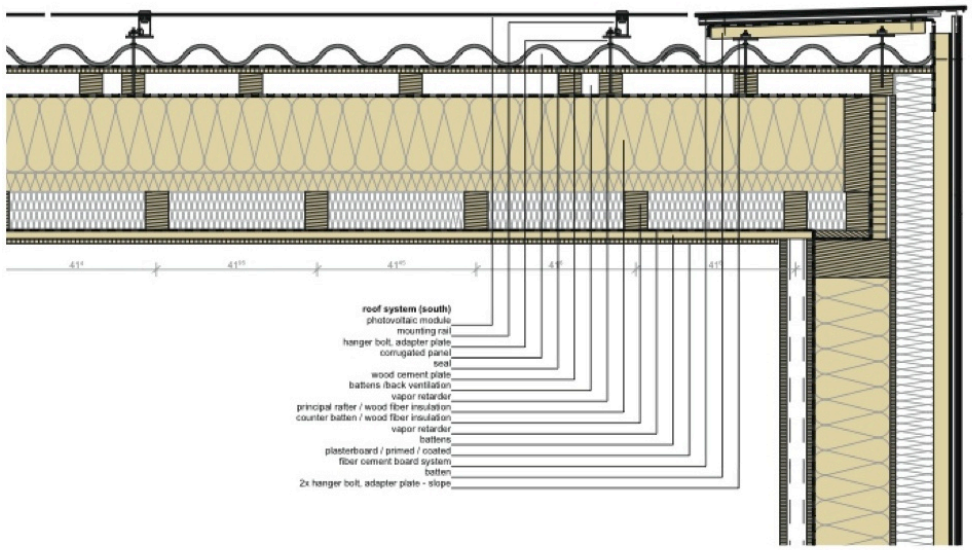
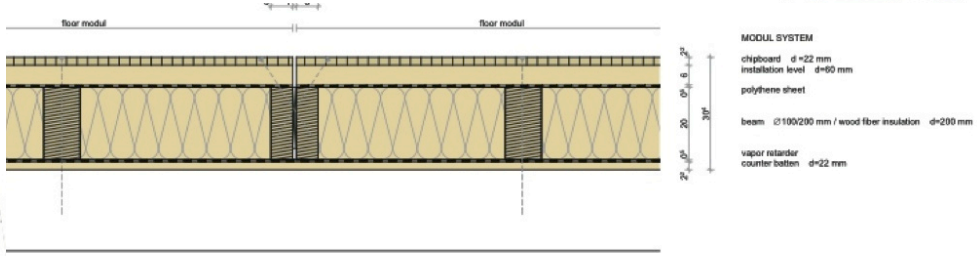
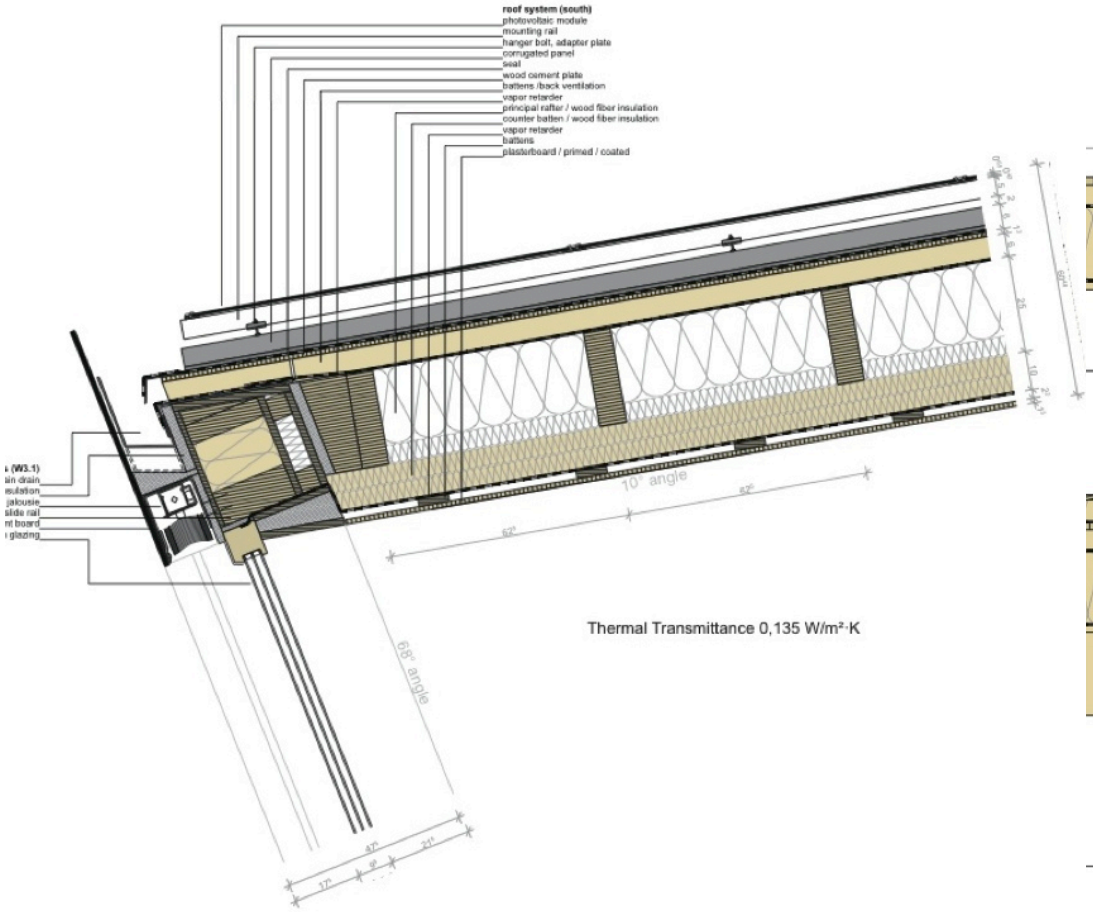
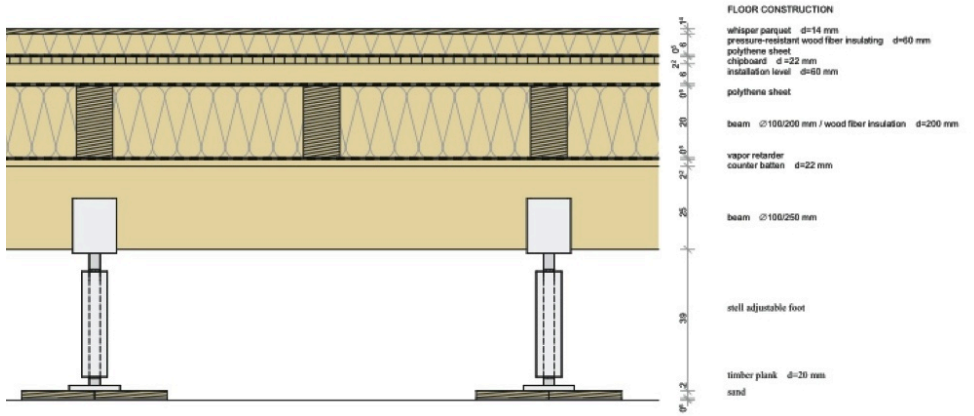




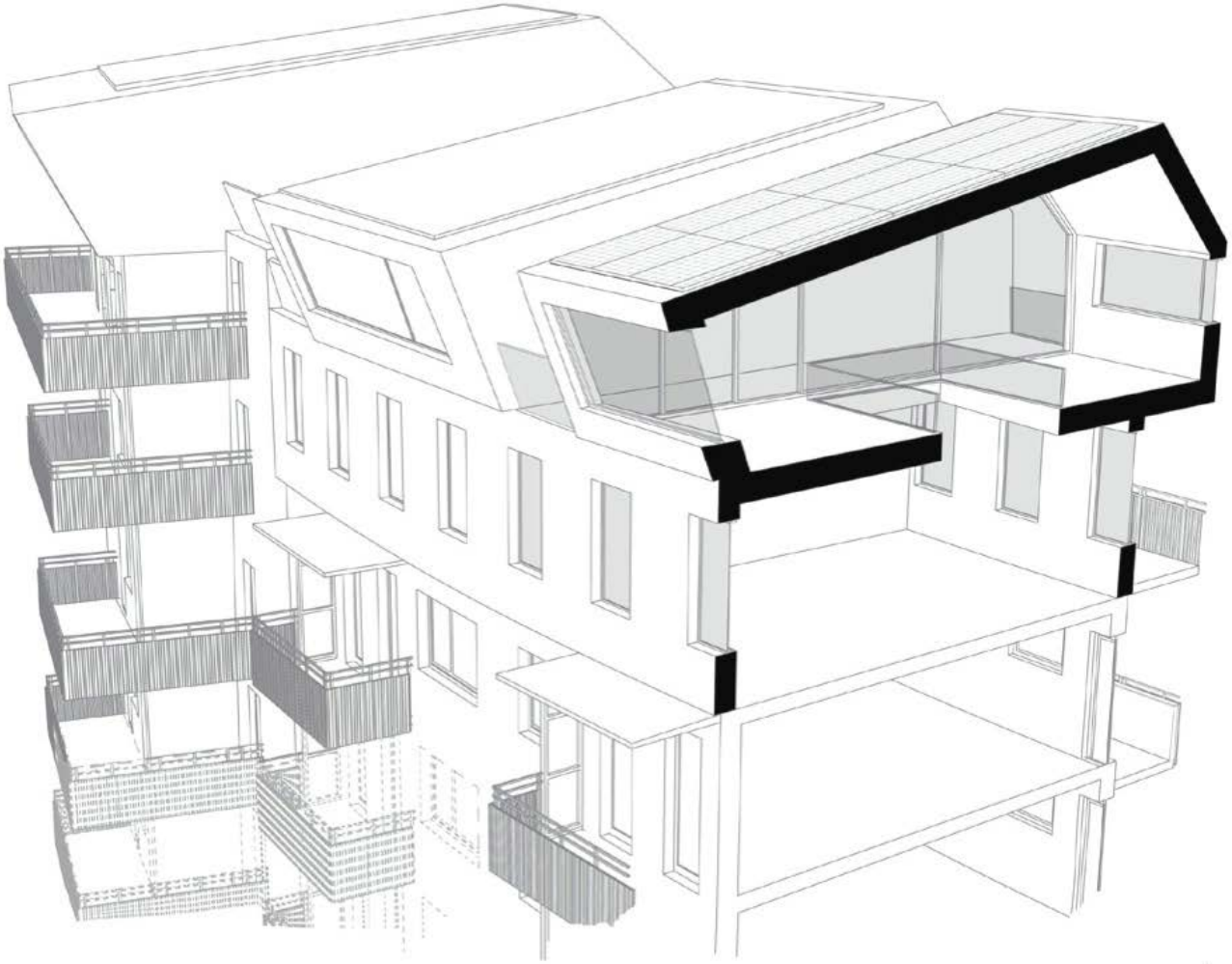
Thermal Transmittance 0,136 W/m²·K



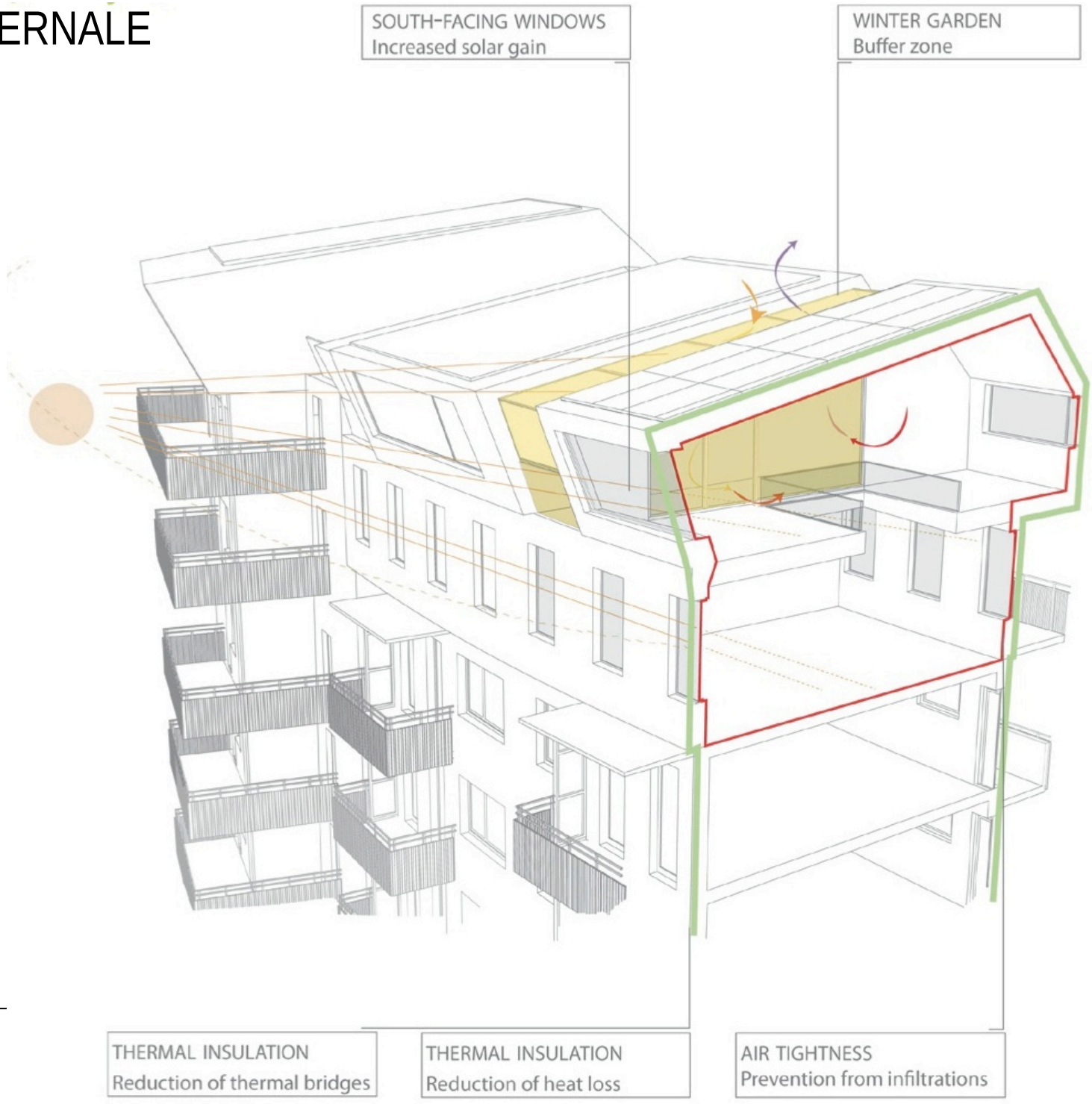
Thermal Transmittance 0,135 W/m²·K



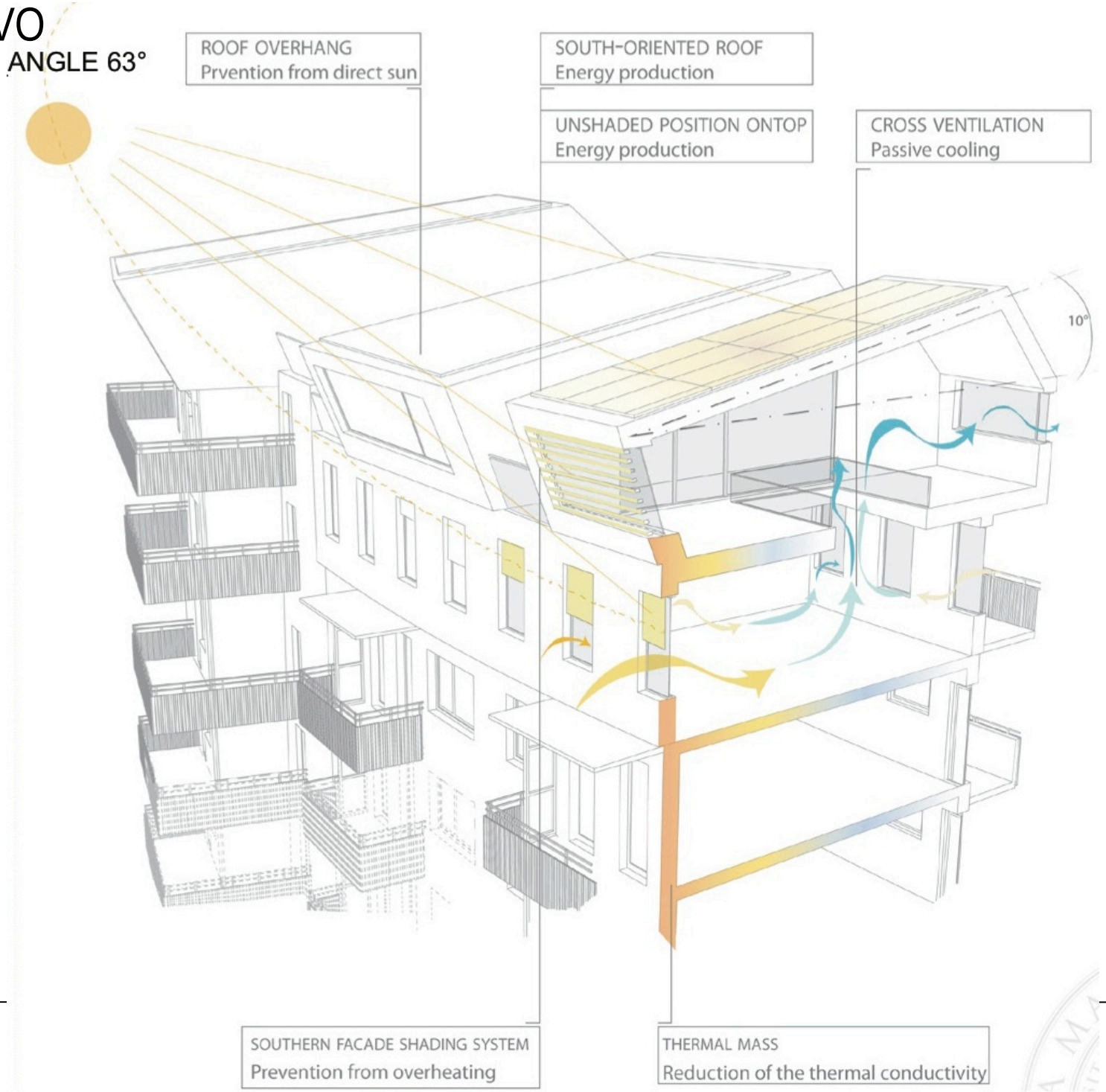
SISTEMI PASSIVI



REGIME INVERNALE



REGIME ESTIVO



BILANCIO

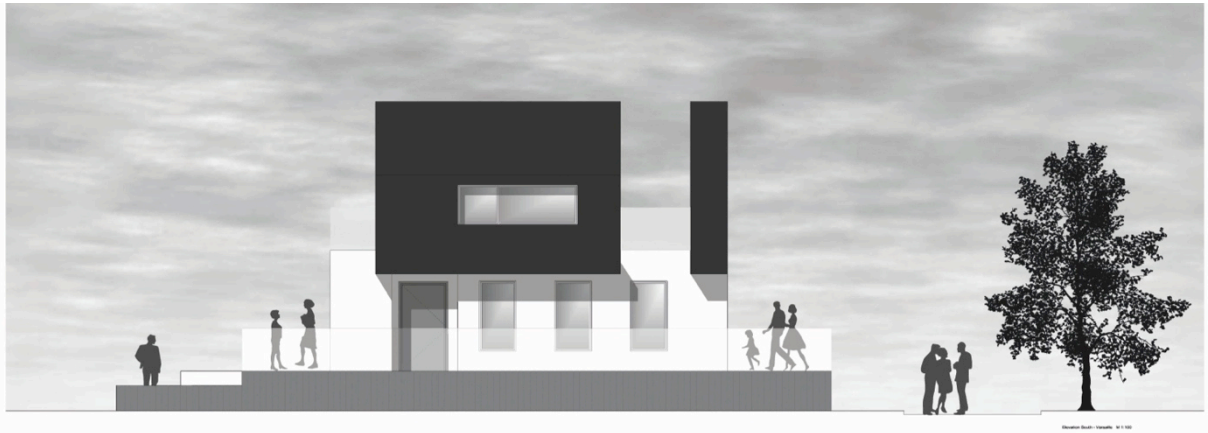
	Savings	Refurbishment	Symbiont	HVAC	Remarks
	kWh/a	kWh/a	kWh/a	kWh/a	
Ventilation Loss	25.600		25.600	0	heat recovery of the ventilation s ystem is calculated in Heating System Loss/Gain
Transmission Roof	-21.300		-21.300		Extension instead of uninsulated top floor
Transmission Walls	-51.300	-51.300			Insulation of backyard walls an coldbridges
Transmission Windows	-32.600	-32.600			new glazing
Transmission Cellar	-31.700	-31.700			insulation of basement ceiling
Solar Gains	-4.900		-4.900		additional window area
Internal Gains	-8.700		-8.700		additional used area
heating energy demand	**-124.900**	**-115.600**	**-9.300**	**0**	
Heating System Loss /Gain	-98.300	-19660	-29490	-49.150	Heat recovery, thermal Solar
Hot Water Energy demand	5.100		5.100		additional used area
Hot Water Energy Loss / Gain	-67.400	-10110		-57.290	thermal Solar
Demand of final energy	**-285.500**	**-145.370**	**-33.690**	**-106.440**	

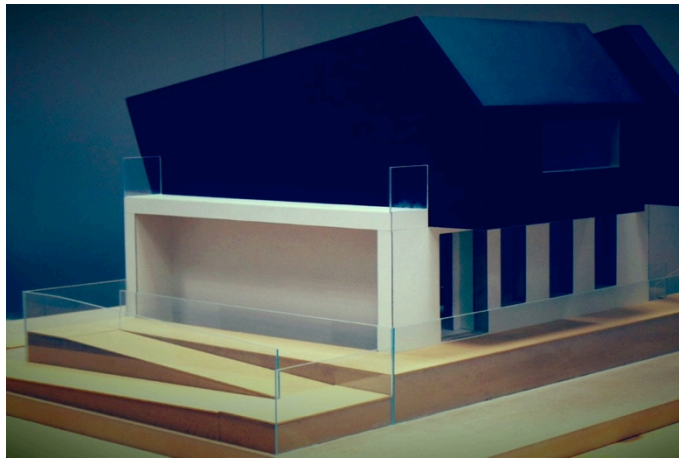
MOUSSONSTRASSE, 53, FRANKFURT AM MAIN (DE)

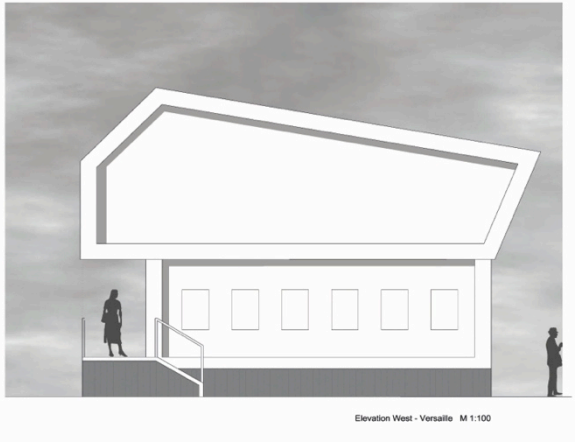

BIEN ZENKER
Herzlich Willkommen
Häuser bauen ist unsere Leidenschaft

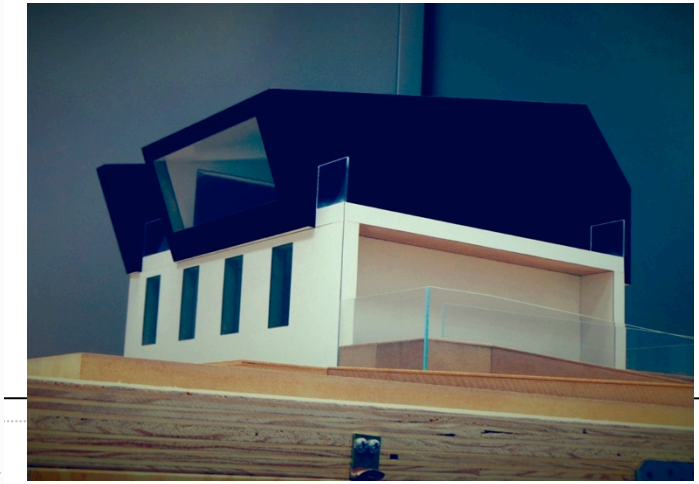

STEKO

ON TOP PROTOTYPE, SD14, VERSAILLES (FR)









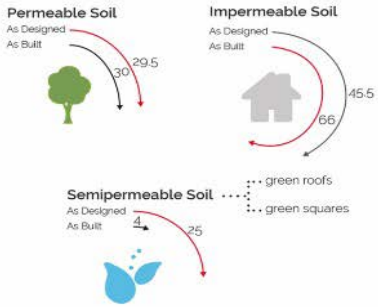

35

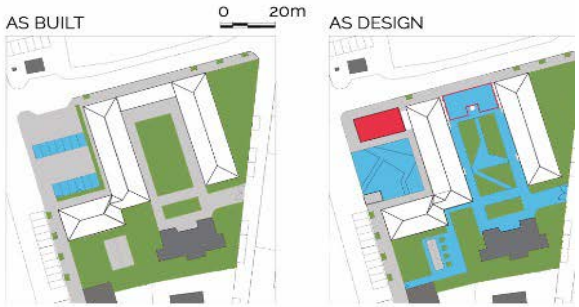

35

ESEMPI

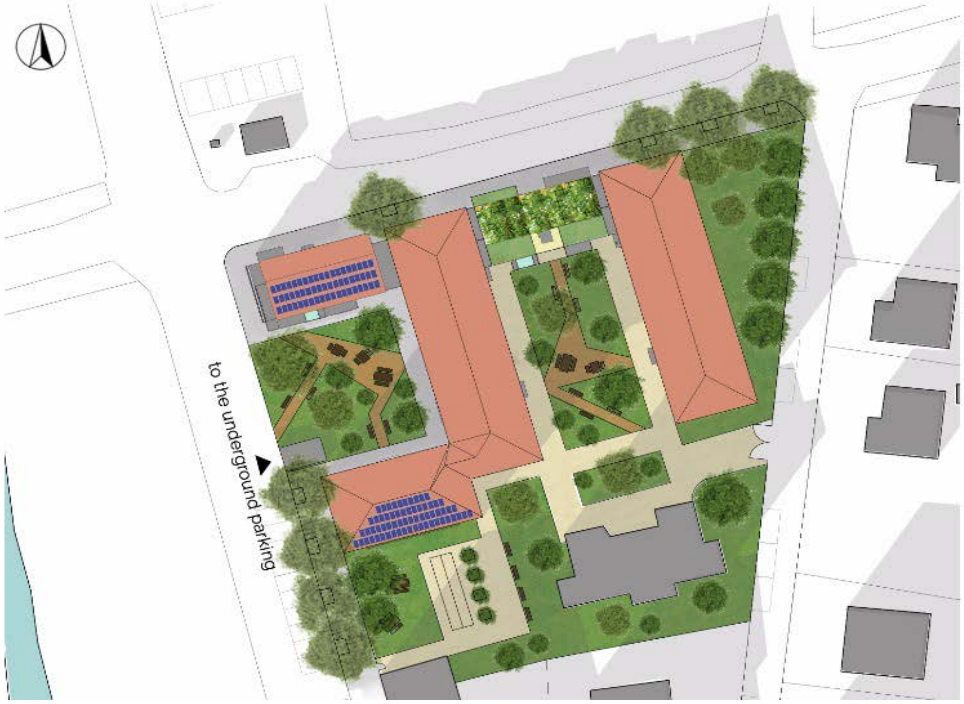
VIA MAGENTA – REGGIO EMILIA

Permeability

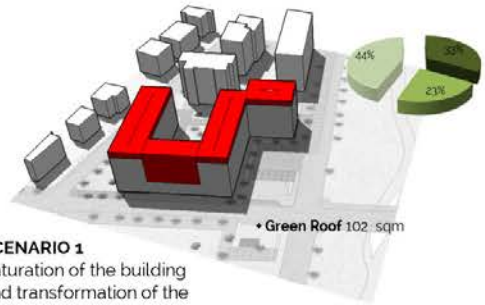




Plan_scale 1:500

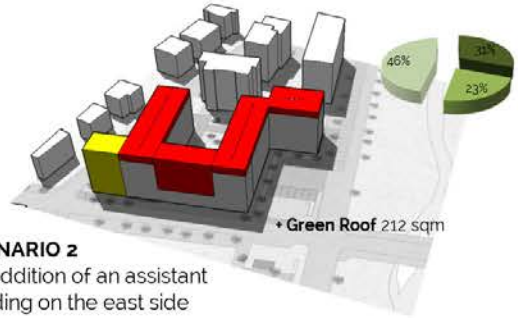


VIA MAGENTA – REGGIO EMILIA



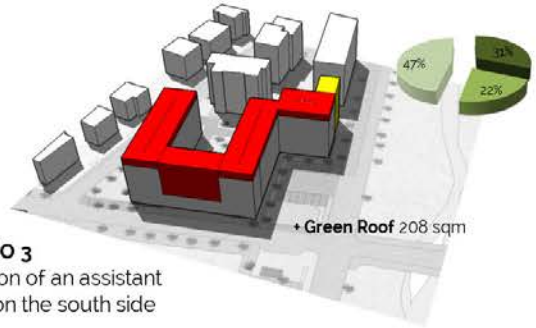
SCENARIO 1
Saturation of the building and transformation of the attic

397+ 775= **1172 sqm**
Return Time 8.2 years



SCENARIO 2
1 + addition of an assistant building on the east side

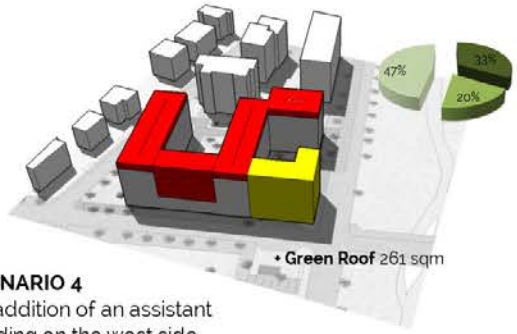
1172+ 428= **1600 sqm**
Return Time 3 years



SCENARIO 3
1 + addition of an assistant building on the south side

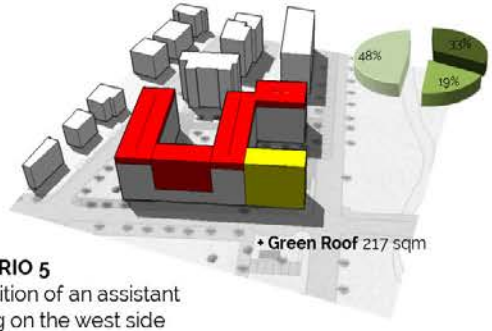
1172+ 430= **1602 sqm**
Return Time 3 years

Saturation
Addition



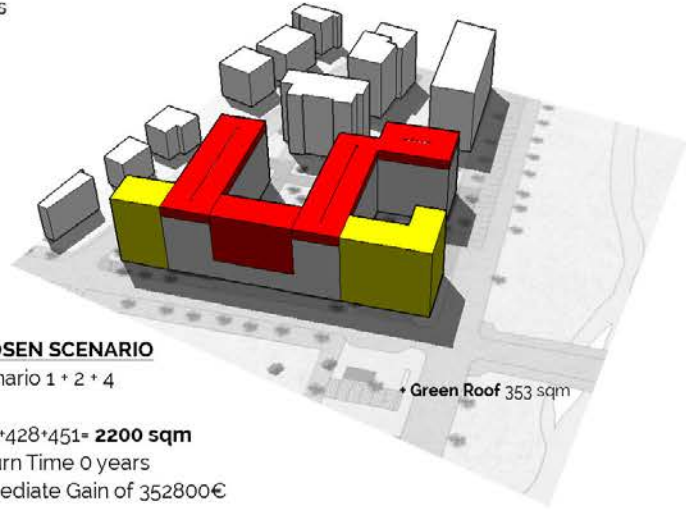
SCENARIO 4
1 + addition of an assistant building on the west side

1172+ 451= **1623 sqm**
Return Time 2,7 years



SCENARIO 5
1 + addition of an assistant building on the west side

1172+ 263= **1435 sqm**
Return Time 5 years



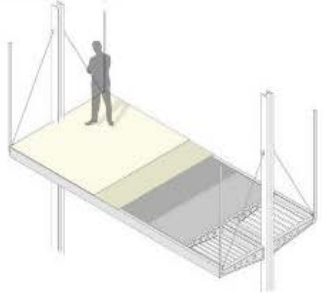
CHOSEN SCENARIO
Scenario 1 + 2 + 4

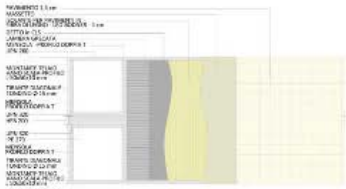
1172+428+451= **2200 sqm**
Return Time 0 years
Immediate Gain of 352800€

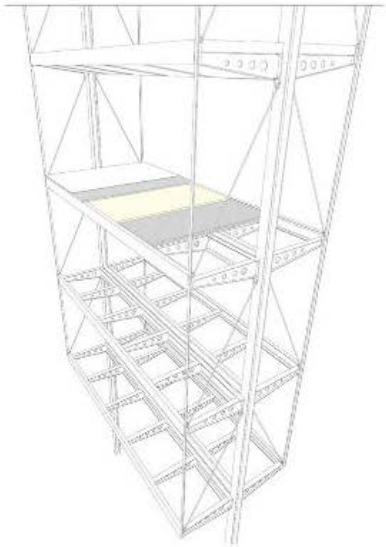
VIA MAGENTA – REGGIO EMILIA

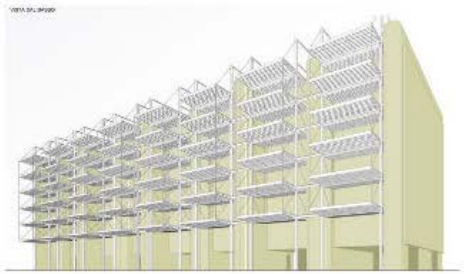
[redacted]

STRATIGRAFIE

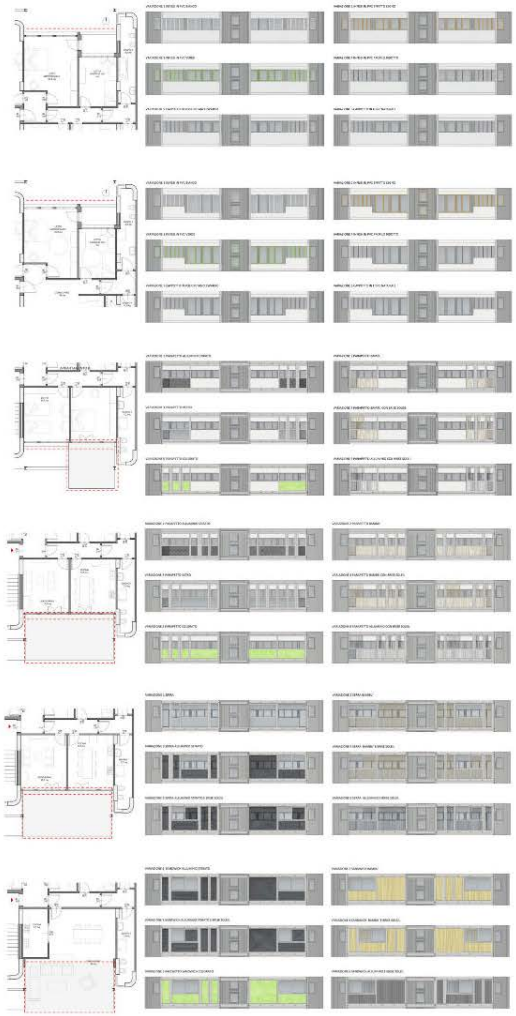






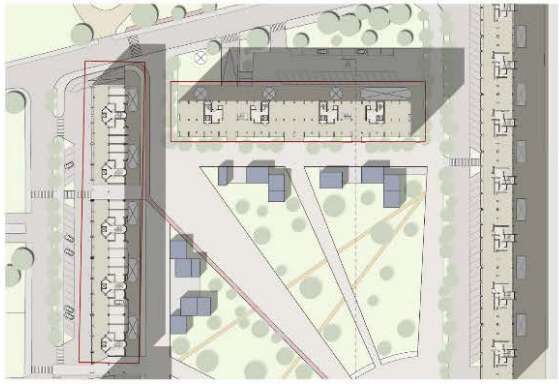


ABACO
POSSIBILI ADDIZIONI VOLUMETRICHE



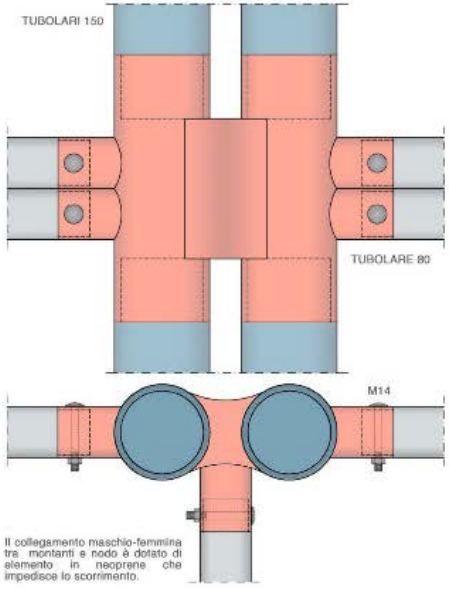
Stato di fatto

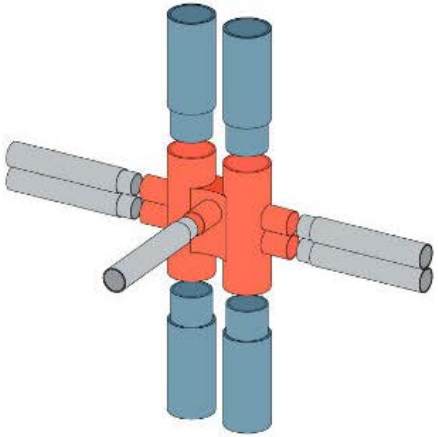
Proposta di progetto
addizioni volumetriche



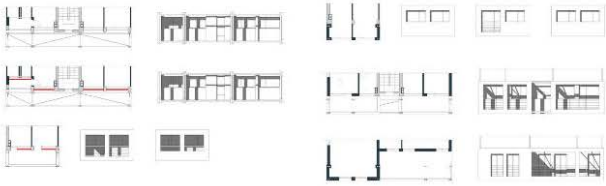
Proposta di progetto addizioni volumetriche

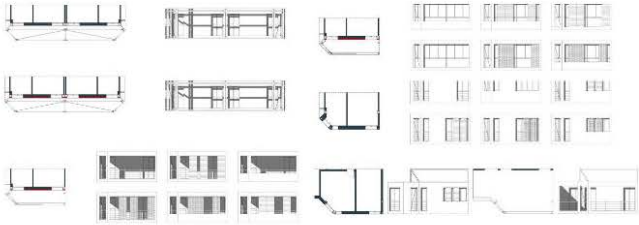
NODO STRUTTURALE



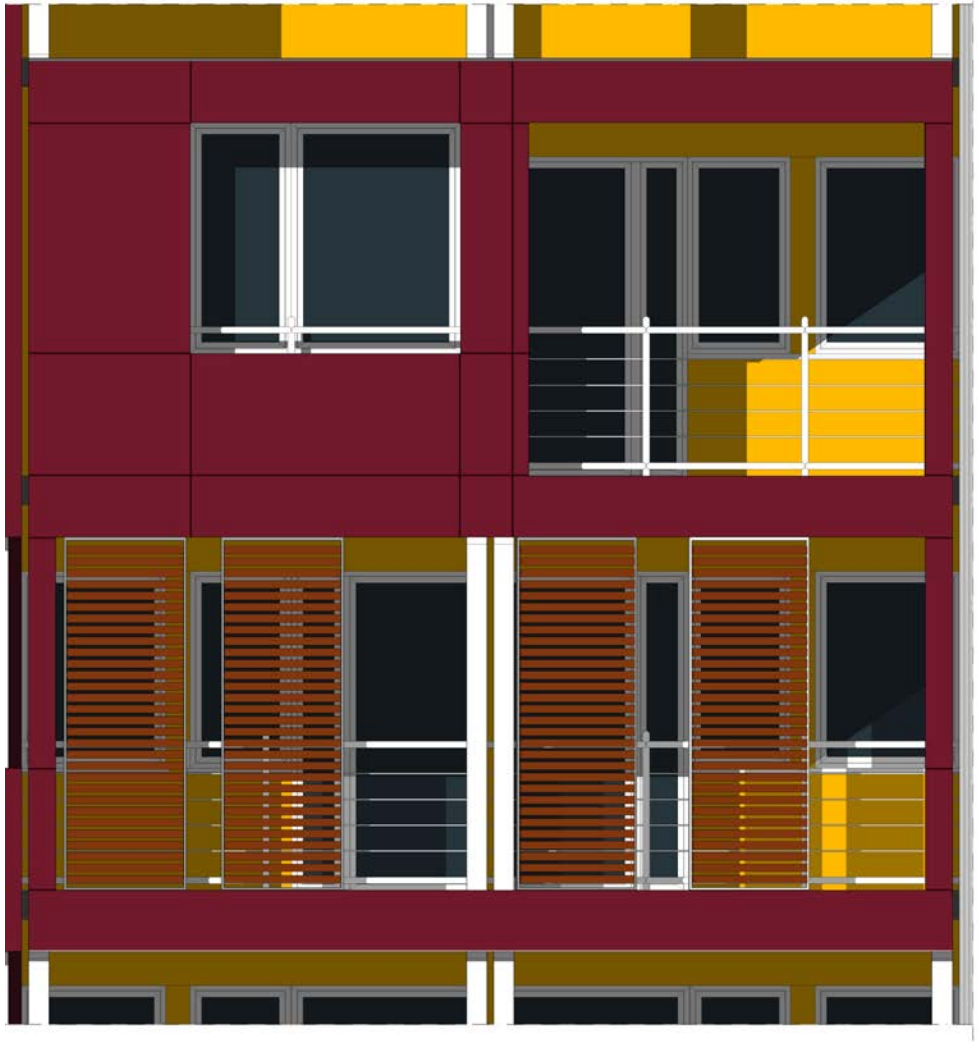


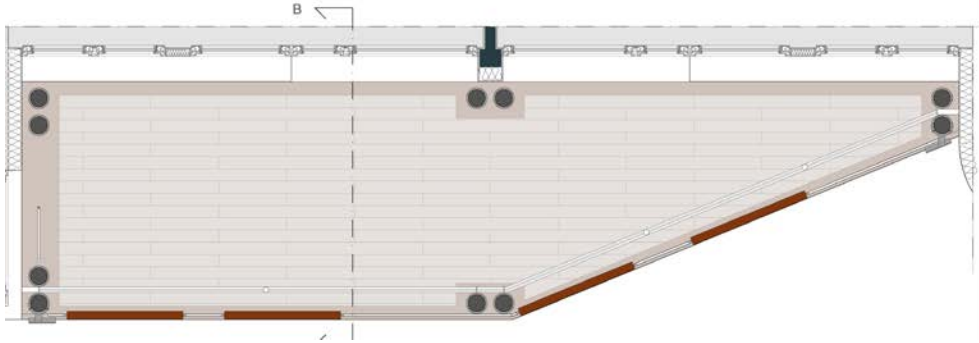
ABACO
POSSIBILI ADDIZIONI VOLUMETRICHE

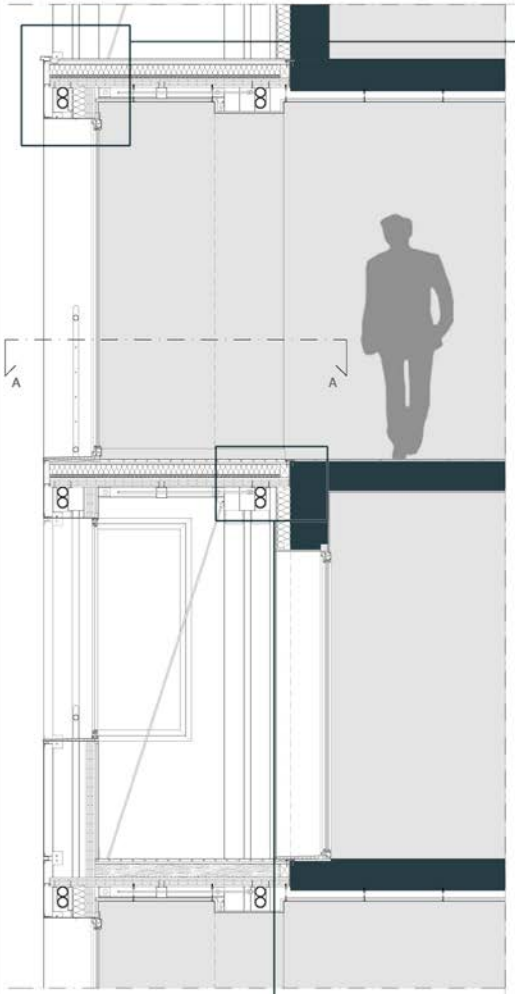




VISION

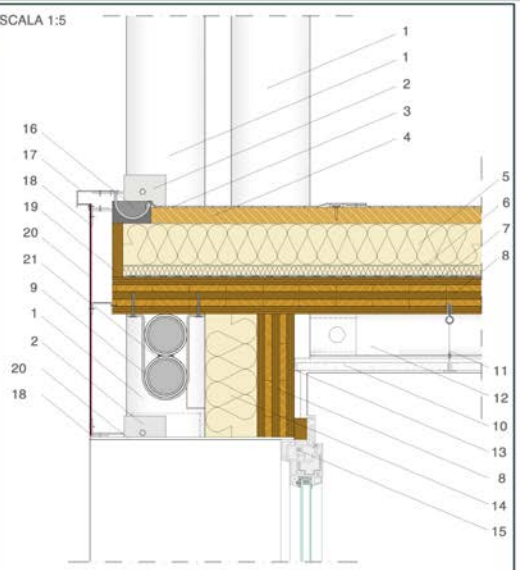






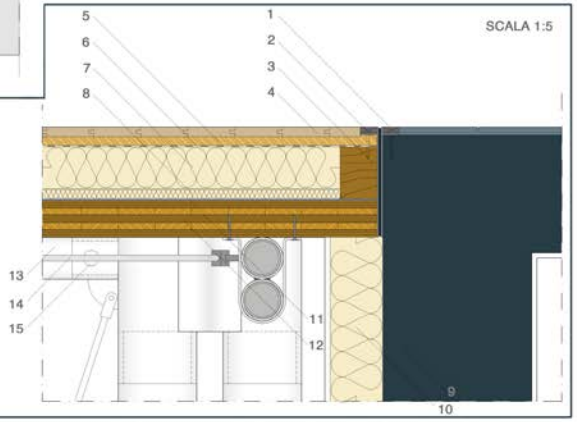
SEZIONE B-B

SCALA 1:5

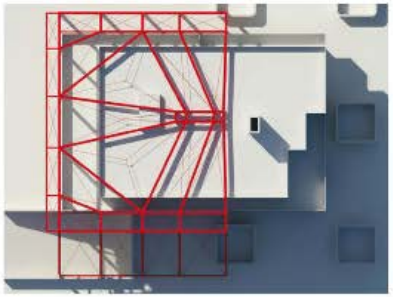


1. Montante tubolare cavo ϕ = 15 cm con s = 1 cm
2. Attacco puntuale al montante mediante piastre sagomate
3. Manto impermeabile s = 1,2 mm con fissaggio meccanico
4. Pannello in compensato OSB 3 con s = 2,8 cm
5. Isolante Rockwool s = 8 cm predisposto per il passaggio impianti
6. Isolante Rockwool s = 2 cm
7. Guaina freno a vapore
8. Pannello X-LAM s = 7 cm
9. Profilo di fissaggio della trave al pannello X-LAM
10. Controsoffitto in cartongesso
11. Sistema di aggancio della struttura di sostegno del controsoffitto al pannello X-LAM
12. Trave tubolare cava ϕ = 8 cm con s = 4 mm
13. Profilo a L di attacco del constrosoffitto alla parete verticale
14. Isolante Rockwool s = 10 cm
15. Infisso in PVC (profilo vuoto) con vetro doppio b.e. 0,05 (argon 90%) 4-12-4
16. Canale di gronda
17. Profilo metallico di copertura dell'intercapedine della parete ventilata
18. Elemento puntuale di aggancio dei correnti trasversali di attacco dei pannelli di finitura esterna
19. Pannello a protezione dell'isolante
20. Pannello di finitura esterna in alluminio
21. Trave tubolare ricalata cava ϕ = 8 cm con s = 4 mm

SCALA 1:5

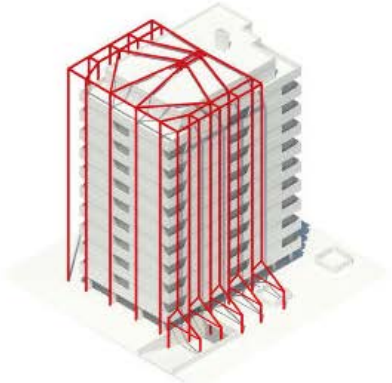


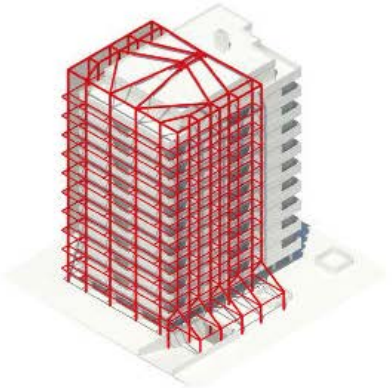
1. Elemento di distacco della pavimentazione dal giunto
2. Giunto in neoprene tra la struttura esistente e la nuova costruzione
3. Elemento di distacco dell'isolante dal giunto
4. Pavimento in teak di dimensioni 19 mm x 90 mm unito con rivetti e viti
5. Pannello in compensato OSB 3 con s = 2 cm
6. Guaina freno a vapore
7. Isolante Rockwool s = 8 cm predisposto per il passaggio impianti
8. Isolante Rockwool s = 2 cm
9. Struttura esistente
10. Isolante Rockwool s = 10 cm
11. Guaina impermeabilizzante di protezione al pannello X-LAM
12. Sistema di aggancio della struttura di sostegno del controsoffitto al pannello X-LAM
13. Trave tubolare cava ϕ = 8 cm con s = 4 mm
14. Controvento orizzontale ϕ = 12 mm
15. Vite a testa tonda per evitare lo scorrimento del giunto maschio-femmina



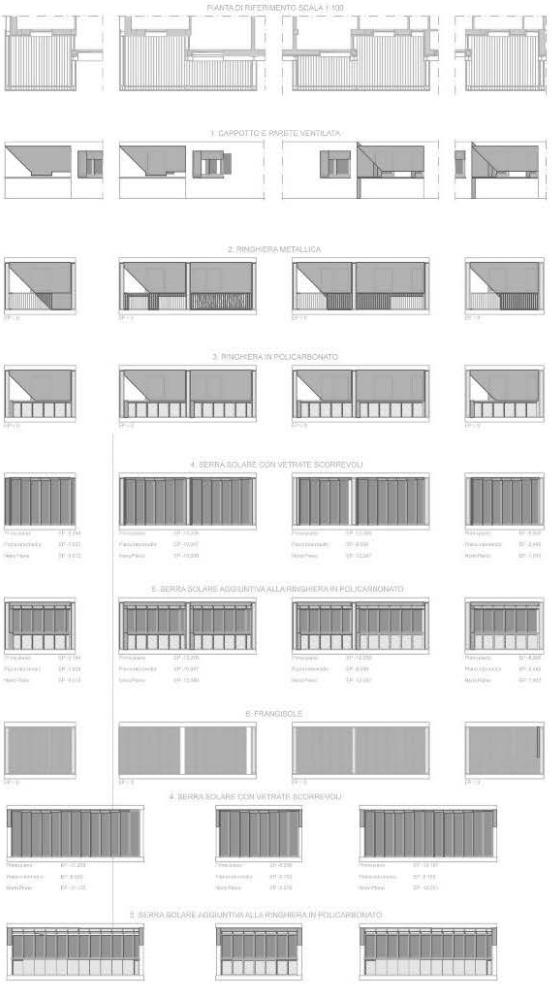
Stato di fatto

Proposta di progetto addizioni volumetriche





ABACO
POSSIBILI ADDIZIONI VOLUMETRICHE



CONCLUSIONI

Si è cercato di delineare una STRATEGIA DELL'ADDIZIONE, in grado di accelerare il processo di attuazione dei progetti di riqualificazione energetica, superando le barriere esistenti:

ECONOMICHE (pay-back time)

SOCIALI (partecipazione degli abitanti e sviluppo di soluzioni ad-hoc)

PROCEDURALI (riduzione disagi, contenimento dei costi e rapidità di costruzione)

LOGISTICHE (organizzazione del cantiere, trasporto, montaggio,life cycle)

E' necessaria una REVISIONE DEGLI STRUMENTI URBANISTICI E LEGISLATIVI che permetta una maggiore flessibilità nel settore della riqualificazione energetica del patrimonio edilizio esistente

Gli scenari presentati evidenziano il GRANDE POTENZIALE dal punto di vista formale, funzionale, strutturale e prestazionale della strategia proposta.

La possibilità di CREARE STRUMENTI FINANZIARI che supportino questo tipo di interventi, ne incrementino la bancabilità e conseguentemente incrementino l'interesse degli investitori, suggerisce che questa possa essere la strada percorribile per facilitare il processo di rinnovo del costruito ma anche il rilancio del settore dell'edilizia

IL PROGETTO ABRACADABRA

ABRACADABRA

Assistant **B**uildings' addition to **R**etrofit, **A**dopt,
Cure **A**nd **D**evelop
the **A**ctual **B**uildings up to ze**R**o energy,
Activating a market for deep renovation

DEEP RENOVATION THROUGH BUILDING ADD-ONS

UP TO ZERO ENERGY WITH ZERO COSTS

WITH ZERO URBAN SPRAWL

SOUNDS MAGIC!

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HOUSING EUROPE	www.housingeurope.eu
Treteknisk	www.treteknisk.no
sarga	www.sarga.es
Kim Knowledge innovation market	www.kimglobal.com
BRAŞOV	www.brasovcity.ro
European Partners for the Environment	www.epe.be
TU Delft	www.tudelft.nl
BSRAEM	www.bsraem.org
RENESCO	www.renesco.lv
BANCA MONTE PASCHI BELGIO	www.montepaschi.be
EnergyPro	www.energyprosolutions.com
ACE	www.ace-cae.eu
UIPI INTERNATIONAL UNION OF PROPERTY OWNERS	www.uipi.com
ICLEI Local Governments for Sustainability	www.iclei-europe.org
Ecuba	www.ecuba.it/

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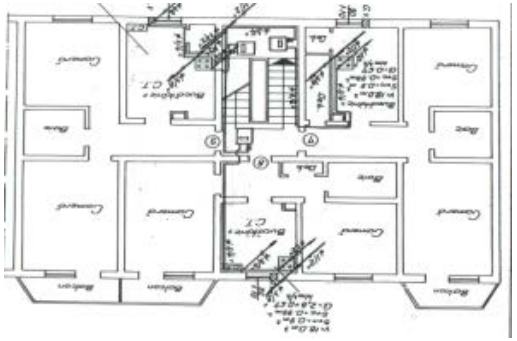
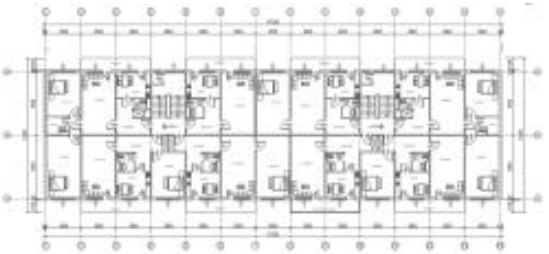
ROMANIA

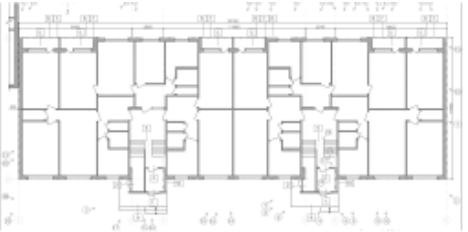


GREECE

BULGARIA



LATVIA



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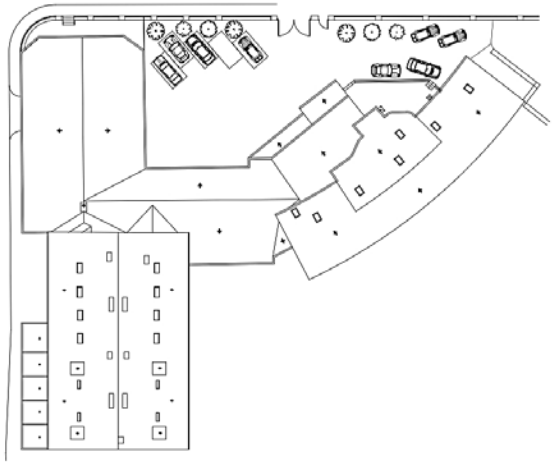
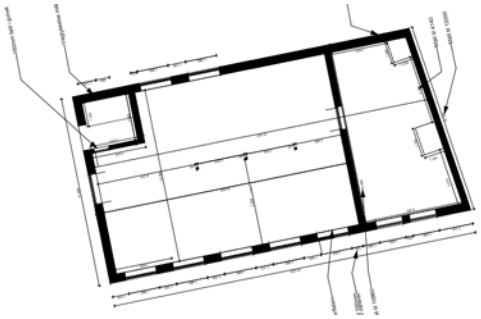
SPAIN



NORWAY



THE NETHERLANDS

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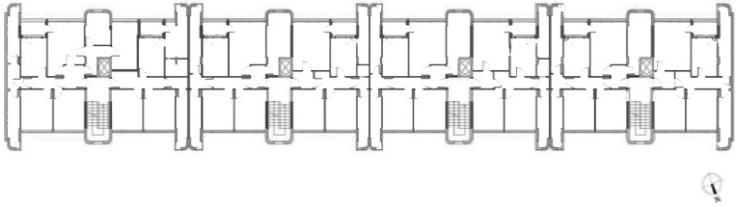
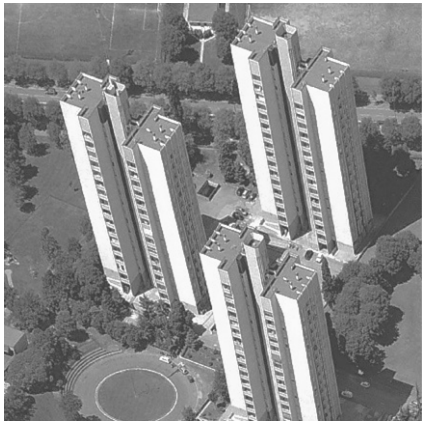
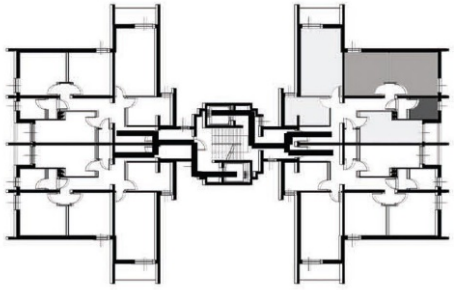
ITALY

ITALY



ITALY





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PILOT CASE STUDIES (CS)	COMPOUNDS	BUILDING TYPES	AVERAGE RESIDENTIAL UNIT	NUMBER OF UNITS	TOTAL AREA	CONSUMPTIONS	TOTAL PRIMARY ENERGY REDUCTION
		n	m²	n	m²	kWh/m²y	kWh/y
ITALY	Viale Magenta	1	85	50	4250	150	637500
	Via Torino - Ortolani	2	100	282	28200	160	4512000
	Corticella	5	100	722	72.200	140	10108000
GREECE	Peristeri	4	85	550	46.750	70	3272500
ROMANIA	Calea Bucaresti	1	58	20	1.160	140	162400
	Lanii Str.	1	66	35	2.310	130	300300
THE NETHERLANDS	Scheveningen	1	100	10	1.000	542	542000
BULGARIA	Mitropolit	1	62	60	3.720	140	520800
LATVIA	Berzupes	1	43	60	2.580	111	286380
	Lielupes	1	55	30	1.650	147	242550
NORWEY	Gulfabrikk	1	200	15	3.000	190	570000
SPAIN	Jaca Hotel	1	18	60	1.480	117	173160
TOTAL IMPACT		**20**	**972**	**1.894**	**168.300**	**2.037**	**21.327.590**

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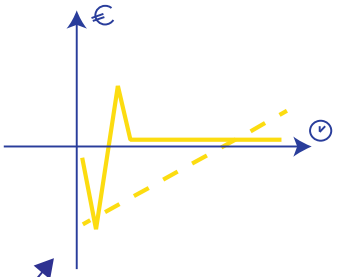
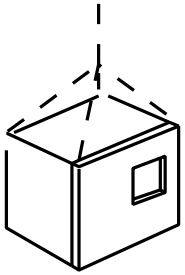


DESIGN & PLANNING

FINANCIAL TOOLKIT
REGULATORY TOOLKIT
TECNICAL TOOLKIT



PROJECT - OUTPUT

PLANNERS CONTROL

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ABRA Scenarios	AdoRes
Current State _ CS	
Deep Renovation _ DR	
Scenario 1 _ S1 →	**GROUND**
Scenario 2 _ S2 →	**ROOFTOP** ★ ★
Scenario 3 _ S3 →	**SIDE** ★
Scenario 4 _ S4 →	**FACADE** ★
Scenario 5 _ S5 →	**ASSISTANT BUILDING** ★

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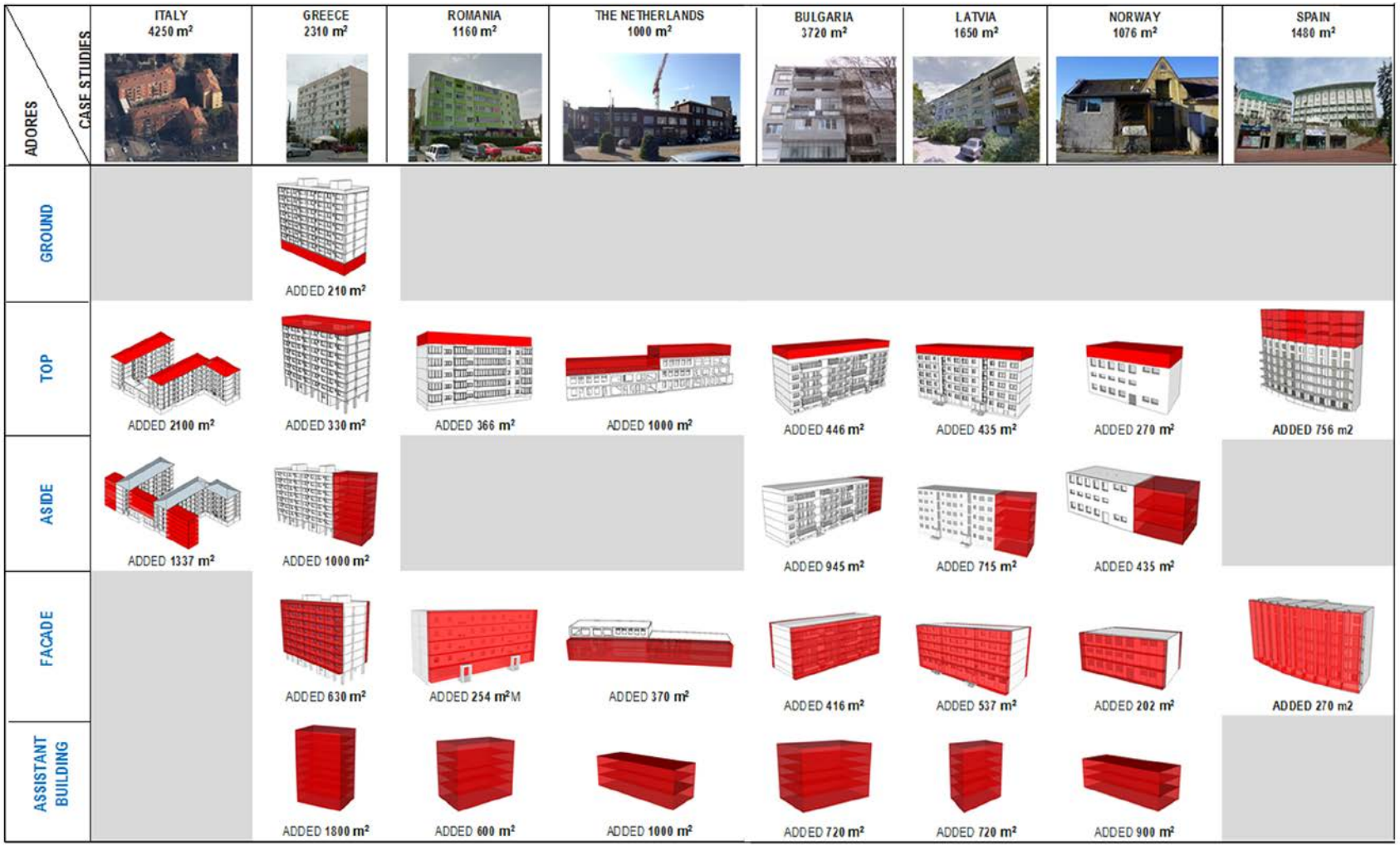
STUDI DI FATTIBILITA'



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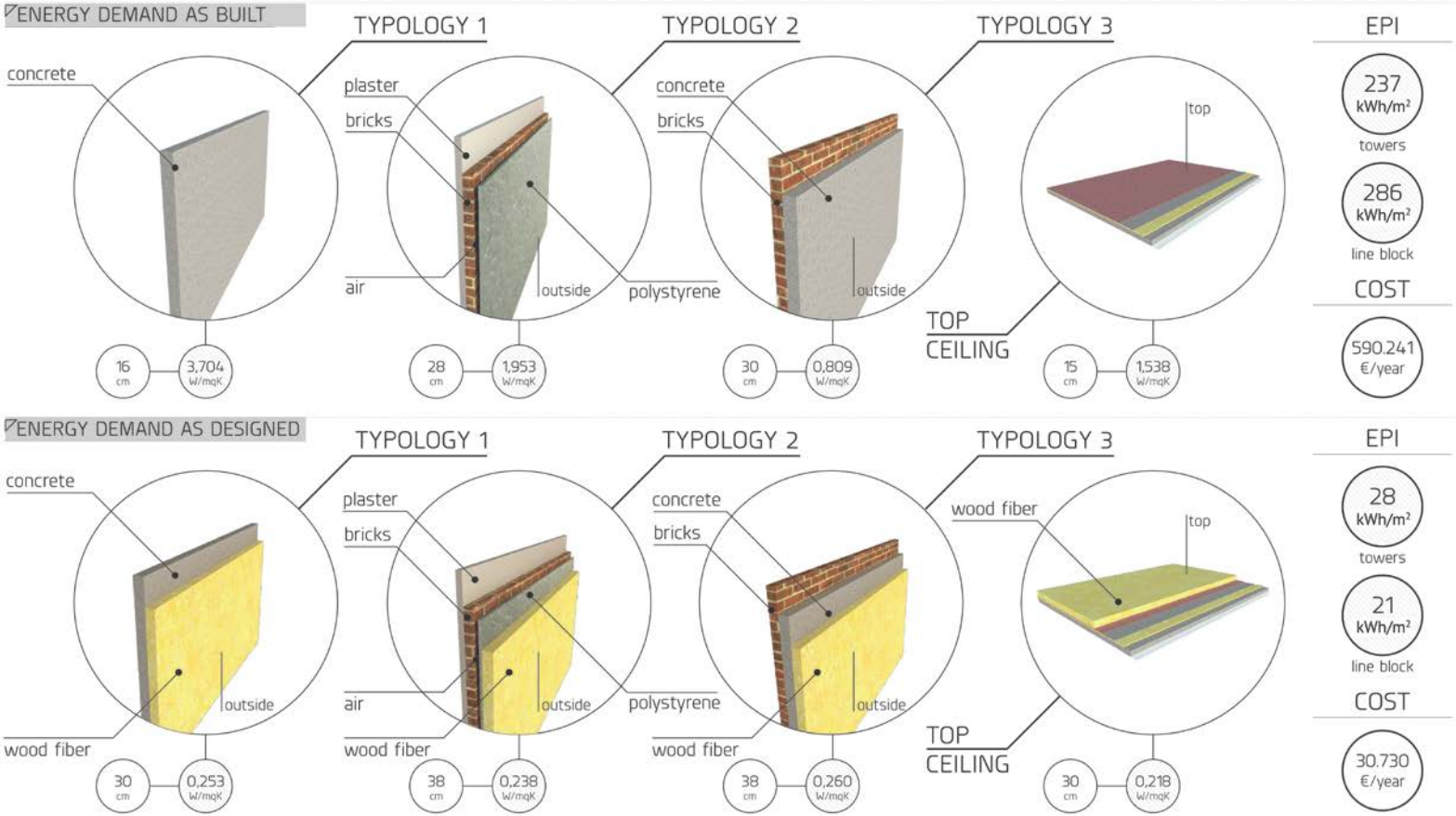
SOLUZIONI TECNOLOGICHE

DEEP RENOVATION

STARTING POINT



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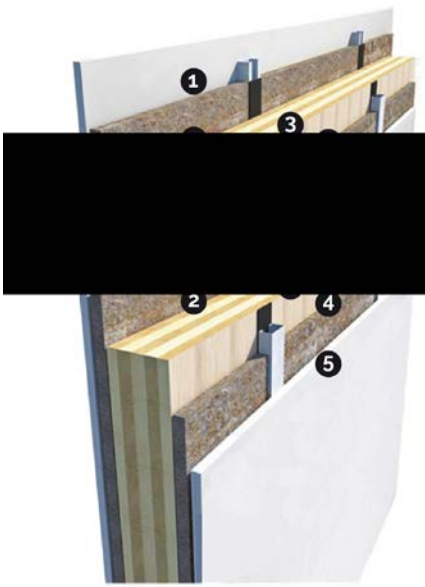
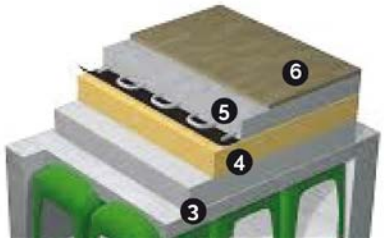
SOLUZIONI TECNOLOGICHE



XLAM wall

1. External thermal insulation plaster
2. Celenit N/C25_wood wool
3. XLAM panel
4. Celenit FL150_wood fiber
5. Internal thermal insulation plaster

Thermal transmittance U = 0.22 W/sqm°K



Foundation

1. Lean mix concrete 10
2. Igloo 32 cm
3. Screed 5 cm
4. Insulating wood fiber 12 cm
5. Underfloor heating

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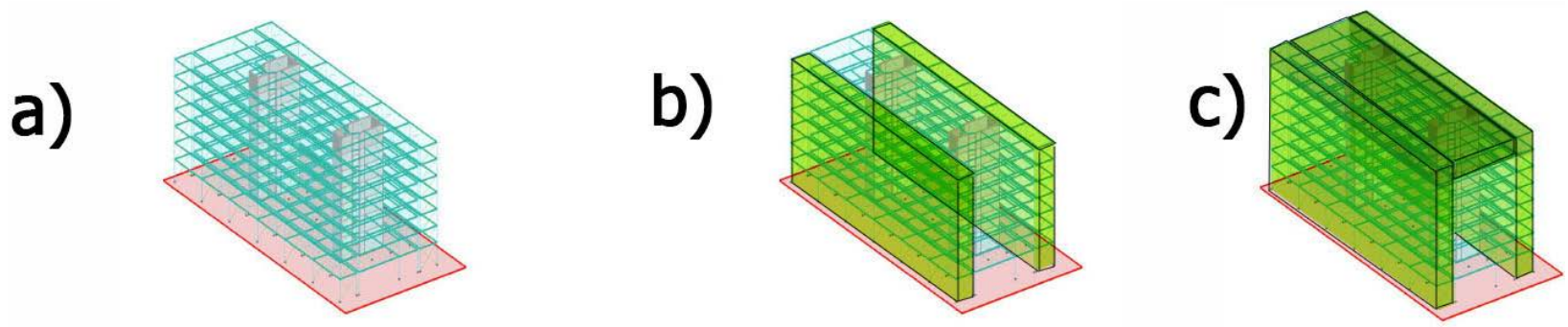
Consolidamento sismico

Potenziali sinergie - valutate in fase preliminare – tra la struttura esistente e la struttura a supporto delle AdoRes dimostrano la possibilità di combinare consolidamento sismico e riqualificazione energetica



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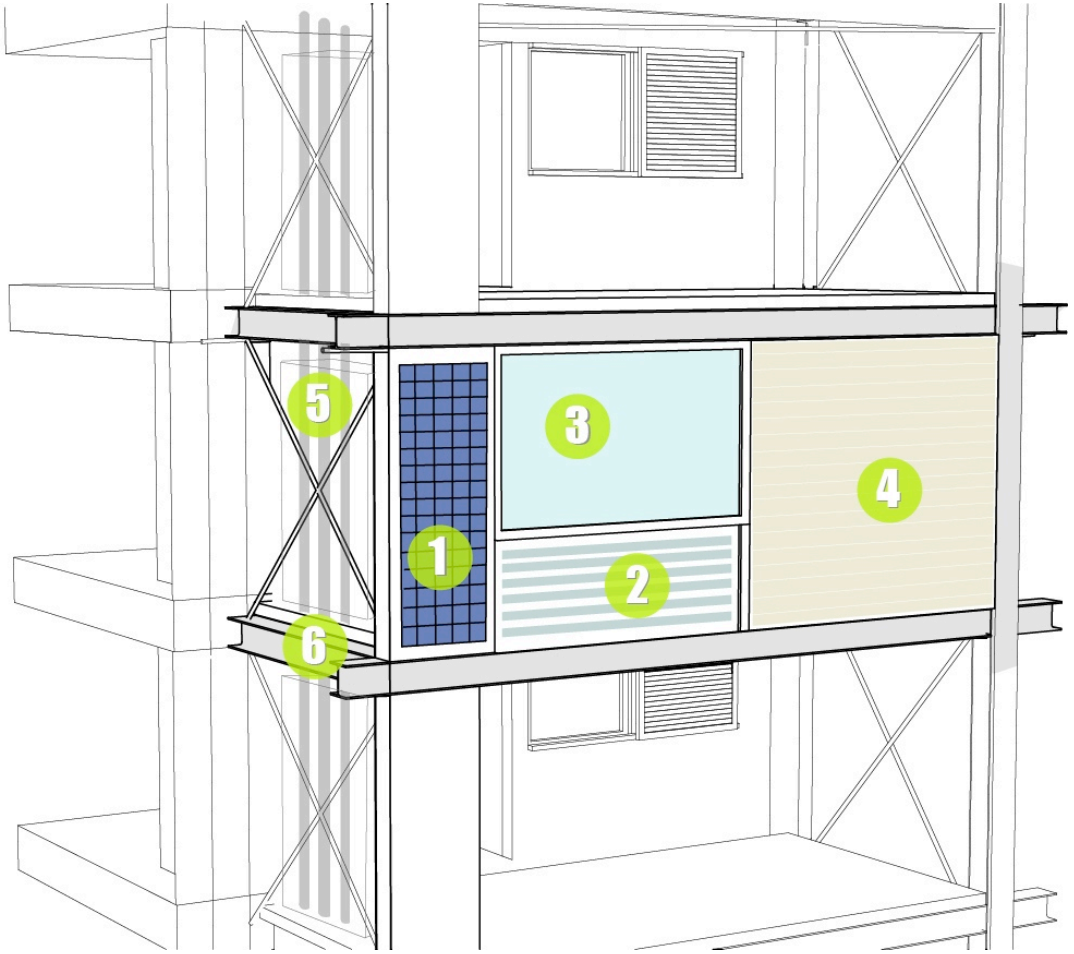

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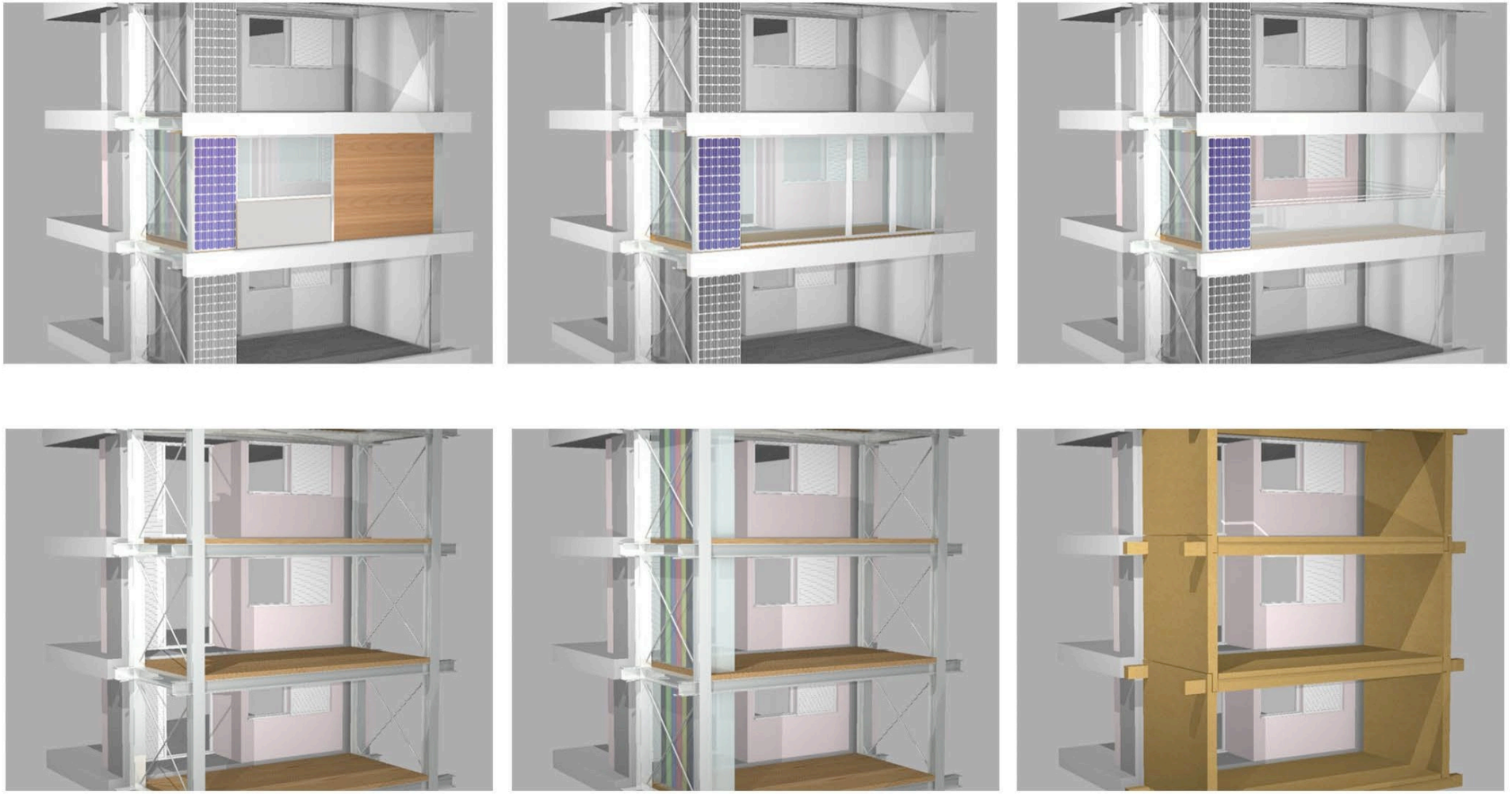

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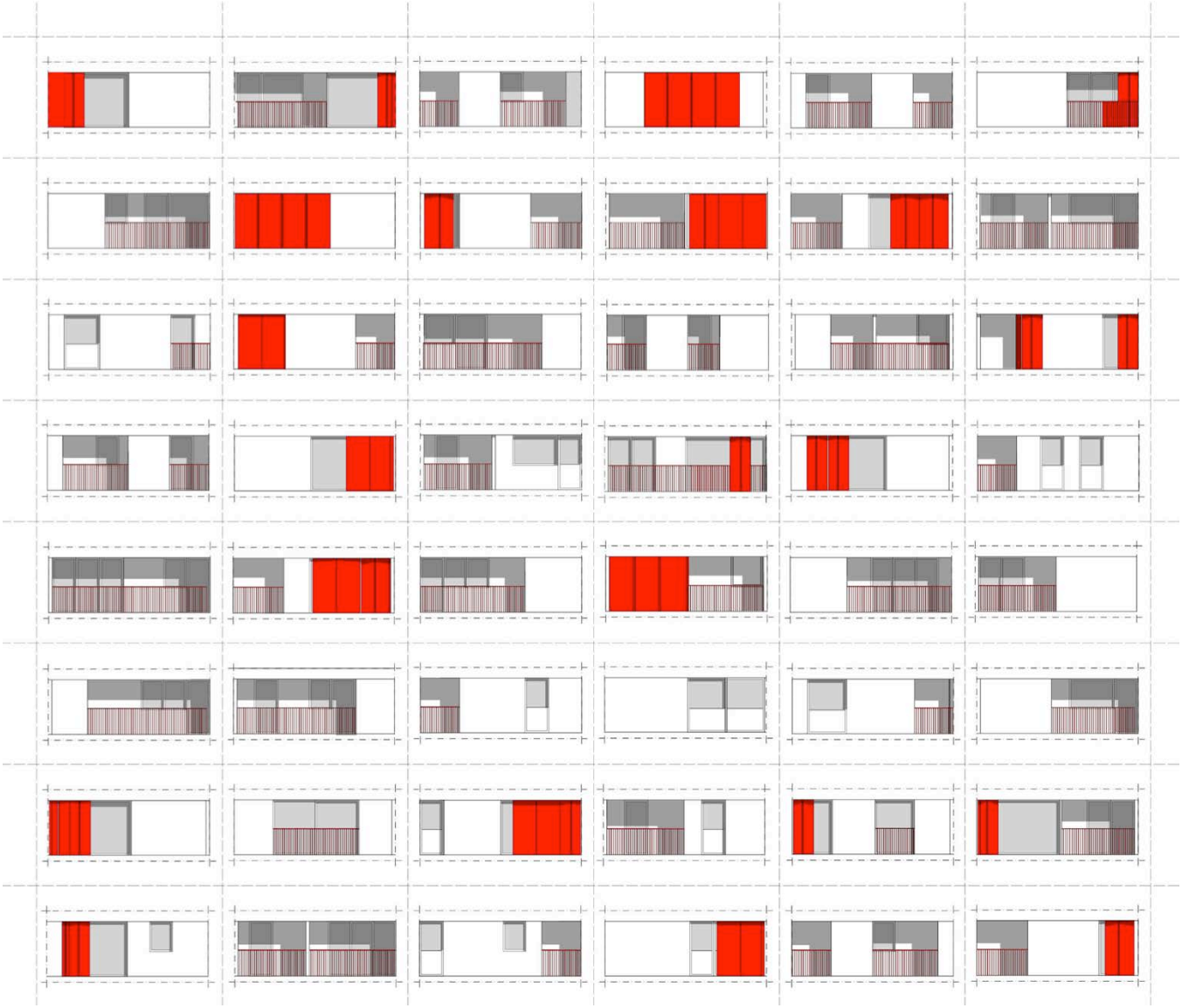

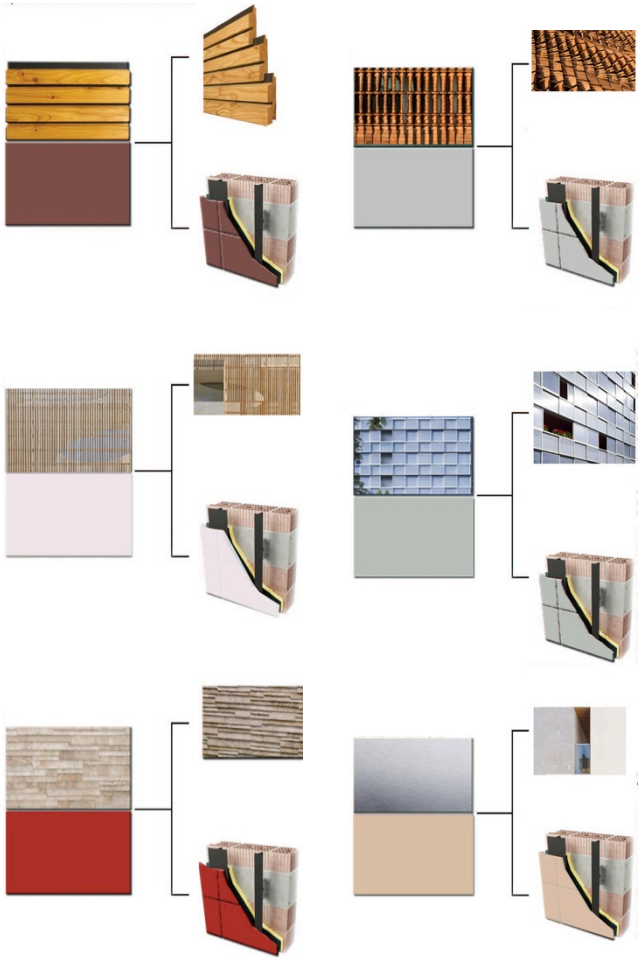

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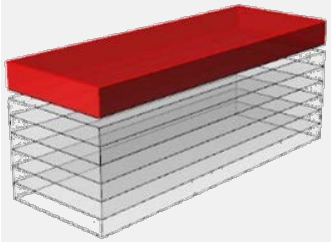
MODELLO SEMPLIFICATO RIDUZIONE ENERGIA/CO_2



AddOn Geometry

Added Conditioned Area	517	m²
Added Conditioned Volume	1294	m³
New Total Conditioned Area	3104	m²
New Total Conditioned Volume	7761	m³

Facade Orientation	South	West	East	North	
Window Orientation	1,99	56,5	74,4	1,99	m²

Construction element	U-value (W/m²K)		Area (external dimensions) m²		H_{tr} W/K
Roof	0,14	▪	671,8	=	94
Ex - Wall	0,15	▪	375,0	=	56
Windows	1,00	▪	134,9	=	135
Doors	1,00	▪	20,4	=	20
	ΔU_{tb}		$A_{envelope}$		$H_{tr,tb}$
Therm. bridges	0,03	▪	517,4	=	15,5

Space for more information to define AdoOn changes

AddOn Losses

WINTER			SUMMER		
Heat Transmition, H_{tr}			Heat Transmition, H_{tr}		
kWh/a		kWh/m²/a	kWh/a		kWh/m²/a
14503	=	28,0	307	=	0,6
Ventilation, H_{ve}			Ventilation, H_{ve}		
kWh/a		kWh/m²/a	kWh/a		kWh/m²/a
7945,0	=	15,4	0,0	=	0,0

AddOn Gains

WINTER			SUMMER		
Solar Gains			Solar Gains		
kWh/a		kWh/m²/a	kWh/a		kWh/m²/a
0	=	0,0	0	=	0,0
Internal Gains			Internal Gains		
kWh/a		kWh/m²/a	kWh/a		kWh/m²/a
#RIF!	=		23331,4	=	45,1

Primary Energy need E_p	138,1	MWh/a	Winter
Index Energy Demand	40,43	kWh/m²a	Winter
Primary Energy need E_p	83,6	MWh/a	Summer
Index Energy Demand	24,48	kWh/m²a	Summer

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ANALISI DI MERCATO

GENERAL INPUTS			Site 1	Site 4	Site 5	Site 7	Site 8	Site 10	Site 11	Site 12
			ITALY	GREECE	ROMANIA	THE NETHERLANDS	BULGARIA	LATVIA	NORWAY	SPAIN
AREA	INITIAL AREA	smq	4.250,00	2.310,00	1.160,00	1.000,00	3.720,00	1.650,00	1.076,00	1.480,00
Ccostr	COST OF CONSTRUCTION	€/sqm								
Cristr	COST OF RENOVATION	€/sqm								
Pvendita	REAL ESTATE REVENUES	€/sqm								
Epi	ENERGY CONSUMPTIONS (PRIMARY ENERGY)	kWh/sqm*y	297,00	100,00	180,00	542,00	140,00	297,00	297,00	297,00
	GAS COSTS	€/m3	0,60	0,60	0,60	0,60	0,60	0,60	0,60	0,60
			8,00	8,00	8,00	8,00	8,00	8,00	8,00	8,00
Cgas	TOTAL PRIMARY ENERGY COSTS		94.668,75	17.325,00	15.660,00	40.650,00	39.060,00	36.753,75	23.967,90	32.967,00

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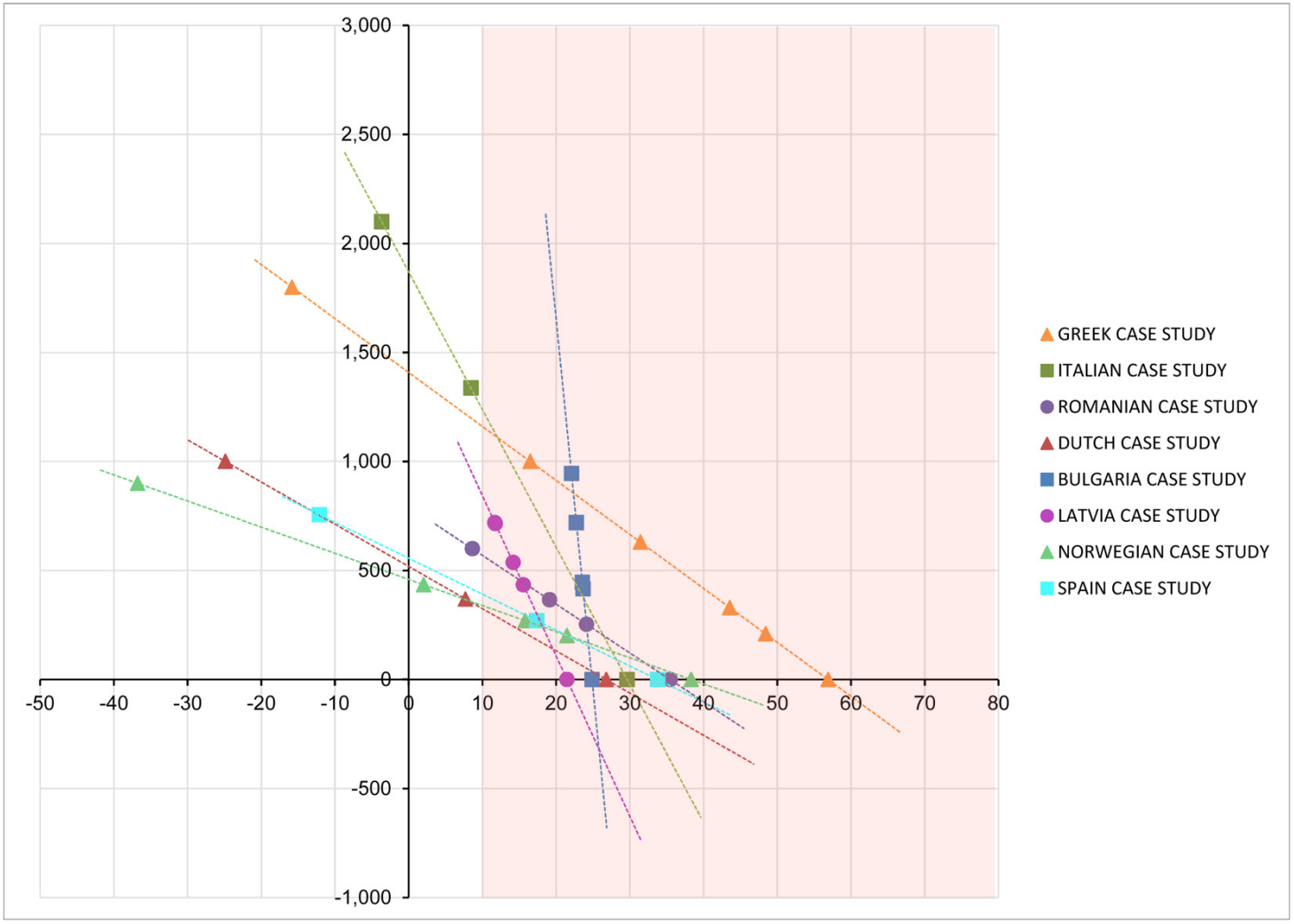
DEFINIZIONE DEL CAMPO DI APPLICAZIONE



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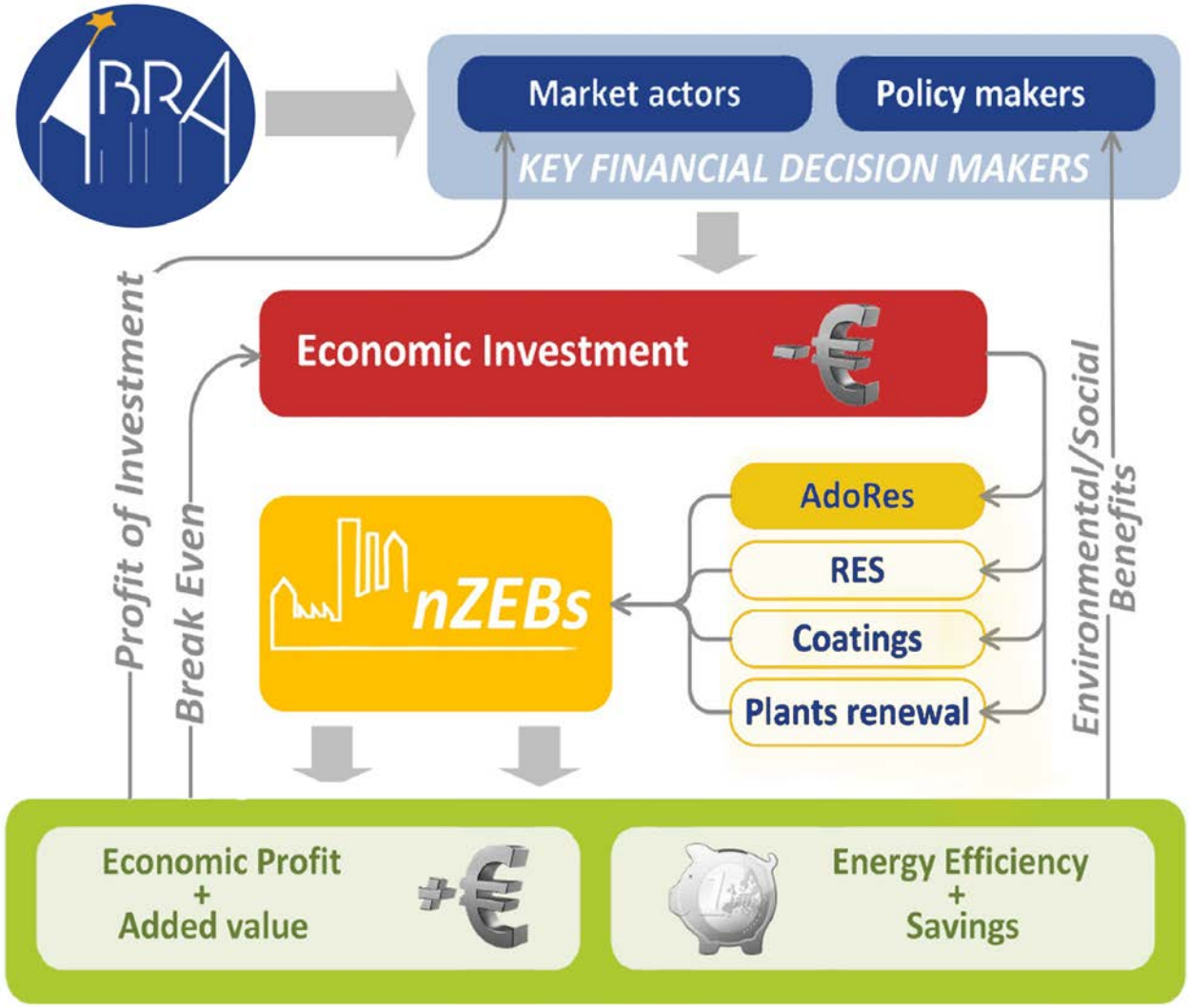

ABRACADABRA mira a costruire **gruppi di attori nazionali ed internazionali** per analizzare il potenziale tecnico, economico finanziario e sociale dell'adozione di AdoRes nel processo di rinnovamento

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- **REVISIONE LEGISLATIVA**
- **BUILDING INFORMATION MODELLING (BIM)**
- **POTENZIALE STRUTTURALE**
- **PROCESSO INDUSTRIALE**
- **USER ORIENTED MODULE**

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GRAZIE PER L'ATTENZIONE

Ing. Elena Cattani
Dottore di ricerca in Architettura Tecnica
Elena.cattani4@unibo.it