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The role of industrial policy in pursuing climate change mitigation objectives in South Africa

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Dissertation presented in partial fulfilment of the requirements for the degree of Masters in Energy

and Development Studies

Energy Research Centre

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11 February 2011

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I hereby declare that this dissertation is my own work. I understand what plagiarism is, and where I have used the ideas of others, I have referenced these correctly.

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Abstract

This thesis has drawn on Fine and Rustomjee's (1996) notion of the Minerals-Energy Complex (MEC) as a tool to analyse the relationship between industrial policy, energy use, and climate change mitigation policy in the South African context.

The analysis finds that the South African economy has clearly developed in response to sets of industrial incentives offered both pre- and post-apartheid, which have structured the economy in such a way that electricity-intensive industry have come to dominate exports and investment in the country, but with very little positive effect on socio-economic development.

This structure has a detrimental effect on possible mitigation actions; firstly because with the current development trajectory, it will be very challenging to meet mitigation targets as laid out in the country's Long-term Mitigation Scenarios (LTMS), and secondly because the mitigation wedges outlined in the LTMS will require significant shifts in the approaches, types and range of industrial policy measures that the country uses.

This thesis therefore examines the current industrial policy incentives that promote South Africa's reliance on mining and minerals beneficiation, as well as the initiatives required to reach the LTMS mitigation wedges, and the broader role of co-ordination in the economy. The recent Integrated Resource Plan is examined in the context of the current energy paradigm, and the importance of a new energy and industrial policy paradigm is discussed as a prerequisite for an effective mitigation strategy.

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List of Abbreviations

ASGI-SA	Accelerated and Shared Growth Initiative of South Africa
BAU	Business as Usual
BBL	Barrel
BEE	Black Economic Empowerment
BRT	Bus Rapid Transport
CCS	Carbon Capture and Storage
CIF	Critical Infrastructure Programme
CO ₂	Carbon dioxide
CO ₂ eq	Carbon dioxide equivalent
CSP	Concentrated Solar Power
CTL	Coal-to-Liquid
DEPP	Developmental Electricity Pricing Policy
DME	Department of Minerals and Energy
DoE	Department of Energy
DOT	Department of Transport
DST	Department of Science and Technology
DTI D	Department of Trade and Industry
EDD	Economic Development Department
EIA	Energy Information Administration
EIUG	Energy Intensive User Group
EMIA	Export Marketing and Investment Assistance Programme
EV	Electric vehicle
FRIDGE	Fund for Research into Industrial Development, Growth and Equity
GDFI	Gross Domestic Fixed Investment
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GHG	Greenhouse gas
GTL	Gas-to-Liquid

GWC	Growth without Constraints
HDI	Human Development Index
HVAC	Heating, ventilation and cooling
IDC	Industrial Development Corporation
IDZ	Industrial Development Zone
IGCC	Integrated gasification combined cycle
IPAP	Industrial Policy Action Plan
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IRP	Integrated Resource Plan of the Department of Energy
KAP	Key Action Plan
kWh	kilowatt hour
LTMS	Long-term Mitigation Scenarios
MEC	Minerals-energy Complex
MIDP	Motor Industry Development Plan
Mt	Million tons
MW	megawatt
NEDLAC	National Economic Development and Labour Council
NERSA	National Energy Regulator South Africa
NIPF	National Industrial Policy Framework
OECD	Organisation for Economic Co-operation and Development
PBMR	Pebble Bed Modular Reactor
PV	photovoltaic
R&D	Research and Development
RBS	Required by Science
RE	Renewable Energy
REFIT	Renewable Energy Feed-in-Tariff
SANS	South African National Standards
SAPIA	South African Petroleum Industry Association
SBT	Scenario Building Team (LTMS)
SETA	Sector Education and Training Authorities
SMEDP	Small and Medium Enterprise Development Programme
SMME	Small Medium and Micro-enterprises
SOE	State owned enterprise
SUV	Sports Utility Vehicle
SWH	Solar water heater
TIPS	Trade and Industrial Policy Strategies
UNEP	United Nations Environment Programme
WTO	World Trade Organisation

Introduction and problem statement

This thesis will examine the relationship between South Africa's industrial structure, industrial policy and climate change mitigation policy, and the current inconsistencies and potential alignments between such policies.

The historical development of what Fine & Rustomjee (1996) termed the "Minerals-Energy Complex" (MEC) has been based on a series of apartheid-era industrial policy decisions that have resulted in the mining, minerals beneficiation and petrochemicals industries dominating the South Africa economy. In the post-apartheid era, rather than diversifying the economy away from these industries, government industrial policy, funding and incentives, coupled with the liberalisation of the economy, have resulted in an increasing dominance of MEC sectors and a concomitant decline in non-MEC manufacturing (with associated negative effects on employment and socio-economic development). This has occurred despite higher level policy statements and documents that have both recognised the associated problems of the MEC and sought to move away from the dominance of these sectors.

South Africa's comparatively cheap electricity is a core component of the MEC, both through the mining of coal for power stations and as a driver of energy-intensive industry in the country; reliance on coal-fired power also makes South Africa highly emissions intensive. The role that industrial policy has played, and continues to play, in creating an economy based on comparatively cheap coal-fired power and energy-intensive industry thus has severe ramifications for climate change mitigation in South Africa.

Under the modelling done for the Long-Term Mitigation Scenarios (LTMS) – on which South Africa's international mitigation pledges are based – it has become clear that given South Africa's current development path and current available technologies, possible mitigation actions are not sufficient to meet science-based targets for reducing emissions. It is thus imperative that more focus be given to climate change mitigation objectives in other areas beyond mere environmental policy – that is, industrial policy and climate change policy must be aligned to reduce emissions. Transformation to a low carbon economy is dependent on industrial policy, and while some conceptual shift has taken place, with a resultant inclusion of the notion of the "Green Economy" in the new Industrial Policy Action Plan, this 'greening of the economy' neither goes far enough towards what is required by South Africa's mitigation plans, nor is it well-aligned with other policies and incentives (nor, indeed, is it well-outlined in detail).

There are therefore two components to the problem. Firstly, despite stated objectives of diversification and job creation, current policies (across several ministries but especially in the

Department of Trade and Industry) benefit the MEC sectors, which has negative consequences for climate change mitigation opportunities (and could render meaningless any attempts at mitigation). It is thus necessary to outline how the MEC sectors have retained their dominance, and how this has affected the structure of South Africa's emissions profile, as well the broader effects that such industries have had on socio-economic development.

Secondly, an analysis of the LTMS and the IRP 2010 will outline the contradictions between current industrial policy and mitigation targets. By analysing the mitigation wedges in the LTMS, it is possible to start to outline the types of industries that are needed for climate change mitigation and low-carbon development. However, other types of industrial policy are required to 'close the gap' between current possible mitigation and that required by the international pledges the country has made. Fundamentally, the LTMS is not able to outline what a low-carbon economy would look like, but it nonetheless an important first step in releasing the potential for cleaner development. Meeting climate change mitigation targets, however, will in the long-term require a new energy and industrial policy paradigm to frame decision-making, so as to enable South Africa to move towards a low-carbon society.

This thesis will start with a discussion around the definition of policy and industrial policy, and will develop an argument for why there is a role for industrial policy in the South African economy. This will be followed by a description of the minerals-energy complex and how the MEC structure has failed to address inequality and unemployment in the country, and how it has retained its dominance in the economy through various state incentives and investment, and through low historical prices for electricity. After a brief account of the climate change policy sphere, the thesis will move onto a discussion of the LTMS, the LTMS wedges and the industrial policy required to promote mitigation. Finally, a brief description of the problems in the IRP 2010 and its relationship to the MEC will follow, to highlight how the MEC continues to function to maintain its dominance in the economy.

Industrial policy theory

What is 'policy'?

Before a discussion of industrial policy in South Africa can proceed, it is necessary to define what is meant by 'policy' and its associated concepts. "Policy" as Marquard (2006: 10) basically defines it, is a "form of intention, norm or 'decision-rule', a higher level principle". This definition can be built upon further, with a view of policy as a "continuous process of adaptation and modification" (Marquard 2006: 11), rather than a precise decision-making moment; policy as defined here is "more the output of a system than the culmination of a process" (ibid 12), but is nonetheless still a

“conscious act” (ibid: 12). Policy can also be viewed as a “complex interaction of different decision processes in multiple (and often competing) state agencies” (ibid: 11), where the actions of ‘the state’ exist only as the conflicting policies that might be produced by different state agencies. Tyler thus summarises Marquard’s conception of policy as comprising “a range of written policy documents (white papers and regulation), statements by policymakers, intentions and directions as included in green papers and strategic documents, institutional capacity and orientation, and actualised policy. Policy is also continuously evolving, is often contested and incohesive, with the dominant policy paradigm driving policy focus and direction” (Tyler 2010: 2). The conflict between stated policy – as in overarching frameworks and plans – and actualised policy is key in the South African case, where despite stated intentions and key decisions being taken, the processes and systems in which lower-level decisions are made – for example around financial incentives – do not reflect the higher-level goals. In this sense, actualised policy differs markedly from stated policy, and indeed, state ‘policy’ in many cases directly contradicts policy made even in the same departments.

Beyond this conception of policy itself, Marquard (2006: 12-13), drawing on Wildavsky’s (1979) notion of a “policy space”, develops the idea of a “policy environment” as the space in which policy-related activity – research, analysis, outline of alternatives, political lobbying, networking etc. – takes place for a particular policy domain. A policy domain is an area of policy that corresponds to the divisions within the state, that is, government departments or positions in the executive, and can have a high “policy density” in its policy space; that is, a domain filled with policies from different state agencies. The notion of a policy domain is thus key, in that “domains inevitably overlap partially, which results in policies in the same domain being made by different agencies, usually with different perspectives” (Marquard 2006: 13). Thus, while overarching policy goals may state one thing, policy as implemented by other agencies can reflect different goals; actualised policy may be in direct contradiction of the stated aims of industrial policy as laid out in the National Industrial Policy Framework or Industrial Policy Action Plans, while still being clearly focused on industrial development. This can be problematic both for policy coherence within and between policy domains. Similarly, while climate change policy making is officially located within the Department of Environmental Affairs, climate change mitigation is dependent upon the actions of other state agencies, particularly the Department of Energy, the Department of Public Enterprises (which oversees Eskom) and others.

Furthermore, since the goals and beneficiaries of industrial targeting are not made clear, “implicit favouring” (Chang 2010: 14) takes place (as is the case with large, capital-intensive projects in South Africa). In particular, for example, funding by the IDC, tax break programmes and other subsidies for

particular industries have had the effect of entrenching the dominance of certain industries, but are not widely seen as 'industrial policy' in the way that the Motor Vehicle Development Programme might be. Such incentives are sometimes administered by organisations other than the Department of Trade and Industry, although such programmes are supposed to function in line with DTI policies such as the National Industrial Policy Framework (and now, under the Zuma Cabinet reshuffle, in line with the new Economic Development Department's policy plans, such as the New Growth Path).

Defining industrial policy

Several author's 'define' industrial policy as including those policies that are in anyway related to the economic or industrial functioning of the state, while others focus on narrow sector-specific targets (Chang 1998: 54). In his review of the differing interpretations of what constitutes industrial policy, Chang (1994: 58-59) shows that it has been taken to include "favouring promising industries; creating skilled workforces; developing infrastructure; regional policy" as well as "general industrial support...; fiscal and financial incentives for investment; public investment programmes; public procurement policies; fiscal incentives for R&D; firm-level policies such as specific R&D support....generalised trade protection; [and] sectoral policies". Donges (quoted in Chang 1994:59) even goes so far as to state that industrial policy "embraces all government actions which affect industry".

However, Chang (1994: 59) argues that "despite the fact that all the above policies would have implications for industrial development...classifying every policy that affects industrial development as industrial policy" is not a very useful way to proceed. Every economic policy affects industrial performance, but including them all as 'industrial policy' "overloads the concept of industrial policy, rendering the concept meaningless".

Chang thus defines industrial policy as "a policy aimed at *particular industries* (and firms as their components) to achieve the outcomes that are *perceived by the state* to be *efficient for the economy as a whole*" (1994: 60), that is, selective industrial policy. In this conception, effects on regions or groups are by-products, rather than aims, of industrial policy. However, between the overly broad general conception and his narrower conception, Chang conceded that "there are those who see the 'core' of industrial policy as targeting. . . but include other non-specific policies such as generalised support for R&D or industrial training" (Chang 1998: 54).

In the South African context it is more appropriate to use a slightly expanded definition of industrial policy that goes beyond mere sectoral targeting by the state, primarily because there are, at least overtly, very few sectorally targeted plans (other than those targeted at motor vehicles and business process outsourcing). There are general policies aimed at increasing small, medium and micro

enterprises (SMMEs), and enhancing Black Economic Empowerment (BEE), but many of the industrial policy incentives on offer can be taken up by any industry (within specific parameters, and often with limitations on certain industries, but without clear industry-based targeting). Also, other policies are having clear effects on the development trajectory of the economy - for example, trade and competition policies, infrastructure investment, fiscal incentives and Research & Development (R&D) - where they are tying South Africa into a particular industrial path, rather than functioning to diversify the economy. This thesis will therefore consider industrial policy as those policies that target specific sectors (although such interventions are currently limited), and also those policies that affect competitiveness more generally – that is, more than just firms in a single sector. It will not be so broad as to consider any policy affecting industry (for example, education), but will draw on what Cloete & Robb (2010: 496) term “midpoint” industrial policy, which includes procurement, trade and competition, and infrastructure policies, as well as industrial financing and research and development (R&D). This definition is in line with the National Industrial Policy Framework’s notion of “cross-cutting” industrial policy (DTI 2007: 6).

The role of the state

The case for the state’s use of industrial policy in changing the structure of the economy is a strong one, with both theoretical and empirical arguments highlighting that explicit use of industrial policy can benefit the economy.¹ Theoretically, the argument for industrial policy is largely based on the presence of information asymmetries, co-ordination externalities and other market failures such as the lack of innovation in the private sector; empirically, the extent of the use of industrial policy in successful industrialised countries in East Asia has provided clear historical precedent for the potential benefits of industrial policy, including several lessons around the various types of industrial policy that South Africa could benefit from. Cimoli et al (2010:1) similarly state that industrial policies must be seen as “intrinsic fundamental ingredients of all development processes”, arguing that every country that has successfully industrialised – from the US and Germany all the way through to Korea, Taiwan, Brazil, China and India - has utilised industrial policies of one type or another. This historical evidence is further added to by Roberts and Rustomjee (2009) and Fine and Rustomjee (1996), who highlight that even within South Africa it is the apartheid-era ‘infant industries’ of Sasol and Iscor

¹ Chang has described the antipathy towards industrial policy thus: “the common reaction to the argument for industrial policy has been one of suspicion and incredulity. The opponents of it regard industrial policy either as bureaucratic meddling that is at best irrelevant . . . or as a peculiar form of state intervention that works only in countries with a particular culture. . . Such reactions are more than understandable when thinking that orthodox economic theory hardly recognises any form of coordination other than the idealised perfect market and ignores the role of endogenous technical change and learning” (1994: 89).

(now Arcelor Mittal) that have, in the post-apartheid era, grown into some of the most successful enterprises in the country.²

Theoretically, Chang (1994: 26) highlights the potential role that industrial policy can play in mitigating against both market and government failures. He notes that market failures that can be effectively dealt with using industrial policy include the under-provision of public goods, non-competitive markets, and information externalities (see Dube et al below on South Africa and structural transformation). Similarly, government failure in the form of information asymmetries with the private sector can to some extent be overcome by the design of institutions.

The use of industrial policy can thus overcome serious market failures in an economy, through lessening the impacts of non-competitive markets and externalities and promoting public goods.

Chang thus sees the usefulness of industrial policy in two forms. Firstly, while the allocation of resources by 'the market' – the competitive process – ensures that 'the losers' are culled, this process is not, as is frequently assumed, costless. Asset specificity and sunk costs (particularly relevant for long-lived energy-related infrastructure) mean that the overall resources available to an economy are reduced during this 'culling' process, reducing efficiency (1994: 65). The state thus has an important co-ordinating role to play in saving transaction costs in the economy by "providing a focal point, or consensus, around which decisions can be co-ordinated", such as in the cases of France and Japan. Here, 'indicative planning' by the state provides "a 'vision' for the future economy" and, can thereby enable the private sector to work towards the national goal (Chang 1994: 53). The state is thus able to 'beat the market' at times because it can "look at things from a national and long-term point of view" (Chang 2010: 16), rather than at purely short-term profit-driven goals. This grand vision of co-ordination must also be supplemented by smaller scale co-

² Indeed, even a Chief Economist and Senior Vice-President of the World Bank, Justin Lin, has acknowledged the value of well-targeted industrial policy, although he argues that only comparative advantage conforming choices should be made by a "facilitating state" (Lin & Chang 2009: 484-485). He states that "there are few if any examples of governments that have succeeded with a purely laissez-faire approach that does not try to come to grips with market failures, and far more examples of rapid growth in countries whose governments have led effectively. Therefore, it is incumbent upon policy-makers and researchers to identify the most effective ways of promoting the productivity growth and change in industrial structure necessary for development."

Similarly, the industrial policy inputs to the Presidency's 15 year review has this to say on the topic of the apartheid government's industrial interventions: "Although often excessively wasteful, the degree of coordination and financial support provided to industry was impressive." (Rustomjee & Hanival 2008: 15).

ordination to promote upstream inputs to new industries (for example, component manufacturing for renewable energy).

The second, and fundamental, role for industrial policy (the first being co-ordination) is that of change. Rodrik (2007: 7) has argued that “development is fundamentally about structural change: it involves producing new goods with new technologies and transferring resources from traditional activities to these new ones” (Rodrik 2007: 7), and it is during the processes of “structural transformation” (Dube et al 2007), that market failures such as those described above are most prominent, requiring the use of industrial policy to guide the changes required for social and environmentally beneficial development. From a traditional focus on mining and minerals, industrial policy can be used to shift to a focus on new, cleaner technologies and other types of manufacturing.

The externalities inherent in the process of structural change include coordination (discussed above) and information externalities. Dube et al (2007: 19), drawing on other work by the Harvard Group, point out that information externalities arise “because the search for new production possibilities involves private costs that generate information that is publicly available. Hence, the market leads to under-provision of the search for new products because the social benefits of these efforts are not appropriable by those who bear the costs”. This is particularly relevant in the case of renewable energy, where the social benefits of new forms of generation far outweigh (at least in the current context and under the current regulatory system) the private costs of discovery; the state thus has a role to play in resourcing newer industries that will have extensive social benefit as well as longer-term private benefit.

The International Panel on the Accelerated and Shared Growth Initiative of South Africa (ASGI-SA) has explicitly drawn attention to the need for state intervention in South Africa, and the need to mitigate against the lack of innovation provided by the market (Hausmann 2008: 12). Developed countries typically use patents and R&D subsidies, while developing countries tend to focus less on new products and more on “the search for products that can be profitably produced in the country given its actual and potential capabilities.” South Africa has the potential to do both, but while low post-apartheid R&D levels have risen in recent years, an examination of the Department of Science and Technology’s R&D Tax Incentive Programme expenditure report seems to suggest that incentives for innovation have been concentrated in certain traditional sectors, notably chemicals. .

There is thus a role for government in the internalization of cost or self discovery externalities (Hausmann et al 2008: 4), as well as for public inputs such as standards, infrastructure, certification

etc. A FRIDGE report produced for NEDLAC³ discussing the role of industrial policy in climate change mitigation has overtly linked these two areas using this theoretical basis. The authors argue that climate change policy, by creating an environment in which climate change considerations are included in industrial decision-making, can even contribute to the self-discovery processes needed for industrial development and higher levels of growth (through increasing global markets for environmentally sustainable products).⁴ They state that

“Countries and firms that identify and act upon these opportunities relatively quickly will have a significant first-mover advantage and enjoy a competitive advantage as the demand for these goods and services grow in the long term” (Genesis analytics 2010: 44).

To solve the problem of information externalities requires some collaboration between government and private sector, and Hausmann et al (2008: 4) state that they “take “good” industrial policy to consist of those institutional arrangements and practices that organize this collaboration effectively”. The question then is what arrangements will allow ‘low-carbon industries’ to gain access to incentives and other benefits? In South Africa, current arrangements ensure that low-carbon industries are largely side-lined, and they lack access to incentives and other benefits, while traditional mining and minerals beneficiation companies are able to access and influence decision-making processes.

There are several key points that authors have made about the use of industrial policy in East Asia that have relevance for the South African context.

Wade (2010: 6) has argued that the use of industrial policy by the state is not solely (as it is often criticised to be) about ‘picking winners’. Rather, he shows that industrial policy can (and in East Asia, did) take two, equally necessary and important forms. Firstly, there is the ‘picking winners’ variety, where the state ‘reads’ the market and promotes entirely new industries. Perhaps the best example of this form of industrial policy is POSCO, the South Korean state-owned steel company.

Interestingly, while the World Bank advised Korea not to invest in steel production because Korea ‘lacked comparative advantage’ in steel-making, the Korean state disregarded their advice and subsequently POSCO grew into one of the largest and most cost-efficient mills in the world (Wade

³ “FRIDGE” stands for the ‘Fund for Research into Industrial Development, Growth and Equity’. NEDLAC is the National Economic Development and Labour Council, the formalised space where government, business, labour and organised civil society meet.

⁴ Similarly, Cloete and Robb point out that carbon pricing can have the same effect because firms will “need to evaluate new production techniques and technologies to either reduce their GHG emissions, or to increase the efficiency of other areas of their production process to offset the increase in production costs” caused by carbon pricing. This may therefore lead to “the development of new technologies, processes, or products” which could become part of the firm’s product mix (2010: 498).

2010, Chang 1994: 118).⁵ Such a decision has key ramifications for industrialisation in a country because – as was the case in South Africa with Iscor – the new industry provides key upstream inputs for others, or is able to act as a catalyst for new upstream industries. Both Korea’s recently released Green Growth Strategy and the United Kingdom’s Low-Carbon Industrial Strategy focus on particular sectors that the state is choosing to pick as potential winners. In Korea, focus is on solar cells (and also nuclear, although whether or not this is ‘green’ (i.e. is environmentally sustainable in the long-term) is debatable), while the UK is targeting spending at wave and tidal power (UNEP 2010, HMG 2009).

This form of market leadership must, however, be supplemented by a second variety of industrial policy. This Wade terms ‘followership’ industrial policy. He describes such policies as being of the “incremental pulling and pushing” kind, where the government provides support for private firms and products (2010: 6). Here, firms may be ‘nudged’ using subsidies, tax breaks and other incentives to expand into new industries, but the government nonetheless follows the market in what Chang terms “guided capitalism” (1994: 125). In South Africa, the promotion of solar water heaters (SWHs), for example, requires only that the state create a more enabling environment for a more widespread rollout of the technology. It need not start its own SWH manufacturing firm- subsidies (effectively targeted, of course) will drive a process that has already started. On the other hand, South Africa could choose to pick a winner in the form of concentrated solar power – a newer technology in which lies the potential for global leadership, provided a targeted government response to developing the industry could be utilised to effectively overcome the self-discovery externalities.

⁵ The difference between ‘comparative’ and ‘competitive’ advantage is complex and widely debated even amongst economists, who tend to have slightly different definitions for each (although the terms are often used interchangeably in broader debates), and conceptions of comparative advantage in particular are often expanded to include elements of competitive advantage. Broadly, ‘comparative advantage’ can be defined as the ability of a country to produce a particular good at a lower opportunity cost than another country. That is, it is the ‘natural’ or ‘inherited’ cost advantage that a particular country may have in producing a particular good or service. The advantage can be driven by technological superiority, resource endowments, government policies or demand patterns, so factors that affect all the firms in a particular industry. Competitive advantage is more often used to refer to firm-specific factors, although “there is no unanimity on the meaning and/or the sources of competitive advantage” (Gupta 2009:6), and the term is often used to refer to the comparative profitability of firms within different nations. In this thesis, the notion of comparative advantage as it is used by Chang (1994), Lin and Chang (2009), and others (see Redding 1999: 21 for an outline of the development of the idea) will be followed, where comparative advantage is a dynamic concept, where advantages may be inherited but can also be built. Thus Lin (in Lin and Chang 2009: 4) advocates “comparative-advantage-following” industrial policy for developing countries, which tends to focus on developing current advantages, typically in the abundance of labour or primary resources. “Comparative-advantage-defying” policies, on the other hand, are those that focus on developing areas of advantage that a country does not have a so-called ‘natural’ or current advantage in, as in many examples in East Asia, where capabilities in particular industries can be accumulated.

However, while East Asian development can and does provide concrete examples of how industrial policy can be successfully used, it is important that South African policymakers do not simply impose a model of development (be it Western or Asian) that has succeeded elsewhere and expect it to work. Thus Chang (1994: 90) writes, “the real question is not whether industrial policy can work or not (because it does), but how it can be made to work”. Rodrik (2007: 3-4) has made a similar point, arguing that rather than focusing on whether industrial policy is necessary, we should focus on how it can be made to work effectively. Industrial policy debates would become far more productive if, like debates around other kinds of policy, they were normalised, and industrial policy were accepted as an integral part of government economic policy-making (which it already has been, albeit often under other names). It is the functioning of industrial policy within a particular context that is important, not debates around whether or not we should use it at all.

South Africa has largely accepted the need for industrial policy, with ASGI-SA emphasising the important role that industrial policy can play in dealing with the economic problems facing the country (Rodrik 2007: 34). Similarly, the state’s “New Growth Path” for job creation specifically emphasises the potential use of industrial policy to meet objectives. But Rodrik points out that it is the institutional design that is of key importance for ensuring effective industrial policy, with three possible aspects that must be addressed.

Firstly, there is a necessary middle ground that must be found between absolute state autonomy and total private capture. He proposes a model of “strategic collaboration and coordination” between the private sector and government, that has as its aims the goals of “uncovering where the most significant bottlenecks are, designing the most effective interventions, periodically evaluating the outcomes, and learning from the mistakes being made in the process” (Rodrik 2007: 40). To do this, several mechanisms could be put in place, including deliberation councils, supplier development forums, search networks, investment advisory councils, sectoral round-tables, private-public venture funds and tenders. Using these mechanisms requires a viewpoint that understands industrial policy not purely as list of possible policy instruments, but rather as a process of discovery, where the process “focuses on learning where the binding constraints lie and on eliciting information on the private sector’s willingness to invest subject to the removal of these obstacles” (Rodrik 2007: 41). The choice of policy instruments then follows from the process of discovering where and how these instruments could be put to best use. In the South African renewable energy case, private sector willingness to invest is high (notably in wind); but the institutional arrangements between the state, its enterprises, and the private sector means that levels of strategic co-ordination (except between historically dominant sectors and the state) remain low.

Secondly, we must use 'carrots and sticks'; the use of incentives - subsidies, tax breaks etc - must be accompanied by performance monitoring and the removal of such incentives if performance is poor (as happened in East Asia). Mechanisms such as conditionalities, sunset clauses, program reviews, monitoring, benchmarking etc. should be put in place to ensure efficient policy outcomes (Rodrik 2007: 41-42). When incentives are given under certain conditionalities and these are not subsequently fulfilled, the private sector must face removal of said incentives – something which has not happened in South Africa.

Thirdly, there needs to be a means by which the public can be sure of the honesty of the bureaucracy, ensuring accountability and hence legitimacy (no less, there must be appropriate regulation by the state). Interestingly, Rodrik points out that in SA, a large portion of industrial policy is actually made by other parts of the state (not just the DTI). So while there may be a minister, that person is not necessarily the person responsible for failure (Rodrik 2010: 44). Similarly, agency accountability can be ensured through the use of targets. The Industrial Development Corporation, for example, would have to show that it has reached targets for new projects and industries. A further aspect of this is the extent to which processes are transparent and information is publicly available. In South Africa, for example, information on tax allowances and other hidden subsidies for big industry is not widely available, and hence accountability of the state by the public is difficult.

Industrial policy in South Africa

The minerals-energy complex

The most significant framework for understanding the relationship between energy and industrial policy in South Africa is Fine and Rustomjee's (1996) notion of the 'Minerals-Energy Complex'. This is arguably the key framework for understanding how the process of capital accumulation in the country is built on, and is driven by, particular linkages in the economy.

Fine and Rustomjee coined the phrase "minerals-energy complex" (MEC) to describe a set of sectors at the heart of the South African economy, which "includes the mining and energy sectors and a number of associated sub-sectors of manufacturing, which have constituted and continue to constitute the core site of accumulation in the South African economy" (1996: 71).

The economic sectors which form the basis of the MEC core include:

- coal, gold, diamond and other mining activities
- electricity
- non-metallic mineral products (for example, bricks, cement, mica)
- iron and steel industries

- non-ferrous metals industries (for example, platinum and silver)
- petrochemical products, chemicals and petroleum.

These sectors form “productive linkages” between each other, thus constituting the core of the South African economic structure (Fine & Rustomjee 1996: 79).

An elaboration of this idea of ‘productive linkages’ describes how electricity generation is based mainly on coal (a mining activity), or on nuclear (based on mined uranium), and in turn, how coal, gold and other mining use a large percentage of electricity in the country. Similarly, a large portion of electricity is used for refining and smelting of iron and steel, non-metallic minerals, and non-ferrous metals. Petrochemical products and liquid fuels similarly rely on coal feedstock and coal-fired electricity for their production, notably the energy-intensive production of synthetic fuels; while iron ore, coal and electricity form the largest inputs in the iron and steel industry (Fine & Rustomjee 1996: 80-81). There is a web of inputs and outputs between sectors of the economy, primarily based on electricity and coal, but also between manufacturing and mining.

They thus argue that typical analyses of economic or industrial performance, in the South African context, should not be used to measure the extent to which the economy has ‘industrialised’ or moved away from primary production. This is because conventional analyses ignore the extent to which the MEC core sectors provide the impetus for other types of manufacturing in the economy. They show that the conventional viewpoint of a shift from mining to increased manufacturing is “misleading . . . [because] it is based on an “unduly aggregated notion of manufacturing” (Fine & Rustomjee 1996: 76). The downstream manufacturing that appeared to be playing an increasing role in the economy at their time of writing can therefore not be divorced from its basis in the mining and minerals sector, and they argue that it would be more useful to refer to the MEC core and the non-MEC manufacturing sector when attempting to analyse the South African economy (1996: 81).⁶

This aspect of the MEC – that it is an entirely new way of framing the South African economy – is linked to a second, and perhaps more important and controversial aspect of Fine and Rustomjee’s argument, wherein the MEC goes beyond being a core set of sectors, to form the *system* of accumulation in the country (Fine & Rustomjee 1996: 91). The MEC can thus be understood as “the

⁶ They argue, and show using data on manufacturing, that “contrary to popular opinion and much assumption in academic inquiry, the economy’s dependence on mining and energy and directly related activity has increased and not decreased. Consequently, the idea that manufacturing has increased in importance [and now, in the post-apartheid era, services] and now overshadows primary production is erroneous... the application of standard industrial classification schemes to the South African economy has given a false picture of the extent and form of the industrialisation that has been achieved” (Fine & Rustomjee 1996: 9).

form taken by capitalism in determining economic and social outcomes” (Fine 2008a: 3), both directly through its core sectors but also indirectly through its “determining weight” in the economy.

In the 1980s, the large mining houses also controlled finance in the country, with a highly concentrated economy dominating the Johannesburg Stock Exchange and industrial activity.

Although there has been no comprehensive update of Fine & Rustomjee’s book, the MEC is still visible as the driving force, and is best typified by the large mining and minerals companies, such as BHP Billiton, Anglo American, and Exxaro, who provide large quantities of coal to Eskom’s power stations, and in turn use large quantities of electricity for either mining or minerals beneficiation.

While the dominance of certain sectors in the South African economy is widely accepted academically, the notion of the MEC as a system of accumulation (one that is unique to South Africa), has not, even by Ben Fine’s own admission, been widely engaged with within South Africa. Thus, for example, Black and Roberts (2009: 214) (amongst others) review the notion of the MEC briefly and superficially, without any further analysis of the potential viability of the system as holding true for South Africa. Beyond a critique (solely of the aspect of the book dealing with the MEC as a system of accumulation) by Bell and Farrell (1997)⁷, Fine (2008b: 5) states that the most significant feature of the MEC is “the failure even to acknowledge it by those who would, presumably, reject it”.

He accounts for this broad lack of engagement by tracing the position of the MEC within broader policy debates, or lack thereof; indeed, Fine’s (2008b: 5) analysis rests partly on his interpretation that transition-era economic and policy analysis “became either the prerogative of mainstream, narrow-minded orthodoxy or of non-economists. The depth of understanding incorporated in the MEC may not have been appreciated in any sense of the term”. However, he also argues that the MEC’s “close correspondence with the empirical realities of the South African economy did, and continues to, allow for it to be embraced at different levels of understanding. So the antipathy to the

⁷ Bell and Farrell’s critique is of certain empirical measurements of the growth in non-MEC versus MEC sectors, but does not deal with the content of Fine and Rustomjee’s (1996) chapter on the development of conglomerate ownership and the interconnectedness of the South African economy. Fine and Rustomjee’s (1998) response to the review also explicitly draws attention to particular misunderstandings in Bell and Farrell’s analysis, and refutes their critique that import-substitution was in fact the driver of industrialisation in the country, by showing that the requisite backwards linkages failed to materialise, and that protection to ensure ISI was far outweighed by policies to promote the MEC sectors (Fine & Rustomjee 1998: 694-695; Fine & Rustomjee 1996). Indeed, they argue not that no import-substitution-driven industrialisation took place (which would be blatantly false given the high tariffs and quantitative restrictions in certain sectors), but rather that it was industry-specific and changed over time, and that blanket tariffs to promote industrialisation were not the primary thrust of industrial policy in apartheid South Africa. Rather, policies aimed at developing the MEC (for a variety of reasons) provided the basis for state intervention. Their critique is supported by Clark’s (1994) description of the early industrialisation process in South Africa, where she shows that import protection was hardly the key driver in promoting industrialisation in the country, certainly in the years preceding the official advent of apartheid but also to some extent during apartheid.

MEC runs deeper and must be sought elsewhere” (2008b: 5). He thus argues that the MEC has been discounted because of the policy struggles around the time of transition, and the eventual dominance of the interpretation of South Africa’s economic problems as based solely upon failed import-substituting industrialisation (ISI), a viewpoint that was put forward at the time by the World Bank (in a paper by Fallon and Pereira da Silva 1994). Several other authors have made similar arguments for why the notion of the MEC has not become more broadly understood and used as a basis for analysing South Africa’s economy (see for example, Freund 2010: 20-21; Padayachee 2010:2)

Black and Roberts (2009: 212-213) similarly argue that the World Bank view of the weaknesses in the South African economy (and indeed, the largely similar Industrial Strategy Project, which formed the other, at least initially significant, policy thrust in the 1990s) has become the dominant framework for understanding the South African economy, and this interpretation has been the basis on which stated South African policy has been formed (Black and Roberts 2009: 212-213).

They therefore argue that it has been *perceived* that trade liberalisation, reduced factor market distortions, increased interest rates and export stimulation are all that are required to undo the interventionist failings of the apartheid government (Black and Roberts 2009: 214). Such an interpretation – that it was the interventions of the apartheid government that has largely been to blame for any economic weaknesses – ignores, however, the extent to which export-orientated free trade was promoted by the apartheid government from the 1980s and the extent to which those industries that did receive government support – notably iron and steel (Iskor) but also Sasol - are now the industries perceived to be some of the most successful in the South African economy. Similarly, while blanket import protection may create inefficiencies, post-apartheid policy has not always effectively used what little space the country did have in the World Trade Organisation (WTO) negotiations to effectively protect particular industries, for example by rapidly lowering duties beyond what was expected under WTO rules. Several writers have argued (for example, Mohamed, see below), that rapid liberalisation of the South African economy has thus resulted in an increased dominance by the MEC sectors as they have expanded (and make up the majority of exports), while other sectors of manufacturing have suffered industrial decline in the face of cheap imports (notably textiles). The underlying reasons for this increasing dominance (for it is not based on a natural comparative advantage), will be highlighted later in this thesis.

Furthermore, analysis of the MEC is equally important given the low-carbon perspective inherent in climate change mitigation objectives. As Marquard (2006: 71) argues, the MEC is key

“not only because of its close relationship with the energy system as whole, but also because of an associated ‘industrial policy complex’, which was very influential in the development of energy-related policies and was focused on a minerals-based and energy-intensive form of industrial development. This industrial policy complex consisted of a number of overlapping policy networks focused on different sectors, and co-ordinated by what can be termed an ‘industrial policy elite’ concentrated in agencies such as the IDC and the state’s economic planning machinery, with close connections to the political elite” (Marquard 2006: 71).

The MEC has for the most part been ignored in energy-related literature, while the energy aspects of the MEC have not been well-researched, beyond an acknowledgment of its key role in structuring South Africa’s economy and hence emissions (other than Mohamed (1998), which is based on data from the 1980s and 1990s and is thus fairly dated, although his findings are still relevant). There is a gap in the MEC literature for analyses that focus explicitly on energy supply and use. For example, the relationship between energy-intensive beneficiation and mining needs to be further untangled, and the role of corporations such as BHP-Billiton, Exxaro, and Xstrata elaborated upon. Given the centrality of energy to the notion of the minerals-energy complex, there is surprisingly little energy-focused research on the MEC.

Finally, it must be borne in mind that while the MEC may be the form that capitalism has taken in South Africa, Fine and Rustomjee show clearly that this structure is not natural or predetermined; rather than the MEC being ‘naturally’ based on South Africa’s minerals endowment, a series of strategic and policy decisions were taken that have ensured the dominance of the MEC both during and post-apartheid. These decisions relate to the development of particular industries, and this is a key point; the structure of the South African economy has been formed through various decisions and is by no means unchangeable. Thus, discussions around South Africa’s ‘comparative advantage’ and the need to retain our reliance on mining and downstream minerals beneficiation because the country is ‘resource rich’ have developed out of a particular path of development, one which could be shifted to new areas of advantage should the state focus, as it did during apartheid, on the development of new areas of advantage and new types of resources.⁸

The MEC in post-apartheid South Africa

Several authors have traced the extent to which the MEC sectors have continued to dominate the South African economy, while recognition of the weight of the MEC sectors in the economy and the structure has entered policy discourse more fully, for example in the National Industrial Policy

⁸ This is part of a larger economic debate. Lin, for example argues that economic development takes place by focusing on the development path a country is already on (i.e. natural comparative advantage). Chang (1994), in his discussion of East Asian development (and similarly Wade, see above) argues that comparative advantage can be built (as Korea did with steel and shipbuilding). While there are obvious difficulties in transitioning, the role of industrial policy is one of co-ordination and it should be designed so as to ensure change happens efficiently.

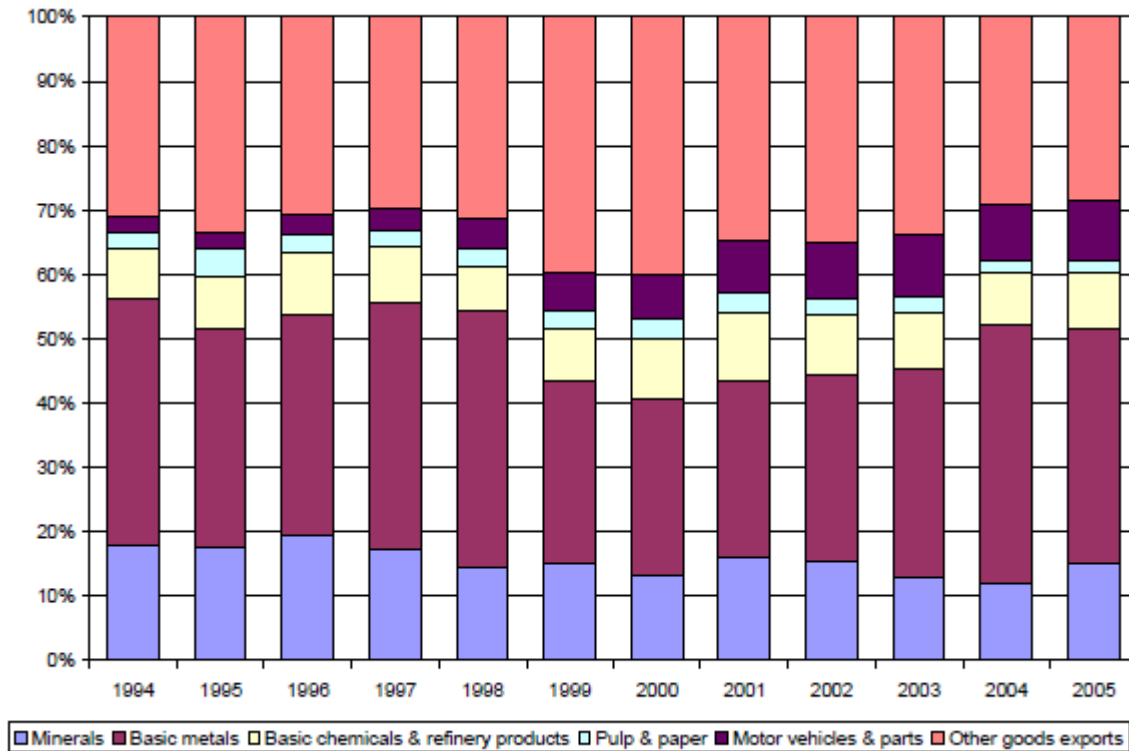
Framework (NIPF); this has not yet, however, translated into implementable policies that seek to diversify the economy away from the MEC.

Writing in 2005, Roberts has highlighted that the South African government “has failed to alter the dominance of the MEC industries” (30), which have continued to perform well partly as a result of historical support but also because MEC sectors have “benefitted disproportionately” from government incentives and tax breaks. So for example, in the 1990s, the capital-intensive industries have far outperformed other industries; ‘other manufacturing’ has had very low growth in value-added, while coke and refineries, auto, chemicals and basic iron and steel have had significantly higher growth rates (2005:5) (see figure below). Sub-sectoral differences need to be teased out to see the extent to which there has been (or has not been, as the case may be) increased diversification. Interestingly, autos have been successful, but also leather products (driven in all likelihood by growth in the motor vehicle sector), as well as furniture (which was made possible by cheap timber because of apartheid forestry policies).

Similarly, more than half of manufacturing Gross Domestic Fixed Investment (GDFI) in 2005 was in the coke and refineries, basic iron and steel, non-ferrous metals, motor vehicles, and basic chemicals sectors (Roberts 2007: 6), industries that are highly concentrated in South Africa (for example, Arcelor Mittal in steel, Sasol in coke and refineries and basic chemicals and a few firms in non-ferrous metals). Motor vehicles is one of the few industries that is widely held to be successful that is not particularly capital-intensive, but the sector has been well-supported by the MIDP (Roberts 2005: 6).

In terms of exports, from 1994-2004 minerals, basic metals and chemicals, pulp and paper constituted 60% or more annually of exports (see figure below) (Roberts 2007: 7)

Figure 1: Breakdown of South Africa's merchandise exports



Source: Roberts (2007: 10)

This is relevant because increased trade liberalisation, while significantly increasing imports and exports in general, has not contributed to shifting the structure of manufacturing. Indeed, from 2000-2005, export volumes of non-commodity products (when motor vehicles are excluded) declined by 3.3%, while resource-intensive products increased substantially (Roberts 2007: 16). The contribution of MEC sectors to Gross Domestic Product (GDP) has also been significant, with a rapid increase in financial services also contributing extensively.

Rather than acknowledging that the role of the MEC in the economy, while important in terms of investment and growth, has not contributed substantially to employment growth or social welfare increases (discussed further below), in the decade following democratisation, the state instead provided further support to these industries. As Roberts (2005: 15) points out, this has come in the form of funding for the mega-projects of the 1990s which were allowed to continue post-apartheid (for example Alusaf, and notably Saldanha Steel), through DTI incentives, through IDC funding, and through infrastructure investments that promote export-based MEC sectors. Even under the new National Industrial Policy Framework and the Industrial Policy Action Plans, for example, new Transnet infrastructure spending that runs into billions of rand remains focused on the extension of

transport systems between mines and export centres such as Richard's Bay or Saldanha, for example the Orex line (Rustomjee 2010). This highlights the extent to which broad policy objectives are undermined by misalignments between different departments and state-owned enterprises, as well as highlighting the degree of importance that MEC sectors hold.

When the 37e tax incentives programme expired in 1999, it was replaced by the Strategic Industrial Projects Programme. This was a DTI-run incentive program aimed at investments of over R50million which were judged to be necessary or important for South African competitiveness, which provided tax relief of R7.7 billion from 2002-2005. Of the 33 approved projects at end 2004, 13 were in chemicals and eight were in metal production (mainly upstream basic metals). Sasol alone accounted for four projects, and 24 per cent of the total tax allowances that were granted, by value (Roberts 2005: 15) (a DTI report, containing information to March 2004 listed two of these, at a value of R900m of tax allowances). This is in a context of high levels of state support for Sasol during apartheid, and serves to emphasise the core relationship between the state and MEC firms, both pre- and post-apartheid.

Besides Sasol, other MEC sector firms that received investment allowances included Iscor (now Arcelor Mittal's) Suprachem Ferro-alloy coke plant (R600m), BHP Billiton's Hillside Aluminium (R300m), Anglo- American's former subsidiary Hulett Aluminium (now Hulamin), Nampak Metal packaging (R80m), Trident Steel (again for aluminium) (R56m), Tata Iron and Steel ferrochrome plant at Richard's Bay (R482m investment allowance and R144m tax forfeit), Sublime Technologies ferrochrome smelting (R139m), and a SAPPI subsidiary (DTI 2004: 9). The Pechiney/Alcan smelter that was to be the anchor tenant at Coega had investment allowances of almost R3.3billion and a tax forfeit of over R600million (the maximum allowed), although that project was later scrapped in light of the electricity shortages and then rising tariffs.⁹

In total, firms in basic non-ferrous metals received the largest allowances, followed by basic chemicals, coke and refined petroleum products, and finally basic iron and steel (Rustomjee and Hanival 2008: 54).

The SIP has been replaced by Section 12i incentives for large projects, which started running in November 2010, although no publicly available information exists on who has thus far applied for support (of four applications received, three are in the chemicals industry and one in cement)(Creamer 2010). Allowances are granted on investment amounts of between R200m and

⁹ Although the location of a smelter at Coega was ostensibly a growth and employment-generation decision, it is clear that the low electricity prices and spare capacity were an important driver for the smelter, which is now expected to be replaced by PetroSA's new 400 000bbl/day oil refinery.

R1.6billion, and 'preferred' projects will be able to claim tax allowances of up to R900m. Clearly, the largest incentives available to firms are focused on capital-intensive projects, including megaprojects (defined by the DTI as projects requiring over R1billion).¹⁰

The development of the MEC (and hence energy-intensive industry) has been further supported by industrial policies that focus on low energy prices as a means of attracting foreign investment. For example, the DTI's 2005 'Developmental Electricity Pricing Programme' makes below-price electricity available for foreign investors in energy-intensive industries, thereby ensuring low input costs and global competitiveness – and an ongoing reliance on heavy energy-users (and thus heavy emitters) for economic development. The DEPP promises especially low tariffs to users for a minimum of seven years, ostensibly only if they pass the cost savings on to downstream industries to promote beneficiation and labour-absorbing growth (see <http://www.thedti.gov.za/publications/DEPP.htm>), although this has not necessarily been enforced. Qualifying sectors included the core MEC sectors, but the cost-savings have not necessarily been passed on, and beneficiary information is limited.¹¹

There is a dearth of recent, publically available information on the various state-run incentive schemes, although there is a fair amount of information up to 2006 or so. Of the available incentive schemes, many have been focused in the MEC sectors in whole or in part, and judging from IDC and other funding, this trend is likely to have continued to the present. So, for example:

1. Up to 2006, of the cumulative incentives granted under the Export Marketing and Investment Assistance Programme (EMIA), the largest allocation of funds went to agroprocessing and the mining and metals/capital goods sectors (Rustomjee and Hanival 2008: 41).
2. Under the Critical Infrastructure Programme (CIF), between 2002 and 2006, around 60 percent of the approved grants were allocated to the Coega and East London IDZs (R472m) (ibid 47). Part of this was for motor vehicle manufacturing development; but part of the proposals received were to have gone to the Alcan smelter at Coega (the new anchor tenant

¹⁰ Interestingly, energy efficiency forms part of the requirements of the points-based system for accessing the incentives (see Government Gazette, July 2010, and www.dti.gov.za). Prerequisites for brownfield investments include at least a 10% saving (based on South African National Energy Development Institute off of a baseline for the preceding 12 months), while Greenfield investments will have to show that they can be benchmarked against energy use for that industry sector as a whole. Furthermore, 'preferred projects' (with higher potential allowances) must achieve certain levels of compliance for a variety of factors, energy efficiency being one of them. These are slightly more stringent, and include brownfield efficiency savings of 12.5-15% (which will garner the project one point) or savings of over 15% (2 points). Greenfield projects must be 'innovative' and points allocation will depend on efficiency savings.

¹¹ Under the Electricity Pricing Policy, price distortions are supposed to be minimised, and contracts renegotiated when they come to an end. However, no information on beneficiaries of the DEPP has ever been made public, so it is not clear whether this has been adhered to, or whether the other requirements of the DEPP were practised.

is likely to be the new PetroSA oil refinery). Over R100m was also allocated to the mining, basic iron and steel, and basic non-ferrous metals sectors (ibid 49).

The Department of Science and Technology's (DST) Research and Development Tax Incentive Programme provides no information on who is receiving the tax breaks because this would 'compromise anonymity' but sectoral breakdown shows that almost 80% of the incentives have gone to chemical and industrial sciences (56 and 23% respectively) (DST 2008: 6), which seems to suggest a focus on MEC sectors, although it is difficult to be sure. Since the release of the 2007/08 Annual Report, however, there has been no further release of information on beneficiaries under this scheme.

It is also important to note that other incentive deals, for example the Small and Medium Enterprise Development Programme (SMEDP), do specifically target more labour-absorbing and downstream industries and have had success in doing so (Rustomjee and Hanival 2008: 56). These programmes have not, however, meaningfully impacted the structure of the economy, as evidenced by the export, investment and GDP information discussed above.

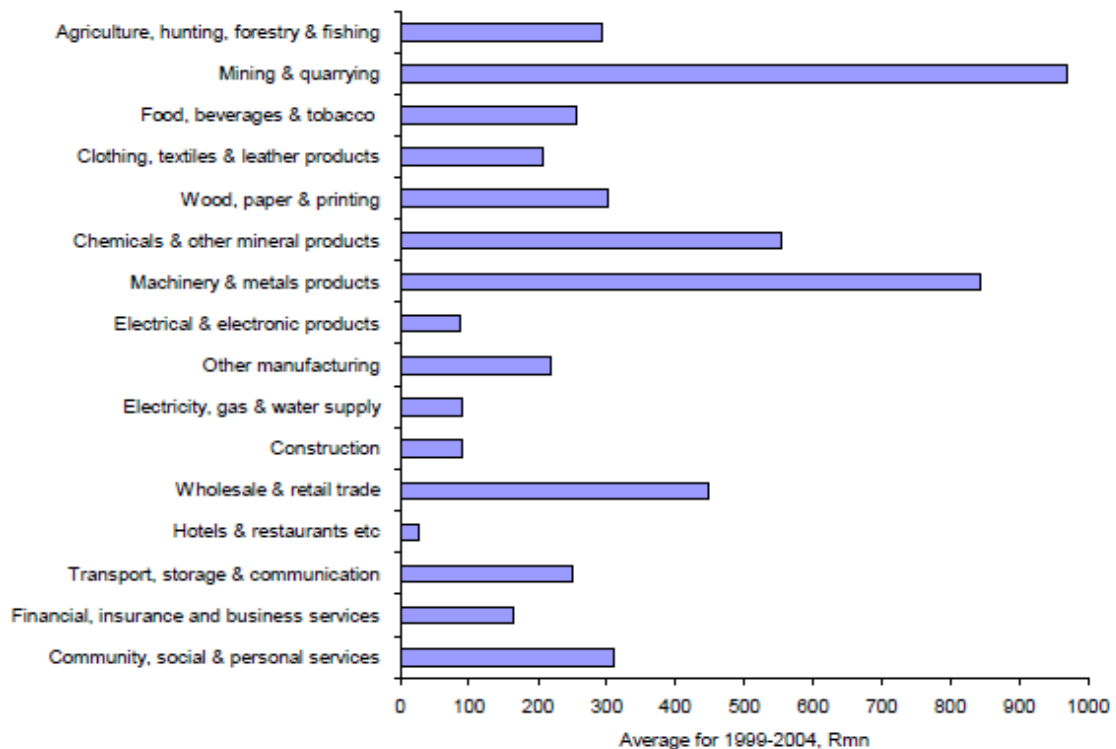
Industrial Development Corporation (IDC) funding

Beyond direct government incentives, IDC funding has similarly followed historical MEC sectors, with a sectoral analysis of IDC investments (from 1995 to 2005) highlighting that post-apartheid there are "strong elements of continuity with the value of financing being concentrated in machinery & metals, mining, and chemicals & other mineral products" (Mondi and Roberts 2005: 8). Financing levels to 2005 were significantly lower than in the past, except for spikes in spending on large mega-projects (especially Mozal 1 and 2) (ibid: 8).

In terms of general IDC funding, there have been an increase in Black Economic Empowerment (BEE) investments, both in terms of numbers of projects and by value (although the trend to 2010 has been a falling number of BEE projects but with increasing value, see IDC Annual Report 2010). However, BEE funding by value is focused heavily in mining and transport, storage and communications, which highlights how MEC sectors are well-supported even when the aims of the funding are broadly focused on increasing economic equity, which has been a key goal in industrial policy. So while it appears that this funding is focused on BEE investments, it is still focused on supporting MEC sectors. There has also been an increased expansion into Africa, with almost a quarter of IDC approvals by value from 2006-2010 being in the rest of Africa. However, continent-wide financing has tended to be focused on mining and basic metals, although it is not clear to what extent these have contributed to broader industrial or economic development in other African countries (Mondi & Roberts 2005: 12). Small, Medium and Micro Enterprise (SMME) funding has

shrunk, and although still relatively labour-intensive according to Mondi and Roberts (2005: 13), the largest SMME sector by value is chemicals. There could be significant potential for diversification of the economy through SMME and BEE funding, but instead, state support for the MEC continues to be channelled through funding intended to meet other industrial policy objectives.

Figure 2: Total IDC financing by sector, average value 1999-2004



Source: Mondi & Roberts (2005: 18).

The Acting Chairwoman of the IDC, MW Hlahla, has pointed out in the 2010 Annual Report that “the development of green industries and the promotion of energy efficiency have taken prime position” in the IDC’s plans towards “setting the economy on a low-carbon growth path” (IDC 2010: 13). This has to some extent been supported by the IDC’s budget allocation of R11.7 billion over the next five years towards green industries (IDC 2010: 13), although as total budgeted expenditure this constitutes only around ten percent.

As of 2009, the ‘green economy’ focus was still exceptionally small, with investment in one biomass plant in George (24MW), and in a photovoltaic (PV) assembly/manufacturing plant near Cape Town,

which is currently producing PV panels for export¹², although with no upstream linkages as yet, and none seemingly envisaged. This is the extent of truly green investment. The IDC, through its Venture Capital Strategic Business Unit, also invested R80million in the Joule, giving the corporation 22 percent ownership of Optimal Energy (IDC 2009a: 47). Up to 2009, however, it is clear that the IDC's (admittedly small) concern with anything 'green' came from the potential it saw in carbon financing and Clean Development Mechanism credits (see IDC 2009a; IDC 2009b). For example, one project involves flaring captured methane gas at South Africa's biggest pig farm and obtaining carbon credits from this (IDC 2009b: 45). While there are benefits in terms of climate change from doing this, it is by no means a sustainable, long-term 'green' investment.

According to its 2010 Annual Report, and in alignment with the new IPAP2 (with its inclusion of a "Green Economy" sub-sector), the IDC has committed funds for feasibility studies for wind farms, solar thermal power, bio-ethanol and bio-mass production, as well as bio-gas electricity generation. A further R56 million has been invested in the development of the Joule (which possibly says more about the country's focus on motor vehicles than on any meaningful green agenda shift). Of the R11.7 billion committed over the next five years, R2.6 billion of that will be funding for the rollout of SWHs.

As of 2010, the IDC's Annual Report claims that the "main objective" of the 'Wood, Paper and Other' Special Business Unit will be to focus on low-carbon development and the green economy, through the coordination of energy efficiency and renewable energy projects (IDC 2010). And the unit's funding thus far in 2010 has been to the tune of R403million (although of the 17 projects, several have been in timber and forestry). The IDC, in the form of Public-Private Partnerships, has approved R54 million for undertaking feasibility studies and developing six wind projects in South Africa. Importantly, the report does claim that local manufacturing of wind technology will be a focus of the unit, which points to upstream manufacturing potential (IDC 2010: 54). Even more importantly, the IDC sees the release of IRP 2 as a key driver of demand for finding of renewable energy, stating that once IRP2 is released "the diversification of the energy mix towards greener sources will underpin demand for IDC funding in the electricity-generation sector" (IDC 2010: 55). Given the small contribution of renewable energy envisaged in the IRP (see below), this may, however, be an overly optimistic assumption.

In a recent presentation to Parliament, several other 'green' projects that the IDC is involved in were discussed (Meer 2010). These include a study into the funding requirements for renewable energy

¹² The plant has a capacity of about 30MW/year, but imports all of the components necessary for production and exports the assembled products.

and energy efficiency, development of plans for investment in building retrofits and input into the new SWH rollout incentives, some further biogas feasibility studies,

Interestingly, an increased involvement in possible (i.e. pipeline or (pre-)feasibility) wind generation projects (totalling 1600MW, of which 450MW is in feasibility stage) has also included one partnership with a local turbine manufacturer with 90% local content in the turbines, although there have yet to be any orders for the equipment. And the IDC claims to have about 300MW of possible solar in the pre-feasibility stage.

The presentation highlighted that the IDC does see financial viability in a range of renewable energy projects, but in almost all the cases there were severe regulatory barriers. These included, especially, a lack of certainty around the Power Purchase Agreement's for the Renewable Energy Feed-in-Tariff (REFIT) and Independent Power Producer (IPP) involvement generally, but also lack of certainty of Department of Energy funding model for SWHs, implementation of SANS 204 (building energy efficiency), IRP 2010 targets, tax incentives for green industry and allowances for energy efficiency. If the IDC – which forms part of the policy-making community – faces investment uncertainty in these areas, the extent of the misalignments in policy and thus private sector uncertainty is certainly very large. Such barriers must be dealt with effectively if these sectors are to grow.

While these investment approvals are laudable, the amounts committed pale in comparison to those granted to the traditional MEC sectors. Continuing the trend from 1994-2004 discussed above, IDC expenditure (in the form of a large loan and other investments) on the chemicals and mining sectors in 2010 alone totalled R1.58 billion and R5.1 billion respectively (i.e. more than half of what the “green economy” will receive over the next five years was spent on MEC sectors in part of one year) (IDC 2010). The IDC's core focus (and the DTI's – discussed below) has not shifted meaningfully away from the sectors that currently dominate South Africa's industrial sector. There has been no emphasis placed on the legitimate possibility that a greener economy can bring about structural change that promotes growth, employment and has positive environmental impacts. This is more about trendily following a global shift in focus to ‘green growth’; but our attempts to cash in on this trend are ludicrously small when compared to other countries (notably Korea). South Africa cannot expect to ever achieve first mover advantage if it does not commit wholeheartedly to something new.¹³ Currently, incentives are geared primarily towards extractive and basic industries, with

¹³ This has been acknowledged by the Minister of Energy, who has pointed out that South Africa missed out on the IT Revolution and will soon miss out on the Green Revolution (see www.polity.org for a full collection of speeches).

industrial policy recognising that there have been little or no downstream benefits to the South African economy.¹⁴

Given that the newly established Economic Development Department has stated that “the IDC can give critical impetus to government’s efforts to realign and restructure the real economy” (EDD 2010: 29), the IDC’s continued focus on MEC sectors shows that core industrial policy producing departments are neither adequately aligned in their policy objectives, nor that the IDC’s claim that it builds on the IPAP objectives is true – there seems to be a fundamental contradiction between policy planning and policy actualisation.

The sad irony of the South African economy is that the areas on which its strength is based, especially in exports and investment, are also the sectors that account for a broader structural weakness in employment and environmental sustainability. Roberts (2005: 15) has argued, however, that “the MEC characterisation is not necessarily determinist. Recognition of the significance of resource-based activities and of the historical influence of the large resource-oriented firms over policy, is the basis for a coherent government strategy to reorient the growth path of the economy” (Roberts 2005:15). This re-orientation is imperative for reaching government goals of job creation and poverty alleviation, which have thus far not been addressed.

Social and economic development

The unequal and racist policies of the apartheid government undeniably led to severe underdevelopment for the majority of the South African population, and it must certainly be acknowledged that dealing with such poverty would always be a difficult, almost overwhelming task for the post-apartheid government. While not disputing the challenges facing the post-apartheid state, it is necessary to highlight the extent to which the economic situation has been worsened by the entrenchment of particular trends in the performance of the economy, with a concomitant deterioration in productive, poverty alleviating outcomes. This is important to note also because,

¹⁴ This is implied in the IPAP2’s problem statement, which recognises that other than the capital- and energy-intensive sectors of the economy, manufacturing has stagnated, and that employment growth in sectors other than services has been low (DTI 2010: 5-6), as well as in the government’s New Growth Path document. The NGP document states, for example, that there are “weaknesses in the state’s use of commodity-based revenue for economic diversification and skills development” (EDD 2010: 5). Roberts and Rustomjee (2009) also allude to the lack of downstream benefits gained through the state’s support of MEC firms, in their discussion of Iscor and Sasol’s monopolistic pricing policies. Despite receiving enormous state support both during and after apartheid, there has been very little development of downstream industries associated with their basic outputs (in the case of Iscor/Arcelor Mittal, the size and nature of the metals fabrication sector, the authors argue, has been limited by the pricing of steel products produced by Arcelor Mittal, despite the firm having very low cost production in South Africa) (Roberts & Rustomjee 2009: 55-58). In the case of Sasol, there are both liquid fuels regulatory system issues, and a lack of diversification into downstream petrochemicals, despite the state’s continued emphasis on chemicals beneficiation (2009: 63-65).

contrary to much popular opinion, ‘the environment’ and environmental protection is not necessarily in opposition to ‘development’. The traditional viewpoint – that the environment and development are opposing goals - however, is typified in statements made by South African politicians. For example, the current Minister of Science and Technology had this to say on the topic of climate change and development: “We cannot eliminate poverty without increasing the use of energy. As developing countries take their peoples out of poverty, there has been a strong growth in greenhouse gas emissions. We cannot stop development in the developing world...” (Retrieved from www.polity.org). What will become clear in the discussion below is that in South Africa’s case, increasing energy use and the associated emissions have *not* been accompanied by increases in human well-being and development, and that increases in energy-use have largely been in industries with low employment rates.

Similarly, Minister of Mineral Resources, Susan Shabangu has said that “there is increasing tension globally between growth and socio-economic development on the one hand, and the environment on the other. We in South Africa grapple with the same challenge...” (Speech given at Annual General Meeting of the Chamber of Mines, retrieved from www.polity.org). A further example of this type of traditional thinking comes from a recent NEDLAC report. The Fund for Research into Industrial Development, Growth and Equity (FRIDGE) study produced for the Trade and Industry chamber of NEDLAC states that “South Africa is still a developing country with high levels of poverty and unemployment, so any climate policies must be balanced against the need to grow the economy, create jobs and limit the impact of policies on the poor” (Genesis Analytics 2010: 30).

This traditional approach to development and environmentalism has been more recently recognised as a false division, first in the idea of sustainable development, and more recently through the notion of the ‘green economy’. This is an attempt to highlight how social and environmental goals can be aligned. A recent UN report on the green economy has this to say

“Perhaps the most prevalent myth is that there is an inescapable trade-off between environmental sustainability and economic progress. There is now substantial evidence that the greening of economies neither inhibits wealth creation nor employment opportunities. To the contrary, many green sectors provide significant opportunities for investment, growth and jobs” (UNEP 2011: 15).

The UN definition of a green economy (the notion does not replace the idea of sustainable development, but builds upon it) is an economy that is “low carbon, resource efficient, and socially inclusive” (UNEP 2011: 16), one where growth in employment and income should be “driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services” (ibid).

During the economic crisis this potential was recognised, with significant portions of many countries' stimulus packages being directed towards green industries - about US\$430bn out of a total of US\$2.8trillion (HSBC 2009: 2). The 'green' elements of the various packages vary from country to country, but China's allocation was about 40% of its total stimulus; Korea's was more than 80%. The allocations focus particularly on energy efficiency in building and vehicles, renewables, water, and rail infrastructure (ibid 2009: 3).

Although there is an undeniable tension between the current structure of the South African economy and a 'green' society, the assumption that 'development' only takes place if accompanied by vast increases in resource use and pollution disregards the evidence that new types of industry offer potential for socio-economic development and environmental sustainability. There are potential alignments between developing a 'green economy' and economic growth. Using discussions of 'development' to oppose environmental sustainability, in the context of widespread environmental injustices in South Africa, is therefore merely a means by which to entrench the status quo. As will be discussed below, South Africa's current development path does not contribute to increasing either social or environmental sustainability, and MEC sectors contribute heavily to costly environmental damages (acid mine drainage and climate change being only two of many).¹⁵

The MEC-based structure of the South African economy inherited in 1994 had several structural weaknesses that have not been addressed. The potential for changing and improving the economic structure so as to increase the material well-being of the country's citizens has not been reached. In fact, as Mohammed and Roberts argue, it is now widely recognised that South Africa's economic trajectory will not result in reductions in unemployment and poverty (2006: 1), regardless of the positive spin put on our economic development by the government. Rather, the trade, competition and industrial policy decisions (or lack thereof) made by the post-apartheid state have exacerbated, rather than alleviated, the poverty and inequality of the country.

For example, Winkler and Marquard (2009: 48) highlight both the inequality within South African society and the disparity between economic wealth and development. Thus, according to the Human Development Report, the Gini coefficient for SA ranks the country as the 117th most unequal (out of 126). In addition, the country's ranking on the Human Development Index (based on the 2009 Human Development Report) is 129th out of 182 countries (EDD 2010: 10). And yet, on a GDP per capita basis, SA is ranked 53rd in the world.

¹⁵ See the Report produced for the Inter-Ministerial Committee on acid mine drainage, for example (Council for Geoscience 2010). The report outlines the hundreds of millions of rands required to prevent decanting of acid mine shafts in only three of the mining areas in the country.

While much of this is directly attributable to the apartheid state's policies of separate (and very unequal) development, the post-apartheid state has had very little success in achieving better development indicators. Indeed, South Africa's HDI has been in decline in the post-apartheid period, decreasing from 0.745 in 1995 to 0.707 in 2000 and then to 0.674 in 2005 (Winkler & Marquard 2009: 49).

The link between energy use and social development is clear, but what is not clear is how the increases in emissions and energy use in the country have had any effect as yet on human wellbeing.

Economically, South Africa has experienced relatively low growth rates (prior to the recent economic crisis), and its performance "has not been particularly good by comparison with similar middle-income developing countries. Above all, the growth rates have been achieved with very low investment and employment rates" (Roberts 2005: 2). Indeed, Dube et al (2007: 2) term South Africa's growth rate "lacklustre". While South Africa had an average per capita growth rate from 1994-2004 of 1.2 percent, the rapid decrease in the late 1980s of per capita GDP means that the country has yet to reach the per capita level it experienced in 1981, and such growth rates have been far surpassed by the average growth rate of 3.7 per cent in South Asia, and 6.2 percent in East Asia (Dube et al 2007: 2).

The relatively low GDP growth rate has been accompanied by large decreases in formal employment in the manufacturing, mining, and agricultural sectors (Roberts 2005, Roberts 2007, Dube et al 2007). Such job losses must be viewed in the context of South Africa's "exorbitant" 26 percent unemployment rate (Dube et al 2007: 17), which rises to 40 percent when discouraged workers are taken into consideration. And these job losses have all been in absolute terms, i.e. not related to outsourcing. At the sub-sectoral level, there have been 60 000 job losses in clothing and textiles, 42 600 in food products, more than 20 000 each in steel, non-metallic minerals and electrical machinery from 1994 to 2007. Compare this to 30 000 more jobs created in machinery equipment, 20 000 in motor vehicles and 18 000 in 'other manufacturing' (Black & Roberts 2009: 218).¹⁶ In the services sector, which is the only employment sub-sector to have experienced significantly increased employment levels, a large portion of the apparent increases are due to outsourcing and subsequent reclassification of jobs; those that are increasing in absolute terms are primarily in the security and cleaning sectors. One third of the increase in jobs in the Business Services sector is attributable to increases in security guards (Roberts 2007). Furthermore, this structural unemployment has worsened considerably due to the recent economic situation, resulting in job losses of 870 000

¹⁶ Interestingly, the automotive sector is one of the only sectors to have a targeted industrial policy, the Motor Industry Development Plan (now the Automotive Production and Development Programme).

between the fourth quarter 2008 and the end of 2009 (DTI 2010: 14-15), a trend which has continued into 2010.

So while employment in the primary sector has been in decline, so too has employment in manufacturing (165, 448 jobs from 1994-2004), and these sectors have typically been those that employed the most unskilled workers (Hausmann 2008: 6). Growth in labour-intensive sectors from 2000-2003 (such as plastic, furniture, professional and scientific equipment) has been reversed since then, with an increase in basic iron and steel, autos and paper dominating from 2004-2006. (Rustomjee & Hanival 2008: 21).

From an energy-supply perspective both direct Eskom jobs and electricity-related mining jobs have been in decline since the 1980s, even while consumption of electricity has increased (Agama 2003). The coal-fired electricity system on which the economy is based did not had a large effect on either direct or upstream (coal mining) employment growth post-apartheid. The employment potential in coal-fired electricity is limited by the nature of the system, whereas renewable technologies may provide better employment benefits (discussed further below)

Beyond the declining levels of employment in the country, Mohammed & Roberts (2006: 4) have shown that post-1994, South Africa's Gross Fixed Capital Formation (GFCF) as a percentage of GDP is much lower in than in selected High Income Countries, all other Middle Income Countries and even in several Low Income Countries.

In the 1970s, for example, GFCF in South Africa had averaged 26.9 percent, whereas in 2000 it had fallen to a low of 15.1 percent (the high level in the 1970s was partly due, however, to the large investment in the core MEC sectors of electricity and CTL).¹⁷ This is comparison with a high growth country such as Malaysia, where investment rates have typically been over 30 percent – and did not fall, even during the 1997 Asian crisis, to below the 20 percent level which is widely viewed as the minimum required for achieving higher growth rates (Mondi & Roberts 2005: 6). Low levels of investment in the post-apartheid era have partly been due to low investment levels by the state in general and state-owned enterprises in particular (although private sector investment dominates) (Mondi & Roberts 2005: 6), but this is due to change given the new generation capacity requirements that Eskom is currently facing and its new build programme.

¹⁷ Although this has increased more recently to over 20% of GDP in 2007 and 2008, due to state-led infrastructure build programmes (Mohamed 2009: 6). However, as Rustomjee & Hanival (2008: 79) point out, increasing the infrastructure build in the context of increased competition from imports means that the domestic benefits will be reduced unless a concerted effort is made to encourage domestic production of inputs.

Thus, while investment levels in the country are low in general, the MEC sectors contribute significantly to investment levels in the country and also to exports. But this has been coupled with very little employment growth (indeed, decline). And South Africa is an outlier when it comes to the relationship between emissions per capita and human development, with a comparatively low level of social development and comparatively higher emissions than most other countries.

National Industrial Policy Framework and Industrial Policy Action Plans

Currently, the industrial policy landscape is defined by a broad National Industrial Policy Framework (NIPF), which is the guiding document for industrial policy objectives in the country. This is supplemented by a somewhat more focused Industrial Policy Action Plan or IPAP (the first in 2007, and the more recent version released in 2010). Then there are various sectoral plans (the most prominent of which was the Motor Industry Development Programme), as well as the various incentive schemes run by the DTI either on its own or in conjunction with other government departments such as the Treasury or the revenue services. The IDC supposedly aligns itself with the IPAP objectives in terms of investment decisions.

Many of the issues raised above have been recognised by the government and are explicitly referred to in the National Industrial Policy Framework (NIPF) and the 2007 Industrial Policy Action Plan, especially those related to low investment levels and the need for an increase in labour-absorbing activities.¹⁸ This has been further emphasised in the IPAP 2, released in 2010, which draws special attention to the structural weaknesses of the South African economy.

The IPAP 2010 interventions are geared towards the generation of a “structurally new path of industrialisation”, one based on higher levels of employment (which are in turn based on higher growth rates in the productive sectors of the economy) (DTI 2010: 3-6). The analysis in the Plan acknowledges the “mediocre” investment and savings levels in the economy (except for investment by SOEs/government, debt-driven consumption, and the MEC sectors), the high real cost of capital (compared to major trading partners), and the extent to which infrastructure content is often imported (as evidenced by the increasing trade deficit in the metal fabrication, machinery and transport equipment sectors).

¹⁸ The core objective of the NIPF, as outlined in the 2010 IPAP is to “facilitate diversification beyond our current reliance on traditional commodities and non-tradable services” (DTI 2010: 3). The 2007 IPAP states that “The major weakness identified in South Africa’s long term industrialisation process has been that the decline in the share of employment in our traditional tradable sectors – notably mining and agriculture – has not been adequately offset by a sufficiently large increase in the share of relatively labour-intensive employment in non-traditional tradable goods and services – particularly in manufacturing.” (DTI 2007: 2)

IPAP2 objectives/focus areas include:

- Improvement of trade balance (increase production domestically and develop new areas of export competitiveness)
- Improved industrial financing (to promote productive investment that drives job creation and value-addition). Specifically, the IPAP points out that BNDES – the Brazilian version of South Africa’s IDC – offers concessional credit at about half the prime lending rate, as well as focusing on other financing mechanisms to promote productive investment.
- Diversification of the economy
- Job creation
- Downstream minerals beneficiation (i.e. increased value-addition to MEC sectors)
- Development of the ‘Green economy’
- Development of Advanced technological capabilities (including a focus on nuclear)
- Rural development
- Stronger integration between sector strategies, skills development plans and publicly funded innovation (DTI 2010: 16-18).

The Plan will also review and strengthen conditionalities attached to on- and off-budget incentives, notably around employment intensity, supply chain localisation, and market behaviour, and promises “stronger scrutiny” for capital- and electricity-intensive ‘megaprojects’ (DTI 2010: 19-20).

Such higher-level recognition of these problems, however, has not resulted in implementation of lower-level policies to change the structure of the economy, as described above (including 2010 IDC and S12i incentives, which seem fundamentally misaligned with these broader goals). There seems also to be a misconception that the ‘green economy’ is something to be added to the traditional commodities-based economic structure, rather than an entirely new way of thinking about competitiveness and environmental sustainability.

Energy, electricity pricing and emissions

Before moving on to a discussion of the relationship between industrial policy and mitigation, it is necessary to outline the energy and emissions context of South Africa, and the relationship between energy-intensive industry and the energy sector in more detail.

The South African energy supply context

Energy supply in South Africa is based primarily, although not exclusively on coal, which provides about 70% of primary energy in the country. Total installed capacity is 44 174MW (Eskom 2010a). Around 93% of electricity produced in South Africa is based on coal-fired power stations (Eskom

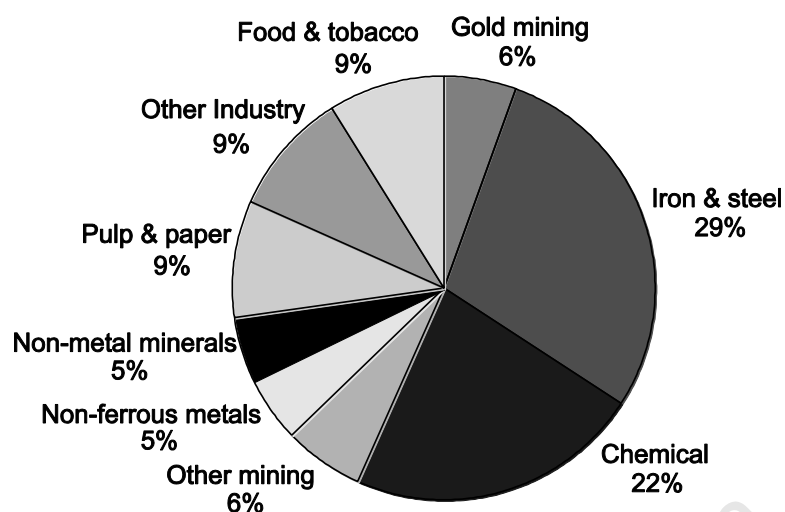
2010b: 1), requiring Eskom to burn over 122Mt of coal in 2010. Koeberg power station near Cape Town is the sole nuclear plant in the country and produces about 5 percent of the electricity, while two small hydroelectric installations and some gas turbines make up the remainder. Electricity from renewable energy in the country is negligible. Eskom dominates electricity supply in the country, although a few companies generate their own power and there are a few independent power producers.

South Africa produces a small amount of crude oil, although imports dominate its crude oil supply, and a substantial portion of the country's petroleum requirements are met through the use of Sasol's Coal-to-Liquid (CTL) and PetroSA's Mossgas Gas-to-liquid (GTL) processes. Of the total refining capacity (of crude and crude equivalent) of 708 000bbl/day (SAPIA 2009), almost 30% is from CTL (150 000bbl/day) and GTL (45 000 bbl/day) (SAPIA 2009), making Sasol's CTL process of strategic importance in the liquid fuel supply sector. As Eberhard (2010: 4) has stated, coal thus "plays a vital role in South Africa's energy-economy"; and it is this reliance on coal-based liquid fuels and coal-fired electricity production that makes South Africa such a carbon-intensive economy (exacerbated by the demands from energy-intensive industry).

Demand

In terms of electricity use, mining alone uses 17.4% of electricity in the country (Winkler 2006: 27). In comparison, domestic use of electricity was 19.4% in 2000. Industry energy demand is based overwhelmingly in electricity and direct coal use, making it highly emissions-intensive, and industry as a whole uses almost half of the electricity in the country. As highlighted in the figure below, final industrial energy consumption (for 2001) is dominated by core MEC sectors, particularly iron and steel (29%) and chemicals (22%), but also gold and other mining.

Figure 3: Final industrial energy consumption by sub-sector



Source: Davidson and Winkler (2006).

Energy Intensity:

Energy intensity is the measure of the relationship between energy use and economic output. While South Africa's energy intensity did fall from 4.03 in 1995 to 3.51 (PJ/R billion) in 2000 (DME, quoted in Winkler 2006), the country is still energy intensive when compared against OECD countries or even South Korea. Similarly, the country's per capita electricity use is remarkably high given the highly unequal access prevalent in South Africa, and points to the electricity-intensive nature of much of industry. . The decline in energy intensity can be accounted for by the growing contribution of the services sector to GDP, but as highlighted above, this heralds neither increased social development nor a real shift away from the MEC.

Emissions info and background

South Africa has produced a greenhouse gas inventory demonstrating the areas of the economy that produce the most emissions; the inventory has highlighted the large contribution made by electricity production and industrial processes. Energy use is thus the biggest driver of emissions (and industry has the greatest demand). The inventory (for the year 2000), puts South Africa's emissions total at 461Mt CO₂ equivalent, with 83% coming from energy supply and use (energy industry accounting for over 218Mt) and 7% from industrial processes (the remainder is made up of 8% agriculture and 2% waste) (Draft SNC 2010).

The quirk of our reliance on synfuels also means that, when the synfuels-related process emissions are included, energy-related emissions account for a substantial portion of the country's emissions.

Indeed, Sasol's Secunda plant is anecdotally assumed to be the single greatest emitter of carbon dioxide on the planet. Eskom and Sasol together thus contribute significantly to the country's emissions, with Eskom emitting 224.7Mt of CO₂ in 2010 (Eskom 2010b: 2). One study has thus argued that this suggests that "strategic decisions made by these two firms will have the potential to influence South Africa's GHG emissions more than any other factor" (Genesis Analytics 2010: 25). However, a closer examination of energy use shows that if one

"allocates emissions to economic sectors (adding electricity and CTL emissions to sectors which consume electricity and CTL-derived liquid fuels), *industry accounts for 66% of the demand for emissions-generating goods and services*" (Winkler & Marquard 2009:51, emphasis added).

(This is followed by the transport sector 12%, residential 9%, agriculture 8% and commerce/services 5%).

Addressing industrial demand for energy - through energy efficiency, for example – can thus considerably reduce both energy demand and the concomitant emissions. A change in the energy- and electricity-intensive nature of the industrial structure would do the same.

Pricing history and relationship to industrial structure

While South Africa's industrial structure, and the industrial policy incentives that continue to promote such a structure, has been summarised above, it is necessary to further discuss the structural effects on the economy of the historically cheap electricity that has been provided by Eskom, and the roots of the country's current reliance on energy-intensive industry.

The primary role of the electricity supply sector has, since the 1920s, been to provide inputs to the mining sector. Eskom's role in the economy has thus been to produce a reliable and economically low-cost product to promote gold-mining and the associated MEC sectors – literally, a "cheap and abundant supply of electricity" (Electricity Act 42/1922, quoted in Marquard 2006: 126).¹⁹ In this role Eskom performed outstandingly for most of the early years of apartheid; as Marquard (2006: 135) points out, Eskom's relationship with energy-intensive industries is historically "one of the main cores of its *raison d'être*. Direct electricity provision for mining and other industry dominated its

¹⁹ Similarly, in its first annual Report the then Chairman of Eskom (Hendrik van der Bijl) stated that "the Commission regards cheap power as an important factor in promoting industrial development, and has, therefore, devoted, and will continue to devote, the closest attention to this aspect of its duties and responsibilities". Eskom's 1984 Annual Report furthermore stated that the organisation's objective was to "provide an adequate supply of electricity, at cost price, to be used for the economic advancement of South Africa" (Eskom Annual Reports 1923 and 1984, quoted in Marquard 2006: 126 and 128).

history; sales to all other consumer types (including bulk sales to local authorities) comprised only around 25% in 1950, and only around 38% in 2000” (see also Steyn 2006; Clark 1994 for the early history of Eskom and Iscor, and chapter four of Marquard 2006 for an in-depth discussion of the development of electricity policy).

Although not without some complexities, the relationship between Eskom and the gold mining industry was largely one of consensus in the 1950s and 1960s, when the electricity system at the same time formed the basis for the development of a “cheap electricity-based industrial complex, at the heart of which were a small number of energy-intensive industries” (all MEC sectors).²⁰ Notably, according to Dupperrut (1998, quoted in Marquard 2006), these industries are especially price sensitive because they are firstly very electricity-intensive; secondly, however, the low electricity price has discouraged both investment in non-fossil fuel-based electricity and more efficient use of energy. Hughes et al (2002) have similarly pointed out that industrial energy efficiency in South Africa is on average far lower than in other countries (Hughes et al 2002).

From the 1970s, a rapid expansion of the grid (completed 1973) and new generation capacity resulted in an enormous overcapacity and an eventual commission of enquiry into Eskom’s investment and planning processes (the 1984 de Villiers Commission). For example, from 1970-1982, Eskom’s installed capacity tripled. In 1969, the sent out rating of Eskom plant was 6500MW, with 3600MW under construction; from 1969 to 1979, the organization added capacity of 25 000 MW (and then announced a further 11 000MW over the next three years) (Marquard 2006: 140-155). At the time, there were rapid price increases to fund this ostensibly much-needed expansion. By 1977, the average tariff had increased by a “staggering” 166% compared to 1971, with price increases of more than 22% in 1975, 30% in 1976, and a further 48.2% in 1977 (Conradie & Messerschmidt 2000: 228).

This expansion came with other serious ramifications that eventually led to the commission of enquiry: Eskom’s GDFI as a percentage of South Africa’s total grew from an average of 4% in 1968-1974, to 12% in 1977, and Eskom accounted for 20% of the net inflow of foreign capital in 1975, and 61.2% in 1976 (Marquard 2006: 162). While there had been genuine threats to supply in the early 1970s due to rapid increases in demand (with a reserve margin of only 11% reported in 1975 – see Steyn 2006: 14), and again in the very early 1980s, the demand forecasts made by Eskom throughout the very late 1970s and 1980s were consistently over-estimated. This was partly as a response to the supply pressures experienced earlier (Steyn 2006: 18), but also did not take into consideration that

²⁰ Winkler & Marquard (2009: 5), using US EIA and Eskom price data, have worked out that both South Africa’s coal and electricity prices have consistently been around 40% of the average price in the US over the last four decades.

higher prices in the 1970s had resulted in lower demand growth; this resulted in enormous overcapacity in the early 1990s, with a 40% reserve margin reported (Steyn 2006: 38).

Eskom thus began, along with the IDC, to “actively explore” potential possibilities for new energy-intensive investments (Marquard 2006: 171).²¹ Notably, these included, for example, (the then) Alusaf’s (now BHP-Billiton) Hillside aluminium smelter near Richard’s Bay, which came online in 1996 (Bayside had been constructed in the 1970s). Eskom’s surplus capacity was dealt with through decommissioning and mothballing plant, and through attracting minerals beneficiation agreements.²² Steyn (2006: 37) puts the figures at 300MW of interruptible supply to Alusaf in 1993 and 760MW in 1996 (when Hillside came online). Ferrochrome smelters received 370MW in 1996 and a further 1470MW were planned for 1997-2000. Several large energy-intensive operations also came online in the early 2000s. And industry received very low priced electricity; a recent Eskom document, leaked to the public, has shown that BHP-Billiton has been paying around 12c/kWh for electricity.

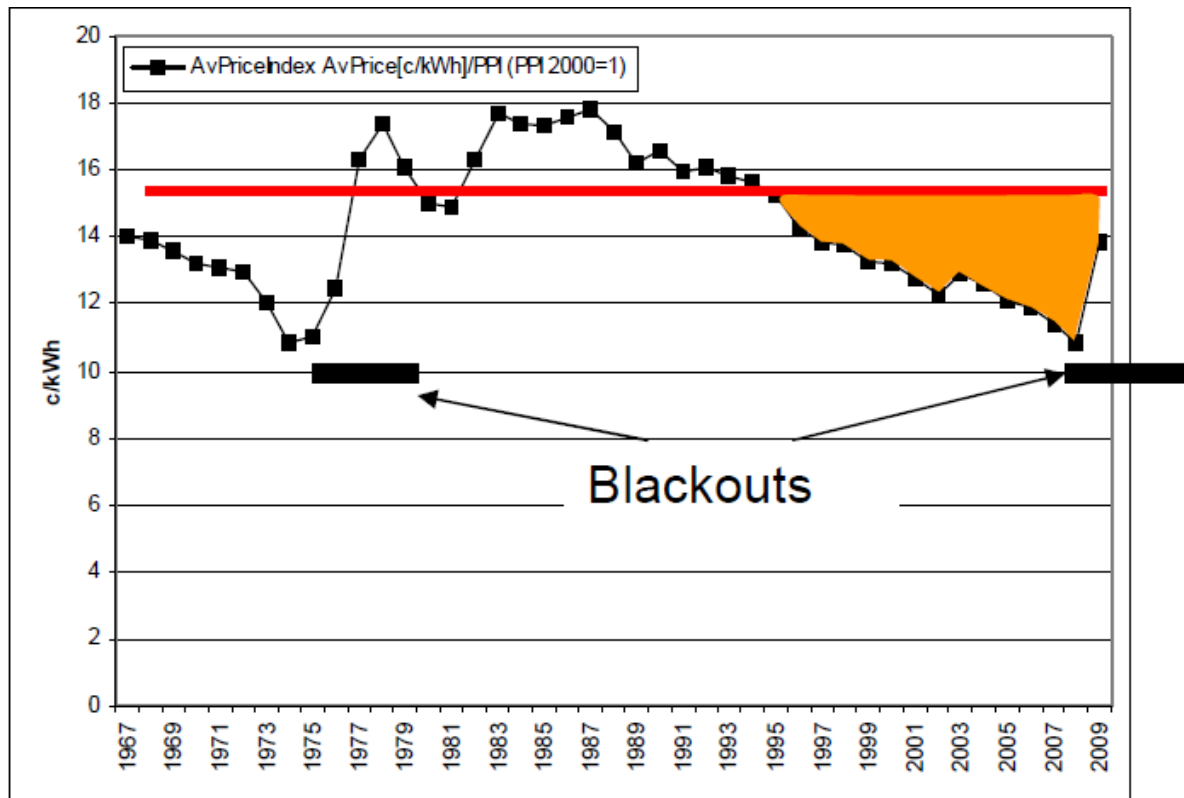
It is thus clear that our ‘comparative advantage’ in electricity-guzzling minerals beneficiation has been built up by the combination of a set of industrial policy incentives and by the particular historical circumstances of Eskom’s over-investment in, and subsequent overcapacity of, generating plant. Having paid off these investments, Eskom was able to lower the real price of electricity in the 1990s, making private sector investment in power generation in South Africa unviable. Now the country’s ‘abundant’ cheap electricity, is no longer so abundant, nor is it likely to be as cheap as in the past, with a 2009 price increase of 31.3% followed by increases of 24.8% in 2011, 25.8% in 2012 and 25.9% in 2013 (and probably beyond)echoing the rapid price increases of the 1970s (Eskom 2010b: 91 and 158). Indeed, the average electricity price increase has risen from 18c/kWh in 2007 to an expected 66c in 2013; this equates to a 250% increase in real terms (Trollip & Marquard 2010: 2). As the graph below illustrates, the real price of electricity fell dramatically in the 1990s. While it therefore appears that the electricity-intensive industry in the country is internationally competitive and more efficient than other manufacturing sectors in the country (because of increasing dominance during and post trade liberalisation), this is actually a myth. The apparent

²¹ One positive spin-off of the large overcapacity was Eskom’s post-apartheid willingness to extend electrification to the thus far largely unelectrified black majority, exceeding government targets and expanding residential access from around 30% in 1990 to over 70% currently (and also thereby repositioning itself as a part of the development landscape of the new government). There remain, however, serious access issues for the majority of South Africa’s poor. Not only do a very roughly estimated 20 percent of households remain unelectrified, but the cost of electricity remains prohibitive for many poorer households, despite cross-subsidisation by Eskom, and there is continued reliance on fuels such as wood, dung, coal and paraffin, with concomitant negative health impacts.

²² The mothballed stations have since been returned to service, at a much higher than initially estimated cost.

competitiveness of such industries is driven by the low, and falling, input cost of electricity in the 1990s, which was essentially being subsidised by Eskom's higher tariffs in the late 1970s and 1980s.

Figure 4: Average electricity price



Source: Gaunt (2010: 10).

And although South Africa's electricity price has historically been lower when compared to other countries, Steyn (2006: 29, quoted in Marquard 2006) also draws attention to the fact that this is something of a myth, with the apartheid state, for example, effectively having provided a R19.1 billion subsidy to Eskom through forward cover on loans for the large expansion programme in the 1970s.²³

This effective subsidisation of capital- and electricity-intensive industry was further increased by the structuring of the coal industry in the 1980s, wherein the provision to firms of export permits by the state depended on agreement by those firms to ensure "optimal extraction" and adequate local supply of coal (Marquard 2006: 110-112). The right to export higher quality coal (some 44% of

²³ This is currently taking place in a similar fashion to the 1970s, with R350 billion in loan guarantees and R60 billion directly allocated to Eskom by the state.

allocations in the early 1980s were linked to mines that supplied Eskom) was therefore inextricably linked to the provision of coal to Eskom as cheaply as possible, the point of which was to keep electricity prices as low as possible.

These three elements – coal export policy, government fiscal support, and the falling price of electricity – thus resulted in massive allocative inefficiency in the economy in the 1990s. South Africa's appearance of competitiveness is based on the inefficient pricing of electricity, and the ongoing dominance of the MEC in the economy is directly based upon this.

In this context, Steyn (2006: 1) has called the 1970s expansion plan "seriously flawed", arguing that the opportunity costs of overexpansion were huge and that South Africa once again runs the risk of "repeating the expensive mistakes in technology choice and investment configuration of the past". He thus calls for a closer examination of the electricity sector's decision-making processes before a repeat performance of Eskom's "significantly exaggerated" forecasts of the 1980s takes place (Steyn 2006: 35).

Steyn (2006: 55, emphasis added) summarises the current situation as this:

"Some of the worst excesses in investment decision-making occurred during the supply crises in the early 1980s when load shedding and other emergency measures had to be taken. With current short-term supply problems...South Africa runs the real risk of repeating the mistakes of the past. While flexible short-term measures are needed to address the immediate problem, special care should be taken to avoid committing to an extremely costly long-term build programme based on inappropriate technology, scale and location choices, under the current atmosphere of crises and political pressure".

While South Africa does face a probable prospect of load-shedding and serious supply shortages between 2011 and 2014, Eskom and the DoE are able to use this pressure to drive through sudden decisions without proper public consultation and debate (notably around the role of nuclear power). The second key means by which the DoE is able to create pressure to take decisions that are not in the long-term interests of the country is by using the threat of 'loss of jobs' or 'lack of economic growth' as a result of load-shedding. While these are real concerns, there are serious issues around current implementation of demand-side management and energy efficiency measures, as well as around the demand forecast on which the DoE has based its generation plan.

Of course, South Africa cannot simply 'shut down the smelters' as is often raised by civil society (while the dominance of the MEC sectors is certainly problematic, they are still key exporters). In the short to medium term, rising prices and the right sorts of incentives are likely to encourage increased energy efficiency measures. In the long-term, however, higher prices coupled with shifts in tax incentives and the like should drive the closure of certain industries – aluminium smelters being

perhaps the best example of an industry that should be located somewhere else in the world. As the Genesis Analytics FRIDGE report (2010: xxviii) has argued:

“At present there are no incentives in place to smooth the transition to a low carbon economy for vulnerable sectors. This is anticipated to be crucial for an economy which is so dependent on highly energy intensive exports. . . Subsidies and soft loans for energy and carbon efficient technologies are likely to play a role in assisting these industries to increase their GHG-emission efficiency.”

The report also found that climate change mitigation policies that focus on shifting to renewable energy (and which increase the price of electricity either through increased renewable or the use of a carbon tax) would in the long-run contribute to South Africa’s industrial policy objective to diversify the economy “away from its current over-reliance on energy- and capital-intensive upstream resource-based manufacturing” (ibid.), making South Africa competitive in new sectors in the long-run. The role of industrial policy in moving away from traditional export sectors and towards renewable energy and ‘green’ areas of advantage is therefore key.

Climate change mitigation policy, the Long Term Mitigation Scenarios and industrial policy

Climate change mitigation policy context

Climate change mitigation policy in South Africa is guided by the Long Term Mitigation Scenarios process and outcomes (see below) and the subsequent Cabinet decision on South Africa’s emissions pathway, as well as by the country’s international pledges (with conditionalities) under the Copenhagen Accord. A recently released National Climate Change Response Strategy Green Paper also provides some initial, higher level policy guidance. The Green Paper supports a transition to a low-carbon society and economy (DEA 2010: 5), and further emphasises Cabinet’s decision on South Africa’s emissions trajectory, stating that South Africa’s climate change response objectives include

“the prioritisation of mitigation interventions that significantly contribute to a peak, plateau and decline emission trajectory where greenhouse gas emissions peak in 2020 to 2025 at 34% and 42% respectively below a business as usual baseline, plateau to 2035 and begin declining in absolute terms from 2036 onwards, in particular, interventions within the energy, transport and industrial sectors.” (2010: 6).

The Green Paper furthermore prioritises mitigation actions that have ‘green economy’ benefits, such as job creation and poverty alleviation, and emphasises that in particular, “interventions that stimulate new industrial activities and those that improve the efficiency and competitive advantage of existing business and industry” (ibid: 6) will be targeted.

The paper also recognises the need for increased alignment between climate change mitigation and other policies. Given the scale of the problem, South Africa needs to ensure a “coordinated,

coherent, efficient and effective response to the global challenge of climate change” (Green Paper 2010: 4), as well as work towards the “mainstreaming” of climate change into all national, provincial and local planning regimes.

The paper is generally quite climate-friendly (although it lacks firm targets), with a focus on sustainable development and the need to incentivise new types of industries with a view to becoming a low-carbon economy. It tacitly recognises the dominance of the MEC although it does not explicitly address the conflicts between climate mitigation and the industrial structure of the country, and sees a ‘green’ mining future because of increased demand for platinum, uranium and copper (for various cleaner technologies) (whatever such a thing might be). It also highlights that South Africa should protect energy-intensive industry in the short to medium term. While some protection may be necessary in the short-term, continued long-term support for energy-intensive industry should be phased out, given both the scale of allowances they have received in the past and the mitigation imperatives faced by the country. This point is made similarly by Cloete and Robb (2010: 497), who argue that South African industrial policy “must start favouring less GHG emissions-intensive industries to facilitate [the] transformation” to a low-carbon economy.

The Long-Term Mitigation Scenarios (LTMS)

The LTMS modelled two different scenarios, Growth Without Constraints (GWC) and Required by Science (RBS). Growth Without Constraints is the ‘worst case’ scenario from an emissions perspective, with no mitigation options pursued, including current policies. Emissions would increase more than four-fold to 2050; this would be driven primarily by increased energy demand in general (industry and transport) and by industrial process emissions from the synfuels, iron and steel, cement and ferroalloy sectors (Winkler 2007: 49). Electricity generation would continue to be based on coal (over 75%) and some nuclear (together around 90% to 2050), with new super critical coal stations coming online from 2016 and IGCC from 2020. Five CTL plants of 80 000bbl/day are built over the period, and five crude refineries of 300 000bbl/day. The contribution of renewable energy is negligible, and the industrial structure of the country is essentially unchanged, as evidenced by the large increases in demand driven by core MEC sectors, as well as the provision of liquid fuels by Sasol’s CTL process (Winkler 2007: 50-52).

On the other end of the spectrum lies the Required by Science Scenario. Required by Science is the goal – it is the level of emissions reductions that South Africa would need to attain as part of a global commitment to reduce emissions to politically realistic, science-based targets. The model constrains emissions to 30% of the 2003 base case. Interestingly, the modelling showed that the RBS climate target *cannot be met* within the current framework. That is, a climate constraint on the model is

“infeasible” when coupled with the current energy system constraints and demand forecast. The conclusion of the Technical Report is that either there needs to be a redefinition of what constitutes ‘realistic’ mitigation action, or there needs to be a shift in the least-cost framework used for understanding potential mitigation options. It is this conclusion, coupled with the LTMS suggestions in Reach for the Goal, which drives an analysis based on shifting the industrial structure of South Africa away from the country’s projected industrial path.

Also included is the Current Development Plans scenario, which assumes that current government policies on energy efficiency and renewable energy are implemented. In this case, the grid is slightly smaller (10GW) than in GWC, and one less crude refinery is built. Total savings are 3412Mt/yr CO₂eq over the whole period, and about 71Mt/yr annually. However, the overall structure of the electricity and energy system is essentially unchanged (ibid 53-55).

Then a suite of possible mitigation actions were modelled, as strategic options – Start Now, Scale Up, Use the Market, Reach for the Goal. Each of these strategic options used different generation technologies, economic instruments and other possible mitigation actions.

Start Now includes easy actions, most of which are negative cost options and which can be superimposed as minor changes onto what is essentially an unchanged system. Start Now options can be undertaken at a cost of negative R13/t CO₂ eq to the economy and will save 11 079Mt CO₂eq from 2003-2050 (or 231Mt/yr) (Winkler 2007: 118). Start Now’s suite of options include:

- residential energy efficiency – Solar Water Heaters (SWHs) and lighting
- commercial energy efficiency
- industrial energy efficiency
- transport: hybrids and modal shifts
- cleaner coal
- renewable and nuclear (15% RE by 2020, 27% Re and nuclear by 2030).
- carbon capture and storage (CCS)

Scale Up results in higher reductions than Start Now, with savings of 13 761Mt to 2050 (or 287Mt per year). This saving comes at an average cost of R39/t CO₂eq (but without technological learning assumed for the renewable energy technologies). Wedges include:

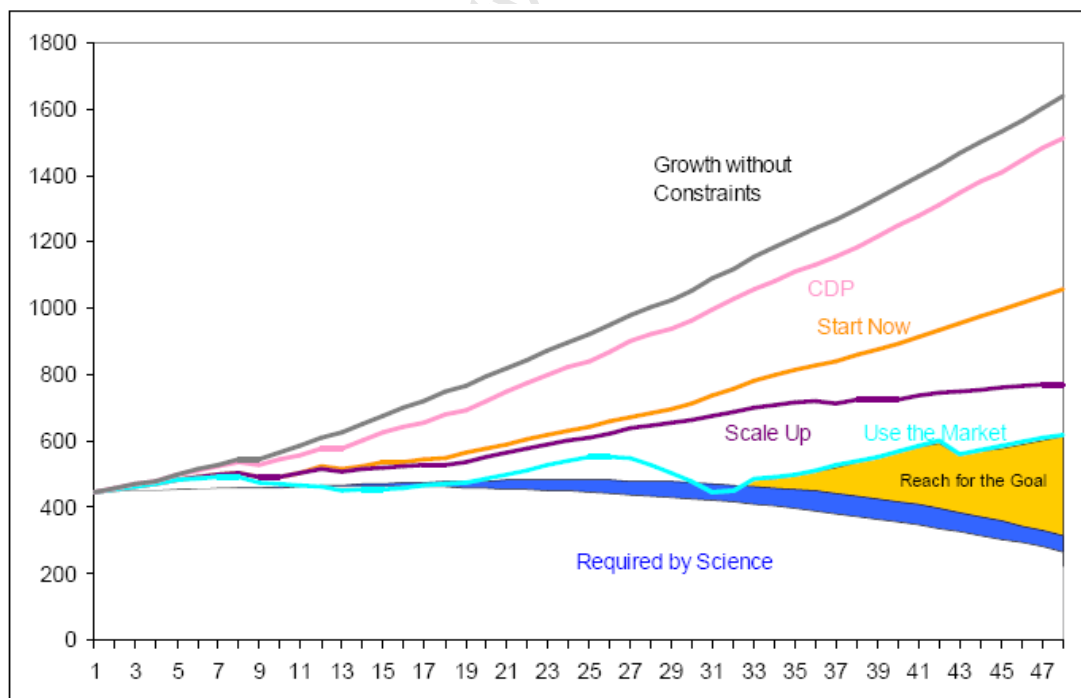
- Wedges from Start Now (as above) but also including:
- Renewables and nuclear comprise 50% each of electricity generation (but without learning)
- Increased carbon capture and storage

- Biofuels
- Electric vehicles
- Limits on SUVs

The third suite of options are Use the Market. Here the use of economic instruments has the greatest effect on emissions reductions. In this case, subsidies are included for SHWs, renewables and biofuels, and most importantly, a price on carbon is set. This rapidly reduces coal use in electricity and synfuels production and drives fuel switching and higher emissions savings from energy efficiency. Up to the mid-2030s, the use of economic instruments holds emissions at close to the level of emissions in the Required by Science scenario, although after this point emissions continue to rise. Overall, reductions of an average 363Mt per year are achieved, with total savings of 17 434MT to 2050; this comes at a cost of R10/t CO₂ eq (Winkler 2007: 121).

Reach for the Goal is the difference between Use the Market and RBS, and as will be discussed below, it is reliant on various factors that cannot be modelled – the effects of behaviour change, new technologies that do not yet exist or are not yet viable (what the LTMS terms ‘fairy godmother’ possibilities), and most importantly, a structural change in the economy based on redefining competitive advantage and thus building new comparative advantage (SBT 2007).

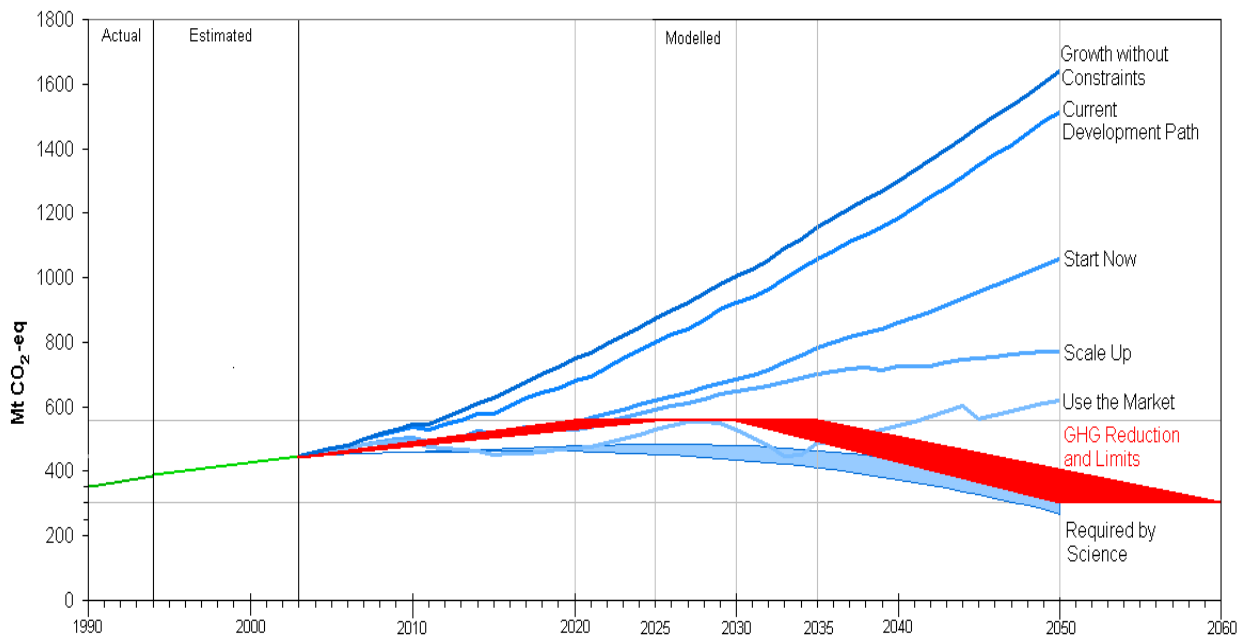
Figure 5: Long-term Mitigation Scenarios



Source: SBT (2007).

From these various scenarios, in 2008 Cabinet approved a peak, plateau and decline trajectory for South Africa’s emissions (see figure below). This is turn has formed the basis of the country’s negotiating position at the international negotiations. At the end of 2009, as part of the Copenhagen Accord, South Africa committed itself to lowering emissions to 34 percent below ‘Business As Usual’ (BAU) by 2020 and 42 percent below BAU by 2025 (Tyler 2010: 4) (dependent on finance and technology transfers).

Figure 6: LTMS ‘Peak, Plateau and Decline’



Limitations of the LTMS

As can be seen above, the LTMS has modelled possible mitigation options to reduce emissions. Fundamentally, however, it is not a transformative mitigation plan. The modelling for the LTMS assumes that there is no structural shift in the nature of the South African economy. To some extent there will have been changes because of reduced use of resources and new industrial foci, specifically around generation; but significant shifts in our current structure will not have taken place and there is still a significant portion of resource-intensive industries in the economy. And if the MEC continues to dominate the industrial landscape of the country, even increasing activity in the services or downstream manufacturing sectors will be MEC-based.²⁴ As demonstrated earlier in this thesis,

²⁴ The Technical Report thus states that “the results of combined wedges in this analysis suggest that taking action in individual sectors may not be enough. Energy efficiency and a cleaner fuel mix are significant mitigation actions, but in the long-run, the challenge is to consider the energy-intensity of our economy, structurally” (Winkler 2007: 132).

what the LTMS terms ‘business as usual’ (that is, the projected structure of the economy in 2050) is merely an extrapolation of our current comparative advantage, one which is based overwhelmingly in MEC sectors, but which is only one possible development path among many.²⁵ Although the current structure of the economy is to some extent rooted in the natural resources possessed by South Africa, and therefore an extrapolated version of the current state might seem an appropriate assumption to make, South Africa’s current comparative advantage is not an inevitable future at all - rather it has been based on industrial policy both pre- and post-apartheid, with significant state support for MEC industries and complex policies around electricity pricing. As argued above, there is evidence to show that comparative advantage is dynamic in nature and can be built and developed by state intervention. It is beyond the scope of the model to imagine a future low-carbon society based on South Africa’s “latent” comparative advantage, but that does not mean that another development path is not possible.

It is therefore not clear to what extent the economy will have shifted away from the MEC sectors because of the use of well-targeted industrial incentives for other industries and/or because of increasing electricity and energy prices. Industrial incentives have driven investment in MEC sectors, but such industries have also located here in many instances because of the availability of cheap electricity and the upstream coal industry on which it is based. Rapidly increasing electricity prices, driven either by rising costs for coal, for example, or for increasing tariffs to fund new generation capacity (be it coal-fired or renewable) would certainly reduce the viability of electricity-intensive sectors. Should prices rise dramatically and incentives be redirected, the shape and form of the economic structure could be substantially different. Although rising electricity prices are included in the LTMS model as a result of funding the construction of new generation capacity, the industrial demand forecasts are a given in the modelling, and cannot be adjusted in response to the price increases. Regardless of how real firms could react to price increases, the model cannot predict how this would affect the demand forecast, and it therefore assumes that the structure of the economy remains unchanged.

The LTMS did model different prices for oil, coal and nuclear fuel. The energy price sensitivity showed that “significant impacts” resulted from oil and coal price increases (Winkler 2007: 143), but not from nuclear fuel increases. The oil prices modelled were firstly, \$55/bbl in 2003 rising to \$100/bbl in 2030 (and extrapolated at same rate to 2050), and then from \$55/bbl in 2003 to

²⁵ The Intergovernmental Panel on Climate Change, in its Fourth Assessment Report, states that there “are always going to be a variety of development pathways that could possibly be followed” and that development paths can be “useful ways to think about possibly, even plausible future states of the world... but changing a development pathway is not about choosing a mapped out path, but rather about navigating through an uncharted and evolving landscape”, (IPCC 2007).

\$150/bbl in 2030 (and extrapolated to 2050). Coal price increases were modelled at the same ratio as the first oil price sensitivity (as were the nuclear increases).

The most notable result of higher energy prices is the increase in total system costs of 6% with the coal price increase and 15% in the first oil price increase, rising to 31% in the second oil price increase (Winkler 2007: 143), which makes mitigation actions – especially energy efficiency and non-fossil fuel based electricity generation – comparatively far cheaper.²⁶

The relationship between the industrial structure and low electricity prices is not clearly defined in the LTMS, however, and this detracts from the possibility of examining how, through the shift from electricity-intensive industries to greener industries, ‘Reach for the Goal’ type of mitigation may take place. It would certainly affect aluminium smelters for example, for whom two thirds of variable costs consist of bauxite and electricity.

While important, the LTMS model is nonetheless unable to show what a structurally different economy would look like, or how to get there. There is however valuable information contained in the LTMS on potential mitigation wedges. It is important to recognise that these wedges highlight those technologies and processes that are necessary to ensure even some compliance with the targets set by Cabinet for South Africa’s emissions reductions. The LTMS has shown what technologies and actions are required *at the very least*, even if it cannot describe a fundamental change to the system. Industrial policy will play an important role in ensuring that such actions can be implemented, and the extent of the changes necessary can be highlighted by examining the current industrial policies around the potential mitigation wedges, which are a necessary, although not sufficient condition for starting to change from a coal-based economy to one based on cleaner technologies and fuels.²⁷

The LTMS and industrial policy

Movement away from the minerals-energy complex will require the development of new complexes and new suites of skills, knowledge and infrastructure. A possible outline of what types of new industrial complexes we should be focused on developing can thus be derived by looking at the linkages between mitigation actions and the upstream technologies required to create them.

²⁶ The impacts are highly complex however, because higher oil prices tend to result in higher use of coal for synfuels production and in industry in the oil price increases cases which result in higher overall emissions, whereas when coal prices are higher, coal use declines in industry (as fuel switching to gas takes place) and some decline in synfuels production takes place.

²⁷ A recent report produced by Camco and TIPS have similarly examined the effects that climate change will have on the South African economy, but in the opposite direction to the analysis contained here – the report starts by looking at sectors according to GDP contribution, then outlines the possible risks and opportunities each sector is facing, but without any longer-term or transformative goals in mind (see Camco and TIPS 2010).

Knowledge of the necessary mitigation can thus inform an analysis of current industrial policy and guide future choices to be made around incentives. The discussion below will focus on current policy initiatives under each mitigation wedge related to energy, as well as the problematic assumptions that have been made by the state around the use of industrial policy for particular technologies.

LTMS wedges and current industrial policy

Taking the LTMS wedges as the starting point, it is possible to see that several of the mitigation options outlined in the LTMS fall far outside the realm of industrial policy (for example the wedges on land use and fire control, agricultural manure management and enteric fermentation reduction, reduced tillage, waste management and so forth), and these will not be discussed in this thesis. One group of wedges are those that require policy not necessarily directly related to, but still reliant upon, industrial policy incentives (for example, those wedges related to energy efficiency and public transport); and the final group are those that require concerted industrial policy development if they are to contribute further to mitigation (for example, the wedges related to renewable energy technologies, notably large-scale solar).

The wedges below should be included in this analysis because industrial policy incentives that bolster upstream industries will be necessary to ensure increased local production and positive economic spin-offs. These wedges include, for example

- building and commercial efficiency
- residential energy efficiency
- industrial efficiency
- And several of the wedges related to transport, such as passenger modal shifts, and improved vehicle efficiency.

However, there are also other ways to promote these wedges by driving growth in demand through, for example, regulations related to procurement and localisation (for public transport), building regulations (for residential and commercial building efficiency) and other targets which must be implemented in tandem with industrial policy that promotes such industries. While demand growth will primarily be driven by policies from other government departments – like housing, transport and so forth – the benefits of greening these areas require industrial policy incentives. One example of this, recognized by the DTI, was the need for South Africa to import buses from Brazil when the Bus Rapid Transit system was implemented in Johannesburg, because South African manufacturers lacked the capacity to scale up bus provision at the required rate and in the required time frames. A similar problem is likely to be encountered in the near future for renewable energy projects, where demand is too small to drive development of local turbine component manufacture, for example.

Building and commercial efficiency:

Commercial energy efficiency has a mitigation potential of 8Mt CO₂eq/year (381Mt over the full LTMS period) at a cost of –R203/tCO₂ eq (all costs quoted from the LTMS are estimated at a 10% discount rate). These savings come from efficient lighting (compact fluorescent lights instead of incandescent), improved heating, ventilation and cooling (HVAC), and water heating. (Winkler 2007: 56-57).

Currently, neither building nor commercial energy efficiency is recognized as potential Key Action Plans (KAPs) in the IPAP2, although industrial efficiency is. But UNEP points out that these are both negative cost options and have positive benefits for employment and economic growth; similarly, the IPCC Third Assessment Report has stated that “most studies agree that energy-efficiency will have positive effects on employment, directly by creating new business opportunities and indirectly through the economic multiplier effects of spending the money saved on energy costs in other ways” (IPCC quoted in UNEP 2008: 133).

These jobs tend to be local (on building sites), and given the high costs associated with meeting demand in South Africa – through the use of diesel powered peaking plants, for example – energy efficiency is a key option for promoting mitigation and for suppressing demand. While some jobs will be very high-skilled, for example ‘green design’ architects, many of the jobs will be in construction, artisanal retrofitting, etc. And these lend themselves to small business opportunities, which ties in well with broader industrial policy objectives around Black Economic Empowerment and small enterprise promotion.

To promote energy efficiency typically requires mandatory building standards, retrofitting targets and programs, financing mechanisms for retrofitting and SWHs, tax incentives, and R&D funding (UNEP 2008). The DoE’s Energy Efficiency Baseline Study outlined the following potential actions to increase building and commercial energy efficiency: firstly, energy efficiency standards for office buildings (SANS 204), which are currently being developed. Secondly, mandatory audits for commercial buildings (the baseline study states that there is a role for Sector Education and Training Authorities (SETAs) and BEE training). The SETA system is currently only partly effective and some of the authorities have been mismanaged, but the framework is there. The system is currently being overhauled with some SETAs being consolidated and others scrapped. Tax incentives to encourage companies to invest in energy efficiency projects (as well as the potential savings) would enable increased numbers of projects to go ahead, as would further focus on small enterprise and skills development.

Residential efficiency

Water heating is a particularly important aspect here, and will be discussed further below. Besides Solar Water Heating, the LTMS included thermal efficiency of houses (which requires retrofitting of homes and building standards), and a switch in lighting to compact fluorescent bulbs. CFLs have already been rolled out in significant numbers by Eskom, with 4.6 million installed, totalling savings of 237MW in FY2010 (Eskom 2010b: 33). The LTMS assumes CFL penetration rates of 40% of poor households by 2030 (to 2050) and 50% of rich households (Winkler 2007: 46), but does not disaggregate total residential efficiency savings. Water heating provides the greatest savings, with some savings from lighting efficiency and improved insulation. The total savings for the residential sector are 9MT per year CO₂eq, at a cost of –R198/t (2007: 66-67). Other possible actions include increased penetration of geyser blankets (65% of electric geysers by 2015), and increased thermal efficiency of house. Here, 100% of new houses are assumed to have improved insulation, with potential savings of 30% of space heating requirements (ibid 42).

Industrial efficiency:

Given both the high industrial energy use and the inefficiencies inherent in the South African system, the potential for industrial energy efficiency in mitigating climate change is large, with annual savings of 95Mt cO₂eq/year achievable according to the LTMS. These would come from improved efficiencies, by 2030, of 16% in boilers and steam systems, 16% in compressed air, 4% in process heat, HVAC 18%, 70% lighting, 11% other motive, pumping/fans 25% and process cooling 7%, at an estimated cost of negative R34/tCO₂eq.

The IPAP2 considers industrial efficiency an opportunity to “establish an industry in relation to machinery and services which improve energy efficiency in the industrial sector” (IPAP 2010: 43), and in particular sees opportunity for the replacement of industrial motors. The DTI intends to develop an Industrial Energy Efficiency Programme and to scale up the National Cleaner Production Centre (which thus far seems only to have conducted a few assessments in the chemicals and agroprocessing sectors – see <http://www.ncpc.co.za/default.html>), to offset rising electricity prices and reach emissions commitments (although concerns around ‘eco-protectionism’ from developed countries against South African exports is also driving this). “Attractive” financing options are being developed by the DTI and by quarters 2-4 of 2010/11 the energy efficiency programme should be up and running.

These are certainly important and necessary interventions, but they do not address the types of industry or the broader plan for ‘greener’ development. The role that industrial policy can play in

industrial energy efficiency is not, however, confined to these sorts of interventions. More directly, as it has done, the DTI can include energy efficiency as a criterion for receiving financial incentives (energy efficiency will count for up to 2 out of 8 points required to receive tax breaks under the new s12i capital investment tax incentives).

Passenger modal shift:

The LTMS modelling found that modal shifts could reduce emissions by 10Mt/yr, or by 469Mt CO₂ eq over the whole period, at a cost of negative R1131 per ton CO₂ eq; this cost includes the infrastructure costs that public transport systems would incur (Winkler 2007: 59), making it an important option (with other beneficial environmental effects, such as reduced local air pollution and more efficient transport systems for the poor).

The DTI has recognized that currently, local manufacture of locomotives, coaches and carriages for Transnet and the Passenger Rail Association of South Africa is impeded by “lumpy” and sub-optimal procurement processes and short delivery times (as with the supply of buses for the BRT system and the transport sector in general), and has long-term aims to deal with the import leakage caused by these issues (DTI 2010: 37 and 55). The objectives include standardisation strategies for prioritised fleets and long-term procurement plans with SOEs. This is viewed as key for manufacturing in general, rather than as a goal for increased mitigation or decreased local pollution from modal shifts to rail and buses, but a focus on mitigation from increased public transport will require better procurement processes if the associated economic benefits are to stay in South Africa. It is far too early to tell whether or not the DTI’s planned interventions from the 2010 IPAP will have a positive effect on this sector, but the fact that it has been recognised by both the DTI and the Department of Transport is promising. The DoT has announced that the public transport recapitalisation programme will be dependent upon local manufacturing of equipment

(<http://www.engineeringnews.co.za/article/sa-should-reduce-carbon-emissions-from-road-transport-cronin-2010-10-26>), and recently more focus has been given by the Department of Transport to the potential for rail to replace road transport for both freight and passengers.

Rail in particular is both more fuel-efficient and labour-intensive than road transport, and has more infrastructure-related jobs than road transport (UNEP 2008: 169). Several studies have shown that large shifts to rail from road would have positive net employment benefits (ibid), as well as creating long-term benefits by reducing our reliance on oil imports in the short/medium term and mitigating the effects of peak oil in the long-term. If Bus Rapid Transit is to dominate the urban mass transit landscape, there is potential for stimulating biofuels production through the use of buses that run on

biodiesel, which is a key area of industrial policy in the IPAP (although this would eventually result in a transport system that would be vulnerable to peak oil and would be limited by the low replacement potential of biofuels). Rail infrastructure backlogs already limit export even for MEC sectors (notably at the Richard's Bay Coal Terminal), but the spin-off benefits of enhanced rail capabilities for both goods and passengers are large, provided co-ordination between the various government departments can be enhanced.

Finally, several wedges can be explicitly promoted by industrial policy initiatives, especially those wedges related to electricity generation. This is partly the 'picking winners' role that industrial policy can play, and is partly requiring industrial policy support because of the scale necessary to catalyse private sector investment (CSP), or because current policies are insufficient to promote local upstream development of technology (REFIT).

These include:

Solar Water Heaters (SWHs)

In terms of the IPAP, solar water heaters are identified as a key sector of the 'green economy'. Currently, about 35 000 units are sold per year, of which 40% were imported, and no local manufacturers have reported exporting any SWHs (DTI 2010: 42). This results in total sales of about R220 million/year, with about 700 people employed overall, of which about 400 are installers (this includes only those for whom SWHs are their primary activity). There is enormous potential for expansion in the sector, which has already faced 72% growth in the market per year (Edkins et al 2009: 10)²⁸; the DTI wants to increase installations from 35 000 to 250 000pa over the next three years (of which 200 000 should ideally be locally manufactured). As the IPAP states, a "co-ordinated effort is required to scale up manufacturing and installation of SWHs" (DTI 2010: 42), recognising that South Africa lacks the installers to meet these targets; similarly, setting such targets is essentially meaningless if the targets are reached primarily through imports from China. The DTI is investigating the use of mandatory requirements for SWHs, which would certainly drive increases in demand, but unless training programmes are put in place (the DTI estimates it takes 6 months so train an installer, meaning the industry can be ramped up quickly) then the upstream benefits would

²⁸ Edkins et al (2010: 6) have worked out that there is potential for SWH penetration of 1 million over next 5 years and 400 000/yr after that to 2030 (31TWh saving, but technical potential of 47TWh). Cumulatively, to 2009 the savings achieved from SWH are estimated at 3.3TWh (Edkins et al 2010: 11), leaving potential growth of 27.6TWh in the medium term.

be lost. The current SWH rollout system, based on an Eskom rebate for SWHs, is patently insufficient to drive uptake, and thus the mandatory targets are a good start, if they are appropriately used.²⁹

In terms of the development of a SWH value chain, the DTI is waiting for the DoE to introduce its funding model for increased SWH penetration; the DTI itself is working on the building regulations and will be working on legislation to make the installation of SWHs compulsory when geysers are replaced. From 2010-2013, the department intends to “leverage DTI incentives and IDC industrial financing to support investment and increasing manufacturing and installation capacity in the SWH value chain”, although it does not outline how this will happen, and nor does the IDC business unit that deals with the ‘green economy’, although the IDC is going to be funding some of this.

The DoE is supposed to be developing a Standard Offer for SWHs, although this has been slow. Even with the DoE model, expansion of the value-chain may not take place unless further policies are put in place to promote it. Solar water heating industry development will dovetail well with other industrial policy objectives such as for SMMEs and BEE businesses, while the DoE’s standard offer policy sees a role for SETA’s in accreditation of training programmes through various institutions. And funding will be given to preferred companies that satisfy other industrial policy goals, especially SMMEs and BEE businesses (DoE 2010: 13). The programme is reliant on NERSA to set the rebate for SWHS at R/kWh x 200kWh/month (assumed saving from SWH which can be adjusted).

Renewable energy generation:

Globally, investment levels in renewables are soaring, with existing renewable energy installed capacity reaching 280GW worldwide, and US\$120 billion invested in new generation capacity in 2008 (REN 21 2009: 9). Similarly, renewables Research and Development (R&D) expenditure exceeded \$15billion US in 2008, while in the EU and US new capacity in renewable energy exceeded new conventional generation capacity (fossil fuels and nuclear) for the first time. These increasing levels of interest in RE also exclude the ‘green stimulus’ components of many economic recovery packages, where HSBC has estimated that 430billion USD in incentives and funding has been set aside for the development of the ‘green economy’, of which 36billion USD is for renewable energy alone (HSBC 2009: 42). Subsidies to the fossil fuel industries, however, still far outweigh subsidies to renewables. The International Energy Agency, for example, estimates that \$57 billion in support was given to RE in 2009; contrast this with their estimate of consumption subsidies for fossil fuels in 2009 – an enormous \$312billion.

²⁹ For example, Eskom settled only 3455 rebates in FY2010, in contrast to the planned rollout of 250 000 SWHs over three years (Eskom 2010b: 157; Trollip & Marquard 2010: 4).

A recent United Nations Environment Programme report on green jobs has neatly summarised the current renewables employment status quo and potential future benefits, highlighting the extent to which growth in renewables has consistently far exceeded projections (UNEP 2008: 93). What is clear from both the REN 21 and the UNEP Reports, however, is that those countries with the largest installed capacities of RE also dominate the manufacturing landscape. Upstream industries are highly concentrated (for example solar photovoltaic and turbine manufacture in Germany and SWHs in China), and both India and China are rapidly scaling up their renewable manufacturing. Investment in sustainable energy generation has grown 160% from 2005-2008 in India, and over 2000% in China (UNEP 2008: 95-96). Although still relatively small when compared to European wind turbine manufacturers, both China's Goldwind and India's Suzlon are expanding rapidly domestically and have begun to export to the global market.

One priority area for upstream intervention contained in the IPAP2 is related to Eskom's coal-fired new build, where the DTI sees potential for localisation of inputs for the planned capital expansion programme; here the DTI says that "adequate demand" (DTI 2010: 37) will drive upstream investments. There is, however, very little focus at all on how to tap into upstream manufacturing for renewable energy projects (although the IDC, for example, is proposing development of a local renewable energy manufacturing sector). This focus also ignores that in the long-term, upstream coal investments will face increasing opposition locally and will have very little export potential in a carbon-constrained world, whereas RE technologies are fast-growing and have high export potential.

This is of particular importance in light of a recent geological study that found that South African coal reserves have historically been overestimated, and that price increases can be expected in the future (Hartnady 2010). Similarly, Heinberg and Fridley have shown that globally, there are increasing constraints on various resources such as coal and oil, and have argued that higher fossil fuel prices will further increase electricity prices, as will, for example, carbon capture and storage (Heinberg & Fridley 2010). The long-term costs of coal-fired power are unknown and in the medium-term are increasing significantly to fund new investment in generating capacity.

Furthermore, comparing the job creation potential of different technologies shows that RE has extensive benefits when compared with conventional generation technologies, where UNEP has estimated that coal-fired power provides on average one job per MW installed (UNEP 2008: 128). The UNEP estimate for coal-linked jobs is comparable to the information for South Africa from Agama Energy. They concluded that already installed coal produces 1.7 jobs/MW, while future coal would create 3 jobs/MW. Compare this to renewable energy job creation potential: CSP could create 5.9 jobs/MW, solar PV 35.4/MW, and wind 4.8/MW. Biomass could potentially create 1 job per MW

and landfill gas 6/MW (these figures include both direct and indirect employment, for example in manufacturing and installation) (Agama Energy 2003: vi).³⁰

Over and above the increased employment benefits of non-fossil fuel electricity generation, localisation of manufacturing will also reduce imports and South Africa could potentially become a global leader in new technologies. But unless we develop these industries by increasing demand domestically, South Africa will not be able to compete either with cheaper imports or as exporters of these technologies. The country would have missed the boat yet again. And as UNEP has argued in a discussion of Germany's RE industry, the country

“views its investment in wind and solar PV as a crucial aspect of its export strategy. The intention is to retain a major slice of the world market in coming years and decades. Thus, most German jobs in these industries will depend on sales of wind turbines and solar panels abroad. This is of limited issue while few countries possess the requisite scientific and manufacturing know-how, and while the markets for wind and solar equipment are experiencing rapid growth. But over time, the interest of new entrants to the renewables sector will inevitably clash with those who seek to dominate world markets.”(UNEP 2008: 128).

If South Africa does not start to focus concertedly on this now, it will soon be too late to either develop advantage in newer technologies or to move past the coal-centred paradigm of past and current planning. This has more recently been recognised through the South African Renewables Initiative (SARI), a Cabinet-approved programme, recently launched by the Department of Public Enterprises and the Department of Trade and Industry as a vehicle for the promotion of RE (SARI 2010a; 2010b). The Initiative premises its promotion of RE on reducing the economic risks that South Africa faces from possible border-tax adjustments, as well as on aligning job creation objectives with energy generation expansion and climate change mitigation. Thus far, the modelling the initiative has done has shown that if 15% of electricity by 2020 came from RE (a mix of solar and wind), there is the potential to create 52 000 jobs. Of these, 13 000 would be direct, and 39 000 indirect (of which around 20 000 would be skilled, 21 000 semi-skilled, and 9000 unskilled) (SARI 2010: 17-18).

As per the LTMS, the role of RE is as follows: by 2020, 15% of electricity must come from RE, rising to 27% by 2030 (443PJ) and 50% by 2050.

³⁰ It is important to note that while international experience has shown that renewable energy technologies have the potential to create more employment than fossil fuels, research on South Africa's potential is extremely limited. Extrapolations can be made from international studies, but given the limited rollout of RE in South Africa, direct research is still challenging to undertake and there is a large gap in knowledge around this. Beyond Agama's (2003) study, the South African Renewables Initiative (2010) is the next most comprehensive analysis, although it bases its modeling assumptions on the Agama study.

At 27% by 2030, and with technology learning included, mitigation costs from renewables are negative, at $-R143/tCO_2eq$, with a saving of 57Mt/yr (15Mt higher than without learning, and substantially cheaper than $R52/tCO_2eq$ without learning) (Winkler 2007: 69). Thus, if South Africa “found itself in a world in which new technologies got cheaper due to investment globally – emissions reductions would be more cost-effective, and still deliver significant reductions” (ibid 70). These rise slightly when extended to 50% by 2050, but with learning costs are still only R3/t.

Renewables also have the potential to compare favourably with nuclear from a mitigation perspective. The LTMS scenario for nuclear includes assumptions about the viability of the Pebble Bed Modular Reactor technology. Subsequent to the LTMS study, the PBMR technology has been shown to be unviable and the project has essentially been shut down. The LTMS plans sees 9GW of PBMR nuclear (which must now be excluded), as well as Pressure Water Reactor capacity of 15% of installed capacity by 2025. The cost of $R18/tCO_2eq$ is lower than RE without learning, but higher than RE with learning, and results in 35Mt mitigated annually. These costs do not, however, include the costs of a nuclear fuel cycle.

Concentrated solar power (CSP)

The IPAP does state that CSP is “the most promising renewable energy generation option in SA and therefore should receive priority support” (IPAP 2010: 43). The full extent of potential renewable energy generation contained in the IPAP is thus the development of a CSP demonstration plant, which the IDC is developing so as to highlight the economic viability of CSP and the possible upstream linkages (this will form part of a proposed ‘Solar Park’ near Upington in the Northern Cape).

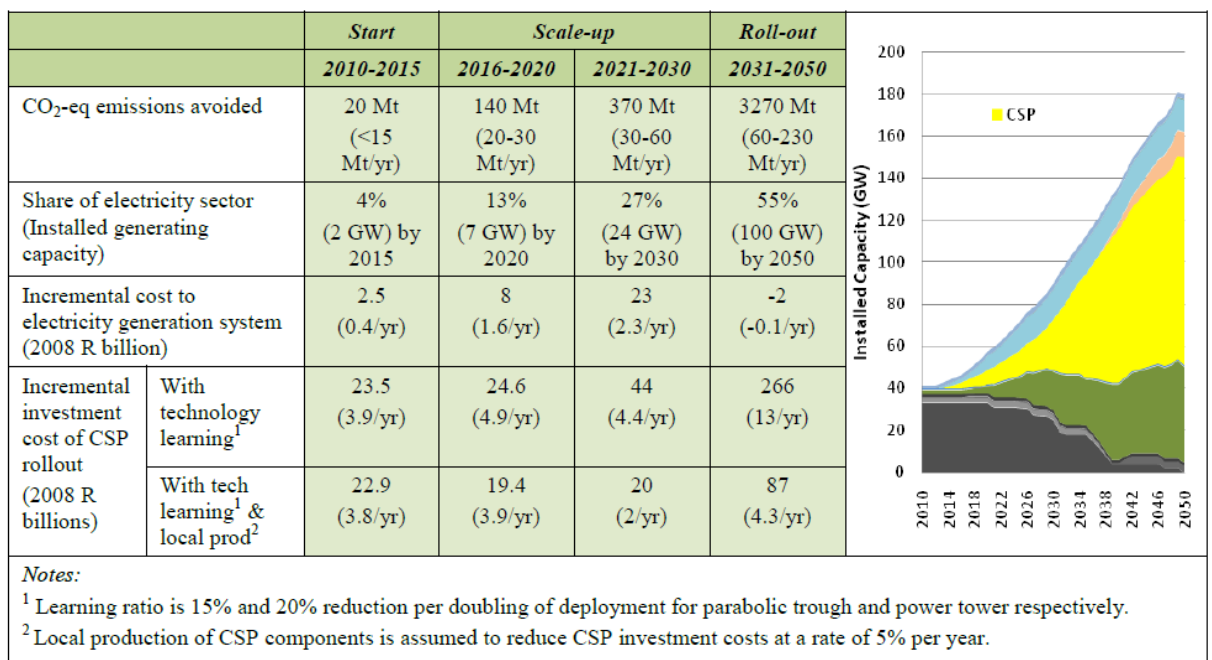
Edkins et al (2009) have analysed the potential for CSP rollout in South Africa in terms of the LTMS targets and future costs (see figure below). They found that to achieve the LTMS targets would require, in the short term (2010-2015), incremental investment costs of R3.9billion per year; this would rise to R4.4-4.9 billion from 2016-2030, and then to R13b per year from 2031-2050 (an average of R9b per year for the whole period). This excludes localisation of components and technological learning.

The potential for localisation of CSP components in South Africa is high; the manufacture of steel, glass and reflective coating already takes place for the automotive industry and there is high potential for industrial shifts. Similarly, the country has a well-developed, large-scale construction sector, which would be required for CSP development (Edkins et al 2009: 16); with local production, investment costs are assumed to decrease at 5 percent per year. The authors advocate a focus on

central receivers and linear Fresnel systems, which are easily adapted to by the South African industrial base.

Reductions in costs due to localisation, coupled with technological learning reduce the averaged R9b down to an incremental cost of R3.7b per year from 2010-2050, with annual costs in 2031-2050 expected at R3.6b per year (substantially less than without learning and localisation) (Edkins et al 2009: 9-10).

Figure 7: Concentrated Solar Power in the LTMS



Source: Edkins et al (2009: v)

The authors propose that Eskom and the DTI develop the Solar Industry Development Programme, modelled on the Motor Industry Development Programme. A survey by Edkins et al (2009: 13) found that the largest barrier to investment in CSP is financial, and that technological issues and regulatory impediments could be dealt with if finance were more readily available. The role of the IDC is thus key, and the corporation's focus on CSP important for encouraging investment.

The new IRP, however, in its "Revised Balanced Scenario" (the favoured option), foresees only 100MW of CSP being built per year from 2016-2019, in addition to REFIT 1 (DoE 2010: 25). This results in a solar thermal cap of 600MW, at which point the IRP becomes technologically neutral and plans only for renewables in general, rather than in a particular form. This is also in sharp contrast to the proposed 5000MW solar park. This is despite a statement that "the proposed IRP 2010 envisages a dramatic transition from a traditional coal-based electricity industry toward a low carbon

environment” (IRP 2010: 20), and it is unlikely that with such a small focus on CSP for generation that the upstream benefits would materialise.

Wind:

Globally in 2008, there was about 100 000MW installed capacity of wind, dominated overwhelmingly by Germany, Spain, the US, and now India and China (UNEP 2008: 103). Despite this global interest and the economic benefits accruing to these countries, the IPAP 2010 has no planned industrial development based on wind (nor biomass nor waste management/recycling), although sector strategies are supposedly to be developed in the future. Given that private sector interest in the wind industry is already large (although facing multiple regulatory barriers), this would make it a prime sector for the government to focus on (in the ‘followership’ sense of industrial policy).

Lewis and Wiser (2005: 2-3) have compared the wind industry policy support mechanisms of different countries and come to several conclusions that are relevant to the South African case. Firstly, they highlight that there are several different forms that localisation could take, including the assembling of parts, the manufacture of components or entire turbines, or local technology development. The benefits of localisation would differ somewhat depending on the form and degree of localisation, but would certainly include economic benefits (sales, job creation and increased tax base), export potential, and cost savings (for equipment and transport, and thus electricity prices).

Secondly, their most pertinent finding is that there is a clear link between domestic market size and industry success. They show that there is a direct relationship between those countries that have large domestic wind industries (large installed capacity) and the success of manufacturers of turbines (especially as exporters); they argue that countries that hope to participate in the wind manufacturing industry will “have to develop a stable and sizable domestic market for wind power utilization” (Lewis & Wiser 2005: 8). A “minimum steady demand” above 200MW per year for at least three years is “crucial to developing a nascent local wind technology manufacturing industry”. In highly successful wind technology exporting countries, this has been far higher though. In Germany, for example, between 1999 and 2004, installed capacity increased by 1500MW/year, while in Spain installed capacity grew by over 1000MW/year from 2001-2004). In an updated version of that research, Lewis & Wiser (2007), showed that successful localisation probably requires annual demand substantially higher than 200MW per year over at least three years, given the time necessary for development of local capacity and ‘stable and sizable demand’.

The policy measures for localisation can take several forms. Indirect measures include demand stimulus through a feed-in-tariff or similar mechanism (such as renewable energy portfolio

standards). Direct measures to develop manufacturing include local content requirements, financial and tax incentives (such as low-interest loans or tax credits for manufacturers), export credit assistance, quality certification, R&D, and favourable customs duties (for example higher tariffs on complete turbines versus lower tariffs on components). There is thus a clear role for industrial policy in developing a local industry, particularly around financial and tax incentives.

There are several international examples of these measures. While most of China's turbine market has historically been controlled by foreign firms (Vestas, Gamesa and GE), this is rapidly changing, with the Chinese government encouraging the domestic manufacturing industry through localisation targets and the application of import duties. Under these policies, the government requires that 70 percent of components are made domestically, and import duties of 3 percent for parts, 8 percent for assembled components, and 17 percent for fully assembled turbines are applied (UNEP 2008: 106). Domestic manufacturers provided a third of all turbines in the country in 2006, and this is increasing every year. Added to this is R&D from about 40 domestic firms who are developing prototypes. Similarly, localisation efforts in India have resulted in some wind companies sourcing more than 80% of wind energy components locally (UNEP 2008: 106).

In the South African case, however, local content requirements without competitive upstream industries could simply make wind investment more onerous than it already is. There would need to be careful research into how to balance the encouragement of local manufacturing with support schemes with the limiting of imported turbines, and the currently relatively high price offered under the REFIT. A larger domestic market than that allowed under the REFIT would be an important start, as would an increased allowance for wind in the IRP, as stronger demand would encourage overseas turbine manufacturers to develop local production facilities.

Waller (2010) has modelled the economic impacts of increased wind capacity in South Africa's generation mix. She found that

“the majority of jobs created in the Wind Scenario relate to the construction, manufacture and installation of wind turbines, and to a lesser extent, to the maintenance of wind farms... Therefore, in order to provide these employment opportunities in South Africa, it will be essential to develop a local wind turbine manufacturing industry.” (2010: 27).

The draft IRP 2010 projects that total wind capacity, including REFIT 1 wind, will be 4500MW in 2019 (DoE 2010: 18). According to the IRP document, this “steady and consistent build up in wind capacity [will] stimulate localisation of manufacturing and job creation” (IRP 2010: 8). The Revised Balance Scenario envisages wind capacity increases as follows: ‘committed build’ of 200MW in 2011-12 and 300MW in 2013, and thereafter 200MW in 2014, 400MW in 2015, and 800MW per year from 2016

to 2019 (IRP 2010: 17). Based on Lewis and Wiser, these initial figures are simply too low to kickstart localisation, and turbines and components are likely to be imported. This will have negative effects on the job creation potential of the wind component of the new build programme, and will result in very little shifting of the industrial base. REFIT is totally insufficient to drive localisation, and the IRP plans are potentially too slow, although with sufficient industrial policy support localisation might still be viable.

Nuclear:

The IPAP2 classifies nuclear as part of its “Advanced Manufacturing” cluster, acknowledging that a lack of demand globally has meant that the component and manufacturing of nuclear equipment is “highly limited”. It then states that a “future nuclear programme will cost in excess of R1 trillion. This will place enormous strain on the balance of payment and without an effective localisation programme will have severe consequences for the South African economy” (IPAP 2010: 88).

Expecting a new reactor every 18-24 months to “ensure viability” of the upstream manufacturing sector, the DTI expects to “enforce localisation” for the industry once accreditation and regulatory standards are met and partnerships with global firms can be established (IPAP 2010:89).

The assumption here is that nuclear is a viable industry on which to focus localisation and development, but renewable energy is not. Given that South Africa lacks engineering capacity in general and in nuclear in particular, focusing resources on the nuclear industry seems nonsensical. The DTI is willing to expend time and money on complex accreditation systems for nuclear sector but does not have even a small focus on wind. The IPAP acknowledges the large shortfalls in trained scientists and engineers (estimated at a five year gap of 11 500 scientists and 29 000 artisans generally, plus a further 3000 and 24 000 respectively for power supply related expansion) but still focuses on an industry that largely requires highly skilled employees; the IPAP acknowledges that the expected impact of 75 000 direct jobs in the nuclear manufacturing industry and 150 000 indirect jobs will all be highly skilled (IPAP 2010: 93).

This directly contradicts research showing that renewable energy provides more jobs per MW installed, and that more low and semi-skilled jobs will be created. A study by Agama Energy (2003) has shown that the employment trend in South African coal-based electricity generation is one of decline (a trend that tracks a global reduction in fossil-fuel industry jobs), and a focus on renewable energy technologies can alleviate the job losses expected. Drawing on international experiences with renewable energy job creation, the study in addition has shown that the job creation potential of RE is far higher than for conventional fossil fuels, and especially when compared against nuclear (2003:

xi). A Koeberg-type reactor (Pressurised Water Reactor) would create 0.54 jobs per MW (2003: 8) (versus 5.9/MW for CSP and 4.8/MW for wind).

The United Nations report on Green Jobs also excludes nuclear on the grounds that it is neither environmentally sustainable nor does it have labour-intensive work creation potential.³¹ In the South African context, the nature of the work – very high skilled, in the context of a lack of engineering capacity – makes the nuclear focus of the IPAP and the IRP almost laughable. Local employment will benefit far more from the types of jobs created by RE, as well as by a concerted focus on energy efficiency measures. The potential for becoming a global nuclear leader is also limited, given that the industry has, in recent years, been in decline in terms of numbers of reactors and output (Schneider et al 2009: 5), and given that the investments for nuclear component manufacturing are also highly capital-intensive (ibid 29-30).

Thomas (2005: 16) has argued that the costs of nuclear power are also frequently underestimated. His analysis of the economics of nuclear power has shown that

“Forecasts of construction costs have been notoriously inaccurate, frequently being a serious underestimate of actual costs and—counter to experience with most technologies where so called “learning,” scale economies, and technical progress have resulted in reductions in the real cost of successive generations of technology—real construction costs have not fallen and have tended to increase through time.”

The cost overruns issue is best exemplified by Areva’s Olkiluoto project in Finland, which Schneider et al (2009) describe as a “financial fiasco” – the project is more than three years behind schedule, and more than 55% over budget.

The potential for learning is far more limited than for RE primarily because the long-lead times for projects results in a lack of timeous feedback. Similarly, because new designs require large effort and research but only very few reactors are produced, and hence there are small production runs for components, the potential for economies of scale is reduced (ibid 18). Furthermore, the Nuclear Energy Agency has itself acknowledged that purchasing multiple units has very little effect on costs. Even twin units have only a 20% reduction in costs between unit 1 and unit 2, but thereafter “the

³¹ The report has this to say: “Some governments and others have proposed an expansion of nuclear power as part of the solution. For the purposes of this report, nuclear power is not considered an environmentally acceptable alternative to fossil fuels, given unresolved safety, health, and environmental issues with regard to the operations of power plants and the dangerous, long-lived waste products that result. Being capital-intensive, the nuclear energy industry is also not a major employer, and is thus similarly ill-suited as a solution to the world’s employment challenges. Trends in nuclear energy’s development—influenced by issues such as safety and cost—contradict rosy assessments.” (UNEP 2008: 89).

standardisation effect for more than two units of identical design is expected to be negligibly low” (Nuclear Energy Agency 2002 quoted in Thomas 2005: 17). This directly contradicts the DTI’s fleet approach to nuclear development, which seems to assume that local development of many reactors will substantially reduce costs.

Other contributions to high costs include capital charges over construction, which are especially high due to the long construction periods, as well as capital costs more generally. Globally, investment in nuclear tends to be highly subsidised, and it is likely this would take place in South Africa too, given the estimated costs of over R1 trillion for the nuclear fleet and the private sectors lack of willingness to invest in the technology. This again directly contradicts the IPAP objectives of reducing subsidies to capital-intensive industry and megaprojects.

Fuel costs are the lowest part of the operating and maintenance costs, but fuel disposal is not generally included and the real, long-term costs of disposal are not known. Fuel reprocessing substantially increases costs per kWh, and increases the amount of low and medium-level waste. Disposal costs for high level waste are completely unknown because there are not as yet any long-term ways of dealing with the waste. Coupled to this are the costs of decommissioning, though these are not necessarily very high given the long time frames. However, ensuring that money set aside for decommissioning remains separate from cash flow/is not spent in the long-term has been problematic in other countries, especially the UK (Thomas 2005: 18-23).

All in all, the costs associated with nuclear have been exceptionally high, and private sector interest exceptionally low. The issue of how to fund nuclear power is an important one, with the cost uncertainties meaning that World Bank loans are out of the question (and loans for coal are mired in controversy, as around the loan for Medupi). By focusing on nuclear, scarce resources are being diverted away from renewable energy, despite its far higher potential for job creation and local economic development. This is of particular importance given South Africa’s relative poverty. As UNEP has pointed out with regard to both nuclear power and coal, “continued heavy investments may draw critical resources (R&D, investment capital, as well as scientists, engineers, and technicians) away from the pursuit of alternatives such as renewable energy and greater energy efficiency” (UNEP 2008: 89).

The lack of a skilled workforce is possibly the greatest barrier for nuclear power in the country; as Schneider et al (2009:6) have argued, domestic maintenance capacity remains problematic internationally – including in France. They state that the “lack of a trained workforce and massive

loss of competence are probably the most difficult challenges for proponents of nuclear expansion to overcome. Even France, the country with perhaps the strongest base of civilian nuclear competence, is threatened by a severe shortage of skilled workers,” something acknowledged by the International Atomic Energy Agency (which sees the lack of trained nuclear staff as the largest bottleneck faced by the industry) (ibid 31).

The nuclear industry thus faces three major problems - “a short term manufacturing bottleneck, a dramatic skilled worker/manager shortage and a sceptical financial sector” (Schneider et al 2009: 21). Oddly enough, there are extreme bottlenecks in manufacturing, but also very small demand. It does seem not make sense to focus scarce resources on such an industry, given that it is in decline, and that the much touted ‘nuclear renaissance’ lacks empirical evidence.

Electric vehicles and hybrids:

These are included here because of the primary role that industrial policy has played, and continues to play, in the development of the automotive sector. The LTMS modelling has shown that, assuming EVs make up 60% of passenger vehicles, even on a GWC grid (i.e. a coal-based electricity system), electric vehicles have the potential to save 9Mt/yr c02 eq. (450Mt to 2050); on a renewables- and nuclear-based grid, this increases to annual savings of 130.32Mt/yr (or 6255 Mt by 2050), which includes the transformed electricity grid; the net savings from EVs in this scenario would be 666Mt of CO₂eq (Winkler 2007: 60). The currently higher costs of EVs would be expected to decline as the technology develops, lowering the GWC cost per ton of carbon mitigated from R607. In the nuclear/renewables-based grid option, the cost of R102/t c02 eq mitigated is far lower because it includes the lower costs of mitigation from nuclear and RE (hence the markedly higher savings).

In terms of industrial policy, electric vehicles are already targeted as a potential area of growth, both as part of the ‘green economy’ and more generally as part of an expansion of the automotives and components sector (see DTI 2010: 54, 58). They are clearly a focus point not because of their mitigation potential but rather because of the potential export opportunities, and this is the one initiative where industrial policy is being well-used in a sector with both ‘green’ and job-creating potential. The IPAP envisages an estimated 160 000 direct jobs will be created over the next ten years, with investment levels of over R20 billion in the next four years (and R3billion per year for the six thereafter) (DTI 2010: 58).

As discussed above, the IDC has invested substantially in the Joule, although it is too early to tell whether this will be a successful venture. It is not clear, however, that when the IPAP refers to the

commercialization of 'our' electric car whether it is referring to the development of the Joule or other electric vehicles.

The industrial policy implications of EV development include the DTI developing

- 1) strategies on the localization of components (as part of its broader focus on localisation of automotive components; implementation of course being the problem)
- 2) a government position on the required associated technical infrastructure as well as purchasing and demand stimulation
- 3) In 2011 and 2012, EV plant construction so that production can start in 2014 (IPAP 2010: 58).

Related employment opportunities include infrastructure development for charging,

The LTMS also analysed the potential contribution of hybrid vehicles, which at 8Mt/yr and a cost of R1987/t CO₂eq, are substantially more expensive than other options (Winkler 2007: 64), especially electric vehicles on a nuclear/renewable based grid. Hybrids do, however, provide more employment per vehicle produced because of the combination of internal combustion engine and electric engine (and battery) (UNEP 2008: 152).

Biofuels:

The justification for the inclusion of biofuels here is the focus it has been given in both the IPAP 2007 and the IPAP 2010. the 2007 IPAP estimated job opportunities in the biofuels-linked agricultural sector at 55 000 (based on the Doe's Biofuels Strategy); the 2010 IPAP has disaggregated the sector in somewhat more detail, with 25 000 agricultural jobs expected from biodiesel production and 100-150 000 direct jobs from the sector as a whole over the next decade (and another 125 000 if the blending targets were increased to 10%) (IPAP 2007: 18; IPAP 2010: 69-70). currently, the IDC and the Central energy Fund have invested in the sector in SA, and the 2010 IPAP expects 350 million euro/year in exports from a 400 000 ton biodiesel refinery.

The LTMS, however, has this to say on the mitigation potential for biofuels – the “moderate scale of reductions reflects the limits on the potential of biofuels in SA”, largely due to food security issues, land and water availability and biodiversity impacts (Winkler 2007: 61). The expected mitigation of biofuels is a mere 3Mt/yr CO₂ eq, and comes at a cost of R524/t. With a subsidy of R166 per litre, this could rise to 12Mt/yr at a cost of R697 per ton; in this scenario biofuels would make up 9% of domestic fuel use.

The LTMS and the IRP

As can be seen from above, there are the first hints of possible moves towards incentives for greener technologies in South Africa, which is laudable given that neither the NIPF nor the previous iteration of the IPAP included any of these 'green' sectors at all (DTI 2007a; DTI 2007b). The IPAP2, however, is most certainly not, as it claims, "a serious first step towards the systematic promotion of Green and energy-efficient goods and services" (IPAP 2010: 16). The first step, certainly, but it is neither serious nor systematic. It seems to disregard broader evidence on the potential benefits of particular renewable energy technologies, including wind and, more simply, solar water heaters, and very superficially points out the possible benefits of CSP; neither does it interrogate the actual viability, costs and benefits of incentivising nuclear generation. Broadly, there is a focus on increasing downstream beneficiation of minerals to add value and leverage South Africa's mineral resources,³² but whether or not the IPAP's more recent implicit acknowledgement of the MEC dominance will be translated into changing sets of fiscal incentives or investments by the IDC remains to be seen. The overall incompatibility of having a minerals-based economy and a shift to the 'green economy' seems to have been largely ignored, probably because no one really has any idea what a green economy would look like, or what the best way of getting to one might be.

Similarly, the LTMS, while consistent with some 'greening' of the South African economy, essentially assumes that the economic structure will remain unchanged; the entire approach taken by the model is driven by an assumed maintenance of the current industrial structure (which is all that is within the model's scope).

This lack of coherence between the much-needed industrial policy to reach the LTMS wedges and the IPAP 2010 and other industrial policy initiatives forms part of a broader discrepancy between climate change and industrial policy, and is further exemplified by the recently released Integrated Resource Plan, discussed below.

The Integrated Resource Plan 2010 process and outcomes typifies the lack of coherence between industrial policy and electricity planning and climate change mitigation objectives. There are two aspects to the IRP2010 process that illustrate this, and which will be discussed in more detail below: firstly, the industrial demand forecasts included in the IRP bear little relation to broad industrial policy objectives such as diversification and job creation (and indeed, are likely to have been overestimated), and nor do they take into account planned shifts in industrial focus areas. While

³² The IPAP2 states that the South African economy is "built upon the back" of mining and resource-based activities, and adds that less than 10% of mineral revenues comes from processing (DTI 2010: 58-59). Meanwhile, it further emphasises that beyond petrochemicals, steel, aluminium, paper and cement (i.e. the core MEC sectors), the "rest of manufacturing has by and large stagnated" (DTI 2010:5). Implicit in this analysis is the dominance of the MEC in the economy.

there are contradictory elements in industrial policy itself, the IRP has not taken industrial development goals into consideration in the planning process, drawing instead on data from industry and disregarding potential development of new areas of advantage. Given that the energy sector invests large amounts of capital in infrastructure development, it has a role to play in policy choices to be made around low-carbon development. Secondly, the few industrial policy considerations that have been included in the IRP (such as around nuclear value-chain development) highlight how the 'public' process for the IRP is deeply flawed, and though these elements are limited, they nonetheless underscore the extent to which firms in the MEC sector continue to dominate decision-making processes in the country (Pienaar & Nakhooda 2010: 5-6).

Several other problems with the modelling have been highlighted in the public comment process, including overestimates in the demand forecast and nonsensical assumptions about the future contribution of various sectors to GDP, and the effect this will have on the energy intensity of the economy. These will be discussed further below.

Integrated Resource Plan 2010

According to the Draft Executive Summary of the Integrated Resource Plan (DoE 2010), its primary objective is to "determine the long term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing and cost" (IRP 2010). Furthermore, the plan "aims to achieve a balance between an affordable price for electricity to support a globally competitive economy, a move to a more sustainable and efficient economy, a move to create local jobs, the demand on scarce resources such as water and the need to meet nationally appropriate emissions targets in line with global commitments" (DoE 2010).

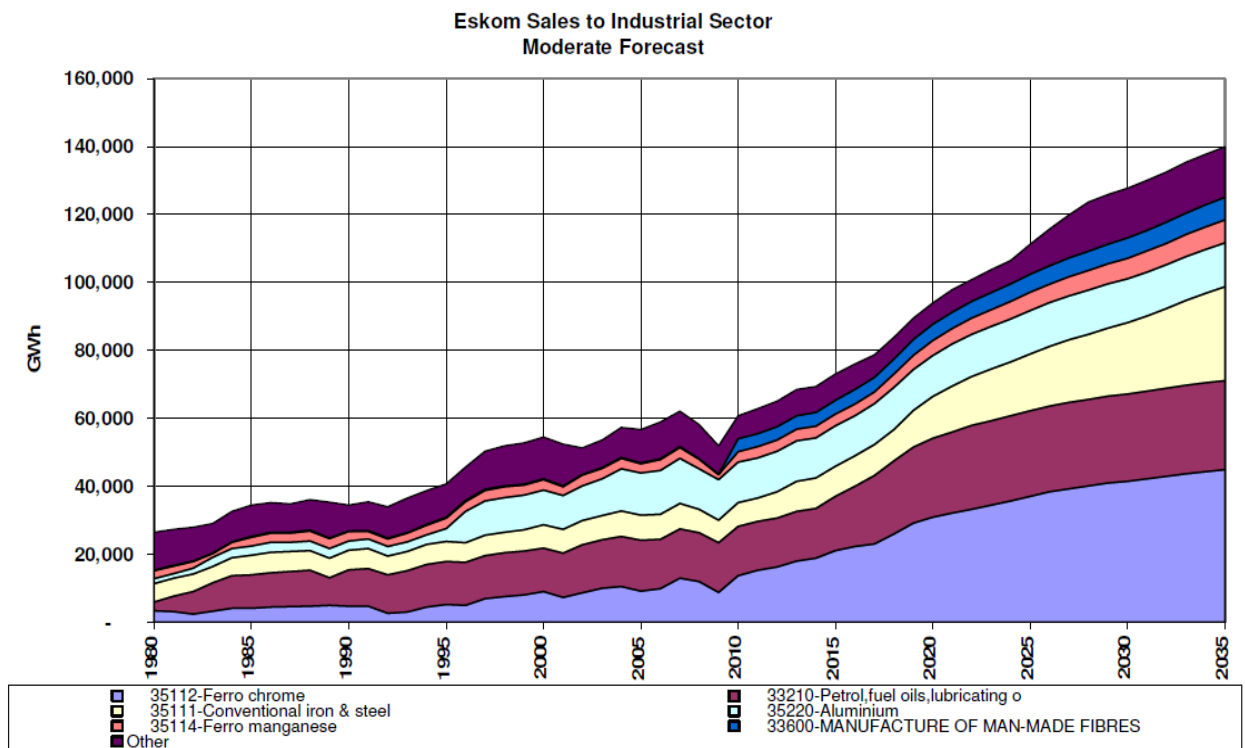
Clearly, however, many of these considerations fall by the wayside in the IRP2 'preferred' scenario (the Revised Balanced Scenario), which has comparatively small contributions to generation capacity coming from renewables (which would contribute to stated aims of sustainability, local job creation, water demand reductions, and emissions targets). Instead, the scenario is focused on coal and nuclear with a relatively smaller (though still larger than in past planning processes) renewable energy component.

Demand forecast:

The two graphs below highlight the planned increases in electricity demand that Eskom has included for the IRP 2010. The first graph illustrates an almost quadrupling in sales of electricity for ferrochrome smelting from 2010 to 2035; as well as an increase in conventional iron and steel from 2020. The second graph contains expected demand increases for the mining sector; here, decreases in consumption by the gold mining sector (as gold deposits decline) is more than offset by rapid

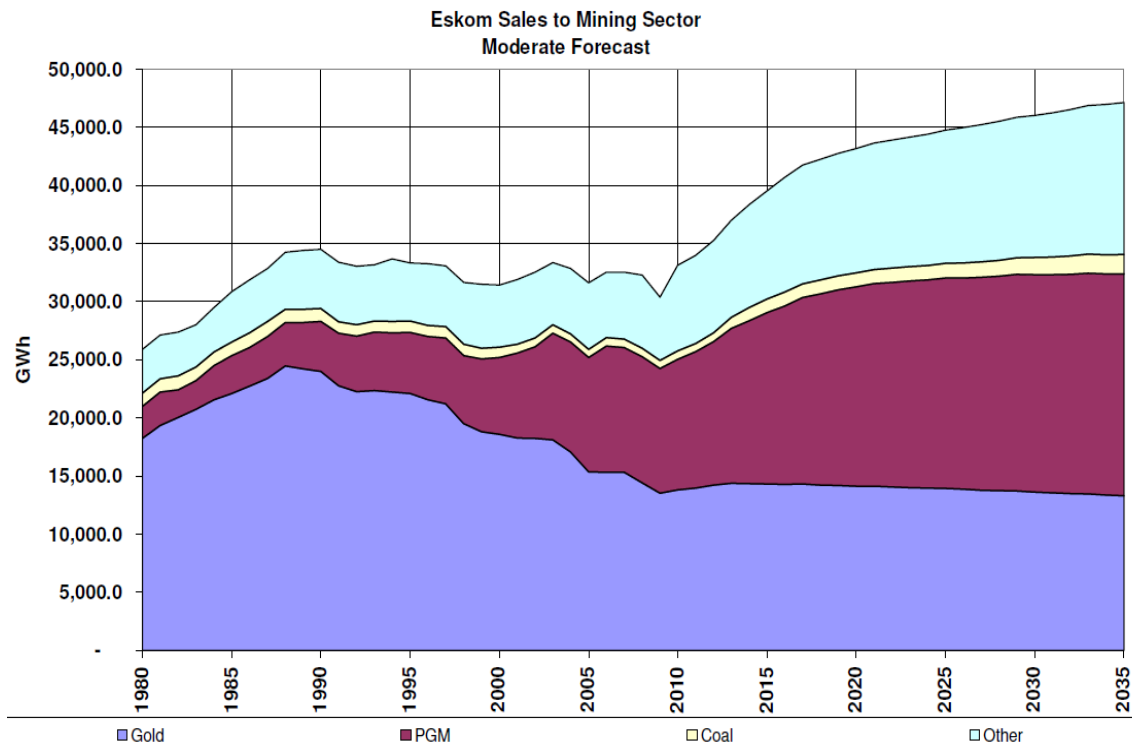
increases in platinum group minerals and other mining. It is thus plain to see that rather than a shift away from mining and the immediate downstream beneficiation of minerals – that is, the core MEC sectors - large increases in energy use, and hence emissions (given the generation capacity plans), is expected from these sectors. This is in line with the continued industrial support for these sectors that was discussed above, and highlights that stated aims of ‘diversification’ and ‘shifting the economy’ are not yet being dealt with adequately.

Figure 8: Forecast Eskom sales to Industrial Sector



Source: DoE (2010).

Figure 9: Forecast Eskom sales to Mining Sector



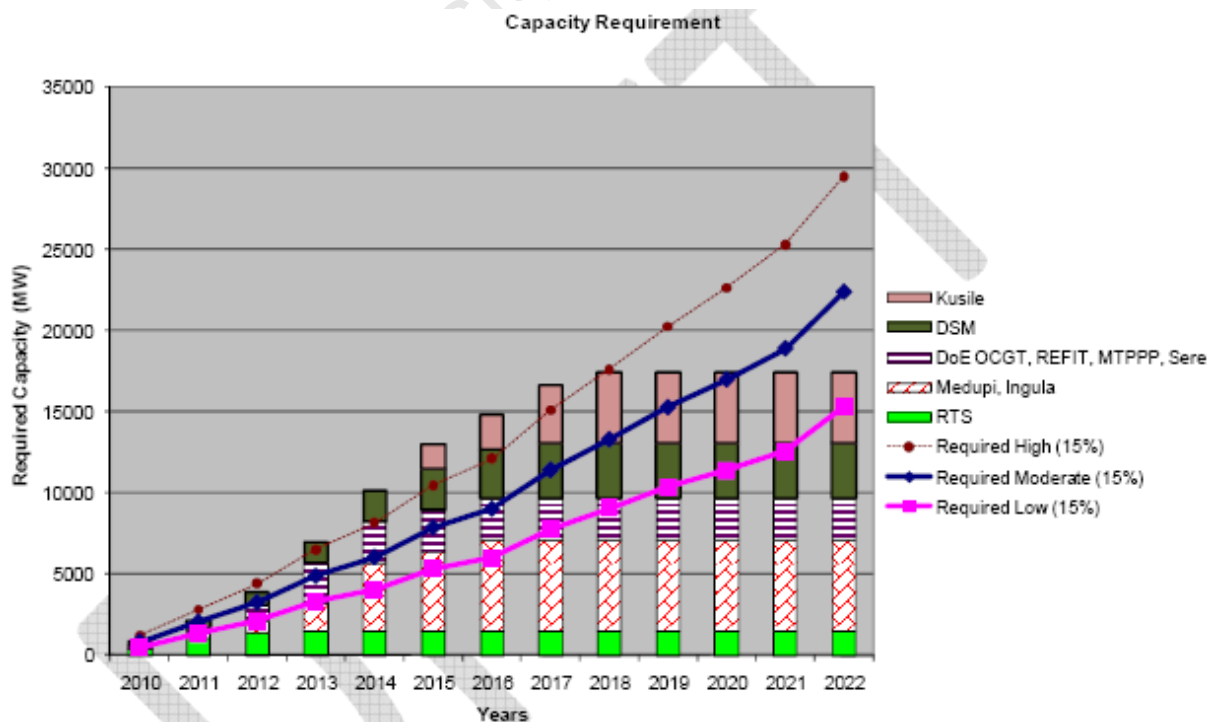
Source: DoE (2010).

Newer industrial policy aims, as outlined in the NIPF and IPAP, which more explicitly deal with minerals dominance in the economy and planned shifts to new areas of comparative advantage are not included in the demand forecasts. Rather than industrial policy informing energy planning decision-making, and vice versa, the energy planning process (which is based on inputs by industry) assumes that the economy will remain on the same trajectory regardless of industrial policy actions, and there is a serious disjunction between capacity planning and policy planning.

The IRP also assumes “a gradual reduction in electricity intensity due to increased efficiency and a diversification to secondary and tertiary sectors in the economy” (DoE 2010: vi). The DoE has an (assumed) “inherent” increase in efficiency that will be achieved through a reduction in energy intensity on the economy. This seems to directly contradict the forecast (large) increases in demand from, primarily, the mining and minerals sector. Although the DoE claims that the economy is going to shift to new sectors and away from the primary sector (assuming that such a development ‘ladder’ from primary, to secondary, to tertiary sectors even exists, especially in the South African context), this is contradicted by their own demand forecast and focus on beneficiation.

Furthermore, the modelling excludes the effects of electricity price increases, and the assumed increases in demand may be over-inflated (energy-intensive industry certainly feel that the indicative price path is beyond what they consider competitive). Given the historically-low price of electricity (below cost), there has been a genuine lack in investment - however, once Kusile comes online there is likely to be, once again, an oversupply of electricity in the country (see graph below). From 2015, there will be more than enough capacity to meet growth and restore the reserve margin; such oversupply will continue until at least 2019, and possibly beyond (to 2022) depending on whether or not the demand growth is equivalent to the forecast 'low' or 'moderate' demand path. It is important to note, however, that this oversupply is only for the medium term, and beyond 2020 or so South Africa could face supply shortages again. Other authors have also, however, called attention to the potentially high demand forecast. Pienaar and Nakhooa have pointed out that the IRP assumes growth in installed capacity from 259 658GWh to 454 367GWh, and that this assumption "seems inadequately grounded in the new green economy aspirations of the 2nd Industrial Policy Action Plan and other Department of Economic Development initiatives" (2010: 7). They further argue that even the energy efficiency scenario "appears excessively conservative about the potential for reducing energy consumption and transitioning to a less energy-intensive economic model", and that the scenario includes energy reduction estimates that are lower than the Department of Energy's own initial estimates (ibid 2010: 7).

Figure 10: Forecast capacity requirements



Source: Gaunt (2010).

From the demand forecasts above, it is clear that stated industrial policy aims to move away from the MEC sectors (and thus to reduce emissions) are disregarded by the DoE. The only area in which there is alignment is the focus on nuclear energy, where the industrial policy objective of developing a nuclear value-chain is used as a basis for nuclear generating capacity's inclusion in the IRP.

Despite the ostensibly 'public' process behind the development of the IRP2 – including stakeholder presentations and written comment and so forth – the result in the Revised Balance scenario clearly shows which interest groups have had the most access to the DoE planners. The graphs above highlight planned expansions by the largest minerals-based corporations in the country, for whom increased prices would be problematic, whether due to increased renewable energy in the grid, or because of their role in supplying coal to Eskom. A shift away from coal towards renewables – that is, a non-MEC-based energy supply sector - would certainly not be in their interests.

Tellingly, the Technical Advisory Committee for the IRP2 (a group whose membership was initially undisclosed and which has high-level input into the planning process) is comprised mostly of representatives from the largest firms in the MEC. The Committee consists of representatives from government (the DoE), Eskom, one academic, and one representative from the SA IPP Association (which represents both renewable energy and fossil fuel IPPs). All the other representatives are from industry, including the Chamber of Mines, Exxaro, Xstrata, BHP Billiton, Anglo American, and Sasol. The Chairman of the task team (Mike Rossouw) also works for Xstrata, and is the chairman of the Energy Intensive User Group.³³

Several of these companies have long-term coal contracts with Eskom, and it would be in their long-term interests to ensure that demand for coal remains high. For example, Anglo American supplies 33Mt of coal annually to Eskom, including to Kriel, Arnot, Tutuka, and Lethabo power stations, as well as 5Mt to Sasol. Anglo is also undertaking a pre-feasibility study at the New Largo mine, which will supply coal to Kusile (<http://www.angloamerican.co.za/en/our-operations/thermal-coal.aspx>). Similarly, Exxaro (which was formed when Anglo unbundled its iron ore assets) supplies over 36Mt of coal to Eskom per year, and is planning an expansion at its Grootgeluk Mine to supply a further 14.6Mt to Medupi once it is operational (see Annual Report 2009). BHP Billiton supplies coal to Eskom power stations such as Duvha and Kendal (see www.bhpbilliton.com), and also relies on extremely low electricity prices to ensure that its aluminium smelters continue to be viable. Xstrata

³³ The Energy Intensive User Group is a lobby group committed to promoting the interests of high energy intensity users in South Africa. Its membership of 35 large corporations and Transnet accounts for roughly 44% of electricity use in the country, and includes large mining and minerals houses, petrochemicals industry members and others. A full membership list is available from <http://www.eiug.org.za/membership/>.

exports the majority of the coal it mines, but also supplies Eskom (6MT in 2006), and furthermore requires low electricity prices for its platinum and chrome mining, and ferrochrome smelting operations (see http://www.xstrata.com/assets/pdf/xc-20080123_investor_trip_sa.pdf), which are currently being expanded. Indeed, about 80% of coal production in South Africa is accounted for from only five companies (Sasol, Anglo-American, Exxaro, Xstrata and BHP-Billiton) (Eberhard 2010). The representative of the Chamber of Mines would obviously represent other mining interests, for whom low electricity prices are important.³⁴

The firms who are advising the DoE on expected demand forecasts (and disregarding industrial policy goals to shift away from basic minerals) are thus also the companies that currently benefit from our carbon-intensive energy supply sector, and it is in their interest to ensure that coal is neither offset by renewables, nor that electricity prices should rise because of the need for an expanded grid. It is clear that 'private capture' (Rodrik 2007) of the electricity planning process has taken place; an occurrence which should be explicitly guarded against when designing policy processes, rather than being encouraged, as by the DoE.

The economic interests of the firms in the advisory group are couched in discussions around 'competitiveness', 'growth' and 'job creation' - despite the clear lack of benefits that the current system has had on job creation, and the fact that this assumed 'competitiveness' has been based on subsidised inputs. Concerns about industrial 'competitiveness' from the business community (many of whom emphasised that they thought the DoE revised balanced scenario placed too much importance on carbon mitigation) have fed into the DoE position, who included a graph (see below) in their presentation supplied to them by the Energy Intensive User Group, who in turn obtained the graph from a report by Frost and Sullivan *commissioned by Xstrata*.³⁵

The Report is focused on analysing what South Africa's "justifiable price path" should be, and finds that 85c/kWh is the 'maximum' industry in the country could handle (justifiable is essentially defined as 'competitive'). The report further emphasises that the IRP is "biased" towards a renewable energy

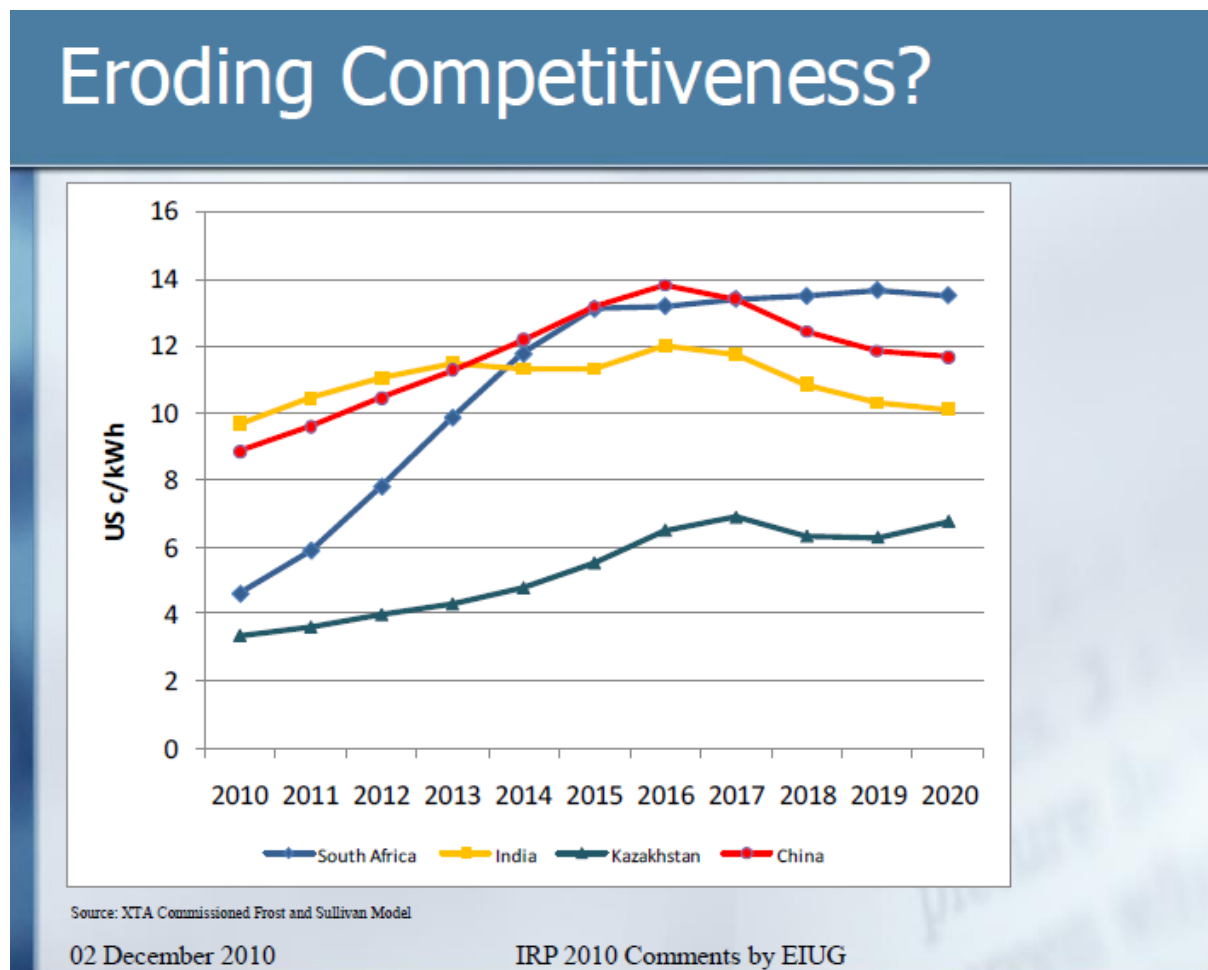
³⁴ See Eberhard (2010) for an elaboration of the cross-holdings and supply contracts between large industries in the country.

³⁵ It states that: "South Africa has in the past attracted a vast amount of capital investment based on its cheap electricity prices. The uncertainty over the price path and the security of supply has been openly cited as a key reason for delaying future investment. The majority of export based manufacturing businesses in South Africa are as efficient as they can be, given the local skills pool, labour policy and other infrastructure constraints. They will therefore not be able to pass the increasing tariffs on to the consumer. Increasingly marginal businesses that compete in a global export market will ultimately be forced to relocate or failing that close" (Frost & Sullivan 2011: 44).

The report, interprets South Africa's poor economic performance as due to increased focus on tertiary sectors as it has lost its competitiveness in energy-intensive industry, and thus calls for further emphasis on mining and minerals (Frost & Sullivan 2011: 58). Xstrata, a large exporter of coal, also has significant ferrochrome interests in the country.

“dominated” capacity build programme that is “overly expensive” and which must be “balanced with maintaining a competitive economy and ultimately an affordable price path” (Frost & Sullivan 2011: 83). What the report means by a competitive economy, of course, is an economy based on the minerals-energy complex, one which has been recently competitive due to a confluence of factors as discussed above.

Figure 11: Energy Intensive User Group comment



Source: EIUG (2010).

The IRP is problematic in that it is filled with (unsubstantiated) assumptions around ‘inherent’ energy efficiency, and a potentially over-inflated demand forecast, as well as its obviously pro-MEC stance and its discounting of climate change mitigation (it completely disregards the scenarios that are closer in line with the LTMS targets, in favour of lower cost - that is, fossil-fuel – alternatives). It provides an excellent counterpoint to the type of co-ordinated energy and industrial policy planning that is required to shift South Africa towards low-carbon development, highlighting the continued

reliance on large, coal-based power stations (as well as large nuclear stations) to drive growth in electricity-intensive industry.

LTMS and IRP conclusion

The IRP exemplifies how - even with the inclusion of more renewable energy than ever before - the energy paradigm has remained essentially unchanged. The LTMS wedges highlight the initial possibilities that are required to start developing a low-carbon focus. The alignments between industrial policy and the energy sector include building, residential and industrial energy efficiency; passenger modal shifts and hybrid and electric vehicles; the use of biofuels to replace oil; solar water heaters; and most importantly, a shift away from coal-fired power towards renewable energy technologies such as wind and concentrated solar power. The inclusion of nuclear power, while problematic given the cost overruns and skills shortages, may nevertheless be a necessary component of decarbonising electricity by reducing overall grid size. There has not been, however, a full interrogation of the costs and benefits of different generating technologies and the upstream benefits these could have for the economy, nor a proper public debate about the role of nuclear in South Africa's energy future.

Renewables in particular, while comparatively more expensive, seem to have far increased potential for job creation when compared to coal or nuclear (Agama 2003), and there is still the possibility of increasing localisation of component manufacturing and upstream industries, provided local demand is strong enough (SARI 2010a; 2010b). From the perspective of industrial policy objectives that are centred on job creation, the IPAP's lack of focus on wind in particular seems an oversight, given the opportunities highlighted above.

While in many of the mitigation wedges discussed above there are already, or are starting to be, policy initiatives in place, the overriding issue seems to be implementation (notably for solar water heaters). Building efficiency standards and compulsory solar water heaters have been talked about for years; similarly, renewables now have a REFIT to promote them but institutional issues and intransigence on the part of Eskom and the DoE means no power purchase agreements have yet been signed.

In essence, the wedges above are the very least required for lower carbon development. Although limited in some ways, if the country is serious about reaching its climate change mitigation objectives, then the initiatives mentioned above need to be strengthened and broadened. Other countries have started to take low-carbon development far more seriously than South Africa currently does (including the UK and Korea), and if the country is to garner the benefits for social and economic development as well as environmental sustainability, then a far more detailed and co-

ordinated approach is required. During apartheid, industrial policy was used effectively to ensure that MEC sectors came to dominate the economy – Sasol, the coal majors, and Iscor are all prime examples of how co-ordinated policies were used; now what is needed is a focus on the industrial policy needed to co-ordinate low-carbon development.

Indeed, while the LTMS wedges are necessary, a fundamentally different approach is needed for understanding how industrial policy can be used cross-sectorally to co-ordinate the promotion of low-carbon technologies and development. A new energy and industrial policy paradigm – one not based on cheap power and extractive industry – will be necessary to reach climate change mitigation objectives. Without this, the current MEC-based structure of the economy will continue to dominate and Reach for the Goal's future 'structural change' will not take place.

Conclusion

This thesis has sought to highlight the role that industrial policy has played in creating South Africa's emissions profile, and the role it should play in pursuing climate change mitigation objectives. As has become clear, there is clear theoretical and empirical evidence for the use of industrial policy in changing the structure of an economy, particularly for products and services in which a country can develop comparative advantage (thus allowing it to become economically competitive in those sectors), and particularly when such goods are underprovided by the private sector. Historically, in South Africa, industrial policy has been used to promote the develop of the minerals-energy complex, a term used to describe those sectors that form the basis for exports, investment and profit within the country; the dominance of firms in these sectors, however, has not contributed to increased socio-economic development, with declining employment in these sectors the general trend, coupled with a decreasing score for the country on the UN's Human Development Index (Black & Roberts 2009; Winkler & Marquard 2009; Roberts 2007). The MEC has also maintained support in the post-apartheid era, when, despite stated objectives to move away from capital- and energy-intensive industries and to promote diversification and downstream manufacturing, many of the industrial incentives offered have gone to core MEC sectors (such as ferrochrome smelting, iron and steel, and chemicals).

Beyond this, historically low priced electricity has further attracted electricity-intensive industry, leading to a belief that South Africa has a natural advantage in the MEC sectors, while in fact a particular set of political decisions and historical events have led to the dominance of these industries. This has included coal export policy in the 1980s, subsidies for Eskom's expansion in the 1980s, and the subsequent pricing of electricity below the long-run marginal cost in the 1990s, which

has given the appearance of competitiveness in particular industries, but which is actually based on very low input costs that promote profitability.

South Africa's particular energy and emissions profile is thus largely due to this industrial structure (with 44% of the electricity in the country being used by 36 large consumers, most of which are industrial) and the coal-fired power on which it is based (which in turn is a core component of the MEC, with only 5 major companies producing most of the coal in the country, and in turn using vast quantities of the electricity produced from its burning).

Under the Cabinet-approved "Peak, Plateau and Decline" mitigation policy, as well as under the pledges made by the country under the Copenhagen Accord, South Africa needs to initially reduce its emissions growth, and eventually, its absolute emissions, quite significantly. The Long-term Mitigation Scenarios project on which these pledges are based, has modelled the potential wedges, combined into suites of options, that provide the means by which to reach the goal of absolute emissions reductions. As was discussed above, there is a need to use industrial policy to develop new industries, and promote current smaller industries, if the mitigation potential of these wedges is to be reached. Perhaps most importantly, however, is the need for incentives to shift further away from MEC sectors so as to change the structure of the economy and lower its emissions intensity; this is particularly important given that the LTMS showed that the science-based target for emissions reductions cannot be met with current technologies and with the extrapolation of the MEC-based demand for energy.

This then is the perhaps the foremost problem in both the LTMS and the recent IRP – the current structure of the economy is assumed to be a natural state of affairs, one which should be expanded upon dramatically and which is unlikely to change beyond some assumed 'progression' into tertiary sectors. The IRP demonstrates this with the large demand forecast for the mining and minerals sector, thus highlighting both the misalignments between industrial policy, electricity generation and climate change mitigation, as well as the key role that the minerals-energy complex continues to play in the economy and in decision-making processes.

For low-carbon development to take place is going to require co-ordinated effort to switch incentives away from MEC sectors and away from the continued provision of low-cost, environmentally unsustainable and economically inefficient electricity, towards, firstly, the mitigation wedges outlined in the LTMS; and secondly, towards a general focus on sectors other than the MEC. Industrial policy has played an historically important role in creating the current demand patterns in

South Africa, and the role of industrial policy in pursuing climate change objectives is therefore of the utmost importance.

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