GAS INVESTMENT AND POWERSHIPS A LOSE-LOSE FOR SA ELECTRICITY SYSTEM

Under the guise of 'Risk Mitigation', the Department of Mineral Resources and Energy (DMRE) is pushing 20-year electricity supply contracts for South Africa (SA) to import Liquified Natural Gas (LNG). Note, that for transport beyond fixed pipelines, the fossil fuel known as natural gas is highly condensed at very low temperature to become a liquid, which then requires a regassification plant before it can be used. The 20-year contracts for 1 220 MW of electricity generation capacity, using combined-cycle gas turbines on powerships along with floating storage and regassification plants, **will increase the share of our energy that is imported and most likely result in more expensive electricity supply.**

The DMRE recognises that the cheapest generation options for SA use our extensive solar and wind resources[1], but ignores recent studies indicating that (due to on-going cost reduction through technology learning) renewable resources with battery storage, which provide dispatchable supply equivalent to gas-fired powerships, is increasingly cost competitive. While the future price of LNG is uncertain, the Council for Scientific and Industrial Research (CSIR) has concluded that battery price trends should allow renewables-plus-storage to displace combined-cycle gas turbines as the most cost-effective choice for SA.[2]

The Risk Mitigation Independent Power Producer Procurement Programme (RMI4P), initiated by the DMRE in December 2019 under its Independent Power Producers (IPP) Office, has the purported objective to reduce the risk of a constrained electricity system that needs load-shedding, by procuring "between 2000 – 3000 MWs of power generation capacity that can be grid connected in the shortest time at the least possible cost"[3].

It has become clear that the procurement of three projects by Karpowership (part of the Turkish Karadeniz Energy Group) is **part of an agenda in which the electricity system is used to justify and subsidise investment in a big gas programme.** As noted by Maduna Ngobeni, the IPP Office Chief Operating Officer: "Once we have FSRUs [regassification units] at the ports, we will have the opportunity to bring in LNG, and we can then start an engagement on how we can utilise these facilities, and the gas, in other sectors of the economy. So, I think this is a good start, with infrastructure that can be used as a stepping-stone for the country."[4]

High-Risk venture for the climate, economy, environment and safety

CSIR data shows that burning gas in combined-cycle turbines at the rate that is required under the RMI4P, from 05h00 to 21h30 (at a capacity factor of about 70%), will be more expensive than optimised system operation where storage is deployed and annual gas offtake is relatively low.[5] Further costs arise from gas in terms of pollution and the various risks associated with LNG supply chains, such as accidents or sabotage.

While the 20-year power purchase agreements (PPAs) being offered will require the same level of government guarantees as provided to renewable energy IPPs, the state will share the risk of gas price volatility, as the promised tariffs are indexed to the global LNG price, which is likely to rise over time. Carbon taxes are being introduced at an international level and pose additional risk of increased costs, and a rising number of investors will not finance gas projects.

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The RMI4P rules have resulted in suboptimal outcomes.

1. The gas- friendly tender has forced non-gas players to include additional components to their projects to fit this mould, which has pushed their price up, so the consumer will pay more than necessary. For example, Scatec had to oversize their solar PV (photovoltaic panels) by a factor of 10 to meet technical requirements but is not allowed to sell the excess power.[6]
2. Long-term use of powerships that are intended to be for short-term, emergency use.
3. Promoting a major gas industry, which is a climate and economic risk to SA.

The presidential economic advisory council has voiced concerns: "Instead of aiming to bring online the low-hanging fruit of short-lead-time, already developed and permitted renewable projects, the widely held view in the industry is that the 'emergency' power producer procurement programme request for proposals is 'extremely complicated' and appears to be specially written for more expensive power ships and gas-to-power projects, and to exclude competition from renewable projects,".[7]

Furthermore, **the need for the RMI4P remains questionable.** Proper energy planning and implementation in response to the onset of load-shedding 13 years ago would have averted the current supply short-fall; instead, shovel ready renewables projects have been put on hold for 5 years.[8] Even now, rapidly implementing the existing commitments to renewable energy procurement would bring more generation capacity on-line within two years than the RMI4P programme promises. Given the situation with Eskom, a tender of 2000MW is far less than needed to avert load shedding[9], but the national renewable energy programme remains side-lined.

While there is an urgent need to deal with the outcomes of the RMI4P, there is an equally pressing need for accountability and progressive action by DMRE in broader areas of the electricity system.

The dangers of over-investment in natural gas

1. Living in the Past

On 18th May 2021, the International Energy Agency reported that to reduce emissions as required to avert climate disaster (i.e. retain a chance of limiting average global warming to 1.5°C) **"there can be no new investments in oil, gas and coal, from now".**[10] On the same day, Minister of Mineral Resources and Energy, Gwede Mantashe, confirmed finalisation of Gas Amendment Bill to "unlock investment into the gas sector and facilitate the development of gas infrastructure".[11] Responsible investors and a growing number of countries are moving away from fossil fuels, including gas, and the socio-economic potential in SA's world-leading renewable energy is constrained only by those seeking to perpetuate the extractive practices of the 20th century.

Understanding any potential role for gas in the electricity sector requires a proper Integrated Energy Plan (IEP). The last drafts of both the IEP and the Gas Utilisation Master Plan were in 2016.[12] So **despite government's appetite for gas, there is no gas plan, and no evidence that gas expansion is prudent.** By contrast, European countries are trying to disinvest from existing gas infrastructure, let alone build more.[13]

2. Financial risk of natural gas increasing due to it climate change impacts.

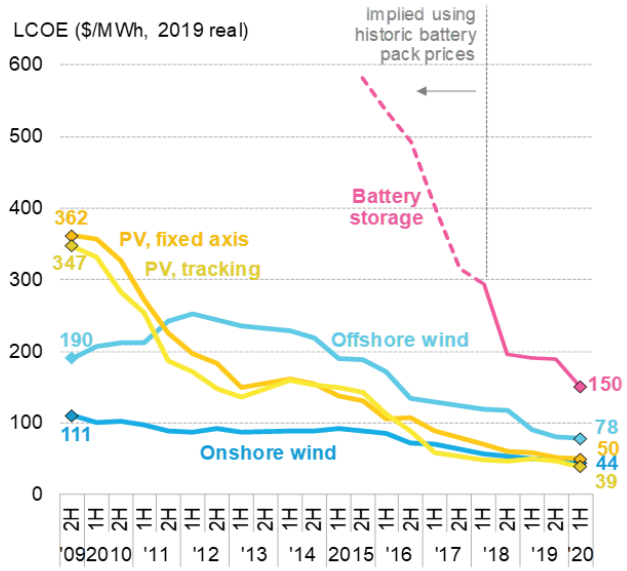
Burning natural gas to produce electricity releases about 50-60% the carbon dioxide compared to coal, which is the basis for claiming benefits regarding climate change[14]. However, gas is composed mainly of methane, which has a global warming potential about 85 times that of carbon dioxide over 20 years.[15] During extraction, piping and storage, methane can escape into the atmosphere. Recent improvements in monitoring show this fugitive methane has long been underestimated and **the gas industry contributes more to climate change than previously thought.**[16] In various cases gas can be worse for the climate than coal.[17] Also, these contracts were developed to meet a supply shortfall, so emissions should be compared not with coal but other options.

These climate risks translate to financial risks. Banks and pension funds are withdrawing huge amounts of money from existing fossil fuel projects.[18] Sweden even ditched Canadian bonds, as Canada was "not known for good climate work".[19] The International Gas Union indicated that most of the proposed LNG liquefaction plants worldwide are 'likely not to progress'[20], and Nedbank will no longer finance new gas exploration projects.[21]

3. Better and cheaper alternatives to natural gas are taking off.

Historically, gas has been the most affordable back-up for renewable energy (providing dispatchable electricity when there is insufficient sun and wind to meet demand), but this situation is changing.

Alternatives include various kinds of energy storage, with pumped-hydro already well-established in SA and battery development advancing rapidly. Building enough renewables and storage can provide sufficient electricity for SA and modelling by the CSIR in 2019 found that **batteries could displace gas turbines in SA assuming expected cost reduction in the future.**[22] Global energy storage deployment increased by 62% in 2020 alone.[23] Global benchmark prices for battery technologies have dropped *dramatically*,[24] as shown in the graph, with aggregate prices for electricity supply on the vertical axis. Actual costs of leading wind and solar technologies are shown from 2009, while the decline in battery storage is shown over the last 5 years.



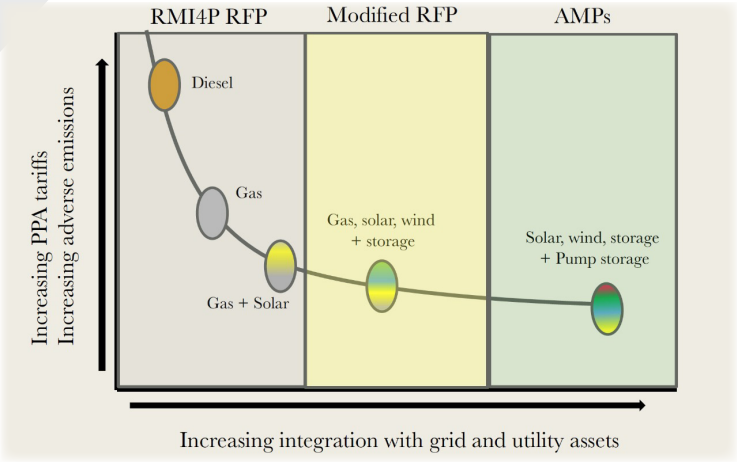
Levelised cost of Energy (LCOE) is a measure to compare electricity supply options, per unit of energy (MWh) that takes into account the full life cycle costs. Global benchmark LCOE in the graph are country weighted averages for utility scale capacity additions.
Source: BloombergNEF (Reference 24)

Another option is to pair variable renewable electricity generation with production of hydrogen, as a form of storage, or for production of liquid fuels. Electricity is used to split water molecules into oxygen and hydrogen, which can then be used to generate electricity, as in fuel cells, already used in large trucks. SA is well-positioned to be a major player in green hydrogen production and export. Mitsubishi Power and GE are converting existing natural gas power plants to run off hydrogen.[25]

Systems approach dramatically reduces electricity price.

Our national electricity utility should be managed as an integrated system, with full consideration of all the interconnected components of 1) electricity – generation (both big power plants and decentralised supply), 2) transmission, distribution and storage, and 3) demand side management, addressing consumer requirements, such as through energy efficiency, time-of-use tariffs and device controllers for geysers, lights etc.

An example of a systems approach that was developed in response to the RMI4P, called the Alternate Mitigation Plans (AMPs), has much better outcomes and lower tariffs.[26] The RMI4P rules prevent a systems approach by treating projects as 'islands' – from each other and from other resources within the system, such as Eskom's pumped storage dams. This results in higher tariffs being required in the PPAs (as shown on the vertical axis in the graphic) as the technology combinations in projects that can meet the technical requirements *in isolation* are more expensive. They are also more carbon intense, noted below as adverse emissions.



The more the system is used, the lower the electricity tariffs and climate impacts. RFP= request for proposals. In a Modified RFP, some of the RMI4P rules are changed to allow partial use of the system, but it is not not a full system approach like the AMPs.
No gas is required in the AMPs.
Source: AMPs webinar presentation, 8 October 2020 (Reference 26)

The weighted average tariff of the RMI4P preferred bidders, as represented in the box to the left, is **R1.60/kWh.**[27] When solar or wind can generate 'surplus' electricity - more than is required by the contract - they cannot sell it, and it will be wasted.

By contrast, where optimal interaction between all facilities within all new projects and all other existing system assets is allowed, as in the AMPs, then the tariff is **R0.61/kWh.**[28]

Such a programme will require some changes in regulations and Eskom transactions, but the concept clearly illustrates the massive benefits of moving in this systems direction. Urgent work should be done to better understand what changes are required to take advantage of a full systems approach and identify measures to start implementation. SA needs to get as much wind, solar and storage onto the system as fast as possible, in such a way that *in combination* they are dispatchable enough to avoid load shedding.

This AMP meets the RMI4P requirements to be dispatchable between 5h00 and 21h30 daily but has **62% cheaper tariffs, provides three times as much electricity and has no risk of fuel price volatility.** For economic recovery, it would require a fourfold increase in infrastructure spend and could create ten times as many jobs, with only a 15% higher treasury guarantee on the PPA than the RMI4P.[29]

Powerships deal is bad for South Africa.

The Karpowership bid is facing multiple legal, financial and environmental challenges, but three aspects of the PPAs alone are sufficient to show why it is unacceptable.

1. Contracts of 20 years for powerships are irrational.

- The RMI4P provides 20-year PPAs for *all* bidders, drawing upon the model developed for the renewable energy procurement process, which recognised that wind and solar power are desirable long-term components of a sustainable electricity system. For RMI4P projects to have 20-year contracts, the rules (such as sale of excess power, location of storage units and interaction between projects) should be adjusted so projects can be optimally designed and costed.
- Powerships are suited for a short-term, emergency measure when there are no alternatives – and a price premium is paid. For example, if electricity infrastructure is damaged by war or natural disaster, then the ships can quickly plug the supply gap until appropriate long-term solutions are implemented.[30] As mobile property of another country, they need to be treated differently to projects that build generation facilities in SA.
- Karpowership's current projects in 11 countries average 5.4 years (longest at 10 years).[31]

2. Gas price affects Karpowership electricity price.

- The PPA contains four payments components. Two cover making capacity available (like a doctor being on call) and two relate to running costs when power is dispatched. However, lack of transparency around the full Karpowership costs, which is another concern, makes detailed analysis impossible.[32]
- The main component of the costs of powership electricity supply is the imported LNG, but this price varies, and is passed onto the customer.[33]
  - This creates an **electricity tariff risk,** as the LNG prices may rise. Furthermore, imports are priced in U. S. dollars, so unfavourable exchange rates could further push up the cost in South African Rand.[34]
  - There is also a **security of supply risk** – as the world moves to lower carbon sources, and carbon taxes take effect, LNG may become less available at an affordable price.

3. Minimum Load Commitment.

- The PPA also ties Eskom into compensating an IPP **for at least 72.72% of the net available capacity during the dispatch period each contract year.** For gas this payment is linked to the fuel price.[35]
- In theory, Eskom dispatches from power plants in an optimal order, which is why the most expensive generators - peaker plants burning diesel - are last in line, only fired up when required to meet peak demand. However, this minimum load commitment rule means that **even if electricity from the powerships becomes more expensive, or is not required to meet demand, Eskom will still need to pay for the majority of what was potentially available, for 20 years.**
- In 2020 the CSIR modelled *least-cost* scenarios for electricity generation in SA, and running a gas fleet at capacity factors above 30% was never required.[36]
- Using gas at much higher capacity factors, as per RMI4P, will cost SA far more than necessary. A conservative estimate of this **unnecessary cost is a minimum of R63Bn over a 15-year period,** relative to other capacity as allocated by the Integrated Resource Plan. This assumes that there is merit in having the powerships as an 'emergency measure' for the first 5 years, otherwise the figure is R84Bn over 20 years.[37]

The trends highlighted in this paper demonstrate a trajectory of increasing risk for gas investment and decreasing need for gas in the electricity system.

The associated economic drivers of these trends mean that pursuing gas would likely increase electricity tariffs in the long term.

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