WHITE PAPER

Reducing Greenhouse Gases Through Intense Use of Information and Communication Technology: Part 1

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IN THIS WHITE PAPER

In this white paper, IDC provides guidance on the technologies that can help build a low carbon economy, and how business and government leaders can get the benefits of those technologies.

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EXECUTIVE SUMMARY

This paper aims to provide support to groups that are looking for practical ways to reduce the potential harm of greenhouse gas emissions that lead to climate change.

As the United Nations convenes in Copenhagen to establish and refresh greenhouse gas and carbon emission levels, IDC believes there is a need for unbiased supporting information that gives countries a true roadmap on how to reach those UN targets. While there has been an abundance of data published about the quantity of greenhouse gases being generated, IDC has conducted a detailed study to determine the opportunity that the whole information and communication technology (ICT) industry has to offer to reduce the levels of greenhouse gases.

The study has taken a comprehensive look at each country's (the G20 minus the European Union) economic indicators, its domestic productivity landscape, and its ICT status to present a practical view of what a country should hope to achieve to reduce its carbon footprint. While IDC fully understands that global economic conditions are likely to change, we believe that ICT has a very significant part to play for a country aiming to create a long-term, sustainable economy.

Our results are comprehensive in that we have quantified the capability of investing in smart energy programs, managed buildings, and improved supply chains. We have also identified which countries are capable of leading this critical UN initiative and report on the gap that many countries need to close to reach the UN targets.

Overview and Aims

We cover three critical topics:

- Firstly, we summarize the ICT technologies that are mostly likely to have a positive impact on reducing GHG emissions. We look at technologies that can make short-term, positive impacts on reducing emissions and how energy use by ICT infrastructure can be controlled and reduced.

- Secondly, we provide two measures to gauge countries' and businesses' success in adopting those technologies, and how likely further success is, given current levels of investment.

- Thirdly, we provide case studies of technology users and vendors and look at their contribution to reducing GHG emissions.

This paper is aimed at a number of audiences:

- For policymakers we recognize that there is a considerable amount of published material on the potential of ICT technologies to reduce GHG emissions. Our aim is to summarize that material and to provide additional support in evaluating the potential for a particular country to use ICT to reduce its emissions. This paper contains actionable recommendations for policymakers who are considering where ICT can help meet their GHG reduction goals.

- For business and public sector managers this paper can assist in two things. Firstly, for those looking at their own use of technology, and the use of technologies by business partners, this paper provides guidance on which technologies will enable you to meet your emission reduction goals. Secondly, the data in the paper can be used to place your own organization's strategies and results in context.

- Finally, the ICT industry itself has a dual role in reducing emissions. Firstly, ICT products consume resources in their manufacture and use, and we believe the ICT industry has worked to reduce the impact of this aspect of the contribution of ICT to climate change. However, much more can, and should, be done. Secondly, this paper aims to provide the ICT industry with a document that helps guide product development on those areas where it can have the most impact.

Main Findings

We have split the findings of this research into three sections.

ICT Potential to Reduce Carbon Emissions

- Our assessment of the technologies selected in this research shows that intensive use of technology can reduce emissions by over 25% annually by 2020 compared with 2006 levels.

- Each of the four areas we considered — energy generation and distribution, buildings, transport, and industry — offer opportunities for carbon emission reduction.

- Using ICT in energy generation and distribution has the greatest possibility of carbon saving, particularly through a more effective integration of renewable and distributed energy sources into the distribution network (smart grids).

- Buildings and transport offer equally large possibilities of savings, the former with ICT-enabled smart building systems and the latter by using ICT to optimize supply chains.

- While industry offers the smallest savings through ICT, these are still significant, particularly ICT-enabled variable speed motor controls.

Preparing Core ICT to Take Advantage of Emission Reducing Technologies

Core ICT — the datacenter and communications infrastructure that underpins emission reducing technologies — needs to do two things: scale to make it possible to get the savings outlined in this paper and minimize the contribution it makes to emissions.

This paper makes the following recommendations:

- As technologies have become more powerful and more widely used to support carbon emission reduction, the emissions from powering those technologies, and the cost of powering them, have grown; any plan for reducing carbon emissions should include evaluating the emissions from core infrastructure.

- Optimize at all levels and consider the use of energy efficient technologies in themselves but also consider the rack, datacenter, and client infrastructure as a whole.

- Ensure that the waste management, recycling, and remanufacturing aspect of infrastructure is built into the emission reduction plan.

Country and Business Sustainability Index

The country indexes show where countries currently are in using ICT to reduce emissions and the potential for reduction. The business index looks at the attitudes of businesses in selected countries to issues related to reducing carbon emissions. The main findings of these indexes are:

- Japan is able to use ICT to reduce emissions more effectively than any other country.

- Closely following Japan a group of emerging and mature markets are well positioned to use ICT (the U.S., France, Germany, the U.K., and Brazil).

- Business attitudes vary, but organizations in China report the strongest alignment between their management, purchasing, and environmental sustainability goals.

SUMMARY OF METHODOLOGY

This paper is based on a number of inputs that are summarized here. We begin by discussing the scope of the paper before looking at the elements detailed in the following headings.

Defining ICT and its Role in Sustainability — How Did We Select the Technologies?

The basis of this paper is selecting ICT applications that have the potential to reduce GHG emissions and evaluating that potential. In doing this we were mindful of a number of principles:

- Firstly, that these are specific ICT applications and not technology trends of which ICT is a part. Obviously strict definitions are not going to be agreed on by every observer, but for this paper we decided that the technology had to:

  - Have significant processing or network bandwidth requirements, or both.

  - Be possible to implement as a credible government policy or business decision that can be adopted in modern, democratic, developing, or emerging markets.

  - Be a discrete technology and not a trivial application of another technology. For example, market mechanisms are already being used to trade and hopefully reduce GHG emissions. Underpinning the physical infrastructure of these markets is ICT, but it would be somewhat redundant to claim that markets are an ICT technology.

- Secondly, we were concerned that the technologies we selected were mature enough that, given a "reasonable" level of investment, they could be implemented in under three years. The reason for this is that we are looking to provide policymakers with information on what they can do now to meet immediate goals.

- Thirdly, the technologies should not be widely adopted, as otherwise benefits are likely to have been realized already.

Measuring the Problem: A Summary of Emissions

The estimate of CO_2e emissions comes from data compiled by the International Energy Agency using IEA energy databases in the 2008 edition of "CO_2e Emissions from Fuel Combustion."

Our sectoral approach contains total CO_2e emissions from fuel combustion. Each sector is defined as follows:

- **Energy generation and distribution:** This contains the sum of emissions from main activity producer electricity generation, combined heat and power generation, and heat plants. Main activity producers are defined as those whose primary activity is to supply the public.

- **Transport:** This contains emissions from the combustion of fuel for all transport activity, regardless of the sector (except for international marine bunkers and international aviation). It includes domestic aviation, domestic navigation, road, rail, and pipeline transport.

- **Buildings, lighting, and heating:** This contains all emissions from fuel combustion in households.

- **Industry:** This contains all emissions from the combustion of fuels in industry and in petroleum refineries for the manufacture of solid fuels, coal mining, oil and gas extraction, and other energy producing industries.

The IDC ICT Sustainability Index: Overview of Methodology

IDC provides two methods to evaluate the likely success of ICT in reducing emissions and comparing countries.

Country Sustainability Index

The aim of the country sustainability index is to give an assessment of a country's ability to use ICT to reduce its CO_2e emissions. The index uses a variety of inputs to determine this. In addition to population and GDP data, the index correlates a country's current energy profile with its ICT investment and spending patterns to help make climate change targets attainable.

By using additional ICT-related input factors to this base line, the index score also effectively measures a country's readiness to leverage ICT to lower its carbon emissions. The index scores enable IDC to rank countries fairly and transparently as they tackle the long-term challenge of environmental and economic sustainability.

Business Sustainability Index

The business sustainability index is based on a survey of 1,650 enterprises and public sector organizations carried out annually, most recently in October 2009. The survey asks a number of questions about their sustainability strategies, focusing on ICT but looking at other sectors too.

We use an index of the respondent's position and attitudes to key topics to assess:

- Organizational commitment to sustainability
- Their investment in sustainability related programs across the organization
- Their investment in ICT sustainability

An average of these three factors compares countries.

MEASURING THE PROBLEM: A SUMMARY OF EMISSIONS

Overall, energy accounts for the majority of greenhouse gas emissions resulting from the production, transformation, handling, and consumption of all kinds of energy commodities. Despite efforts to grow non-fossil energy sources, fossil fuels have maintained their share of the world's energy supply. In particular, coal is expected to satisfy much of the growing energy demand of developing countries, especially China and India, where energy intensive industrial production is growing rapidly.

In 2006, the U.S., China, Russia, India, and Japan together produced 55% of the world's CO_2e emissions. However, a closer look at each country along with an examination of their GDP and population reveals a more nuanced picture. In 2006, the U.S. generated 20% of the world's carbon emissions despite a population of less than 5% of the global total. However, the U.S.'s sizeable share of global emissions is due to its economic output, which is the largest in the world. While industrialized countries emit far larger amounts of CO_2e emissions than the world average, some developing countries, namely China and India, are rapidly increasing their share of global emissions. In 2006, these two countries accounted for almost 40% of the world's population but contributed 20% and 4% respectively to global greenhouse gas emissions.

By sector, energy generation and distribution and transport produced over half of each country's CO_2e emissions with the former accounting for anywhere between a quarter to well over a half of the country's CO_2e emissions. Brazil and France were the two notable exceptions — almost 50% of Brazil's energy comes from renewable resources and about 40% of France's primary energy supply is nuclear.

The rapid growth in population and income in developing countries, the continuing increase in the number of electrical devices used in homes and commercial buildings, and the growth in electrically driven industrial processes will continue to drive demand for electricity. For countries such as Australia, China, India, and South Africa, which produce the majority of their electricity and heat through coal, the quest to find smart solutions will become increasingly important.

Transport, which is usually the second-largest producer of CO_2e emissions by sector, relies almost entirely on oil and is also the strongest driver of world dependence on oil. Given economic growth trends, global demand for transport — both for personal mobility and for shipping goods — appears unlikely to abate in the near future. Improving the energy efficiency and reducing the carbon footprint of both these sectors will be instrumental in reducing global carbon emissions.

One of the more interesting and noteworthy recent developments that have had a major impact on global CO_2e emissions is the rise of the BRICS countries — Brazil, Russia, India, China, and South Africa. Since the industrial revolution, most of the carbon emissions have originated from industrialized countries. However, this trend appears to be shifting with the rise of the BRICS. This group of countries represents over a quarter of world GDP and in 2006 contributed to 33% of global CO_2e emissions from fuel combustion. Given the continued strong economic performance of these countries, there is no doubt that their appetite for energy use and their share of global emissions will increase rapidly.

TABLE 1

Summary of Emissions by Country and Sector

Country	% Contribution: Energy Generation and Distribution	% Contribution: Transport	% Contribution: Buildings, Lighting, and Heating	% Contribution: Industry	Total Emissions
Argentina	19%	29%	13%	26%	148.75
Australia	57%	20%	2%	17%	394.45
Brazil	6%	42%	5%	37%	332.42
Canada	20%	30%	7%	30%	538.80
China	49%	7%	4%	35%	5,606.50
France	8%	35%	17%	23%	377.49
Germany	37%	19%	15%	17%	823.46
India	50%	8%	6%	26%	1,249.74
Indonesia	27%	22%	8%	41%	334.63
Italy	29%	27%	12%	22%	448.03
Japan	31%	20%	5%	27%	1,212.70
Mexico	27%	34%	5%	26%	416.26
Russia	34%	14%	8%	18%	1,587.20
Saudi Arabia	33%	24%	1%	35%	340.03
South Africa	61%	13%	4%	15%	341.96
South Korea	37%	18%	7%	25%	476.10
Turkey	30%	18%	12%	29%	239.74
U.K.	33%	24%	14%	18%	536.48
U.S.	41%	32%	5%	16%	5,696.80
EU	32%	24%	12%	21%	3,983.00

Source: IDC, IPCC, Others, 2009 (data refers to 2006)

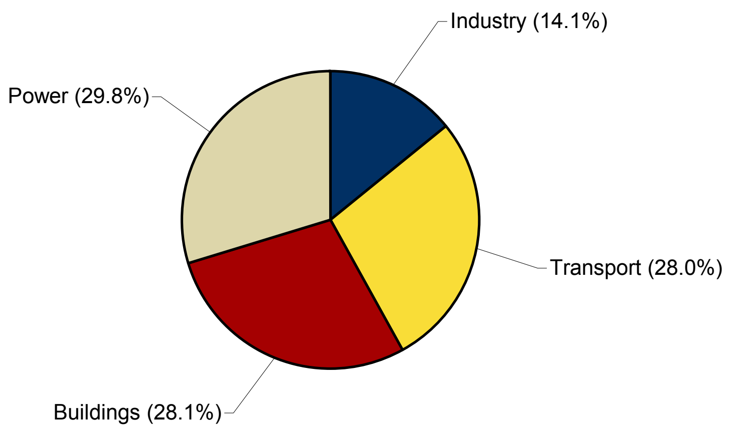
THE IMPACT OF TECHNOLOGY: KEY TECHNOLOGIES AND THEIR POTENTIAL FOR GHG EMISSION REDUCTION

The role of ICT as an enabler of GHG emission reductions is becoming increasingly relevant due to ICT pervasiveness and the digitalization of mechanical technologies. A simple example of that trend is the evolution of traditional electromechanical meters into electronic meters. The first measures consumption, and have to be periodically read by a person who needs to physically access them. Smart meters not only allow more accurate measurement of electricity, gas, water, or heat or cooling usage but can be read remotely (removing the need for crews to drive to sites) and can provide information on the characteristics of supply. They allow a two-way communication (from and to the meters) enabling, at least with electricity, remote disconnection or activation. They provide information to grid operators, allowing them to better manage grids, and to consumers, raising awareness and impacting on their consumption behavior. This profound transformation is possible only because of ICT. The key issue we have addressed in this section is how much ICT can help in the fight against climate change by rationalizing, innovating, and creating new business models in the G20 countries in four major areas — energy, transport, buildings, and industry.

Our analysis identified an annual savings potential of about 5.8 GtCO_2e in 2020 in the G20 countries, representing more than 25% of G20 countries' total emissions in 2006. The relative contribution of key ICT technologies in energy, transport, buildings, and industry is shown in Figure 1.

FIGURE 1

Contribution by Sector to Saving of 5.8 Gt CO_2e Through Intensive ICT Use by 2020



Source: IDC, 2009

This section provides insight into the ICT technologies that our research identifies as offering the greatest potential to reduce GHG emissions. We have organized the section by sector, presenting data for the G20 countries and a summary of the technologies.

Key Technologies: Energy Generation and Distribution

Table 2 shows the key technologies identified for the energy sector, and our assessment of the annual maximum potential savings of implementing those technologies through to 2020.

TABLE 2

Energy Generation and Distribution: Quantified Potential Savings From Key Technologies (Annual Potential Million Tonnes CO_2e Saving by 2020)

Country	Transmission and Distribution Network Management (Smart Grid)	Smart Metering (Smart Grid)	Renewable Energy Management Systems (Smart Grid)	Intelligent Power Generation (RES Excluded)	Total
Argentina	1	2	3	1	7
Australia	8	10	17	8	43
Brazil	1	1	2	1	6
Canada	4	5	8	4	21
China	102	121	202	97	522
France	2	2	4	2	10
Germany	13	15	25	12	64
India	26	31	51	24	131
Indonesia	3	4	6	3	17
Italy	5	6	11	5	28
Japan	17	20	33	16	86
Mexico	5	6	10	5	25
Russia	33	40	66	32	171
Saudi Arabia	5	6	10	5	25
South Africa	8	10	16	8	41
South Korea	8	9	15	7	39
Turkey	3	4	6	3	15
U.K.	8	9	15	7	39
U.S.	88	105	175	84	452
G20 (excluding EU)	341	405	673	324	1,743

Source: IDC, Others, 2009

Summary of Technologies: Benefits and Challenges

In the energy sector, smart grids are the key enabling technology for emissions abatement. Overall they account for about 28% of total savings.

Smart grids have been defined in many different ways, but IDC views them as an energy delivery network modernized with ICT to meet the following key functions:

- Enabling active consumer participation
- Accommodating all generation and storage options
- Enabling new services
- Optimizing assets and operating efficiency
- Anticipating and responding to system disturbances in a self-healing manner
- Operating resiliently against physical and cyber attacks and natural disasters
- Providing the power quality for the range of needs in a digital economy

There are several ICT technologies that can be added to make grids smarter:

- Intelligent devices such as smart meters, smart transmission and distribution sensors, distribution automation equipment, renewable and distributed energy resource management systems, and in-home technology (programmable communicating thermostats, in-home displays, home energy management systems, etc.)
- Communication networks, home area networks, metro area networks, and wide area networks
- Application software, grid automation and control (DMS/SCADA — distribution management systems/supervisory control and data acquisition), meter data management, analytics, and consumer portals

Our analysis estimates the contribution of the different components of a smart grid to increase efficiency and stability in energy delivery (6%), smart metering and demand management (10%), and in allowing better integration of renewable and distributed generation (12%). This last point includes ICT solutions to manage virtual power plants, allow better production forecast and monitoring, and increase availability for these variable power resources.

Key Technologies: Transport

Table 3 shows the key technologies identified for the transport sector, and our assessment of the annual maximum potential savings of implementing those technologies through to 2020.

TABLE 3

Transport: Quantified Potential Savings From Key Technologies (Annual Potential Million Tonnes CO_2e Saving by 2020)

Country	Supply Chain and Logistic Optimization	Private Transport Optimization (Navigation Tools, Eco-Driving)	Virtual Conferencing and Telecommuting	Efficient Vehicles (PHEV, EV)	Traffic Flow Monitoring and Optimization	Total
Argentina	10	3	2	1	1	17
Australia	18	6	3	2	1	31
Brazil	33	11	5	3	2	55
Canada	38	12	6	4	2	63
China	86	28	14	9	6	144
France	31	10	5	3	2	52
Germany	36	12	6	4	2	60
India	24	8	4	3	2	40
Indonesia	17	6	3	2	1	28
Italy	28	9	5	3	2	47
Japan	58	19	10	6	4	96
Mexico	33	11	5	3	2	55
Russia	54	18	9	6	4	89
Saudi Arabia	19	6	3	2	1	32
South Africa	10	3	2	1	1	17
South Korea	20	7	3	2	1	34
Turkey	10	3	2	1	1	17
U.K.	31	10	5	3	2	51
U.S.	426	140	70	45	28	709
G20 (excluding EU)	983	323	162	103	65	1,637

Source: IDC, Others, 2009

Summary of Technologies: Benefits and Challenges

In transport, supply chain and logistic optimization is where ICT plays the most significant emissions abatement enabling role (17%).

There is a long list of technologies in this category, including radio frequency identification (RFID), tag and track inventory, stock and other items throughout the supply chain, applications for warehouse management optimization, geographical information systems (GIS) and global positioning systems (GPS), application optimizing route planning in real time and congestion avoidance, real-time fleet tracking and management, and loading optimization systems.

About 6% of overall potential emissions savings are related to private transportation optimization. Here navigation solutions and eco-driving applications play a major role.

The adoption of electric vehicles, meanwhile, is expected to contribute almost 2% to the reduction of GHGs.

Key Technologies: Building

Table 4 shows the key technologies identified for the buildings, lighting, and heating sector, and our assessment of the annual maximum potential savings of implementing those technologies through to 2020.

TABLE 4

Buildings, Lighting, and Heating: Quantified Potential Savings From Key Technologies (Annual Potential Million Tonnes CO_2e Saving by 2020)

Country	Energy Management Systems for Buildings	Smart Lighting (Automation)	Intelligent Building Design	Teleworking	Demand-Side Management and Energy Box (Smart Grid)	Total
Argentina	3	1	2	1	3	10
Australia	19	0	12	0	1	33
Brazil	3	1	2	1	2	9
Canada	9	2	6	2	6	26
China	228	16	151	16	37	448
France	4	4	3	4	10	25
Germany	28	8	19	8	19	82
India	57	5	38	5	11	115
Indonesia	7	2	5	2	4	19
Italy	12	4	8	4	8	35
Japan	38	4	25	4	10	80
Mexico	11	1	7	1	3	25
Russia	75	8	49	8	18	158
Saudi Arabia	11	0	7	0	1	19
South Africa	18	1	12	1	2	34
South Korea	17	2	11	2	5	38
Turkey	7	2	4	2	4	19
U.K.	17	5	11	5	12	50
U.S.	198	20	130	20	47	415
G20 (excluding EU)	762	87	503	87	203	1,641

Source: IDC, Others, 2009

Summary of Technologies: Benefits and Challenges

Building energy management systems are the most promising technology for the reduction of GHG emissions in this cluster (13%), and IP convergence is revolutionizing the way building management systems can be integrated.

Building energy management systems (also defined as building control systems or building automation) improve the quality of comfort, health, and safety of indoor environments. In contrast to passive energy efficiency measures (e.g., insulation) and conventional heating/cooling technologies, building management systems ensure the integrated interaction of a much broader range of technological elements (heating, ventilating, air conditioning, and lighting, life safety equipment, architecture) and of people who live or work in them in order to influence the indoor environment. Recent developments in nanotechnology (e.g., windows, surfaces), sensor/actuator technology, wireless communication technology, and data processing and control have enabled the embedding of ambient intelligence in buildings.

Emissions reduction can be achieved not only in building management but also in all phases of the life cycle, starting with an efficient design (9%). For instance, modeling software can help architects determine the design impact on energy use and simulation tools enable the identification of the most efficient solutions.

Key Technologies: Industry

Table 5 shows the key technologies identified for the industry sector, and our assessment of the annual maximum potential savings of implementing those technologies through to 2020.

TABLE 5

Industry: Quantified Potential Savings From Key Technologies (Annual Potential Million Tonnes CO_2e Saving by 2020)

Country	Intelligent Motor Controllers (HD+SW)	Industrial Process Automation	Digital Commercial Print (ePaper, eMedia)	Total
Argentina	3	1	0	5
Australia	6	3	1	9
Brazil	12	5	2	19
Canada	12	5	2	19
China	219	93	29	341
France	9	4	1	14
Germany	15	6	2	23
India	35	15	5	55
Indonesia	12	5	2	19
Italy	10	4	1	15
Japan	36	15	5	57
Mexico	8	3	1	12
Russia	28	12	4	43
Saudi Arabia	10	4	1	15
South Africa	6	3	1	9
South Korea	12	5	2	18
Turkey	8	3	1	12
U.K.	8	3	1	12
U.S.	79	34	10	122
G20 (excluding EU)	527	225	70	821

Source: IDC, Others, 2009

Summary of Technologies: Benefits and Challenges

Intelligent motor controllers, industrial process automation, and digital commercial print (epaper, emedia) contribute 9%, 4%, and 1% respectively to overall ICT-enabled emission reductions.

Motors are installed in all manufacturing plants and account for a high share of total electricity used in industry; motor drives are rarely electronically controlled today. The vast majority of them could be equipped with variable speed drives (VSDs) to achieve energy savings, during partial load, of up to 50%.

Automation increases production optimization. In the past energy consumption was rarely considered part of the cost function to be optimized, but this is changing. Embedded smart components and systems, sensor/actuator networks, and control algorithms can be used to achieve a positive effect on emissions.

On top of more advanced control schemes, today's automation architectures enable a wide range of optimization loops by enabling data exchange between the automation system, the manufacturing execution system, and the enterprise resource planning system.

Advanced asset monitoring systems analyzing data, extracting information about the state of the production and the health of the plant, are another means of optimizing energy consumption and reducing emissions. They are powerful tools to detect abnormal plant behavior that very often translates into increased energy consumption.

HOW CAN CORE ICT INFRASTRUCTURE SUPPORT EMISSIONS REDUCTION?

As this paper demonstrates, there is the potential for a considerable reduction in emissions through more use of ICT-enabled technologies. However, government and industry should be mindful of the demands that these technologies will place on core ICT infrastructure — the datacenters and communications infrastructure that provides the analytical backbone for ICT-enabled emissions reduction.

There is considerable concern over carbon emissions from ICT infrastructure, concerns that will only be increased with significant investment in the technologies covered in this paper. This section looks at the challenge ahead for those implementing these technologies, and some responses to that challenge.

Energy Use and Carbon Emissions From ICT: The Scale of the Challenge

Datacenters are a small part of overall energy use, but two factors make them the focus of attention for those looking to reduce carbon emissions:

- Firstly, these facilities are geographically concentrated users of energy. The number of large datacenters is limited but, because they draw significant amounts of power, they are a focal point for power consumption, particularly in services-based businesses.

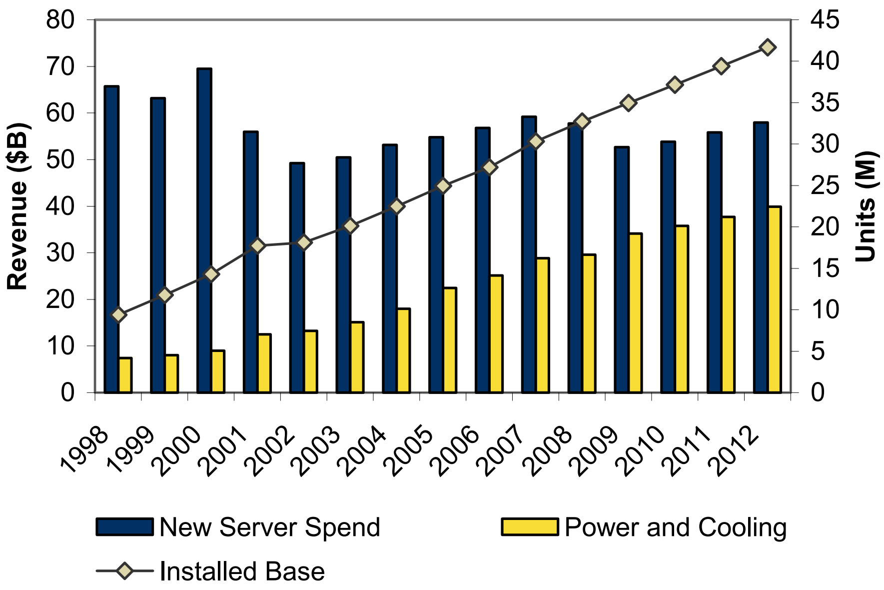
- Secondly, the growth in datacenters is already considerable and, should technology be used more intensely to reduce carbon emissions, they will take a larger share of emissions.

A look at spending on powering and then cooling ICT infrastructure shows the importance of these two factors. IDC's research shows that datacenter managers consider power and cooling their number 1 challenge, ahead of the historically important issues of availability and security. Historically, computer processing power has doubled every 18 months (known as Moore's Law). As compute densities continue to rise in the datacenter, overall power consumption increases. The impact of this can be seen in the relative cost of ICT equipment and the cost of powering and cooling that equipment.

The cost to power and cool the worldwide installed base of servers in 2008, at an estimated $29.6 billion, is shown in Figure 2. IDC expects this to increase to $34.2 billion for 2009. Worldwide power and cooling costs will grow at a compound annual growth rate (CAGR) of 6.7% to $39.9 billion in 2012. By comparison, new server spending will actually decline, at a CAGR of 0.4% to $57.9 billion over the same period.

FIGURE 2

Worldwide Cost to Power and Cool Server Installed Base, 2007–2012

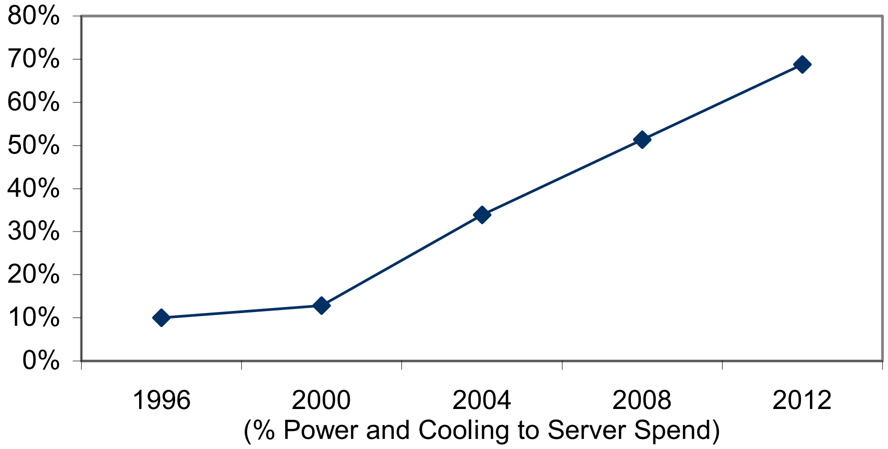


Source: IDC, 2009

IDC believes that comparing the power and cooling expense as a percentage of total new server spending places the energy challenges in a practical context. Figure 3 provides historical and forecast ratios between power and cooling expense and server spending. Worldwide, in 2008, for every dollar spent on a new server, datacenter owners spent an additional 51 cents to power and cool their installed servers. This ratio is up drastically from a decade ago, when the worldwide ratio was 10 cents on the dollar. Under current industry conditions, IDC expects the ratio to increase to 69 cents for every new dollar of server spending. The fact that organizations are spending an additional 50% of their server spend to simply supply power and adequately cool their servers is evidence of the magnitude of the situation inside the datacenter. The sharp increase in the ratio of power and cooling to server spend is a key reason that customers consistently identify power and cooling as their biggest challenge in the datacenter today.

FIGURE 3

Power and Cooling Server Expense as a Percentage of New Server Spend



Source: IDC, 2009

If ICT is going to keep its own emissions under control, and support wider use of technology to reduce emissions across all sectors, then we will need more focus on technologies that support better use of energy resources in the datacenter.

Solutions to the ICT Emissions Challenge

IDC's research shows that solutions to this challenge are likely to combine four elements:

- Firstly, they minimize the energy used in component parts so that each part consumes the minimum power for the work done.
- Secondly, they optimize across the datacenter so that components work together to reduce power consumed.
- Thirdly, they look at energy efficiency by optimizing the work done by computer systems.
- Fourthly, they minimize overall carbon emissions by reducing waste in manufacturing and recycling.

Looking at each of these areas shows how ICT can respond to these challenges.

Energy Efficiency at the Component Level

Semiconductors and other component parts have traditionally been built without the need to conserve energy. As the scale of energy use by ICT infrastructure has become clear, manufacturers have focused on reducing energy use at the component level. This is combined with energy efficiency through measures such as optimizing airflow in the unit, improving cabling, and optimizing power supplies to create energy efficient infrastructure.

Energy Efficiency at a Datacenter Level

Leading organizations are building new datacenters, and fitting older facilities, to build energy efficiency into every aspect of the building. This includes measures such as:

- Measuring and optimizing airflow and sources of air and energy so that the datacenter produces the maximum work for the energy consumed

- Using modular datacenters, which are very dense, standardized units that avoid many of the physical constraints of fitting equipment into standard datacenter buildings

Energy Efficiency at a Workload Level

Research by IDC and other sources has shown that workloads in the datacenter are not optimized and that there is spare capacity that is consuming energy but is not creating any useful work.

Technologies such as virtualization, power management, and improved workload management offer the opportunity to move workloads to under-utilized systems and switch off older systems that are no longer needed.

THE IDC ICT SUSTAINABILITY INDEX

This section provides an evaluation of ICT sustainability progress and potential as well as business attitudes to sustainability in a selection of countries surveyed by IDC in September 2009.

Country Sustainability Index

Table 6 shows the country sustainability index rankings.

TABLE 6

ICT Sustainability Index — Country Ranking (Lower is Better)

Country	Intermediate ICT Sustainability Score	Difficulty Ranking (Ability to Implement ICT Solution)	Final ICT Sustainability Scores
Japan	13	3	16
U.S.	18	2	20
France	13	8	21
Germany	17	4	21
Brazil	10	11	21
U.K.	15	6	21
Italy	14	9	23
Canada	14	10	24
Mexico	14	16	30
Turkey	14	18	32
South Korea	18	14	32
China	27	5	32
Australia	16	17	33
India	22	15	37
Saudi Arabia	17	20	37
Russia	26	12	38
Argentina	15	23	38
Indonesia	20	21	41
South Africa	19	22	41

Source: IDC, 2009

Business Sustainability Index

Table 7 shows the commitment to sustainability in selected countries surveyed by IDC.

TABLE 7

Business Sustainability Index — Selected Countries (Higher is Better)

	Organizational Support	Environmental Program Commitment	Environmentally Efficient ICT	Business Sustainability Score
China	60%	93%	97%	83%
U.S.	53%	86%	92%	77%
Germany	56%	84%	89%	76%
U.K.	50%	85%	89%	75%
Brazil	55%	86%	83%	75%
Mexico	57%	85%	74%	72%
France	53%	83%	77%	71%
Australia	43%	84%	81%	69%
Japan	42%	84%	80%	69%
Spain	46%	80%	77%	68%
Mean	52%	85%	84%	73%

Source: IDC, 2009

Country Sustainability Index Overview

It is important to recognize that each country has the right and the ability to manage its own economic growth through a long-term strategy that blends its technology capabilities with its individual sustainability levels. IDC's Green IT and Sustainability Market Taxonomy is a starting framework that allows IDC to position a country's ability to mix its economic, environmental, social (and political) sustainability goals with its green business, energy, and ICT investments.

FIGURE 4

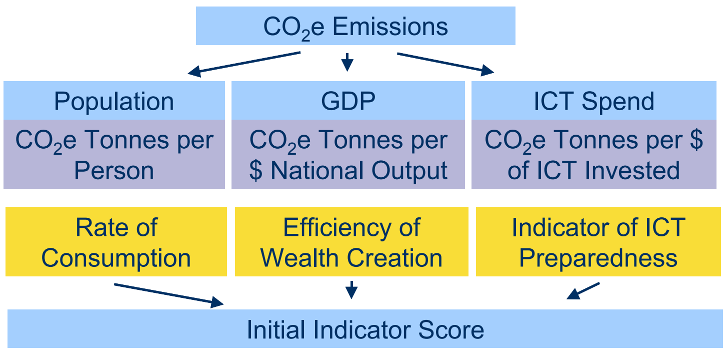
The ICT Sustainability Index is Based on IDC's Market Taxonomy of Green and Sustainability Technologies

Source: IDC, 2009

Using this taxonomy as a cornerstone, IDC was then able to create its ICT Sustainability Index for countries. The index scores a country's ability to use ICT to effectively reduce its CO_2e emissions. The ICT Sustainability Index uses a variety of inputs to determine a country's ability to use ICT to reduce its CO_2e emissions. In addition to population and GDP data, the index correlates a country's current energy profile with its ICT investment and spending patterns to help make climate change targets attainable. By using additional ICT-related input factors to this base line, the index score also effectively measures a country's readiness to leverage ICT to lower its carbon emissions. The index scores enables IDC to rank countries fairly and transparently as they tackle the long-term challenge of environmental and economic sustainability. The following figures show how the index model is created and, later in this document, how the results are interpreted.

FIGURE 5

IDC ICT Sustainability Index — Country Level

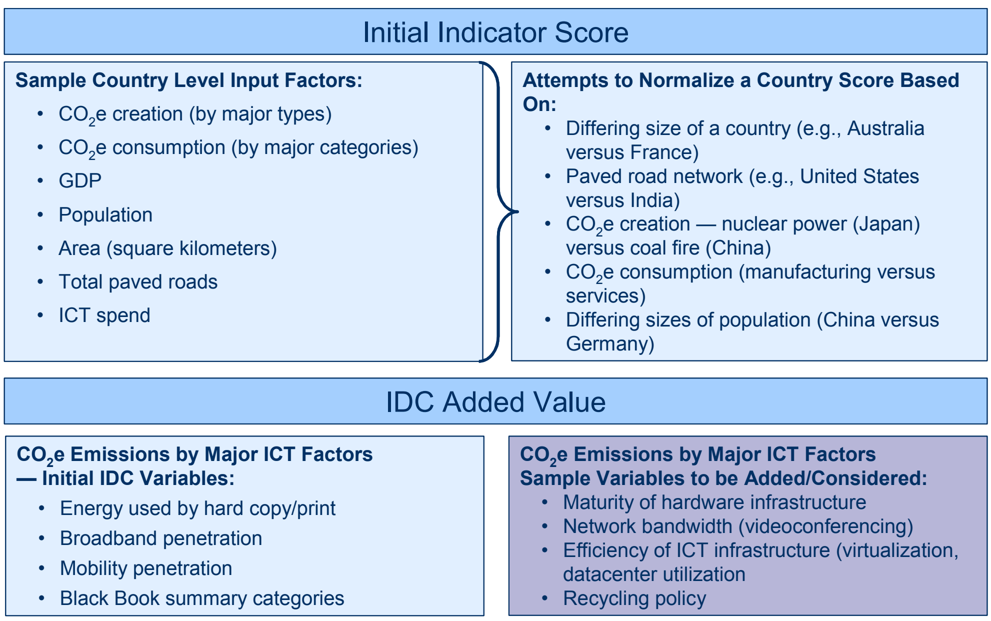


Source: IDC, 2009

The initial indicator score is the first attempt by IDC to normalize the differences among countries. IDC has taken into consideration many economic, political, geographical, and technology related measurements to ensure that countries such as Australia, China, and the United States may be fairly compared in this process.

FIGURE 6

IDC ICT Sustainability Index — Country Level Sample Input Factors



Source: IDC, 2009

The following is a description of where and how the various sources have been used in creating the index. While the list is not inclusive of all the sources IDC has used, it will give readers a very good understanding of the intent of the input data and how it has been used.

FIGURE 7

ICT Sustainability Index — 1 of 2

Aggregate	Category	Purpose	Metric	Source
Current and forecast CO_2e creation	✓ Population ✓ CO_2e ✓ CO_2e per capita	Predicted CO_2e output per capita	✓ No. of people ✓ CO_2e KGs ✓ GDP	✓ GDP — IMF ✓ EU Eurostat ✓ IEA report "CO_2e Emissions From Fuel Combustion"
Territory and geography infrastructure	✓ Area — country size (sq/km) ✓ Paved roads — km	Normalize country and distances	✓ CO_2e to GDP to paved road	✓ CIA World Fact Book ✓ IEA report "CO_2e Emissions From Fuel Combustion"
Energy consumption	✓ GDP ✓ CO_2e per GDP $	Shows CO_2e per industry activity	✓ Real growth projection	✓ IEA report "CO_2e Emissions From Fuel Combustion"
ICT impact	✓ Broadband ✓ Mobility ✓ Print hardcopy output ✓ Virtualization ✓ Datacenter buildout ✓ IT age of hardware ✓ IT sophistication (software/services)	Shows ICT ability to affect sustainability	✓ % penetration ✓ CO_2e per page ✓ Maturity — tel./network infrastructure	✓ IDC Galaxy Database ✓ IDC Black Book ✓ IDC Server installed Base Forecast ✓ IDC HCP Forecast ✓ IDC Datacenter and Virtualization Multiclient Studies (2008)

Source: IDC, 2009

FIGURE 8

ICT Sustainability Index — 2 of 2

Aggregate	Category	Sample Output	Normalized Score	Weight
Current and forecast CO_2e creation	✓ Population ✓ CO_2e ✓ CO_2e per capita	✓ 50% of CO_2e = creation	✓ Scores based on range 1 to 10 — e.g., 57% = 6	20% DRAFT
Territory and geography infrastructure	✓ Area — country size (sq/km) ✓ Paved roads — km	✓ Total square km ✓ Total km paved roads	✓ Scores based on range of 1 to 5 for size and road network	20% DRAFT
Energy consumption	✓ GDP ✓ CO_2e per GDP $	✓ CO_2e per total used category per GDP $	✓ Absolute values and added to CO_2e creation	20% DRAFT
ICT impact	✓ Broadband ✓ Mobility ✓ Print hardcopy output ✓ Virtualization ✓ Datacenter buildout ✓ IT age of hardware ✓ IT sophistication (software/services)	✓ Broadband % penetration ✓ Mobility % penetration ✓ Print hardcopy CO_2e per page ✓ Black Book % for ICT ready	✓ Broadband = 90% telco score (mobility = 10%) ✓ Print score based on percent CO_2e emissions ✓ IT readiness based on SW/SVCS %	40% DRAFT

Source: IDC, 2009

The output from each country's data is then weighted according to the model's overall level of importance. Given that the index favors the use of ICT, it is appropriate to model the impact that ICT will have on the overall score. For example, as part of the process, IDC has established an "ICT readiness score" for each country. A sample is shown below. (Please note: The ICT readiness score is a factor, not an absolute result, towards the ICT Sustainability Index.)

The ICT Ready Score (top line) is a measurement of the importance and impact of the three major IDC-defined market segments (hardware, software, and telecom services). IDC accounts for the impact first, and then weighs this score based on the contribution of the segment towards the countries' overall ICT readiness. In the following example, Argentina has an IDC-based ICT readiness score of 3 (out of a maximum of 4).

FIGURE 9

ICT Ready Score — Argentina Example

Proportions (%)	Segment	2006
Argentina	Hardware total	16.2
Argentina	Packaged software total	4.1
Argentina	IT services total	7.0
Argentina	Telecom services total	72.8
		100.0
	Hardware total	16
	Packaged software total	4
	IT services total	7
	Telecom services total	218
		246
	Hardware total	5
	Packaged software total	1
	IT services total	1
	Telecom services total	66
		73
Score		3

Source: IDC, 2009

As well as being a view of a country's current technological ability to reduce its carbon emissions, the ICT Sustainability Index is also a view of its future investments. To this end, the index has a component that is additive to the "intermediate" score to create the final score. The final score, while it is numeric and can be viewed as being absolute, is presented within a tiered structure. Currently there are five tiers. Tier 1 contains countries that typically have very sustaining economies, long-term investment in broad ICT technologies, and many best practices for how to reduce carbon emissions. IDC has found that even though outward characteristics of countries are extremely different, those countries within a tier do have common challenges and opportunities towards using ICT to reduce their carbon emissions.

FIGURE 10

Possible Scoring — Absolute Values, or Tiers 1 to 5

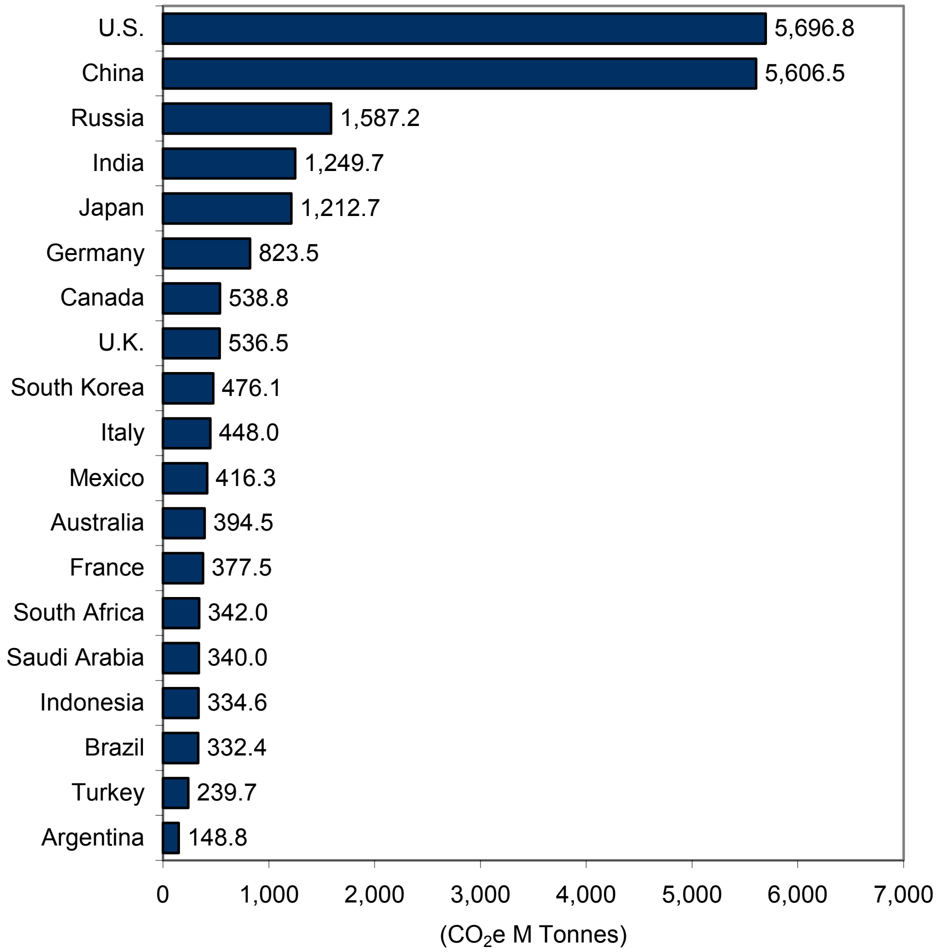
G20 Countries	Score	Tier
Japan	16	Tier 1
U.S.	20	Tier 2
U.K.	21	
France	21	
Germany	21	
Brazil	21	
Italy	23	Tier 3
Canada	24	
Mexico	30	Tier 4
China	32	
South Korea	32	
Turkey	32	
Australia	33	
Saudi Arabia	37	Tier 5
India	37	
Argentina	38	
Russia	38	
Indonesia	41	
India	41	

Source: IDC, 2009

Figure 11 provides the annual CO_2e emissions of G20 countries in 2006. The U.S. is the largest contributor of CO_2e global emissions, accounting for almost a third of all CO_2e produced in the G20 (minus the EU) area by 2020. Along with China, the two countries will account for over half of CO_2e contributions in the G20 zone by 2020.

FIGURE 11

Annual CO_2e Emissions (Million Tonnes)

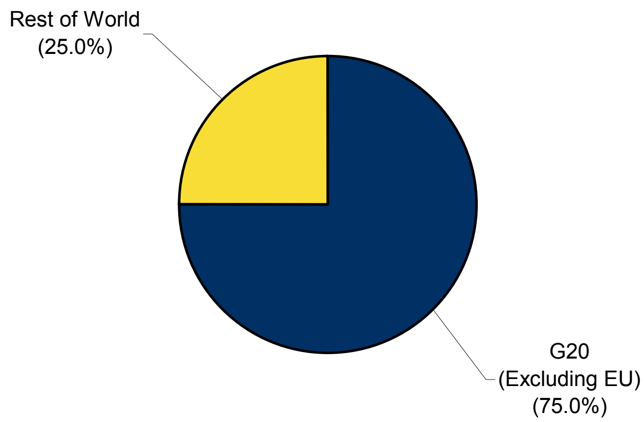


Source: IDC, 2009 based on 2006 IEA data

Figure 12 shows how much the CO_2e emissions of the G20 countries weigh on total worldwide CO_2e emissions. The impact of the G20 countries on worldwide emissions is significant, accounting for 75% in 2006.

FIGURE 12

Annual CO_2e Emissions, G20 Versus Rest of World (Million Tonnes)

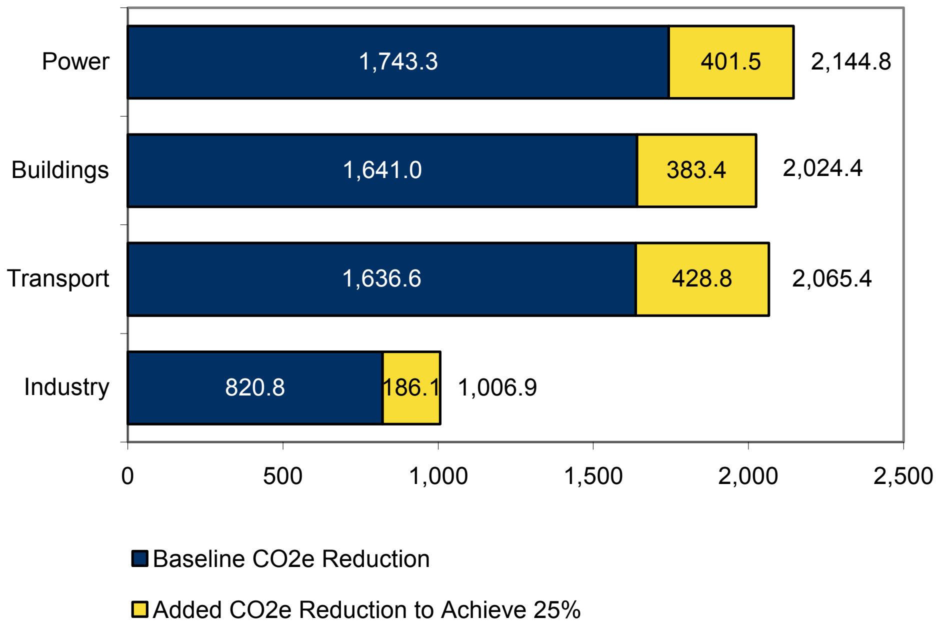


Source: IDC, 2009 based on 2006 IEA data

Under the current scenario, the G20 is projected to achieve a CO_2e reduction of 5,841.6 million tonnes annually by 2020. For the region as a whole to achieve a 25% reduction by 2020, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile.

FIGURE 13

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target



Note: Total baseline CO_2e reduction: 5,841.6 total CO_2e reduction at 25% target: 7,241.5

Source: IDC, 2009

Overview of Specific Initiatives

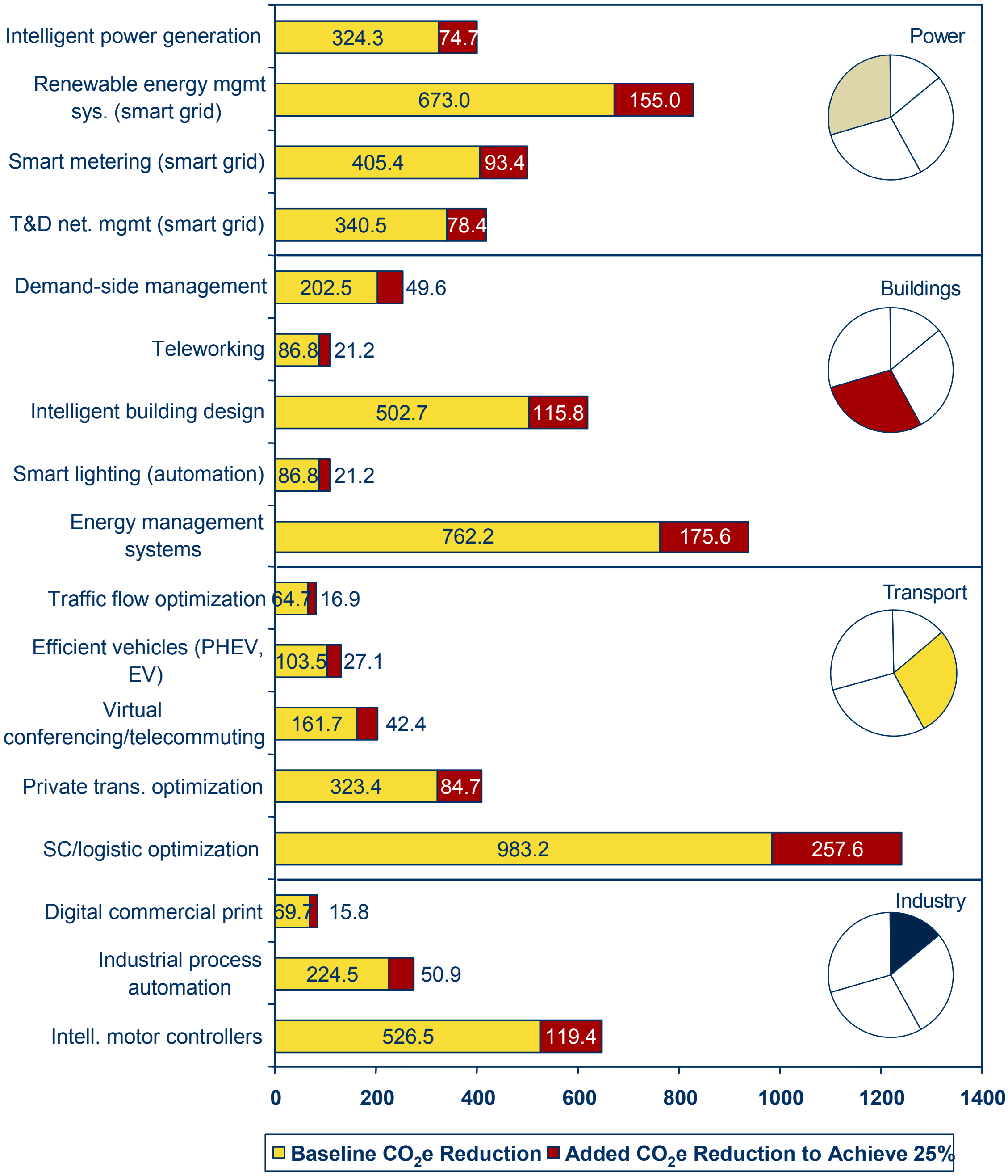
Looking more closely at the technologies in each of the sources of contributors to CO_2e emission reductions, there is at least one technology in each category that has the potential to account for a quarter of CO_2e emission savings (see Figure 14).

Overall supply chain and logistics optimization technologies have the greatest potential to reduce CO_2e emissions, not just within the transport segment, but in all the technologies proposed in this study, with a potential 98.3 million tonne savings in the G20 zone.

Renewable energy management systems, through the use of smart grids, are expected to be the main technology in the power segment.

FIGURE 14

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target G20 Less EU, CO_2e M Tonnes Equivalent



Note: Total baseline CO_2e reduction: 5,841.6 total CO_2e reduction at 25% target: 7,241.5

Source: IDC, 2009

CO_2e Reduction Analysis for Tier 1 Countries

Within the overall scope of this analysis, countries within the G20 have been rated on each country's underlying potential for CO_2e reduction. These determinations are based on a series of measurable variables that relate to:

- The current state of technology penetration and practices within the country
- Characteristics of the physical infrastructure and geographic factors
- The relative difficulty each country will have in achieving its underlying potential

Within this framework, countries are mapped across a spectrum, based on the degree to which technology investment can be leveraged to close the gap between each country's current CO_2e reduction potential and its true "maximum" potential. Viewed as a continuum, lower tier countries (by virtue of existing technology infrastructure, among other things) are closest to their potential, while higher tier countries have a larger gap (hence a greater opportunity to leverage technology).

Within this framework, tier 1 countries are those whose technology, process, and physical infrastructure make them highly advanced, hence close to their CO_2e reduction potential. The only G20 country qualifying for tier 1 status under the IDC model is Japan. The following sections compare Japan's CO_2e reduction potential with that of the G20 as a whole.

Profile: Japan — Tier 1

As Figure 15 shows, transport-related sources constitute the largest share of CO_2e reduction potential in Japan (30%), just over the equivalent share for all G20 countries (29%). The next largest reduction potential in Japan is for power and buildings, at 27% and 25% respectively, which is somewhat less than the G20 as a whole. At 18%, the CO_2e reduction potential represented by industry sources in Japan is also somewhat higher than that of the G20 as a whole (14%). This suggests that in the realm of CO_2e reduction opportunities, industry-based sources are especially important in Japan.

Figure 16 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction for Japan (10%), a share roughly in synch with that of G20 countries as a whole (11%). Of the remaining components of the power category, by 2020:

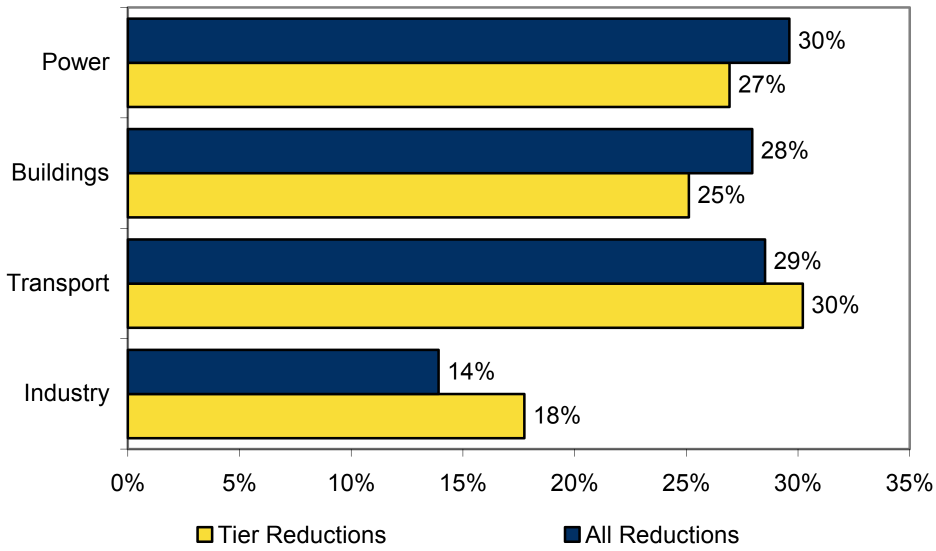
- Smart metering will account for 6% of Japan's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 5% of Japan's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of Japan's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems and intelligent building design are expected to account for 12% and 8% respectively of overall CO_2e reduction opportunities in 2020 for Japan, a pattern also seen in G20 as a group.

In the transport category (and across all categories), supply chain and logistics optimization represents Japan's most significant CO_2e reduction opportunity (18%), a share marginally higher than G20 countries as a group (17%). The next largest source of CO_2e reduction opportunity for Japan is in private transport optimization, accounting for 6% of Japan's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunities include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

FIGURE 15

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 1/Japan Versus G20 Less EU



Source: IDC, 2009

Within the industry category, the use of intelligent motor controllers is seen as providing the category's largest CO_2e reduction opportunity, accounting for 11% of Japan's overall CO_2e reduction (compared with 9% for G20 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 5% and 2% respectively of Japan's overall CO_2e reduction potential.

The 25% Scenario: Tier 1's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020.

This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first metric is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%. The second has been based on a country's ranking within IDC's ICT Sustainability Index and its ability to try to reach the 25% reduction in CO_2e emissions.

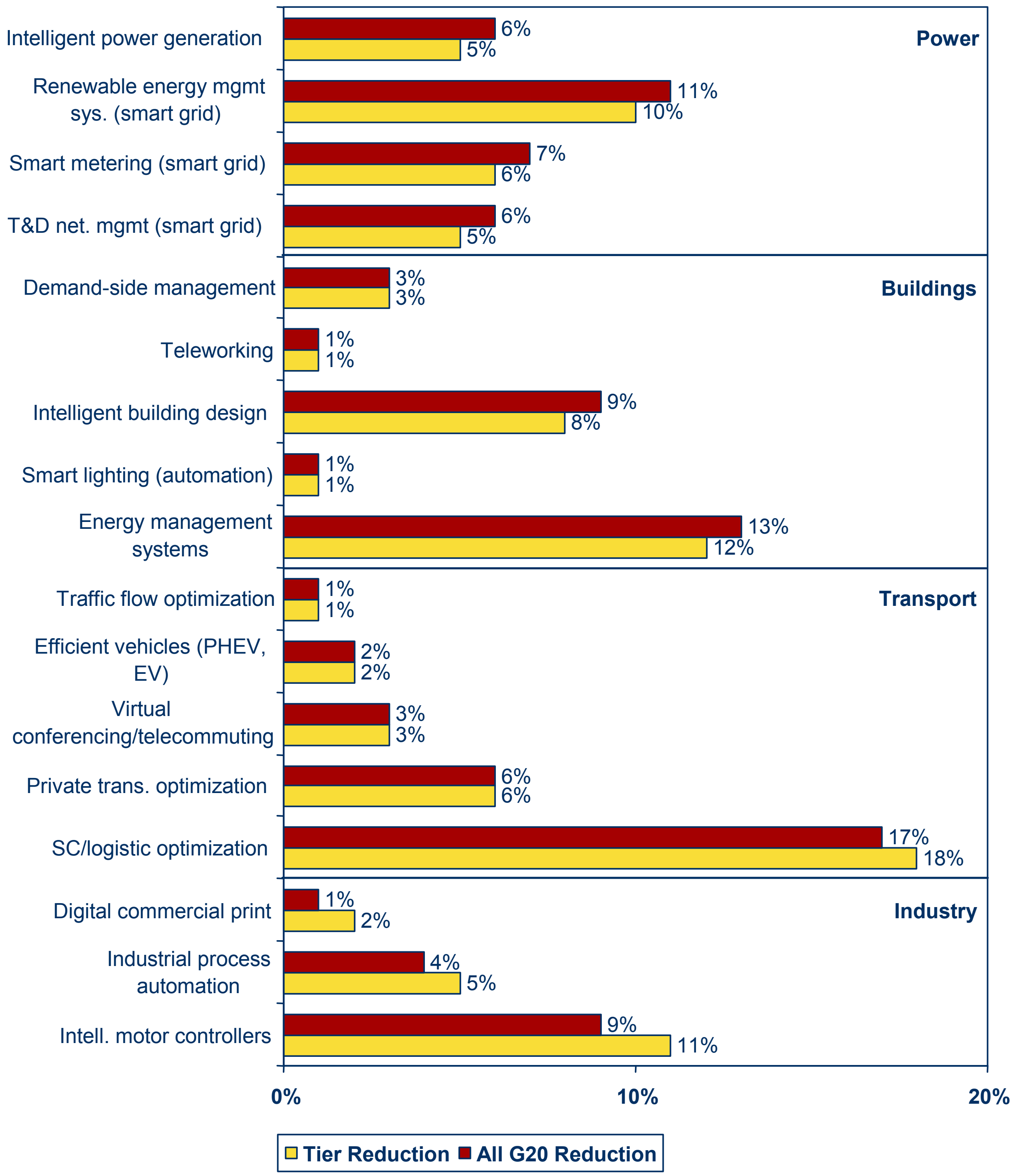
Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Japan is projected to achieve a CO_2e reduction of 318.5 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile (the factors used to group G20 countries into different tiers).

Within the IDC sustainability framework, Japan will need to increase annual CO_2e reductions by 35% (111.5 million tonnes) to 430.0 million tonnes. As Figure 17 shows, the largest increase (33.7 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 18), with the CO_2e reduction target raised from 20.2 million tonnes to 78 million tonnes in 2020. CO_2e reductions associated with private transportation optimization need to rise from 19.08 million tonnes to 25.7 million tonnes in 2020.

CO_2e emissions from power sources, which constitute the second-largest share of Japan's overall emissions savings, require an increase of 30 million tonnes, from 85.8 million tonnes to 115.8 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 33.1 million tonnes to 44.7 million tonnes a year in 2020.

FIGURE 16

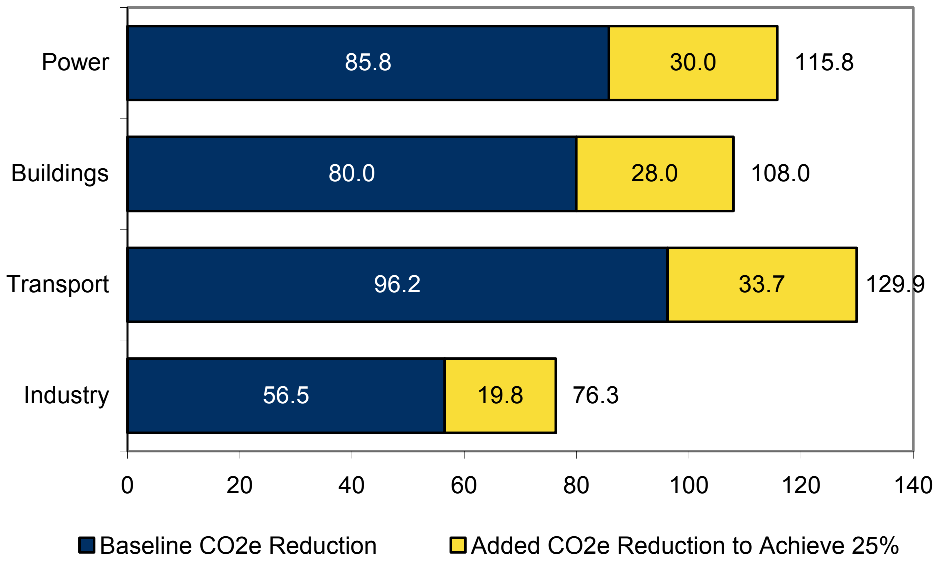
Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 1/Japan Versus G20 Less EU



Source: IDC, 2009

FIGURE 17

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 1/Japan



Note: Total baseline CO_2e reduction: 318.5M tonnes total CO_2e reduction at 25% target: 430.0 M tonnes

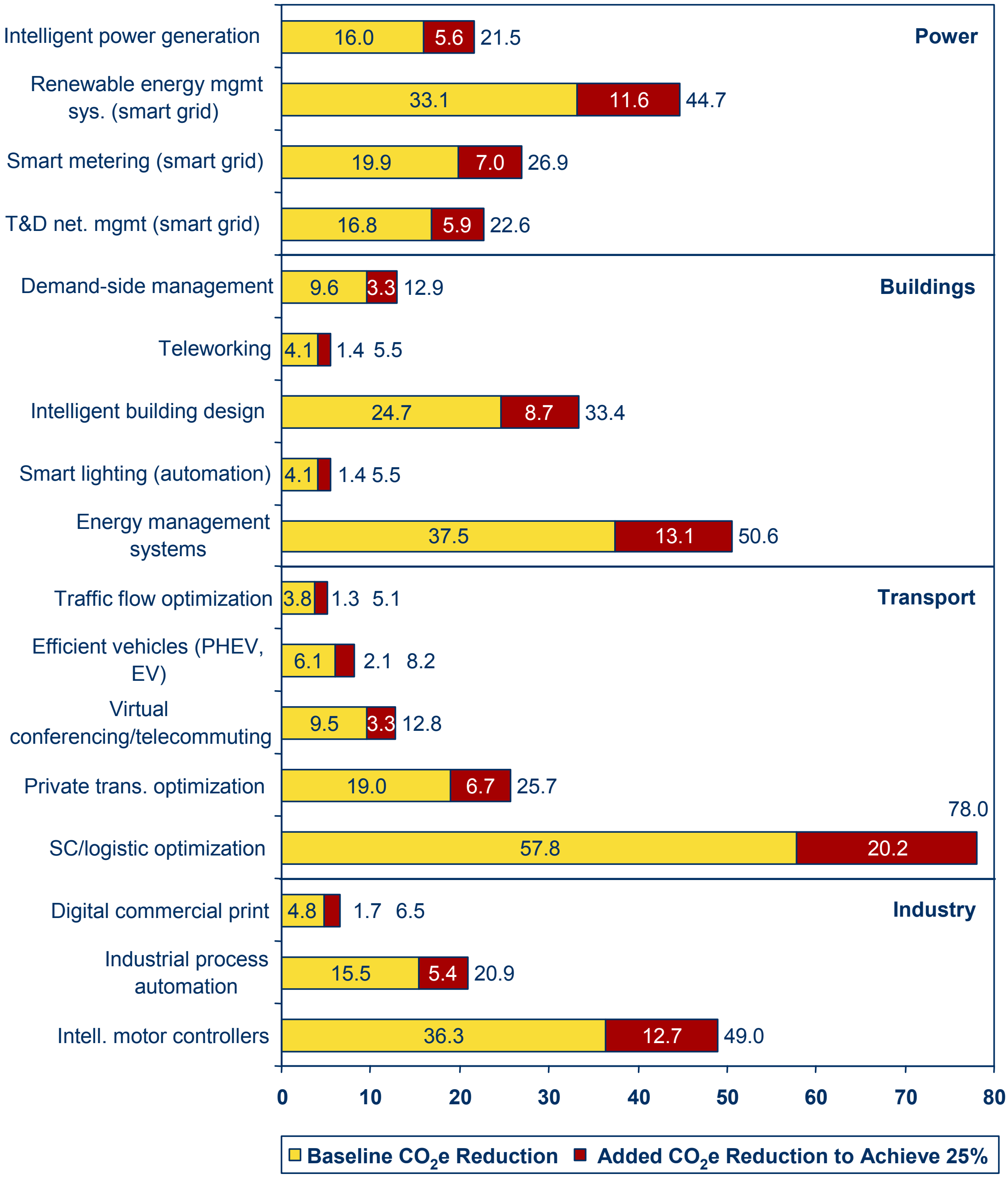
Source: IDC, 2009

Among sources in the buildings category, the largest increases in Japan's CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 37.5 million tonnes to 50.6 million tonnes a year in 2020. Overall, CO_2e reductions in Japan's buildings segment need to rise 35%, from 80 million tonnes to 108 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The IDC model holds that CO_2e reductions in Japan's industry segment need to be increased from 56.4 million tonnes a year to 76.3 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 36.3 million tonnes to 49.0 million tonnes in annual CO_2e emissions) and industrial process automation (from 15.5 million tonnes to 20.9 million tonnes).

FIGURE 18

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 1/Japan



Note: Total baseline CO_2e reduction: 318.5M tonnes total CO_2e reduction at 25% target: 430.0 M tonnes

Source: IDC, 2009

CO_2e Reduction Analysis for Tier 2 Countries

Within the overall scope of this analysis, countries within the G20 have been rated on each country's underlying potential for CO_2e reduction. These determinations are based on a series of measurable variables that relate to:

- The current state of technology penetration and practices within the country
- Characteristics of the physical infrastructure and geographic factors
- The relative difficulty each country will have in achieving its underlying potential

Within this framework, countries are mapped across a spectrum, based on the degree to which technology investment can be leveraged to close the gap between each country's current CO_2e reduction potential and its true "maximum" potential. Viewed as a continuum, lower tier countries (by virtue of existing technology infrastructure, among other things) are closest to their potential, while higher tier countries have a larger gap (hence a greater opportunity to leverage technology).

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020. This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first metric is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%. The second has been based on a country's ranking within IDC's ICT Sustainability Index and its ability to try to reach the 25% reduction in CO_2e emissions.

Within this framework, tier 2 countries are those whose technology, process, and physical infrastructure make them relatively advanced, hence close to their CO_2e reduction potential. G20 countries within tier 2 (profiled later in this section) are:

- Brazil
- France
- Germany
- U.K.
- U.S.

Profile: Tier 2 Countries

As Figure 19 shows, transport-related sources are projected to represent a substantially higher share of CO_2e reduction potential for tier 2 countries (41%) than for the G20 overall (29%) in 2020. In all other major impact categories, the relative shares are roughly comparable between tier 2 countries and the G20 overall. As such, transport issues can be seen as a distinguishing characteristic of tier 2 countries as a comparatively important source of CO_2e reduction potential.

Figure 20 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction for tier 2 countries (10%), a share roughly in synch with that of G20 countries as a whole (11%). Of the remaining components of the power category, by 2020:

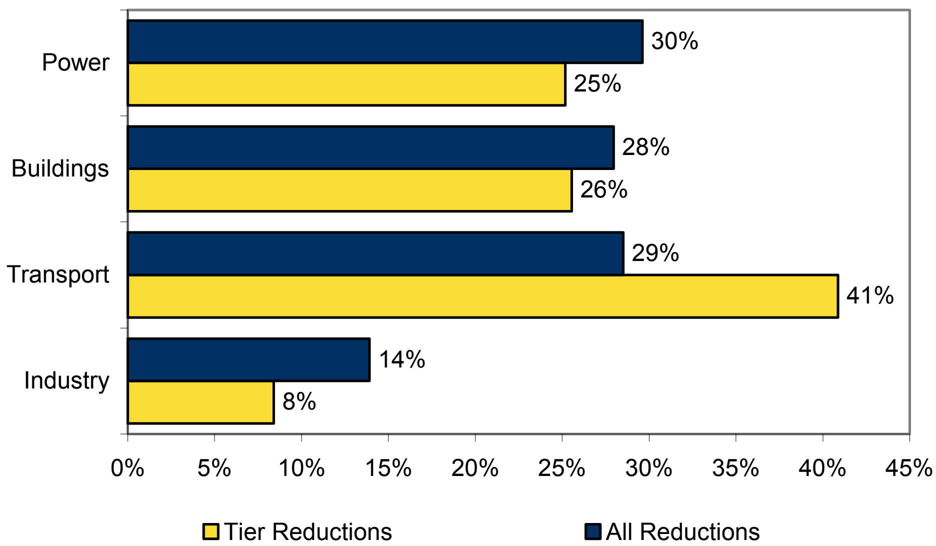
- Smart metering will account for 6% of tier 2's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 5% of tier 2's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of tier 2's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems and intelligent building design are expected to account for 11% and 7% respectively of overall CO_2e reduction opportunities in 2020 for tier 2 countries, a pattern also seen in G20 as a group.

In the transport category (and across all categories), supply chain and logistics optimization represents tier 2's most significant CO_2e reduction opportunity (25%), a share notably higher than G20 countries as a group (17%). The next largest source of CO_2e reduction opportunity for tier 2 countries is in private transport optimization, accounting for 8% of the tier's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (4%), efficient vehicles (3%), and smart traffic systems (2%).

FIGURE 19

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 2 Versus G20 Less EU



Source: IDC, 2009

Within the industry category, the use of intelligent motor controllers is seen as providing the category's largest CO_2e reduction opportunity, accounting for 5% of tier 2's overall CO_2e reduction (compared with a somewhat higher 9% for G20 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 2% and 1% respectively of tier 2's overall CO_2e reduction potential.

The 25% Scenario: Tier 2's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020. This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%.

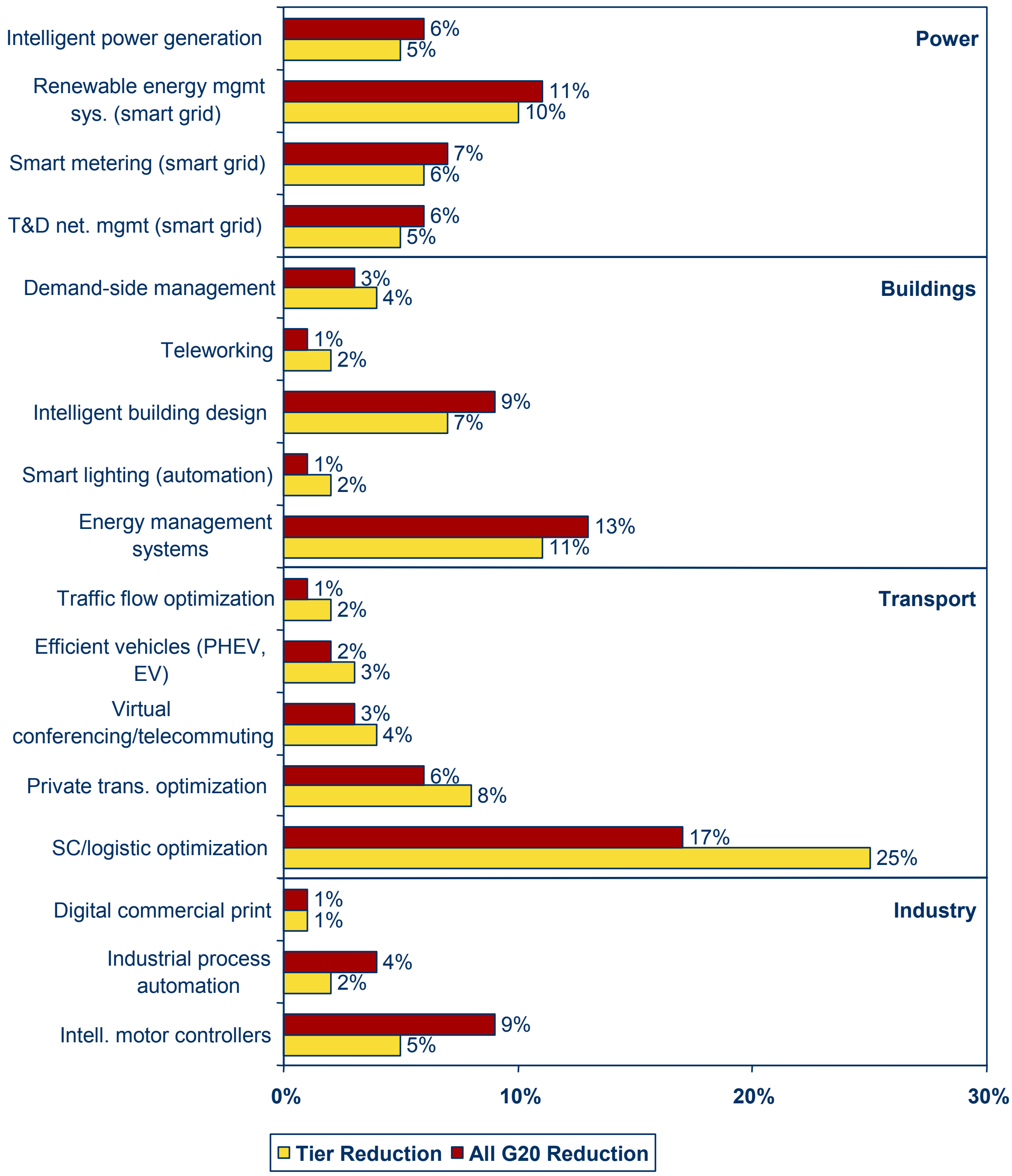
Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), tier 2 countries as a group are projected to achieve a CO_2e reduction of 2,269.5 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction by 2020, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile (the factors used to group G20 countries into different tiers).

Within this framework, all countries within tier 2 will need to increase annual CO_2e reductions by 30% (680.9 million tonnes) to 2,950.4 million tonnes. As Figure 21 shows, the largest increase (278.3 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 22), with the CO_2e reduction target raised from 557.3 million tonnes to 724.5 million tonnes in 2020. CO_2e reductions associated with private transportation optimization need to rise from 183.3 million tonnes to 238.3 million tonnes in this timeframe.

CO_2e emissions from power sources require an increase of 171.5 million tonnes, from 571.5 million tonnes to 743.0 million tonnes annually by 2020.

FIGURE 20

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 2 Versus G20 Less EU

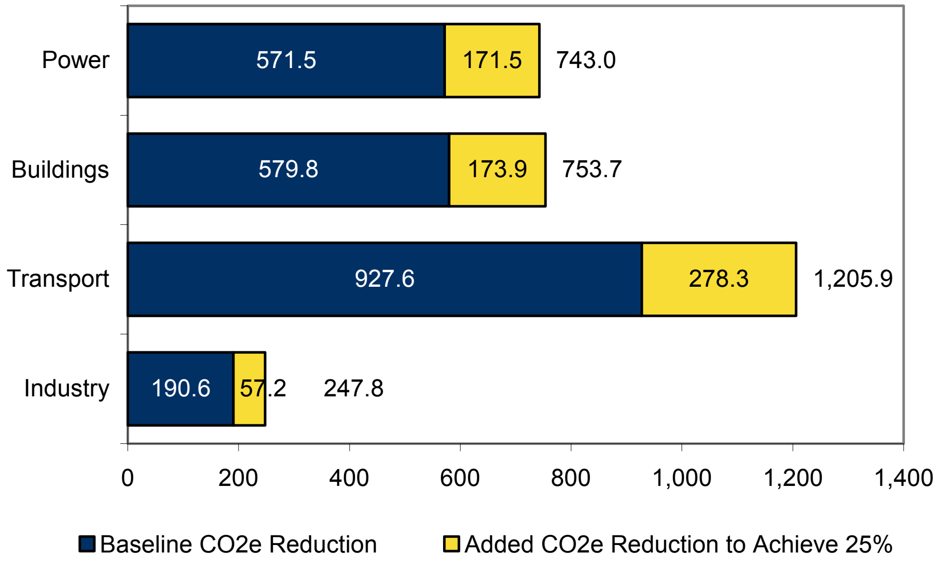


Source: IDC, 2009

Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 220.6 million tonnes to 286.8 million tonnes a year in 2020.

FIGURE 21

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 2



Note: Total baseline CO_2e reduction: 2,269.5M tonnes total CO_2e reduction at 25% target: 2,950.4 M tonnes

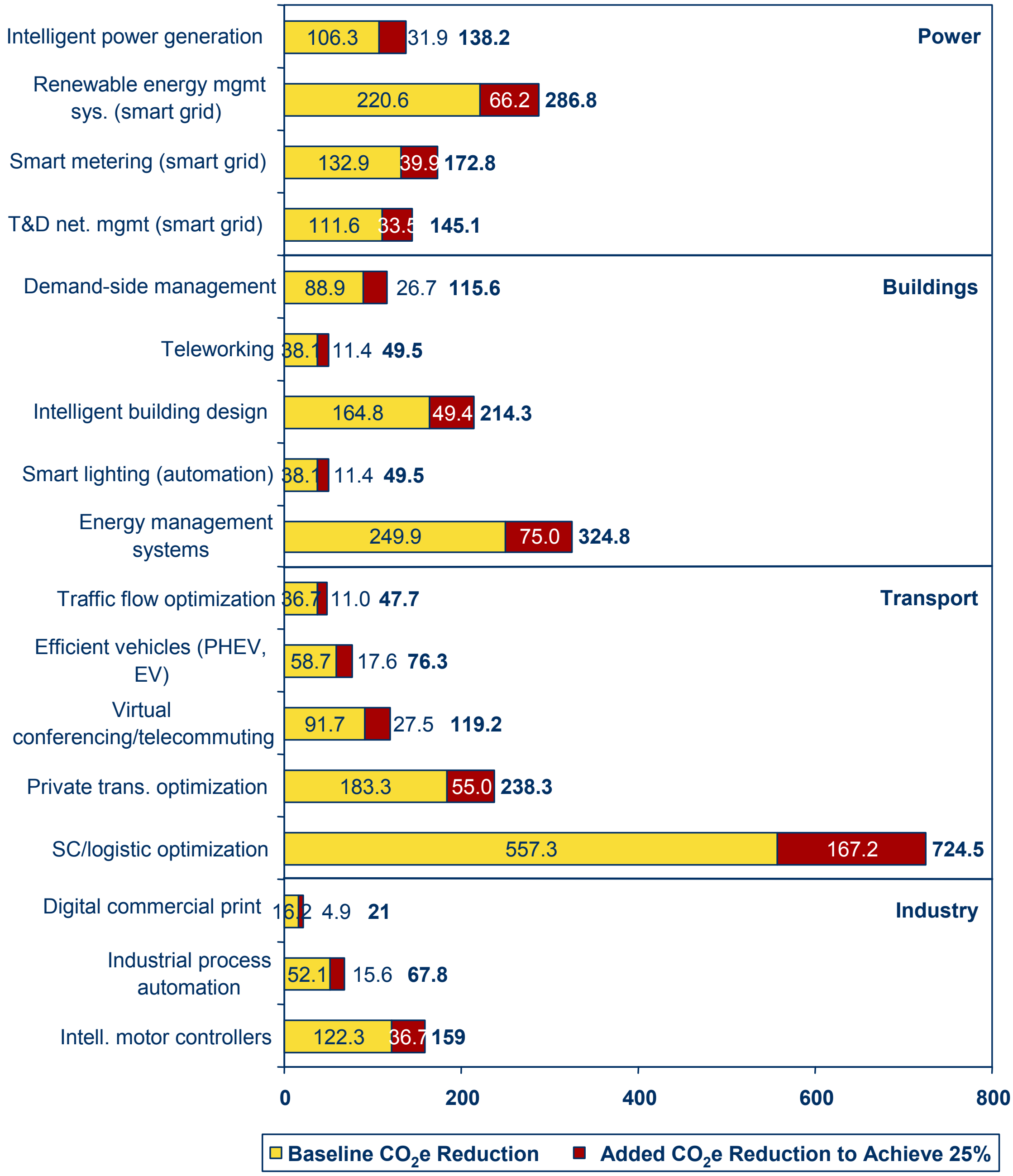
Source: IDC, 2009

Among sources in the buildings category, the largest increases in tier 2 CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 249.9 million tonnes to 324.8 million tonnes a year in 2020. Overall, CO_2e reductions in tier 2's buildings segment need to rise 30%, from 579.8 million tonnes to 753.7 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The IDC model holds that CO_2e reductions in tier 2's industry segment need to be increased from 190.6 million tonnes a year to 247.8 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 122.3 million tonnes to 159.0 million tonnes in annual CO_2e emissions) and industrial process automation (from 52.1 million tonnes to 67.8 million tonnes).

FIGURE 22

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 2



Note: Total baseline CO$_2$e reduction: 2,269.5M tonnes total CO$_2$e reduction at 25% target: 2,950.4 M tonnes

Source: IDC, 2009

Country-Specific Overviews

The following sections present country-level overviews of each of the countries in tier 2: Brazil, France, Germany, the U.K., and the U.S. Each overview looks at the current potential for CO_2e reduction by 2020, as well as each country's modified CO_2e reduction requirement for the G20 countries overall to achieve a 25% CO_2e reduction by 2020.

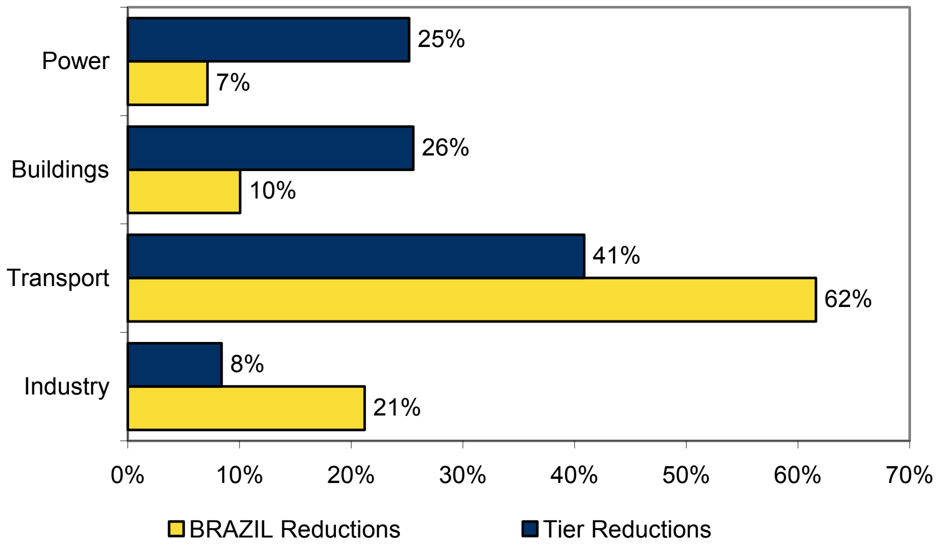
Brazil

The Current CO_2e Reduction Scenario

Brazil is ranked 16th among G20 countries in terms of projected CO_2e emissions by 2020, at 332.4 million tonnes a year. Under baseline assumptions (or normal ICT capable reduction as modeled by IDC), Brazil's CO_2e reduction capability is 89.6 million tonnes annually. As Figure 23 shows, the largest share of Brazil's projected CO_2e reduction opportunity is in transport. At 62%, the share of CO_2e reduction opportunities associated with transport sources is significantly higher than that of tier 2 countries as a group (41%). The same holds true for industry-based sources, which represent 21% of Brazil's CO_2e reduction opportunities in 2020, nearly three times the percentage of tier 2 countries as a group. The share of CO_2e reduction opportunities derived from power and buildings sources (at 7% and 10% respectively) is substantially lower than that of tier 2 countries as a group (25% and 26% respectively).

FIGURE 23

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Brazil Versus Tier 2



Source: IDC, 2009

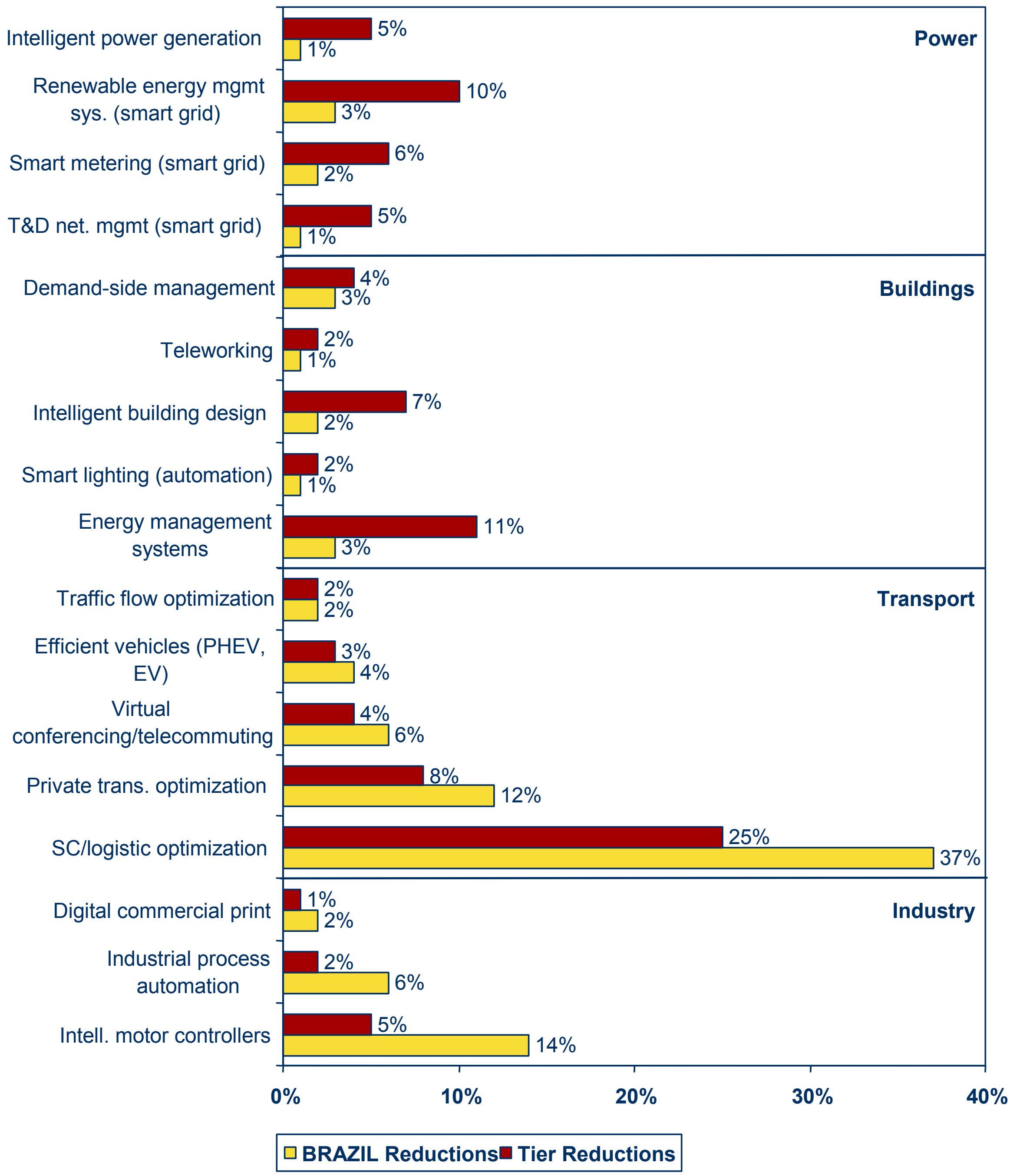
Figure 24 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Brazil (3%), although it is well below the percentage seen for tier 2 as a whole (10%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 2% of Brazil's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 1% of Brazil's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 1% of Brazil's overall CO_2e reduction opportunity.

As with the power category, there are no standout CO_2e reduction sources in the buildings category; all represent 3% or less as a percentage of overall CO_2e reduction in Brazil. This contrasts with tier 2 as a whole, where energy management systems and intelligent building design are expected to account for 11% and 7% respectively of overall CO_2e reduction opportunities in 2020.

FIGURE 24

Projected CO_2e Reduction Opportunity in 2020, by Source — Brazil Versus Tier 2



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Brazil's most significant CO_2e reduction opportunity (37%), even more than tier 2 as a group (25%). Brazil's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 12% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting, efficient vehicles, and smart traffic systems.

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 14% of Brazil's overall CO_2e reduction (compared with 5% for tier 2 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 6% and 2% respectively of Brazil's overall CO_2e reduction.

The 25% Scenario: Brazil's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Brazil is projected to achieve a CO_2e reduction of 89.6 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within the IDC sustainability framework, Brazil's requirement is to increase annual CO_2e reductions by 30% (26.9 million tonnes) to 116.5 million tonnes. As Figure 25 shows, the largest increase (16.6 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 26), with the CO_2e reduction target raised from 33.2 million tonnes in 2020 to 43.1 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 10.9 million tonnes to 14.2 million tonnes in this timeframe.

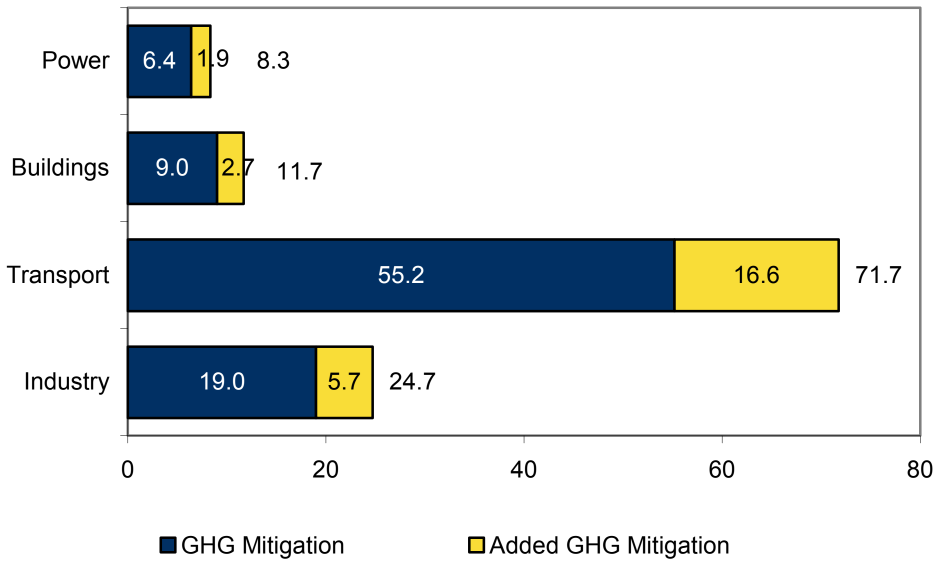
The IDC model holds that CO_2e reductions in Brazil's industry segment need to be increased from 3.8 million tonnes a year to 5.7 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 2.4 million tonnes to 3.7 million tonnes in annual CO_2e emissions) and industrial process automation (from 1 million tonnes to 1.6 million tonnes).

Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 2.8 million tonnes to 3.6 million tonnes a year in 2020. Overall, CO_2e reductions in Brazil's building segment need to rise 30%, from 9.0 million tonnes to 11.7 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from power sources, which constitute the smallest share of Brazil's overall emissions, likewise require the smallest increase of the four major categories — an increase of 1.9 million tonnes, from 6.4 million tonnes to 8.3 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 2.5 million tonnes to 3.2 million tonnes a year in 2020.

FIGURE 25

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Brazil

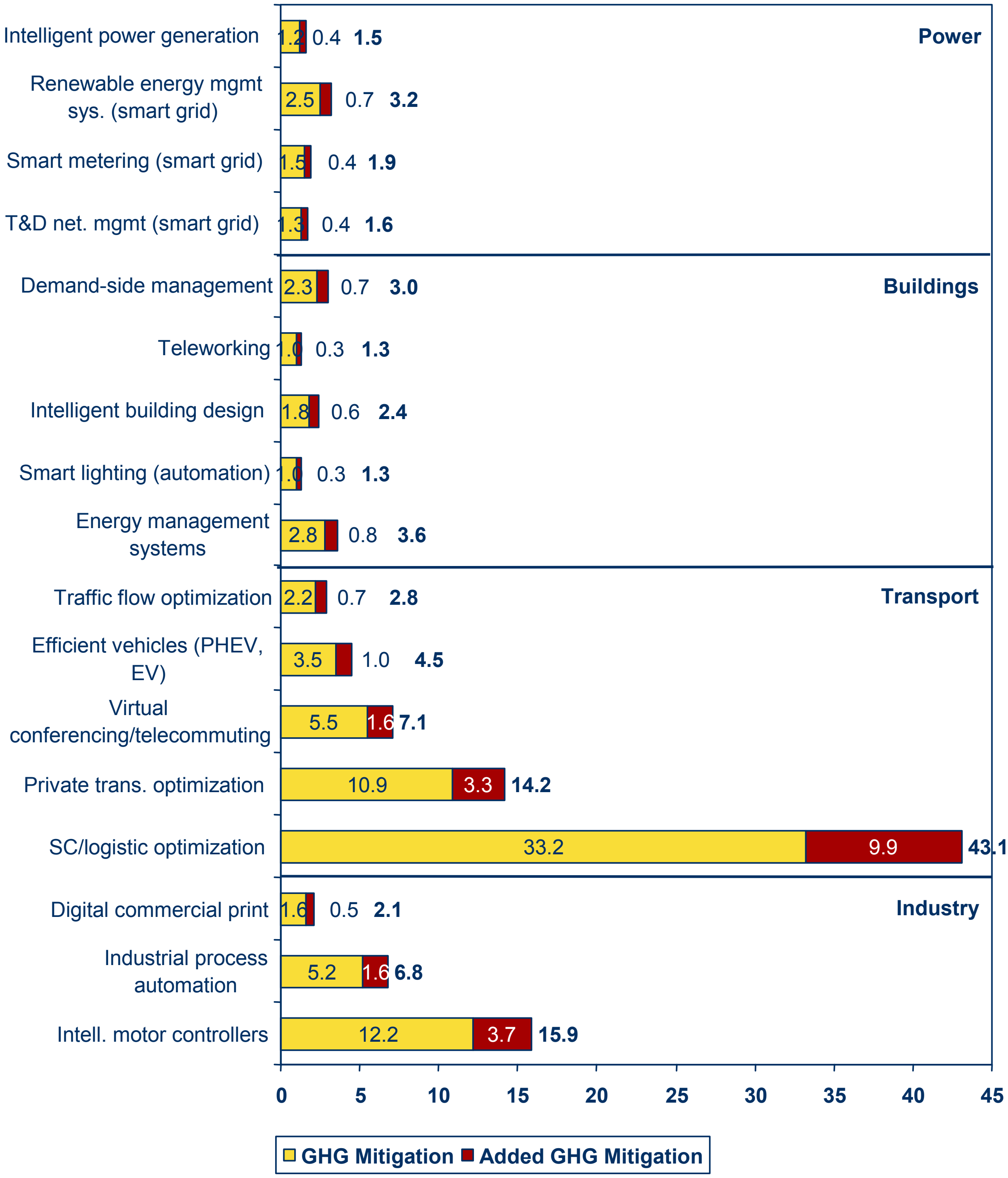


Note: Total baseline CO$_2$e reduction: 89.6M tonnes total CO$_2$e reduction at 25% target: 116.5M tonnes

Source: IDC, 2009

FIGURE 26

CO₂e Reduction Opportunity: Baseline Scenario Versus 25% Target — Brazil



Note: Total baseline CO_2e reduction: 89.6M tonnes total CO_2e reduction at 25% target: 116.5M tonnes

Source: IDC, 2009

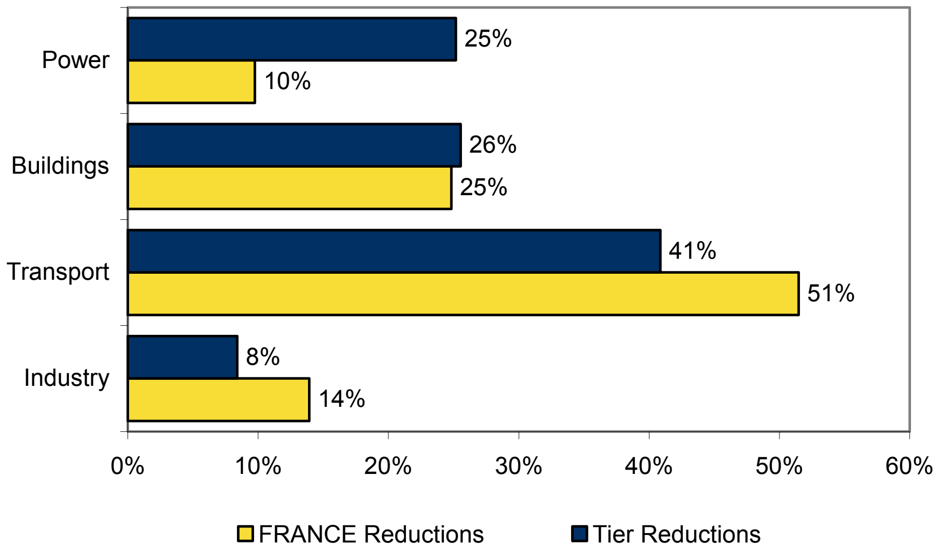
France

The Current CO_2e Reduction Scenario

France is ranked 14th among G20 countries in terms of projected CO_2e emissions by 2020, at 377.5 million tonnes a year. Under baseline assumptions, France's maximum CO_2e reduction capability is 100.1 million tonnes annually. As Figure 27 shows, the largest share of France's projected CO_2e reduction opportunity is in transport. At 51%, the share of CO_2e reduction opportunities associated with transport sources is higher than that of tier 2 countries as a group (41%). The second-largest share of France's CO_2e reduction opportunities are derived from the buildings category, which accounts for 25%, compared with 26% for tier 2 countries as a group. The share of CO_2e reduction opportunities derived from industry in France (14%) is somewhat higher than that of tier 2 countries as a group (8%), while the share of CO_2e reduction opportunities related to power sources in France (10%) is substantially lower than that of tier 2 countries as a group (25%).

FIGURE 27

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — France Versus Tier 2



Source: IDC, 2009

Figure 28 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in France (4%), although it is less than half the share of tier 2 as a whole (10%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 2% of France's overall CO_2e reduction opportunity.

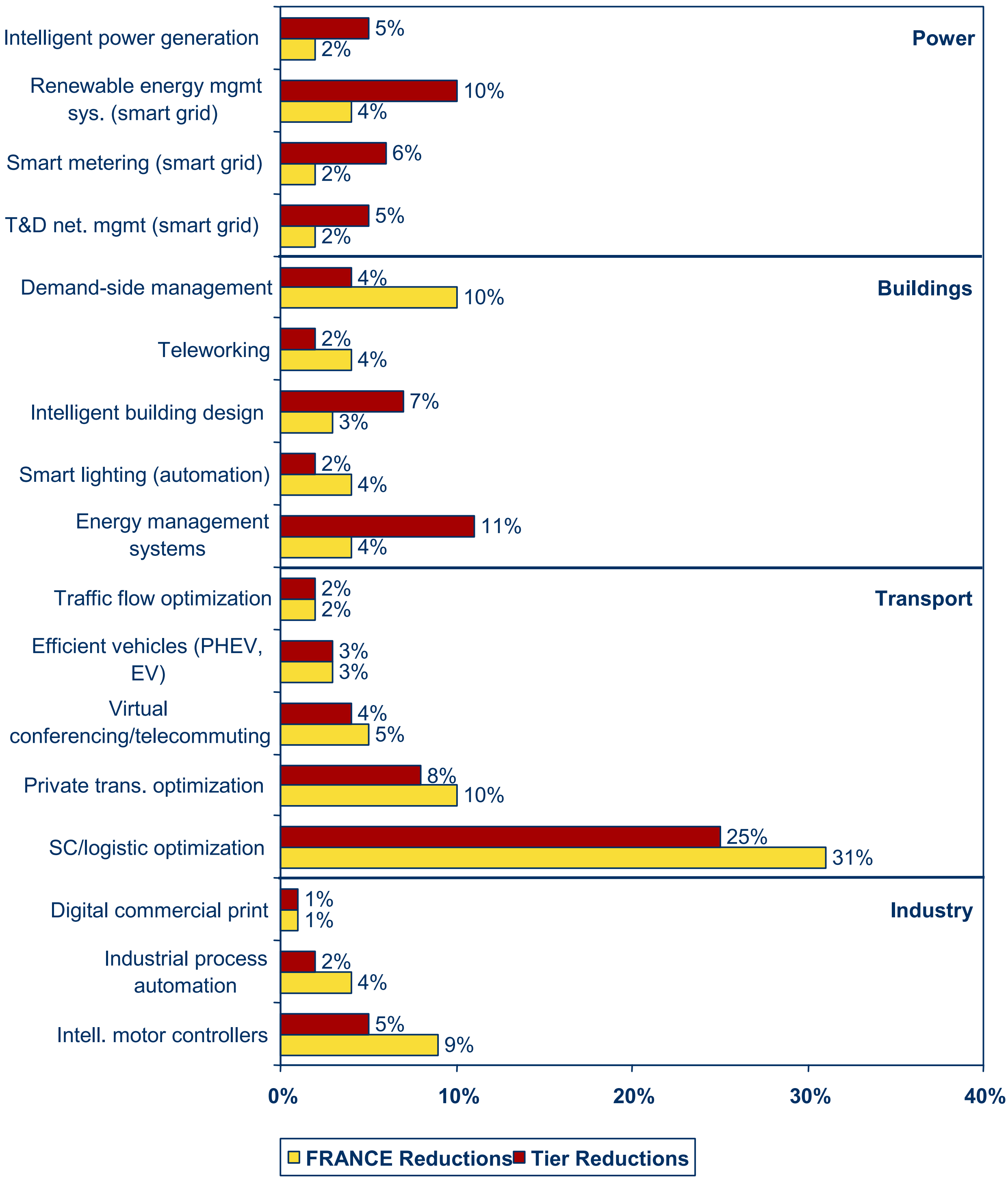
- Intelligent power generation will account for 2% of France's overall CO_2e reduction opportunity.

- Transmission and distribution network management systems will also account for 2% of France's overall CO_2e reduction opportunity.

Within the buildings category, demand-side management and smart box programs represent the largest source of potential CO_2e reduction in France (10%, compared with 4% for all of tier 2). In contrast, energy management systems and intelligent building design are seen as the largest source of potential reductions in tier 2 as a whole, at 11% and 7% respectively in 2020.

FIGURE 28

Projected CO_2e Annual Reduction Opportunity in 2020, by Source— France Versus Tier 2



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents France's most significant CO_2e reduction opportunity (31%), somewhat more than tier 2 as a group (25%). France's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 10% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (5%), efficient vehicles (3%), and smart traffic systems (2%) — each of which are in line with tier 2 as a group.

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 9% of France's overall CO_2e reduction (compared with 5% for tier 2 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 4% and 1% respectively of France's overall CO_2e reduction.

The 25% Scenario: France's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), France is projected to achieve a CO_2e reduction of 100.1 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within the IDC sustainability framework, France's requirement is to increase annual CO_2e reductions by 30% (30 million tonnes) to 130.1 million tonnes. As Figure 29 shows, the largest increase (15.5 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in supply chain and logistics optimization (Figure 30), with the CO_2e reduction target raised from 30.1 million tonnes in 2020 to 40.3 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 10.2 million tonnes to 13.2 million tonnes in this timeframe.

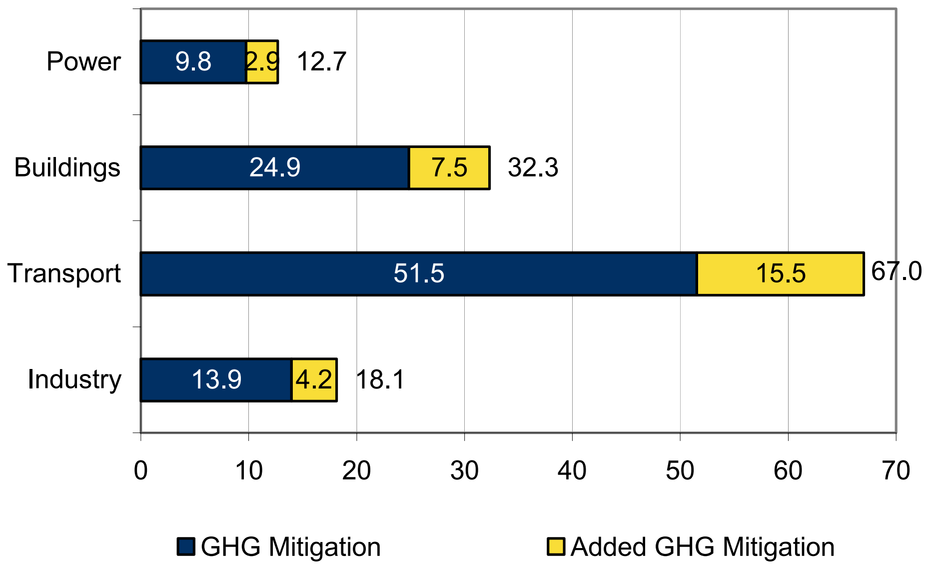
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in demand-side management and smart box systems, with associated CO_2e reductions rising from 9.6 million tonnes to 12.4 million tonnes a year in 2020. Overall, CO_2e reductions in France's buildings segment need to rise 30%, from 24.9 million tonnes to 32.3 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The IDC model holds that CO_2e reductions in France's industry segment need to be increased from 13.9 million tonnes a year to 18.1 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 8.9 million tonnes to 11.6 million tonnes in annual CO_2e emissions) and industrial process automation (from 3.8 million tonnes to 5.0 million tonnes).

CO_2e emissions from power sources, which constitute the smallest share of France's overall emissions, likewise require the smallest increase of the four major categories — an increase of roughly 2.9 million tonnes, from 9.8 million tonnes to 12.7 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 3.8 million tonnes to 4.9 million tonnes a year in 2020.

FIGURE 29

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — France

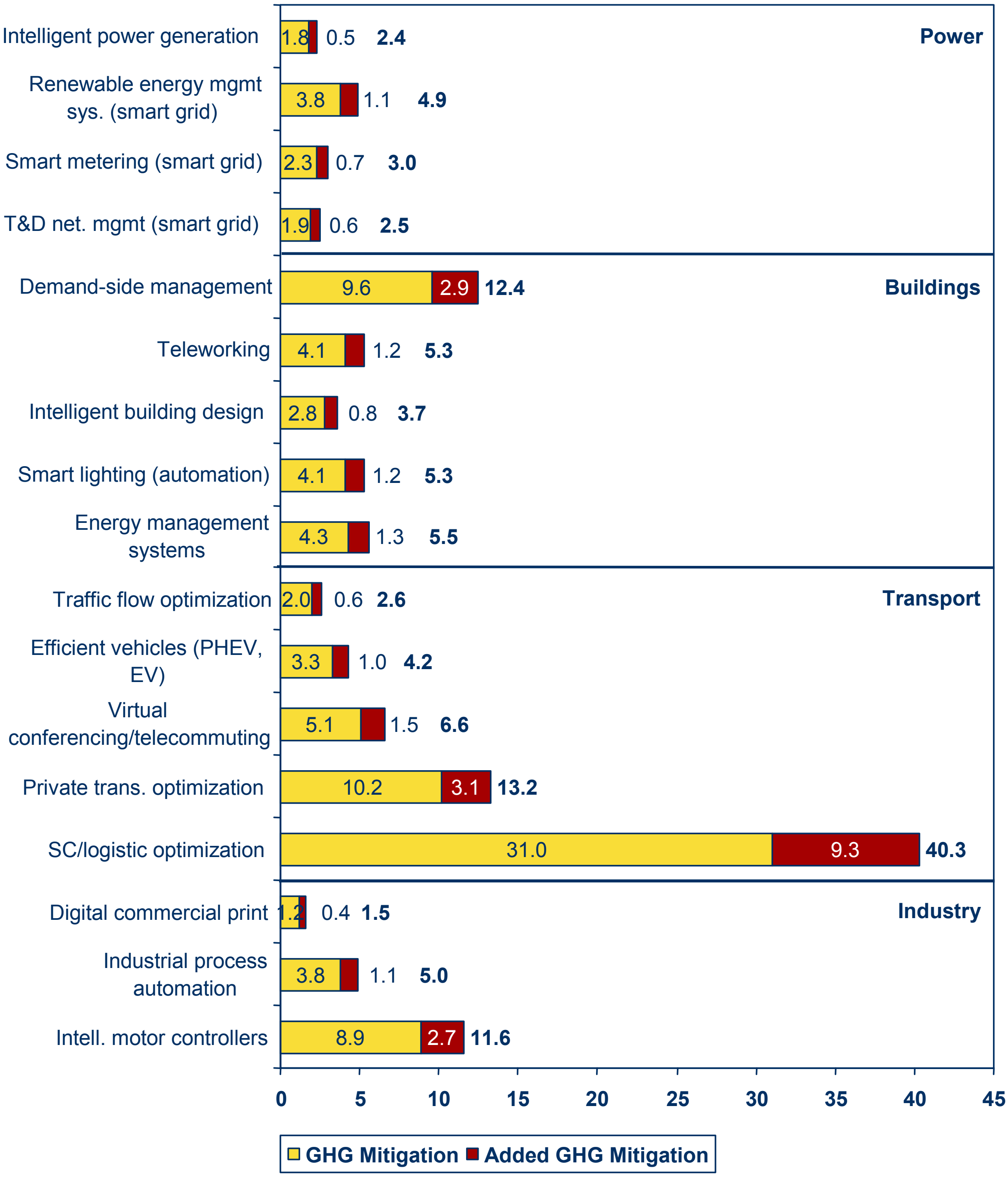


Note: Total baseline CO_2e reduction: 100.1M tonnes total CO_2e reduction at 25% target: 130.1M tonnes

Source: IDC, 2009

FIGURE 30

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — France



Note: Total baseline CO_2e reduction: 100.1M tonnes total CO_2e reduction at 25% target: 130.1M tonnes

Source: IDC, 2009

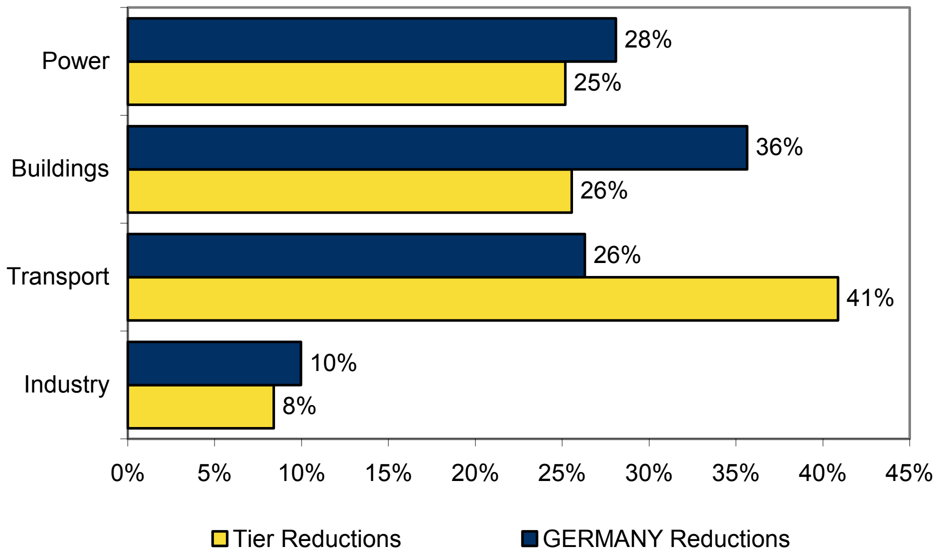
Germany

The Current CO_2e Scenario

Germany is ranked sixth among G20 countries in terms of projected CO_2e emissions by 2020, at 823.5 million tonnes a year. Under baseline assumptions, Germany's maximum CO_2e reduction capability is 229.2 million tonnes annually. As Figure 31 shows, the largest share of Germany's projected CO_2e reduction opportunity is in buildings. At 36%, the share of CO_2e reduction opportunities associated with buildings sources is higher than that of tier 2 countries as a group (26%). The power category is a close second, representing 28% of Germany's CO_2e reduction opportunities in 2020, which is roughly in line with tier 2 countries as a group. The share of CO_2e reduction opportunities derived from transport sources in Germany (26%) is substantially lower than that of tier 2 countries as a group (41%), while Germany's share of CO_2e reduction opportunities derived from industry sources (10%) is essentially in line with tier 2 countries as a group (8%).

FIGURE 31

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Germany Versus Tier 2



Source: IDC, 2009

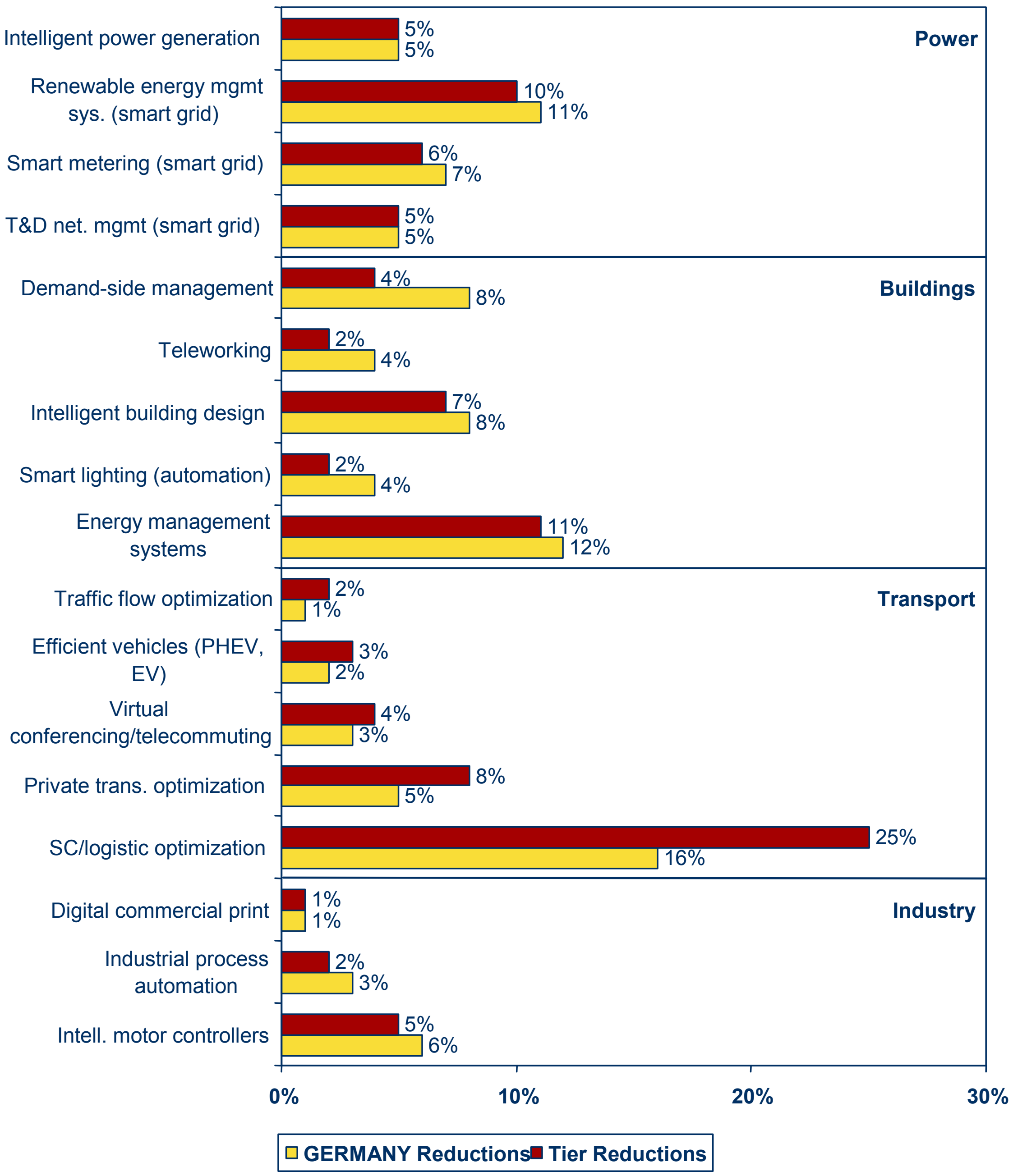
Figure 32 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Germany. The 11% share of overall CO_2e reductions is approximately the same as tier 2 as a whole (10%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 7% of Germany's overall 2020 CO_2e reduction opportunity.
- Intelligent power generation will account for 5% of Germany's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of Germany's overall CO_2e reduction opportunity.

Within the buildings category, the largest sources of CO_2e reduction under the baseline scenario are energy management systems (12%), demand-side management programs (8%), and intelligent building design (8%). Compared with tier 2 as a whole, the most marked difference in reduction potential is for demand-side management, which is roughly twice as large as that of all tier countries.

FIGURE 32

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Germany Versus Tier 2



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Germany's most significant CO_2e reduction opportunity (16%), although it is a significantly lower share than tier 2 as a group (25%). Germany's next largest source of CO_2e reduction opportunity in this category is in private transport optimization, accounting for 5% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a moderate CO_2e reduction opportunity, accounting for 6% of Germany's overall CO_2e reduction (compared with 5% for tier 2 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 3% and 2% respectively of Germany's overall CO_2e reduction.

The 25% Scenario: Germany's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Germany is projected to achieve a CO_2e reduction of 229.2 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Germany's requirement is to increase annual CO_2e reductions by 30% (68.8 million tonnes) to 298.8 million tonnes. As Figure 33 shows, the largest increase (24.5 million tonnes) needs to occur in buildings. Among sources in the buildings category (Figure 34), the largest increases in CO_2e abatement should come from investments in:

- Energy management systems, raising the level of annual CO_2e reductions by 28.2 million tonnes to 36.6 million tonnes.
- Demand-side management, raising the level of annual CO_2e reductions by 18.8 million tonnes to 24.5 million tonnes.
- Intelligent building design, raising the level of annual CO_2e reductions by 18.6 million tonnes to 24.1 million tonnes.

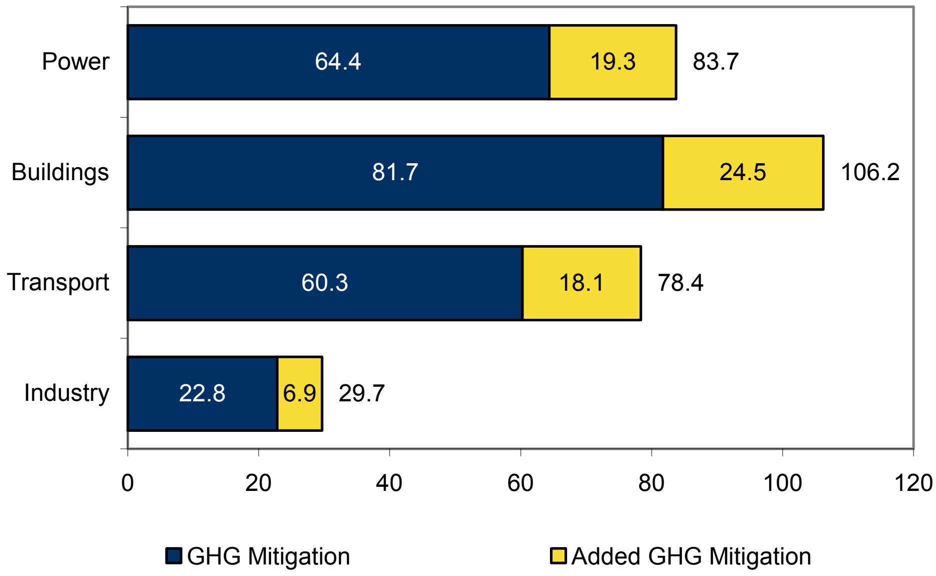
CO_2e emissions from Germany's power sources, which make up the second-largest share of the country's overall emissions, need to be cut by an additional 19.3 million tonnes a year, to 83.7 million tonnes, within the framework of a 25% G20 reduction by 2020. Within the overall power category, the largest reductions should be induced by investments in renewable energy management systems (with associated CO_2e cuts rising from 24.9 million tonnes to 32.3 million tonnes a year in 2020).

The third-largest increase (18.1 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 36.2 million tonnes in 2020 to 47.1 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 11.9 million tonnes to 15.5 million tonnes in this timeframe.

CO_2e reductions in Germany's industry segment need to be increased from 22.8 million tonnes a year to 29.7 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (with targeted CO_2e reductions rising from 14.7 million tonnes to 19.0 million tonnes annually) and industrial process automation (with targeted CO_2e reductions rising from 6.2 million tonnes to 8.1 million tonnes).

FIGURE 33

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Germany

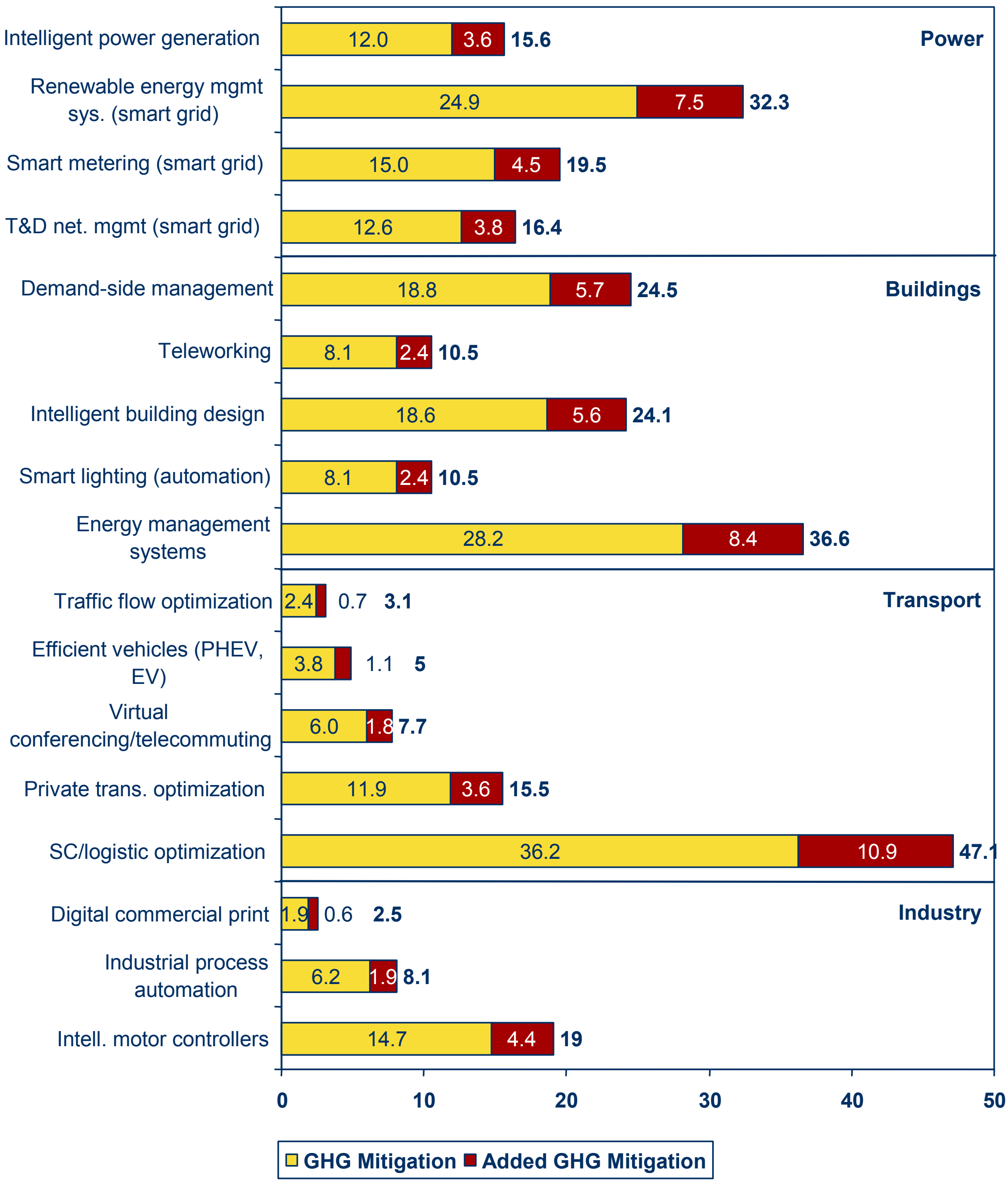


Note: Total baseline CO_2e reduction: 229.2M tonnes total CO_2e reduction at 25% target: 298.0M tonnes

Source: IDC, 2009

FIGURE 34

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Germany



Note: Total baseline CO_2e reduction: 229.2M tonnes total CO_2e reduction at 25% target: 298.0M tonnes

Source: IDC, 2009

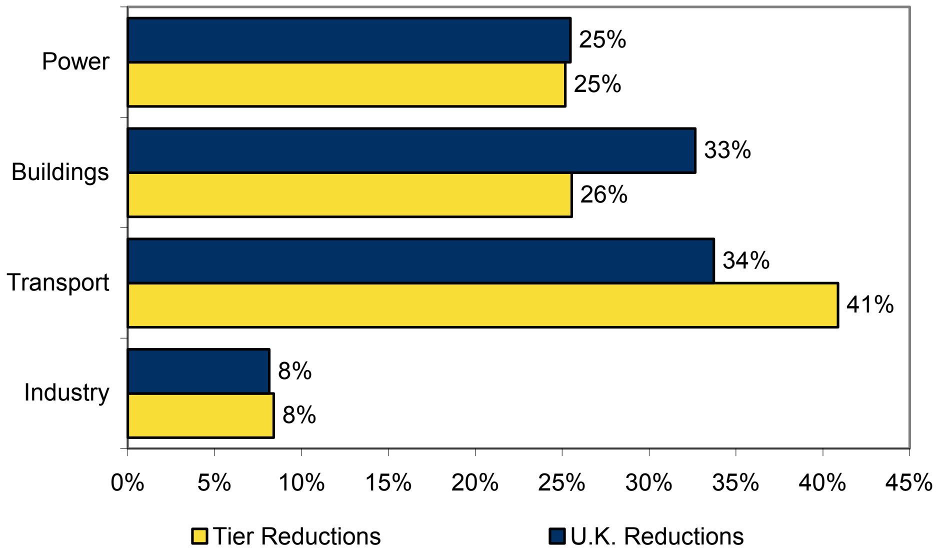
U.K.

The Current CO_2e Reduction Scenario

The U.K. is ranked seventh among G20 countries in terms of projected CO_2e emissions by 2020, at 536.5 million tonnes a year. Under baseline assumptions, the U.K.'s maximum CO_2e reduction capability is 151.8 million tonnes annually. As Figure 35 shows, the largest share of the U.K.'s projected CO_2e reduction opportunity is in transport. At 34%, the share of CO_2e reduction opportunities associated with transport sources is lower than that of tier 2 countries as a group (41%). Conversely, the share of CO_2e reduction opportunities associated with the buildings category in the U.K. (33%) is higher than that of tier 2 countries as a group (26%). The share of CO_2e reduction opportunities derived from power and industry sources (at 25% and 8% respectively) is roughly equal to that of tier 2 countries as a group (likewise 25% and 8% respectively).

FIGURE 35

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — U.K. Versus Tier 2



Source: IDC, 2009

Figure 36 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction opportunities in the U.K. (10%). Of the remaining components of the power category:

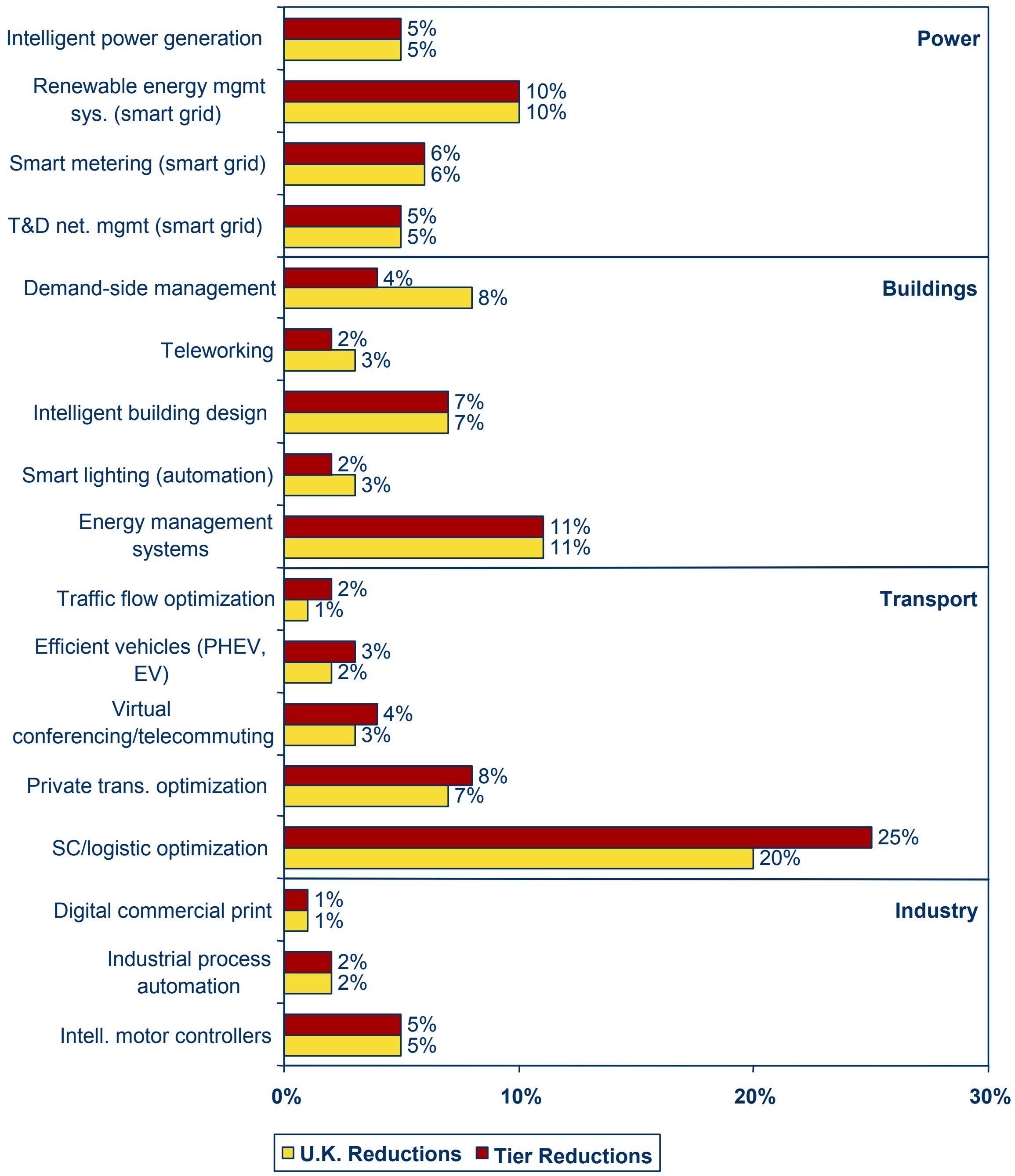
- Smart metering will account for 6% of the U.K.'s overall CO_2e reduction opportunity by 2020.
- Intelligent power generation will account for 5% of the U.K.'s overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of the U.K.'s overall CO_2e reduction opportunity.

These percentage distributions are a near mirror image of the distributions seen in tier 2 as a whole.

Within the buildings category, the largest sources of CO_2e reduction under the baseline scenario are energy management systems (11%), demand-side management programs (8%), and intelligent building design (7%). Compared with tier 2 as a whole, the most marked difference in reduction potential is for the subcategory of demand-side management, which accounts for roughly twice the share in the U.K. as the average for all tier countries.

FIGURE 36

Projected CO_2e Annual Reduction Opportunity in 2020, by Source— U.K. Versus Tier 2



Source: IDC, 2009

In the transport category (and overall for the U.K.), supply chain and logistics optimization represents the country's most significant CO_2e reduction opportunity (20%), although it is a somewhat lower share than tier 2 as a group (25%). The U.K.'s next largest source of CO_2e reduction opportunity in this category is in private transport optimization, accounting for 7% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a moderate CO_2e reduction opportunity, accounting for 5% of the U.K.'s overall CO_2e reduction (compared with 5% for tier 2 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 2% and 1% respectively of the U.K.'s overall CO_2e reduction.

The 25% Scenario: The U.K.'s Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC) the U.K. is projected to achieve a CO_2e reduction of 151.8 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, the U.K.'s requirement is to increase annual CO_2e reductions by 30% (45.5 million tonnes) to 197.3 million tonnes. As Figure 37 shows, the largest increase (15.4 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 38), with the CO_2e reduction target raised from 30.8 million tonnes in 2020 to 40.0 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 10.1 million tonnes to 13.2 million tonnes in this timeframe.

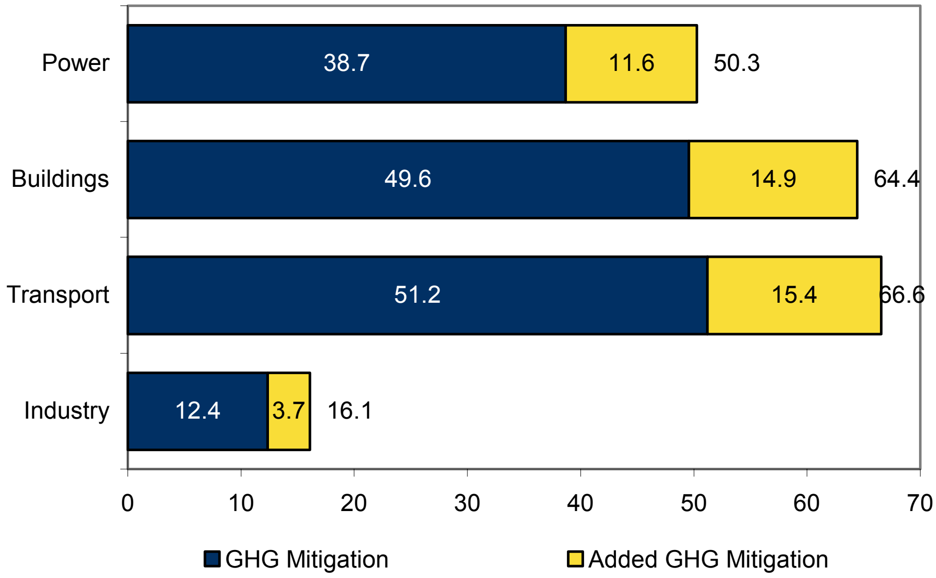
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 16.9 million tonnes to 22.0 million tonnes a year in 2020. Overall, CO_2e reductions in the U.K.'s buildings segment need to rise 30%, from 49.6 million tonnes to 64.4 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from power sources, which constitute the third-largest share of the U.K.'s overall emissions, require an increase of 11.6 million tonnes, from 38.7 million tonnes to 50.3 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 14.9 million tonnes a year to 19.4 million tonnes a year in 2020.

The IDC model holds that CO_2e reductions in the U.K.'s industry segment need to be increased from 12.4 million tonnes a year to 16.1 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 7.9 million tonnes to 10.3 million tonnes in annual CO_2e emissions) and industrial process automation (from 3.4 million tonnes to 4.4 million tonnes).

FIGURE 37

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — U.K.

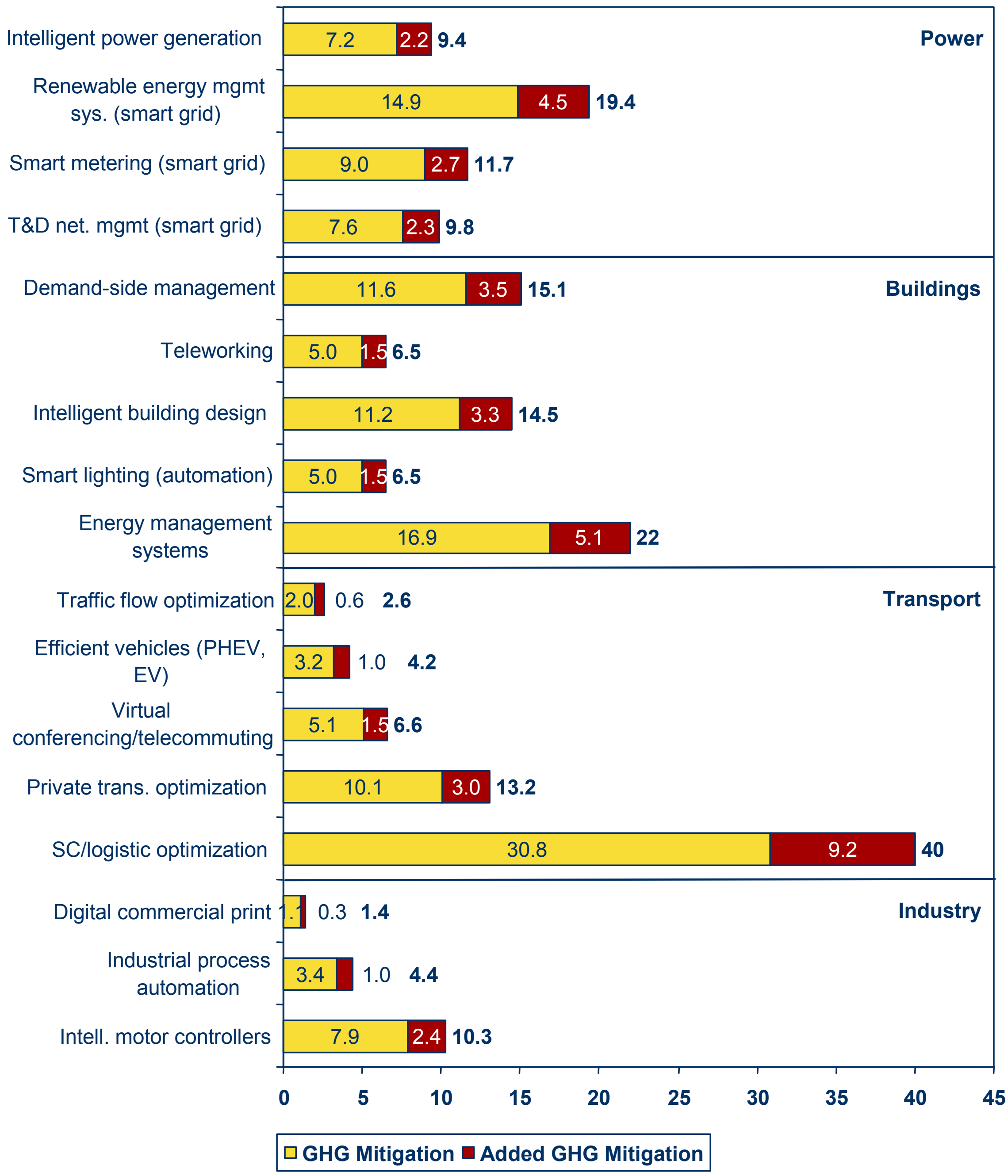


Note: Total baseline CO$_2$e reduction: 151.8M tonnes total CO$_2$e reduction at 25% target: 197.3M tonnes

Source: IDC, 2009

FIGURE 38

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — U.K.



Note: Total baseline CO_2e reduction: 151.8M tonnes total CO_2e reduction at 25% target: 197.3M tonnes

Source: IDC, 2009

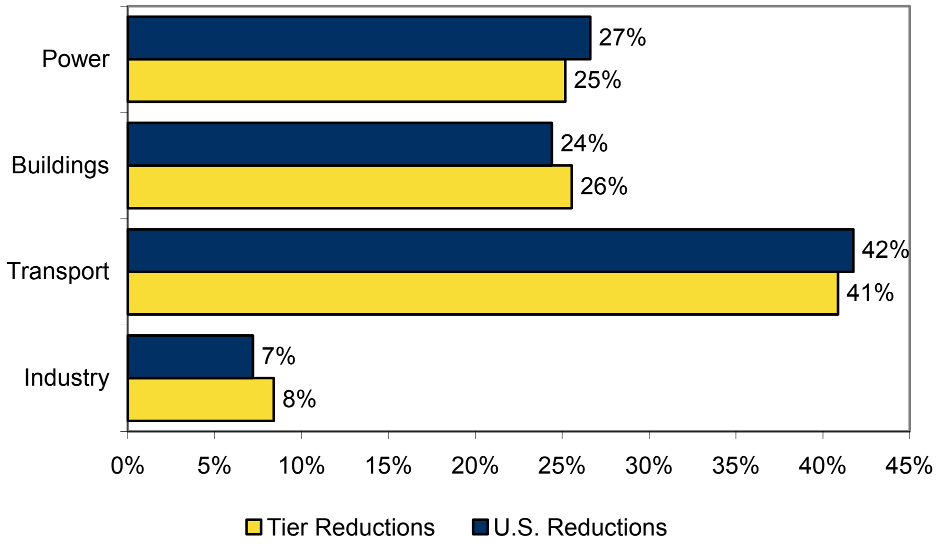
U.S.

The Current CO_2e Reduction Scenario

The U.S. is ranked first among G20 countries in terms of projected CO_2e emissions by 2020, at 5.7 billion tonnes a year. Under baseline assumptions, the U.S.'s maximum CO_2e reduction capability is 1,698.8 million tonnes annually. As Figure 39 shows, the largest share of the U.S.'s projected CO_2e reduction opportunity is in transport. At 42%, the share of CO_2e reduction opportunities associated with transport sources is roughly equal to that of tier 2 countries as a group (41%), reflecting the proportionately large impact of the U.S. within tier 2. The second-largest share of the U.S.'s CO_2e reduction opportunities are derived from the power category, which account for 27%, compared with 25% for tier 2 countries as a group. The share of CO_2e reduction opportunities derived from buildings in the U.S. (24%) is somewhat higher than that of tier 2 countries as a group (26%), while the share of CO_2e reduction opportunities related to industry sources in the U.S. (7%) essentially mirrors that of tier 2 countries as a group (8%).

FIGURE 39

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — U.S. Versus Tier 2



Source: IDC, 2009

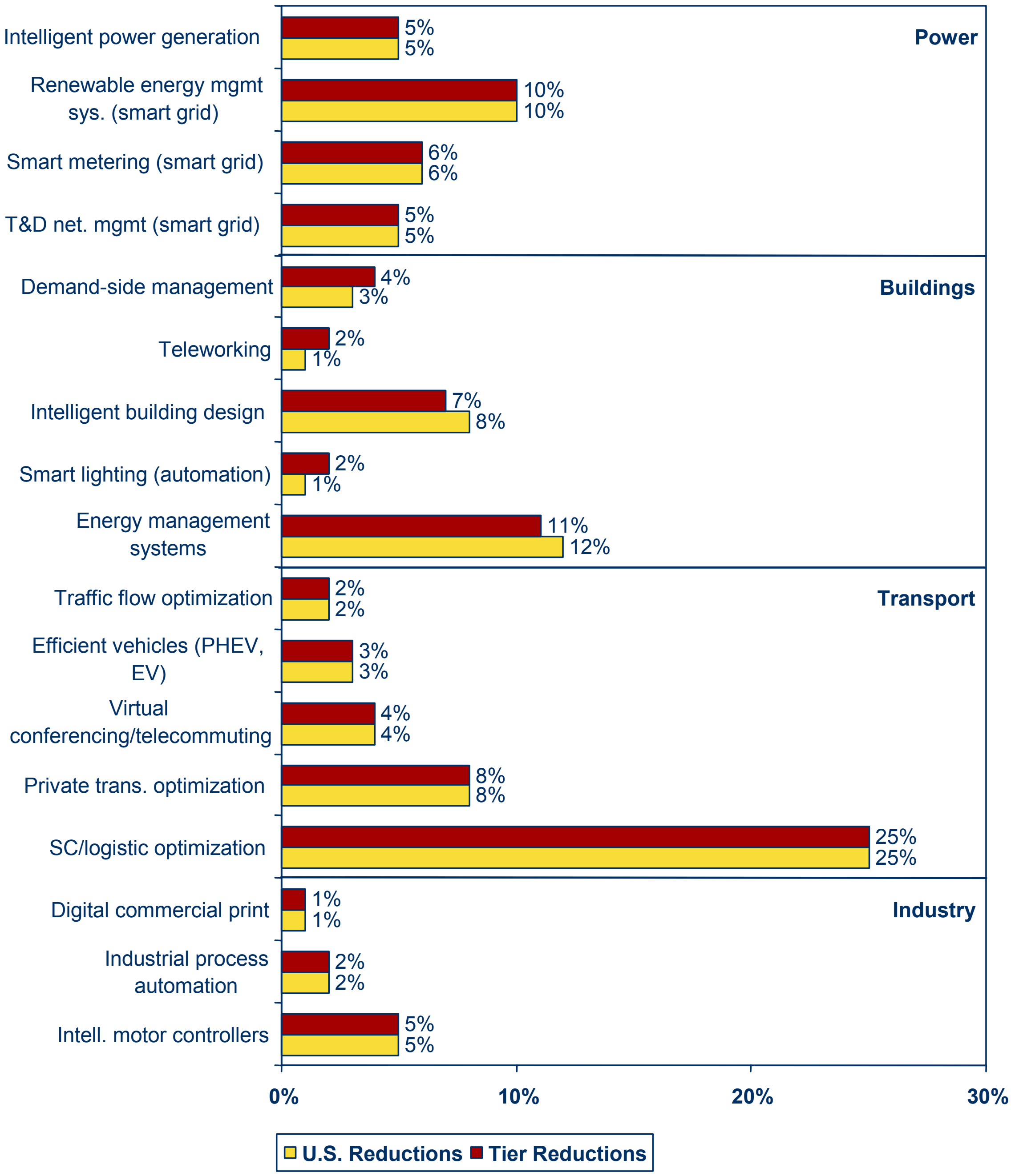
Figure 40 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in the U.S. (10%), approximately the same as for tier 2 countries as a whole (10%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 6% of the U.S.'s overall CO_2e reduction opportunity.
- Intelligent power generation will account for 5% of the U.S.'s overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of the U.S.'s overall CO_2e reduction opportunity.

Within the buildings category, energy management systems represent the largest source of potential CO_2e reduction in the U.S. (12%, compared with 11% for all of tier 2). The next largest source of potential CO_2e reduction in the U.S. is intelligent building design (8% versus 7% for all tier countries), followed by demand-side management (3%), teleworking (1%), and smart lighting (1%).

FIGURE 40

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — U.S. Versus Tier 2



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents the U.S.'s most significant CO_2e reduction opportunity (25%), accounting for roughly the same share as the average for tier 2 as a group (25%). The U.S.'s next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 8% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (4%), efficient vehicles (3%), and smart traffic systems (2%).

Within the industry category, the use of intelligent motor controllers accounts for 14% of the U.S.'s overall CO_2e reduction opportunity (comparable to tier 2 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 2% and 1% respectively of the U.S.'s overall CO_2e reduction.

The 25% Scenario: U.S.'s Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC) the U.S. is projected to achieve a CO_2e reduction of 1,698.8 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, the U.S.'s requirement is to increase annual CO_2e reductions by 30% (509.6 million tonnes) to 2,208.4 million tonnes. As Figure 41 shows, the largest increase (212.8 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 42), with the CO_2e reduction target raised from 426.2 million tonnes in 2020 to 554.1 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 140.2 million tonnes to 182.3 million tonnes in this timeframe.

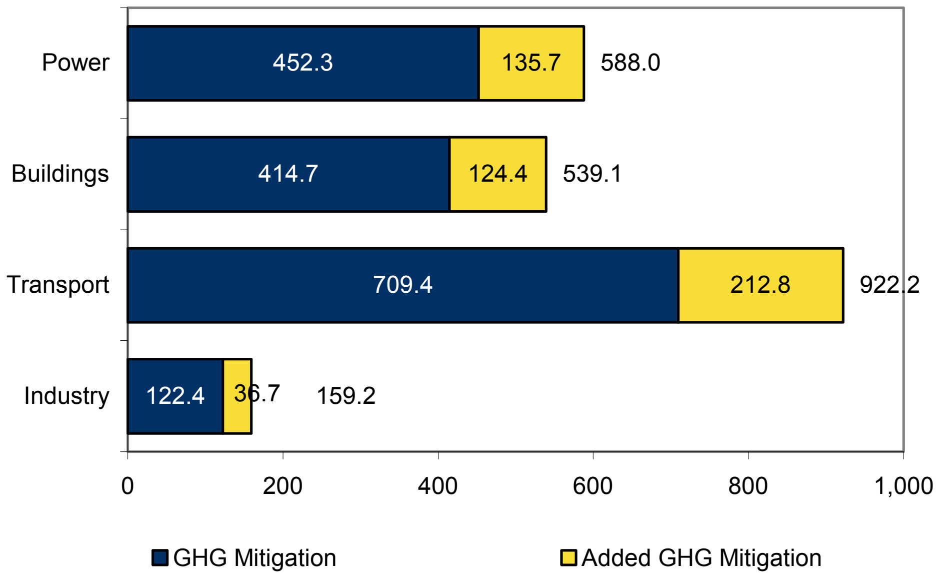
CO_2e emissions from power sources, which constitute the second-largest share of the U.S.'s overall emissions, require an increase of 135.7 million tonnes, from 452.3 million tonnes to 588.0 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 174.6 million tonnes to 227.0 million tonnes a year in 2020.

Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 197.7 million tonnes to 257.1 million tonnes a year in 2020. Overall, CO_2e reductions in the U.S.'s buildings segment need to rise 30%, from 414.7 million tonnes to 539.1 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e reductions in the U.S.'s industry segment need to be increased from 122.4 million tonnes a year to 159.2 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 78.6 million tonnes to 102.1 million tonnes in annual CO_2e emissions) and industrial process automation (from 33.5 million tonnes to 43.6 million tonnes).

FIGURE 41

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — U.S.

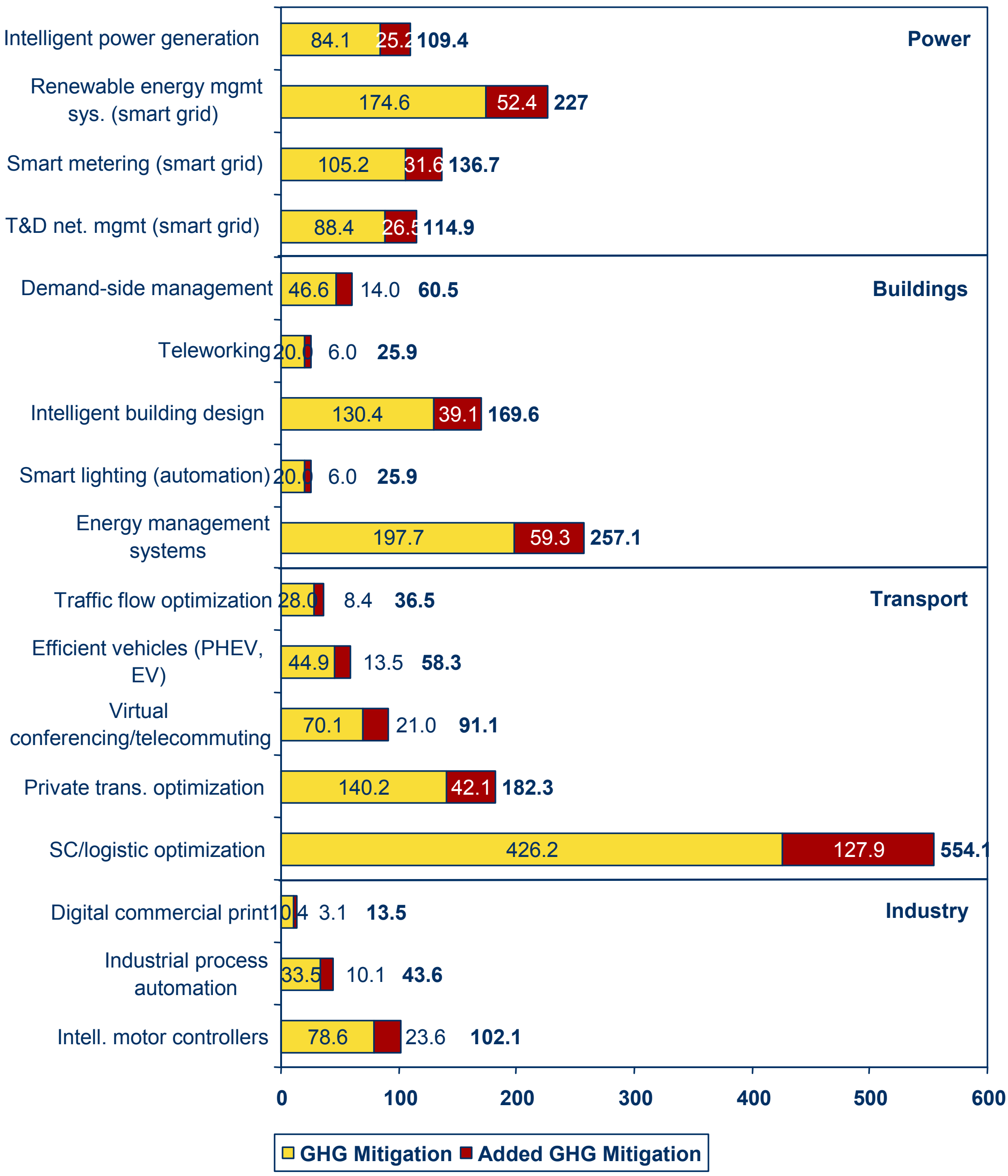


Note: Total baseline CO_2e reduction: 1,698.8M tonnes total CO_2e reduction at 25% target: 2,208.4M tonnes

Source: IDC, 2009

FIGURE 42

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — U.S.



Note: Total baseline CO_2e reduction: 1,698.8M tonnes total CO_2e reduction at 25% target: 2,208.4M tonnes

Source: IDC, 2009

CO_2e Reduction Analysis for Tier 3 Countries

Within the overall scope of this analysis, countries within the G20 have been rated on each country's underlying potential for CO_2e reduction. These determinations are based on a series of measurable variables that relate to:

- The current state of technology penetration and practices within the country
- Characteristics of the physical infrastructure and geographic factors
- The relative difficulty each country will have in achieving its underlying potential

Within this framework, countries are mapped across a spectrum, based on the degree to which technology investment can be leveraged to close the gap between each country's current CO_2e reduction potential and its true "maximum" potential. Viewed as a continuum, lower tier countries (by virtue of existing technology infrastructure, among other things) are closest to their potential, while higher tier countries have a larger gap (hence a greater opportunity to leverage technology).

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020. This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first metric is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%. The second has been based on a country's ranking in IDC's ICT Sustainability Index and its ability to try to reach the 25% reduction in CO_2e emissions.

Within this framework, tier 3 countries are those whose technology, process, and physical infrastructure make them moderately advanced, hence moderately close to their CO_2e reduction potential. G20 countries within tier 3 (profiled later in this section) are:

- Canada
- Italy

Profile: Tier 3 Countries

As Figure 43 shows, transport-related sources are projected to represent a substantially higher share of CO_2e reduction potential for tier 3 countries (43%) than for the G20 overall (29%) in 2020. The share of reduction potential associated with power sources, at 19%, is significantly lower than the G20 as a whole (28%). In all other major impact categories, the relative shares are roughly comparable between tier 3 countries and the G20 overall. As such, transport can be seen as a comparatively important source of CO_2e reduction potential in tier 3 countries.

Figure 44 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction for tier 3 countries (7%), a somewhat lower share than that of G20 countries as a whole (11%). Of the remaining components of the power category, by 2020:

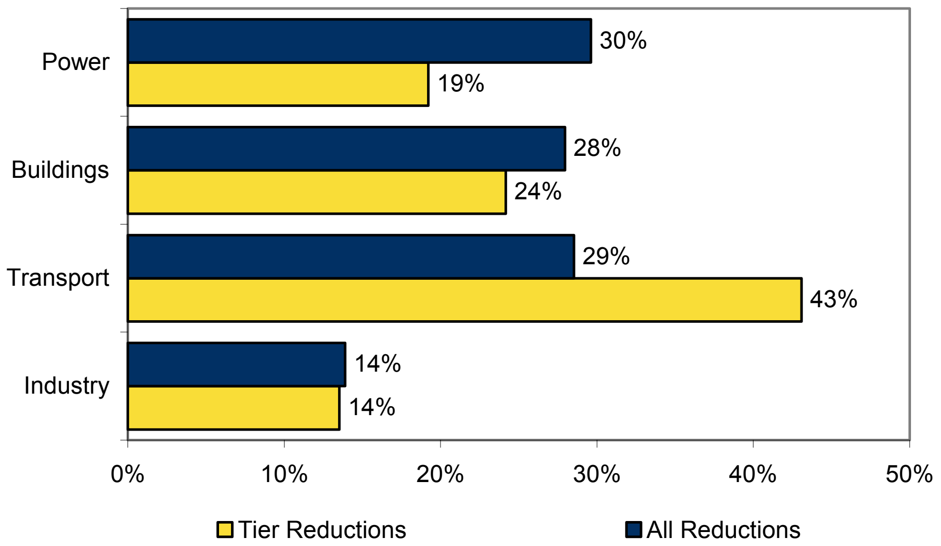
- Smart metering will account for 4% of tier 3's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 4% of tier 3's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 4% of tier 3's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems, intelligent building design, and demand-side management programs are expected to account for 8%, 6%, and 5% respectively of overall CO_2e reduction opportunities in 2020 for tier 3 countries, reflecting a pattern also seen in G20 as a group.

In the transport category (and across all categories), supply chain and logistics optimization represents tier 3's most significant CO_2e reduction opportunity (26%), a share notably higher than G20 countries as a group (20%). The next largest source of CO_2e reduction opportunity for tier 3 countries is in private transport optimization, accounting for 9% of the tier's total CO_2e reduction opportunity in 2020.

FIGURE 43

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 3 Versus G20 Less EU



Source: IDC, 2009

Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (4%), efficient vehicles (3%), and smart traffic systems (2%).

Within the industry category, the use of intelligent motor controllers is seen as providing the category's largest CO_2e reduction opportunity, accounting for 9% of tier 3's overall CO_2e reduction, a share in line with that of G20 countries as a group (8%) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 4% and 3% respectively of tier 3's overall CO_2e reduction potential.

The 25% Scenario: Tier 3's Requirement for a 25% CO_2e Reduction for the G20 by 2020

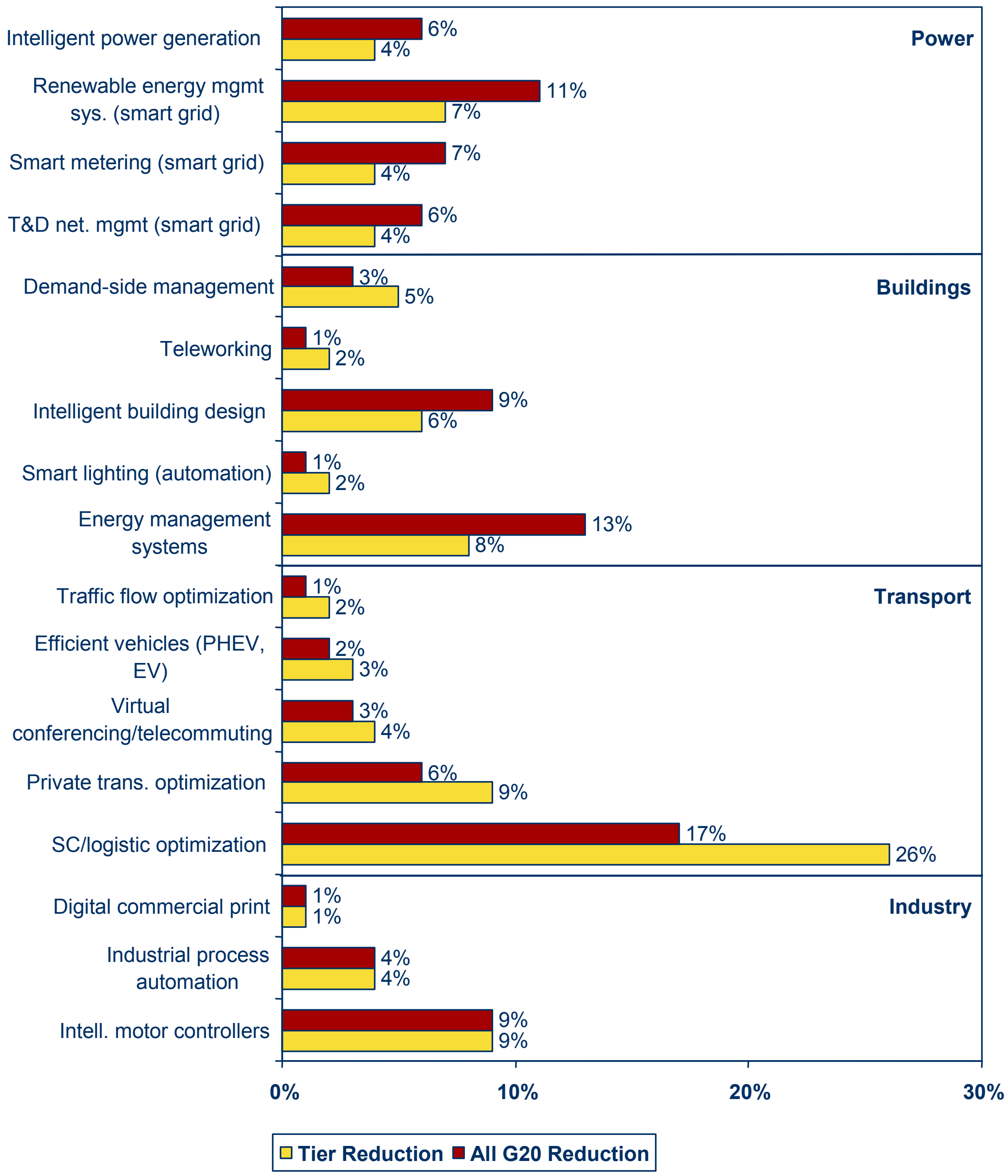
Under the baseline scenario, tier 3 countries as a group are projected to achieve a CO_2e reduction of 254.8 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile (the factors used to group G20 countries into different tiers).

Within this framework, all countries within tier 3 will need to increase annual CO_2e reductions by 25% (63.7 million tonnes) to 318.4 million tonnes. As Figure 45 shows, the largest increase (27.4 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 46), with the CO_2e reduction target raised from 65.9 million tonnes in 2020 to 82.4 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 21.7 million tonnes to 27.1 million tonnes in this timeframe.

Among sources in the buildings category, which constitutes the second-largest share of tier 3's overall emissions, the largest increases in tier 3 CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 21.4 million tonnes to 26.8 million tonnes a year by 2020.

FIGURE 44

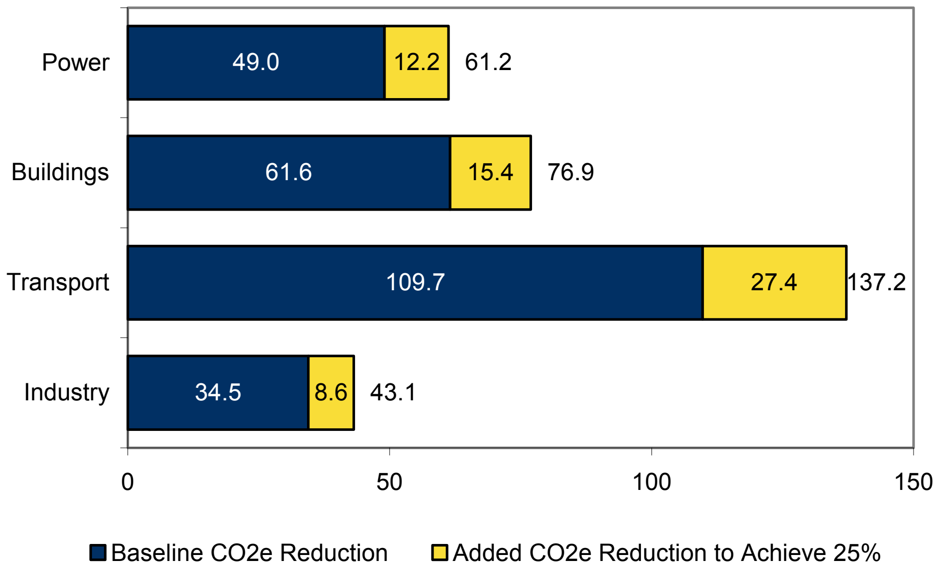
Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 3 Versus G20 Less EU



Source: IDC, 2009

FIGURE 45

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 3



Note: Total baseline CO$_2$e reduction: 254.8M tonnes total CO$_2$e reduction at 25% target: 318.4M tonnes

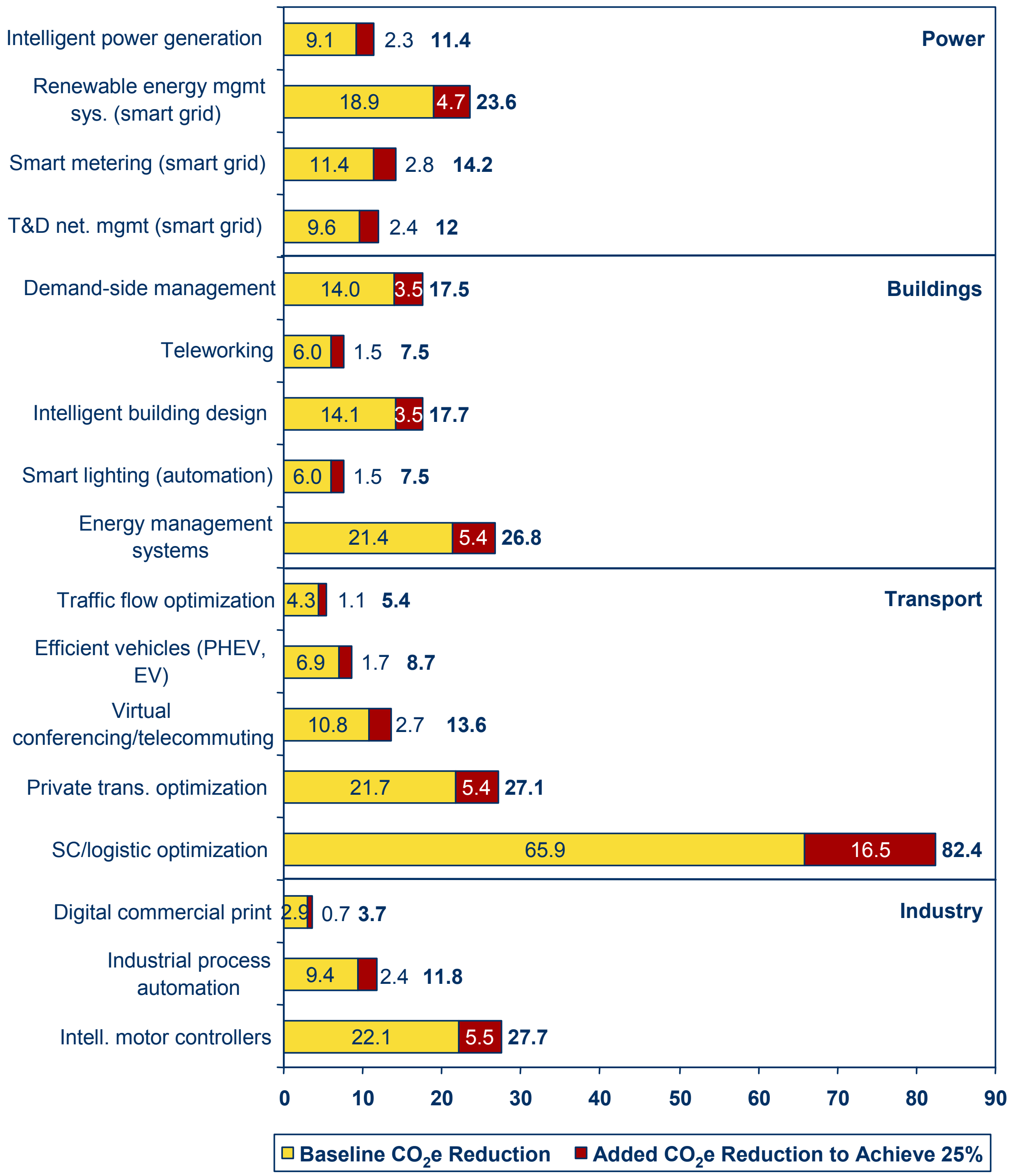
Source: IDC, 2009

CO$_2$e emissions from power sources require an increase of 12.2 million tonnes, from 49.0 million tonnes to 61.2 million tonnes annually by 2020. Within the overall power category, the largest increases in CO$_2$e abatement should come from investments in renewable energy management systems, whose associated CO$_2$e reductions should increase from 18.9 million tonnes to 23.6 million tonnes a year in 2020.

The IDC model holds that CO$_2$e reductions in tier 3's industry segment need to be increased from 5.2 million tonnes a year to 8.6 million tonnes for the G20 countries to achieve an overall CO$_2$e reduction of 25%. Within the industry segment, investments to further decrease CO$_2$e emissions should be targeted at intelligent motor controllers (from 3.3 million tonnes to 5.5 million tonnes in annual CO$_2$e emissions) and industrial process automation (from 1.4 million tonnes to 2.4 million tonnes).

FIGURE 46

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 3



Note: Total baseline CO_2e reduction: 254.8M tonnes total CO_2e reduction at 25% target: 318.4M tonnes

Source: IDC, 2009

Country-Specific Overviews

The following sections present separate, country-level overviews of each of the countries within tier 3: Canada and Italy. Each overview looks at the current potential for CO_2e reduction by 2020, as well as each country's modified CO_2e reduction requirement for the G20 countries overall to achieve a 25% CO_2e reduction in this timeframe.

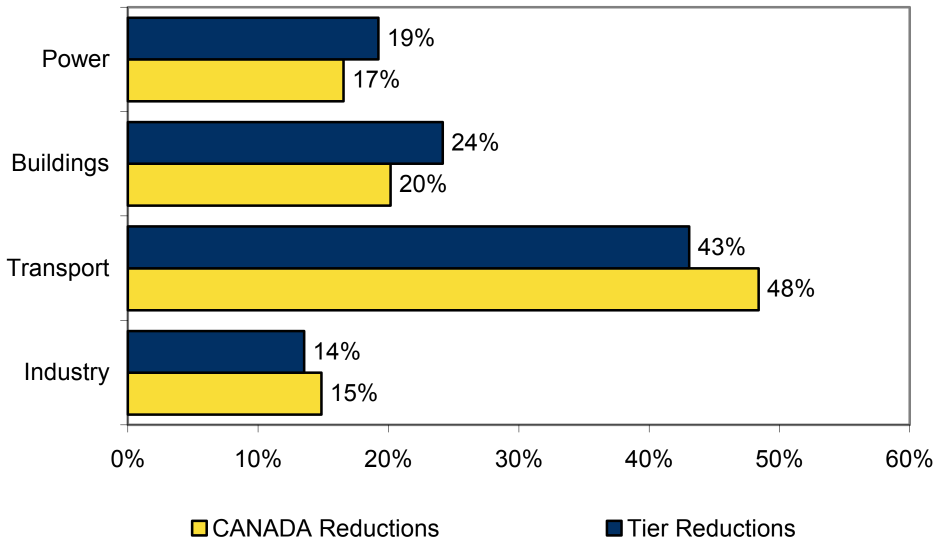
Canada

The Current CO_2e Reduction Scenario

Canada is ranked ninth among G20 countries in terms of projected CO_2e emissions by 2020, at 538.8 million tonnes a year. Under baseline assumptions, Canada's maximum CO_2e reduction capability is 129.2 million tonnes annually. As Figure 47 shows, the largest share of Canada's projected CO_2e reduction opportunity is in transport. At 48%, the share of CO_2e reduction opportunities associated with transport sources is somewhat higher than that of tier 3 countries as a group (43%). The second-largest share of Canada's CO_2e reduction opportunities are derived from the buildings category, which accounts for 20%, compared with 24% for tier 3 countries as a group. The share of CO_2e reduction opportunities related to power sources in Canada (17%) is marginally lower than that of tier 3 countries as a group (25%), while the share of CO_2e reduction opportunities derived from industry in Canada (15%) is roughly the same as that of tier 3 countries as a group (14%).

FIGURE 47

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Canada Versus Tier 3



Source: IDC, 2009

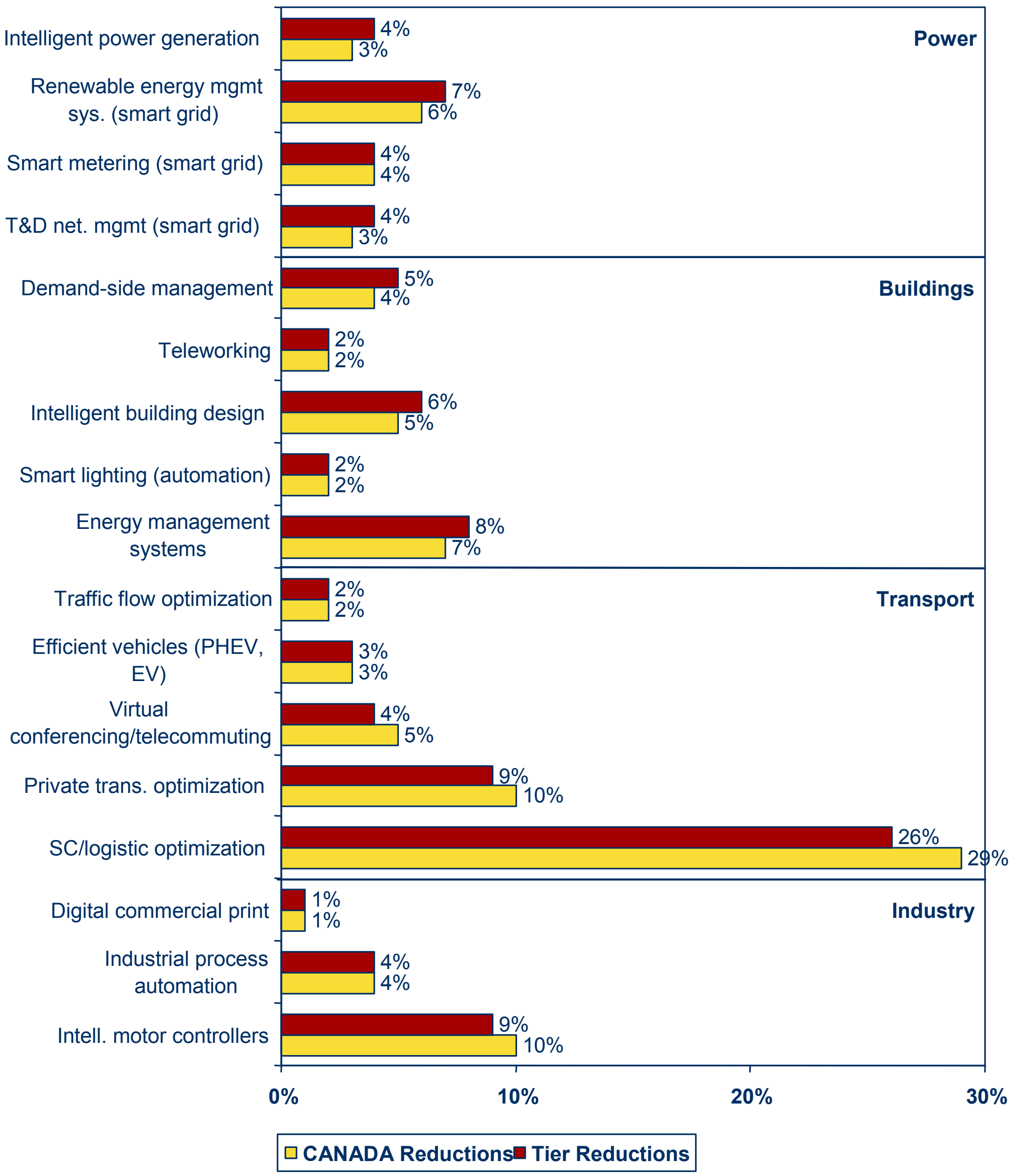
Figure 48 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Canada (6%), roughly in line with its share for tier 3 as a whole (7%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 4% of Canada's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 3% of Canada's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 3% of Canada's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems represent the largest source of potential CO_2e reduction in Canada (7%, compared with 8% for all of tier 3). Other significant sources for CO_2e reductions in the buildings category include intelligent building design (5%), demand-side management programs (4%), teleworking (2%), and smart lighting (2%).

FIGURE 48

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Canada Versus Tier 3



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Canada's most significant CO_2e reduction opportunity (29%), a somewhat higher share than tier 3 as a group (26%). Canada's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 10% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunities include reduced travel through telecommuting (5%), efficient vehicles (3%), and smart traffic systems (2%).

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 10% of Canada's overall CO_2e reduction (compared with 9% for tier 3 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 4% and 1% respectively of Canada's overall CO_2e reduction.

The 25% Scenario: Canada's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Canada is projected to achieve a CO_2e reduction of 129.2 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Canada's requirement is to increase annual CO_2e reductions by 25% (32.3 million tonnes) to 161.6 million tonnes. As Figure 49 shows, the largest increase (15.6 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 50), with the CO_2e reduction target raised from 37.6 million tonnes in 2020 to 47.0 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 12.4 million tonnes to 15.5 million tonnes in this timeframe.

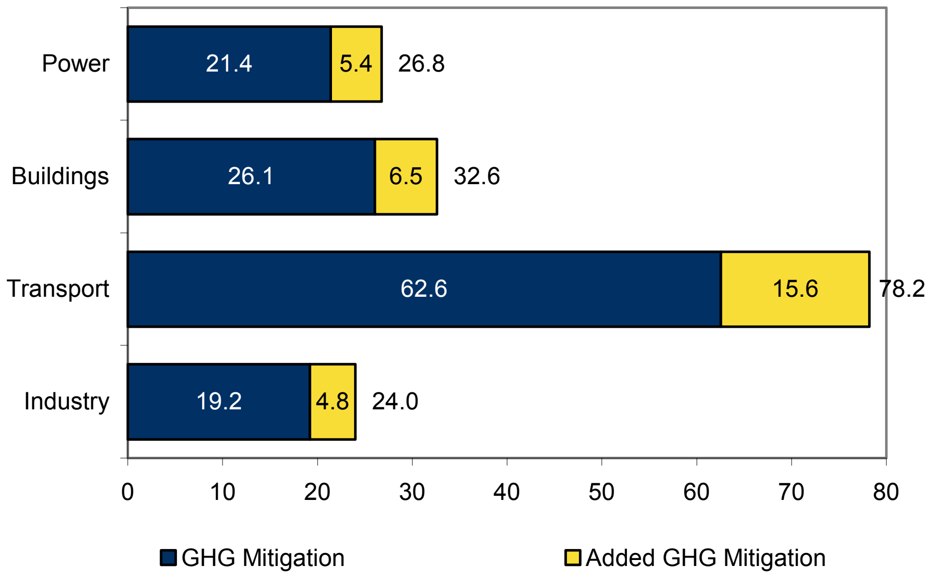
Among sources in the buildings category (the second largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 9.4 million tonnes to 11.2 million tonnes a year in 2020. Overall, CO_2e reductions in Canada's buildings segment need to rise 25%, from 26.1 million tonnes to 32.6 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from power sources, which constitute the third-largest share of Canada's overall emissions, require an increase of 5.4 million tonnes, from 21.4 million tonnes to 26.9 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 8.3 million tonnes to 10.3 million tonnes a year in 2020.

CO_2e reductions in Canada's industry segment need to be increased from 19.2 million tonnes a year to 24.0 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 12.3 million tonnes to 15.4 million tonnes in annual CO_2e emissions) and industrial process automation (from 5.3 million tonnes to 6.6 million tonnes).

FIGURE 49

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Canada

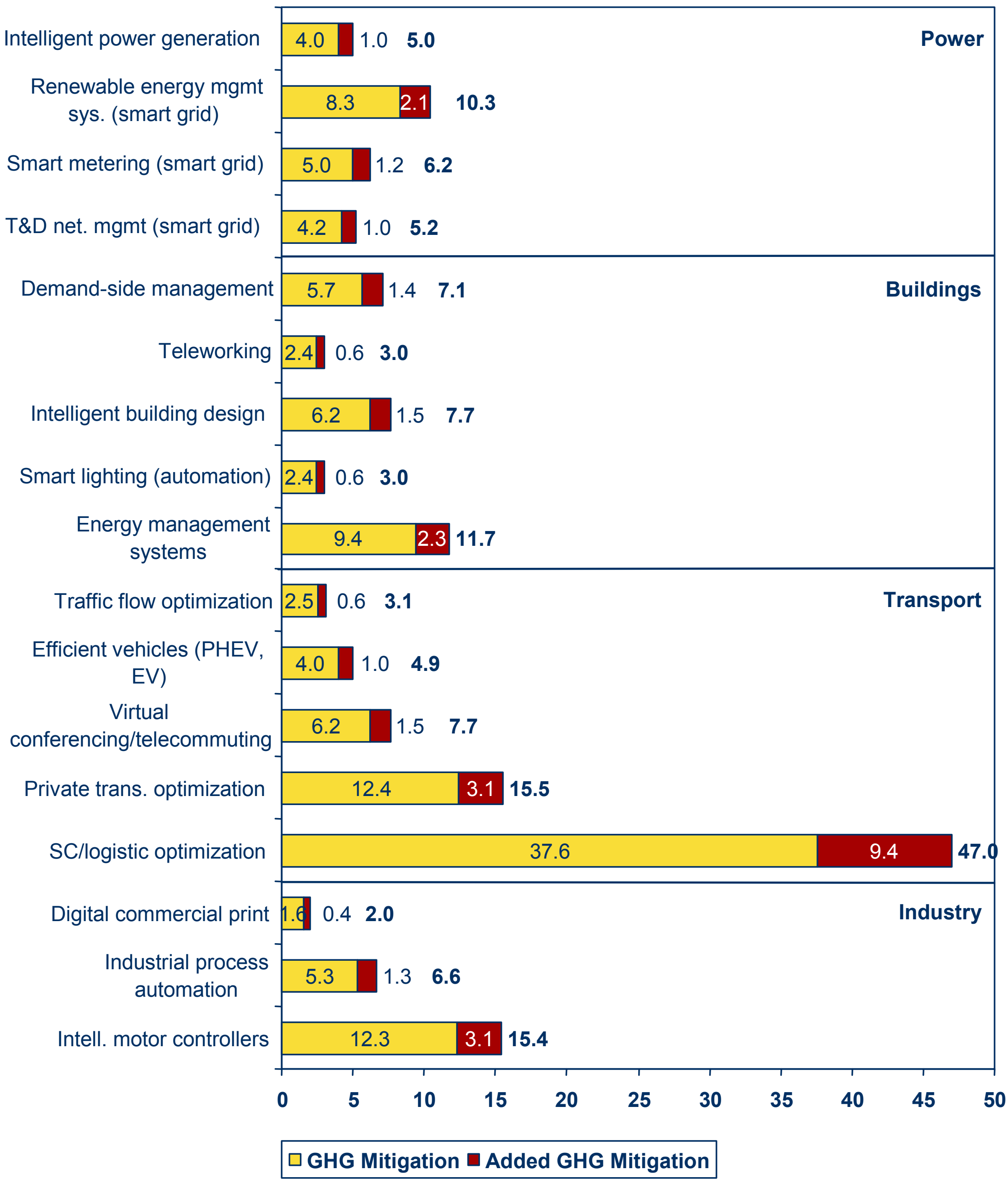


Note: Total baseline CO_2e reduction: 129.2M tonnes total CO_2e reduction at 25% target: 161.6M tonnes

Source: IDC, 2009

FIGURE 50

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Canada



Note: Total baseline CO$_2$e reduction: 129.2M tonnes total CO$_2$e reduction at 25% target: 161.6M tonnes

Source: IDC, 2009

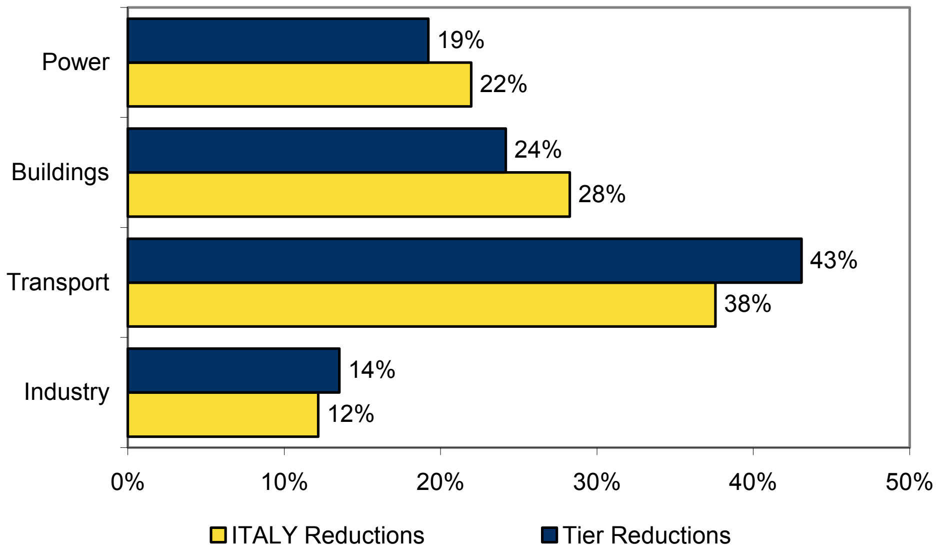
Italy

The Current CO_2e Reduction Scenario

Italy is ranked 10th among G20 countries in terms of projected CO_2e emissions by 2020, at 448.0 million tonnes a year. Under baseline assumptions, Italy's maximum CO_2e reduction capability is 125.5 million tonnes annually. As Figure 51 shows, the largest share of Italy's projected CO_2e reduction opportunity is in transport. At 38%, the share of CO_2e reduction opportunities associated with transport sources is somewhat lower than that of tier 3 countries as a group (43%). The second-largest share of Italy's CO_2e reduction opportunities are derived from the buildings category, which accounts for 28%, compared with 24% for tier 3 countries as a group. The share of CO_2e reduction opportunities related to power sources in Italy (22%) is somewhat higher than that of tier 3 countries as a group (19%), while the share of CO_2e reduction opportunities derived from industry in Italy (12%) is marginally lower than that of tier 3 countries as a group (14%).

FIGURE 51

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Italy Versus Tier 3



Source: IDC, 2009

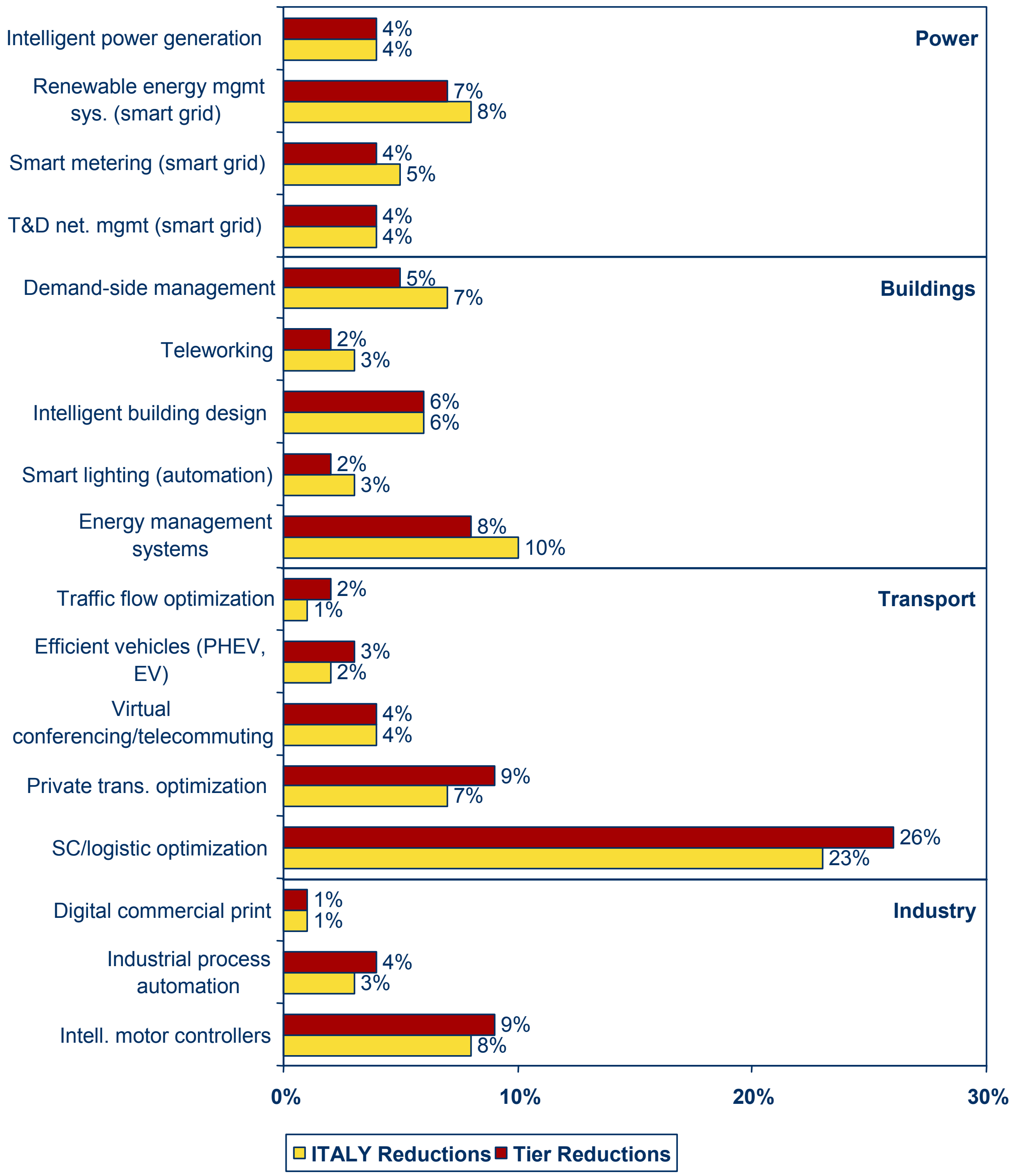
Figure 52 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Italy (8%), roughly in line with its share for tier 3 as a whole (7%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 5% of Italy's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 4% of Italy's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 4% of Italy's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems represents the largest source of potential CO_2e reduction in Italy (10%, compared with 8% for all of tier 3). Other significant sources for CO_2e reductions in the buildings category include demand-side management programs (7%), intelligent building design (6%), teleworking (3%), and smart lighting (3%).

FIGURE 52

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Italy Versus Tier 3



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Italy's most significant CO_2e reduction opportunity (23%), a somewhat lower share than tier 3 as a group (26%). Italy's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 7% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (4%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 8% of Italy's overall CO_2e reduction potential (compared with 9% for tier 2 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 3% and 1% respectively of Italy's overall CO_2e reduction.

The 25% Scenario: Italy's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Italy is projected to achieve a CO_2e reduction of 125.5 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Italy's requirement is to increase annual CO_2e reductions by 25% (31.4 million tonnes) to 156.9 million tonnes. As Figure 53 shows, the largest increase (11.8 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 54), with the CO_2e reduction target raised from 28.3 million tonnes in 2020 to 35.1 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 9.3 million tonnes to 11.73 million tonnes in this timeframe.

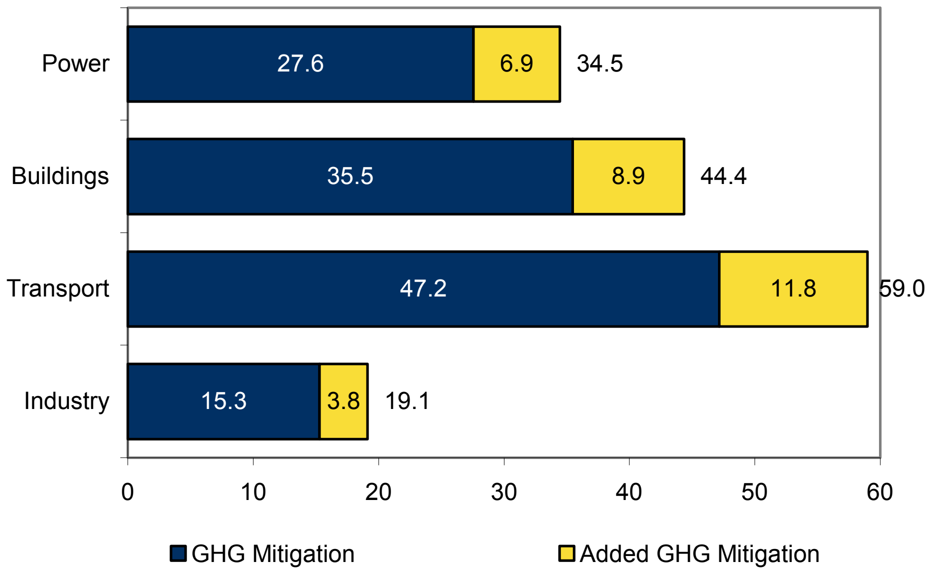
Among sources in the buildings category (the second largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 12.1 million tonnes to 15.1 million tonnes a year in 2020. Overall, CO_2e reductions in Italy's buildings segment need to rise 25%, from 35.5 million tonnes to 44.4 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from power sources, which constitute the third-largest share of Italy's overall emissions, require an increase of 6.9 million tonnes, from 27.6 million tonnes to 34.5 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 10.6 million tonnes to 13.3 million tonnes a year in 2020.

CO_2e reductions in Italy's industry segment need to be increased from 15.3 million tonnes a year to 19.1 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 9.8 million tonnes to 12.3 million tonnes in annual CO_2e emissions) and industrial process automation (from 4.2 million tonnes to 5.2 million tonnes).

FIGURE 53

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Italy

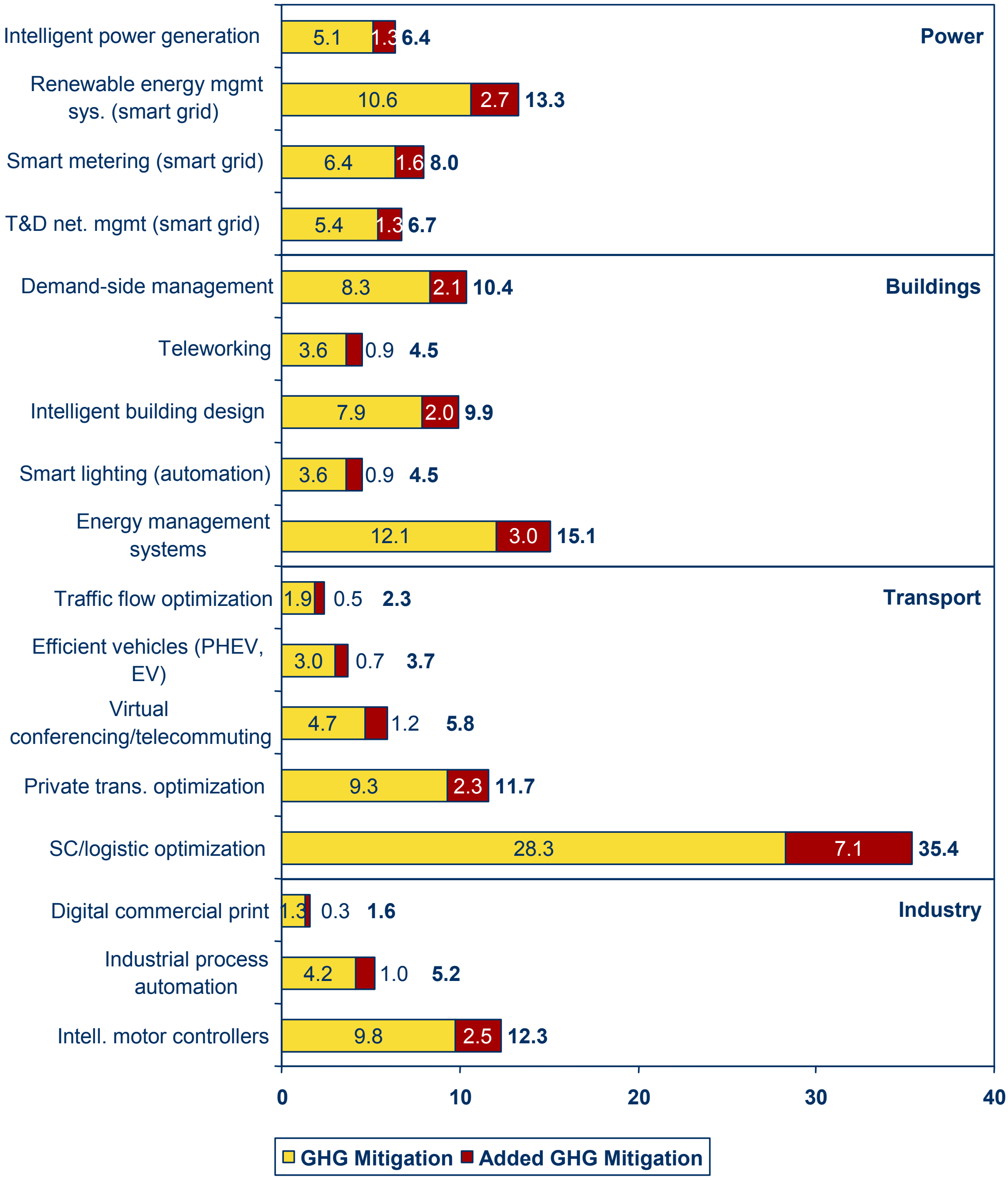


Note: Total baseline CO$_2$e reduction: 125.5M tonnes total CO$_2$e reduction at 25% target: 156.9M tonnes

Source: IDC, 2009

FIGURE 54

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Italy



Note: Total baseline CO$_2$e reduction: 125.5M tonnes total CO$_2$e reduction at 25% target: 156.9M tonnes

Source: IDC, 2009

CO_2e Reduction Analysis for Tier 4 Countries

Within the overall scope of this analysis, countries within the G20 have been rated on each country's underlying potential for CO_2e reduction. These determinations are based on a series of measurable variables that relate to:

- The current state of technology penetration and practices within the country
- Characteristics of the physical infrastructure and geographic factors
- The relative difficulty each country will have in achieving its underlying potential

Within this framework, countries are mapped across a spectrum, based on the degree to which technology investment can be leveraged to close the gap between each country's current CO_2e reduction potential and its true "maximum" potential. Viewed as a continuum, lower tier countries (by virtue of existing technology infrastructure, among other things) are closest to their potential, while higher tier countries have a larger gap (hence a greater opportunity to leverage technology).

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020. This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first metric is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%. The second has been based on a country's ranking within IDC's ICT Sustainability Index and its ability to try to reach the 25% reduction in CO_2e emissions.

Within this framework, tier 4 countries are those whose technology, process, and physical infrastructure provide substantial opportunity to increase CO_2e reduction potential through investments in technology-based initiatives. G20 countries within tier 4 (profiled later in this section) are:

- Australia
- China
- Mexico
- South Korea
- Turkey

Profile: Tier 4 Countries

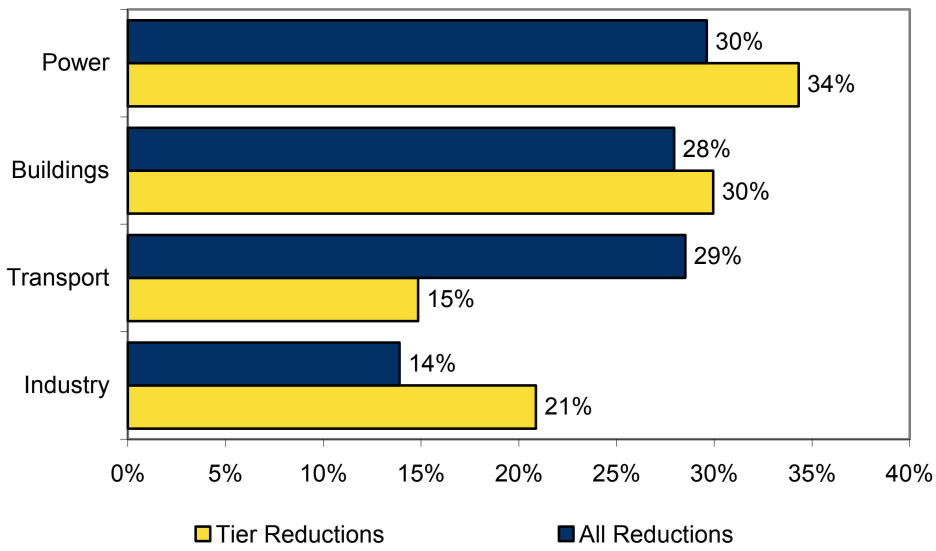
As Figure 55 shows, power-related sources are projected to represent a somewhat higher share of CO_2e reduction potential for tier 4 countries (34%) than for the G20 overall (30%) in 2020, as does the share of reduction potential associated with buildings sources (at 30%, compared with 28% for the G20 as a whole). The most significant difference between tier 4 countries and the G20 as a whole is in the transport category, with tier 4 countries having a far lower share of their CO_2e reduction potential (15%) and G20 countries as a whole (29%). Conversely, a considerably higher share of tier 4 CO_2e reduction potential (21%) derives from industry related activities than the G20 overall (14%). As such, issues related to transport (less) and industry (more) can be seen as distinguishing characteristics of tier 4 countries from the overall G20 population.

Figure 56 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction for tier 4 countries (13%), a somewhat higher share than that of G20 countries as a whole (11%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 8% of tier 4's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will account for 7% of tier 4's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 6% of tier 4's overall CO_2e reduction opportunity.

FIGURE 55

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 4 Versus G20 Less EU



Source: IDC, 2009

Within the buildings category, energy management systems and intelligent building design and demand-side management programs are expected to account for 15% and 10% respectively of overall CO_2e reduction opportunities in 2020 for tier 4 countries, reflecting a pattern also seen in G20 as a group.

In the transport category, supply chain and logistics optimization represents tier 4's primary CO_2e reduction opportunity (9%), a share significantly lower than G20 countries as a group (20%). The next largest source of CO_2e reduction opportunity for tier 4 countries is in private transport optimization, accounting for 3% of the tier's total CO_2e reduction opportunity in 2020. Transport factors delivering comparably lower

CO_2e reduction opportunity include reduced travel through telecommuting (1%), efficient vehicles (1%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing the category's largest CO_2e reduction opportunity, accounting for 13% of tier 4's overall CO_2e reduction, a significantly higher share than that of G20 countries as a group (8%) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 6% and 2% respectively of tier 4's overall CO_2e reduction potential.

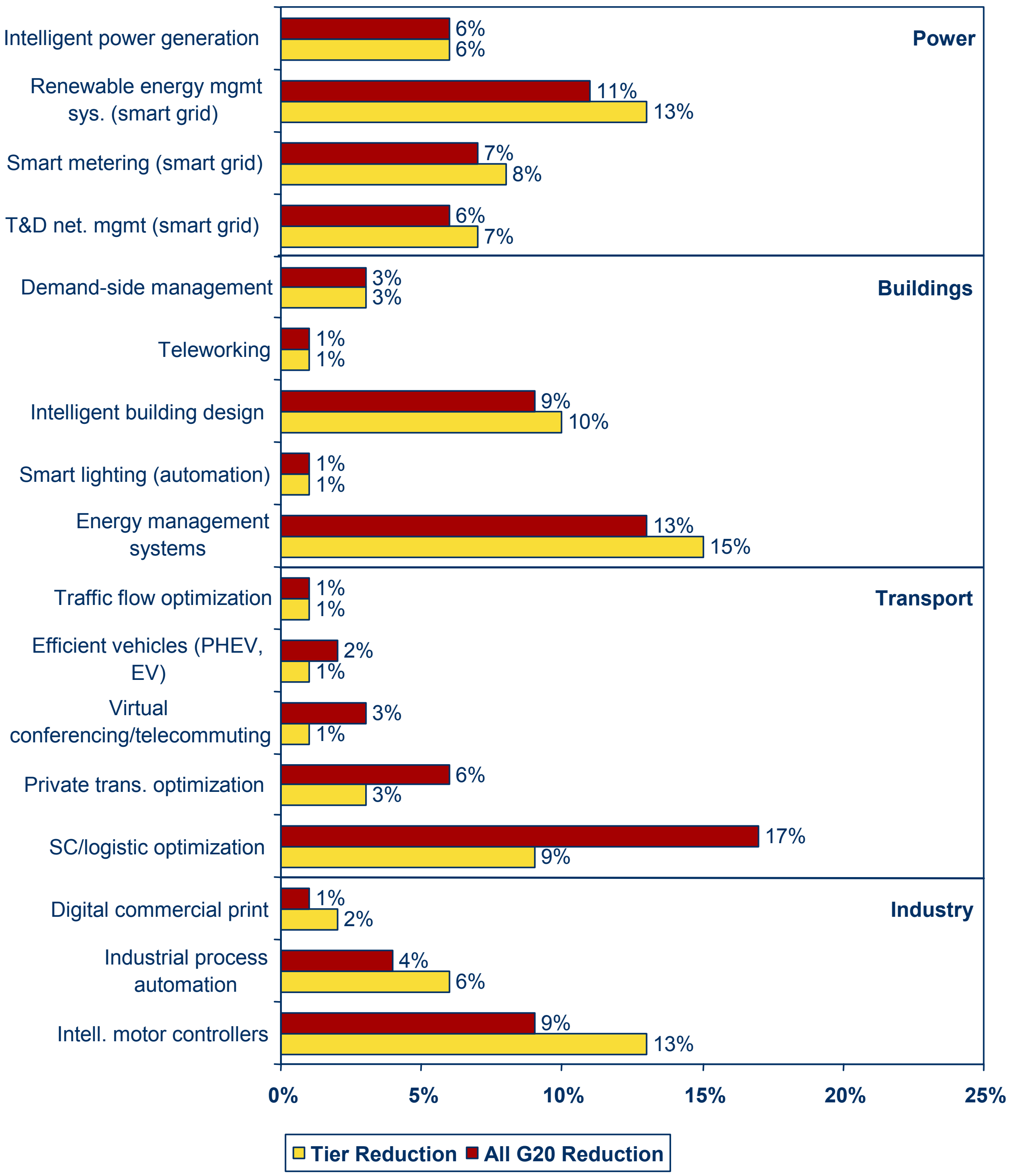
The 25% Scenario: Tier 4's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario, tier 4 countries as a group are projected to achieve a CO_2e reduction of 1,881.3 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile (the factors used to group G20 countries into different tiers).

Within this framework, all countries within tier 4 will need to increase their annual CO_2e reductions by 20% to 2,257.6 million tonnes. As Figure 56 shows, the largest increase (129.1 million tonnes) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from renewable smart energy.

FIGURE 56

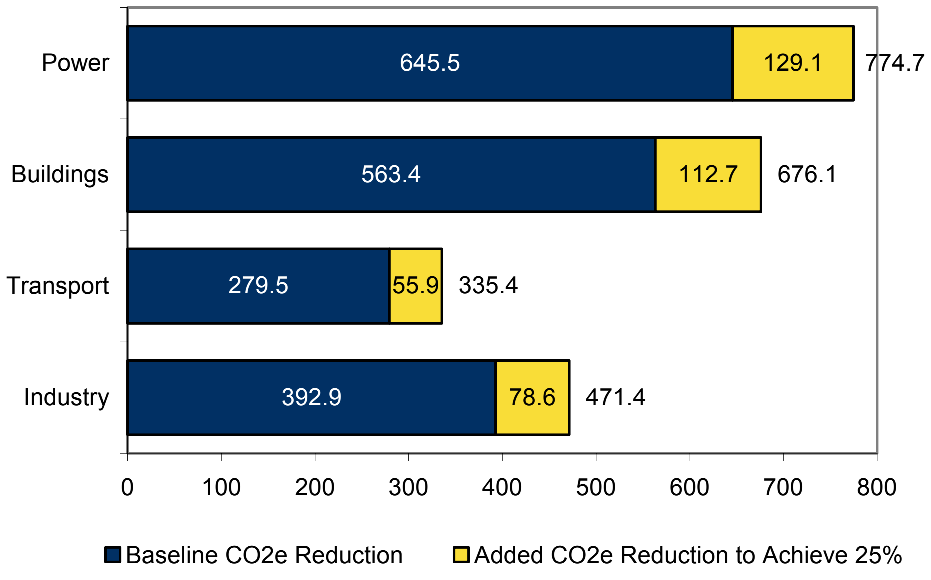
Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 4 Versus G20 Less EU



Source: IDC, 2009

FIGURE 57

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 4



Note: Total baseline CO_2e reduction: 1,881.3M tonnes total CO_2e reduction at 25% target: 2,257.6M tonnes

Source: IDC, 2009

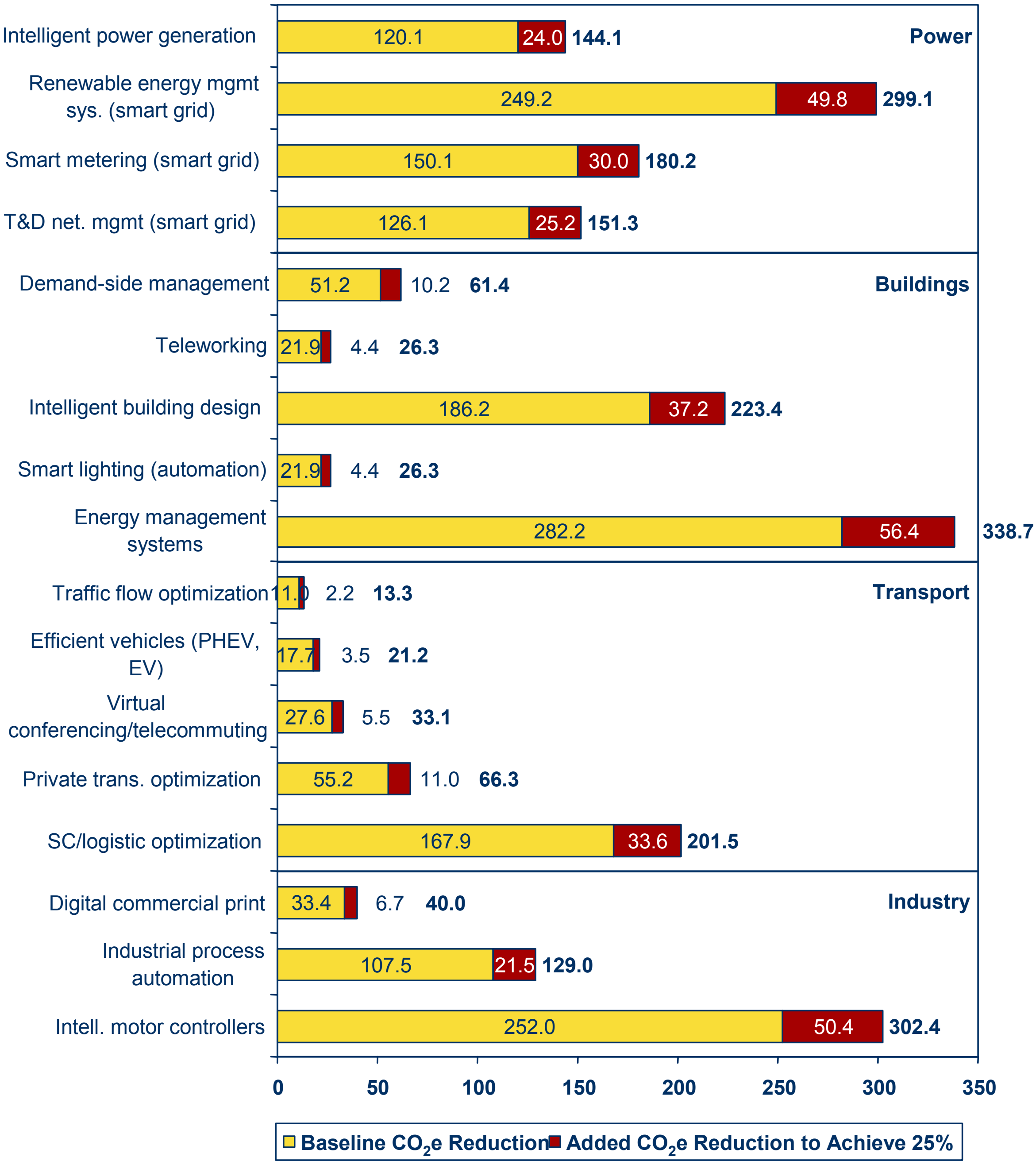
Among sources in the buildings category, which constitutes the second-largest share of tier 4's overall emissions, the largest increases in tier 4 CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 282.2 million tonnes to 338.7 million tonnes a year in 2020. Overall, CO_2e reductions in tier 4's buildings segment need to increase from 563.4 million tonnes to 676.1 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The IDC model holds that CO_2e reductions in tier 4's industry segment need to be increased from 392.9 million tonnes a year to 471.4 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 252.0 million tonnes to 302.4 million tonnes in annual CO_2e emissions) and industrial process automation (from 107.5 million tonnes to 129.0 million tonnes).

CO_2e emissions from transport sources — the smallest share of tier 4's overall reduction potential — require an increase of 55.9 million tonnes to 335.4 million tonnes annually by 2020. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 167.9 million tonnes in 2020 to 201.5 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 52.2 million tonnes to 66.3 million tonnes in this timeframe.

FIGURE 58

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 4



Note: Total baseline CO$_2$e reduction: 1,881.3M tonnes total CO$_2$e reduction at 25% target: 2,257.6M tonnes

Source: IDC, 2009

Country-Specific Overviews

The following sections present separate, country-level overviews of each of the countries within tier 4: Australia, China, Mexico, South Korea, and Turkey. Each overview looks at the current potential for CO_2e reductions by 2020, as well as each country's modified CO_2e reduction requirement for the G20 countries overall to achieve a 25% CO_2e reduction in this timeframe.

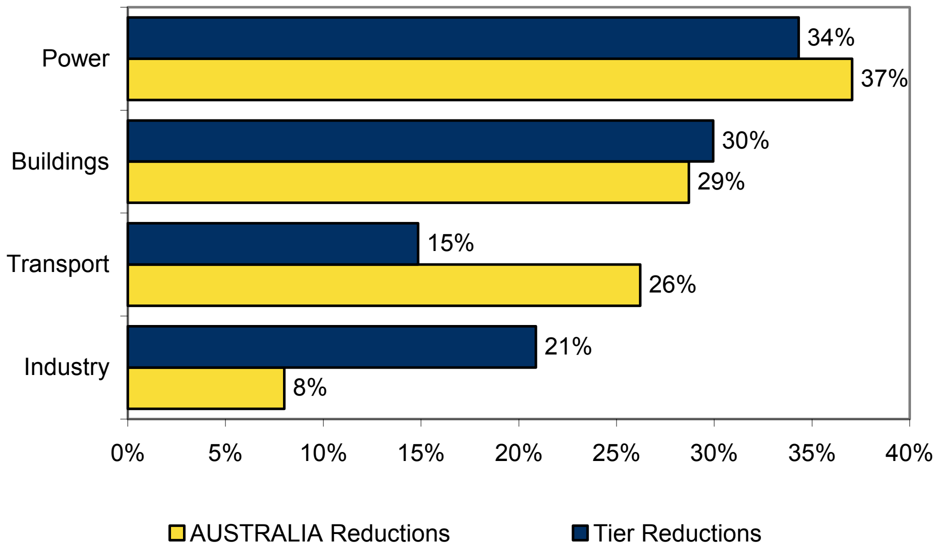
Australia

The Current CO_2e Reduction Scenario

Australia is ranked 11th among G20 countries in terms of projected CO_2e emissions by 2020, at 394.5 million tonnes a year. Under baseline assumptions, Australia's maximum CO_2e reduction capability is 116.6 million tonnes annually. As Figure 59 shows, the largest share of Australia's projected CO_2e reduction opportunity is in the power area. At 37%, the share of CO_2e reduction opportunities associated with power sources is somewhat higher than that of tier 4 countries as a group (34%). The buildings category represents the second-largest area, at 29% of CO_2e reduction potential in 2020, roughly equivalent to the share for tier 4 as a group (30%). The share of CO_2e reduction opportunities derived from transport sources is substantially higher for Australia (26%) than for tier 4 collectively (15%). Conversely, industry-oriented sources of reduction are expected to account for a far lower share in Australia (8%) than tier 4 countries as a group (21%).

FIGURE 59

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Australia Versus Tier 4



Source: IDC, 2009

Figure 58 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Australia (14%), roughly in line with the percentage seen for tier 4 as a whole (13%). Of the remaining components of the power category, by 2020:

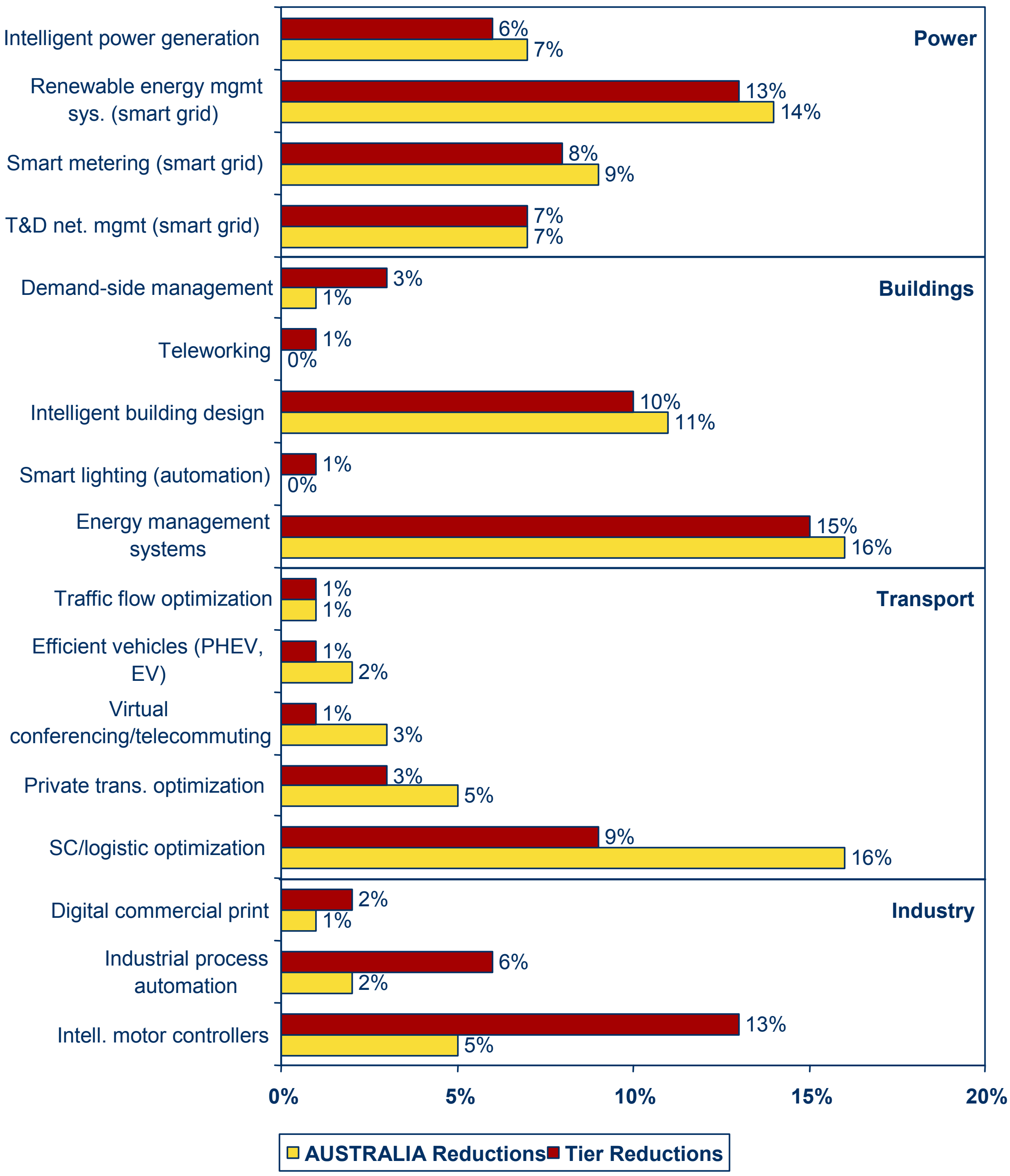
- Smart metering will account for 9% of Australia's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 7% of Australia's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 7% of Australia's overall CO_2e reduction opportunity.

In each of these categories, Australia's percentages generally mirror those of the overall tier 4 population.

In the buildings category, the largest potential for CO_2e reductions are in the areas of energy management systems and intelligent building design, which are expected to account for 16% and 11% respectively of Australia's CO_2e reduction opportunities in 2020. Demand-side management programs (1%), teleworking (<1%), and smart lighting (<1%) are among the least significant sources of reduction potential, both for Australia and tier 4 as a group.

FIGURE 60

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Australia Versus Tier 4



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents Australia's most significant CO_2e reduction opportunity (16%), a significantly higher share than tier 4 as a group (9%). Australia's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 5% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a modest CO_2e reduction opportunity, accounting for 5% of Australia's overall CO_2e reduction (considerably lower than the 13% for tier 4 countries as a group) in 2020. Likewise, the reduction share associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 2% and 1% respectively) are somewhat lower than that of the tier 4 population as a group (6% and 2%).

The 25% Scenario: Australia's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Australia is projected to achieve a CO_2e reduction of 116.6 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Australia's requirement is to increase its annual CO_2e reductions by 20% (23.3 million tonnes) to 140.0 million tonnes. As Figure 61 shows, the largest increase (8.6 million tonnes, to 51.9 million tonnes annually) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 16.7 million tonnes to 20.0 million tonnes a year in 2020 (Figure 62).

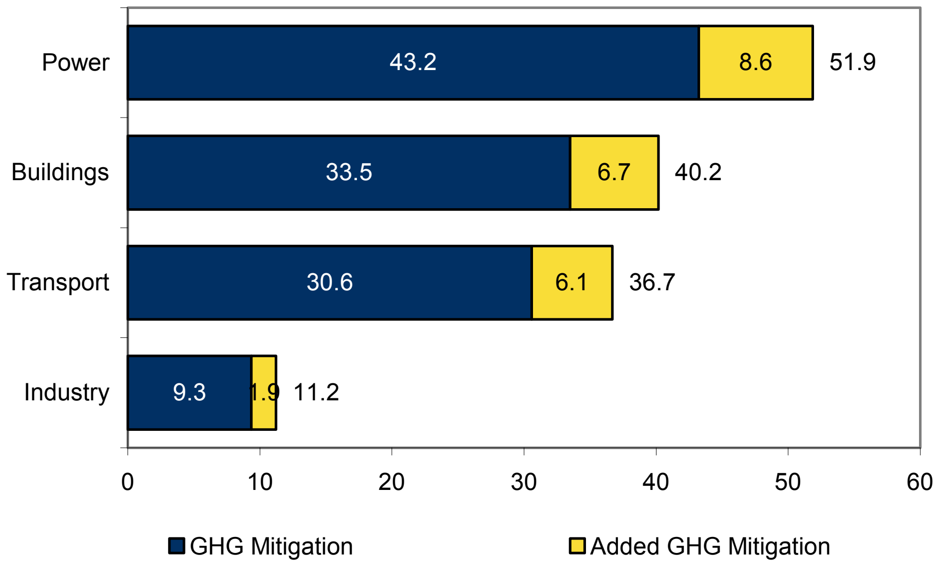
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 18.9 million tonnes to 22.7 million tonnes a year in 2020. Overall, CO_2e reductions in Australia's buildings segment need to increase from 33.5 million tonnes to 40.2 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 18.4 million tonnes to 22.0 million tonnes in 2020. CO_2e reductions associated with private transportation optimization need to rise from 6.0 million tonnes to 7.3 million tonnes in this timeframe. Overall, reductions associated with the transport segment need to increase from 30.6 million tonnes to 36.7 million tonnes by 2020.

Reductions in Australia's industry segment, the smallest of the four general categories, need to be increased from 9.3 million tonnes a year to 11.2 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 6.0 million tonnes to 7.2 million tonnes in annual CO_2e emissions) and industrial process automation (from 2.6 million tonnes to 3.1 million tonnes).

FIGURE 61

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Australia

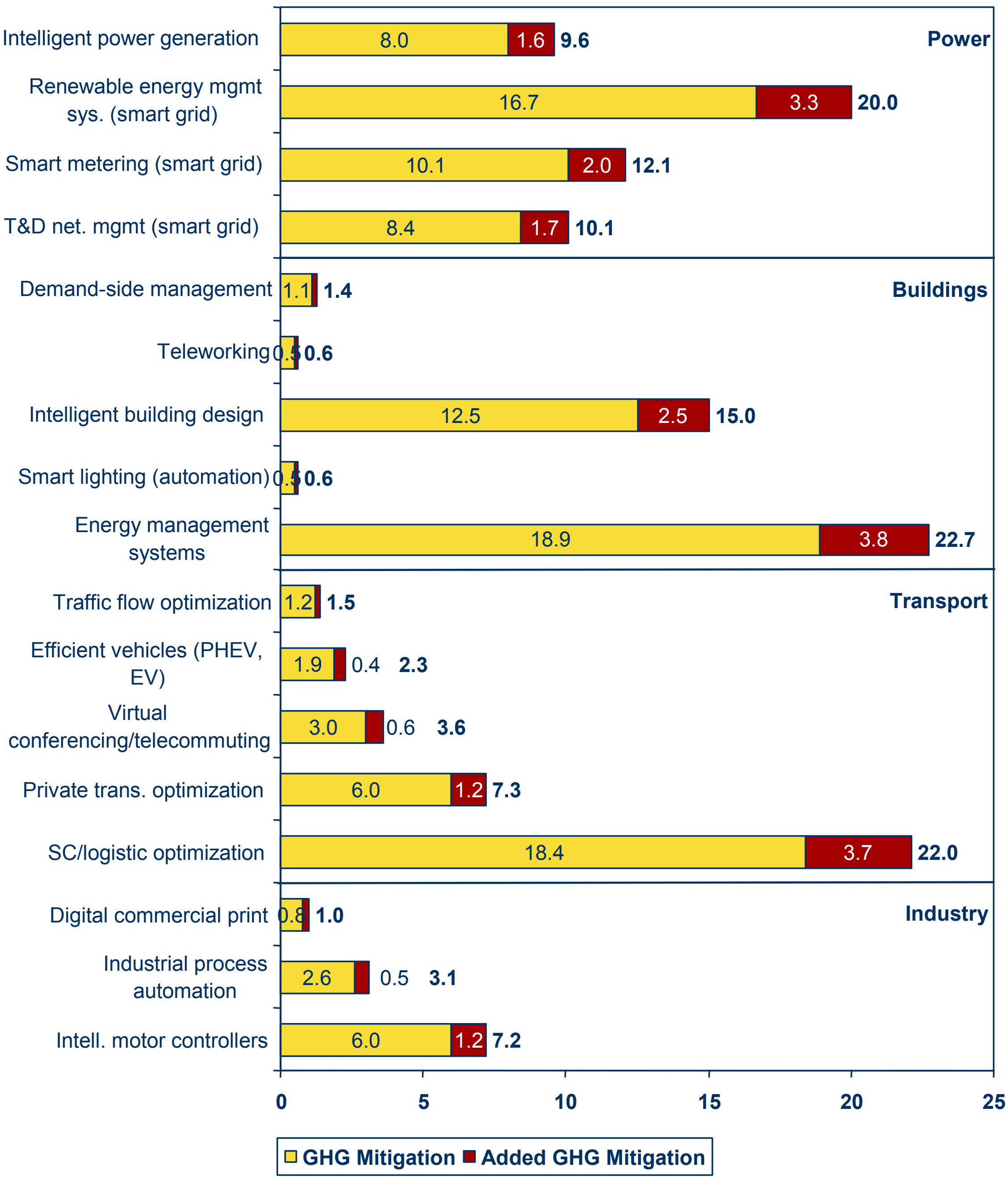


Note: Total baseline CO$_2$e reduction: 116.6M tonnes total CO$_2$e reduction at 25% target: 140.0M tonnes

Source: IDC, 2009

FIGURE 62

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Australia



Note: Total baseline CO_2e reduction: 116.6M tonnes total CO_2e reduction at 25% target: 140.0M tonnes

Source: IDC, 2009

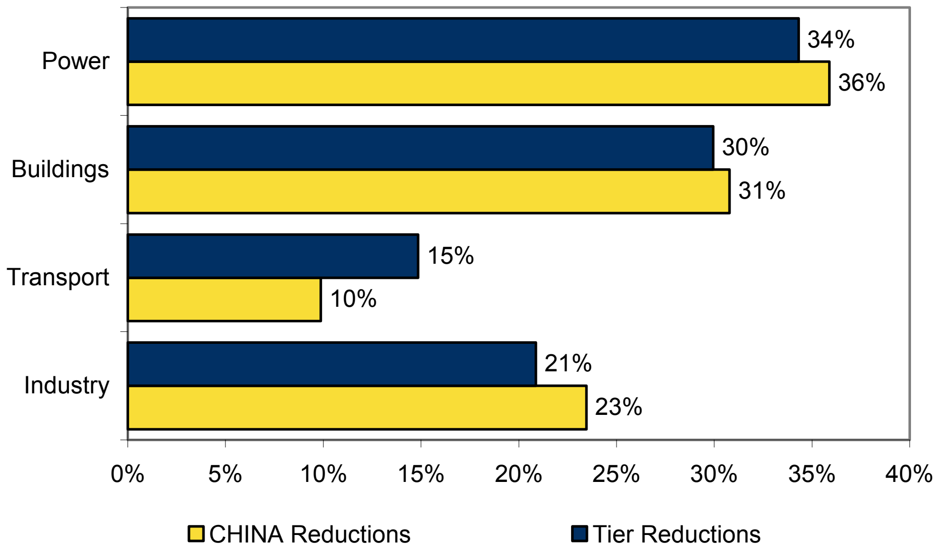
China

The Current CO_2e Reduction Scenario

China is ranked second among G20 countries in terms of projected CO_2e emissions by 2020, at 5.6 billion tonnes a year. Under baseline assumptions, China's maximum CO_2e reduction capability is 1,455.4 million tonnes annually. As Figure 63 shows, the largest share of China's projected CO_2e reduction opportunity is in the power area. At 36%, the share of CO_2e reduction opportunities associated with power sources is somewhat higher than that of tier 4 countries as a group (34%). The buildings category represents the second-largest area, at 31% of CO_2e reduction potential in 2020, roughly equivalent to the share for tier 4 as a group (30%). The share of CO_2e reduction opportunities derived from industry sources (23%) is also somewhat higher than tier 4's collective percentage (21%), while China's share of CO_2e reductions from transport sources (10%) is somewhat lower than that of tier 4 countries as a group (15%).

FIGURE 63

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — China Versus Tier 4



Source: IDC, 2009

Figure 64 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in China (14%), roughly in line with the percentage seen for tier 4 as a whole (13%). Of the remaining components of the power category, by 2020:

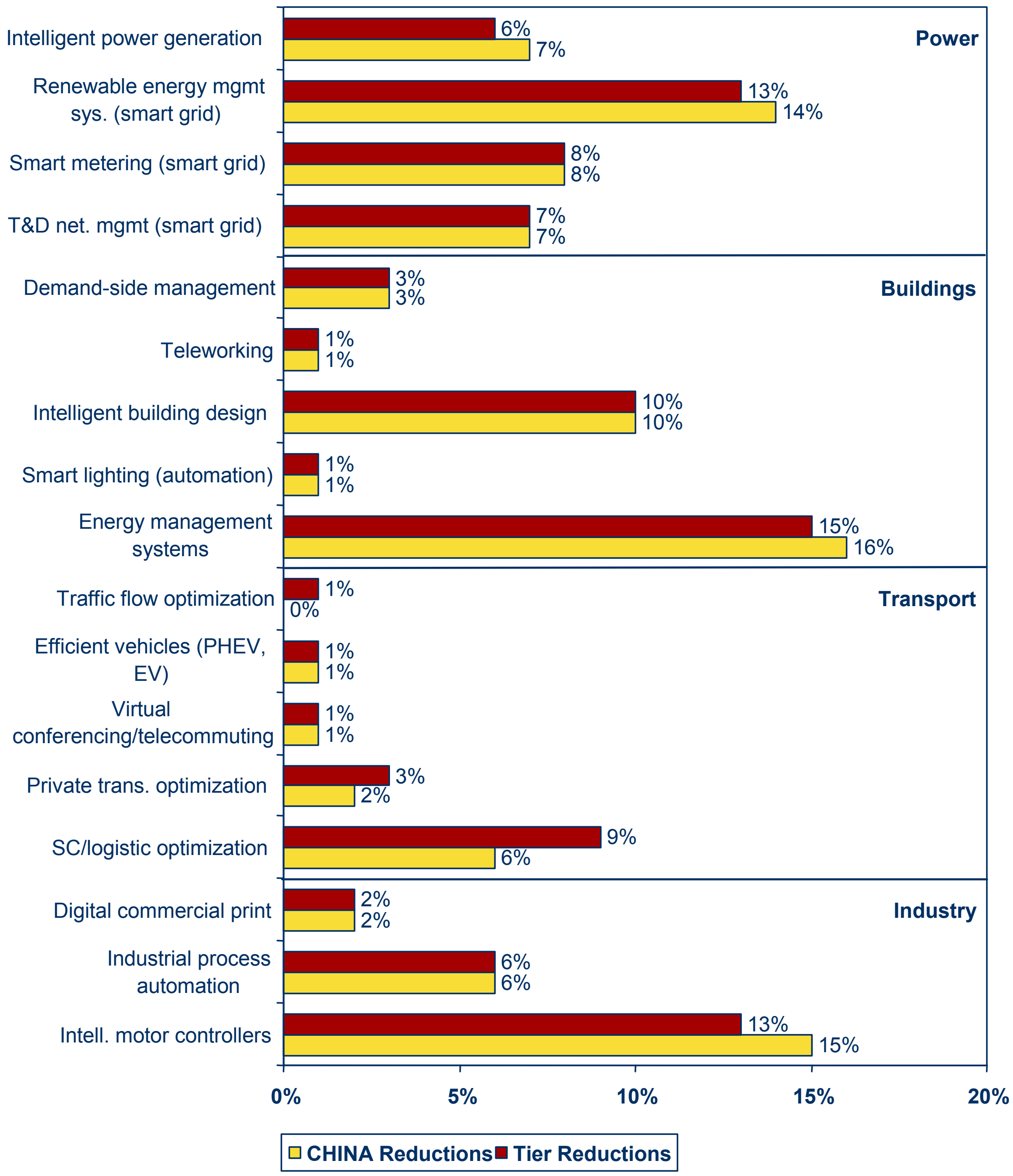
- Smart metering will account for 8% of China's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 7% of China's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 7% of China's overall CO_2e reduction opportunity.

In each of these categories, China's percentages generally mirror those of the overall tier 4 population, a reflection of China's large statistical impact on tier 4's aggregate numbers.

In the buildings category, the largest potential for CO_2e reductions are in the areas of energy management systems and intelligent building design, which are expected to account for 16% and 10% respectively of China's CO_2e reduction opportunities in 2020. Demand-side management programs (3%), teleworking (1%), and smart lighting (1%) are among the least significant sources of reduction potential, both for China and tier 4 as a group.

FIGURE 64

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — China Versus Tier 4



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents China's most significant CO_2e reduction opportunity (6%), although somewhat less than tier 4 as a group (9%). The remaining transport factors represent a comparably lower share of CO_2e reduction potential in the transport sector. They include private transport optimization (2%), telecommuting (1%), efficient vehicles (1%), and smart traffic systems (<1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a significant CO_2e reduction opportunity, accounting for 15% of China's overall CO_2e reduction (slightly higher than the 13% for tier 4 countries as a group) in 2020. The reduction share associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 6% and 2% respectively) are generally in line with the tier 4 population as a group.

The 25% Scenario: China's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), China is projected to achieve a CO_2e reduction of 1,455.4 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, China's requirement is to increase its annual CO_2e reductions by 20% (291.1 million tonnes) to 1,746.4 million tonnes. As Figure 65 shows, the largest increase (104.5 million tonnes, to 626.7 million tonnes annually) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 201.6 million tonnes to 242.0 million tonnes a year in 2020 (Figure 66).

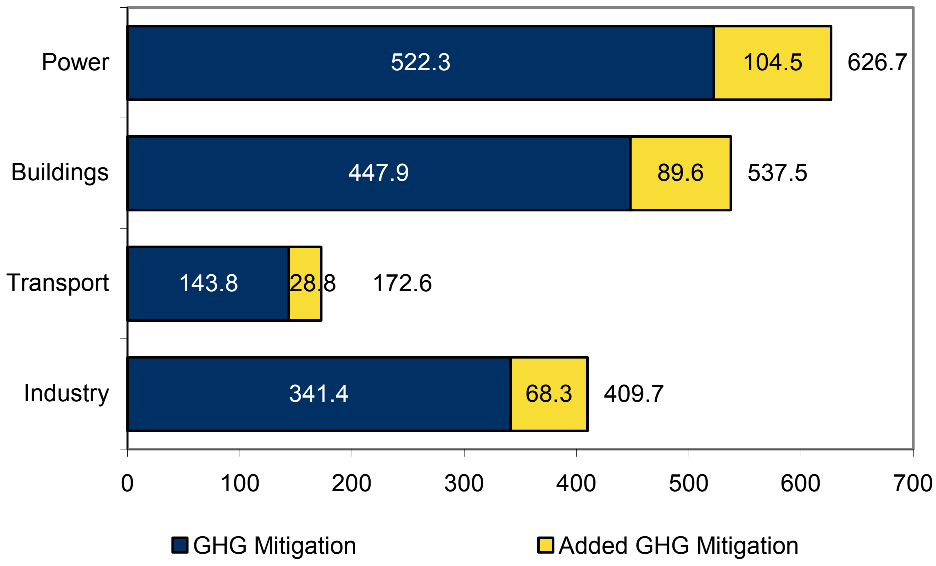
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 228.3 million tonnes to 274.0 million tonnes a year in 2020. Overall, CO_2e reductions in China's buildings segment need to increase from 447.9 million tonnes to 537.5 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The principal source of added CO_2e reductions in transport — the smallest of the four general categories — should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 86.4 million tonnes to 103.7 million tonnes in 2020. CO_2e reductions associated with private transportation optimization need to rise from 28.4 million tonnes to 34.1 million tonnes in this timeframe. Overall, reductions associated with the transport segment need to increase from 143.8 million tonnes to 172.6 million tonnes by 2020.

Reductions in China's industry segment need to be increased from 341.4 million tonnes a year to 409.7 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 219.0 million tonnes to 262.8 million tonnes in annual CO_2e emissions) and industrial process automation (from 93.4 million tonnes to 112.1 million tonnes).

FIGURE 65

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — China

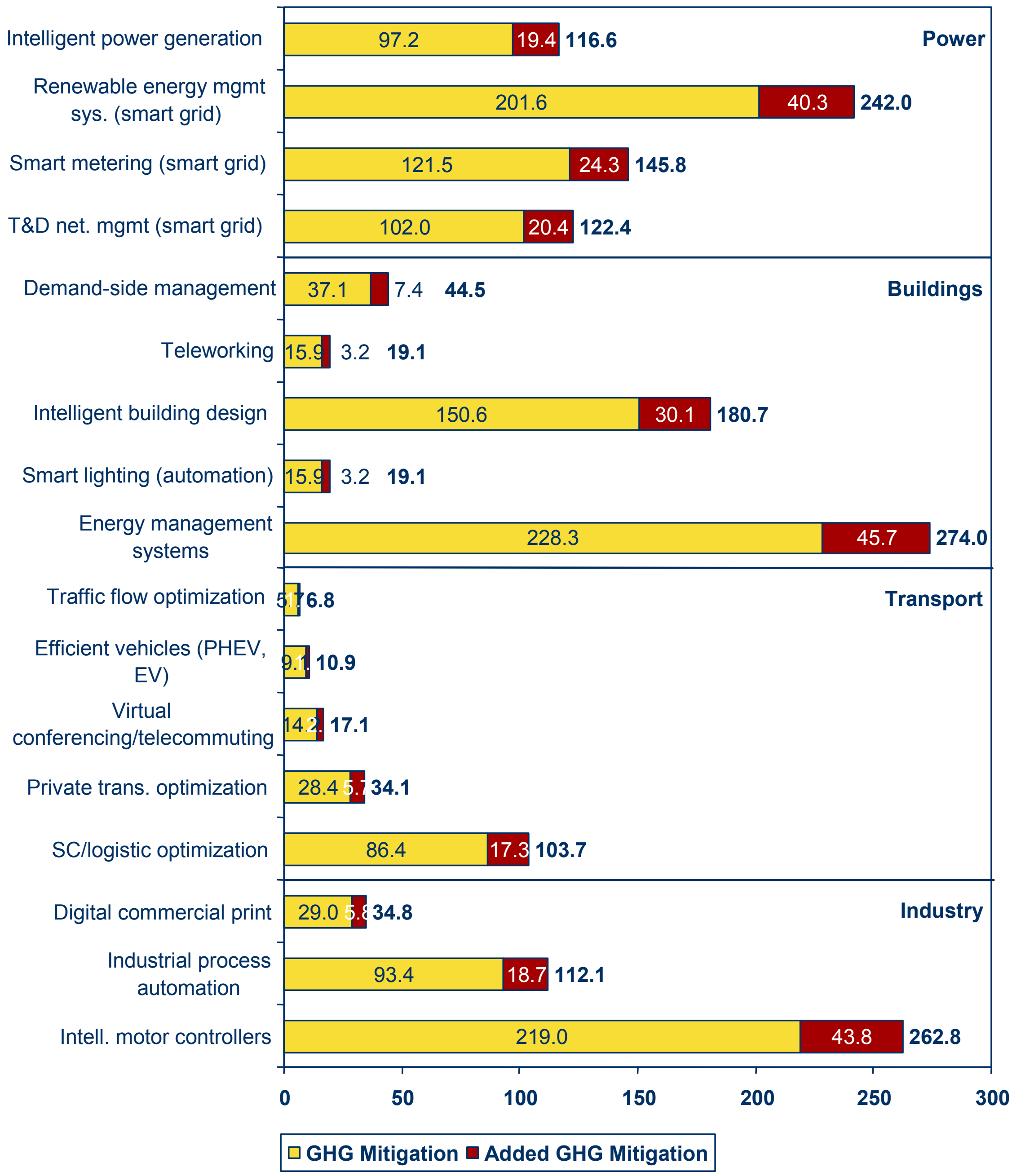


Note: Total baseline CO$_2$e reduction: 1,455.4M tonnes total CO$_2$e reduction at 25% target: 1,746.4M tonnes

Source: IDC, 2009

FIGURE 66

CO₂e Reduction Opportunity: Baseline Scenario Versus 25% Target — China



Note: Total baseline CO_2e reduction: 1,455.4M tonnes total CO_2e reduction at 25% target: 1,746.4M tonnes

Source: IDC, 2009

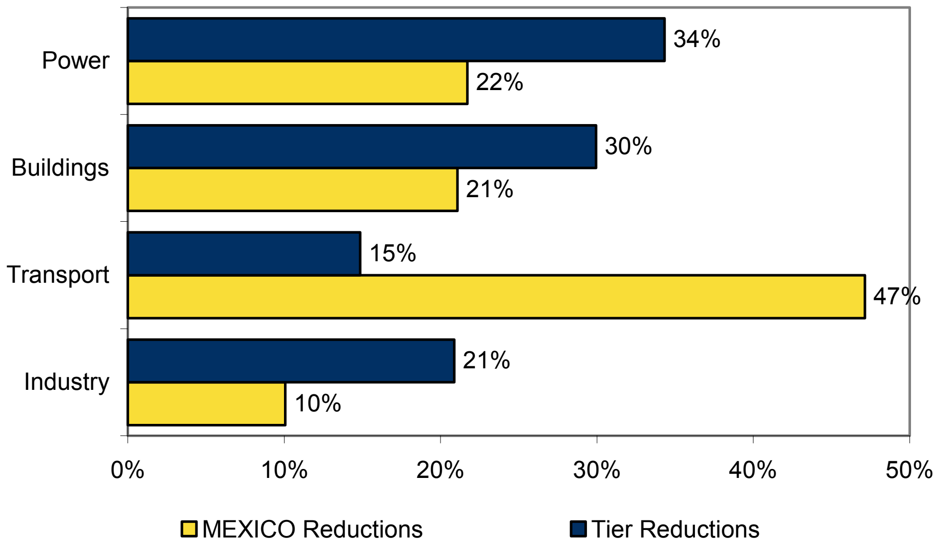
Mexico

The Current CO_2e Reduction Scenario

Mexico is ranked 12th among G20 countries in terms of projected CO_2e emissions by 2020, at 416.3 million tonnes a year. Under baseline assumptions, Mexico's maximum CO_2e reduction capability is 116.3 million tonnes annually. As Figure 67 shows, the largest share of Mexico's projected CO_2e reduction opportunity is in transport. At 47%, the share of CO_2e reduction opportunities associated with transport sources is three times higher than that of tier 4 countries as a group (15%). The power category represents the second-largest area, at 22% of CO_2e reduction potential in 2020, significantly lower than the share for tier 4 as a group (34%). The share of CO_2e reduction opportunities derived from buildings sources is likewise lower for Mexico (21%) than for tier 4 collectively (30%). industry-oriented sources of reduction are expected to account for a considerably lower share in Mexico (10%) than tier 4 countries as a group (21%).

FIGURE 67

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Mexico Versus Tier 4



Source: IDC, 2009

Figure 68 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Mexico (8%), compared with 13% for tier 4 as a whole. Of the remaining components of the power category, by 2020:

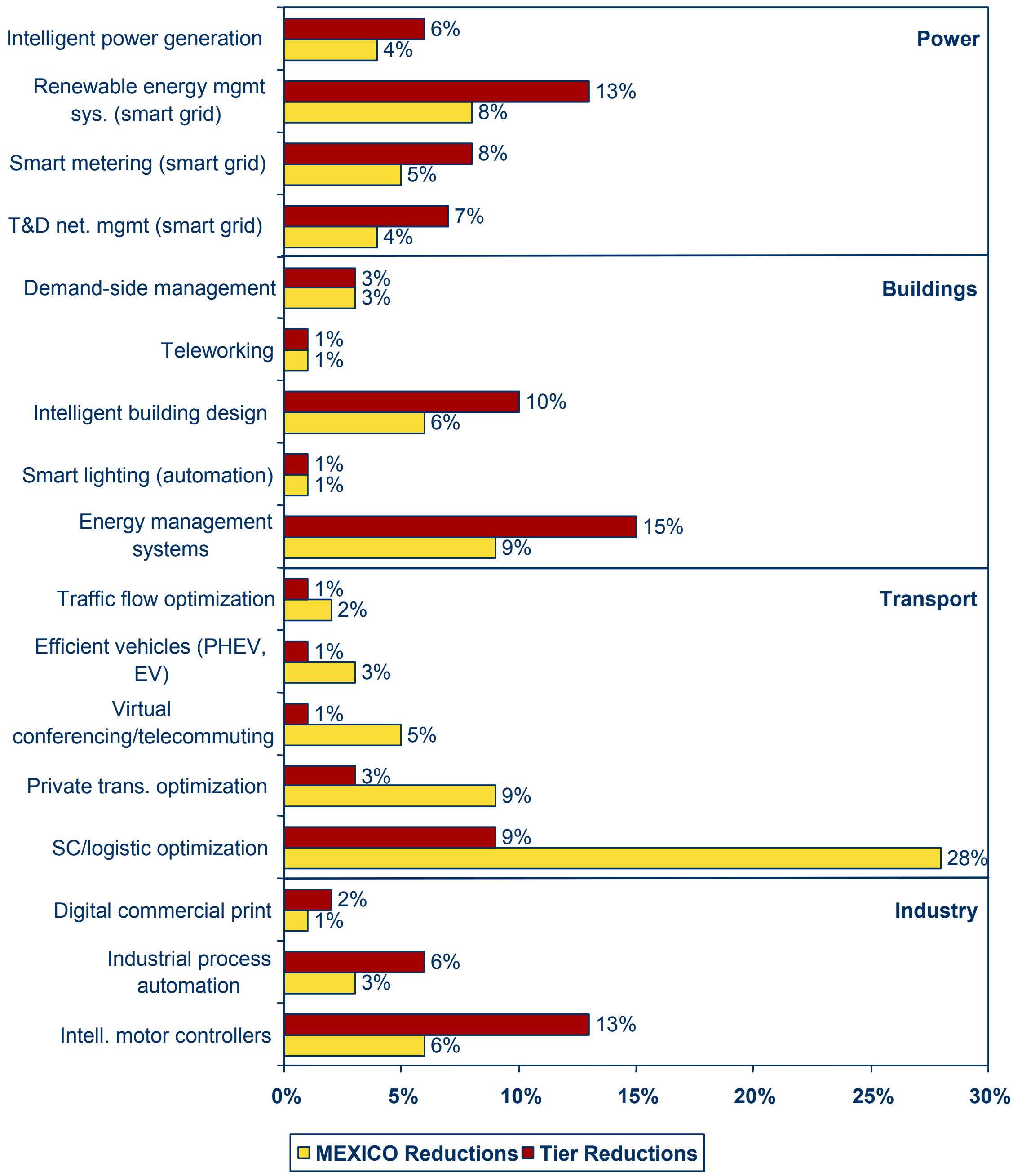
- Smart metering will account for 5% of Mexico's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 4% of Mexico's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 4% of Mexico's overall CO_2e reduction opportunity.

In each of these categories, Mexico's percentages are generally lower than those of the overall tier 4 population, but are of the same relative magnitude.

In the buildings category, the largest potential for CO_2e reductions are in the areas of energy management systems and intelligent building design, which are expected to account for 9% and 6% respectively of Mexico's CO_2e reduction opportunities in 2020. Demand-side management programs (3%), teleworking (1%), and smart lighting (1%) are among the least significant sources of reduction potential, both for Mexico and tier 4 as a group.

FIGURE 68

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Mexico Versus Tier 4



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Mexico's most significant CO_2e reduction opportunity (28%), a significantly higher share than tier 4 as a group (9%). Mexico's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 9% of the country's total CO_2e reduction opportunity by 2020, significantly more than tier 4 as a group. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (5%), efficient vehicles (3%), and smart traffic systems (2%).

Within the industry category, the use of intelligent motor controllers is seen as providing a modest CO_2e reduction opportunity, accounting for 6% of Mexico's overall CO_2e reduction (considerably lower than the 13% for tier 4 countries as a group) in 2020. Likewise, the reduction share associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 3% and 1% respectively) are somewhat lower than that of the tier 4 population as a group (6% and 2%).

The 25% Scenario: Mexico's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Mexico is projected to achieve a CO_2e reduction of 116.3 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Mexico's requirement is to increase its annual CO_2e reductions by 20% (23.3 million tonnes) to 139.5 million tonnes. As Figure 69 shows, the largest increase (11.0 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 70), with the CO_2e reduction target raised from 32.9 million tonnes in 2020 to 39.5 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 10.8 million tonnes to 13.0 million tonnes in this timeframe.

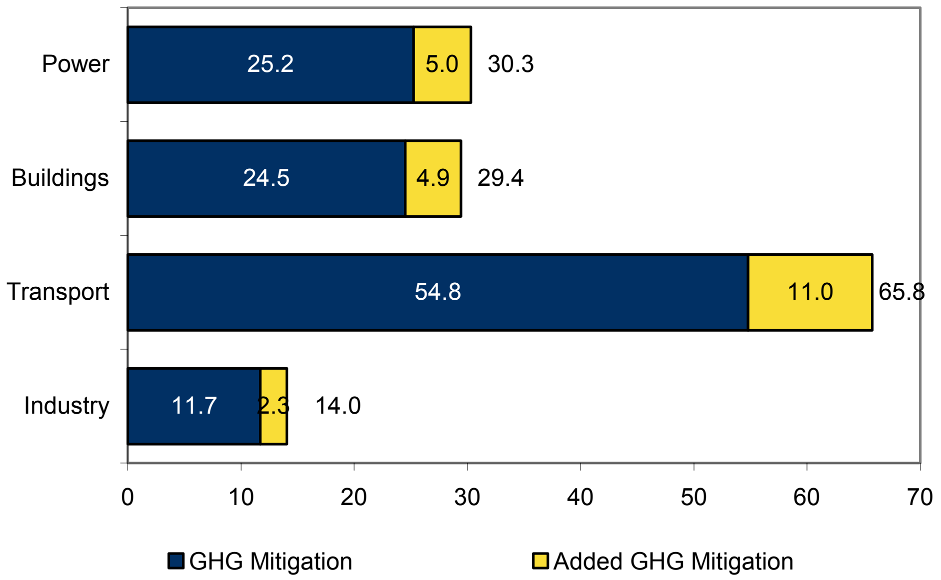
CO_2e emissions from power sources, which constitute the second-largest share of Mexico's overall emissions, require an increase of 5.0 million tonnes, from 25.2 million tonnes to 30.3 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 9.7 million tonnes to 11.7 million tonnes a year in 2020.

Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 11.0 million tonnes to 13.2 million tonnes a year in 2020. Overall, CO_2e reductions in Mexico's buildings segment need to rise 20%, from 24.5 million tonnes to 29.4 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e reductions in Mexico's industry segment need to be increased from 11.7 million tonnes a year to 14.0 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 7.5 million tonnes to 9.0 million tonnes in annual CO_2e emissions) and industrial process automation (from 3.2 million tonnes to 3.8 million tonnes).

FIGURE 69

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Mexico

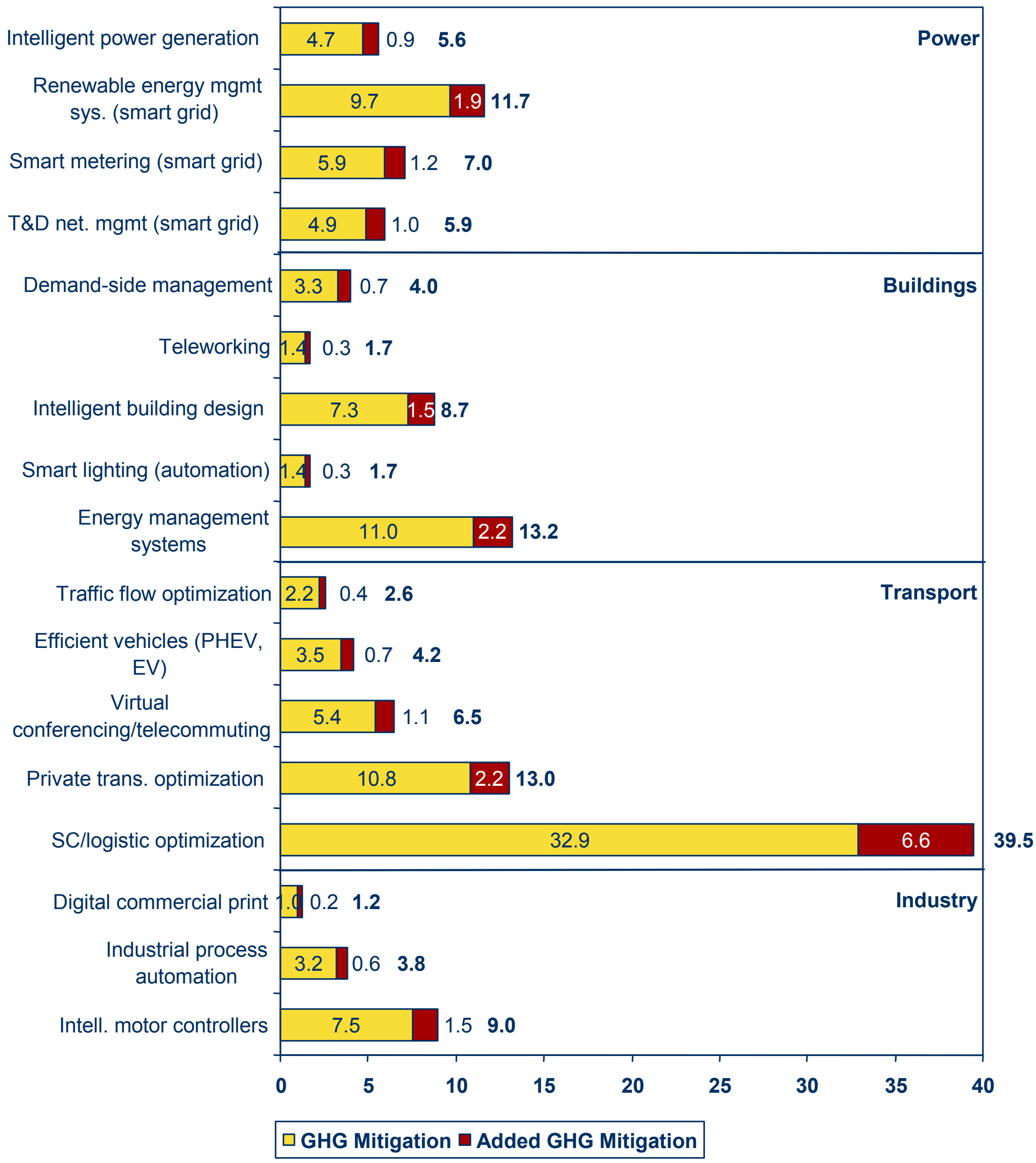


Note: Total baseline CO_2e reduction: 116.3M tonnes total CO_2e reduction at 25% target: 139.5M tonnes

Source: IDC, 2009

FIGURE 70

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Mexico



Note: Total baseline CO$_2$e reduction: 116.3M tonnes total CO$_2$e reduction at 25% target: 139.5M tonnes

Source: IDC, 2009

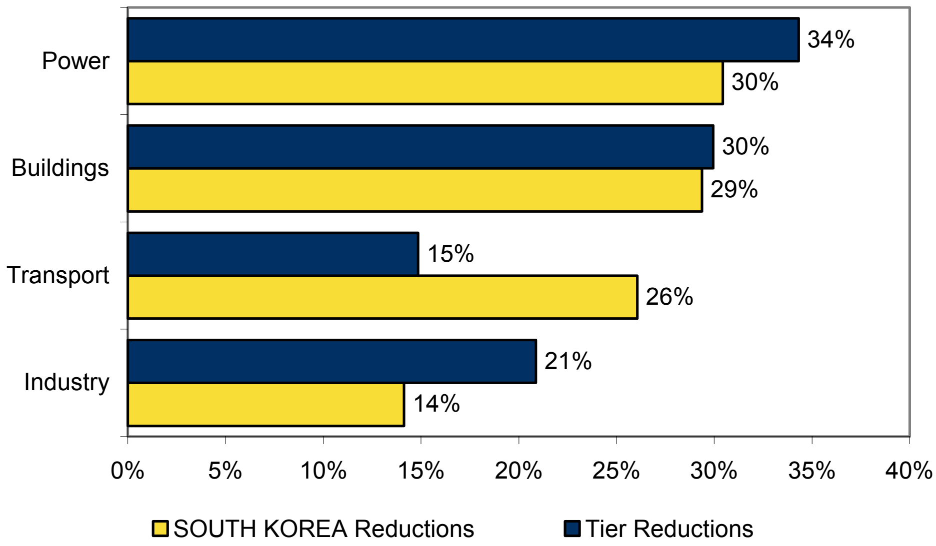
South Korea

The Current CO_2e Reduction Scenario

South Korea is ranked eighth among G20 countries in terms of projected CO_2e emissions by 2020, at 476.1 million tonnes a year. Under baseline assumptions, South Korea's maximum CO_2e reduction capability is 129.6 million tonnes annually. As Figure 71 shows, the largest share of South Korea's projected CO_2e reduction opportunity is in the power area. At 30%, the share of CO_2e reduction opportunities associated with power sources is somewhat lower than that of tier 4 countries as a group (34%). The buildings category represents the second-largest area, at 29% of CO_2e reduction potential in 2020, roughly equivalent to the share for tier 4 as a group (30%). The share of CO_2e reduction opportunities derived from transport sources is substantially higher for South Korea (26%) than for tier 4 collectively (15%). Conversely, industry-oriented sources of reduction are expected to account for a significantly lower share in South Korea (14%) than tier 4 countries as a group (21%).

FIGURE 71

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — South Korea Versus Tier 4



Source: IDC, 2009

Figure 72 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in South Korea (12%), roughly in line with the percentage seen for tier 4 as a whole (13%). Of the remaining components of the power category, by 2020:

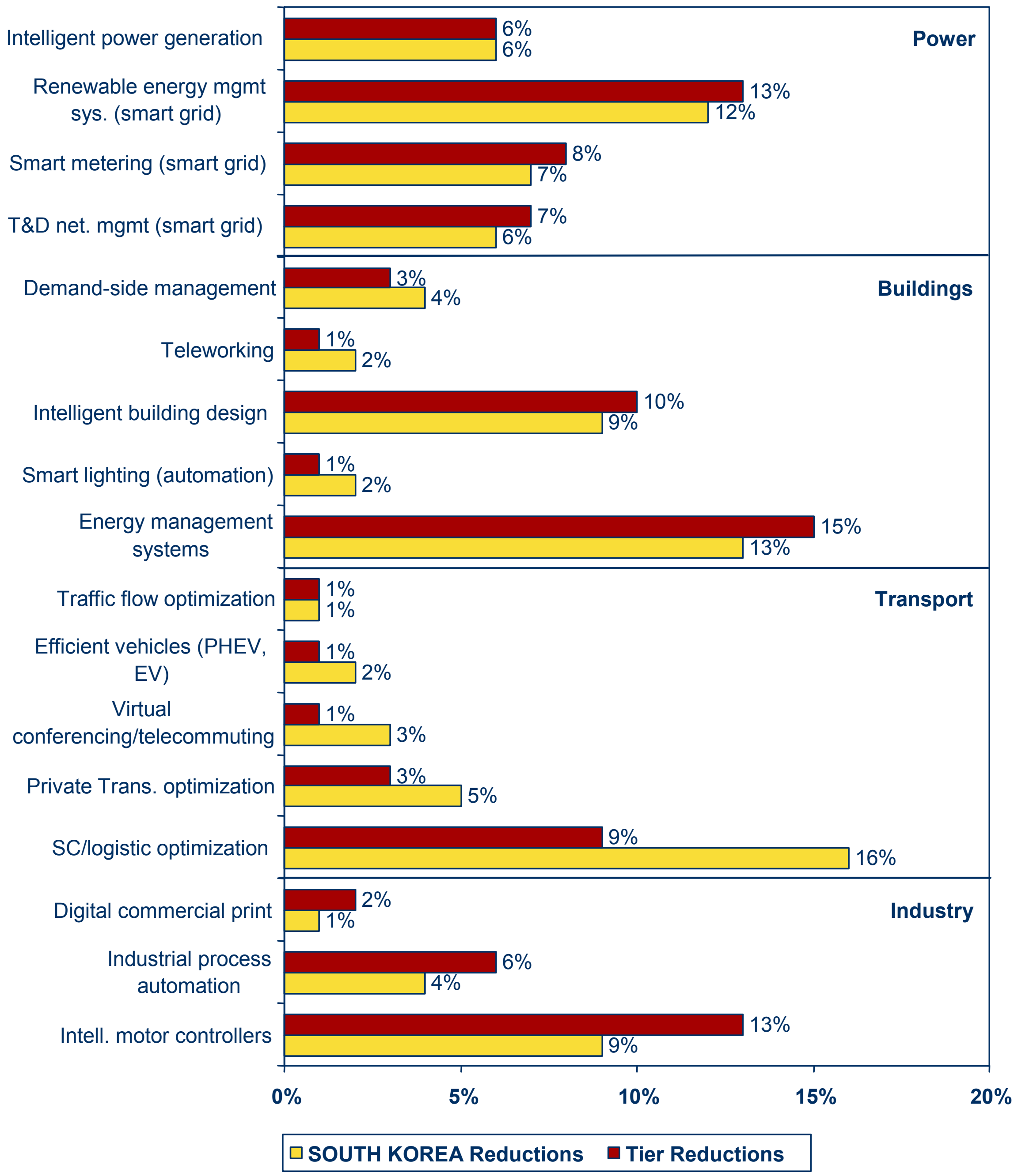
- Smart metering will account for 7% of South Korea's overall CO_2e reduction opportunity.
- Intelligent power generation will also account for 7% of South Korea's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will account for 6% of South Korea's overall CO_2e reduction opportunity.

In each of these categories, South Korea's percentages generally mirror those of the overall tier 4 population.

In the buildings category, the largest potential for CO_2e reductions are in the areas of energy management systems and intelligent building design, which are expected to account for 13% and 9% respectively of South Korea's CO_2e reduction potential in 2020. Demand-side management programs account for 4% of potential CO_2e reductions, followed by teleworking (2%) and smart lighting (2%).

FIGURE 72

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — South Korea Versus Tier 4



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents South Korea's most significant CO_2e reduction opportunity (16%), a significantly higher share than tier 4 as a group (9%). South Korea's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 5% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a modest CO_2e reduction opportunity, accounting for 9% of South Korea's overall CO_2e reduction (somewhat lower than the 13% for tier 4 countries as a group) in 2020. Likewise, the reduction share associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 4% and 1% respectively) are somewhat lower than that of the tier 4 population as a group (6% and 2%).

The 25% Scenario: South Korea's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), South Korea is projected to achieve a CO_2e reduction of 129.6 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, South Korea's requirement is to increase its annual CO_2e reductions by 20% (25.9 million tonnes) to 155.5 million tonnes. As Figure 73 shows, the largest increase (7.9 million tonnes, to 47.3 million tonnes annually) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 15.2 million tonnes to 18.3 million tonnes a year in 2020 (Figure 74).

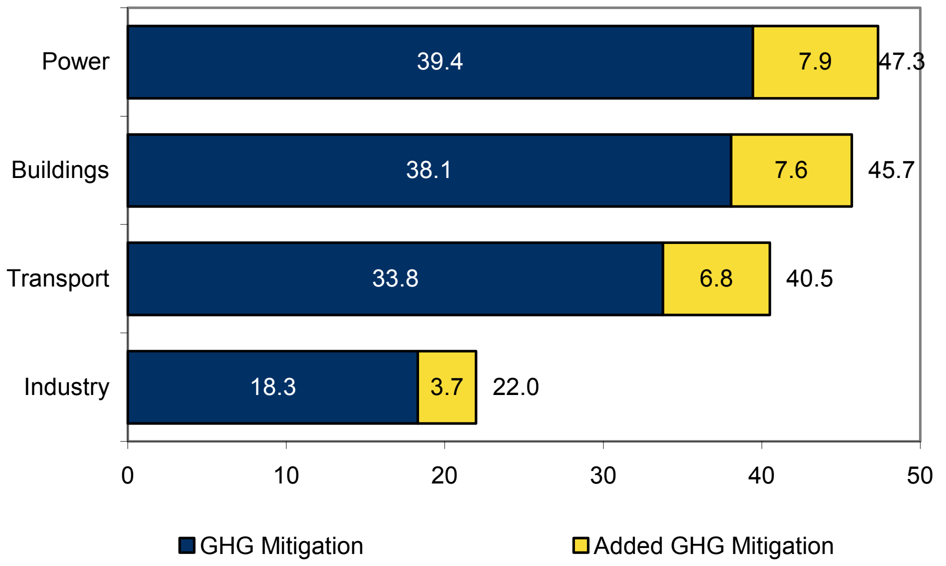
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 17.2 million tonnes to 20.7 million tonnes a year in 2020. Overall, CO_2e reductions in South Korea's buildings segment need to increase from 38.1 million tonnes to 47.5 million tonnes annually under the 25% G20 CO_2e reduction scenario.

The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 20.3 million tonnes to 24.3 million tonnes in 2020. CO_2e reductions associated with private transportation optimization need to rise from 6.7 million tonnes to 8.0 million tonnes in this timeframe. Overall, reductions associated with the transport segment need to increase from 33.8 million tonnes to 40.5 million tonnes by 2020.

Reductions in South Korea's industry segment, the smallest of the four general categories, need to be increased from 18.3 million tonnes a year to 22.0 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 11.7 million tonnes to 14.1 million tonnes in annual CO_2e emissions) and industrial process automation (from 5.0 million tonnes to 6.0 million tonnes).

FIGURE 73

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — South Korea

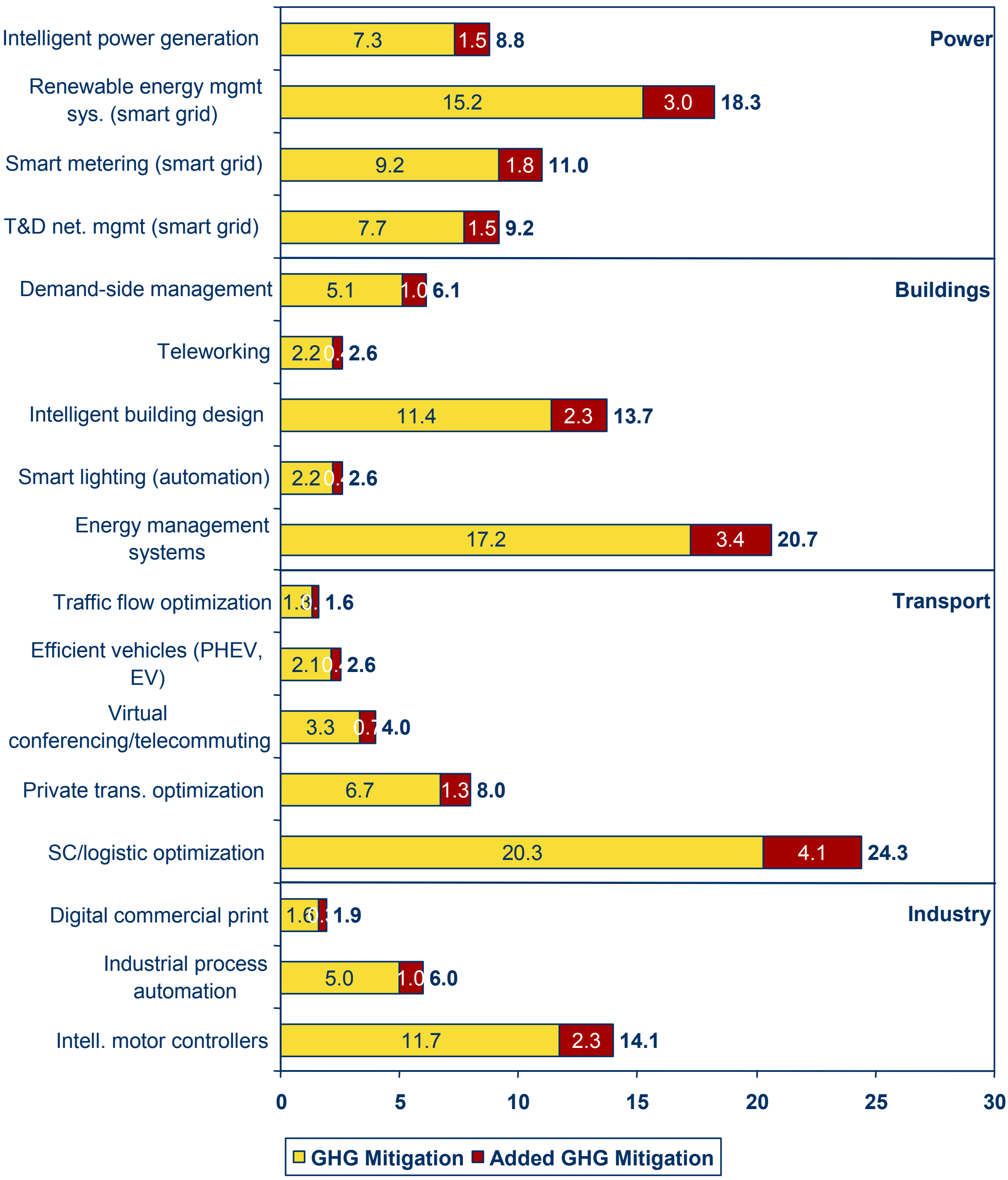


Note: Total baseline CO_2e reduction: 129.6M tonnes total CO_2e reduction at 25% target: 155.5M tonnes

Source: IDC, 2009

FIGURE 74

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — South Korea



Note: Total baseline CO_2e reduction: 129.6M tonnes total CO_2e reduction at 25% target: 155.5M tonnes

Source: IDC, 2009

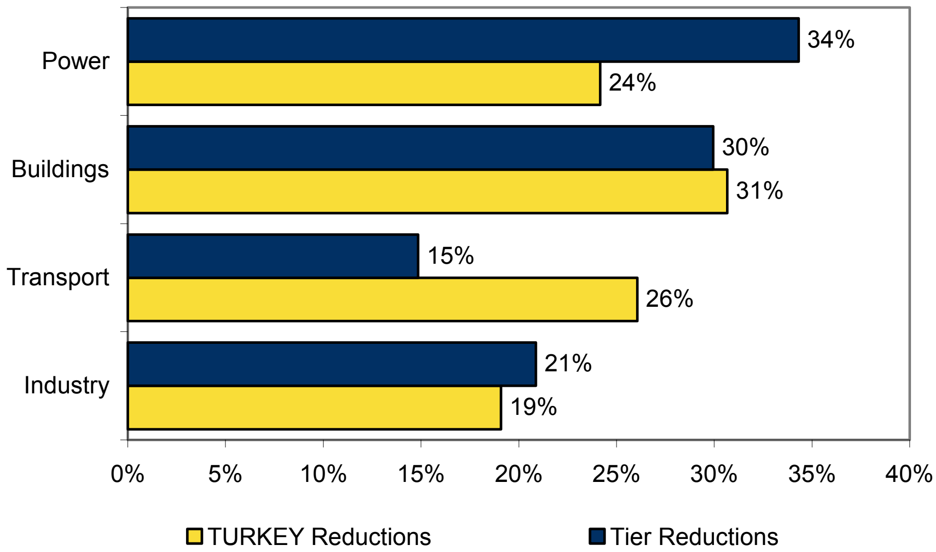
Turkey

The Current CO_2e Reduction Scenario

Turkey is ranked 18th among G20 countries in terms of projected CO_2e emissions by 2020, at 239.7 million tonnes a year. Under baseline assumptions, Turkey's maximum CO_2e reduction capability is 63.5 million tonnes annually. As Figure 75 shows, the largest share of Turkey's projected CO_2e reduction opportunity is in buildings. At 31%, the share of CO_2e reduction opportunities associated with power sources is roughly equivalent to that of tier 4 countries as a group (30%). The power category represents the second-largest area, at 24% of CO_2e reduction potential in 2020, a significantly lower share than tier 4 as a group (34%). The share of CO_2e reduction opportunities derived from transport sources is substantially higher for Turkey (26%) than for tier 4 collectively (15%), while industry-oriented sources of reduction are expected to account for a slightly lower share in Turkey (19%) than tier 4 countries as a group (21%).

FIGURE 75

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Turkey Versus Tier 4



Source: IDC, 2009

Figure 76 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Turkey (9%), somewhat lower than the percentage seen for tier 4 as a whole (13%). Of the remaining components of the power category, by 2020:

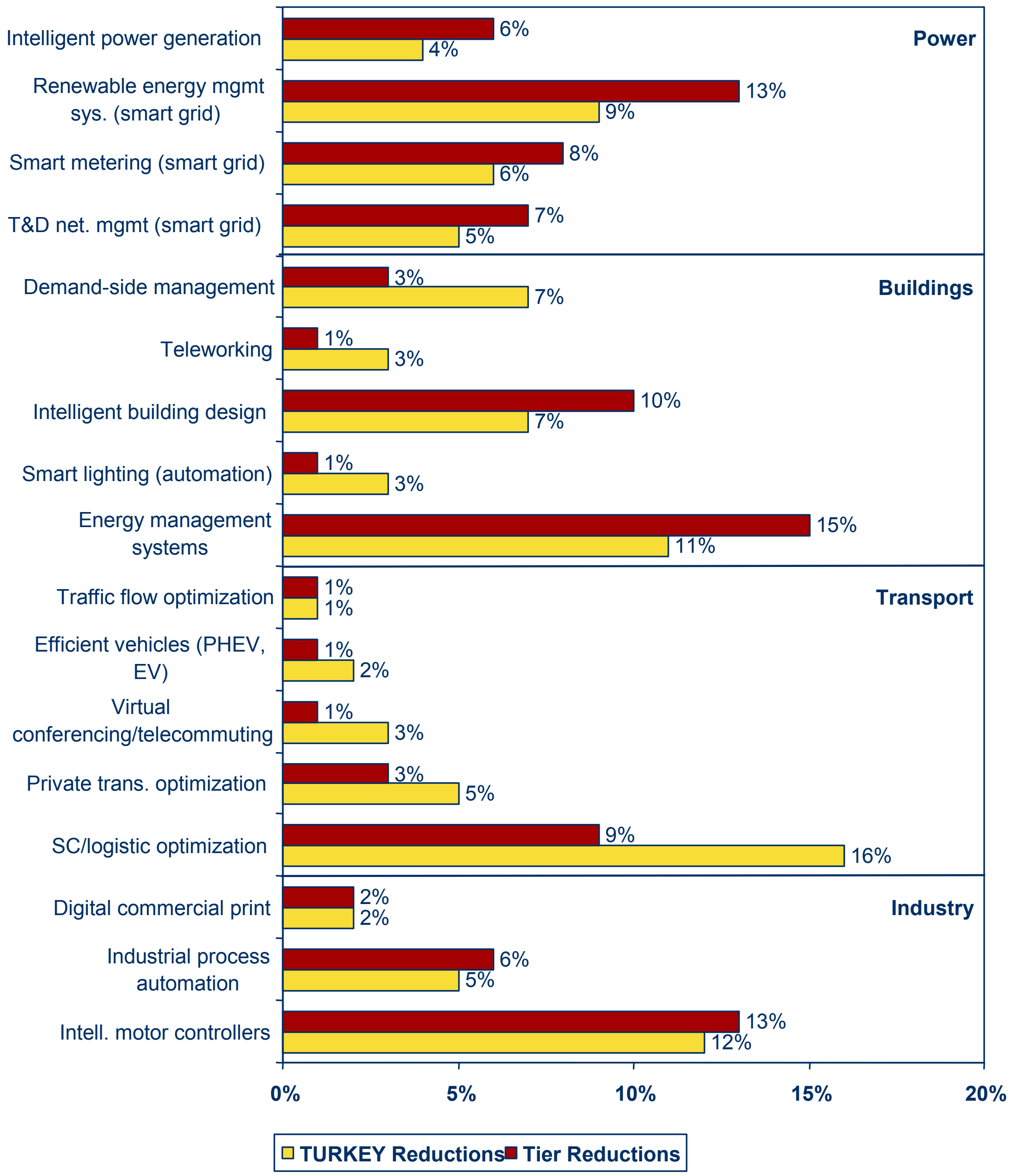
- Smart metering will account for 6% of Turkey's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will account for 5% of Turkey's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 4% of Turkey's overall CO_2e reduction opportunity.

In each of these categories, Turkey's percentages are generally lower than those of the overall tier 4 population, but are of the same relative magnitude.

In the buildings category, the largest potential for CO_2e reductions in 2020 is in energy management systems (11%), intelligent building design (7%), and demand-side management programs (7%). The reduction opportunity percentages for teleworking (3%) and smart lighting (3%) are somewhat higher than for tier 4 as a group (1% for both).

FIGURE 76

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Turkey Versus Tier 4



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents Turkey's most significant CO_2e reduction opportunity (16%), a significantly higher share than tier 4 as a group (9%). Turkey's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 5% of the country's total CO_2e reduction opportunity by 2020 (versus 3% for all of tier 4). Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a modest CO_2e reduction opportunity, accounting for 12% of Turkey's overall CO_2e reduction (roughly equivalent to the 13% for tier 4 countries as a group) in 2020. Likewise, Turkey's reduction potential associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 5% and 2% respectively) is in line with the tier 4 population as a group (6% and 2%).

The 25% Scenario: Turkey's Requirement for a 25% CO_2e Reduction for the G20 by 2020

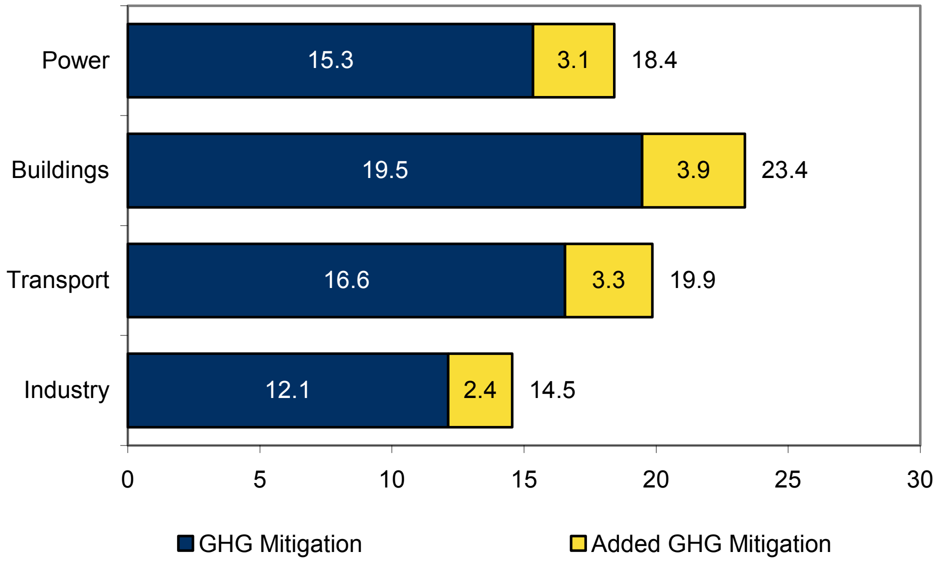
Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Turkey is projected to achieve a CO_2e reduction of 63.5 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Turkey's requirement is to increase its annual CO_2e reductions by 20% (12.7 million tonnes) to 76.2 million tonnes. As Figure 77 shows, the largest increase (3.9 million tonnes, to 23.4 million tonnes annually) needs to occur in buildings. Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 6.7 million tonnes to 8.1 million tonnes a year in 2020 (Figure 78). Other significant increases in CO_2e reductions need to occur in the subcategories of demand-side management (from 4.5 million tonnes to 5.4 million tonnes) and intelligent building design (from 4.4 million tonnes to 5.3 million tonnes).

The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 9.9 million tonnes in 2020 to 11.9 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 3.3 million tonnes to 3.9 million tonnes in this timeframe. Overall, reductions associated with the transport segment need to increase from 16.6 million tonnes to 19.9 million tonnes in the 2020 timeframe.

Reductions in Turkey's industry segment, the smallest of the four general categories, need to be increased from 12.1 million tonnes a year to 14.5 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 7.8 million tonnes to 9.3 million tonnes in annual CO_2e emissions) and industrial process automation (from 3.3 million tonnes to 4.0 million tonnes).

FIGURE 77

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Turkey

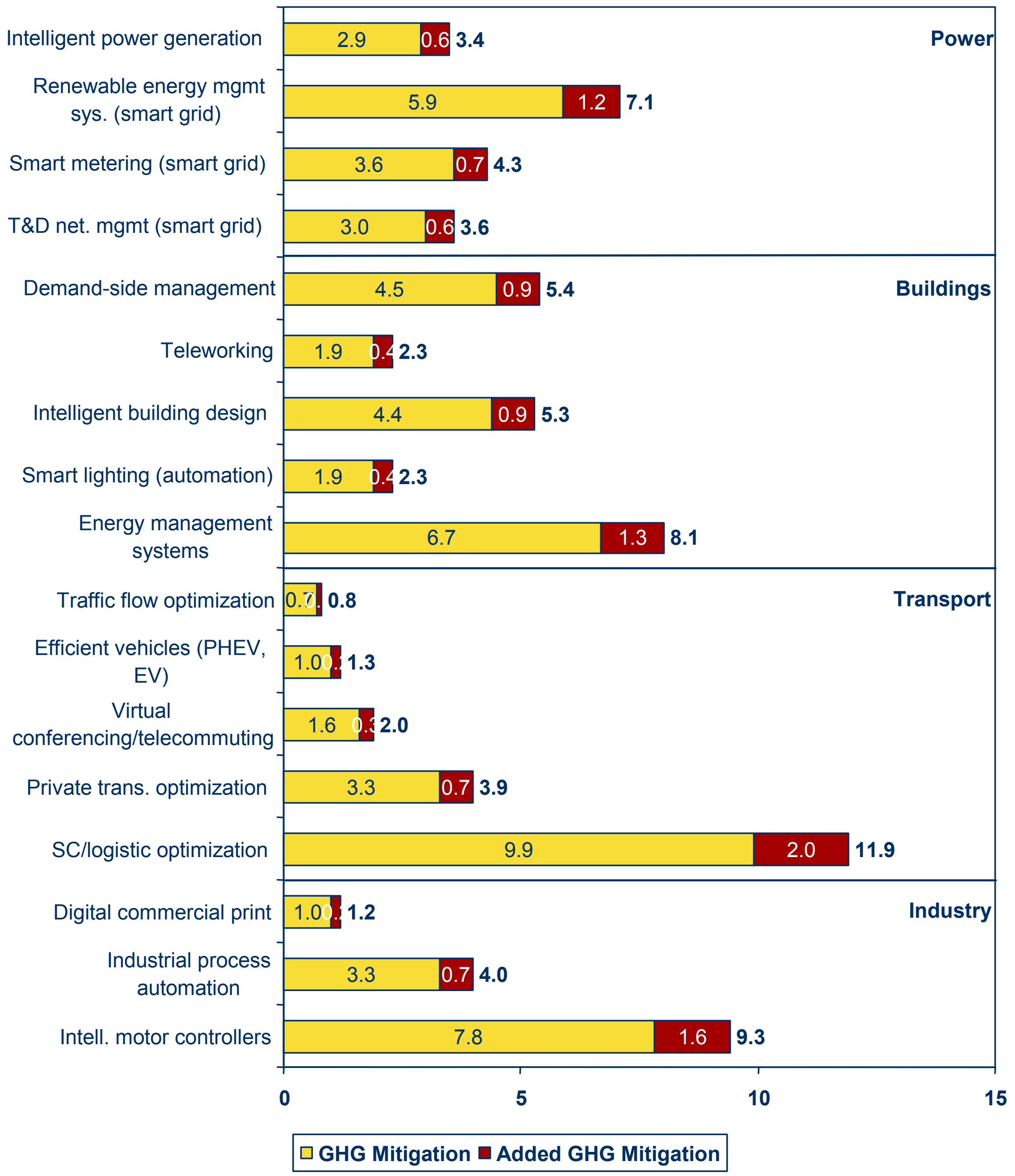


Note: Total baseline CO$_2$e reduction: 63.5M tonnes total CO$_2$e reduction at 25% target: 76.2M tonnes

Source: IDC, 2009

FIGURE 78

CO₂e Reduction Opportunity: Baseline Scenario Versus 25% Target — Turkey



Note: Total baseline CO_2e reduction: 63.5M tonnes total CO_2e reduction at 25% target: 76.2M tonnes

Source: IDC, 2009

CO_2e Reduction Analysis for Tier 5 Countries

Within the overall scope of this analysis, countries within the G20 have been rated on each country's underlying potential for CO_2e reduction. These determinations are based on a series of measurable variables that relate to:

- The current state of technology penetration and practices within the country
- Characteristics of the physical infrastructure and geographic factors
- The relative difficulty each country will have in achieving its underlying potential

Within this framework, countries are mapped across a spectrum, based on the degree to which technology investment can be leveraged to close the gap between each country's current CO_2e reduction potential and its true "maximum" potential. Viewed as a continuum, lower tier countries (by virtue of existing technology infrastructure, among other things) are closest to their potential, while higher tier countries have a larger gap (hence a greater opportunity to leverage technology).

Based on IDC research, we have established an estimate for GHG mitigation (or reduction in CO_2e) by 2020. This scenario was used to create a baseline of CO_2e reductions where the technologies identified by IDC would provide relief to CO_2e emission reductions. The following figures highlight the key metrics. The first metric is the total GHG levels mitigated by a G20 country using the technologies; the second is the added effort by a country to mitigate GHG even further in an attempt to meet a long-term goal of global reductions of 25%. The second has been based on a country's ranking within IDC's ICT Sustainability Index and its ability to try to reach the 25% reduction in CO_2e emissions.

Within this framework, tier 5 countries are those whose technology, process, and physical infrastructure provide a major opportunity to increase CO_2e reduction potential through investments in technology-based initiatives. G20 countries within tier 5 (profiled later in this section) are:

- Argentina
- India
- Indonesia
- Russia
- Saudi Arabia
- South Africa

Profile: Tier 5 Countries

As Figure 79 shows, power-related sources are projected to represent a significantly higher share of CO_2e reduction potential for tier 5 countries (35%) than for the G20 overall (30%) in 2020, as does the share of reduction potential associated with buildings sources (at 32%, compared with 28% for the G20 as a whole). The most significant difference between tier 5 countries and the G20 as a whole is in the transport category, with tier 5 countries having a much lower share of their CO_2e reduction potential (20%) and G20 countries as a whole (29%). The share of CO_2e

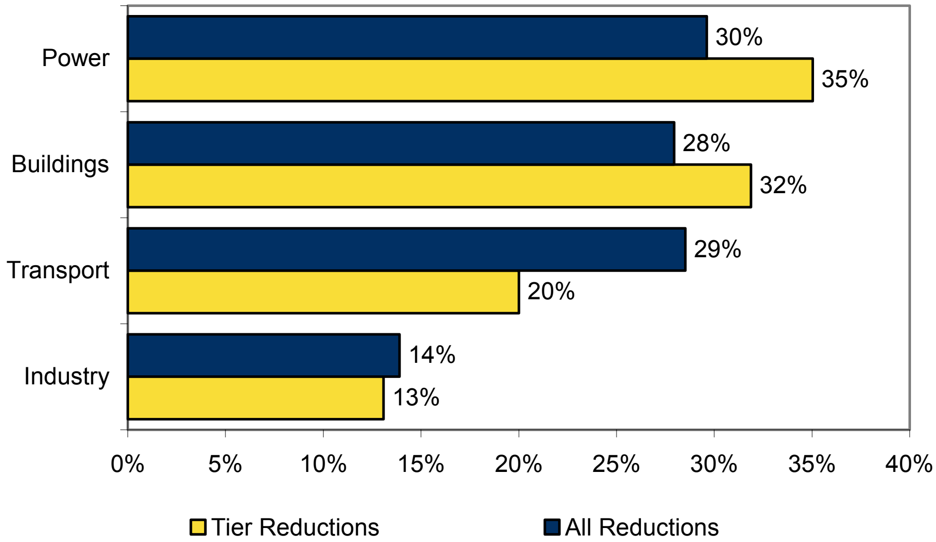
reduction potential derived from industry sources is roughly the same for tier 5 countries (14%) and the G20 as a whole (both at 13%). As such, transport-related activities represent the primary factor distinguishing tier 5 countries from the overall G20 population.

Figure 80 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction for tier 5 countries (14%), a somewhat higher share than that of G20 countries as a whole (11%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 8% of tier 5's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will account for 7% of tier 5's overall CO_2e reduction opportunity.
- Intelligent power generation will also account for 7% of tier 5's overall CO_2e reduction opportunity.

FIGURE 79

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 5 Versus G20 Less EU



Source: IDC, 2009

Within the buildings category, energy management systems and intelligent building design and demand-side management programs are expected to account for 15% and 10% respectively of overall CO_2e reduction opportunities in 2020 for tier 5 countries, reflecting a pattern also seen in G20 as a group.

In the transport category, supply chain and logistics optimization represents tier 5's primary CO_2e reduction opportunity (12%), a share significantly lower than G20 countries as a group (20%). The next largest source of CO_2e reduction opportunity for tier 5 countries is in private transport optimization, accounting for 4% of the tier's total

CO_2e reduction opportunity in 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (2%), efficient vehicles (1%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing the category's largest CO_2e reduction opportunity, accounting for 8% of tier 5's overall CO_2e reduction, roughly the same as that of G20 countries as a group (8%) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 4% and 1% respectively of tier 5's overall CO_2e reduction potential.

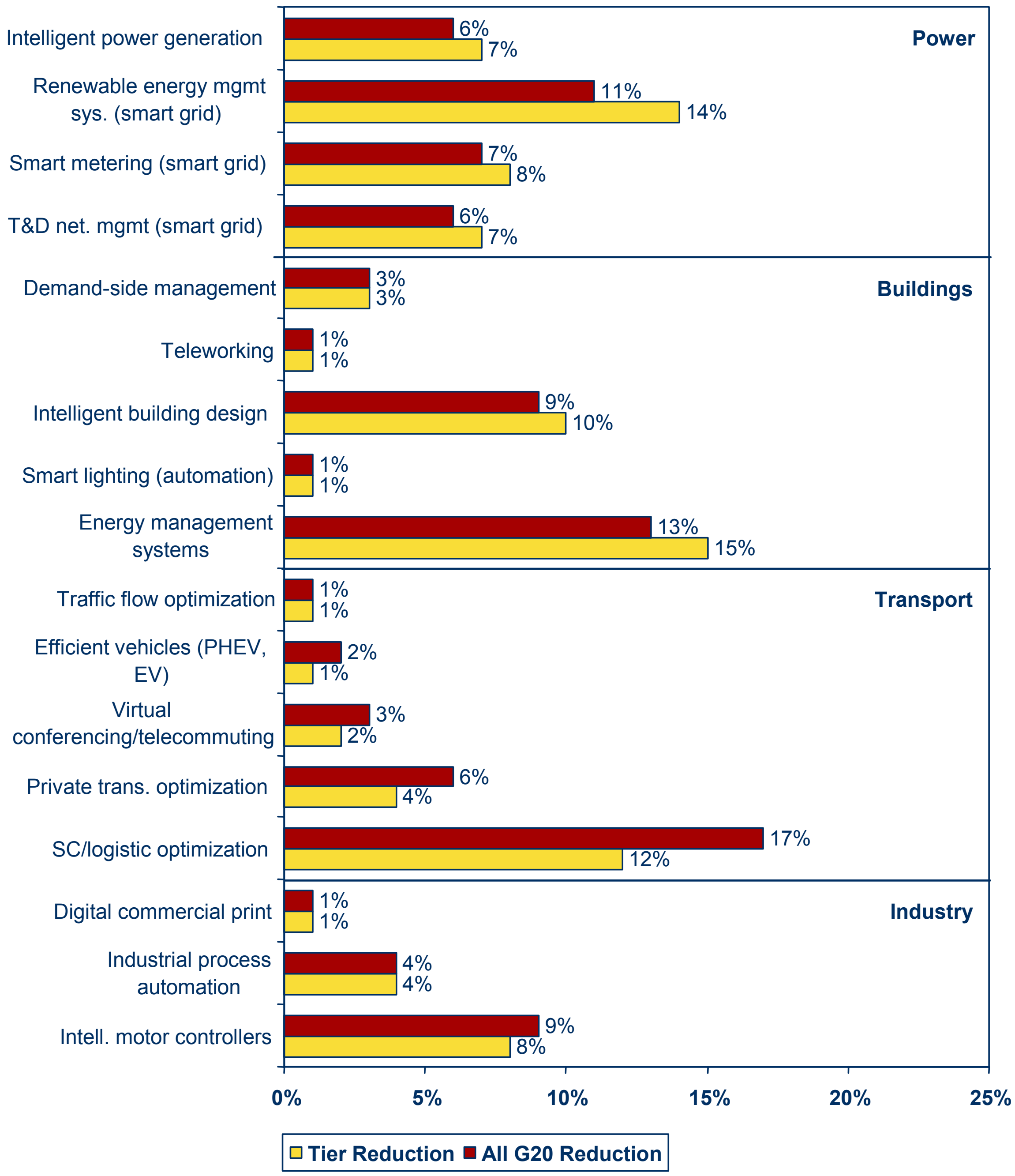
The 25% Scenario: Tier 5's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario, tier 5 countries as a group are projected to achieve a CO_2e reduction of 1,117.5 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile (the factors used to group G20 countries into different tiers).

Within this framework, all countries within tier 5 will need to increase their annual CO_2e reductions by 15% to 1,285.1 million tonnes. As Figure 80 shows, the largest increase (58.7 million tonnes) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 151.1 million tonnes to 173.8 million tonnes a year in 2020 (Figure 81).

FIGURE 80

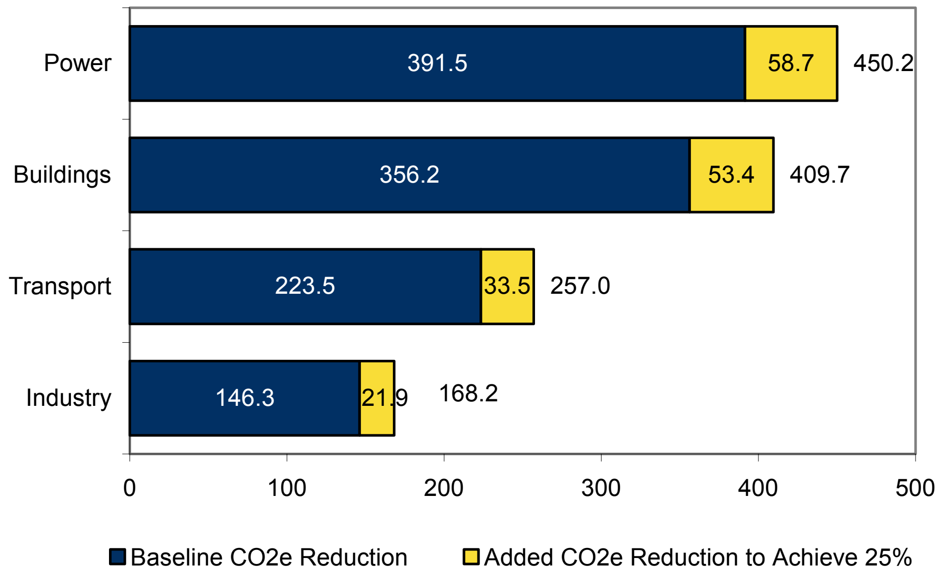
Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Tier 5 Versus G20 Less EU



Source: IDC, 2009

FIGURE 81

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 5



Note: Total baseline CO_2e reduction: 1,117.5M tonnes total CO_2e reduction at 25% target: 1,285.1M tonnes

Source: IDC, 2009

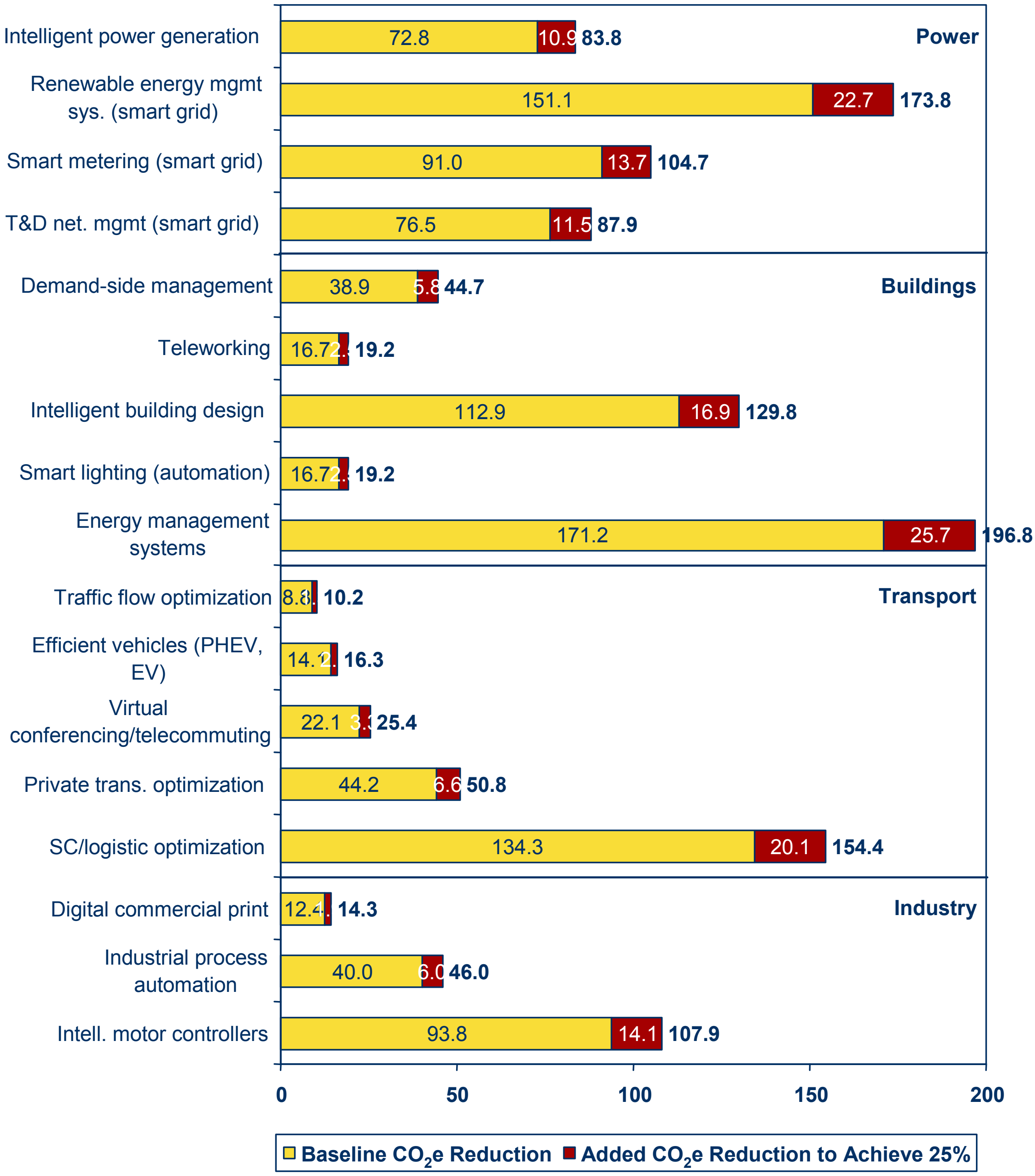
Among sources in the buildings category, which constitutes the second-largest share of tier 5's overall emissions, the largest increases in tier 5 CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 171.2 million tonnes to 196.8 million tonnes a year in 2020. Overall, CO_2e reductions in tier 5's buildings segment need to increase from 356.2 million tonnes to 409.7 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from transport sources require an increase of 33.5 million tonnes to 257.0 million tonnes annually by 2020. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 134.3 million tonnes in 2020 to 154.4 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 44.2 million tonnes to 50.8 million tonnes in this timeframe.

The IDC model holds that CO_2e reductions in tier 5's industry segment — the smallest share of tier 5's overall reduction potential — need to be increased from 146.3 million tonnes a year to 168.2 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 93.8 million tonnes to 107.9 million tonnes in annual CO_2e emissions) and industrial process automation (from 40.0 million tonnes to 46.0 million tonnes).

FIGURE 82

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Tier 5



Note: Total baseline CO_2e reduction: 1,117.5M tonnes total CO_2e reduction at 25% target: 1,285.1M tonnes

Source: IDC, 2009

Country-Specific Overviews

The following sections present separate, country-level overviews of each of the countries within tier 5: Argentina, India, Indonesia, Russia, Saudi Arabia, and South Africa. Each overview looks at the current potential for CO_2e reductions by 2020, as well as each country's modified CO_2e reduction requirement for the G20 countries overall to achieve a 25% CO_2e reduction in this timeframe.

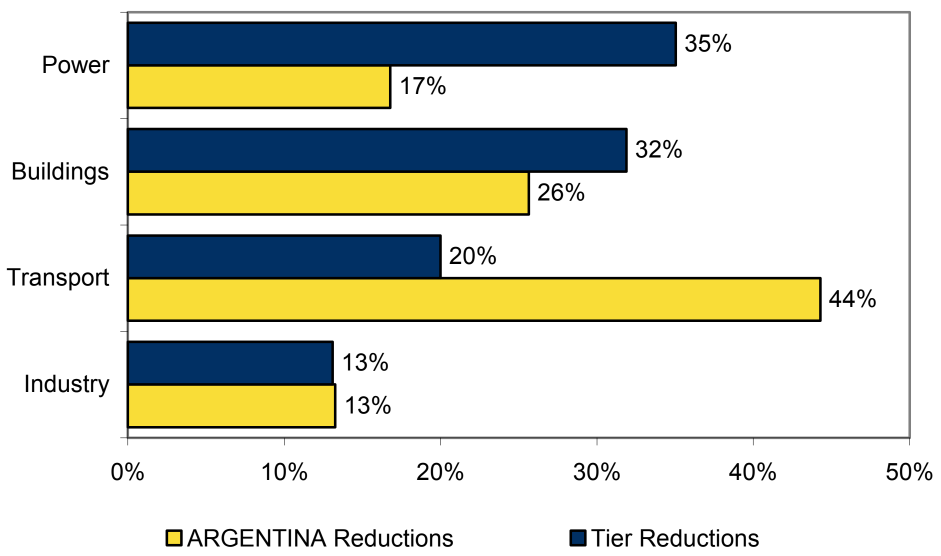
Argentina

The Current CO_2e Reduction Scenario

Argentina is ranked 19th among G20 countries in terms of projected CO_2e emissions by 2020, at 148.8 million tonnes a year. Under baseline assumptions, Argentina's maximum CO_2e reduction capability is 38.8 million tonnes annually. As Figure 83 shows, the largest share of Argentina's projected CO_2e reduction opportunity is in transport. At 44%, the share of CO_2e reduction opportunities associated with transport sources is significantly higher than that of tier 5 countries as a group (20%). The second-largest share of Argentina's CO_2e reduction opportunities are derived from the buildings category, which accounts for 26%, compared with 32% for tier 5 countries as a group. The share of CO_2e reduction opportunities related to power sources in Argentina (17%) is significantly lower than that of tier 5 countries as a group (35%), while the share of CO_2e reduction opportunities derived from industry in Argentina (13%) is roughly the same as that of tier 3 countries as a group (13%).

FIGURE 83

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Argentina Versus Tier 5



Source: IDC, 2009

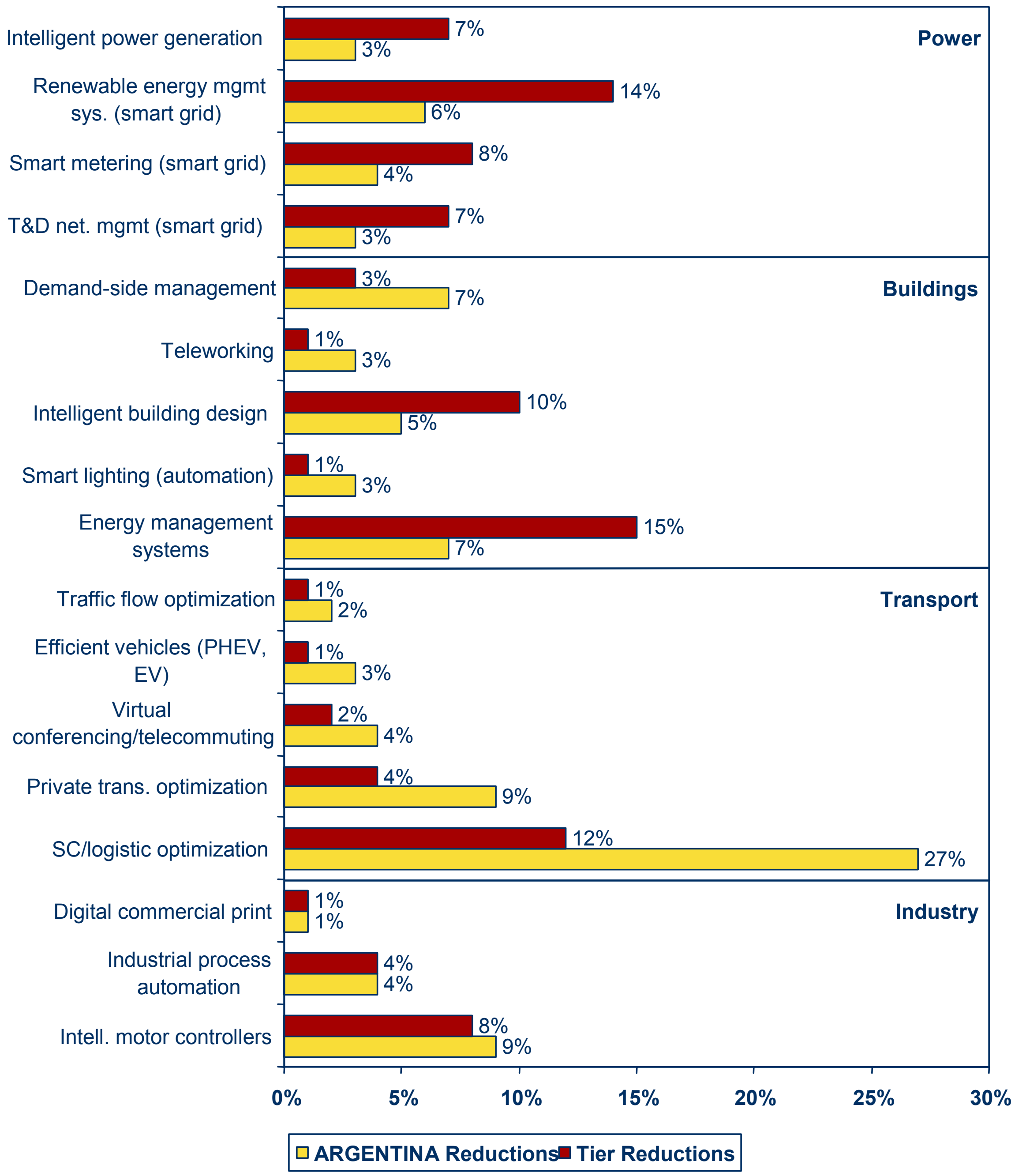
Figure 84 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Argentina (6%), significantly lower than the share for tier 5 as a whole (14%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 4% of Argentina's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 3% of Argentina's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 3% of Argentina's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems represent the largest source of potential CO_2e reduction in Argentina (7%, compared with 15% for all of tier 3). Other significant sources for CO_2e reductions in the buildings category include intelligent building design (5%), demand-side management programs (4%), teleworking (3%), and smart lighting (3%).

FIGURE 84

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Argentina Versus Tier 5



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Argentina's most significant CO_2e reduction opportunity (12%), a share less than half that of tier 5 as a group (27%). Argentina's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 9% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (4%), efficient vehicles (3%), and smart traffic systems (2%).

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 9% of Argentina's overall CO_2e reduction (compared with 8% for tier 5 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 4% and 1% respectively of Argentina's overall CO_2e reduction.

The 25% Scenario: Argentina's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Argentina is projected to achieve a CO_2e reduction of 38.2 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Argentina's requirement is to increase its annual CO_2e reductions by 15% from 38.2 million tonnes to 44.6 million tonnes. As Figure 85 shows, the largest increase (2.6 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 86), with the CO_2e reduction target raised from 10.3 million tonnes in 2020 to 11.9 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 3.4 million tonnes to 3.9 million tonnes in this timeframe.

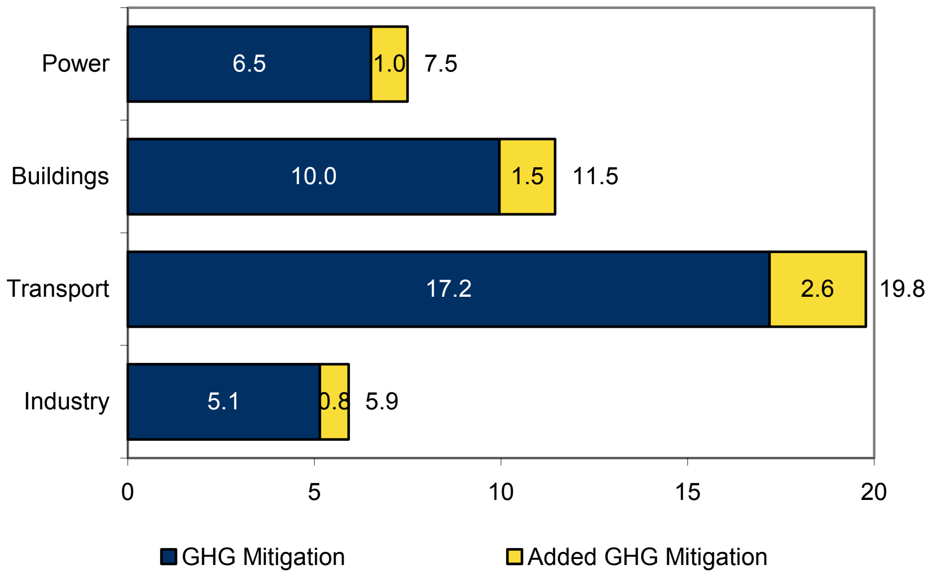
Among sources in the buildings category (the second largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 2.8 million tonnes to 3.3 million tonnes a year in 2020. Overall, CO_2e reductions in Argentina's buildings segment need to increase from 10.0 million tonnes to 11.5 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e emissions from power sources, which constitute the third-largest share of Argentina's overall emissions, require an increase of 1.0 million tonnes, from 6.5 million tonnes to 7.5 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 2.5 million tonnes to 2.9 million tonnes a year in 2020.

CO_2e reductions in Argentina's industry segment need to be increased from 5.1 million tonnes a year to 5.9 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 3.5 million tonnes to 3.8 million tonnes in annual CO_2e emissions) and industrial process automation (from 1.4 million tonnes to 1.6 million tonnes).

FIGURE 85

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Argentina

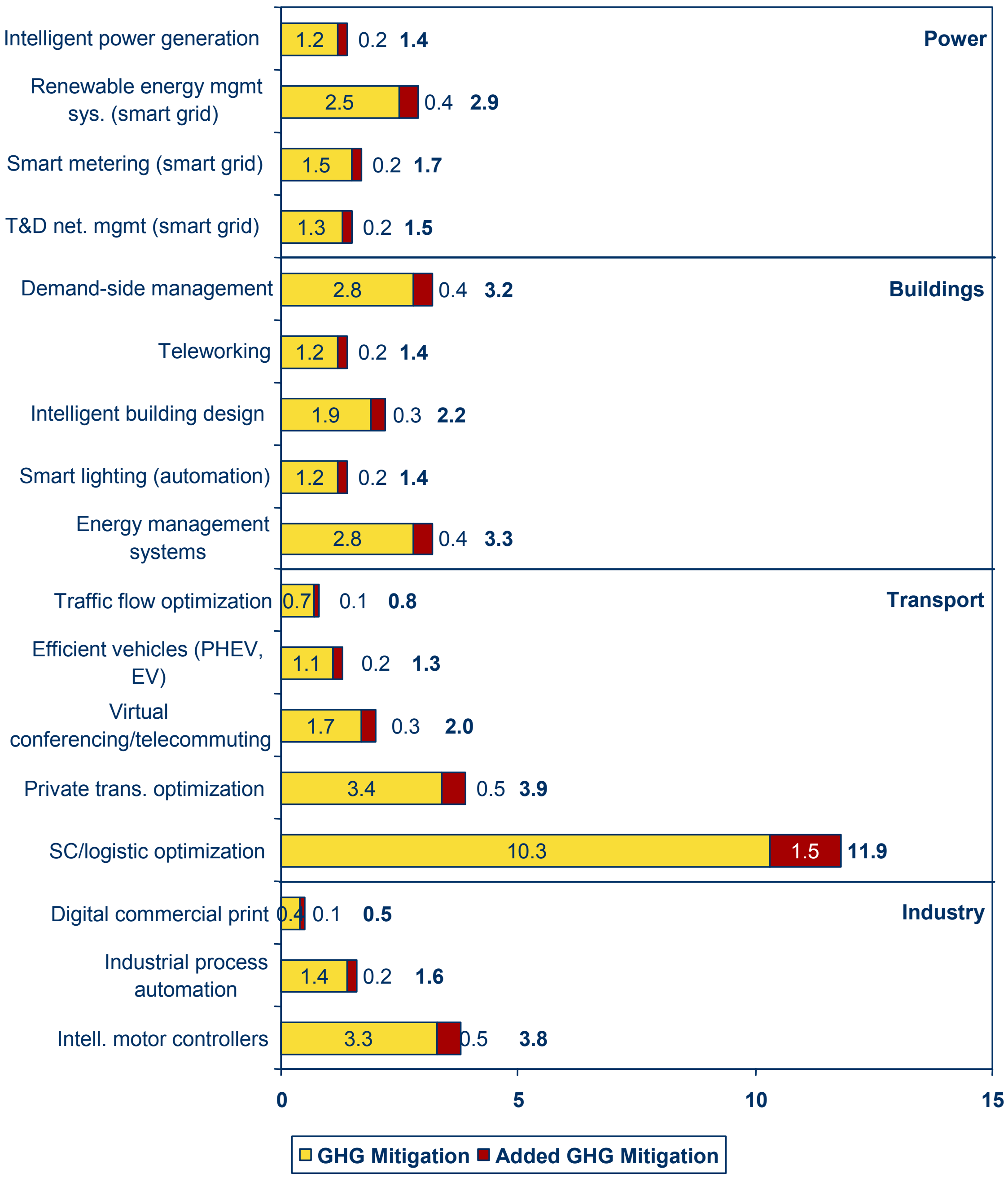


Note: Total baseline CO_2e reduction: 38.8M tonnes total CO_2e reduction at 25% target: 44.6M tonnes

Source: IDC, 2009

FIGURE 86

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Argentina



Note: Total baseline CO_2e reduction: 38.8M tonnes total CO_2e reduction at 25% target: 44.6M tonnes

Source: IDC, 2009

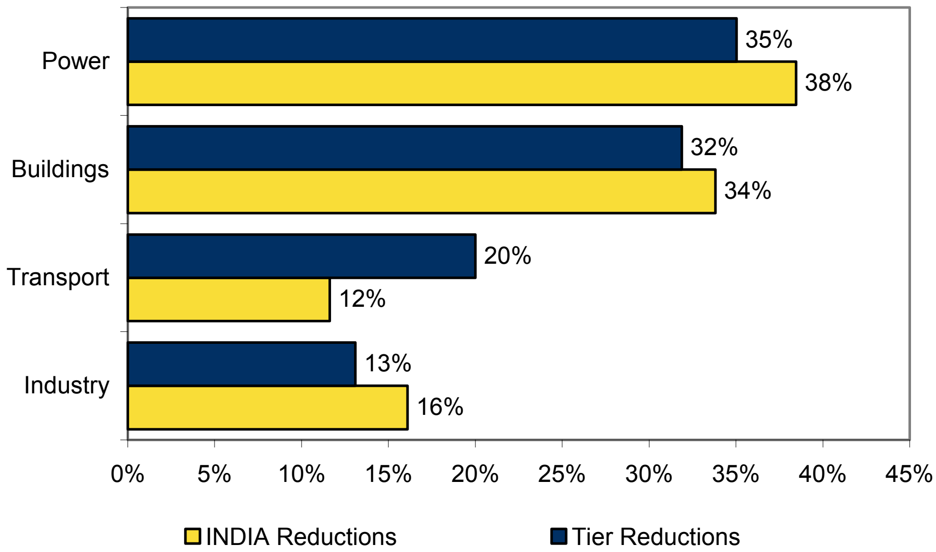
India

The Current CO_2e Reduction Scenario

India is ranked fourth among G20 countries in terms of projected CO_2e emissions by 2020, at 1.2 billion tonnes a year. Under baseline assumptions, India's maximum CO_2e reduction capability is 341.3 million tonnes annually. As Figure 87 shows, the largest share of India's projected CO_2e reduction opportunity is in the power area. At 38%, the share of CO_2e reduction opportunities associated with power sources is slightly higher than that of tier 5 countries as a group (35%). The buildings category represents the second-largest area, at 34% of CO_2e reduction potential in 2020, roughly equivalent to the share for tier 5 as a group (32%). The share of CO_2e reduction opportunities derived from transport sources is somewhat lower for India (12%) than for tier 5 collectively (20%), while India's industry-oriented sources of reduction are expected to account for a somewhat higher share (16%) than tier 5 countries as a group (13%).

FIGURE 87

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — India Versus Tier 5



Source: IDC, 2009

Figure 88 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in India (15%), roughly in line with the percentage seen for tier 5 as a whole (14%). Of the remaining components of the power category, by 2020:

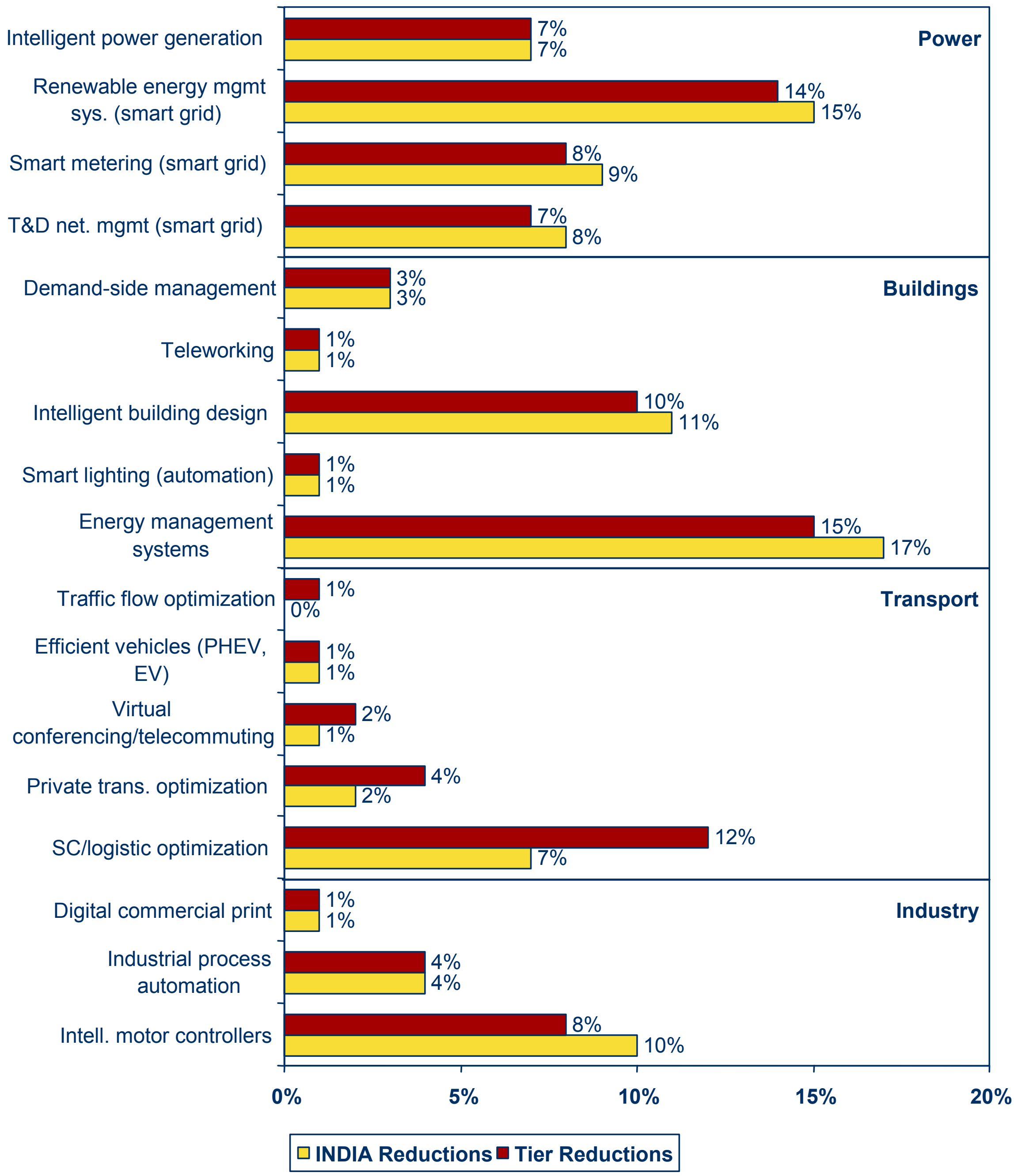
- Smart metering will account for 9% of India's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will account for 8% of India's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 7% of India's overall CO_2e reduction opportunity.

In each of these categories, India's percentages generally mirror those of the overall tier 5 population.

In the buildings category, the largest potential for CO_2e reductions are in the areas of energy management systems and intelligent building design, which are expected to account for 17% and 11% respectively of India's CO_2e reduction opportunities in 2020. Demand-side management programs (3%), teleworking (1%), and smart lighting (1%) are among the least significant sources of CO_2e reduction potential, both for India and tier 5 as a group.

FIGURE 88

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — India Versus Tier 5



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents India's most significant CO_2e reduction opportunity (16%), a somewhat lower share than tier 5 as a group (12%). India's next largest source of CO_2e reduction opportunity is in private transport optimization, accounting for 2% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (1%), efficient vehicles (1%), and smart traffic systems (<1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a significant CO_2e reduction opportunity, accounting for 10% of India's overall CO_2e reduction (somewhat higher than the 8% for tier 5 countries as a group) in 2020. The reduction shares associated with improvements in industrial process automation and savings derived from the use of digital commercial print (at 4% and 1% respectively) essentially mirror those of the tier 5 population as a group.

The 25% Scenario: India's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), India is projected to achieve a CO_2e reduction of 341.3 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, India's requirement is to increase its annual CO_2e reductions by 15% (51.2 million tonnes) to 392.4 million tonnes. As Figure 89 shows, the largest increase (19.7 million tonnes, to 150.9 million tonnes annually) needs to occur in the power area. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 50.7 million tonnes to 58.3 million tonnes a year in 2020 (Figure 90).

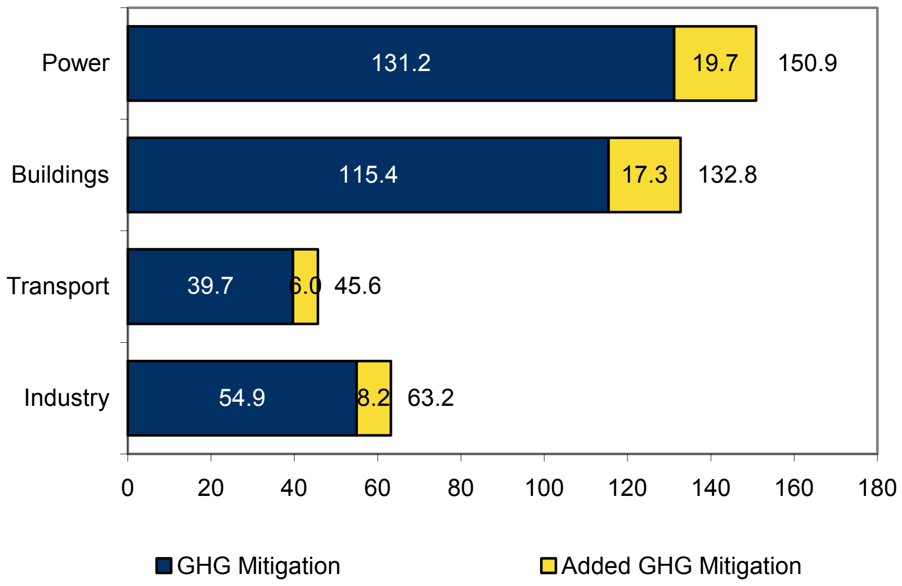
Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 57.4 million tonnes to 66.0 million tonnes a year in 2020. Overall, CO_2e reductions in India's buildings segment need to increase from 115.4 million tonnes to 132.8 million tonnes annually under the 25% G20 CO_2e reduction scenario.

Reductions in India's industry segment need to be increased from 54.9 million tonnes a year to 63.2 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 35.2 million tonnes to 40.5 million tonnes in annual CO_2e emissions) and industrial process automation (from 15.0 million tonnes to 17.3 million tonnes).

The principal source of added CO_2e reductions in the transport category, the smallest of the four general categories, should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 23.8 million tonnes in 2020 to 27.4 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 7.8 million tonnes to 9.0 million tonnes in this timeframe. Overall, reductions associated with the transport segment need to increase from 39.7 million tonnes to 45.6 million tonnes by 2020.

FIGURE 89

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — India

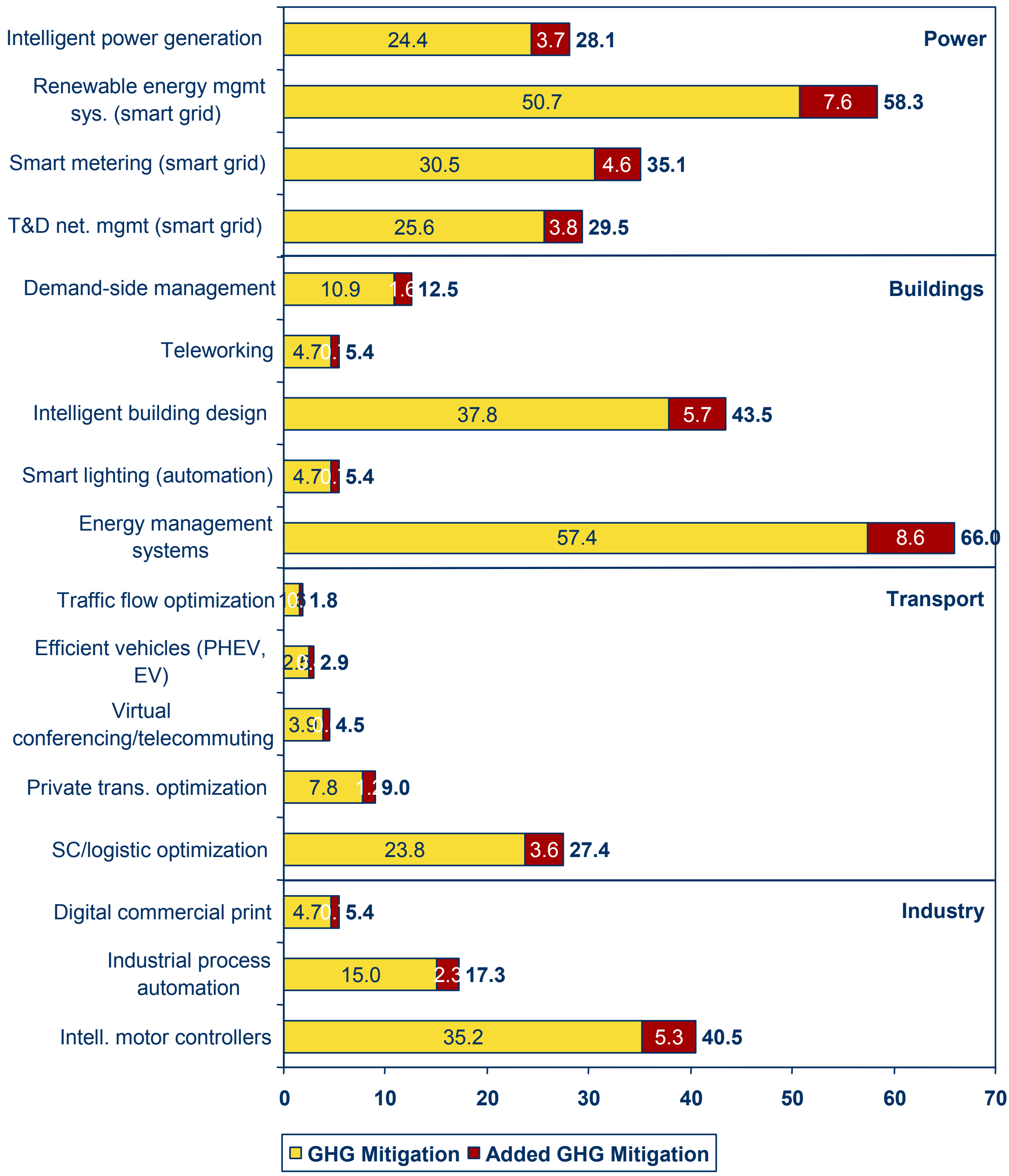


Note: Total baseline CO_2e reduction: 341.3M tonnes total CO_2e reduction at 25% target: 392.4M tonnes

Source: IDC, 2009

FIGURE 90

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — India



Note: Total baseline CO$_2$e reduction: 341.3M tonnes total CO$_2$e reduction at 25% target: 392.4M tonnes

Source: IDC, 2009

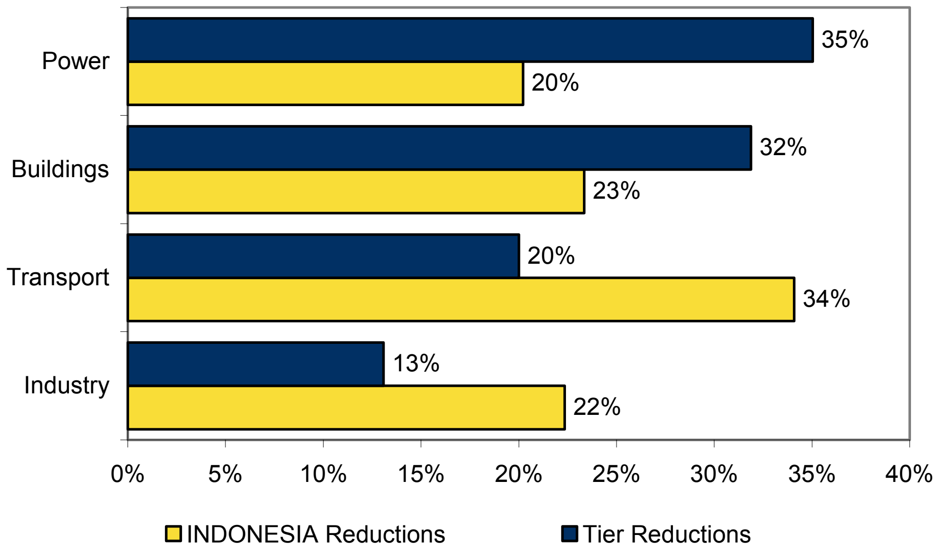
Indonesia

The Current CO_2e Reduction Scenario

Indonesia is ranked 17th among G20 countries in terms of projected CO_2e emissions by 2020, at 334.6 million tonnes a year. Under baseline assumptions, Indonesia's maximum CO_2e reduction capability is 83.2 million tonnes annually. As Figure 91 shows, the largest share of Indonesia's projected CO_2e reduction opportunity is in transport. At 34%, the share of CO_2e reduction opportunities associated with transport sources is significantly higher than that of tier 5 countries as a group (20%). The second-largest share of Indonesia's CO_2e reduction opportunities are derived from the buildings category, which accounts for 23%, compared with 32% for tier 5 countries as a group. The share of CO_2e reduction opportunities derived from industry in Indonesia (22%) is moderately higher than that of tier 5 countries as a group (13%), while the share of CO_2e reduction opportunities related to power sources in Indonesia (20%) is significantly lower than that of tier 5 countries as a group (35%).

FIGURE 91

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Indonesia Versus Tier 5



Source: IDC, 2009

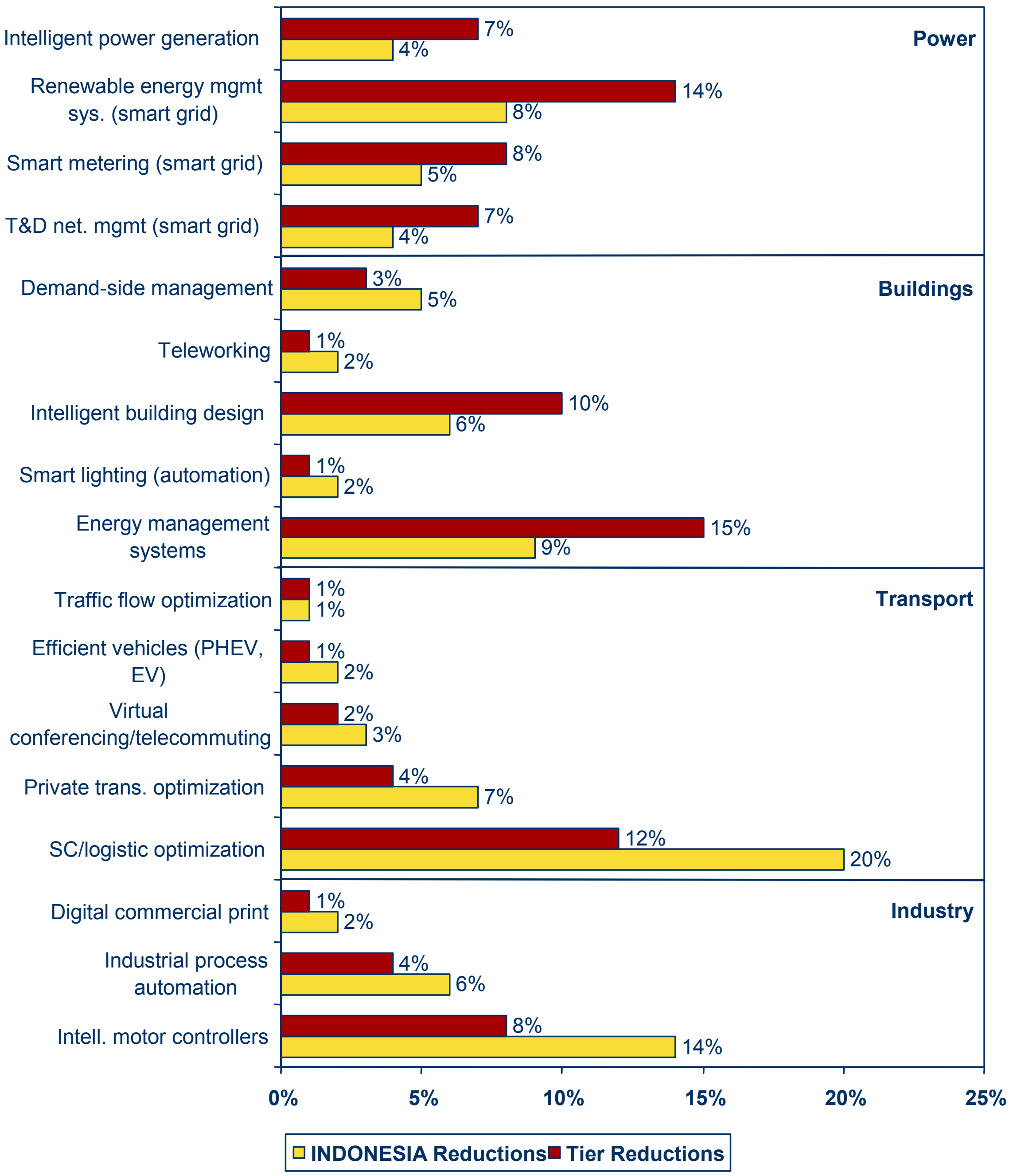
Figure 92 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Indonesia (8%), somewhat less than the share for tier 5 as a whole (14%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 5% of Indonesia's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 4% of Indonesia's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 4% of Indonesia's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems, at a 9% share, represents the largest source of potential CO_2e reduction in Indonesia; this compares with a 15% share for all of tier 5. Other significant sources for CO_2e reductions in the buildings category include intelligent building design (6%), demand-side management programs (5%), teleworking (2%), and smart lighting (2%).

FIGURE 92

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Indonesia Versus Tier 5



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Indonesia's most significant CO_2e reduction opportunity (20%), a considerably higher share than tier 5 as a group (12%). Indonesia's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 7% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 14% of Indonesia's overall CO_2e reduction (compared with 8% for tier 5 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 6% and 2% respectively of Indonesia's overall CO_2e reduction.

The 25% Scenario: Indonesia's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Indonesia is projected to achieve a CO_2e reduction of 83.2 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Indonesia's requirement is to increase its CO_2e reductions by 15% to 95.7 million tonnes. As Figure 93 shows, the largest increase (of 4.3 million tonnes, for a total of 32.6 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 94), with the CO_2e reduction target raised from 17.0 million tonnes in 2020 to 19.6 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 5.6 million tonnes to 6.4 million tonnes in this timeframe.

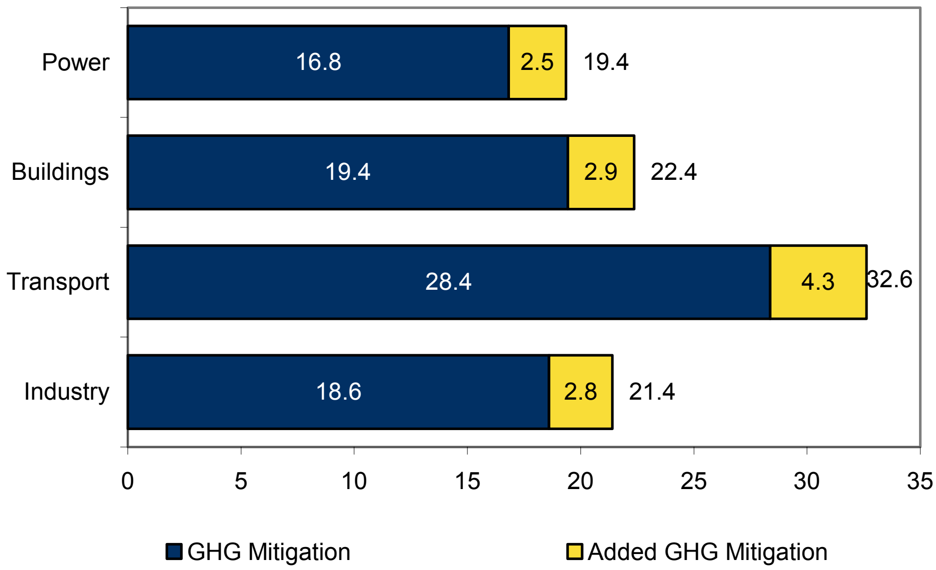
Among sources in the buildings category (the second largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 7.4 million tonnes to 8.5 million tonnes a year in 2020. Overall, CO_2e reductions in Indonesia's buildings segment need to rise from 19.4 million tonnes to 22.4 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e reductions in Indonesia's industry segment, which constitute the third-largest share of Indonesia's overall emissions, need to be increased from 18.6 million tonnes a year to 21.4 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 11.9 million tonnes to 13.7 million tonnes in annual CO_2e emissions) and industrial process automation (from 5.1 million tonnes to 5.9 million tonnes).

CO_2e emissions from power sources require an increase of 2.5 million tonnes, from 16.8 million tonnes to 19.4 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 6.5 million tonnes to 7.5 million tonnes a year in 2020.

FIGURE 93

CO_2e Reduction Opportunity: Baseline Scenario vs. 25% Target — Indonesia

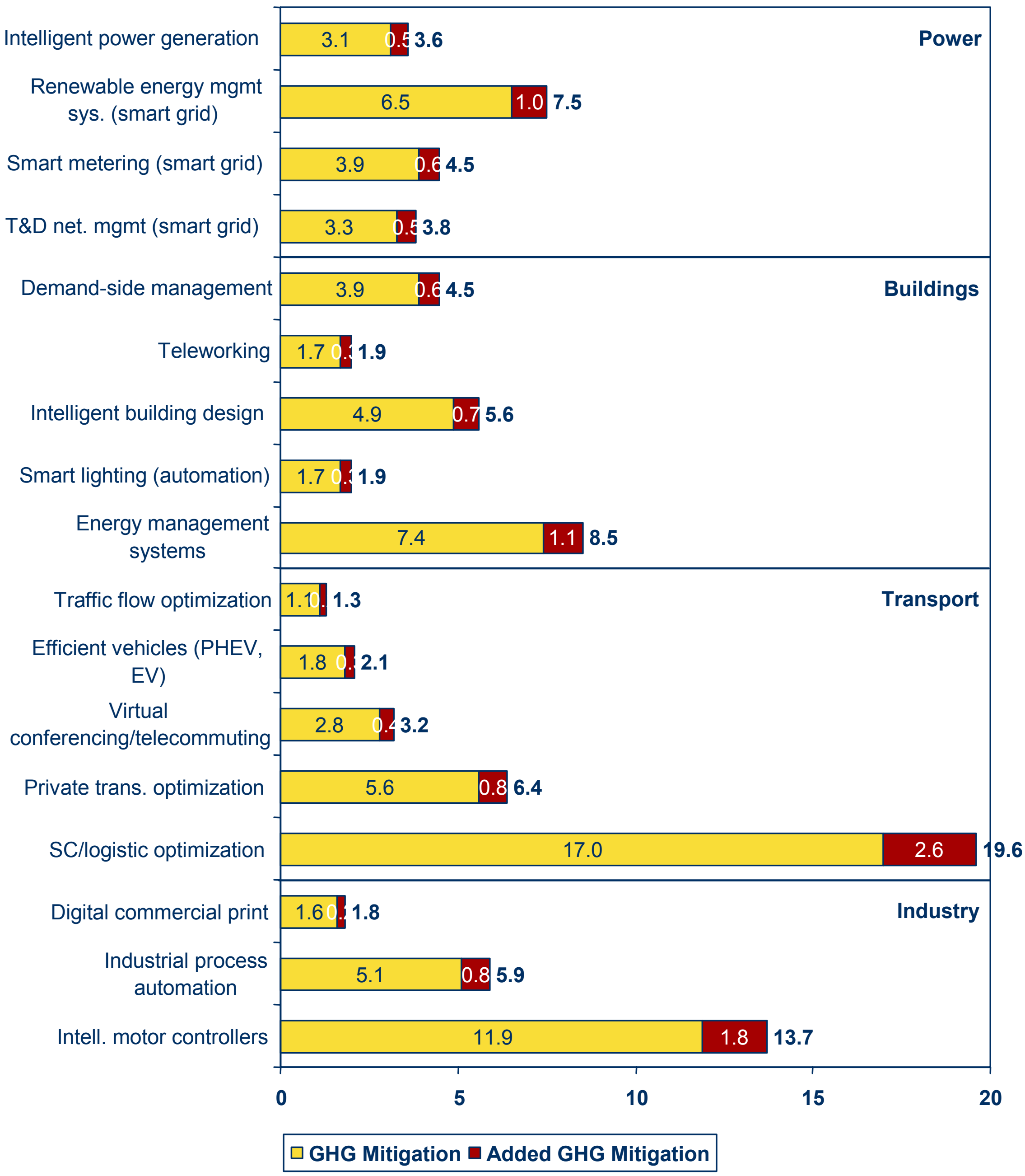


Note: Total baseline CO_2e reduction: 83.2M tonnes total CO_2e reduction at 25% target: 95.7M tonnes

Source: IDC, 2009

FIGURE 94

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Indonesia



Note: Total baseline CO$_2$e reduction: 83.2M tonnes total CO$_2$e reduction at 25% target: 95.7M tonnes

Source: IDC, 2009

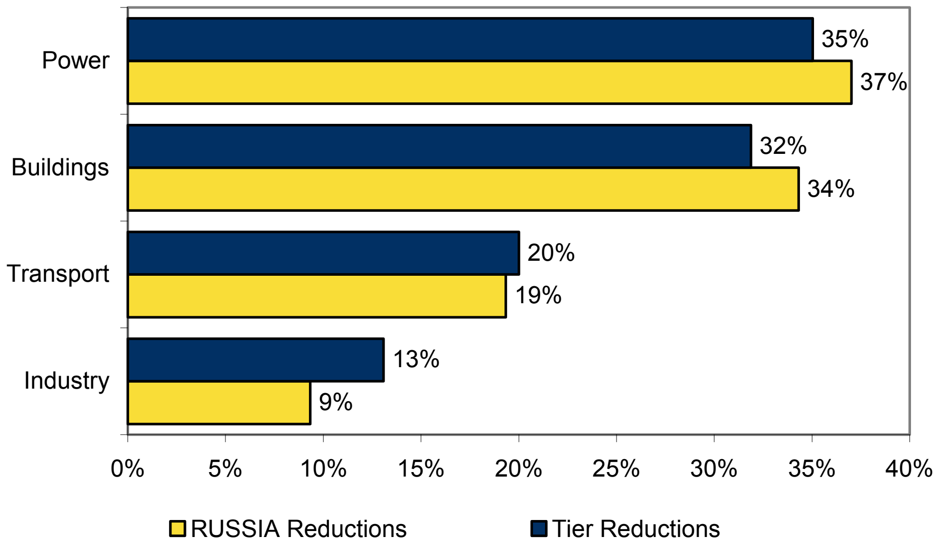
Russia

The Current CO_2e Reduction Scenario

Russia is ranked third among G20 countries in terms of projected CO_2e emissions by 2020, at 1.6 billion tonnes a year. Under baseline assumptions, Russia's maximum CO_2e reduction capability is 460.9 million tonnes annually. As Figure 95 shows, the largest share of Russia's projected CO_2e reduction opportunity is in the power area. At 37%, the share of CO_2e reduction opportunities associated with power sources is roughly in line with that of tier 5 countries as a group (35%). The buildings category is a close second, representing 34% of Russia's CO_2e reduction opportunities in 2020 — again roughly in line with tier 5 countries as a group. The share of CO_2e reduction opportunities derived from transport sources in Russia (19%) is likewise comparable to tier 5 countries as a group (20%), while Russia's share of CO_2e reduction opportunities derived from industry sources (9%) is slightly lower than tier 5 countries as a group (13%).

FIGURE 95

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Russia Versus Tier 5



Source: IDC, 2009

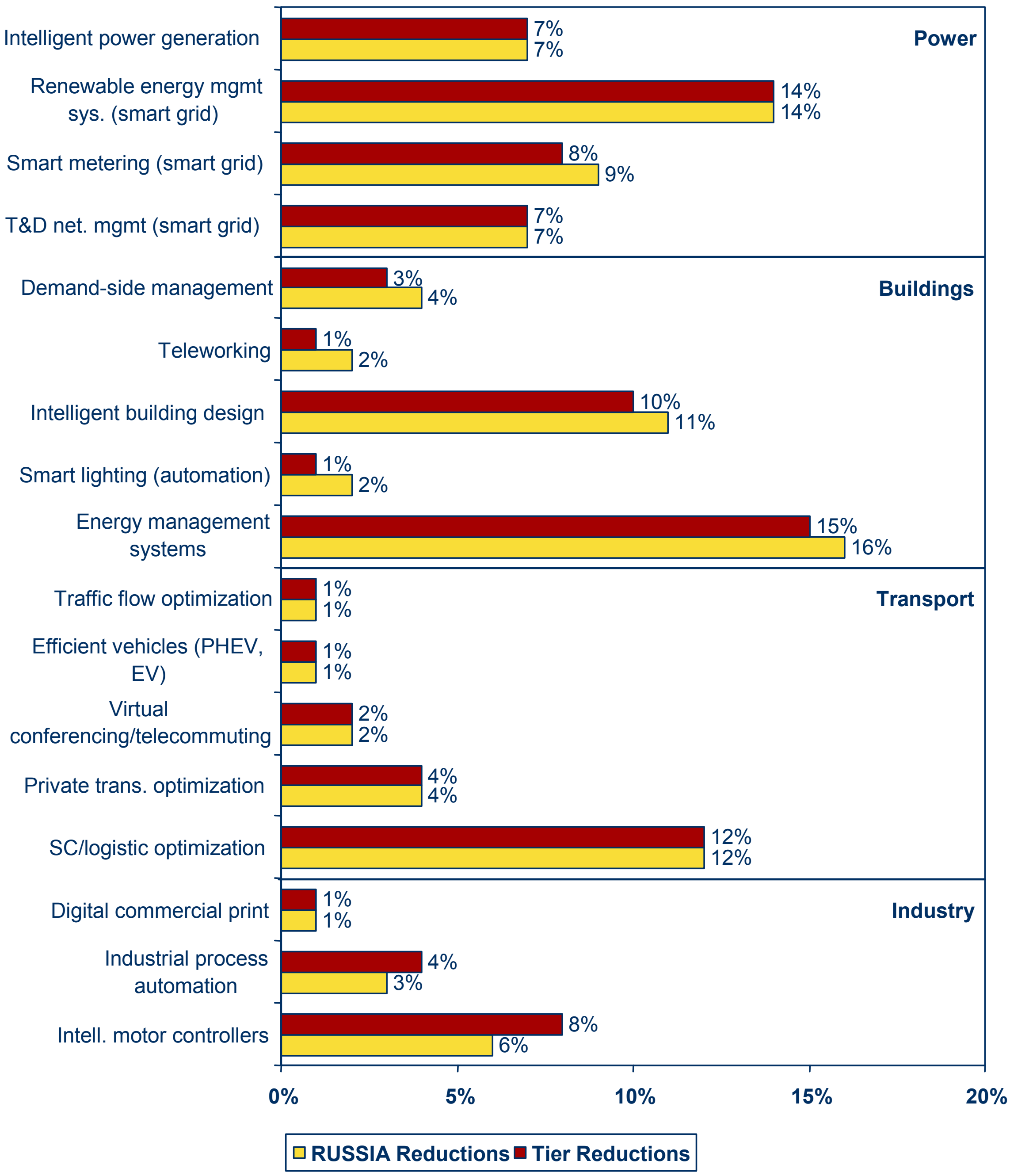
Figure 96 shows that within the power category, renewable energy management systems are seen as providing the most significant source of CO_2e reduction in Russia. The 14% share of overall CO_2e reductions is approximately the same as tier 5 as a whole (14%). Of the remaining components of the power category, by 2020:

- Smart metering will account for 9% of Russia's overall 2020 CO_2e reduction opportunity.
- Intelligent power generation will account for 7% of Russia's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 7% of Russia's overall CO_2e reduction opportunity.

Within the buildings category, the largest sources of CO_2e reduction under the baseline scenario are energy management systems (16%) and intelligent building design (11%), followed by demand-side management programs (4%), teleworking (2%), and smart lighting (2%).

FIGURE 96

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Russia Versus Tier 5



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents Russia's most significant CO_2e reduction opportunity (12%), a roughly equivalent share to that of tier 5 as a group (12%). Russia's next largest source of CO_2e reduction opportunity in this category is in private transport optimization, accounting for 4% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (2%), efficient vehicles (1%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a moderate CO_2e reduction opportunity, accounting for 6% of Russia's overall CO_2e reduction (compared with 8% for tier 5 countries as a group) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 3% and 1% respectively of Russia's overall CO_2e reduction.

The 25% Scenario: Russia's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Russia is projected to achieve a CO_2e reduction of 460.9 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Russia's requirement is to increase its annual CO_2e reductions by 15%, to a total of 530.0 million tonnes annually. As Figure 97 shows, the largest increase (25.6 million tonnes) needs to occur in the power area. Within the overall power category, the largest reductions should be induced by investments in renewable energy management systems, with associated CO_2e cuts rising from 65.9 million tonnes to 75.8 million tonnes a year in 2020 (Figure 98).

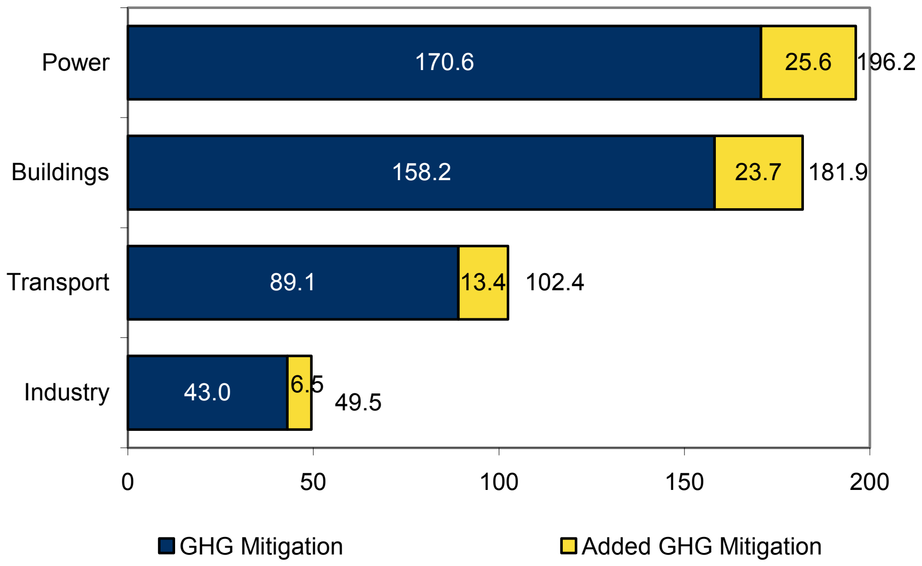
CO_2e emissions from Russia's buildings sources, which make up the second-largest share of the country's overall emissions, need to be cut by an additional 23.7 million tonnes a year, to 181.9 million tonnes, within the framework of a 25% G20 reduction by 2020. Among sources in the buildings category, the largest increases in CO_2e abatement should come from investments in energy management systems, raising the level of annual CO_2e reductions by 74.6 million tonnes to 85.8 million tonnes; intelligent building design, raising the level of annual CO_2e reductions by 49.2 million tonnes to 56.6 million tonnes; and demand-side management, raising the level of annual CO_2e reductions by 18.5 million tonnes to 21.3 million tonnes.

The third-largest increase (13.4 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 53.5 million tonnes in 2020 to 61.5 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 17.6 million tonnes to 20.2 million tonnes in this timeframe.

CO_2e reductions in Russia's industry segment need to be increased from 43.0 million tonnes a year to 49.5 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within Russia's industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (with targeted CO_2e reductions rising from 27.6 million tonnes to 31.7 million tonnes annually) and industrial process automation (with targeted CO_2e reductions rising from 11.8 million tonnes to 13.5 million tonnes).

FIGURE 97

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Russia

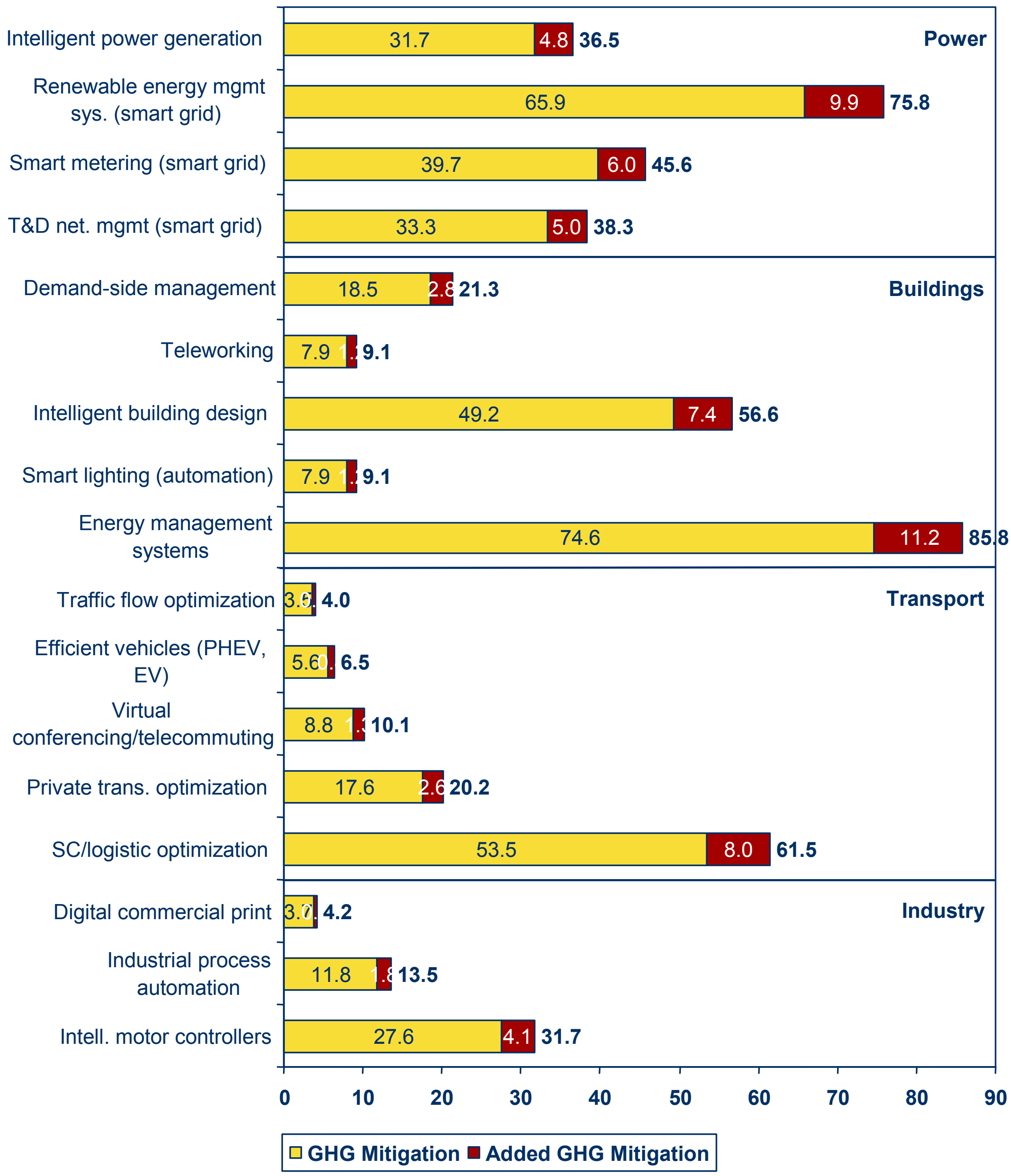


Note: Total baseline CO$_2$e reduction: 460.9M tonnes total CO$_2$e reduction at 25% target: 530.0M tonnes

Source: IDC, 2009

FIGURE 98

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Russia



Note: Total baseline CO$_2$e reduction: 460.9M tonnes total CO$_2$e reduction at 25% target: 530.0M tonnes

Source: IDC, 2009

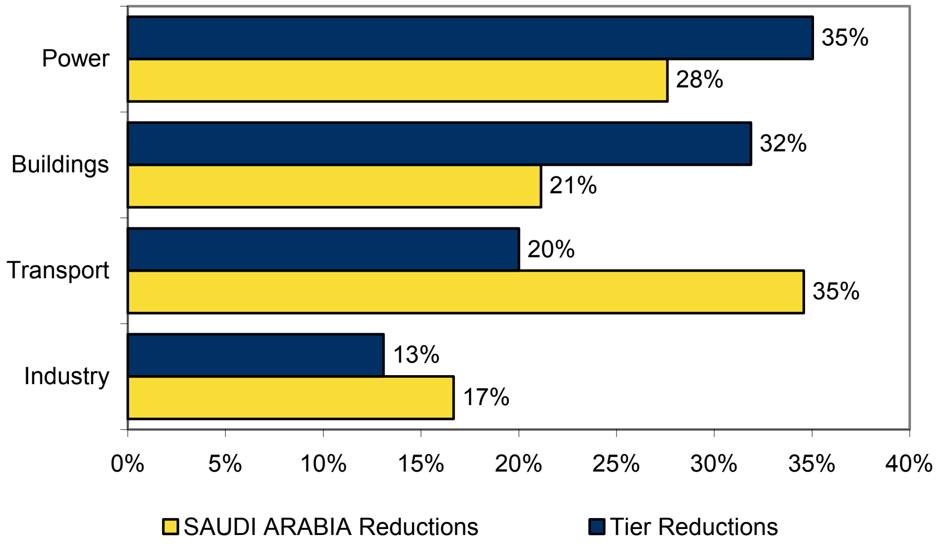
Saudi Arabia

The Current CO_2e Reduction Scenario

Saudi Arabia is ranked 15th among G20 countries in terms of projected CO_2e emissions by 2020, at 340.0 million tonnes a year. Under baseline assumptions, Saudi Arabia's maximum CO_2e reduction capability is 91.9 million tonnes annually. As Figure 99 shows, the largest share of Saudi Arabia's projected CO_2e reduction opportunity is in transport. At 35%, the share of CO_2e reduction opportunities associated with transport sources is considerably higher than that of tier 5 countries as a group (20%). The second-largest share of Saudi Arabia's CO_2e reduction opportunities are derived from the power category, which account for 28%, compared with 35% for tier 5 countries as a group. The share of CO_2e reduction opportunities related to buildings sources in Saudi Arabia (21%) is lower than that of tier 5 countries as a group (32%), while the share of CO_2e reduction opportunities derived from industry in Saudi Arabia (17%) is marginally higher than that of tier 5 countries as a group (13%).

FIGURE 99

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Saudi Arabia Versus Tier 5



Source: IDC, 2009

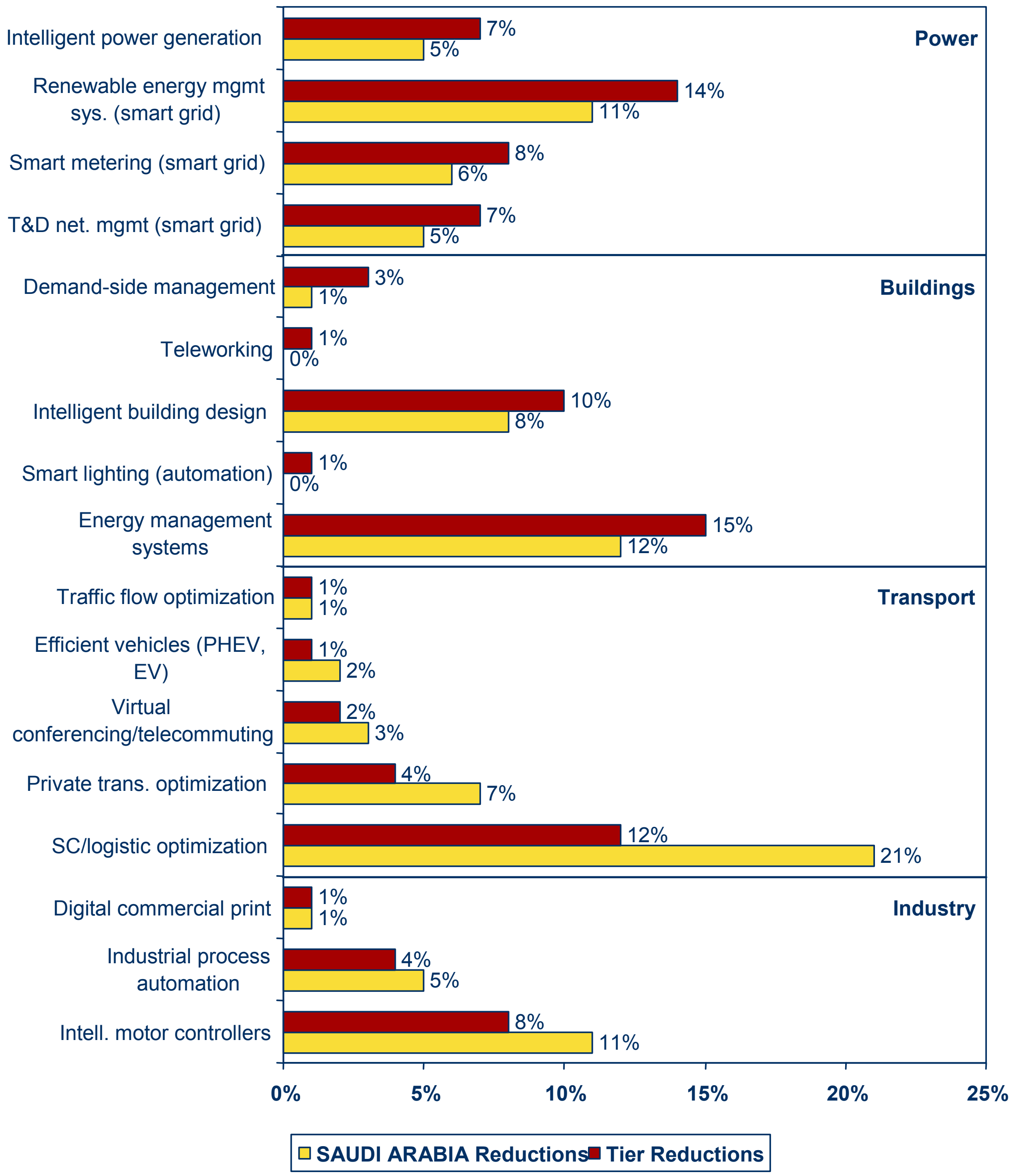
Figure 100 shows that within the power category in Saudi Arabia, renewable energy management systems are seen as providing the most significant share (11%) of CO_2e reduction potential. This compares with 14% for tier 5 as a whole. Of the remaining components of the power category, by 2020:

- Smart metering will account for 6% of Saudi Arabia's overall CO_2e reduction opportunity.
- Intelligent power generation will account for 5% of Saudi Arabia's overall CO_2e reduction opportunity.
- Transmission and distribution network management systems will also account for 5% of Saudi Arabia's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems (12%) and intelligent building design (8%) represent the largest sources of potential CO_2e reduction in Saudi Arabia, as well as for tier 5 countries as a whole (15% and 10% respectively). Other less significant sources for CO_2e reductions in the Saudi Arabia's buildings category include demand-side management programs (1%), teleworking (<1%), and smart lighting (<1%).

FIGURE 100

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — Saudi Arabia Versus Tier 5



Source: IDC, 2009

In the transport category (and overall), supply chain and logistics optimization represents Saudi Arabia's most significant CO_2e reduction opportunity (21%), a significantly higher share than tier 5 as a group (12%). Saudi Arabia's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 7% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (3%), efficient vehicles (2%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a substantial CO_2e reduction opportunity, accounting for 11% of Saudi Arabia's overall CO_2e reduction potential (compared with 8% for tier 5 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 5% and 1% respectively of Saudi Arabia's overall CO_2e reduction.

The 25% Scenario: Saudi Arabia's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), Saudi Arabia is projected to achieve a CO_2e reduction of 91.9 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, Saudi Arabia's requirement is to increase its annual CO_2e reductions by 15% to 105.7 million tonnes, an increase of 13.8 million tonnes.

As Figure 101 shows, the largest increase (4.8 million tonnes) needs to occur in transport. The principal source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area (Figure 102), with the CO_2e reduction target raised from 19.1 million tonnes in 2020 to 22.0 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 6.3 million tonnes to 7.2 million tonnes in this timeframe.

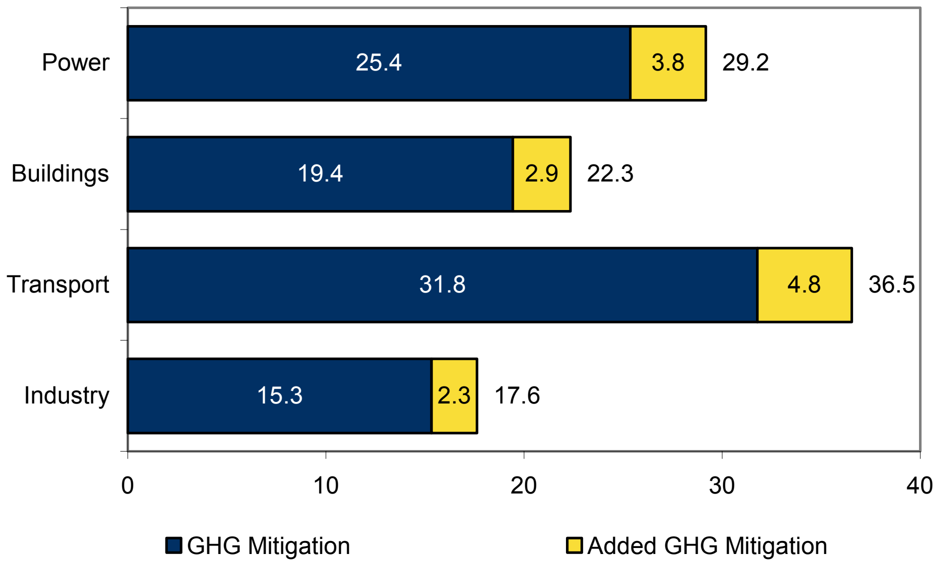
CO_2e emissions from power sources, which constitute the second-largest share of Saudi Arabia's overall emissions, require an increase of 3.8 million tonnes, from 25.4 million tonnes to 29.2 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 9.8 million tonnes to 11.3 million tonnes a year in 2020.

Among sources in the buildings category (the third largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 11.1 million tonnes to 12.8 million tonnes a year in 2020. Overall, CO_2e reductions in Saudi Arabia's buildings segment need to rise from 19.4 million tonnes to 22.3 million tonnes annually under the 25% G20 CO_2e reduction scenario.

CO_2e reductions in Saudi Arabia's industry segment need to be increased from 15.3 million tonnes a year to 17.6 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 9.8 million tonnes to 11.3 million tonnes in annual CO_2e emissions) and industrial process automation (from 4.2 million tonnes to 4.8 million tonnes).

FIGURE 101

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — Saudi Arabia

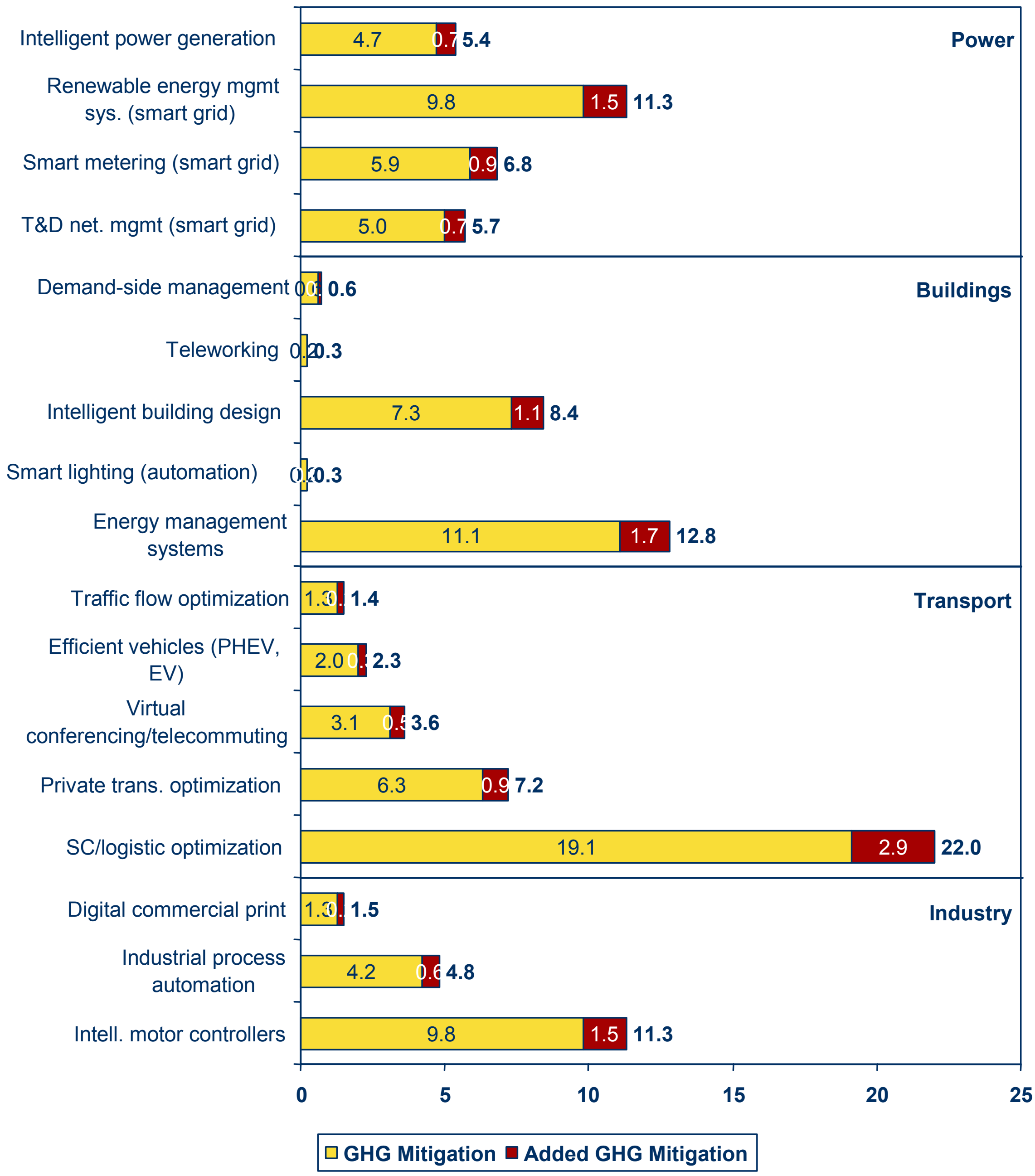


Note: Total baseline CO_2e reduction: 91.9M tonnes total CO_2e reduction at 25% target: 105.7M tonnes

Source: IDC, 2009

FIGURE 102

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — Saudi Arabia



Note: Total baseline CO$_2$e reduction: 91.9M tonnes total CO$_2$e reduction at 25% target: 105.7M tonnes

Source: IDC, 2009

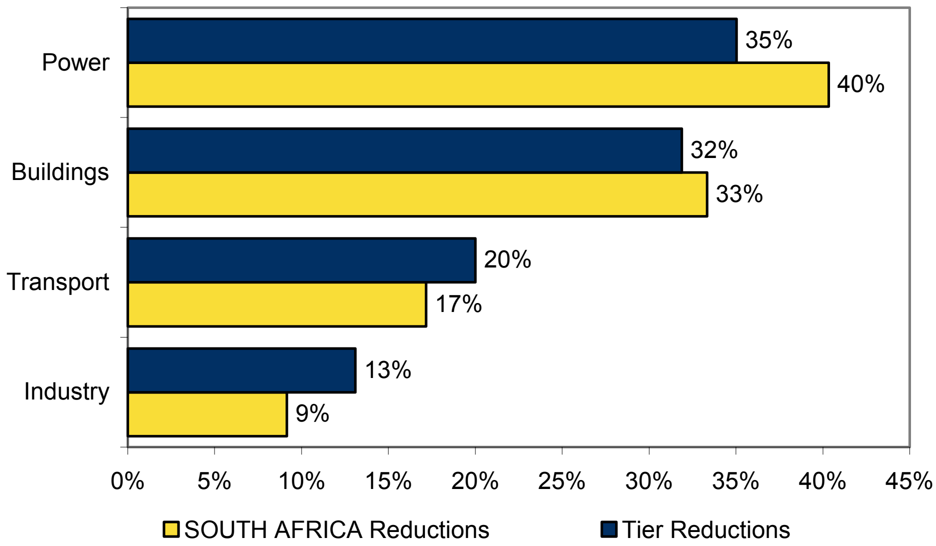
South Africa

The Current CO_2e Reduction Scenario

South Africa is ranked 13th among G20 countries in terms of projected CO_2e emissions by 2020, at 342.0 million tonnes a year. Under baseline assumptions, South Africa's maximum CO_2e reduction capability is 101.4 million tonnes annually. As Figure 103 shows, the largest share of South Africa's projected CO_2e reduction opportunity is in the power area. At 40%, the share of CO_2e reduction opportunities associated with transport sources is modestly higher than that of tier 5 countries as a group (35%). The second-largest share of South Africa's CO_2e reduction opportunities is derived from the buildings category, which accounts for 33%, compared with 32% for tier 5 countries as a group. The share of CO_2e reduction opportunities related to transport sources in South Africa (17%) is slightly lower than that of tier 5 countries as a group (20%), while the share of CO_2e reduction opportunities derived from industry in South Africa is 9%, marginally lower than that of tier 5 countries as a group (13%).

FIGURE 103

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — South Africa Versus Tier 5



Source: IDC, 2009

Figure 104 shows that within the power category in South Africa, renewable energy management systems are seen as providing the most significant share (16%) of CO_2e reduction potential. This compares with 14% for tier 5 as a whole. Of the remaining components of the power category, by 2020:

- Smart metering will account for 8% of South Africa's overall CO_2e reduction opportunity.

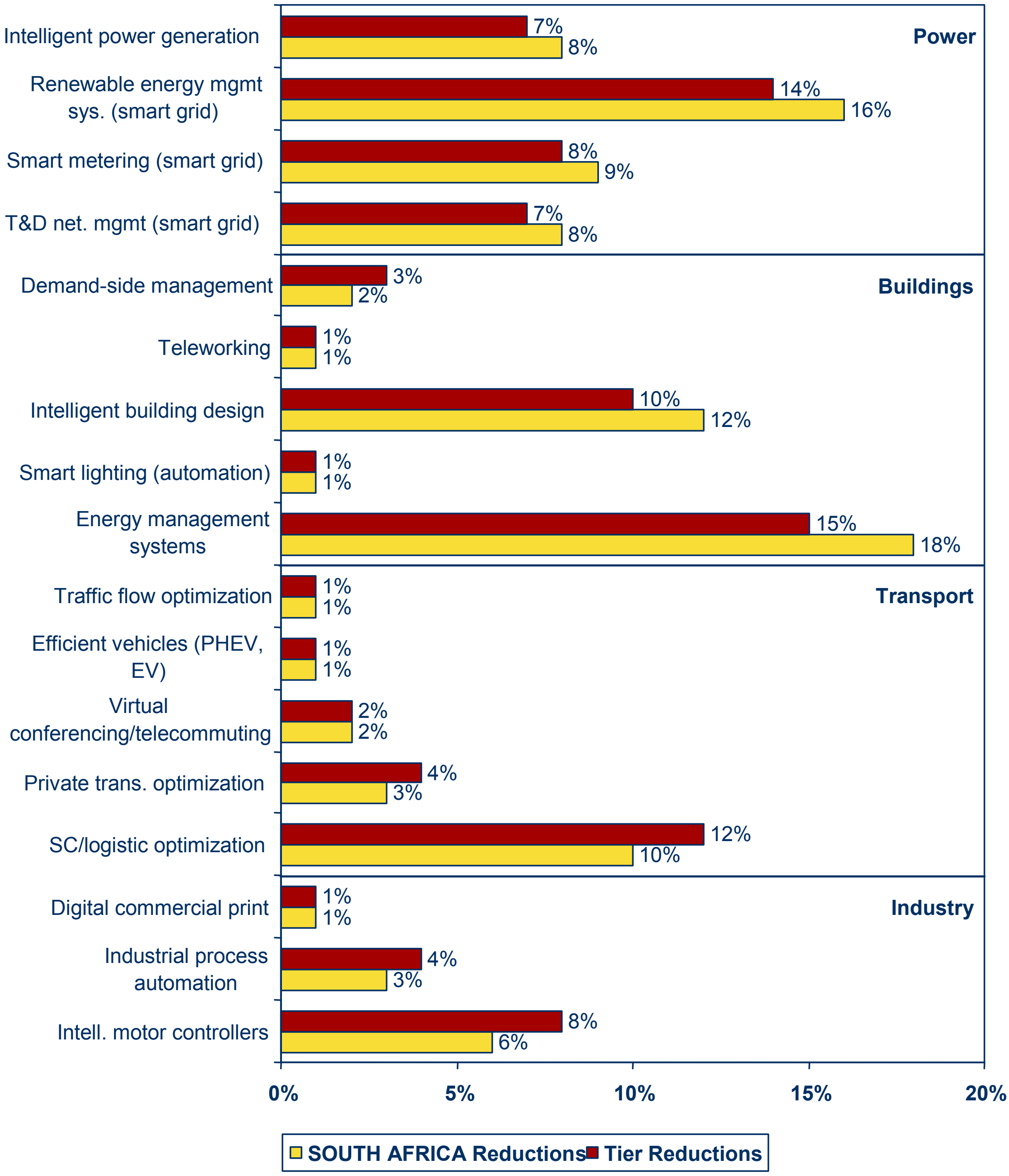
- Intelligent power generation will also account for 8% of South Africa's overall CO_2e reduction opportunity.

- Transmission and distribution network management systems will also account for 8% of South Africa's overall CO_2e reduction opportunity.

Within the buildings category, energy management systems (18%) and intelligent building design (12%) represent the largest sources of potential CO_2e reduction in South Africa, as well as for tier 5 countries as a whole (15% and 10% respectively). Other less significant sources for CO_2e reductions in the South Africa buildings category include demand-side management programs (2%), teleworking (1%), and smart lighting (1%).

FIGURE 104

Projected CO_2e Annual Reduction Opportunity in 2020, by Source — South Africa Versus Tier 5



Source: IDC, 2009

In the transport category, supply chain and logistics optimization represents South Africa's most significant CO_2e reduction opportunity (10%), a slightly lower share than tier 5 as a group (12%). South Africa's next largest source of CO_2e reduction opportunity in the transport category is in private transport optimization, accounting for 3% of the country's total CO_2e reduction opportunity by 2020. Transport factors delivering comparably lower CO_2e reduction opportunity include reduced travel through telecommuting (2%), efficient vehicles (1%), and smart traffic systems (1%).

Within the industry category, the use of intelligent motor controllers is seen as providing a moderate CO_2e reduction opportunity, accounting for 6% of South Africa's overall CO_2e reduction potential (compared with 8% for tier 5 as a whole) in 2020. Improvements in industrial process automation and savings derived from the use of digital commercial print are expected to account for 3% and 1% respectively of South Africa's overall CO_2e reduction.

The 25% Scenario: South Africa's Requirement for a 25% CO_2e Reduction for the G20 by 2020

Under the baseline scenario (or normal ICT capable reduction as modeled by IDC), South Africa is projected to achieve a CO_2e reduction of 101.4 million tonnes annually by 2020. For the G20 as a whole to achieve a 25% reduction in this timeframe, each member country will need to expand its reduction-producing activities in accordance with its current resources and energy usage profile. Within this framework, South Africa's requirement is to increase its annual CO_2e reductions by 15% to 116.6 million tonnes, an increase of 15.2 million tonnes. As Figure 105 shows, the largest expansion of CO_2e reduction needs to occur in the power area, where annual emissions need to increase by 6.1 million tonnes, from 40.9 million tonnes to 47.0 million tonnes annually by 2020. Within the overall power category, the largest increases in CO_2e abatement should come from investments in renewable energy management systems, whose associated CO_2e reductions should increase from 15.8 million tonnes to 18.2 million tonnes a year in 2020 (Figure 106).

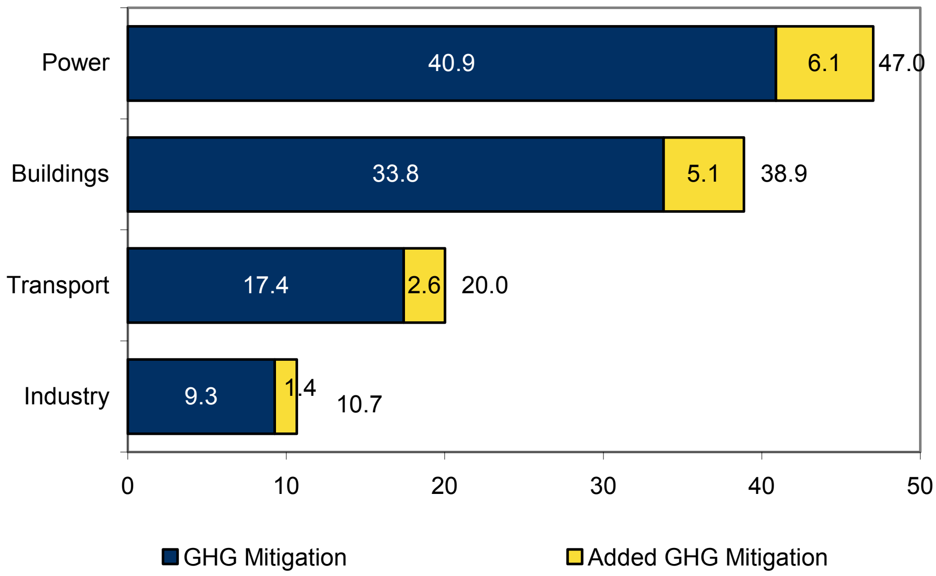
Among sources in the buildings category (the second largest in terms of CO_2e reduction opportunity), the largest increases in CO_2e abatement should come from investments in energy management systems, with associated CO_2e reductions rising from 17.9 million tonnes to 20.6 million tonnes a year in 2020. Overall, CO_2e reductions in South Africa's buildings segment need to rise from 33.8 million tonnes to 38.9 million tonnes annually under the 25% G20 CO_2e reduction scenario.

Reductions in transport, which constitutes the second-largest share of South Africa's overall emissions, need to increase by 2.6 million tonnes annually, to 20.0 million tonnes. The main source of added CO_2e reductions in the transport category should come in the supply chain and logistics optimization area, with the CO_2e reduction target raised from 10.5 million tonnes in 2020 to 12.0 million tonnes. CO_2e reductions associated with private transportation optimization need to rise from 3.4 million tonnes to 4.0 million tonnes in this timeframe.

CO_2e reductions in South Africa's industry segment need to be increased from 9.3 million tonnes a year to 10.7 million tonnes for the G20 countries to achieve an overall CO_2e reduction of 25%. Within the industry segment, investments to further decrease CO_2e emissions should be targeted at intelligent motor controllers (from 5.9 million tonnes to 6.8 million tonnes in annual CO_2e emissions) and industrial process automation (from 2.5 million tonnes to 2.9 million tonnes).

FIGURE 105

CO$_2$e Reduction Opportunity: Baseline Scenario Versus 25% Target — South Africa

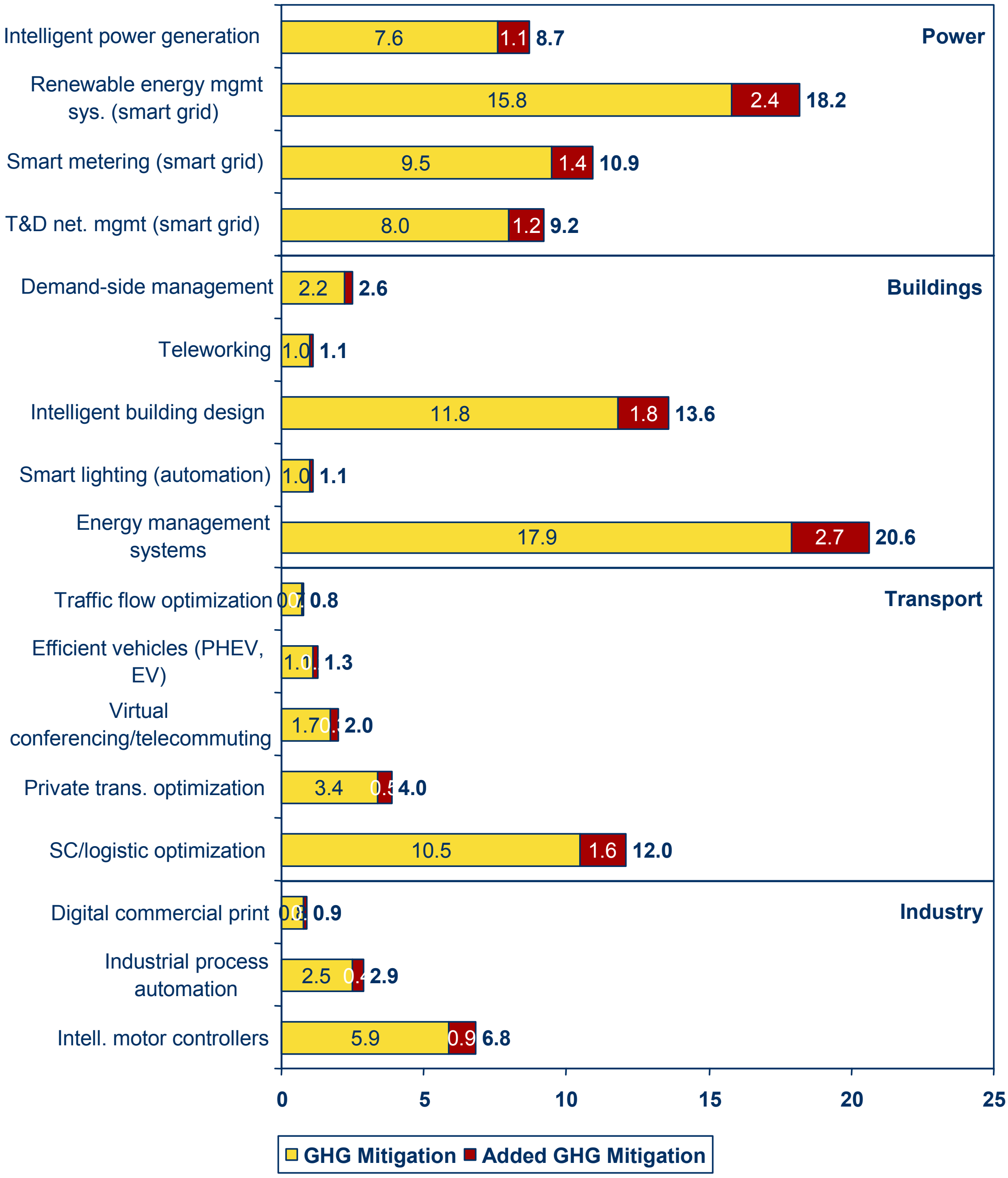


Note: Total baseline CO$_2$e reduction: 101.4M tonnes total CO$_2$e reduction at 25% target: 116.6M tonnes

Source: IDC, 2009

FIGURE 106

CO_2e Reduction Opportunity: Baseline Scenario Versus 25% Target — South Africa



Note: Total baseline CO_2e reduction: 101.4M tonnes total CO_2e reduction at 25% target: 116.6M tonnes

Source: IDC, 2009

CASE STUDIES: HOW DO YOU MAKE A DIFFERENCE?

Amsterdam Smart City — Project Background

The Amsterdam Smart City (ASC) project is a collaboration among the inhabitants of Amsterdam, the local and national government, and businesses, including several ICT vendors and leading knowledge institutions (such as TNO and ECN — the Energy Research Centre of the Netherlands), that seeks to demonstrate how energy can be saved today and tomorrow. ASC was launched in 2009 and focuses on four areas, corresponding with the largest CO_2e emitters in the city. The focus areas are sustainable living, sustainable mobility, sustainable public space, and sustainable working. In all four areas there are projects that are enabled by smart meters and smart grid development.

The project was developed to address the climate targets set by the EU and the Netherlands. Following the establishment of the EU's 20-20-20 climate targets, the City of Amsterdam set itself even more ambitious goals: to have municipal organizations climate-impact-neutral before 2015, use 20% of renewable energy by 2025, and achieve a 40% CO_2e reduction by 2025 compared with 1990.

These goals matched the strategy of the grid operator, Liander, to invest in its network, enabling the integration of higher shares of renewable and distributed generation units and storage facilities; provide infrastructure for electric vehicles; pilot and deploy smart meters; and, more broadly, start the implementation of their smart grid vision.

The initiators of the ASC initiative are Liander (the largest network company in the Netherlands, 100% owned by provinces and municipalities), the City of Amsterdam, and Amsterdam Innovation Motor (AIM), a facilitator that promotes mutual cooperation between knowledge institutions, commerce and industry, and government and social organizations in the Amsterdam region. Amsterdam Smart City committed itself to the New Amsterdam Climate, a platform in which the City of Amsterdam and public and private partners are working closely together to achieve the Amsterdam climate goals. The other partners involved in ASC include housing corporations, the Port of Amsterdam, techno starters, universities, financial institutions, ICT vendors, and transportation and waste companies.

Other active partners of ASC include Van Gansewinkel, Far West, Favela Fabric, JCDecaux, Accenture, IBM, Cisco, Philips, Nuon, Rabobank, Plugwise, Home Automation Europe, and the University of Amsterdam. Many others are expected to join the initiative.

Project Description

The Amsterdam Smart City project enables its partners to apply innovative technologies and stimulate behavioral change with end users in the program's sustainability projects. The sustainability initiatives are organized into four main domains:

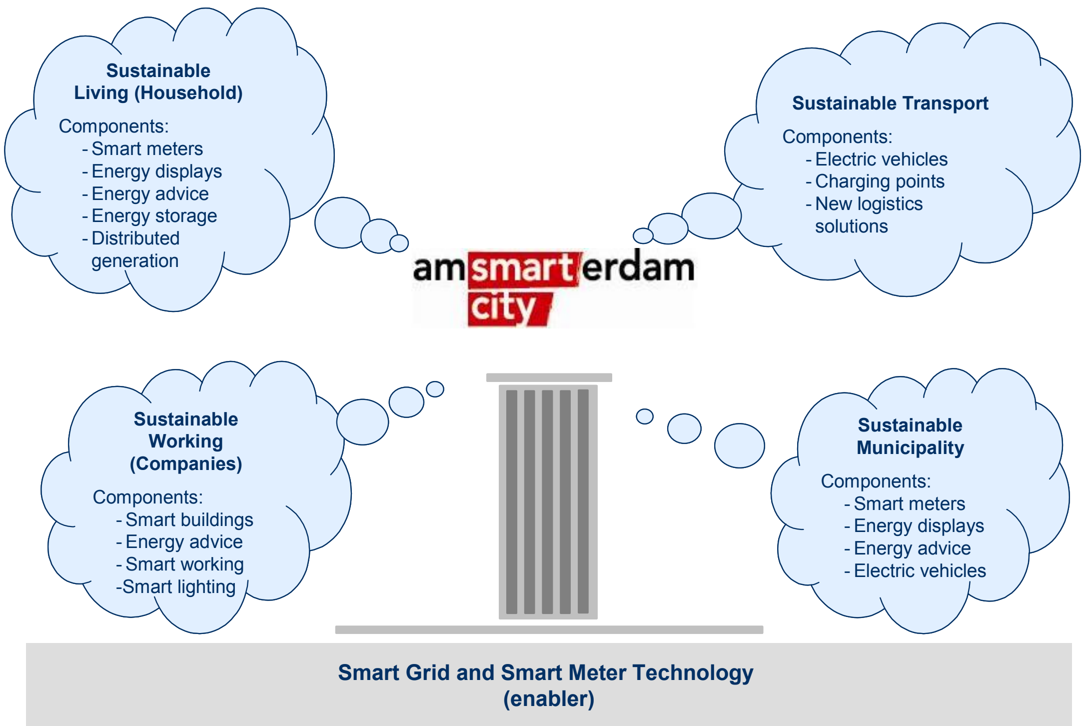
- **Sustainable Living:** Creating awareness and reducing energy consumption in households (with smart meters, energy display devices, energy advice, distributed generation, etc.).

- **Sustainable Working:** Creating awareness and reducing energy consumption in office buildings (with smart buildings, energy advice, smart working, smart lighting, etc.).
- **Sustainable Public Space:** Creating awareness and reducing energy consumption in municipal buildings and public areas (with waste collection, smart lighting, smart meters, energy displays, energy advice, EVs, etc.).
- **Sustainable Transport:** Creating awareness and reducing CO_2e emissions in transport (with electric vehicles, charge-points, new logistic solutions, etc.).

For each of the sustainability domains, the key ICT technologies identified for testing and piloting during ASC over the next 15 years are shown in Figure 107.

FIGURE 107

Amsterdam Smart City Project — Project Focus Areas

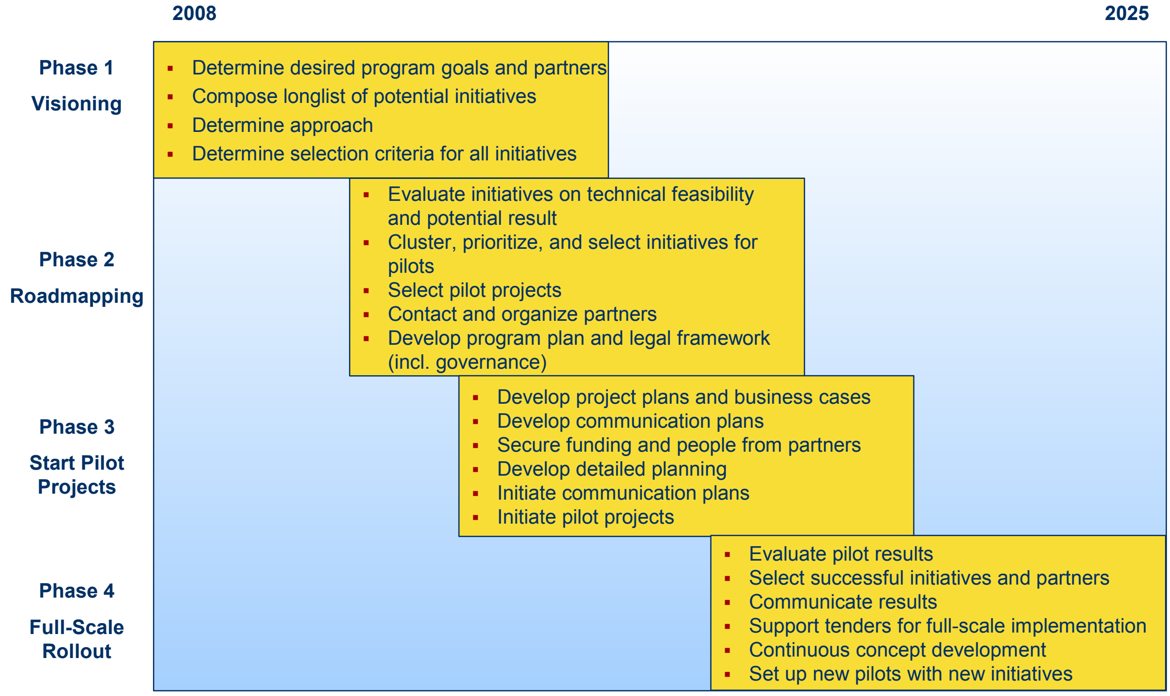


Source: Amsterdam Smart City Project, redrawn by IDC, 2009

The ASC work plan is organized into four phases: visioning, road mapping, pilot projects, and full-scale rollout. The main activities in each of the four phases are shown in Figure 108.

FIGURE 108

Amsterdam Smart City Project — Phase Description



Source: Amsterdam Smart City Project, redrawn by IDC Energy Insights, 2009

Pilot Initiatives in Action

ASC has designed about 20 target pilots to be launched in between 2009 and 2010, leveraging on the following technologies: smart meters, energy displays to provide information to customers, tools to analyze energy savings and impact customer behavior (energy advice), smart lighting (LED), building management systems, and EVs and charging station solutions.

Pilots are the first step to test solutions in the field and most importantly to understand the best approach to scale the initiatives to a national level. For sustainable living, plans have been developed to equip homes in Geuzenveld with smart meter (installed by Liander) and in-home displays. In conjunction with housing corporations (Ymere and Farwest) and energy company Nuon, 500 homes will be equipped with smart meters and energy feedback displays to stimulate behavioral change.

For sustainable working, the Ito Tower, a large office building in Amsterdam of about 38,000 square meters, will be equipped with diverse energy saving and behavior changing technologies. The goal is to minimize energy use while making sure that usage and comfort in the building are not affected. The Smart Building solution that will be implemented is a sensor-driven total solution, managing lighting, heating, cooling, access control, and safety.

Finally, for sustainable mobility, at Amsterdam's port, 73 shore power connections for inland freighters and river cruisers will be installed. This will test the viability of the ship-to-grid concept. The shore power will be available through connections that use a pay-by-phone system. With a simple call, the captain of the vessel can activate a connection with the shore power station by entering his personal ID. Logging off or plugging out at the connection point then deactivates the connection and the amount of money owed for the consumed electricity is transferred to the vessel account.

To test how these four areas will work together, ASC designated Utrechtsestraat as "climate street." This includes 130 small and medium-sized businesses (SMBs). The goal is to implement a holistic concept of sustainable logistics and energy saving/behavior changing initiatives with residents, entrepreneurs, and in the public space. In the climate-street initiative, it will be possible to learn which technologies and approaches are the most successful when it comes to making shopping streets more sustainable on a large scale. Ongoing projects include:

- Saving energy through new and sustainable street/facade lighting: integrating street and facade lighting to eliminate over-lighting, installing energy efficient light bulbs, and dimming the entire system late at night.

- Replacing tram stops and billboards with more sustainable versions based on life-cycle analysis, with the required power for displays and light generated by solar panels.

- Using garbage bins with built-in solar-powered garbage presses to reduce the empty frequency fivefold, save fuel and money, and reduce traffic congestion.

- Installing smart meters and feedback monitors for shops.

Project Costs and Possible Impact

ASC is a very large and comprehensive project, involving many stakeholders and significant investment. Over the next three years the municipality, energy companies, and private firms are expected to invest several hundred million euros in the ASC project. The European Commission will also provide financial support through the European Regional Development Fund (ERDF). Efforts include investment by local electricity network operator Liander to upgrade its entire network to a smart grid. This will include installing new meters in homes and investment by Nuon (the Dutch energy company, which was acquired by Vattenfall after being unbundled from Liander) in energy efficiency related technologies.

The project will serve as a testing ground for new technologies and will enable program partners to realize significant economic and social value at a city level. Lessons learned will provide vital guidance on scaling initiatives to a national level. In addition the project will look at how to increase public opinion awareness and engagement by actively involving students (the education system) in the project.

Overall, the Amsterdam metropolitan area will achieve sustainability and carbon emission reduction goals, create a good place to live, and drive new economic activities. Being an innovation leader in this area will position Amsterdam as a sustainable region ("sustainable valley") and will hopefully create a significant number of new jobs over the next three years.

Liander expects to benefit by creating an electricity grid suited for future development, minimizing future risks related to its investments in smart grid development between now and 2020, and addressing its societal mission and community involvement.

All other parties involved in the ASC project will gain a lead for the future through the lessons learned from collectively working on delivering climate goals and will benefit from the reduced costs and efforts to realize pilots through facilitation and support secured by ASC.

CASE STUDY: FUJITSU

This case study looks at Fujitsu's sustainability strategy.

Fujitsu's Sustainability Policy

Founded in 1935 and based in Tokyo, Fujitsu is a global provider of IT and communications solutions with over 186,000 employees supporting customers in more than 70 countries. Fujitsu designs and manufactures a wide range of products, from microelectronics and telecommunications to middleware, PCs, servers, and storage systems.

Fujitsu sees the environment as an important area and has carried out environmental management activities to help achieve a low carbon society, and since its establishment in 1935, "manufacturing in harmony with nature" has been a Fujitsu creed. By 1989 Fujitsu had established its first environmental committee and in 2002 it installed the world's first plant-based biodegradable plastic parts in notebook computers. The following year it achieved zero waste emissions in all 13 plants in Japan and in 2006 it obtained global integrated ISO 14001 certification of its environmental management system. In recognition of its world-leading green governance and carbon-reduction programs, Fujitsu has been selected as a member of the Dow Jones sustainability world index for 11 years in a row.

In line with the "Fujitsu Way," the Fujitsu Group drafted its environmental policy under the CSR umbrella to promote environmental management in a way that reflects the distinct nature of its business. In addition, it formulated the "Green Policy 21" environmental concept; "Green Policy 2020," its medium-term environmental vision with targets to meet by 2020; and the "Fujitsu Group Environmental Protection Program," designed to clarify specific objectives every three years. In parallel with these policies, it is promoting the Green Policy Innovation, which aims to mitigate the environmental impact of its customers and society as a whole by offering innovative green ICT solutions. In pursuing these policies and targets, Fujitsu is striving to reduce the environmental impact through planned and continuous promotion of activities across its business domains.

- **Green Policy 21:** With the slogan "We make every activity green," Fujitsu broke the idea down into five categories: Products, Factories, Solutions, Earth, and Management. Fujitsu puts this policy into practice in its daily activities.

- **Green Policy 2020:** In response to the Japanese government's "Cool Earth 50" initiative to reduce the level of greenhouse gas emissions by half by 2050, and by encouraging global warming countermeasures, Fujitsu sees ICT playing a vital role in coming up with innovative new technology and systematic reforms. Fujitsu's target is to see greenhouse gas emissions peak in 2020 and then decline thereafter. Specifically, its goal is to reduce CO_2e emissions in Japan by 30 million tonnes annually by 2020. In addition, it will pursue world-class overall energy efficiency in all of its business areas and preserve biodiversity.

- **Green Policy Innovation:** This initiative pulls together Fujitsu's expertise in environmental technologies and know-how to provide green ICT products and solutions to reduce CO_2e emissions from customers and society by more than 7 million tonnes from 2007 to 2010. Fujitsu aims to reduce carbon emissions using two approaches:

  - To reduce the environmental burden of the ICT infrastructure itself ("OF ICT") through the provision of energy efficient platform products

  - To reduce customers' environmental burdens through ICT solutions ("BY ICT")

Fujitsu's Approach to Green ICT Hardware

The Fujitsu Group has adopted a unified groupwide approach to eco-design for newly designed products and has worked to improve environmental performance throughout the product life cycle. It has also established its own green product assessment regulation, which has helped strengthen its green product development.

The key products in this category include:

- **Fujitsu ServerView:** Fujitsu ServerView is a complete set of power consumption management software for PRIMERGY. Power consumption can be monitored, limited by user definition, scheduled, and budgeted at boot time. Power supply units can be dynamically switched. All of these features help the user to save energy.

- **Fujitsu PRIMERGY:** PRIMERGY is the x86 server product line. For small offices, retail premises, or libraries, products like TX120 are energy efficient and space saving. These products offer best-in-class silence with heat pipe cooling and low-voltage processors. For datacenter use, products like RX300 offer high scalability, energy efficiency, and EPA compliance with pulse width modulation fans. Fujitsu's new BX900 blade server is the largest rack-mounted blade server in the world, with 18 CPU blades, and it achieved an energy consumption rating of roughly 40% compared with Fujitsu's rack servers introduced three years ago.

- **Fujitsu SPARC Enterprise:** SPARC Enterprise is sold by Sun Corporation. The entry model M3000 cuts 58% of CO_2e emissions compared with the previous model and offers 50% server space saving. The high throughput Web/application server T5220 cuts 73% of CO_2e emissions compared with the previous model, with an 80% space saving.

- **Fujitsu ETERNUS Storage:** The ETERNUS storage system has been designed to reduce CO_2e emissions. CO_2e emissions in one cabinet, at 1,120kg/year, are 43% lower in 2009 than in 2005. New entry-level storage systems such as the DX60 and DX80 have a MAID (massive array of idle disks) based EcoMode function, which enables unused backup drives to shut down to conserve energy. The DX60 and DX80 also have capacitor-based cache memory protection, which eliminates batteries and enables quick recharge of cache memory.

- **Fujitsu Zero-Watt PC and Monitor:** In August 2008, Fujitsu announced a couple of patent registered displays with the class of absolute zero power consumption during standby mode. Fujitsu is the only vendor to offer absolute zero power displays. In March 2009 at CeBIT, Fujitsu announced the Esprimo

Green PC with absolute zero power consumption during standby mode — this is the first PC with this feature and it can be still managed with LAN, Bluetooth, or UMTS. This feature will be required from 2010 for any new PC released in Europe.

Fujitsu's Approach to Sustainable Datacenters

In combination with its hardware strategy Fujitsu is focusing its efforts on "sustainable datacenters."

The Fujitsu Group has been working on sustainable datacenters through efficient operation of air conditioning, power supplies, lighting, cooling equipment, structures, and proactive use of green energy such as solar power. At its new datacenter in Tatebayashi, Japan, it has reduced facility power consumption by about 40% compared with its latest datacenters. Outside of Japan, Fujitsu's north London green datacenter is the only tier 3 datacenter certified by the Uptime Institute in Europe. This datacenter achieved dramatic improvements in energy efficiency with a result of 1.4 PUE. Fujitsu also has several sustainable datacenters in Australia.

Fujitsu Labs has developed a new technology that enables accurate and real-time temperature distribution measurement in large datacenters that have multiple heat sources. This technology makes it possible to measure the temperature of over 10,000 areas in a facility, enabling visibility of temperature distribution in large datacenters. When combined with an air-conditioning control system, this technology will enable fine-tuning of air-conditioning, thereby allowing more energy efficient large-scale datacenters.

Fujitsu's Approach to Green ICT Solutions

The Fujitsu Group develops and offers a wide range of green ICT solutions that are aimed at both reducing environmental burdens and increasing economic value at various fields such as homes, financial institutions, hospitals, factories, local and national governments, supermarkets, and schools.

Fujitsu has developed a methodology for evaluating the impact of ICT in reducing carbon emissions. This methodology assesses the savings possible through ICT use in seven environmental areas:

- Resource use
- Travel
- Supply chain and transportation
- Office space
- Warehouse and other storage space
- Power consumption of ICT equipment
- Data communication

This enables Fujitsu to quantitatively evaluate the carbon reduction benefits of using its ICT solutions. Fujitsu is working closely with ITU and Japan's Green IT Promotion

Council to promote green ICT and to standardize the methodology of environmental impact assessment of ICT.

Case Study: Healthcare

Fujitsu has significant experience in promoting carbon reduction in the healthcare industry. In Finland, for example, it provides the country's national electronic patient record archive project. Kela, the Social Insurance Institution of Finland, and Fujitsu Services Oy signed the agreement in September 2007. The project manages the medical information of 5.3 million Finnish citizens and has increased the efficiency of the country's entire national health system. The aim of the project is to enable effective information exchange between healthcare service providers, but also to open the e-access service to citizens to enable them to view their own health information and to reduce visits to health services that are caused by lack of information. Fujitsu has undertaken similar roles in deploying electronic health record (EHR) projects in Canada and Spain, where access to patient records has dramatically reduced the need for printed paper and film-based patient records.

Another Fujitsu solution in the healthcare industry is its medical archive system, which has also had a positive environmental impact. By adopting the system, customers have reduced their total carbon emissions by 21%, and the reduction in resource use and storage space has outweighed the increase in power consumed by ICT equipment.

Case Study: Supply Chain and Transportation

Fujitsu is also a leading provider of supply chain and transportation optimization solutions. It implemented a CO_2e reduction initiative based on centralized vehicle allocation control throughout the entire supply chain and developed a leading-edge tool that automatically calculates CO_2e emissions from detailed transport data measured by vehicle-mounted terminals. In 2007, Fujitsu received the "Minister of Economy, Trade, and Industry Award" for this initiative. Through such efforts, Fujitsu reduced carbon emissions associated with transportation by 38% in fiscal 2008 compared with fiscal 2000, taking into account the effect of changes in the quantities of materials.

Leveraging this experience, Fujitsu provides a number of supply chain and transportation solutions, including Operations Support System, which improves the efficiency of vehicle allocation and delivery routes, and Modal Shift Simulation, which visualizes carbon emissions.

Case Study: Agriculture

Fujitsu also tries to bring innovation to agriculture. One of Fujitsu's customers, Japan Agricultural Cooperatives Echigo-Santo, is a high-quality rice grower that uses remote sensing technology through optical satellites. Before the system was adopted, it monitored fields by car. With the new system, however, the company has found it easier to gather useful information, such as the level of protein in each rice field, via the satellite. The new system resulted in a carbon reduction of almost 98%, mainly due to travel reduction.

Fujitsu Consulting Service on Sustainability

Fujitsu's portfolio of sustainable enterprise services enables its customers to deliver sustainable green ICT initiatives, thereby increasing profitability, managing risk, and addressing regulatory requirements. Within this portfolio Fujitsu offers two consulting approaches that work together to align customers' sustainability and business objectives.

The first approach is the Enterprise Sustainability Framework, which is used to identify the risks of climate change to customers' business, help them develop and implement a sustainability strategy, and measure and modify the strategic outcomes to business environment changes.

The second approach is the Green ICT Framework, which starts with a current ICT state assessment, identifies risks and opportunities, inputs them into the green ICT value framework, and then measures and realizes the benefit.

Case Study: Toyota Australia

In response to Toyota Australia's requirements to develop sustainability strategies to meet its five-year environment plan target, Fujitsu Australia conducted in-depth interviews to build a clear picture of the current ICT strategy against its environmental impact. Based on this assessment, Fujitsu Australia's consultants worked with Toyota to formulate a sustainable ICT strategy that linked directly to its existing strategies and outlined a number of actions, projects, and programs that could be implemented to achieve a potential 43% cost reduction and greenhouse gas emission saving.

"It's an opportunity for an IT department to move from a more reactive approach. It builds on the business' existing environmental strategies and outlines a framework for collecting information on emission and carbon trading" — James Scott, CIO, Toyota Motor Corporation Australia.

Conclusion

Fujitsu has promoted a systematic approach in implementing green ICT in its businesses by setting clear targets and action plans at different stages. As a group, Fujitsu offers a wide range of sustainability solutions, including low-power compact ICT hardware, sustainable datacenters and outsourcing services employing the latest technologies, green ICT solutions, and consulting. By leveraging its long history of sustainable practices, Fujitsu aims to reduce the environmental load of its customers and society as a whole.

CASE STUDY: HEWLETT-PACKARD

This case study looks at HP's sustainability strategy.

HP's Sustainability Strategy

Founded in 1939, HP is one of the largest companies worldwide, with revenue of over $118 billion at the end of the latest fiscal year. The vendor supplies a wide range of IT products, including printers, desktops, laptops, enterprise software, datacenter storage, servers, and networking, as well as a large portfolio of IT services, which was further expanded after the EDS acquisition in 2008. It employs around 321,000 people worldwide, and reaches out to as many as 170 countries in all continents.

HP plans to invest almost $20 billion in R&D over the next five years, focusing primarily on three areas of growth: automation and optimization of IT environments, in particular datacenters; improving the computing experience for individuals in order to provide ubiquitous access to content and services; and enhancing the way content is created and consumed physically and digitally, both for consumers and businesses.

HP's Corporate Objectives, written in 1957 by co-founders Bill Hewlett and Dave Packard, are centered on customer satisfaction, and include a strong commitment to corporate responsibility, as the company pledges to improve the economic and intellectual environment of each and every geography it covers.

Since 2001 HP has published an annual Global Citizenship Report that lays out its internal and external targets for corporate social responsibility for the coming year. In formally launching a "Global Citizenship Strategy," steps have been taken to ensure that HP leads the way in educating the world on how we can reduce the overall negative environmental impact attributed to IT, from manufacture through distribution and operations.

HP believes there are two main ways it can positively impact global issues related to the environment:

- By presenting itself as an example in terms of green best practices in its own organization
- By delivering IT products and services that are compliant to standards and help individuals and businesses reduce their own carbon footprint

HP Internal Green Policy

In the general frame of its own CSR policies, HP has set clear environmental goals. The vendor aims to reduce the combined energy consumption and associated GHG emissions of its own operations and products to 25% below 2005 levels. HP plans to do so by:

- Cutting down energy consumption and the resulting GHG emissions from HP-owned and HP-leased facilities worldwide to 16% below 2005 levels
- Reducing the energy consumption of HP products and associated GHG emissions through specific goals for representative product categories

Specifically, HP targets a 40% energy efficiency improvement in ink/laser printers from 2005 to 2011, a 50% energy efficiency improvement in ProLiant servers from 2005 to 2010, and a 25% reduction in energy consumption of HP desktop and notebook PC families from 2005 to 2010.

HP made progress towards its goals in 2008. It was able to cut its global GHG emissions from operations by 4% compared with 2007 in absolute terms and 13% normalized to revenue. Although absolute electricity use increased 0.9% in 2008 compared with 2007, because of acquisitions and growth in outsourced datacenter services, HP countered that with a strict space consolidation effort. In 2008, the company decommissioned 163 sites around the world, yielding a net reduction of nearly 136,204 square meters (2% of total space).

2008 was also pivotal in that HP completed projects (lighting retrofits in parking lots and office spaces, fluorescent lights, motion sensors, etc.) that are expected to deliver savings of more than 40 million kWh of electricity in 2009. Also, in 2008 HP completed the consolidation of 85 of its HP internal IT datacenters into just six locations in three U.S. cities, leading to a 35% space reduction.

HP also has a strong commitment as far as its own suppliers are concerned; it reports GHG emissions of its first-tier suppliers, representing more than 80% of total product manufacturing spend. In 2008, it also audited 142 suppliers at 246 facilities for compliance with its code of conduct, and incidences of non-conformance, such as discrimination practices, have been substantially reduced.

Activity in Environmental Campaigns

HP's interest in sustainability reaches further, as the company is actively engaged with a number of non-profit organizations aimed at containing the impact of GHG emissions. In 2008, HP strengthened its partnership with the conservation organization WWF, and joined other leading global companies in signing a communiqué from the Corporate Leaders Group on Climate Change at the Poznan negotiations in December 2008. The communiqué called for a treaty to be agreed in Copenhagen in December 2009 to be based on targets for emission reductions by 2050.

Examples of HP's Sustainability Push by Product Line

HP follows green guidelines when designing its PC products. In 2008 the HP Pavilion dv6929wm Entertainment Notebook PC featured a reusable bag, made from 100% recycled materials, instead of conventional cardboard and plastic packaging. The HP TouchSmart IQ 500 series uses a new packaging design that virtually eliminates plastic foam cushioning materials. HP PCs are also energy efficient as most commercial PC products support Energy Star configurations. HP also offers a wide range of product reuse and recycling solutions to meet business and personal needs, including a PC buyback program in the U.S. In 2008, HP launched SkyRoom, a PC-based real-time collaboration tool that helps users save time and energy by connecting live with colleagues around the world via videoconferencing.

Due to its pervasive portfolio in all major IT segments, HP is well positioned to have a positive impact and to enable a low-carbon economy.

Some of the examples of the direct and indirect benefits linked with specific HP technologies include:

- **Personal computers** — As mentioned previously, HP follows green guidelines when designing its PC products, with the HP Pavilion dv6929wm Entertainment Notebook PC featuring a reusable bag made from 100% recycled materials instead of conventional cardboard and plastic packaging, and the HP TouchSmart IQ 500 series using a new packaging design that virtually eliminates plastic foam cushioning materials.

- **Printing products and services —** Conscious of the critical role played by print in terms of paper waste and environmental impact, HP has worked on different fronts to enhance the energy efficiency of its products, and more importantly to provide customers with tools that allow them to rationalize printing processes. One example is the recently updated HP Web Jetadmin software, which, as part of the Database Connectivity Module, helps IT managers collect data from networked and PC-connected printing devices and enables administrators to reduce energy and paper consumption.

- **Unified communications** — HP well understands the environmental advantages of reducing the CO_2e footprint by implementing comprehensive unified communication solutions. HP has been active in the unified communication environment for a long time, but has recently strengthened its UC portfolio with the HP Halo video collaboration suite. HP Halo offerings deliver high-quality videoconferencing solutions and associated managed services, reducing the need for business travel. According to HP, between October 2007 and September 2009 HP Halo studios at both HP and customer facilities have saved over 104,000 metric tonnes of CO_2e, which is equivalent to emissions from 1,400 gasoline tanker trucks or removing over 19,000 U.S. passenger vehicles from the road for one year.

Servers and Datacenters

One area in which HP is especially engaged in when it comes to reducing energy waste is datacenters. HP is active in The Green Grid and other similar initiatives to contain the energy footprint of datacenters, being aware that unregulated growth in computing performance will bring enormous energy costs and deleterious effects on the environment. To counter this, HP encourages the use of standardized methods to measure datacenter efficiency, such as the power usage effectiveness (PUE) metric.

In its own portfolio, initiatives cover a number of areas and are driven by long-standing work on developing innovative technologies and services that benefit both business operations and facility related expenses.

- **HP POD (Performance Optimized Datacenter)** — Over the last two years, containerized datacenter solutions — i.e. server/storage environments that come preinstalled in standard shipping containers including all the power and cooling gear needed to support them — have been proposed as an ideal solution to build out a highly efficient extendable computing block. HP's containerized datacenter, the POD, was launched in 2008 and boasts a power usage efficiency ratio of 1.25 or lower, if attached to external cooling infrastructure, which represents a real breakthrough. The overall power capacity of a 40-feet container can exceed 600kW.

- **HP Critical Facilities Services (CFS) —** HP can deliver significant optimization at a datacenter facility level thanks to the acquisition of EYP Mission Critical Facilities, a consulting company specializing in designing datacenter and R&D facilities, now active under the HP CFS division. HP Critical Facilities Services offer support that spans from datacenter assessment to datacenter design and transformation, and aims at delivering cutting-edge, space-efficient datacenters that reduce the cost of operations through energy efficient power and cooling technologies.

- **HP Energy Efficiency Services —** HP's portfolio includes a range of services to help customers devise and implement energy usage strategies. These focus on cutting down operating expenses by eliminating over-provisioning of power and cooling resources and improving power usage effectiveness by redesigning datacenters and facilities.

- **Intelligent Volume Servers** — The latest G6 generation of HP's ProLiant x86 servers embed recently released Intel Nehalem and AMD Istanbul processors, which guarantee much-improved power management tools compared with previous generations. In addition, HP also included its own innovation on the hardware level. Improvements in the idle mode power usage of the PSUs have brought their efficiency levels to 90% and new PCU cards can be powered down if unused, while RAM speed can be fine-tuned (with subsequent energy savings) to the workload. Also, thanks to as many as 32 smart sensors embedded in each machine (a technology first applied on blade servers), administrators can measure temperature and power consumption out-of-band, independently from the software layer. Also, HP Insight Control System management tools can be integrated with onboard controllers to steer remotely and cap, if needed, power consumption levels on each machine or pool of machines.

- **Blades and Scale-Out Products** — HP's flagship blade servers (more than 550,000 shipped in 2008 worldwide) consolidate on the chassis backplane PSUs and connectivity modules, enabling significant power savings. Lately, the vendor has also announced a specific product line, the Extreme Scale-Out (ExSO), to serve vast datacenter environments with extremely dense and efficient computing power. The line is based on "skinless" rack servers, i.e. server trays without external cases that are installed two by two in a lightweight 2U chassis providing power and cooling components. According to HP, a 90,000-node infrastructure based on ExSO hardware can save customers 30% of the energy consumption and 10% of the capex compared with comparable pool of rack servers.

Conclusion

Since 2001, HP has been committed to reporting in the Global Citizenship Report its progress in reducing the energy and carbon footprint of its organization. In 2008, the company was able to cut its global GHG emissions from operations by 4% compared with 2007. On the product side, solutions such as advanced telepresence systems, Halo, and optimized datacenter products such as the POD container and the Extreme ScaleOut server line are all directly or indirectly able to reduce the energy and carbon footprint of businesses worldwide, proving that a large part of the multibillion-dollar investments HP is making in its technology are targeted at making IT and business more environmentally sustainable.

CASE STUDY: HITACHI

This case study looks at Hitachi's sustainability strategy.

Hitachi's Sustainability Policy

Founded in 1910 and based in Tokyo, the Hitachi Group comprises 1,100 companies with over 400,000 employees and revenues of about 10 trillion yen. This large multinational company group offers a wide range of products, including information and telecommunications systems, electronic devices, power and industrial systems, digital media and consumer products, high-end functional materials and components, logistics, and financial and other services.

Since its inception, Hitachi has operated under the philosophy "contribute to society through the development of superior, original technology and products." Some notable milestones for the company include:

- The establishment of a pollution prevention committee in 1970
- The start of groupwide investment in environmental facilities in 1972
- The incorporation of environmental audits into its operations audits in 1973
- The establishment of an Environmental Policy Office in 1991
- The voluntary introduction of a system of usage reduction and the elimination of particularly toxic chemicals in 1997
- The formulation of a new Environmental Vision in 2001
- The assignment of a chief environmental officer (CEnO) in 2007
- The establishment of an Environmental Strategy Office in 2008

Along the way, Hitachi has also received numerous accolades for its environmental efforts, including the Stratospheric Ozone Layer Protection Award from the U.S. Environmental Protection Agency (1991), the Global Environment Prize from WWF Japan (1993), and the Award for Excellence at the Fourth Environmental Report Awards (2000).

Today, the company remains fully committed to the prevention of global warming, the conservation of resources, and the preservation of the ecosystem. These three pillars are the foundation of Hitachi's "Environmental Vision," through which it hopes to achieve a more sustainable society by promoting global production that reduces the environmental burden of a product throughout its life cycle.

Based on the Environmental Vision, Hitachi has outlined some concrete objectives and goals in all its business. These include:

- A Medium-Term Environmental Vision 2015: Based on this medium-term plan, Hitachi is pursuing a two-pronged environmental management strategy to (1) reduce the environmental burden through monozukuri (designing, manufacturing, or repairing of products) aimed at reducing the environmental burden of products throughout their life cycle to ensure environmental conservation, and (2) to supply environmentally conscious products and services.

- Environmental Vision 2025: This long-term plan aims to reduce carbon emissions by 100 million tonnes by 2025 by using technology to make and distribute products and services that are environmentally efficient and by promoting green technology, environmental business investment, and collaborative projects in global markets.

In addition, to ensure continuous improvements to raise the level of environmental activities, Hitachi uses the Green 21 evaluation system in every business group and affiliate. The Green 21 system measures how Hitachi is performing in its quest to become more environmentally responsible. The results help create more competitive products.

Green 21 measures 55 items spread over eight "sustainability compass" categories from fiscal 1999 to 2010. Version 3 was implemented in fiscal 2006. In fiscal 2006, a Hitachi Group average score of 845 green points was achieved, exceeding the target of 768 by 77 points. Green 21 verifies Hitachi's compliance with internationally recognized standards such as ISO 14001, the EU's Restriction of Hazardous Substances (RoHS), Waste Electrical and Electronic Equipment (WEEE), and Energy-using Products (EuP) (2005/32/EC) directives.

In the short term, Hitachi's focus is on developing and distributing products that achieve substantial energy savings. In line with this goal, the company is making all its products Hitachi Eco-Products. Hitachi's long-term program concentrates on innovative technologies to accelerate the development of environmentally conscious and energy saving products and services with a special emphasis on a few core projects: nuclear power generation, which emits very little CO_2e, renewable energies and smart grids for sustainable energy, and environmentally conscious datacenters.

The Importance of Integration of IT and Facility at an Eco-Friendly Datacenter

In the ICT area, Hitachi's environmental efforts have ranged from environmentally conscious datacenters based on leading-edge green IT technologies, to the hard disk drives that are an essential part of various IT systems. One of Hitachi's major launches includes the Eco-Friendly Datacenter Project. Typical datacenters require a lot of specialized, expensive capital equipment to provide the environment with uninterrupted power supplies (UPS), transformers, chillers, and coolers. Realizing the importance of maximizing the efficiency of the datacenter's infrastructure, Hitachi has invested heavily in these products. This is a key feature of Hitachi's comprehensive approach to making power savings in every aspect of datacenters, from IT equipment to the air conditioning and lighting. The datacenter building itself may even be refitted to enable further power savings. With energy costs accounting for nearly 30% of a datacenter's total operating costs and pressure on businesses to be more environmentally conscious and reduce their carbon footprint, Hitachi's goal is to reduce power consumption in datacenters by up to 50% in FY12 compared with FY07 by mobilizing all its available resources.

The Eco-Friendly Datacenter project embraces three fundamental principles of the modern datacenter. These are:

- Virtualization in a ubiquitous manner — IDC believes that tomorrow's datacenters will become "virtual datacenters" where virtualization of the server, storage, network, and application (through a software-as-a-service delivery model) will become mandatory. Hitachi is responding to the need for a virtualization platform with BladeSymphony and Hitachi's enterprise storage platform, Hitachi Universal Storage Platform V.

- Modularity — Every IT component needs to be acquired, installed, and delivered in the smallest, most economical manner. This will be done through products such as server blades, in which the infrastructure is established through modular building blocks. The aim of Hitachi's modular datacenter is to build a datacenter from the ground up, or retrofit an existing facility, with components that maximize the efficiency of the facility and its equipment.

- Management automation — Datacenters will have to be managed in a fully automated environment, where only exception processing triggers manual intervention. Hitachi is using its AirSense wireless sensors to measure environmental variables and automate the management of the datacenter through cooperation with integrated systems management software Job Management Partner 1.

These key elements will drive better asset management, reduce capital costs, and significantly reduce energy consumption, which collectively drive IT towards a much more competitive and sustainable environment. Hitachi has fully embraced these concepts with its products and is now offering them to its customers.

To better understand the environmental impact of datacenters, Hitachi has started work on a state-of-the-art datacenter where it can demonstrate the collective efforts of the Hitachi Group. The Third Yokohama Datacenter has been built and operated with the following goals and principles:

- Use energy efficiently — The cost of energy is the main reason why IT organizations embark on any green IT project. Within the Yokohama datacenter, Hitachi will use its Eco-Friendly Datacenter Project technologies (to reduce the energy consumed by 50% of 2007 levels by 2012).

- Use energy efficient and power saving IT products — Core to this is a broad implementation of a virtual datacenter concept where server, storage, and network equipment can be managed in a seamless and efficient manner.

- Expand the datacenter only when the business units need more IT capacity — The Yokohama datacenter is completely modular in its design, allowing all aspects of construction, energy use, IT equipment, and so on to be added only when there is demand for it.

Hitachi products and services support these goals and principles. A brief overview of the key platforms is described as follows:

- The Modular Datacenter is Hitachi's approach to the facilities and equipment in the datacenter. It is a packaged and energy and performance optimized solution containing the power and cooling infrastructure for the datacenter, along with the

ICT equipment described in this case study. By optimizing all components of the datacenter Hitachi can ensure that equipment placing and airflow is as efficient as possible. Hitachi's AirSense technology measures environmental variables and allows the management technology to manage the datacenter.

- Hitachi's BladeSymphony is a range of server products that incorporates the latest innovations in Hitachi's research and development into lower energy solutions. Hitachi has developed a power supply that reduces the power loss from AC/DC transformation, and its power supply units operate at 92% efficiency, with much higher levels of efficiency at lower utilization than standard components.

- Hitachi's virtualization technology load balances workloads across servers, moving workloads from under-utilized servers to increase the average utilization of a group of servers and then switching off servers that are not utilized. As BladeSymphony utilizes hardware acceleration, the operation speed is very fast and overhead is small.

- The Hitachi Universal Storage Platform V is a storage services platform that provides common storage services to heterogeneous storage assets across the enterprise, regardless of type, cost, or functionality. As with BladeSymphony, it benefits from modular design, management technology, and improvements in power efficiency.

- Hitachi Dynamic Provisioning software acts as a new feature of the Universal Storage Platform V. It enables users to allocate virtual disk storage based on anticipated needs without having to dedicate or put aside physical disk storage up front. The software can reduce administration costs and improve utilization, resulting in lower "carbon footprints" and greater application availability. Implementation occurs transparently, without any disruption to mission-critical applications. Dynamic provisioning software also enables organizations to save power and money, and provides the economic benefits that can make their datacenter environments more eco-friendly.

- Services — Maximizing storage productivity can result in immediate and measurable returns. Hitachi Data Systems Global Solution Services helps identify potential risks, plans the right storage architecture, optimizes storage performance, and manages the storage environment. Hitachi's Global Solution Services offers the tools to help organizations reduce costs and increase service levels while minimizing disruption to the production environment. GSS services can help companies get the most efficient return on their storage investment and reduce associated power and cooling costs.

Hitachi's Global Environment Management — Hitachi is building a global network to support environmental management and remains committed to its efficient operation. These range from instilling eco-mindedness into the company's corporate culture to building a systematic environmental management system. Ultimately, Hitachi strives to constantly improve and enhance its efforts to support efficient environmental management and activities:

- Framework for pursuing environmental administration — The Hitachi Group has developed an environmental administration structure that covers the group as a whole. Under this system, the Senior Executive Committee for Environmental Policy, chaired by the president of Hitachi, deliberates and sets environmental policies and strategies for the entire group. These policies are disseminated via committees, such as the Environmental Strategy Officers Committee, made up of the heads of the environmental operations units of business groups and group companies. The Environmental Committee and subcommittees draft policies and action plans, and then develop the technologies and evaluation methods needed to resolve issues and achieve goals.

- Environmental management system — Within the Hitachi Group, a minimum level of environmental management is determined for each plant or factory according to its environmental load, based on a multiple-criteria evaluation system. Any location where the environmental load exceeds a certain level is required to develop an environmental management system based on ISO 14001 standards and is then required to be certified by an accredited outside agency. As of March 2009, individual certification had been obtained by 353 group business locations inside and outside of Japan.

- Evaluating environmental activities — For the steady implementation and improvement of the Environmental Action Plan and to make its environmental activities more effective, Hitachi developed a self-evaluation system — Green 21 — which quantifies progress toward each year's action goals, then displays radar charts. Hitachi uses this to improve its environmental management. The evaluation consists of 55 items in eight categories. Assessments are made for each business site, with the results reflected in the performance evaluation of every business group and group company. In this way, Hitachi is able to identify weaknesses and show where improvements are needed for the next fiscal year.

- Environmental accounting — Hitachi uses an environmental accounting system to promote efficiency and to improve its environmental investments and activities, as well as to aid stakeholder understanding by providing information on the extent, efficacy, and efficiency of how management resources are allocated for environmental activities.

Conclusion

Hitachi has strategically targeted the environment as an area of focus and the company's systematic approach is apparent in its near-term and long-term plans. Hitachi has created an environmental vision in order to achieve a more sustainable society by promoting global production that reduces the environmental burden of a product throughout its life cycle. The Yokohama Datacenter is living proof that Hitachi has the technology to support its vision. The company's Environmental Vision 2015 to become emission neutral by 2015 and its Environmental Vision 2025 to reduce annual CO_2e emissions by 100 million tonnes by 2025 through Hitachi products and services are clear indications of the company's commitment to this cause. Hitachi's environmental conservation efforts are not only focused on observing local, national, and international environmental regulations, but also on conserving the environment by implementing voluntary environmental standards when necessary with an environmental management framework and communicating its efforts and results with stakeholders.

CASE STUDY: INTEL

This case study looks at Intel's sustainability strategy.

Intel's Sustainability Strategy

With an annual turnover of $38 billion in FY08, Intel is the largest silicon company and one of the major IT suppliers worldwide. Intel develops and manufactures silicon technologies that empower a range of computing devices, from ultra-mobile laptops and PDAs to massive scale-out server farms for Web and high-performance computing. The company has a vast presence worldwide, with a workforce of more than 80,000 employees and 300 facilities located in more than 50 countries.

Founded in 1968, Intel has grown to be the leading integrated designer and manufacturer of microprocessors, memory, and other components, and is making considerable investments in software to optimize desktop and datacenter computing.

Intel's mission is that of continuously delivering technology advancements in the computing area, as testified by an annual $5.7 billion investment in R&D. The strong focus on excellence and discipline that characterizes the company is accompanied by a strong commitment in all aspects of corporate responsibility, with sustainability playing a core role in that.

Intel has three components to its sustainability strategy:

- **Product design.** Intel's role as a designer of technologies requires it to develop products that optimize energy use. This is even more crucial when considering the volumes to which Intel's silicon products are shipped and delivered worldwide. With almost 300 million PCs and 8 million servers shipped every year worldwide, every little improvement on the energy efficiency of its core CPU components turns into a considerable energy saving.

- **Managing operations for sustainability.** Intel's operations focus on energy efficiency in all the processes needed to source, manufacture, and deliver its products to OEM companies. These include great attention to the sources of power needed to operate its plants, strict practices of efficiencies when building new facilities, and strong encouragement to all employees to participate in environmental programs.

- **Partnerships and active participation in environmental organizations.** Intel recognizes the need to cooperate with other manufacturers and end-user organizations to promote standards and best practices in sustainability. It was a founder of the Climate Savers Computing Initiative and is a board member of The Green Grid.

Intel Product Design Improvements

Intel's product portfolio is composed mainly of processors, motherboards, solid state drives, additional components, and software.

Being the core element of a computing system, be it a server or a PC, CPUs are a key element in determining its energy needs, both directly and indirectly, as more powerful CPUs are generally combined with larger memory and more powerful chipsets, which in turn requires a larger amount of energy to be powered and cooled. All this proves how critical it is for CPU manufacturers to aggressively push energy efficiency on their platforms, as this generates exponential savings to the whole system (and to whole datacenters in the case of servers).

Intel has long recognized this need and over the last few years it has increased its focus on this, pushing forward innovative approaches in many areas. A first, crucial improvement is linked to the miniaturization of CPU technologies. By shrinking transistor size from 65nm to 45nm and using different transistor materials, Intel dramatically increased the performance and efficiency of Intel Core microarchitecture. Intel's 45nm processors are produced using a lead-free process and use Hi-K Metal Gate silicon technology for reduced transistor leakage, enabling more energy efficient, high-performance processors. These products result in sleeker, smaller, and more energy efficient desktops, notebook PCs, mobile devices, and server designs. Intel will ship the next generation of processors based on 32nm technology in late 2009.

A second, important initiative is the launch of low-energy CPUs to deliver the best solution in those situations (in netbooks, where battery life is critical, or in massive scale-out datacenters) where energy efficiency is the key factor. Atom is the most power-efficient CPU for low-end mobile computing platforms, and each new generation of the Centrino mainstream mobile platform brings further improvements in battery life. Intel's latest microarchitecture, Nehalem, helps lower energy costs with automated energy efficiency features that deliver a 5x reduction in idle power. Specifically on the server side, Intel's Xeon family includes low-power CPUs that consume as little as 30W thermal design power (TDP).

Thirdly, Intel is moving ahead of the curve with specialized energy management capabilities embedded at a CPU level. With Intel Intelligent Power Technologies embedded in Xeon 5500 CPUs, CPU cores can be manually or automatically set to an almost-off state when unused, and the transition from idle to full-power states is five times faster than in previous generations. IDC believes this to be a crucial feature for next-generation servers and system management tools, as energy is poised to be a primary source of expense in datacenters in the future.

All of these advancements will bring noticeable gains in sustainability in the coming years, as shown in recent research by Jonathan Koomey et al (*Assessing Trends in the Electrical Efficiency of Computation Over Time*, August 2009), which estimates that the power needed to perform a task requiring a fixed number of computations will fall by half every 1.5 years, opening up the way to more powerful mobile devices.

At the same time, Intel's progress is already starting to have a concrete impact in some areas. For example, on the server side, IDC has seen a positive trend in the typical power consumption (TPC) values of servers in Europe, with TPC on average cut by 5% between 2007 and 2008, which in turn lowered the absolute energy footprint in European datacenters by 3% year on year in 2008 (*Energy Footprint of the European Server Infrastructure*, IDC #GE11R9). The main reason behind this downward trend was the gradual expansion of newer, more energy efficient x86 servers in the installed base.

In addition to the evolutions on the CPU side, Intel is also among the leading vendors in the development of a crucial energy efficient component that will revolutionize the way systems store and access data — solid state drives (SSDs). Compared with traditional hard disks, SSDs have extremely low energy consumption values due to the absence of a rotational disk. Products embedding SSDs, both on the server and PC side, offer much-improved efficiency as well as clear improvements in performance.

Intel Focus on Sustainable Operations

Along with a solid commitment to delivering computing technology that makes a more optimized use of power sources, Intel's sustainability vision includes clear goals in the way operations are run within the company itself. Intel's performance in sustainability is internally managed by the Environmental Health and Safety (EHS) department, which among other things oversees all aspects of environmental sustainability, from product design to product disposal after end of life (see Figure 109).

FIGURE 109

Intel Environmental, Health, and Safety Product Cycle

Source: Intel Corp., 2009

As part of its corporate social responsibility strategy, Intel reports annually on its progress in a number of fields, including environment goals. Intel has been a member of EPA's Climate Leaders program since 2006, and within this has set specific environmental goals to make its contribution towards climate change:

- Reduce its total worldwide greenhouse gas emissions by 30% per unit of production from 2004 to 2010
- Reduce the absolute CO_2e impact of its operations by 20% below 2007 levels by 2012
- Reduce water use per chip to below 2007 levels by 2012
- Reduce energy consumption per chip by 5% a year from 2007 to 2012
- Reduce generation of chemical waste per chip by 10% by 2012 from 2007 levels

The company is on track to meet all of these goals. In 2008, Intel lowered the amount of energy it uses (including electricity, gas, and diesel) by 2% compared with 2007, to 5,643 million kWh. It was also able to reduce its CO_2e emissions by 26% (on a per chip basis, -23% YY) compared with 2007, thanks to a large ratio of green power (in

2008 Intel was the largest purchaser of green power in the U.S., according to the EPA).

As far as fabs are concerned, Intel follows a set of practices internally referred to as Design for the Environment (DfE). These help Intel engineers optimize cooling systems and heating recovery systems and have been implemented since the buildout of the Intel site in Ocotillo, Arizona, in 1997.

Finally, Intel is very active in the material used to design its products, working with several consortia to develop and provide EU RoHS (European Union Restriction of Hazardous Substances) compliant products; it also provides Material Declaration Data Sheets (MDDS) to demonstrate compliance to EU RoHS.

Engagement in Industry Associations

As a primary player in the IT industry, Intel is keen to promote energy efficiency and ecological awareness initiatives. Intel and Google started the Climate Savers Computing Initiative (CSCI) in 2007, a non-profit group of eco-conscious consumers, businesses, and conservation organizations aimed at encouraging consumers and businesses to cut carbon dioxide emissions related to their IT equipment, both by making use of eco-efficient products and, more importantly, by adopting best practices and good habits at a user level. CSCI targets a 50% reduction in power consumption by computers by 2010, aiming to collectively save $5.5 billion in energy costs.

Similarly, Intel is heavily engaged in The Green Grid, the leading industry association promoting energy efficiency practices in datacenters. The Green Grid promotes standards to help end users better measure and manage datacenter energy efficiency, and including metrics such as PUE and datacenter infrastructure efficiency (DCiE).

Since 2007, Intel has been a member of the Chicago Climate Exchange, a cap and trade system for greenhouse gases, with members making a legally binding commitment to reduce their aggregate CO_2e emissions by 6% by 2010 compared with a baseline of average annual emissions from 1998 to 2001.

Thanks to its venture capital investment fund Intel Capital, Intel also has the chance to promote and invest in companies working to deliver new, sustainable sources of energy to the planet. The Intel Open Energy Initiative includes this activity, but also extends to other actions Intel is taking to accelerate the adoption of alternative energy sources and smart grid programs, such as influence in standards bodies, consortia, and coalitions and partnerships to reach a synergy between intelligent renewable energy sources, smart grids, smart buildings, and empowered energy consumers.

Conclusion

As one of the primary players in the IT industry, Intel is conscious of its role in adopting sustainable behavior while delivering products that always improve the performance per watt ratio, be it at a personal computing, consumer electronics, or datacenter level. The company is on track to deliver on its own goals to reduce its carbon and energy footprint, with an ambitious target of cutting its greenhouse gas emissions by 30% per unit of production between 2004 and 2010.

CASE STUDY: SCHNEIDER ELECTRIC

This case study looks at Schneider Electric's sustainability strategy.

Schneider Electric's Transformation: A Global Specialist in Energy Management

Founded in 1836 as Schneider & Cie, Schneider Electric is now a global specialist in energy management. From its roots in the iron and steel industry, the company has transitioned through power and control systems into electricity, energy, and automation management. After more than 170 years, Schneider Electric has become a leading solution provider to help companies make the most of their energy.

Schneider Electric offers integrated solutions across five core market segments — energy and infrastructure, industry, buildings, datacenters, and networks — and has a strong presence in residential applications. It does not generate energy, focusing instead on making energy safe, reliable, efficient, productive, and green. It has 114,000 employees and had sales of more than $23 billion in 2008 from operations in over 100 countries. Ranked 330 in the Fortune 500, Schneider Electric spends 5% of its revenue on R&D.

From 2001 to 2008, Schneider Electric embarked on a strategy of targeted acquisitions to refocus its growth profile from power and control to energy management systems. The decision was made to focus on active emerging markets, energy efficiency, critical power and cooling, and value-added services.

In 2007, Schneider acquired U.S.-based American Power Conversion, a major player in critical power and cooling, which tripled Schneider's business in this area. The brand, now known as APC by Schneider Electric, aims to offer energy savings of 30% to 40% by leveraging breakthrough technologies and innovative architectures and management systems. In 2008, Schneider acquired Xantrex, a leader in inverters for solar and wind power installations, strengthening its position as a major player in renewable energy solutions and its ability to meet the world's need for energy efficiency solutions. Schneider believes that new market opportunities will ultimately create a category of technologies and services that deliver "intelligent energy."

During the 2001-2008 period, the company embarked on a strategy of targeted acquisitions, acquiring a total of 56 companies for over €10 billion. The results of this strategic transformation clearly demonstrated that the company had made the right decision. Revenue jumped from €9.06 billion in 2002 to €18.3 billion in 2008, an annual average growth of 12%, and the company's workforce grew by 63%. In 2008, emerging economies accounted for 32% of sales while energy efficiency solutions represented 30% of the business, and Schneider Electric's newly acquired datacenter and network customer base generated 17% of sales.

Schneider Electric has actively and consistently worked to reduce its environmental footprint, while making energy easier to use and more sustainable. The creation of the Sustainable Development Department in 2002 developed Schneider's Principles of Responsibility, and in 2005 Schneider created a quarterly Planet and Society Barometer, which tracks and reports on a variety of performance criteria in three key areas — planet, profit, and people. This group also oversees Schneider Electric's reliable design and production targets, which provide customers with relevant environmental performance information and guidelines on how best to dispose of a product at the end of its life.

Schneider Electric was the first manufacturer to sign French environmentalist Nicolas Hulot's pact for the environment and the sixth global enterprise to join the Clinton Climate Initiative (CCI). It became an active member of the United Nations Global Compact in 2002 and is also a member of the Alliance to Save Energy.

Energy University

Schneider Electric created the Energy University, an elearning Web site, in June 2009 in response to a need for education and awareness on all levels for all organizations. The program is aimed at a global customer audience, focusing on practical energy management and delivering elearning courses and certification. It is free of charge to all users, which ensures accessibility for everyone.

The Energy University site addresses the issues surrounding human behavior, financial positioning, and personal motivation and knowledge of energy management and issues, and is intended to raise the capability of individuals regarding energy efficiency. This includes information about regulations and public policy, business collaboration, innovative technologies, and public education. Schneider Electric aims to drive this change through education and services that will help people make the most of their energy.

The program is found at www.MyEnergyUniversity.com.

Schneider Electric's Planet and Society 13 Progress Plans, 2009–2011

In order to measure its sustainable development commitment, Schneider Electric has laid out the following objectives for 2011, divided into the three key areas of its sustainable development program.

Planet:

- To reduce CO_2e emissions by 30,000 tons annually
- To achieve two-thirds of the company's product revenue with Green Premium products
- To have two-thirds of the company's employees work in ISO 14001 certified sites

Profit:

- To attain seven points above average growth gained by its energy efficiency activities
- To set up a recovery process for SF6 gas in 10 countries
- To give 1 million low-income households access to energy with Schneider Electric's solutions
- To have 60% of purchases come from suppliers that support Global Compact
- To have four major SRI index families select Schneider Electric

People:

- To achieve a 10% annual reduction in the frequency of occupational accidents
- To increase the company's employee recommendation score by 14 points
- To train 2,000 employees on energy management solutions
- To train 10,000 young people at the bottom of the pyramid in electricity professions
- To have 500 entrepreneurs at the bottom of the pyramid start businesses in the electricity sector

Schneider Electric started tracking its new goals in January 2009, with a grade of 3/10. Its goal is to reach 8/10 by 2011; currently (at the end of 2009) the company has a score of 4.32/10.

EcoStruxure

Schneider Electric will accelerate its drive to address end users' need for customized solutions with strong energy efficiency benefits. EcoStruxure is the brand name of Schneider Electric integrated system solutions, a series of proven integrated system architectures that address the design of the energy management systems. Schneider Electric will leverage a portfolio of solutions and adapt its organization to align with end-user segmentation.

InfraStruxure

APC by Schneider Electric, formally American Power Conversion, developed InfraStruxure, an on-demand architecture for the datacenter that integrates power, cooling, rack, management, and services. As an integrated solution design, InfraStruxure incorporates standardized, modular components to create a customized solution. This standardization, coupled with APC by Schneider Electric's Design Portal, enables an easily scalable architecture designed to meet customers' changing needs and future expansion. This approach provides increased availability, improved adaptability, and speed of deployment, as well as lower total cost of ownership for IT environments, from wiring closets to computer rooms to datacenters.

In 2008, Schneider Electric became the datacenter industry's first company to publicly release the electrical efficiency data of its products. As a member of the Green Grid, Schneider Electric maintains its dedication to advancing energy efficiency in datacenters and business computing ecosystems.

Buildings

Schneider Electric's buildings business provides solutions to manage energy and other aspects of a building, such as security, safety, and usability. Schneider Electric works on new buildings and refitting existing buildings so that they meet high power management standards. Schneider Electric helps commercial businesses reduce their energy consumption through analyzing the data in their existing buildings management system and making changes in the way the building is managed that can reduce the environmental impact of the building. Given the potential to reduce carbon emissions through the Energy Edge program will improve the standard of buildings. Schneider Electric has a financing program that uses the future savings from energy efficiency to finance the immediate capital investment needed to get this efficiency, after a complete energy assessment. These programs are a growth area for Schneider Electric and a key focus area.

Buildings are often not recognized as a critical factor of global CO_2e emissions. In fact, buildings are a significant source of man-made CO_2e emissions, leading to global climate change. Governments around the world are introducing increasingly stringent energy regulations, which are a call to action for building owners.

Bella Center Leads by Example, Cutting CO_2e Emissions by 20%

The Bella Center A/S in Copenhagen is Scandinavia's largest exhibition and congress center, hosting a wide range of events such as international fairs, exhibitions and conferences, meetings, and functions. It covers 122,000 square meters and has just reached its goal of cutting CO_2e emissions by 20%, or 1,150 tonnes a year. In December the center will host the United Nations Climate Change Conference, and this sends out an important message to participants — that building emissions can and must be reduced as a significant cause of CO_2e emissions.

Schneider Electric has helped Bella Center A/S reach this goal with its energy management and security solutions. Schneider Electric optimized control of the building's energy consumption and modernized the ventilation and cooling systems, circulation pumps, and thousands of light fittings. These measures have saved more than DKK 2 million (€270,000) a year.

PlantStruxure

Schneider Electric's process and industry business manages solutions in a wide range of markets, including mining and metals, HVAC, material handling, manufacturing processes, packaging, food and beverage, and microelectronics. Schneider Electric argues that with 48% of global energy used in industry markets, automation has a huge role to play in cutting carbon emissions and reducing the amount of energy used.

Process automation, energy management, and production management systems are in need of open and accessible data across the entire process enterprise, and Schneider Electric's PlantStruxure leverages Schneider Electric solutions to provide plantwide control. With one of the world's leading providers of industrial automation within its portfolio, Schneider Electric offers a complete automation and control solution offering.

With PlantStruxure, Schneider Electric is able to deliver integrated solutions globally and from a single source. For industry markets, PlantStruxure will integrate product solutions under the common, collaborative architecture of EcoStruxure, making them more flexible when they are adapted to end-user energy management issues at all levels and with third-party software systems.

Conclusion

Schneider Electric is set on becoming the benchmark in sustainable development through the management of efficient energy use and by offering the cleanest and most efficient products, processes, and plants in the industry and complying with or anticipating the most demanding global environmental regulations. With its repositioned business portfolio, Schneider Electric offers innovative responses to the 21st century's paradox of producing more, more effectively. The company's portfolio includes a broad, synergistic lineup of products, systems, and services, and its solutions help customers reduce costs, stay connected at all times, and tap into an ultrapure, secure, and uninterrupted power supply.

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