MAPS
Mitigation Action Plans & Scenarios

ENERGY MODELLING FOR THE INDUSTRIAL SECTOR

A summary of the SATIM methodology

TECHNICAL // Industry

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Purpose

Energy economy environment models such as TIMES are often used to look at opportunities and costs of reducing greenhouse gases (GHGs). The South African TIMES model (SATIM) has been developed for this purpose and its methodology is documented online. This document presents an overview of this methodology and may be of interest to researchers faced with similar challenges of poor data and of defining a practical model structure for this very complex sector.

The full SATIM methodology is available on the Energy Research Centre website http://www.erc.uct.ac.za/

Introduction

The industrial sector in South Africa accounted for 40% of final energy consumption in 2006 and is, in general, energy intensive, being dominated by heavy industries in the mining and metals refining sub-sectors. Mitigation actions designed around energy efficiency programmes were identified in the South Africa Long Term Mitigation Scenarios (LTMS) to be amongst the most cost effective ways to reduce emissions although the net reductions attainable were estimated to be significant but not large (Hughes et al. 2007).This sector is therefore an important component of the SATIM model and has seen a fairly significant investment of modelling effort (although not as much as the transport and power sectors).

Structural assumptions and modelling decisions

Modelling the structure of the energy chain from fuel input through to energy services in the industry sector will present a challenge because of the great diversity of activities and processes. Data collection is further complicated, relative to say the similarly complex but centrally regulated transport sector, by the large number of regulatory and industry bodies. The challenges and expense involved with detailed disaggregation of the industrial sector means that the modeller needs to make critical decisions at an early stage as to the level of detail in the structure of the sector within the model.

In SATIM the industrial sector is organised into dominant sub-sectors, dominant energy carriers and dominant energy services. Certain sub-sectors listed in the national energy balance, for example Textile & Leather, contribute so little (0.1%) to the sector's total final consumption (TFC) it makes sense to omit them. Similarly, gasoline (0.05% of TFC) is not considered as an industrial sector energy carrier in SATIM. The situation in other countries will depend on their economies. Nine of the 15 sub-sectors and seven of the 17 energy carriers listed in the energy balance are included in SATIM. Furthermore, bagasse and wood are also included, although absent from the energy balance. This latter difference highlights the fact that the energy

balance should be considered critically as a structural guide in this highly complex and difficult to research sector. More detail is available in the SATIM methodology document.

Coal and the problem of poor data

Coal used for process heating is the dominant non-electricity energy source for the industrial sector, accounting for nearly 39% of TFC in 2006 (DOE, 2009). Therefore most of the effort in mitigating errors in base year consumption data has focussed on improving the poor quality data for coal use by industry. The assumptions of sub-sector coal use for the SATIM model rely heavily on national statistics for expenditure flows between sub-sectors, called 'Supply and Use' tables published by Statistics South Africa (Stats SA). This data is supplemented with Annual Reports to shareholders published by dominant firms in key industries. Money is therefore used to track quantity. Historical estimates from publications and personal communications (confidential) from industry insiders are also considered to try and prevent any gross errors.

Energy services supplied by electricity

Of potential interest to researchers, in the absence of local data, is the assumed breakdown of electrical energy services by sub-sector in SATIM (Table 1). There has been a lack of recent studies in South Africa and this cannot be considered exhaustive, even for its country of origin, but may still be a useful check for other modelling teams.

TABLE 1:

ASSUMED SHARE OF ELECTRICITY CONSUMPTION BY ENERGY SERVICES WITHIN INDUSTRY SUB-SECTORS

ENERGY SERVICE FRACTIONAL SHARES BY SUB-SECTOR	MINING	IRON & STEEL	CHEMICALS	PRECIOUS & NON-FERROUS METALS	N.M.M PRODUCTS	FOOD, BEVERAGE & TOBACCO	PULP & PAPER PRODUCTS	OTHER
Elec Heating	2.0%	40.0%	2.0%	1.0%	23.0%	7.0%	2.0%	9.7%
Compressed air	18.6%	5.0%	15.0%	0.0%	13.0%	4.0%	35.0%	10.9%
Lighting	4.5%	3.5%	4.0%	1.0%	5.0%	5.0%	10.0%	8.1%
Cooling	8.1%	1.0%	5.0%	0.0%	0.0%	23.0%	0.0%	5.1%
HVAC	8.0%	2.0%	2.0%	1.0%	2.0%	6.0%	4.0%	8.5%
Pumping	17.9%	2.5%	35.0%	0.0%	8.5%	28.0%	35.0%	13.0%
Fans	6.9%	4.5%	8.0%	0.0%	9.0%	4.0%	0.0%	5.5%
Other motive	33.8%	41.5%	20.0%	7.0%	39.5%	21.0%	14.0%	36.9%
Electrochemical	0.2%	0.0%	8.0%	90.0%	0.0%	0.0%	0.0%	1.3%
Boiler/process heating	0.0%	0.0%	1.0%	0.0%	0.0%	2.0%	0.0%	1.0%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Energy efficiency programmes

Energy efficiency programmes in industry will likely be one of the mitigation actions explored by modellers in a greenhouse gas mitigation project. Essentially this involves the improvement of the efficiency of energy services by direct intervention rather than just organic technological change. Two methodologies, using dummy technologies and the lookup table method, are outlined in the SATIM methodology which can be found on the ERC website (www.erc.uct.ac.za).

South Africa's LTMS

The Long Term Mitigation Scenarios (LTMS) was a cabinet-mandated process from 2005-2008, led by the then South African Department of Environmental Affairs and Tourism, to establish the evidence base for a national low carbon development path. Key to the process was its unique blend of facilitated stakeholder engagement and rigorous research.

The LTMS arose out of the realisation that South Africa would need to contribute its fair share to greenhouse gas mitigation. Greenhouse gas emissions in South Africa come mainly from energy use and supply. Moving to a low carbon development path would require a major shift in thinking and in action. Hence a blend of process and research was critical when assessing mitigation potential within the country. Having accurate numbers would build confidence, but equally important was that a wide range of key stakeholders within South Africa agreed that the numbers were credible.

The LTMS research was peer-reviewed and found to be of best practice. Reviewers recommended sharing the experience with other developing countries. From this recommendation the MAPS Programme was born. For more information see http://www.erc.uct.ac.za/Research/LTMS/LTMS_project_report.pdf.

The projection of demand for energy

In common with most optimisation models, the demand for energy from a sector is an exogenous input to TIMES. The projection of demand for the industrial sector in SATIM relies on projected GDP growth for the industry sub-sectors, the relationship between GDP projections for the sub-sector and sub-sector output and estimates of historical energy intensity of industry sub-sectors.

Conclusion

The methodology of the TIMES based modelling framework for the SATIM model, which evolved from the LTMS, has been documented and is available online at www.erc.uct.ac.za. SATIM is a live project and the need to improve the treatment of the industrial sector still further has been identified. Other countries may be modelling at a greater or lesser level of detail depending on the particular role of the sector in GHG emissions. In either case some aspects of SATIM may be of interest particularly with regard to dealing with data issues and the problem of defining a practical model structure for this very complex sector.

References

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MORE ABOUT MAPS

Mitigation Action Plans and Scenarios (MAPS) is a collaboration amongst developing countries to establish the evidence base for long term transition to robust economies that are both carbon efficient and climate resilient. In this way MAPS contributes to ambitious climate change mitigation that aligns economic development with poverty alleviation.

Central to MAPS is the way it combines research and stakeholder interest with policy and planning. Our participative process engages stakeholders from all sectors within participating countries and partners them with the best indigenous and international research.

MAPS grew out of the experience of the Government mandated Long Term Mitigation Scenarios (LTMS) process that took place in South Africa between 2005 and 2008. The LTMS, with its home-grown stakeholder-driven approach, its reliance on scenarios and the rigour of its research and modelling were key to its approach. The LTMS informed South Africa's position for Copenhagen and is the base of much of the country's domestic policy.

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