ICMM
International Council on Mining & Metals

Report

The cost of carbon pricing: competitiveness implications for the mining and metals industry

Climate Change
April 2013

Contents

Foreword

In October 2010, ICMM's Council of CEOs approved the establishment of a new program of activities aimed at the climate change issue. The program would have at its core the idea of championing a "principle-based" approach to guide developing climate change policies, regulations and laws. In addition, it would establish ICMM as a "thought leader" in certain key topics. The following year, they approved a set of seven principles for climate change policy designed to guide the development of effective and efficient national and sub-national climate change approaches that contribute to sustainable development while remaining competitive in a low carbon economy.

The cost of carbon pricing: competitiveness implications for the mining and metals industry is one of a series of three reports that describe our work in those areas over the last two years. The other publications look at responding to the risks associated with the physical impacts of climate change and examine options for revenue recycling out of carbon pricing policies.

We recognize that it is the right of governments to set their own specific targets, policies and measures to manage their emissions. That said, this report demonstrates that careful consideration in both design and implementation phases is required for such policies and measures to be both environmentally and economically effective.

This report includes a survey of the current policy environment in select regions, new research on the quantitative impacts of climate change on four commodities in different carbon pricing regions and also provides an assessment of these current policies against ICMM's *Principles for climate change policy design.*

ICMM and its members are committed to playing a constructive and substantive role in the ongoing climate change policy dialogue. This report is a demonstration of that commitment.

Ultimately, our aim is to ensure that we strengthen our contribution to sustainable development by playing our part in addressing the climate change challenge, while at the same time securing the continued competitiveness of the mining and metals industry.

R Anthony Hodge
President, ICMM

Executive summary

The objective of this report is to assess how best to develop carbon pricing policies that achieve a transition to a low carbon economy without compromising the ability of national industries to compete internationally. The assessment is based on a survey of the current policy environment, new research quantifying the impacts of climate change policies on member companies, a series of interviews with members[1] and an assessment of policies based on ICMM's *Principles for climate change policy design*.

ICMM member companies have interests at some 800 sites in over 60 countries across the globe, not including exploration activities. These interests include the extraction of raw materials, subsequent processing and refining of these materials in a range of processes and the production of end products for sale in local and international markets. Between them, ICMM member companies produce metallic and non-metallic outputs that account for around 20 per cent of the value of global mining production.

The geographic regions analyzed include the European Union (EU), South Africa, Australia, Canada and the US, as well as sub-national jurisdictions within the US and Canada, namely California, Quebec and British Columbia. These are regions where ICMM member companies have a significant production presence and where there are climate policies currently in place or under development.[2]

Four commodities are included in the analysis: iron ore, copper, aluminium and coal. These commodities encompass a range of widely produced and used outputs and a variety of extraction and production techniques in a number of locations globally. The analysis on iron ore and coal focuses on upstream; the analysis of aluminium focuses on the smelting process; and the analysis of copper covers both mining and refining processes to show the impact of carbon pricing on financial metrics for both upstream and downstream processes. Many of the lessons drawn from the analysis are applicable to the mining and metals industry as a whole.

Carbon pricing policy

Recent years have seen an increase in the number of carbon pricing systems that have been proposed or implemented. The type of policy mechanism – carbon trading or carbon taxation – and its design differs across jurisdictions, which may present a risk to industry competitiveness as carbon costs will not be equivalent. Multinational companies may face a range of different carbon costs, different costs for complying with other direct regulations and will also need to comply with different operational requirements and monitoring and reporting practices, again adding costs.

Table 1 indicates that, at least for the mining and metals sector, the world of carbon policy and pricing is extremely heterogeneous with different rules for coverage and pricing in each scheme.

"Recent years have seen an increase in the number of carbon pricing systems that have been proposed or implemented. The type of policy mechanism – carbon trading or carbon taxation – and its design differs across jurisdictions, which may present a risk to industry competitiveness as carbon costs will not be equivalent."

1 This report uses quotes from interviews with member companies for illustrative purposes. The quotes have not been identified with the interviewee and are not representative of the views of a sector or of ICMM member companies more generally.

2 Alberta established a carbon pricing system in 2007. Due to limited production interests of ICMM members in the province, the system is not part of the quantitative analysis presented in Section 2, but is included in the analysis throughout the rest of the document due to its interesting design features.

Table 1: **Coverage of carbon pricing policy relevant to the mining and metals industry (gases, thresholds and emissions sources)**

Carbon pricing policy	Gases, thresholds and emissions sources
Australia carbon pricing mechanism	Covered where emissions from the following activities exceed 25kt per annum: • stationary energy sources, eg on-site power generation • industrial process emissions, eg emission of perfluorocarbons (PFCs) in aluminium production • fugitive emissions from operational mines • emissions from waste and waste water, eg emissions from on-site landfill. The list of liable entities published by the Clean Energy Regulator in June 2012 included over 80 (out of 294) entities engaged in mining and metals industries.
South Africa	Not yet determined, but indications are that it is likely to cover mining and metals.
EU emissions trading system	Production and processing of ferrous metals is one of the sectors explicitly captured under the EU emissions trading system. Facilities that include a combustion installation with a thermal input above 20 MW are also included. As of Phase III, CO_2 from the primary production of aluminium and PFCs from the aluminium sector will also be included.
Quebec emissions trading system	Covered where emissions exceed 25kt per annum.
British Columbia carbon tax	Fossil fuel purchases by the sector covered.
Canada regulation	Not currently regulated.
California emissions trading system	Covered where emissions exceed 25kt per annum. An initial list of liable entities identified six companies operating in the areas of steel and iron production, mineral mining and lime manufacture, and metals product manufacturing.
US regulation	Not currently regulated.

Addressing competitiveness and leakage

As Table 1 indicates, pricing policies vary, as will costs for participants. This may lead to relocation of production and investment and the distortion of trade flows, particularly if industries are emissions intensive and trade exposed (EITE).

As a consequence, governments often introduce measures to compensate for higher costs that arise as a result of carbon pricing. These policies are listed in Table 2. The most frequently adopted approach seen in the systems under review is free allocation of allowances to industries that are most vulnerable. Other potential approaches include border adjustments (which have not been implemented to date), tax rebates and direct financial aid to industries. While these measures provide some compensation, they may not be adequate to overcome the competitive impact of pricing in certain sectors. The challenge is to identify a price signal that sufficiently protects industry while also serving as an incentive to reduce emissions in their operations. Indeed, in some cases there may be no room for a price signal due to other particular domestic circumstances, such as electricity costs, or acute international competitiveness pressures.

The diversity of the sector and differences in how EITE is defined means that similar activities are considered eligible for compensation in one system, and ineligible in another. Furthermore, the level of compensation provided is highly variable. Metals production is widely identified as an EITE industry in the systems that have been reviewed, particularly steel, iron and aluminium production. Mining activities are less commonly classified as an EITE industry although a number of systems do include mining activities. For example, Australia awards a higher level of compensation to integrated iron and steel manufacture than to production of iron ore pellets. These variations are a further source of differences in costs and competitiveness across industries and regions.

Table 2: **Policies to address competitiveness and leakage in the mining and metals sectors**

Policy	Mining	Metals
Australia carbon pricing mechanism	No assistance under the Jobs and Competitiveness Program (JCP). Specific assistance package for gassy coal mines set out in separate legislation.	Highly emissions-intensive activities receive free allowances equivalent to 94.5% of industry average carbon emissions (based on 2005–08) in the first year (2012/13), declining at the rate of 1.3% per annum thereafter; the industry average carbon emissions includes both Scope 1 emissions and Scope 2 emissions associated with purchased electricity use and steam. This includes zinc smelting, aluminium smelting, alumina refining, magnesia production, integrated iron and steel manufacturing, manufacture of carbon steel from cold ferrous feed, manganese production, production of fused alumina, copper production. Moderately emissions-intensive activities receive free allowances equivalent to 66% of industry average carbon costs in fixed-price period, declining at the rate of 1.3% per annum. This includes integrated production of lead and zinc, production of iron ore pellets, magnetite concentrate production. Specific assistance package for steel production and iron foundries.
South Africa – under discussion	Gassy coal mines will receive 10% uplift on tax-free threshold for high process emissions and a further 10% uplift for trade exposure. Offsets can be used for up to 5% of liability.	Iron and steel and aluminium will receive 10% uplift on tax-free threshold for high process emissions and a further 10% uplift for trade exposure. Offsets can be used for up to 5% of liability. Other sectors deemed to be highly trade exposed can receive 10% uplift on their tax-free threshold.
EU emissions trading system	In Phase III (2013–20), mining of hard coal, iron ores, non-ferrous metal ores and other mining and quarrying activities will receive benchmarked free allowances covering a large portion of their emissions (depending on efficiency).	In Phase III, identified activities will receive benchmarked free allowances covering a large portion of their emissions (depending on efficiency). Potential for additional assistance in relation to higher electricity costs resulting from carbon pricing under the framework for state aid.
Quebec emissions trading system	Identified activities will receive benchmarked free allowances when the system begins in 2013. Revenue recycling will include some allocation to energy efficiency technologies in the industrial sector.	Activities identified will receive benchmarked free allowances when the system begins in 2013. Revenue recycling will include some allocation to energy efficiency technologies in the industrial sector.
British Columbia carbon tax	General corporate tax reductions.	General corporate tax reductions.
California emissions trading system	Mining and manufacturing of soda ash and diatomaceous earth mining will receive free allowances in line with highly emissions-intensive activities.	Steel production using electric arc furnace, hot rolled steel sheet production, coke calcining will receive free allowances in line with highly emissions-intensive activities (see Table 6). Picked steel sheet production, cold rolled and annealed steel sheet production, galvanized steel sheet production, tin steel plate production, secondary smelting and alloying of aluminium, secondary smelting, refining and alloying of non-ferrous metal (except copper and aluminium), iron foundries will receive free allowances in line with moderately emissions-intensive activities (see Table 6).

Quantitative analysis of systems

The quantitative analysis evaluates the impact of carbon pricing policies on key financial metrics for the mining and metals industry, including sales; capital spent; a measure of profit whereby earnings before interest, taxes, depreciation and amortization (EBITDA) are used; and cash costs (defined as a company's sales (revenue)) minus EBITDA. Only publicly available information has been used and inferences are only made when directly supported by the evidence.[3]

Illustrative results for each of the four commodities considered are shown in Figures 1–4, which compare carbon costs – based on levels set out in legislation or recent carbon market analyses – to the selected financial indicators. General inferences from the quantitative analysis are:

- As prices or tax levels increase, the scale of potential impact increases and the impacts become increasingly divergent between regions, largely due to differences in the electricity-generating mix.
- The inclusion or exclusion of a sector from compensation measures will strongly influence the cost impact of pricing on the bottom line.
- There is the potential for large variations on the impact of financial metrics from year to year, particularly for globally traded commodities.

Aluminium and copper production (see Figures 1 and 2) are both electricity-intensive industries. The impact of emissions reductions policies is likely to be acute if power generation is included and/or the electricity generation type emits high levels of greenhouse gases (GHGs). Analysis suggests if all costs are passed through to aluminium producers, carbon costs can be as high as 70 per cent of EBITDA. For aluminium, potential impacts are considerably lower if renewable electricity is purchased rather than electricity with a grid-based average carbon intensity. Compensation measures significantly reduce costs, except in British Columbia and in the EU, when grid-based electricity is consumed. A similar pattern of results is seen for copper, except that the difference in potential impacts between grid electricity and renewables is much less pronounced.

The impact of emissions reductions policies on iron ore mining is likely to be lower due to its relatively low emissions intensity. Emissions mainly arise from the combustion of oil products. Figure 3 shows that the potential impact of carbon costs, without any compensation, is less than 1 per cent for all jurisdictions and all financial indicators except for total costs in British Columbia and for annual capex for all four jurisdictions. However, emissions intensity can vary across production sites and the policy impact can differ accordingly. The ranges on Figure 3 illustrate the variation that ICMM member companies have around these averages.

Figure 4 shows that the potential carbon costs for coal production are similar on average for the four jurisdictions where ICMM member companies have a significant share of production. However, coal production has a highly variable emissions intensity by mine, which depends on the product mined (metallurgical or thermal coal) and the type of mine (gassy or non-gassy mine).

> "The impact of emissions reductions policies is likely to be acute if power generation is included and/or the electricity generation type emits high levels of greenhouse gases."

3 A full description of the inputs and assumptions to the quantitative analysis can be found in Section 2.

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Figure 1: Carbon cost impacts on aluminium production

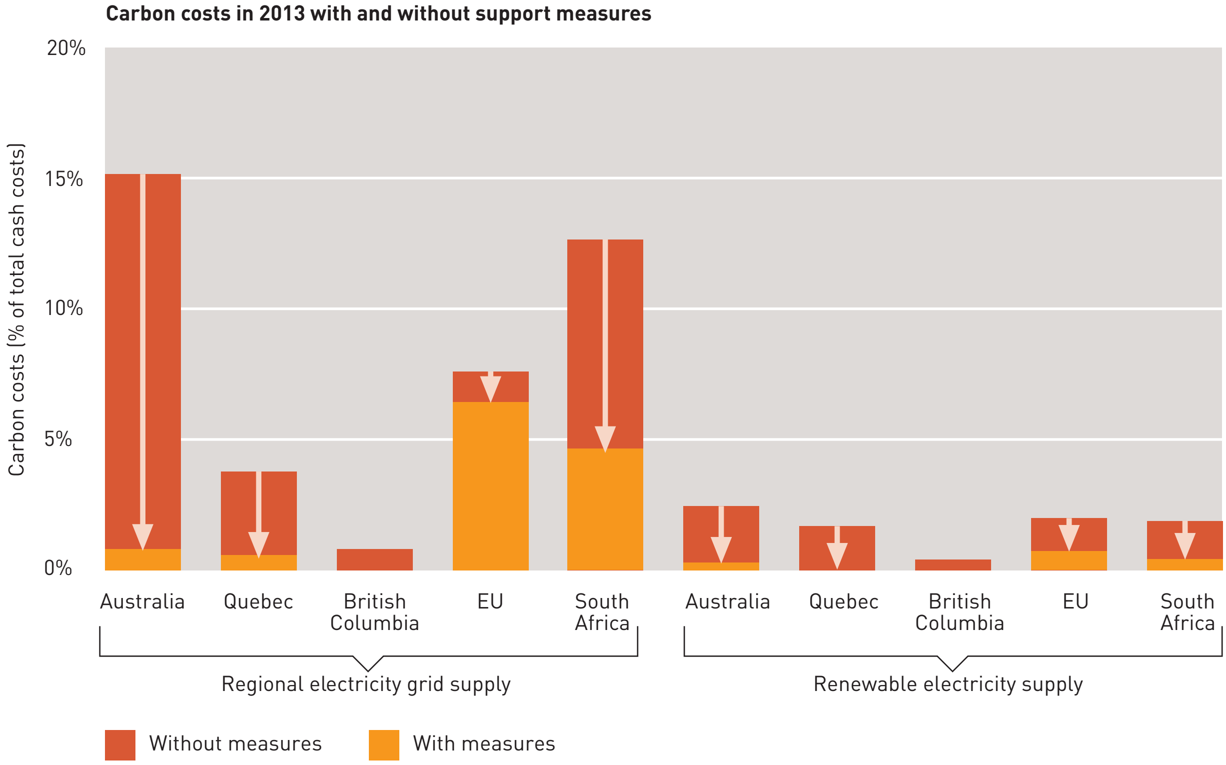


Figure 2: Carbon cost impacts on copper production
Note that at present, copper smelting is not undertaken in British Columbia; the results shown are therefore illustrative only

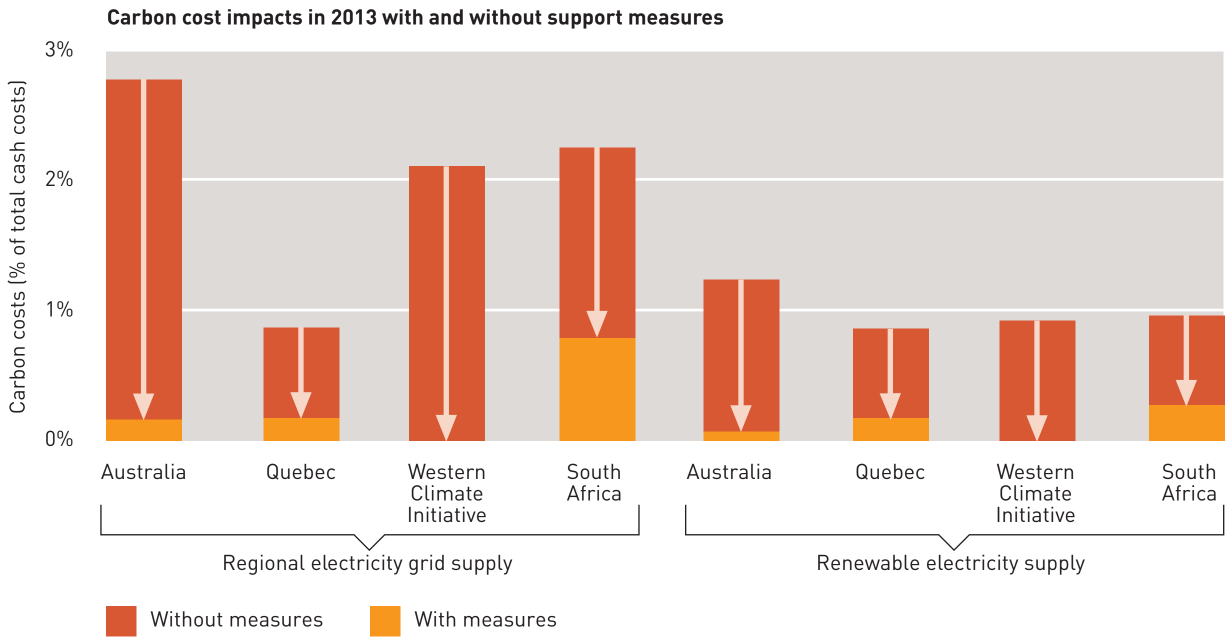


Figure 3: **Carbon cost impacts on iron ore production**
Emissions intensity data (indicated by vertical bars) submitted by ICMM member companies under the Carbon Disclosure Project

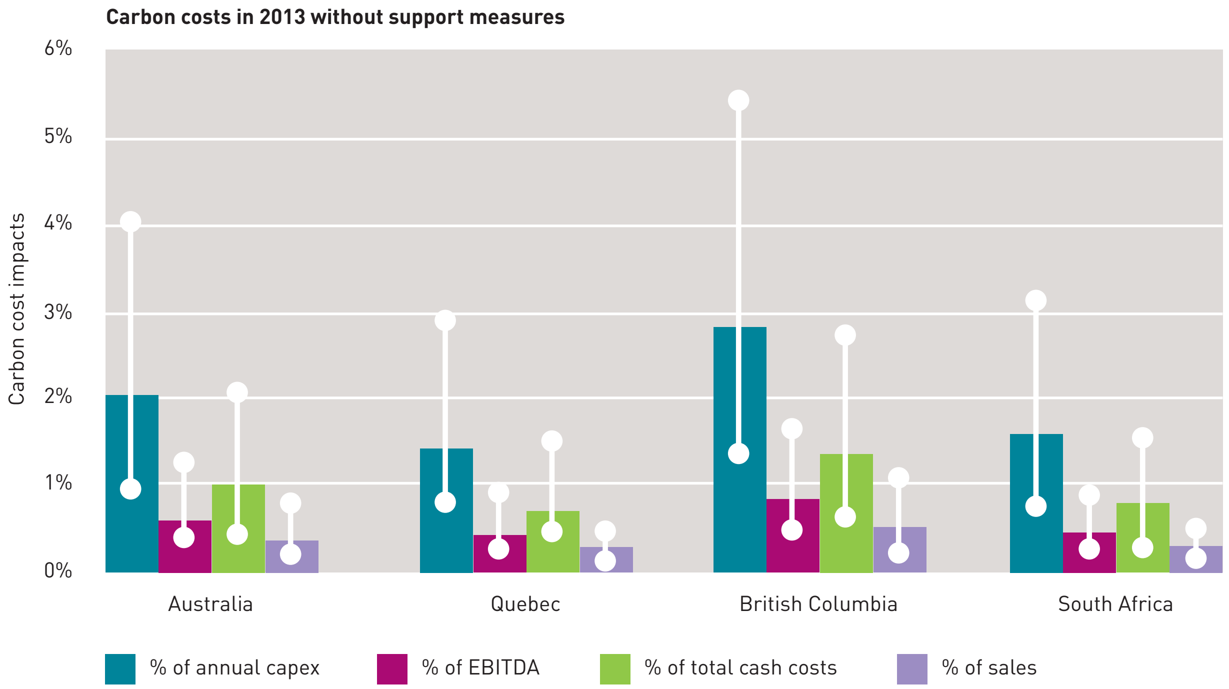
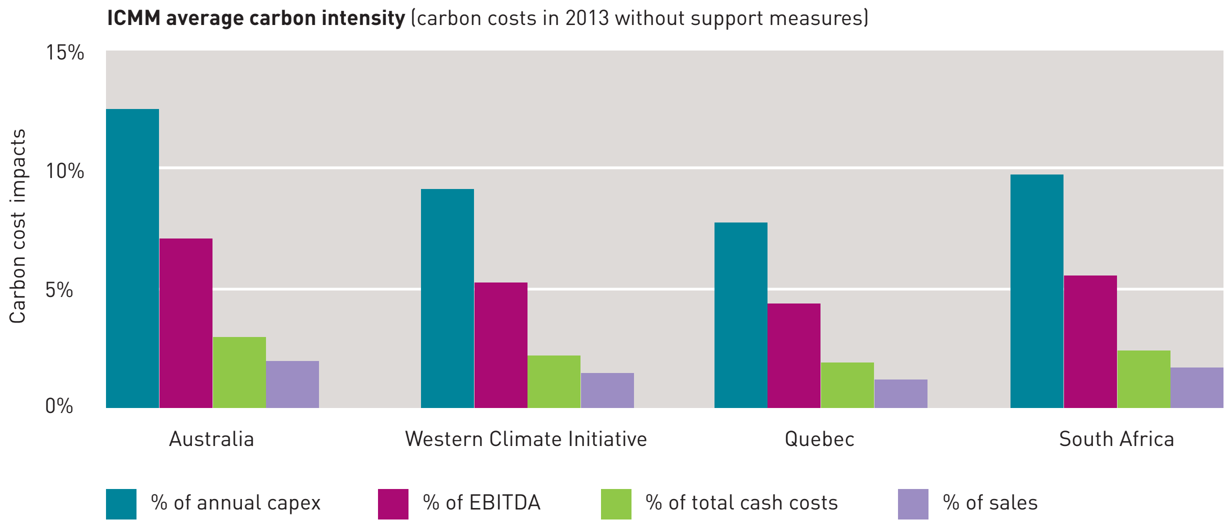


Figure 4: **Carbon cost impacts on coal production**



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Assessment of climate change policies

Governments must balance multiple policy objectives when introducing a carbon pricing system. These include environmental effectiveness, economic efficiency in incentivizing reductions and ease of implementation. ICMM's Council of CEOs have published an integrated set of principles for climate change design to support these objectives while minimizing the impact on industry competitiveness and ensuring long-term economic prosperity. These principles, shown in Box 1, must be applied collectively.

Box 1: Principles for climate change policy design

Overall, we are advocating an approach to policy and action that will ensure our industry plays its full part in contributing to sustainable development while remaining competitive in a low carbon economy. Our approach is based on applying a set of seven principles for guiding development of policy and action for industry commitments.

In summary, the principles for climate change policy design are:

1. **provide clear policies for a predictable, measured transition to a long-term price on GHG emissions**
2. **apply climate change-related revenues to manage a transition to a low carbon future**
3. **facilitate trade competitiveness across sectors**
4. **seek broad-based application**
5. **be predictable and gradual**
6. **be simple and effective**
7. **support low-emission base-load generation technology development.**

ICMM and its members will work with governments to develop climate change policy and regulation reflecting all of these principles and supported by a strong analytical foundation.

Specific concerns for mining and metals sectors

The characteristics of a given commodity and the process used to produce it are fundamental to the effects that an emissions reduction policy will have on the production costs and, in turn, on the relative competitiveness of production. The quantitative analysis presented in Section 2 highlights the following important characteristics.

Price
An indication of the percentage increase in costs of a carbon policy enables the easy identification of the most vulnerable commodities. The increase will be relatively low if the commodity's energy intensity of production is low, and if other costs, for example labour or capital, are high.

Trade exposure and emissions intensity
The impact of carbon pricing on industry costs is likely to be lower on average where there is less trade of a commodity, but trade exposure should be considered at the installation level. Some installations are exposed to global competition whereas others are not. Similarly, while it is evident that lower emissions intensities should lead to lower exposure, this will also be influenced by the scope of emissions coverage (direct and/or indirect), the sources of emissions (combustion, process, fugitive) and the types of gases that are captured by the system. Where a large part of emissions are omitted due to narrow coverage, the effects are expected to be less acute than otherwise, and particularly for certain industries whose emissions are dominated by a specific gas. A well-designed system will have a test for trade exposure to determine eligibility for compensation, noting the difficulty in designing indicators to serve this purpose.

Volatility over the economic cycle
This report uses five-year average (2007–11) financial figures that include a high variation in specific figures within that timeframe. The financial performance of commodity industries is highly variable and carbon costs become more or less affordable according to industry and market trends. The "high" and "low" points in the commodity cycle may or may not be included in the period analyzed. Carbon systems need to be responsive to market turbulence.

Emissions reductions technologies
The impact of carbon pricing can be more easily mitigated if there are low carbon technologies still to be implemented. Unfortunately, this is not often the case for energy-intensive industries: as energy is a major part of their production costs, its use has been largely optimized over a long period. However, some cases exist where policy can spur development and those need to be carefully identified in close consultation with the relevant industry.

Recommendations

Based on the analysis undertaken, the following recommendations have been drawn:

1. Carefully consider the treatment of the electricity sector and how this will affect all industrial users of electricity
Inclusion of the electricity sector within a system may result in carbon costs being passed through to users through their electricity bills. The potential impact is greater for those industries such as metal smelting that are electricity intensive and in cases where the electricity grid is fossil fuel dominated. The fuel mix of a grid is largely out of industry's control. To mitigate the impact, carbon pricing systems need to consider how best to treat the electricity sector and how to account for and mitigate any related increases in user costs.

2. Link long-term emissions reductions targets into policy measures
Significant reductions in GHG emissions from the mature processes used in the majority of mining and metals process will tend to require significant investment in research, development, dissemination and deployment. Where carbon pricing policy is implemented, the objective of compensation measures should be to give support to industries in making the transition to a low emissions economy and to act against the disadvantages that are created by unequal carbon costs.

> "The timescale for policy introduction should aim to reflect company investment concerns and environmental effectiveness rather than the political cycle."

3. Make policies specific to regional context and priorities
The introduction of climate change policy has to take into account the context in which it is being developed and implemented. Domestically, the level of economic and social development, the political and industrial support for the policy as well as government priorities will help to determine the feasibility and likely impacts of policy. External factors are also important: trade links and policies elsewhere will have a bearing on the outcome of domestic policy.

The links with the broader policy environment also need to be considered since this environment can support or undermine the achievement of emissions reductions policies. Support can come through the introduction of policies to support low carbon electricity generation (eg feed-in tariffs for renewable energy or fiscal incentives for carbon capture and storage (CCS) demonstration projects) or through funding for initiatives to deploy sector-specific emissions reductions technologies. By contrast, success in achieving emissions reductions may be weakened by a tax environment that is too onerous or in the absence of support measures that will help to develop a low carbon electricity sector.

4. Provide clear and consistent incentives
The mining and metals industries have extremely long investment cycles with investment proposals that may be developed and implemented over periods in excess of 50 years. As a result, policy certainty and stability is essential. It is beyond the capacity of government to provide long-term prices and operational details. However, establishing long-term targets for emissions reductions and long-term objectives for policies can bring some certainty to participants. More importantly, building a political and social consensus around the need for emissions reductions policies will increase the likelihood that such policies will continue to exist in the future. Policies should be gradual and announced in advance of implementation to give time for consultation and preparation. The timescale for policy introduction should aim to reflect company investment concerns and environmental effectiveness rather than the political cycle.

A clear and consistent price signal is also important although the certainty of a price signal over the longer term will depend on a range of complex interlinked factors such as political credibility, long-term targets and objectives, and the existence of price controls or future tax rates.

5. Reflect industry and facility heterogeneity in policy design
Coverage of a carbon pricing policy should be broad enough to ensure that the cost of emissions reductions is shared across the economy and narrow enough to guarantee that the system is workable. To ensure viability, a number of systems have adopted a phased approach for different sectors under which coverage increases over time as well as emissions thresholds that limit the number of entities within a system.

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In terms of addressing the risk of competitiveness impacts and carbon leakage, the criteria for receiving support need to be clearly defined and assessed on an industry-by-industry basis at the very least. A more granular assessment may be required within an industry but this needs to be balanced with the associated costs of doing so.

As with emissions reductions policies, compensation policies need to be developed with the understanding that they are one in a range of factors that affect the competitiveness of an industry and also one in a range of factors that will determine where a company produces and invests. Other factors that are of relevance include resource availability and quality, cost of inputs, company strategy and the fiscal and political regime. To the extent that the government can have an impact on these factors, it could consider how best to support production and investment by industry.

6. Adopt a collaborative approach and aim for a global emissions system
Policymakers should strive to build a political and social consensus on climate change policy. All industries that are likely to be affected by the introduction of policies should be consulted. Mining and metals industries have a key role to play based on their importance to national economies both in terms of gross domestic product (GDP) and the products they provide.[4]

Policymakers should also look to industry and government experience internationally to help design an effective carbon system. This could also facilitate the harmonization of various elements of policies such as reporting requirements and the use of offsets, reducing costs and competitiveness implications to participants. Such harmonization would also support a global emissions system in the long run.

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4 *Competitiveness implications for mining and metals* (ICMM, 2011) discusses the economic and strategic importance of the mining and metals industry. It notes six countries where mineral rents are over 10 per cent of GDP, and six more where coal rents alone are over 2.5 per cent of GDP. It also notes that outputs from the mining and metals industry are often necessary inputs to sectors of the economy that can be vital to economic and technology development, and that governments often consider the mining and metals industry to be of high strategic importance.

SECTION

1

Background to carbon pricing policy, competitiveness and carbon leakage

SECTION 1

Background to carbon pricing policy, competitiveness and carbon leakage

Introduction

While progress to establish a legally binding global regime to address climate change has been slow, recent years have witnessed the development of a range of emissions reductions policies. Systems currently in operation include the EU emissions trading system, the New Zealand emissions trading system, the British Columbia carbon tax and the Alberta Specified Gas Emissions Reduction System, as well as a range of national carbon taxes. Recently introduced systems include the Australia carbon pricing mechanism, which began operation in July 2012, and emissions trading systems in Quebec and California, which commenced trial operations in January 2012 prior to full launch in January 2013. Furthermore, a number of policies are under development. South Africa has announced plans for a carbon tax, South Korea has passed legislation for an emissions trading system and emissions trading systems are under development in seven Chinese provinces and cities raising the possibility of a national system developing in China in the near future.

Some systems have also been abandoned or reduced in recent years. In the US, the proposed Midwest Greenhouse Gas Reduction Accord (MGGRA) (an emissions trading system) was disbanded while six states announced their withdrawal from the Western Climate Initiative (WCI) cap and trade system, and New Jersey withdrew from the Regional Greenhouse Gas Initiative (RGGI). These resulted from changes in the political and economic landscape, partly driven by global recession. These factors may also threaten the ongoing viability of existing systems. Recently, controversy over the Australia carbon pricing mechanism culminated with the leader of the opposition vowing to abandon the system should his party win the next general election. Regardless of the likelihood of this occurring, it indicates the political importance of a carbon pricing policy in Australia.

Despite such developments, the impetus for emissions reductions systems continues and the diversity of carbon pricing policies gives rise to potential competitive distortions in a number of sectors.

"The objective of this report is to compare existing, formal carbon pricing policies currently implemented around the world in order to explore the opportunities and challenges arising for each for carbon emissions reduction, economic viability for the mining and metals industry, competitiveness and carbon leakage."

The objective of this report is to compare existing, formal carbon pricing policies currently implemented around the world in order to explore the opportunities and challenges arising for each for carbon emissions reduction, economic viability for the mining and metals industry, competitiveness and carbon leakage. As such, it does not cover policies that target carbon emissions reduction outside of formal pricing mechanisms, such as renewable energy targets or fuel economy standards. It is recognized that such policies also present opportunities and challenges for industry, in some cases more significantly than carbon pricing.

While this report focuses on a comparison of jurisdictions that have implemented carbon pricing policies, it is worth stating the implicit fact that industrial players that do not operate under formal carbon pricing policies benefit from having no carbon price compared to those that do and that such regions are currently at a competitive advantage over those included in this report because of this fact. Having said that, the report does not consider those areas where carbon pricing is under development (eg China at the provincial level).

Background to emissions reductions policies

Direct carbon pricing can be in the form of an emissions trading system or carbon taxation. These market-based instruments create a financial rather than legal incentive (as is the case with direct regulation) to reduce emissions. There are also hybrids of these approaches. For example, an emissions trading system can contain added design elements such as a buyout price or price floor. Please see Table 3, which outlines a number of design features.

Table 3: Design features common to regulatory and pricing approaches

All systems: carbon tax, emissions trading system, regulatory	
Emissions scope	A system can cover Scope 1 emissions only (emissions occurring directly as a result of a production process), or it can also include Scope 2 emissions (emissions that result from consumption of purchased electricity and steam).
Emissions sources	A policy can target upstream sources (the producers and suppliers of fossil fuels) or downstream sources (the users of fossil fuels). Downstream sources can be distinguished as large-scale and small-scale emitters. Policies do not typically aim to capture all economic sectors, but instead focus on a sub-set of emitters often by sector or scale.
Target design	The overall emissions reduction target and the targets for relevant sectors need to be determined. Targets can be either absolute (ie a reduction in emissions levels) or intensity based (ie a reduction in emissions per tonne of output). Alternatively, the policy objective can be the successful implementation of certain technologies or processes.
Gases covered	A system can cover one or more GHG emissions.
Data and reporting	The existence of an emissions inventory is an important precursor to the development of policy. This is necessary to monitor and ensure progress. Robust monitoring, reporting and verification (MRV) systems and procedures will vary by system, with some systems having stricter requirements than others.
Carbon pricing systems: carbon tax, emissions trading system	
Cost containment	A system can include design elements to reduce the cost of compliance. While these will usually be different for a carbon tax and emissions trading system, some mechanisms such as offsets could be used in both cases.
Revenue recycling	Carbon pricing systems may generate revenue. In each case, it has to be decided how revenue should be used.

Emissions trading systems

There are two types of emissions trading systems. Cap and trade is the most common approach to emissions trading. A government sets a maximum level of emissions that a sector is permitted to emit (thereby giving a certain environmental outcome). It then allocates a specified quantity of allowances, which represent the right to emit a unit of emissions, to each of the participants in the sector. At the end of a given period, typically a year, these entities are required to submit allowances to cover their total emissions in that compliance period. Participants holding insufficient allowances to cover actual emissions must buy allowances in the carbon market to cover their shortfall, while entities that have excess allowances can sell these allowances or, where permitted by the system, retain them for use in future periods ("banking"). The penalties for non-compliance can be severe, for example in Australia, failure to surrender sufficient allowances exposes liable entities to a monetary penalty of 130 per cent of the applicable fixed price, during the fixed-price phase, and up to 200 per cent of the average auction price, during the floating-price phase.

Allowances can be allocated directly to firms either free of charge or at a fixed price or can be auctioned. The design of the allocation will have different cost impacts on the firm as allowances are valued in the market. Direct allocation can be based on historical emissions (grandfathering), a firm's current production (output based) or based on industry-wide performance (benchmarking). A mix of allocation approaches might be used in the same emissions trading system or the allocation method might change over time (typically phasing out free allocation in favour of auctioning).

There are a number of additional features that can refine how the emissions trading system operates. Frequently, these are aimed at increasing certainty and reducing the cost of compliance for participants. These include offsets, banking and borrowing provisions and the use of price ceilings and floors.

An offset is a tradable allowance representing a unit of emissions that has been reduced outside of the formal covered sector in the emissions trading system.

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Background to carbon pricing policy, competitiveness and carbon leakage

A banking provision allows participants to carry over excess allowances from previous compliance periods to the current period. Similarly, a borrowing provision allows them to use allocations from future periods.

Finally, a government may choose to introduce a price floor and/or ceiling to ensure that the price of carbon stays within a certain range. This offers some price stability and certainty for participants.

In a baseline and credit system, the government sets an absolute or intensity baseline. Emissions up to this baseline are free of charge. Participants are required to submit allowances for any emissions in excess of this baseline.

Emissions trading systems can be linked to one another either directly or indirectly. Under direct linking, different emissions trading systems recognize each other's allowances and permit trade between them. Under indirect linking, different trading systems have access to a common set of offsets or other credits eligible for compliance in either system, thus creating indirect arbitrage between systems each recognizing the same category of offsets. Both types of linking should lead to a decrease in the overall cost of emissions reductions as systems converge on a single carbon price.

Carbon taxes

A carbon tax is a price charged on every unit of emissions a participant produces. The price is usually fixed but can also be set ad valorem, based on the cost of emission to the environment. The overall quantity of emissions remains outside the control of the government, although adjustments in the tax level could be made in order to attempt to meet targets.

A carbon tax does not lend itself to the same design variations as an emissions trading system. For example, tax systems are unlikely to be linked since taxes operate nationally and tax revenues are not shared outside the given country. However, it is possible to incorporate offsets and other forms of credits into the tax system. The mechanisms of the tax system such as tax rebates, exemptions and credits can also be used to reduce costs to certain consumers, with such measures being funded through the revenue collected through the tax.

Subsidies

Governments may also offer direct compensation to participants in the form of the subsidy to reduce the cost of decreasing emissions.

To date, subsidies have not been used widely for incentivizing the reduction of industry emissions. Possible reasons include the potential costs for governments (requiring a direct transfer of public funds to industry), difficulties with knowing which abatement opportunities to prioritize in different sectors and how long a subsidy would need to last to create sustained incentives for industry to reduce its emissions. Subsidies are outside the scope of this report.

Regulation

There are three ways to directly regulate emissions:

1. placing a limit on absolute emissions
2. mandating a maximum emissions intensity
3. specifying a requirement to use a certain production process or technology.

While these policies do not directly put a price on emissions, regulations ultimately carry price impacts on GHG emissions.

Regulation is typically developed on a sector-by-sector basis. It requires that each company meet a uniform standard, regardless of the cost incurred, and offers no flexibility around compliance (eg use of offsets), nor does it offer any rewards for over-compliance.

The broader policy environment

Achieving economy-wide emissions reductions targets requires a range of policy measures to be introduced simultaneously.

Perspectives of a member company:

While legislation to reduce emissions is desirable, the costs need to be considered in the context of the costs of other government measures. In addition to the costs faced by all industries, the mining industry often also faces taxes on the extraction of resources, permitting and regulation costs, property taxes and royalties. The viability of an operation in a certain region and its continued contribution to economic and environmental goals may be impaired where these costs become unduly onerous.

However, it is important to ensure that the policy environment is coherent as a whole. Policies to reduce emissions should be designed to be mutually reinforcing and avoid any duplication or conflict, for example, the use of revenue from a carbon tax to complement other sources of funding or ensuring complementarity when participants are required to comply with more than one policy. Governments should consider the overall cost of policies for participants, which includes both the cost of actual emissions reductions and the costs of reporting them. These should be manageable or else the viability of operations and the effectiveness of policy may be compromised.

Policy approaches adopted

The national and international political and economic context will shape the type of emissions system that is introduced and it must be balanced with the other objectives of government. For example, South Africa proposed a carbon tax rather than an emissions trading system based on the belief that a tax-based system would have lower administrative requirements and higher price certainty, suiting its current level of economic and political development. There are, however, concerns it will conflict with the government priority of stimulating job creation since it will reduce the funds available to companies to increase employment.

Table 4 presents an overview of carbon pricing and regulation policies that have been proposed, disbanded or are currently in operation in regions where ICMM member companies operate or where there is a large market for the products of ICMM member companies. It also includes other regions with established emissions systems. The use of an emissions trading system is the most common policy approach (principally cap and trade) and some systems contain elements of both a tax and an emissions trading system.

Table 4: Emissions reductions policies[5]

System	Carbon policy	Operation	Status
Canada			
Quebec cap and trade	Emissions trading system	Cap and trade system covering absolute emissions of industrial and electricity facilities that emit more than 25kt CO_2e/annum. Linking to California under the WCI is in progress, but not yet finalized.	Legislation passed in 2011. Transition year in 2012. Full implementation from 2013.
Alberta Specified Gas Emitters Regulation (SGER)	Hybrid tax/emissions trading system	Intensity-based system with facilities emitting more than 50kt CO_2/annum required to make a 12% reduction in emissions intensity. Any shortfall must be covered by verified offsets (from projects within Alberta) or a payment of C$15/t into a technology fund. Surplus credits can be sold.	Introduced in 2007.
British Columbia carbon tax	Carbon tax	Tax levied on the purchase of fossil fuels for use in industrial facilities, buildings, homes, cars and trucks. Introduced at the rate of C$10/t CO_2 rising by increments of C$5 per year to C$30 in 2012.	Authorized in 2008.
Federal regulation	Direct regulation	Sector-by-sector mandated standards. Already implemented in the transport sector; in progress for the electricity sector; forthcoming for oil, gas and EITE sectors.	Ongoing, with a sector-by-sector approach adopted.

continued

5 Red indicates the legislation failed, orange indicates ongoing introduction of a policy, green indicates a policy is in operation.

Table 4: Emissions reductions policies *continued*

System	Carbon policy	Operation	Status
USA			
California cap and trade	Emissions trading system	Cap and trade system covering absolute emissions of industrial and electricity facilities that emit more than 25kt CO_2e/annum. Linking to Quebec under the WCI is in progress, but not yet finalized.	Legislation passed in 2011. Initial trial period in 2012. Full implementation as of 2013.
RGGI	Emissions trading system	Cap and trade system covering absolute emissions of the electricity sector in selected New England and Mid-Atlantic states.	Introduced in 2008.
American Clean Energy and Security Act (ACES) (federal)	Emissions trading system	Cap and trade system covering absolute emissions of large stationary sources emitting more than 25kt/annum of GHGs, producers and importers of all petroleum fuels and distributors of natural gas.	Legislation introduced in 2010, but failed to pass in Senate.
Federal regulation	Direct regulation	Transport already covered. Standard issued for new power plants in 2012. Subsequent Environmental Protection Agency (EPA) rules are expected to cover existing power plants, smaller installations and other stationary sources of emissions.	Ongoing, with a sector-by-sector approach adopted.
Europe			
EU emissions trading system	Emissions trading system	Cap and trade system covering absolute emissions of CO_2 from the electricity sector and a range of industrial sectors. Coverage of gases and sectors to be extended as of 2013 (Phase III) as well as phase-in of auctioning allowances.	In operation since 2005. Phase III from 2013–20.
Switzerland	Hybrid tax/ emissions trading system	A CO_2 tax is levied on the purchase of stationary fossil fuels (transport fuels excluded). Companies can opt out of the tax by participating in the emissions trading system – to date, participants are mainly, but not exclusively, from EITEs.	CO_2 tax introduced in 2001. Voluntary emissions trading system introduced in 2008.
Africa			
South Africa carbon tax[6]	Carbon tax	Tax of R120 (US$15) per tonne of direct emissions as of 2013–14, rising by 10% a year until 2020. At least 60% of emissions will be tax free.	At the time of publication, the South African Government, in its budget of 2013, announced that it plans to impose a carbon tax at the rate of R120 per ton of CO_2 equivalent, effective from 1 January 2015. It also proposed a tax-free exemption threshold of 60%, with additional allowances for EITE industries.
Asia Pacific			
Australia carbon pricing mechanism	Emissions trading system	Cap and trade system with an initial period (2012–15) in which the price is fixed at A$23/tonne and then increased at a fixed rate of 5% per year, followed by a floating price (to be linked to the EU emissions trading system no later than 1 July 2018).	Legislation passed in 2011, in force as of 1 July 2012. Amendment announced 28 August 2012, including provisions to link to the EU emissions trading system.
New Zealand emissions trading system	Emissions trading system	Cap and trade system covering all major sectors and all six GHGs specified in the Kyoto Protocol.	Introduced in 2008. Sectors will enter the system at different dates.
China emissions trading System	Emissions trading system	Emissions trading system under development in seven provinces and cities. Sector-specific systems also being prepared, including electricity and buildings.	Expected implementation by 2013–14, with potential expansion to a nationwide system by 2016.

6 The Department of Environmental Affairs issued a White Paper on the national climate change response in November 2011. This document outlines a process, to be concluded within a two-year period, for developing (in consultation) sector and company carbon budgets that align with South Africa's pledge at Copenhagen. Carbon tax and emissions trading system can be seen as potential mechanisms to assist with the implementation of these budgets.

Each policy will also include measurement, reporting and verification components to ensure compliance. These include an emissions inventory detailing the sources and levels of emissions in the economy. The form of the inventory, the data requested of companies and the timeline for submission are likely to vary by system, with a company operating in a range of jurisdictions needing to fulfil the requirements of each jurisdiction at both the national and sub-national level, representing additional administrative costs for participants.

Variation in policy approach and detail give rise to complications for companies operating in more than one jurisdiction. The policy requirement, the options for meeting this requirement and the cost of doing so will vary by system. Companies must invest significant time and resources in identifying and following the correct approach at both the local and global level. The development of a global system would minimize this complexity and reduce the time and resources that a company is required to spend. In the absence of such a global approach, national systems could be linked together. Precedents for this already exist, for example discussions on linking the EU emissions trading system to the Swiss and Australian systems are almost complete.

“Companies must invest significant time and resources in identifying and following the correct approach at both the local and global level. The development of a global system would minimize this complexity and reduce the time and resources that a company is required to spend.”

Coverage of mining and metals in carbon pricing systems

The diversity of the mining and metals sector means that it is difficult to make generalizations about how a particular industry, commodity or installation will be affected, but a number of challenges and opportunities can be identified from carbon pricing policy. For example, copper is widely used in renewable energy systems and the use of aluminium instead of heavier materials reduces fuel consumption in vehicles. In addition, reliance on energy sources such as nuclear and clean coal may increase, leading to increased demand for these commodities. However, the industry will also be exposed to additional costs resulting from a carbon pricing or regulatory system. These costs will broadly depend on the carbon price and the emissions from production and will vary significantly across the different systems and commodities.

Emissions from the mining and metals sectors can account for a significant proportion of a country’s total emissions. Data from Australia suggest that mining accounted for almost 14 per cent of direct and indirect GHG emissions in 2010, while metals production accounted for just over 12 per cent. In South Africa, mining was estimated to account for 11 per cent of direct and indirect CO_2 emissions in 2006. In other regions, where mining and metals production is less significant as a proportion of the economy, the share in emissions is likely to be much smaller. In 2010, in Canada, mining accounted for 2 per cent of emissions, and metals production 3 per cent of emissions. In the US, mining and metals production each accounted for approximately 1 per cent of direct emissions, also in 2010. Of these, the majority of emissions from mining were CH_4 emissions from operating coals mines and the majority of emissions from metals production were from iron and steel production.

Table 5: Coverage of mining and metals activities

Carbon pricing policy	Mining and metals activities
Australia carbon pricing mechanism	Covered where emissions from the following activities exceed 25kt per annum: • stationary energy sources, eg on-site power generation • industrial process emissions, eg emission of PFCs in aluminium production • fugitive emissions from operational mines • emissions from waste and waste water, eg emissions from on-site landfill. The list of liable entities published by the Clean Energy Regulator in June 2012 included over 80 (out of 294) entities engaged in mining and metals industries.
South Africa	Not yet determined, but indications are that it is likely to cover mining and metals.
EU emissions trading system	Production and processing of ferrous metals is one of the sectors explicitly captured under the EU emissions trading system. Facilities that include a combustion installation with a thermal input above 20 MW are also included. As of Phase III, CO_2 from the primary production of aluminium and PFCs from the aluminium sector will also be included.
Quebec emissions trading system	Covered where emissions exceed 25kt per annum.
British Columbia carbon tax	Fossil fuel purchases by the sector covered.
Canada regulation	Not currently regulated.
California emissions trading system	Covered where emissions exceed 25kt per annum. An initial list of liable entities identified six companies, operating in the areas of steel and iron production, non-ferrous metals production, mineral mining and lime manufacture, and metals product manufacturing.
US regulation	Not currently regulated.

"The diversity of the mining and metals sector means that it is difficult to make generalizations about how a particular industry, commodity or installation will be affected, but a number of challenges and opportunities can be identified from carbon pricing policy."

Table 5 sets out the treatments of mining and metals activities in carbon pricing policies. The extent to which the emissions of an activity are captured by a system will vary – key factors here include which gases are included (exclusion of PFCs, for example, will be particularly significant for the aluminium sector), whether the system includes fugitive emissions (as in the case of Australia) and the threshold level of emissions required for a facility to be included in the system.

Even where the mining and metals sector is not covered, or only partially covered, it is likely to be affected if suppliers are included. In particular, if a system covers emissions from the electricity or transportation sector, mining and metals companies may see an increase in their costs as a result.

Competitiveness impacts of carbon pricing policies

Differences in national and regional carbon pricing policies will create different additional costs for participating companies. A key determining factor for competitiveness is relative prices across competitors producing the same product, as well as competitors producing substitute products. Additional carbon costs may be passed on to customers depending on the market structure. If costs cannot be passed on, those companies that experience a higher incidence of carbon pricing might become less competitive internationally and may also lead to relocation of production and investment (carbon leakage) to regions outside the carbon pricing area to take advantage of differences in carbon costs.[7] These effects are more likely to occur if industries are EITE, leaving little scope to pass through carbon cost increases. ICMM member companies may fall within this category since a large part of production is globally traded and many production activities are associated with high levels of emissions, particularly metals activities such as smelting and refining.

Governments often introduce measures to compensate for higher costs that arise as a result of carbon pricing. The most frequently adopted approach seen in the systems under review is free allocation of allowances to industries that are most vulnerable. This measure protects certain companies from paying some or all of the costs of emitting GHGs. Other approaches include border adjustments, tax rebates and direct financial aid to industries. While these measures provide some compensation, they may not be adequate to overcome the competitive impact of pricing in certain sectors.

"In the long term, the additional cost of carbon pricing may reduce the ability of companies to cover their capital costs."

Effects of carbon pricing on industry

Concern about adverse economic consequences, particularly with respect to the EITE industries, is the most widely stated rationale for the implementation of competitiveness and leakage policies. This may not occur in the short term if facilities can cover their operating costs. However, in the long term the additional cost of carbon pricing may reduce the ability of companies to cover their capital costs. In extreme cases, where carbon costs prevent companies from covering their short-term operating costs, operational facilities may close, leaving stranded assets.

A number of factors increase vulnerability to these effects:

- industries that have high levels of direct or indirect emissions that are technically difficult or costly to reduce
- where these emissions lead to an increase in costs equivalent to a significant proportion of product value
- where a large proportion of output is traded on international markets and competes against similar products at a uniform price.

Where these factors apply, an industry is less likely to be able to absorb or pass on the costs of carbon pricing, and becomes more likely to relocate production and investment.

While these factors indicate that an industrial sector may be at risk of leakage, a number of characteristics can reduce this risk for individual installations, which will have their own individual risk profile – for example, if emission reduction technologies can be introduced at low cost, or if the installation's output is traded in isolated markets without international competition.

Where an industry does relocate, this may have environmental, economic and social consequences. If domestic production is substituted with more emissions-intensive overseas production, global emissions will increase and the environmental objectives of policy will be compromised. Many mining and metals products are also fundamental to economic development, particularly coal, iron and steel. Any interruptions to the supply of these materials may hinder development. In some cases, jurisdictions are particularly dependent on the industry as a source of income and jobs, and policymakers will need to consider how the introduction of an emissions reduction policy will affect these priorities.

7 Carbon costs are one of a number of considerations for determining the location of production (eg availability and costs of labour and energy, access to markets and infrastructure, and the broader fiscal environment).

SECTION 1

Background to carbon pricing policy, competitiveness and carbon leakage

Defining industries at risk of leakage

In academic and government studies, a small number of sectors are repeatedly identified as being at risk of carbon leakage (frequently referred to as EITE industries). This list of sectors often includes cement manufacture, aluminium production, iron and steel production, chemical manufacture, pulp and paper production and refining. However, this categorization will vary depending on specific circumstances – emissions intensity will depend on the energy source and fuel mix for a particular plant, and trade exposure will depend on local demand for a product and on the availability or cost of transport.

Criteria for defining EITE industries usually assess the extent of exposure to international trade and whether pricing is likely to increase costs significantly for an activity based on its emissions profile. Criteria and thresholds to determine this vary across jurisdictions. For example, emissions intensity in the EU emissions trading system is assessed using a measure based on increase in production costs. Australia, on the other hand, measures physical emissions intensity.

"Emissions intensity will depend on the energy source and fuel mix for a particular plant, and trade exposure will depend on local demand for a product and on the availability or cost of transport."

Mining and metals as EITE industries

Much of the literature on the subject of EITE identifies smelting, refining and metals production at risk of leakage and competitiveness loss based on emissions intensity and trade exposure. Classification for other mining activities is more ambiguous.

Mining activities are classified as EITE in only a selection of systems. By contrast, all systems that define EITE industries include at least some forms of metals processing and production. Typically, this includes iron and steel production and aluminium smelting, with the inclusion of other processing and production activities varying by system. Again, the coverage is particularly wide in the Quebec and EU systems, but also in the California and Australia systems. Initial proposals from South Africa list aluminium and iron and steel production as EITE.

In terms of the commodities identified for further analysis in this report (coal, copper, iron ore and aluminium), only Quebec and the EU define the mining of each of these commodities as EITE, while South Africa only includes gassy coal mines. With respect to metals production, iron and steel production is defined as EITE in all systems. Similarly, aluminium smelting is defined as EITE in all cases, although the California system only includes secondary production and alloying. Copper production is defined as EITE in the EU, Quebec and Australia.

Competitiveness and leakage policies

The policies required to address the risk of leakage will vary according to the design of the system. For example, the use of flexibility measures (eg ability to use international offsets against a liability) would assist with identifying the lowest-cost option for compliance.

Each policy contains a number of elements that must be determined. These include which sectors are compensated, the level of compensation provided and the period for which this compensation applies.

Table 6: **Classification of mining activities as EITE within systems considered**

Region	Definition of industries eligible for assistance	Mining activities included in EITE definition	Metal production included in EITE definition	Policy measures for EITE industries
California	Based on trade exposure and emissions intensity: • Emissions intensity = emissions/US$m of value added. Results classified as high (>5,000), medium (1,000–4,999), low (100–999) and very low (<100). • Trade exposure = (imports + exports) / (shipments + imports). Results classified as high (>19%), medium (10–19%) and low (<10%). The measures are combined to give a leakage risk category. High risk: sectors with high or medium emissions intensity and high trade share. Medium risk: sectors with medium emissions intensity and medium or lower trade share and sectors with low emissions intensity and at least medium trade share. Low risk: sectors with very low emissions intensity.	High risk: mining and manufacturing of soda ash and related products and diatomaceous earth mining.	High risk: steel production using electric arc furnace, hot rolled steel sheet production, coke calcining. Medium risk: picked steel sheet production, cold rolled and annealed steel sheet production, galvanized steel sheet production, tin steel plate production, secondary smelting and alloying of aluminium, secondary smelting, refining and alloying of non-ferrous metal (except copper and aluminium), iron foundries. Low risk: none.	Free allowances allocated at a declining rate to all sectors, with allocation varying between the industrial, refining and electricity sectors, and factored in line with leakage risk. For all entities, the factor is 100% in the first commitment period (CP), for medium-risk entities it falls to 75% in CP2 and 50% in CP3, and for low-risk entities to 50% in CP2 and 30% in CP3. For high-risk entities, this factor is 100% in all CPs. In addition to the leakage risk, the allocation is also based on an emissions benchmark and a cap adjustment factor.
Quebec	No criteria set out, although legislation lists a number of industries that will be allocated free allowances to help mitigate adverse effects on competitiveness.	Bituminous coal and lignite surface mining, bituminous coal underground mining, anthracite mining, iron ore mining, gold ore mining, silver ore mining, lead ore and zinc ore mining, copper ore and nickel ore mining, uranium-radium-vanadium ore mining, all other metal ore mining.	All manufacturing activity covered, including metals production (six-digit North American Industry Classification System (NAICS) code starting with 31, 32, 33).	2012–14: free allowances based on historic emissions intensity, with 80% allocation for combustion, 100% for process and other emissions. 2015–20: allocation decreases annually determined by an emissions intensity target and depending on industry.
British Columbia	No definition given.	No definition given.	No definition given.	Proportion of revenue recycled as corporate tax cuts.

continued

Table 6: Classification of mining activities as EITE within systems considered *continued*

Region	Definition of industries eligible for assistance	Mining activities included in EITE definition	Metal production included in EITE definition	Policy measures for EITE industries
EU	Based on increase in production costs and trade intensity: • Production costs = sum of direct and indirect additional costs increase production costs >5% of gross value added (GVA). • Non-EU trade intensive = exports to non-EU + imports from non-EU >10% of annual turnover plus total imports into the EU. Alternatively, a sector is deemed at risk if subject to very high increase in production costs (>30%) or very high non-EU trade intensity (>30%).	Mining and agglomeration of hard coal, mining of iron ores, mining of non-ferrous metal ores (except uranium and thorium ores), other mining and quarrying.	Manufacture of basic iron and steel and of ferro-alloys; cold drawing; aluminium production; copper production; other non-ferrous metal production; manufacture of cast iron tubes; lead, zinc and tin production; casting of iron; casting of light metals.	Phase I and II: free allocation across all industries. Phase III: sectors at risk receive free allocation, in line with performance against the 10% most efficient installations in the EU. Installations meeting benchmarks will in principle receive all allowances they need. However, as this need is based on past production, the free allocation to such installations could fall short of future allowances demand. Installations not meeting benchmarks will have a shortage of allowances and will have to lower emissions or purchase additional allowances.
South Africa	Based on trade exposure and process emissions.	Initial list suggests that coal mining in gassy mines would be classified as being at risk of leakage.	Initial list suggests that iron and steel and aluminium would be classified as being at risk of leakage.	Proposal: a basic tax-free threshold of 60% will be increased for industries with significant process emissions and those that are trade exposed.
Australia	Based on emissions intensity and trade exposure: • Emissions intensive: industry-wide weighted average emissions intensity of an activity >1,000t CO_2eq/A$m of revenue; or 3,000t CO_2eq/A$m of value added. Highly emissions intensive: at least 2,000t CO_2eq/A$m of revenue or 6,000t CO_2eq/A$m of value added; moderately emissions intensive: 1,000–1,999t CO_2eq/A$m of revenue, or 3,000–5,999t CO_2eq/A$m of value added. Trade exposed = (value of imports + exports)/value of domestic production >10% or demonstrated inability to pass through costs due to international competition.	Highly emissions intensive: none included. Moderately emissions intensive: none included. Coal covered under a separate package for the gassiest mines (threshold is at least 0.1t CO_2-eq/tonne of saleable coal).	Highly emissions intensive: aluminium smelting, alumina refining, zinc smelting, manufacture of carbon steel from cold ferrous feed, magnesia production, integrated iron and steel manufacture, copper production, manganese production, production of fused alumina, production of rolled aluminium. Moderately emissions intensive: integrated production of lead and zinc, production of iron ore pellets, magnetite concentrate production.	JCP: highly emissions-intensive activities receive free allowances equivalent to 94.5% of industry average carbon emissions (based on 2005–08) in the first year (2012/13), declining at the rate of 1.3% per annum thereafter; the industry average carbon emissions includes both Scope 1 emissions and Scope 2 emissions associated with purchased electricity use and steam. Moderately EITE activities receive 66% of industry average carbon costs. Coal mining excluded.

Free allocation of allowances

A government may remove a large proportion of the costs of carbon pricing by allocating some or all allowances to sectors free of charge. There are three methods used to determine how free allowances are distributed: grandfathering, benchmarking and output-based updating. Each allocation method will create different incentives for participants.

Grandfathering

Allowances are allocated free of charge based on a historical baseline such as emissions or output in a previous period. Gaming is possible if baseline years are known in advance. There is also a risk of rewarding historically high emitters.

Benchmarking

Allowances are allocated in proportion to an entity's performance against a baseline for emissions intensity. Those entities that fall below the benchmark will receive a smaller proportion of required allowances than those entities that meet the benchmark.

Output-based updating

Future allowances are allocated based on the emissions output of the current period. This may be effective in preventing leakage since allowances rise in line with production, which risks weakening the incentive to reduce emissions.

A free allowances system must also adopt policies for the treatment of new entrants and plant closures. Since new entrants do not have historical emissions, allowances may be based on actual emissions or on the basis of technology-specific benchmarks. When a plant closes, it may be able to profit from unused allowances due to decreased production or encourage inefficient plants to continue production. It is important to define when a plant ceases operation and whether this is partial, temporary or complete.

Perspectives of a member company:

Application of benchmarking to direct emissions from aluminium smelting makes sense because it is a fair way of rewarding the most efficient smelters. A benchmark on indirect emissions can also be used to provide assistance to the most electricity efficient users. Using current production data rather than historic data is preferred as the latter penalizes the support for expanding capacity.

There is a concern that product benchmarking in the mining sector might target issues that are outside the operator's control. For example, due to geology, two different operations could have different carbon intensities. In such cases, a bottom-up approach that takes account of GHG intensity and abatement opportunities at the mine level is preferable.

CASE STUDY
Benchmarking in emissions reductions policies

The "polluter pays" principle is that those responsible for emissions should pay for them. This should include those emissions associated with electricity purchased externally. Ideally, emissions should be measured directly, based on recorded data. Where such data is not available, the use of a benchmark can be considered.

A product benchmark is a value reflecting the average GHG emissions per unit of output for installations producing the same product or products. Installations can then be ranked according to their relative performance. Benchmarks can be designed to reward top performers in a class and to require lower performers to improve. Benchmarking can also be used to provide other incentives, for example tax breaks and other exemptions. The main benefit of using benchmarking rather than historical emissions as a means to allocate allowances is that it helps to incentivize emissions reductions without the perverse effect of providing more free allocation to the highest-emitting installations.

In the EU emissions trading system, benchmarks for designated trade-exposed industry sectors have been established on the basis of the principle "one product = one benchmark". Such an approach can work relatively well when standardized processes are comparable across the sector and when direct emissions are largely dependent on controllable factors such as technology, equipment efficiency and plant scale, for example from aluminium smelting. Benchmarks for the consumption for electricity generation are also possible, for example by using national grid averages.

Shortlist of "uncontrollable" factors in mining:
- mine/plant scale or throughput
- mine type
- mine depth
- co-products and by-products
- stripping ratio (waste rock)
- rock composition/type
- ore grade
- transport distances (mine to smelter).

Benchmarking may be less effective where production processes vary substantially from facility to facility, and where this variation is the result of factors outside the operator's control (see above for a shortlist of such factors in the mining sector). Mining covers a huge range of process types, scales of operation as well as different types of terrains and geographies. As a result, operations are less homogeneous than many other industrial sectors, making it much more difficult to define comparative performance benchmarks. A flexible approach, where the uniqueness of each mine is recognized, supports effective carbon pricing regulation at the mine level.

SECTION 1

Background to carbon pricing policy, competitiveness and carbon leakage

Border carbon adjustments

Border carbon adjustments (BCAs) impose a carbon cost on imported goods or rebate the cost of carbon to exporters to countries that do not have equivalent carbon pricing systems.

However, designing and implementing an effective BCA is challenging. A number of complex factors need to be determined. This includes the basis on which carbon content is assessed, the level at which a product is to be assessed, and thresholds for the application of the BCA in terms of trade flows and in terms of emissions associated with a product. There is a trade-off between the accuracy and administrative costs of a BCA policy.

The design of a BCA would also need to be compatible with World Trade Organization (WTO) legislation. Equivalent carbon pricing maintains the incentive to reduce emissions and establishes a "level playing field" for foreign competitors to face the same carbon costs as domestic producers.

Perspectives of a member company:

Measures need to address both the potential for competitiveness loss in the home market as domestic output competes against imports, and the potential for competitiveness loss in overseas markets as domestic output is exported and competes with output from other jurisdictions.

Direct financial aid to industry

An alternative way of compensating affected industry is by awarding direct financial aid to industry to compensate for potential loss of competitiveness, and/or to assist with the development and deployment of emissions reductions technologies. This could be funded through recycling the revenues raised from auctioning allowances or from tax collection, as discussed further in the forthcoming report *Options in recycling revenues generated through carbon pricing*.

British Columbia has made ad hoc payments to such industries and the EU has announced a framework under which member states will be able to make payments to electricity-intensive industries in Phase III of the EU emissions trading system. The requirements for accessing this aid will vary by system.

The broader policy environment

Alternative proposals to address the effects of carbon pricing on competitiveness include tax rebates or exemptions for those industries considered to be at risk, carbon intensity standards on imported goods and sector-wide emissions reduction strategies that would cut across borders and carbon pricing regimes.

As with carbon pricing policy, a government may adopt one or more of these discussed measures to address competitiveness loss and leakage concerns, both by increasing flexibility for compliance and compensation to cover costs of carbon pricing policies when there is a significant risk to competitiveness. Compensatory payments need to be designed that minimize distortions. However, any form of assistance will distort the signals and operations of a carbon price and some loss of efficiency can be expected.

Overview of policies adopted

Table 6 gives an overview of the current policy approaches adopted in a range of jurisdictions. They focus solely on compensation in taxes and emissions trading systems.

In some cases, no specific compensation policies are applied to EITE industries – in British Columbia, tax cuts and rebates for the public and for business in general, rather than being targeted at EITE industries or low carbon technologies.

For emissions trading systems, free allocation of allowances has been the most commonly adopted approach, but each system differs in terms of the definition of economic sectors, the sectors receiving free allowances, the level of compensation received and the provisions for phase-out. Ensuring the right sectors are compensated to the right degree is a very complex and data-intensive process.

There has been some tentative discussion of BCAs in the US, South Africa and in the EU but implementation of such an approach does not look likely in the near term and would likely apply only to a limited number of commodities.

In a large number of cases, direct financial aid to assist industries has been introduced to compensate costs or develop low emissions technologies. Often, this is explicitly related to carbon pricing policies through the recycling of revenue or else through legislation.

Lessons may also be drawn from other systems that are not under detailed consideration here. For example, Norwegian and Swedish carbon tax systems apply different rates to different economic sectors.

Finally, jurisdictions may offer additional forms of support under other policy initiatives. These may not be explicitly directed at reducing the cost of compliance with carbon pricing systems. This could include support for renewable energy generation in the form of subsidies or power buy-back programs that provide support for facilities that generate their own power from renewable energy sources.

Differences in the coverage and protection in carbon pricing policies will result in an uneven impact in terms of competitiveness of national industry even though these policies aim to minimize competitiveness distortions and the risk of carbon leakage. The cumulative impact of these measures and other policies makes the impact on relative competitiveness unclear.

New systems are being discussed in a number of countries including China, India and Brazil. While more countries taking carbon pricing measures may help pave the way to a global pricing regime in the future, it currently creates further complexity for linking and ensuring comparable carbon costs among international competitors.

"Differences in the coverage and protection in carbon pricing policies will result in an uneven impact in terms of competitiveness of national industry even though these policies aim to minimize competitiveness distortions and the risk of carbon leakage."

Policies for the mining and metals sector

Australia

The JCP does not provide compensation for the mining sector. The Coal Sector Jobs Package is a separate legislation that establishes an assistance package for coal mining, focusing on mines with fugitive emissions in excess of 0.1t of CO_2e per tonne of product, and will compensate costs in relation to 80 per cent of fugitive emissions above this level. The Coal Mining Abatement Technology Support Package will also provide A$70 million of grants over a period of six years to assist with the development of technologies to reduce fugitive emissions from coal mines and develop safe abatement practices.

Broader assistance is provided to the metals production sector. The JCP categorizes nine activities as highly emissions intensive and three activities as moderately emissions intensive. In addition to the support received under the JCP, the steel sector will also receive assistance in the form of an increased allocation baseline for EITE assistance as of 2016/17. It will also receive A$300 million of funding for innovation and efficiency activities under the Steel Transformation Package. Finally, the metal forging and foundries sector has a dedicated A$50 million fund to support investment in energy-efficient capital equipment and low emissions technologies, processes and products.

South Africa

Under current proposals, iron and steel, aluminium and production from gassy coal mines will receive a 10 per cent increase in their tax-free threshold due to high trade exposure and a further 10 per cent uplift due to emissions intensity. The resultant tax-free threshold is 80 per cent. In addition, each of these industries has the opportunity to use offsets to meet up to 5 per cent of its liability.

European Union

Under Phase III, mining of coal, iron ores and non-ferrous metal ores will receive up to 100 per cent of the allowances required to meet their liability. The proportion awarded to each installation depends on its performance in comparison to the most efficient installations in the EU. Production of a range of metals and metals casting activities (nine in total) are also eligible for assistance on the same basis. In addition, the metals sector is likely to be eligible for compensation that member states may provide for the increased costs of electricity. These are expected to result from 100 per cent auctioning of allowances to the electricity sector. This form of compensation is not guaranteed and it is a matter for individual EU member states.

Quebec
A number of mining and metals activities are explicitly listed and the remainder are captured under "All Other Metal Ore Mining" and "All Other Non-metallic Mineral Mining". The coverage of metals production is also comprehensive. (It extends to all manufacturing activities with a six-digit NAICS code starting with 31, 32 and 33.) All activities are eligible for free allocation determined by efficiency benchmarks. Between 2012 and 2014, allowances will be allocated based on an entity's average historic emissions intensity between 2007 and 2011, with 100 per cent allocation for process emissions, 80 per cent for combustion emissions and 100 per cent for emissions from other sources. From 2015 to 2020, allocation decreases annually in line with a declining emissions intensity target, with the rate of decrease that differs across industry.

California
Only some non-metallic mining activities are eligible for free allowances. Again, the coverage of metals production activities is broader, with certain types of steel production eligible for 100 per cent free allocation until 2020 and secondary production of aluminium and other non-ferrous metals, iron foundries and other types of steel production eligible for free allocation at the rate of 100 per cent in the first commitment period, 75 per cent in the second commitment period and 50 per cent in the third commitment period.

Summary

Governments that have introduced carbon pricing have often introduced measures to compensate for the costs it imposes on vulnerable economic sectors. In the policies under consideration, the most frequently adopted approach is free allocation of allowances to EITE industries. Other approaches include border adjustments, tax rebates and direct financial aid to industries. While such measures provide some compensation, they may not be adequate to address competitiveness loss in certain sectors.

Metals production, in particular steel, iron and aluminium, is widely identified as an EITE industry in the systems that have been reviewed. Mining activities are less commonly considered to be an EITE industry although a number of systems identify them as such. The diversity of the sector and the variation in how it is defined means that certain activities may be considered eligible for compensation in some systems and not eligible in others. In addition, some systems will award different levels of protection to different metals activities. For example, Australia awards a higher level of compensation to integrated iron and steel manufacture than to production of iron ore pellets. These variations are a further source of differences in cost and competitiveness across industries and regions.

"The diversity of the sector and the variation in how it is defined means that certain activities may be considered eligible for compensation in some systems and not eligible in others. In addition, some systems will award different levels of protection to different metals activities."

SECTION

2

Quantitative analysis of systems

SECTION 2
Quantitative analysis of systems

Introduction

This section quantifies the potential effects of carbon pricing policies and associated competitiveness and leakage policies on ICMM member companies. The analysis is based on aggregated financial metrics reported by member companies and published data on emissions intensity of production. The objective is to refine understanding of the potential financial impacts arising from the existing and proposed carbon pricing systems.

The analysis focuses on four commodities (aluminium, coal, copper and iron ore) and five focus regions (Australia, Canada, EU, South Africa and US). Analysis of the impact of carbon pricing on financial metrics is limited to areas where ICMM members have significant production.

Characteristics of key commodities

The mining and metals sector is characterized by considerable diversity. Very broadly speaking, the basic value chain of mining, processing and production is the same across the industry. However, the specifics of this chain vary across a number of features, for example processing requirements and extraction technology.

Accordingly, the emissions profile will vary across product, process and operations. At the mining stage, emissions arise principally from the energy needed to operate the mine, and extract and transport the resource in question. Initial treatment of the extracted resource will produce additional emissions from the energy required to crush, grind, separate and process the material. Finally, production of the final output may require further processing such as smelting and refining. Significant emissions can arise from the energy requirements of these processes. The share of each stage's total emissions (from mine to product) will be specific to each operation.

Copper

Copper production in 2010 was 16.2 million tonnes from mines in more than 50 countries. Chile accounted for a third of this production, with Peru the second largest producer at 8 per cent. Copper is produced from open pit or underground mines with open pit mines being the predominant method of production. To produce copper, deposits of copper-bearing ores are extracted and concentrated to give deposits containing 20 per cent to 40 per cent copper. These deposits are smelted to produce a copper anode, and subsequently undergo electrolytic refining to produce a pure copper cathode. A less common production route is through an acid leaching and electrowinning process avoiding the smelting stage. This process accounted for 18 per cent of copper production in 2009.

In the last decade, prices have quadrupled from US$2,000/t in 2000 to over US$8,000/t at the end of 2011, with significant peaks and troughs within this period. Copper products across the value chain are traded openly on international markets and there is little opportunity for producers to pass through any increases in costs.

A number of features characterize the current copper industry. Production is increasingly capital intensive. As high-grade surface deposits are exhausted and demand increases, deeper deposits and lower-grade ores are exploited, which often increases energy consumption and the associated emissions.

The sources reviewed for this report suggest a range of emissions intensity of between 1.25t and 6t CO_2/t copper cathode (with most cases falling in the 3–4.5t CO_2/t range), covering both mining and processing (electro-refining) stages.[8] Broadly speaking, emissions are split fairly evenly between the mining and processing stages (ie from ore to concentrate, and then from concentrate to cathode) although this will vary depending on the features of a particular mine. These include mine depth (deep mines may be expected to have higher emissions than shallower mines), the quality of the deposit (low-grade ores require more processing to obtain the same amount of concentrate), the production process (the electrowinning or electro-refining routes) and the emissions intensity of electricity supply. The electricity supply is particularly important.

8 It may be possible to compare these intensities to the provisions classifying processes as EITE in the various systems. This analysis has not been attempted within this report.

Iron ore
Iron ore production in 2010 was 2.8 billion tonnes (US Geological Survey), with ICMM member companies accounting for around 30 per cent of output. It is mined in approximately 50 countries, with Australia, Brazil and China as the largest producers. Iron ore is generally found in the form of oxides – primarily, magnetite (Fe_3O_4) and haematite (Fe_2O_3). The ore is mined, crushed and sorted before it is smelted in blast furnaces to produce iron. In the principle smelting process, iron ore and coke are fed into a blast furnace and subjected to a stream of very hot air, resulting in chemical reactions that form molten iron and slag. The molten iron, once cooled, is known as pig iron, and is used to produce steel or further refined to produce pure iron. The overwhelming majority (98 per cent) of iron ore production is used to produce steel. Demand for iron ore is therefore linked primarily to the state of the global steel industry, particularly the Chinese steel industry, which accounts for around half of global steel production.

Since 2006, prices have risen from less than US$40/t to over US$140/t in 2011. In 2012, prices decreased on the back of lower steel demand in China (data from indexmundi.com). Prices for iron ore were traditionally set by negotiation between large mining companies and steel producers. This fixed price was generally replicated in the market. Recent years have seen a reversal of this trend. There has been an increase in market trading and spot price contracts and these prices are now generally used as the benchmark in contract negotiations. Accordingly, producers have little influence over price and are generally unable to pass through any cost increases beyond those applying to the global market. As such, mining iron ore tends to be a low-margin business, with revenue generated through high volume of production.

The emissions from iron ore mining arise from the operation of mines, the production of steel and transportation. Although the emissions intensity of iron ore production is low compared to many other commodities, values can vary significantly according to various site- and region-specific factors. Sources reviewed for this report suggest a range of between 8kg and 21kg CO_2/tonne for direct emissions and between 0 and 17kg CO_2/tonne for electricity requirements (depending largely upon the carbon intensity of the electricity supply).

Aluminium
Global production of primary aluminium in 2011 was approximately 44 million tonnes. China accounted for over 40 per cent of this production, Russia for 9 per cent and Canada for 7 per cent. There are two main methods to produce aluminium. Primary production produces aluminium from virgin materials. Secondary production works by recycling scrap aluminium and is out of the scope of this report.

Primary production of aluminium consists of three stages: first, the mining and refining of bauxite to produce alumina; second, the reduction of alumina into aluminium metal in a smelting process; and finally, casting of aluminium metal into the primary product. The reduction stage is an electricity-intensive process. It is examined in detail below.

Once alumina has been extracted from bauxite, the smelting process uses electrical energy to break the strong bonds between the aluminium metal and the oxygen in the alumina (Al_2O_3). Alumina is fed into reduction cells, where it is dissolved in molten cryolite. Electricity is passed through the cells causing the alumina in the mixture to react with the carbon anode, forming aluminium and CO_2. The aluminium, in molten form, sinks to the bottom of the reduction cell and is siphoned off while the CO_2 and other gaseous by-products form at the top of the cell. The aluminium that is tapped is cast into products at temperatures of 700°C.

Current prices of aluminium are approximately US$2,000/t. Aluminium is traded in international markets, with prices historically being set on international exchanges in response to changes in physical demand and supply. In the past five years, however, low interest rates combined with low warehousing costs and ongoing increases in primary production have led to contango conditions that have driven up metal stocks but the availability in the market is low. This has led to two-track pricing for aluminium, which is a significant departure from historical pricing.

Mining, refining, smelting and casting primary aluminium releases about 0.6 billion tons of CO_2e emissions per year (IAI, 2012). Data published by the International Aluminium Institute (IAI) in 2007 indicates that average GHG emissions intensity is around 10t CO_2e per tonne of primary aluminium product.[9] Of this, emissions resulting from electricity inputs required for electrolysis account for 55 per cent, with emissions from other parts of the process accounting for 35 per cent and PFCs for the remaining 10 per cent. However, within this, there will be large variations: the emissions intensity of electricity generation will vary by facility with some of the industry's electricity generation coming from fossil fuels and some from hydroelectricity. Where the electricity used for smelting is provided by fossil fuel-based grids, indirect emissions will typically outweigh

9 It may be possible to compare these intensities to the provisions classifying processes as EITE in the various systems. This analysis has not been attempted within this report.

the direct (energy and process) emissions. This will affect the emissions from a facility and the associated costs arising from the implementation of a carbon pricing system.[10]

Coal
Coal provides almost one-third of global primary energy needs and generates 42 per cent of the world's electricity. Global coal production in 2011 was 7,678 million tonnes (Mt). Of the total production, China accounted for 45 per cent, the US 13 per cent and India 8 per cent. Production of coal involves extraction from mines, crushing and milling, and transportation.

There are two main types of coal: hard coal and brown coal. Hard coal is of higher quality as it has fewer impurities and a higher proportion of combustible materials. Hard coal can be subdivided into thermal and metallurgical coal. Thermal coal is of a lower grade and carbon content than metallurgical coal and is used as fuel in both the electricity sector and in other industries. Metallurgical or coking coal is primarily used in blast furnaces in the production of iron for iron ore. In 2011, hard coal accounted for most of global production (6,600 Mt). Of this, thermal coal accounted for 85 per cent and metallurgical coal for 15 per cent.

Differences in coal quality is reflected in coal prices. In 2011, thermal coal prices were typically US$75–100/tonne (US$83/tonne in both the US and Europe). Metallurgical coal was approximately double this value (US$167/tonne in Europe and US$170/tonne in the US).[11] For thermal coal, the price reflects the demand for electricity and the price of competing fuels and energy sources. Metallurgical coal price fluctuations reflect changing demand for steel. While coal is less widely traded than the other commodities in this report, international trade still accounts for approximately 16 per cent of total consumption.

GHG emissions from coal mining arise from the electricity consumption for working operations, from transportation, and from unintended release of CO_2 and CH_4 from geological formations ("fugitive emissions"). For some mines, fugitive emissions can be significant. This can have a large impact on global warming since the warming potential of CH_4 is 21 times that of CO_2. CO_2 pricing will increase the costs of production for a coal producer and will also change the relative cost of energy sources, with the potential outcome of declining product demand.

Methodology

The choice of metrics and modelling assumptions can greatly affect the assessment of the impact of carbon pricing on industry competitiveness. Theoretical models measure elements such as potential trade movements and the behaviour of industry over time. These metrics are contentious because they are often opaque in how they operate and because their results are often limited in their applicability. However, empirical data from the operation of carbon pricing systems is sparse, and, even if data was more available, it would be difficult to distinguish carbon pricing from the wider economic and environmental situation, which determines relative competitiveness.

This analysis models direct financial impact rather than the behaviour of companies or changes in trade flows. It analyzes potential costs arising from each pricing system as a proportion of a company's annual capital expenditure, revenues, profits and operating costs. No attempt is made to predict potential secondary effects such as shifts in patterns of commodity production, changes in trade movement or the relocation of operations outside of regions with carbon pricing.

Publicly available data has been used for this analysis, including data published in recent company reports, studies provided by well-respected sources and industry association databases subject to appropriate quality provisions. The assumptions used are clearly stated throughout the analysis and results, which are presented as objectively as possible.

"The choice of metrics and modelling assumptions can greatly affect the assessment of the impact of carbon pricing on industry competitiveness.

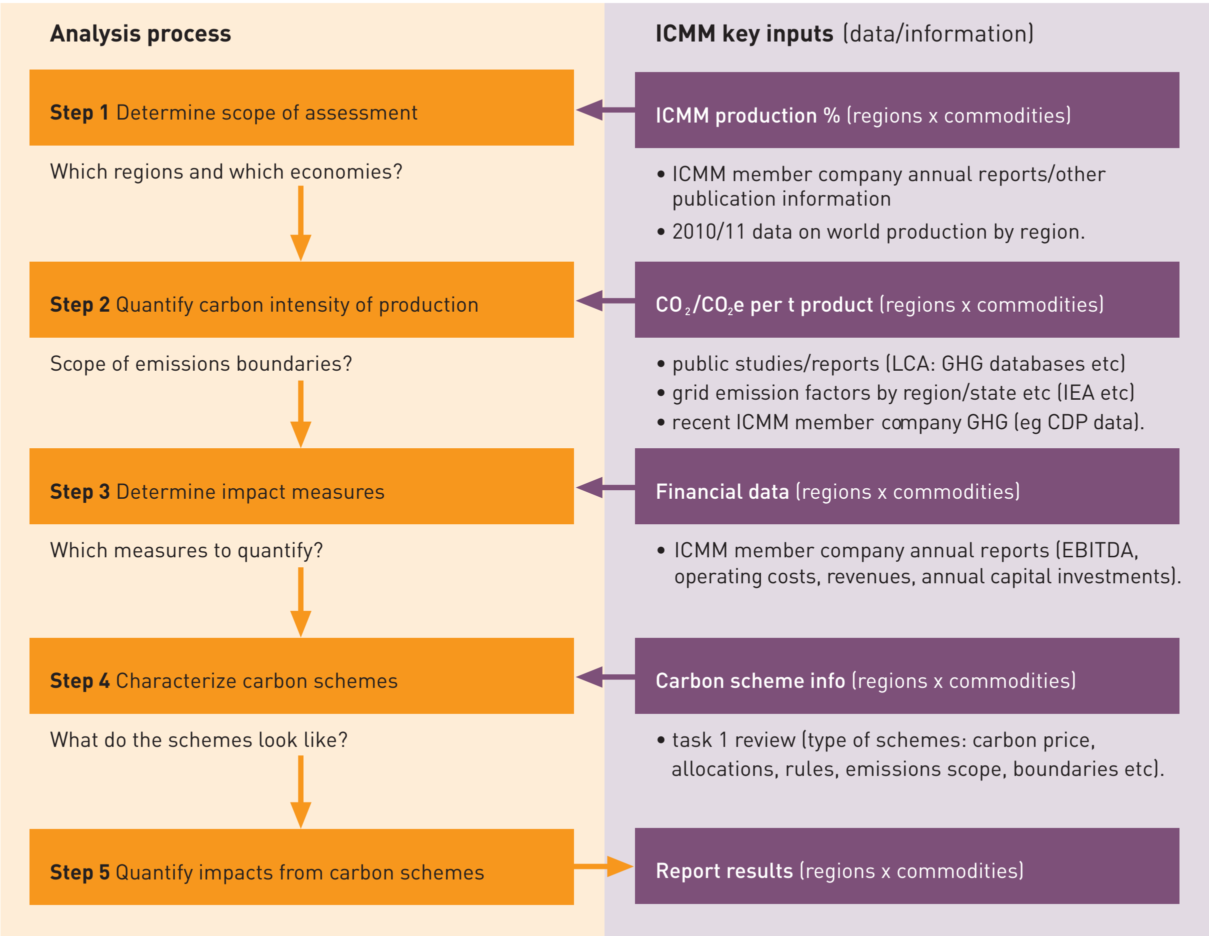
10 Recycling only requires about 5 per cent of the amount of energy that is needed for electrolysis.

11 US DOE/EIA 2012 quarterly energy price updates (steam and coking coal export prices); see www.eia.gov/countries/data.cfm#undefined

Process

Figure 5 summarizes the process and inputs used in the quantitative analysis. This follows five steps that are described below.

Figure 5: Process and inputs for quantitative analysis



Quantitative analysis of systems

Step 1
Determine scope of assessment – which region and which commodities?

Table 7 indicates there is significant ICMM member company coverage across most of the focus regions and commodities. The exceptions are the EU, where there is significant ICMM production of aluminium only, and the US, which is limited to analysis on copper for the same reason.

Table 7: Scope of quantitative analysis

Region	Commodities covered (ICMM member company % share of total regional production)			
	Aluminium	Copper	Iron ore	Coal
EU	37%	–	–	–
Australia	44%	59%	66%	31%
South Africa	100%	41%	62%	45%
British Columbia	84%	71%	21%	35%
Quebec	84%	71%	21%	–
US (WCI)	–	57%	–	2%

Sources:
ICMM member company annual report data (reported commodity production for 2011); British Geological Survey (BGS); *World Mineral Production* (BGS, 2012).

Please note that for British Columbia and Quebec, the coverage figures refer to Canada total; US figures refer to US total. Copper includes reported concentrate and cathode production. Where specific sites/operations are owned jointly by both ICMM and non-ICMM companies, production figures have been allocated to ICMM member companies on the basis of ownership.

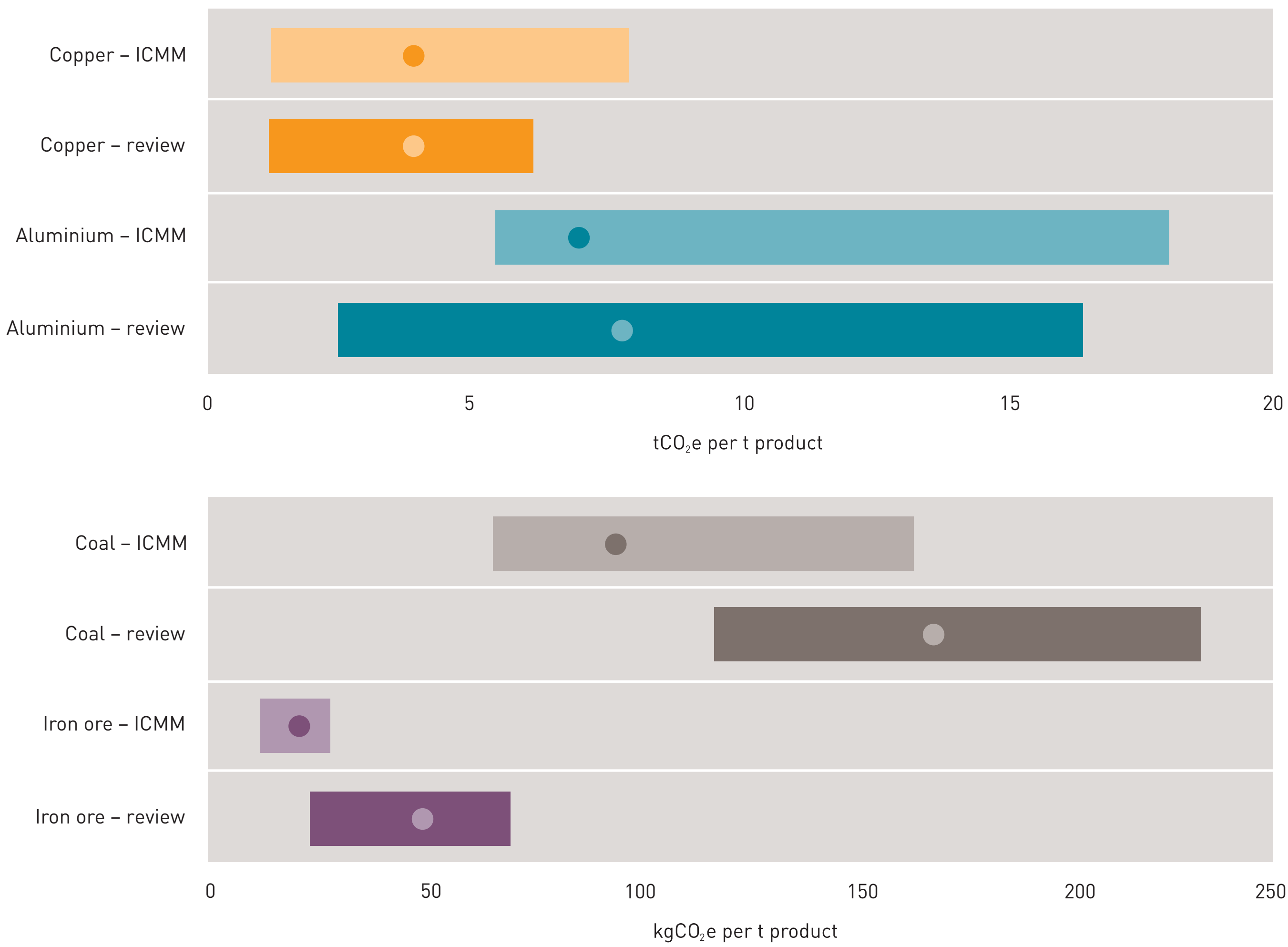
2

Step 2
Quantify carbon intensity of production

The carbon intensity of production is quantified by developing a set of emissions factors (tonnes of CO_2e per tonne of product) across the chosen commodities and regions. This was difficult to establish due to regional differences in the scope of GHG included, emissions sources, process/product boundaries, technology routes, energy use and electricity supply assumptions. Great care therefore needs to be taken in choosing data sources and assumptions that are both representative and transparent, with uncertainties or variations captured through the use of ranges and average values.

Figure 6 shows emissions intensity values based upon ICMM member company reported data and literature review. There is a wide range in reported figures (reflecting the factors mentioned above) and variation between values identified in publicly available sources and the values obtained from ICMM member company annual reports (also due to differing regional scope and the performance of ICMM member companies compared to that of the broader industry).

Figure 6: GHG emissions intensity ranges (ICMM member companies and literature review)



Sources:
ICMM data is at the corporate level derived from Carbon Disclosure Project company submissions (accessed July 2012) and supplemented with annual report 2011/12 data where necessary. The literature review data is based on various sources in the public domain, eg industry association publications, life cycle assessment studies and government statistics.

Please note that the emissions intensity ranges reflect minimum and maximum reported values; the circles indicate production weighted average values (for ICMM data) and mean values (for literature review). All values shown include Scope 1 (fuel combustion, process and fugitive emissions) and Scope 2 (indirect emissions from electricity generation and purchased steam) GHG emissions. Copper values include both concentrate and cathode production.

Box 2: The impact of carbon pricing on electricity prices

Estimating the impact of carbon pricing policies in a jurisdiction requires an estimation of how the price of electricity consumed will change. A first-order estimate can be made by assessing how much carbon was consumed in the generation of the electricity, and multiplying this by the carbon price that electricity generators will be subject to. This formulation is simple to state but there are often highly complex considerations, notably for grid-supplied electricity. For example, determining what combination of plants was used, and at what times, is very difficult to ascertain in practice. The second complexity is that electricity is generally supplied within a market environment, where supply and demand considerations can lead to price changes that do not follow exact changes in underlying costs, typically being more closely aligned to changes in marginal costs. Cost pass-through is commonly used as an indicator. It expresses – generally in percentage terms – how much of the cost increase faced by producers is passed through into consumer price increases. Again, this simple concept can be challenging to apply in practice. Different combinations of electricity plants meet system demand at different times, and prices are typically set in competitive markets at the level of the cost of marginal plant (the most expensive plant, which meets the last part of the demand). The price realized is then paid to all generators, whatever their technology, efficiency and cost structure. Thus, the implementation of a carbon pricing policy can be expected to see even a zero carbon generator – such as renewables or nuclear – experiencing an increase in the electricity price it receives. The price increase to all generators may reflect the average cost increase that plants face, but is more likely to vary from this, and could be above or below the average at various times throughout a day or a year. A region's average fuel mix is therefore not necessarily a good proxy for the carbon element driving the power price.

Modelling and empirical analysis have sought to estimate how electricity prices have changed, or may change, due to carbon pricing policies. It is difficult to draw conclusions that allow the expected impact on electricity price to be drawn with a high degree of certainty, and even more difficult to apply the results from one jurisdiction to another. However, studies and model simulations do tend to show that cost pass-through rates are significant. This is to be expected, as consumers of electricity generally have little substitution potential, at least in the short term. Reviewing experience in the first year of EU emissions trading system (ETS) operation, Sijm, Neuhoff and Chen (2006) concluded that pass-through rates were typically 60–100 per cent. Econ Pöyry (2009) estimated that a carbon price increase of €1/tonne CO_2 led to an average price rise of €0.76/MWh over the period 2005–08 in the price of electricity in Germany, which would be expected from a mix at the margin of natural gas- and coal-fired plant. Pöyry (2011) conducted a regression analysis on the impacts of the EU ETS on Norwegian prices over the period 2004–08 and concluded that cost pass-through is at the rate of 0.67 tonne CO_2/MWh, which would again correspond to marginal price setting coming from a mixture of gas- and coal-fired plant. This result is notable in that Norwegian generation is almost entirely zero carbon; the result is explained by the interconnection of the Norwegian grid to that serving its European neighbours, notably Germany and Denmark.

All of these results are calculated across the system, whereas cost pass-through for individual plants will vary depending on their relative carbon intensity. Further, much of the work to date has focused on the EU and it is not clear how applicable the results may be to other jurisdictions.

The literature indicates that there is some link between average grid carbon intensity and changes to electricity price, with a system that reduces its share of coal- relative to gas-fired power and to renewables expected to have lower price increases arising from carbon pricing policy. But the literature also notes the importance of which plants are at the margin, with the possibility that systems with low average emissions factors having relatively high price increases if marginal plant are fossil fuel fired. Empirical evidence is limited by the lack of experience of carbon pricing to date, and by the difficulty of singling out the effect of carbon pricing among other drivers for lower power prices, for example lower demand due to financial crisis and substantial subsidies to renewable energy outside the carbon regime.

Certain carbon pricing schemes have offered, or plan to offer, compensation to electricity generators. This introduces a further consideration: how will electricity generators modify electricity prices if they receive free allowances to cover some or all of their carbon emissions? In a competitive market, this comes down to bidding strategy. Evidence from the EU ETS tends to show that compensation measures have not impacted the pricing strategies of electricity generators to any significant degree: in the first order, they have passed on carbon cost increases independent of whether they subsequently received any free allowances against the increased costs of their inputs. This "opportunity cost" argument – that generators will treat allowances as having value whether they received them for free or not – has a strong basis in economic theory.

The quantitative analysis within this report is based on transparent and simple assumptions, which aim to show the range of possible outcomes rather than making projections of which would be the most likely. It is assumed that electricity consumed comes from either zero carbon-rated renewable energy, or from plant representing the grid average of annual electricity generated. The cost pass-through is assumed to be 100 per cent in the base case, with a sensitivity of 50 per cent applied purely for illustrative purposes. Where compensation measures are applied to electricity generation, it is assumed that these would decrease electricity prices (noting that the "no compensation" case quantified shows the impact of full cost pass-through).

The results obtained are necessarily illustrative and show average impacts across all electricity plant and facilities. Further sensitivity analysis, and new modelling, could be used to obtain a better understanding of impacts on individual plants and in individual countries or regions. Other scenarios could illustrate impacts of different combinations of carbon intensity and cost pass-through. One issue to explore is what the upper bound could be for cost increases: for example, could it be higher than the product of a grid average electricity supply with 100 per cent cost pass-through (as modelled within this report)?

Step 3
Determine impact measures

Impact measures can be determined by comparing the impact of systems on company financial metrics for each commodity. The key metrics identified are carbon costs as a share of:

- EBITDA: this gives an indication of a company's operational profitability. The omission of taxes, interest and amortization allows for a fairer comparison of companies or operations (by removing the effects of different tax structures, capital structures, ownership histories etc).
- Sales: income (revenue) received by a company through the sale of commodities produced.
- Total cash costs: this indicates the company's overall production cost basis in each year. It is calculated as a company's sales (revenues) minus EBITDA, and also referred to as gross costs or simply cash costs.
- Annual capital expenditure: this reflects year-to-year investments made in assets, equipment and plant refurbishment.

Due to some differences in reporting formats between ICMM member companies, it is not possible to accurately align the reported financial data with the associated commodities and regions in all cases. Therefore, the financial data used in the analysis reflects a sample of ICMM member companies only. However, in all cases, these cover the majority of ICMM production in each region and for each commodity. Data has been collected from a five-year period (2007–11). Financial metrics can vary significantly between years and a five-year production weighted average is more representative than a single-year figure. Box 3 discusses the implications of using a five-year average compared with analysis for a single year.

Step 4
Characterize carbon systems

The key features used to determine the impact of a carbon price include the price level, GHGs covered, scope of emissions, system boundaries, thresholds and compensation measures. This is based on the information provided in Section 1.

Step 5
Quantify impacts from carbon systems

Finally, the impacts of the pricing systems are quantified according to the measures determined in Step 3, and using the quantitative inputs provided by Steps 2, 3 and 4.

"Certain carbon pricing schemes have offered, or plan to offer, compensation to electricity generators. This introduces a further consideration: how will electricity generators modify electricity prices if they receive free allowances to cover some or all of their carbon emissions? In a competitive market, this comes down to bidding strategy."

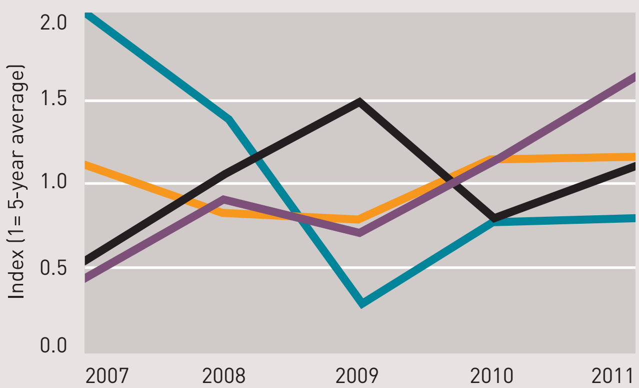
Box 3: Variability of financial metrics over the assessment time period

The financial data used in the analysis is taken from ICMM member annual reports for the past five years. Combined with company-level reported production volumes for each of the four focus commodities, this data provides the basis for quantifying the potential economic impacts arising from regional carbon pricing systems.

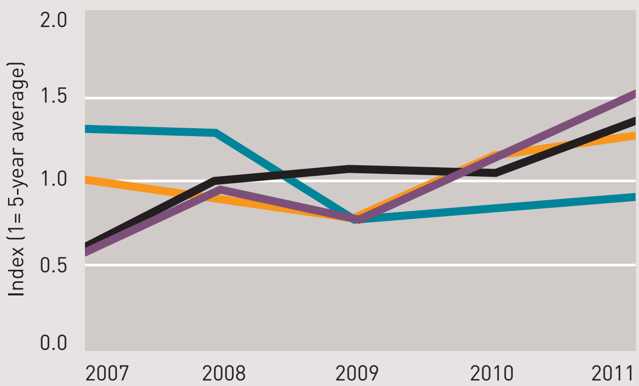
It is important to note the significant year-on-year variability in each of the key chosen metrics over the period 2007–11 (EBITDA, cash costs, sales and capital expenditure). The observed fluctuations reflect a range of market dynamics acting over the period, some of which are specific to each commodity or sector. For example, the falls in copper and aluminium prices seen through 2009 – coinciding with a downturn in many world markets – resulted in significant reductions in company profitability reported for that year (as measured by EBITDA per tonne). Realized sales prices and EBITDA for ICMM member company iron ore producers were similarly impacted in 2009, albeit against a general trend of increasing global demand and strong financial performance. Coal prices have also risen in a similar manner since 2007, driven by high demand in non-OECD markets, although with significant volatility in year-on-year EBITDA results. With the exception of coal production, capital expenditure also fell in 2009, coinciding with the peak of the global economic downturn. Expenditure has since increased significantly.

Given the significant year-on-year volatility in the reported data and the presence of anomalous or "unrepresentative" years, five-year average values have been used. These give an assessment that should correspond more closely to the average across the economic cycle than the value of any single year. In addition, periods of different length or different start and end dates could be chosen, but none are considered to have any more validity than the chosen period. The data period chosen corresponds to the most recent data available. Finally, the period chosen is relatively short, and thus the structure and ownership of the industry should be relatively stable.

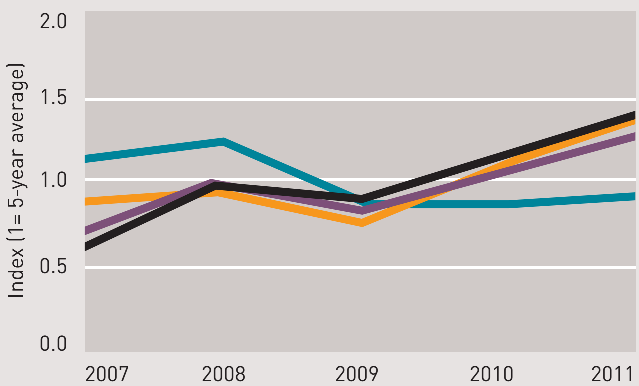
EBITDA per tonne



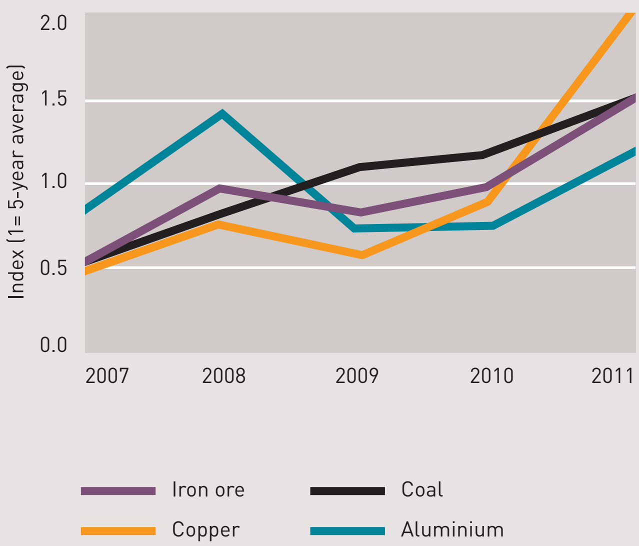
Sales price per tonne



Total cash costs per tonne



Capital expenditure per tonne



Inputs and assumptions

The analysis in this section is based on a number of inputs and assumptions. These relate to the process and product being assessed, emissions intensity of production, financial data and the key features of each carbon system. The assumptions used are outlined below and subsequently summarized in Annex 2.

Product and process characteristics

The value chain of each commodity can be divided into different processes, each of which yields a different product. For example, the production of aluminium products first requires mining of bauxite, processing to yield alumina, refining to produce aluminium and subsequent casting into products. It is also possible to distinguish between different products within a sector, for example metallurgical and thermal coal production due to the difference in financial and emissions data between the two commodities. The analysis and results are based on particular stages of a process and products for each of the four commodities.

Emissions intensity

For each commodity, data is needed on both direct emissions arising from the production itself (Scope 1 emissions) and for indirect emissions arising from electricity use and purchased steam (Scope 2 emissions), which will vary according to the electricity source used by facilities. Within Scope 1 emissions, the relative contribution made by fuel combustion, process and fugitive emissions varies by commodity, process, technology and facility. The contribution of fugitive (methane) emissions is particularly important in the case of coal production (see page 32). This is a significant problem for gassy mines.[12]

Financial data

The financial data is compiled from as many ICMM member companies as possible (given issues of reporting comparability) and includes the largest ICMM producers of each commodity. Data reported in financial annual reports for the years 2007–11 is combined with reported annual production volumes to give five-year weighted average per tonne values. Average exchange rates over the period 2007–11 have been used to arrive at a single set of average values, and all local currencies converted into US$ based on this value.[13] Within each commodity, the analysis does not attempt to differentiate between regions in terms of the financial metrics (eg EBITDA per tonne). While some information indicating differences across regions exists, the data available is of insufficient quality and coverage to use for robust analysis.

Carbon pricing systems

The key parameters for each carbon pricing system are outlined in Annex 2. These are combined with the carbon intensity and financial data figures to quantify the potential financial impacts. Many of the systems propose important rule changes during initial phases of implementation. So in order to ensure comparability, the analysis focuses on 2013 for all systems. For most of the proposed systems, this represents the first year of system operation (exceptions are British Columbia and the EU). The carbon prices and taxes used reflect levels set out in legislation or representative values from recent carbon market analyses.

For the Australia carbon pricing mechanism scheme, the initial fixed-price level of A\$23/tCO_2 (US\$20/tCO_2) is used, whereas for the South African and British Columbian tax schemes, initial stage levels of R120/tCO_2 (US\$16/tCO_2) and C\$30/tCO_2 (US\$24/tCO_2) respectively are chosen. The price levels chosen for the cap and trade schemes and informed by recent carbon market analyses of future price projections; for the EU emissions trading system, a Phase III level of €12/tCO_2 (US\$17/tCO_2) is chosen, and for the Quebec and WCI (US states) schemes, values of C\$15/tCO_2 (US\$14/tCO_2) and US\$15/tCO_2 respectively. It is important to note that, unlike the tax schemes, any future price levels within market-based cap and trade schemes are inherently uncertain, with the values chosen here being representative of recent market projections. Where details for a system are not known, the relevant key features have been assumed, based on the analysis in Sections 1 and 2.

> "It is important to note that, unlike the tax schemes, any future price levels within market-based cap and trade schemes are inherently uncertain."

12 The distinction between gassy and non-gassy mines is also important because certain systems propose support measures for only those operations considered gassy. For example, under the Australia carbon pricing mechanism, support provided by the Coal Sector Jobs Package applies only to those mines with fugitive emissions in excess of 0.1 tonne of CO_2e per tonne of product sold (with assistance provided at the rate of 80% of fugitive emissions above this level).

13 Values used are: C\$/US\$: 0.9486, A\$/US\$: 0.8875, €/US\$: 1.3915, R/US\$: 0.1325.

Quantitative analysis of systems

Results and key lessons

This section outlines the results from the analysis. It also compares the design and implementation of the pricing systems under consideration in order to derive lessons for future policy development. While this analysis focuses on the four chosen commodities, many of the key lessons are applicable to the broader mining and metals sector and to industry in general. The results can be grouped according to the following categories: the role of the electricity sector, carbon pricing system design, effects of compensation measures, variation across commodities and facilities, and the economic cycle.

Electricity sector: cost pass-through and generation mix

Where electricity generation is included in a carbon pricing system, there is potential for the sector to pass through the associated costs to consumers. The extent to which this occurs (the "cost pass-through rate") will have a direct impact on the indirect carbon costs for these consumers, and therefore on the cost of production. All commodities that use electricity in the production process would be affected by this pass-through, but this is particularly the case for the electricity-intensive industries (aluminium and copper have been analyzed, but this will also apply to other metal production processes such as nickel and zinc production).

> "Where electricity generation is included in a carbon pricing system, there is potential for the sector to pass through the associated costs to consumers. The extent to which this occurs will have a direct impact on the indirect carbon costs for these consumers, and therefore on the cost of production."

Figure 7 shows the cost impacts of carbon pricing in the case of aluminium production, assuming a range of cost pass-through rates. The smelting stage of production requires a large amount of electricity. Thus, the ability of operators to pass on additional electricity costs is a key factor in determining the impact of pricing. Where an operator is unable to pass on these costs, costs will be high for producers. In the example shown, it can be seen that if all costs are passed through to aluminium producers, carbon costs can be as high as 70 per cent of EBITDA. However, depending upon the scheme, this may be reduced to less than 2 per cent of EBITDA where costs are not passed through. Note also that the scope of emissions sources within the scheme is a key factor. For example, impacts are seen to be relatively low in the case of British Columbia: here the tax is applied to fuel combustion emissions only, whereas for aluminium production, fuel combustion accounts for only a portion of typical direct (Scope 1) emissions with process CO_2 and PFC emissions representing significant sources.

The electricity generation mix in a specific region will also affect CO_2 emissions and therefore the cost impact on industry. Where the generation mix is based predominantly on coal, for example, the costs of carbon pricing can be expected to be higher than when it is based on decarbonized sources such as hydropower. In turn, the impact associated with a given rate of pass-through will be much higher.[14] Figure 8 gives an example of this effect in the case of aluminium. In Australia and South Africa, where the electricity grid is supplied primarily by coal, emissions from electricity are significantly higher than in British Columbia and Quebec, which are fed by a hydro-based grid.

The generation mix also varies across sites. Some sites rely on self-generated renewable energy or waste heat while others rely on a fossil fuel-dominated grid supply. Figures 7 to 19 are averages across five years and many suppliers. Carbon costs could be significantly higher or lower for a particular supplier or year.

14 It should also be noted that electricity markets and systems are complex, with the mix of plants supplying the system and the last plant (the "marginal" plant) altering on a continuous basis. It is very difficult to decide the level of emissions from electricity supply that should be applied to any customer's consumption. This report uses a series of transparent assumptions rather than attempting a detailed analysis.

Figure 7: **Carbon cost impacts on aluminium production**
Note that most Canadian smelters are currently based on dedicated hydro supply and therefore have no Scope 2 emissions

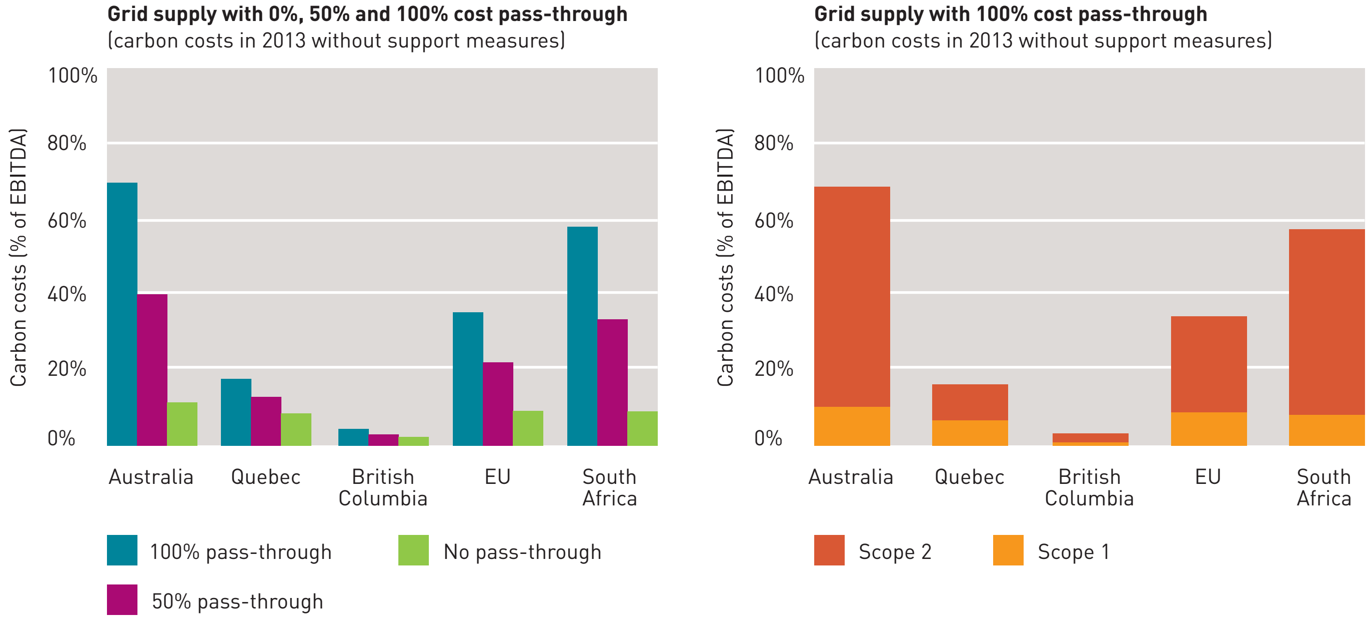
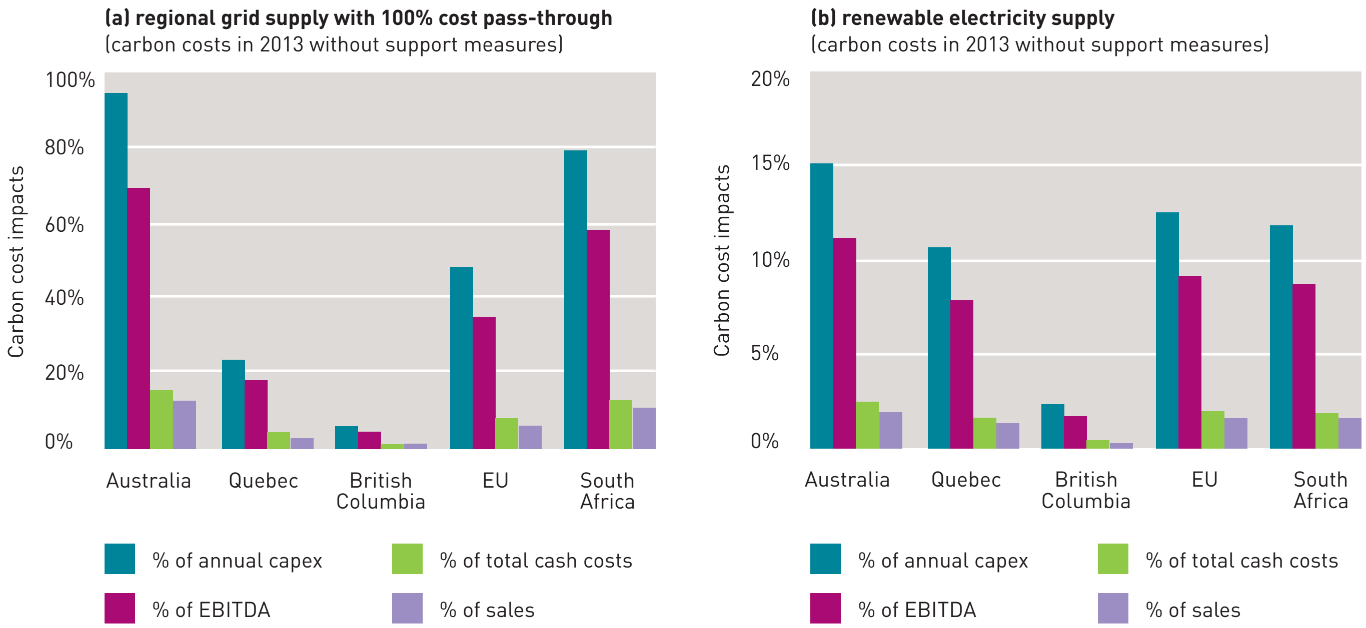


Figure 8: **Carbon cost impacts on aluminium production: grid supply vs renewable energy**



Quantitative analysis of systems

Effects of carbon system design

The design and operation of a system will significantly influence the cost impact of carbon pricing. Two important elements of design are the coverage of emissions and the carbon price.

Coverage of emissions
The broader the range of gases and emissions sources covered, the greater the potential impact on the financial bottom line. For example, in British Columbia, fugitive emissions from coal mines are not captured under the carbon tax. As a result, the potential financial impact is much lower than in other systems despite the high carbon price assumed (Figure 9).

Carbon price/tax level
The analysis conducted uses a single carbon price estimated for 2013. This price is based on proposed carbon tax levels and/or market forecasts of carbon prices. Clearly, a different carbon price will have a different impact on costs. Figure 10 shows the potential impact of a range of carbon prices on total cash costs and annual capital expenditure in the aluminium sector (the circles denote the 2013 levels used in the analysis). As prices or tax levels increase, the scale of potential impacts increases. In addition, the impacts become increasingly divergent between regions (given all other factors such as system coverage and grid mix remain the same). Emissions from the electricity supply sector largely drive this effect. For example, although 2013 prices are highest in British Columbia, the impact of higher prices is lower than for other regions. This is because electricity used by British Columbia aluminium producers is powered by a decarbonized grid and they will avoid the additional costs of fossil fuel-based electricity. Furthermore, the British Columbia tax is applied to fuel combustion emissions only, whereas the majority of aluminium direct (Scope 1) emissions are process related.

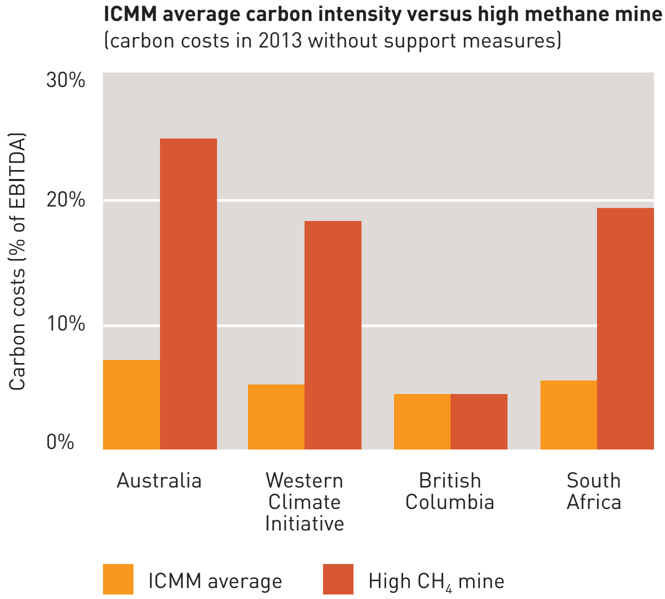
> "How these carbon pricing policies evolve over time and the extent to which they become harmonized will have an important bearing on the financial costs of carbon pricing."

A number of implications arise from the analysis. These are listed below.

- Increasing emissions caps or tax levels are reflected in higher carbon prices. In the absence of compensatory support measures, this results in additional costs for industry.
- As carbon prices rise, cost impacts become increasingly different between regions largely due to differences in the mix of the electricity grid. This can be mitigated by harmonizing the rules and coverage of pricing systems, including the linkage of systems.
- The inclusion of electricity in pricing systems can lead to a significant cost impact if the cost of electricity is easily passed on and if the production process is electricity intensive.

How these carbon pricing policies evolve over time and the extent to which they become harmonized will have an important bearing on the financial costs of carbon pricing.

Figure 9: Carbon cost impacts upon coal production



2

Design of compensation measures

As discussed in Section 1, compensation measures vary between systems. The key factors identified by the quantitative analysis are discussed below. They include coverage, treatment of the electricity sector, level of compensation, other measures and reduction in compensation over time.

Coverage of industry sectors

The inclusion or exclusion of a sector from compensation measures will strongly influence the cost impact of pricing on the bottom line. This is illustrated by the case of copper production in British Columbia. In this case, the lack of compensation provided under the carbon tax regime results in much higher impact on cash costs than elsewhere (Figure 11).[15]

Figure 10: Carbon cost impacts upon aluminium production: carbon price range
Note that the circles indicate expected price/tax level in year 1 (2013) of each regional carbon system

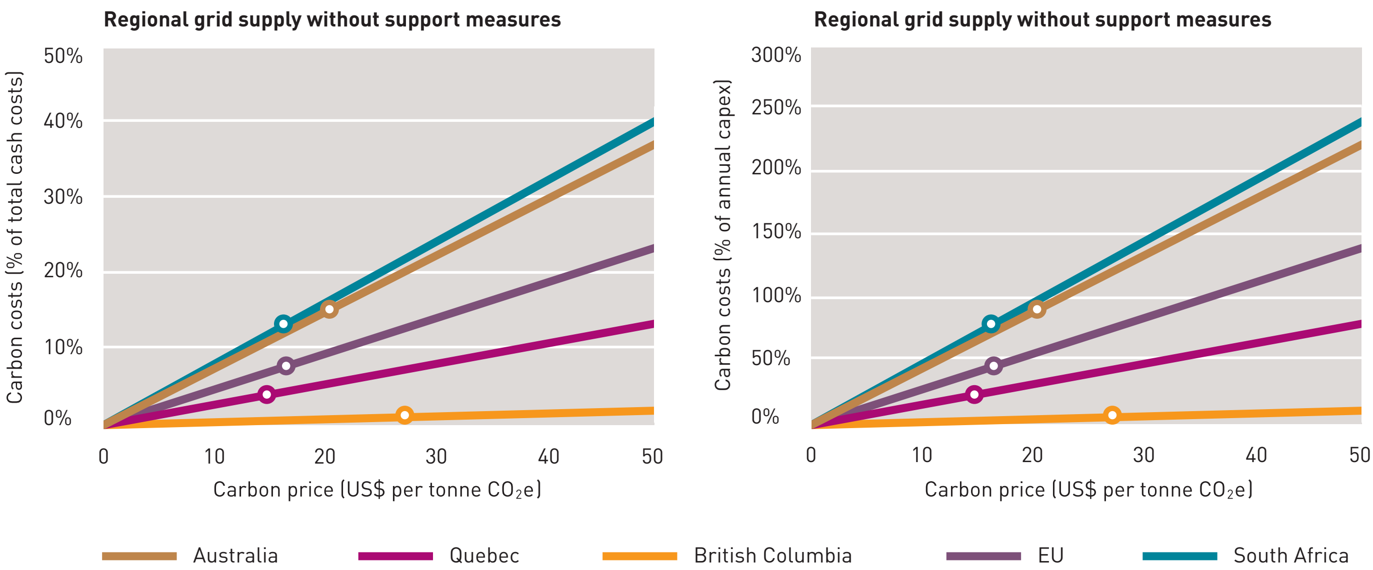
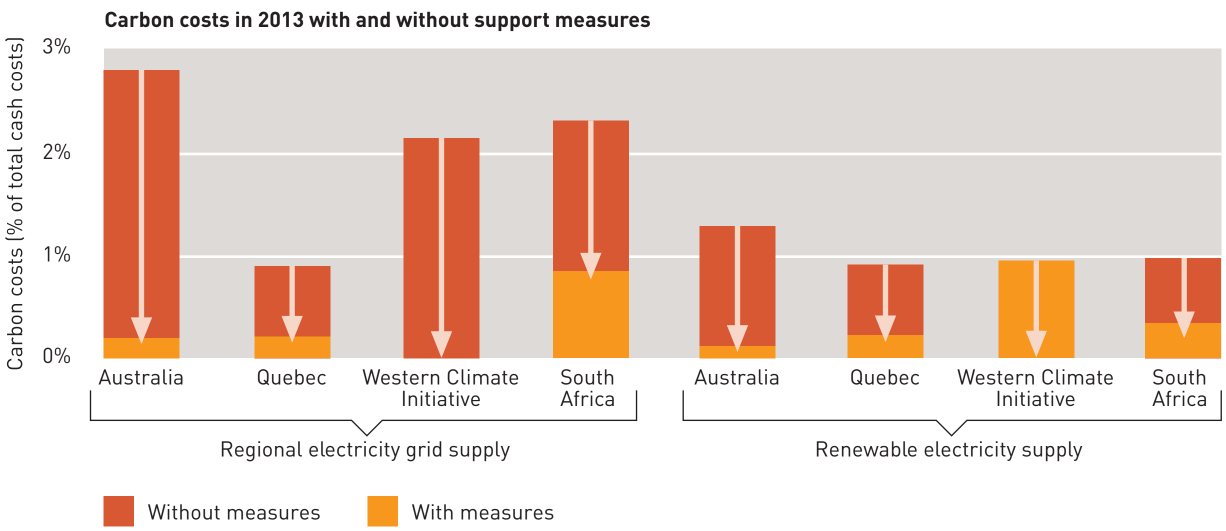
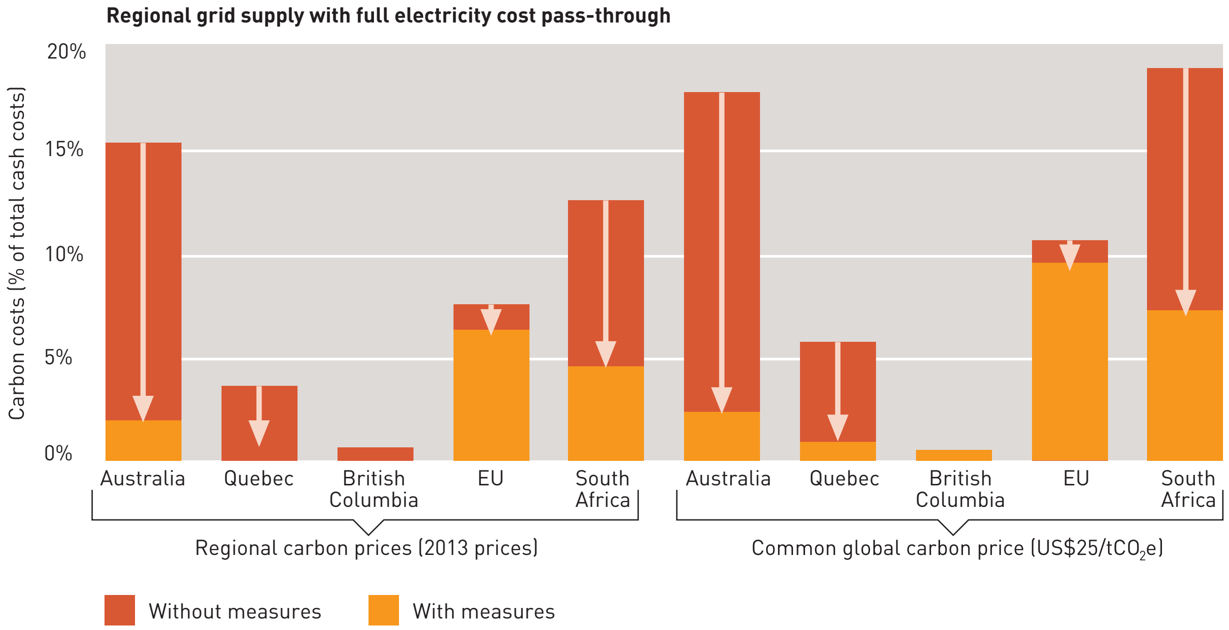


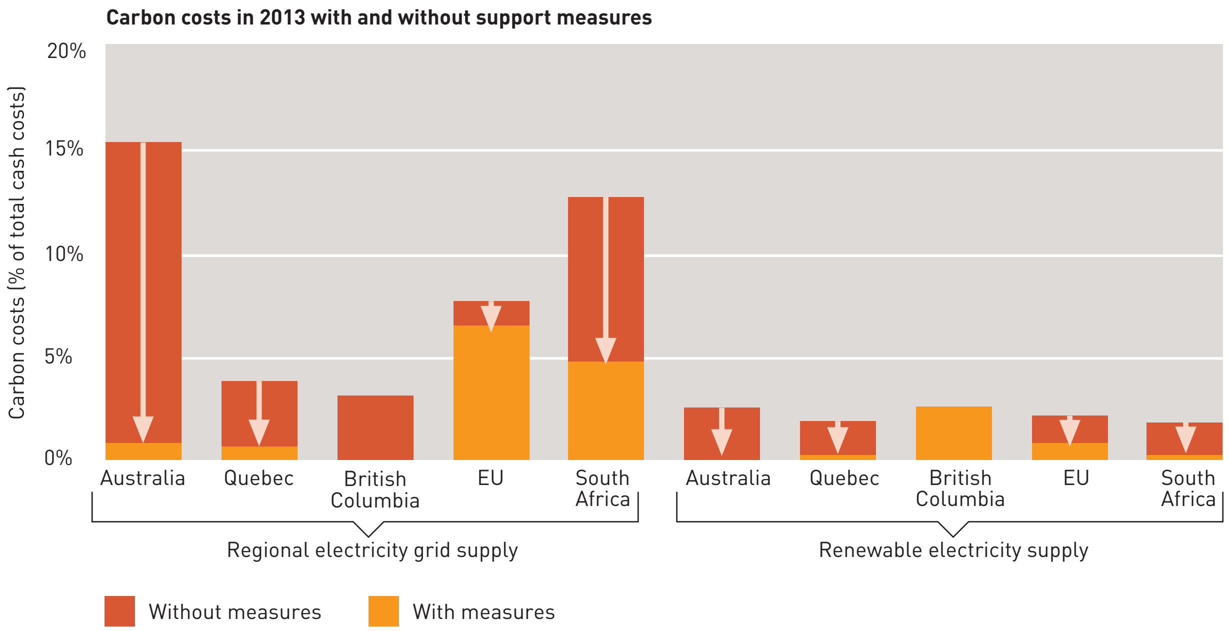
Figure 11: Carbon cost impacts upon copper production



15 It is important to note, however, that at present there is no copper smelting undertaken in British Columbia; the specific result is therefore illustrative only.

Figure 12: **Carbon cost impacts upon aluminium production**





Treatment of electricity sector

Another important cost factor is whether support is provided to the electricity sector and whether it can pass on the costs of carbon pricing (Table 5). This also varies considerably between systems. For example, in the EU emissions trading system, power generators will not receive any free allocation in Phase III. However, in most other cap and trade systems, generators are exempted or given free allowances. For the sake of simplicity, this analysis assumes that only that share of carbon costs to power generators that is not covered by support measures (eg free allocation or tax exemption) can be passed through to industry. Figure 13 shows that indirect carbon costs vary according to this rate of cost pass-through.

Level of compensation

The level of support provided to a sector will directly affect the potential cost impacts. For example, aluminium in Australia was initially given a high level of protection through free allowances that reduced cost impacts well below other systems such as British Columbia and South Africa (Figure 12) based on the analysis.

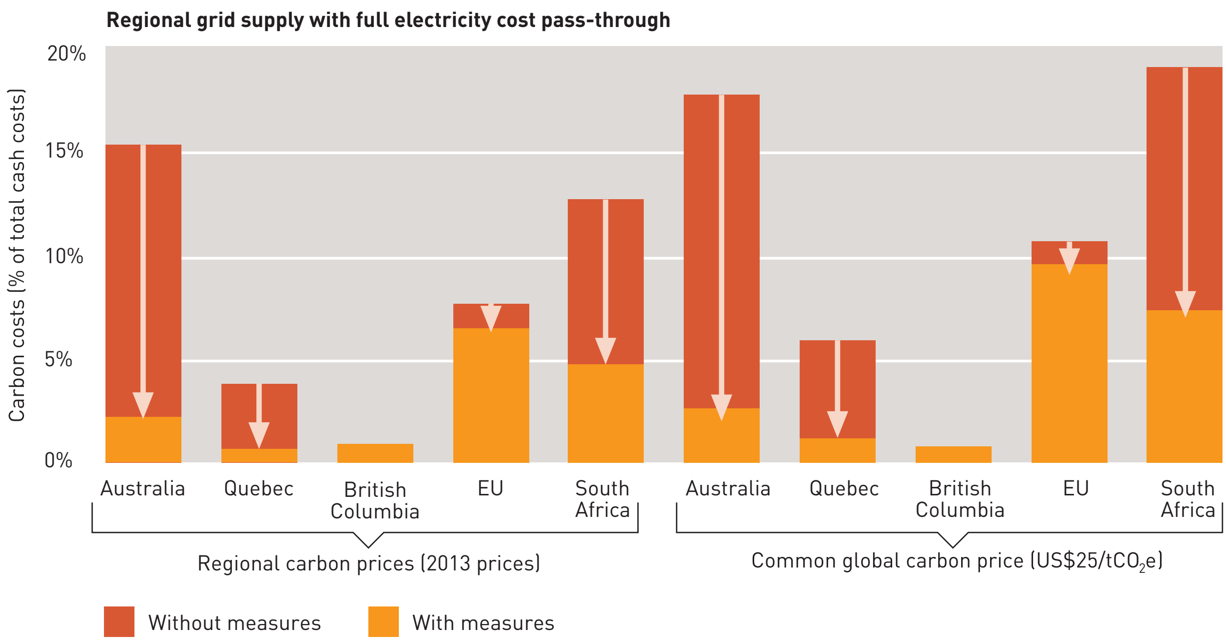
Other measures

This analysis examines compensation in the form of free allowances and tax reductions only. However, other measures that are not assessed here may be significant. These include granting of state aid to electricity-intensive industries such as aluminium and copper smelting in the EU, funds for technology development in Australia and corporate tax reductions in British Columbia. Many of the details of these measures are not currently known, and are likely to evolve in response to ongoing assessments of system impacts upon industry.

Reduction of support over time

Most of the systems assessed within the analysis foresee the gradual reduction of support measures over time. Figure 13 shows how the use of support measures will mitigate the cost impact of pricing in the aluminium sector in 2020. Results are shown for two hypothetical cases: (a) using the 2013 carbon price or tax level; and (b) using a common global carbon price of US$25/t$CO_2$e. For case (a) the impacts are only marginally higher in 2020 than they are in 2013 (see Figure 13) in most systems. The most significant change between 2013 and 2020 is Australia, which foresees a reduction in free allocation of 1.3 per cent per year. Case (b) demonstrates that even in the case of a common carbon price, impacts with and without support measures can still be significant between regions and systems. This is due to the other factors that impact costs (the inclusion of electricity in the system, the rate of cost pass-through, the generation mix and system design factors other than price/tax level).

Figure 13: Carbon cost impacts upon aluminium production in 2020



Variation by commodity and facility

The four commodities involve different production processes, technologies and patterns of energy use, which in turn give rise to differing carbon intensity values (Figure 6). This means that cost impacts vary considerably by commodity and facility. The four selected commodities are discussed below.

Iron ore

Carbon pricing is expected to have a relatively limited cost impact on iron ore facilities (Figure 14). This is largely due to the low emissions intensity associated with iron ore production, arising principally from fuel use in mining and pelletization operations. Emissions from iron ore production arise mainly from the combustion of oil products. As these are captured under all systems, the impacts are similar across regions – with the differences being attributable to different carbon price/tax levels. In spite of this general similarity, data submitted by ICMM member companies under the Carbon Disclosure Project indicates that emissions intensity can be highly variable, depending on facility- and mine-specific factors (indicated by vertical bars in Figure 14).

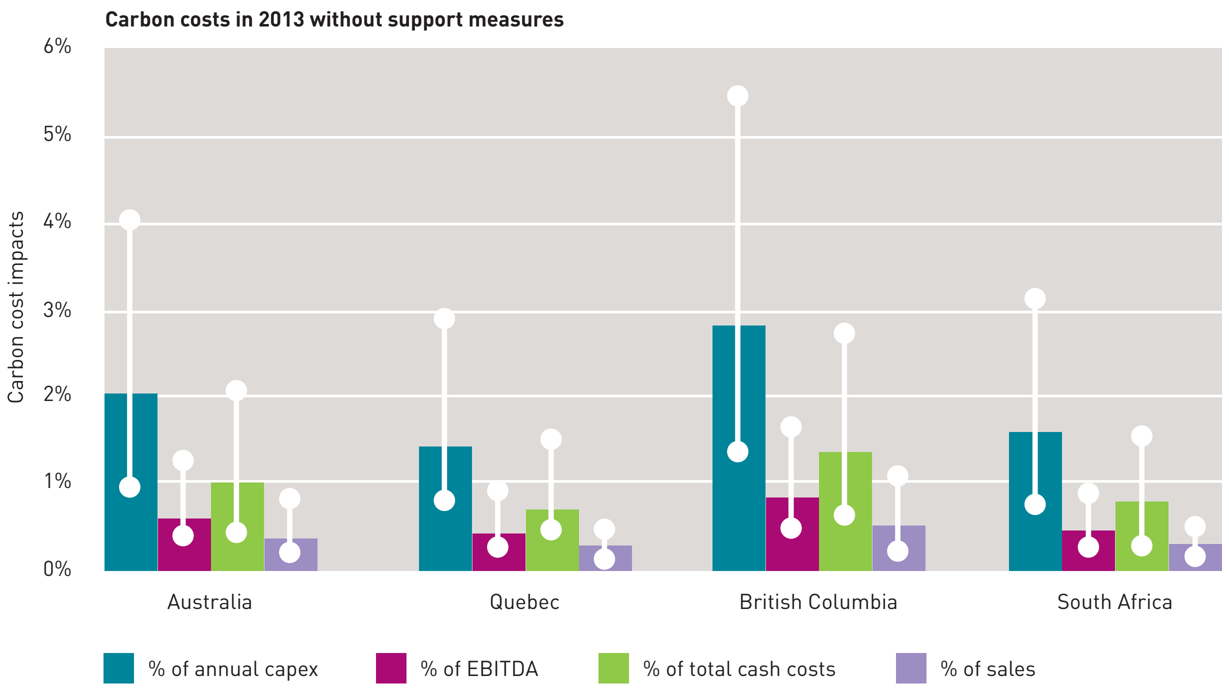
Aluminium

Carbon pricing systems may have a significantly greater cost impact on aluminium production. This is primarily due to the significant electricity requirements for smelting. Figure 8 shows the cost impact in the case of full pass-through of carbon costs. In regions where electricity is supplied by a fossil fuel-based grid, the cost of compliance can reach 90 per cent of annual capital expenditure, over 70 per cent of EBITDA and around 15 per cent of cash costs. Where electricity requirements are met through low carbon grid supply (British Columbia and Quebec) or through self-generated renewable energy, cost impacts are dramatically reduced.

Copper

The potential impact of carbon pricing systems on copper production arises as a result of direct and indirect emissions associated with refining (Figure 15).[16] Due to the current high sale price of refined copper in recent years, this analysis indicates impact is likely to be significantly less than on aluminium. The copper price has increased from US$2,000 per tonne in 1980 to over US$8,000 per tonne in 2011, with most of this increase occurring since 2000.[17] However, should the price fall back to earlier levels, the impact will be considerably greater.

Figure 14: Carbon cost impacts upon iron ore production



16 Note that at present no copper smelting takes place within British Columbia; the results should therefore be considered as illustrative only.

17 Historic prices from BP (2012). 2011 price derived from ICMM annual company reports.

Figure 15: Carbon cost impacts upon copper production

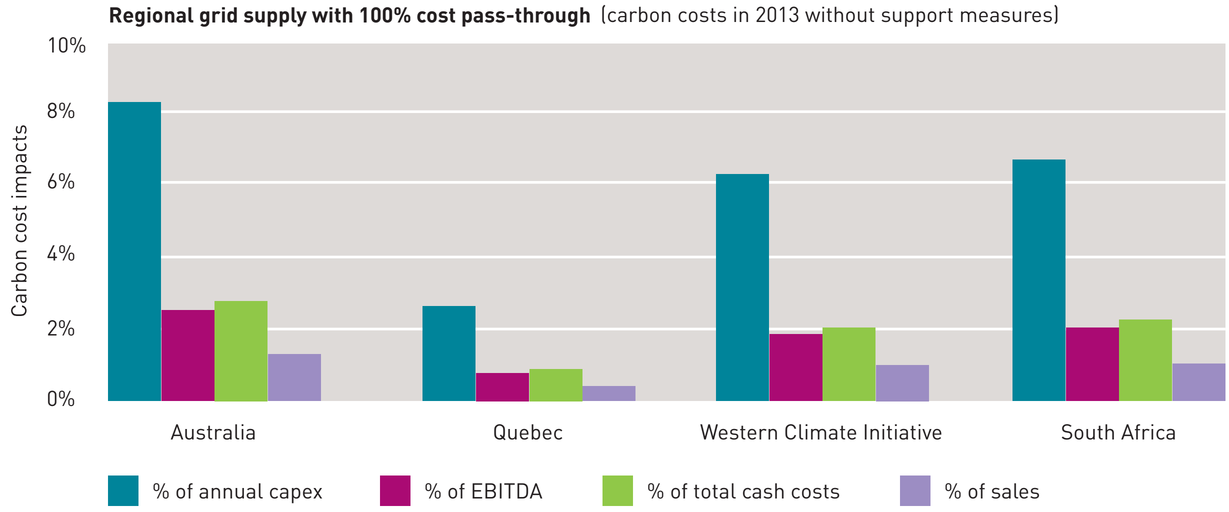


Figure 16: Carbon cost impacts upon coal production

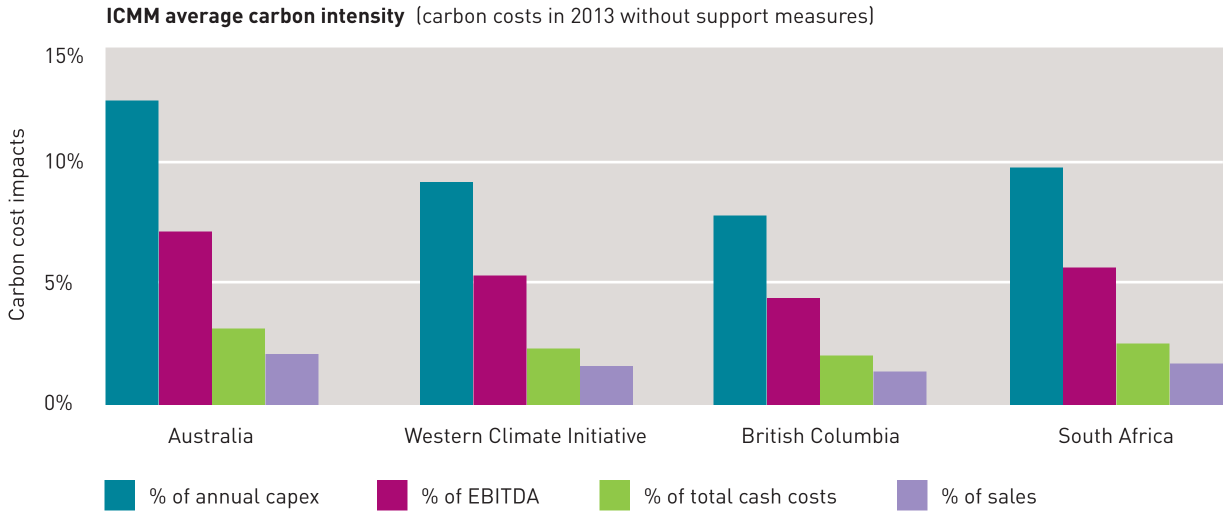
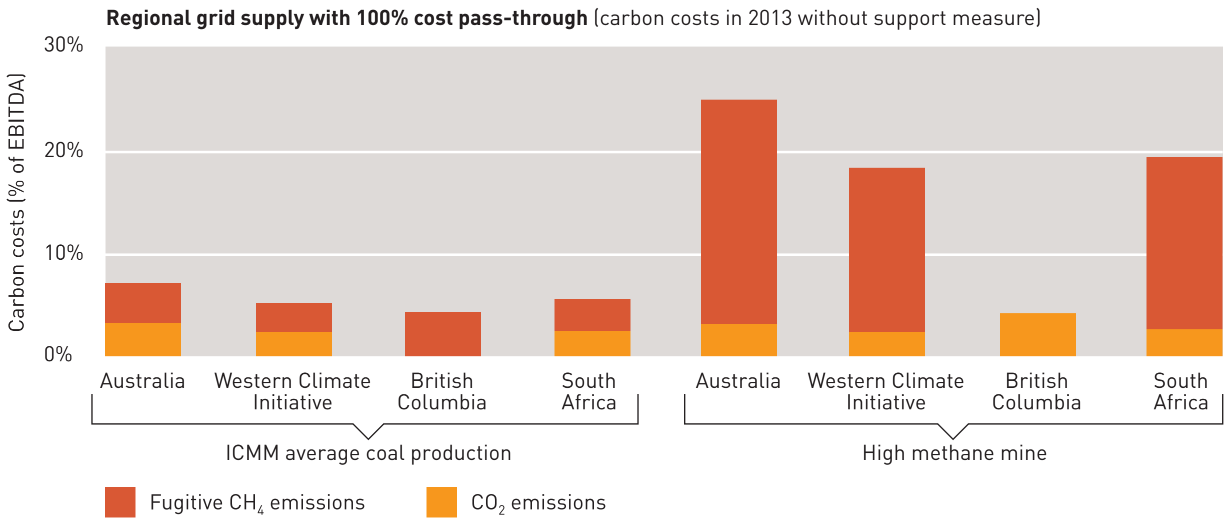


Figure 17: Carbon cost impacts upon coal production: CH_4 vs CO_2 emissions



Coal

The impact of carbon pricing on coal operations varies significantly, but based on average ICMM emissions intensity, it is expected to be similar in scale to the impact on copper (Figure 16). Coal production is less emissions intensive than copper production, but its sales prices are also lower, resulting in a similar cost impact.

The geological characteristics of coal mines are a key factor to determine emissions intensity. This is shown in Figure 17. In particular, mines with high levels of fugitive methane emissions will have a higher liability (when these emissions are included in the system).[18] A complicating factor in the estimation of these costs is the measurement of fugitive emissions, which remains particularly challenging.

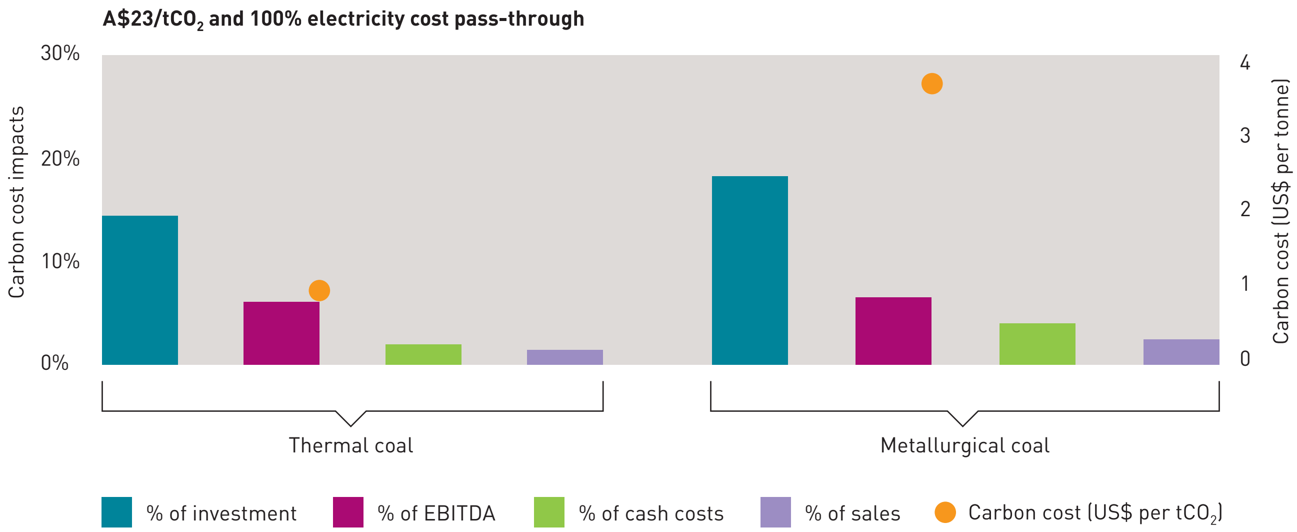
The emissions intensity of coal also varies by production. Available emissions data published by ICMM member companies indicates that the emissions intensity of metallurgical (coking) coal production is around three times that of thermal coal production.[19] Figure 18 shows the case of Australia, where cost impacts are expected to be similar for both coal types. There are two reasons for this. First, there is difference in coal sales prices – metallurgical coal is generally approximately double the price of thermal coal.[20] Second, cash costs per tonne of production of metallurgical coal are also around twice as high and EBITDA per tonne is more than three times as high (see footnote 32 in Annex 2).

The importance of the economic cycle

The analysis presented in this section indicates the potential for carbon price systems to significantly impact the financial performance of companies producing minerals and metals. The greatest financial impact is seen in terms of annual capital expenditure, followed by EBITDA or cash costs, and finally sales. This pattern applies across the commodities and systems assessed.

The data used to represent cost impacts for each commodity (eg EBITDA per tonne iron ore) is a single value representative of several years of ICMM member company data. However, the use of weighted average values does not capture the potential for large variations in financial metrics from year to year. For example, Figure 19 shows that sales prices for globally traded commodities such as copper can fluctuate by a factor of two over several years. Price volatility, driven by a range of complex market factors, is a feature of the four commodities assessed and an important factor affecting earnings and profitability. As a result, the impacts presented in this section have the potential to be significantly higher or lower. Possibilities for further analysis around the economic cycle are presented in recommendations in Section 3.

Figure 18: Carbon cost impacts upon thermal vs metallurgical coal production

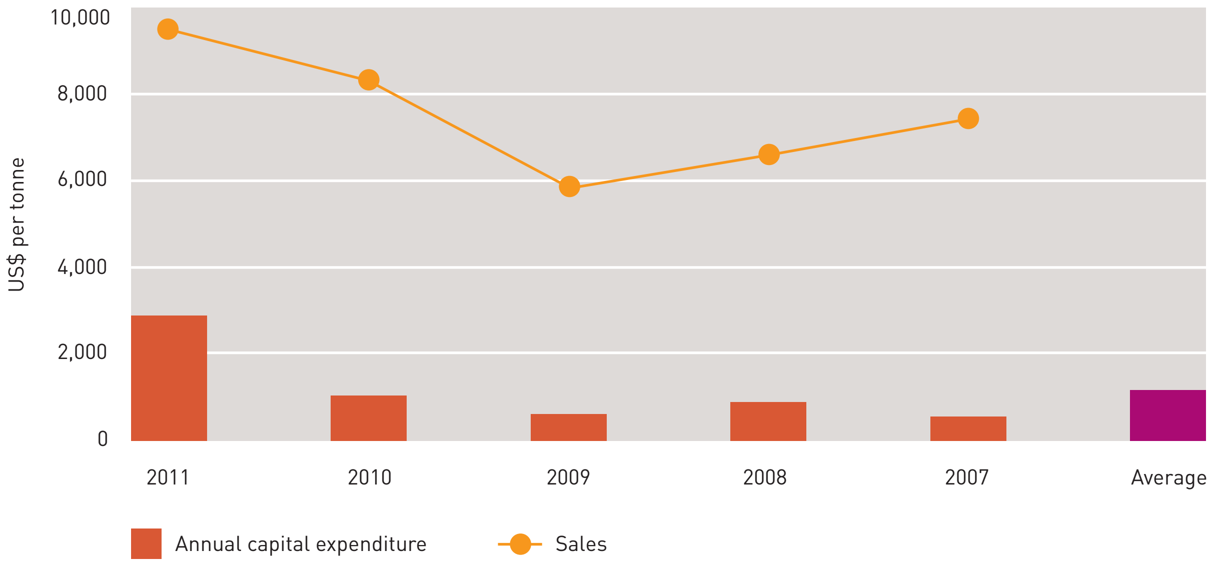


18 So-called gassy mines can vary significantly in terms of fugitive emissions levels; mines with greater than 0.1 tonnes CO_2e per tonne coal produced are considered gassy under the Australia carbon pricing mechanism.

19 Based on a partial analysis only, using data from two large ICMM coal producers.

20 Australia thermal coal price from indexmundi.com (2012).

Figure 19: Annual capital expenditure and sales: copper production



Financial data indicates that annual capital expenditure closely follows revenues. Figure 19 illustrates this in the case of copper production. This follows business logic. A positive cash flow leads to expenditure in new facilities, equipment and refurbishments, including emissions abatement investments. It follows that carbon costs faced by producers at times when revenues and profitability are constrained are more likely to limit such investments.

This analysis suggests that firms are more vulnerable to the pressure of cost impacts at particular periods in the economic cycle. This raises the issue of carbon leakage as a result of competitive pressure, acting both over the short term (eg shifts in production patterns and trade effects) and long term (eg relocation of production facilities).[21] Importantly, pricing systems should have support measures that reflect cost impacts across the entire economic cycle to avoid the possibility of adverse effects.

The literature indicates a high level of uncertainty surrounding the markets for commodities produced by EITE sectors and the behaviour of firms and consumers acting within them.

Notwithstanding differences in the results of models concerning the scale of impacts across sectors, and the limited availability of empirical evidence, studies agree upon the potential for both short-term and longer-term impacts upon EITE sectors, including minerals and metals production. These findings are reflected in the range of compensatory measures provided by the carbon systems.

Extensions to the analysis

The analysis presented above represents an initial attempt to assess the cost of carbon pricing for minerals and metals producers, and to highlight the key factors that influence these costs. This analysis is deliberately limited in scope and design, focusing on a limited range of commodities and financial metrics and restricted by a number of other assumptions. Further research can develop this analysis to give a broader and deeper assessment of carbon policies and their effects. A number of recommendations are listed below.

Vary and refine assumptions

The assumptions used in the analysis can be varied to illustrate how effects vary with changes in the structure and parameters of systems. Specifically, price variations could be added to capture historic prices and future price evolution in addition to variations in compensation mechanisms. Alternatives to the five-year averages of financial data could also be investigated, for example single-year values, high and low values, and averages over different periods with alternative start and end dates. Technical and financial assumptions could be further refined to better reflect real-world circumstances, for example through the greater use of region-specific data inputs.

21 Drawing explicit conclusions concerning these secondary impacts is not within the scope of this report. Further research is required to determine the precise effects.

Change time period of analysis
The current analysis is primarily based upon the characteristics of each system in the forthcoming period (ie from 2013), using five years of ICMM member company data. A useful extension would be to consider the actual historic effects using the known characteristics of the system. The analysis could also be extended into the future based on announced details for systems (including the comparison of alternative options) indicating how they may vary over time.

Scope of commodities
The range of commodities under focus could be broadened to enable a more detailed analysis of the effects across the sector. Research with a broader focus would be informative for a range of commodities with similar characteristics (eg multiple type electricity-intensive metal production). In addition, the commodity scope could be deepened to capture the entire value chain, rather than only certain stages. For example, rather than focusing on alumina refinement, all stages of aluminium production could be considered. Furthermore, greater differentiation between key production stages could be made, for instance, between copper mining, concentration and subsequent production of cathode. Analysis at the facility level could be undertaken, providing that commercial confidentiality was respected, noting that it may be difficult to extrapolate from the specific cases analyzed to a wider sample.

Scope of carbon systems
This analysis captures the key carbon pricing systems in ICMM member countries. But future research could include systems that are currently only under discussion (eg carbon pricing in South America). Other regulation that impacts industry could also be included, such as "secondary" carbon regulation (eg renewable policy), in OECD regions and emerging carbon systems in important regions and markets in which ICMM members are not currently active.

Data quality and scope
Improved data availability and quality would enable a more accurate and reliable assessment of carbon costs. In particular, a well-developed set of emissions factors with clear product and regional boundaries would improve the accuracy of the quantitative analysis, although variations at the facility level would still be relevant. Similarly, further refinement of financial data and closer alignment with regions and commodities would produce results of greater accuracy and granularity.

Summary

The analysis presented in this section quantifies the potential effects of carbon pricing policies and their associated support measures on ICMM member companies. The objective is to refine understanding of the potential financial impacts that arise across specific regions and commodities. This will help to substantiate conclusions concerning the design and effectiveness of different carbon systems.

Carbon pricing policies are evaluated based on how they impact key financial metrics of companies, including sales, capital spend, cash costs and EBITDA. The evaluation draws on a significant body of data, previous research and specific assumptions to inform the analysis. To ensure transparency and credibility in the findings, only publicly available information has been used. Inferences not directly supported by the evidence are not made. In particular, no conclusions concerning carbon leakage and competitiveness effects are specified.

The analysis revealed a number of factors that influence the cost impact of carbon pricing. Although a key factor, the carbon price or tax level is not the only determinant of financial impacts. The results indicate the importance of the electricity sector in determining impacts, particularly in the case of electricity-intensive processes such as aluminium smelting and copper refining. This effect depends on the extent to which this sector passes through costs to consumers as well as the carbon intensity of electricity supply. The details of carbon pricing systems also help to determine the financial impact. Factors such as the coverage of emissions and processes are important and are found to vary considerably across regions, while the use of proposed compensation measures can significantly reduce these impacts. Finally, potential cost impacts fluctuate significantly by commodity – aluminium and coal production from gassy mines are most severely affected. Impacts also vary by region and facility.

"The results indicate the importance of the electricity sector in determining impacts, particularly in the case of electricity-intensive processes such as aluminium smelting and copper refining."

SECTION

3

Assessment of climate change policies

SECTION 3
Assessment of climate change policies

Introduction

In the absence of an integrated and globally effective carbon pricing policy, ICMM's Council of CEOs developed an integrated set of seven principles for climate change policy to achieve effective and efficient national and sub-national specific climate change policies and measures. These principles assist with balancing multiple policy objectives while minimizing the impact on industry competitiveness and ensuring long-term economic prosperity.

This principles-based approach is not intended as a means of driving a particular policy mechanism. Instead, it recognizes the need to respect the different cultural, social, political, economic and physical environments around the world.

This section assesses the selected climate systems in relation to the seven principles. Each principle is outlined and reviewed in turn. The discussion is also informed by interviews with ICMM member companies.

ICMM principles for climate change policy

The seven principles are set out below and provide a basis for assessing different carbon pricing policies. It should be noted that some of these are in development or under review and details are likely to change.

Perspectives of a member company:

In some cases, the approach adopted by the government is too short term to address the climate change problem, or is orientated towards using the climate change problem to generate additional revenues to fund government spending.

Principle 1
Provide clear policies for a predictable, measured transition to a long-term price on GHG emissions

Description
Principle 1 is concerned with ensuring that policies are formulated to ensure that the long-term cost of GHG emissions is clearly articulated. This will enable industry to make plans for the future and transition to a low emissions economy without compromising sustainable economic growth.

Key elements
To ensure an effective pricing system, policies should contain the following:

- a clear, long-term price signal
- a clearly articulated policy path
- strong support for the development of low carbon technologies.

Application to policies
A clear, long-term price signal is important for the mining and metals industry where investments are planned and operated over a long time period and where economic factors such as commodity prices and demand can fluctuate greatly over the economic cycle. Governments can bring some degree of certainty and clarity to investors through long-term targets and objectives and by outlining the expected future development of policies, including any views on price development. These long-term plans are more likely to be credible if a policy has broad-based political and public support.

A regulatory approach will not provide clarity on price levels since the cost of meeting targets will vary by facility. Under an emissions trading system and carbon tax, there is a clear price signal, but that can fluctuate. This can be managed to some extent by the introduction of price caps and floors that put a maximum and minimum price on carbon. Any changes in the level of a tax should have a clearly outlined timeline for amendments and clarity on the grounds under which the tax will be revised. Linking carbon pricing policies will also help to guarantee policy stability over the long term.

Support for the development of low carbon technologies will also offer some predictability around the mechanism by which industry is to transition to a low emissions economy.

However, even where clearly articulated, the extent to which policies – and therefore prices – can be guaranteed over the timeframe in which investment occurs is limited.

Policy assessment		
Carbon tax	British Columbia	When British Columbia introduced a carbon tax in 2008, a schedule of tax increases over the next five years was also announced. This enabled industries to develop operational and investment plans based on a known price level. However, no further announcements were made and a review was announced in 2012 – this has led to uncertainty in the future tax level. The broader direction of carbon pricing policy is also somewhat unclear – the Government is still engaged with the WCI and has passed cap and trade legislation.
	South Africa	Although South Africa has shown commitment to reducing emissions, there is uncertainty about what policies it will adopt. Although the Government committed to a carbon tax in 2010, it has also announced its intention to use a carbon budgeting approach and has not yet ruled out the possibility of an emissions trading system in the future. Proposals for the carbon tax are also unclear, including the form that the tax will take and the details of implementation. This limits the capacity of industry to plan in advance of the proposed 2013–14 start date.
Cap and trade emissions trading system	EU	The level of political consensus around the EU emissions trading system suggests a good level of commitment to the aims of the system and a high level of vested interest in the ongoing operation of the system. These factors suggest that the system will continue and that accordingly, industry will be subject to a carbon price. However, low and volatile price levels have damaged the integrity of the price signal. Intervention measures are now under discussion introducing some uncertainty.
	California	The development process of the California emissions trading system has been characterized by a high level of political and public support, which has been attributed to the fact that it was passed by referendum. In addition, California has continued to support the WCI process, despite the withdrawal of many US states. This offers some certainty that carbon pricing policy will continue in the long term. Fluctuations in price will be reduced somewhat by the implementation of an auction floor price and the release of additional allowances in the event that the price reaches a certain level through the Allowance Price Containment Reserve (APCR).
	Quebec	The policy development process in Quebec has been less widely debated and publicized than in California. However, the Quebec Government has remained committed to the WCI despite the withdrawal of many states. By linking the system to the California system, the Quebec Government is providing a level of assurance that carbon pricing will be in place for some time into the future. Since auctions cover Quebec and California, a floor price and an APCR will apply. These mechanisms will serve to bring some certainty to the price level.
	Australia	While legislation envisages the carbon pricing mechanism as a long-term policy instrument to support 2050 emissions reductions targets, the opposition party has strongly stated its objection and vowed to unwind this should it win the next election even though this would be a politically risky and lengthy process. In addition, concerns have been raised by industry that the policy is inconsistent with the economic context in the country. Currently, the price is managed by fixing the price for the first three years and subsequently applying a price ceiling that is based on the EU emissions trading system price. As with the EU emissions trading system, there will be access to a wide range of offsets that will impose an effective floor price once the fixed price expires. These measures provide some certainty to the price level in the medium term.

Perspectives of a member company:

There needs to be clarity as to the objectives and priorities of funds established under revenue recycling mechanisms if these funds are to be effectively used.

"The primary objective of policy measures should be to address climate change-related challenges, particularly progressively reducing emissions, not revenue generation."

Principle 2
Apply climate change-related revenues to manage a transition to a low carbon future

Revenues generated as a result of carbon pricing policies should be allocated to the development and implementation of emissions reductions technologies and to compensating exposed industrial sectors and vulnerable populations. The primary objective of policy measures should be to address climate change-related challenges, particularly progressively reducing emissions, not revenue generation. This principle is discussed in more depth in a forthcoming ICMM report on revenue recycling.[22]

Key elements

To ensure effective revenue recycling, policies should:

- provide a clear revenue recycling mechanism
- target revenue at low carbon technologies
- target revenue at exposed industries and populations.

Application to policies

Revenue will be raised under carbon pricing policies, but not under a regulatory approach. In a taxation system, revenue is generated by tax payments. In an emissions trading system, revenue is generated by auctioning allowances.

These support measures should include funding to compensate exposed industries and populations for their increased costs in addition to allocation of free allowances under an emissions trading system and tax exemptions under a carbon tax scheme.

Revenue can also be used to finance funds for the development and deployment of specific technologies. By directing these funds towards low carbon technologies applicable in EITE industries, governments can assist in the transition of these industries while having the maximum impact on emissions levels.

To ensure that this principle is achieved, legislation should mandate the recycling of revenues. This should be accompanied by a plan setting out specifically how the revenues will be used, the basis on which they will be allocated and the process for allocation. By setting these elements out clearly, governments can give certainty and transparency to industry.

22 The ICMM report entitled *Options in recycling revenues generated through carbon pricing* limits the scope of revenue recycling measures to "spending programs linked to the revenue source…in the legislation… or where a package of measures is designed to be revenue-neutral to government".

3

Policy assessment

Carbon tax	British Columbia	The British Columbia legislation mandates that all revenues raised from the carbon tax must be recycled. However, this has not been earmarked for those affected by carbon pricing. Recycling has taken the form of cuts in personal and income tax rather than targeted payments. The only exception is a specific payment to low income households to address the impact of higher costs. The tax revenues are not directly used to fund measures aimed at addressing competitiveness loss and developing low carbon technologies, and thus the impact on emissions reductions may be limited, particularly over the longer term.
	South Africa	The Government has stated that it will consider the impact on the poor and the competitiveness of key industries. A program of environmental expenditure will also be considered. However, a 2011 White Paper stated that revenues will not be earmarked.
Cap and trade emissions trading system	EU	In Phases I and II of the EU emissions trading system, the majority of allowances were freely allocated, giving little scope for revenue recycling. In Phase III, there will be a non-legally binding commitment for member states to spend at least 50 per cent of auction revenues on measures to tackle climate change.
	California	The cap and trade legislation mandates recycling of revenues. These revenues will be used to develop a fund to support investments in clean and efficient energy, low carbon transportation, natural resource protection, and research and development related to these areas. One of the criteria for awarding funds is that a project should maximize economic and environmental benefits to the state, and another is that it should protect vulnerable populations. It does not allocate funds specifically to the EITE industries.
	Quebec	The revenues raised from the emissions trading system will be used to fund the 2013–20 Climate Change Action Plan. It is estimated that revenues will account for C$2.4bn of the C$2.7bn budgeted for the plan. Two-thirds of funding will be dedicated to transportation, and the remainder to other sectors, including the development and implementation of energy efficiency technologies in the industrial sector.
	Australia	Legislation mandates that all of the revenues raised as a result of the carbon pricing mechanism will be recycled to the public and to industry, with an emphasis on supporting vulnerable populations and industries. At the industry level, this will include allocation of free allowances to compensate for increased costs (see Principle 3) in addition to direct funding for the development of emissions reductions technologies and efficiency measures. While a large part of these funds are targeted at manufacturing in general, some are allocated specifically to EITE industries, including steel production, coal mining from gassy mines, and foundries. Funds are capped and distributed over a fixed number of years. There is no certainty around how much will be allocated each year.

Assessment of climate change policies

Principle 3
Facilitate trade competitiveness across sectors

Description
Principle 3 ensures that regional climate policies leading to unequal carbon costs do not have an adverse impact on the competitiveness of national industry, particularly EITE industries. The result could be a relocation rather than a reduction in emissions and a decline in investment, employment and tax revenues over time and the potential for distortion of trade flows.

Key elements
To maintain trade competitiveness, policies should:

- implement cost-containment measures
- implement competitiveness policies specific to the requirement of each sector
- ensure that policies are consistent with WTO principles.

Application to policies
A range of policies are available to maintain trade competitiveness. If compensation is chosen, it should address the costs arising from direct inclusion in a carbon pricing system as well as the indirect carbon costs arising from the inclusion of suppliers. Policies that are typically employed include free allowance allocation, tax rebates, BCAs and direct funding. There are a number of trade-offs with these different support mechanisms. For example, under free allocation, firms will not face any costs for purchasing allowances, but it remains unclear whether long-term leakage will be prevented.

To ensure the correct coverage, period and level of compensation for each sector to facilitate trade competitiveness, pricing policies should be accompanied by a review of leakage. Cost impacts are driven to a large extent by the pass-through of costs from fossil fuel-based electricity grids (see Section 2). Policy should take account of these costs and recognize that appropriate coverage may involve a considerable administrative burden. At the industry level, the type of policy instrument used should vary in line with the characteristics of that industry in order to address leakage. Addressing leakage potential comprehensively and accurately would require that compensation is awarded based on an installation level analysis, but this would increase administrative costs and complexity.

Perspectives of a member company:

Since most minerals and metals production is for export, a BCA would need to address the competitiveness of industry in the common export market, not just the import market.

The viability of measures from a legal perspective also needs to be considered. The viability of a measure may be jeopardized if it is judged to conflict with the legal requirements of the WTO. Box 4 outlines the key considerations that need to be taken into account to minimize the likelihood of this occurring.

While compensation can remedy some competitiveness-related issues it can also be the source of further distortions. Differences in scope and level of protection may lead to a differential impact in terms of competitiveness of national industry. Implementing a global carbon system, linking regional systems or harmonizing some elements of separate systems may help to address these impacts and ensure that national industries compete on a similar basis.

Box 4: WTO and climate change policies

The WTO sets out a number of regulations that govern the legality of international trade. Two primary aspects of the WTO are most relevant here. Non-discrimination under the General Agreement on Tariffs and Trade (GATT) stipulates that imported goods must be treated no worse than "like" domestic goods, and that there should be no discrimination among goods on the basis of country of origin. Article XX of GATT outlines exemptions to this law including one that is particularly relevant for climate change protection: the conservation of exhaustible natural resources. The text of Article XX suggests exemptions for legitimate environmental measures, but not for protection against competitiveness impacts.

The second relevant aspect of the WTO is under the Agreement on Subsidies and Countervailing Measures (SCM), which prohibits certain types of subsidies (including those that are linked to export promotion) and allows challenges to other subsidies that cause harm to foreign producers. BCA applied to exports would be a prohibited export subsidy if the rebate were in excess of the costs borne by goods destined for domestic consumption. But there is no legal consensus (or even strong opinion one way or the other) on whether all export adjustment would constitute prohibited subsidies under SCM rules. This depends on whether the domestic system (either a tax, a cap and trade, or other regulation) is legally considered an indirect tax. Indirect taxes such as VAT can be legally adjusted for at the point of export, but direct taxes (such as payroll taxes) cannot, and carbon taxes fall into a grey zone in between.

Emissions trading systems with free allocation of allowances may be considered in violation of subsidy rules, although there is considerable legal uncertainty on this question. It is unlikely that they would ever be challenged in the WTO's dispute settlement mechanism. Carbon taxes would very likely not run afoul of subsidy law. Other support measures for EITE industries such as tax preferences may or may not be actionable subsidies. On these instruments there is almost no legal analysis to guide us.

To date, no formal dispute proceedings on competitiveness and leakage issues arising from climate policies have been launched at the WTO. However, there is a risk that the implementation of BCA in particular may lead to deterioration of relations between trade partners that leads to retaliatory action. The focus on free allowances rather than on BCA as a means of compensation in jurisdictions like the EU and Australia is likely to reflect, at least in part, the desire to avoid such conflict.

Policy assessment		
Carbon tax	British Columbia	For industry, the only transitional support has been through general corporate tax reductions and a gradual increase in the level of tax paid. There are no specific measures in the carbon tax legislation to compensate industry for higher costs or to develop low emissions technologies. Following consultation with industry, this will be revisited as part of the current review of the carbon tax. The provincial government funds other programs that are not directly related to the carbon tax but which may support industry in the transition. These include policies to develop clean energy technologies, energy efficiency and demand-side management of electricity.
	South Africa	It is proposed that all entities will be eligible for a basic tax-free threshold of 60 per cent, with EITE industries eligible for additional compensation in the form of a higher threshold and a higher limit for the use of offsets. A list of eligible sectors and level of support has been proposed but the exact basis on which this has been determined has not been given. The support will be temporary and a broad schedule for phase-out has already been announced.
Cap and trade emissions trading system	EU	A number of cost-containment measures have been introduced under the EU emissions trading system, including the right to bank and borrow allowances and the use of offsets to comply with obligations. In addition, the majority of allowances were allocated for free in Phases I and II to compensate for increased costs. In Phase III, the proportion of allowances that are auctioned will be increased until it reaches 100 per cent in 2027. Industries at risk of leakage will continue to receive free allowances in a benchmarking approach to incentivize emissions reductions. A large number of the sectors currently defined as eligible for support may not genuinely be at risk of leakage and incentives for emission reductions have been weakened. The treatment of the electricity sector has been particularly significant within the context of the EU emissions trading system. In Phases I and II, the sector received free allowances but nonetheless passed carbon costs through to end-users, including those industries outside the system. In Phase III, 100 per cent of power sector allowances will be auctioned (Section 2 highlights some exceptions). In an attempt to address the associated cost impact on end-users, the EU has based its criteria for assessing carbon leakage on both direct and indirect carbon costs, and has also announced a framework under which member states can give aid to electricity-intensive industries.
	California	A thorough analysis of leakage risks and measures to address this risk was carried out when designing the California emissions trading system. Separate approaches have been adopted for the industrial, refining and electricity sectors. The industrial sector is further disaggregated with industries classified as having a high, medium or low leakage risk, dependent on emissions intensity and trade exposure. This classification is used to determine the proportion of free allowances received and the rate of decline over each of the three compliance periods between 2013 and 2020. This should provide a more accurate identification of industries in need of support and incentives for emissions reductions should be less distorted, but this accuracy is achieved at the cost of greater administrative complexity. A number of cost-containment measures have also been adopted (offsets, banking and borrowing, APCR). Linking to the Quebec system under the emissions trading system will also serve to reduce compliance costs across the two jurisdictions.
	Quebec	A number of cost-containment measures have been adopted in Quebec although these are limited. Linking with California is likely to reduce costs of emissions reductions, particularly since the hydro-dominated electricity grid means that there are fewer low-cost abatement measures in Quebec than in California. Specific compensation is given to a wide range of industries (including all manufacturing activity) through the free allocation of allowances. In the first commitment period, allowances will be allocated based on an entity's average historic emissions intensity with 100 per cent allocation for process emissions, 80 per cent for combustion emissions and 100 per cent for emissions from other sources. The allocation will subsequently decline based on industry-specific efficiency benchmarks. However, effectiveness may be compromised by the broad industry coverage since it is unlikely that all of the industries cited are at risk of leakage. Furthermore, the detail of the policies remains absent: the basis on which industries are classified as being at risk of leakage has not been published and the data necessary to calculate the rate of decline in assistance is not yet available. This is contributing to uncertainty, which may limit investment.
	Australia	In the Australia carbon pricing mechanism, mechanisms to reduce costs such as offsets and banking and borrowing are not permissible during the fixed-price phase. Participants can submit up to 5 per cent of their annual liability using land-based offsets generated under the Carbon Farming Initiative. Industries are classified as moderately or highly emissions intensive and free allowances are awarded to exposed industry, providing some level of differentiation by industry. In addition, a range of funds has been established to support the development and implementation of low emissions technologies in the manufacturing sector in general and in EITE industries specifically (see Principle 2). However, there are some inconsistencies in the application of measures to protect against leakage. For example, the steel sector receives considerable levels of assistance, which has been criticized as well in excess of requirements, potentially leaving the regime open to trade law disputes. By contrast, the coal sector is excluded from the JCP. The only assistance provided to gassy mines is through annual budgetary appropriations (A$1.3bn to be spent over six years with no indication of how much will be distributed per annum). Furthermore, the support provided to gassy mines applies only to a limited number above a defined level of emissions, leaving those below the threshold exposed.

Principle 4
Seek broad-based application

Description
The most cost-effective reduction of GHG emissions is needed so policy design must consider covering the broadest possible range of carbon emissions activities, policy mechanisms and low carbon energy strategies across sectors internationally.

Key elements
To ensure broad-based application, policies should:

- encompass all sectors
- include all GHGs and emissions sources
- consider a range of policies and links with international mechanisms.

Application to policies
A broad-based approach can be achieved in all systems by choosing the design most appropriate to local circumstances. In an emissions trading system, low-cost abatement can also be secured by allowing access to a wide range of offset opportunities. For example, authorizing the use of offsets from sequestration projects such as forestation, avoided land use change and CCS may provide lower-cost mitigation opportunities (see Principle 7). Such offsets are typically associated with emissions trading systems, but could also be applied to a carbon tax by reducing the liability of a company.

Ultimately, this principle would imply a global system with all sectors, gases and geographies subject to the same requirements and operational procedures. In the absence of such a system, integrating or linking systems could increase the breadth of coverage and minimize costs. Differences in cost impacts between systems are reduced when there is movement towards a common price signal (see Section 2). It may be preferable to link systems in gradually to avoid risks of oversupply and too much administrative complexity, for example commencing with the integration of selected elements such as reporting requirements or authorizing offsets from a range of international sources.

Perspectives of a member company:

Access to the offsets market broadens the range of mechanisms by which reductions can be achieved and reduces the cost of doing so. It can also represent an additional opportunity if reductions made by companies generate offsets.

"In an emissions trading system, low-cost abatement can also be secured by allowing access to a wide range of offset opportunities."

Policy assessment		
Carbon tax	British Columbia	The carbon tax has relatively broad coverage: it is paid by all entities that purchase fossil fuels and penalizes those that are particularly energy intensive. However, it excludes emissions of GHGs that arise as a result of activities other than fossil fuel combustion.
	South Africa	The proposals published to date suggest that the tax will be applied to a broad range of industrial sectors. It is not clear what range of gases and sources of emissions will be covered.
Cap and trade emissions trading system	EU	Phases I and II of the EU emissions trading system were relatively restricted in their scope, covering only CO_2 emissions and a limited number of sectors. For Phase III, some additional gases and industries will be covered, although this extension is limited. The EU has stated its intention to develop links with a range of other emissions trading systems, and recently announced an agreement to eventually link with the Australian system. Linking has proceeded at the direct level (through formal linking to other emissions trading systems) and at the indirect level (through accepting offsets from reduction projects covering a range of geographies, gases and emissions sources).
	California	The California system includes all six Kyoto GHGs plus nitrogen trifluoride. Coverage includes electricity generators, CO_2 suppliers, large industrial sources, petroleum and natural gas facilities. In the second commitment period (2015–17), suppliers of imported electricity, natural gas, transportation fuel and other fuels will be added. Overall coverage of GHG emissions is initially relatively low (estimated at 37 per cent), but it expands significantly in the second commitment period (estimated at 85 per cent).
	Quebec	Similar to the California system, the Quebec system has broad coverage. It includes the same seven GHGs from industrial and electricity sectors in the first commitment period. In the second commitment period, this extends to distributors and importers of fuel. However, agriculture, which accounts for 9 per cent of emissions, is excluded from the system.
	Australia	The Australia carbon pricing mechanism covers direct emissions of CO_2, CH_4, N_2O and PFCs from stationary energy sources, industrial processes, waste sectors and fugitive emissions from operational mines. This amounts to 60 per cent of Australia's total GHG emissions, but it does not include the transport, forestry and agriculture sectors. Emissions from these sectors are being addressed through other measures. The transport sector is subject to an equivalent carbon price through fuel duty. An attempt has also been made to include agriculture and forestry through the Carbon Farming Initiative, a carbon offsets system that enables the agricultural and forestry sectors to earn carbon credits through land use projects and sell these credits to entities liable for emissions reductions. As mentioned in the above on the EU, Australia and the EU recently announced plans to eventually link their systems.

Assessment of climate change policies

Principle 5
Be predictable and gradual

Description
Imposing sudden, erratic and unclear climate change policies can render parts of the economy irreversibly uncompetitive and can unnecessarily harm consumers. Instead, policy should provide long-term price signals, incentives and time for all segments of the economy to adapt to a low carbon future.

Key elements
To ensure suitable timing and predictability, policies should:

- be announced well in advance
- be introduced, extended and modified gradually over time.

Application to policies
Policymakers can ensure that all carbon systems are introduced well in advance of implementation. Changes to and the implementation of policy should occur in line with a preannounced schedule. This will give industry adequate time to develop the necessary operational systems and emissions reduction measures. Each policy should also be introduced gradually. This could entail an initial period of reporting only, allowing participants to familiarize themselves with operational requirements, followed by a gradual expansion of coverage to allow the integrity of the system to be tested and improved over time. Alternatively, emissions reductions targets could be gradually tightened. Carbon policies should be introduced at a rate that is politically credible and, at the same time, achievable for participants.

Perspectives of a member company:

Uncertainty on the price level and on the political prospects for policies result in the risk that investment will be delayed.

> "The implementation of policy should occur in line with a preannounced schedule. This will give industry adequate time to develop the necessary operational systems and emissions reduction measures. Each policy should also be introduced gradually."

Similarly, measures to compensate operators for competitiveness loss and to assist in the transition to a low carbon economy need to be announced well in advance. These announcements should articulate the sectors and technologies eligible for support, the criteria under which these have been selected, the level of support provided and the process for allocation. Similarly, the phase-out of support should be announced in advance. It should give industry time to adjust while maintaining the impetus for emissions reduction and economically efficient policy. Different industries may require support over different periods of time, depending on the emissions reductions technologies available.

While the predictability of policy can be facilitated by the measures outlined above, the mining and metals sector makes investment decisions that are long term, in many cases for over 50 years. It is not possible for governments to make commitments over such time horizons. However, consistency and predictability of policy in the shorter term will help to assure participants that a system may continue to exist. Furthermore, by setting out the vision and objectives for an emissions reduction system, a government can help to orient its future evolution.

Policy assessment		
Carbon tax	British Columbia	In the early stages of the policy formation, tax levels were announced well in advance of implementation. However, in recent years this has not been the case and the predictability of policy has been reduced. This is most notable for the extensions in the coverage of sectors and fuels. In other respects, such as increases in the tax level, the policy remains predictable.
	South Africa	The South Africa carbon tax has been under discussion since 2010, with government commitment confirmed in a 2011 White Paper on climate strategy and some further details announced in early 2012. It proposes a start date of 2013–14, which gives little time for consultation or for preparation. The policy itself may be introduced gradually. The White Paper suggests that the Government will introduce the tax at a low rate and phase in higher rates over time to allow for adjustments. Announcements in 2012 raised the possibility that the tax would be gradually rolled out to all economic sectors.
Cap and trade emissions trading system	EU	The EU emissions trading system has been rolled out steadily. The first phase of the EU emissions trading system was a trial period with minimal coverage. The scope of the system was gradually expanded in Phase II and III to cover a wider range of gases and industries. The allocation of free allowances has also reduced in each phase, and in Phase III free allowances will be targeted at those at risk of leakage. The review of these sectors was conducted in line with a preannounced schedule although the outcomes of this review are uncertain. In addition, uncertainty has characterized other elements of the system, including market intervention and the authorization of state aid for electricity-intensive industries. In spite of this uncertainty, most broad changes in the system have been signalled in advance.
	California	The California emissions trading system has been introduced over an extended period and following extensive consultation, both within the WCI and at the state level. The system commences with a trial period of one year and gradually extends sector coverage and tightens the emissions cap. Compensation policies will decline between 2013 and 2020. Developments after this time are unclear.
	Quebec	Quebec has been part of the WCI since 2008. In this respect, participation in a cap and trade system has been anticipated. However, the legislative process was concluded quickly and without much consultation. The emissions trading system itself is gradual in its approach: a trial year precedes full operation; sector coverage increases over the first two commitment periods and the cap is tightened over time. It is harder to assess whether the phase-out of transition measures occurs at a suitable pace since not all of the parameters required for the calculation are published in the legislation.
	Australia	All relevant sectors are covered from the outset of the scheme. The division of the carbon pricing mechanism into a fixed and floating period enables a gradual transition to a full market pricing system. Price controls in the first three years of the floating-price system further ease this transition. The phase-out of transition measures will take place over time and according to a preannounced schedule. For the floating-price phase, annual emissions caps are set on a five-year rolling basis, taking into account the recommendations of the independent Climate Change Authority. This is an attempt to give industry some certainty.

Principle 6
Be simple and effective

Description
Policies and regulations must lead to a climate change management regime that is simple to understand and administer so that the associated costs do not outweigh the benefits, and delivers on the environmental objective of effectively reducing GHG emissions.

Key elements
To provide simplicity and effectiveness, policies should:

- provide clear incentives to reduce emissions
- ensure costs of implementation do not exceed the associated environmental benefit
- support environmental targets.

Perspectives of a member company:

The costs of compliance can be considerable in terms of financial costs and resources necessary. The actual cost will depend on the requirements of the system in question and on the quality of company data.

Application to policies
Policies should create incentives to reduce emissions, either through a carbon price signal or to directly reward mitigation action or investment undertaken to reduce emissions associated with production.

When designing a carbon pricing policy, consideration should be given to the cost of both administering the scheme and compliance. Multinationals in particular will have to comply with multiple carbon pricing policies across many jurisdictions where they operate. Harmonizing particular elements, for example reporting requirements, would help reduce some costs for participants in the absence of a global carbon pricing system. Governments can reduce administrative costs by assessing the strengths and weaknesses of existing policies. Industry stakeholders can also provide valuable lessons on the clarity of incentives to reduce emissions under different carbon pricing policies. Policy formulation should be an inclusive process.

Effective carbon pricing policies are those that achieve the desired environmental outcomes while minimizing any adverse economic impacts for the jurisdiction it covers. Simple policies that incorporate successful elements from existing policies are most likely to achieve the desired environmental outcome. This is particularly true if policies are introduced gradually (Principle 5) as a policy can be refined slowly to ensure that the incentives to reduce emissions are as clear as possible.

"When designing a carbon pricing policy, consideration should be given to the cost of both administering the scheme and compliance. Multinationals in particular will have to comply with multiple carbon pricing policies across many jurisdictions where they operate."

Policy assessment		
Carbon tax	British Columbia	The carbon tax is relatively simple in design and implementation, and collection is based on existing tax collection structures. Some evidence suggests that the tax has been effective in reducing emissions, although causality has not yet been established.
	South Africa	The 2010 discussion paper proposes a system with fewer participants and a lower administrative burden as the reasons for preferring a tax to an emissions trading system. However, there are concerns that the Government may be prioritizing simplicity over accuracy since the proposed system is based on benchmarking emissions intensities, which may not fully reflect the differences in emissions and the opportunities available for emissions reduction that arise purely as a result of mine characteristics.
Cap and trade emissions trading system	EU	The EU emissions trading system is a complex policy mechanism that requires technical understanding by participants largely as a result of the geographic spread as well as compensation and cost-containment mechanisms in the EU system. The effectiveness of the EU emissions trading system is still not clear. Some commentators have argued that environmental effectiveness has been compromised by under-ambitious caps on emissions and by the allocation of high levels of free allowances that have in turn led to low prices.
	California	The California system requires a high level of technical understanding from participants – for example, the development of different compensation measures for the refining, electricity and industrial sectors. The categorization of the industrial sector into high, medium and low risk may help to maintain incentives in line with the actual risk of leakage. However, the system is also likely to be more expensive in terms of finance and other resources both for operators and participants.
	Quebec	The Quebec system is complex in its design. Much of the complexity arises in relation to the compensation measures. For example, the rate of decline of compensation will vary by industry and is calculated using one of a number of complex formulae.
	Australia	As is the case for the other emissions trading systems, the Australia carbon pricing mechanism has been criticized for its complexity. This may be the result of the political trade-offs that were made in the design of the system. For instance, compensation to the coal sector is set out in separate legislation.

Principle 7
Support low-emission base-load generation technology development

Description
It is clear from all credible scenarios that the transition to effectively address climate change will require a significant technology transition over the next few decades, in particular base-load generation. Investments developing such technologies are substantial and high risk, so a collective effort will be required to ensure sufficient emphasis is placed on seeking such technological solutions.

Key elements
To provide support for low-emission base-load generation technology, policies should:

- generate funds for technology development
- put other supporting measures in place.

Application to policies
Carbon pricing may inhibit the development of certain technologies by reducing the funds available to companies for investment. Section 2 shows that carbon costs have the potential to significantly impact financial performance, accounting for up to 90 per cent of annual capital expenditure in some cases.[23] Alternatively, if emissions from electricity generation are included within the coverage of a system, carbon pricing may provide additional incentives for development and deployment of low carbon technologies, particularly if an industry is very electricity intensive. However, carbon pricing policy alone is not sufficient to address the high risk and high cost of developing these low carbon technologies. Public–private investment partnerships are key.

Revenues from carbon pricing can be used to fund technology development. Typical structures for distribution include dedicated funds and grants. Alternative mechanisms include targeted free allowances or tax rebates for specific investments. However, much of the revenue generated from carbon pricing is needed to compensate exposed industries and vulnerable households. Thus, revenue recycling alone is unlikely to provide the necessary funds required to develop and deploy low emissions generation technologies on a large scale.

Perspectives of a member company:

Carbon prices are not sufficient to stimulate the investment required for a low emissions electricity sector – complementary policies are required.

Given the scale of investment needed to bring these technologies to market, and the relevance of clean electricity (both base-load and non-base-load) to all sectors of the economy, cross-industry and cross-country collaborations should be explored. This will leverage the funding available and ensure that the technologies developed are widely applicable. Similarly, given that low carbon electricity generation is in many ways a public good, collaborations between the private and public sector should be supported. The public sector can provide support in a number of ways. It can provide research facilities and connect participants from the industry and electricity sectors. It can also reduce risk by guaranteeing investments or providing green bonds.

"Revenues from carbon pricing can be used to fund technology development. Typical structures for distribution include dedicated funds and grants. Alternative mechanisms include targeted free allowances or tax rebates for specific investments."

23 For aluminium production based upon fossil fuel grid supply with full cost pass-through, and without support measures.

Policy assessment		
Carbon tax	British Columbia	The generation mix in British Columbia is primarily hydroelectricity based. As such, Principle 7 is less important for the province than for other areas. The carbon price and low corporate tax rates can further incentivize de-carbonization. Additional support comes from a range of other projects funded, at least in part, from the provincial government budget. This includes a CCS project in partnership with the private sector, which may have application in both the electricity generation sector and other industries.
	South Africa	The electricity generation mix in South Africa is predominantly coal based, with the market dominated by the state-owned utility Eskom. Reduction of emissions will require a shift away from this generation mix towards cleaner base-load technology. A 2011 White Paper announced a flagship program aimed at developing a CCS demonstration plant but there is no specific commitment as yet to earmark carbon pricing revenue for technology development.
Cap and trade emissions trading system	EU	An EU directive due to come into force as of 2013 includes provisions for incentivizing CCS. It provides that CCS will be incentivized directly through the EU emissions trading system, as carbon dioxide stored in geological formations will not be classed as emitted and power stations will not have an obligation to submit certificates for these emissions. In addition, up to 300 million allowances will be available to help stimulate the construction and operation of up to 12 commercial demonstration CCS projects and innovative renewables projects. This fund will also support demonstration projects for innovative renewable energy technologies. A number of separate EU initiatives exist that encourage the development of low carbon base-load technologies. These include specific funding for both CCS and clean coal research and general funding provided by the EU Framework Program for Research and Technological Development. This funds a range of development activities across the EU, including public–private partnerships.
	California	The development of clean and efficient energy is one of the activities identified for revenue recycling from the emissions trading system. In addition, incentives will be provided by the inclusion of the electricity sector in the cap and trade system. However, the focus of clean energy initiatives in California has been renewable energy, rather than base-load generation. Support has come under the Renewable Portfolio Standard and the Renewable Electricity Standard, both of which were established under the Scoping Plan for AB 32, together with the framework for the cap and trade program.
	Quebec	As in British Columbia, the generation mix in Quebec is primarily hydroelectricity based, making Principle 7 less relevant than in other regions. Nonetheless, some support is provided. The Climate Change Action Plan allocates revenue funds to developing bioenergy options as well as renewable and clean energy sources.
	Australia	The Clean Energy Package envisages that the carbon price will play a role in incentivizing clean energy, but acknowledges that additional support is required. Funded by recycled revenue, the Clean Energy Finance Corporation will invest in the commercialization and deployment of renewable and clean energy. In addition, the Clean Technology Innovation Program will award grants to businesses for R&D in renewable energy and other low-pollution measures. While these programs are largely aimed at renewable energy, they also capture clean energy technologies such as low emissions co-generation. However, the majority of support for clean base-load technology is given through initiatives outside of the Clean Energy Legislative Package. The CCS Flagships program supports the construction of two to four commercial scale CCS projects through grant funding for up to one-third of construction costs. This is complemented by the National CO_2 Infrastructure Plan that aims to identify and develop sites suitable for long-term storage of CO_2. Finally, the National Low Emissions Coal Initiative supports the development and deployment of technologies to reduce emissions from coal use, including a joint project with participants from China as well as industry.

SECTION 3
Assessment of climate change policies

Summary

The influence of carbon pricing is extensive and governments must balance a number of policy objectives when introducing a system. These include environmental effectiveness, economic efficiency in incentivizing reductions and ease of operation. The ICMM *Principles for climate change policy design* aim to support these objectives while minimizing the impact on industry competitiveness in a future low carbon economy.

A global regime for carbon pricing is the preferred approach over the long term. If properly designed, this would support many of the ICMM *Principles for climate change policy design*. In particular, a global regime would facilitate trade competitiveness since industries in each jurisdiction would be subject to the same carbon price and the same operational regime, thus removing unequal distribution of carbon costs (not counting variation from different fuel mixes). It would also reduce the need to develop complex competitiveness and leakage policies. In the absence of a global system, the integration or linkage of regional systems would decrease price difference by providing access to credits originating from other jurisdictions.

Governments that are currently designing new climate policy systems have an existing, although fledgling, body of experience to learn from. Policymakers must draw on this experience while ensuring to develop systems that reflect the specific circumstances of the region. The ICMM *Principles for climate change policy design* will help to achieve this objective and ensure a measured transition to a low carbon economy without detrimentally impacting the local and international competitiveness of major industries.

"In the absence of a global system, the integration or linkage of regional systems would decrease price difference by providing access to credits originating from other jurisdictions."

Specific concerns for mining and metals sectors

The characteristics of a given commodity and the process used to produce it are fundamental to the effects that an emissions reduction policy will have on the production costs and, in turn, on the relative competitiveness of production. The quantitative analysis presented in Section 2 highlights the following important characteristics.

Price

An indication of the percentage increase in costs of a carbon policy enables the easy identification of the most vulnerable commodities. The increase will be relatively low if the commodity's energy intensity of production is low, and if other costs, for example labour or capital, are high.

Trade exposure and emissions intensity

The impact of carbon pricing on industry costs is likely to be lower on average where there is less trade of a commodity, but trade exposure should be considered at the installation level. Some installations are exposed to global competition whereas others are not. For example, some coal mines serve local demand only. Similarly, while it is evident that lower emissions intensities should lead to lower exposure, this will also be influenced by the scope of emissions coverage (direct and/or indirect), the sources of emissions (combustion, process, fugitive) and the types of gases that are captured by the system. A well-designed system will have a test for trade exposure to determine eligibility for compensation, noting the difficulty in designing indicators to serve this purpose.

Volatility over the economic cycle

This report uses five-year average (2007–11) financial figures that include a high variation in specific figures within that timeframe. The financial performance of commodity industries is highly variable and carbon costs become more or less affordable according to industry and market trends. The high and low points in the commodity cycle may or may not be included in the period analyzed. Carbon systems need to be responsive to market turbulence.

Emissions reductions technologies

The impact of carbon pricing can be more easily mitigated if there are low carbon technologies still to be implemented. Unfortunately, this is not often the case for energy-intensive industries: as energy is a major part of their production costs, its use has been largely optimized over a long period. However, some cases exist where policy can spur development such as the reduction of fugitive emissions from open-cut coal mining.

Recommendations

Based on the quantitative analysis undertaken, the assessment of each carbon pricing scheme considered against the ICMM *Principles for climate change policy design*, a survey of ICMM members and the specific concerns of the mining and metals sectors, the following recommendations have been drawn:

1. Carefully consider the treatment of the electricity sector and how this will affect all industrial users of electricity
Inclusion of the electricity sector within a system may result in carbon costs being passed through to users through their electricity bills. The potential impact is greater for those industries such as metal smelting that are electricity intensive and in cases where the electricity grid is fossil fuel dominated. The fuel mix of a grid is largely out of industry's control. To mitigate the impact, carbon pricing systems need to consider how best to treat the electricity sector and how to account for and mitigate any related increases in user costs.

2. Link long-term emissions reductions targets into policy measures
Significant reductions in GHG emissions from the mature processes used in the majority of mining and metals process will tend to require significant investment in research, development, dissemination and deployment. Where carbon pricing policy is implemented, the objective of compensation measures should be to give support to industries in making the transition to a low emissions economy and to act against the disadvantages that are created by unequal carbon costs.

3. Make policies specific to regional context and priorities
The introduction of climate change policy has to take into account the context in which it is being developed and implemented. Domestically, the level of economic and social development, the political and industrial support for the policy as well as government priorities will help to determine the feasibility and likely impacts of policy. External factors are also important: trade links and policies elsewhere will have a bearing on the outcome of domestic policy.

The links with the broader policy environment also need to be considered since this environment can support or undermine the achievement of emissions reductions policies. Support can come through the introduction of policies to support low carbon electricity generation (eg feed-in tariffs for renewable energy or fiscal incentives for CCS demonstration projects) or through funding for initiatives to deploy sector-specific emissions reductions technologies. By contrast, success in achieving emissions reductions may be weakened by a tax environment that is too onerous or in the absence of support measures that will help to develop a low carbon electricity sector.

4. Provide clear and consistent incentives
The mining and metals industries have extremely long investment cycles with investment proposals that may be developed and implemented over periods in excess of 50 years. As a result, policy certainty and stability is essential. It is beyond the capacity of government to provide long-term prices and operational details. However, establishing long-term targets for emissions reductions and long-term objectives for policies can bring some certainty to participants. More importantly, building a political and social consensus around the need for emissions reductions policies will increase the likelihood that such policies will continue to exist in the future. Policies should be gradual and announced in advance of implementation to give time for consultation and preparation. The timescale for policy introduction should aim to reflect company investment concerns and environmental effectiveness rather than the political cycle.

A clear and consistent price signal is also important although the certainty of a price signal over the longer term will depend on a range of complex interlinked factors such as political credibility, long-term targets and objectives, and the existence of price controls or future tax rates.

5. Reflect industry and facility heterogeneity in policy design
Coverage of a carbon pricing policy should be broad enough to ensure that the cost of emissions reductions is shared across the economy and narrow enough to guarantee that the system is workable. To ensure viability, a number of systems have adopted a phased approach for different sectors under which coverage increases over time as well as emissions thresholds that limit the number of entities within a system.

In terms of addressing the risk of competitiveness impacts and carbon leakage, the criteria for receiving support need to be clearly defined and assessed on an industry-by-industry basis at the very least. A more granular assessment may be required within an industry but this needs to be balanced with the associated costs of doing so.

As with emissions reductions policies, compensation policies need to be developed with the understanding that they are one in a range of factors that affect the competitiveness of an industry and also one in a range of factors that will determine where a company produces and invests. Other factors that are of relevance include resource availability and quality, cost of inputs, company strategy and the fiscal and political regime. To the extent that government can have an impact on these factors, it could consider how best to support production and investment by industry.

6. Adopt a collaborative approach and aim for a global emissions system
Policymakers should strive to build a political and social consensus on climate change policy. All industries that are likely to be affected by the introduction of policies should be consulted. Mining and metals industries have a key role to play based on their importance to national economies both in terms of GDP and the products they provide.[24]

Policymakers should also look to industry and government experience internationally to help design an effective carbon system. This could also facilitate the harmonization of various elements of policies such as reporting requirements and the use of offsets, reducing costs and competitiveness implications to participants. Such harmonization would also support a global emissions system in the long run.

"A global regime would facilitate trade competitiveness since industries in each jurisdiction would be subject to the same carbon price and the same operational regime, thus removing unequal distribution of carbon costs."

24 The forerunner to this report, *Competitiveness implications for mining and metals* (ICMM, 2011), discusses the economic and strategic importance of the mining and metals industry. It notes six countries where mineral rents are over 10 per cent of GDP, and six more where coal rents alone are over 2.5 per cent of GDP. It also notes that outputs from the mining and metals industry are often necessary inputs to sectors of the economy that can be vital to economic and technology development, and that governments often consider the mining and metals industry to be of high strategic importance.

SECTION 4

Annexes

SECTION 4

Annex 1: Detailed policy description

The policy descriptions are accompanied by data relating to emissions levels per capita, CO_2 emissions from energy use, reduction targets and sources of emissions by sector.[25]

Australia

Since 2006, when the Government announced proposals for a national emissions trading system, Australia has been engaged in a highly political debate on the introduction of a carbon pricing system. The Clean Energy Bill was passed in 2011, establishing Australia's carbon pricing mechanism. An accompanying memorandum set out the rationale for the carbon pricing mechanism, citing Australia's commitment to cut emissions by a minimum of 5 per cent on 2000 levels by 2020. The current government has also proposed an 80 per cent reduction on 2000 levels by 2050.

The Government of Australia supported a market-based approach rather than regulation on the basis that it was a more efficient means of securing cuts and it gives incentives to businesses to reduce emissions. The carbon pricing mechanism combines a carbon tax (fixed-price phase) as a way of transitioning to a cap and trade system (floating price phase) in 2015. Liable entities are required to pay A$23/t CO_2e in the first year, A$24.15/t CO_2 (2013/14) and A$25.40/t CO_2 (2014/15). For the first three years after this switch, the carbon price will be kept below a ceiling of the expected EU emissions trading system carbon price in 2015–16. This ceiling rises 5 per cent per annum for each of the succeeding two years and is intended to control price shocks and to give certainty to investors. There is no price floor in the Australian emissions trading system.

The emissions trading systems will be linked to the EU emissions trading system with effect from 1 July 2015. However, this is a one-way linkage in the sense that EU allowances will be able to be surrendered in the Australian emissions trading system.

It also covers direct emissions (Scope 1) of CO_2, CH_4, N_2O and PFCs attributable to aluminium production (CF_4 and C_2F_6) and expected to cover approximately 60 per cent of Australia's GHG emissions. Entities emitting more than 25kt CO_2e per annum in association with stationary energy, industrial processes, waste and fugitive emissions from operational mines are included in the system. Australian emissions trading system also imposes liability on natural gas suppliers for the embodied emissions in the natural gas that they supply. The transport sector is excluded, but an equivalent carbon price will be charged through changes in fuel tax credits or fuel excise. The agriculture and forestry sectors are also excluded.

25 The data on emissions levels refers to and is sourced from the Energy Information Administration (EIA). The data on emissions sources is taken from country-level submissions to the United Nations Framework Convention on Climate Change (UNFCCC) and may not be comparable across countries.

A number of flexibility mechanisms are included to reduce costs to participants. These vary between the fixed- and floating-price period. No banking or borrowing is allowed in the fixed-price phase, but banking is permitted up to 100 per cent and borrowing up to 5 per cent in the floating-price phase. Offsets can be used but these must be sourced domestically in the fixed-price phase whereas international offsets can be used to cover up to 50 per cent of a liability in the floating-price phase (with a limit of 12.5 per cent certified emission reductions (CERs), ie offsets from Clean Development Mechanism (CDM) projects).

Competitiveness and leakage
Australia's Clean Energy Legislative Package includes a number of elements aimed at mitigating adverse economic effects of pricing. These will either be through the direct allocation of permits or funded by revenue raised from auctioning permits, with half of auction revenues being used to support EITE industries and to invest in a clean energy future.

The primary policy is the JCP, which is specifically designed "to reduce the incentives for (EITE industries) to be located in, or relocated to, foreign countries as a result of different climate change policies applying within and without Australia". Highly EITE activities will receive free allowances equivalent to 94.5 per cent of industry average carbon costs in the first year of the carbon price while moderately EITE activities will receive free allowances equivalent to 66 per cent. The assistance will be provided for an initial three-year period, and will be reduced by 1.3 per cent each year to encourage industry to cut pollution. Coal mining is excluded from JCP assistance. The Government has committed that it will not reduce assistance levels applying under the JCP until 1 July 2017 and three years' notice of any adverse changes must be given.

In addition, a number of EITE industries are eligible for support from a range of funds established in the Clean Energy Legislation. These include a clean technology program aimed at providing assistance in improving energy efficiency and reducing emissions as well as a number of specific funds – for example, funds for the coal-mining sector aimed at developing abatement measures and addressing job losses in gassy mines; and a fund for the steel sector aimed at supporting innovation and efficiency measures.[26] CCS is explicitly prohibited from accessing these technology funds. There is a separate A$1.68bn CCS Flagships program administered by the Department of Resources, Energy
and Tourism.

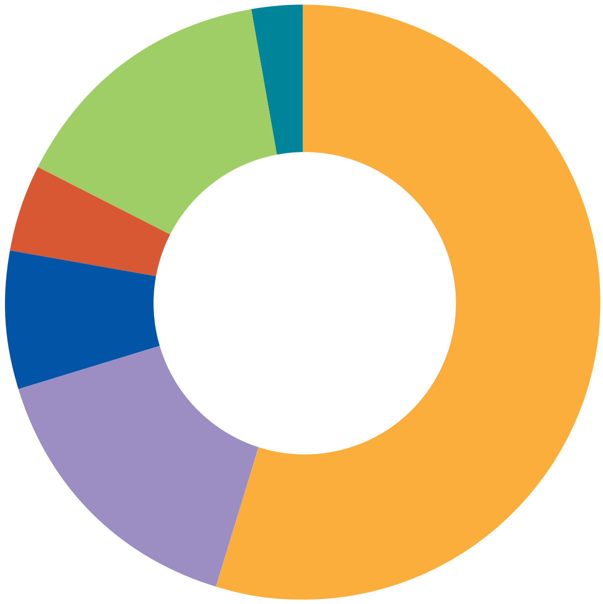
Emissions per capita (2010)

18.8 metric tonnes

Reductions target

Reduction of 5% on 2000 levels by 2020 without global agreement, between 15% and 25% with a global agreement.

Emissions sources (2010)



26 Again it is useful to note that how effective these funds are, and hence how valuable they are as compensatory measures, depends both on the scale and design of the funds but also how large the potential is within a particular sector for reducing energy use.

SECTION 4

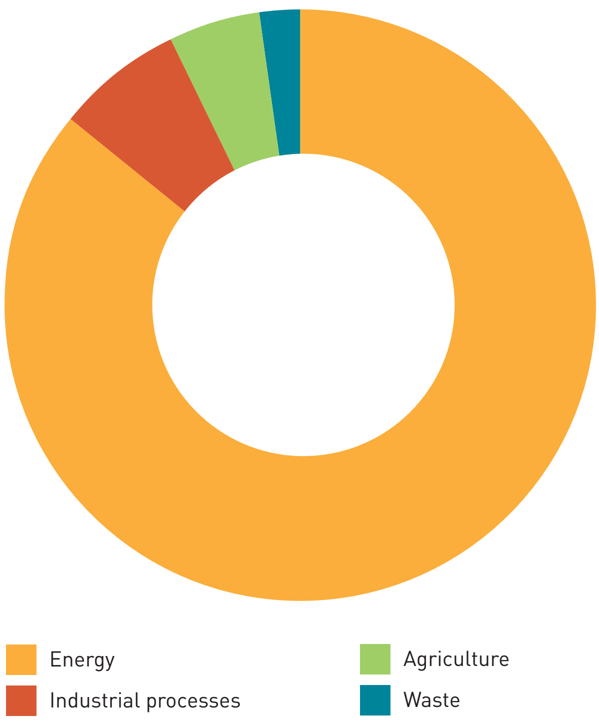
Annex 1: Detailed policy description

South Africa

In 2011, the South African Government released its National Climate Change Response White Paper, which aimed to manage climate change impacts and to contribute to global mitigation efforts.

At the time of publication of this report, the South African Government, in its budget of 2013, announced that it plans to impose a carbon tax at the rate of R120 per ton of CO_2 equivalent, effective from 1 January 2015. It also proposed a tax-free exemption threshold of 60 per cent, with additional allowances for EITE industries. A tax policy was reviewed in a 2010 discussion paper, which concluded that market-based instruments offer a least-cost way to reduce emissions and create incentives for producers and consumers to invest in low-GHG products, technologies and processes. A carbon tax was preferred to an emissions trading system given the lower complexity and administrative requirements. However, the Government is retaining the possibility of transitioning to an emissions trading system in the long run.

Emissions per capita (2010)
9.5 metric tonnes
Reductions target
Reductions of 34% from business as usual levels by 2020 and 42% by 2025. This target was taken voluntarily outside the UNFCCC process and is dependent on finance, technology and capacity-building support from industrialized countries.
Emissions sources (2000)



Perspectives of a member company:

It is widely recognized that the mining and metals industry can play a particular role in the South Africa context due to both its role in the economy and the resources that it has available, and, in common with many developing countries, the relative lack of capacity in the public sector to develop policy alone. The development of credible policy requires a good-quality data set and resources to identify and assess the effects of possible emissions reductions policies. The mining and metals industry is in a position to help supply these elements, and to contribute to well-informed policy that reflects the specifics of the South Africa social and economic environment.

In early 2012, the Government outlined its initial proposals for the tax. It suggested a tax to be levied on direct emissions of CO_2e as of 2013–14. At least 60 per cent of emissions would be tax free, and the remaining amount would be charged at R120 (US$15) per tonne of CO_2, with the tax rising by 10 per cent a year between 2014 and 2020. Tax-free thresholds would be reduced during the second phase (2020–25) and may be replaced with absolute emission thresholds thereafter. Companies would be permitted to use offsets to meet their liability, but proposals envisage restricting this to a proposed maximum of 5 per cent or 10 per cent (depending on sector) of total liability until 2019/20. A further discussion paper is forthcoming. It will be challenging to develop a carbon taxation policy that is aligned with government priorities for social development and job creation.

Competitiveness and leakage

Proposals announced in 2012 suggest that industries at risk will receive an increase in the basic tax-free threshold of 60 per cent, with a 10 per cent increase applying in the case of high process emissions, and in the case of trade exposure, giving a maximum tax-free threshold of 80 per cent. In addition, industries will also be permitted to submit offsets to meet a proportion of their liability (a maximum 5 per cent or 10 per cent, depending on the industry). The proposals also raised the possibility of temporary exemptions for certain sectors as well as a phased introduction of the tax. However, none of these proposals have been confirmed.

Perspectives of a member company:

A particular concern of operators is how the costs relating to electricity will be treated. The generation mix is predominantly coal based, with the market dominated by the stat-owned utility Eskom. This makes it difficult for users – both residential and industrial – to reduce emissions in the short term but also leaves them exposed to the higher costs that will arise if electricity generation is included in the carbon tax. This comes on top of increases that were mandated in 2008 to help Eskom pay for new power plants and infrastructure and any cost increases arising from plans targeting 17,800 MW of new renewable capacity by 2030.

4

The European Union

In 2000, the EU launched the European Climate Change Programme (ECCP), which aims to identify and develop an EU-wide strategy to tackle climate change and meet its target of an 8 per cent emissions reduction of GHGs on 1990 levels by 2012. The EU emissions trading system is a key component of the ECCP and it is expected to outlive the Kyoto Protocol's first commitment period.

In Phase I and II (2005–07 and 2008–12), the EU emissions trading system covered direct emissions of CO_2 from power and industry sectors. This includes combustion plants, oil refineries and iron and steel works, as well as installations producing cement, glass, lime, bricks, ceramics, and pulp and paper. In 2012, aviation was introduced to the system and in Phase III coverage will expand to include installations producing bulk organic chemicals, hydrogen, ammonia and aluminium. Phase III will also expand the gases covered by the system to include N_2O emissions from the production of nitric, adipic and glyocalic acid and PFCs from the aluminium sector.

In Phase I and II, the majority of allowances were allocated free of charge based on historical emissions. In the third phase, an increasing proportion of allowances will be auctioned. The remainder will be allocated for free to installations based on a benchmarking approach, dependent on the performance of the participant relative to the most efficient installations in each sector at the EU level.

The power sector will face 100 per cent auctioning in Phase III. This will prevent a recurrence of windfall profits that companies generated in Phase I and II by passing on the cost of carbon to consumers in spite of receiving free allowances.[27] Control of allocation will also pass from member states to the European Commission in an attempt to prevent national governments favouring domestic industries when allocating allowances. The sector and gas coverage has been expanded, and price control mechanisms are currently under consideration.

Flexibility mechanisms that have been introduced include unlimited banking and borrowing within commitment periods, and limited banking between Phases II and III. Offsets are also permitted, with international emission reduction projects certified by the Kyoto Protocol (CDM and joint implementation (JI)) being permitted for up to 50 per cent of a company's liability in Phase III. No price controls applied in the first two phases of the system, but in July 2012 the European Commission announced a consultation on the possibility of delaying sales of allowances in response to widespread concern that allowance prices were too low to incentivize action on emissions reductions.

27 Some new member states will initially be exempt from this requirement, subject to approval by the European Commission.

The EU emissions trading system is expected to deliver a 21 per cent reduction in emissions between 2005 and 2020. Phase I verified emissions (6,093 Mt CO_2) were well below the cap (6,542 Mt CO_2) but it is unclear the degree to which these reductions are attributable to the EU emissions trading system or other factors such as the economic downturn and policies for renewables. Criticisms of the system's performance to date concern volatility in prices and price collapses, limited environmental effectiveness as the result of overgenerous caps, and narrow coverage of sectors and gases that has resulted in only 30 per cent of total GHG emissions being covered in Phases I and II.

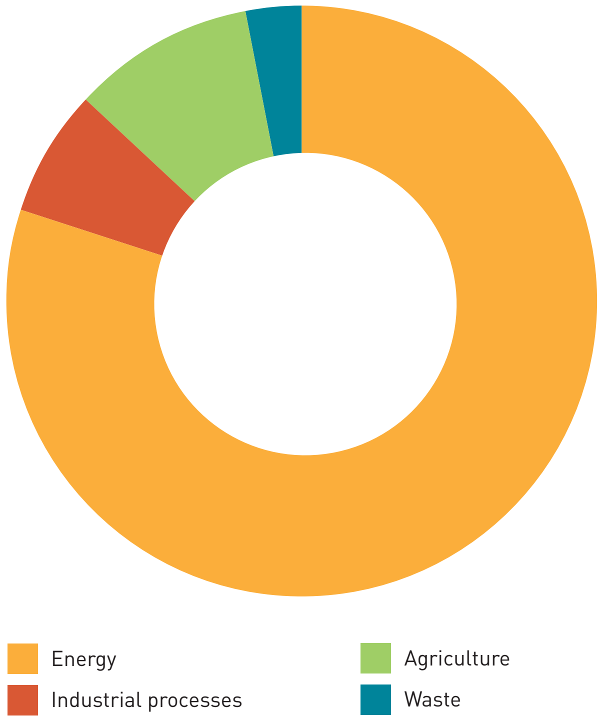
Emissions per capita (2010)

7.9 metric tonnes

Reductions target

Reductions of 20% on 1990 levels by 2020, rising to 30% with a global agreement.

Emissions sources (2010)



Annex 1: Detailed policy description

Competitiveness and leakage

In Phases I and II of the EU emissions trading system, a large majority of allowances were allocated free of charge based on a grandfathering approach. Auctioning accounted for 5 per cent of allowances in Phase I and 10 per cent in Phase II. As of Phase III, sectors not deemed at significant risk of carbon leakage will receive 80 per cent of their benchmarked allocation for free in 2013, declining to 30 per cent in 2020 and 0 per cent in 2027. Sectors at risk of leakage will receive up to 100 per cent of allowances for free, with allowances allocated on a benchmarking approach (reflecting the average performance of the 10 per cent most efficient installations in a sector or subsector in the EU).

In addition to free allowances, a number of other support measures have also been announced. As of Phase III, 300 million allowances will be set aside to support the development of CCS technologies. The European Commission has also announced the adoption of a framework under which member states may compensate some electricity-intensive users, such as steel and aluminium producers. This is aimed at addressing higher electricity costs expected to result from auctioning of allowances to the power sector.

The United States

A number of unsuccessful attempts have been made to introduce a national emissions trading system in the United States. This includes the American Clean Energy and Security Act (ACES), which passed the House of Representatives in 2009 but failed to pass through the Senate. Subsequent action at the federal level has been through regulation. Two emissions trading systems exist at the regional level. The RGGI is an emissions trading system among states in the North-West and covers emissions from the electricity sector only. The California emissions trading system is more comprehensive.

Federal

In December 2009, a judicial process found that CO_2 and five other GHGs constitute a threat to public welfare and that emissions from vehicles contribute to climate change. GHG regulation in the US is based on existing authority, and therefore the only additional action needed in order to regulate GHGs is to pass an implementing regulation.

Regulation includes mandatory reporting and emissions standards. The Mandatory Reporting of Greenhouse Gases Rule (74 FR 56260) requires facilities that emit more than 25kt CO_2e per annum to monitor emissions and submit annual reports on GHG emissions to the EPA as of 2010. Another emissions regulation at the federal level is the best-available control technology for new or modified facilities for those facilities exceeding prescribed GHG emissions thresholds. The regulation is for all sectors, including mining and metals.

The EPA has also issued rules mandating GHG standards for cars and light-duty vehicles and subsequently for medium- and heavy-duty engines and vehicles. In March 2012, the EPA proposed a carbon pollution standard that requires new power plants above a certain size to meet an emissions rate of 454kg CO_2/MWh on an operating annual average basis. The regulation encourages plants to be built with CCS as average emissions over a 30-year period have to be less than 454kg CO_2/MWh. Subsequent rules are expected to cover existing power plants, smaller installations and other stationary sources of emissions. A number of legal challenges have been filed against the rules reflecting concern that the EPA is imposing unreasonable regulations to reduce GHG emissions. These include a challenge to the endangerment finding and to the authority of the EPA to set GHG regulations for stationary sources.

California

In 2006, California passed the Global Warming Solutions Act (AB 32) requiring a reduction in emissions to 1990 levels by 2020 and aiming for 80 per cent below 1990 levels by 2050. This was followed in 2008 by the AB 32 Scoping Plan that outlined a number of emissions-reducing policies, including a cap and trade program (the details of which were finalized in 2011). The reasons for adopting an emissions trading system included addressing local and international and environmental impacts of climate change, the detrimental economic impacts of climate change on Californian industry, reducing reliance on fossil fuels and driving investment into low GHG activities.

The system will cover emissions of the six Kyoto GHGs and nitrogen trifluoride (NF_3), including stationary combustion, process and fugitive sources. The sectors covered in the first compliance period 2013–14 encompass electricity generators, CO_2 suppliers, large industrial sources, and petroleum and natural gas facilities that emit over 25kt CO_2e per annum. The California system is expected to cover 37 per cent of GHG emissions in the first compliance period and 85 per cent of emissions in the second (2015–16). In the second period, the scope will be extended to cover suppliers of natural gas, distillate fuel oil and liquefied petroleum gas. The system will also cover emissions from imported electricity.

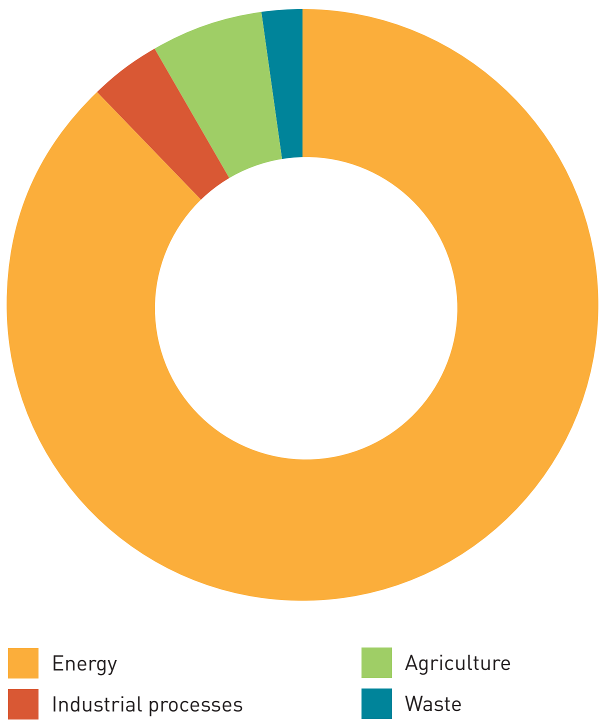
Auctions will account for at least 10 per cent of allocation in 2013, with the majority allocated for free to the covered entities. Between 2013 and 2020, more and more allowances will be auctioned. Auctions will have a floor price of US$10 for 2013 allowances, rising by annually by 5 per cent plus the rate of inflation. Flexibility mechanisms have been introduced, but these are relatively stringent in their application. No more than 8 per cent of a company's total compliance obligation for each compliance period can be satisfied using offsets and these must originate from the US, Canada and Mexico. Banking is allowed, but is subject to holding limits, and borrowing is only allowed under limited conditions.

California's emissions trading system is designed to achieve 273 Mt CO_2e of reductions by 2020.

Competitiveness and leakage

Free allowances are awarded to sectors deemed at risk of leakage, including some mining and metals activity. Also included are electricity generators (including imported electricity), CO_2 suppliers, large industrial sources and petroleum and natural gas facilities. For industrial sectors, the allocation is based on multiplying total product output by an emissions benchmark, a cap adjustment factor (which decreases over time to reflect a tightening cap) and an industry assistance factor (classified as high, medium or low risk of leakage). For the first compliance period, 100 per cent of allowances will be freely allocated to all industry sectors regardless of leakage classification. For the second compliance period, entities in the medium or low leakage category are freely allocated 75 per cent and 50 per cent of their respective allowances. During the third compliance period, free allocation drops to 50 per cent and 30 per cent for medium- and low-risk entities respectively. Free allocations to high-risk entities remain at 100 per cent through all compliance periods.

Emissions per capita (2010)
18.1 metric tonnes
Reductions target
Dependent on final legislation, a reduction of 17% on 2005 levels by 2020.
Emissions sources (2010)



Annex 1: Detailed policy description

Canada

As in the US, government regulation is used to control emissions at the federal level. Canadian regulation is essentially harmonized at the same level as US GHG regulation. Performance standards have been implemented for transportation and will soon be implemented for electricity. Further standards are expected to be forthcoming for the oil and gas sector as well as emissions-intensive industries. Market-based systems have been used at the provincial level. The British Columbia and Quebec systems are discussed below.

British Columbia

In July 2007, the British Columbia Government passed legislation mandating reductions in GHG emissions of 12 per cent on 2007 levels by 2012, a 33 per cent reduction by 2020 and an 80 per cent reduction by 2050. A carbon tax was subsequently announced in 2008, on the basis that there was an immediate need to address climate change and that it would be economically beneficial, generating more jobs, more investment and greater prosperity.

The carbon tax is levied on the purchase of fossil fuels for use in industrial facilities, buildings, homes, cars and trucks. As set out in the initial legislation, the tax has risen in annual increments of C$5 per annum, from C$10/tonne in 2008 to C$30 tonne in 2012, with the charge being calculated on the basis of emissions of CO_2, CH_4 and N_2O resulting from combustion of fuel. The legislation mandates that the tax must be revenue neutral, with revenues raised returned to the public through tax cuts and rebates.

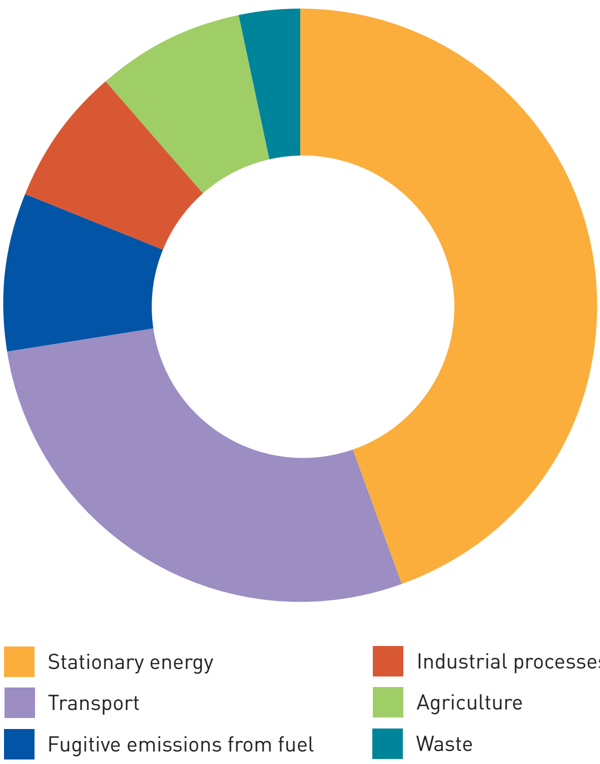
The British Columbia carbon tax has produced some clear results. Since its introduction in 2008, per capita consumption of products subject to the tax has dropped by 15.1 per cent, compared to an increase of 1.3 per cent in the rest of Canada. The decline in total GHG emissions between 2008 and 2010 was also greater than that seen elsewhere in Canada, with a decline in emissions per capita of 210 per cent compared to 4.6 per cent. However, the tax has not yet been sufficient to support the province's emissions reductions targets. When the carbon tax was originally introduced, regulators expected that comprehensive federal legislation would follow. Further increases in the tax rate and an expansion of coverage to sectors beyond fossil fuel combustion are being considered but it is not certain a tax alone will be sufficient to fulfil climate change targets.

The provincial government has indicated that it may modify the system at a later date to develop a cap and trade system. Legislation to enable this was passed in 2008 and 2010. In 2012, a review of the carbon tax was announced and the tax will not be increased until after this is completed.

Competitiveness and leakage

There are no specific provisions for EITE but revenue arising as a result of the carbon tax must be recycled, which has been in the form of corporate tax cuts. This has not necessarily been in proportion to carbon tax payments and not dedicated to the purpose of further emissions reduction. In recent years, some ad hoc payments have also been made to certain energy-intensive industries. There is also a forthcoming review of the carbon tax that will include its impacts on the competitiveness of industry.[28]

Emissions per capita (2010)
16.3 metric tonnes
Reductions target
Reduction of 17% on 2005 levels by 2020, to be aligned with final US targets.
Emissions sources (2010)



Note: Solvent and other product use (0.03%)

28 Also note that the Alberta SGER legislation does not include any provision for compensation of EITE industries. However, a benchmark of 88 per cent of emissions is allowed free of charge, effectively equivalent to a free allocation. Also, entities have the option of complying through payment into a technology fund, which is subsequently recycled in the form of grants for energy efficiency and low carbon technologies.

Quebec

The 2006–12 Climate Change Action Plan cites the environmental impacts of climate change, the economic advantages of increased energy efficiency, reduced fuel consumption and technological innovation as rationales for an emissions policy. The province has an emissions reduction target of 20 per cent below 1990 levels by 2020. It states that an emissions trading system would allow targets to be met at the lowest cost and ensure emissions reductions in the industrial sector. In many respects, the Quebec emissions trading system is similar to the California system, which reflects the anticipated linking of the two systems under the WCI. As with the California cap and trade, it covers the Kyoto gases and the electricity and industrial sectors. The allocation methodology, the use of banking and borrowing, and the use of offsets are also similar.[29]

Initial assessments of the Quebec system suggest that it will cover 88 per cent of Quebec's industrial emissions in the first compliance period, but only 24 per cent of total GHG emissions initially. The percentage of emissions covered will be much higher when transportation is included in 2015.

Competitiveness and leakage

The Quebec system will provide free allowances to sectors classified as being at risk of leakage. It will be based on efficiency benchmarks determined each year. Mining, quarrying and metal manufacturing are included. All other manufacturing activity is included in this list. It also covers oil and gas, steam and air conditioning suppliers, and electricity imports (from jurisdictions that are covered under a separate cap and trade program but not linked to Quebec's). It also covers electric power production sold under certain conditions (ie sold under a contract with a fixed sale price, signed before 1 Jan 2008, and not renewed or extended after that date). Between 2012 and 2014, allowances will be allocated based on an entity's average historical emissions intensity between 2007 and 2011, with 80 per cent for combustion emissions, and 100 per cent for both process emissions and emissions from other sources. From 2015 to 2020, allocation decreases annually determined by an emissions intensity target that also decreases annually. Different industrial activities will see different rates of decrease, and allocations to process emissions will remain at 100 per cent.

29 Although note that there are slight differences in the offset types accepted under the two systems, and provisions in the event that offsets are judged invalid.

SECTION 4

Annex 2: Key assumptions used in quantitative analysis for each commodity

Aluminium				
Product and process characteristics		Analysis applies to smelting of aluminium (anode production, electrolysis and ingot casting). Bauxite mining and alumina refining are excluded, as are subsequent semi-fabrication processes. Note that product recycling, and any associated potential GHG benefits, are not included within the analysis.		
Emissions intensity	**Direct emissions**	Data: 1.9 tCO_2/t (CO_2 fuel combustion and process emissions); 0.6 tCO_2e/t (PFC process emissions). Source: derived from Aluminium for Future Generations (IAI, 2009); UNFCCC submission, containing world average intensity values by process stage; and additional World Aluminium member survey data (2011).		
	Indirect emissions	Data: ranges from 0.39 (British Columbia) to 13.89 tCO_2/t (South Africa) for grid electricity supply; 0 tCO_2/t for renewable supply. Source: IEA (2011), CIEEDAC (2011), EC (2012), IAI (2009).		
Financial data	**Data source**	Annual reports (2007–11) for the three largest ICMM aluminium producers. Five-year weighted average figures.		
	EBITDA	US$451/tonne	**Sales**	US$2,510/tonne
	Total cash costs	US$2,059/tonne	**Annual capital investment**	US$332/tonne

Copper				
Product and process characteristics		Analysis applies to production of refined copper (cathode and/or concentrate production) including all upstream processes including mining and concentrate production covering smelting operations and electrowinning or electro-refining production routes.[30]		
Emissions intensity	**Direct emissions**	Data: weighted average ICMM sample value of 2.2 tCO_2e per tonne Cu. Source: 2010 CDP submissions for four ICMM members, divided by reported Cu production levels.		
	Indirect emissions	Data: ranges from 0.01 (Quebec) to 2.91 tCO_2/t (South Africa) for grid electricity supply; 0 tCO_2/t for renewable supply. Source: IEA (2011), CIEEDAC (2011), US DOE (2007), CoChilco (2009), CSIRO (2000).		
Financial data	**Data source**	Annual reports (2007–11) for five ICMM copper producers, including the three largest. Five-year weighted average figures.		
	EBITDA	US$3,965/tonne	**Sales**	US$7,541/tonne
	Total cash costs	US$3,592/tonne	**Annual capital investment**	US$1,210/tonne

30 Robust analysis of each of the two principal stages – mining of ore and subsequent concentration, and production of cathode from concentrate – has not been possible using existing data. It is therefore assumed that the ICMM reported emissions and financial data used in aggregate covers all activities from mining to refined copper production. Similarly, it has not been possible to provided separate analyses of concentrate and cathode production based on the available data. Noting that whereas all copper smelting sites produce concentrate but not all produce cathode, this means that in aggregate, GHG and financial data, as well as the resulting analyses, reflect a mix of cathode and concentrate production across ICMM members.

Iron ore				
Product and process characteristics		Analysis applies to the production of iron ore including all upstream processes including mining, and also where relevant pellet production (pelletization).[31]		
Emissions intensity	Direct emissions	Data: range of 8–21 kgCO_2/t assumed (minimum and maximum values). Source: 2010 CDP submissions for three ICMM members, divided by reported iron ore production levels. Note that its data reflects both mining and pelletization, where relevant.		
	Indirect emissions	Data: range of 0–17 kgCO_2/t assumed (minimum and maximum values) Source: 2010 CDP submissions for three ICMM members, divided by reported iron ore production levels.		
Financial data	Data source	Annual reports (2007–11) for the three largest ICMM iron ore producers. Five-year weighted average figures.		
	EBITDA	US$65/tonne	Sales	US$104/tonne
	Total cash costs	US$39/tonne	Annual capital investment	US$19/tonne

Coal				
Product and process characteristics		Production of thermal and metallurgical coal from surface and underground mines.		
Emissions intensity	Direct emissions	Data: 75 kgCO_2e/t for ICMM weighted average; 300 kgCO_2e/t for illustrative gassy mine with high levels of fugitive methane emissions. Source: 2010 CDP submissions for five ICMM members, divided by reported coal production levels; Australian Government (2010).		
	Indirect emissions	Data: 15 kgCO_2e/t for ICMM weighted average. Source: 2010 CDP submissions for five ICMM members, divided by reported coal production levels.		
Financial data[32]	Data source	Annual reports (2007–11) for five ICMM coal producers, including the three largest. Five-year weighted average figures.		
	EBITDA	US$26/tonne (ICMM weighted average)	Sales	US$91/tonne (ICMM weighted average)
	Total cash costs	US$59/tonne (ICMM weighted average)	Annual capital investment	US$15/tonne (ICMM weighted average)

31 It has not been possible to disaggregate mining and pelletization/processing emissions with sufficient robustness and comparability within the analysis.

32 For thermal coal production, values are: EBITDA (US$15/t), cash costs (US$44/t), sales (US$59/t), annual capital investment (US$7/t); for metallurgical coal production, values are: EBITDA (US$55/t), cash costs (US$84/t), sales (US$139/t), annual capital investment (US$20/t). Both sets of values are based upon data provided by two ICMM member companies only.

SECTION 4

Annex 2: Key assumptions used in quantitative analysis for each commodity

Key features of regional carbon systems

System details		Australia carbon pricing mechanism	Quebec cap and trade	British Columbia carbon tax
Overview	Country	Australia	Canada	Canada
	Jurisdiction	Australia	Quebec	British Columbia
	Type of system	Carbon tax/trading	Cap and trade	Carbon tax
	Start of system	2012	2013	2008
Carbon price/tax levels		Fixed price of A$23/$tCO_2$ (2012–15); trading thereafter with use of floor and ceiling pricing[33]	Market-based pricing under cap and trade linked through WCI. C$15/$tCO_2$ assumed	Tax levied on carbon content of purchased fossil fuels; equal to C$30/$tCO_2$ for 2012
Emissions scope	Scope 1 fuel comb.	X	X	X
	Scope 1 process	X	X	
	Scope 1 fugitive	X	X	
	Scope 2 (elec.)			
GHG inclusion	CO_2	X	X	X
	CH_4	X	X	
	N_2O	X	X	
	PFCs	X	X	
Sector coverage	Al production	X	X	X
	Cu production	X	X	X
	Iron ore mining	X	X	X
	Coal mining	X	X	X
	Power generation	X	X	X
Compensatory measures	Al production	94.5% free allocation	Free allocation (100% for process emissions; 80% for fuel combustion emissions)	None (ad hoc compensation to date to certain sectors only, eg agriculture)
	Cu production	94.5% free allocation		
	Iron ore mining	66% free allocation		
	Coal mining	80% compensation[34]		
	Power generation	94.5% for cost pass-through to industry		
Use of offsets[35]		Up to 50% use of international offsets during trading phase, of which no more than 12.5% can be CERs	Permitted up to 8% of liability	Not relevant

33 The provisions of the Australian system modelled were those announced in the Clean Energy Legislative Package of 2011. It does not take account of the amendments subsequently made under the Clean Energy Legislation Amendment Act 2012. Note that the amended mechanisms are referred to throughout the remainder of the report.

34 Applies to fugitive emissions from gassy mines (above 0.1 tCO_2e/tonne coal) only;

35 First phase only; various caveats and details apply – see Section 1.

Key features of regional carbon systems

System details		South Africa carbon tax	EU ETS Phase III	WCI cap and trade
Overview	Country	South Africa	EU member states	US
	Jurisdiction	South Africa	EU member states	State level
	Type of system	Carbon tax	Cap and trade	Cap and trade
	Start of system	2013 (proposed)	2013	2013
Carbon price/tax levels		R120/tCO_2 in year 1, rising by 10% a year thereafter 2014–20	€30/tCO_2 highest price to date. €12/tCO_2 chosen for Phase III forecast[36]	Market-based pricing under cap and trade linked through WCI. US$15/$tCO_2$ assumed
Emissions scope	Scope 1 fuel comb.	X	X	X
	Scope 1 process	X	X	X
	Scope 1 fugitive	X	X	X
	Scope 2 (elec.)			
GHG inclusion	CO_2	X	X	X
	CH_4	X		X
	N_2O	X	X	X
	PFCs	X	X	X
Sector coverage	Al production	X	X	X
	Cu production	X (assumed)	X	X
	Iron ore mining	X	X	X
	Coal mining	X	X	X
	Power generation	X	X	X
Compensatory measures	Al production	80% tax exemption	Benchmarked free allocation (1.514/tonne for aluminium smelting)	100% free allocation in year 1 of system
	Cu production	70% tax exemption		
	Iron ore mining	80% tax exemption		
	Coal mining	80% tax exemption[37]		
	Power generation	60% tax exemption	None	
Use of offsets		10% maximum of liability for Al, Cu, iron and coal through 2020	Limited to 50% of ETS compliance	Permitted up to 8% of liability

36 Recent Reuters Point Carbon forecasts for EU ETS Phase III range from €22/tCO_2 (Jun 2011) and €12/tCO_2 (Dec 2011) to €8/tCO_2 (Jan 2012).

37 Applies to fugitive emissions only.

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ICMM Steering Group

Stan Pillay (Anglo American)
Edwin Mongan (BHP Billiton)
Veronika Kohler (National Mining Association)
Adam Whitmore (Rio Tinto)

ICMM National Policies and Competitiveness Working Group

Stan Pillay (Anglo American)
Andrew Parsons (AngloGold Ashanti)
Lyn Staib (AngloGold Ashanti)
Melissa Barbanell (Barrick)
Evan Verkade (Barrick)
Edwin Mongan (BHP Billiton)
Mukund Bhagwat (Eurometaux)
Jernej Vernik (Eurometaux)
Jim Miller (Freeport-McMoRan Copper & Gold)
Chris Bayliss (International Aluminium Institute)
Ron Knapp (International Aluminium Institute)
Ajit Advani (International Copper Association)
Elize Swart (Lonmin)
Sid Marris (Minerals Council of Australia)
Justyna Laurie-Lean (Mining Association of Canada)
Brendan Marshall (Mining Association of Canada)
Troy Hey (MMG)
Veronika Kohler (National Mining Association)
Nick Cotts (Newmont)
Joe Pollara (Newmont)
Adam Whitmore (Rio Tinto)
Chris Adachi (Teck)
Mark Edwards (Teck)
Joao Faria (Vale)
Carolina Lima (Vale)
Milton Catelin (World Coal Association)
Benjamin Sporton (World Coal Association)
Cassandra McCarthy (Xstrata)
Markus Noethiger (Xstrata)

ICMM team

John Drexhage and Simone Cooper led the process to develop this publication on behalf of the ICMM Secretariat, with support from Meera Thankey.

Consulting team

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ICMM
35/38 Portman Square
London W1H 6LR
United Kingdom

Phone: +44 (0) 20 7467 5070
Fax: +44 (0) 20 7467 5071
Email: info@icmm.com

www.icmm.com