THE **NEW** CLIMATE **ECONOMY**

The Global Commission on the Economy and Climate

Working Paper

Raising Energy Efficiency Standards to the Global Best

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Overview

Greater energy efficiency can benefit countries at all stages of development, but particularly fast-growing economies trying to achieve universal energy access with limited resources. In developed countries, while 2010 energy use was around 20% higher than in 1974, it would have almost doubled without the savings made by energy efficiency investments. By offering cost-effective opportunities to avoid new energy supply, energy efficiency is increasingly recognised as the "first fuel".

Globally, enhanced energy efficiency investments could boost cumulative economic output by US$18 trillion to 2035, increasing growth by 0.25–1.1% per year. Cooperation to raise energy efficiency standards for appliances, lighting, vehicles, buildings and industrial equipment can unlock energy and cost savings, expand global markets, reduce non-tariff barriers to trade, and reduce air pollution and GHG emissions.

The Global Commission on the Economy and Climate recommends that G20 and other countries converge their energy efficiency standards in key sectors and product fields to the global best by 2025, and that the G20 establish a global platform for greater alignment and continuous improvement of standards.

To support further action on energy efficiency, international organisations, with business and national governments, should work towards internationally accepted product definitions, metrics for energy efficiency, test protocols, and better information provision. Institutions and initiatives such as the International Partnership for Energy Efficiency Cooperation (IPEEC), the International Energy Agency (IEA) and the UN's Sustainable Energy for All (SE4All) can help in the collection of comparable data, policy analysis, and can advise countries on implementing better energy efficiency standards.

Gradually raising and aligning national efficiency standards could reduce annual GHG emissions by 4.5–6.9 Gt CO_2e by 2030.

Photo credit: Asian Development Bank/Flickr

About this working paper

This New Climate Economy Working Paper was written as a supporting document for the 2015 report of the Global Commission on the Economy and Climate, *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. It reflects the research conducted for Section 2.4 of the full report and is part of a series of 10 Working Papers. It reflects the recommendations made by the Global Commission.

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1. Introduction

The global energy system has undergone an unprecedented expansion in the last 25 years, with energy demand growing by almost 60% since 1990 to fuel an economy that has more than doubled in size.[1] Efficiency is an essential component of any strategy to deliver affordable energy, with an abundance of opportunities to reduce demand and improve the use of energy resources at a lower cost than equivalent supply-side options. By improving energy efficiency, countries reduce the need to build new energy production infrastructure. And by reducing demand for energy that often comes from fossil fuels, efficiency plays a key role in curbing GHG emissions. Countries at all stages of development can benefit.

Yet many energy efficiency opportunities go untapped, even when they would yield savings, because of misaligned incentives and other market failures. As noted in *Seizing the Global Opportunity*, carbon pricing and the phase-out of fossil fuel subsidies are crucial parts of any policy framework to improve energy efficiency, as they ensure the right policy signal is sent to encourage efficient energy use. But a number of non-price barriers – such as the effort required to change ("hassle"), lack of information, and lack of upfront finance – can hamper the effectiveness of carbon pricing if it is used alone. This is what makes standards such valuable policy tools: as part of a wider policy package, they can help overcome such barriers.

Most standards are set at the national level; in this paper we show how international cooperation to align and raise energy efficiency standards to the global best could greatly amplify the benefits. A convergence on "global best" standards for appliances, buildings, industry and transport can expand global markets for efficient technologies, reduce non-tariff trade barriers and improve market efficiency.[2] This is in addition to benefits to economic growth, jobs, public budgets, health and competiveness derived from energy cost savings and reduced fossil fuel use.

Countries may not all be ready to converge around the *same* standards; different approaches are needed in each economic and regulatory context. Adoption would likely be voluntary, and standards could be applied in different ways. In all cases, a key principle is that standards should be subject to continuous improvement – the "global best" is not a static concept, but a constantly evolving one. The Commission believes that the G20 countries are well positioned to take the lead, in collaboration with international standards organisations, representatives from industry, and energy efficiency best practice networks. Together, given their market scale and influence on technological uptake, the G20 countries can make a global impact.

Substantial international efforts to improve energy efficiency are already under way. The International Partnership for Energy Efficiency Cooperation (IPEEC),[3] the Clean Energy Ministerial,[4] the UN Sustainable Energy for All (SE4All) initiative,[5] and the Global Best Practice Networks,[6] among others, are working to analyse energy efficiency options, design model policies, and identify finance mechanisms. Through the "en.lighten" initiative,[7] led by the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF), more than 60 countries have committed to implement policies to reduce inefficient lighting by 2016. The Global Fuel Economy Initiative[8] is helping more than 20 countries improve vehicle fleet efficiency. The International Energy Agency (IEA) is also playing a prominent role, through its Energy Efficiency Working Party and the Energy Technology Network.[9] At the same time, several countries are raising their national standards – China, the EU, Brazil, India, and Mexico, for example, have all proposed, adopted or implemented new fuel efficiency standards for light-duty vehicles in the past two years.[10]

This paper begins by examining the role of energy efficiency is boosting economic growth and reducing greenhouse gas (GHG) emissions. It then examines the role of standards in delivering energy efficiency benefits, and shows how the international convergence of standards presents an opportunity for international collaboration. It ends with detailed recommendations, with particular attention to the G20, proposing that they agree on a programme for convergence of energy efficiency standards - building on the existing G20 plan for voluntary collaboration on energy efficiency.

2. Energy efficiency: the 'first fuel'

2.1. ENERGY EFFICIENCY BENEFITS AND POTENTIAL

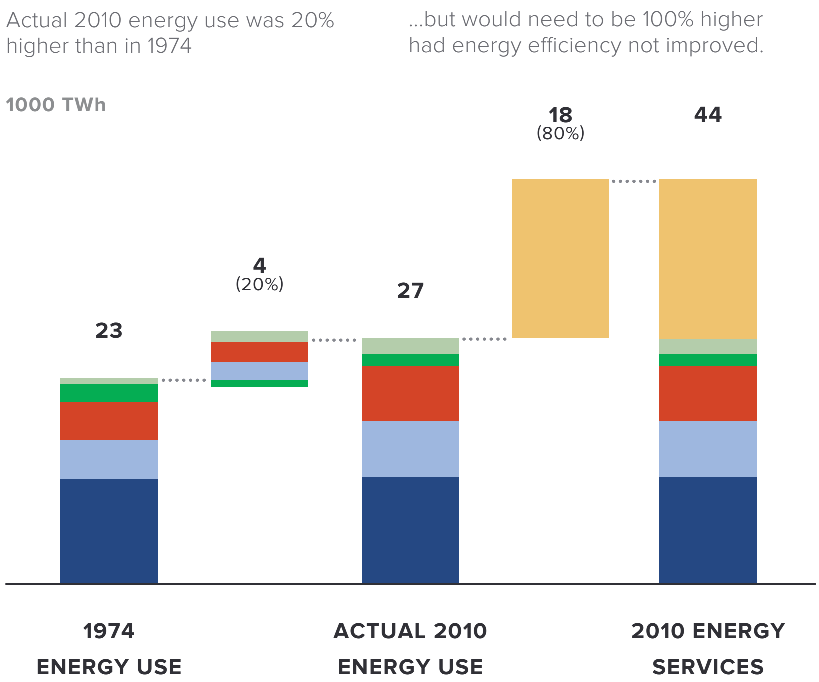
Energy efficiency increases the "services" derived from each unit of energy. This is particularly important given that energy demand typically rises with population growth, development and rising incomes. Unlike measures to expand the energy supply, however, such as building a new power plant, energy efficiency can seem abstract and intangible, with success measured in terms of energy not consumed or costs avoided. Thus, it has been called a "hidden fuel".[11] Yet the benefits of energy efficiency are broad and go well beyond immediate cost savings.

Maximising output per unit of energy increases GDP and can provide other macroeconomic benefits, including job growth, a better trade balance, lower energy prices and greater security of supply.[12] Not all energy efficiency measures are "cost-effective" – investments need to be economically rational, given opportunity costs and underlying fixed and ongoing costs. Still, modelling for the International Energy Agency (IEA) *World Energy Outlook* shows that the uptake of economically viable energy efficiency investments would boost cumulative economic output to 2035 by US$18 trillion.[13] This has been assessed in macroeconomic models to increase growth by 0.25–1.1% per year, with associated increase in employment. Energy efficiency increases output because it frees up resources for other, more productive investments, which is why the IEA estimates that efficiency measures yield benefits up to 2.5 times the avoided energy costs. Energy efficiency measures are typically more labour-intensive than equivalent investment in fossil fuel supply, and create up to three times the number of jobs per million dollars of investment.[14]

A more energy-efficient economy is also less susceptible to price and supply shocks, and can help drive down energy prices. Energy markets have changed markedly in the last 25 years, becoming globalised and highly volatile, with large, frequent and unpredictable price fluctuations. While the large fall in oil prices in early 2015 offered welcome relief to consumers, medium- to long-term price uncertainties remain – and price volatility can have negative economic impacts.[15] A more energy-efficient economy can help lower and stabilise prices. In the IEA's New Policies Scenario (NPS),[16] which broadly represents current policy ambition, primary energy demand is expected to be 9% lower in 2040 than it would be under business as usual (the Current Policies Scenario, or CPS), with two-thirds of the difference due to energy efficiency. In the more ambitious 450 Scenario (meant to represent a 2°C pathway), demand is another 15% lower.[17]

Energy efficiency also reduces energy supply investment needs. Meeting projected energy demand growth on the supply side alone would require spending US$45 trillion by 2030 in new infrastructure. Yet energy efficiency can greatly narrow the gap between supply and demand. Between 1974 and 2010, for example, energy efficiency saved more energy in IEA member countries than any single supply-side resource provided (see Figure 1).[18] While 2010 energy use was around 20% higher than in 1974, it would have almost doubled without the savings made by energy efficiency investments. Similar analysis shows energy savings from energy efficiency in 11 IEA member states in 2011 of over 1,300 Mtoe, equivalent to the EU's entire energy consumption.[19] Energy efficiency is thus increasingly seen as the "first fuel".[20] Improving efficiency can be particularly valuable for countries that are still working to achieve universal energy access, as it enables them to serve more people through existing capacity.[21]

Figure 1
Impact of energy efficiency on energy consumption in 11 countries, 1974-2010



NOTE: The figure shows the actual increase in annual final energy consumption, and the energy that would have been needed without energy efficiency improvements. Energy services doubled, but energy use went up by only 20%. The countires surveyed are Australia, Denmark, Finland, France, Germny, Italy, Japan, the Netherlands, Sweden, UK, and the US Energy efficiency was four times more important than any actual fuel source for enabling growth in energy services.

Source: IEA, 2013.[22]

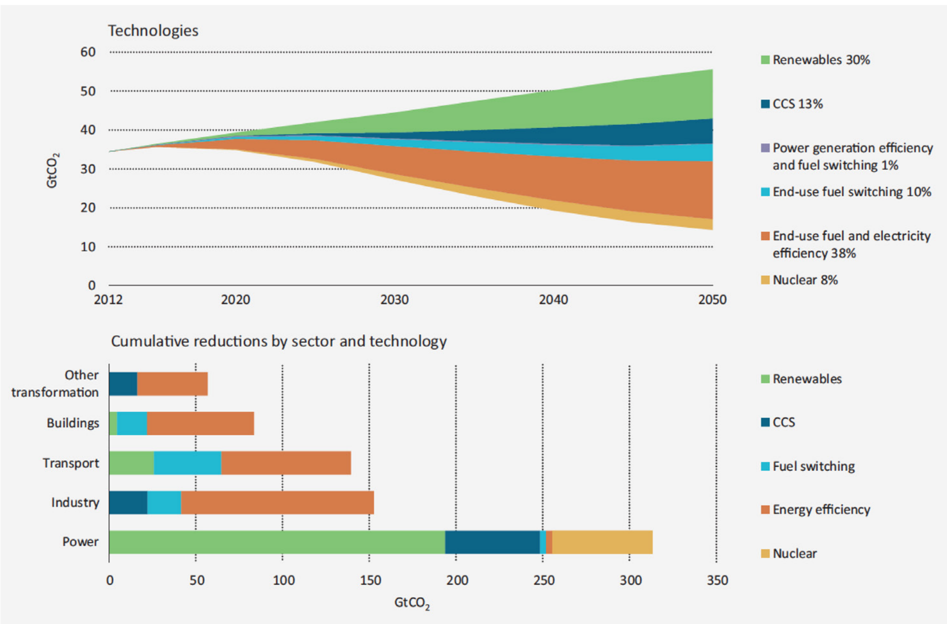
Energy efficiency improvements also free up resources for other, more productive investments, which is why the IEA has estimated that energy efficiency measures yield benefits up to 2.5 times the value of the narrower assessment of avoided energy costs.[23] A study of the EU showed improving the energy efficiency of buildings would save up to US$56 billion for the public budget, rising to US$174 billion if job creation, tax revenue from increased economic activity, and other effects were included.[24]

It is important to note that the benefits of energy efficiency can be limited, to different degrees, by the "rebound effect"– where the savings from improved energy efficiency lead to some increased demand for energy services. There are several types of rebound (e.g. direct and indirect), and the extent of the rebound effect is difficult to quantify – much less predict.[25] This is particularly important for developing countries, which can certainly expect energy efficiency measures to improve resource productivity, but are likely to still experience strong energy demand growth. Energy efficiency would thus slow, not eliminate, this demand growth.

From a climate perspective, improving energy efficiency is crucial, as it is a proven way to reduce GHGs cost-effectively. The challenge in the energy sector is twofold: to reduce energy demand, and to decarbonise what is left. The Intergovernmental Panel on Climate Change (IPCC) calls energy efficiency measures "a key mitigation strategy" in scenarios that keep atmospheric CO_2e levels at 450–500 ppm by 2100, emphasising their ability to deliver near-term energy demand reductions cost-effectively.[26] To stay on a 2°C path, the IEA shows the energy intensity of GDP would need to decline by around 60% by 2050.[27] This would allow economic output to triple with only a 20% increase in primary energy use. Of the total energy-sector GHG reductions needed by 2050 for a 2°C pathway, the IEA envisions 38% coming from improved efficiency in end uses (see Figure 2).[28]

Figure 2

Contribution per technology area and sector to global cumulative CO_2 emission reductions needed for a 2°C pathway.



NOTE: Percentage numbers represent cumulative contributions to emissions reduction relative to the 6DS (broadly equivalent to an emissions path associated with a six degrees scenario). End-use fuel and electricity efficiency inludes emissions reduction from efficiency improvements in end-use sectors (buildings, industry, and transport), and in end-use fuels (including electricity). End-use fuel switching includes emissions reduction from changes in the fuel mix of the end-use sectors by switching from fossil to other end-use fuels (excluding renewables; fuel switching to renewables is balanced under the category "Renewables"). Renewables include emissions reduction from increased use of renewable energy in all sectors (electricity, fuel transformation, end-use sectors). Power generation efficiency and fuel switching includes reduction from efficiency improvments in fossil electricity, co-generation and heat plants as well as from changes in the input fuel mix of the power sector from fossil fuels to less carbon-intensive fossil fuels (e.g. from coal to gas). Reductions from increased use of renewables or nuclear in the power sector are not included here, but accounted for under the corresponding categories. CCS includes emissions reduction from the use of CCS in electricity generation, fuel transformation and industry. Nuclear includes emissions reduction from increased use of nuclear energy in the power sector.

Source: IEA, 2015.[29]

Energy efficiency opportunities are present across all sectors and regions.[30]

- In buildings, appliances and lighting (currently around a third of energy use), demand is expected to rise by 1% per year between 2012 and 2040, driven by population and economic growth. However, efficiency measures in the IEA's NPS help reduce the sector's energy use by 7% (relative to the CPS) in 2035. More than 50% of the expected improvements in energy efficiency are in three markets: the US, China, and the EU. The 450 scenario results in a further 11% fall in demand, relative to the NPS.
- In transport (accounting for 28% of energy use) demand is expected to rise by around 1.2% annually to 2040 in the NPS, but is still 24% lower than under the CPS. A 450 scenario requires energy demand to fall by a further 24% in 2040 relative to the NPS. This is largely due to car markets (China, EU, North America, Japan, Brazil, India and Korea) all implementing fuel efficiency standards for cars, although further policy is needed for light and heavy goods vehicles (LGVs and HGVs).
- Energy demand from industry (currently 38% of the total) is projected to grow by 1.4% per year, with 50% of the growth expected to 2030 from China and India. This is less than in the past 30 years (1.7% growth annually). Energy-intensive industries (steel, cement, chemicals and paper) make up around 60% of the sector, but this share will decline over time. The energy demand growth relative to today under the NPS is 7% lower than under the CPS by 2040. A 450 scenario requires energy demand to fall by a further 11% relative to the NPS.

2.2 BARRIERS TO ACHIEVING THE POTENTIAL

Yet as much as governments – and businesses – recognise the value of energy efficiency, studies show that many cost-effective options are not pursued. The IEA estimates that in the New Policies Scenario, which reflects governments' plans and policy commitments, as much as two-thirds of cost-effective energy efficiency potential will remain untapped in 2035 (see Figure 3),[31] although there is active debate about the size of these overall potentials.[32] There are a number of barriers and market failures which drive this gap between potential and current uptake, including:

- **Energy prices do not reflect externalities:** When the price of energy does not reflect its social and environmental costs, private actors may not see a large benefit in reducing energy use through efficiency investments. This is exacerbated by energy subsidies, which further distort energy prices.
- **The presence of "hidden" costs and benefits:** Studies of the overall potential need to incorporate unobserved costs and benefits to fully understand welfare effects and ensure that energy savings are not overestimated.[33] One factor that is often not captured in cost-benefit analysis is "hassle" – the time and effort required to research different options and/or to install new technologies. These transaction costs can be significant, estimated at 3–8% of investment costs.[34] Conversely, indirect benefits are often not included – such as lower air pollution and resulting benefits to public health.
- **Lack of awareness of opportunities:** Consumers may not always have access to trusted, easy-to-understand information about their options to improve energy efficiency, the energy performance of individual products, or broader benefits of energy efficiency measures.
- **Scarce upfront capital:** Often energy efficiency measures pay for themselves over time, but require capital to install. There is often a perceived risk of investing in energy efficiency. When the opportunity to replace equipment occurs (e.g. during the retrofit of a building), an energy-efficient option may have a relatively high upfront cost, requiring more capital than households and businesses have available. Lack of affordable finance is thus a key barrier, particularly for smaller businesses and poorer households.[35]
- **Misaligned incentives:** Often the actors incurring the cost of efficiency upgrades are not the same as the beneficiaries – such as in the classic landlord-tenant example. A landlord may not want to invest in measures that will lower the tenant's energy bills, but not be captured in the rental price. Similarly, the tenant may not be willing to invest in measures that pay off over a long time, beyond the lease term.[36]
- **Complexity, risk and uncertainty:** Decisions are often made by "rules of thumb", habitually and through social norms, particularly when great effort would be required to make a rational, fully informed decision. This can limit the effectiveness of policies that rely on such decisions, especially where understanding the energy savings from a measure requires a complex analysis. Energy efficiency is also only one of several factors that consumers may consider in a purchase, and

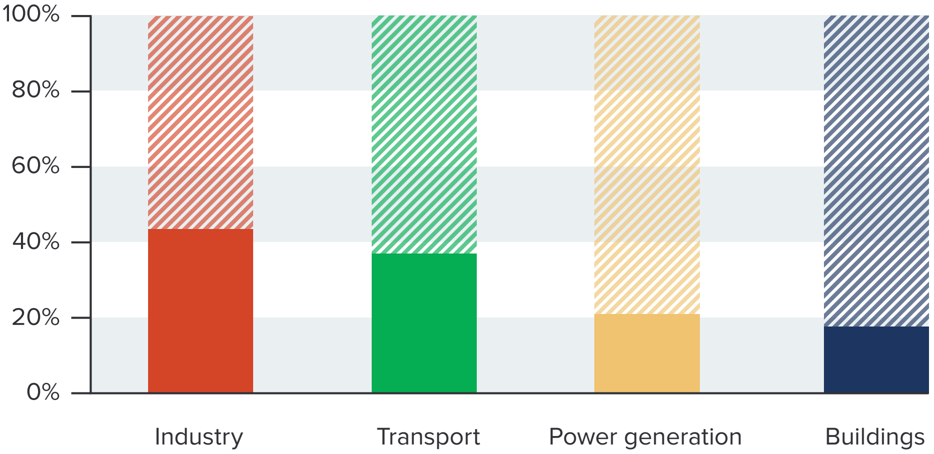
may be trumped by others (e.g. overall price or performance). Energy efficiency savings may also not be monitored after implementation, and the "hidden" nature of the benefits (as discussed above) may lead investors to perceive these investments as risky. Lower and more volatile fuel prices are also likely to influence consumer decision-making.

Figure 3
Impact of energy efficiency on energy consumption in 11 countries, 1974-2010

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

Realised energy efficiency potential

Unrealised energy efficiency potential



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 ametric. 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, 2014.[37]

3. The role of energy efficiency standards

3.1 A POLICY PACKAGE FOR ENERGY EFFICIENCY

Energy efficiency policies and measures now have a long track record, and from the last 40 years' experience, a clear picture is emerging of best practices and guiding principles. Building on insights from the Stern Review, we can identify the following components of a "policy package" to overcome market failures and other barriers:[38]

- **"Getting prices right" for energy** – removing implicit and explicit fossil fuel subsidies, pricing energy competitively, and accounting for environmental externalities. There has been substantial recent effort in this field both to adopt carbon pricing (around 40 countries and 20 subnational jurisdictions have now adopted or are planning carbon taxes or trading schemes), and to reduce fossil fuel subsidies (where 28 countries have recently implemented reforms).[39]
- **Providing incentives for innovation** – encouraging technological research, development and diffusion; this drives down costs and brings forward new technologies. While some efficiency improvements often lead to only marginal gains in energy productivity, further innovation can magnify those gains and may lead to transformational changes.
- **Providing information to overcome habitual choices and ease decision-making** – this can be through effective design of "nudges", such as making an efficient product the default choice, and providing information to consumers and end-users through labelling and free energy audits. The UK Behavioural Insights Team has advanced understanding of effective measures, including ways to increase the impact of Energy Performance Certificates used to provide information about building efficiency. For example, optimising the timing of heating and cooling contributed emissions reductions of 10% across the UK central government estate between 2010 and 2011.[40] However, where technical skill to implement measures is an issue, information alone will not be enough.

- **Providing effective financing** – this includes loans, subsidies, tax rebates, and obligations on energy suppliers to help their customers improve energy efficiency. Such measures are crucial for lowering transaction costs and overcoming misaligned incentives. Initiatives such as the low-interest loans for building energy efficiency provided by Germany's KfW[41] and energy efficiency financing from the European Bank for Reconstruction and Development (EBRD)[42] provide examples on how to overcome this barrier.
- **Setting mandatory standards** – this shifts the burden of action away from individuals, removing the need to choose efficiency. That has several advantages: it is the simplest, most direct approach; it provides certainty to policy-makers in terms of outcomes; it can induce and encourage technological innovation; it removes inefficient technologies from the market and avoids lock-in; and it can reduce transaction costs.

3.2 ENERGY EFFICIENCY STANDARDS

It is clear from the outline above that improving energy efficiency requires an array of policies and strategies. For the rest of this paper, we focus on the role of standards in particular. The World Bank has found that policy-makers in both developed and developing countries have had considerable success with energy efficiency standards for buildings and appliances, for example, achieving much faster progress than would have been feasible through market forces alone.[43] Indeed, a large majority of the savings from energy efficiency achieved to date are due to standards. For example, a study of five major economies found that productivity increases attributable to standards ranged from one-eighth to one-quarter in 2000–2010.[44] California, which has implemented the strongest efficiency standards in the US, has kept per capita energy use roughly flat since 1970, even as it rose by more than 50% across the rest of the US,[45] although this success is argued to be partly due to climate and demographic factors in addition to standards.[46]

Energy efficiency standards can be mandatory (all market actors must comply) or voluntary. There are three main types of mandatory standards: [47]

- **Prescriptive standards,** which require a particular feature or device to be included in new products, buildings or renovations (e.g. requiring houses to have cavity wall insulation);
- **Minimum energy performance standards (MEPS),** which set a minimum level of efficiency or a maximum for energy consumption – commonly used for vehicles, appliances and buildings;
- **Class average standards,** which apply to the average efficiency of a type of manufactured products or a suite of products. For example, the vehicle standards in the EU and US use fleet averages (see discussion below), which provide increased flexibility for manufacturers to meet the standards at lowest cost.

As noted above, mandatory standards are the most direct approach to achieving energy efficiency goals, and their use over the last 40 years has resulted in significant efficiency gains. However, some key issues need to be considered in their design. First, mandatory standards need to be set at a level that can be economically justified; where the upfront costs are higher than for less-efficient alternatives, complementary financial measures may be needed. Second, standards are only as good as their enforcement, and in practice, enforcement can be difficult, with varied success across countries. Third, standards work well in some areas (e.g. new cars and new buildings), but less so in others (e.g. existing buildings, where enforcement can be difficult and costs can be high).

Voluntary standards and labels can also be very effective. By explicitly telling consumers how different products rate in terms of efficiency, they make it easier to choose an efficient option. They can also be used to designate industry leaders or the highest performers in a category (these are called high energy performance standards, or HEPS), such as the Leadership in Energy and Environmental Design (LEED) initiative, which sets standards for high performance buildings, one metric of which is energy efficiency.[48] These HEPS can also be combined with other incentives, such as tax relief, to achieve higher levels of energy efficiency (see discussion of the UK's Enhanced Capital Allowance scheme in Box 1).

Mandatory and voluntary standards can also be used in complementary ways: governments can begin with voluntary standards to inform setting mandatory standards, or they can use mandatory standards as a baseline, and then use voluntary standards to gradually raise the bar. For example, the EU Ecodesign initiative sets MEPS for a wide range of energy-using (e.g. appliances) and energy-related products (e.g. insulation, windows, shower heads), and also requires labelling with energy efficiency ratings (A to G, with A being the best).[49]

One important issue to address with mandatory and voluntary standards alike is whether the standards apply to test conditions or to real-world performance. Large differences have been documented between the two, with real-world performance offering significantly lower energy savings than assumed in modelling exercises.[50] This feeds through to reduced cost savings, and can undermine the effectiveness of energy efficiency programmes by eroding consumers' trust of efficiency labels. Good enforcement is important to ensure that manufacturers accurately report the performance of their products.[51]

There is an emerging field of best practice in energy efficiency standards, embodied in a number of best practice organisations in key technology areas.[52] Overall, however, the pace of uptake has been slow. Below we summarise progress in specific sectors:

- **Appliances:** There has been substantial progress in many countries with regard to standards and labelling, with around 81 countries using labels and standards as of 2013.[53] An analysis of nine major economies found more than 400 MEPS, covering 100 products and eight different product categories.[54] MEPS for refrigerators and air conditioners, for example, have driven market transformations to higher-efficiency products.[55] Labels can be very useful for improving consumers' awareness of energy-efficient options. A prominent example of voluntary labelling is the US Energy Star programme, which is credited with reducing energy consumption by 300 TWh in 2014 alone. Since 1992, the initiative has lowered household and utility bills by an estimated total of US$360 billion and avoided 2.5 Gt CO_2 of emissions.[56] The programme has been widely adopted, even outside the US.
- **Transport:** Low-carbon policy focuses on cleaner fuels, and standards for air pollution, emissions, and fuel economy. As of 2014, all major car markets except Australia and Russia had implemented fuel efficiency and GHG regulations for passenger vehicles. In contrast, only Japan, China, the US and Canada have taken a similar approach to larger vehicles, such as heavy-duty trucks and buses, although there is increased momentum in this sub-sector.[57] Fuel efficiency standards have led to cost-effective efficiency improvements and emission reductions. Recent regulations in the US, EU, Canada, Mexico, India and China have resulted in fuel savings that pay off incremental vehicle costs within one to five years.[58]
- **Buildings:** There are two policy areas related to energy efficiency – standards, which commonly only apply to new buildings, and the retrofitting of existing buildings. Energy efficiency relates to heating and cooling systems, and the building fabric. Buildings normally last for decades, and sometimes over 100 years, though lifespans are typically shorter in developing countries. More than half of the current building stock will still be standing in 2050 (with the figure closer to three quarters in OECD countries); this highlights the importance of implementing cost-effective energy efficient options on major refurbishments of existing buildings, which typically occur only about every 30 years.[59] However, standards can be difficult to implement and enforce for existing buildings. A review of progress around the world found labelling to be the prevalent policy approach for promoting energy efficiency in buildings, including new construction.[60] For example, in China, the Green Building Evaluation and Labelling program (GBEL) and the Building Energy Efficiency Labelling Program (BEEL) set performance targets for new buildings, with subsidised upfront finance for measures, with support needed on specifying and enforcing adequate codes. Similar approaches are seen elsewhere in the world, including in the EU (under the Energy Performance of Buildings directive, which also includes some provisions for retrofits of existing buildings), in the US (the LEED programme), India (the Energy Conservation Building Code), and Singapore (the Green Mark Scheme).
- **Industry:** There are specific approaches for high-efficiency industrial equipment that are amenable to standards (e.g. in motors, fans, compressors and boilers), and these standards often overlap with policies for appliances and equipment (for example, industrial equipment is included in the EU Ecodesign directive). One area where there is scope for improvement is larger motors that do not currently have MEPS attached.[61] In industrial operations, the energy efficiency "standard" relates to energy management systems (EnMS). This is recognised internationally through the ISO 50001, which countries and regions have adopted as a tool, instead of a MEPS, to identify procedures and ensure systematic tracking, analysis and planning of energy use in industry. EnMS is often integrated into government-led industry energy efficiency programs supported by technical tools such as sub-sectoral benchmarks and energy audits. Examples include Denmark's Agreement on Industrial Energy Efficiency, the Netherlands' Long-term Agreements with industry through the "Benchmark Covenant", India's Perform, Achieve, Trade Scheme and the US Superior Energy Performance programme.[62]

Box 1
Examples of standard-setting in practice

Japan's Top Runner Approach

Japan introduced mandatory energy efficiency standards in 1980 but identified a need to continually revise standards for an ever-evolving market. To help keep up with improving technologies, in 1998, the Ministry of Economy, Trade and Industry (METI) adopted the "Top Runner Approach" for energy efficiency in appliances. The highest level of energy efficiency currently available (and sometimes an improvement on that level) becomes the new standard for the sales-weighted average of each manufacturer's products in that category in future years. The approach covers 28 different appliance types (including electronic appliances in cars). It is seen as a world-leading approach, sharply increasing energy efficiency and driving innovation. Efficiency improvements range from 16% to 80% of total energy consumption across different appliances. This has also help reduce overall energy demand in Japan – and, through exports, has benefited other markets as well.[63]

The US CAFE Standards

The US introduced its Corporate Average Fuel Economy (CAFE) standards for the auto industry in 1975. The aim of these standards is to improve the average fuel economy of new passenger vehicles. CAFE is applied to each manufacturer's current model-year fleet of passenger cars or light trucks under a specified weight that are manufactured in the United States. If the fuel efficiency of the sales-weighted average miles per gallon (mpg) is below the standard, there is a financial penalty (currently set at $55 per mpg differential, multiplied by total number of vehicles produced).[64] This was very successful in raising the fuel economy of vehicles up to 1985, but then progress slowed and was even reversed for some time. Fuel efficiency has increased again since 2007.[65] Standards were given a strong policy boost in 2012, with a plan to raise the CAFE standard steadily to 54.5 mpg (4.3 litres/100 km) by 2025 for cars and light trucks.[66]

Enhanced Capital Allowance Scheme for Energy Saving Technologies

The UK introduced this scheme in 2001 to drive up the use of energy-saving technologies by businesses. The scheme provides accelerated tax relief for the purchase of equipment included on the Energy Technology List (ETL). Products listed on the ETL have to meet top-quartile HEPS, and manufacturers have to provide evidence to show that they meet agreed industry product standards. Every three years, ETL-qualifying HEPS criteria are strengthened to reflect recent product innovations and stimulate further product innovation. This scheme supports nearly 17,000 listed products from nearly 60 technologies used by industry, retail and commerce (e.g. LED lights, boilers, refrigerated display cabinets, electric motors). International and UK manufacturers use the scheme to showcase their most energy-efficient products and, to date, it has influenced £12.5 billion in UK industrial product sales. It has also reduced carbon emissions by 41 Mt CO_2 when compared with a baseline scenario in which less efficient products are used.[67]

3.3 DIFFERENT COUNTRIES, DIFFERENT STANDARDS

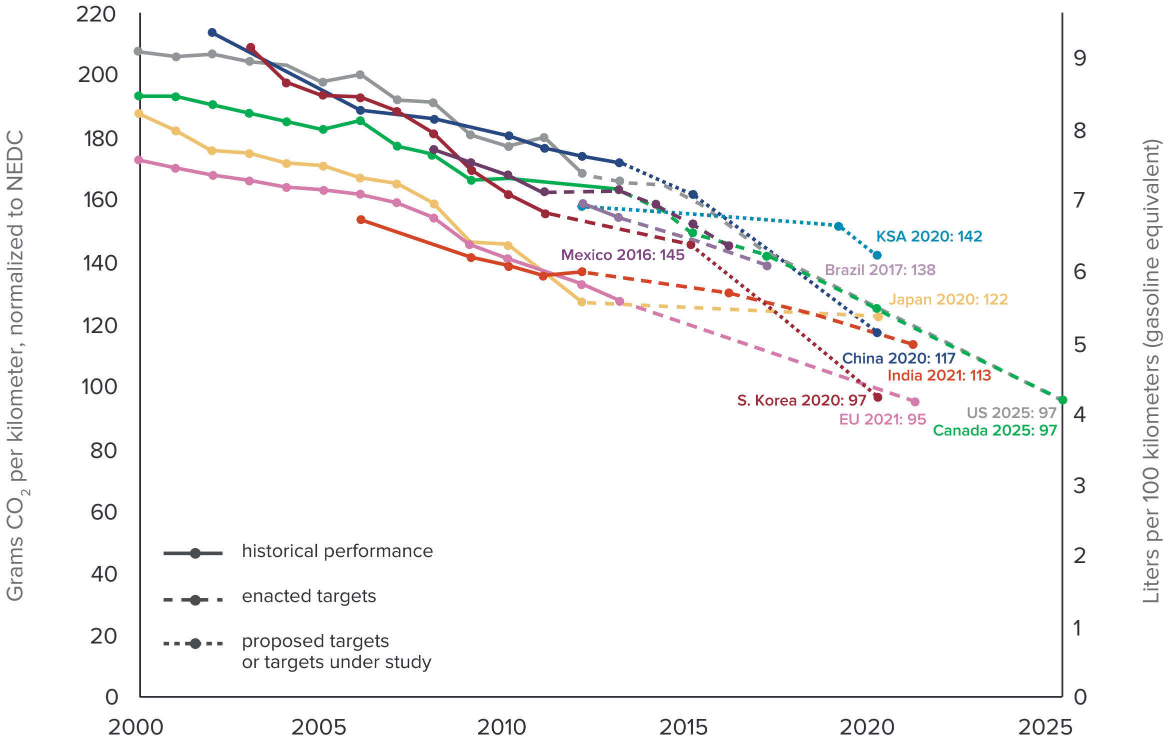
Countries vary significantly in their energy productivity (GDP per energy used), their underlying energy efficiency, and their energy efficiency standards. Countries' performance in energy efficiency is partly a result of structural factors, such as the level of development and sectoral make-up of economies.[68] However, the diffusion and stringency of energy efficiency standards are also key drivers of differing energy efficiency performance. The stringency of standards for buildings, appliances, transport, and industry varies significantly across countries, even for countries at similar levels of growth and policy maturity.

Appliances: A comparative analysis of 72 appliance products across nine countries[69] shows that when the same products are used worldwide, there is substantially more alignment of both testing procedures and efficiency metrics used for standards in lighting, consumer electronics, motors, fans, pumps and transformers. Household appliances have larger regional differences, but are largely regulated in major economies. There is less alignment for air conditioning and commercial refrigeration; the same test procedures may be used, but there is large variation in the efficiency metrics used for components. There is virtually no alignment in space and water heating or in cooking products, where there are large regional differences in design, usage and characteristics that it extremely difficult to compare MEPS and labels.[70]

Transport: Around 75% of new light-duty vehicles sold worldwide are in markets with a CO_2 standard,[71] but those standards do not apply to cars already on the road, which may continue to be used for many years. An analysis of G20 countries identified three groups based on policy maturity for transport and related standards. The first – Canada, the EU, Japan, South Korea and the US – have "world-class" emissions standards, nationwide implementation of low-sulphur fuels, fuel efficiency standards for passenger vehicles, and green freight programmes. The second have clean or low-sulphur fuels either available or planned, but not world-class emissions standards or fuel economy standards; those countries are Argentina, Australia, Brazil, China, India, Mexico, Russia and Turkey. The third group – India, Saudi Arabia and South Africa – have no low-sulphur fuels available and no emissions or fuel economy standards implemented. Even where countries have standards they are set at different levels – for example, 2013 standards for fuel efficiency in cars ranged from 5.2 litres/100 km in the EU, to 6.8 in the US, to 7 in China, to 8.8 in Mexico.[72] Figure 4 compares CO_2 emission and fuel economy standards for passenger cars across different major markets.

Figure 4

Global comparison of passenger vehicle efficiency standards in selected countries (2000-2025)



Source: ICCT, 2015.[73]

Buildings: All elements of a building affect energy use within it (i.e. the roof, wall, floors, doors, windows, ventilation, and heating and cooling systems). The energy use of the building as a whole depends on a number of factors, including materials, building design, climatic context, and user behaviour. Energy efficiency levels vary widely both across and within countries.[74] There is also a wide range of different standards within heating and cooling systems.[75] Comparability has been recognised internationally as an issue in achieving energy efficiency and climate benefits, due to the need to have globally comparable methods for benchmarking energy use in buildings that can also facilitate GHG measurement.[76]

Industry: As highlighted above, policies for appliances and equipment can overlap with energy efficiency standards for industrial equipment, and there is a voluntary international standard for industrial energy management (ISO 50001). A recent study found that energy efficiency targets for industry are only present in a small number of major economies: China, Japan, Russia, and Turkey.[77]

It is clear from the preceding review that in all sectors, standards diverge, and in many countries there are either no standards, or the standards are not set at the levels needed to unlock the potential benefits. Thus, there remains a large scope for raising standards in countries that currently lag behind. International cooperation to raise standards to world-leading levels could thus yield significant benefits.

4. International convergence of standards

4.1 INTERNATIONAL CONTEXT

As noted, energy efficiency has risen to prominence on the international agenda in recent years, and several significant efforts are under way. They are working in particular to identify best practices and model policies, develop financial instruments, and build capacity. The largest international initiatives are the International Partnership for Energy Efficiency Cooperation (IPEEC), the Clean Energy Ministerial, the UN Secretary-General's Sustainable Energy for All (SE4All), and the Global Best Practice Networks (GBPNs). These are described in more detail in Box 2. The IEA also plays a key role in fostering collaboration through its Energy Technology Network,[78] which includes the Energy Efficient End Use Equipment (4E) initiative.

These initiatives are platforms for collaboration that aim to bring together some of the many institutions and projects already working on energy efficiency. SE4All has identified 168 institutions and 145 initiatives around the world in this field.[79] While this indicates the growing importance which countries place on energy efficiency, it also suggests that greater coordination and convergence would be beneficial.

Box 2
International initiatives for energy efficiency

The **International Partnership for Energy Efficiency Cooperation** (IPEEC) is an independent forum that helps its 16 member countries identify and share effective solutions and data on energy efficiency. Key activities of IPEEC include coordinating 12 task groups on different areas of energy efficiency and maintaining a catalogue of energy efficiency initiatives in a select group of countries through its Making Energy Efficiency Real (MEER) database Made up of many of the G20 members,[80] IPEEC also supports and coordinates the G20 work on energy efficiency.

Sustainable Energy for All (SE4All) in an initiative launched by UN Secretary General Ban Ki-moon in 2011. It has three objectives for 2030: (i) universal access to modern energy services; (ii) doubling the global rate of improvement in energy efficiency; (iii) doubling the share of renewable energy sources in the global energy mix. SE4All's Global Energy Efficiency Accelerator Platform provides a menu of options across all major sectors to assist governments in planning energy efficiency.

The Clean Energy Ministerial (CEM), a collaboration among major economies, focuses on energy efficiency in two sectors: buildings and industry (GSEP), and appliances (SEAD). GSEP conducts a number of case studies and demonstration projects to showcase energy efficiency benefits. SEAD encourages the adoption of energy efficiency standards and policies through knowledge-sharing and awareness-raising activities, working with the IEA 4E initiative.

Global Best Practice Networks (GBPNs) are sector-specific international organisations dedicated to supporting government policies and fostering best practices to improve energy efficiency in each of the major energy end-sectors: vehicles and fuels, buildings, appliances, energy production, and transportation systems. Originally established by the ClimateWorks Foundation, these best practice networks include the Collaborative Labelling and Appliances Standards Program, the International Council on Clean Transportation, the Institute for Transportation and Development Policy, the Regulatory Assistance Project (power sector) the Institute for Industrial Productivity (Industry) and the Global Building Policy Network.

The G20, in collaboration with the major international initiatives, could provide a particularly effective platform for action. The G20 is strategically important for converging standards due to the market size it represents: G20 countries are responsible for 80% of global energy consumption. It is also significant in terms of market production of goods and associated knowledge and capital – for example, 94% of total vehicle production is in G20 countries. Thus, the G20 could have a major influence on uptake of efficient technologies worldwide.[81] In November 2014, the G20 agreed to a voluntary collaboration on energy efficiency and published an action plan. The plan looks at six areas of energy efficiency work within the G20 and other participating countries. These areas are split between priorities for new initiatives – where there is a perceived gap in existing international collaboration – and opportunities to accelerate ongoing work.[82] IPEEC supports the collaboration in each area, with the assistance of a variety of expert bodies and existing energy efficiency initiatives such as the IEA, the International Energy Forum (IEF), the Organisation for Economic Development (OECD), the International Renewable Energy Agency (IRENA) and Sustainable Energy for All (SE4All). On 2 October 2015, IPEEC presented to G20 Energy Ministers recommendations and options for future collaboration under the action plan. Ministers, through their Communiqué , welcomed the proposed next steps - and gave particular attention to principles for energy efficiency investments by G20 countries.[83]

A focus on the G20 does not preclude non-G20 countries from advancing measures on energy efficiency. Indeed, this is critical to their development. As developing countries continue to grow rapidly and energy demands increase, ensuring that energy efficiency standards are integrated into growth plans will be essential.[84]

4.2 INTERNATIONAL COLLABORATION: BENEFITS OF CONVERGENCE

This G20 energy efficiency initiative offers a valuable opportunity to focus on a clear goal, that of converging energy efficiency standards in its countries to the "global best". Such a goal would offer both major economic benefits and a significant contribution to reducing GHG emissions. Non-G20 countries could be invited to join the G20 in raising their energy efficiency ambition. Convergence of standards has been discussed previously in international forums, but to date has not been widely implemented.[85] There are several advantages to this approach:

It will help raise standards in countries that now lag behind, overall or in specific sectors. By acting collectively, the G20 can build political momentum in places where energy efficiency has perhaps not been a priority to date, or where measures have faced political resistance. Countries can also learn from one another and share experiences and technologies.

It will expand the size of global markets for the most efficient technologies and reduce non-tariff barriers to trade. Global Investments in energy efficiency markets in 2012 reached an estimated US$310–360 billion.[86] The larger the market, the greater the incentive for companies to cater to it – and to apply the higher efficiency standards to all their products, taking advantage of economies of scale. In free trade areas (such as the EU) where standards are comparable, suppliers gain access to larger markets. International standards and harmonisation have generally been found to have a positive (or at least neutral) effect on trade.[87] The benefits of common standards accrue not just to the largest product manufacturers, but also to smaller national producers seeking larger overseas markets.

Adopting a simple, common and consistent approach will facilitate more effective coordination and policy dialogue among countries, businesses and regions. Setting standards goes beyond the technical standards; it also entails identifying standard product definitions, simplifying testing, defining efficiency metrics and regulatory energy service classifications (i.e. creating different classifications according to a local context). This, in turn, can serve to drive technology transfer, as other countries import higher-efficiency products, such as cars or appliances, from countries with higher standards.

Convergence of standards has been shown to work as part of a broader programme of policy convergence. For example, in 1990, the EU-12 economies' energy intensities differed by 0.11 kgoe per unit of GDP; by 2007, that difference had shrunk to 0.04 kgoe,[88] driven by a *"common desire to target excellence"* and a common set of policies such as the Ecodesign Directive. While not all of this convergence is due to standards alone (structural transformation and growth were also important drivers), the convergence of standards is a critical part of the story.

A G20 programme to gradually converge energy efficiency standards would need to be voluntary. Measured in terms of energy savings and productivity improvement, higher standards are in all countries' economic interests. But different countries will face different challenges in raising standards, and not all will share the same priorities. A voluntary programme would allow countries to join over time.

4.3 PRINCIPLES FOR ACHIEVING CONVERGENCE

It is important to recognise that the goal of converging energy efficiency standards towards the global best does not mean that all countries have to use the same standards. Countries differ in economic and social circumstances, climate and culture. Standards will inevitably differ too. Similarly, the "global best" is not a single or static concept. The following principles set out how the goal can be achieved.

Principle 1: Standards should be economically feasible and limited in number, and reflect differing national circumstances.

A key goal of convergence is to reduce the number of standards in use across countries and product markets. But the differences between national circumstances mean that standards will inevitably differ. For example, there are important differences between countries that affect cost-effectiveness. These include energy and equipment prices and the ways in which energy, vehicles and equipment are used.[89] Technical feasibility has to be balanced with considerations of economic feasibility based on national conditions. For example, American and European consumers expect different features from their refrigerators, which makes energy use higher in the US.[90] In the short term at least, US and EU standards will therefore inevitably differ. It is notable that when Japan adopted a stringent international standard on refrigerators, it later had to change it after it proved too difficult to implement given the local context.[91] Similarly, building standards will inevitably differ in countries with different climates, and building stock composition (e.g. predominantly houses, housing blocks, or flats), particularly in relation to the use of heating and air conditioning.

The solution is therefore to reduce the number of standards operating in different countries without seeking absolute and unrealistic uniformity. Countries are not infinitely different, so a small number of "tiered" standards have been shown to provide an effective approach.[92] This allows for convergence among countries with similar conditions, while recognising differences across regions. A system of tiered standards also allows countries to improve their standards at their own pace. This will be particularly important in cases such as lighting, where the technical needs are the same but the ability to pay for the most efficient technologies varies. Low-income countries will inevitably adopt higher standards later.

Within countries, it is important to be clear about how economic feasibility is defined. Typically, a standard is defined as cost-effective, and therefore as economically feasible, if the reduction in energy consumption over its lifetime (assuming a given discount rate) provides a net economic benefit.[93] However, the criterion of cost-effectiveness might need to be adjusted if efficient products are substantially more expensive to purchase upfront, than other alternatives. This is especially important in developing countries where low incomes are prevalent and where access to energy will contribute significantly to social welfare. Enforcing standards might otherwise reduce or prohibit initial uptake of energy efficient solutions.

One common concern about convergence of standards is the barriers that more stringent standards may create for local producers. In some sectors, the latter might not be able to produce energy-efficient goods or equipment as cost-effectively as international competitors. But the corollary is also true: diverging standards worldwide lock out national producers from export markets. Large multinational firms are much more able to produce tailored products for different local markets than smaller ones.[94]

Principle 2: Standards should aim for the "global best", and should incorporate continuous improvement over time to reflect technological progress.

It is important that convergence of standards aims upward, towards the highest economically rational levels, rather than down to those of the lowest common denominator. In this sense the notion of "global best" should not be seen as static. Rather, as in Japan's Top Runner approach, standards need to improve continuously over time to reflect (and further drive) technological advances. These rising standards can be "tiered", allowing countries to "step up" as their markets mature. In addition to demonstrating flexibility in local conditions, manufacturers would get a clear signal of the direction of standards overall. Ideally, the level of global best would be determined through consultation with participating countries and other partners, including private industry.

There are examples of such approaches at the international level. For instance, a voluntary approach to harmonise regional test procedures for mid-size industrial electric motors has been coordinated between standards bodies, trade bodies, manufacturers, and country governments. The initiative has developed a set of recommended energy efficiency thresholds (with countries choosing the one that is most suitable), with dates for progression sending a clear direction for manufacturers.[95] There is already ongoing work related to passenger vehicles in the G20 through the Global Fuel Economy Initiative, which also works with other multilateral policy processes such as the UNFCCC.[96]

National circumstances in terms of both policy and market maturity also need to be reflected in ambitions for countries as they converge. In the G20, for example, there is varying degree of expertise in implementing energy efficiency standards. Some countries have more mature energy efficiency policies, are near global best in some areas, and have established markets for energy efficiency goods and services. Their policies also often establish, and then re-establish, global best practices. However, others have less experience in energy efficiency policy and have larger potential gains given their starting point, but will need longer to reach global best standards. An approach which encapsulates countries differing starting points was taken in the Montreal Protocol, which gives developing countries a "grace period" (typically 10 years) to implement required measures, and provides finance to support these efforts.[97]

Principle 3: The design process for convergence should include strong coordination between relevant governments, best practice networks, domestic and international regulators, and industry.

National governments have limited resources and time. Inertia on the issue of international convergence is, at least in part, a function of the complexity of any such discussions. In addition, even if standards are designed and agreed upon at the international level, they will require compliance and enforcement efforts at the national level. For governments struggling with compliance issues themselves,[98] the real and perceived transaction cost of engaging in these activities needs to be addressed.

There are organisations that promote model procedures for standards and labelling, such as the International Organization for Standardization (ISO). Despite their strong engagement within the industry, the measures are often not translated into domestic policies. In practice, due to limited resources and complexity,[99] countries adapt standards to their own jurisdiction, and the model standards are not legally enforceable. Most economies could also improve their use of internationally standardised test procedures and work more closely with these bodies to align their approaches with internationally recognised best practice.[100] Countries' approaches can be so different that it is difficult even to compare standards across jurisdictions. Successful collaborative efforts include the US-EU Energy Council which enables cooperation on energy policy, including the Energy Star programme,[101] and the UNEP-led en.lighten initiative which has helped more than 50 developing countries to adopt harmonised standards for lighting.[102]

In this context, is important for any convergence process to start by reviewing past efforts, and to understand the practical constraints faced by countries. Second, it should engage industry and global best practice networks to provide baseline data about international best practices, including effective regulatory processes, compliance regimes, and consumer communications. Third, as convergence has trade implications (especially negative ones for those excluded), the process should be open to the widest possible membership (i.e. all countries) as a basis for policy exchange, dialogue and mutual learning. Fourth, international organisations and domestic regulators need to work together to align standards and test procedures so they can be compared internationally, to facilitate cooperation and drive up ambition.[103]

Principle 4: Convergence of standards should be complementary to other international efforts on energy efficiency.

The push for convergence should be seen as complementary to, and building on, other areas of energy efficiency policy where international support is needed, recognising that multiple approaches are required for success.[104] This includes building effective governance systems, delivering upfront finance, and providing information to consumers.[105] Getting the domestic policy package right remains a priority for most countries; in particular, pricing carbon and removing fossil fuel subsidies are crucial for ensuring that energy prices reflect social costs and benefits.

The standard-setting process itself goes beyond just setting a technical standard (e.g. minimum fuel efficiency). It also requires defining the products to be covered, the metrics for energy efficiency, test protocols, labelling requirements, and, perhaps most important, compliance and enforcement mechanisms. These are all areas that would benefit from international cooperation, to align approaches and provide targeted support to governments. Compliance and enforcement in particular can be extremely challenging for developing countries, and effective mechanisms to address these issues should be given appropriate attention.

Convergence in the context of wider energy efficiency policy also requires high-quality policy analysis and dissemination of the resulting knowledge. This will require finance to support both international-level research and analysis, and work in countries with limited resources of their own where capacity building efforts may be required to ensure effective policy implementation.[106] Countries will also need expert support in adapting internationally agreed standards to local conditions, or in setting their own standards. Such support can be provided and formalised through existing institutions such as IPEEC, IEA, Efficiency Valuation Organisation, or through sector specific groups and networks such as the World Green Building Council.

4.4 ABATEMENT POTENTIAL FROM A CONVERGENCE OF STANDARDS TO THE GLOBAL BEST

It is clear that most countries could strengthen their energy efficiency standards. As noted earlier, without policy reforms, the IEA expects two-thirds of cost-effective energy efficiency potential to be left untapped.[107] Converging national standards to world-leading levels can help to close the gap between current levels of ambition and this full potential. Analysis for the Global Commission shows that raising energy efficiency standards in G20 countries alone to levels regarded as world-leading in key sectors could reduce annual global GHG emissions by 4.6–6.9 Gt CO_2 by 2030.[108] This includes savings of 2.1–2.7 Gt CO_2 in transport, 0.1–0.2 Gt CO_2 in industry, 1.8–2.9 Gt CO_2 in appliances and lighting, and 0.6-1.0 Gt CO_2 in buildings.

The range of forecast energy savings depends not only on the stringency of the standards, but also on enforcement and on the extent of the rebound effect (which remain uncertain). These ranges are based on analysis conducted by Ecofys for the New Climate Economy.[109] The specific sector estimates were constructed in the following ways:

- **Appliances:** A 2011 study found that applying the most stringent energy efficiency standards currently in place globally by 2030, would save 2.6 Gt CO_2, 4,000 TWh of electricity demand (12% of total), and a further 4% of oil and gas demand. A further 28% of electricity demand and 6.7 Gt CO_2 could be saved in 2030 if "theoretically possible" (but not necessarily economic) standards were applied.[110] The findings are broadly in line with studies reviewed in the IPCC's Fifth Assessment Report.[111] The analysis for the NCE adapted these estimates with a base year of 2011 (as opposed to 2006), enforcement and compliance challenges, correcting to include only G20 countries, and uncertainty about rebound effects.
- **Transport:** An International Council on Clean Transportation (ICCT) analysis of 11 economies that account for 85% of sales of passenger vehicles and heavy-duty trucks shows that the energy efficiency savings of current policies adopted in major markets could save around 2.5 Gt CO_2 and 10 million barrels of oil per day (bpd) relative to business as usual by 2030. Adopting "best practices" would save an additional 3.3 Gt CO_2 and 20 million bpd. This is based on strengthening existing standards in major markets, expanding standards to all vehicle modes (heavy-duty trucks and buses, aircraft), and extending vehicle standards to major emerging markets. The estimates have been cross-referenced and calibrated to the IEA's Energy Technology Perspectives.[112] The analysis carried out for the NCE also accounted for enforcement and compliance challenges, geographical corrections, and uncertainty around rebound.
- **Buildings:** The methodology focuses solely only on new buildings, as mandatory standards are not generally applied to existing buildings, due to cost and feasibility issues. Our analysis shows potential savings of 0.6-1.0 Gt CO_2 by 2030 if building energy efficiency standards were set at the current world-leading level according to different climatic zones. We also assume that the standards are applied in retrofits of 1.4–3.0% of existing buildings per year.[113] As called for by the International Union of Architects,[114] this would imply almost net zero energy consumption and net zero carbon emissions, following the lead of the EU, which has already set a near-zero energy consumption standard for new buildings, effective in 2020.[115]
- **Industry:** Focusing only on motors and other equipment that are amenable to standards, savings estimates range from 80 to 160 Mt CO_2 by 2030.[116] This is small relative to the total size of industry energy use and emissions, but the large majority of industry energy can be unlocked through energy audits and by ensuring compliance with the ISO 50001.[117]

5. Conclusions and recommendations

The benefits of energy efficiency for economic growth and climate change are well documented, but there are many barriers to realising its potential. International cooperation to support the adoption of ambitious energy efficiency standards is a key part of a policy package to overcome those barriers.

The Global Commission on the Economy and Climate recommends that G20 and other countries converge their energy efficiency standards in key sectors and product fields to the global best by 2025, and that the G20 establish a global platform for greater alignment and continuous improvement of standards. Doing so could save 4.6–6.9 Gt CO_2 in 2030 across the sectors of appliances, industry, transport, and buildings, and deliver multiple economic benefits.

The G20 Summit in Turkey in November offers a major opportunity to take further action. This should build on the commitments of the G20 energy efficiency action plan at the 2014 G20 Summit in Australia, making it a clear priority to implement that plan. The following goals should inform this programme:

- **Set a timetable:** Implementing the Commission's recommendation will require effort not just in 2015, but also beyond. The commitment is the first step; a timetable and action plan should also be agreed for coordination of activities and stakeholders and delivery of results.
- **Leverage the best available expertise to set and harmonise standards:** Bring together top experts and provide a platform to discuss how to set and harmonise standards through time, including defining what constitutes the global best. This should include experts on energy (e.g. IEA), regulators, industry, and experts within individual sector areas (e.g. best

practice networks on appliances, transport, industry, etc.). This will require finance to support both international-level research and analysis, and work in countries with limited resources of their own.

- **Provide flexibility to ensure momentum:** Countries should be flexible to adopt standards that are tailored to their own economic and social context, especially to ensure that standards are economically viable. One useful approach might be to set staggered time-frames, allowing some countries extra time, for example, to meet a given standard.
- **Provide a mechanism for continuous improvement of standards:** As Japan has demonstrated through its Top Runner Approach, standards are most effective when they are steadily raised to reflect – and further drive – technological advances. The G20's approach to convergence should similarly provide a mechanism for continuous improvement. This is important even where standards or time-frames are differentiated to accommodate national circumstances.
- **Be inclusive:** While the Commission's recommendation focuses on the G20, other countries should also be encouraged to raise their own ambitions for energy efficiency, as some have (e.g. Tanzania, Vietnam, Peru). The G20 should invite broad participation in any efforts to raise and converge standards as energy efficiency is critically important for countries at all stages of development.
- **Ensure a coordinated international effort:** The design of standards needs to be incorporated into current international efforts to support countries on energy efficiency (including how to improve enforcement and compliance to standards), and these efforts should be mutually reinforcing. Any gaps in current efforts should be addressed, either through existing institutions and initiatives, or through new initiatives.
- **Provide institutional support for implementation and monitoring:** An obvious option is to rely on IPEEC, which has provided oversight on five of the six G20 priority areas for energy efficiency; the IEA could also assist. This role could be expanded to track progress towards the overall recommendations decided at the G20, which would also incorporate and track other international commitments on energy efficiency. It could also include supporting access to comparative data on performance levels, which would greatly help international cooperation.

ENDNOTES

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Note that the figures here differ from those included in the synthesis of this paper in *Seizing the Global Opportunity*, as they have been updated to reflect the latest available data. Energy consumption growth estimates vary depending on methodology, data sources and reference years used; IEA data show total primary energy demand rose by 52% from 1990 to 2012, slightly lower than the 54% shown in BP data for that same period. See: IEA, 2014 World Energy Outlook 2014. International Energy Agency, Paris. Available at: http://www.worldenergyoutlook.org/publications/weo-2014/.

World GDP in 2014 was US$103.6 trillion, in constant 2011 international dollars, purchasing power parity (PPP); that is a 123% increase from US$46.6 trillion in 1990. See: The World Bank, 2015. *World Development Indicators 2015*. Last updated 1 July 2015. Available at: http://data.worldbank.org/data-catalog/world-development-indicators.

2 Standards are also an important part of energy supply policy, but that is beyond the scope of this paper.

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4 See: http://www.cleanenergyministerial.org.

5 See: http://www.se4all.org.

6 See, for example: http://www.gbpn.org.

7 See: http://www.enlighten-initiative.org.

8 See: http://www.globalfueleconomy.org.

9 See: https://www.iea.org/topics/energyefficiency/workingpartyeewp/ and http://www.iea.org/techinitiatives/.

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13 Ibid. This is based on a Net Present Value calculation.

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15 Klevnäs, P., Stern, N., and Frejova, J. 2015. *Oil Prices and the New Climate Economy*. Global Commission on the Economy and Climate briefing paper, Available at http://newclimateeconomy.report/misc/working-papers.

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24 IEA, 2014. *Capturing the Multiple Benefits of Energy Efficiency.*

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For a detailed discussion see page 151 of New Climate Economy, 2014 and Gillingham, K., Rapson, D., & Wagner, G. 2015. *The rebound effect and energy efficiency policy.*

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41 See: https://www.kfw.de/inlandsfoerderung/Unternehmen/Energie-Umwelt/index-2.html.

42 This is part of the EBRD Sustainable Energy Financing Facility; see: http://www.ebrdseff.com.

43 The World Bank, 2013. *Energy Efficiency: Lessons Learned from Success Stories*. Washington. Available at: http://documents.worldbank.org/curated/en/2013/01/17597865/energy-efficiency-lessons-learned-success-stories.

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There are also energy management system standards (EnMS) which provide a model to follow when setting up and operating a management system, based on best practice and expert consensus. They are applied at the organisation level, regardless of size or sector. EnMS are typically employed in industry and reflect that industrial facilities are complex and cannot be bound to a standard on a building or piece of equipment. Instead, the best approach is to seek to manage their operations strategically across all processes, systems, technologies and through employee engagement.

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79 The data here were extracted from the UN Sustainable Energy for All Energy Efficiency Hub, Programme Mapping review. Available at: http://www.energyefficiencycentre.org/Resources.

This is likely an underestimate; for example, IPEEC has identified more than 200 multilateral initiatives in Brazil, China, India, Mexico, Russia and South Africa alone. The latter focus on industry (45), utilities (38), buildings (19), finance (19), and transport (7). There are three predominant types of projects: technical assistance (100), capacity-building (63), and mobilising finance (55). See IPEEC's MEER database, available at: http://www.ipeec.org/meer.html.

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81 Analysis based on data from Organisation Internationale des Constructeurs d'Automobiles (OICA). Available at: http://www.oica.net/category/production-statistics/.

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ABOUT THE NEW CLIMATE ECONOMY

The Global Commission on the Economy and Climate, and its flagship project The New Climate Economy, were set up to help governments, businesses and society make better-informed decisions on how to achieve economic prosperity and development while also addressing climate change.

In September 2014, the Commission published *Better Growth, Better Climate: The New Climate Economy Report*. Since then, the project has released a series of country reports on the United States, China, India and Ethiopia, and sector reports on cities, land use, energy and finance. In July 2015, the Commission published *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. It has disseminated its messages by engaging with heads of governments, finance ministers, business leaders and other key economic decision-makers in over 30 countries around the world.

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