

12 strategies to step up global energy efficiency

Advice from three expert NGOs to IEA's High-Level
Commission on Energy Efficiency

Introduction

Only a drastic reduction in global energy demand will allow an affordable and manageable transition to a global energy system based on renewables.¹ Ambitious and forceful energy efficiency to manage demand is key to meeting sustainable development goals.

Urgent action is needed. Global growth in energy use is largely outpacing decarbonisation² and in 2018, primary energy intensity – an important indicator of how much energy is used by the global economy – improved by just 1.2%, the slowest rate since 2010. This was significantly slower than the 1.7% improvement in 2017 and marked the third year in a row the rate has declined. It was also well below the average 3% improvement consistent with the IEA's Efficient World Strategy, first described by the IEA in 2018.³

While carbon pricing and the removal of fossil-fuel subsidies are important to create a level playing field for energy efficiency, price and market signals alone are far from enough to steer the world in the right direction. We need ambitious measures on many levels, including strict requirements for product, vehicle and building performance, agreed metrics, innovation, research, financial support and improved understanding of investment behaviour and economic drivers.

Below, we have summarized a number of general principles that should serve as the foundation for energy efficiency policies. These principles are followed by 12 recommended strategies to enable the change.



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Principles that support efficiency

- **Energy sufficiency** and focus on limiting energy consumption. We should first ask how we can limit the needs for a service before we think about how to supply it efficiently.⁴
- **Multiple benefits** of energy efficiency are often much more valuable than the energy savings alone. Energy efficiency investments will become more viable and attractive by systematically factoring in aspects such as increased productivity, improved comfort and health, less staff turnover, job creation and energy security.
- **Strict energy performance requirements** for products and appliances, buildings and vehicles ensure that the poorest performing products from an energy or climate perspective are taken off the market, while labelling and other measures help promote better products. Progressive standards with stricter energy requirements for larger houses or appliances than for smaller ones, can provide further leverage. Performance requirements must be supported by stringent metrics, standards and definitions.
- **Proper design** from the beginning. Passive technologies for heating and cooling will reduce the need for further investments in energy using technologies and energy supply. These design choices tend to create better, healthier and more comfortable dwellings and work spaces. Recent thermal comfort studies help define comfort objectives based on large comfort surveys⁵, showing that passive technologies can deliver comfort with low energy use and are hence resilient to shocks and climate change.
- **Track progress.** We need clearer energy efficiency indicators and a uniform nomenclature to enable comparison and transfer of lessons learned and reduce costly communication mistakes.⁶ We must collect data on progress and evaluate what works and what doesn't. ACEEE's city, state and international scorecards⁷, and the European Odyssey-MURE⁸ project offer good examples.
- **Unlock capital.** Recent analysis show that efficient end-use technologies provide higher social returns on investment than energy-supply technologies.⁹ An increasing number of investors want to invest in energy efficiency and need an appropriate policy framework for encouraging market forces can help unlock capital.
- **Make energy utilities allies** of energy efficiency. In more than 50 jurisdictions around the world systems for energy efficiency obligations, white certificates or energy company performance standards are in place. These require utilities not just to deliver energy but also savings to their customers and include tariff regulation or other mechanism to align the economic interests of utilities to societal and environmental objectives.¹⁰
- **Understanding behaviour** and what drives energy consumption is needed to create effective policies. Price signals are not enough, and policies should factor in research on behavioural aspects and structural changes needed to facilitate climate friendly and low-energy behaviour.
- **Circular economy** and resource efficiency go hand in hand with energy efficiency. Look at low life cycle costs and favour products that last.
- **A just and fair energy transition.** The transition needs to be equitable. Energy efficiency can help create the right conditions for that, but vulnerable citizens may need more support to be able to take part in the transition.
- **Access to energy is not a given.** All citizens of the world should have access to sustainable energy services, such as lighting, cooking and thermal comfort; energy efficiency and passive technologies can make this affordable.

Which sector matters most?

Energy demand must be reduced in all end-use sectors. According to IEA, the 2018 global final energy use by sector is:¹¹

Buildings	31%
Industry	29%
Transport	29%
Non-energy use (other)	11%

In addition to addressing end-use consumption, losses in transmission and distribution are costly and increase the fuel consumption in generation. According to the World Energy Council, losses in the electricity networks can be as high as 23–27% (Ghana, Nepal and Paraguay) or as low as 3% or below (Luxembourg, Iceland, Trinidad and Tobago, and Finland).¹² Losses in gas or district heating networks must also be addressed.

12 strategies for global urgent action on energy efficiency

Net Zero-energy, water, waste and carbon buildings and homes (NZEBS/NZCBs)

Many organizations, states and countries are working to make zero energy and zero resources buildings common practice in new construction by 2030 or earlier. For example, the EU requires all Member States to set building codes that require new buildings to be “near zero” energy by 2021 (public buildings from 2019)¹³ and Canada is now developing a set of step-codes to reach ZEB levels. A key step to reach net zero energy is energy efficiency, which can dramatically reduce demand by as much as 80% relative to typical new construction, allowing moderate-sized renewable energy systems to provide the remaining energy at lower cost. Similarly, for waste and water, the focus is to first minimize usage and then find alternatives to achieve the net zero target.

To make net zero buildings normal practice goals must be set, for instance building codes that make new buildings net zero mandatory by 2030. To achieve this, technical assistance to architects, engineers and builders is needed and innovative incentive packages for developers, as well as R&D on strategies for material efficiency (low carbon alternatives and demand reduction). Strategies for energy-intensive buildings such as hospitals, malls and grocery stores must be developed.

Home and building retrofits

Most homes and commercial buildings that will be standing in 2050 have already been built, making efficiency retrofits critically important. Typical retrofits currently save 10–40% of energy use, but to tap their full potential, they will need to cover more buildings and deliver more savings per building. They should be complemented with innovative business and financing models. Passive retrofit measures such as proper insulation can help to reduce heating needs by up to 70%.¹⁴ Building and home performance labels can provide important information to help owners and buyers identify buildings that need efficiency improvements.

Retrofit programs should be expanded. Ultimately, we will likely need building codes to require minimum levels of performance also for existing buildings, and we will need to provide time, financing and technical assistance for the necessary upgrades. Examples include the Boulder, Colorado (USA) and UK programs for rental housing and commercial building programs in Tokyo, New York City, Washington DC and Washington State. Policies should pay particular attention to low- and moderate-income households that often cannot afford retrofits on their own along with easy access to finance for ESCOs and other actors to scale up energy efficient retrofits.

Other notable examples include the Energy Passport efforts in Belgium, France and Germany. The Netherlands is implementing strict legislation that will make it mandatory for office buildings to meet the buildings performance level “C” by 2023, and the performance level “A” by 2030. After that date, an office building without the required energy performance label can no longer be used. Currently, an estimated 15,000 office buildings will have to be upgraded to meet the 2023 requirements.¹⁵ The Czech Republic and France are using revenues from the EU Emissions Trading System to leverage private investments in building renovations.¹⁶

Low energy cooling

Cooling is the fastest-growing end use in buildings, as its energy demand more than tripled between 1990 and 2018 to around 2,000 terawatt hours (TWh) of electricity.¹⁷ The right to thermal comfort is increasingly recognized as a basic necessity in a warming world, but unfortunately the world’s population continues to be divided along the lines of heat inequality between the “cool haves” and the “heat exposed have-nots”. This divide is particularly lopsided in developing economies. However, with increasing incomes the air conditioning market is projected to grow rapidly. China and India account for around half of the total projected increase in the household ownership of ACs worldwide, with over 2 billion residential air-conditioners installed in China and India by 2050. In the same projection, the total space-cooling output capacity of residential ACs worldwide will grow four times by 2050.¹⁸ If left unchecked, energy demand from air conditioners will more than triple by 2050, equal to China’s electricity demand today.¹⁹

Air-conditioning is energy-intensive and has a large emissions footprint, both from the use of fossil fuels and from the use of refrigerants, many of which have a high global warming potential (GWP) and are regulated substances under the Montreal Protocol. While strict energy performance standards for air-conditioning equipment are key to counter the rising cooling energy demand, a whole-systems approach of ‘Lean-Mean-Green’ can act as a key facilitator of this goal: energy-efficient building design and construction, including “passive” cooling strategies, will reduce building cooling loads; these reduced loads can be met with energy-efficient cooling equipment and behavioural intervention to optimize cooling utilization. A holistic and coordinated effort between policy action, technology advancement, and consumer awareness will be key in achieving thermal comfort for all sustainably. The Global Cooling Prize has recently (November 2019) been awarded to a number of finalists to develop cooling solutions that have the potential to deliver affordable solutions for developing countries that are five times as efficient as today’s standard units.²⁰

Smart buildings and homes

Sensors, automated controls, and other smart software can optimize energy use and reduce it by 15% or more if applied correctly.²¹ Examples include learning thermostats (like Nest or ecobee) in homes that automatically adjust heating and cooling based on residents' patterns, as well as more sophisticated systems used in commercial buildings that often leverage energy and building management systems. Steps to encourage wide use of these systems include adopting common communication protocols so that systems from different vendors can talk to each other; developing systems for using information and communication technologies to document savings so that incentive programs can include intelligent efficiency approaches; better educating home and building owners on intelligent efficiency capabilities and benefits; documenting best practices from early projects; and demonstrating projects in promising market niches that lack documented results. The policies discussed above under home and building retrofits will also encourage use of smart systems.

Electrification of space and water heating

As the electric grid gets cleaner, high-efficiency heat pumps and heat pump water heaters can generally reduce both energy use and emissions in regions with substantial space and water heating loads and clean electricity grids. It should be noted that buildings must be very efficient in order to offer affordable heat-pump solutions and to guard against excessively high winter peak electric demand. Electrification should start with the most promising markets, such as new construction, regions with only moderate heating demand, and buildings heated with expensive fuels. Building electrification will make less sense in areas where a high proportion of electricity comes from coal. Policies to promote electrification include consumer incentives, building codes, and limiting expansion of gas distribution systems.

Appliance and equipment efficiency

Appliance and equipment standards are generally regarded as a very effective energy efficiency policy²². In jurisdictions such as Canada, China, EU and the US appliance and equipment energy performance standards now cover more than 50 product types ranging from refrigerators to industrial pumps. Countries with fewer standards should be adding additional products to their programs based on international best practices and all countries must improve their capacity to enforce the standards. All standards must also be periodically updated to reflect continued technology progress. The growing demand for smart equipment and Internet of Things (IoT) requires a special focus on how best to channel these capabilities to achieve energy savings while keeping the direct energy use of these products as low as possible.

Programs such as the voluntary ENERGY STAR® as well as incentives for high-efficiency equipment can produce substantial additional savings by encouraging purchases beyond minimum requirements and covering products not subject to standards. Labelling and incentive programs also lay a foundation for future upgrades to minimum standard levels. The mandatory European A–G label is harmonized with the EU energy performance standards (called ecodesign requirements), and the higher-class label requirements are thus directly linked to future upgrades of the performance standards.

Industrial efficiency

Energy intensity in this diverse sector has steadily improved for decades, but there is still a very large potential for industry to produce nearly twice as much value per unit of energy use in 2040, according to the IEA. Overall manufacturing energy intensity could improve by 44% between now and 2040 with 70% of the energy savings potential in less energy-intensive manufacturing sectors.²³

National policies should encourage and incentivise strategic energy management, mandatory data reporting and smart manufacturing programs (e.g. as Germany and the Netherlands are doing). Improvements in key processes (e.g. “green” steel and cement) and integration of waste-to-energy flows should be pursued. For instance, the Swedish government is supporting a project to develop carbon-free steel based on hydrogen reduction that could reduce total carbon emissions in Sweden by 10% and in Finland by 7%^{24, 25}. Fundamental changes in the way we use energy-intensive products should also be explored, e.g., by replacing energy-intensive products such as steel and cement with low energy products such as flyash bricks and structural wood products (which also can act as a carbon sink).

To tap the full potential savings will require expanded R&D efforts for information and communication technology integration, more performance standards for industrial equipment (e.g. motors, compressors, boilers, variable speed drives), technical assistance, incentives, financing, and sector or company specific measures. For example, China and India have made substantial progress with their Top 10,000 Industries²⁶ and Perform Achieve Trade (PAT)²⁷ programs respectively. Countries should develop roadmaps for decarbonizing high emitting sectors and set up policy frameworks for a circular economy.

Light- and heavy-duty vehicle fuel economy

Vehicles have substantially increased in energy efficiency in recent years, driven by ambitious fuel economy standards as well as high fuel prices in many countries. However, recent IEA analysis has shown the SUV ownership trend has more than offset savings offered by efficiency in lighter vehicles.²⁸ It is crucial that countries adopt or continue to improve their fuel efficiency standards to ensure that manufacturers are pushed to provide wide range of fuel-efficient options, and to avoid loopholes for categories such as SUVs. Additionally, more electric vehicles (EVs) are entering the market, which generally reduces energy use and emissions, especially in areas with cleaner electric grids. We can further boost vehicle efficiency and EV deployment with R&D efforts, requirements for clean vehicle purchases (e.g. some cities have legislated gradual conversion of public bus fleets), and greater promotion and incentives (both financial and non-financial) for EVs and other high-efficiency vehicles (e.g. hybrid and fuel-cell trucks). These efforts need to address not only passenger vehicles but also trucks, including tractor-trailers. As part of these efforts, electric vehicle charging and hydrogen fuel networks will need to be built out.

Reducing vehicle distance travelled and modal shift

Improved vehicle fuel economy will not adequately address energy use over the long term in the transportation sector if growth in vehicle distance travelled goes unchecked. Mobility planning at the local and regional level that incorporates GHG and mode share targets will aid in finding comprehensive solutions and incorporating emerging mobility options in a way that creates sustainable transportation systems. Improved mobility options such as ridesharing, bike sharing, and expanded public

transit, combined with compact and walkable communities, can reduce car use and save energy. So, too, can the continued revitalization of transit-friendly cities and inner suburbs. Revamping urban zoning codes, creating sustainable funding for public transit construction and expansion, as well as creative supportive policies to encourage the use of bicycle and pedestrian infrastructure, among other policies, will be necessary to reduce vehicle energy use and emissions

Improving freight transport

The freight sector can save energy through mode switching, providing seamless transitions among highway, rail, water, and air modes; the digitization of logistics; “green corridors” and using collaborative shipping arrangements to optimize vehicle loads and avoid empty back hauls. Improved management of supply chains also can reduce and shorten freight shipments. Smart freight management systems based on information and communication technologies can help maximize loading and efficiency. Policies to spur these savings include energy or emissions reduction targets in freight planning, road use and congestion fees, and infrastructure investments.

Aviation efficiency and long-distance travel

Energy use and emissions are growing rapidly in aviation. Increased access to trains, including high speed, and virtual meetings in lieu of air travel can help offset this trend. In aviation, improved engines, operational efficiency by air traffic control, airlines and pilots, and reductions in the amount of travel can cut aviation energy use and emissions by about 50%. Increased use of cleaner fuels in aviation and railways is important as well. However, the difficulty in reducing direct climate impacts from air travel is reflected in the controversy between the International Civil Aviation Organization (ICAO) and the EU. ICAO reached consensus on capping GHG emissions for international aviation at 2020 levels (including offsets), while the EU wants to force carriers to join a carbon trading scheme²⁹. The carbon offsetting policy by ICAO is also met with scepticism as being opaque.³⁰

Reducing losses in electric distribution systems

New electric grid technologies, such as conservation voltage reduction and amorphous core transformers, can reduce power losses in the grid (as well as in homes and buildings). Better grid design, smart metering, integration of demand-side management (DSM) and demand-response (DR) interventions and theft prevention efforts can reduce losses, particularly in developing countries. These savings can be spurred by regulatory policies to encourage or require utilities to use these technologies as well as increased budgets for grid improvements.

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