

Executive Summary

As energy efficiency continues to gain attention as a key resource for economic and social development across all economies, understanding its real value is increasingly important. The multiple benefits approach to energy efficiency policy seeks to expand the perspective of energy efficiency beyond the traditional measures of reduced energy demand and lower greenhouse gas (GHG) emissions by identifying and measuring its impacts across many different spheres.

The term “multiple benefits”¹ aims to capture a reality that is often overlooked: investment in energy efficiency can provide many different benefits to many different stakeholders. Whether by directly reducing energy demand and associated costs (which can enable investment in other goods and services) or facilitating the achievement of other objectives (e.g. making indoor environments healthier or boosting industrial productivity), recent research acknowledges the enormous potential of energy efficiency. This publication demonstrates its role as a major contributor to strategic objectives across five main themes: enhancing the sustainability of the energy system, economic development, social development, environmental sustainability and increasing prosperity.

Underpinned by a comprehensive review of existing evidence, the aim of this book is two-fold: to build knowledge and understanding of the nature and scope of the multiple benefits of energy efficiency, and to provide practical guidance on how to apply policy development and assessment tools to account for these impacts. The combination of theory and practice will help policy makers and other stakeholders to integrate multiple benefits into strategic planning in order to maximise the potential for positive outcomes.

Energy efficiency: The “first fuel” with large untapped potential

Energy efficiency is taking its place as a major energy resource in the context of national and international efforts to achieve sustainability targets. This reflects a paradigm shift that is beginning to give credence to actions on both the supply and the demand side in the quest to achieve economic growth while supporting energy security, competitiveness and environmental sustainability.

In effect, attention to energy efficiency has begun to evolve, progressing from the lack of visibility inherent in its identification as “the hidden fuel” (i.e. measured and valued only as the negative quantity of energy not used) to an increasing recognition of its role as the “first fuel”. Energy use avoided by International Energy Agency (IEA) member countries in 2010 (generated from investments over the preceding 1974 to 2010 period), was larger than actual demand met by any other single supply-side resource, including oil, gas, coal and electricity – making energy efficiency the largest or “first” fuel. Aggregate annual investments in energy efficiency have been estimated at USD 300 billion in 2011, which is equal to aggregate investments in coal, oil and gas power generation. Macroeconomists have stated that energy efficiency is the surest energy supply that exists. Harnessing economically viable energy efficiency investments would facilitate a more efficient

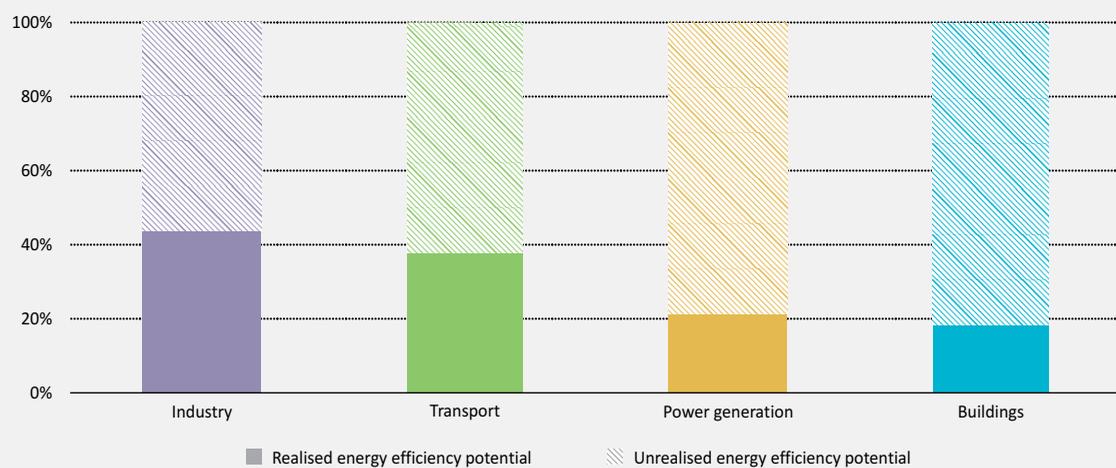
¹ In other literature, these impacts have been variously labelled “co-benefits”, “ancillary benefits” and “non-energy benefits” – terms often used interchangeably with “multiple benefits”. The IEA uses the term multiple benefits, which is broad enough to reflect the heterogeneous nature of outcomes and to avoid pre-emptive prioritisation of various benefits; different benefits will be of interest to different stakeholders.

allocation of resources across the global economy, with the potential to boost cumulative economic output through 2035 by USD 18 trillion – larger than the current size of the economies of North America combined (namely, the United States, Canada and Mexico). Energy efficiency has also become a pillar of global development goals, including the United Nations Sustainable Energy for All initiative. In the face of rising energy demand, global growth aspirations and the pressing need to limit GHG emissions, the market for energy efficiency could develop rapidly – provided that stakeholders understand its value.

Notwithstanding this emerging role for energy efficiency, future projections reveal that under existing policies, the vast majority of economically viable energy efficiency investments will remain unrealised (Figure ES.1).

Figure ES.1

Long-term energy efficiency economic potential by sector



Note: These energy efficiency potentials are based on the IEA New Policies Scenario outlined in the World Energy Outlook 2012. Investments are classified as “economically viable” if the payback period for the up-front investment is equal to or less than the amount of time an investor might be reasonably willing to wait to recover the cost, using the value of undiscounted fuel savings as a metric. The payback periods used were in some cases longer than current averages but they were always shorter than the technical lifetime of individual assets.

Source: IEA (2012), *World Energy Outlook 2012*, OECD/IEA, Paris.

Key point

IEA projections to 2035 show that as much as two-thirds of energy efficiency potential will remain untapped unless policies change.

Many barriers contribute to the limited uptake of energy efficiency opportunities;² one main obstacle is the lack of attention paid to energy efficiency investment opportunities by stakeholders in both the private and government sectors relative to supply-side opportunities, including new resources such as shale gas and oil. The multiple benefits approach seeks, in part, to address this barrier by rendering more apparent the benefits that energy efficiency can generate for these stakeholders. It also helps to address the challenge of the invisibility of energy efficiency (i.e. representing energy *not* used), by appropriately crediting it with the value of the positive impacts it triggers across a variety of areas.

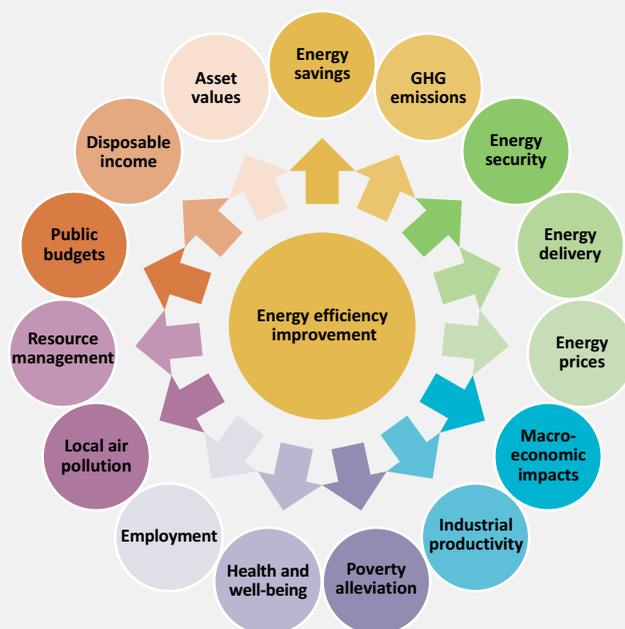
² These include information failures, split incentives, subsidised pricing of energy, inadequate pricing of externalities and a shortage of financing.

Capturing the multiple benefits of energy efficiency

Research has brought to the fore a range of areas, beyond energy demand reduction and lower GHG emissions, in which clear benefits of energy efficiency have been documented (Figure ES.2). Most of these benefits are relevant to IEA member countries and non-member countries alike, although prioritisation by individual countries is likely to vary. Experts increasingly acknowledge the important role of energy efficiency in generating a broad range of outcomes that support ambitions to improve wealth and welfare – goals that the public and policy makers both understand and aspire to achieve.

Figure ES.2

The multiple benefits of energy efficiency improvements



Note: This list is not exhaustive, but represents some of the most prominent benefits of energy efficiency identified to date.
Source: Unless otherwise noted, all material in figures and tables in this chapter derives from IEA data and analysis.

Key point

A multiple benefits approach to energy efficiency reveals a broad range of potential positive impacts.

To date, these broader impacts of energy efficiency have not been systematically assessed, in part due to a lack of critical data and the absence of mature methodologies to measure their scope and scale. As a result, the degree to which energy efficiency could enhance economic and social development is not well understood, and generally considered in national policy decision-making processes only in a qualitative way, if at all.

In examining how methodologies – many of which are well known to economic and policy evaluation – can be applied to the multiple benefits of energy efficiency, this publication demonstrates how often overlooked, and even intangible, outcomes can be captured, offering the possibility to send better socio-economic signals to complement market signals. Strengthening capacity in both the public and private sectors to better assess the full range of outcomes of energy efficiency will improve both the basis for economic analysis of policy options and the ability to communicate the value that energy efficiency can deliver for the economy and society.

A deep dive into key benefit areas

Drawing on best available information from governments and academia, this book provides in-depth analysis of five benefit areas: macroeconomic development; public budgets; health and well-being; industrial productivity; and energy delivery. These areas were chosen for two reasons:

- they tend to be policy priorities in IEA member countries and beyond
- enough evidence is available about their potential impacts to begin robust analysis.

Macroeconomic development

Macroeconomic assessment is a mainstream branch of economic analysis that has built up a huge body of knowledge and evidence over many years; however, the impact of energy efficiency policies on macroeconomic performance still needs to be better understood and systematically measured. Energy efficiency improvements can deliver benefits across the whole economy, with direct and indirect impacts on economic activity (measured through gross domestic product [GDP]), employment, trade balance and energy prices. In general, analysis of GDP changes due to large-scale energy efficiency policies show positive outcomes with economic growth ranging from 0.25% to 1.1% per year. The potential for job creation ranges from 8 to 27 job years per EUR 1 million invested in energy efficiency measures. How energy efficiency measures influence these areas (i.e. positively or negatively) depends on a country's economic structure and on the design and scale of the underlying policies.

Public budgets

Whether by reducing government expenditures on energy or by generating increased tax revenues through greater economic activity and/or increased spending on energy efficiency-related and other goods and services, energy efficiency improvements can have important impacts on the budgetary position of national and sub-sovereign entities. An important impact on public budget is on reduced fuel costs for heating, cooling and lighting, a budget line that is expected to increase over time as energy prices rise. One of the greatest impacts overall is the reduced budget for unemployment payments when energy efficiency policies lead to job creation. Public budget impacts are thus closely linked to macroeconomic impacts.

Although most governments have developed methodologies to estimate the costs and benefits of a policy to the public budget, the full range of public budget benefits are rarely estimated. This broader range of benefits can multiply the calculated value to the public budget by two or three times. An initial evaluation of initiatives to advance energy efficiency in buildings, for example, calculated a value of USD 41 billion to USD 55 billion (EUR 30 billion to EUR 40 billion) to the European public budget; adding tax revenues and reduced unemployment payments increased the value to USD 91 billion to USD 175 billion (EUR 67 billion to EUR 128 billion). Similarly, reduced energy demand can create long-term, cumulative savings for governments that subsidise energy production and consumption.

Health and well-being

Energy efficiency retrofits in buildings (e.g. insulation retrofits and weatherisation programmes) create conditions that support improved occupant health and well-being, particularly among vulnerable groups such as children, the elderly and those with pre-existing illnesses. The potential benefits include improved physical health such as reduced symptoms of respiratory and cardiovascular conditions, rheumatism, arthritis and allergies, as well as fewer injuries. Several studies that quantified total outcomes found benefit-cost ratios as high as 4:1 when health and well-being impacts were included, with health

benefits representing up to 75% of overall benefits. Improved mental health (reduced chronic stress and depression) has, in some cases, been seen to represent as much as half of total health benefits.

Realised health improvements generate downstream social and economic impacts, including lower public health spending. Addressing indoor air quality through energy efficiency measures could, in a high energy efficiency scenario, save the European Union's economy as much as USD 259 billion (EUR 190 billion) annually.

Industrial productivity

Industry often views energy as an operational cost; energy savings are perceived as incidental benefits of other investments rather than as a central value-generating proposition. Yet, industrial energy efficiency measures deliver substantial benefits in addition to energy cost savings – enhancing competitiveness, profitability, production and product quality, and improving the working environment while also reducing costs for operation and maintenance, and for environmental compliance. Introducing multiple benefits can help to better align energy efficiency with strategic business priorities, thereby strengthening the business case for investment. The value of the productivity and operational benefits derived can be up to 2.5 times (250%) the value of energy savings (depending on the value and context of the investment). Including such productivity outcomes in financial cost assessment frameworks can substantially reduce the payback period for energy efficiency investment, in some cases from four years to one year.

Energy delivery

Even utilities and other energy providers gain in a variety of ways from energy efficiency measures. Direct benefits include lower costs for energy generation, transmission and distribution, improved system reliability, dampened price volatility in wholesale markets and the possibility of delaying or deferring costly system upgrades. Providers can also benefit indirectly through benefits that accrue to customers from improved affordability of energy services, which in turn can reduce arrears and the associated administrative costs for utilities. To date, these and other customer benefits have proven difficult to integrate properly into cost-effectiveness tests and therefore have not been accurately measured; however, standard practice valuation frameworks are being developed to accommodate measurement of a broader range of benefits for energy providers and their customers.

Different country perspectives on benefits

While all of the benefits described above are likely to be relevant in all economies, national circumstances, as well as economic and social priorities, will play important roles in their prioritisation. Different countries will value distinct benefits differently, and within a specific national context, different stakeholders will be interested by different benefits. Many developing countries with low energy access rates, for example, can use energy efficiency to service more customers from a given asset base. In countries with near universal access rates, improved industrial productivity may be the main driver for energy efficiency. Given projections of substantial economic growth and related energy demand increase in emerging and developing economies, multiple benefits analysis can and should be adapted to their specific needs and challenges (Box ES.1).

A few cautions to keep in mind

The effects that drive these benefits are dynamic and present several complexities that are important to consider when applying a multiple benefits approach to assessment of energy efficiency policies.

Box ES.1

Energy efficiency generates important benefits for emerging economies

Improved energy efficiency provides a variety of benefits of particular importance for emerging economies and developing countries as they seek to exploit their resource base to reduce poverty and support sustainable growth:

- **Access:** Energy efficiency can help countries to expand access, effectively enabling them to supply power to more people through the existing energy infrastructure.
- **Development/growth:** Energy efficiency has a variety of positive impacts that support economic growth, for example by improving industrial productivity and reducing fuel import bills.
- **Affordability/poverty alleviation:** Energy efficiency can increase the affordability of energy services for poorer families by reducing the per-unit cost of lighting, heating, refrigeration and other services.
- **Local pollution:** Energy efficiency (both supply side and end-use) can help to reduce the need for generation – and lower associated emissions – while supporting economic growth.
- **Climate change resilience:** By reducing the need for energy infrastructure, energy efficiency reduces the amount of energy assets exposed to extreme weather events.

- A holistic and comprehensive analytical approach is needed to enable evaluators to assess whether individual effects – and also the net effect – of a particular energy efficiency policy is positive or negative.
- Some benefits are indirect or are the product of a chain of effects; identifying a causal link between a particular energy efficiency measure and a specific benefit can present a challenge and requires analytical effort.
- Impacts can occur simultaneously at different levels of the economy – from individual citizens or households or sub-sectoral to sectoral levels – at the national or international scale. They can also create flow-on impacts, making it extremely important to establish mechanisms to avoid double-counting of benefits when comparing benefits with costs.

The rebound effect

One of the most persistent challenges in energy efficiency policy is accounting for the phenomenon known as the “rebound effect” – where improved energy efficiency is used to access more energy services rather than to achieve energy demand reduction. A multiple benefits perspective helps to understand the impacts, as well as the sources and causes, of an observed rebound effect and accordingly to manage better any trade-offs that might take place. Some benefits can come with an energy consumption price tag (e.g. when improved energy affordability leads to increased consumption of heating). Where energy savings are “taken back” in the achievement of health benefits, poverty alleviation, or improving productivity, the rebound effect can be viewed as having a net positive outcome, amplifying the benefits of the energy efficiency intervention. In some contexts, such as developing countries with high growth rates where activity tends to be more energy-intensive, rebound may often be desirable as it enables the economy to capitalise further on its energy resources and stimulate other efficiencies.

It remains important to fully assess any potential rebound effects, taking them into account when calculating the actual energy demand reductions (in particular when the objective is reduced pollution, reduced fuel imports, or GHG emissions reductions tied to lower electricity generation). One must also consider the rebound effect against the backdrop of

the particular energy efficiency policy, the specific benefit(s) being targeted and the relevant economic conditions. Unbundling the relationship between energy savings and the broader outcomes of energy efficiency can provide a fuller understanding of the rebound effect, and a clearer appreciation of where this effect either reduces or amplifies the benefits of an energy efficiency intervention.

Putting the tools in the hands of policy makers

Thorough evaluation of the impacts of energy efficiency policies across a variety of areas underpins the multiple benefits approach. To provide policy makers with better information to develop and evaluate energy efficiency policies (and broader energy policy portfolios), the assessment must go beyond merely measuring energy demand reductions.

Analysis of multiple benefits needs to be supported by a robust evidence base. This requires finding better ways to measure, quantify and, ideally, monetise benefits so that they can be integrated into existing policy assessment frameworks. Most governmental policy assessment guidelines³ recommend consideration of a range of social, economic and environmental issues. In practice, multiple benefits assessment remains limited for two reasons: methods for assessing the costs and benefits of non-market impacts have not been fully developed; and such assessments require greater resources (financial and human) than more traditional policy evaluation methods.

Of the range of existing tools and methods governments use for policy assessment, some are better suited than others to measuring multiple benefits. The choice of tools depends on several factors, including the time and resources available for the analysis, and the quality of available data. However, even rough estimates provide more accurate information on which to base policy decisions than assuming a value of zero for observed benefits. Experts advocate for the triangulation of evidence from mixed methodologies to ensure that all impacts reported by beneficiaries of an energy efficiency intervention are taken into account and verified when assessing the net value of an energy efficiency policy.

This book demonstrates how currently available tools can be used to put the multiple benefits approach into practice. Existing policy assessment tools are expected to develop and new ones will emerge to better serve the growing interest of policy makers in the impacts of energy efficiency, and support their ability to optimise energy efficiency policies.

Conclusion

Applying a multiple benefits approach to energy efficiency policy should enable a fuller understanding of the potential of energy efficiency. It signals a shift away from the traditional view of energy efficiency as simply delivering energy demand reductions, and recognises its important role in delivering concrete social and economic improvements. This shift could initiate a step-change in the uptake of energy efficiency opportunities and spur the international community onto an economically efficient path to achieving shared development goals. The multiple benefits approach could accelerate the shift of energy efficiency from its status as the “hidden fuel” to its emerging role as the “first fuel”.

This book aims to articulate the scope and scale of several of these benefits, thereby building the case for considering multiple benefits as a matter of course in the energy efficiency policy process. A cross-section of emerging evidence provides evaluators with examples of how to better account for the benefits and costs of energy efficiency measures to support design and implementation of policy portfolios that maximise

³ For example, the *Green Book* in the United Kingdom (UK HM Treasury, 2003), the *Impact Assessment Guidelines* issued by the European Commission (EC, 2009) and the *California Standard Practice Manual* which is used throughout the United States (CPUC, 2001).

prioritised benefits. Ultimately, improved knowledge will enable governments to make their own assessment of the value of the multiple benefits approach, in line with national strategies. Significant further work is needed to deepen understanding of the policy-outcome dynamics at work, to improve metrics for measuring multiple benefits, and to continue building the evidence base to support policy decision making.

Each country taking steps towards a multiple benefits approach will have unique priorities, and will need to adapt the approach to its particular national context. This will influence evaluation requirements and data resources needed. Armed with more comprehensive information about the value of energy efficiency, countries will be better able to design energy efficiency policies that maximise these additional positive impacts within the context of achieving prioritised policy objectives.

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