



Realizing the Potential of Energy Efficiency

Targets, Policies, and Measures for G8 Countries



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EXECUTIVE SUMMARY

Key Points

- The report recommends that world governments exploit energy efficiency as the energy resource of first choice because it is the least expensive and most readily scalable energy resource option that fuels sustainable global economic growth, enhances national security, and does not further damage the climate system.
- This report calls for the G8 nations to commit to double the global rate of energy efficiency improvement to 2.5 percent per year, provides a menu of proven policy options to help guide and inform national strategies, and suggests a framework for cooperation and action within the G8+5 and beyond.
- Doubling energy efficiency improvement will:
 - Allow the world to hold CO₂ concentrations below 550 ppmv
 - Avoid \$3.0 trillion worth of new generation
 - Save consumers \$500 billion per year by 2030
 - Reduce the energy demand that would have been supplied by 2,000 coal power plants
 - Return the globe to 2004 energy consumption levels
 - Drive business productivity improvements and new employment opportunities

Efficiency First

The need to provide adequate, sustainable, and environmentally sound supplies of energy to fuel global economic growth has created an imperative for increased energy efficiency. A strategy that emphasizes energy efficiency is the most economically and environmentally sensible way of meeting the twin objectives of providing energy for sustainable development and avoiding dangerous interference in the climate system.

Supplying energy for sustainable economic development is an objective shared by developed and developing countries alike, although the urgency is particularly great in the developing world, where large populations do not have access to modern energy services such as electricity and instead rely on traditional and often unsustainable energy sources such as fuel wood. Demand for global energy services to support economic growth has grown by 50 percent since 1980 and is expected to grow another 50 percent by 2030.

There are two options available to meet the increased demand for energy: supply more energy or improve energy end-use and supply efficiencies. Clearly, both approaches are needed. However, of the two, only energy efficiency can generate nearly immediate results with existing technology and proven policies and do so while generating strong financial returns that exceed those from investments in conventional energy supply. Simply increasing conventional energy supply is not a viable option because continued

reliance on the predominant energy source, fossil fuel, exacerbates energy insecurity and raises serious environmental concerns, especially related to climate change. Deploying clean energy alternatives will be needed to meet global development and environmental objectives.

G8 Leadership Toward an Efficiency Goal

These recommendations call for the Group of Eight (G8) countries¹ to commit to a collective goal of doubling the global historic annual rate of energy efficiency improvement to 2.5 percent per year from approximately 2012 through 2030. The G8 countries have the opportunity and responsibility to take the lead and can gain clear economic and security benefits from improving their own efficiency performance. The G8 countries are economically well-positioned to begin the drive toward this goal and represent a significant share of world primary energy consumption (46 percent). In addition to improving their internal efficiency performance, G8 countries should reach out beyond their borders to the +5 and other developing countries.² Greater opportunities exist for significant efficiency improvements in these countries that will help them meet their goals for energy efficiency improvement and sustainable development. By working effectively with the +5 nations, the G8 countries can spur efficiency improvements in economies that together consume nearly 70 percent of global primary energy.

In a series of summit declarations, G8 leaders have recognized the importance of promoting energy efficiency as a means to save valuable resources and money, reduce pollution, and mitigate climate change. The 2005 Gleneagles Declaration expressed support for specific energy efficiency activities and policies related to buildings, appliances, transportation, industry, power generation, and other sectors. The 2006 St. Petersburg declaration reiterated support for existing proposals and extended discussions to improve efficiency to the energy supply sector. At their 2007 Summit in Heiligendamm, Germany, the G8 leaders issued a declaration that placed even more emphasis on improving energy efficiency as a means to address climate change, energy security, and sustainable development.

While important statements of principle, the Summit declarations are short on commitments to action that will bring about the substantial changes needed to improve efficiency at scales relevant to sustainable economic development and climate stabilization. The statements of the Summit should serve as a basis for G8 countries to make much more ambitious commitments to concrete actions, which would constitute a practical approach to making significant energy efficiency gains. The recommendations in this report are intended to inform and deepen the discussion of efficiency among the G8+5 countries.

This document represents the consensus of a team of international energy experts convened by the United Nations Foundation. It presents 21 proven policy options to reach

¹ The G8 countries are Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States.

² The +5 countries are Brazil, China, India, Mexico, and South Africa.

the goal of 2.5 percent per year efficiency improvements and calls for a robust evaluation and review process that combines high-level political coordination with ongoing technical cooperation. The recommended implementation process includes:

- (1) formulating individualized national efficiency strategies by participating countries,
- (2) convening an annual high-level “summit” consisting of G8+5 countries to maintain the momentum of attaining efficiency goals, with supporting working groups to facilitate technical cooperation, and
- (3) collecting and analyzing internationally comparable data by a body such as the International Energy Agency (IEA), working with an agency of the United Nations.

The report cites a number of definitive studies that draw on the full range of established knowledge in this field. These analyses cover a wide variety of regions and countries.

Doubling Efficiency: Ambitious but Achievable

There is a wide body of evidence demonstrating that a significant proportion of the potential for energy efficiency improvement remains untapped. The difference between the actual level of investment in energy efficiency and the higher level that would be economically beneficial from the consumer’s (i.e., the individual’s or firm’s) point of view is often referred to as the “efficiency gap” and is generally caused by market failures and barriers.

This gap can be reduced with significant economic and environmental benefits. Attaining a 2.5 percent annual improvement in energy efficiency would reduce G8 energy demand by about 20 percent in 2030, avoid the consumption of 55 exajoules³ of primary energy in the G8 (equivalent to the output of more than 2,000 power stations), and return energy consumption to 2004 levels.⁴ While 55 exajoules is only about 25 percent of the total global demand growth projected by the IEA, reducing energy demand by that amount in only the G8 countries would offset the equivalent of 80 percent of the increased energy supply needs currently projected to be met by coal-generated power.

Improvements in efficiency drive down energy consumption and, in turn, reduce greenhouse gas emissions. The calculations in this document assume that the 2.5 percent rate of efficiency improvement is maintained through 2030 and then declines linearly to 1.0 percent in 2100. As figure ES-1 shows, modeling completed for this report reveals how integral an ambitious efficiency strategy is to addressing the looming climate crisis.

³ An exajoule (EJ) is slightly less than a quadrillion British thermal units (BTUs), more commonly shortened to “quad.” Thus, 55 EJ is about 52 quads.

⁴ The calculation assumes the Reference Case of the IEA World Energy Outlook 2006 (IEA, 2006c) as the baseline scenario. The power plant calculation assumes a 1,000 megawatt (MW) generating facility operating at 85% annual availability. Achieving this goal globally would avoid the consumption of 97 EJ.

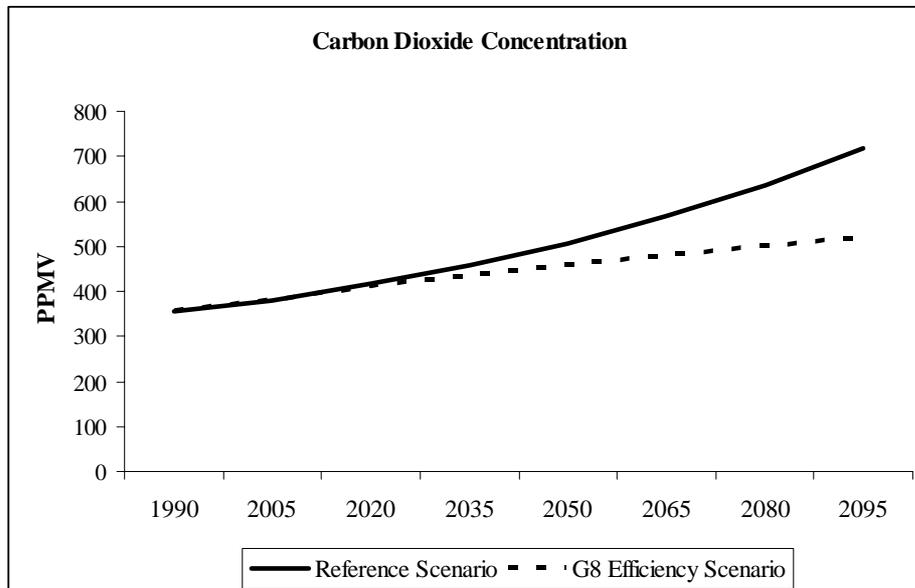


Figure ES-1. Comparison of the “2.5 percent efficiency scenario” proposed in this report to a reference scenario prepared for the US Climate Change Science Program. If extended globally, this scenario would hold atmospheric CO₂ concentrations below 550 ppm. The reference scenario for these calculations is defined in Clarke et al. (2007) and differs from the IEA reference scenario cited elsewhere in this report in that it assumes lower economic growth. Results for the 2.5 percent scenario were calculated using the Pacific Northwest National Laboratory’s “MiniCAM” integrated assessment model specifically for this report.

If the goal of doubling the rate of energy efficiency improvement were extended worldwide, it would be possible to keep carbon dioxide (CO₂) concentrations in the atmosphere below 550 parts per million through the end of the century.⁵ If development of low- or non- CO₂ emitting supply technologies were accelerated, attaining even lower stabilization levels would be possible.

Doubling the rate of energy efficiency improvement in the G8 is neither trivial nor impossible. The target is proposed as an average for the G8, and different nations will achieve different rates of improvement. Some countries are already much more efficient than others. As Figure ES-2 shows, a strategy to achieve 2.5 percent annual efficiency improvements is more ambitious than, but not significantly beyond, assumptions in existing global and regional energy forecasts.

⁵ These results were prepared for this study using the MiniCAM Model of the Joint Global Change Research Institute, a partnership between the Pacific Northwest National Laboratory and the University of Maryland (see Clarke et al., 2007).

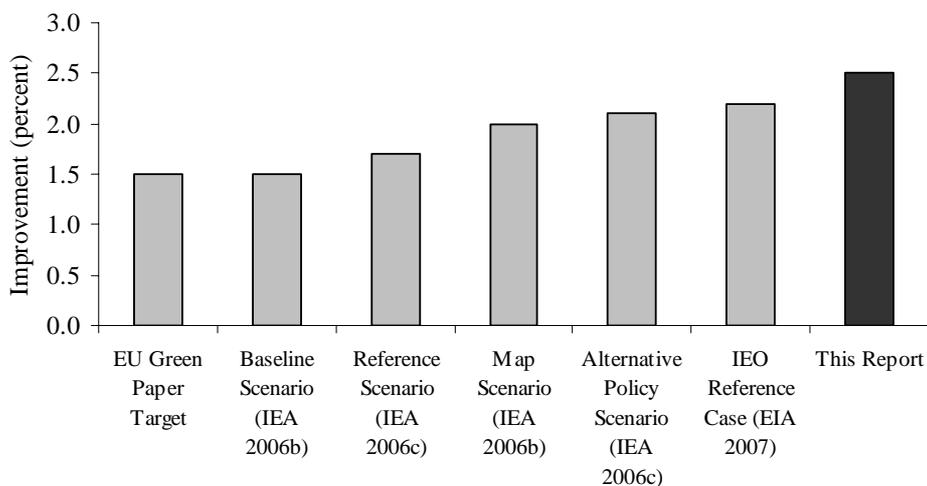


Figure ES-2: Assumptions of annual efficiency improvements from selected energy projections. Recommendations in this report call for slightly more aggressive annual improvements in efficiency than recent energy scenarios assume.

To achieve this goal, the G8 must apply ingenuity, technology, and capital to get more economic benefit out of every unit of energy produced and consumed. While each G8 nation will strive for its goal using a different collection of policies and measures, a sustained, high-level commitment to improve energy efficiency is a common requirement for success.

Economic Benefits of Energy Efficiency

Given the need to support sustainable global economic development, investments in efficiency offer the most financially favorable returns of any energy policy option. The Reference Scenario in the IEA's *World Energy Outlook 2006* (IEA, 2006c) estimates that investments of US\$20 trillion for energy supply will be needed to meet global demand through 2030.⁶ This report estimates that an investment of US\$3.2 trillion⁷ will be required worldwide to double the rate of energy efficiency improvement, US\$2.3 trillion of which will be invested by the G8 countries. These efficiency investments avoid new supply investments of US\$3 trillion worldwide and US\$1.9 trillion in the G8 countries, and result in a net incremental investment of US\$200 billion worldwide and US\$400 billion in the G8 countries.

⁶ Reference Case, IEA 2006c. The high-efficiency Advanced Policy Scenario of the IEA *World Energy Outlook 2006* assumes an incremental investment in efficiency of US\$600 billion that is offset by US\$700 billion in avoided investment in new generation.

⁷ Investments include the costs of physical upgrades and the purchase of high-efficiency appliances and vehicles.

These relatively small net efficiency investments generate significant additional benefits in improved business productivity and reduced consumer energy bills worth approximately US\$500 billion annually by 2030. This implies an average payback of approximately three to five years for the efficiency investments needed to reach the target suggested in this report.

Other major forecasts have also identified the significant economic benefits of efficiency investments. The IEA's *World Energy Outlook* (WEO) 2006 (IEA, 2006c) and the 2007 Report of Working Group III of the Intergovernmental Panel on Climate Change (IPCC, 2007) identified significant cost-effective potential for energy efficiency to reduce greenhouse gas emissions over the next 20 to 30 years. For example, the WEO (IEA, 2006c) showed that the high-efficiency Alternative Policy Scenario yielded “substantial savings in energy consumption and imports compared with the Reference Scenario. They thereby enhance energy security and help mitigate damaging environmental effects. *Those benefits are achieved at lower total investment cost than in the Reference Scenario*” (emphasis added). Similarly, the IPCC (2007) report clearly showed that energy efficiency policies play a critical part in cost-effective strategies for reducing CO₂ emissions in the near term.

Many corporations, including multinationals Wal-Mart, Dow, Philips, Unilever, and 3M, have voluntarily undertaken substantial internal energy efficiency campaigns because these projects represented a good return on their investment.

In addition to the inherent economic advantage of efficiency investments, improved efficiency will help mitigate energy price increases and volatility by easing short- and medium-term imbalances between demand and supply and will also help reduce CO₂ emissions.

The Way Forward: Policy Options to Meet the Goal

This document does not recommend a “one size fits all” strategy but rather suggests a menu of policy options and measures to help countries achieve their efficiency targets. Each country will select the policies that best suit its efficiency commitment as well as its unique economic, social, and political situation. Examples of policy recommendations detailed in this report include:

Economy-Wide Policies to Improve Efficiency: There are pro-efficiency policies that have impacts across the economy and in all sectors. G8 governments have a variety of options to consider. For example, they could consider phasing out subsidies to established energy sources, many of which are also carbon-intensive. Energy supply subsidies distort the price signal for demand-side energy efficiency investments, and reduce costs to energy companies and consumers at the expense of the taxpayer.

The G8 governments could establish a small surcharge (e.g., 0.5 to 1 percent) on every dollar of energy sales to fund efficiency activity and investment. Several US states, South Korea, and Switzerland have successful surcharge programs currently in place.

Creating innovative financing structures and developing a more robust energy service company (ESCO)⁸ industry to reduce the risks and up-front costs of energy efficiency investments is another option. Additionally, multilateral organizations and export credit agencies need guidance from international leaders to direct investments and foreign aid in the energy arena toward energy efficiency in newly industrialized, transition economy, and developing countries.

G8 governments could emphasize efficiency in procurement strategies. Governments should routinely review procurement specifications for vehicles, equipment, and buildings to ensure that each achieves “best-in-class” efficiency performance. National governments can provide incentives to exceed minimum efficiency purchasing standards and encourage procurement of efficient fleets and products at a regional and local level to drive further improvements.

Public information on the importance of efficient energy consumption as well as practical ways to adopt efficient practices in homes and businesses are two other important strategic options.

Improving Efficiency of Buildings and Equipment: Residential electricity consumption is one of the fastest-growing areas of energy use, especially in developing countries. In the commercial sector, electricity consumption is growing faster than the overall economy, especially in countries with air conditioning requirements. There are many potential improvements to be made in this sector.

This report recommends that countries adopt stronger building codes, engage the ESCO market to aggressively refurbish existing building stock, and encourage the installation of advanced lighting. Governments should also develop and implement incentives and other measures to ensure that new buildings are designed and constructed to be as energy efficient as possible.

In the appliance sector, the document recommends that internationally coordinated minimum performance standards be adopted for specific equipment classes in conjunction with support for research and development to help manufacturers achieve the new targets. The IEA and other bodies have initiated work in this area, but product labeling should be further standardized and improved to allow consumers to make more informed decisions, and incentives should be provided to improve market penetration of the most energy efficient products.

Improving Industrial Efficiency: Industry accounts for nearly 40 percent of worldwide energy use. Historically, industrial energy efficiency has improved at a rate of 1 percent annually, but experience demonstrates that improvements can occur at twice this rate over medium- or longer-term time frames (i.e., 10 years or more). The necessary conditions to set the stage for substantial improvements in industrial energy efficiency

⁸ Energy service companies (ESCOs) invest in energy efficiency improvements for third parties and rely on a contract with owners to recoup their investment.

include access to information; improved decision-making processes; access to financing, company (human) resources, and technology; and the ability to measure and verify the achieved energy savings.

A variety of policies and measures can help create these necessary conditions and reduce actual or perceived barriers. Governments can focus the attention of corporate senior leadership on efficiency by working with industrial users to establish an energy management standard and by providing forums to share best practices across firms and industrial sectors. Governments and industry may also choose to work together to establish binding targets similar to the Long-Term Agreement process in the Netherlands.

Improving Transportation Efficiency: Transportation accounted for 26 percent of total global energy use in 2004 (IEA, 2006c). Light-duty vehicles and freight trucks accounted for some 45 percent and 25 percent of this global total, respectively. Energy use for transportation is likely to increase dramatically in the coming decades as the world's economies develop. If transportation services are not made more efficient, energy use in the sector will continue to grow rapidly in both absolute and relative terms.

The costs of energy consumption in the transportation sector are huge, in terms of overall expenditures, oil imports, climate change, and other environmental impacts, yet many countries' transportation systems are surprisingly inefficient. The development and penetration of advanced technologies will depend as much on political and institutional issues as on technological ones.

Policy options include establishing coordinated standards to reduce carbon emissions from vehicles, providing incentives for the purchase of fuel-efficient, low-emission vehicles, and directing the replacement and/or recycling of the existing inefficient vehicle stock. Governments should lead by example and aggressively reduce both fuel and carbon intensities of the public vehicle fleet. Greater use of more efficient mass transit, rail, and air transportation should be encouraged through national and local policies. Governments should also consider upgrading transportation infrastructure to improve efficiency and providing incentives for "teleworking."

Improving Energy Supply Efficiency: Four policies in particular offer great potential for savings from energy suppliers: innovative utility rate structures that provide incentives for efficiency; more combined heating, cooling, and power installations; greater efficiency in existing generation and transmission infrastructure; and reductions in natural gas flaring.

Utility regulations can be realigned to provide utilities with incentives for reduced consumption rather than increased generation. Historically, electric utilities have been compensated for building power generation and transmission infrastructure, and for selling electricity. Rate structures should be revised to reward utilities for meeting the demand for energy services by increasing end-use energy efficiency. Modernization of the electricity grid should also be encouraged and will have many other benefits in addition to greatly enhancing energy efficiency, including reducing the need for new

capacity, increasing the ability to integrate intermittent renewable energy generation into the grid, and greatly improving grid security and reliability.

Highly efficient combined heating and power operations should be expanded. Combined heating, cooling, and power (CHP, or cogeneration), the conversion of fuels to electric power in conjunction with the generation of heat for industrial processes or buildings, can be twice as efficient as current central station power generation. Generating power simultaneously with heat uses 80 percent or more of the useful energy in fuel compared to 35 to 50 percent of the useful energy in fuel when used for power alone. Governments should aim to increase penetration of CHP to at least 20 percent of total generation by 2020 by making it easier for facilities to sell excess electricity and heat into distribution grids and encouraging municipalities to adopt CHP where feasible.

Governments should help drive greater efficiency in existing coal and natural gas facilities by setting minimum efficiency targets and pursuing public-private partnerships to encourage research and development and reduce risks associated with demonstration projects. The report recommends a minimum standard for new and recommissioned fossil fuel power plants of 50 percent efficiency for coal plants and 60 percent for natural gas plants by 2030. Transmission infrastructure, particularly for natural gas, should be improved to reduce energy loss during transportation.

Reducing gas flaring is an area that is particularly ripe for able, enlightened leadership. Governments should immediately encourage the natural gas industry to accelerate modernization of high-pressure transmission pipelines. Over the next year, governments could also restructure gas utility pricing to create incentives for reduced leakage. In particular, governments could ensure through regulatory reform that producers of associated gas⁹ have access at a market-based price to existing high-pressure transmission pipelines that could connect them to a ready marketplace.

Improving Energy Efficiency in Developing and Transition Economies: It is unavoidable that energy consumption will continue to grow in developing countries. Developing and transition-economy countries may have more energy-intensive growth than developed nations because of their need to manufacture energy-intensive materials for construction and infrastructure. Recognizing the need for this difference in the structure of economic activity, there is still scope for attaining more economic benefit from each unit of energy consumed thus making the citizens of all countries better off. Acute energy shortages in key developing economies such as China and India highlight that energy efficiency is key to sustained and sustainable economic development. Many rapidly developing countries have already set ambitious objectives for improving energy efficiency.

The G8 countries can play a critically important role in driving global sustainable development by helping developing and transition economies to incorporate modern and efficient technologies in both the supply and the demand sectors as they develop. Specifically, G8 countries can provide technical assistance, work with international financial institutions to establish loan guarantee funds for efficiency investments, invest

⁹ Associated gas is natural gas that is co-located with oil deposits.

in human and institutional capacity building, and foster the export market for energy efficient technologies while simultaneously reducing the flow of inefficient second-hand technology.

Working Together To Achieve the Goal

Efficiency improvements at the scale proposed in this report will provide a bridge to affordable low- and zero-carbon energy systems of the future. Leaders of the G8 countries must find the will to take advantage of this opportunity to increase energy efficiency and make it the essential first step for avoiding dangerous human interference in the climate system. Nongovernmental organizations, interested businesses, financial institutions, and other levels of government must also play a role by holding G8 leaders to account and issuing periodic evaluations on national progress. Climate stabilization, sustainable development, and energy security ultimately depend on society's steps along this path, and we must work together to ensure progress.



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