Sustainable Cost-Effectiveness Assessment Methodology for Energy Transformation Support Programs

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EXECUTIVE SUMMARY

1. Introduction: The Challenge in Evaluating Energy Efficiency Programs

Achieving the ambitious climate and energy goals set by the European Union and Poland, particularly under the *Fit for 55* package, depends critically on the effective implementation of a wide range of financial support instruments for energy efficiency. These programmes, spanning industry, services, and construction, play a central role in driving the national energy transformation. However, their true impact and efficiency are often obscured by outdated evaluation methods.

Traditional assessment approaches, typically based on a simple annual cost-effectiveness ratio (PLN per unit of energy saved per year), present a distorted picture of an investment's real social value.

These methods systematically fail to account for crucial long-term factors that determine a project's genuine contribution. In particular, they overlook:
a) the substantial differences in the operational lifespans of technologies and the inevitable degradation of technical performance over time;
b) the increasing economic value of saved energy, driven by the growing scarcity of cost-effective energy-saving solutions, rising carbon prices, and related structural trends;
c) the significance of non-energy benefits, such as improved public health, enhanced energy security, and broader positive social impacts.

These methodological gaps lead to distorted assessments and suboptimal policy choices, resulting in an inefficient allocation of public funds and a flawed understanding of the true social costs and benefits of energy efficiency interventions.

To address these shortcomings and their policy implications, a new assessment methodology has been developed, offering a more comprehensive and realistic framework for evaluating long-term energy efficiency interventions.

2. The Proposed Sustainable Assessment Methodology

This report, developed by KAPE S.A. as part of the Ensmov Plus project, introduces a comprehensive and transparent assessment methodology designed to overcome the limitations of conventional approaches. Rather than relying on a simplified metric, the methodology provides an integrated evaluation framework that enables consistent comparison of diverse energy efficiency interventions—from industrial process upgrades to building thermo-modernisations—across multiple perspectives.

In particular, it explicitly distinguishes between the perspectives of public finance, the broader economy, and the private investor. The framework is built on three core pillars: a double correction of long-term effects, a multi-perspective assessment of efficiency and public spending, and the systematic quantification of non-energy benefits.

2.1. The "Double Correction" Principle for Valuing Long-Term Effects

To calculate a realistic cumulative energy saving, the methodology applies an innovative *double correction* concept that accounts for two opposing forces acting over a project's lifetime.

First, **technological degradation** captures the gradual decline in a technology's physical efficiency and performance over time due to wear, corrosion, contamination, and other operational factors.

Second, **climate capitalization** represents the annual appreciation in the value of an energy-saving effect, driven by structural economic trends such as rising energy prices, increasing costs of CO_2 emissions, and the growing scarcity and marginal cost of achieving additional energy savings. For example, the nominal price of CO_2 emissions in the EU ETS increased sixteen-fold between 2017 and 2023, illustrating the rapid growth in the economic value of avoided emissions.

These two forces are combined into a single durability-adjusted correction rate, which adjusts the physical energy-saving effect for both technical decay and increasing economic and environmental value. This approach provides a more accurate, risk-adjusted representation of a project's true long-term energy impact.

2.2. Multi-Perspective Assessment of Efficiency and Public Spending

A central objective of the methodology is to assess both the efficiency of energy efficiency interventions and the effectiveness of the public funds used to support them. Importantly, efficiency is not understood as a single, universal concept. The same project may appear equally efficient from a technical or economic perspective, yet lead to very different conclusions when evaluated from the viewpoint of public finance or the private investor.

For this reason, the methodology evaluates each intervention simultaneously from three complementary perspectives. This approach makes it possible to distinguish between technological efficiency, public spending efficiency, and investor-level incentives, and to identify trade-offs between these objectives.

Rather than focusing solely on total project cost, the methodology explicitly analyses how the financial burden of an intervention is shared between the state and the investor. For example, two projects may have the same total investment cost, but differ substantially in the level of public support provided. While such projects may be equivalent from a purely technical perspective, they can have very different implications for public budgets, distributional objectives, and policy priorities.

• **Economy perspective:** This perspective reflects the full, unsubsidized cost of achieving a unit of discounted energy savings. It serves as a benchmark for comparing the underlying technical and economic efficiency of different interventions, independent of how they are financed.

• **State perspective:** This perspective measures the public expenditure required to achieve a unit of discounted energy savings. It allows policymakers to assess the efficiency of public spending and to compare alternative support schemes in terms of budgetary impact. Importantly, a higher public cost is not inherently inefficient, but may be justified by distributional or social policy objectives, such as supporting low-income households or vulnerable groups.

• **Investor perspective:** This perspective captures the investor's net contribution to achieving a unit of discounted energy savings. It provides insight into project profitability and investment incentives, and helps identify cases where public support may exceed what is necessary to trigger investment, potentially leading to windfall profits rather than additional energy savings.

2.3. Quantifying Non-Energy Benefits and Integrating Them into the Final Assessment

To capture the full social value of energy efficiency interventions, the methodology incorporates a structured approach to identifying, assessing, and—where feasible—quantifying non-energy benefits. These effects are widely recognised in policy analysis, yet are often excluded from formal evaluation due to methodological and data limitations.

As a first step, non-energy benefits are systematically assessed using a **Matrix of Non-Energy Benefits**, which scores projects against a predefined set of criteria, including strategic technological resilience, environmental gains beyond direct CO_2 reductions, investment scale, and positive social impacts. This matrix ensures transparency and comparability across projects, even where monetary valuation is not possible.

Where data availability and methodological robustness allow, selected non-energy benefits may additionally be valued in monetary terms using tools developed, inter alia, under the **KnowNEBs project**. These tools enable the explicit inclusion of monetised non-energy benefits in standard financial appraisal techniques, such as Net Present Value (NPV) and Internal Rate of Return (IRR) analyses, thereby extending the conventional assessment of project profitability. The KnowNEBs methodology does not constitute an established evaluation standard, but rather a prototype analytical framework designed to support experimental and exploratory applications. Its use within this methodology is therefore optional and conditional on data availability and analytical purpose.

Independently of whether monetary valuation is applied, the results of the non-energy benefits assessment are integrated into the final evaluation through a **Non-Energy Premium**, which reflects the additional social and systemic value generated by a project. This premium is used to adjust the interpretation of the baseline social unit cost derived from the economy-wide perspective, yielding a final unit cost that reflects both energy efficiency and broader societal impacts.

By combining qualitative assessment, optional monetary valuation, and transparent integration into the overall evaluation framework, the methodology moves beyond purely financial metrics while preserving analytical rigour. This integrated approach provides a robust and flexible foundation for policy evaluation and has been tested through empirical case studies.

3. Empirical Verification through Case Studies

The validity and practical applicability of the sustainable assessment methodology were examined through a detailed analysis of pilot projects implemented under three major Polish energy efficiency support programmes. These programmes represent distinct policy instruments and financing mechanisms aimed at promoting energy efficiency across different sectors of the economy.

In each case, the analysis explicitly incorporated the cumulative nature of energy savings over time, applied durability-adjusted discounting, and accounted for the changing economic value of savings through the capitalisation mechanism embedded in the methodology.

- **White Certificates (BC):** A market-based obligation scheme primarily targeting the industrial and service sectors, in which energy savings are standardised, certified, and traded.

- **Thermo-modernisation Act:** A public support scheme providing grants and premiums for comprehensive energy efficiency upgrades in residential and public buildings.

- **Ecological Credit:** A programme co-financed by European funds, offering a combination of subsidised loans and grants to enterprises undertaking large-scale or transformative energy efficiency investments.

Applying the methodology to real-world projects drawn from these three programmes enabled a comparative assessment of their design features, efficiency outcomes, and broader social value, thereby demonstrating the methodology's capacity to operate consistently across diverse policy contexts.

4. Key Findings and Comparative Analysis

The application of the sustainable assessment methodology to the analysed case studies revealed substantial differences in the real cost-effectiveness of existing energy efficiency support schemes, offering important insights for future policy design.

The analysis of the White Certificates system highlighted a structural challenge related to allocative efficiency under current design conditions. The reliance on the Substitution Fee mechanism effectively creates a price ceiling toward which certificate prices converge. As a result, public expenditure per unit of achieved energy savings remains constant—approximately 2,235 PLN per tonne of oil equivalent saved, including administrative costs—regardless of the actual cost of individual projects, which in many cases is significantly lower. For highly efficient projects, this mechanism can lead to excessive levels of support and the generation of windfall profits for investors, pointing to a weak alignment between public spending and real project costs.

In contrast, grant-based instruments such as the Thermo-modernisation Act and the Ecological Credit demonstrated a closer link between public support and actual investment needs. In these schemes, support levels are directly tied to real project costs, which limits systemic overcompensation and improves the efficiency of public expenditure, even when higher support levels are intentionally used to pursue social or distributional objectives.

The scale of differences in real-world project performance was clearly illustrated by the range of the final unit cost indicator. Across the analysed projects, values ranged from approximately 79 PLN per tonne of oil equivalent saved for an industrial optimisation project to more than 12,300 PLN per tonne for a high-cost enterprise modernisation. This more than 150-fold difference underscores the importance of evaluation tools capable of distinguishing between genuinely effective interventions and structurally inefficient investments.

Taken together, these findings provide a robust empirical basis for improving the design of existing support instruments and for developing more targeted and efficient energy efficiency policies.

5. Conclusions and Policy Implications

The sustainable assessment methodology presented in this report offers a transparent and comprehensive framework for evaluating energy efficiency policies and support schemes. By explicitly accounting for cumulative effects, long-term durability, and broader social value, it moves beyond simplified metrics that risk misrepresenting the true impact of public investments in the energy transition.

From a policy perspective, the methodology provides a strong case for using the final unit cost indicator as a core reference metric within public evaluation frameworks. Applied alongside conventional financial indicators, it enables a more informed and strategic allocation of public funds and facilitates consistent comparisons across different types of support instruments, including market-based mechanisms and direct grant schemes.

Importantly, the approach also supports the transparent justification of investments in projects with high social or environmental value—such as measures addressing energy poverty, public health, or local environmental quality—that may appear less attractive under a narrowly financial assessment. By making these value judgments explicit, the methodology strengthens the credibility of policy decisions rather than obscuring them.

Finally, the methodology provides a solid foundation for national reporting and for demonstrating the effectiveness of Polish energy efficiency policy in an international context, including reporting to the European Commission. Further research is recommended to refine key parameters related to the durability of technical effects and the evolving economic value of energy savings, ensuring that the framework remains robust and relevant over time. By providing a consistent, transparent, and evidence-based framework, the methodology supports more informed public decision-making and strengthens the strategic management of the energy transition.

References

Full report:

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