DEDICATED TO MAKING A DIFFERENCE

Enabling frameworks

for technology diffusion

A business perspective

World Business Council for
Sustainable Development

Contents

1. Key findings: Enablers for low-carbon technology diffusion

The diffusion of low-carbon technologies to developing countries is essential if we want to achieve a 450 parts per million (ppm) atmospheric CO2 objective and keep an increase of global temperature below 2°C, since 85% of future worldwide growth in energy demand will occur in developing countries.

The private sector is ready to play a leading role in achieving this objective and will bring innovative low-carbon solutions to the market without government intervention. However, in some cases, governments will need to create adequate frameworks for investment, including specific regulations tailored to particular technologies and their stage of maturity.

Cross cutting enablers

Business has experienced that five elements are necessary to enhance investments and sales of low-carbon technologies:

1. Strong signals from governments towards low-carbon growth nationally and internationally, either through targets or regulatory measures.
2. Adequate institutional frameworks that provide stable policies, transparent investment regulation and conducive local conditions.
3. Appropriate absorptive capacity in institutions, business and society including a functioning education system, a receptive environment and targeted capacity building programs.
4. Economic and financial incentives to bridge the gap between low-carbon solutions and their commercial viability.
5. Energy efficiency drivers through removing barriers such as perverse subsidies, introducing economic incentives and consumer outreach.

6. Business engagement with governments would allow business expertise and know-how to be incorporated into the design of new instruments that aim to enhance technology diffusion to developing countries. WBCSD member companies believe that the private sector should have an active role in the international and national climate change process to increase the likelihood of success in reaching common objective.

Sector specific enablers

In addition to these cross-cutting elements, individual industry sectors require specific enablers to encourage diffusion of low-carbon technologies.

Power sector

The greatest emissions reductions are possible through action in the power sector. This will require technology breakthroughs, large-scale investment and unprecedented and far-reaching policies in the energy sector.

Recommendations for the power sector include:

- Defining national road maps for low-carbon electricity
- Directing subsidies to low-carbon alternatives
- Putting a value on the reduction of carbon emissions
- Covering all low-carbon technologies through market mechanisms
- Building efficient energy markets and more efficient electricity pricing
- Providing sufficiently resilient transmission and distribution infrastructure.

Cement sector

Population growth and increasing urbanization continue to drive the demand for cement, which is required to manufacture concrete. All countries need to encourage the use of low-carbon cement products and provide incentives to reduce greenhouse gas (GHG) emissions from cement production.

Recommendations for the cement sector include:

- Overcoming sector barriers to implementation
- Developing international standards
- Sharing best practices
- Ensuring data monitoring on energy-use and emissions data.

Road Transport

The major share of the projected increase in road transport activity will occur in developing countries. Efforts should be made to channel growth of low-carbon options, such as cars and light vehicles, to these markets to reduce GHG emissions.

Recommendations for the transport sector include:

- An integrated approach across all stakeholders: the automotive industry, its suppliers, the fuel industry, policy-makers, infrastructure providers, car buyers and users – to cooperate across the whole chain to reduce CO2 emissions in the most cost-effective way
- Global harmonization of regulations and standards with the level of stringency subject to the country's capabilities and circumstances and ensuring technology neutrality so that companies choose their preferred technology routes
- Ensuring appropriate infrastructure and regulatory environments are in place to take advantage of innovative technologies
- Innovative financing options to overcome high upfront cost in emerging markets.

Buildings

With the rapid growth in the number of buildings in developing countries and the higher energy intensity of urban dwellings, an integrated approach to the diffusion of low-carbon technologies is needed. Effective regulation, market interventions and subsidies are likely to be necessary to kick-start the market for low-carbon buildings.

Recommendations for the building sector include:

- Regulations, such as: building codes and standards to ensure acceptable levels of energy efficiency; minimum

performance standards for individual technologies and equipment; transparency on building energy performance and mandatory systems

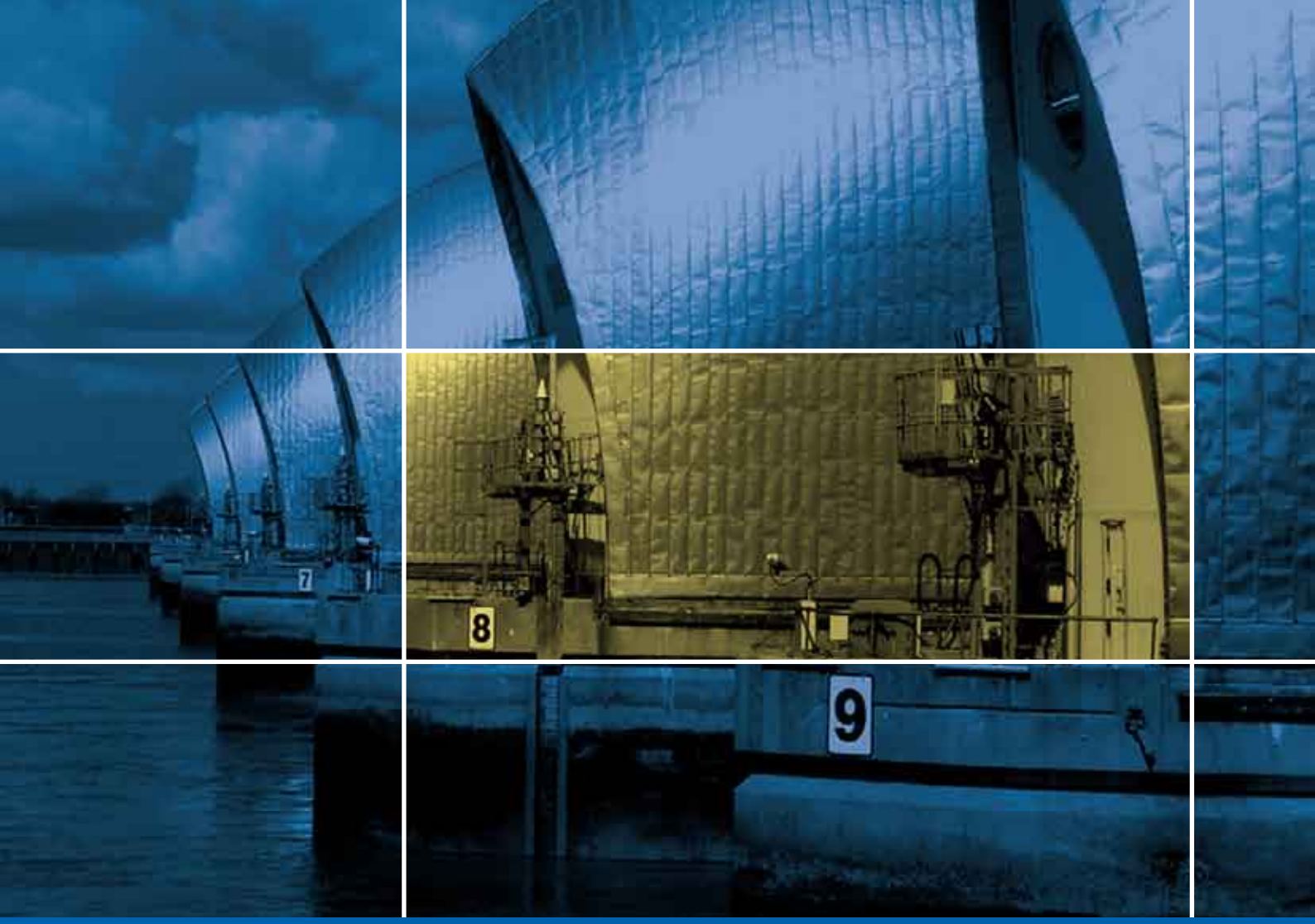
- Appropriate pricing of energy and energy-efficient technology, which will determine the speed of introduction of low-energy buildings; subsidies and price signals to overcome important initial investment
- Integrated design processes to create energy-efficient buildings, involving relevant participants from the start, to help bridge the gap between building owners and users and overcome the fragmentation in the building supply chain
- Capacity building to ensure that adequate skills are available from design and construction to fitting advanced technology.

Forests

Forests that are sustainably managed sequester, store and recycle atmospheric carbon. Addressing the direct drivers of deforestation and degradation in developing countries and creating incentives for forest conservation, sustainable management of forests, and enhancement of forest carbon stocks can deliver very significant carbon emission.

Recommendations for the forest sector include:

- Encouraging the practice of sustainable forest management
- Recognizing and rewarding forest-based ecological services in addition to carbon sequestration
- Eliminating perverse subsidies
- Developing and deploying biomass based breakthrough technologies
- Removing existing regulatory barriers that discourage maximization of combined heat and power technology
- Including public and private sector procurement policies for wood, paper-based products and bio-mass energy
- Promoting faster turnover of capital stock depreciation so improvements in energy and carbon intensity can be accelerated with the sustainable forest products industry.



2. The technology diffusion challenge

According to the International Energy Agency (IEA), to achieve a 450-ppm scenario by 2050 there is a need to reduce global emissions by 50 Gt CO_2 emissions from 2005 emission levels. With an increase in energy demand in non-OECD countries that is expected to account for 85% of the increase of world energy demand, a major challenge is to accelerate the diffusion of low-carbon technologies to developing countries. This requires developed and developing countries to take urgent actions.

In some cases, this involves finding new ways to widely deploy existing technology or to adapt technologies to local conditions. About 70% of the reductions needed could be achieved with existing technologies. In others, it will involve the creation of new technologies. As the inventor, developer and owner of most technologies, and the engine of most technology deployment, the private sector is a critical party in this discussion. Estimates suggest that more than 80% of worldwide investment in technology deployment currently comes from the private sector. The IEA estimates that an additional US$ 45 trillion total investment will be required by 2050 for a 450-ppm scenario.[1]

Defining technology transfer needs

Under the UNFCCC negotiations there are calls for an increase in technology transfer to developing countries. Each developing country has very different needs, and technology transfer has varying applicability and needs within different industries.

In emerging economies the challenge lies in fueling economic growth while avoiding a lock-in of high-emission technologies. In some markets, such as China, India, Brazil and other rapidly developing economies, the spread of advanced clean technologies is happening at least at the same rate as in developed economies. For some technologies and countries it is even faster, since they are able to bypass the challenges of “restructuring” entrenched installations and infrastructure.

In the least developed countries the challenge of pursuing economic and social progress necessitates facilitation and support to access existing low-carbon technologies and to strengthen their endogenous technological capabilities.

Business' understanding of technology transfer

Business understands technology transfer to be technology diffusion, a means for the deployment of new equipment, products, processes or knowledge, previously not accessed by a recipient country. It can include more efficient equipment, products or processes that are similar to technology already available in the recipient country.

The private sector diffuses technology on a commercial basis every day. Technology diffusion takes place through equipment sales, products, partnerships with local companies, joint ventures and other means. High-quality cleaner technologies are being deployed in developing countries continuously. The deployment of low-carbon technologies to any country will depend on the investment environment and commercial viability, rather than by classification of countries under certain groupings (developed/developing countries).

However, business could do more in developing countries if the risk of low-carbon investment was reduced. In commercial terms, business will allocate resources to projects where the projected returns are sufficient for the level of risk being taken. Sometimes specific frameworks or investment incentives are required to channel investment decisions to low-carbon projects. Individual projects are always competing for finite capital resources. Long payback periods or uncertainty of demand are some of the most important barriers to low-carbon technology deployment.

Technology learning phases

Technologies are diverse and numerous; they are at different stages of maturity, progressing from an initial learning phase down the cost curve to commercial viability. They also have different carbon-mitigation potentials and require different policy responses in different countries depending on their international commitments for GHG reductions (figure 1). To stimulate investment in appropriate technologies, to deliver at the right time, place and cost, countries will need to consider the full life-cycle of technology and enable a portfolio of technologies to be developed in parallel, not sequentially. It is important to consider the life-cycle and turnover of existing capital infrastructure as new low-carbon technologies are phased-in, and new long-term infrastructure is built.

There are specific policy measures that need to be taken today to enhance the urgent deployment of existing low-carbon technologies in developing countries (some of these enablers affect both developed and developing countries; here we focus on the latter) and to avoid the risk of high-carbon technology lock-in.

In the next section we will explore the business case for technology diffusion and general enablers for investment in developing countries and, in particular, in low-carbon technologies. After this cross-cutting perspective we will explore enabling policy frameworks for diffusing low-carbon technologies in specific sectors (power, car industry, cement, buildings and forests).

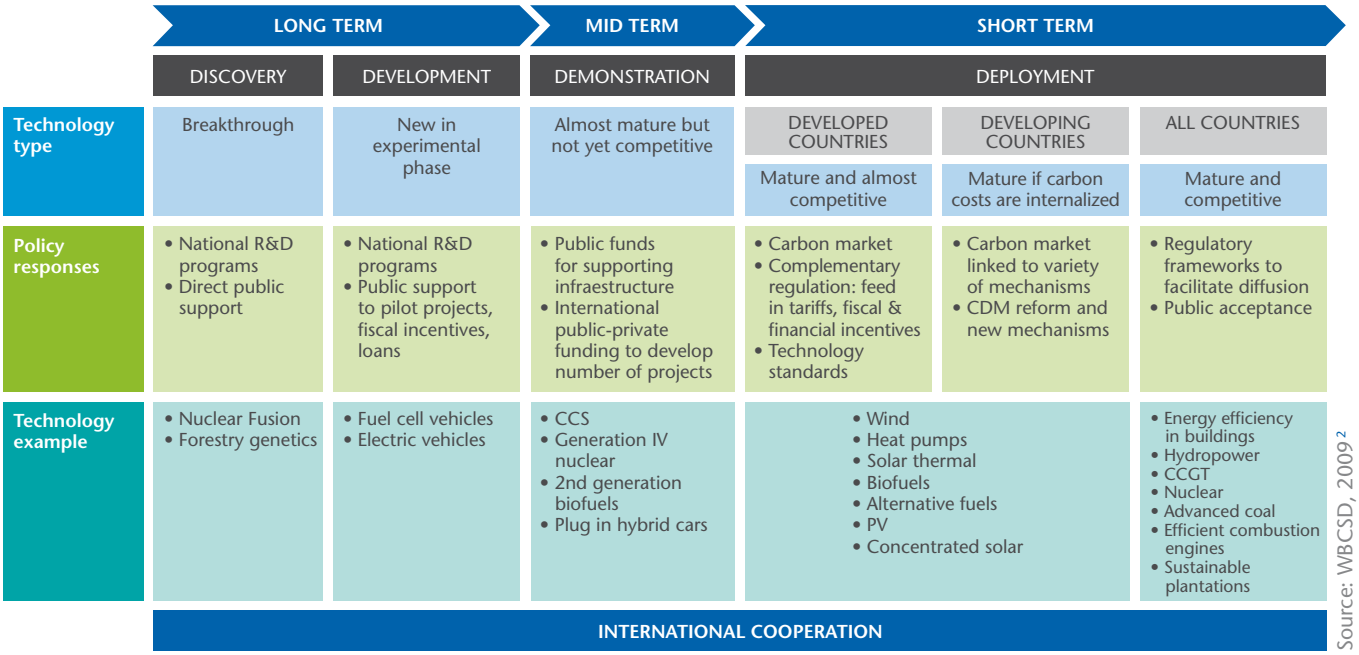
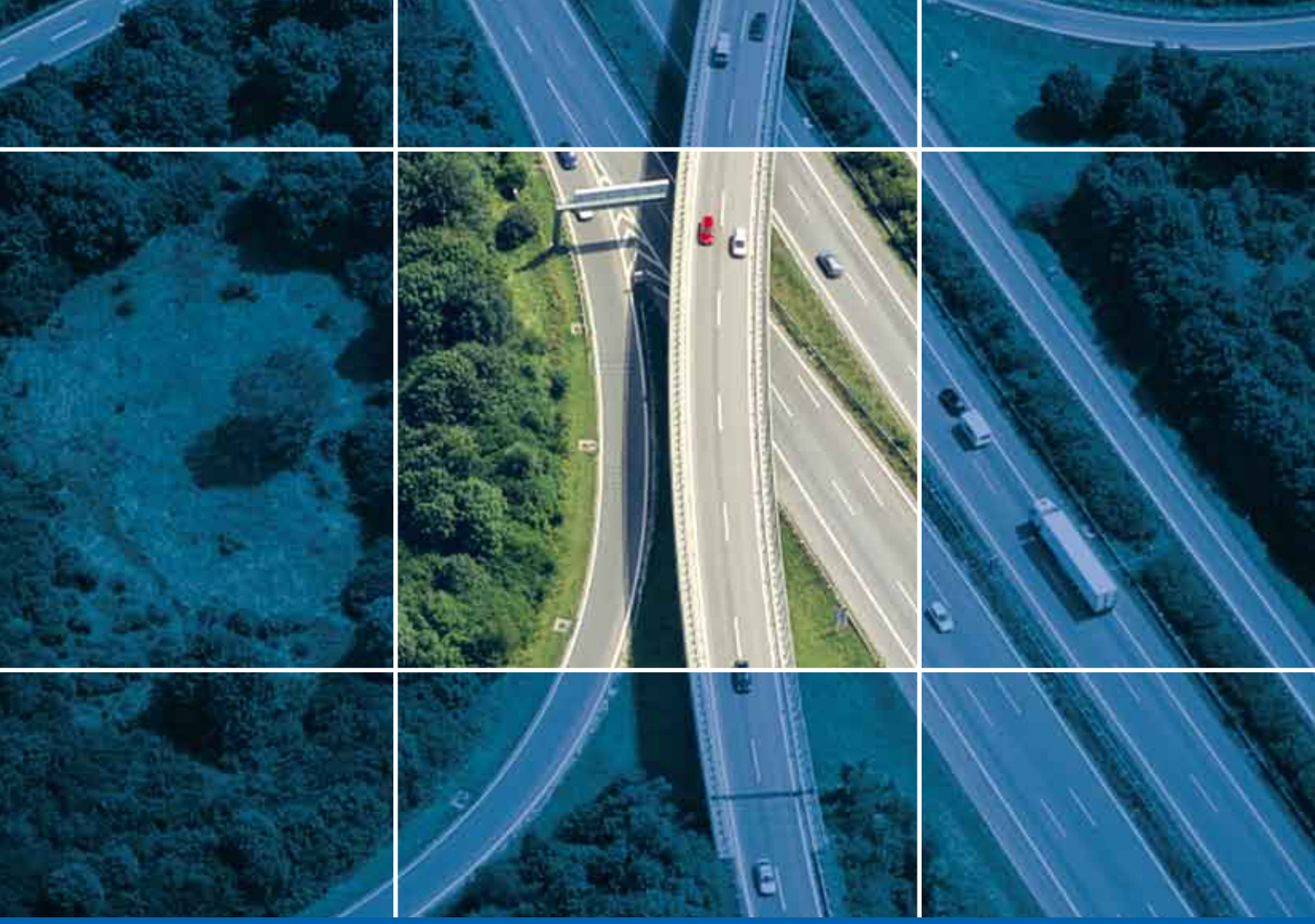


Figure 1: Technology learning phases and policies



3. Cross-cutting issues

The business case for low-carbon technology diffusion

From a business perspective, technology is generally not the end-goal, but a tool to enhance the delivery of revenue and profit-generating activities that contribute to economic and social development. Technology diffusion normally occurs through direct investment (e.g., wind turbine manufacturing plant), sales (e.g., car) or a license to use a technology (e.g., component of a wind turbine).

Investment in any particular country needs to have a strategic fit. From a business perspective individual investments do not generally make sense if they are not linked to a regional strategy.

The drivers for investing or selling products in developed or developing countries are diverse: size of the market, customer's interest in the product, long-term commercial relationship with local businesses, the availability of a skilled work force, strategic interest, etc.

More than all those drivers, it is fundamental that the country have a stable and transparent investment framework, underpinned by appropriate legislation and regulation.

The enabling frameworks that influence the deployment of low-carbon technologies are quite different when it comes to infrastructure investments or selling products in a particular market. According to the UNFCCC, an enabling environment encompasses government policies that focus on creating and maintaining an overall macroeconomic environment that brings together suppliers and consumers in an inter-firm cooperative manner. They include government actions that create an environment conducive to private and public sector technology transfer.

When there is a need to build low-carbon infrastructure in the country, an investment analysis is undertaken and options evaluated prior to implementing the project. This requires a number of crucial considerations to ensure the long-term viability and financial success of a project (figure 2). In general, projects will not be implemented if these criteria are not achieved, regardless of country.

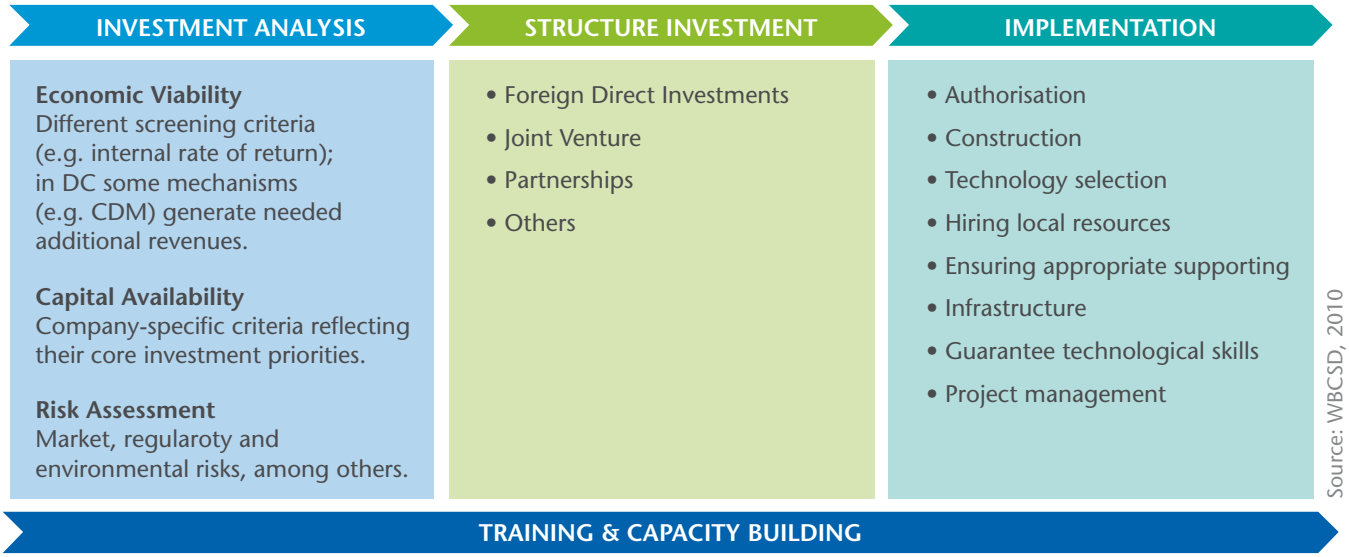


Figure 2: Investment process

How can governments facilitate the acceleration of technology diffusion to developing countries?*

Deploying low-carbon technologies to developing countries requires innovative mechanisms with joint efforts from developed countries, the private sector and developing countries. There are planned and existing efforts to help developing countries create enabling environments for low-carbon growth. However, these are insufficient and more needs to be done rapidly. The private sector – from multinationals to local SMEs - views these efforts as commercial opportunities that are, at the same time, aligned with their own sustainable development goals.

An enabling framework for technology investment in developing countries will also provide clear benefits for the country and local community. Investment in developing countries translates into job creation, infrastructure development and local GDP increase. Investment in low-carbon technologies or products also reduces the share of GDP spent on energy imports, either through energy efficiency or the use of local renewable sources, and reduces the total cost of many products (especially through efficiency).

Business believes that there are five necessary elements for enhancing technology diffusion:

- Strong signals from governments towards low-carbon growth, either through national targets or regulatory measures.
- Adequate institutional and regulatory frameworks to support technology development and / or deployment.
- Adequate absorptive capacity.
- Economic and financial incentives, such as funding, financing, fiscal or tax measures and the absence of perverse subsidies or trade barriers.
- Removal of barriers to energy efficiency.

Broadly, developing country governments will have to make decisions on nationally appropriate actions or commitments and set appropriate institutional frameworks. Developed countries should provide economic incentives to low-carbon products and investment in developing countries and provide assistance to overcome the barriers for their broader deployment.

Institutional frameworks

Business operates under the rule of law and requires stable political and legal systems that ensure a sound investment environment. To enhance technology diffusion to developing countries, open markets, fair trade and competition rules are a must. They could be facilitated by removing non-technological barriers, such as legal requirements that prevent or limit foreign investment or taxes on imports that slow and diminish access to some low-carbon technology by local business. Ensuring protection of intellectual property rights (IPR) is also essential to the technology development and deployment to any market.

Predictable, objective, transparent, consistent and stable energy and environmental policies are necessary both for investment in low-carbon infrastructure projects and the creation of new markets for low-carbon products.

* This analysis explores the enabling frameworks for technology diffusion in developing countries; however most of them also apply to developed countries. Technologies could be owned by developed or developing country businesses; both will benefit from these frameworks.

Due to the long-term nature and high capital cost of some energy or infrastructure projects, introducing credible, consistent and non-conflicting regulatory obligations that enhance foreign investment is particularly important. For consumer goods, appliances and motor vehicles, harmonizing regulations and standards is important, especially in sectors that are subject to strong international trade.

Absorptive capacity

Developing local technology absorption capacity is an essential pillar for low-carbon growth. This involves investing in education at all levels, developing local business absorption capacity, and ensuring adequate training for government officials and municipalities.

For infrastructure investment, facilitating training to achieve local competency in the use of the technology (organizational, operational, etc.) is critical to long-term project success.

It is important to take into account the potential for regional benchmarking, industry clustering and public-private partnerships that increase the technology literacy of society, governments and businesses. Such clusters could disseminate information to local business on the best available technologies that best suit the local circumstances.

To enhance absorptive capacity and facilitate developing country access to low-carbon technology and knowledge in developing countries, three areas have been identified where business can contribute: technology assessment and capacity building, providing expertise and implementing new projects. These three areas require new forms of collaboration between the public and private sector.

Technology assessment and capacity building

Adequate capacity to develop and use technology is an important consideration for business when planning to invest in any country. To enhance capacity building programs, governments and the private sector should:

- Build trust between technology developers and users. Many projects fail in developing countries because they use technology that is inappropriate due to lack of capacity building, ill-defined ownership, or lack of infrastructure. Any new technology framework should minimize this risk and ensure efficient diffusion of the appropriate technologies. Technology assessments should take a holistic approach that encompasses "host-country" capabilities with the technologies needed.
- Develop local management capability. One of the biggest obstacles to technology deployment is the difficulty of

finding skilled local business partners in some developing countries. For energy projects, especially renewable energy, a local partner who can put the deal together is critical. This demands business and political skills, along with strong ethics.

- Be specific in identifying the needs. Clear requirements create the opportunity for tangible solutions and are more meaningful and actionable than vague "we need technology" demands. Products and technology identified through Technology Needs Assessment under the United Nations Framework Convention on Climate Change (UNFCCC) are more likely to be addressed successfully.

- Collect necessary data for the implementation of appropriate policies. Solid data is a prerequisite for policy-makers and business. This will help policymakers design the most cost-effective policy options and impact assessments, while business can reduce uncertainty and thus risk premiums. Often there is a substantial lack of reliable statistical data on issues such as energy use, infrastructure, or demand.

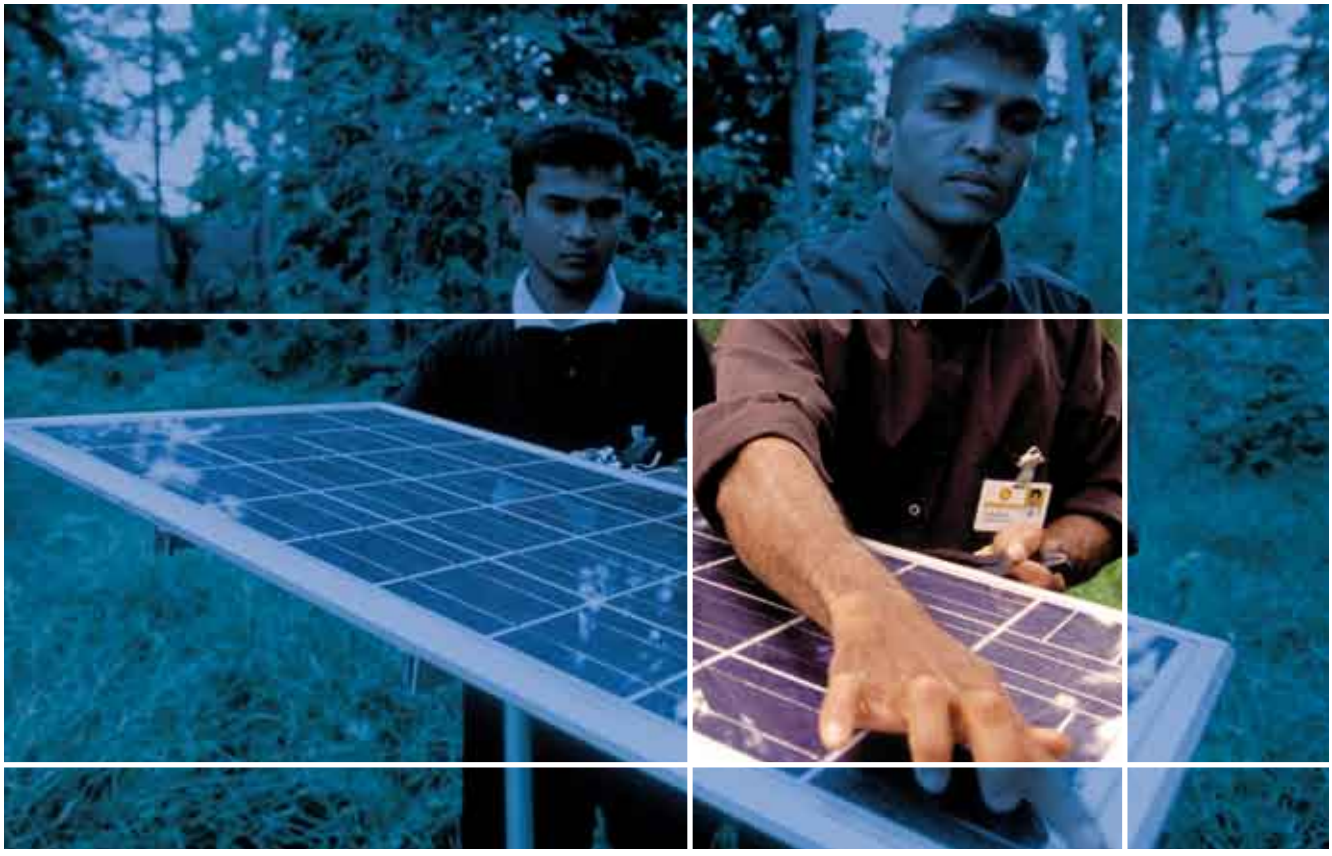
- Be prepared to partner with business for solutions. Many companies look to developing countries for growth opportunities. A country can create a bigger opportunity by selecting a few key technologies and competitively seeking partners who will work with them over the longer term on research, application development and deployment. Focusing a country's academic resources on the most appropriate technologies is crucial.

- Address installation and maintenance as a key element of technology deployment. Much of the focus around technology diffusion is on the manufacturing. For many energy technologies, scale and experience are needed to ensure the manufacture quality products at cost-efficient prices. Achieving indigenous manufacturing in every country is unrealistic. But the infrastructure of every country needs maintenance, which can lead to long-term, high-quality jobs related to installation and servicing of equipment.

Utilize existing expertise

To attract skilled workers and trainers, capacity building programs should be presented as a commercial opportunity for investors by:

- Making training and support services commercial. Many large multi-nationals and consulting firms have capacity to provide detailed training and technical support. However, it would be rare for a business to divert those resources from other commercial activities.



- Funding it. Traditional foreign aid projects are an effective mechanism to help address specific needs. This is especially true in areas such as the design of the regulatory system or staffing permitting processes. These are inherently government functions and critically important to enabling technology deployment.

Bundle opportunities for implementation

Companies invest in countries and technologies that fit into their business strategy. Sometimes a single country might not be attractive for investment, but bundling different possibilities could create opportunities for implementation:

- Bundle customers (or countries): Companies will expend significant resources doing business in a country like China and India because the opportunities are immense. It is much harder to justify that effort in a small country. If countries with similar needs around a specific technology type are grouped together, the larger opportunity they present would be much more attractive for business.

- Bundle solutions or services: Some companies would be interested in providing a larger service, e.g. equipment or operation and maintenance across a range of infrastructure technologies, to create a bigger opportunity and present the upside of a long-term business relationship.

- Bundle standard packages: Standardizing bundled solutions or technology offerings to customers with similar needs is another way to speed up deployment. If the need for customized engineering can be reduced, costs typically come down.

Economic incentives

Business reality shows that selling products or investing in low-carbon facilities faces commercial barriers, such as:

- Competition from higher carbon products and technologies that are subsidized

- Higher costs of low-carbon products and technologies, requiring subsidies or regulation

- Lack of sufficient demand. Companies will enter certain markets only once a specific volume of sales is achievable due to high fixed costs and the need to establish long-term relationships with local partners; in the case of new technologies, it often takes time before consumers understand the technology and its potential for emissions reductions and therefore create the demand

- Diffusion of some low emission technologies is likely to be limited without government incentives. Demand for low-emission technologies or products is driven by government policies not consumer preferences; because developing countries do not have international GHG emissions commitments, demand for low-carbon products depends on voluntary domestic policies.

Specific regulations and economic incentives are necessary to bridge the gap between low-carbon solutions and commercial viability:

- Regulations: These might include renewable portfolio standards, efficiency standards or emission limits. For developing countries without international commitments, such policies would be voluntary. An important enabler would be the development of innovative financing mechanisms to generate low-carbon demand. This would include utilizing existing mechanisms, such as the Clean Development Mechanism (CDM).

- Economic incentives: These might include fiscal incentives, feed-in tariffs or subsidies. Developing countries, helped by developed countries, need to create innovative mechanisms. Financial mechanisms should be tailored to the size and characteristics of the mitigation opportunities:

  – Low-cost mitigation projects (e.g., energy efficiency measures) can be often self-financed, but require specific policy measures to overcome the main barriers to implementation (e.g., information failures)

  – Direct incentives to promote a fast and widespread uptake of energy efficient and low-carbon products in consumer markets (generally capital intensive products), such as time-bound subsidies, tax rebates or soft credits

  – Manufacturing industry and power generation projects require stable long-term incentives; funding should come from the carbon markets (or other mechanisms that put a value on carbon reductions) as they develop at national and regional levels

  – Reforestation and avoided deforestation require funding designed to achieve the multiple benefits of sustainable forest management, based on real and verifiable practices[3]

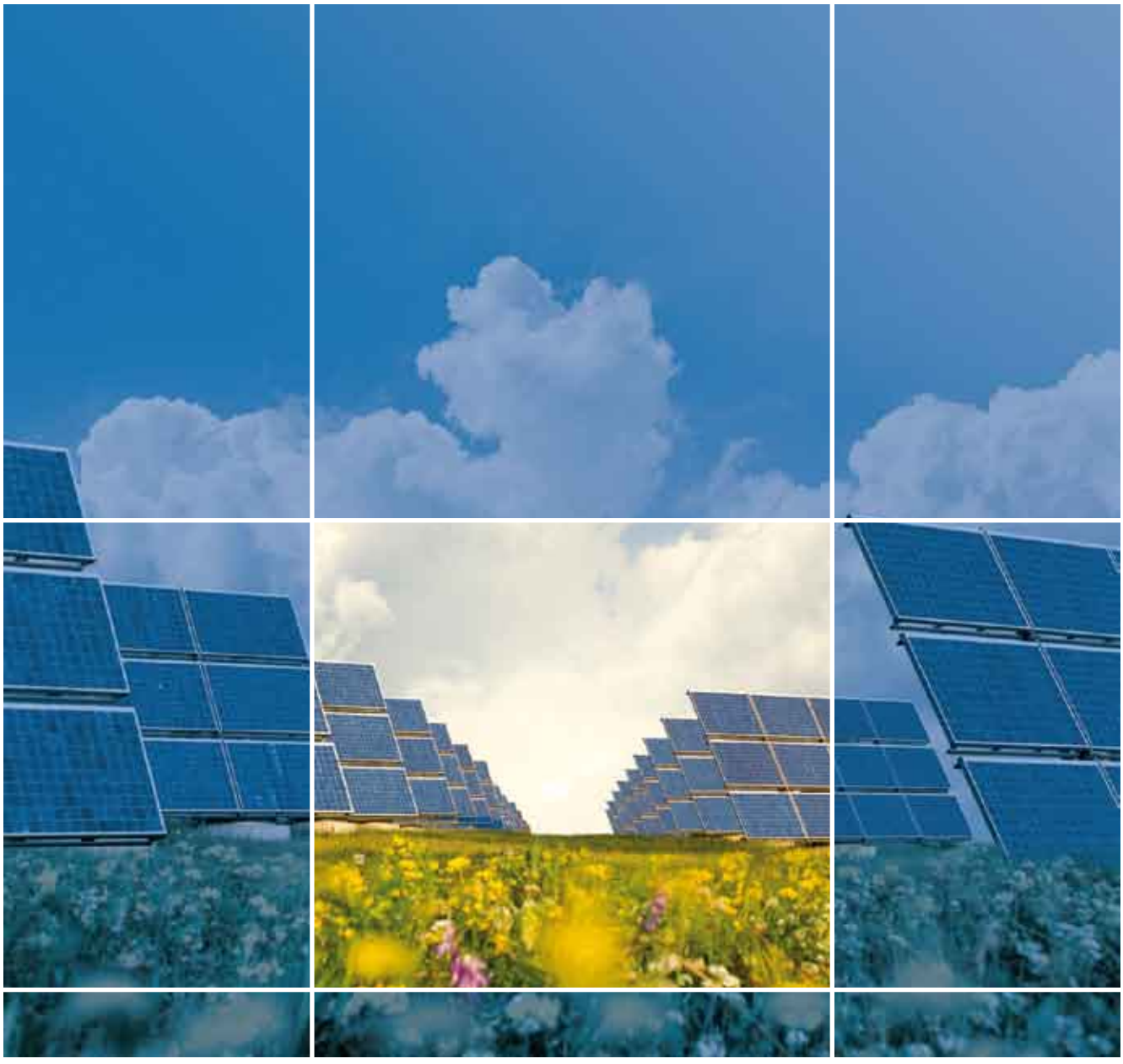
  – High-cost mitigation options (e.g., CCS) require new funding mechanisms to leverage private sector investment and bridge the funding gap for innovators as they attempt to scale-up demonstration projects.

- Carbon markets create a price for carbon, which can act as a powerful economic incentive, particularly for existing and mature technologies. Establishing a more inclusive carbon price in the medium and long term requires linking various carbon markets to other economic and/or regulatory mechanisms and enhancing the clean development mechanism (together with the design of new economic instruments). These will effectively engage industry in adopting cleaner technologies.

Removing barriers to energy-efficient solutions

Energy efficiency is widely accepted as the most cost-effective way to mitigate climate change and accounts for 50% of the potential to halve energy-related CO_2 emissions by 2050. The business case for energy efficiency is clear and includes: reducing energy costs, alleviating energy dependency, decreasing vulnerability to energy price volatility, reducing emissions and improving the efficient use of natural resources.

Energy efficiency can generate positive returns on investment and has the potential to promote high value adding activities and job creation. Deployment of energy efficient technologies can alleviate energy supply shortages and contribute to reducing energy investment costs. However, energy efficiency faces implementation barriers, and a number of policies are recommended to address these challenges (figure 3).



BARRIER	WHY IS THIS A BARRIER?	HOW TO OVERCOME THE BARRIERS
Low or volatile energy prices	• Subsidies to high carbon options • Prices do not include environmental costs	• Eliminate perverse subsidies globally • Put a value on carbon and ecosystem services
High upfront costs for production facilities	• Lack of capital	• Use finance mechanism to leverage investments
Slow diffusion of existing technologies	• Lack of skills, knowledge and support on the use of technologies • Fragmented and non integrated industry structures (e.g., building sector) • Lack of effective intellectual property rights (IPR) protection	• Technology standards • Enhance capacity building • Ensure IPR protection in accordance with World Trade Organization (WTO) regulations • Best practice sharing and energy efficiency education
Entrenched business models	• Lack of incentives for energy companies to reduce customer demand	• Internalize carbon prices in energy services • Financially reward end-user energy efficiency measures • Promote energy service companies (ESCOs)
Diversity of consumers and energy needs	• No single solution fits all	• Promote voluntary sectoral initiatives and negotiated agreements
High upfront costs and long payback periods for building investment	• Lack of capital for residential building investments or new vehicles. Most consumers value the present cost of consumption	• Economic incentives (e.g., tax reductions) to decrease first cost • Low interest rates, sponsored leasing contracts
Information failures	• Lack of information or imperfect information regarding future energy prices and energy efficiency alternatives	• More effective technology standards (e.g., building codes) • Product energy labeling • Advice on smart energy metering
Split incentives (principal agent problem)	• Those making decisions on energy efficiency do not benefit (e.g., building owners and tenants)	• Provide clear information and incentives (e.g., tax rebates, mortgage discounts, preferential loans)
Uncertainties on investment and risks	• Uncertainties add a premium to investments	• Economic incentives to reduce costs and risks • Develop robust energy and carbon markets • Establish stable regulatory frameworks
Consumer behavior	• Low priority of energy efficient investments • Lack of awareness and information on energy consumption and costs	• Improve product information • Incentives to remove and replace old equipment • Education and awareness on energy efficiency
Investment costs higher than expected	• Projects do not include all transaction costs	• Boost best practice sharing and energy efficiency education

Source: WBCSD, 2009[4]

Figure 3: Barriers to the deployment of energy efficient technologies and practices

4. Sector perspectives

In the previous section we reviewed the cross-cutting characteristics that affect all sectors in general. However, this provides a partial picture. Technology diffusion occurs in diverse ways in different sectors. Each sector has different technology needs in terms of capacity, economic incentives or government regulations. When companies seek to achieve competitive advantage, competition within sectors is an important driver for technology diffusion. Therefore tackling the challenge of technology diffusion to developing countries requires the consideration of sector perspectives and sector technological capacities.

Business has considerable experience implementing mitigation activities on a sector basis. Sector-based initiatives and projects have led to positive contributions to GHG emissions reductions through technology development, deployment and capacity building. The WBCSD believes that new cooperative sector actions could be adopted to enhance the scale of mitigation actions globally.[5]

In this section we present different sector perspectives and try to define: the importance of each sector in mitigation strategies; what technology transfer means for each sector; and what are the specific enabling frameworks that will enhance technology transfer from a business perspective.

Understanding these sector perspectives is key to providing adequate regulation, incentives and capacity building in developing countries that would enhance the deployment of low-carbon technologies. The WBCSD believes that in certain cases sector perspectives or sector approaches can be a platform for actions to diffuse technologies, more so than other geographical perspectives.

Power

Why is the power sector important in mitigation strategies?

The power sector must play a key role in the transition towards a low-carbon economy. By 2050 electricity will be the preferred energy carrier. The sector will have to make an unprecedented effort to decarbonize its fuel mix. The IEA estimates that the power sector should reduce 18.3 Gt of CO_2 in energy-related CO_2 from 2005 to 2050, which is roughly the equivalent to the 450-ppm scenario and figure 6 shows which technologies will be needed to achieve those reductions. In this analysis we focus on enabling frameworks for low-carbon technology diffusion, and explore the frameworks that will enhance the deployment of existing technological solutions.

Decarbonizing the electricity mix will become more challenging due to the growth in demand related to its close links to economic development (projections suggest sector emissions could double by 2030), the long life cycles of the power sector investments (40-60 years) and the cost of some of the low-carbon technologies. The policy complexity increases when balancing carbon reductions with energy security measures, competitiveness and other sustainability issues.

According to the IEA, US$ 11 trillion of investment is required by 2030, a four-fold increase from investment recorded in the second half of the 20th century. More than half of these investments are needed to improve transmission and distribution, which is critical for the successful integration of many clean technologies and maximizing the impact of energy-efficiency measures.

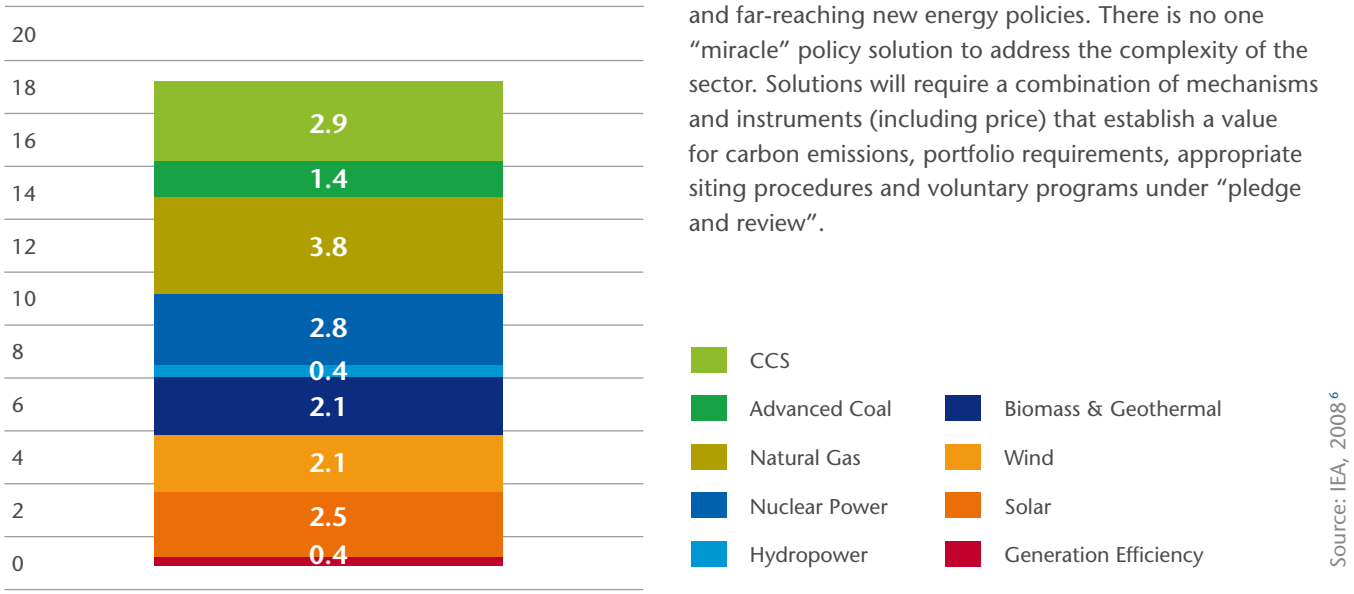


Figure 4: Power sector emission reductions in Blue Map scenario

While there is an urgent need to drive investment toward existing low-carbon technologies to avoid lock-in effects, many technologies have not reached maturity and require government support.

What does technology transfer mean for the power sector?

Electricity utilities normally buy the hard technologies from equipment manufacturers. The most important technology consideration for the utilities, once the decision to invest has been made, relates to engineering, construction management and operations and maintenance of plants, the availability of skills to use it (local, business but also institutional) and the need to ensure that an appropriate supporting infrastructure is in place. This includes a sufficiently resilient power grid consisting of transmission and distribution lines, power storage devices, metering, protection relays and overall supply-demand controlling systems.

What specific frameworks does the power sector need to increase technology transfer?

The power sector often operates in national or regional markets and, therefore, requires regionally tailored policy frameworks, resource availability and technology. However, the WBCSD Electricity Utilities Sector project identified commonalities when deploying certain technologies that require both domestic and international policy measures (figure 5).

Achieving 18 Gt CO_2 reductions will require radical action, technology breakthroughs and large-scale investment, in addition to the urgent implementation of unprecedented and far-reaching new energy policies. There is no one "miracle" policy solution to address the complexity of the sector. Solutions will require a combination of mechanisms and instruments (including price) that establish a value for carbon emissions, portfolio requirements, appropriate siting procedures and voluntary programs under "pledge and review".

To ensure widespread and effective low-carbon technology deployment, governments should:

- Commit to developing consistent and effective policy packages to deploy best available technologies, on both the supply and demand side. This could be done through national roadmaps for the power sector and technology needs assessments, which could include an identification of specific barriers.
- Streamline and enlarge the Clean Development Mechanism (CDM) as well as the definition of new economic mechanisms, which include mitigating technologies such as nuclear, large hydro and clean coal.
- Coordinate energy policies to help cross-fertilization between countries and foster deployment.
- Promote new regulations (or regulatory changes) in the host country (especially in emerging countries) aiming to evolve towards more efficient electricity pricing, as well as fostering international harmonization and standardization of frameworks and practices.
- Promote south-to-south business operations by recognizing that, in some cases, emerging countries may be a source, as well as a recipient, of new technology for developing and least developed countries.
- Enhance international cooperation to promote technology diffusion to encourage developing countries to mitigate emissions without jeopardizing growth. This includes international best practice sharing on regulatory and policy approaches, which could favor joint ventures that could play a positive role in transfer of know-how.

Low-carbon technologies are at different stages of maturity (figure 5) and require different policy responses depending on the technology status in the host country.

For technologies that are mature and competitive in developed countries, emerging economies and developing countries (e.g., hydro), efforts need to be focused on sharing knowledge (on project management, operations feedback, regulatory frameworks, etc.) and best practices.

For technologies at the brink of competitiveness (e.g., wind), there is a need for regulation to enable their effective market deployment, which include, among others: subsidy schemes (feed-in tariffs, renewable portfolio standards, etc.); streamlining administrative procedures; tax credits; efficiency standards; and appropriate electricity prices. In some countries, where these types of technologies already exist or are progressively being introduced, energy policies need to balance the accelerated descent of the learning curve with cost controls for the power system and the customers.

For technologies that are mature in developed countries, but not yet to the same extent in emerging economies and developing ones (e.g., ultra super critical boiler), the objective is to achieve significant cost reductions to reach competitiveness in the host country. For that, policies should be aimed at securing and encouraging foreign direct investment (FDI), joint-ventures and investments in CDM projects in partnership with local players.

The electricity sector is very fragmented, has a wider spectrum of technologies and national energy policies are closely integrated into its decision-making processes. An electricity specific approach should be based on an understanding of:

- The electricity sector's challenges and perspectives, shared by all relevant stakeholders worldwide, including operators, public authorities, customers, national and international agencies, etc.
- The whole spectrum of technologies, their respective costs and maturity timeframes
- Policies that enable national authorities to improve a country's carbon intensity, in the short term through more efficient use of fossil fuels and, in the long-run through a decarbonized electricity mix by identifying best available mitigating technologies (nuclear, large hydro and other renewable, clean coal, more efficient thermal plants, etc.)
- The cross-sector role of the power sector in realizing low-carbon economies through greater energy efficiency and substitution of conventional fossil fuel use at the end-user level (e.g., electrification in production processes, modal shift to rail transport and electric vehicles/plug-in hybrids, and heat pumps in buildings).

At national and international levels, the establishment of public policies based on this common vision and understanding can be built upon platforms for capacity building and exchange on best practices.

ELECTRICITY SECTOR STABILIZATION WEDGE	CHALLENGES	ROLE OF ELECTRIC UTILITIES
Generation efficiency – including combined heat and power (CHP)	• Inadequate O&M practices & lack of knowledge • Low cost of some fuels • Lack of relevant knowledge for identification & implementation of CHP schemes	• Maintain & improve efficiency of operating plants • Invest in higher efficiency options for new plants
Solar	• High cost of generated power • 'Not in my backyard" (NIMBY) attitude towards new sites • Variability & predictability of power generation & its impact on the grid	• Collaborate on R&D of new technologies • Test & demonstrate new technologies • Invest in multi-MW systems
Wind	• High cost of generated power • "Not in my backyard" (NIMBY) attitude towards new sites • Variability & predictability of power generation & its impact on the grid	• Integrate large scale variable output wind farms • Provide backup power & stability for the grid under the guaranteed scheme for incremental cost recovery
Biomass & geothermal	• High cost relative to conventional energy	• Cooperate on assessments of resource strength & reliability
Hydropower	• In developing countries (which have substantial resource potential), high capital cost for large projects & limited financing resources • Shared concerns about social & environmental impacts	• Extend the power grid to remote facilities • Implement & share best practices for sustainability
Nuclear Power	• Maintaining, ensuring & deploying a safety culture • Public acceptance & NIMBY syndrome • Uncertainty in licensing & procedures leading to excessive construction cost & delay	• Operate safely & transparently • Invest in capital-intensive new plant projects for the long-term
Natural Gas	• Rising cost of natural gas • Tight gas supply market • NIMBY attitude towards new LNG infrastructure	• Invest in/operate CCGT where gas is available & affordable
T&D	• Lack of incentive for investment • Unclear division of responsibility for the integration of renewables & distributed resources • NIMBY syndrome towards new T&D infrastructures	• Invest in grid expansion & reinforcement

Figure 5: Challenges and enabling frameworks for technology diffusion

ENABLING FRAMEWORKS FOR TECHNOLOGY DIFFUSION	
DOMESTIC POLICIES & MEASURES	**INTERNATIONAL POLICIES AND MEASURES**
• Set guidelines & clear incentives for higher efficiency • Develop & promote programs for energy audits & optimization of O&M	• Provide platforms for transfer of knowledge & best practice • Develop efficiency & operational guidelines for new plants • Introduce programmatic international flexibility mechanisms for improvement of generation efficiency
• Assess resource availability, reliability & costs • Set achievable national targets • Provide for grid access & offtake provisions	• Set up programmatic international flexibility mechanisms for distributed solar
• Set achievable national targets • Assess resource availability, reliability & costs • Provide for grid access & offtake provisions • Invest in R&D for utility-scale electricity storage	
• Assess resource availability, reliability & costs • Provide for grid access & offtake provisions	
• Develop a reliable institutional framework in the energy & water sector • Engage stakeholders on sustainability considerations • Streamline permitting process • Extend the grid to remote facilities • Support climate modeling & forecasting to help optimize development & operation	• Enhance opportunities for sustainable large hydropower within international flexibility mechanisms • Promote uptake of International Hydropower Association Assessment Guidelines
• Establish an independent safety authority & promote safety culture & stakeholder consultation • Clarify & streamline licensing & permitting procedures • Take relevant legal decisions with respect to long-term management of waste	• Recognize within the international flexibility mechanisms • Integrate technology transfer in nuclear power development agreements • Foster international cooperation & standards on safety, waste management, & non-proliferation
• Provide a clear regulatory framework for liquefied natural gas (LNG) & identify suitable locations for receiving terminals • Promote long-term predictability & stability in prices & delivery of natural gas • Provide guidance on the best opportunities for CHP	
• Adopt clear policy with adequate return on investment in regulated T&D infrastructure, & incentives for superior reliability & efficiency • Establish clear roles & responsibilities for integration of renewables & distributed resources, & provision on backup power	

Source: WBCSD, 2008[7]

Cement

Why is the cement sector important in mitigation strategies?

The cement sector is responsible for approximately 5% of current global anthropogenic CO_2 emissions. As a result of population growth and increasing urbanization around the world, demand for concrete, the end product of cement manufacture, is growing. In response, cement production is expected to double by 2050, particularly in developing countries (IEA, 2008). No alternative to concrete is envisaged at a sufficient scale for at least the coming decade. Yet about 60% of CO_2 emissions from cement production result from limestone calcination in the cement kiln – a process that cannot be replaced by existing technology.

The WBCSD Cement Sustainability Initiative (CSI) has shown that mitigation progress can be made through sector collaboration. The CSI is currently working with governments and international organizations to identify how they could effectively advance their own technology for emissions reductions. This includes modeling a sector-wide approach to emissions reductions.

What does technology transfer diffusion mean for the cement sector?

Technology diffusion in the cement sector is straightforward. Firstly, the equipment used is well understood across the sector and many companies use the same equipment suppliers. China currently supplies about 30% of the global demand for cement-making equipment. Often, developing countries have more modern kilns using cleaner technology than developed countries due to the long life-span of older cement kilns (50-70 years). For the cement sector, technology diffusion also includes operational know-how which is less easily shared between companies due to anti-trust laws and confidentiality concerns. The CSI has helped facilitate this kind of interchange where legally permissible; including sharing understanding of effective policy frameworks based on successful mitigation strategies in specific regions.

What specific frameworks does the cement sector need to increase technology transfer?

Developing countries often have modern and cleaner technology than many developed countries. However, diffusion of knowledge about key levers for CO_2 emissions reductions should be facilitated in all regions of the world. Each lever requires a specific focus and policy framework,

which together can enable the sector to greatly reduce its process emissions, as in the past decades. For example, between 1990 and 2006, cement production from the 18 members of the WBCSD CSI grew by 53%, whereas corresponding absolute CO_2 emissions grew by only 35%. This resulted mainly from increased energy efficiency, use of alternative fuels, and production of blended cements (i.e., cement with a reduced clinker factor).

Cement companies believe that technology diffusion could be enhanced in the sector with the following elements:[8]

- Overcome sector barriers to implementation: A wide range of energy efficient technologies are already available, but:
  - High investment costs and long lifetimes for older equipment are often a barrier to implementation
  - Energy price subsidies reduce or hide the economic impact of energy inefficiencies and can act as a barrier to energy efficiency technologies being implemented
  - Broader implementation is possible through well-known project support policy instruments, even when investment is not economically justified.

BUSINESS CASE 1

Overcoming barriers to alternative fuel use

A good example of overcoming barriers to alternative fuel use in the cement industry is the European Waste Incineration Directive, or the Norwegian National Waste Policy, where cement kilns are the preferred method for hazardous waste management. Such policy-based initiatives can help stakeholder and public understanding of the role of alternative fuel use in emissions reductions.

To advance alternative fuel use (co-processing) in regions where uptake was low, Holcim and GTZ developed a strategic alliance in 2003. Together, they developed guidelines on co-processing, including basic rules and principles for industry and local authorities, and have run training workshops for policy-makers from across the world. Alternative fuel use has successfully advanced in various countries, including the Philippines and Costa Rica, because the local framework has effectively supported it. Much can be learned from this alliance's experience related to alternative fuel use but also the process of collaborating together to share good practice around the world.

BUSINESS CASE 2

Joint R&D on carbon capture and storage

Some examples of progress on carbon capture and storage (CCS) development in the cement sector exist, for example the European Cement Research Academy (ECRA), funded by its company members who are all cement manufacturers. ECRA is currently mid-way through a research and demonstration project for CCS in the cement industry. CEMEX has also received funding support for exploration of a pilot project for carbon capture at a plant in the USA.

- Develop international standards: Governments should develop international standards for energy efficiency and CO_2 emissions in the cement sector. In some countries, governments must develop new, or revise existing, cement standards and codes to allow more widespread use of blended cement (e.g., basing standards on performance rather than composition) and include newly emerging cements and hydraulic binders, ensuring they are accepted by local authorities.
- Share best practices: It is crucial to share best practice policies on the promotion of energy efficiency and CO_2 emissions reductions in the cement industry. For example the Asia Pacific Partnership's Centre of Excellence in Beijing focuses on technology diffusion and capacity building. Governments can promote international training events with national standardization bodies and accreditation institutes to exchange experiences on concrete standards, long-term performance of new cements, and environmental and economic impacts.
- Monitoring, Reporting and Verification (MRV): Data monitoring of technological advances is essential to understanding the sector's history and potential for emissions reductions.
  - Industries should be encouraged to gather sector-wide energy use and emissions data; this can be used to track performance, identify regional and national performance gaps and best practice benchmarks
  - Government-industry collaboration within the UNFCCC process must continue to explore key elements for successful frameworks will be crucial in the near future
  - There is good industry understanding of how alternative fuels can lead to emissions reductions in this sector. However, appropriate legislative and regulatory frameworks are also necessary to strengthen environmental authorities' capacities for monitoring and enforcement.

Road transport

Why is road transport important in mitigation strategies?

Transport is a key enabler for economic development and globalization. Giving access to mobility options is crucial to enable people to participate in economic and social activity. This is even more the case in an increasingly globalized world, where the exchange of goods and people is becoming ever more important. Therefore, road transportation activity, both in terms of passenger and freight, is projected to increase substantially in the decades ahead. Following current trends would mean the GHG emissions from road transport would increase by 80% by 2050 according to IEA projections.

A major share of this growth is due to fast economic development in emerging economies. In these countries large parts of the population are just starting to use motorized transport options or switching from 2-wheelers to cars. Putting these countries on a low-carbon development path for transportation is crucial in a global strategy for reducing GHG emissions.

What does technology transfer mean for road vehicles?

In order to reduce GHG emissions from road transport there are four factors that need to be addressed simultaneously, as can be seen en figure 6: improve fuel efficiency; reduce travelling coefficient; lower emission factors; and reduce total distance travelled.

An integrated approach is needed where all relevant stakeholders cooperate in concerted efforts to reduce CO_2 emissions in the most cost-effective way. Substantial and cost effective reductions in road CO_2 emissions can only be delivered if all stakeholders are involved – these include the automotive industry and its suppliers, the fuel industry, policy-makers and infrastructure providers, car buyers and users, etc. Vehicle manufacturers develop and deploy fuel-efficient technologies; fuel producers are responsible for providing appropriate fuels; business and consumers influence transport emissions when deciding on the transport mode, purchasing low-carbon vehicles or changing their driving behavior (e.g., eco-driving). Road infrastructure design and intelligent transport systems can improve overall transport efficiency. The role of policy-makers is to integrate all those measures when they formulate and implement road transport policy.

Following the logic above, technology transfer for the road transport sector means deploying vehicle technology, fuel production and distribution technology, infrastructure technology as well as technologies that help business and consumer to use vehicles in a more efficient way (for example GPS systems and ITS applications, Gear Shift Indicators or Cruise Control Systems) at a faster rate.

Here we mainly focus on ways to speed up the deployment of vehicle technology in emerging and developing countries.

The car and truck industry is global in its nature. It is a very concentrated industry and exposed to global competition. For example, five companies, active in all world regions, delivered 50% of annual global motor production (IEA;

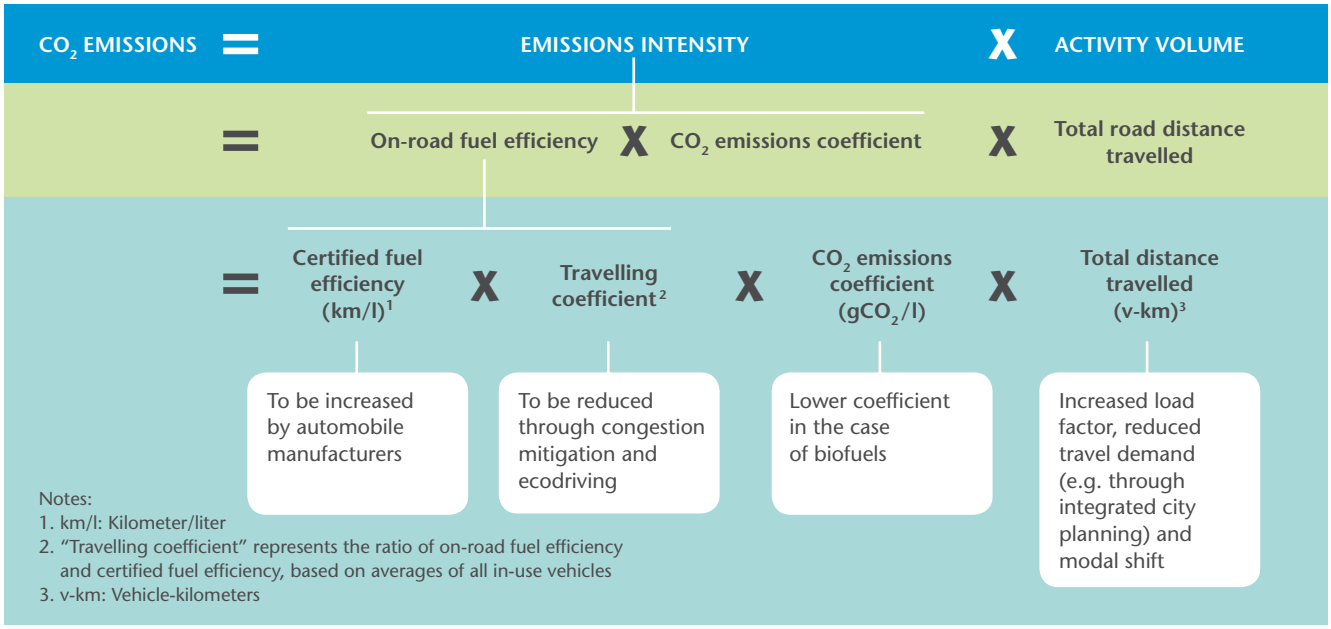


Figure 6: Decomposition of CO_2 emissions from road transport

WEO 2008). Due to the decentralized nature of car and component production, final products are produced for local and global markets. Technology transfer in the car sector means the deployment of innovative products in the emerging markets with little or no delay compared to developed country markets.

To some extent, vehicles are designed individually for the various markets (this trend will be reinforced in the future) to best meet local mobility demands. However, technologies for reducing carbon intensity are quite universal: increasing drive-train efficiency; reducing weight; improving the efficiency of additional devices like air conditioning; switching to alternative, low-carbon energy carriers like electricity. Enabling frameworks can help speed up the development and deployment of these technologies, especially in emerging and developing countries.

What specific frameworks do road vehicles need to increase technology transfer?

Besides the transfer of car technology, there is also a need to diffuse the production technology for clean cars. This occurs mainly within multinational companies in countries with existing manufacturing plants. The challenge is the creation of a market for low-carbon technologies in developing countries, which requires international and national policies that include the following elements:*

* In this document we are focusing on technology transfer to developing countries. However most of these recommendations are aplicable and needed in developed countries that should move faster in the implementation of new technologies.

- Data collecting requirements: Road transport-related statistical data is often not available. In order to balance the various elements of an integrated approach (vehicle, fuel and infrastructure) in the most cost-effective way, measuring, reporting and verifying data is essential. Therefore it is recommended to collect and generate relevant road transport statistical data, especially in emerging and developing countries.

- Global harmonization of regulations and standards is necessary because vehicle manufacturers operate globally. Governments should follow the same methodology for setting emissions limits for CO_2 and local pollutants. The level of stringency would have to take into account the country's capabilities and circumstances. Generally, regulations should be technology neutral, setting the targets, but allowing companies to find the best and most cost effective solution to meet those targets. This requires:

  – Harmonizing test procedures for measuring vehicle emissions, which today differ widely between the various markets; the UNECE is currently working on a Worldwide Harmonized Light vehicles Test Procedure (WLTP)[9]

  – Harmonizing method of defining targets or limits, e.g. using a physical parameter like weight for defining the CO_2 emissions limit for vehicles.

  – Accompanying regulations with thorough impact assessments, anticipating the costs and benefits of the planned regulation. Aspirational long-term goals should be set with concrete near-term targets, including review steps along the way to adjust targets with respect to technological and overall development.

– Standardizing innovative concepts like electric vehicles or fuel cell vehicles. Global agreement on the design for charging or refueling infrastructure reduces costs for local adaptation and ensures interoperability.

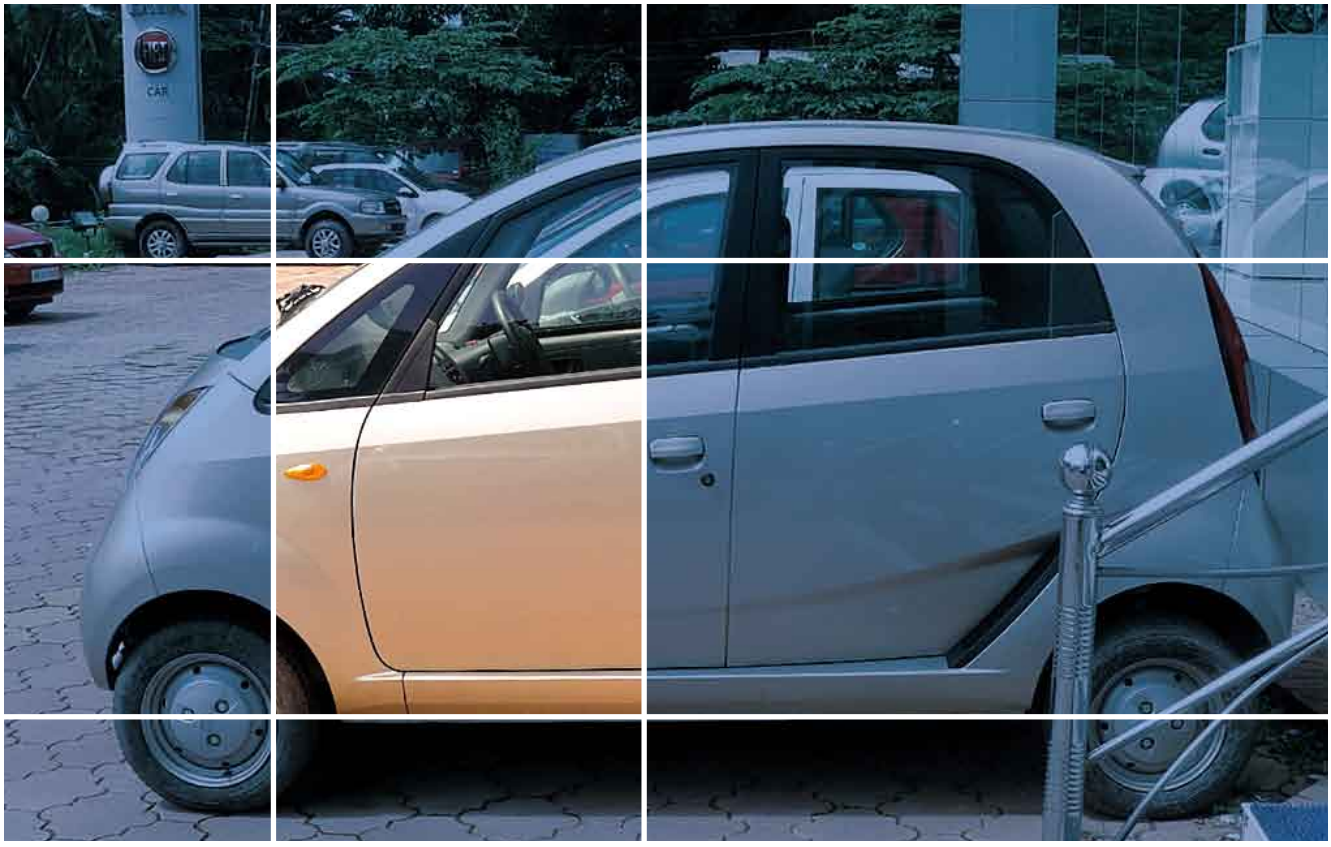
– Adopting safety and environmental regulations for new technologies and harmonizing them as much as possible, because they frequently appear as minor, but become important barriers for low-carbon technology deployment.

With all the above, companies developing vehicle technologies or alternative fuels (ethanol, biodiesel, hydrogen) could focus on their preferred technology routes without the need to multiply their investment in developing products and adapting to each market regulation separately.

- An appropriate infrastructure and regulatory environment needs to be in place to take advantage of innovative technologies. An important issue for realizing efficiency gains from optimized combustion engines is the spatially inclusive and comprehensive availability of high quality fuels, which is currently only available in developed countries. For many technologies that increase safety, traffic flow and overall efficiency, appropriate infrastructure needs to be available. In efforts to make cities low-carbon areas, and especially in urban areas where significant population influxes are projected, effective road congestion-mitigation measures, including road network development and intelligent transportation system (ITS) applications should be integrated into city planning initiatives from their earliest stage. This starts with simple prerequisites, well maintained roads, ICT infrastructure for car-to-car and car-to-infrastructure (C2X) communication, high quality traffic management, etc. Sharing best practices, capacity building and appropriate funding are important.

- Early deployment of projects and public acceptance of new technologies is very important when products are chosen by consumers and businesses. Public support in promoting new technologies, like plug-in hybrids electric vehicles (PHEV) or electric vehicles (EV) is indispensable. Large-scale, early deployment projects are important to showcase the viability of these technologies. Early deployment is critical for raising public awareness and acceptance by business and consumers and gaining experience by manufacturers and public authorities.

  However these projects are capital intensive, because they require that a substantial number of proto-type vehicles be manufactured manually. Public funding should focus on early technology deployment, because the preceding development phase is usually covered by the companies themselves as part of their strategy and implies competitiveness concerns.



Given that business-oriented transfer for both products and technologies is already taking place through licensing, joint ventures and plant transfer, intellectual property rights cannot be barriers to technology transfer for the road transport sector. Open markets, fair trade and competition rules and, in particular, the protection of intellectual property rights are essential for technology diffusion. Companies will only be able to invest in R&D if they earn sufficient cash flow from current technologies and have adequate return on investment prospects for next generation technologies. Breaking this cycle would slow down substantially innovation.

A broad product portfolio is also needed because it allows manufacturers to introduce innovations in the premium sector with a solid business case. Higher costs should be reduced when these technologies are diffused into more price-sensitive volume segments. This benefits customers and the environment.

- Overcoming up front investments barriers: Technology diffusion has always taken place in the automobile sector. UN regulations contributed to this development by enabling mutual recognition of technical standards (including product certifications) and support for global harmonization. Furthermore, trade liberalization made significant steps forward leading to a global harmonization of technology availability in developed and developing countries. However, technology deployment could be accelerated if the affordability issue is addressed. Favorable framework conditions should enable customers to buy more sustainable technologies. Technologies that outperform mandatory rules could be incentivized, thus accelerating their adoption and deployment.

A major barrier for efficient vehicles is the higher upfront investment cost. Even if this initial investment is paid back over the lifetime of the car, consumers are often discouraged by the higher car price. This is especially true in emerging markets, where many consumers are acquiring their first car, thus making a qualitative change in their mobility, and are not willing to wait until they can afford to buy a more efficient car. They want to make this step change as soon as possible.

Innovative financing options could help to overcome this barrier. Options include low interest rates, sponsored leasing contracts, payback by fuel saved, etc. Close cooperation between private banks, dealers and climate funds is necessary in order to bring these benefits and solutions to consumers, taking into account the specific processes and circumstances of the car market in contrast to buildings or other consumer goods.

Buildings

Why are buildings important in mitigation strategies?

Approximately 40% of most countries' energy consumption happens in buildings. This rises to 50% if the energy use in manufacturing materials and construction is included. This energy consumption will grow rapidly in developing countries because of the rapid growth in the number of buildings to accommodate growing populations. Urbanization exacerbates this trend because urban dwellings tend to be more energy-intensive than in the countryside.

What does technology transfer mean in buildings?

Some aspects of technology transfer will increase energy use as developing country populations gain access to additional technologies and equipment. This makes the transfer of efficient technologies even more important. The characteristics of the building sector imply the use of various technologies in an integrated design rather than installing them individually. Specific low-energy technologies suitable for transfer include heating, ventilation and air conditioning (HVAC), lighting, insulation, micro-generation and smart electricity grid applications. Services are at least as important as hard technologies, especially design skills, because passive measures (such as material selection and the use of natural ventilation, light and shade) are crucial to reduce energy needs.

What specific frameworks does the building sector need to increase technology transfer?

An energy-efficient building sector requires inter-related frameworks to stimulate appropriate market responses underpinned by government actions. Effective regulation and market interventions are essential to creating a context, a culture and a skill base that will support energy-efficient solutions. Subsidies and regulations are likely to be necessary to kick-start the market.

- Institutional frameworks: The market needs the right institutional frameworks to deliver energy-efficient buildings in sufficient numbers.
  - Regulations, building codes and standards are necessary to prescribe minimum acceptable levels of energy efficiency in the same way that they dictate safety requirements in most countries.

– Regulations need to cover whole building performance as well as minimum performance standards for individual technologies and equipment.

– Transparency on building energy performance will help to create demand but will only occur widely if mandated by the authorities.

– The Top Runners program in Japan is an example of a mandated system that drives up performance through the market.

- Market conditions: The costs of energy and of energy-efficient technology are crucial determinants of the speed with which low-energy buildings are introduced. Subsidies and price signals will be needed to incentivize investments and especially to overcome the "first cost syndrome" which leads to an excessive concentration on initial costs instead of savings over time.

  – Access to the markets is necessary to ensure that technology is available and implemented effectively.

  – Prospects for growth must be promising for businesses to be prepared to invest in a country on a sufficient scale to make the substantial difference that is necessary to achieve transformation of energy in buildings.

  – Low-cost but inefficient local designs and technologies must not create barriers to the transfer of alternatives meeting higher standards.

  – Market development can be stimulated by interventions such as subsidies for low-carbon energy and technologies and generous feed-in tariffs for on-site generation.

  – Public finance may be required to complement private investment required to retrofit large numbers of properties.

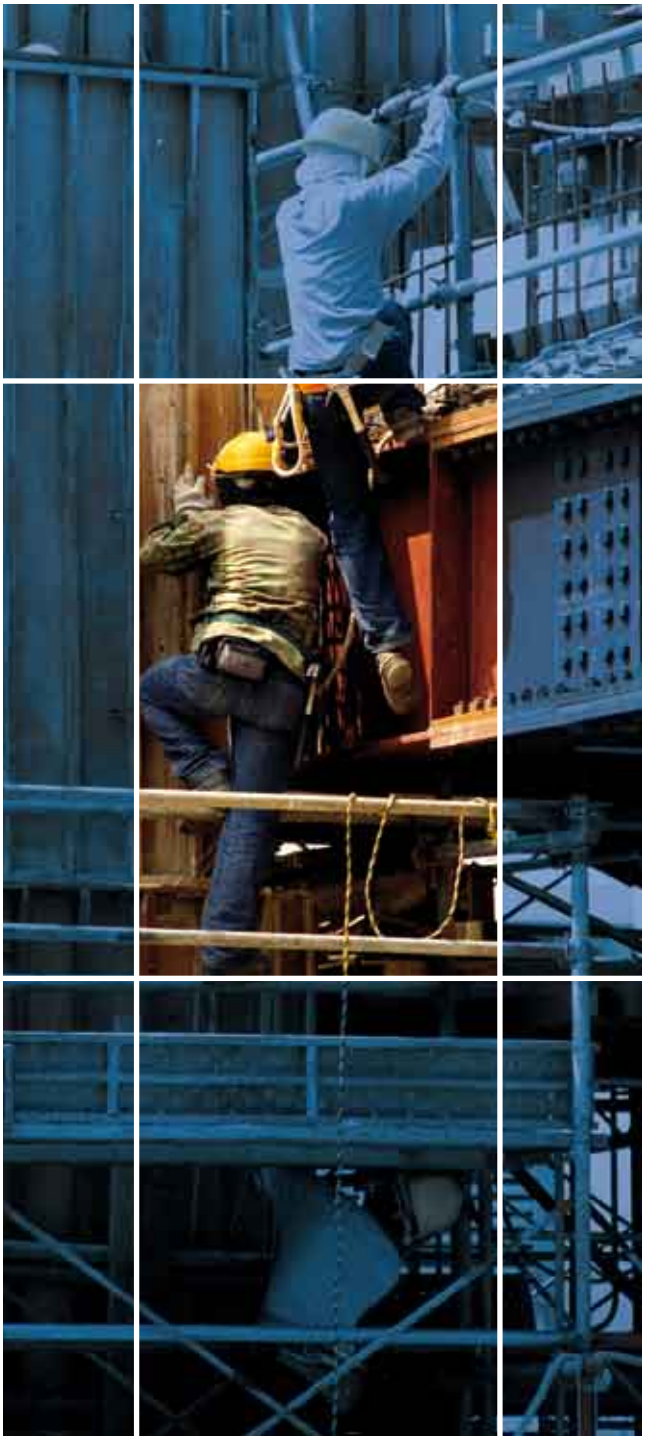
- Relationships in the building sector: An integrated design process is necessary, involving all relevant participants from the start, to create energy-efficient buildings.

  – Integration is needed to bridge the gap between building owners' concentration on cost and users' desire for energy efficiency.

  – It is also essential to overcome the fragmentation in the building supply chain and bring together designers, suppliers and contractors in an effective project team.

- Capacity building: Constructing energy-efficient new buildings and retrofitting old ones on a large scale requires a wide range of skills to be widely available. Required skills range from design and construction to fitting advanced technology. Good understanding of energy-efficiency requirements is also essential in municipalities responsible for setting and applying building regulations.

- Culture change: Government authorities and others need to mount sustained campaigns to build an energy-aware culture that will stimulate the necessary awareness, interest and behavior changes without which energy-efficiency will not be achieved.



Sustainable forest products

Why is this sector important in mitigation strategies?

Sustainable forest management can provide a strong foundation for both climate mitigation and adaptation, because forests that are sustainably managed sequester, store and recycle atmospheric carbon (WBCSD, SFPI, 2007).[10] Addressing the direct drivers of deforestation and degradation in developing countries – primarily permanent conversion of forests to agriculture or biofuel crops – and creating incentives for forest conservation, sustainable management of forests, and enhancement of forest carbon stocks through reducing emissions from deforestation and forest degradation (REDD plus mechanism), can deliver very significant carbon emission reductions (see figure 7). This can be done by:

- Bringing more of the world's forests under sustainable management can support expansion of markets for low-carbon and carbon neutral forest biomass energy;
- Considering harvested wood products (HWP) as a way to store carbon and avoid carbon emissions when substituted for more energy intensive and non renewable alternatives (see Box 1);
- Providing critical ecosystems services (such as water quantity and quality), which contribute to climate adaptation and the transition to a low-carbon and more resource-efficient economy.

With the right policy frameworks and incentives, the sustainable forest products industry (SFPI) can increase its contribution to mitigation through sustainable forest management practices; growing markets for wood products, paper and biomass energy from sustainably managed sources; increasing its capture and use of recycled fiber for products and energy; and improving energy efficiency and uptake of new technology solutions throughout its value chain.

BUSINESS CASE 3

Carbon benefits of harvested wood products

Harvested wood products (HWP) from forests that are sustainably managed already contribute to climate mitigation through:[12]

- Carbon sequestered or stored in wood-based and paper products, which represents an expanding net carbon sink. The National Council for Air and Stream Improvement (NCASI) estimates that globally, the amount of embodied carbon stored in production of wood- and paper-based products is around 350 million tonnes per year. Other sources estimate larger amounts. Miner and Perez-Garcia (2007)[13] estimate that the net amount of carbon stored in wood and paper-based products is increasing by 150 million tonnes per year – equivalent to removing 540 million tonnes of CO_2 from the atmosphere per year.
- Avoided emissions when substituted for more energy intensive materials. The University of Hamburg estimates that every cubic meter of wood substituted for fossil fuel-intensive material saves 2 tonnes of CO_2 emissions. A review of 20 studies (Sathre, R. and J. O'Connor, 2008)[14] concluded that each tonne of carbon in wood products substituted for non-wood products reduced carbon emissions by approximately two tonnes. This equals to roughly 3.7 t CO_2 equivalent emissions reduction per tonne of dry wood used, which is a reasonable estimate of the GHG mitigation efficiency of wood product use.

FOREST MITIGATION OPTION	CARBON POTENTIAL UNTIL 2030 (EMISSION REDUCTION OR SEQUESTRATION)
REDD	77 GtCO2e (3.76 GtCO2e per year)
Natural forest management of existing production forests	6.6 GtCO2e
Forest restoration	117 GtCO2 e
Total	**200.6 GtCO2e**

Source: The Forests Dialogue (TFD), 2009[11]

Figure 7: Mitigation size and scale of the REDD plus

What does technology transfer mean for the forest products industry?

Technology transfer means the expansion of sustainable forest management practices and sustainable forest products processing operations globally so as to fully recognize, incentivize and leverage the climate benefits of forests as well as the carbon benefits of wood, paper and biomass energy from sustainably managed forests.

What specific frameworks does the sustainable forest products industry need to increase technology transfer?

The enabling frameworks that could facilitate the expansion of sustainable forest practices include policies that:

- Encourage practice of sustainable forest management, primarily although not exclusively, in developing countries

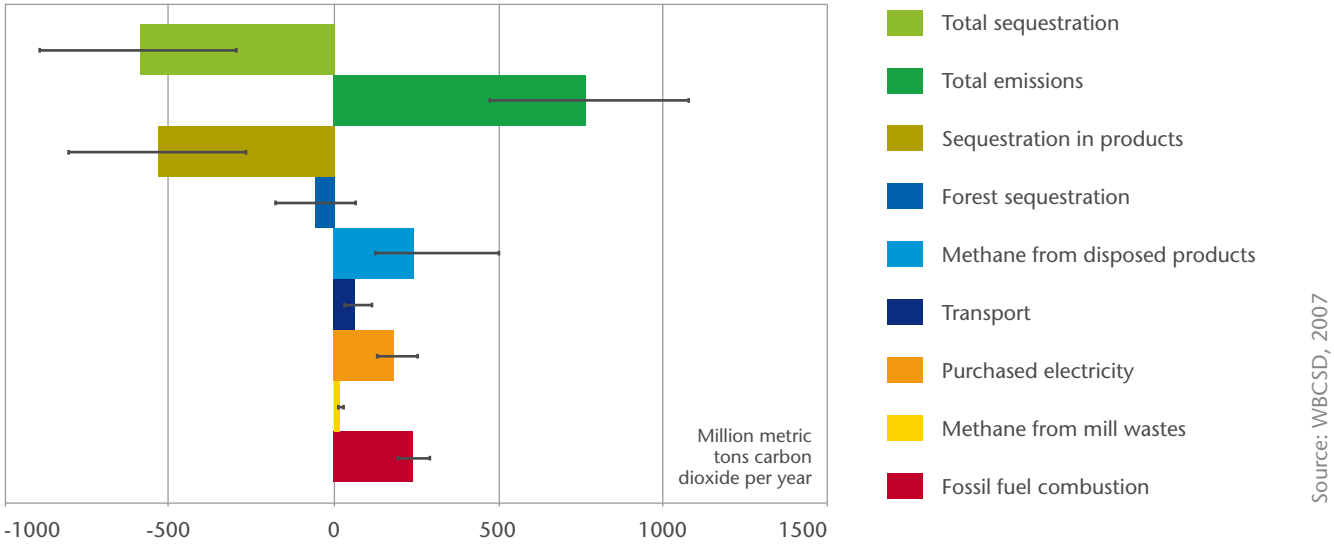


Figure 8: Carbon benefits for forest products[15]

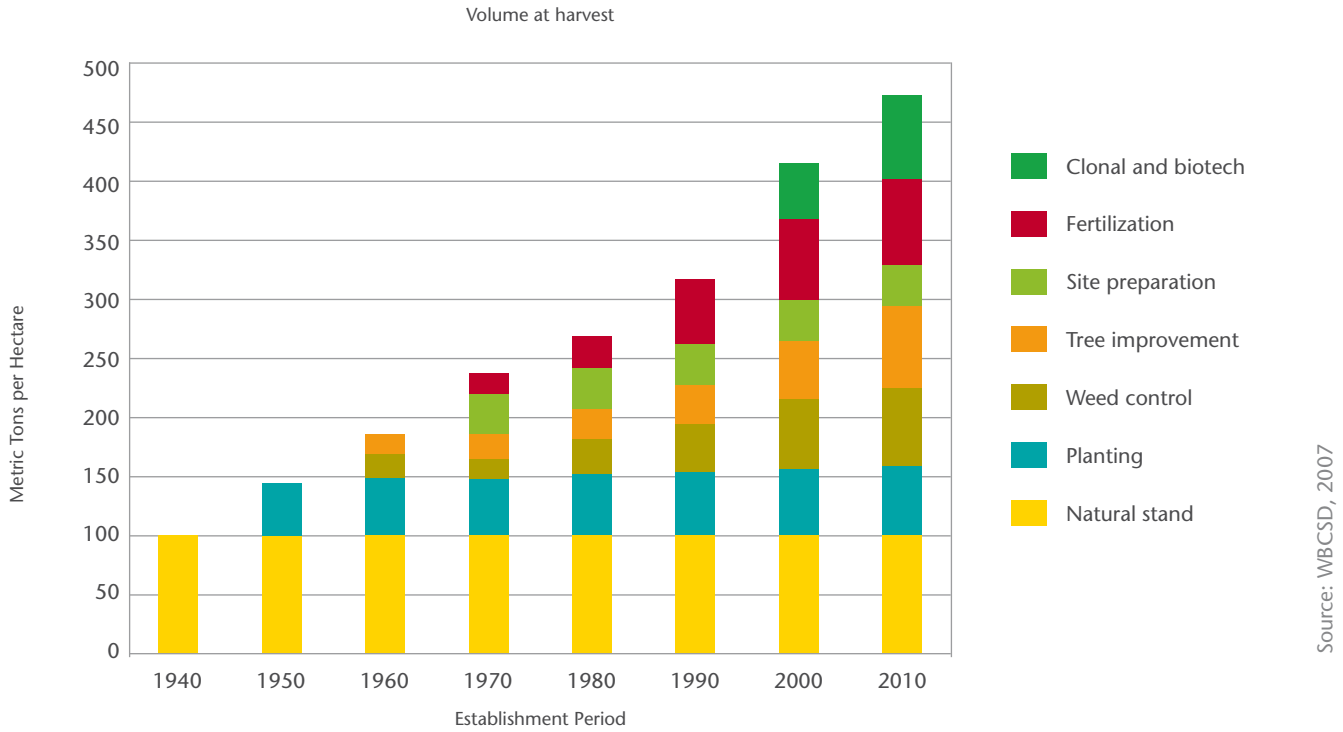


Figure 9: Role of sustainable forest management as a technology[17]

via a REDD mechanism. This includes establishing the appropriate deployment of intensively managed planted forests that maximize environmental and social benefits and increase fiber availability for products and energy on an eco-efficient and sustainable basis.

- Recognize and reward, where appropriate, resource managers for forest-based ecological services in addition to carbon sequestration. This could include water quality, erosion control, biodiversity habitat and recreational use
- Eliminate perverse subsidies on agricultural or bio-fuel crop production that primarily drive deforestation and degradation in developing countries[16]
- Avoid or eliminate large bio-fuel crop production subsidies that, in addition to contributing to forest degradation and conversion, distort markets and divert forest fiber from low-carbon/carbon neutral use in wood, paper and energy applications
- Promote research and practices that improve forest productivity, allowing sustainably managed forests to meet growing demand for fiber in the face of increased competition for productive land
- Adjust infrastructure policies for urban expansion, new roads and hydro power in order to reduce and mitigate direct deforestation and degradation impacts
- Develop and deploy biomass-based breakthrough technologies – such as biomass gasification – to make the sector energy self sufficient and a net energy supplier
- Remove existing regulatory barriers that discourage maximization of combined heat and power technology
- Include public and private sector procurement policies for wood, paper-based products and bio-mass energy. This should fully support suppliers using sustainably sourced fiber and allow them to fully leverage the carbon benefits, recyclability and renewability of this resource and this sector
- Encourage the appropriate use of sustainably produced wood products in buildings to realize wood products' carbon sequestration and low-carbon production benefits
- Encourage recycling and reuse of wood and paper-based products to extend the forest resource and sequestration time and minimize landfill methane emissions
- Encourage appropriate, region-specific land development practices that retain or increase tree cover that sequesters carbon and, in the urban context, mitigate temperature extremes
- Promote faster turnover of capital stock depreciation so improvements in energy and carbon intensity can be accelerated with the sustainable forest products industry.

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4. See note 2.

5. See note 2.

6. See note 1.

7. World Business Council for Sustainable Development (WBCSD), Power to Change, 2008.

8. See Cement Technology Roadmap 2009: Carbon Emissions Reductions up to 2050 (IEA/WBCSD, 2009) for more details.

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16. In addition to agriculture producing 13.5 % of global GHG emissions, land-use change primarily for agriculture produces a further 18.3 % of GHG emissions according to Inter-governmental Panel on Climate Change (IPCC) data.

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About **WBCSD**

The World Business Council for Sustainable Development (WBCSD) brings together some 200 international companies in a shared commitment to sustainable development through economic growth, ecological balance and social progress. Our members are drawn from more than 36 countries and 22 major industrial sectors. We also benefit from a global network of 60 national and regional business councils and partner organizations.

Our mission is to provide business leadership as a catalyst for change toward sustainable development, and to support the business license to operate, innovate and grow in a world increasingly shaped by sustainable development issues.

Our objectives include:

Business Leadership – to be a leading business advocate on sustainable development;

Policy Development – to help develop policies that create framework conditions for the business contribution to sustainable development;

The Business Case – to develop and promote the business case for sustainable development;

Best Practice – to demonstrate the business contribution to sustainable development and share best practices among members;

Global Outreach – to contribute to a sustainable future for developing nations and nations in transition.

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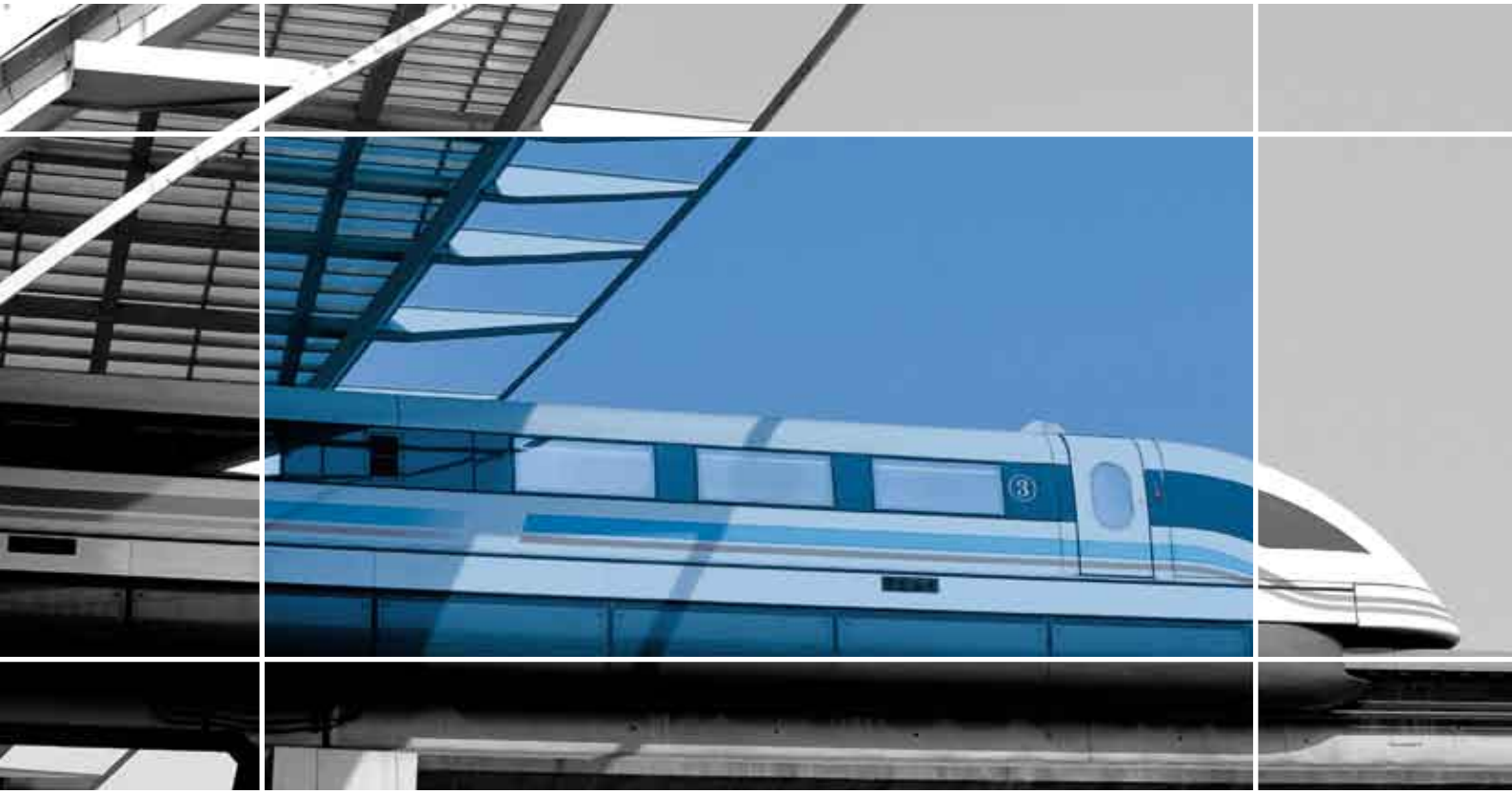

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