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Supplementary Input into the IEP Externalities Committee

10th October 2014

Introduction
After the latest discussions which took place regarding the IEP externalities subcommittee, and after the technical workshop, SAFCEI offers some additional input to the modelling process. I attach the original May 2014 input to this document for your information.

Water:
We have raised the issue of water quality which we believe is an externality that is separate to that of ensuring water supply.
Various data have been put forward to calculate a water supply cost, averaging now at R42 rand/m3 (Goyns ppt at 23rd Sept meeting).
However, the provision of the fuel (coal) incurs a separate externality, namely the cost of water pollution. This cost should be added to the fuel costs of coal.
Unlike the water supply costs which should be added to all energy technologies that use water (eg nuclear, solar csp etc), the pollution costs of coal mining are additional costs applicable only to coal.

Drawing on various reports including the DWAF report no: P RSA 000/00/12610 used by the modelling team, the cost of treating AMD to potable water quality is given ranging from R8.87 to R10.22 rands/m3 (incremental URV). SAFCEI would like to see this cost included in the external costs of water as an additional externality related to water quality.

Nuclear water use.
Although nuclear power stations use sea water for cooling, there is still a requirement of 8000 m3 per day per power station. The cost of water supply should be added to the nuclear costings.
We include the conclusion from the Eskom's EIA report for the nuclear power plants as explanation for the need to include this.

> *Eskom Holdings Limited Generation Division. Nuclear 1 Environmental Impact Assessment and Environmental Management Programme: SPECIALIST STUDY: FRESHWATER SUPPLY. NSIP-NSI-020567#P1-23. J27035 SEPTEMBER 2007*
> *South Africa is a water scarce country with an average rainfall of some 460 mm per annum compared to a World average of 880 mm. Droughts are common and often severe. An additional demand of 8000 m3/day will therefore have a significant impact on local water resources, but less on major regional schemes such as the Orange River. Koeberg is already connected to the municipal reticulation system but pipelines will have to be constructed to the other four sites for surface water supply.*
>
> *Groundwater could possibly be used during the site construction phase to meet potable water demands.*
>
> *Desalination could have the least environmental impact and be cost effective as there would be a ready supply of sea water and power at each site. Disposal of brine would have an environmental impact on marine ecology.*
>
> *In terms of obtaining fresh water supply from conventional sources, an additional demand of 8000 m3/day means that all sites will have a high sensitivity. Groundwater is only a potential option for partial contribution to this supply. Supply from major schemes/sources such as the Orange River (Thyspunt, Brazil, Schulpfontein), Berg (Koeberg) and Riviersonderend/Breë (Bantamsklip) are the likely options for full fresh water supply. This would be subject to application of the principles contained in the National Water Act and other relevant legislation. Desalination is a potential cost effective option at all sites.*

'

Additional nuclear externalities.

The recent press statements regarding nuclear agreements that have been signed with various countries indicates that for the purpose of IEP modelling, we cannot assume any particular nuclear model. However, in line with international best practice, we would assume that safety features like core-catchers and ability to withstand aircraft collisions as well as any increased safety features that arise out of Fukushima would be included in any model procured by South Africa.

At this point, we would argue that it is not realistic to assume cost reductions for which we do not have meaningful evidentiary experience.

We would also argue for the need to include decommissioning and waste disposal costs.

Although, theory suggests that funds are supposed to be set aside for decommissioning, but their adequacy is often based on "highly optimistic estimates of the cost and the interest that can be earned" (Thomas 2014). These risks have played out in the UK, where according to Prof Steve Thomas, nuclear economics expert of Greenwich University," In the UK repeated failures of the provisioning for decommissioning, including using methods similar to those used by Eskom, have resulted in future taxpayers be liable for a bill in excess of £100bn (R1.8tn) to decommission its existing nuclear facilities". Prof Thomas estimates the decommissioning costs of Koeberg's two reactors at R34bn. Current US estimates are around R 18 240/kw.

However, waste disposal costs are an unknown as we have no commercially operating high level waste disposal site in the world. Waste disposal costs cannot be zero but are very difficult to quantify.

Similarly, the costs of additional regulatory capacity needed for thousands of years is an almost impossible situation to assess monetarily.

For disaster management, we would therefore agree with NIASA that while it is difficult to quantify externalities, particularly the health impacts at this stage, for this round of the IEP, the estimate for a large nuclear accident be used – an amount of $1.6 trillion. According to NIASA, "the about 400 generation II nuclear reactors on the planet currently produce one accident about every 25 years, the external costs about to about R0.48c/kwh produced." Since we do not have sufficient reliable practical data regarding generation III reactors, we do not agree with NIASA's proposed generation three accident risk reduction.

Air Pollution and Health costs

SAFCEI would support the inclusion of health costs, particularly for air pollution, and would particularly support Greenpeace and GroundWork's calculations in this regard.

We would also like to emphasise once again that we would oppose any calculations regarding monetizing the deaths of people due to pollution in a manner that implies that the life of a person in South Africa is worth less than that of a person in the UK or other northern countries.

In conclusion, SAFCEI would like to reiterate our appreciation for the manner in which the modelling team have conducted their work. They have engaged with the stakeholders on the subcommittee and have been open to our inputs acknowledging that these are provided in order to strengthen the IEP results. We are also open to further consultation should there be a need to clarify our inputs further.

We wish you all strength and wisdom in your efforts to carry out the modelling to produce a professional report.

Liz McDaid
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Input into the IEP Externalities Committee
Comment on the vivid Economics Report

26th May 2014

Introduction

SAFCEI welcomes the formation of the working committee on externalities. We appreciate the attention that DoE is taking to consult with stakeholders in this regard, and are committed to working with DoE to produce an IEP that reflects an appropriate energy plan for South Africa.

Within the time and resource constraints of this process, we have given comments in this document that are not in any way comprehensive but hopefully provide some thoughts on the kind of data we would like to see included in the externalities for the IEP.

In responding to the Vivid Economics report, as pointed out before, the report raises more questions than it answers, and appears as if it is a summary. It is extremely limited in that it fails to cover a number of externalities and we support project90's submission in highlighting some of these flaws. The fact that it is created as part of the Shell scenarios process is of major concern. Civil Society has largely been excluded from the Shell scenario process, and given that this process (as understood from yourselves) is to develop an energy vision for South Africa, we would regard it as a fatal flaw for such a process to exclude a large sector of society. If this externalities report is an example of the outcomes of that process, it would further support the view that such a Scenario process outputs is flawed and cannot lead to an energy vision supported by all South Africans.

Globally, and here at home, environmental quality is seen as a public good that the state must secure by preventing it from being damaged. Ways of doing this are through regulation or the application of pigouvian taxes (the polluter pays principle), for example the carbon tax.

From an economic point of view "to the extent that government bears the security costs associated with ensuring that uninterrupted supplies of fuels reach the relevant markets, then these fuels are being subsidised and hence there exists an inefficient allocation of resources. The price to the ultimate consumer would be too low and consequently demand (and pollution) levels would be higher than in the absence of this subsidy"[1].

Failure to implement FGD technology for the Eskom fleet would be one example, and failure to cost the externalities of the nuclear industry would be another. If we include externalities in our electricity costs, energy choices can be taken that reduce human destruction of the ecosystem, and provide opportunities to heal the earth. Failing to include externalities means that those affected by the environmental burdens of energy production (such as nuclear accidents, coal related air pollution, polluted water etc) are bearing the costs that polluters should pay. Failing to implement the polluter pays principle in effect means that society, particularly poor and marginalised people who bear the highest burden are, in effect, subsidising the energy industry. SAFCEI believe that this status quo is unjust and should be corrected.

[1] Owen Environmental Externalities pg 127-

The Approach
SAFCEI believes that the earth's systems are an integrated whole, and supports a life cycle analysis (LCA) approach. In order to ensure that all externalities are included in the analysis, a LCA approach that sees fuel extraction, transportation, preparation of fuels, plant construction, plant operation, waste and decommissioning – i.e all upstream and downstream processes. Using such an approach enables a cost benefit comparison (even if using shadow prices, or ranking to determine priority pollutants or externalities) and gives us the opportunity to look at the long term implications of alternative energy technologies.

In assessing some of the costs, we would like to see a differentiation between damage costs and control costs. Control costs are costs imposed to achieve a certain level of environmental quality that restrict the negative impacts to some agreed acceptable level. Damage costs are the actual loss of wellbeing resulting from specific adverse environmental impacts.

For example, nuclear control costs are the cost of monitoring, and ensuring safety at a nuclear power plant, while damage costs would include the massive costs when something goes wrong. Fukushima is the most recent disaster in this sector where radiation has now been detected in Canadian waters. In our view, the potential damage costs of certain technologies render them unacceptable options for countries focused on ensuring a sustainable future.

Actual numbers
We have cut and pasted data from specific reports, and have used peer reviewed academic literature where possible.
The Health costs of Mpumalanga residents is another example, where the control costs may be R200 bn (according to Eskom) but the misery of deaths and diseases for residents from ambient air pollution in the Highveld Air Quality priority area cannot be quantified, but have been estimated by various studies including Greenpeace (2014) "The economic cost associated with the premature deaths, and the neurotoxic effects of mercury exposure, is estimated at 230 billion rand, with a confidence interval of 32 to 1,010 billion rand". According to a high level EPA study, the it would cost about $65 billion for the USA to meet the requirements of their clean air act, while the improved welfare, reductions in air pollution related disease are estimated to be almost $2 trillion for the year 2020 (EPA 2010).

The difficulty is that to choose values and express lives lost in monetary terms is morally unacceptable to SAFCEI. For example, in 2008, the EPA dropped the value of a life. "When drawing up regulations, government agencies put a value on human life and then weigh the costs versus the lifesaving benefits of a proposed rule. The less a life is worth to the government, the less the need for a regulation, such as tighter restrictions on pollution.

Consider, for example, a hypothetical regulation that costs $18 billion to enforce but will prevent 2,500 deaths. At $7.8 million per person (the old figure), the lifesaving benefits outweigh the costs. But at $6.9 million per person, the rule costs more than the lives it saves, so it may not be adopted".[2]
Another example looking at a transport case study in Sierra Leone valued African travellers as worth US$577 000 compared to US$924 000 for non-African travellers[3] by calculating their transport preferences, while Leon & Miguel (2013) refer to other studies that suggest that using a subjective life

[2] http://www.huffingtonpost.com/2008/07/10/american-life-worth-less_n_112030.html
[3] http://emiguel.econ.berkeley.edu/assets/miguel_research/5/10-2013WP.pdf

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approach, the monetary value attached to the death of a relative is less than 1% of most estimates for wealth countries (Deaton et al 2009, quoted in Leo & Miguel 2013).

Our understanding of the nature of the externalities working committee, is that we would have an opportunity to discuss which values would be appropriate for this round of the IEP. SAFCEI believes that there are a range of papers available and that such literature should be consulted in order arrive at an appropriate figure.

Distributed electricity

Owen (2004) points out that the use of solar pv near the site of use, for example, rooftop pv reduces transmission and distribution costs, and regards pv as a 'delivered" or distributed and its costs should therefore be compared with the delivered costs of grid based electricity.

Coal and carbon

Given that our economy is currently coal based, both for electricity, industry burning coal, and CTL technologies, the following table provides some useful data. The approach of looking at coal as a primary fuel, rather than adding in externalities at the end user point, for example electricity charges, seems appropriate to the IEP process. The Blignaut &king (2002) paper needs updating and SAFCEI would suggest that Prof James Blignaut and Dr Nick King be approached as specialists who could provide useful insights into the costing of externalities in the energy sector.

Table 5 The cost of emissions: 2000

	Coal purchased	CH_4			CO_2			Total	
	t	t	R364,1 / tonne	R728,21 / tonne	t	R17,34 / tonne	R34,68 / tonne	Lower scenario	Higher scenario
			R millions	R millions		R million	R million	R million	R million
ISCOR	1 583 865	39 121	14	28	3 195 475	55	111	70	139
Metallurgical	1 272 014	31 419	11	23	2 964 507	51	103	63	126
Agriculture	69 053	1 706	1	1	142 447	2	5	3	6
Iron and Steel	2 881 311	71 168	26	52	5 929 036	103	206	129	257
Industries	2 630 809	64 981	24	47	5 315 411	92	184	116	232
Chemical Industries	1 080 816	26 696	10	19	2 208 196	38	77	48	96
Merchants and Domestic	3 920 241	96 830	35	71	8 146 003	141	283	177	353
Gold and Uranium Mines	24 043	594	0	0	48 399	1	2	1	2
Other Mining	120 998	2 989	1	2	243 569	4	8	5	11
Water	146 534	3 619	1	3	301 958	5	10	7	13
SASOL (calculated)	46 334 788	1 144 469	417	833	66 316 667	1 150	2 300	1 567	3 133
SASOL (Own figures)	51 800 000	1 144 469	417	833	57 713 000	1 001	2 001	1 417	2 835
Cement and Lime	1 071 221	26 459	10	19	2 156 368	37	75	47	94
Electricity (Non-ESKOM)	1 556 304	38 441	14	28	2 425 240	42	84	56	112
ESKOM (calculated)	91 811 056	2 267 733	826	1651	143 072 229	2 481	4 962	3 307	6 613
ESKOM (Own figures)	92 300 000	2 267 733	826	1651	161 200 000	2 795	5 590	3 621	7 242
Brick and Tile	176 517	4 360	2	3	355 329	6	12	8	15
Total (Only own figures)	160 633 726	3 820 585	1 391	2782	252 344 938	4 376	8 751	5 767	11 534

Source: Own analysis.

Owen (2004) provides a table of costs including current and expected but only for carbon emissions.

Table 3. External Costs for Electricity Production in the EU (range: euro¢/kWh)

Country	Coal & Lignite	Peat	Oil	Gas	Nuclear	Biomass	Hydro	PV	Wind
Austria				1-3		2-3	0.1		
Belgium	4-15			1-2	0.5				
Germany	3-6		5-8	1-2	0.2	3		0.6	0.05
Denmark	4-7			2-3		1			0.1
Spain	5-8			1-2		3-5			0.2
Finland	2-4	2-5				1			
France	7-10		8-11	2-4	0.3	1	1		
Greece	5-8		3-5	1		0-0.8	1		0.25
Ireland	6-8	3-4							
Italy			3-6	2-3			0.3		
Netherlands	3-4			1-2	0.7	0.5			
Norway				1-2		0.2	0.2		0-0.25
Portugal	4-7			1-2		1-2	0.03		
Sweden	2-4					0.3	0-0.7		
United Kingdom	4-7		3-5	1-2	0.25	1			0.15
EU range	**2-15**	**2-5**	**3-11**	**1-4**	**0.2-0.7**	**0-5**	**0-1**	**0.6**	**0-0.25**

Source: Adapted from European Commission (2003)

However, Owen (2004) points out that his figures are only for explicit external damage costs due to carbon emissions, and that other types of externalities must be included in order to ensure a balance across technologies. For example, Owen refers to nuclear power which appears to have an apparent competitive advantage over all other technologies without taking into account significant subsidies and radio-active waste costs. It is difficult to quantify the long terms storage costs for nuclear waste as a permanent storage facility for the storage of high level waste has yet to be built.

Nuclear risk

"Security issues are viewed as significant by policy makers in the operation of nuclear plants "(Metcalf 2013). Metcalf highlights the industry requirements such as ability to repel attack (according to the literature, 10 out of 136 mock attacks resulted in simulated destruction of the nuclear facility) and the nuclear regulatory commission (NRC) then ordered increased security requirements. Regulatory requirements require nuclear plants to be able to withstand aircraft crashing into them, and cybersecurity has become another area of concern after a computer virus caused damage to the Iranian nuclear programme in 2010 (Metcalf 2013). Such escalating costs need to be included into the costs of supply for nuclear energy.

However, part of the nuclear challenge is the risk of an accident. The probability of such accidents appears small but their impacts are catastrophic. According to Laes (2011), it is argued that the insurance market could provide the best means of assessing nuclear risk, as in advanced capitalistic society, the insurance sector balances widely variable risks for society and itself. With this logic, nuclear power stations should pay full indemnity insurance, and if one could then fully internalise the costs of the risk, the insurance industry could then work out the premiums that should be paid by the nuclear operators. However, according to Laes (2011), the nuclear industry since its beginnings, has implemented a limited liability, to "allow the growth of the nuclear industry", and so in Europe, an international liability arrangement has been set up through international convention that in effect results in states having to cover the costs of nuclear accidents, both their own and those of other states. However, all of these liabilities are limited, up to 700 M€ according to Paris and Brussels conventions. This principle of limited liability results in an implicit subsidy for the nuclear sector which has been estimated at 1.1-162.4 M€/year but this is not the full cost, and the authors conclude that until nuclear operators are forced to pay full indemnity insurance, no reliable cost estimates of nuclear externalities can be made (Laes 2011).

While Laes (2011) argues that political climate of the initial start up of nuclear power resulted in the nuclear industry receiving subsidies in the form of limited liability, the political context has changed over recent years. Three mile island, Chernobyl and Fukushima demonstrated that a nuclear accident is not hypothetical, and the proposed expansion of the nuclear industry "could at the political level lead to a debate on why, some 50 years after the introduction of nuclear energy, this energy form still deserves an implicit subsidy through a financial limit on liability."(Laes 2011)

The failure to dispose of nuclear waste responsibly has led to mounting clean up costs. According to a report by Friends of the Earth, plans to clean up Sellafield in the UK have missed their deadlines and costs continue to rise. Total lifetime costs for dealing with the waste and decommissioning the site now stand at pounds £67.5 bn, with an enormous amount of public money (about £1.6 bn) spent at Sellafield each year.

SAFCEI requests that the estimates for the additional externalities outlined above, should be included in the IEP as a minimum.

Intergenerational inequity.

"The inevitable absence of future generations from current decisions, determining intergenerational allocation, establishes an unusual and distinctive intergenerational externality: the welfare potentials of future generations are possibly affected without 'compensation'"(Bithas 2011). In effect, environmental degradation implies that polluters "steal welfare from the sufferers" and without internalising externalities, such "theft" is permitted by the institutional setting (Bithas 2011).
The manner in which discount rates are calculated results in a situation where future major expenses appear negligible and although polluters are tasked with paying some time in the future, their ability

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to pay is clearly dependent on their ability to survive into the future, ironically i.e. on their continued polluting activities.

SAFCEI would like to see the costs of future externalities evaluated in a manner that does not favour leaving such a burden to future generations.

Water:
Water pollution carries the direct impact of pollution that renders the water unfit for consumption by animal or human. However, contamination of water over time can also lead to loss of property and livelihoods, possible increasing food insecurity and increasing illnesses, as well as the impact on biodiversity. Acid Mine Drainage (AMD) is the result of over a hundred years of mining, and the problem, which is estimated to cost millions to mitigate will not be borne by the generations that caused the problem. It is therefore important to ensure that such pollution ceases and that future generations are not forced to pay for the actions of their ancestors.

To illustrate this point, we insert a paragraph from McCarthy (2011) who discusses limited remediation of water for communities, and the continued pollution of the environment.
"Coal mining in the Witbank/Middelburg area commenced in 1894 to supply coal to the growing diamond and gold mining industries and this region therefore provides insight into the longer-term impacts of coal mining. Many mines in the region lie abandoned; some are on fire, some have collapsed and most are decanting acidic water. The water is entering the local river systems (tributaries of the Olifants River) where it is slowly neutralised by dilution and various chemical and biological reactions. However, the water remains highly saline and sulphate concentrations are particularly elevated. An indication of the problem is provided by the rising salinity and sulphate concentration of the water in the Middelburg and Witbank dams (Figures 4 and 5). The problem is exacerbated during dry periods and improves somewhat during wet periods, which is the reason for the high degree of variability in these plots, but the general trend is one of steadily increasing salinity and sulphate concentration. The sulphate concentration in Witbank Dam now regularly exceeds the 200 mg/L level, which is the recommended maximum in water for domestic use. The quality of local water is so poor that ESCOM imports water from the eastern escarpment for use in the power stations in the Witbank-Middelburg area".

Fracking:
The cost externalities for hydraulic fracturing for shale gas and for coal-bed methane in South Africa cannot be reliable quantified as there has been no drilling for natural gas and hydraulic fracturing undertaken yet. The published examples from the US are hardly applicable. Therefore, at this point in time, there can only a **broad categorization** of the **different types of externalities** associated to this particular **gas industry**.

Here are the main categories known at this point in time:

- **Groundwater contamination** in the immediate neighborhood of wells
- **Land degradation**
- Contamination of **aquifers on a wider, regional scale**
- Excessive use of **fresh water**
- **Health effects** of undisclosed components **of fracturing fluids**
- **Spills and treatment of waste** fluids,
- Public investment in additional **water treatment facilities**

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- Blowouts, **house explosions** and flaming kitchen faucets
- **Earthquakes**, as amply shown in Oklahoma and Texas, with potentially huge capital cost and human losses
- **Road damage**
- Additional **pipelines and transmission lines**, with associated **land degradation**
- **Inflationary tendencies** in underserved areas
- **Air pollution** from drilling, compressor stations, refineries, pipelines
- **Dust pollution** from heavy haulage on dust roads
- **Traffic accidents, cost of policing**
- Rise in **criminal offences**
- Cost of additional **regulatory bodies**
- Loss of **property values** close to gas installations

Always keeping in mind, that the first item alone can – in the case of just one major accident – wipe out all positive externalities of shale gas production.

Some of the more detailed studies:

- An excellent analysis of potential externalities from **methane contamination of groundwater** by Osborn, Vengosh, Warner, and Jackson, all from Duke, can be found in this paper. In addition radioactive wastewater is a particular threat in the Karoo where many uranium-bearing formations are known.

- A recent study from MIT, "The Future of Natural Gas," gives detailed projections for the inclusion of **GHG pricing in natural gas production**. Under the assumptions of the MIT study, a system that priced in GHG emissions would cause gas to displace coal completely for electric power and make substantial inroads against oil as a transportation fuel.

- The **cost of water** is calculated in a study by Katie Philipps from Appalachian State University, Boone (NC). She finds that these vary considerably across the different shale plays in North America.

- Using data from the American Lung Association, Rogers calculated that the impact on public health of air pollution caused by gas drilling activities adds up to $200,000 a day in just the Barnett region.

- Professor of Agricultural Economics at Penn State Tim Kelsey developed a basic graph for the economic activity generated by shale production which shows the boom-bust potential of the industry. Kelsey was assisted in research by David Kay, an economist at Cornell and author of "The Economic Impact of Marcellus Shale Drilling: What Have We Learned? What are the Limitations?" In Kay's view, local governments need to restructure taxation and investment strategies so funds can be set aside for community development. Kelsey is in the research stage of developing a model that would quantify the negative externalities imposed by drilling. He argues there has not been substantive analysis of the societal costs of natural gas drilling.

Decision-making model

Templet (1995) developed a green index which looked at pollution abatement costs, levels of regulation and suggested that poor environmental policies lead to avoided pollution costs, which means higher pollution subsidisation for the industry. Such a model might benefit South Africa as it enabled comparisons across states, and tried to address racial environmental equity issues. Templet (1995) concluded "The desire for increased profits by firms may lead to intervention in state policies and procedures and increased externalities, in the absence of governmental vigilance, which yield internal subsidies to the firms. The subsidies are generally paid by the public and the indicators of public welfare, energy and environmental quality are shown to decline as externalities increase". Another important consideration to be brought into the decision-making is the valuing of green infrastructure. This approach could be used and valued as part of calculating the control and damage costs. The value of wetlands to absorb and treat pollutants such as AMD, or the value of soil carbon that is destroyed when coal is strip mined.

Conclusion:

SAFCEI believes that it is government's responsibility to conduct adequate research in order to ensure that externalities are included in the IEP. We have provided a few examples for a number of studies as an illustration of the type of data that is available and should have been in the Vivid-economics report. We could provide more but we believe that government has the obligation to ensure that our taxes are spent wisely, and we would ask that vivid-economics and the DoE revise this report to extend beyond climate change related impacts and which adopts a life cycle approach.

We request an opportunity to meet with the authors of the report in order to discuss how they might incorporate externalities meaningfully into their report.

Liz McDaid

SAFCEI: Climate and Energy Programme Coordinator

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References are incomplete due to time constraints. Papers available on request.