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Technological Imagination in the Green and Digital Transition

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Chapter 38
The Regulatory Apparatus at the Service of Sustainable Planning of the Built Environment: The Case of Law 338/2000

Claudio Piferi

Abstract It is wrongly assumed that the environmental sustainability of the building organism is only achievable thanks to the contribution of the systems and their ability to reduce harmful emissions and generate energy from alternative and natural sources. So, system projects have assumed an increasingly considerable importance both in terms of the quantity of documents and the cost of the building. The quantity and complexity of the most recent plant engineering solutions amplify the difficulty of dialogue between the different design levels (architectural, structural, and system design) forcing the professionals involved to compromise that end up disregarding the expected quality. Although it is now clear that the design levels must progress hand in hand from the first hypotheses, and that all must contribute equally to the overall sustainability of the intervention, this does not always happen by preferring to derogate from the system designers the choice of environmentally sustainable solutions. In summary, more and more, often we rely on the technical solutions of the machines used, rather than on the technological qualities of the project. This inevitably involves problems in the construction, operation, and eventual decommissioning phase of the building, especially in the public sphere where the low economic resources of the contracting stations are increasingly used in the purchase, maintenance, management, and disposal of plant engineering tools. A well-structured regulatory system can help to minimize these criticalities: this is the case of law 338, enacted in 2000 with the aim of increasing the availability of residences for university students, which is distinguished for the attention to the environmental issue, orienting the realization of accommodation places towards solutions able to contain waste, soil consumption, etc. The paper aims to describe and analyse the attention paid by the specific legislation to environmental sustainability.

Keywords Environmental sustainability · Law 338/200 · Built environment · Buildings and urban regeneration · Energy efficiency

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38.1 Introduction

If the regulations on energy saving are now established in our country, just think of the innovative law no. 373/76, replaced by law no. 10/91, and with Legislative Decree 192/05 and with Legislative Decree n. 311/07, less present are the rules for a 360-degree sustainable technological design. The Minimum Environmental Criteria[1] represent an undoubted innovation as they not only aim at reducing environmental impacts, but also at promoting sustainable production and consumption models aimed at identifying the best design solution, product, or service under the environmental profile over the life cycle assessment given the market availability. Law no. 338/00 is the first national example of an organic program aimed at increasing the number of residences and accommodation places for university students and is strongly characterized by the attention paid to actions and policies aimed at the sustainability of the built environment (Piferi 2021). In Germany, the construction and administration of university residences are entrusted to a state-run non-profit organization, the Deutsches Studentenwerk (DSW), partly funded by the Lander and partly by private companies, which is legally responsible for the construction and management of student accommodation (Germany Visa 2021), while in France, the organization responsible for allocating and managing student accommodation is the Centre National des Œuvres Universitaires et Scolaires (CNOUS), which is financially autonomous and reports to the Ministère de l'Enseignement Supérieur et de la Recherche (MESR 2011). In Spain, in addition to public universities, the construction of university residences is mainly delegated to private investors, including foreign ones (JLL 2018), and in Ireland, the public Housing Finance Agency (HFA) has been allowed to finance Higher Education Institutions (HEI) to build Purpose-Built Student Accommodation (PBSA), bespoke student accommodation built by private investors (CEB 2021). In Italy, Law 338/00 provides state co-financing for measures aimed at upgrading regulations, extraordinary maintenance and renovation, new construction and purchase of buildings already intended or to be intended as university residences.

38.2 Framing

The legislator immediately understands how the relationship between generations in training between the ages of 19 and 26 and sustainability is now indissoluble: young people are generally more aware and interested in ecological issues and climate change, as well as naturally predisposed to the use of new technologies. The university residence can be configured as an exemplary place where to experiment and implement solutions in support of environmental sustainability. In the twenty years

[1] In Italy, the effectiveness of CAM is guaranteed by art. 18, L. No. 221/15 and by art. 34, Legislative Decree No. 50/2016, containing "Criteria for energy and environmental sustainability", amended by art. 23, Legislative Decree No. 56/17 and subsequent amendments.

and in the five calls (2002, 2007, 2011, 2016, 2021), the law has further evolved, becoming a real best practice also in this area. Perhaps, the most important aspect lies precisely in the fact that the law goes into detail on the expected energy performance and addresses the issue of sustainability with a circular approach, taking care of the environmental, economic, social, and cultural aspects of the operation, because only the satisfaction of all these components can guarantee the real sustainability of the intervention. The strong orientation of the legislation towards the recovery of the existing building heritage, rather than towards the construction of new buildings, underlines this conviction. Informed that new buildings involve a considerable use of energy, that Italian cities are characterized by the presence of abandoned buildings, and that the system of "disseminated" universities over the territory, typical of the Italian reality, is mainly structured in the historic centres of city (Del Nord 2014), the legislator, in art. 1, specifies that the law was created to allow the state to contribute to the implementation of interventions necessary for the removal of architectural barriers, for the adaptation to the current provisions on safety and for extraordinary maintenance, recovery, and renovation of buildings already existing, as accommodation or residences for university students, as well as for new construction and purchase of areas and buildings to be used for the same purpose: the priority, therefore, appears to be to recover the existing building stock, compared to new construction interventions This has allowed the recovery of abandoned buildings, and the urban and social regeneration of depressed and degraded areas (Baratta and Piferi 2015): if we add the inevitable efficiency improvements to the theme of urban and social redevelopment energy and the low (or zero) economic investment that the proponents have had to support, we can understand the circular sustainability of the program. The recovery of the existing building stock is encouraged by the possibility, offered by the law, to bring the value of the property as part of the co-financing amount and consequently obtain state funding equal to the total amount of the work. Also, the interventions on the existing building patrimony of value and constrained have considerable advantages in terms of compliance with dimensional standards, providing for decreasing percentages on legal obligations. More than 76% of the 323 projects in progress concern existing buildings: almost 13,000 of the over 38,000 accommodation places involved are in existing buildings and around 11,500 are newly built (Figs. 38.1 and 38.2).

Very significant are the projects of the residences of "Crociferi" in Venice and of "Benedettini" in Palermo, which have redevelop abandoned historic buildings and, at the same time, regenerate neighbourhoods characterised by significant social complexity or that were slowly depopulating (Figs. 38.3 and 38.4).

The focus on the recovery of existing assets was further strengthened in 2021 when the law was specifically amended. Art. 15, Legislative Decree no. 152/21, amends art. 1, adding paragraph 4-bis which states: "In order to pursue the objectives identified in the communication of the European Commission of 11 December 2019 on the European Green Deal, implemented in the National Recovery and Resilience Plan, restructuring, transformation, also through demolition and reconstruction interventions, and the purchase of existing structures and buildings with the aim of pursuing

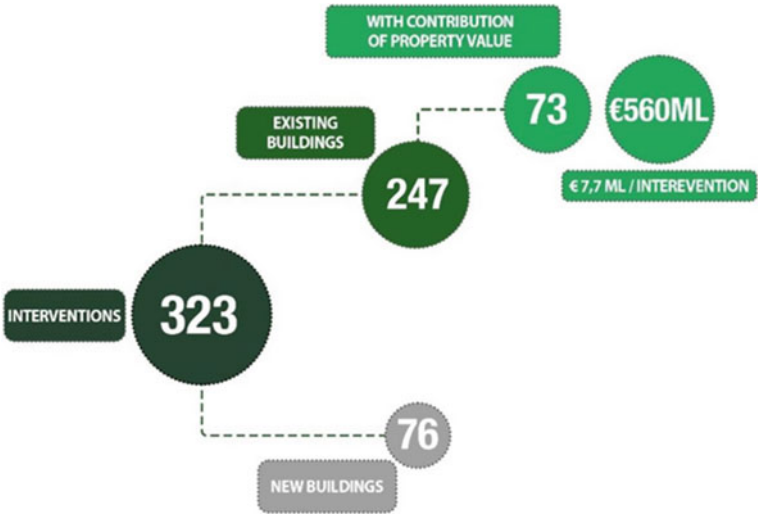

Fig. 38.1 Interventions in progress financed by law no. 338/00: new construction and recovery of the existing building heritage (*Author* arch. Andera Sichi)

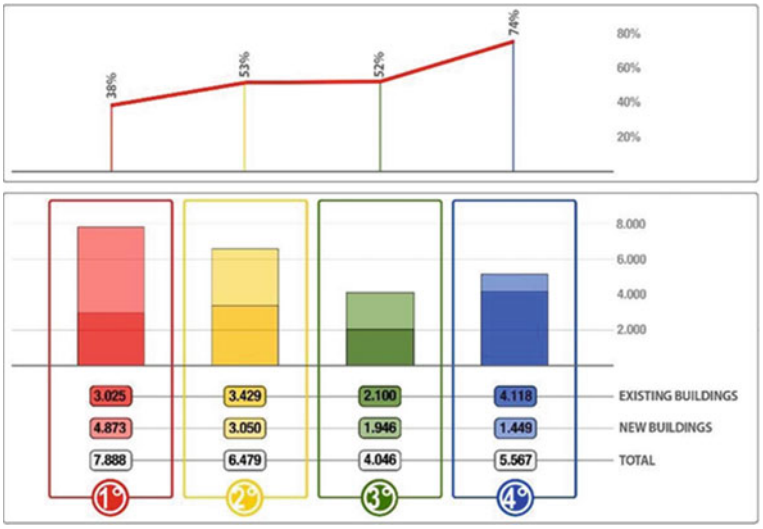

Fig. 38.2 Accommodation places financed by law no. 338/00 divided by calls for tenders and between former nine and existing buildings (*Author* arch. Andera Sichi)

Fig. 38.3 "Benedettini" University Residence, Palermo (*Source* TESIS archive)

Fig. 38.4 "Crociferi" University Residence, Venice (*Source* TESIS archive)

high environmental standards in the construction and management of the interventions". The D.M. n. 1256/21, the fifth call of the law, sharpens this concept, specifying in paragraph 1, art. 4, that in implementation of the provisions of the annex relating to the approval of the PNRR assessment of 8 July 2021, new construction of green-field buildings is not admissible, except for interventions included in existing campuses, or in neighbouring areas to university settlements. In the first issue,[2] the law, among the technical performance requirements to be respected, introduces, energy saving, maintenance, and well-being (thermo-hygrometric, olfactory, visual, etc.), etc. The annex specifies that the building and its systems must be designed and built so that energy consumption during use is optimized in relation to the conditions of well-being for the occupants. So, it is necessary to control solar irradiation and ventilation

[2] Annex B "Guidelines relating to technical and economic parameters", Ministerial Decree No. 118/2001.

and to comply with the indications of the legislation regarding heat loss. Furthermore, it specifies that the energy needs must be met preferably using renewable and alternative sources. The annex defines some factors, subsequently implemented by specific legislative apparatus aimed precisely at energy saving, to be taken into consideration for a correct energy conception of the building, i.e.:

- local climatic conditions;
- geomorphological characteristics of the area and exposure;
- typological and local settlement characteristics;
- control of solar radiation in summer: reduction to 30% of the heat due to summer heat radiation in the absence of external protections and possible adoption of selective glass;
- use of free heat supplies in winter but their limitation to 20% of the energy requirement calculated for each room;
- use of solar systems such as capturing walls, greenhouses, solar panels, etc.;
- exploitation of natural ventilation;
- innovative systems for the exploitation of natural lighting;
- control of the thermal behaviour of opaque and transparent components, with the elimination of interstitial and surface condensation;
- plant efficiency, with recovery of residual energy and reductions in exhaust emissions;
- introduction of integrated regulation and control systems between the electrical system, heating, and air conditioning.

To underline the importance reserved to the topic, the law specifies that newly constructed buildings must consider the principles of environmental protection, even in the absence of indications in urban planning tools and building regulations: these principles must be respected, whenever possible, also in the interventions of extraordinary maintenance, recovery, or renovation of existing buildings. Finally, particular importance is given to the feasibility study which must include an exhaustive characterization of the site (depending on the climate, availability of renewable energy sources, availability of natural light, etc.) and the environmental factors that may be influenced by the intervention, to direct it towards their respect (air, water balance and water cycle, soil and subsoil, ecosystems and landscape, historical typological aspects).

This attention to the issue of environmental sustainability was further expanded in the fourth call (2016) and is certified with the introduction of a specific category of projects, those aimed at energy efficiency of existing buildings, for which the Ministry identifies a specific line of co-financing equal to 15 million euros.

38.3 Analysis and Structuring of the Data Collected with the Research Activity

The research activity carried out with specific agreements with the MUR and with CDP S.p.A., through the investigation and monitoring of the interventions financed with law no. 338/00, has also made it possible to identify and catalogue the energy solutions promoted by the subjects, investigating the most significant ones and verifying the expected results with those achieved. About 490 projects were examined: for each request for co-financing a specific verification form was prepared to understand and validate the environmental and technological solutions, both traditional and innovative, adopted by the subjects (Fig. 38.5).

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Residenze per studenti universitari. Richieste di cofinanziamento ai sensi della L. 338/00 — Istruttoria

CRITERI DI SOSTENIBILITÀ

TIP.	SOGGETTO	CAT.	LOCALIZZAZIONE	REGIONE	CODICE	FASCICOLO
...	.....	...	.....	.....	.....	...

	OGGETTO	VERIFICA SI	VERIFICA NO
1	SOLUZIONI AMBIENTALMENTE SOSTENIBILI		
1.1	Impianto fotovoltaico		
1.2	Impianto solare termico		
1.3	Impianto di teleriscaldamento		
1.4	Impianto geotermia		
1.5	Impianto eolico		
1.6	Impianto rigenerazione		
1.7	Impianto VRF-VRV-VMC		
1.8	UTA		
1.9	Pompa di calore		
1.10	Free cooling		
1.11	Centrale termica alimentata a biomasse		
1.12	Cogeneratore ad alto rendimento		
1.13	Pannelli radianti		
1.14	Sistema di controllo dei consumi energetici		
1.15	Sistemi di regolazione temperatura		
1.16	Caldaia o gruppo termico a condensazione		
1.17	Gruppo frigo con recupero calore		
1.18	Sostituzione di illuminazione con corpi illuminanti a LED		
1.19	Sistemi di risparmio idrico		
1.20	Copertura verde/tetto giardino		
1.21	Sistemi di recupero acque meteoriche, grigie, di condensa o acqua di laguna		
1.22	Uso di materiali ecocompatibili		
1.23	Infissi ad alto rendimento termico/finestre solari		
1.24	Ventilazione basso consumo		
1.25	Cappotto termico		
1.26	Isolamento termico con materiali naturali		
1.27	Miglioramento/salvaguardia del contesto ambientale e naturalistico circostante		
1.28	Certificazione (NZEB, LEED, ARCA, ecc.)		
1.29	Protocollo ITACA		
1.30	Corretto orientamento		
1.31	Facciata ventilata		
1.32	Sistema di ombreggiamento		
1.33	Rapidità di costruzione, salubrità e riciclabilità dei materiali, uso di soluzioni a secco		
1.34	Riutilizzo di rifiuto umido per compost		
1.35	Gestione partecipata mediante "crediti energetici" (manutenzione del verde, orti urbani, ecc.)		
1.36	Massimizzazione dell'illuminazione naturale		
1.37	Approccio LCA-LCC		
1.38	Integrazione con il contesto urbano		
1.39	Bilancio energetico e carbonzero		
1.40	Classe energetica di partenza		
1.41	Classe energetica di progetto		
NOTE			

Fig. 38.5 Monitoring board for sustainable solutions (*Source* TESIS archive)

The research first identified and catalogued the solutions and technologies put in place to increase the energy efficiency of buildings and reduce their consumption and verified their actual presence and potential. In some cases, the inspections, carried out on over 170 residences, also made it possible to document and verify the effectiveness of the solutions adopted. If we take into consideration the 93 requests for co-financing accepted in the fourth call, we see that the subjects, to reduce the energy needs of existing buildings, many of which characterized by a starting energy class equal to F or G, have focused mainly on the potential of the systems, even if there is no lack of broader architectural solutions. Among the most adopted system solutions, it is necessary to mention the use of photovoltaic panels, solar thermal systems and heat pumps, VRF or VMC ventilation systems, and the replacement of lighting devices with LED bodies, (between 40 and 50% requests for co-financing): almost all the solutions also adopt software and systems for controlling energy consumption, which regulate the temperature, the electricity consumed, the opening of the windows, etc.: there are fewer interventions that provide for the use of condensing boilers (15%). For the "architectural solutions", the most adopted ones are the use of thermal insulation on open spaces (not many with the use of natural materials) and the use of high thermal performance windows with triple glazing and systems solar collection (between 40 and 60% of requests). Particularly, interesting are some types of thermal insulation that provide for the use of nanotechnologies to allow the use of reduced thickness insulators to comply with the requirements of the superintendence for interventions concerning listed buildings and which guarantee the reduction of the transmittance of the facades to about one third. About 15% of the requests proposed solutions for the recovery of rainwater, grey and condensate water, to be reintroduced into the water circuit, and provided for specific solutions aimed at reducing water waste: garden roof solutions were not widely adopted (less than 5%). Also, there were many requests that used ventilated facade systems (7%), often integrated with a brise-soleil system for shielding solar radiation (15%). Few projects have exploited the thickness of the ancient walls to raise the building's thermal inertia or orientation to favour natural lighting and cooling (less than 5%) (Fig. 38.6).

The monitoring of the interventions, carried out through inspections on the residences built, made it possible to verify, in many cases, the results achieved: on average, the interventions in progress had a reduction in energy requirements of about 30% and the overcoming of three energy classes. Over 40% of the interventions guarantee an energy class equal to A, or higher, but only 10% have an energy certification (LEED, NZEB or similar): less than 10% of the buildings (of architectural value, listed, for which the subjects could not adopt some improvement solutions) presents, at the end of the works, an energy class lower than E. It seems appropriate to mention some proposals of the applicants who, correctly interpreting the intentions of the law, have oriented their choices towards broader solutions such as participatory management, or the recognition by the energy credit manager of the most virtuous students in the recovery of materials recyclable, in the maintenance of greenery and in the shared use of urban gardens, the re-naturalization of areas, the elimination of asphalts, and the use of dry construction solutions to reduce waste

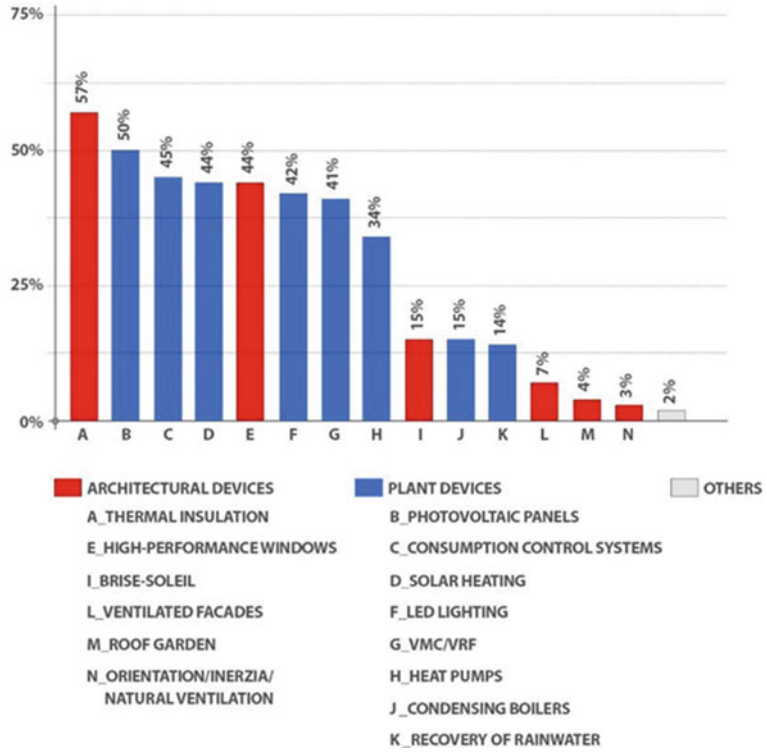

Fig. 38.6 Solutions adopted for the energy efficiency of university residences (*Author* arch. Andrea Sichi)

during construction and facilitate the possible disassembly and recycling of building components.

38.4 Results of Research and Regulatory Developments

In addition to confirming the availability of a specific financing quota for energy efficiency interventions, the evolution of law no. 338/00 in the field of environmental sustainability is inseparably linked to the PNRR which dedicates a specific paragraph precisely to university residences and to reform of the law and obliges the regulatory apparatus to comply with the environmental and digital parameters established in Europe.[3] To access the resources, attention to the climate issue and energy saving are further emphasized from the perspective of the Do No Significant Harm principle.

[3] Mission 4: education and research. Reform 1.7: Student housing and reform of student housing legislation.

The DNSH principle[4] is based on the concept that when you intend to plan an intervention, you need to ask yourself questions whose answers define the actual sustainability of the project in terms of:

- mitigation of climate change: is the intervention expected to involve significant greenhouse gas emissions during construction and use?
- adaptation to climate change: is the intervention expected to lead to a worsening of the negative effects of the current climate and the expected future climate on itself or on people?
- sustainable use and protection of water and marine resources: is the intervention expected to harm the good status or ecological potential of water bodies, including surface and groundwater or the good ecological status of marine waters?
- circular economy, including waste prevention and recycling: is the intervention expected to lead to a significant increase in the production, incineration, or disposal of waste, […] or to lead to significant inefficiencies […] in direct use of indirect natural resources at any stage of their life cycle or cause significant and long-term environmental damage from the point of view of the circular economy?
- prevention and reduction of air, water, and soil pollution: is the measure expected to lead to a significant increase in emissions of pollutants into the air, water, or soil?
- protection and restoration of biodiversity and ecosystems: is the measure expected to significantly harm the good condition and resilience of ecosystems or harm the conservation status of habitats?

In addition to the evaluation of the efficacy and usefulness of the project, understood as the ability to achieve the objectives assigned in the indicated times and as the convenience for the reference "community", the efficiency of the project is included, understood as the degree of achievement of the objectives with the minimum possible consumption of resources and the sustainability/durability of the project, understood as the ability of the project to sustain itself over time and in the subsequent management and implementation phases. The previously described research activity also allowed the identification of some parameters that will be used to assess eligibility for co-financing and to define the ranking of interventions. Regarding the admissibility of the interventions, the call specifies that at least four of the following parameters must be respected:

- the reduction of the consumption of material resources through:
  - the use of material with a content of recycled or recovered material for at least 20% by weight estimated on the total of all materials used, excluding plants;
  - the use of prefabricated mechanical assembly solutions for at least 60% of the volume of the works;
- the reduction of energy consumption:
  - for interventions on existing assets, increase of three energy classes;

[4] EU Regulation no. 2020/852.

  - the achievement of any energy class A, for new buildings, energy positive building or energy positive district;

- the reduction of water consumption, so the adoption of recovery and reuse systems for at least 50% of rainwater;
- the reduction of soil consumption, so no increase in the surface ratios between artificial and non-artificial coverings.

In relation to the assignment of the score for the definition of the ranking, however, environmental impact indicators are introduced, such as:

- the energy sustainability indicator: use of renewable energy (solar, wind, geothermal water, biomass);
- the energy efficiency indicator (energy class of new buildings and, in the case of intervention on existing assets, increase in energy class);
- the consumption reduction indicator of material resources (cubic metres of material to be reused or recycled of materials and products/cubic metres of total material used);
- the sustainability indicator (adoption of environmentally sustainable products and technical solutions).

38.5 Conclusions

The law calls for the adoption of solutions aimed at limiting energy consumption, regulating the functioning of the energy systems used, resorting when possible to renewable energy sources, intervening on the regulation and improvement of the local microclimate, adopting solutions aimed at reducing the consumption of drinking water, with the adoption of integrated plant solutions and systems that also promote energy saving, together with the incentive for the reuse of water resources, suitably purified to reduce the polluting load in the environment. The regulatory system, therefore, defines design criteria aimed at a circular sustainability that contemplates the plant solutions but integrates them with a broader cultural approach. Although plant evolution has played, and still plays, a very important role in energy efficiency and the achievement of environmental sustainability of building interventions, law no. 338 has shown, in the twenty years of its application, how the issue of sustainability can also be tackled with a circular approach, allowing particularly "enlightened subjects" to experiment with innovative solutions. The research activity highlighted how the solutions can be chosen, implemented, and specifically calibrated according to the specific needs of end-users and facility managers.

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