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Return of the DEEP: One platform to benchmark them all

COLLECTION: INDUSTRY

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ABSTRACT

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The De-risking Energy Efficiency Platform (DEEP), developed within the Energy Efficiency Financial Institutions Group (EEFIG) in 2016–2023 and since 2024 hosted by the European Energy Efficiency Financing Coalition (both funded by the European Commission), is the largest open-source European database for energy efficiency investments. With more than 36,000 projects from industry and buildings DEEP aims at strengthening the ability of policymakers and financial institutions to assess risks and profitability, supporting the development of coherent and financeable energy efficiency measures. The platform provides aggregated information on investment costs, energy savings and financial performance indicators such as payback time and avoidance cost, enabling benchmarking of energy efficiency projects across countries and technologies.

This paper updates the analysis of DEEP originally presented by Rohde et al. (2018) using the substantially expanded dataset. The updated results confirm the main structural patterns of earlier analyses, including short payback periods for many cross-cutting technologies and higher capital intensity for building fabric and system-level measures.

In addition, the paper conducts a structured cross-country comparison between German and US projects included in DEEP. The results reveal systematic differences in reported economic indicators, with US projects showing lower investment levels and shorter payback periods. The analysis shows that these differences primarily reflect structural characteristics of the underlying datasets rather than technological performance differences. The findings highlight the importance of considering dataset provenance, project scale and programme design when interpreting benchmarking indicators for energy efficiency investments.

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INTRODUCTION

The green transition towards a climate-neutral economy is a key challenge for the EU and requires substantial investment to 2030 and beyond. Energy efficiency investments are widely recognized as a central pillar of industrial decarbonization and cost-effective climate mitigation. However, the scale of the required transformation is unprecedented. The additional green investment needed to achieve the EU's energy and climate goals – specifically the target of reducing greenhouse gas emissions by at least 55% by 2030 – has been estimated at approximately €477 billion annually (Malin, Petra & Carolin 2025).

Despite this urgency, current investment trends indicate that capital flows into energy efficiency remain significantly below the required level. In particular, private investment in energy efficiency needs to increase substantially to close the existing investment gap. A central barrier to scaling up private investment in energy efficiency is the perceived risk and insufficient performance transparency of such projects. The 2015 report of the Energy Efficiency Financial Institutions Group (EEFIG) highlighted that the lack of empirical evidence on the performance of energy efficiency investments makes their financial benefits and risks more difficult to assess for investors (EEFIG 2015).

Building on the experience and results of EEFIG, the European Energy Efficiency Financing Coalition (the Coalition) was officially launched in April 2024 (European Commission 2026). The Coalition is a European Commission initiative bringing together EU Member States, financial institutions and relevant stakeholders with the objective of identifying concrete actions to improve private financing for energy efficiency. Its work aligns with the objectives of the Energy Efficiency Directive and the Energy Performance of Buildings Directive, both of which underline the importance of scaling up investment and strengthening the financial ecosystem for energy efficiency.

Within this context, the **De-risking Energy Efficiency Platform (DEEP)**[1] was established to enhance transparency in energy efficiency investment performance and to provide empirical evidence for investors and policymakers. The primary aim of DEEP is to upscale energy efficiency investments in Europe by improving the sharing and transparent analysis of existing projects in the buildings and industrial sectors. The main rationale behind the DEEP database is to enable financial institutions to assess the benefits, risks and performance results of energy efficiency projects based on empirical evidence rather than anecdotal information.

DEEP was initially launched in November 2016 by EEFIG with the support of the European Commission and was subsequently revamped in June 2021 as DEEP 2.0. In its current version, the database is hosted on the European Commission's cloud infrastructure, ensuring stability, accessibility and long-term data governance. Over time, DEEP has expanded substantially in project volume and sectoral coverage, thereby improving statistical robustness and allowing for greater category differentiation.

As of May 2026, DEEP represents the largest pan-European open-source database containing detailed technical and financial performance data of more than 36,000 industrial and building-related energy efficiency projects, contributed by more than 32 data providers. The platform is designed as a statistically robust database based on aggregated information from successfully implemented as well as recommended projects from Europe and the United States. It allows highly customizable comparisons of energy efficiency projects, for example by country, measure type, building type, and verification status.

An earlier analysis of DEEP data from Rohde et al. (2018) examined aggregate distributions of payback time, avoidance cost and investment characteristics as the main financial indicators of the platform. Since that publication, the number of projects recorded in the database has increased significantly from 10,000 to more than 36,000. This expansion enables an updated descriptive assessment and strengthens the empirical basis of earlier conclusions. For further information on the general design, usage and functionality of DEEP, the reader is referred to Rohde et al. (2018).

1 https://deep.ec.europa.eu/.

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In addition to updating the descriptive analysis, this paper introduces a structured cross-country comparison between German and US data within DEEP. The objective of the comparison is not to establish causal superiority of one country's efficiency measures over another's, but rather to identify systematic structural differences in reported economic indicators across institutional contexts.

The paper pursues two main objectives:

1. To update and reassess the descriptive findings of Rohde et al. (2018) using the expanded DEEP dataset.
2. To conduct a structured cross-country comparison between German and US datasets focusing on comparable measure categories in buildings and industry.

Within this paper, we first describe the underlying data sources and methodological approach of the analysis. Subsequently, we update the descriptive analysis of the key financial indicators of DEEP, followed by a structured cross-country comparison of German and US projects. The paper concludes with a discussion of structural differences, institutional contexts and implications for energy efficiency finance.

DATA AND METHODS

DATA OVERVIEW

As of May 2026, the DEEP platform provides access to data on more than 36,000 energy efficiency projects in the buildings and industry. The data is publicly accessible via the DEEP website in aggregated form. Users can explore selected subsets of project data through interactive graphs, charts and tables. However, information at the individual project level is not accessible to users or any external entity. The DEEP analysis toolbox enables the dynamic and highly customizable creation of charts, while the benchmarking service allows users to compare their own projects against aggregated data within DEEP. For further details regarding the platform services, user interface, database architecture and security design, the reader is referred to Rohde et al. (2018).

The data analysed in this paper were collected during two main reporting phases (2016/2017 and 2020–2023), while the underlying projects cover a substantially longer time span. The majority of projects in the dataset were implemented after 2010, with a particularly strong increase from around 2014 onwards. The highest concentration of projects falls within the period between 2016 and 2021, indicating that the database currently largely reflects implementation activity of the past decade.

Figure 1 shows the number of datasets in the DEEP database aggregated by country. For each country, the number of projects reporting the following three key indicators is displayed:

- Projects with total investment
- Projects with energy cost savings
- Projects with energy savings

Total investment represents a mandatory indicator for inclusion in the analyses presented in this paper. For a basic descriptive assessment, either energy savings or energy cost savings is required. The DEEP platform does not currently allow the use of user-defined energy prices. Consequently, energy cost savings are not derived ex post from reported energy savings but are included only when explicitly reported within the dataset.

The majority of projects in the current DEEP dataset originate from Germany (11,252 projects with reported total investment), followed by Bulgaria (7,428) and the United States (5,978). A second group of countries – including Sweden, Denmark and the United Kingdom – also contributes substantial numbers of projects, each exceeding 1,500 entries. Several additional countries, such as France and Poland, provide between 700 and 1,100 projects, while a broader set of Member States is represented with smaller but still relevant contributions. While the number of projects reporting total investment and energy savings is generally high for most major contributing countries, the availability of energy cost savings varies more strongly. Despite the dominance of German projects in the database, the increasing participation of additional countries has significantly broadened the geographical coverage of the platform. This expanded and more diverse project base strengthens the robustness of the descriptive analysis and enhances the cross-country comparability of the key financial indicators.

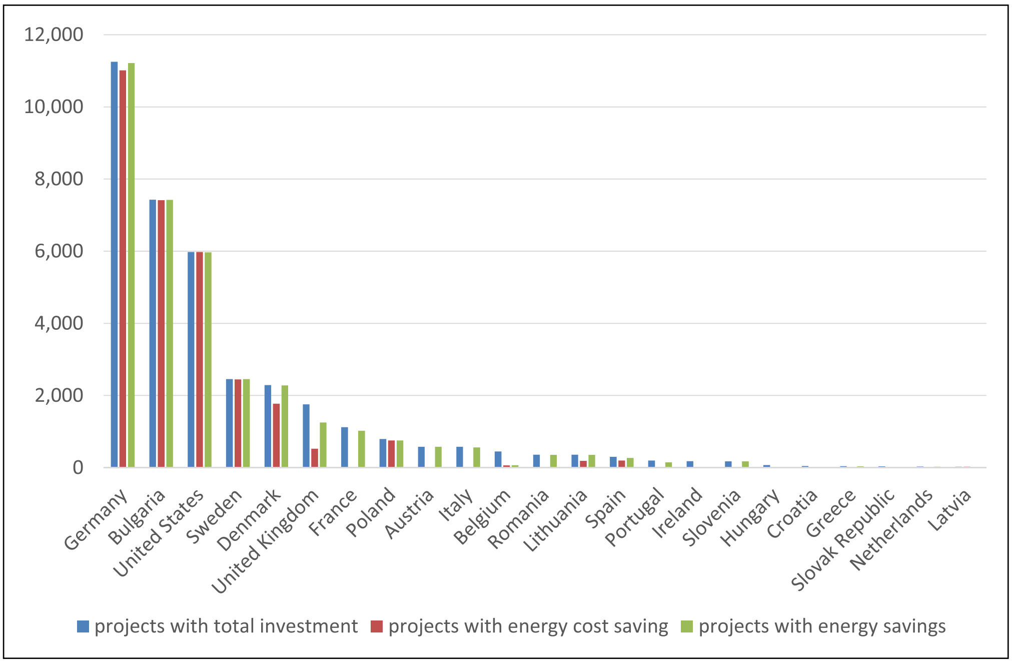

Figure 1 Data availability (by country).

Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 36,496 (projects with total investment) from a Database total of 36,559.

INDICATOR DEFINITIONS

In the analysis presented in this paper, a set of key performance indicators (KPIs) from the DEEP database is used.

The static **payback time** is defined as the average (median) number of years required for annual monetary savings to recover the initial investment cost, without taking interest rates or discounting into account. It is calculated directly from the underlying project data. If no information on energy cost savings is available for a project, no payback time can be computed. Payback time represents the principal indicator of financial return within DEEP. Because it is based on project-specific cost savings, it implicitly reflects the individual energy price assumptions underlying each project. No harmonisation of national energy prices was performed for this analysis.

Avoidance cost represents the average (median) capital cost per unit of energy saved over the assumed lifetime of a measure. It is expressed in eurocent per kilowatt-hour (ct/kWh) and calculated using a 0% discount rate in this analysis. Unlike payback time, the indicator is independent of project-specific energy prices and can be interpreted as a levelised cost of energy efficiency as an energy resource. The assumed lifetimes underlying the calculation are based on standardised reference values from the European Committee for Standardization (CEN 2007) and the depreciation tables (AfA-Tabellen) provided by the German Federal Ministry of Finance (Bundesministerium der Finanzen 2000).

Median **total investment** per measure category is used as an indicator of project scale and capital intensity. Given the skewed distribution typically observed in investment data –where a small number of large-scale projects can disproportionately influence average values – median values are used throughout the analysis. While more sophisticated financial performance metrics (e.g. internal rate of return or net present value) would in principle allow for a more comprehensive economic assessment, their calculation is constrained by the structure and availability of the data within the DEEP database.

For further details on the indicator definitions and calculation methodologies applied within DEEP, the reader is referred to Rohde et al. (2018).

DATA FOR CROSS-COUNTRY COMPARISON

German data source

The German dataset included in DEEP and used in this study combines three institutionally independent empirical sources. Although these sources are not programmatically linked, they cover largely overlapping technological domains, particularly cross-cutting industrial technologies.

- **EEE Module 1 (Cross-Cutting Technologies):** Introduced in 2019, Module 1 of the federal funding scheme 'Federal Funding Scheme for Energy and Resource Efficiency in the Economy' (EEE) supports investments in cross-cutting technologies, including Motor systems, Compressed air systems, Pumps, Heating and cooling technologies, Ventilation and related efficiency measures (Bafa 2026). The projects included in the dataset represent financially supported capital investments from 2020 and 2021 that underwent a formal application and approval process (Neusel & Hirzel 2025).
- **Energy Efficiency Fund:** Between 2011 and 2017, the Energy Efficiency Fund represented the largest cross-sectoral funding instrument for improving energy efficiency in Germany. The fund provided financial support for enterprises investing in cross-cutting technologies, waste heat utilization and energy-efficient production processes (Hirzel & Schlomann). Similar to EEE Module 1, projects included in the dataset represent funded capital investments from the fund that underwent a formal application and approval process.
- **30 LEEN Pilot Networks:** The project '30 Pilot Networks' (Learning Energy Efficiency Networks, LEEN) established 30 regional company networks in Germany between 2008 and 2014, involving approximately 350–400 participating firms. Within these networks, companies conducted structured energy reviews, identified efficiency measures and monitored implementation progress over several years (Rohde et al. 2020). The projects included in the dataset represent implemented energy efficiency measures originating from these pilot networks involving approximately 350–400 participating firms. Unlike the funding-based instruments described above, LEEN was based on a network approach combining peer exchange, structured monitoring and voluntary commitment mechanisms rather than direct capital subsidies.

US data source

The US data used for the cross-country comparison originates from the Industrial Assessment Centers (IAC) program administered by the US Department of Energy (U.S. Department of Energy 2026). The IAC program provides no-cost energy assessments to small- and medium-sized manufacturing enterprises (SMEs) across the United States. Originally established in the late 1970s, the program aims to promote energy efficiency improvements in the industrial sector through structured technical assessments.

University-based teams conduct standardized on-site facility assessments and develop technical recommendations including estimated investment costs, expected annual energy and cost savings as well as static payback time. The assessments follow a standardized procedure consisting of site visits, data collection, system analysis, and the identification of energy efficiency measures. All identified measures are uploaded to the publicly accessible IAC database.

Importantly, the IAC database contains all recommended measures from the assessments rather than exclusively implemented projects. Approximately 300 days after the assessment, facilities are contacted to determine implementation status. The implementation status is updated in the database for each individual measure. Over the period 1981–2022, a total of 151,198 recommendations was identified across 20,290 assessments, with an average implementation rate of approximately 47% (Miera et al. 2025).

The IAC program is voluntary and not directly linked to investment subsidies. The IAC data included in DEEP compile assessment-based recommendations collected between 2016 and 2023. In contrast to the German data, which mainly represent realized financially funded projects, the IAC data reflect structured advisory recommendations generated within an assessment framework.

Harmonisation for Cross-Country Comparison

Prior to inclusion in DEEP, all datasets underwent a harmonisation and processing procedure. Measures were translated into the DEEP measure taxonomy to ensure consistent categorization across countries. For the US dataset, monetary values originally reported in US dollars were converted into euros using the conversion rate of the assessment date. In addition, plausibility checks and data cleaning procedures were conducted to ensure internal consistency and remove implausible or incomplete entries.

To ensure comparability in this study, only measure categories that were present in both datasets and conceptually equivalent were retained for the cross-country comparison. The analysis therefore focuses on the following harmonised categories:

- **Buildings:** Building Fabric Measures, HVAC Plant, Lighting
- **Industry:** Compressed Air, Cooling, Heating, Motors, Waste heat (without power generation)

The analysis is descriptive in nature. No normalization for national energy price differences, purchasing power parity, firm size or sectoral composition was applied. The comparison therefore reflects structural differences in reported economic indicators within the harmonised framework rather than econometrically adjusted performance differentials.

RESULTS

UPDATED ANALYSIS OF DEEP DATA

For each figure presented in this section, the date of data extraction from the DEEP database is indicated, together with the number of analysed projects in the respective graph compared to the overall dataset. The update of the former analysis from Rohde et al. (2018) follows the same descriptive approach to ensure comparability. The analysis is presented in box-plot graphs showing the 10%, 25%, 50% (median), 75% and 90% percentiles of the analysed data.

The expanded DEEP dataset substantially increases the number of available projects compared to the earlier analysis. In January 2018, the analysis was based on a total of 10,166 projects available in DEEP (Rohde et al. 2018). As of May 2026, the database comprises 36,559 projects. Data availability remains high across the key indicators – total investment, energy savings and energy cost savings – indicating stable reporting quality despite the significant expansion of the dataset.

Building projects

As of May 2026, DEEP includes 20,710 building projects (18,384 for the EU27+UK) with a median payback time of 6.0 years and a median avoidance cost (undiscounted) of 2.0 Eurocent/kWh. The original analysis by Rohde et al. (2018) focused exclusively on industrial building projects and was based on 1,454 observations (1,385 for the EU 28). The updated dataset is substantially larger and now includes non-residential and residential building projects. Building projects represent 55% non-residential projects (thereof 10% industrial buildings, corresponding to 1,606 projects) and 45% residential projects.[2] While this broadens the scope beyond purely industrial buildings, the core technological categories remain comparable, allowing for structural comparison over time.

Regarding **investment size** (Figure 2), the updated data confirm and further sharpen the structural differences between measure categories. Lighting projects continue to represent the smallest investment volumes, with a median clearly below €10,000. HVAC projects show intermediate investment levels, with a median around €10,000. Building fabric measures exhibit substantially higher investment volumes and a wide dispersion, with the upper percentiles extending into the high six-figure range. Compared to the earlier dataset, building fabric measures now show higher median investment levels, which may be attributed to a higher share of comprehensive renovation measures and general increases in construction and material costs in recent years. A new and particularly capital-intensive category in the updated dataset is integrated renovation, which shows the highest median investment (around

2 Based on a total of 20,675 projects with available information on total investment.

or above €100,000) and a large interquartile range. This category reflects the inclusion of more comprehensive renovation projects, often combining multiple building elements within a single intervention.

The right-skewness of investment distributions remains pronounced across all categories, confirming the earlier observation that a relatively small number of large projects drive the upper tail.

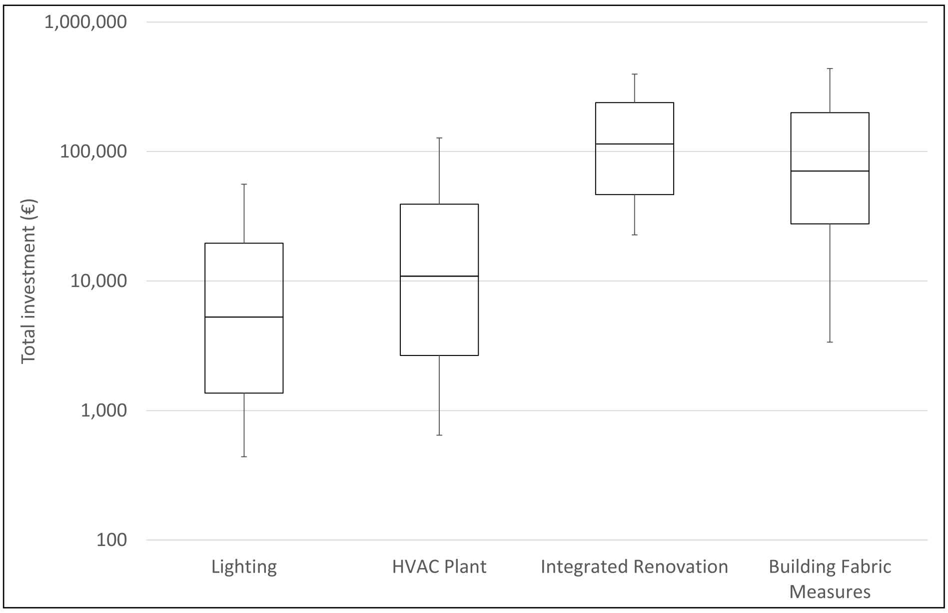

Figure 2 Total investment for building projects (by measure type, logarithmic scale). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 20,574 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

Regarding **payback time** (Figure 3), the general hierarchy of payback times remains structurally consistent with the earlier findings. Lighting and HVAC measures continue to show comparatively short median payback periods (approximately 3–4 years). In contrast, building fabric measures display substantially longer median payback times, now in the range of roughly 11–12 years, with a long upper tail extending well beyond 20 years. Integrated renovation exhibits intermediate to long payback times (median around 7–8 years), reflecting the higher capital intensity of comprehensive refurbishment measures. Compared to the earlier industrial buildings-only analysis (median around 3 years overall for industrial buildings, Rohde et al. 2018), the broader dataset shifts the overall distribution slightly upward. This is consistent with the inclusion of more comprehensive and possibly deeper renovation measures beyond strictly industrial contexts, which typically require higher upfront investment and yield savings over longer time horizons.

However, the central structural finding remains unchanged: Short payback measures are concentrated in lighting and HVAC, while fabric-related interventions are associated with longer amortisation periods.

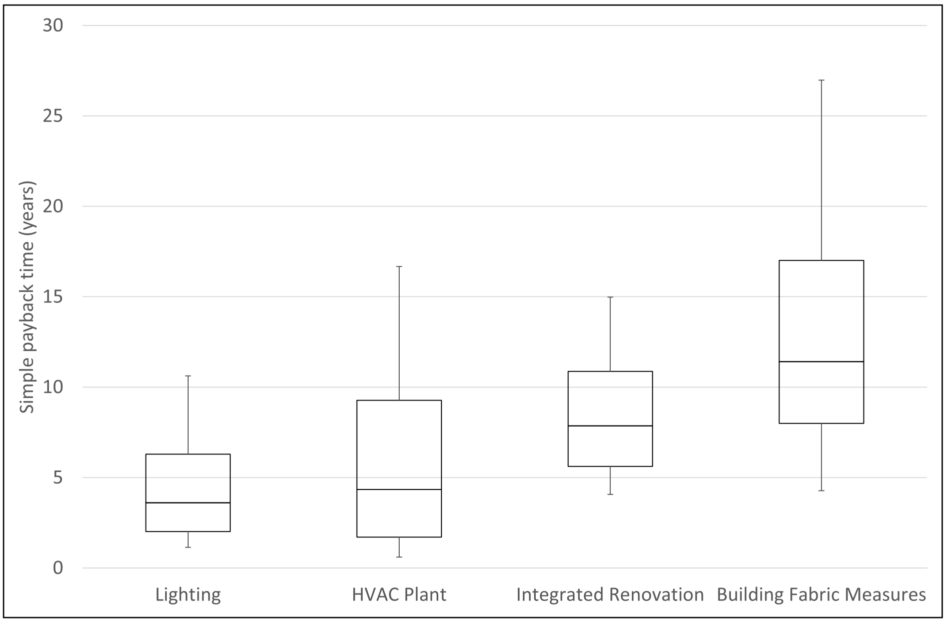

Figure 3 Payback time for building projects in EU27+UK (by measure type). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 14,579 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

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The **avoidance cost** results (Figure 4) reinforce the lifecycle perspective identified in the earlier study. Despite longer payback times, building fabric measures do not exhibit proportionally higher avoidance costs. Median values remain in a moderate range (around 2.8 ct/kWh), reflecting long technical lifetimes that distribute investment costs over extended savings periods. HVAC and Lighting measures show comparable median avoidance costs, around 3 ct/kWh. Integrated Renovation displays relatively low median avoidance costs compared to its investment size, again indicating that lifetime energy savings compensate for high upfront expenditure.

The expanded dataset therefore confirms the key structural insights of the original analysis for the main building-related efficiency technologies, while substantially increasing statistical robustness and improving coverage of more capital-intensive renovation types.

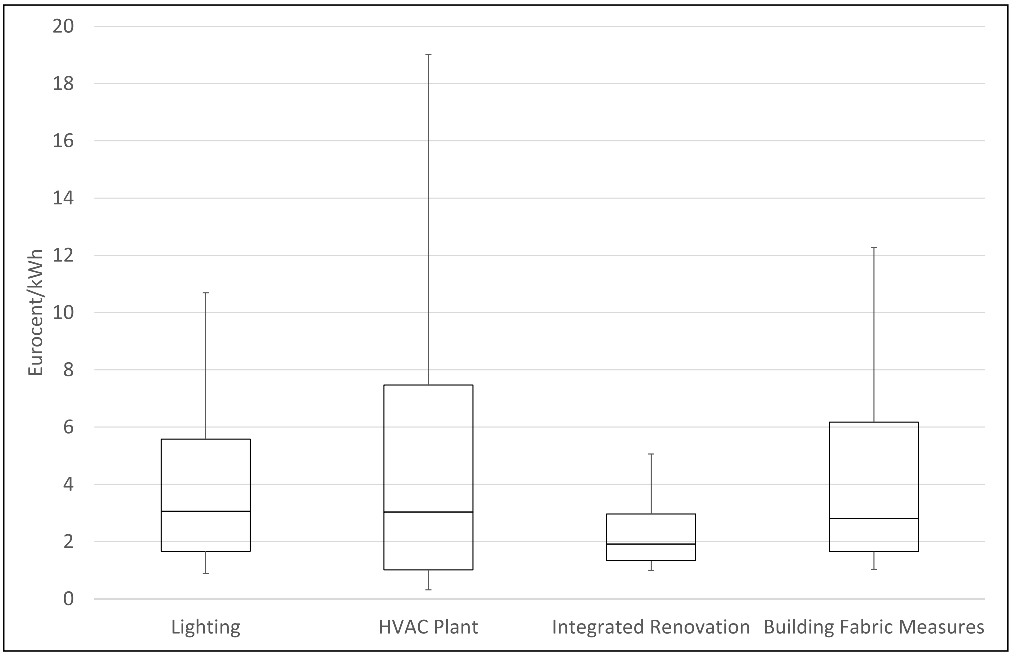

Figure 4 Avoidance cost for building projects in EU27+UK (by measure type, no discounting). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 17,194 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

Industrial projects

As of May 2026, DEEP includes 15,832 industrial projects (12,180 for the EU27+UK) with a median payback time of 3.0 years and median avoidance costs (undiscounted) of 2.2 Eurocent/kWh. The original analysis by Rohde et al. (2018) was based on 5,014 observations. While the original results already indicated low median investments and short payback periods for many cross-cutting technologies, the enlarged dataset confirms the overall structural patterns, while revealing moderate shifts in distribution and dispersion.

Regarding **investment size** (Figure 5), in the 2018 dataset, the median total investment of industrial projects was below €9,000, with 25% of projects below €2,000 and 10% above €100,000 (Rohde et al. 2018). The updated data show a somewhat higher capital intensity in several categories. For many cross-cutting technologies (motors, pumps, compressed air, heating, cooling), median investment levels now lie in the range of roughly €10,000–20,000, indicating a moderate upward shift compared to the earlier dataset. General price increases for industrial equipment and installation in recent years might be a reason for this. Capital-intensive categories such as waste heat (without power generation), refrigeration and power systems display median investment levels clearly above €40,000–60,000, with upper percentiles extending well into the high six-figure range. Compared to the earlier analysis, the upper tails appear more pronounced, suggesting a growing presence of larger-scale and system-integrated projects.

At the same time, the right-skewed structure of the distributions remains unchanged, confirming that a relatively small number of large projects drives the upper end of the investment spectrum.

A special case is ICT (Information and Communication Technologies). The category comprises only 26 projects in the current dataset. These measures are often functionally driven (e.g. digitalization, process control, monitoring infrastructure) rather than purely efficiency-driven investments. Consequently, their economic indicators should be interpreted with caution due to both the very small sample size and their hybrid investment character.

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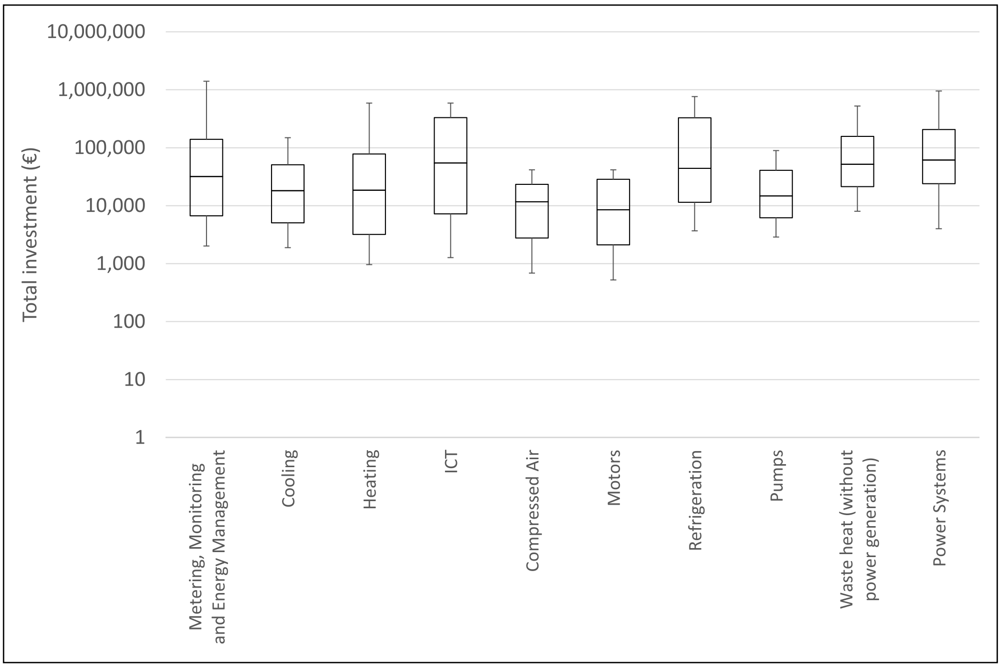

Figure 5 Total investment for industrial projects (by measure type, logarithmic scale). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 14,995 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

Regarding **payback time** (Figure 6), in Rohde et al. (2018), median payback times for most industrial cross-cutting technologies were below four years, with motors below two years and compressed air around one year. The updated dataset confirms that the majority of classical cross-cutting technologies continue to exhibit short payback periods. Median payback times for metering, monitoring and energy management, cooling, heating, compressed air and motor systems remain firmly in the range of approximately two to four years. However, compared to the earlier dataset, some categories now show slightly higher medians and wider interquartile ranges. For example, refrigeration, pumps and waste heat measures frequently exhibit median payback times around five years or more, with substantial dispersion toward longer durations. Overall, the updated data do not suggest a structural upward shift in payback times compared to the earlier dataset. Rather, the core pattern remains stable: most cross-cutting efficiency measures cluster around a three-year median, while longer payback periods are primarily associated with capital-intensive and system-level technologies. A plausible explanation is that many of the most straightforward efficiency opportunities have already been realised in earlier investment cycles. Additionally, increasingly stringent regulatory standards and minimum efficiency requirements may reduce absolute savings potentials per intervention, thereby increasing payback times for marginal improvements.

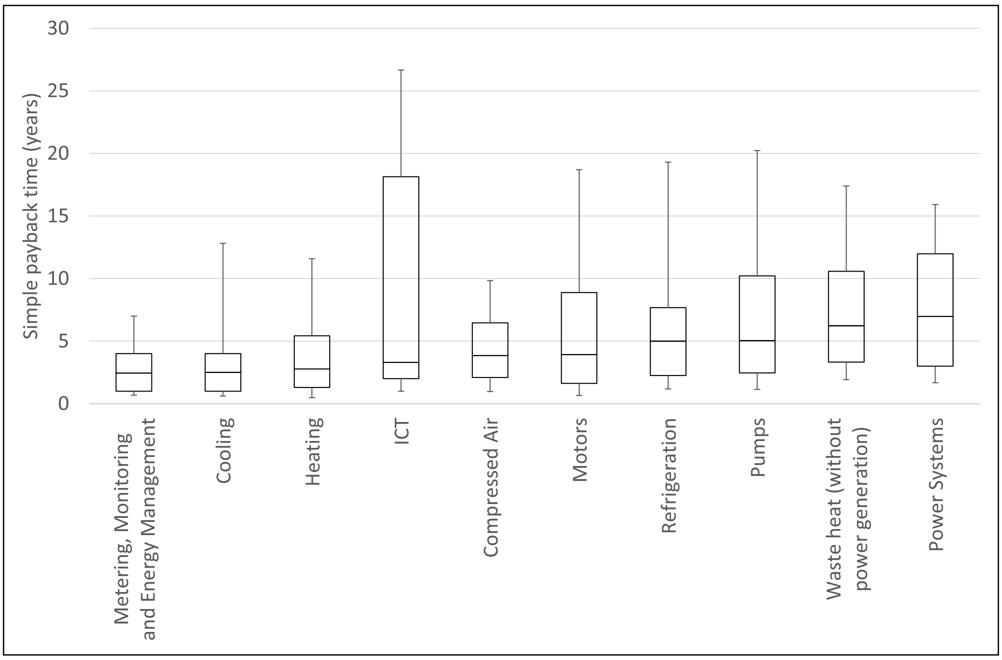

Figure 6 Payback time for industrial projects in EU27+UK (by measure type). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 9,408 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

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In the 2018 analysis, most industrial cross-cutting technologies exhibited median **avoidance costs** below 2–3 ct/kWh (Rohde et al. 2018). The updated dataset (Figure 7) confirms the generally low cost level of industrial energy efficiency measures but indicates a more differentiated distribution across technologies compared to the earlier snapshot. Heating and metering-related measures continue to show comparatively low median avoidance costs below 2 ct/kWh. Motor systems, cooling and refrigeration also remain within a low avoidance cost range. At the same time, pumps and compressed air now exhibit noticeably higher median avoidance costs than observed in parts of the earlier dataset. Waste heat and power system measures also display higher lifecycle costs, reflecting their capital-intensive and site-specific character.

In aggregate, the majority of industrial cross-cutting technologies remain cost-effective when compared to typical industrial energy prices. However, the broader dispersion of avoidance costs suggests that the investment landscape is gradually moving toward more complex, site-specific and system-integrated measures.

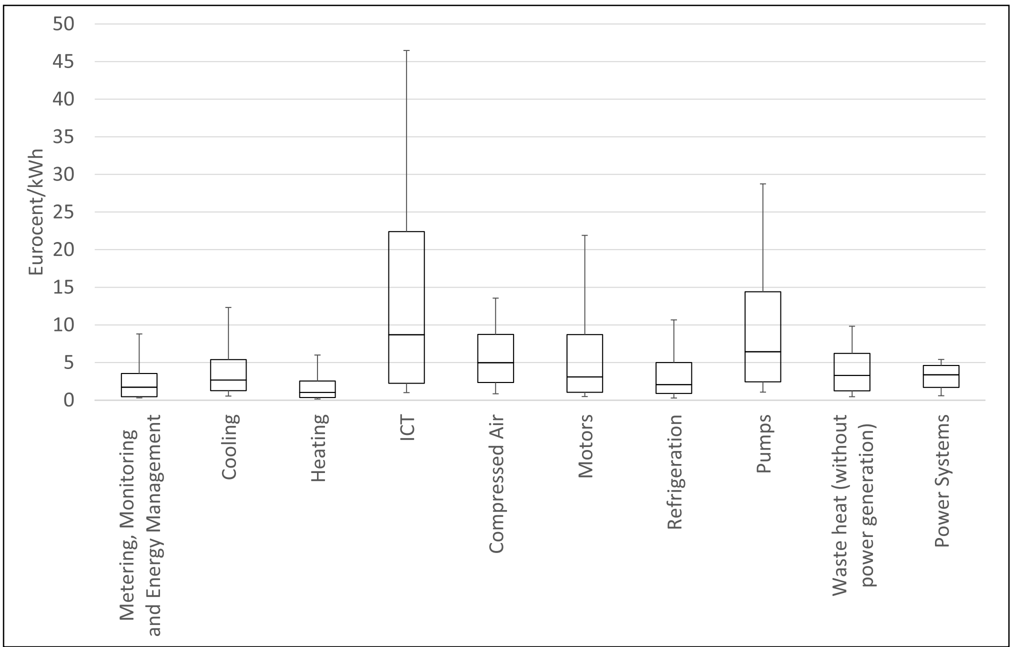

Figure 7 Avoidance cost for industrial projects in EU27+UK (by measure type, no discounting). Source: DEEP Output data on 13/05/2026. Sub-set of projects shown in Chart = 11,212 from a Database total of 36,559. 10%, 25%, 50%, 75% and 90% percentiles are shown in the boxplot.

CROSS-COUNTRY COMPARISON

Tables 1 and 2 present median payback times, avoidance costs and median investment levels for selected measure categories in buildings and industry in the German and the United States dataset included in the DEEP. In total, the comparison is based on 10,614 German projects and 5,917 US projects across the harmonised measure categories. While the German dataset is larger overall – particularly in the industrial sector – the number of building projects is of comparable magnitude in both countries. The sample sizes therefore allow for a structurally meaningful descriptive comparison.

Across both buildings and industry, reported economic indicators differ systematically between the two datasets. Median payback times in the US database are around one year or below for most comparable categories, whereas the German projects typically exhibit median payback periods between two and eight years.

Avoidance costs show a similar pattern: US values are generally below 1 ct/kWh, while German values range from approximately 1 to 6 ct/kWh depending on category.

Median investment levels differ markedly across the two datasets. German projects frequently exceed US median investment values by factors between two and thirty. These pronounced differences in project scale are likely to explain a substantial share of the observed differences in payback time and avoidance cost. Importantly, the direction and magnitude of differences are consistent across both buildings and industry. This suggests that the observed discrepancies reflect structural differences in the composition and scale of projects contained in the two databases.

MEASURE	DE NO. OF PROJECTS	US NO. OF PROJECTS	DE PAYBACK (YEARS)	US PAYBACK (YEARS)	DE AVOIDANCE (CT/KWH)	US AVOIDANCE (CT/KWH)	DE INVESTMENT (€)	US INVESTMENT (€)
Lighting	585	1,536	3.2	1.1	3.1	0.7	7,800	3,248
HVAC Plant	2,034	562	5.1	0.9	4.0	0.2	23,134	2,727
Building Fabric Measures	335	223	7.6	1.0	4.1	0.1	57,600	1,500

Table 1 Buildings: Median economic indicators and number of projects by measure category for Germany and the US.

Note: Sample sizes differ across economic indicators because not all projects report complete information for every indicator. Payback is static. Avoidance cost calculated at 0% discount rate.

MEASURE	DE NO. OF PROJECTS	US NO. OF PROJECTS	DE PAYBACK (YEARS)	US PAYBACK (YEARS)	DE AVOIDANCE (CT/KWH)	US AVOIDANCE (CT/KWH)	DE INVESTMENT (€)	US INVESTMENT (€)
Heating	540	384	2.4	0.8	0.9	0.1	14,928	2,727
Cooling	251	115	2.5	1.6	2.8	1.0	20,000	10,724
Compressed Air	3,413	1,399	3.9	0.6	5.7	0.5	16,348	1,364
Motors	1,118	1,333	3.9	1.1	4.9	0.6	12,539	4,164
Waste heat (without power generation)	2,338	365	6.3	1.5	3.9	0.2	56,924	9,091

Table 2 Industry: Median economic indicators and number of projects by measure category for Germany and the US.

Note: Sample sizes differ across economic indicators because not all projects report complete information for every indicator. Payback is static. Avoidance cost calculated at 0% discount rate.

DISCUSSION

The cross-country comparison reveals systematic differences in reported economic indicators between the German and US datasets. Across both buildings and industry, median payback times are considerably shorter in the US database, and median avoidance costs are consistently lower. Importantly, these differences occur across multiple measure categories, which suggests that the divergence cannot be attributed to isolated categories or sector-specific characteristics.

However, the results do not imply that energy efficiency measures are inherently more profitable in one country than the other. Rather, they reflect structural differences in the composition and scale of projects contained in the respective databases.

STRUCTURAL ROLE OF INVESTMENT SCALE

As shown in the results section, the German projects display substantially higher median investment volumes than the US projects across both buildings and industrial measure categories. Investment scale directly affects both payback time and avoidance cost. Higher upfront capital expenditures increase static payback periods unless accompanied by proportionally higher annual savings. Likewise, higher capital intensity increases lifecycle cost per unit of energy saved. The magnitude and consistency of the observed investment differences therefore suggest that project scale is a primary structural driver of the cross-country discrepancies. While the US dataset contains a larger share of relatively small-scale, low-investment measures, the German dataset includes more capital-intensive projects, particularly within EEE Module 1 and the Energy Efficiency Fund.

This observation underscores the necessity of interpreting publicly reported economic indicators in the context of project scale and structural characteristics, rather than assuming inherent technological superiority or inferiority based solely on aggregated payback or cost metrics.

INSTITUTIONAL CHARACTERISTICS OF THE DATASETS

The structural differences can be traced back to the institutional origins of the datasets, as described in the data and methods section, which likely shape the composition and economic profile of the reported projects.

The German dataset primarily combines projects from public funding schemes (EEE Module 1 and the Energy Efficiency Fund) and implemented measures from the 30 LEEN pilot networks. These sources predominantly represent realised, capital-intensive investment projects that have undergone formal application, approval and, in many cases, verification procedures. The funding-based nature of these programmes favours medium- to high-investment technical measures, often involving equipment replacement, system upgrades or process optimisation with substantial capital expenditure.

In contrast, the US dataset originates from the IAC programme. The IAC database consists of audit-based technical recommendations developed during structured on-site energy assessments of small- and medium-sized enterprises. Importantly, the database includes recommended measures rather than exclusively implemented projects. Recommendations generated in audit settings often emphasise measures with rapid financial returns to increase adoption probability. This creates a structural selection mechanism favouring low-cost interventions.

This distinction is critical. Audit-based recommendations such as in the IAC tend to prioritise low-investment, quickly implementable and often organisational or operational measures. Such measures naturally exhibit short payback periods and low avoidance costs due to minimal capital denominators. Earlier works analysing the IAC data also highlight the predominantly advisory and exploratory nature of IAC data analyses, focusing on energy-efficiency recommendations and payback properties of about 9 months (Qiu, Wang & Wang 2015). By contrast, funded German projects represent realised capital investments frequently of higher technological complexity (Neusel et al. 2024). These projects include deeper technical interventions that may involve higher capital intensity and longer amortisation horizons.

Although all datasets address cross-cutting technologies, their institutional formats differ in terms of: Capital commitment, project selection mechanisms, advisory versus funding orientation. Taken together, this highlights that the economic indicators are shaped by the institutional framework in which projects are generated and selected.

ENERGY PRICE ENVIRONMENT AND CALCULATION FRAMEWORK

Payback time in both datasets reflects project-specific energy prices, and no harmonisation of national energy price levels was applied. Differences in energy price environments between Germany and the United States may therefore influence the magnitude of observed payback periods and avoidance costs. Lower energy prices would, ceteris paribus, lead to longer payback times. The US dataset shows shorter payback times despite generally lower industrial energy prices compared to Germany. This suggests that energy price differences alone do not account for the observed discrepancies in economic indicators and reinforces the central role of structural project differences. The investment structure and selection mechanisms appear to be more decisive explanatory factors.

IMPLICATIONS FOR INTERPRETATION AND BENCHMARKING

The findings underscore the importance of contextual transparency when interpreting benchmarking results from large-scale project databases. Economic indicators such as payback time and avoidance cost are not purely technological performance metrics; they are shaped by:

- the institutional origin of projects
- the investment scale of included measures
- the distinction between recommended and implemented measures
- programme design and selection mechanisms

The cross-country differences observed therefore do not indicate intrinsic performance gaps between countries. Instead, they illustrate how programme architecture and dataset composition systematically influence reported economic indicators.

From an energy efficiency finance perspective, this highlights that benchmarking platforms must be interpreted in light of dataset structure. Comparisons across countries are meaningful only when the institutional and methodological origins of the underlying data are taken into account.

CONCLUSION AND OUTLOOK

This paper updates the descriptive analysis of the DEEP database originally presented by Rohde et al. (2018) using a substantially expanded dataset of more than 36,000 projects. Despite the significant increase in project volume, the core structural findings remain stable. For building projects, lighting and HVAC measures continue to exhibit comparatively short payback periods, whereas building fabric measures involve higher investment volumes and longer amortisation periods. In industry, most cross-cutting technologies remain clustered around median payback periods of roughly two to four years, while more capital-intensive measures such as waste heat recovery show longer payback times.

In addition, a cross-country comparison between German and US projects included in DEEP is conducted. The analysis reveals systematic differences across all economic indicators. US projects consistently show substantially lower median investment levels combined with very short payback periods and low avoidance costs, while German projects display higher capital intensity and longer amortisation periods.

The findings suggest that these differences are primarily driven by structural characteristics of the underlying datasets rather than by differences in technological performance. This largely reflect the institutional origin of the datasets: the German data mainly represent implemented investment projects from funding programmes, typically involving more complex capital-intensive interventions, while the US dataset is based on audit recommendations from the IAC programme, which frequently include low-investment, quickly implementable operational or organisational measures.

From a policy perspective, the results highlight that benchmarking economic indicators across countries requires careful interpretation. Cross-country comparisons should therefore account for structural factors such as investment scale and dataset provenance, not only technological categories. In particular, audit-based recommendation datasets and investment-funding datasets represent different stages of the energy efficiency project pipeline and follow different operational logics. Consequently, commonly used indicators such as static payback time and avoidance cost should be interpreted with caution in financing contexts, as they may conceal important differences in project scale and dataset composition. Policymakers should therefore consider segmenting benchmarking data, for example by investment scale or project maturity, before drawing conclusions for funding decisions.

Future developments of the DEEP platform could enable more refined benchmarking approaches. In particular, analysing projects within comparable investment ranges could help separate technological performance from structural investment differences. Furthermore, econometric analysis of the data could help to support the hypotheses presented in the analytical part of this paper. Such analyses would likely require more granular access to project data which is currently not foreseen in the DEEP's data governance framework.

USE OF GENERATIVE AI TOOLS

An internal AI-based language model (based on ChatGPT) was used for data processing support and text refinement. All analytical interpretations and final content decisions were carried out and validated by the authors.

ADDITIONAL FILE

The additional file for this article can be found as follows:

- **PowerPoint Slides.** PowerPoint Slides relating to this article. DOI: https://doi.org/10.66506/essp.9-013-26.s1

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COMPETING INTERESTS

The authors have no competing interests to declare.

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