Rethinking the (near) future of postwar built environment: a systemic approach through façades-only replacement

RETHINKING THE (NEAR) FUTURE OF POSTWAR BUILT ENVIRONMENT: A SYSTEMIC APPROACH THROUGH FAÇADES-ONLY REPLACEMENT

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Highlights

The difficult heritage of postwar residential building stock because of its progressive loss of value, functionality, performances, and closeness to the end-of-life. The limits of a general demolition & rebuilding. Facing decarbonizing perspectives with an all-embracing view on carbon footprint (both operational and embodied carbon). The necessity to consolidate a methodology to correctly upgrade these buildings by increasing their micro-resilience and environmental value. The façades-only replacement as a systemic retrofit strategy to improve long-term carbon footprint, functionality, and environmental sustainability.

Abstract

There is a noticeable portion of the Italian building stock, typically concentrated in suburban areas, whose performance obsolescence and vulnerability are worsening its value and urban image as well. Even though a large-scale construction replacement seems to be apparently the expected way to solve the problem, current global strategies towards the built environment demand different approaches. The paper identifies envelope replacement as a systemic and feasible tactic to extend the service life of such target buildings and to enhance their resilience towards climate change and users' needs, also with positive fallouts for the environment and urban image.

Keywords

Carbon footprint, Embodied carbon, Postwar residential buildings, Envelope, Façades.

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1. INTRODUCTION

Data collected in the 2011 census by ISTAT (Italian statistic center) return an overall overview of residential buildings' consistency and, albeit in a concise way, their state of preservation. Among the whole censused residential stock (12,187,698 buildings), it is particularly significant to highlight that nearly 48% (5,869,320 buildings) was built during the postwar period, precisely between 1946 and 1980, and the 32% of it (1,887,191 buildings) concerns multi-story residential buildings with reinforced concrete structural frame. This study is focused on this last segment, that is to say at least 40 years old buildings, most of them at the end of their (designed) service life, usually affected by performance obsolescence, high seismic vulnerability, and living discomfort, especially for that substantial quota with inadequate maintenance status, which reaches about 70%. The

criticalities mentioned above are always accompanied by lexical poverty of the facades lowering the urban image as well, especially in suburbs and past fast-growing areas where these low-quality buildings have been the answer to the growing real estate demand of postwar period, generated by a substantial increase in the population of urban areas.

This current performance obsolescence and vulnerability issue is not only age-related, but can be traced back also to the particular historical context of these buildings construction: within a few decades, a vast residential stock has been built, without no need of any particular urban planning or compositional care, but only by ensuring a minimum indoor quality standard threshold. Furthermore, the lack of thermal and anti-seismic strong regulations of that period (about 77% of the whole Italian building residential stock was built before 1981 when only 25% of territory was classified as seismic; even 88% of it was built before the first framework law with thermal insulation requirements of 1990 [1]) contributed to give back today buildings with hard structural and thermal deficiencies, mainly due to envelopes' energy waste and obsolete facilities.

This worrying situation is also spread in whole Europe: data collected by national Energy Performance Certificates (EPC) show that substantially all European buildings built before 1990 have energy-inefficient envelopes, as illustrated in Fig. 1, as well as structural deficiencies with respect to both static and seismic actions [2].

By now, there is no doubt about how much this residential building stock represents a difficult heritage, because of the progressive loss of its value and stiffness in meeting the new housing needs. Outlining a near future for these buildings inevitably involves a choice between replacement and retrofitting. It is not easy to outline a one-sided answer. Retrofit strategies on this kind of buildings are a recent and developing issue, somewhat lacking a systemic approach, but there are indisputable criticalities that could make a construction replacement inapplicable in many cases. An Italian apartment block usually involves very fragmented ownership, which hardly manages a decision-making process in a synergistic way: different goals and expectations make the total replacement decision almost impossible, also because the demolition phase is not even regulated by the condominium legal framework (Italian Civil Code only considers total or partial "destruction" due to accidental causes and not a planned demolition of the building for reconstruction purposes [3]). In addition, there is an objective difficulty to temporarily relocate all the residents (owners more than tenants) for the entire rebuilding period.

On the other hand, disjointed ownership usually tends to favor only single and autonomous remedial services,

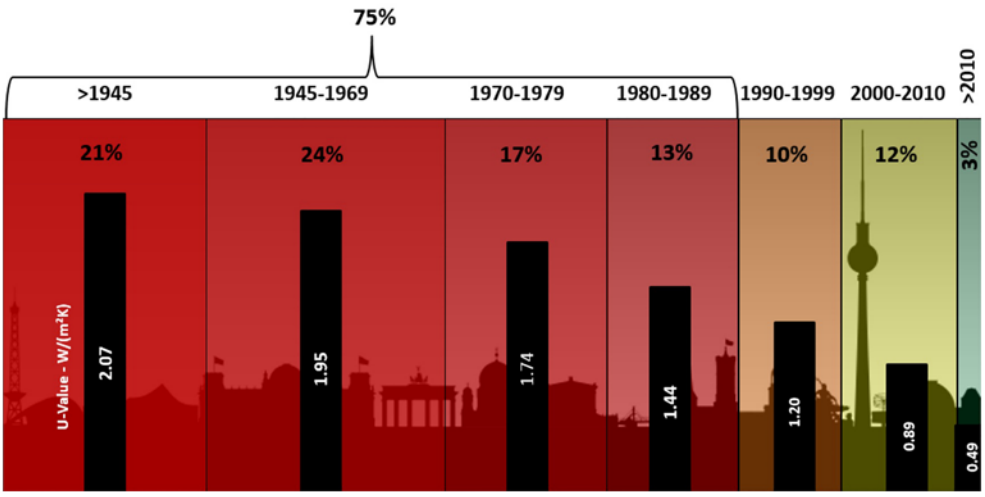

Fig. 1. *Age of EU building stock and corresponding average U-value for building envelopes. Source: BPIE Building Performance Institute Europe, 97% of buildings in the EU need to be upgraded. Factsheet (http://bpie.eu/wp-content/uploads/2017/12/State-of-the-building-stock-briefing_Dic6.pdf)*

mostly for emergency or purely monetary purposes (e.g. tax relief, volumetric premiums, etc.), to the detriment of more organic and systemic renovation strategies.

In order to offer an alternative to irreversible degradation, it is necessary to overcome the mentioned criticalities with really feasible strategies that need to be found halfway between total replacement and random retrofit attempts.

This research explains why a selective facade-only demolition could rebuild the envelope no more like a simple closure, but rather as an active, dynamic, and multifunctional interface. This can open up to new scenarios of a systemic reorganization of the entire building, with the aim to enhance not only indoor comfort and building performance, but also a functional improvement, environmental footprint and its resilience towards climate and users' needs, also with positive fallouts for the environment and urban image as well.

2. REPLACEMENT VS RETROFITTING

According to the 2019 Global Status Report for Buildings and Construction of the International Energy Agency (IEA) [4], the built environmental sector is responsible for 39% of global energy-related CO_2 emissions. Nevertheless, "operational" emissions concerning buildings in-use phase e.g. fossil fuel combustion for heating, cooling, or power generation for electricity, are only a part of the above percentage (28%). The other share, fairly substantial (11%), concerns process-related emissions during manufacturing, transportation, construction, and end of life phases. These emissions, commonly called "embodied" carbon, have been largely overlooked in the balance of built environment impact in the past, but the current climate emergency demands global strategies to achieve full decarbonization of construction sector, as pointed out, for example, in the recent World Green Building Council's report of 2019 "Bringing embodied carbon upfront" [5], even if Energy Performance Certification of Italian buildings does not consider embodied energy yet.

Moreover, embodied emissions footprint appears to have recently become an important key factor also in buildings lifecycle assessment, especially for those at the end of their service life, which feed the debate "retrofitting vs. demolition & rebuilding". Even if it is not easy to correctly quantify embodied carbon footprint in the two different scenarios due to data shortage, the majority of the literature review [6, 7] found that refurbishment strategies generally have lower embodied carbon emissions (and lower environmental impact) than demolition and new build.

Besides the importance of tackling embodied carbon emissions growth, with regard to the considered building stock, further reasons could make challenging to apply a general replacement (in addition to the problem of a decision-making process put into a fragmented property's head) such as the European waste framework Directive 2008/98/EC, which implies the recycling of at least the 70% of construction and demolition waste (CDW). The problem lies in the typological and material characteristics of those buildings: LCAs on real building demolitions and disposal phases highlighted the extremely predominance of inert materials (about even 97% for 60's and 70's multi-story residential buildings with a reinforced concrete structure and brick infill envelope [8]). It seems obvious that the only way to respect the Directive is to recycle (or at least "downcycle" by re-using on-site) inert wastes, but, in a typical replacement operation of such buildings, which usually take place in high-density urban areas with very limited site area size, it is almost impossible to keep and re-use on-site the 70% of inert waste. Thus, the alternative is to manage recycling activities, which require source separation and energy supply. Here comes another problem: because of the heterogeneity of common building structural frame (i.e. the presence of clay blocks in reinforced concrete floors), it has been proven that more than 60% of total inert waste consists of non-separable concrete, brick, mortar and ceramic [8] (or separable only with processes requiring high charges also for energy). The traditional "wet" technology, which characterizes the considered building stock, does not seem to facilitate recycling processes of complete demolition waste.

It is then inevitable to adopt different strategies oriented towards an extension of these buildings' service-life, with a significantly lower impact on C&D waste and CO_2 emissions.

A very first sustainable way to respect the waste framework Directive is to minimize material waste, to get it as less heterogeneous as possible, and with higher waste quality. In this frame, a concrete strategy is particularly suitable for the reference building stock: applying selective demolition processes, mainly to the building envelope.

3. METHODOLOGY

Considering all the issues associated with postwar apartment blocks, a change of perspective can widen the façades-only replacement potential largely. Their global upgrading can be considered as a best practice, improving long-term carbon footprint, practical feasibility, and getting several "side-related" favorable goals.

3.1. EMBODIED CO_2 IN FAÇADES

Globally addressing total carbon footprint is now a must also with reference to the building stock we are considering. Now a fair approach shall focus on embodied carbon impact too since strategies to reduce operational emissions are already underway. It is not easy at all to give real and comparable data about embodied carbon, mainly because of the wide variety of input data in LCA studies and, above all, their different boundary conditions (i.e. cradle-to-gate, cradle-to-grave etc.). Chastas et al. [9], for example, give evidence of that by identifying a wide range indeed of embodied carbon emissions (179.3÷1050 $kgCO_2e/m^2$) upon 95 residential buildings case studies based on 50-year building lifespan. Other reviewed literature [10-12] narrow that range between 300÷600 $kgCO_2e/m^2$ instead. The LCA of Grönvall et al. [13] is particularly significant because they take into account a hypothetical apartment block with an on-site cast reinforced concrete frame (four-story building with 16 flats in total) quite parallel to the reference stock. Their results show a total embodied carbon of 344 $kgCO_2e/m^2$, split as follows: 86% raw material extraction, building material production, and transportation; 2% construction phase; 12% end of life phase. Since this study refers to existing buildings with a reasonable possibility to undergo a service life extension, the end of life stage is not considered, thus assuming a reference "cradle-to-construction" approximate value of 300 $kgCO_2e/m^2$. Thus, a 5-story apartment building measuring e.g. 26x12x15(H) m, has embodied about 468 tons of CO_2e after its construction.

Material	Thickness [m]	Surface [m²]	Volume [m³]	Density [kg/m³]	Total mass [kg]	Embodied Carbon [$kgCO_2$/kg]	Total material Embodied Carbon [$kgCO_2$]	Incid. [%]
gypsum plaster (int)	0.015	390.00	5.85	1120.00	6552.00	0.12	786.24	3.29
general clay brick	0.12	390.00	46.80	800.00	37,440.00	0.22	8236.80	34.47
air gap	0.13							
general clay brick	0.12	390.00	46.80	800.00	37,440.00	0.22	8236.80	34.47
cement plaster (ext)	0.015	390.00	5.85	1760.00	10,296.00	0.12	1235.52	5.17
cement screed (balconies)	0.1	35.00	3.50	2100.00	7350.00	0.21	1565.55	6.55
ceramic (balconies)	0.02	35.00	0.70	1700.00	1190.00	0.59	702.10	2.94
cement plaster (intrados balconies)	0.015	35.00	0.53	1760.00	924.00	0.12	110.88	0.46
iron (parapet)		53.00		20.00 [kg/m²]	1060.00	1.91	2024.60	8.47
windowsills (limestone)	0.04	11.00	0.44	2180.00	959.20	0.017	16. 31	0.07
windows (wood frame with single glazed, no coating)		70.00				14.00 [$kgCO_2e$/mq] [15]	980.00	4.10
						existing façade embodied carbon	**23,894.80**	100
						Incidence on the assumed total building embodied carbon	**5.11 %**	

Tab. 1. *Assessment of existing building facade embodied carbon incidence.*

In this frame, what is the embodied CO_2 share of e. g. a street-side façade? The following Fig. 2 table estimates this value on the basis of the University of Bath's ICE Database [14]. The boundary conditions of selected material shown in Tab. 1 and Tab. 2 are all "cradle-to-gate". In both existing and new façade embodied carbon evaluation, the materials' transportation to site and construction phase incidences are disregarded.

Since the evaluation is referred to a façade replacement, the above embodied CO_2 value needs to be increased by a certain amount (12% according to Grönvall et al. [13]) to take into account CDW wastes disposal: this value could be lowered through a smart managing of recycling activities or selective de-constructions.

In the same frame, the embodied CO_2 impact of the new envelope (with its optimized and updated performances) can be assessed, as shown in Tab. 3.

As predictable, the new façade shows an almost double value of embodied carbon mainly due to process-related emissions for high-performance windows and some of selected mineral-based and fossil-based building materials.

However, the whole building carbon footprint modification due to the facade-only replacement needs to be considered. The reference building has slightly increased embodied carbon footprint (which is the sum of existing façade demolition incidence increased by some percentage to take into account also CDW disposal, and the new façade realization), but there is a significant decrease of the operational carbon, thanks to the lower energy demand for heat generation and the higher thermal comfort performance of the new façade. Considering a thermal transmittance decrease from 2 W/m^{2}K (existing façade) to 0.19 W/m^{2}K (new façade, as detailed in Fig. 3) and a traditional fossil fuel-based heating system, the building carbon dioxide operational savings can be appraised in 7800 kgCO_2 per year This saving will balance the increased embodied carbon (approximately 70.000 kg-CO_2e) within about 9 years, which is a relatively short period of time compared to the achieved building service life extension (at least another 50 years).

The façade-only replacement in such a kind of buildings showed to be very effective in reducing their long-term global carbon footprint. Nevertheless, how is this feasible?

Material	Thickness [m]	Surface [m^2]	Volume [m^3]	Density [kg/m^3]	Total mass [kg]	Embodied Carbon [kgCO_2/kg]	Total material Embodied Carbon [kgCO_2]	Incid. [%]
gypsum plasterboard (int)	0.025	390.00	9.75	900.00	8775.00	0.38	3334.50	7.71
plasterboard counterwall steel framing	0.075	390.00		10.00 [kg/m^2]	3900.00	1.71	6669.00	15.42
rockwool panel	0.04	390.00	15.60	23.00	358.80	1.05	376.74	0.87
air gap (plant passage)	0.28							
precast concrete panel	0.04	390.00	15.60	2400.00	37,440.00	0.215	8049.60	18.61
polystyrene panel	0.140	390.00	54.60	20.00	1092.00	3.400	3712.80	8.59
cement plaster (ext)	0.02	390.00	7.80	1760.00	13,728.00	0.12	1647.36	3.81
cement screed (balconies)	0.1	35.00	3.50	2100.00	7350.00	0.21	1565.55	3.62
ceramic (balconies)	0.02	35.00	0.70	1700.00	1190.00	0.59	702.10	1.62
cement plaster (intrados balconies)	0.015	35.00	0.53	1760.00	924.00	0.12	110.88	0.26
iron (parapet)		53.00		20.00 [kg/m^2]	1060.00	1.91	2024.60	4.68
windowsills (concrete)	0.04	11.00	0.44	2400.00	1056.00	0.215	227.04	0.52
windows (2x glazed, krypton filled, aluminum framed)		70.00				211,80 [kgCO_2e/mq] [15]	14,826.00	34.28
						new façade embodied carbon	**43,246.17**	100
						Incidence on the assumed total building embodied carbon	**9.24 %**	

Tab. 2. *Assessment of hypothetical new building facade embodied carbon incidence.*

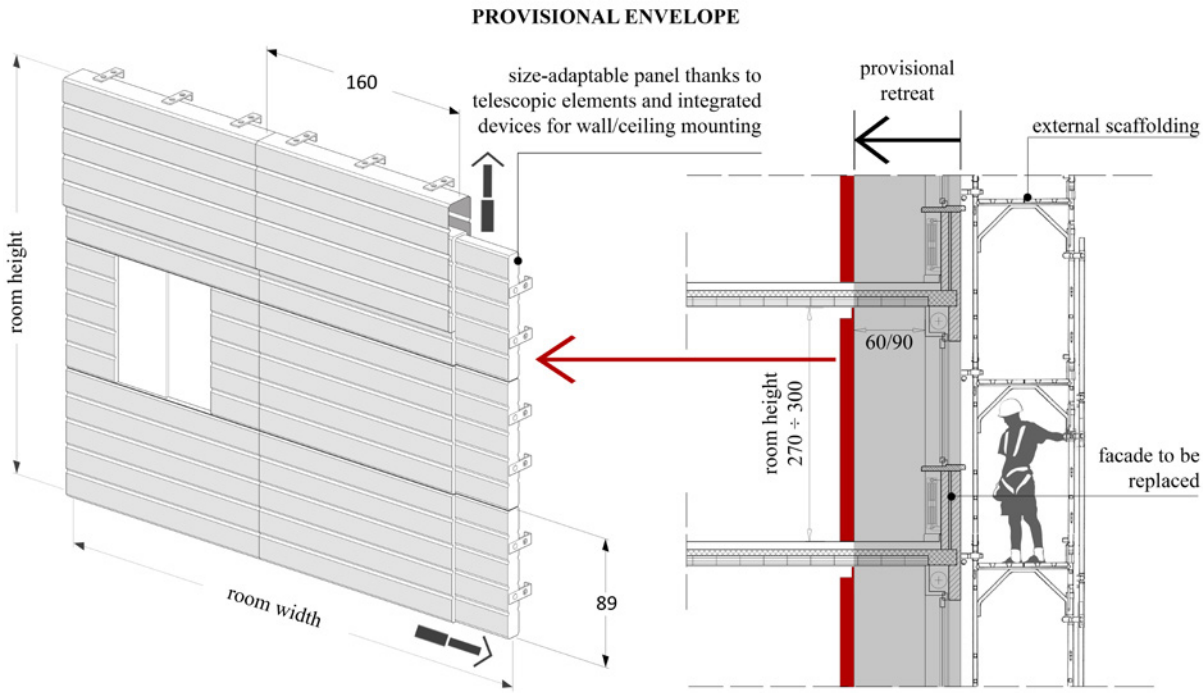

Fig. 2. *Easy-mount and telescopic low-mass prefab elements for the "provisional envelope".*

A building envelope-only replacement requires specific techniques to manage the site, mainly because of the intrinsic difficulties to operate in a sensitive context such as highly-density urban environment, which involves limited available space for the site, logistical and handling difficulties and last but not least the users' & owners' life very close to the working site. This requires specifically trained operators and entrepreneurs also concerning the demolition phase, where a selective de-construction is certainly the correct strategy to respond to the project goals properly and to improve the CDW management.

The whole envelope replacement process will keep the building usage ongoing and fairly compatible with the working site, thus overcoming the problem of relocating occupants. This feasibility goal is based on provisional works, basically by realizing a "provisional envelope", consisting of easy-mount and reusable low-mass prefab elements (a sort of sandwich panels with tongue-and-groove joints and high soundproofing capacity), which would also be size-adaptable thanks to specific telescopic elements, as illustrated in Fig. 2.

This provisional closure should be mounted directly inside the rooms, close to the envelope to be replaced (approx. 60÷90 cm back from it), thus creating a sort of usable gap where operators can also gradually work as the selective demolition goes on.

Some of the panels could provide a sliding window made of unbreakable synthetic material and internal shutters, to assure fresh air and light control, especially when staffs are not working on that room's envelope.

If the building envelope's substitution is limited to the outer layers, the provisional closure may be unnecessary: this is certainly a low-cost compromise solution, moreover with a faster site timeline. In this case, the inner envelope is kept in place with some adjustments to fit the new windows and facilities.

3.2. THE REAR FAÇADE: AN OPPORTUNITY FOR A FUNCTIONAL IMPROVEMENT

In addition to performance, obsolescence, and vulnerability criticalities, second postwar buildings have a qualitative deficit primarily. It heavily weighs on the environment, user comfort, and proxemics: an important role is played by "non-functional" building envelopes (meaning they do not offer any kind of dynamic interaction), thus related to simple idle closures. The building

culture of that period was used to create a hierarchy that rather became a "visual" antithesis, between a (not even always) properly designed street façade, which living spaces stood on, and a simple "window-holder" closure of the rear one, with no whatsoever formal dignity. This has contributed to giving buildings with an increasing loss of today's value and functionality.

Despite that, rear facades themselves, which are usually less normatively restricted because they insist on private courtyards, have favorable conditions to receive a more organic retrofit intervention, aimed firstly to functional improvement. In order to maximize and join functional and performance enhancement, a systemic approach is needed. If rear façade replacement is recon-

Fig. 3. *Post-war residential building (built in 1960-1961) in Kapfenberg (Austria) before (a) and after renovation (b); Rear counter-façade with new spatial arrangements (c). Source: https://architizer.com/projects/renovation-residential-building-kapfenberg/.*

ceived with a greater degree of freedom, for example, by adding a multifunctional counter-façade, new scenarios open up, even to operate indirectly on the whole building.

Such intervention could create e. g. new spatial arrangements, both private and communal, like wider balconies or even covered spaces like loggias; new update horizontal and vertical distribution, as well as a more congenial access system for apartments, which would benefit from a rise in value thanks to the new private transitional in/out spaces. A rear counter-façade also has huge potential in terms of new grid-connections, renewable energy technologies integration, and solar shading control; the latter may be favorably oriented towards greenery systems to take advantage of "free" benefits deriving from vegetal-based materials (i.e. carbon dioxide absorption, cooling through evapotranspiration).

This kind of multi-benefit approach (functional, performance, imagery etc.) has already consolidated in various research fields [16-18], which originated from some European experiences of existing façade over-cladding (overlapping) and re-cladding (replacement), like in the case illustrated in the following Fig. 3.

It is also important to highlight this kind of approach can better convey adaptive and subject-oriented interventions, with a positive return for users' well-being and quality of life.

3.3. THE STREET-SIDE FAÇADE: A KEY ELEMENT FOR ENVIRONMENTAL SUSTAINABILITY

Most of these postwar buildings are located in high-density urban areas, where climate change due to global warming intensifies air pollution, peel temperatures and heat island effects (UHI): this is a non-negligible factor and, moreover, their street-side facades' impervious surfaces are partly responsible for harmful microclimates increasing e.g. for the urban canyon effect.

Every building can do its counteracting part by enhancing its environmental sustainability, much more if it is part of a well-balanced urban scale green planning based on vegetation improvement. Street-side façade rethinking can be a concrete solution: no longer a traditional closure, but rather an active and dynamic interface capable of giving an added value to environmental quality e. g. by integrating vertical greenery systems (VGS). More precisely, indirect VGS framed on external light structures made of trellises, meshes, cables, or wired ropes for climbing plants development, are very well suited to these buildings because of their over-cladding propensity.

According to reviewed literature estimations [19], VGS CO_2 absorption capacity depends on many factors but is around fairly low values like 1 kgCO_2 per year (and would weigh very little in the balance estimated in par. 3.1). The real strengths of these systems are rather related to other intrinsic skills like shading and evapotranspiration cooling since they have higher values of *albedo* than most of the common building materials.

Thus, VGS proved to give a real contribution to UHI mitigation [20], especially in high-density urban areas where the availability of vertical surfaces (façades indeed) for greening is much more potentially usable than horizontal spaces at street level [21]. Obviously, this mitigation effect needs to be evaluated at a neighborhood scale, considering each building contribution, as well as these measures, should be encouraged by urban planning and tax-incentive mechanisms. It might be useful to introduce an indicator at building scale, a kind of UHI mitigation performance (P_{UHI}) for an indirect green façade system, to be evaluated through the capacity to change the balance between paved or impervious surfaces and greenery-cooling surfaces, considering the portion of the built environment in front of that façade, as drafted in the schemes of the Fig. 4.

The increase of cooling surfaces due to indirect green façade implementation is evaluated as the delta value Δ_{UHI}:

The formula (1) is illustrated in Fig. 4 considering different situations: street only; UHI-worsening façade; façade already fully or partially covered with indirect green façade systems (in this last case it is possible to evaluate benefits of increasing the vegetal layer on the indirect façade system).

The resulting delta parameter (1) needs to be related to the built context (different kinds of suburbs, middle town etc.) and decreased with a reduction coefficient when the greening façade takes place in rural

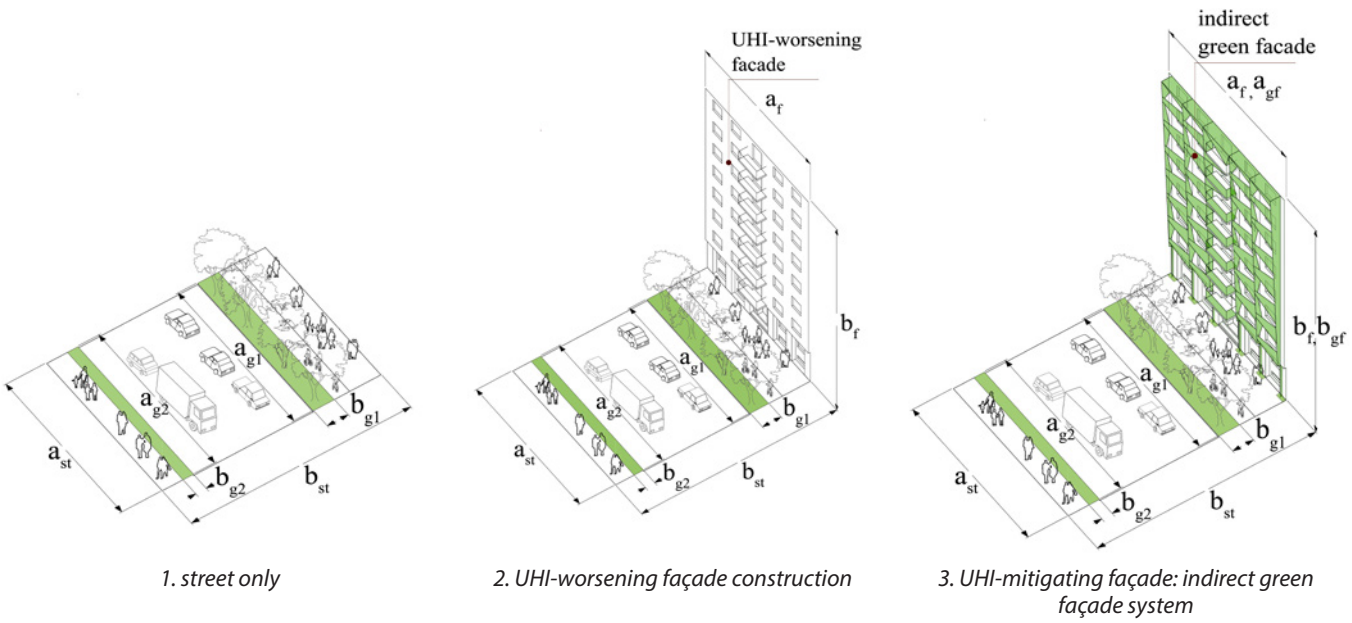

Fig. 4. *Axonometric cross-sections of a built environment according to three configurations: 1. no building; 2. UHI-worsening façade; 3. cool façade optimization with indirect green façade.*

$$\Delta_{UHI} = \left[\frac{\sum(a_{gi} * b_{gi}) + (a_{gf} * b_{gf})}{(a_{st} * b_{st}) + (a_f * b_f) + (a_{gf} * b_{gf})}\right]_1 - \left[\frac{\sum(a_{gi} * b_{gi}) + (a_{gf} * b_{gf})}{(a_{st} * b_{st}) + (a_f * b_f) + (a_{gf} * b_{gf})}\right]_0 \quad [0 \div 1] \quad (1)$$

Where:

$\sum(a_{gi} < b_{gi})$ existing cooling surfaces in the street portion

$(a_{st} < b_{st})$ façade-related street portion*

$[\ ]_1$ final situation

$(a_{gf} < b_{gf})$ façade portion with an indirect green façade system

$(a_f < b_f)$ façade portion without indirect green façade system

$[\ ]_0$ initial situation

*The façade-related street portion considered must never exceed the area of the façade itself. In these cases, the street portion to be considered is represented by the façade overturning on the ground.

or peripheral areas that are marginally or not at all affected by UHI effects. Since there is a recognized relation between UHI effect and population density [22], the following diagram (Fig. 5) adapts the coefficient mentioned above for rural (scarcely populated) and peripheral (intermediated populated) neighborhoods. The product between the reduction coefficient $C_{r,UHI}$, and the Δ_{UHI} generates the urban heat island (UHI) mitigation parameter P_{UHI} (2).

$$P_{UHI} = C_{r,UHI} * \Delta_{UHI} \, [0 \div 1] \quad (2)$$

The population-weighted density thresholds shown in Fig. 5 diagram derives from the European Degree of urbanization DEGURBA [23], which provides am harmonized classification of thinly, intermediate, and densely populated areas.

This behavioral and performance parameters approach could be favorably extended in order to value many different aspects of an indirect VGS, thus going so far as to define a global performance indicator [24].

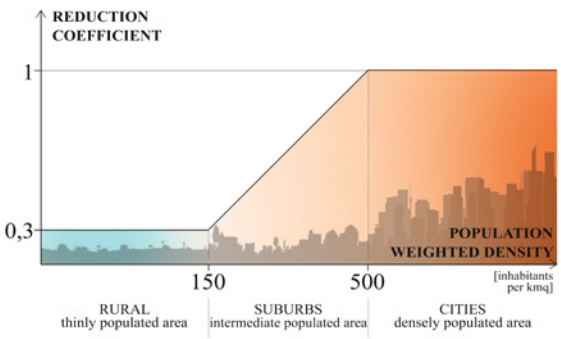

Fig. 5. *Graphic illustrating a reduction coefficient Cr for ΔUHI (2), compared to the population density.*

4. RESULTS

The typical assessment on the carbon footprint balance depending on façade-only replacements on post-WWII buildings has a rather low increase of the embodied carbon (around 15% compared to the total embodied carbon) and instead of significant weight on operational carbon savings, thanks to new façade thermal performances. Such interventions appear, therefore, particularly virtuous, so that the balance point between embodied carbon increase and operational carbon saving can be reached in 9 years only, after which the new façade system starts lowering the building's long-term CO2 footprint.

The sustainability of such works could be enhanced by expedients and strategies, like the selective de-construction of the existing façade in order to properly manage recycling activities of CDW wastes, here less heterogeneous, in compliance with the Waste Framework Directive; more quick and efficient site management, for example implementing a "provisional envelope", can feasibly keep ongoing the building usage in spite of a good compatibility with the working site.

According to the authors, particularly interesting and worthy of more in-depth analysis in the future are also some "side effects" e. g. the inward/functional rear-façade importance and the outer/environmental street-side value.

5. CONCLUSIONS

Rethinking the sustainable housing renewal facing a decarbonized EU building stock by 2050 requires a real focus on postwar buildings, because of their anything but negligible amount and their closeness to the end-of-life. General demolition & rebuilding seems to be the right choice to achieve the goal of an updated and environmentally friendly building: better energy rating and CO_2 footprint. At a closer look, the common way to assess the CO_2 footprint neglects the carbon embedded in the building: it is an "on duty-only" rating. But if we consider the whole carbon footprint balance (construction, service life, de-construction) a new option comes into the limelight: demolition & rebuilding of the vertical envelope only: quicker works, no need to reallocate inhabitants, less waste impact and a great improvement for thermal performances and building functionality with a better fallout on the environment.

Façade-only rebuilding showed to be an effective strategy to increase the micro-resilience and the environmental value of post-WWII building heritage. In doing so, a methodology to correctly upgrading these buildings needs to be consolidated and encouraged above all.

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