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Applying a marginal abatement cost curve as a strategic instrument to manage a company's exposure under the South Africa carbon tax.

Date: 5th of November 2012 By: Henk Sa and Jan Willem Timmer

Summary

Although the implementation date has not been defined the government of South Africa is **set to implement** a **Carbon Tax**. The objective behind the move is to reduce carbon emissions, in order to ameliorate the effects of global warming, and raise revenue. South Africa's main industrial sectors will be exposed to the Carbon Tax, which will initially be set at a rate of **120 ZAR/tCO_{2e}**. The Carbon Tax will be based on the quantity of fossil fuel utilised within an installation, multiplied by the emission factor of the specific fossil fuel to determine the taxable emissions. By **developing a Marginal Abatement Cost curve** for a company's activities the options to mitigate its Carbon Tax exposure become apparent. A Marginal Abatement Cost curve therefore represents a critical instrument in a company's inventory to **strategize, adapt and respond** to the introduction of **the Carbon Tax**.

Background

Although the scale and timing of the implications is still under debate with the global scientific community, the existence and cause of climate change is not. There is strong global consensus that climate change is caused by the anthropogenic (i.e., man-made) emissions of GreenHouse Gases (GHG's). EcoMetrix operates on the forefront of the fight against climate change and specializes in the mitigation activities towards climate change applied in Southern Africa. One of the main activities is the analysis of and the consultation on climate change policies currently in place and under development. The South African Carbon Tax (the Carbon Tax) is such a proposed technology. This paper looks at the utilization of a Marginal Abatement Cost curve (MAC curve) as a strategic instrument to manage a company's Carbon Tax exposure. This paper was written in close cooperation with Jan Willem Timmer who is currently working as a freelance consultant.

The South African Carbon Tax

The two main economic policy instruments available for putting a price on carbon and curbing the output of GreenHouse Gases (GHG) emissions are carbon taxation and emissions trading schemes. A carbon tax seeks to reduce emissions through the price mechanism directly (i.e., a price instrument), while emissions trading schemes establish targets for specific levels of emissions through the trade in allowances (i.e., a quantity instrument). To date, the relative merits and feasibility of these policies have been demonstrated primarily in Europe.

The South African government is planning to implement a Carbon Tax. The objective of the tax is to reduce carbon emissions to mitigate the effects of global warming and to raise revenue. The proposal calls for a levy of 120 ZAR/tCO_{2e} (rand per tonne of carbon dioxide equivalent) emitted. As described by the South African Treasury in its paper 'The Carbon Tax Option', the Carbon Tax will be applied as an 'upstream tax' based on the carbon content of the fuels at the start of the process and applying an appropriate emission factor to determine the taxable emissions. Industry would have a self-monitoring system to evaluate emissions using a structured standard. The emissions would be reported to the South African Revenue Services (SARS) and the Department of Environmental Affairs (DEA) would verify these emissions on behalf of SARS.

Although the specifics are still being discussed, a basic tax-free threshold would be set at 60% for all sectors with a maximum obtainable tax-free threshold of 90%, taking into account an adjustment of the basic threshold and allowances to be applied. Initially, the Carbon Tax will be reduced via the application of a tax-free threshold and several 'relieves' that can be staggered to reduce the Carbon Tax burden to the maximum of 90%. In addition to the 'relieves', the basic tax-free threshold can be adjusted with the so-called Z factor. The Z factor aims to incorporate the measured and verified carbon intensity of the output of an installation in relation to the benchmarked intensity for the sector the installation is categorized within. In this way, installations emitting higher than the sector benchmark would have a lower basic percentage tax-free threshold and vice versa. In addition to this, an installation can reduce its Carbon Tax burden by using offsets up to a maximum allowed per sector. These offsets could result from the issuance of Certified Emission Reductions (CERs) resulting from a South African Clean Development Mechanism project activity (CDM). The development of a CDM project is overseen by the United Nations as part of its Kyoto protocol mandate. Under the Carbon Tax these South African CERs can be presented to SARS as part of a company's annual Carbon Tax application to be granted an additional reduction of between 5% and 10% on top of the tax-free threshold and other 'relieves'.

As per the table below the tax is likely to impose a significant burden on industry, particularly in energy-intensive sectors. The table provides an overview of the exposure per sector taking into account the sector's emissions, the cumulative tax-free threshold and a Carbon Tax rate of 120 ZAR/tCO_{2e}. As a result, companies have an incentive to adopt carbon-reducing technologies and or pass on the additional costs to consumers.

Sector	Phase 1 Basic Tax Free Threshold	Total (including max. 'relieves')	tCO_{2e} per sector	Total Carbon Tax exposure (120 ZAR per tCO_{2e})
Electricity	60%	60%	199,040,000	9,553,920,000
Petroleum (coal to liquid)	60%	70%	60,047,000	2,161,692,000
Petroleum - oil refinery	60%	70%	13,288,900	478,400,400
Iron & steel	60%	80%	92,620,000	2,222,880,000
Aluminium	60%	80%	2,000,000	48,000,000
Cement	60%	80%	9,300,000	223,200,000
Glass & ceramics	60%	80%	30,000	720,000
Chemicals	60%	80%	5,030,000	120,720,000
Pulp & paper	60%	70%	7,490,000	269,640,000
Total:	**N/A**	**N/A**	**388,845,900**	**15,079,172,400**

Table 1: South African Carbon Tax exposure per sector[1] (not all sectors covered by the Carbon Tax where included)

[1] Sources: CDP 2012, ERC 2007, SAF SAM 2003, ipcc-nggip.iges and EcoMetrix team analysis.

A Marginal Abatement Cost curve

A good starting point to determine a company's options to manage its Carbon Tax exposure is the construction of a so-called MAC curve. The MAC curve is an instrument that summarizes the options that are available to an economy, sector or company in reducing its emission of GHGs into the atmosphere. MAC curves can incorporate hundreds of tested technologies that may contribute to lower GHG emissions. The diagram below gives a theoretical example of the MAC curve for an African utility (the example is strictly hypothetical).

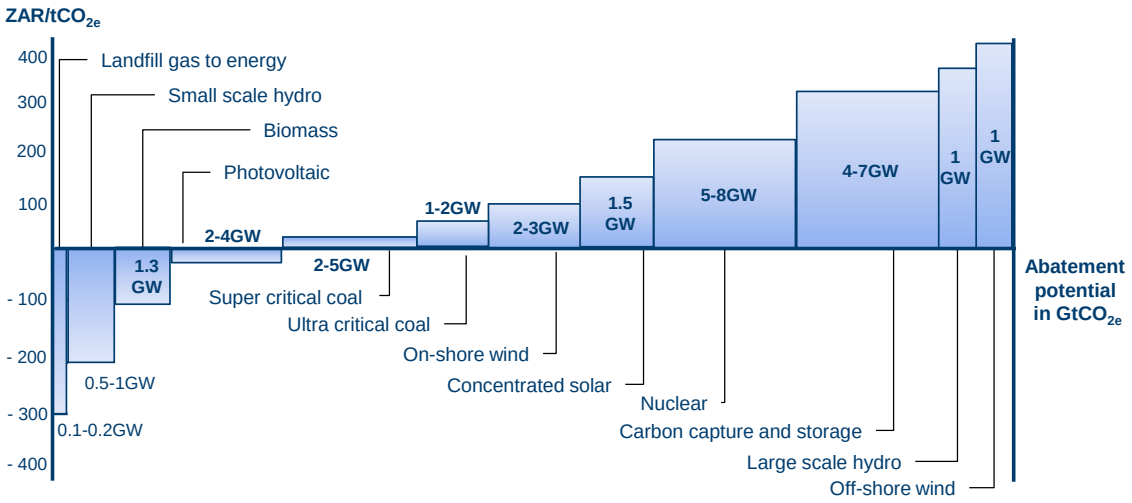

Figure 1: Utility MAC curve example

The horizontal axis of the diagram enumerates available low-carbon technologies, as well as the total abatement potential of each option in $GtCO_{2e}$/year (gigatonne carbon dioxide equivalent per year). The vertical axis reflects the marginal abatement cost associated with each technology in ZAR/tCO_{2e}. These costs would be computed relative to a baseline. Constructing a baseline requires making certain assumptions, for example, regarding future economic growth or baseline technologies (i.e., technologies that would be used in a business-as-usual scenario). Furthermore, the baseline scenario assumes the use of sub-critical coal. Typically, MAC curves project between 10 to 30 years into the future and cover proven and commercial available technologies as well as technologies that are expected to be commercially available within the next decade.

The MAC curve is useful for a number of reasons. For instance, company's use it to identify the low hanging fruit from a GHG emission reduction investment opportunity perspective. Policymakers in government could and should use a MAC curve to identify options for reform and trade-offs between GHG emission reduction, with the aim of improving economic efficiency and direct incentives and penalties appropriately and proportionately.

Carbon taxes are predicated on the idea that companies have an incentive to invest in technologies that reduce their GHG emissions, as long as the cost of abatement per unit emitted are lower than the tax otherwise imposed. In other words, it is in the interest of a company to adopt a new technology if, and only if, this is a cheaper option per tCO_{2e} it manages to abate. If this is not the case, the company will simply go ahead and emit and pay the tax.

Utilisation of a MAC curve in relation to the South Africa Carbon Tax

Within a South African company's business context, it thus would make sense to plan ahead and explore a strategy that provides the greatest 'bang for the buck' in responding to the introduction of the Carbon Tax. A MAC curve isolates those low-carbon options that provide the greatest abatement potential for the least additional cost. Set against the marginal cost of the Carbon Tax, a company's MAC curve enables the company to prioritize investment opportunities and decide which ones are worthwhile to undertake first. This will improve overall efficiency and the relative position vis-à-vis competitors.

An interesting feature of the global MAC curve included above is the existence of investments with negative marginal costs, even without the Carbon Tax in place (i.e., all technologies left of and including for example 'Photovoltaic'. These represent low-carbon options that, if adopted, are less expensive than current baseline technologies (i.e., business as usual). In practice, this means real business opportunities are being foregone (although in some cases non-market barriers to entry and externalities may prevent investors from reaping the full return to investment, which is then the reason that it is not being realized). The introduction of the Carbon Tax would lower the investment threshold for certain technologies that were previously considered unviable, because of the internalisation of externalities as a result of the Carbon Tax. The higher the Carbon Tax, the more technologies would shift into positive net present value territory. The below diagram provides an example of the MAC curve for the previously mentioned African utility, factoring in a Carbon tax of 120 ZAR/tCO_{2e}.

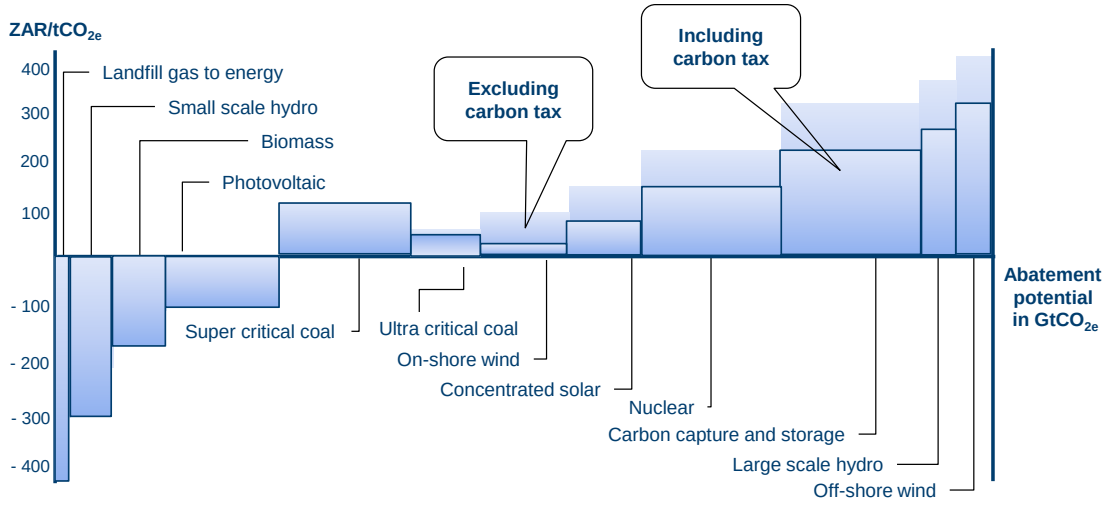

Figure 2: Utility MAC curve example including Carbon Tax

The above diagram uses the same expression as defined in the previous figure, which is shown in the background. The different costs and available capacity outlined in the diagram project a Carbon Tax of 120 ZAR/tCO_{2e}. As per the diagram, the inclusion of the Carbon Tax moves the cut off point for viable investments up to somewhere between 'On-shore wind' and 'Concentrated solar'. As mentioned, this example is strictly hypothetical, so that caution is warranted in making inferences in more specific cases. In order to derive any meaningful results for South Africa, for a sector or for a particular company, one would need to construct a specific MAC curve to this end. Other caveats exit. Some argue that MAC curves should not be used as merit order curves because they list options that would take decades to implement.[2] Perhaps most importantly,

[2] Source: Vogt-Schilb, A. and Hallegatte, S., 2011. When Starting with the Most Expensive Option Makes Sense: Use and Misuse of Marginal Abatement Cost curves. World Bank Policy Research 5803.

uncertainty exists about the future state of technology. MAC curves are based on known technologies that are currently economically viable or will be in the near future. Yet innovation is an on-going process. Over time, existing technologies will become more efficient and new low-carbon options will be discovered. Estimating the baseline, including business-as-usual technologies and future emission levels, also carries uncertainty.

Despite these limitations (and the above summary is not exhaustive), the MAC curve provides a good starting point to map out low-carbon technologies. At a later stage, this may be complemented by further analysis of, for example, the interaction between alternatives (e.g., when technologies are liable to replace the same existing emission source) or case-specific barriers to implementation (e.g., political constraints or the need for infrastructure adjustments with some options). Nevertheless, with a Carbon Tax in place, constructing a MAC curve is an important step towards implementing an efficient carbon strategy.

In conclusion, the South African Carbon Tax will have a substantial impact on the competitive position of the company's covered by the tax. To be able to mitigate the impact, a company should conduct a specific and detailed analysis of the options it has at its disposal to this end. A MAC curve provides insight into the carbon-related costs per technology option available to a company when producing its output. A Marginal Abatement Cost curve therefore represents a critical instrument in a company's arsenal to proactively **strategize, adapt and respond** to the introduction of **the Carbon Tax**.

About the Authors

EcoMetrix Africa has been at the forefront of the fight against climate change since its inception. The EcoMetrix team is made up of a group of highly motivated and capable individuals originating from all walks of life. This paper was written by Henk Sa and Jan Willem Timmer:

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