TIMEPAC
The new EPC for Europe

Hourly simplified calculation to identify cost-optimal energy requirements for the Italian building stock

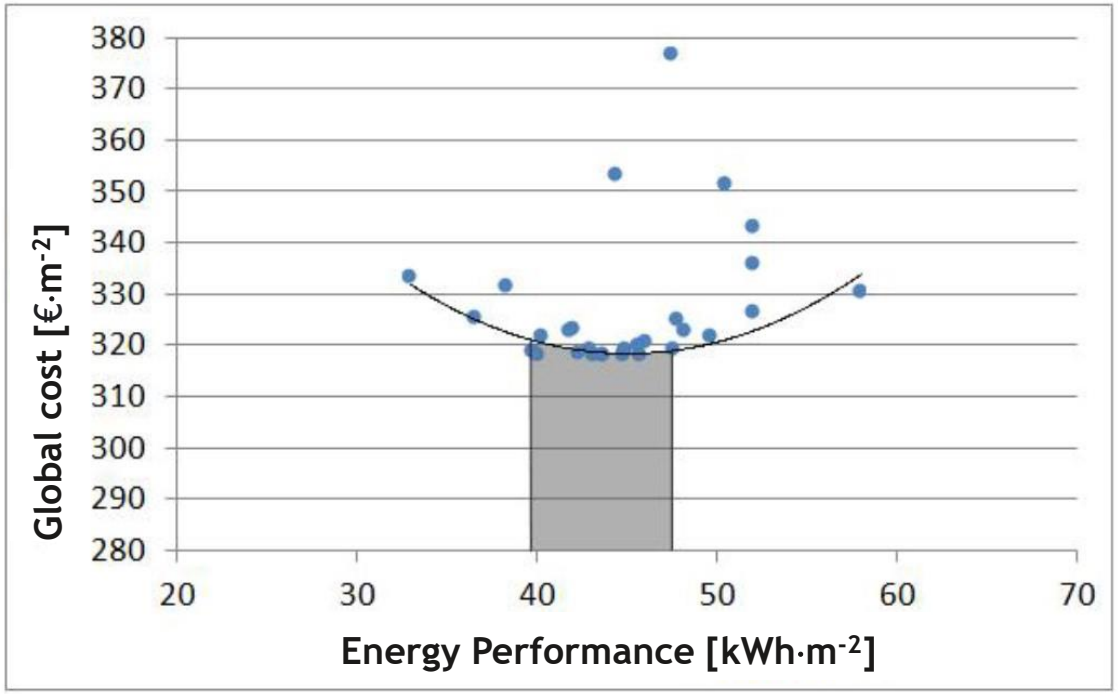
Matteo Piro, Franz Bianco Mauthe Degerfeld, Ilaria Ballarini, Vincenzo Corrado

Politecnico di Torino
Turin, Italy

EPC Enhancement

AIM: EPC enhancement

HOW? Introducing cost-optimal level in EPC



ITA EPC - RECOMMENDATIONS

RIQUALIFICAZIONE ENERGETICA E RISTRUTTURAZIONE IMPORTANTE
INTERVENTI RACCOMANDATI E RISULTATI CONSEGUIBILI

Codice	TIPO DI INTERVENTO RACCOMANDATO	Comporta una Ristrutturazione importante	Tempo di ritorno dell'investimento anni	Classe Energetica raggiungibile con l'intervento ($EP_{gl,nren}$ kWh/m² anno)	CLASSE ENERGETICA raggiungibile se si realizzano tutti gli interventi raccomandati
REN1	Coibentazione_pareti	NO	5,00	E (293,07)	E 265,39 kWh/m² anno
REN2	Sostituzione				
REN3					
REN4					
REN5					
REN6					

COST-OPTIMAL LEVEL INTRODUCTION

EU Legislation References

DIRECTIVE 2010/31/EU (EPBD Recast)

Directive on the energy performance of buildings

COMMISSION DELEGATED REGULATION (EU) No 244/2012

Supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements

Comparative Methodology

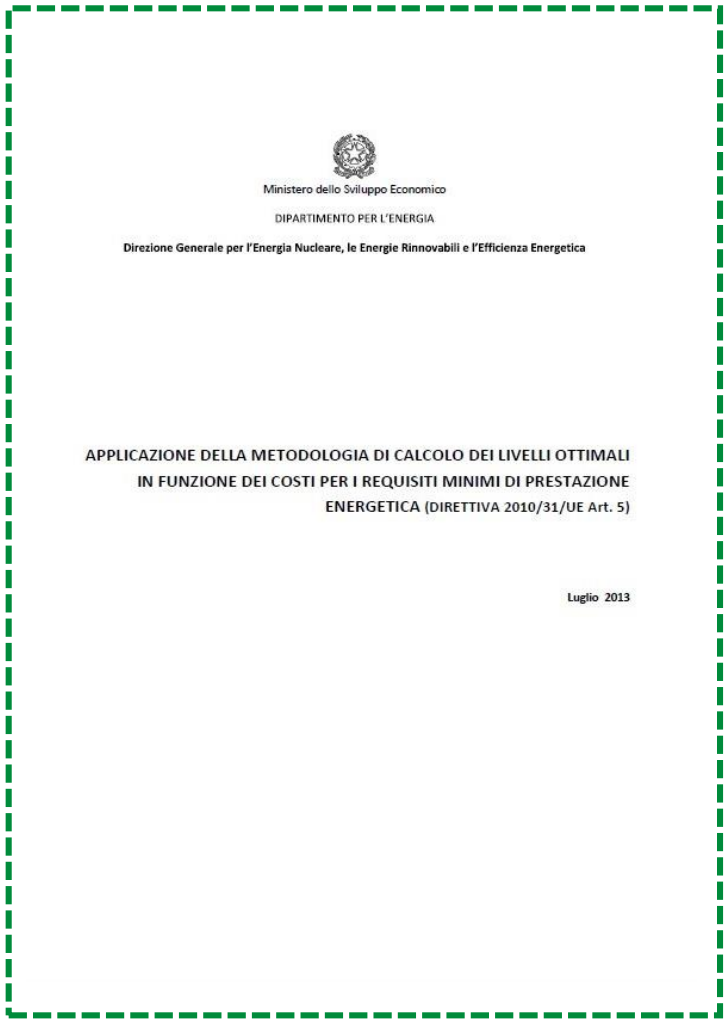
The comparative methodology framework enables Member States to compare the results of the cost-optimal calculations with the **minimum energy performance requirements.**

The comparative methodology framework must be used by Member States for calculating cost-optimal levels of minimum energy performance requirements for **new and existing buildings.**

Comparative Methodology Framework

1. Definition of **reference buildings**
2. Identification of **Energy Efficiency Measures (EEMs)**
3. Calculation of the **primary energy demand**
4. Calculation of the **global cost**
5. Determination of the **cost-optimal level** for the reference building

Cost-Optimal Methodology in Italy


Ministero dello Sviluppo Economico

DIPARTIMENTO PER L'ENERGIA

Direzione Generale per l'Energia Nucleare, le Energie Rinnovabili e l'Efficienza Energetica

APPLICAZIONE DELLA METODOLOGIA DI CALCOLO DEI LIVELLI OTTIMALI IN FUNZIONE DEI COSTI PER I REQUISITI MINIMI DI PRESTAZIONE ENERGETICA (DIRETTIVA 2010/31/UE Art. 5)

Luglio 2013

REPORT 2013

REPORT 2018

REPORT 2021

Applications of the simplified hourly calculation model (UNI EN ISO 52016-1) and update of the methodology for calculating cost-optimal levels of energy performance

Reference Buildings

Reference buildings that **characterize the national building stock** can be established on the basis of building subcategories (e.g. differentiated by size, age, climatic zone, etc.).

For each building category, at least **one** reference building shall be defined for the **new buildings** and at least **two for** the **existing buildings**.

Reference Buildings

Single Building

Building Typology

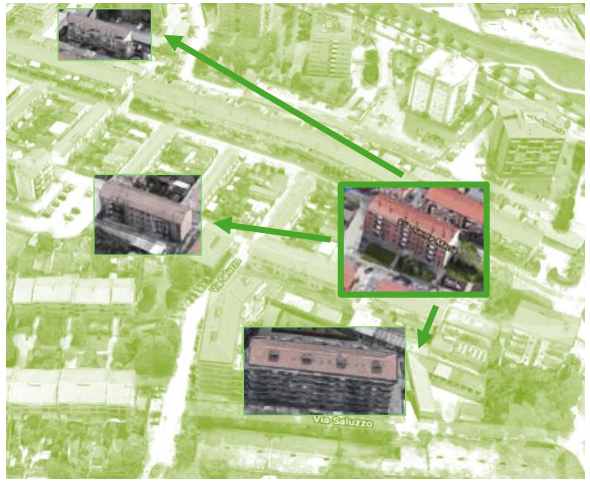
TABULA

CLASSE DI DIMENSIONE EDILIZIA

CLASSE DI EPOCA DI COSTRUZIONE — *Area climatica media (Zona climatica E)*	CASE MONOFAMILIARI	CASE A SCHIERA	EDIFICI MULTIFAMILIARI	BLOCCHI DI APPARTAMENTI
1 Fino al 1900				
2 1901-1920				
3 1921-1945				
4 1946-1960				
5 1961-1975				
6 1976-1990				
7 1991-2005				
8 Dopo il 2005				

[Reference: V. Corrado, I. Ballarini, S.P. Corgnati, 2014. Building Typology Brochure - Italy. Fascicolo sulla Tipologia Edilizia Italiana. Politecnico di Torino]

Building Stock



Italian Building Typology

Climatic zone →
- Zone B – Palermo
- Zone E – Milan

Construction period →
- E1 - 1946 – 76
- E2 - 1977 - 90
- N0 - New

Intended use →
- Residential buildings (RMF, RPC, RGC)
- Office buildings (UFF)
- Educational buildings (SCU)

TIMEPAC

Italian Building Typology

Single-family houses (RMF)

- RMF_N0_B
- RMF_E1_B
- RMF_E2_B
- RMF_N0_E
- RMF_E1_E
- RMF_E2_E

Multi-family houses (RPC)

- RPC_N0_B
- RPC_E1_B
- RPC_E2_B
- RPC_N0_E
- RPC_E1_E
- RPC_E2_E

Apartment blocks (RGC)

- RGC_N0_B
- RGC_E1_B
- RGC_E2_B
- RGC_N0_E
- RGC_E1_E
- RGC_E2_E

Office buildings (UFF)

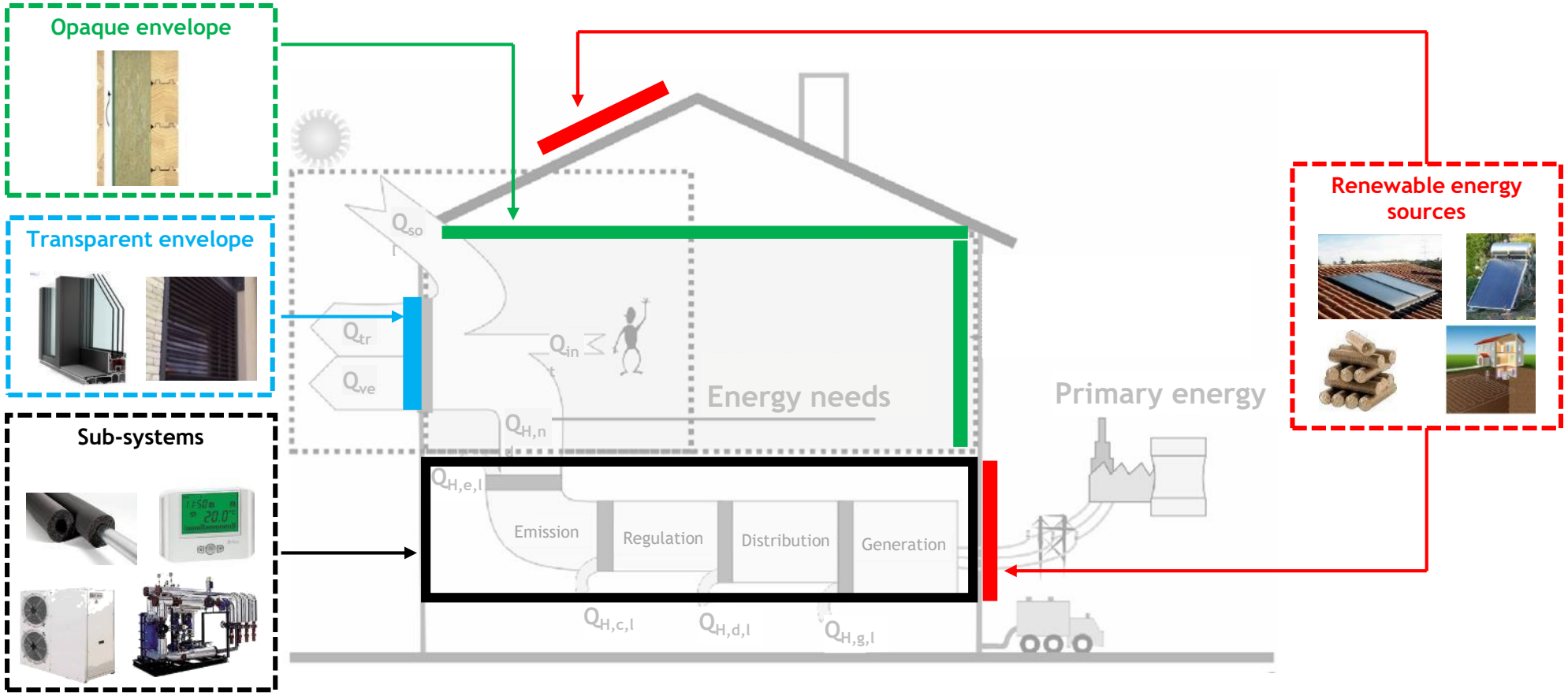
- UFF_N0_B
- UFF_E1_B
- UFF_E2_B
- UFF_N0_E
- UFF_E1_E
- UFF_E2_E

Educational buildings (SCU)

- SCU_E1_B
- SCU_E1_E

TOTAL: 26 reference buildings

Definition of Energy Efficiency Measures



Energy Efficiency Measures (EEMs)

BUILDING ENVELOPE

No.	EEM
1	External wall thermal insulation
2	Cavity wall thermal insulation
3	Roof thermal insulation
4	Floor thermal insulation
5	Window thermal insulation
6	Solar shading system

TECHNICAL BUILDING SYSTEMS

No.	EEM
7	Chiller
8	Generator for space heating
9	Generator for domestic hot water
10	Combined generator for space heating and domestic hot water
11	Heat pump for space heating, domestic hot water and space cooling
12	Thermal solar system
13	Photovoltaic system
14	Heat recovery ventilation system
15	Heating system control
16	Lighting system

Energy Needs

Three different calculation methods to determine the **energy needs for space heating and cooling** are provided:

- A fully prescribed **monthly quasi-steady-state calculation method**;
- A fully prescribed **simple hourly dynamic calculation method**;
- Calculation procedures for detailed dynamic simulation methods.

Global Cost

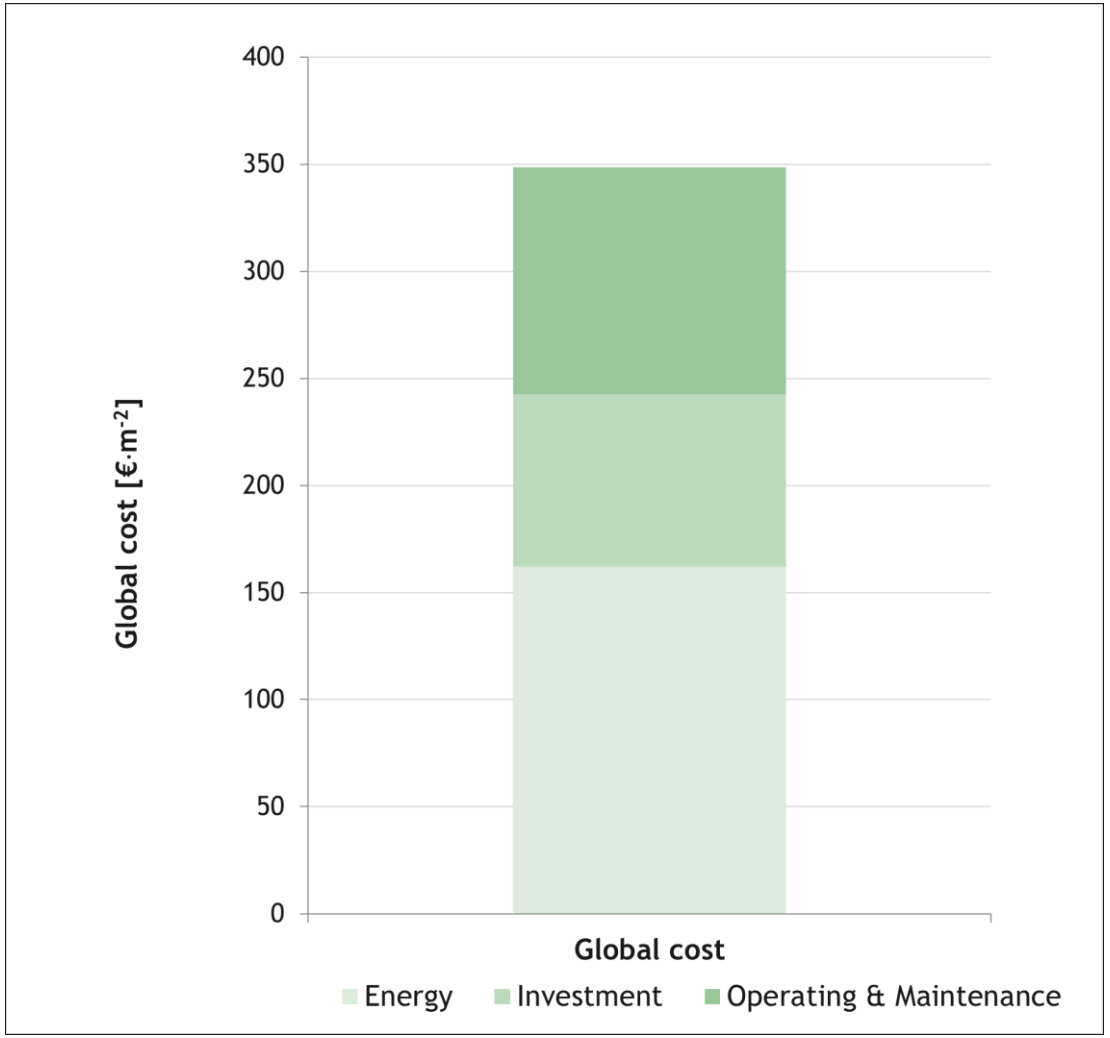
Cost-optimal is based on the **net present value** (global costs) methodology.

The comparative methodology framework prescribes calculation of cost-optimal levels for both **macroeconomic** and **financial perspectives**.

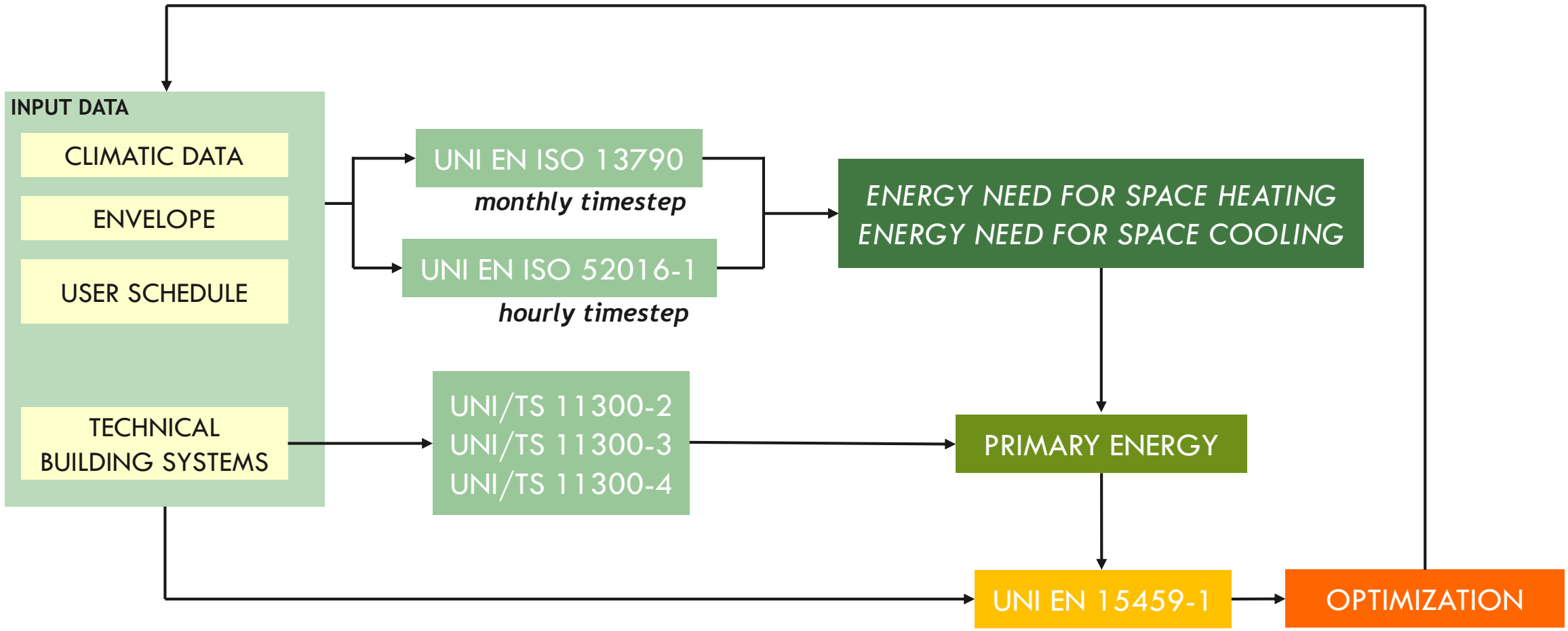
Member States shall use a calculation of **30 years for residential buildings**, and a calculation period of **20 years for commercial, non-residential buildings**.

Cost-Optimal Level

For each reference building, Member States compare the **global cost results** calculated for **different energy efficiency measures** based on renewable sources and packages/variants of those measures and find the solution that minimises the global cost.



Cost-Optimal Methodology

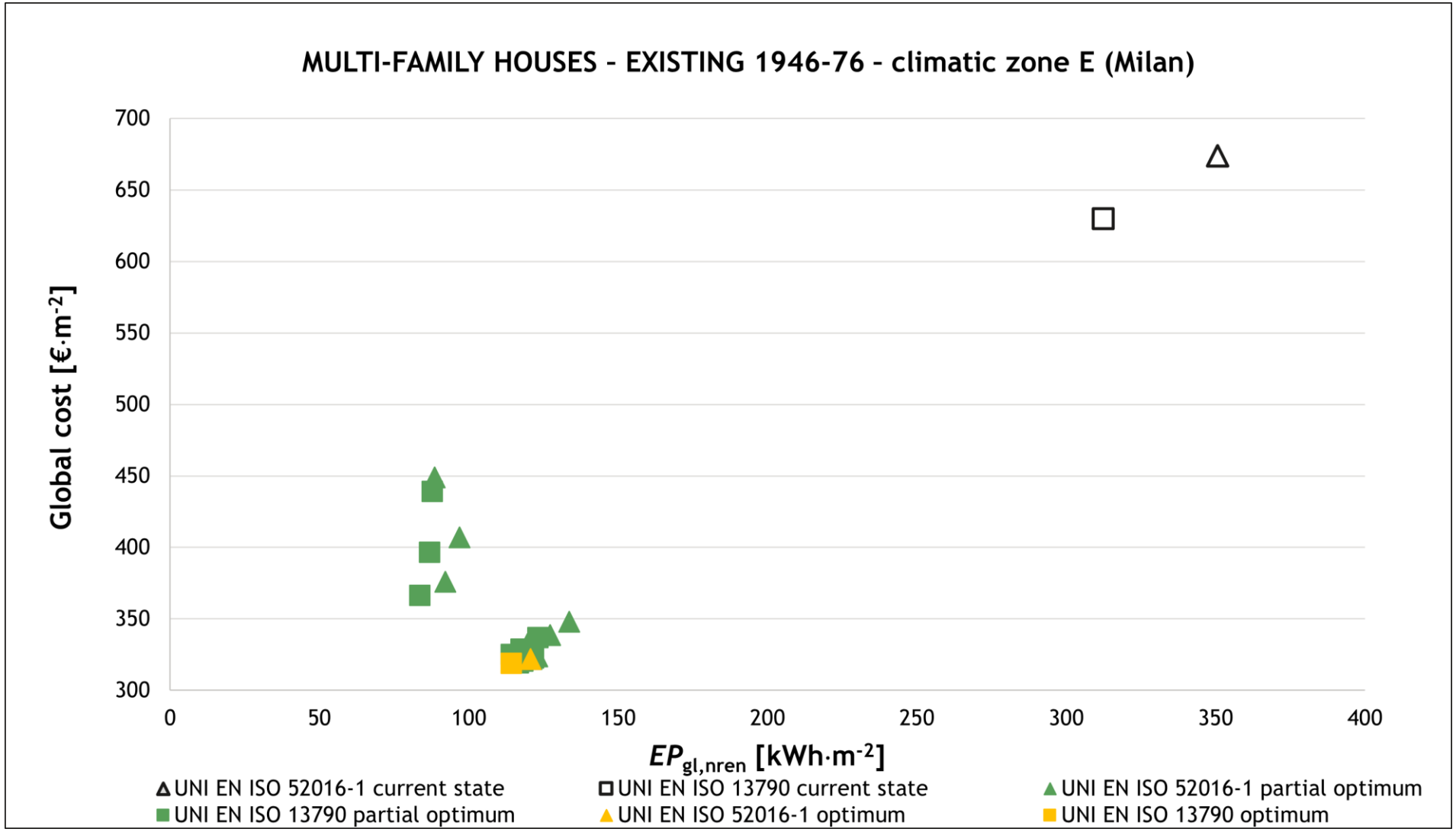


Example: Package of EEMs

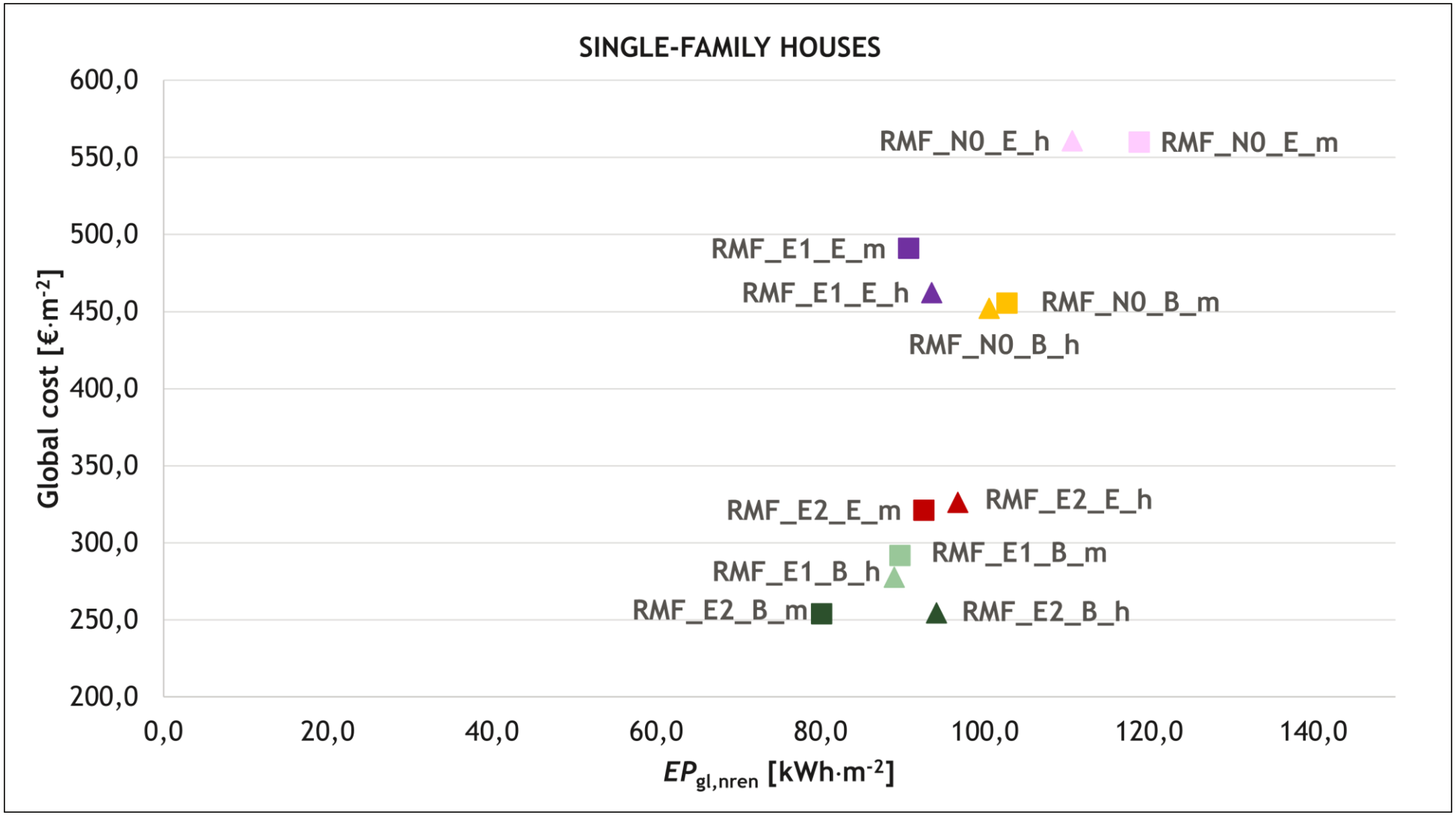
MULTI-FAMILY HOUSES - EXISTING 1946-76 – climatic zone E (Milan)

MULTI-FAMILY HOUSES - EXISTING 1946-76 (RPC_E1_E) - climatic zone E (Milan)								
No. EEM	Energy Efficiency Measures (EEMs)	Parameter	Symbol	Current state value	Monthly optimal		Hourly optimal	
					Optimal value	No. EEO	Optimal value	No. EEO
1	External wall thermal insulation	Thermal transmittance [$W\cdot(m^{-2}K^{-1})$]	U_p	-	-	-	-	-
2	Cavity wall thermal insulation	Thermal transmittance [$W\cdot(m^{-2}K^{-1})$]	U_p	1,15	**0,37**	2	**0,37**	2
3	Roof thermal insulation	Thermal transmittance [$W\cdot(m^{-2}K^{-1})$]	U_r	1,16	**0,20**	5	**0,20**	5
4	Floor thermal insulation	Thermal transmittance [$W\cdot(m^{-2}K^{-1})$]	U_r	0,78	**0,19**	5	**0,29**	4
5	Window thermal insulation	Thermal transmittance [$W\cdot(m^{-2}K^{-1})$]	U_w	4,90	**4,90**	1	**4,90**	1
6	Solar shading system	Fix solar shading or movable	-	absent	**movable**	3	**movable**	3
7	Chiller	Energy efficiency ratio at design conditions	*EER*	2,35	**2,35**	1	**2,35**	1
8	Generator for space heating	Generator efficiency at design conditions	η_{gn}	0,85	**1,00**	3	**1,00**	3
9	Generator for domestic hot water	Generator efficiency at design conditions	$\eta_{gn,Pn,W}$	0,75	**0,93**	2	**0,93**	2
10	Combined generator for space heating and domestic hot water	Generator efficiency at design conditions	η_{gn}	-	-	-	-	-
11	Heat pump for space heating, domestic hot water and cooling	Coefficient of performance at design conditions	*COP*					
		Energy efficiency ratio at design conditions	*EER*					
12	Thermal solar system	Surface of solar collectors [m^2]	m^2	absent	**absent**	1	**absent**	1
13	Photovoltaic system	Peak power [kW]	kWp	absent	**8,40**	4	**8,40**	4
14	Heat recovery ventilation system	Heat recovery efficiency	η_r					
15	Heating system control	Climatic (C), room (R), zone (Z), room + climatic (RC)	η_{ctr}	C	**RC**	4	**RC**	4
16	Lighting system	Lighting power density [$W\cdot m^{-2}$]	P_N					
		Occupancy dependency factor	F_O					
		Constant illuminance factor	F_C					
		Daylight dependency factor	F_D					

Example: Cost-Optimal Levels



Optimal EEM Packages for Single-Family Houses



Conclusion

NATIONAL BUILDING STOCK → BUILDING TYPOLOGY

EPC Recommendations

Cost-optimal EEMs

EPC Enhancement

Cost-optimal level per building type

Thanks for your attention!

If you would like to have more information, please contact us:

matteo.piro@polito.it

franz.bianco@polito.it

ilaria.ballarini@polito.it

vincenzo.corrado@polito.it

TIMEPAC

The new EPC for Europe