Energy Performance Contracts (EPCs): a public-private partnership for the energy retrofitting of historic buildings in the Italian context

Cristina Boniotti[1*], Alessia Buda[1] and Valeria Pracchi[1]

[1] Politecnico di Milano, Department of Architecture, Built Environment and Construction Engineering, Milan, Italy.



*E-mail: cristina.boniotti@polimi.it; alessia.buda@polimi.it; valeria.pracchi@polimi.it

Abstract. In recent years, public-private partnerships have increasingly been adopted in the cultural heritage sector due to the lack of both public funding and the managerial expertise required to ensure long-term conservation and valorization. Cross-disciplinary collaborations make possible the acquisition of new resources, both in terms of financial support and skills. Interactional expertise and negotiations also promote the sharing of best practices and the development of innovative processes.
In this context, the paper focuses on the Energy Performance Contract (EPC), a contractual model fostering public-private cooperation to improve the energy efficiency of existing buildings in the context of built heritage by presenting the main legislative framework, various EPC models, and their implementation in Italy through several case studies.

Keywords – Energy Performance Contract (EPC); Public-Private Partnership; Energy Retrofitting; Historic Buildings.

1. Introduction

The European Green Deal is the growth and recovery strategy aiming to turn Europe into the first climate neutral bloc by 2050 [1]. Given that renovating existing buildings in an energy and resource efficient way is a key area of action (art. 2.1.4, European Green Deal) – without which the full decarbonization of the European economy cannot be achieved – investments in this way are expressly necessary. Thus, the European Union is currently leveraging energy efficiency investments by means of tailored instruments, project development assistance, and co-financing for private investments [2; 3]. The European Energy Efficiency Financing Coalition was also established, which is a Commission bringing together European countries, financial institutions, and other stakeholders, to identify actions aimed at improving energy efficiency-related private funding [4]. The Coalition's work aligns with the objectives of the Energy Performance of Buildings Directive (EU/2024/1275) [5], thus supporting European countries to implement these rules at national level on the existing building stock, including built heritage (art. 17, comma 7).

Considering the above, this paper explores public-private partnerships as being among the institutional options suitable for adoption to ensure the energy retrofitting of historical buildings. Indeed, and in recent years, the cultural heritage sector has increasingly turned to public-private partnerships as a strategy to address the challenges of conserving and valorising heritage assets. The above trend is largely driven by both a shortage of public funding and the need for specialized managerial expertise. Heritage sites, particularly so in the case of historic buildings, require steady maintenance and conservation activities, which in turn presents a significant financial and technical burden to public authorities.

Not surprisingly, the involvement of private entities has emerged as a critical solution to supplement public resources and provide innovative, long-term sustainability strategies. Public-private collaborations do not rest solely upon the presence of shared funding, but furthermore involve the exchange of skills and expertise across various sectors. Such cross-disciplinary interactions encourage the development of new management models, the sharing of best practices, and the fostering of innovative solutions to conserve and enhance cultural heritage [6].

Among such innovative public-private financial models is the Energy Performance Contract (EPC), a scheme aimed at streamlining energy efficiency improvements in buildings through public-private cooperation. The EPC model offers a unique opportunity to address the dual goals of heritage conservation and energy sustainability by integrating public interests with private sector expertise, particularly in the form of Energy Service Companies (ESCos), companies specialized in the provision of technical and financial services for energy improvement.

In the light of the above, this study aims to highlight the potential of EPCs as a tool for promoting energy efficiency in historic buildings, while at the same time ensuring their long-term preservation, focusing on the specific challenges and opportunities presented by its application in historic buildings in Italy through some case studies.

2. The role of public-private partnerships in the cultural heritage sector

A public-private partnership (P3) is a long-term cooperative arrangement between public and private entities, aimed at accomplishing publicly relevant duties, such as financing, designing, constructing, renovating, or operating public works or services [7]. In a P3, resources, responsibilities, and risks are shared based on each party's capabilities and contribution. Indeed, the resources to be shared can be either tangible (capital and funds, i.e. both costs and revenues), or intangible (managerial and technical skills, which the public sector often lacks). P3s constitute an opportunity for carrying out large interventions funded through total or partial investments provided for by private entities.

The P3 commonly comes to fruition in sectors such as transportation, social housing, public health, education, national security, waste management, and water and energy procurement. Nevertheless, and in recent years, institutional entities suggested the introduction of the P3 in the heritage sector [8] whilst scholars, for their part, began to define the heritage P3 and analyze the early experiences [9-17].

Not surprisingly, P3s have gradually been adopted in the cultural heritage field as a response to the increasing complexity and cost of managing historical sites. Indeed, the lack of public funding and management support begets a few difficulties in ensuring the long-term conservation and valorization of public buildings, which entails, among others, the presence of high maintenance costs, and the need for both significant technical expertise in the field of preservation methods and uncompromising compliance with regulatory standards.

On the one hand, a public partner should specify the quality and quantity of works and/or services they expect as part of a given contract. On the other hand, such private partner shall attain a return on investment through the cash flow generated by the management of a given asset, or the payments effected by public authorities [18].

In recent decades, a wide range of P3 contract types have been introduced which vary in the degree of responsibility and risk assumed by a given private partner [19]. P3s generally fall within the following categories, which display ever-increasing levels of private sector involvement: Design-Build (DB), Design-Build-Maintain (DBM), Design-Build-Finance (DBF), Design-Build-Finance-Maintain (DBFM), Design-Build-Finance-Operate (DBFO), and Design-Build-Finance-Operate-Maintain (DBFOM), respectively [20]. In the cultural heritage sector, the same P3 contracts can be adopted, provided that the "Build" stage is replaced by the "Conserve" stage.

In the Italian context, P3s have expanded from just over 300 calls for bids in 2002 [21] to 19,4% of the total value of tenders in 2023 (for both works and services) [22], with a slight decrease in 2020-2021 due to the impact of COVID-19. Italian P3 experiences in heritage field have been often developed as instances of concession, which is generally considered a Design-Build-Finance-Operate-Maintain (DBFOM) instrument of P3 [23], such as the "Valore Paese Fari" (Country Value – Lighthouses) project of the Demanio Agency (State Property Office), the Royal Villa in Monza [24], and the "Le Navi Antiche di Pisa" Museum.

Private resources should bring advantages to the financing and valorization of public buildings thanks to their: combination of public (social utility) and private interest (profit); efficiency in the time and ways of project implementation (achievement of expected cash flow); effectiveness, since a public activity transformed into a business is evaluated according to profitability and competitiveness criteria; finally, transparency, since the further involvement of entities required to work interdependently typically provides additional cross-checking opportunities.

However, most practical experience has been exposing some difficulties in implementing P3 operations. By way of example, the central wing of the Royal Villa in Monza was restored and managed for some years by means of a concession in which the property, represented by various public owners united into a consortium, struck a formal arrangement with a private tenant. Unfortunately, the latter withdrew from the contract after only six years, during the worst months of the pandemic, due to overwhelming difficulties in eliciting any return on investment.

Given the above difficulties, the limited number of cases performed, and the risk of losing control over the quality of interventions, P3s still require further study and the construction of shared paths [25]. Most importantly, there is a need to examine the use of novel P3 tools aimed at developing sustainable operations, including energy efficiency measures. More specifically, the following section attempts to delve into the issue of Energy Performance Contracts (EPCs) and Energy Service Companies (ESCos) aimed at designing and implementing energy efficiency retrofitting within historical buildings.

3. An overview of Energy Performance Contracts (EPCs)

In the framework on P3s, EPCs are a third-party funding scheme widely used to support energy efficiency interventions within existing buildings on part of public administrations that enjoy both international (especially in the EU energy Directives 2024/2476 and 2023/1791, artt. 131-133) [26; 27] and national recognition (e.g., in the Legislative Decree 36/2023 – Public Procurement Code, art. 200 the P3 discipline is extended to EPCs) [28].

The EPC consists in a contract established between a beneficiary, typically a public institution or building owner, and a private service provider boasting special expertise in the field, e.g. an Energy Service Company (ESCo). In Italy, according to Italian Statistics Institute data [29], it is estimated that EPC contracts represent 29% of the total amount of concession agreements. Besides, the total contractual value of EPCs in the public sector between 2020 and 2023 has amounted to about 424 million euros, with only 34% of which having been produced in the past year. However, the geographical distribution in the use of EPCs exposes an outspoken disproportion between regions of northern Italy (especially Lombardy) on the one hand, and the rest of the Italian peninsula, thus highlighting a certain degree of mistrust vis-à-vis this financial tool.

But how does an EPC work? The basic principle of EPCs is that investments in energy efficiency are paid overtime (in whole or in part) through the cash flows achieved from the energy savings obtained. In simple terms, a public administration/building owner (beneficiary) turns to the ESCo market (supplier) by way of a public tender (which usually consists in a negotiated procedure) to carry out energy efficiency improvements over a given number of years. Indeed, the ESCo is responsible for implementing and maintaining energy efficiency improvements over the contract duration, assuming the financial risk associated with these improvements. The cost of the project is often recouped through the energy savings generated by the retrofits, which provides an incentive for the ESCo to ensure that the upgrades are effective and efficient. In this process, an efficient allocation of risks is of crucial importance not only during the contract award phase, but for the success of the transaction.

In terms of risk sharing, financing coverage, and remuneration of the ESCo, EPCs can be framed in several contractual forms of energy performance [30-32].

A typical form of EPC contract is that of “Shared Savings”. In this arrangement, both beneficiary and ESCo agree on the division of the income from savings, generated by the energy retrofitting according to an energy auditing. This model is often used when the building owner is well willing to invest some capital upfront but wants to share the financial risk with the ESCo. The contracts have a duration of about 5-10 years in consideration of the fact that only a portion of the savings contributes to the recovery of the initial investment. This type of contract stimulates the ESCo to maximum efficiency but has the disadvantage of making it more difficult to evaluate the savings and knowing in advance the share that the beneficiary must pay to the ESCo.

In the “Guaranteed Savings” model there is instead a third-party lender with respect to the beneficiary (who underwrites the loan). The ESCo normally assumes the role of finding and organizing financing, as well as guaranteeing a specific level of energy savings, assuming the technical risk of the operation and receiving a fee for the operation and maintenance service of the technical systems. This EPC usually lasts for 4-8 years. This model provides a high level of security for the beneficiary, as the financial risk is transferred to the ESCo, and it has the certainty that the investment annual rate will not exceed the historical annual energy costs.

With the “Chauffage Model”, the ESCo takes full responsibility for the energy management of a building (mainly operation and maintenance), which includes both supply and demand-side measures. The beneficiary pays a fixed fee for energy services equal to the energy expense that it faced before the entry into force of the contract minus an agreed discount. The ESCo will retain any savings generated for the entire duration of the contract, which usually lasts for 20-30 years to allow an adequate payback time for investments.

Lastly, in the so-called “First out” model, the ESCo takes charge of the initial investment (also through third-party lenders) for the construction of new technical installations. The savings achieved are entirely used to repay the investment and remunerate the ESCo. At contract expiration, which may vary in length usually in 3-5 years, all savings obtained, and the ownership, management, and maintenance of the technological systems will be passed on to the beneficiary.

In addition to the EPC models listed above, there are also hybrid contracts in which savings are guaranteed by way of risk sharing [33; 34]. In particular, in literature we can find special EPCs (called “EPC Plus”) where the service of the ESCo extends to the implementation of intervention measures on the building envelope. These services are usually not part of typical EPCs as they require overly long amortization timespan, which in turn explains why such contractual agreements include a unique system of clauses. Savings are usually calculated by field measurements on the thermal transmittance of building components or by means of thermal simulations; however, difficulties in historic buildings to have reliable performance data of the building components often discourage private partners from proceeding with these contracts. According to this point, it is common that in this EPC model the beneficiary pays a share of the investment for the envelope-related interventions through external funding systems (i.e., European calls, regional funding programs, etc.). This type of EPC models, based on the concept of Third-Party Financing, lends itself well to the recovery of historic buildings, leading to energy savings of up to 50%.

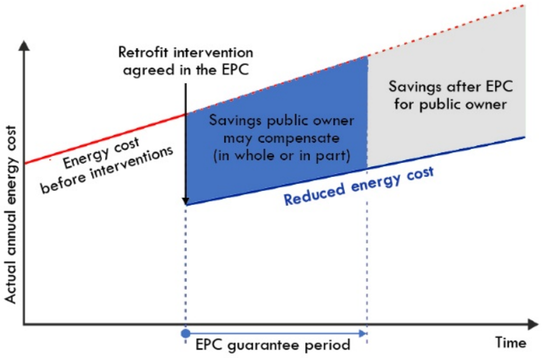

Figure 1 Graphic example of EPC functioning [35].

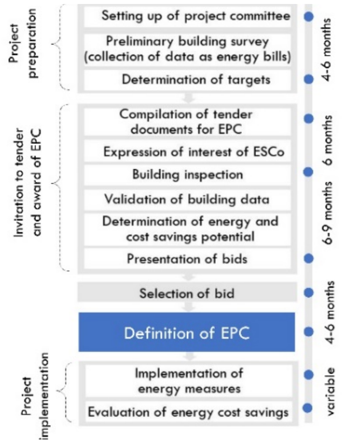

Figure 2 Graphic example of EPC definition [35].

Table 1. EPCs models (authors' elaboration).

EPCs models	**Risk allocation** Beneficiary / Public partner	 ESCo/ Private partner	**Investor**	**Remuneration mechanism**	**Contract duration**
Shared Savings	• Part of performance risk • Part of financial risk		Both	Revenues generated by the energy retrofitting are shared in accordance with a pre-arranged percentage (generally 70% ESCo, 30% beneficiary)	Fixed period (average 5-10 yrs)
Guaranteed Savings	• Financial risk	• Performance risk	Beneficiary through an external investor (e.g. bank)	The ESCo receives a fee based on demonstrated performance; if the savings are less than expected the ESCo covers the shortfall	Fixed period (average 4-8 yrs)
Chauffage Model	-	• Performance risk • Financial risk	ESCo	The beneficiary pays a fixed fee for energy services equal to the energy expense that it faced before the entry into force of the contract minus an agreed discount. The ESCo will retain any savings	Fixed period (average 20-30 yrs)
First out	-	• Performance risk • Financial risk	ESCo	ESCo receives all energy savings each year, until it has recovered its original capital and the rate of return	Variable period
EPC Plus	• Part of financial risk	• Performance risk • Part of financial risk	ESCo and Beneficiary / through external fundings	Such contractual agreements include a unique system of clauses for the ESCo remuneration according to the energy savings obtained through technical installations and envelope retrofitting	Variable period

4. Application of EPCs in built heritage

The application of EPCs in built heritage can present unique challenges and opportunities: firstly, it can alleviate the need for upfront capital investment, as the ESCo covers the initial costs of the retrofits; secondly, the performance-based nature of the contract can ensure that the private company is incentivized to deliver high-quality and long-lasting energy solutions; finally, the long-term nature of EPC agreements typically includes maintenance services, thus ensuring that the building energy systems are consistently monitored and optimized.

However, historic buildings often have architectural and material constraints that limit the types of energy efficiency measures suitable for implementation without compromising their integrity. For example, the installation of modern insulation panels or windows may alter the building authenticity or damage historically significant features. Therefore, any energy efficiency intervention must be carefully planned and executed in accordance with the utmost heritage preservation standards [35].

In the European context, the use of EPC Plus seems to have a counterpart in the field of cultural heritage mostly within European projects (e.g., EnPC-INTRANS [33]; CERtuS [36]; PROSPECT+ [37]). A relevant example is that of the City Municipality of Kranj: through an EPC Plus, energy efficiency measures aimed at the thermal comfort of the building users were implemented in three listed buildings. A cogeneration system, 30 kWp PV systems, and a geothermal heat pump were installed and managed by an ESCo, while the envelope solutions were supported through third-party financing, but managed by the ESCo itself. Soft measures such as education and capacity building of employees have been introduced as well, bringing additional savings of energy and related operational costs [36, 37].

In Italy, the use of EPCs in built heritage conservation has gained little attention in recent years, despite the extensive stock of historic buildings in the Country. One notable example of EPC Plus implementation within a heritage context was developed by means of the instrument termed “POR FESR Sicily 2014-2020”, which allocated a budget of 23 million euros for the energy retrofitting of 106 historic buildings owned by the Region of Sicily [38]. This set of buildings includes offices, monumental assets, museums, and archaeological areas ranging over many centuries (from the Arab-Norman era all the way to the rationalist period), which display various architectural, material, climatic, morphological, urban constraints, and construction peculiarities [39].

Upon request of the Regional Administration, a P3 was set up co-financed with public contribution from European Funds (up to 49%) for conservation activities of building envelopes. At the same time, and thanks to the private participation of ESCos through a special EPC Plus, it was possible to manage the design and improvement of technical installations, whilst providing support to the administration for maintenance of the whole building. The main advantages of this hybrid EPC include guaranteeing attainment of long-term objectives and reporting for allocated European funds [35, 39].

A different but equally relevant experience is the work carried out at the Egyptian Museum of Turin by the Foundation of Egyptian Antiquities. The latter corresponds to the first experiment in the establishment, by the National Government, of a museum management tool involving the participation of a private non-profit organization, characterized by a high degree of decision-making and budgetary autonomy [40]. The Foundation pursues the purposes of enhancing, promoting, managing and structurally and functionally adapting the Egyptian Museum and the cultural heritage received in conferral both through patrimonial contributions and through an endowment fund that varies over the years.

In an interval of about 10 years, the Egyptian Museum has undergone two major retrofit interventions. The two interventions (2012-2015; 2023-2024, still ongoing) were carried out thanks to the collaboration between the Egyptian Museum Foundation, the Compagnia di San Paolo, the CRT Foundation (a local philanthropic body), the ministry of cultural heritage and local institutions, in a synthesis of public and private partners [41]. The interventions of the first *tranche* covered the re-functionalization of the museum spaces, the rearrangement of the collection, the installation of the new air conditioning systems, the architectural restoration of the Palace and the restoration of archaeological artifacts. About the technical system, this has been entrusted to the management by an external company by way of an EPC entailing collaboration with the museum technicians to pursue the objectives of microclimatic control of all exhibition rooms [42].

In the second *tranche*, the construction of the glass roof of the internal courtyard of the Palazzo del Collegio dei Nobili and a series of urban rooms connected to the historic centre are being built [43]. This intervention is hoped to raise revenues, which have fallen in the budgets in last years [44]: after its reopening in 2015, the new Egyptian Museum enjoyed – on average – only 30% of public support, while 70% of revenues were generated through self-financing, i.e., mainly from ticketing, education, audio guides, and royalties from the museum shop; however, the COVID-19 period has led to a substantial reduction in box office admissions and the stop of numerous activities, such as the loan of artworks [45].

5. Conclusion

The application of EPCs in the cultural heritage sector offers a promising solution to the dual challenges of conservation and energy efficiency. By leveraging the expertise and financial resources of private companies through the EPC model, public entities can implement energy-efficient solutions without compromising the historical value of heritage buildings. The Italian experience demonstrates the potential of this approach, with successful case studies highlighting the benefits of EPCs for both heritage preservation and sustainability.

However, the successful application of EPCs in heritage sites requires careful planning and adherence to preservation requirements. The potential risks for an EPC not to work in a historic building may be several: delays in works, unforeseen costs, energy or conservation regulatory changes, oversizing/overestimation of performance in the *auditing* phase, economic inflation, etc. Moreover, the involvement of specialized ESCos with experience in working with historic buildings is essential to ensure that energy efficiency measures do not compromise the building architectural integrity: an incorrect calibration of interventions from the technical compatibility viewpoint can be detrimental.

Going forward, the continued development of legislative frameworks and the sharing of best practices across Europe will be crucial to expanding the use of EPCs in the cultural heritage sector. In addition, it is hoped that the use of EPCs in cultural heritage aims in the future to also include additional aspects aimed at the conservation and enhancement of assets. For example, it is hoped that EPCs will reflect the importance of ongoing maintenance and monitoring to ensure that energy systems continue to perform efficiently without degrading the building structure or historical value. At the same time, it is hoped that public financing activities for the sustainability of historic buildings will underline the need for involving local communities and stakeholders in the decision-making process, ensuring that interventions meet not only technical and financial criteria but also align with cultural and social expectations.

References

[1] European Commission, "Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions the European Green Deal. COM/2019/640 final", Bruxelles, 11th December 2019. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN. Accessed: September 2024.

[2] European Commission, “Current funding. Leveraging energy efficiency investments via tailored instruments and project development assistance”, 2024. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/financing/eu-programmes/current-funding_en. Accessed: September 2024.
[3] European Commission, “Financing. EU funding programmes, support mechanisms and technical assistance on energy efficiency financing and investments”, 2024. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/financing_en. Accessed: September 2024.
[4] European Commission, “European Energy Efficiency Financing Coalition”, 2024. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/financing/european-energy-efficiency-financing-coalition_en. Accessed: September 2024.
[5] European Commission, “Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast). PE/102/2023/REV/1”, Official Journal of the European Union, 8th May 2024. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024L1275&qid=1727695599010. Accessed: September 2024.
[6] S. Macdonald, “Leveraging heritage: public-private, and third-sector partnerships for the conservation of the historic urban environment”, in “Le patrimoine, moteur de développement. Heritage, a driver of development”, proceedings of the 17th ICOMOS general assembly symposium, ICOMOS, Paris, 2011, pp. 893-904.
[7] Commission of the European Communities, “Green Paper on public-private partnerships and Community law on public contracts and concessions”, 2004. Available at: https://op.europa.eu/en/publication-detail/-/publication/94a3f02f-ab6a-47ed-b6b2-7de60830625e/language-en. Accessed: September 2024.
[8] European Commission, Directorate-General for Research and Innovation, “Getting cultural heritage to work for Europe. Report of the Horizon 2020 Expert Group on Cultural Heritage”, 2015. Available at: https://op.europa.eu/en/publication-detail/-/publication/b01a0d0a-2a4f-4de0-88f7-85bf2dc6e004. Accessed: September 2024.
[9] E. Rojas, “Old cities, new assets: preserving Latin America’s urban heritage”, Inter-American Development Bank, Washington, 1999.
[10] E. Rojas, “Urban Heritage Conservation in Latin America and the Caribbean. A Task for All Social Actors”, Inter-American Development Bank, Sustainable Development Department, Technical Papers Series, Washington, 2002.
[11] G. Codecasa and F. Di Piazza, “Governare il partenariato pubblico-privato. Strategie di governo e strumenti del management pubblico nei progetti di riqualificazione urbana”, in G. Codecasa (ed.), “Governare il partenariato pubblico e private nei progetti urbani”, Maggioli Editore, Santarcangelo di Romagna, 2010, pp. 1-20.
[12] R. Cori and I. Paradisi, “Una ipotesi di lavoro: l’applicazione ai servizi del sistema dei beni culturali del Project Financing”, in A. Leon and P. Verdinelli De Cesare (eds.), “Qualità dei bandi per l’acquisto di servizi nel sistema dei beni culturali. I servizi del sistema dei beni culturali: come interpretarli, combinarli, innovarli, qualificarli”, vol. 2, 2011, pp. 41-52. Available at: https://www.promopa.it/images/ricerca/i-servizi-del-sistema-dei-beni-culturali_2.pdf. Accessed: September 2024.
[13] D. Rypkema and C. Cheong, “Public-Private Partnerships and Heritage: A Practitioner’s Guide”, Heritage Strategies International, Washington, 2012.
[14] S. Macdonald and C. Cheong, “The Role of Public-Private Partnerships and the Third Sector in Conserving Heritage Buildings, Sites, and Historic Urban Areas”, The Getty Conservation Institute, Los Angeles, 2014.
[15] V. Bachi, A. Fresa, C. Prandoni, T. Masi, and E. Debernardi (PROMOTER), “Public-Private Partnership Guidelines for CH”, RICHES Project, 2016. Available at: https://resources.riches-project.eu/d7-3-public-private-partnership-guidelines-for-ch/. Accessed: September 2024.
[16] V. Sessa, “Il Partenariato pubblico-privato”, *Giustamm. Rivista di Diritto Amministrativo*, no. 7, 2016, pp. 1-36.
[17] P. Petraroia, “Partenariato tra pubblico e privato nella tutela e nella valorizzazione dei beni culturali”, in A. Bellini, P. Petraroia, and A. Robbiati Bianchi (eds.), “Individuazione e tutela dei beni culturali - Problemi di etica, diritto ed economia”, Istituto Lombardo Accademia di Scienze e Lettere, Milano, 2018, pp. 23-39.
[18] OECD, “Recommendation of the Council on Principles for Public Governance of Public-Private Partnerships”, 2012. Available at: https://legalinstruments.oecd.org/public/doc/275/275.en.pdf. Accessed: September 2024.

[19] The World Bank, “PPP Arrangements/Types of PPP Agreements”. Available at: https://ppp.worldbank.org/public-private-partnership/agreements. Accessed: September 2024.
[20] L. Martin, “Public Procurement Practice. Public-Private Partnership (P3): Facilities and Infrastructure, Guidance issued by the National Institute of Governmental Purchasing to state and local government procurement officials”, 2016, pp. 1-14. Available at: https://www.nigp.org/resource/global-best-practices/Public-Private%20Partnership%20P3%20Facilities%20and%20Infrastructure%20Best%20Practice.pdf?dl=true. Accessed: September 2024.
[21] Senato della Repubblica. Ufficio Valutazione Impatto, “Partners wanted (for investment). Where, how and how much does the public-private partnership in Italy work?”, 2018, pp. 1-8. Available at: https://www.senato.it/service/PDF/PDFServer/BGT/01078796.pdf. Accessed: September 2024.
[22] L. Best, “PPP’s central role in Italy’s economic recovery Re-evaluation of risk and rejuvenation of the PPP model could prove key to Italy’s pandemic recovery”, 19th August 2024. Available at: https://www.partnershipsbulletin.com/article/1885442/ppps-central-role-italys-economic-recovery. Accessed: September 2024.
[23] L. Martin, “Making sense of public-private partnerships (P3s)”, *Journal of Public Procurement*, vol. 16, no. 2, 2016, pp. 191-207, doi: https://doi.org/10.1108/JOPP-16-02-2016-B002.
[24] R. Moioli, C. Boniotti, A. Konsta, and A. Pili, “Complex properties management: Preventive and planned conservation applied to the Royal Villa and Park in Monza”, *Journal of Cultural Heritage Management and Sustainable Development*, Special Issue: Preventive and planned conservation approaches for built heritage management, vol. 8, no. 2, 2018, pp. 130-144, doi: https://doi.org/10.1108/JCHMSD-06-2017-0035.
[25] Comitato direttivo SIRA 2021/2023 (ed.), “Documento di indirizzo per la qualità dei progetti di restauro dell’architettura. Ad esito del III Convegno della SIRA Società Italiana per il Restauro dell’Architettura Restauro dell’architettura. Per un progetto di qualità. Napoli, 15-16 Giugno 2023”, in S. Della Torre and V. Russo (eds.), “Restauro dell’architettura. Per un progetto di qualità”, Edizioni Quasar, Roma, pp. 1-75.
[26] European Commission, “Commission Recommendation (EU) 2024/2476 of 13 September 2024 setting out guidelines for the interpretation of Article 29 of Directive (EU) 2023/1791 of the European Parliament and of the Council as regards energy services”, Official Journal of the European Union, Bruxelles, 20th September 2024. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202402476. Accessed: September 2024.
[27] European Commission, “Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast)”, Official Journal of the European Union, Bruxelles, 20th September 2023. Available at: https://eur-lex.europa.eu/eli/dir/2023/1791/oj. Accessed: September 2024.
[28] Dipartimento per la Programmazione e il Coordinamento della Politica Economica, “PPP & contratti di prestazione energetica (EPC) dalla a alla z una guida per le amministrazioni e gli operatori vademecum”, May 2022. Available at: https://www.programmazioneeconomica.gov.it/media/tnyguvvs/vademecum-epc_ppp_dipe_vs-pubblicata_13052022.pdf. Accessed: September 2024.
[29] Dipartimento per la programmazione e il coordinamento della politica economica – DIPE, “Relazione sull’attività svolta dal DIPE nell’anno 2023 in materia di Partenariato Pubblico Privato e Finanza di Progetto”, July 2024. Available at: https://www.programmazioneeconomica.gov.it/media/a13ctspt/relazione-annuale-ppp-anno-2024-attivita-2023_pubblicata.pdf. Accessed: September 2024.
[30] European Commission Joint Research Centre (ed.), “Energy Performance Contracting”, European Energy Efficiency Platform (E3P). Available at: https://e3p.jrc.ec.europa.eu/articles/energy-performance-contracting. Accessed: September 2024.
[31] eu.ESCO - European Association of Energy Service Companies (ed.), “What is an EnPC?”. Available at: https://euesco.org/about-coc-for-epc/. Accessed: September 2024.
[32] Graz Energyagency (ed.), “Standard EPC documents VI. Financing European Energy Service Initiative”, EESI IEE/08/581/SI2.528408 July 2011. Available at: https://www.codema.ie/images/uploads/docs/Standard6_Financing.pdf. Accessed: September 2024.
[33] EnPC-INTRANS, 2016. “Energy Performance Contracting (Epc) for Public Buildings - Training Materials for 3 Webinars”. Available at: https://cordis.europa.eu/project/id/649639/reporting/it. Accessed: September 2024.
[34] A. Gallerand, J. Heemann, M. Dragovic Matosovic, D. Prsancova, and C. Anders, “Learning Handbook

Public Buildings Module Innovative financing schemes to improve the energy performance of public buildings”, May 2022. Available at: https://h2020prospect.eu/sites/default/files/learning_handbooks/PROSPECT%2BLearning-Handbook-on-Public-Buildings-pdf. Accessed: September 2024.
[35] A. Buda, “Conservazione ed efficienza energetica dell’edilizia storica”, Nardini editore, Collana Atlanti della conservazione, Firenze, 2023.
[36] S.S. Fanou (ed.), “Cost Efficient Options and Financing Mechanisms for nearly Zero Energy Renovation of existing Building Stock”, ENEA editor. Available at: https://www.pubblicazioni.enea.it/le-pubblicazioni-enea/edizioni-enea/anno-2018/cost-efficient-options-and-financing-mechanisms-for-nearly-zero-energy-renovation-of-existing-building-stock.html. Accessed: September 2024.
[37] A. Gallerand, J. Heemann, M. Dragovic Matosovic, D. Prsancova and C. Anders (eds.), “Learning Handbook Public Buildings Module”, May 2022. Available at: https://h2020prospect.eu/sites/default/files/learning_handbooks/ PROSPECT%2BLearning-Handbook-on-Public-Buildings-pdf.pdf. Accessed: September 2024.
[38] EuroInfoSicilia, Dipartimento della Programmazione, “PO FESR 2014/2020 – Azione 4.1.1 – Efficientamento energetico edifici pubblici di proprietà regionale”. Available at: https://www.euroinfosicilia.it/po-fesr-1420-efficientamento-elenco-edifici-pubblici-regione-sicilia/. Accessed: September 2024.
[39] A. Buda, V. Pracchi, R. Sannasardo, “Built Cultural Heritage and Energy Efficiency. The Sicily Case: Pros and Cons of an Innovative Experience”, SBE19 Milan - Resilient Built Environment for Sustainable Mediterranean Countries, IOP Conference Series: Earth and Environmental Science, Volume 296, 2019. doi: 10.1088/1755-1315/296/1/012001
[40] Museo Egizio, “La storia della Fondazione”. Available at: https://www.museoegizio.it/chi-siamo/. Accessed: September 2024.
[41] M.C. Voci, “Verde, luce e spazi aperti alla città così cambia il museo Egizio”, *Il Sole 24 ore*, 31th May 2024. Available at: https://www.ilsole24ore.com/art/verde-luce-e-spazi-aperti-citta-cosi-cambia-museo-egizio-AFSIEB2D. Accessed: September 2024.
[42] G. Bonfante and M. Filippi, “Climatizzazione per il nuovo Museo Egizio di Torino”, *Aicarr Journal*, 8, march-april 2017, Milano, pp. 40-47.
[43] P. Mezzi, “Torino, il Museo Egizio apre alla città”, May 2023. Available at: https://www.infobuild.it/progetti/torino-museo-egizio-oma/#:~:text=resto%20della%20citt%C3%A0.-,Il%20progetto%20di%20Oma,propria%20scala%2C%20funzione%20e%20qualit%C3%A0. Accessed: September 2024.
[44] M. A. Marchesoni, “Museo Egizio: motore di ricchezza per Torino”, *Il Sole 24 ore*, 16th July 2024. Available at: https://www.ilsole24ore.com/art/museo-egizio-motore-ricchezza-torino-AFxqS4sC. Accessed: September 2024.
[45] Museo Egizio, “Fondazione trasparente. Bilanci”. Available at: https://museoegizio.it/trasparenza/bilancio/. Accessed: September 2024.