Appendix A
Southern Africa's Energy Economy and the Marketability of Gas

A. Comparative and Absolute Trade Advantage

Energy development is frequently the cornerstone of economic development. Private or public investment in cost effective energy systems that aid in the production of commodities that can be profitably traded in the international market will contribute to rapid economic growth and full employment. Investments that unnecessarily raise energy costs will lessen a country's ability to compete in the global economy.

The "globalization" of the world economy means that no nation or region of the world can isolate itself from international competition and prosper. Developing countries, like everyone else, must identify those economic activities for which they have a comparative or absolute advantage. Some of South Africa's more important trade advantages lie with cheap coal and prolific mineral deposits — gold and diamonds to name two. These minerals have been the foundation of its economy.

Before examining the details of South Africa's energy economy and the role that natural gas might play, it is important to note a central fact. Compared to many regions of the world, neither South Africa nor its immediate neighbors to the North have vast deposits of cheap natural gas. From an international perspective, South Africa itself has little or no comparative or absolute advantage in the development of gas-intensive industries. Other countries endowed with abundant natural resources that depend on gas for processing and manufacturing (for example, Australia, Canada, and parts of the U.S.) also have relatively cheap domestic supplies of gas. Unless gas can be delivered at internationally competitive prices (which means at prices below $2 per Gj) to sites in South Africa where there are large industrial demands for energy, imported natural gas will not make a significant contribution to the economic development of the Republic of South Africa.

The prospective role of natural gas is particularly evident when its cost and availability are compared to coal. In much of South Africa, coal can be delivered for about one-quarter the expected price of natural gas. This cost

differential does not, of course, account for the impact on air quality and other environmental side effects of switching to gas. In most instances the cost of reducing noxious emissions from coal is far cheaper than switching to natural gas. There are, however, some exceptions to the superior cost-effectiveness of coal. For example, in cases where coal is converted to gas before utilization it may be economic to go to natural gas directly.

The coal-to-gas process widely used in South Africa by Sasol and other industrial companies could well be the key to opening the market for natural gas. Even though these operations might not be fully viable as new investments, the modification of existing facilities and plants to use natural gas could be economic if the cost of mining and processing coal has a higher variable cost than the price of natural gas. Put another way, if natural gas can be imported into South Africa at delivered prices less than the cost of converting coal to gas, there is a real chance for the gas market to develop. Moreover, it certainly makes sense to use natural gas located in Namibia and Mozambique before investing in new facilities to convert coal to gas.

There is, however, an important qualification to the preceding observation. An investment in a new energy resource must consider not only the measured accounting cost but the recirculation of benefits within the Southern African economy. Coal mining, transportation and marketing are all activities that take place within the local economy. On the other hand, construction of natural gas transmission pipelines and production facilities may depend on the import of engineering expertise, equipment and materials. Likewise, if financing is provided from outside Southern Africa, the debt service will create a drain on the economy. Suffering the outflow may be worthwhile only if the gas adds more in incremental value to internationally traded goods than it costs.

Natural gas has an important role to play in South Africa's future. One must, however, be realistic about the benefits and costs that the development of this market will entail. On balance, substituting gas for coal or high-sulfur fuel oil will have a positive impact on the environment. This is particularly so, in those instances where emission controls are neither practical nor economic. It is the purpose of this appendix to describe the present energy economy and identify the size and likely development of a future gas market.

B. Coal-based energy economy

South Africa's energy market is unique. It is the only country with a temperate climate and inexhaustible supply of cheap good-quality coal. China, North Korea and Poland have similar levels of coal usage (about three quarters of total energy demand), but these countries also have large demands for space heating. And, in the case of China, very rapid economic growth is accelerating the demand for alternative fuels.

Coal costs in South Africa are lower than anywhere else in the world. There are over 100 billion tons of low sulfur coal reserves widely available through the industrial region.[1] Labor for the coal mines is also low cost and coal mining provides substantial employment. The network of coal mining, distribution, and use is well established. As a consequence, the "B-fuels" market (boiler, black, bunker, bulk, etc.) is totally dominated by coal. In many other energy markets there is active competition between heavy fuel oil, coal, and gas, but not in South Africa; alternative fuels have been nearly driven from the market.

Table A-1 summarizes current and forecasted coal prices. In the industrial heart of South Africa, the Gauteng area around Johannesburg, bulk delivered coal prices range from $.60 to $.77 per Gj. This is about one-quarter of the lowest prices available for coal gas or the expected delivered cost of natural gas. Coal has a staggering cost advantage and this is crucial because the B-fuels market is unforgiving. The demand for heat is on a large enough scale and in a stationary setting so that the form of the fuel does not matter. The demand is for therms, and the cheaper the better.

Most of South Africa's coal deposits are near the surface, making it possible to substitute capital for labor if wage rates rise. As a consequence, there is little or no expectation of a significant rise in coal prices. The SADC study forecasted a modest price increase over the next decade, about 10% or less than 1% per year. Even this forecast is likely to prove too high. If the petroleum

[1]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper A: Southern African Gas Markets***, pp. 3-6.

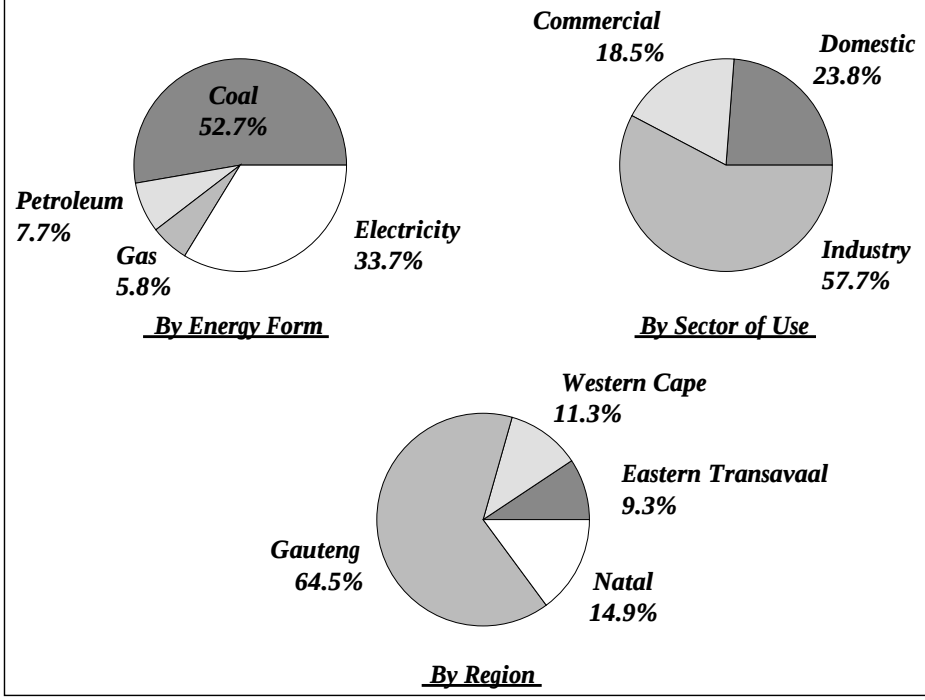
Table A-1	Delivered Price of "Optimised Grade" Coal in South Africa ($/Gj)					
	1994			2005 Forecast		
	Bulk	By Lorry	By Bag	Bulk	By Lorry	By Bag
Gauteng						
North	$0.77	$0.94	$1.98	$0.87	$1.04	$2.09
Central	$0.70	$0.86	$1.90	$0.79	$0.96	$2.01
South	$0.82	$0.98	$2.03	$0.92	$1.08	$2.15
East	$0.63	$0.80	$1.83	$0.73	$0.90	$1.94
West	$0.77	$0.94	$1.98	$0.87	$1.04	$2.09
Eastern Transavaal						
West	$0.60	$0.77	$1.79	$0.70	$0.87	$1.91
East	$0.77	$0.94	$1.98	$0.87	$1.04	$2.09
North	$1.15	$1.31	$2.39	$1.25	$1.41	$2.52
Natal						
North Coast	$1.30	$1.46	$2.54	$1.40	$1.56	$2.67
Inland	$0.85	$1.01	$2.07	$0.95	$1.11	$2.18
Greater Durban	$1.50	$1.66	$2.76	$1.60	$1.76	$2.89
Cape	$2.36	$2.51	$3.71	$2.47	$2.62	$3.83

product market is deregulated, as expected, heavy fuel oil prices will soften and this will put downward pressure on coal prices.

B-fuels are used for industrial process heat and electrical generation. A brief review of South Africa's energy demand is instructive in this respect. Figure A-1 illustrates the net thermal energy consumption, by energy form, sector of use and region. It is accompanied by Table A-2. The graphics make it immediately obvious that South Africa's thermal consumption is mainly located in Gauteng, dominated by the industrial sector and dependent on coal. The preeminence of coal is even greater than it first appears, because one-third of the demand for energy is served by coal-generated electricity.

It is worth noting that the use of electricity for heat (rather than just light and mechanical motion) is quite common around the world and often is the most economic choice. The transmission and distribution cost of electricity can be lower than for competing sources of energy, particularly for low-volume uses which are standard in South Africa. The centralized burning of bulk fuels means that emissions can be controlled, with sulfur and other pollutants economically removed at the source. Moreover, the use of heatpumps and similar technologies

Figure A-1 -- South Africa's Net Thermal Energy Consumption, 1991 Distribution by Form, Use and Region



can make a comparison just on the basis of therms inappropriate.

South Africa's energy economy has another unique feature: coal-to-coal competition. Coal resources are widely dispersed in South Africa and there are enough independent coal producers to ensure that coal prices sink to the level of marginal cost. Scarcity and limited competition in some countries allow coal prices to rise to near the level of competing fuels — industrial natural gas and heavy fuel oil. But, not in South Africa. This is a crucial point when considering the future price and availability of natural gas. Several decades into the future South Africa might achieve gas-to-gas competition. But, initially there are only two potential gas producers and they are unlikely to compete in the same regions.

Table A-2		South Africa's Net Energy Consumption (MM Gj/year)				
		Coal	Petroleum	Gas	Electricity	Total
Eastern Transvaal	Domestic	3.96	0.29	0.00	1.88	6.13
	Commercial	1.13	0.06	0.00	0.78	1.97
	Industry	9.55	0.29	0.18	14.89	24.89
	Total	14.63	0.65	0.18	17.53	32.99
Western Cape	Domestic	0.22	1.46	0.00	9.74	11.42
	Commercial	1.06	0.59	0.00	4.73	6.38
	Industry	9.30	10.72	0.08	1.87	21.96
	Total	10.58	12.76	0.08	16.34	39.76
Gauteng	Domestic	29.03	3.59	0.20	21.06	53.88
	Commercial	27.54	0.10	0.75	24.06	52.14
	Industry	72.41	4.82	19.08	24.32	121.80
	Total	128.63	8.29	20.39	70.48	227.83
Natal	Domestic	2.76	2.57	0.00	7.27	12.59
	Commercial	0.94	0.08	0.00	3.85	4.87
	Industry	28.63	2.78	0.00	3.67	35.10
	Total	32.33	5.43	0.00	14.80	52.56
Total	Domestic	35.97	7.91	0.20	39.95	84.02
	Commercial	30.67	0.83	0.75	33.42	65.36
	Industry	119.89	18.61	19.34	44.75	203.75
	Total	186.17	27.13	20.65	119.15	353.14

C. Electricity costs and prices

One major advantage of South Africa's vast coal resource is an abundance of relatively low cost power generation facilities. The average price of electricity in the Gaunteng area is 4.3¢ per kWh and is expected to drop to 3.9¢ over the next few years.[2] These prices are considerably lower than prices in other countries. This provides a major competitive advantage for South Africa.

It is, however, important to keep in mind the technical and regulatory changes underway in the rest of the world. The efficiency of gas turbines has improved to the point that they are now being installed as base load facilities. In the United States, where natural gas is commonly available at prices from

[2]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper A: Southern African Gas Markets***, pp. 3-5.

$1.40 to $2.00 per Gj (and even less in Canada), electric power can now be generated at costs less than 2¢ per kWh. Electricity rates to industry are usually much higher, reflecting the embedded high-cost of nuclear power stations and "alternative energy" facilities mandated by regulatory authorities. The U.S. is, however, in the process of deregulating its power industry, based on the success of deregulation in the gas industry. This process will result in a significant drop in industrial power prices, not only in the U.S., but in other countries which will adopt similar policies. Moreover, gas turbines are now meeting much of the increase in power demand, in developing countries endowed with large deposits of natural gas.

The dramatic change in expected power generation costs is reflected in

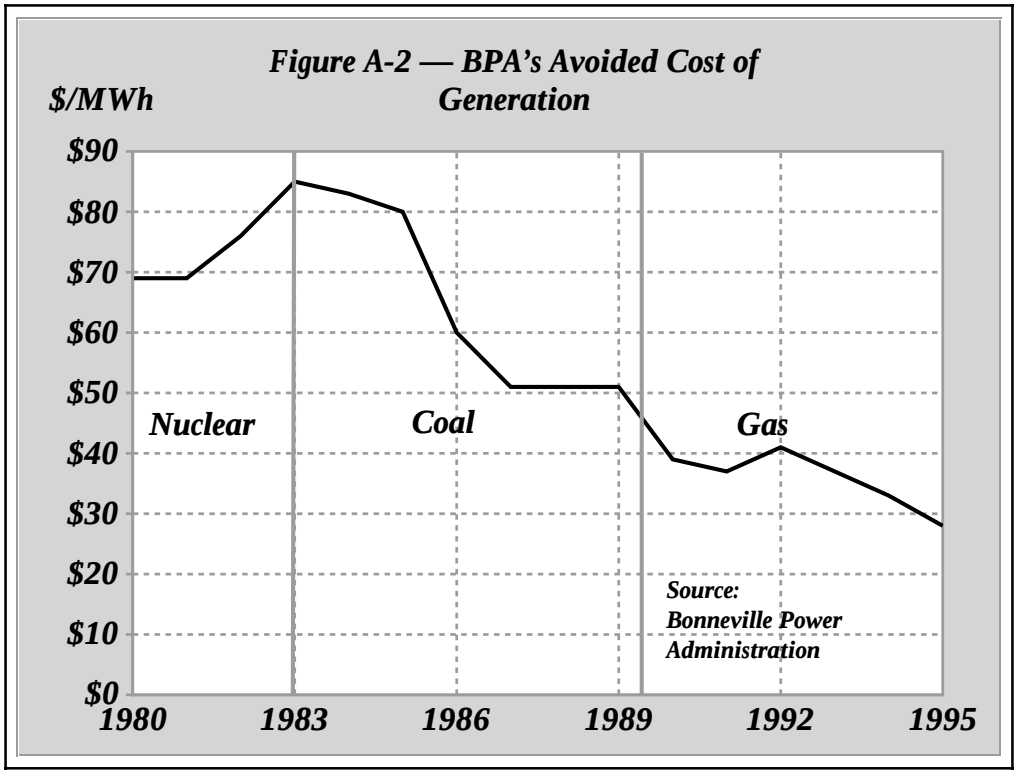


Figure A-2. These data were prepared by Bonneville Power Administration

(BPA).[3] (BPA's calculation of coal cost includes transportation.) BPA's wholesale rates are now down to 2.4¢ per kWh and still it is losing customers to more aggressive marketers.

In the U.S. and elsewhere, mine-mouth coal generation is still cost-competitive with gas generation if the deposits are close to the surface and of good quality. Coal power generation with modern facilities ought to be able to produce power at under 2¢ per kWh. Adding scrubbers to remove unwanted emissions costs about .5¢ per kWh. In addition there are technological improvements on the horizon. Substituting alternative fluids for water in the steam cycle may be able to improve efficiency by 10 to 15%.

South Africa has an estimated 40% surplus capacity in power generation. Much of this capacity is antiquated and would be expensive if brought on line. However, the SADC study estimated that the cost of new coal-fired generation would range from 1.7¢ to 3.1¢ per kWh, less than current costs.[4]

In view of South Africa's surplus generating capacity, the cost of new facilities, and increasing international competition, it is a mystery why the SADC study forecasted a 62.5% increase in real electricity rates from 1997 to 2008.[5]

D. Competition from petroleum products

The Republic of South Africa intends to deregulate the petroleum product industry.[6] Deregulation will consist of two parts: 1) elimination of tariff

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[3]BPA is a federal power marketing agency in the United States.

[4]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper A: Southern African Gas Markets***, pp. 4-40 to 4-43.

[5]Ibid, pp. 3-5.

[6]There is a debate about the length of time required to phase out the protection program, but a consensus has emerged that protection ought to be eliminated sooner or later.

protection for synthetic fuel oils and 2) elimination of product price controls and restrictions on marketing behavior.

Table A-3	Actual and forecasted heavy fuel oil prices from the SADC Study in $/Gj					
	Singapore	Landed Cost	Ex Local Depot		Bulk Contracts	
			Central PWV	Coastal	Central PWV	Coastal
Low Sulfur						
1994	$13.83	$18.18	$3.99	$3.46	$3.25	$2.73
1995	$15.22	$19.64	$4.21	$3.69	$3.48	$2.95
1996	$16.63	$21.17	$4.44	$3.92	$3.71	$3.18
1997	$17.64	$22.30	$4.61	$4.08	$3.87	$3.35
1998	$19.50	$24.30	$4.91	$4.38	$4.18	$3.65
1999	$20.37	$25.23	$5.06	$4.53	$4.32	$3.79
2000	$21.05	$25.97	$5.16	$4.64	$4.44	$3.90
2001	$20.74	$25.63	$5.11	$4.59	$4.38	$3.85
2002	$20.43	$25.30	$5.06	$4.54	$4.33	$3.80
2003	$20.13	$24.97	$5.01	$4.49	$4.28	$3.75
2004	$19.82	$24.63	$4.96	$4.44	$4.23	$3.70
2005	$19.51	$24.30	$4.91	$4.39	$4.18	$3.65
3% Sulfur						
1994	$10.15	$14.18	$3.39	$2.86	$2.65	$2.13
1995	$11.36	$15.51	$3.58	$3.06	$2.85	$2.33
1996	$12.41	$16.65	$3.75	$3.23	$3.02	$2.50
1997	$13.46	$17.78	$3.93	$3.40	$3.19	$2.67
1998	$14.86	$19.31	$4.15	$3.63	$3.42	$2.90
1999	$15.56	$20.04	$4.27	$3.74	$3.53	$3.01
2000	$16.26	$20.77	$4.38	$3.86	$3.65	$3.12
2001	$15.98	$20.51	$4.34	$3.81	$3.60	$3.08
2002	$15.70	$20.17	$4.29	$3.77	$3.56	$3.03
2003	$15.42	$19.91	$4.24	$3.72	$3.51	$2.99
2004	$15.14	$19.57	$4.20	$3.67	$3.47	$2.94
2005	$14.86	$19.31	$4.15	$3.63	$3.42	$2.90

The deregulation of the petroleum market will have substantial benefits for the South African economy. Not the least of those benefits will be a likely reduction in gasoline, diesel, and heavy fuel oil prices. Table A-3 provides a summary of actual and forecasted heavy fuel oil prices contained in the SADC study. Because of the regulatory program, the differential between Singapore free-market prices and the price of fuel oil on the South African coast and inland is unusually high. The program will take a number of years to phase out; during this period it is highly likely that distribution margins will compress, in step with

the elimination of tariff protection. The SADC study fails to account for this change in its projection. Moreover, it assumes that crude oil prices in the Gulf will rise from an average of around $14 to $15 per barrel in 1994 to $20 per barrel in 2005. (It is unclear whether or not they are referring to nominal or inflation adjusted U.S. dollar prices.) This is not a view of the future universally shared in the oil industry.

Table A-4

	Competitive Alternative Forecast of heavy fuel oil prices in $/Gj					
	Singapore	Landed	Ex Local Depot		Bulk Contracts	
		Cost	Central PWV	Coastal	Central PWV	Coastal
Low Sulfur						
1994	$13.83	$18.18	$3.98	$3.46	$3.25	$2.73
1995	$15.00	$19.35	$4.16	$3.64	$3.43	$2.91
1996	$15.00	$18.70	$4.06	$3.54	$3.33	$2.81
1997	$15.00	$18.02	$3.96	$3.44	$3.23	$2.71
1998	$15.00	$17.34	$3.85	$3.33	$3.12	$2.60
1999	$15.00	$16.66	$3.75	$3.23	$3.02	$2.50
2000	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
2001	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
2002	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
2003	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
2004	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
2005	$15.00	$16.00	$3.20	$2.90	$2.70	$2.40
3% Sulfur						
1994	$10.15	$14.18	$3.38	$2.86	$2.65	$2.13
1995	$13.50	$17.53	$3.88	$3.36	$3.15	$2.63
1996	$13.50	$16.91	$3.79	$3.27	$3.06	$2.54
1997	$13.50	$16.31	$3.70	$3.18	$2.97	$2.45
1998	$13.50	$15.71	$3.61	$3.09	$2.88	$2.36
1999	$13.50	$15.11	$3.52	$3.00	$2.79	$2.27
2000	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18
2001	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18
2002	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18
2003	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18
2004	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18
2005	$13.50	$14.50	$2.98	$2.68	$2.48	$2.18

Slightly different assumptions produce significantly different results. Assuming a much more modest rise in Singapore residual oil prices and a compression of margins in South Africa could easily result in heavy fuel prices much lower than those forecast. Table A-4 illustrates that high sulfur fuel oil

could sell for around $2 per Gj in the not too distant future. Under these assumptions, fuel oil would be cheaper than expected gas prices, but still more expensive than coal, at Richards Bay or other coastal destinations.

E. Africa's climate limits commercial and household demand for natural gas

Excepting the Cape Town area there is little or no demand for space heating in South Africa. Typically, there are only a few days per year in which space heating would be required. During this period temperatures drop rapidly in the evening, but rise to comfortable levels during the day. This climatic pattern, combined with abundant clear weather make solutions such as passive solar heating supplemented by wood or coal stoves far cheaper than the installation of gas or oil furnaces.

It is interesting to note that coal by the sack can be delivered throughout South Africa at prices that range from $1.90 to $3.71 per Gj. Coal stoves and furnaces are not particularly efficient and can create serious air pollution, but this energy source is incredibly cheap. Without government intervention gas will have a very difficult time penetrating the residential heating market.

F. Estimates of Gas Marketability

Various studies of the marketability of natural gas in South Africa have been made by Sasol and by Southern African Development Community (SADC). Both looked at the uses of gas for specific industrial processes. Despite differences in approach and assumptions they arrived at similar results with respect to initial primary demand and anchor projects.

Sasol conducted a market survey and contacted over 600 companies with total heat fuel consumption of 200 million Gj.[7] Eliminating potential customers not on viable distribution routes or facing other constraints, Sasol estimated a penetrable market of 65 million Gj per year. This corresponds closely with the SADC estimate of total coal and petroleum consumption in the industrial sector, 139 million Gj, in the regions likely to be served by gas. (See Table A-2.) The

[7]ENH, Sasol, and Pluspetrol, Pande Gas Project Information Brochure, p. 4.

SADC study identified eight potential projects within South Africa. Only four had an "affordable gas price" greater than $2.00 per Gj. The total volume of gas demand from these four projects amounted to 61 million Gj.[8]

The SADC study also analyzed gas transmission costs from both the Pande field in Mozambique and Kudu field in Namibia. Pipeline transportation costs varied from $1.09 to $1.94 per Gj, depending on location and flow rate. Unfortunately the viable projects and pipeline routings generally do not mesh. There is no obvious single anchor project of adequate size available to cover pipeline expenses. For example, the minimum pipeline size from Pande to Secunda is 65 million Gj, with an average cost of $1.83.

Gas-fired electricity generation is the motivating force in most gas development projects around the world. The positioning of large generators, over 1000 MW, is sufficient to justify a natural gas pipeline and other infrastructure investments. Once these large anchor projects are in place, other uses for natural gas emerge and the distribution network expands. In South Africa, however, there is no such demand for gas-fired generation. As discussed earlier, the combination of unused capacity and the opportunities for mine mouth coal production severely limit gas demand. The SADC study identified two potential generation projects at Richards Bay. Affordable gas prices were calculated at $.27 to $1.47, less than the average cost of transmitting the gas to the project.

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[8]Three projects were identified near Secunda: The first is the production of Direct Reduced Iron at Phalaborwa. SADC calculated that the Phalaborwa Mining Company could afford to pay up to $2.93 per Gj for 12 million Gj per year. The likely start up is in 1999. A second project is the conversion of the AECI ammonia plant at Modderfontein. According to SADC this plant could be converted to natural gas and could afford to pay up to $2.22 for 9.27 million Gj. The likely start up is in 1999. A third project concerns mineral beneficiation at Phalaborwa. Assuming reduced capital and operating expenses the project could afford to pay $3.04 per Gj for 25.7 million Gj per year. The likely start up is in 2002. A fourth project, iron reduction, is located at Richard's Bay. It could afford to pay $2.86 for 12 million Gj but would have the additional cost of moving the gas from Secunda to Richard's Bay. Its likely start up is in 1999.

In general, the development of the Kudu field and the transport of natural gas to the Saldanha Bay and the Cape Town area appears to be a much more attractive option than the import of Pande gas to Secunda or the Gauteng area. SADC calculated that the gas generation project at Saldanha Bay could afford to pay $1.84, while the likely cost of transport would range from $1.19 to $1.84, depending on flow rates. There is also an iron ore reduction project at Saldanha Bay, the possibility of gas-fired power generation at the Orange River in Namibia, and significant residential heat demand in Cape Town. No combination of projects appears as promising for Pande gas.

If an anchor project (or combination of projects) can be located, construction of one or more long-distance natural gas transmission pipelines will provide the basis for the broader development of South Africa's natural gas industry. The longer-term potential for this market, which would include the residential and commercial sectors, as well as small industrial customers is speculative. Sasol believes that there is a potential gas demand of 430 million GJ in the Republic of South Africa.[9] The SADC study projects a range of gas demand from 225 to 535 million Gj, excluding power generation and 271 million to 1028 million Gj including generation.[10]

In the opinion of the authors both Sasol and SADC have over-estimated potential gas demand. Sasol has underestimated the delivered cost of imported natural gas and the SADC study made a number of implicit and explicit assumptions which are internally inconsistent and contradictory.

A brief review of the SADC study's key assumptions is important both for understanding its forecast results and for framing the policy debate regarding the regulation of natural gas transmission and distribution in the Republic of South Africa, which is the main topic of this paper.

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[9]Speech by Wikus Kritzinger.

[10]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper A: Southern African Gas Markets***, pp. 6-11 to 6-14 and ***Paper H: Regional Benefits from Increased Gas Utilization,*** pp 2-4 to 2-5.

The SADC study offers two basic scenarios — "Policy Vacuum" and "Policy Creativity."

Policy Vacuum:
- Real economic growth of 2.5%;
- Primary (anchor project) gas prices $2.50 per Gj;
- Other gas prices, $3.30 per Gj at city gate;
- Constant relative energy prices.

Policy Creativity:
- Real economic growth of 4.0%;
- Primary (anchor project) gas prices $2.50 per Gj
- Other gas prices, $3.30 per Gj at city gate;
- SADC's "Forecasted" energy prices.

As noted earlier, the present relative price structure is almost certain to change as the petroleum product market is deregulated. All things equal, the price of gasoline, diesel, and fuel oil will be lower, not higher. This will likely result in reduced demand for natural gas in either of the two scenarios. The SADC study acknowledged this problem by noting: "Another uncertainty related to future energy prices is the possible consequences of a removal of the existing legislated fuel prices in South Africa. This could have an important impact on the attractiveness of gas. Analysis of such impacts have, however, been outside the scope of this SADC study."[11]

The energy price forecast assumptions of the "policy creativity" scenario are interesting. They include:

- An approximate 10% rise the real price of coal;
- From 1996 to 2008 a 62.5% increase in the real price of electricity;
- From 1994 to 2005 a 29% rise in real bulk fuel oil prices in the Gauteng area;
- Constant gas prices.

It is difficult to understand how such substantial energy price increases to industry and other energy consumers could be consistent with high economic

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[11]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper A: Southern African Gas Markets.***

growth. Moreover, in view of the world wide trend toward decreasing energy prices and compressed profit margins it is hard to understand how a competitive market could produce such a result. A deeper look at the report may provide the answer: "...a major fuel substitution from electricity to gas in existing industrial applications can only be expected if electricity prices rise in real terms (for example due to the introduction of an environmental tax);."[12] In short, the extraordinary difference in demand between the scenarios is produced by unrealistic differences in economic growth and unexplained policy initiatives to be taken by the Republic of South Africa that result in higher prices for competing fuels.

[12]SADC, ***Study of the Economics of Natural Gas Utilization in Southern Africa, Technical Paper H: Regional Benefits from Increased Gas Utilization,*** p. 3-2.