McKinsey&Company

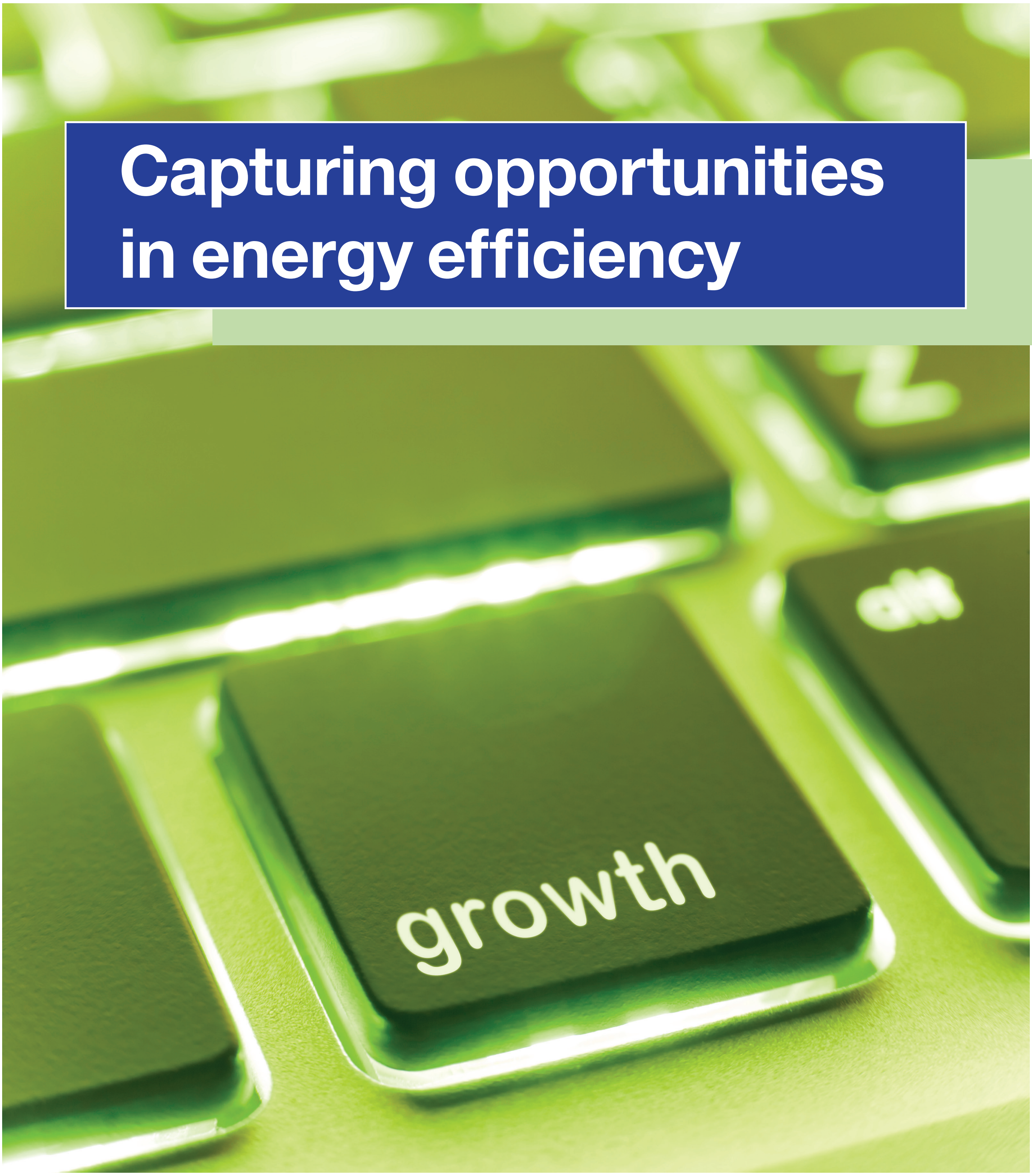
WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

ICT and Eco-Sustainability Working Group

Annual Meeting 2011
Davos-Klosters – 27 January 2011

Capturing opportunities in energy efficiency



Capturing opportunities in energy efficiency

Institutional acknowledgements

The World Economic Forum would like to extend special thanks to its Information Technology and Telecommunications Industry Partners that have been involved in and contributed to the ICT and Eco-Sustainability Initiative. Their support and commitment is highly valued.

Accenture
Adobe
Akamai
Alcatel-Lucent
Amdocs
Applied Materials
BMC Software
BT
Bharti Airtel
Brightstar
CA Technologies
CSC
China Mobile
Cisco
Dell
Deutsche Telekom
EMC
France Telecom
Google
HCL Technologies
HP
HTC-VIA
Huawei
Infosys
Intel
Juniper Networks
Lenovo
Liberty Global
Lockheed Martin
Mahindra Satyam
Marvell
Microsoft
NCR
NetQin
Qualcomm
SAP
SAS
SK Telecom
Salesforce.com
Saudi Telecom Company
TCS
TIBCO Software
Telefónica
Telenor
Turkcell
VeriFone
VimpelCom
Vodafone
Wipro Technologies
Wyse

World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Tel.: +41 (0)22 869 1212
Fax: +41 (0)22 786 2744
E-mail: contact@weforum.org
www.weforum.org

Contents

Preface 7

Executive summary 9

1 The challenge 11

2 The opportunity 13

3 Ramp-up: Status and projections 17

4 The action needed 21

5 Signposts: Implementation ideas 27

6 The road ahead 35

Appendix 36

Preface

The Information and Communication Technology (ICT) sector has entirely transformed the way we work, learn and interact. Whether cloud computing or social media, technology is having a huge impact on human behaviour, from raising productivity to facilitating communications. As we enter the second decade of the 21st century, ICT solution providers are poised to contribute substantial and innovative technologies in support of an increasingly pressing sustainability agenda.

But ICT-enabled sustainability and energy efficiency initiatives are more than just a challenge: they also represent a great opportunity. A paradigm shift to a low-carbon economy by 2050 has the potential to write the next chapter of technological innovation. Realizing this potential will require a third – this time a green – industrial revolution, which must harness the power of the market to deliver on this environmental imperative. Executed properly, the ICT-enabled part of this revolution could have a greater impact than any other sustainable development initiative in history.

The importance of energy efficiency initiatives as cost-efficient mitigation options cannot be overstated. Energy efficiency is projected by the International Energy Agency (IEA) to be the single largest contributor to carbon emission reductions in all of its scenarios. Other analyses suggest that improving so-called no-regrets energy end-use and supply efficiencies in residential and commercial buildings and transport alone could contribute nearly a quarter of the global abatement needed by 2030 to reduce current emission levels by 20%. Beyond the environmental impact, realizing such improvements also constitutes a business opportunity of grand proportions, likely to be in the trillions of US dollars.

The ICT industry is well positioned to help enable sustainability initiatives across a broad range of industries and capitalize on these emerging business opportunities, but is it ready to take the lead in these integrated solutions? If so, what bottlenecks are holding back the various opportunities, and how can they be removed? The ICT and Eco-Sustainability Working Group has explored these questions over the past nine months in a series of workshops and based on interviews and additional research. This report presents the results of this work and summarizes the discussions held on this topic at the World Economic Forum Annual Meeting 2011 in Davos-Klosters. Our hope is that it can serve as the starting point for further work and contribute to realizing the many opportunities discussed.

This process of gathering information and synthesizing the current status and road ahead for ICT and eco-sustainability has involved over 40 companies and 60 individual experts. We would like to express our deep gratitude to all of these as well as to McKinsey & Company, who have supported this work throughout as project advisers.

Alan Marcus
Senior Director, Head of IT and Telecommunications Industries
World Economic Forum

Executive summary

The world is undergoing unprecedented change. With topics such as access to water, land use and climate change, sustainability is now constantly at the forefront of global debate. Industry and governments alike have started the quest for greater resource productivity and increased use of renewable resources – both necessities for our planet to support us long term. The fundamental shift that is clearly needed is underway, but much remains to be done.

Consensus is broad that improved energy efficiency plays a crucial role in this shift, and Information and Communication Technology (ICT) can make a significant contribution. We need to find smarter ways of designing, constructing and using items and buildings, and of transporting people and goods – and it is ICT that enables these solutions.

The challenge

It is generally agreed – and set forth in the Cancún Agreement of December 2010 – that the average rise in global temperatures needs limiting to no more than 2°C over pre-industrial levels to avoid dangerous interference with the climate system. To achieve this, long-term atmospheric concentration of CO_2 must not exceed 450 parts per million, requiring a reduction in emissions of around 25% by 2020 compared to business as usual. This amounts to roughly 15 $GtCO_2e$.

Achieving this level of carbon abatement requires a multitude of actions, including developing new fuels and new sources of electric power as well as curbing deforestation and reforming agricultural practices. According to the International Energy Agency, however, the single largest potential contributor to the abatement required is energy efficiency. This is particularly evident when examining the development of global resource productivity over the last 20 years. Whereas labour productivity has risen at a global average of 2.1% per year, oil productivity has gone up by only 1.6% annually, and electrical power productivity has literally not improved at all, with a change rate of 0.0%. Clearly, the potential for improvement is considerable.

The rewards ahead

Though achieving the goal of greater energy efficiency promises to be a significant challenge, it is also a huge opportunity – for business as well as society. By 2020, the development and dissemination of ICT-enabled energy efficiency solutions has the potential to:

- Reduce annual greenhouse gas emissions by approximately 8 $GtCO_2e$ – one-third of the total abatement believed to be achievable over the next decade
- Result in energy-related cost savings at a level of US$ 1.4 trillion per year – generating new business opportunities of the same order of magnitude
- Create 15 million jobs in the ICT and high-tech industries, of which 7 to 8 million will be entirely new jobs and 8 to 9 million a shift from other industries.

This will be accomplished by pursuing solutions in four technology groups – Smart Grids, Smart Buildings, Smart Logistics and Smart Industry – plus a handful of miscellaneous high-impact solutions, such as traffic management and combined heat and power generation.

The action needed

The great rewards notwithstanding, reaching the full potential of ICT-enabled energy efficiency will not be possible without deliberate and concerted action from all the main stakeholders. This includes providers of ICT solutions, other industry players and the public sector via national and local governments as well as regulatory bodies.

The most important actions needed can be divided into four categories. First, governments and regulators need to push a smarter regulation, including financial and non-financial incentives, striving to align multiple stakeholders and to foster rapid scaling of solutions on a global scale. At the same time, the ICT industry needs to forge ahead with standardization, ensuring compatibility and interoperability of solutions. Second, the involved industries will often need to extend their offerings along the value chain and create new business ecosystems. Third, new business and financing models must be devised to mitigate upfront investment costs and improve short-term profitability. Finally, the public and private sectors need to jointly create awareness around energy efficiency, increase transparency of energy use and costs and build the energy efficiency capabilities and know-how that are often lacking so far.

Showcase projects

There are several approaches to put these actions into practice. One approach is through showcase projects, designed to demonstrate the feasibility and attractiveness of ICT-enabled energy efficiency solutions, thus helping to accelerate development. Five specific initiatives that could serve such a purpose and that are presented in this report are:

- **Energy scorecards for urban municipalities.** Allowing cities to track and actively reduce their energy consumption on a continuous basis
- **Energy Contracting Agencies (ECAs).** Assisting companies and organizations in the implementation of energy efficiency solutions – either as a government agency or as a public-private partnership – by assuming project ownership
- **Centres of excellence in energy efficiency.** Bringing together companies, research institutes and leading educational institutions for joint research and development as well as hands-on educational programmes
- **Smart city logistics concepts.** Addressing congestion in the world's largest metropolitan areas by reducing cargo traffic via innovative cross-docking concepts and optimized routes
- **Large-scale interoperability test bed for smart grids.** Offering companies opportunities to develop and test standards for the interoperability of smart grid solutions via an open collaboration.

* * *

ICT-enabled energy efficiency represents a huge opportunity, and its implementation over the coming decade promises to be a most rewarding journey if tackled in the right spirit. This report is intended to serve as a call for action and help accelerate this journey, which will not only be rewarding but also vital to our future.

1 The challenge

In many ways, energy is the most fundamental of all resources. To generate or collect any other resource, we must expend energy. For over 40% of the total world economy, energy is of strategic importance. This includes not just the energy industry itself, but also energy-intensive industries, transportation, construction and many other sectors. Beyond being a major cost factor for many organizations, the supply of energy is a highly complex endeavour. The world's nations regularly debate energy security and the need to reduce their dependence on foreign sources. Energy also lies at the very heart of what is generally considered the most pressing sustainability issue on a global level: climate change. While the economic and political significance of energy has long been high, we believe it is the urgency of the sustainability aspects that, more than anything else, will bring energy to centre stage in the coming decade.

As for many other natural resources, worldwide energy consumption today is higher than the Earth can sustain long term. While several types of resources, such as water and arable land, are already facing shortages in different parts of the world, the key issue with energy is that global demand is vastly higher than renewable production. Current consensus is that the resulting emissions may well lead to catastrophic climate change unless brought under control within a relatively short time frame. Dramatic action is needed now rather than later.

It is generally agreed, and set forth in the Cancún Agreement of December 2010, that the average rise in global temperatures needs limiting to no more than 2°C over pre-industrial levels to avoid dangerous interference with the climate system. To achieve this, long-term atmospheric concentration of CO_2 must not exceed 450 ppm, requiring a reduction in emissions of around 25% by 2020 compared to business as usual. This amounts to roughly 15 $GtCO_2e$. As if the magnitude itself were not enough, the issue is further complicated by the need for global solutions. Reducing emissions in one part of the world does no good if they continue to climb at a higher rate elsewhere.

In the long term, renewable energy production may well come to provide us with virtually unlimited carbon-free power. Until then, however, it is vital to find ways to reduce energy consumption. With a growing world population and a natural desire to increase prosperity, the most viable road is not reduced end-product demand but increased productivity. To achieve this, consumers as well as suppliers of energy have some catching up to do. Since 1990, global labour productivity has risen at a rate of 2.1% per year. Oil productivity, however, has only gone up by 1.6% per year, and the figure for electrical power is 0.0%. Looking further back in time, the same trend remains apparent: energy productivity gains tend to lag behind those of most other resource types – sometimes substantially.

McKinsey & Company's Global Greenhouse Gas Abatement Cost Curve has shown that around 35% of viable technological abatement potential on both the ten- and twenty-year scales is directly related to greater energy efficiency. Additionally, energy efficiency constitutes the bulk of abatement opportunities that have a net positive business case. It should therefore be clear that energy efficiency is both an environmental imperative and the source of great business opportunities.

To a large extent, efficiency-based carbon abatement requires technology solutions that allow or facilitate more effective and efficient use of available energy, including such things as smart electricity meters, videoconferencing solutions and route optimization software. Some measures – improving building insulation, for example – are relatively simple from a technological perspective. For the remainder, however, ICT plays a large role. As the next chapter will show, ICT-enabled efficiency levers (including the enablement of renewables and behavioural change) represent roughly a third of total abatement potential up to 2020. Combined with what we know about the economic and political significance of energy, energy efficiency will be a cornerstone in the world's pursuit of sustainable growth in the decades to come.

2 The opportunity

Information and Communication Technology has grown to be ubiquitous in our society, forming an integral part of our economy, with a huge impact on many industries as well as everyday life. It should therefore come as no surprise that ICT plays an important role in the potential for greater energy efficiency. The ICT and Eco-Sustainability Working Group's studies reveal that ICT-enabled energy efficiency has enormous potential to impact society in three ways: environmentally, economically and in terms of employment (Exhibit 1). Apart from the effect of reducing emissions, which has been studied before, the global economic impact could amount to over US$ 1.4 trillion each year from 2020 onwards. The technological solutions that will contribute to this fall into four main categories, with a fifth category containing several miscellaneous solutions that also have high savings and economic potential. Together, these could generate some 15 million new jobs in the ICT solution industry.

Benefits along three dimensions

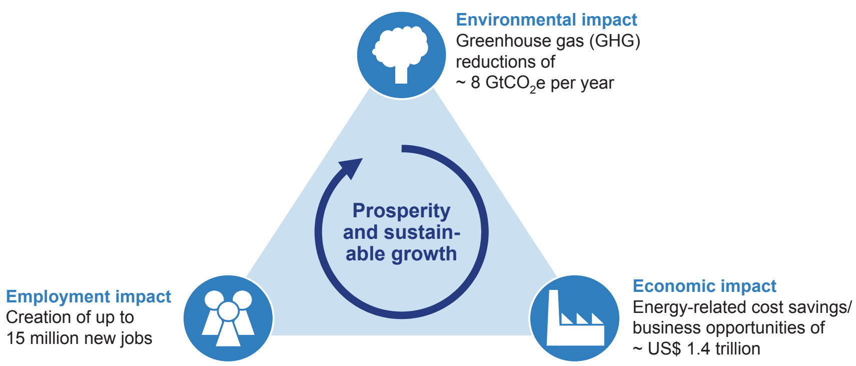
The benefits in the environmental and economic dimensions are directly related to lower energy use due to greater efficiency and the value this delivers. Along the employment dimension, the benefits arise from the new business opportunities that will be created.

Environmental impact. The most immediate impact of improved energy efficiency will be lower greenhouse gas emissions due to less demand for electrical power, and in many instances for fossil fuels (such as natural gas or vehicle fuel) directly. By 2020, the abatement potential of ICT-enabled solutions will amount to roughly 8 $GtCO_2e$. This is around a third of total abatement potential, as shown in Exhibit 2. As a comparison, this is almost as much as the full abatement achievable from all forestry- and agriculture-related activities combined. It is also nearly six times the ICT solution industry's own projected direct and indirect emission footprint for 2020 of approximately 1.4 $GtCO_2e$.

Exhibit 1

ICT-enabled eco-sustainability will have enormous impact on prosperity and sustainable growth

2020 PROJECTION



SOURCE: ICT and Eco-Sustainability Working Group

Economic impact. The high environmental impact outlined above can also be translated into financial terms. Potential energy savings have been quantified in terms of reduced need for electrical power, natural gas and/or vehicle fuel (as appropriate) for each energy efficiency initiative analysed. Applying estimated resource costs, the total potential gross cost savings (i.e., not taking into account the cost of implementing the efficiency measures) amount to almost US$ 1.2 trillion per year by 2020. If we also assume that a pricing mechanism for carbon – a carbon tax, for example – applicable to the emissions in question will have been introduced by then, that would add almost US$ 200 billion of avoided costs. In total, this brings the savings potential to approximately US$ 1.4 trillion. Taking expected growth into account, this is roughly equivalent to the GDP of the Netherlands or the combined revenue of the world's three largest corporations. Encompassing all sectors, these potential savings would also be accompanied by corresponding revenue potential for the ICT solution industry. Bottom-up analyses of individual technologies have revealed this revenue potential to be of the same order of magnitude as the savings – i.e., possibly exceeding US$ 1 trillion per year. Net savings for the end customers will vary between different efficiency solutions, and the detailed calculation of implementation costs is part of realizing the business opportunity. However, high-level estimates show consistently positive business cases across all technology groups.

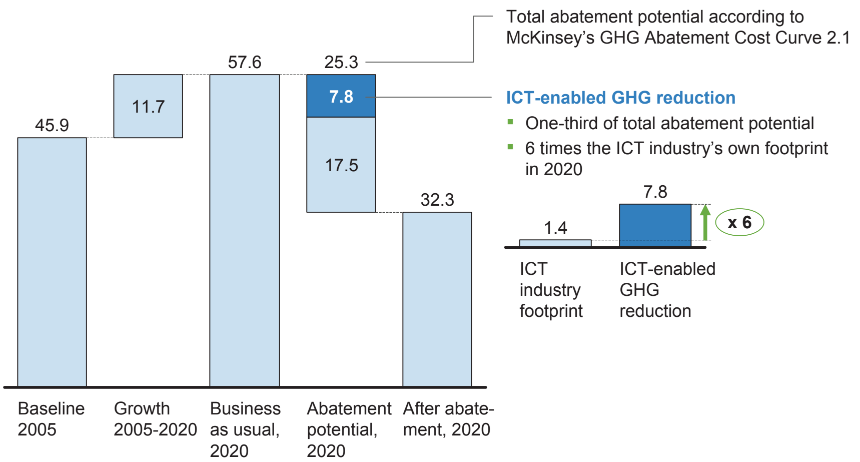
Employment impact. The huge business opportunity for the ICT solution industry entails an equally massive job creation opportunity. We estimate that full implementation of the ICT solutions for energy efficiency described could create as many as 15 million full-time jobs in the ICT solution industry. Of these, 8 to 9 million would be jobs shifted from other industries (mainly the transportation and energy sectors), while 6 to 7 million would be entirely new. These 15 million jobs can be compared to Poland's total labour force, at just over 17 million. This figure also roughly equals the total number of employees of the world's 25 largest private employers, and is seven to eight times the number employed by Wal-Mart, which tops the list.

Exhibit 2

With an enablement potential of ~ 8 $GtCO_2e$, ICT solutions will contribute one-third of the total abatement achievable in 2020

Global GHG emissions, 2020

$GtCO_2e$ per year



SOURCE: SMART 2020; IPCC; McKinsey

All these figures assume that a certain end state is reached by 2020. This state is the sum of individually constructed development scenarios for each of the technologies involved. These scenarios are based on a combination of historical development, published forecasts and assessments by industry experts. Wherever possible, multiple applicable indicators have been combined to yield a compound development metric, thus increasing accuracy and decreasing sensitivity. It is our belief that each of the scenarios represents a fully realistic development trajectory, though they all require that action be taken by the stakeholders concerned. Examples of such actions are detailed in Chapters 4 and 5.

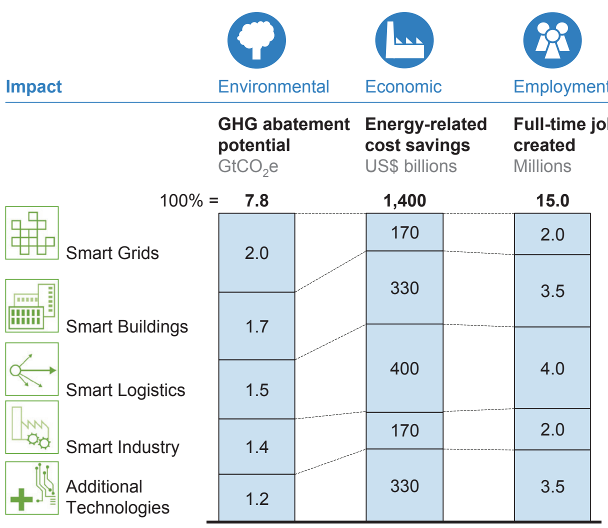
Technology solutions in five groups

The environmental, economic and employment opportunities listed above have been calculated from a number of individual technological solutions, organized under four headings: Smart Grids, Smart Buildings, Smart Logistics and Smart Industry. A handful of technologies that do not fit into any of these categories have also been analysed and placed under a heading of their own: Additional Technologies. Exhibit 3 presents the results of this analysis by type of impact for each technology group.

The following sections give a brief outline of each group, including its contribution to the total impact along each of the three dimensions. It is important to note that the economic/employment potential is not directly proportional to the environmental potential. The reason for this is that the relationship between these depends on which resource types are affected by the technologies in question. For example, the carbon intensity (amount of CO_2 emissions per unit of energy) is, on average, higher for electrical power than for natural gas, given the current global energy mix. Please refer to the appendix for more detailed descriptions of the specific solutions in each group.

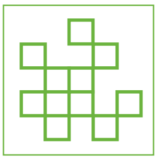
Exhibit 3

Overview of impact by technology group



SOURCE: SMART 2020; ICT and Eco-Sustainability Working Group; McKinsey

2.0 $GtCO_2e$
US$ 170 billion
2 million jobs

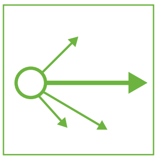


Smart Grids: The transmission, distribution and use of electricity. The Smart Grids category covers solutions for the ICT-enabled control and management of power networks and installations. An important component is better grid management, leading to reduced losses in transmission and distribution. This category also includes the enabling of higher renewables penetration as well as smart meters to allow better demand control. The resource abated is electrical power. Its high carbon intensity leads to high emission reduction potential compared to its (relatively speaking) lower economic potential.

1.7 $GtCO_2e$
US$ 330 billion
3.5 million jobs

Smart Buildings: Energy needs and use patterns in buildings. Smart Buildings as a category comprises both design tools and automation systems. This includes computer simulation techniques that enable superior building designs with lower energy consumption. Automation systems are applied during the entire life of a building, employing sensors and smart algorithms to reduce its energy consumption via the integrated management of lighting, heating, air conditioning and other energy uses. An estimated 30% of the carbon abatement would stem from a reduction of primary energy sources, which have lower carbon intensity than electrical power. The economic impact is therefore greater than for the Smart Grids category, despite the lower emission reduction.

1.5 $GtCO_2e$
US$ 400 billion
4 million jobs

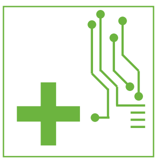


Smart Logistics: Transportation of goods and related services. Smart Logistics help logistics providers optimize their networks with regard to routes, loading, inventories and other factors affecting energy consumption. Solutions can also be used to reduce the fuel consumption of individual vehicles and drivers by tracking consumption, reducing packaging volumes and proposing eco-driving initiatives. The main resource abated is vehicle fuel, which is why this category offers the highest economic impact, both in absolute terms and relative to emission reduction.

1.4 $GtCO_2e$
US$ 170 billion
2 million jobs

Smart Industry: Production of goods. In industry, solutions include smart motors that flexibly adapt their speed and energy consumption to the current load of, for example, a manufacturing line. Energy management systems are another important component, measuring, analysing and optimizing the energy consumption of a manufacturing or processing unit and managing peak demand. The resource abated is electrical power. Its high carbon intensity leads to high emission reduction potential compared to its (relatively speaking) lower economic potential.

1.2 $GtCO_2e$
US$ 330 billion
3.5 million jobs



Additional Technologies. In addition to the four main categories, we have chosen to analyse a number of further technologies that fall outside these groups. These are combined heat and power generation, passenger traffic management systems and telecommuting/videoconferencing solutions. Though the main resource abated is electrical power, a significant share of the abatement also stems from vehicle fuel and, to a lesser extent, primary energy sources. This mix of carbon intensities leads to relatively high economic potential compared to this category's emission reduction potential.

3 Ramp-up: Status and projections

To map the road ahead, we need to know where we are today. Which solutions offer the greatest potential impact, how feasible are they given current preconditions and how far have we already come in realizing them?

As we have already seen, ICT-enabled energy efficiency solutions have tremendous potential to lower greenhouse gas emissions and costs while creating new business opportunities and jobs. However, none of the solutions analysed have achieved wide-spread deployment to date. Several of them, though, have seen very interesting developments over the past few years. Some technologies have only recently taken the step from theoretical possibility to market-ready solution. Initiatives have also been taken that have pioneered the use of these new solutions. The final results are not yet known in many cases, so it may not be possible to use them as blueprints for future projects. However, they all serve to inspire action. To mention just a few of these initiatives:

- The Telegestore Project, a cooperation between Enel, Telecom Italia, Electrolux and Indesit, has supplied over 30 million customers in Italy with smart meters, enabling utilities to install energy-efficient technologies such as load-based tariffs and peak shaving.
- Construction of completely new sustainable and energy-efficient pilot cities has begun, such as Masdar City in Abu Dhabi – a global, clean-technology cluster entirely powered by renewable energy. These cities showcase the large-scale use of energy efficiency solutions and create an international hub for developing and piloting new clean-tech solutions.
- The market share of energy-efficient industrial motors increased by 35% in Europe between 2006 and 2009. This share is expected to rise even faster in China, where several financial incentives already exist and more are planned. Coupled with these incentives, a sales ban on non-efficient motors will become effective in 2011.

These are, however, only three in a vast array of examples. To create a holistic picture of the status quo for the technology solutions in the groups specified, we have used a framework called the Eco-Sustainability Altimeter (Exhibit 4). The Altimeter is designed to visualize three aspects of each of the technologies analysed. The first is the size of the opportunity offered by the technology, in terms of emission reduction potential. Second, it displays the readiness of the technology, determined by analysing the potential obstacles to successful implementation. The third dimension, implementation progress, is derived from development of the metrics used to set the targets for 2020.

The Altimeter indicates that overall implementation is more or less on track given developments over the past few years and the targets set for 2020. However, it also shows that the pace needs to increase over the years to come. On the readiness side, our studies reveal that the barrier to successful implementation is seldom technology itself. The roadblocks are found among other factors, and vary depending on geography, industry and technology. The findings also allow us to draw a number of conclusions on what needs to change for the 2020 goal to be reached – a topic further explored in Chapter 4.

The Eco-Sustainability Altimeter: Methodology

Each bubble on the Eco-Sustainability Altimeter represents an energy efficiency technology. The size of the bubble is proportional to the size of the enablement (or greenhouse gas abatement) potential as discussed in Chapter 2. Its distance from the centre (readiness) indicates how challenging implementation is expected to be, and its radial position (progress) shows how far implementation has progressed: the left endpoint is the 2007 starting point, and the right endpoint the 2020 target.

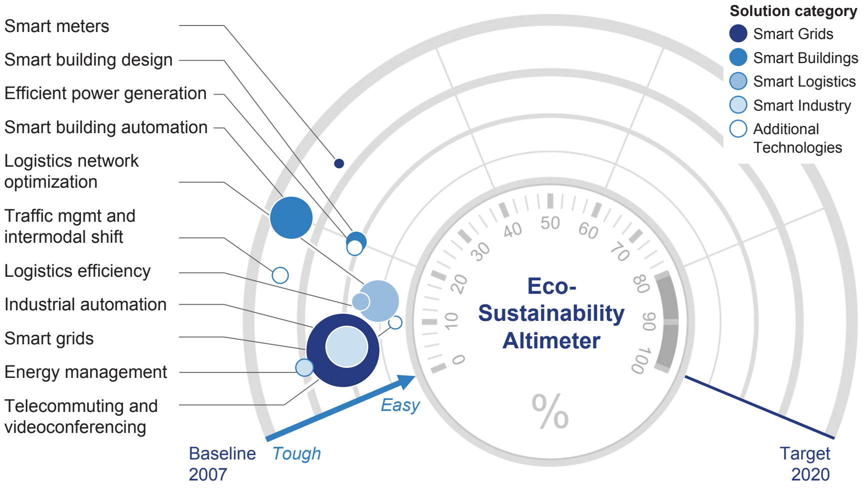
Quantifying implementation readiness. Implementation readiness is a metric quantifying how much effort is required to realize the potential of a given lever, i.e. its feasibility, with higher readiness representing less effort required. In the Altimeter, this is denoted as a scale from "easy" near to the centre to "tough" near the edge, illustrating that the path between two "altitudes" (levels of progress) on the Altimeter is longer if readiness is low, making it necessary to progress along an outer circle rather than an inner one. Readiness for each technology has been assessed along four dimensions, as detailed in Exhibit 5, using industry expert assessments combined with clear, detailed criteria to assign a point value on a five-degree scale. The overall readiness of a technology is defined as its average score on all four dimensions.

Quantifying implementation progress. Defining what is meant by progress is essential to be able to detail both how implementation has progressed historically, and how it will continue going forward. To do this, we have defined key performance indicators (KPIs) for each technology. These are either direct metrics of progress in that area, or can reasonably be assumed to correlate strongly with such progress. A combination of operational and market KPIs have been used, with preference given to the former. Where suitable indicators are scarce, the KPIs have been supplemented

Exhibit 4

The Eco-Sustainability Altimeter: Core technology is ready – action is needed to speed up adoption and reduce barriers to implementation

Status 2010



SOURCE: SMART 2020; Frost & Sullivan; GIA; ARC Advisory Group; BCC Research; ABS Energy; McKinsey by interviews with industry experts on the current status as well as historical and projected development. Finally, the trends identified have been extrapolated to yield a probable end state for 2020, and progress is reported as the percentage of the 2020 target that has been reached compared to the baseline year of 2007.

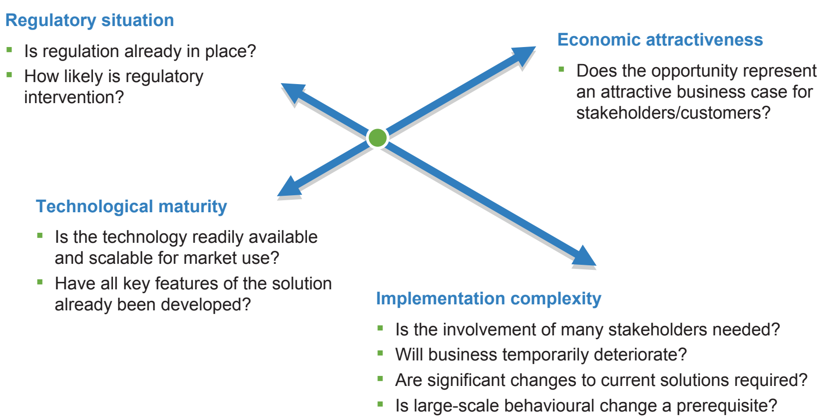
The development trajectory

A glance at the Altimeter may be disheartening at first, as most technologies appear to be hovering around the 10 to 20% progress mark, which might initially appear low. However, it is important to remember that less than 25% of the time from the baseline year of 2007 to the target year of 2020 has passed, and that implementation is expected to speed up towards the second half of this time period (as technologies progress along the learning curve, lowering barriers to implementation). Notably, the high-potential smart grids and industrial automation technologies' positions at the low end of the spectrum are largely in line with expectations. In other words, the Altimeter's progress assessment shows that most enablement opportunities are on track. Developments since 2007 translate into an achieved reduction of annual greenhouse gas emissions of approximately 1 $GtCO_2e$.

The projected development trajectory is illustrated in Exhibit 6, where it is clearly apparent that growth is non-linear for all the technology groups. Specifically, in 2010, three years or roughly 23% of the time from 2007 to 2020, only 12% of the target is expected to have been achieved. This is more or less equal to the actual progress of 12.4%.

Exhibit 5

The 4 dimensions of implementation readiness

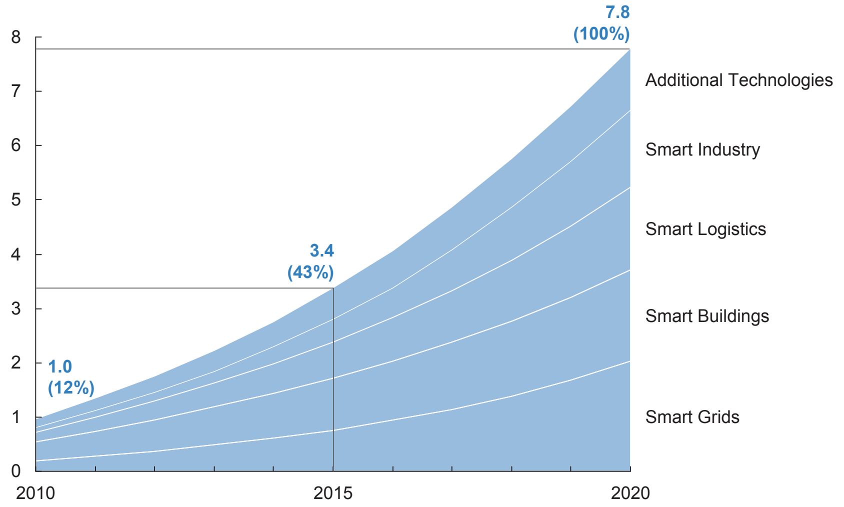


SOURCE: ICT and Eco-Sustainability Working Group

Exhibit 6

Possible ramp-up scenario for ICT energy efficiency solutions

Predicted emissions reduction via ICT enablement solutions
$GtCO_2e$ per year (per cent of 2020 goal)



SOURCE: McKinsey

Looking ahead, market forecasts for the different solutions suggest that ramp-up will continue with increasing speed. By 2015, 43% of the total emissions reduction target should have been reached. In other words, the lion's share of the effect will be seen in the final five years, between 2015 and 2020, when efficiency measures have become more widely deployed. All in all, the abatement goal for 2020 of just over 8 $GtCO_2e$ appears achievable given the 2007 to 2010 trajectory, and the assumptions regarding future development.

4 The action needed

As the Altimeter results in the previous chapter revealed, the technological hurdles to implementation of the ICT-enabled energy efficiency solutions analysed have already largely been overcome. The key obstacles ahead lie in the fields of regulation, value chain and operating models, end-customer awareness and business/financing models.

These four issue types can clearly be identified both in the Altimeter readiness assessment and the results of a survey conducted at the World Economic Forum 2010 Annual Meeting of the New Champions in Tianjin. Conducted among participating industry representatives, this survey aimed to clarify the industry's own view of what will define the direction going forward. The full results are available in the appendix and include the following:

- Two actions surfaced as by far the most important for governments and regulators: *providing financial subsidies* (41%) and *pursuing binding regulation* (36%)

- 45% saw *adapting their strategies and operations to these new opportunities* by shifting focus, management attention and incentives away from legacy business as the single most important action for industry players.

- When asked about the main challenge for the ICT solutions industry in supporting implementation, 40% of respondents considered the *creation of new business and financing models most important.*

- 31% of participating leaders consider cost savings for customers to be the main driver for implementing energy efficiency solutions. However, this will not happen without *awareness and sufficient transparency*.

What is needed now is to act decisively in each of these areas to create attractive solutions, stimulate demand and facilitate adoption. This must include addressing challenges such as changing mindsets and behaviours, not only within the industry itself, but also among customers. Market uncertainty due to a lack of standards and doubts about which technologies will take the lead also needs to be countered by greater global coordination.

Inaction at this point will inevitably result in failure to reach the set targets. Interestingly, however, the results to date suggest that additional effort could lead to an even faster ramp-up scenario. If 2020 targets were to be reached one to two years earlier and development continued along similar trends, this would mean an increase in business potential of roughly 30% from 2016 to 2020. Such business potential would equal a total value of US$ 1 to 2 trillion over this five-year period beyond the annual value after 2020 of approximately US$ 1.4 trillion described earlier.

So what is needed to ensure implementation? The ICT Eco-Sustainability Working Group has summarized the most important steps to be taken, identifying a series of industry and government/regulator actions needed for each of the four "Smart" categories. These do of course need interpreting in a local context, as different markets and regulatory environments have diverging requirements.

Smart regulation and standardization

"Smart regulation" means more than simply specifying technical or environmental thresholds or granting subsidies. Regulatory measures need to reflect the complexity of the challenge at hand and should be designed to align the objectives of the different stakeholders involved. In other words, they should ensure that the aspired behaviour – the implementation of energy efficiency solutions – is logically and financially sound, and also that this attractiveness is readily apparent. Additionally, targeted subsidies or incentives aimed at kick-starting the market may be necessary during an initial (limited) period.

While this is the task of governments, the industry also needs to drive a regulation of sorts, namely standardization. A lack of standards makes a field less appealing, since customers can be unclear as to which technologies will survive in the long run, and to what extent solutions from different vendors will be interoperable. Potential solution providers can also be discouraged, being unsure which technologies to back. This uncertainty slows adoption rates, and can only be tackled by establishing clear standards as early as possible.

Government action

Create a regulatory framework for long-term growth in energy efficiency. Regulations are by no means always aligned with the goal of greater energy efficiency. The advantages of smart building automation systems, for example, stem largely from levelling energy demand and minimizing consumption during peak periods. However, energy tariffs are currently usually flat throughout the day, eliminating any benefit to the owner from installing such systems. Sometimes it also takes much too long to obtain regulatory approval for new technical solutions. Governments should review energy-related regulation to ensure that it creates constructive alignment between their, the industry's and consumer interests, promoting the long-term growth of energy efficiency solutions.

Government action

Kick-start the market with short-term, targeted support. Among the strongest arguments for ICT-enabled energy efficiency is the fact that its business case is largely positive. Solutions are therefore not dependent (long term) on subsidies or on regulation mandating their use. However, a bouquet of regulatory and financial levers applied to specific key areas may well be needed to activate the market and provide impetus to deploy the various enablement solutions. As the first step is often the most difficult, governments should provide selected, well-targeted subsidies and other financial incentives to help the market overcome initial barriers – whether real or perceived – to the adoption of ICT-enabled energy efficiency solutions.

It is important that this support be time-limited, as experience has shown that long-term subsidization can create unnecessary dependence that actually hinders market development. The objective should be to activate the market, not to attempt to maintain it, and the goal should be the development of globally competitive and scalable solutions. Examples could include providing a cash bonus for the first 1,000 installations of smart motors, or a tax credit for implementing smart building solutions.

As another form of support, it is also essential that governments help build nation-wide state-of-the-art ICT infrastructure. For instance, a well-developed broadband network is a prerequisite for many ICT-based solutions to function effectively and achieve fast and widespread acceptance and adoption.

Utilize existing consortia, or create new ones, to define standards for interoperability. History has shown that standardization often plays a crucial role in the success of a new technology and may even be a prerequisite for market development. Many of the solutions covered in this report would require the interoperability of products and systems from different vendors. Smart metering equipment from any vendor needs to be viable in any network, to take just one example. Interoperability standards should be defined as soon as possible to reduce uncertainty and facilitate adoption. Existing consortia that form suitable arenas for such cooperation are often the easiest option, but new alliances should also be formed wherever necessary.

Industry action

Value chain reengineering

Many of the energy efficiency solutions analysed span multiple industries and/or value chains. This is partly due to the frequent need for a systems-level perspective to make capturing energy savings opportunities possible, and partly because innovations in this area typically take the form of integrating ICT solutions in other systems or processes. These characteristics necessitate new partnerships, as realizable innovations will mainly arise from cooperation between players from different industries and varying parts of the value chain. To maintain market momentum once it picks up, the industry will also need to make investments to ensure that their solutions are not just innovative and attractive, but can also be delivered as promised.

Develop innovative solutions at the intersection of industries. New partnerships need to be formed across industries and industry clusters to pursue many of the energy efficiency solutions analysed. Representatives of ICT and other industries should proactively pursue partnerships of this kind to stimulate innovation and growth. Examples could include bringing together ICT companies and manufacturers as well as users of industrial equipment to develop industrial energy management solutions, or having a regional government and public transportation providers cooperate with the industry to create a traffic management solution.

Solution providers will also need to ensure access to a service and support network to assist in implementation. The technological and process know-how needed to adapt and apply the new solutions will often not yet be in place, and it will sometimes prove hard to acquire it within existing structures. Some solution providers will prefer to offer such consulting services themselves, whereas others will prefer to partner with specialized service providers. As a result, a wave of small businesses is likely to emerge to support the implementation of solutions such as co-generation, energy management, smart motors and smart meters. In the end, entire new business ecosystems will ideally develop around the centres of innovation.

Industry action

Invest in performance excellence in quality and time of delivery. New technologies and solutions run the risk of swiftly losing momentum early in their implementation if performance or delivery issues arise that affect customers' confidence as well as their short-term return on investment. This is true for everything from the provider not delivering as scheduled to the solution not working properly or not achieving the expected energy savings. The industry should make the additional, targeted investments needed to ensure it can deliver on its promises.

Industry action

New financing models

Most energy efficiency solutions, ICT-enabled and otherwise, offer a clear and significant return on investment, sometimes even in the short term. However, financing this investment is often a challenge. It is vital to overcome a number of initial related hurdles. Most obviously, potential customers will need access to the capital, requiring the industry to revisit their business models and be prepared to try new variants that can make it easier for customers to finance their investments.

Financing of a sort can also come from early adopters: their investments in new technologies help offset development costs and allow production ramp-up, making it easier to achieve good scalability. The public sector can play an important role in this by supporting energy efficiency not just via regulation, but also by adopting efficiency solutions in government operations.

Industry action

Develop new business and financing models to enhance economic attractiveness. Energy efficiency solutions are often (though far from always) associated with fairly high upfront investments and relatively long payback times that often discourage customers. This should be addressed by developing and trying out new and innovative business/financing models that can mitigate the perceived drawbacks. For instance, several solution providers already guarantee projected energy savings for their solutions and even provide financing. Variations on this theme are possible, for example with the solution providers – or a third party – shouldering the investment costs and being reimbursed through a share of the savings generated.

Often, however, this is not sufficient. Specific savings are frequently difficult to pinpoint, since energy is consumed at multiple places in a building, a manufacturing line or a logistics network. This makes it hard to establish clear ownership within the customer organization: who actually sees the benefits? Solution providers may need to help customers build their internal business case. This is especially true in industries with short investment cycles, such as manufacturing, where decision processes are not adapted to the sometimes long payback periods of these solutions.

Industry action

Cooperate with financial institutions to ensure access to capital and financing expertise. Many of the new models discussed above rely on helping customers finance energy efficiency investments. However, ICT solution providers themselves might not always be willing (or even able) to provide the capital required. These companies are typically experts in their field – not in developing financing solutions. It is therefore vital that the industry establishes relationships with financial institutions, and jointly develops models of cooperation where institutions of this kind can provide access both to capital and to their financial expertise. Financing solutions in the automotive industry may serve as an example to some extent.

Government action

Lead by example by focusing public investments, and via showcase projects. Apart from its role as regulator, the public sector should use its position as a major purchaser and investor to spearhead adoption of energy efficiency measures. Governments need to ensure that public investments are intelligent and focused on cutting-edge, energy-efficient solutions, rather than older ones with lower efficiency – even when upfront costs are higher. This will enable public sector spending to help many solutions reach the scale required for wider dissemination. Further, among these public early-adoption investments, showcase projects should be identified, where governments shine the spotlight on innovative technologies.

Transparency, awareness and capabilities

Main barriers to widespread adoption of energy efficiency measures are low transparency regarding their economic and environmental impact, and low awareness of energy efficiency topics and their importance in general. Transparency and awareness are vital prerequisites for the acceptance of energy efficiency solutions. This applies equally to business/government customers and consumers. A prime example is that energy costs remain highly opaque: business and government customers are often not aware of how much energy they consume, where specifically the costs originate, or of the savings energy efficiency could generate. For consumers, this transparency is often even lower. Beyond the fundamental issue of transparency, both industry and governments need to take steps to increase general awareness. Finally, investments must also be made in knowledge and capability building in order to ensure that stakeholders, and society as a whole, will actually have the ability to act on improvement opportunities.

Industry action

Create tools for greater transparency of energy efficiency. The fundamental issue today is that data availability on energy use is very limited. The problem often starts at the hardware level: measuring consumption is frequently only possible on an aggregate level, for instance for an entire industrial site. Also, most resource planning and shop floor systems do not allow for reporting on energy consumption and costs, even when it can be measured. The ICT solution industry needs to take steps to greatly increase transparency in these areas, such as by developing tools for data collection as well as easy analysis of energy consumption and the effects of applying efficiency technologies.

Another reason contributing to this lack of transparency is that responsibility for energy costs is typically spread across business units or geographical sites, hindering a holistic perspective. Costs and potential savings appear relatively low to each unit, although they may well be very significant on a corporate and organization-wide scale. Energy is still managed as a commodity rather than as a scarce resource. Stringent energy accounting is essential to come to terms with this, treating energy in much the same way as money.

On the consumer side, it is important to highlight energy efficiency issues in general, and to promote relevant products and services. Compare a typical energy bill with the detailed breakdown of many telephone bills. An equivalent tool that would make it easier for consumers to understand what drives energy costs would be most welcome. Also, consumer awareness of the environmental impact of energy efficiency is usually qualitative at best. Very few have the knowledge necessary to be able to quantify the impact of switching to LED lighting, for example, or choosing to telecommute. Eco-labels have been a successful tool to this end for many types of consumer products, especially household appliances. They are gaining recognition and acceptance in many markets, driving measurable changes in purchasing behaviour. However, much remains to be done, and many areas still lack labelling schemes altogether, for example building automation and transportation.

Industry action

Promote energy efficiency on the public agenda. The higher the awareness of and interest in energy efficiency among decision-makers – both public and private – the faster the acceptance of new technologies will be. From its expert position in the field, the ICT solution industry should therefore strive to bring attention to the topic of energy use, and the ways in which greater efficiency could be achieved, in as many settings as possible, such as by taking the initiative to instigate dialogues with and know-how transfer to politicians and civil servants.

Government action

Introduce sustainability topics in education to build long-term awareness and capabilities. The long-term success of energy efficiency and other aspects of sustainability requires widespread general understanding of the topic and its importance as well as access to deep expertise in the field. Governments and the public sector should therefore do their part to ensure that sustainability topics are considered in the design of educational programmes. An example of how this can be done is Sweden. There, the national curricula for both primary and secondary schools underline the importance of a sustainable development perspective. On the university level, national ordinances for the award of all engineering (and several other) degrees require the demonstration of both theoretical and applied understanding of sustainability. Introducing dedicated higher education programmes centred on sustainable engineering and/or management is another important part of accelerating development.

5 Signposts: Implementation ideas

Multiple energy-saving initiatives are already being implemented across the world, many of them with the backing of governments or major corporations. Wal-Mart, the world's largest corporation, with annual sales of over US$ 400 billion, has declared a three-pronged aspiration to produce zero waste, be powered 100% by renewable energy and sell products that sustain resources and the environment. Such ambitious goals play an important role in transforming into a sustainable world, and we believe the 2020 targets set out in this report can serve as such a high-level goal. However, setting that goal is not enough – we also need concrete initiatives that contribute to reaching it.

The previous chapter outlined a number of key actions for industry and governments/regulators. These key actions can be viewed as principles for designing specific implementation projects. This chapter presents five examples:

1. *Develop integrated energy scorecards for urban municipalities.* A way for cities to achieve a holistic view of their energy use and allow them to identify and implement efficiency improvement ideas, while building awareness for energy efficiency.

2. *Set up Energy Contracting Agencies (ECAs).* Public or private/public bodies that act as energy efficiency catalysts by providing expertise and facilitating access to capital.

3. *Create centres of excellence in energy efficiency.* Local clusters of academic institutions and companies that gather talent and provide state-of-the-art education and training in energy-efficiency-related topics, combined with R&D cooperation.

4. *Launch smart city logistics concepts in the world's largest metropolitan areas.* A concept for reducing inner-city cargo traffic by pooling cargo loads along backbone routes.

5. *Set up a large-scale interoperability test bed for smart grid/smart meter networks.* An evolution of smart grid model regions facilitating the development of interoperability standards.

These initiatives are designed to jointly cover all of the technology groups studied and a majority of the actions described in the previous chapter. However, these are just a small number of selected examples. By no means do they cover the entire spectrum of what is needed. They are intended to inspire and possibly trigger future coordinated action to achieve widespread deployment of energy efficiency solutions.

The ideas are all presented in a similar format. A brief definition of the problem is followed by an explanation of the suggested solution. Relatively specific recommendations are proposed, along with an estimated time frame. The latter should be interpreted as the time a full-time project team would likely need to spend on the initiative before it went live. This is only a rough estimate, however. The exact duration would depend heavily on the project set-up.

1. Develop integrated energy scorecards for urban municipalities

Problem

Cities hold the key to vast energy-saving potential: around half the world's population currently lives in urban areas, and this share is likely to increase to 57% by 2020. Moreover, a strong correlation exists between urbanization and GDP per capita, with higher productivity in urban environments helping to drive economic growth. This, in turn, means higher energy consumption and greenhouse gas emissions.

Urban municipalities have tremendous decision-making power over the amount of energy consumed within their city. This clout stems directly from their role as large energy consumers, and indirectly from their ability to influence other energy users via local policy. They can also play an important role in fostering awareness among their citizens.

Many cities, however, face the challenge that transparency of energy consumption is lacking, and that municipal responsibility for energy consumption is highly fragmented across individual units. A holistic perspective, however, is essential to unlock the full potential of a city's role.

Solution

Cities must first achieve much greater transparency in their energy use. This is a prerequisite to both identifying improvement opportunities and communicating their achievements to the public. Implementing an energy scorecard would make it possible to attain this transparency, enabling a systematic and continuous approach to collecting and consolidating consumption data from multiple sources, quantifying the potential of individual improvement ideas and tracking progress.

Initial attempts in this direction, such as the development of a carbon abatement cost curve for London, have led to successful analyses of improvement areas and potential. Building on these results, the next evolutionary step will be to create an integrated scorecard that offers:

- Aggregation and flexible perspectives on relevant energy data
- Continuous tracking and granular scrutiny of energy consumption
- KPIs to measure and communicate achievements
- Internal and external benchmarking to identify best practices and set targets for KPIs.

Such a system would allow a city to quickly improve its energy use and create pressure for officials to act, while also credibly and concisely demonstrating its achievements. The complexity of the energy scorecard would require the use of state-of-the-art ICT systems for data collection, processing and reporting.

Implementation steps

Select cutting-edge pilot city. Select a suitable pilot city based on potential impact, cost and feasibility of implementation, building on available energy consumption data (an existing abatement cost curve, for instance). The pilot should also be visible on a global scale and have the potential to act as a trendsetter.

Develop an initial scorecard, identifying key drivers and quick wins. Use existing data and best-practice know-how to form hypotheses on key areas of energy consumption. Determine ways to reduce energy use in these areas quickly and set up an initial version of the scorecard, focusing on KPIs that are clearly measurable and can be updated without a huge data analysis operation. Use this first version of the scorecard to build momentum by publishing the results.

Extend the scorecard. Refine the system to include the city's total energy consumption by adding additional data sources and energy consumption drivers. Identify additional KPIs needed to comprehensively report on improvements achieved. This step should still follow a pragmatic approach to form an adequate basis to move forward.

Implement the ICT solution. Implement a comprehensive ICT system based on the scorecard specifications, leveraging the ICT solutions available on the market. A special focus should be on integrating the diverse data sources of a city – a key success factor for the initiative. ICT solution providers should be directly involved in this work, supplying products as well as their technical expertise.

This approach of capturing quick wins in parallel to full implementation should mean that initial KPIs are available in two to three months; the first improvements could result shortly afterwards. The estimated time frame for full implementation of the energy scorecard system is 12 to 18 months.

2. Set up Energy Contracting Agencies (ECAs)

Problem

Industrial operations, and to a large extent buildings, are often not optimized for energy efficiency. This may seem surprising, since business cases are typically clearly positive for ICT-enabled solutions in these settings – such as smart building technologies, smart motors and energy management in green production systems. Industrial players and building owners/managers often find it hard to quantify the values at stake, and frequently lack the technical expertise to be able to properly evaluate the options. Also, investment costs are still considered high, even though financial incentive schemes have started appearing (such as government subsidies for smart motor investments in China). Combined with the low general awareness surrounding energy efficiency issues, these factors have prevented energy optimization from taking off in these contexts so far.

Solution

One way of catalysing industrial adoption of ICT-enabled energy efficiency solutions is to use an independent mediator that provides project management capabilities, technical expertise, and access to private as well as public funding. One such concept is the Energy Contracting Agency. An ECA would approach potential customers, conduct comprehensive energy savings analyses, and propose solutions that best meet each customer's individual needs. The agency can then oversee or even drive implementation at the customer site, secure all available financial incentives, subsidies and other public funding, while also seeking out private investment funds as needed.

Depending on local conditions, the most suitable vehicle for an ECA is most likely either a public agency or a public-private partnership. Either way, the goal should be to strike the optimal balance between technical and regulatory know-how on the one hand, and independence on the other.

The fundamental concept has already proved successful in some areas. The Berliner Energieagentur, for example, is an agency along these lines based in Germany's capital. Its shareholders are the Federal State of Berlin, the utilities Vattenfall (electricity) and Berliner Gaswerke (gas), and Germany's Reconstruction Loan Corporation. The agency provides consulting, funding and project management services for building contractors, and helps design viable business plans to bring together providers and users. However, ECAs are by no means a widespread phenomenon. Also, the untested arena of industrial operations could yield even greater improvements than buildings, but applying the agency concept may be harder due to the obstacles involved in measuring impact and identifying the right stakeholders in the customer organizations.

Implementation steps

Analyse agency models. Perform an in-depth analysis of potential agency set-ups and success stories for at least two different industries, such as building systems and industrial operations.

Generate concepts. Generate and prioritize a set of viable agency concepts, where each concept needs to specify (at the very least) the technology it is targeting, the geographical region, and the operational model such as ownership structure, working mode, organizational set-up and financing models.

Approach partners. For each of the concepts selected, approach potential partners. Partnerships will depend on the operational model of the agency but certainly need to include ICT solution providers as suppliers of the relevant technologies (such as smart motors, energy management or building automation), providers of non-ICT-related energy efficiency solutions (e.g., insulation), public institutions to provide public funding or financial incentives and private financial institutions with investment capital and financial experience.

Set up agencies. Once the partners have been selected, set up the different agencies according to plan. Preferably, agencies are kick-started quickly followed by a gradual ramp-up. The first initiatives can be launched with only a core project team in place, without having to wait for the full agency organization to be in place.

The estimated time frame from the start of the analysis phase to initiation of the first projects is three to six months. The full-scale establishment of the ECA, running in parallel to these initial projects and making use of the experience gained through them, is expected to take six to twelve months.

3. Create centres of excellence in energy efficiency

Problem

For decades, energy had been considered a commodity. Entering a new era, in which energy efficiency is high on the agenda, we are now facing a significant lack of know-how and skilled resources around this topic. The development of innovative energy efficiency solutions requires a new combination of skills, and many organizations still find it difficult to implement solutions such as the ones described in this report, due to insufficient capabilities in their workforce. A specific challenge identified is the often missing combination of technological and management expertise. This combination is, however, crucial to develop market-ready solutions.

Solution

To accelerate the development of new and capable talent, industry must work closely with academia – mainly in the form of universities along with engineering and business schools. Joint centres of excellence in energy efficiency are needed, ones that offer qualified training for a new generation of experts with both technology and management skills. These centres of excellence will also play an important role in creating and fostering energy efficiency clusters.

Centres of excellence would gather both academic and industrial experts in the field and house targeted educational programmes. The centres should be designed around three major elements. First, joint research and development with a close link to industry production to ensure that innovation quickly finds its way into the market. Second, specialized education that includes full degree programmes, individual courses for students and active professionals alike, plus combined work/study and Internet-based models. Finally, an energy efficiency "model factory" approach with practical training in a real-life environment (as, for example, realized at the Technische Universität München) would round out the centre's repertoire.

Implementation steps

Identify candidates. Identify suitable candidate centres with a critical mass of industry and academic know-how as well as support from the public sector.

Design cooperation model. Reach out to potential centre partners and jointly design and agree on a cooperation model, including a development plan that takes into account the specific conditions of each individual centre. Ensure adequate involvement of academia, industry and public institutions.

Launch first initiatives. Develop and launch a first set of courses as well as a few high-profile joint initiatives. Visible results early on will serve to build enthusiasm and attract additional talent, business and investments.

Continue ramp-up process. Further develop the centre, successively adding additional elements of cooperation, while also continuously improving existing elements and recruiting the talent needed.

The time frame for initiating a centre and launching its first joint efforts is estimated at four to eight months, with larger educational programmes up and running after 12 to 18 months and full-scale operations being in place after 18 to 24 months.

4. Launch smart city logistics concepts in the world's largest metropolitan areas

Problem

Inner-city congestion is a major problem in metropolitan areas around the world: most developed cities with at least 3 million inhabitants are severely congested. The effects are increased transit time for people and goods, local air pollution and high carbon emissions, with a negative impact on the environment, public health and the economy.

Regulation is likely to become a necessity in many cities to address this problem. Some have already started, with congestion charges in London and Stockholm, for example, and road space rationing in Mexico City and São Paulo. However, such measures are primarily directed at personal vehicles, but a large share of city traffic consists of cargo trucks. These often run only half full due largely to fragmented trucking industries and a lack of central coordination. This is highly inefficient, especially since cargo transportation flows are often relatively concentrated on a smaller number of backbone routes (between hubs such as airports and train stations, industrial areas and city centres).

Solution

Analyses have shown that the overall optimization of inner-city cargo transportation flows has a significant (as yet still theoretical) potential of up to 30% reduction of total vehicle distance travelled, at almost no additional cost. This optimization requires a cross-docking concept, with docks at each location with major transportation demand, as well as a strong coordinator. This coordinator role can be played by municipalities, either directly or by contracting a large logistics service provider for the task. In any case, the municipalities must likely utilize their regulatory power to install a system of this kind, as the direct financial incentives for the players involved are small or non-existent. Another core component of the concept would be strong ICT support via integration of the different operational, planning and tracking and tracing systems involved.

The city logistics concept has already been successfully piloted by the city of Kuala Lumpur in cooperation with DHL and McKinsey & Company. The next stage will include developing a standard approach that can easily be applied to different cities.

Implementation steps

Select cities/regions. Select suitable cities/regions from a pool of interested candidates based on the criteria of potential impact, cost and feasibility. Municipalities need to be deeply involved from the onset, as they will become the main stakeholders.

Select and integrate partners. Once a partner city has been identified, select logistics partners and decide how to fill the coordinator role. Close cooperation with the city's transportation planners and local logistics providers is essential. Seek early integration of large transportation services customers (inner-city factories and major businesses, for example) to ensure early buy-in from the customer side.

Develop blueprint. Develop a blueprint for the logistics concept and the underlying ICT architecture and solution. The blueprint needs to detail the transportation flows (such as connections and routes), the cross-docking operations and the ICT solutions in place (e.g., systems, communication infrastructure, standards and interfaces with other systems). The blueprint should be designed with adaptability in mind, to facilitate replication of the initiative in other cities. This activity needs to be driven primarily by ICT solution providers with transportation and logistics experience.

The estimated time frame for designing and starting the implementing of a city logistics platform is six to ten months.

5. Set up a large-scale interoperability test bed for smart grid/smart meter networks

Problem

A multitude of smart grid/smart meter showcase projects and some full-scale implementations already exist today, many of them applied to model regions to demonstrate feasibility. To capture the full potential of these technologies, however, interoperability between the different technical solutions on the market is needed. This is valid both for interfaces between different parts of one network and for interfaces between multiple, even competing network operators with different types of smart meters and other equipment installed. An industry-wide interoperability standard, resulting from a concerted and ideally global effort, would also help companies promote their solutions on a global instead of a merely regional level.

Solution

Standardization efforts have been initiated in several countries. In the United States, for example, the National Institute of Standards and Technology is in the process of developing standards for the interoperability of smart grid devices and networks. Similar efforts are underway in Australia, China and the European Union. However, multiple simultaneous endeavours could lead to duplicated effort and potential compatibility issues on a global level at a later stage. Considering this, moving towards global interoperability standards by consolidating ongoing efforts comes across as an attractive alternative. Moreover, applying rapid prototyping methods and setting up a large-scale test bed that interconnects a multitude of different systems has the potential to provide the requisite framework to develop and test new standards and ensure the compatibility of standards already under discussion. Ideally, such a test bed would be based in a major, existing model region and be coordinated by a powerful public institution, such as a national or regional government. Involving a large consortium of competing industry players would also be an option. A considerable number of consumers and businesses need to be involved in testing the technical solutions and their interconnections under real-life conditions.

Implementation steps

Create blueprint. Detail potential ICT solution blueprint and define basic infrastructure requirements; identify fields of standardization to be tested and detail the required architecture for the test bed installation.

Select test bed region. Select a suitable region for the test bed based on implementation cost and feasibility as well as on support from policy-makers and local utilities. Identify potential partners including academic and scientific institutions and define organizational set-up, ownership and financing.

Develop standards. Develop an initial version of the basic ICT infrastructure and interoperability standards for the test bed. Frontload the process for one or a few individual components to generate early results to enable rapid evaluation of the approach. This step needs to be driven primarily by the ICT solution providers and utilities.

The estimated time frame to set up the test bed and develop the first, “fast-tracked” application settings would be around 12 months, with the full process taking around 24 months.

6 *The road ahead*

Climate change is a formidable challenge. Reducing carbon emissions by 15 to 20 $GtCO_2e$ per year by 2020 will not be easy – but it is not impossible. As demonstrated in this report, there are many ways to address this challenge – many technological solutions that will lead not only to significant emission reductions, but also to equally significant benefits for the global economy.

Simple availability of technologies is, however, not enough: they also need to be adopted by the market and implemented. All the major stakeholders – private and public alike – need to act, and act decisively, for the potential described in this report to be realized. Previous chapters have outlined a set of key actions for the industry and for governments and other regulators that we believe are necessary for success. We have also presented five specific initiatives that could spearhead the widespread deployment of ICT-enabled energy efficiency solutions. What is needed now, more than anything, is leadership.

As the potential enabler of one-third of the potential carbon abatement during the next decade, the ICT solution industry should take the initiative and lead by example. The ICT solution industry should without delay survey its own operations to identify and implement any and all relevant energy efficiency measures. While delivering all the direct benefits of being efficient energy users, this would also clearly demonstrate their firm commitment to the potential of ICT-enabled energy efficiency, create a showcase of their own technologies and solutions and earn them an undisputed "right to talk" in matters of energy use.

With the ICT solution industry itself leading the charge, we are confident that others will join. As a challenging but fully attainable short-term goal, we aspire to see the following by the 2012 Annual Meeting of the World Economic Forum:

- Major ICT solution providers on all continents should be able to demonstrate significant emission reductions and energy cost savings as a result of applying ICT-enabled solutions.

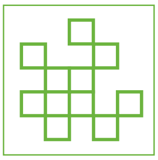
- At least three of the five initiatives outlined in Chapter 5 should have been initiated with measurable progress and a date set for full implementation.

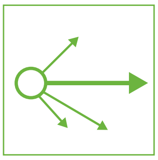
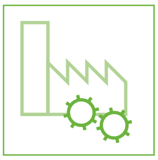
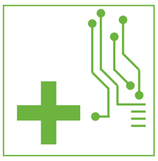
- At least two of the technologies studied in this report should have reached at least 30% implementation progress, as defined in Chapter 3.

ICT-enabled energy efficiency represents a huge opportunity, and its implementation over the coming decade promises to be a most rewarding journey if tackled in the right spirit. We ask you to join us in helping this movement take shape.

Appendix

Detailed technology descriptions

	2020 targets	
	Emission reduction GtCO$_2$e	**Economic impact** US$ billions
 **Smart Grids**	**2.0**	**170**
Electricity grid improvements. Electric power grids equipped with measurement and control devices as well as means for two-way communication, allowing grid analysis and optimization, but also control of power supply and demand via intelligent software.	1.7	135
Reduction of transmission/distribution losses. Being able to measure the in- and outgoing power at nodes in the grid makes it possible to identify and optimize those parts of the grid where losses occur, and electric power generation can be reduced accordingly.	0.9	113
Integration of renewables. The intermittent nature of several important renewable energies – notably solar and wind – means that increased penetration could pose substantial challenges to grid stability. Smart grid technology is necessary to measure the supply from renewable sources and adjust power generation from other sources accordingly, while also regulating the overall flow of electricity through the grid.	0.8	22
Smart metering. Smart meters provide consumers and the grid with real-time information on power consumption. Consumers can reduce their consumption and – in combination with flexible energy tariffs – shift part of it to off-peak times. The grid can match demand to supply more accurately and potentially even control power consumption of applications remotely.	0.3	35
 **Smart Buildings**	**1.7**	**330**
Smart building automation. These solutions reduce the energy consumption of buildings by using sensors to control equipment, such as lighting or HVAC, according to actual needs.	1.1	218
Smart building design. During a building's design phase, simulation software is used to consider the impact of various design decisions on the building's energy needs, taking into account location-related factors, such as local weather patterns. These methods could, for example, allow the reduction of electric lighting by maximizing sunlight incidence, and use wind for cooling/ventilation.	0.6	112

		2020 targets	
		Emission reduction $GtCO_2e$	**Economic impact** US$ billions
	**Smart Logistics**	**1.5**	**400**
	Network optimization. Fuel consumption in logistics can be reduced by using software to maximize the load factor, optimize the network layout (via improved distribution of hubs, for example) and plan efficient routes/itineraries. More efficient logistics also leads to smaller inventories, reducing the warehouse and retail space required.	1.0	266
	Efficiency. ICT solutions can be used to measure, analyse and optimize fuel consumption of trucks to improve the effectiveness of eco-driving efforts.	0.5	134
	**Smart Industry**	**1.4**	**170**
	Industrial process automation and smart motors. ICT-driven process automation makes industrial processes more efficient, not only in terms of production yield but also in terms of energy. Smart motors are more energy-efficient since their speed can be adapted according to the production load.	1.0	117
	Energy management. ICT solutions make it possible to measure, analyse and optimize energy consumption throughout the production process and directly control processes according to load. Integration with enterprise resource planning software permits comprehensive reporting of energy consumption, optimization of energy purchasing and energy peak demand management.	0.4	53
	**Additional Technologies**	**1.2**	**330**
	Efficient power generation. Using combined heat and power technology utilizes the heat produced as a by-product in power generation.	0.4	149
	Traffic management and intermodal shift. Congestion is reduced by optimizing traffic flows using traffic management systems. Overall road traffic can be reduced by using ICT systems to facilitate and encourage shifting from private vehicles to public transport.	0.4	112
	Telecommuting and videoconferencing. Using modern communication and collaboration technologies can reduce work-related travel and traffic. Employees can work from home, and videoconferences replace in-person meetings, reducing total travel needs.	0.4	69

Please note: Figures may deviate due to rounding or currency conversion

Calculation assumptions

All monetary calculations have originally been performed in euros. For the purpose of this report, all values have been converted to US dollars, using the 2010 average rate of US$ 1.33 per euro. When calculating the economic value of energy efficiency measures, the following assumptions were made about the various resource types.

Resource type	Cost per unit	Carbon intensity per unit
Electrical power	US$ 53/MWh	0.55 tCO_2e/MWh
Natural gas	US$ 55/MWh	0.16 tCO_2e/MWh
Vehicle fuel	US$ 0.67/litre	0.00268 tCO_2e/litre
Carbon (tax)	US$ 27/tCO_2e	–

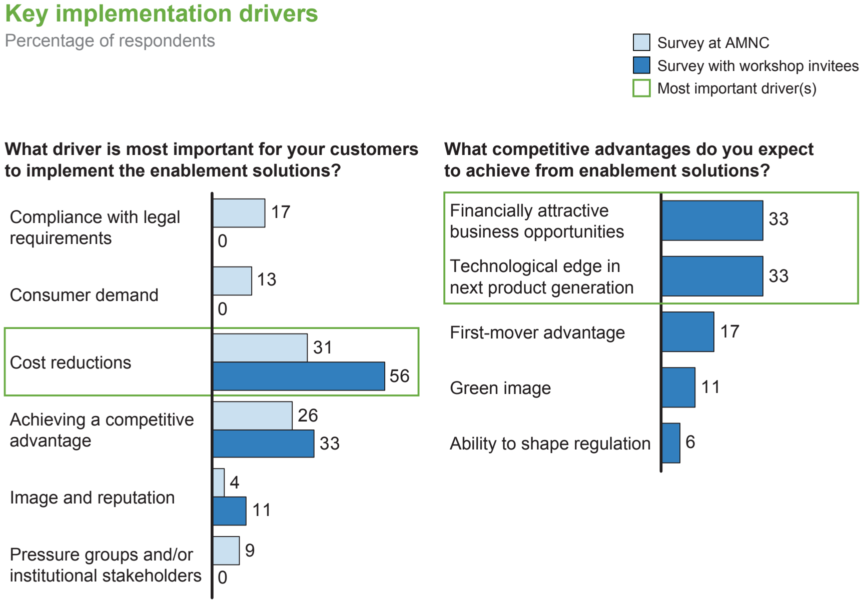
Additionally, when calculating the employment impact, a labour intensity of US$ 93,000 in revenue per employee was assumed for the ICT solution industry and one of US$ 200,000 in revenue per employee was assumed for the energy industry.

Industry survey results

As part of this project, industry surveys were conducted among participants of the 2010 Annual Meeting of the New Champions in Tianjin as well as among invitees to the ICT and Eco-Sustainability Working Group's workshop in New York. These surveys posed questions regarding the main drivers behind energy efficiency solutions, the challenges in implementing/disseminating them and the required government actions. The main results of these surveys are presented below.

Key implementation drivers

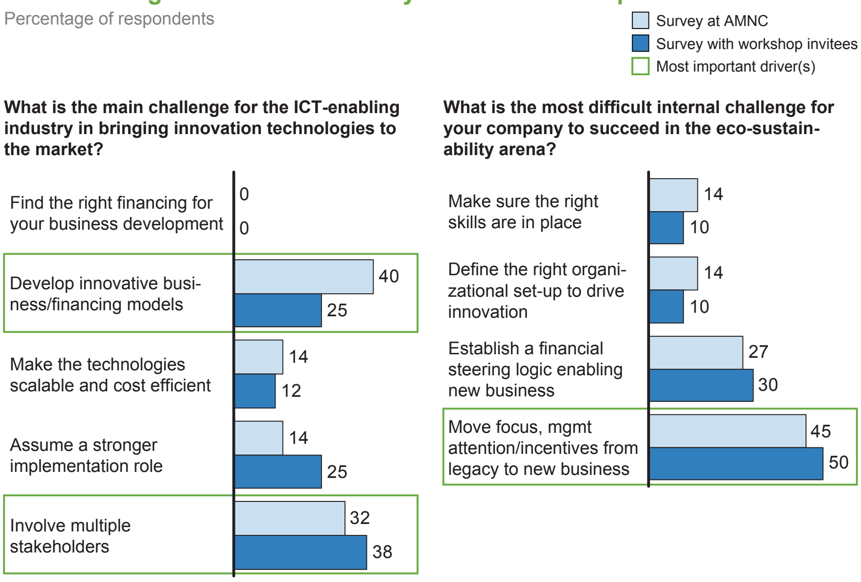
Percentage of respondents



SOURCE: AMNC 2010; ICT and Eco-Sustainability Group; McKinsey

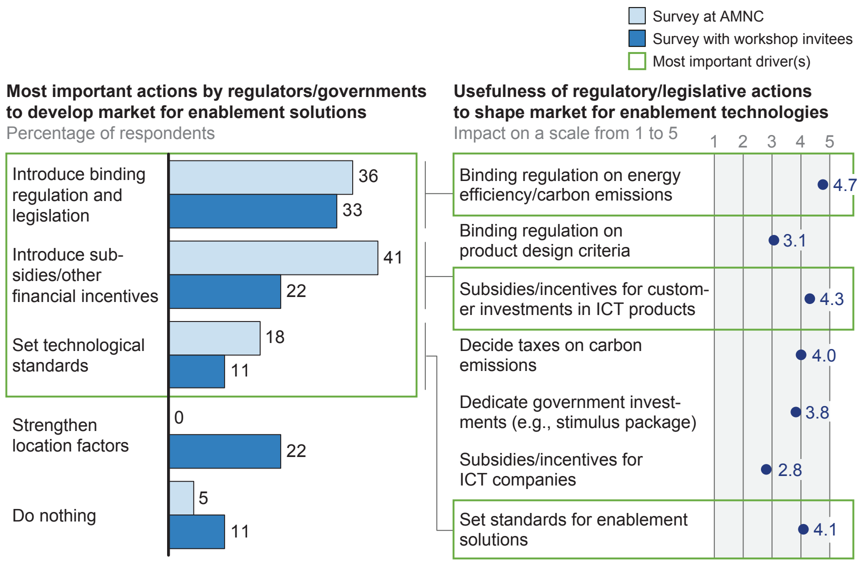
Main challenges for the ICT industry and ICT solution providers

Percentage of respondents



SOURCE: AMNC 2010; ICT and Eco-Sustainability Group; McKinsey

Actions needed from governments and regulatory bodies



SOURCE: AMNC 2010; ICT and Eco-Sustainability Group; McKinsey

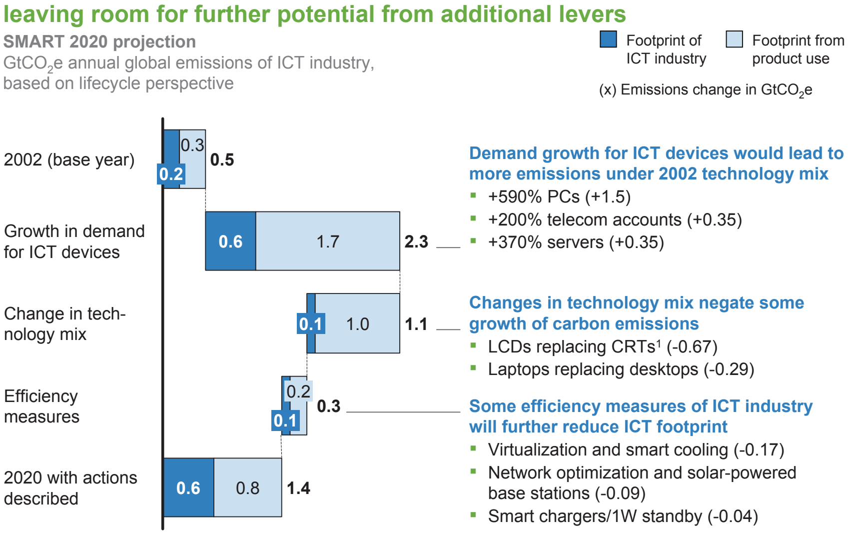
The ICT industry's own carbon footprint

The lion's share of the contribution that ICT solution providers can make to reducing global emissions of greenhouse gases comes from their role as energy efficiency enablers. However, they of course also consume energy themselves, and ICT products also cause emissions throughout their lifecycle. The carbon footprint and abatement potential of ICT itself are clarified below.

Projecting ICT footprint to 2020 shows 1.4 $GtCO_2e$ is achievable, leaving room for further potential from additional levers

SMART 2020 projection

$GtCO_2e$ annual global emissions of ICT industry, based on lifecycle perspective



1 Display technologies: CRT = cathode ray tubes, LCD = liquid crystal display

SOURCE: SMART 2020

Individual acknowledgements

A number of individuals have been directly involved in the work of the ICT and Eco-Sustainability Working Group. The World Economic Forum would like to thank them for their contributions, without which this report would not have been possible.

Core project team

Leadership

Alan Marcus
Senior Director, Head of IT and Telecommunications Industries
World Economic Forum

André Andonian
Director, Global Leader of Advanced Industries Sector
McKinsey & Company

Dr Detlev Mohr
Director
McKinsey & Company

Claudia Nemat
Director, Leader of EMEA High Tech Practice
McKinsey & Company

Dickon Pinner, PhD
Principal
McKinsey & Company

Heinrich Rentmeister
Associate Principal
McKinsey & Company

Working team

Bastian Bauwens
Tarun Biswas
Dr Florian Endter
Jon Karlfeldt
Nicholas Kim
Dr Felix Papier
Sebastian Schink

External adviser

Subramanian Rangan, PhD
Professor of Strategy & Management
INSEAD

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum is an independent international organization committed to improving the state of the world by engaging leaders in partnerships to shape global, regional and industry agendas.
Incorporated as a foundation in 1971, and based in Geneva, Switzerland, the World Economic Forum is impartial and not-for-profit; it is not tied to political, partisan or national interests.
www.weforum.org