September 3, 2004

To: David Waskow, Friends of the Earth
From: Bill Powers and Richard Kamp, E-Tech International

Dear David:

The attached report from E-Tech responds to FOE’s request to conduct a credible overview of the West African Gas Pipeline and the Bonny Island LNG plant as credible paths to reduce and/or eliminate Nigerian gas flaring, per the current commitments to do so by 2008. We have made every effort to base our assessment on: 1) published information, 2) interviews industry representatives and consultants, and 3) World Bank staff including the project manager of the Nigeria Strategic Gas Plan (February 2004) and the Global Gas Flaring Reduction team leader. Due primarily to interviewee August vacation schedules some of the interviews were not completed until September 1.

We hope this report is of use in addressing concrete investment issues, such as the potential OPIC involvement in the project. Do not hesitate to call Bill Powers at 619-295-2072 (619-917-2941 cell) and myself, at 505-983-4642 or 505-670-1337 cell.

Sincerely

[Signature]

Bill Powers, P.E.
Assessment of West Africa Gas Pipeline and Nigeria LNG as Credible Paths to Reduce/Eliminate Niger Delta Flare Emissions

September 3, 2004

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1. **Executive Summary**

As much as 2.5 billion cubic feet per day (Bcfd) of associated gas (AG) is currently flared in the Niger Delta region. This flaring produces more greenhouse gases than all of sub-Sahara Africa combined, as well as pollutants hazardous to human health, from a relatively small area. Nigeria has established a policy to terminate AG flaring by 2008. However this commitment has been met with some skepticism by many stakeholders. The proposed West African Gas Pipeline (WAGP) would transport Nigerian gas to Togo, Benin, and Ghana. According to industry and World Bank sources, the WAGP appears to be on schedule to be operational no later than early 2006. Proponents of WAGP have argued that the pipeline, along with the operation of the existing Bonny Island Liquefied Natural Gas (LNG) plant, will play a major role in reducing AG flaring in Nigeria. To assess the role of the WAGP in reducing AG flaring, E-Tech International: 1) reviewed published information on current flaring practices in Nigeria and options available to eliminate flaring by 2008, 2) interviewed industry representatives and consultants familiar with flaring reduction options, and 3) interviewed World Bank staff including the project manager of the Nigeria Strategic Gas Plan (February 2004) and the Global Gas Flaring Reduction team leader regarding the Bank’s position. E-Tech’s recommendations based on this assessment are:

- Gas transported in the WAGP must be AG.

- A prohibition against flaring AG in new projects must be condition of a WB or OPIC loan to WAGP.

- WAGP owners must provide a written commitment and an enforceable plan to end flaring, whether or not directly connected with the WAGP, prior to funding. Funding disbursement should be linked to gas-flaring elimination by 2008.

- WAGP owners must submit an enforceable and independent auditing and monitoring plan to ensure that gas flaring will be ended by 2008 to OPIC and WB. Funding disbursement for WAGP should be linked to this plan.

- Feasible gas flaring market driven penalties should be developed that make routine flaring of AG economically unattractive to producers.

- Claims by producers that AG reinjection projects are uneconomical as a rationale for delay are unacceptable. Gas gathering and reinjection projects should be judged economically as an integral component of the oil project producing the AG when evaluating the cost of such projects.
2. Background - Massive Flaring of Associated Gas in Niger Delta

Nigeria presently has more than 250 oil and gas fields of which some 120 fields are producing.\(^1\) The production industry is centered in the Niger Delta region of the country. Nigeria’s proven reserves stand at over 32 billion barrels of oil from its onshore, proximal, deep and ultra-deep offshore areas. The country has proven natural gas reserves 124 trillion cubic feet (Tcf) with recoverable gas reserves of 45 Tcf ranking Nigeria as the ninth largest producer in the world. Current oil company projections show an increase in the oil production level from the current level of approximately 2 million barrels per day (mbpd) to 3 mbpd by 2010.\(^2\)

Most of the current oil and gas exploration in Nigeria is focused offshore. Fifty-seven percent of Nigeria’s gas production, or 2.6 billion cubic feet per day (Bcfd) is from offshore wells.\(^3\) Ninety percent of the discoveries made in the last five years have been offshore, and nearly half of these have been in deep water.\(^4\)

The Nigerian government has instructed all oil producers that gas flaring, which is the source of more greenhouse gas emissions than all of sub-Sahara Africa combined and a major source of carcinogenic benzene, lung irritants NO\(_x\), SO\(_x\), H\(_2\)S, and ozone, must cease by 2008.\(^5\) In 2000 Nigerian gas production amounted to around 4.6 Bcfd with as much as approximately 55 percent being flared or as high as 2.5 Bcfd, and the balance split between reinjection, NLNG feedstock, internal fuel usage, and a small percentage marketed as liquefied petroleum gas (LPG).\(^6\) The Nigerian government estimates that the flaring of 2.5 Bcfd represents an economic loss of $2.5 billion/yr.

3. Status of Oil Company Progress Toward Ending Flaring

Five oil companies produce virtually all of Nigeria’s oil and gas production. The oil and gas production rates of these companies, and quantity of AG flared, are shown in Table 1.

\(^{3}\) Ibid, p. 29.
\(^{4}\) Ibid, p. 25.
\(^{5}\) Ibid, p. 57.
\(^{6}\) Ibid, p. 13.
Table 1. Oil and Gas Production Rates of Oil Majors in Nigeria\(^a\)

<table>
<thead>
<tr>
<th>Company</th>
<th>Oil output (bpd)</th>
<th>Total gas output (mmcfd)</th>
<th>AG total (mmcfd)</th>
<th>AG sold/reinjected (mmcfd)</th>
<th>AG flared (mmcfd)</th>
<th>Estimated supply allocation to NLNG (mmcfd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell Petroleum Development Co.</td>
<td>950,000</td>
<td>1,900</td>
<td>1,600</td>
<td>200(^b)</td>
<td>700(^b)</td>
<td>700(^{fg})</td>
</tr>
<tr>
<td>ChevronTexaco Nigeria</td>
<td>500,000</td>
<td>800</td>
<td>800</td>
<td>285(^c)</td>
<td>515</td>
<td>0</td>
</tr>
<tr>
<td>ExxonMobil Nigeria</td>
<td>500,000</td>
<td>1,200</td>
<td>740</td>
<td>0</td>
<td>740(^d)</td>
<td>0</td>
</tr>
<tr>
<td>Nigerian Agip Oil Co. (NAOC)</td>
<td>120,000</td>
<td>1,000</td>
<td>460</td>
<td>?</td>
<td>?</td>
<td>390(^f)</td>
</tr>
<tr>
<td>Elf/Total</td>
<td>120,000</td>
<td>400</td>
<td>175</td>
<td>?</td>
<td>?</td>
<td>260(^f)</td>
</tr>
</tbody>
</table>


Note (d): ExxonMobil will complete $1.7 billion enhanced oil recovery gas reinjection project in 2006 that will eliminate flaring from its Nigeria operations. Source: Alexander’s Gas & Oil Connections, Vol. 8, Issue 15 - Friday, August 8, 2003.

Note (e): NAOC states it is only selling 10 mmcfd equivalent from its natural gas liquids (NGL) plant, 40% of production, and flaring the remaining 15 mmcfd due to lack of local markets. Alexander’s Oil & Gas Connections, *Nigerian Agip seeks export market for gas to end flarings*, Vol. 6, Issue #22 – Wednesday, November 21, 2001, [www.gasandoil.com/goe/company/cnal4712.htm](http://www.gasandoil.com/goe/company/cnal4712.htm).

Note (f): NLNG currently has the capacity to process up to 1,300 mmcfd (Trains 1, 2, and 3). Shell owns half of the joint venture component owned by producing oil companies (Shell, NAOC, Elf/Total) and could be expected to provide at least 50% of the gas supply to NLNG. 50% of NLNG capacity is currently ~650 mmcfd, and will rise to 1,300 mmcfd when Trains 4 and 5 come online in 2005/06.

Note (g) The *Nigeria Strategic Gas Plan*, Table A.3.3, indicates only 300 mmcfd of Shell’s total estimated gas production in 2002 is non-AG. This 300 mmcfd production is equally split between East and West onshore production fields. However, the 2003 Shell Nigeria annual report indicates Shell sold nearly 1,000 mmcfd of non-AG. There is a discrepancy in one or both of the data sets.

Shell completed the Offshore Gas Gathering System (OGGS) to supply AG to the NLNG plant in December 2003. According to Shell, the commissioning of the OGGS will facilitate getting offshore AG to the NLNG plant.

An August 30, 2004 article titled “Shell Plans $9bn Five-Year Investment” states: 7

*Mr. Chris Finlayson will assume the position of Chief Executive Officer of Shell Exploration and Production (Shell EP) in Africa with effect from October 1, 2004. He will be succeeded as head of the Nigerian operations by Mr. Basil Omiyi, a Nigerian. According to Finlayson, oil and gas production remains the heart of the company's business. "The aspirations of the Federal Government and the current favourable oil price environment both represent unique opportunities for the industry to grow," he said. Projects that will benefit from the investment include, the NLNG Train Six, Soku gas plant expansion, Offshore Gas Gathering System (OGGS) and the Bonga Southwest deepwater field with capacity of 145,000 barrels per day (bpd).*

Also speaking at the occasion, the SPDC managing director designate, Omiyi, said he would on assumption of duty on September 1, this year, be leading a new team that would deliver on Shell’s commitment as operator of the NNPC/Shell/Total/Agip Joint Venture. The immediate focus of the team, according to Omiyi, will be to reposition the business to be able to deliver real value to stakeholders, achieve a gas flare down by 2008, pay more attention to sustainable community development and work closely with the government to eradicate criminality in the oil producing areas, especially oil theft. Shell said it was currently losing on the average, 50,000 barrels per day (bpd) to crude theft. "We will therefore continue to depend on governments at local, state and federal levels, as well as community leaders to address the situation. "The challenges posed by SPDC’s importance to the national economy and the sensitivities surrounding oil and gas production mean there has never been and would never be a dull moment for us," he said.

Essentially all of ChevronTexaco’s operations producing significant amounts of AG are in the West, onshore and offshore, in the Escravos region. ChevronTexaco has installed a gas gathering system to provide AG to its gas processing facilities at Escravos (See Figure 2). ChevronTexaco produces approximately 800 mmcf/d of AG and processes 300 mmcf/d of this amount at the Escravos Gas Project (EGP). The second phase of the EGP (EGP-2) added 135 mmcf/d of gas processing capacity and started operation in 2000. The stated purpose of EGP-2 is to provide export gas to Benin, Togo, and Ghana through the West Africa Gas Pipeline (WAGP). It is unclear whether EGP-2 is actually processing gas at this time given the WAGP has not yet been built. A planned EGP-3 expansion will add an additional 395 mmcf/d of AG processing capacity and is scheduled for completion by late 2007. Total EGP AG processing capability will be 680 mmcf/d when EGP-3 is completed. The company plans to construct the 35,000 bpd Escravos gas-to-liquids (GTL) project adjacent to the EGP plant. The GTL plant will use synfuels conversion technology to produce ultra low sulfur diesel fuel and naphtha for sale to Europe and the U.S. Start-up is currently slated for 2007. The stated purpose of the EGP-3 project is to provide gas to the WAGP and GTL projects. Clearly the 140 mmcf/d initial flow in the WAGP would have to come from EGP-2 if the WAGP does come online in 2005.

ChevronTexaco would appear to have nearly enough productive outlets for its current production of 800 mmcf/d of AG by late 2007 if the WAGP, EGP-3, and the GTL project are developed on schedule. However, the ChevronTexaco presentation given at the World Bank International Gas Flaring Conference in May 2004 appears to show the company reducing AG flaring in Nigeria by only 30 percent or so from 2003 to 2008. Considerable flaring of AG continues out to 2019 and beyond. It would appear that ChevronTexaco will not meet the 2008 flare out target date based on the presentation. ChevronTexaco has also suggested that using non-AG might be a more profitable approach than AG in the WAGP, potentially undercutting a primary stated goal of the WAGP (convert flared AG to powerplant fuel).

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9 ChevronTexaco GTL project website, http://www.sasolchevron.com/escravos_project.htm
Most of ExxonMobil’s production is from shallow water offshore fields. ExxonMobil has indicated it is on schedule to end flaring in 2006.

Elf/Total indicates the consortium will reinject all AG not immediately saleable to the NLNG plant from the consortium’s new offshore Amenam field in 2003, and will reinject AG that is currently being flared in the adjacent Ofon and Odudu fields in 2005.

NAOC has installed gas gathering systems for two production areas (Oshie and Ebocha) to supply AG to the NLNG plant. NAOC currently provides up to 76 mmcf/d to the NLNG plant. The joint venture has installed an AG reinjection system to enhance oil recovery at its Obiafu-Obrikom field. NAOC is also constructing the Kwale Region 480 MW power plant, expected to utilize approximately 75 mmcf/d of AG starting in 2005.

All five companies/joint ventures shown in Table 1 have stated verbally to the World Bank their commitment that there will be no routine flaring in any new oil or gas fields they develop in Nigeria.

We can conclude at this time that the five major players in Nigeria are generally on track to have the tools in place to eliminate flaring of AG by 2008. However, the information available for ChevronTexaco is contradictory. The company should have sufficient AG processing assets in place by 2007 to utilize virtually all AG that is currently being flared, yet current information available from the company seems to indicate ChevronTexaco Nigeria will reduce AG flaring by 30 percent over current levels. The company also suggests that use of non-AG in the WAGP may be a more financial attractive approach. Clearly ChevronTexaco needs to make an unambiguous statement that it will adhere to the 2008 flare out target date and non-AG will be used in the WAGP pipeline only after all AG currently being flared by the company is being utilized.

4. West Africa Gas Pipeline and Its Relationship to Flaring

The WAGP is expected to begin construction in late 2004 and be operational in late 2005. This schedule presumes that international lending institution loans and guarantees are successfully closed in the fall of 2004. This project has been in development for over 20 years. The Economic Community of West African States proposed the development of a natural gas pipeline throughout West Africa in 1982. A feasibility report, prepared for the World Bank in the early 1990’s, concluded that a pipeline to transport Nigerian natural gas to Benin, Togo, and

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12 http://www.nigerianoil-gas.com/upstream/joint_venture_companies.htm#MOBIL
15 Ibid.
Ghana was commercially viable. The report's conclusion was based on the ChevronTexaco’s AG\textsuperscript{18} reserves in Nigeria's Escravos region. Figure 1 shows the proposed route of the WAGP.

Nigeria, Benin, Togo, and Ghana signed an agreement on the implementation of the WAGP in February 2003. The treaty, which is for a 20-year period, provides for a comprehensive legal, fiscal and regulatory framework, as well as a single authority for the implementation of the project. The WAGP partners are ChevronTexaco, Nigeria National Petroleum Company (NNPC), Shell, Ghana's Volta River Authority, and SoBeGaz (Benin) and SoToGaz (Togo).

The WAGP will traverse 620 miles (1,033 kilometers) both on and offshore from Nigeria's Niger Delta region to its final planned terminus in Ghana. The first portion of the pipeline, which will deliver gas to the greater Lagos area, is already in existence. The Escravos-Lagos Pipeline (ELP) was commissioned in 1989, supplying natural gas to Nigeria's Egbin power plant and other industrial consumers in Lagos and Ogun States. ELP has a capacity to handle nearly 900 million cubic feet per day (mmcmd) of natural gas, but currently the majority of this capacity is not utilized. Gas deliveries are expected to increase to 150 mmcmd in 2007, to 210 mmcmd in 7 years and be at 400 mmcmd when the pipeline is functioning at its capacity approximately 15 years after construction.\textsuperscript{19}

The project has been promoted as a way to put some of the AG currently being flared in the Niger Delta to productive use. "The concept for the WAGP was developed in an attempt to reduce such flaring and identify regional markets where the natural gas could be used to promote environmentally responsible industrial growth."

In reality only a relatively modest amount of AG will be transported in the pipeline by the 2008 flare out target date, 150 mmcmd\textsuperscript{21} or approximately 5 to 10 percent of total AG being flared in Nigeria. The target market is approximately 700 MW of kerosene and crude oil fired power plants in Ghana, Togo, and Benin. It is also not clear whether the consortium building the WAGP is bound to utilize at least this quantity of AG in the WAGP or whether non-AG from new gas fields might substitute for the AG.

5. WAGP Economic/Social Impacts Outside of Nigeria

There are no written compacts stating that the WAGP will use AG as a first priority.\textsuperscript{22} However, it is the understanding of the World Bank that this is the case. It is likely that the WAGP gas would be at least cost-competitive with the current practice of burning kerosene or crude oil in existing power stations in Ghana, Togo, and Benin, and far cleaner from an air emissions standpoint.

\begin{itemize}
  \item \textsuperscript{18} Associated gas means gas produced as a byproduct in oil production fields. Non-associated gas refers to hydrocarbon reservoirs that contain only gas and no oil.
  \item \textsuperscript{19} U.S. DOE Energy Information Administration, \textit{West Africa Gas Pipeline (WAGP) Project}, \url{www.eia.doe.gov}, March 2003.
  \item \textsuperscript{21} Ibid, p. 47.
  \item \textsuperscript{22} Telephone conversation between Bill Powers and Mourad Belguedj of World Bank, September 1, 2004.
\end{itemize}
However, the assertion that the WAGP will reduce desertification caused by firewood gathering, which assumes Ghanaians will use electric power for home needs when the power is produced from gas at a base cost presumably in the range of $2 to $3 per million British thermal units (MMBtu), has not been addressed in the WAGP EIA. It is hard to imagine how the predominantly poor citizens could pay for this power as a substitute for continuing to deforest and burn any freely available combustible material, continuing to degrade Ghana’s environment. According to the Netherlands Commission for Environmental Impact Assessment analysis of the WAGP impacts on Ghana to J A Allotey, Executive Director of the Ghana Environmental Protection Agency: “...at the national level: how does the WAGP relate to the energy planning and distribution in Ghana, how can the people of Ghana benefit from WAGP, how are social benefits claimed by the WAGP reflected in the Ghana Poverty Reduction Strategy or can they be integrated? Will the WAGP cause induced development, what kind of foreseeable new developments should be anticipated?”

Ghana’s Energy Commission’s Executive Secretary recently expressed great skepticism that his nation could afford the gas from WAGP and requesting that current investments in the pipeline be postponed for six months due to the belief that current pipeline investment plans are damaging to Ghana.

6. Nigeria LNG Bonny Island

The Nigeria Liquefied Natural Gas (NLNG) liquefaction plant at Bonny Island began operation in September 1999, consisting of two liquefaction trains (Trains 1 and 2), with the capacity to consume approximately 1 bcfd of gas. Train 3 came online in 2003, adding an additional 500 to 600 mmcf/d of gas demand. The NLNG plant is the primary productive AG use option for NLNG joint venture partners Shell, NAOC, and Elf/Total at this time. The Bonny Island facility is on schedule to add to additional liquefaction trains, Trains 4 and 5, in the 2005/2006 timeframe that will increase total gas consumption capacity to approximately 2.5 bcfd. Shell is the principal supplier of gas to the NLNG project, accounting for up to 50 percent of NLNG gas supply. Elf/Total and NAOC supply up to 30 percent and 20 percent, respectively. A sixth train may ultimately be added by Shell toward the end the decade, which would further increase gas demand by up to an additional 600 mmcf/d. A sixth train may be added by the end of the decade. Industry analysts indicate that the six LNG trains is the maximum the Bonny Island facility can support due to capacity of the harbor to handle LNG tanker shipping.

A legal advisor familiar with the WAGP project indicates that current AG being flared in Nigeria is in the range of 1.8 Bcf/d, considerably less than the 2.5 Bcf/d estimates for the 2001 – 2002

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25 Comments of Kofi Asante, Executive Secretary of the Ghana Energy Commission, Accra Mail, August 20, 2004
Train 3 is now online at the Bonny Island NLNG plant and has the capacity to process 500 to 600 mmcfd of AG and came online in 2003. That may account for the discrepancy in "amount of gas flared" estimates, as the 2.5 mmcfd estimate uses a base year that predates the startup of Train 3.

**7. West Africa Power Pool**

A project that would directly compete/complement the WAGP is the West Africa Power Pool (WAPP) and transmission project. The WAPP concept envisions building power plants in Nigeria to supply neighboring countries via transmission lines. Nigeria already supplies power to Niger on a continuous basis, and periodically supplies power to Togo and Benin. The WAPP is in a conceptual stage at this point in time.

Building power plants in Nigeria with transmission lines to WAGP countries would appear to provide the same air quality and AG usage benefits as the WAGP. Associated gas from Nigerian oil production fields would be used as fuel in Nigerian power plants serving the region, displacing diesel and heavy oil used in existing regional power plants.

It is not known whether constructing a major transmission line from Nigeria to Ghana through Benin and Togo would present a greater environmental impact than the WAGP.

The U.S. AID website provides the following description of the WAPP:

*The West African Power Pool is an ambitious project initiated by ECOWAS Energy Ministers and championed by the ECOWAS Department of Infrastructure to provide a reliable and competitively-priced supply of energy in response to this long-acknowledged impediment to regional economic growth and competitiveness. The project also aims to increase the trade in energy amongst member states and to promote foreign investment in the sector. The WAPP is now an ECOWAS priority project for the New Partnership for African Development (NEPAD).*

*A key achievement was the signing of the ECOWAS Energy Protocol by Heads of State in December, 2003. The Energy Protocol calls for the swift elimination of cross-border barriers to trade in energy, and encourages investment in the energy sector by providing for investor friendly terms as international arbitration for dispute resolution, repatriation of profits, protection against expropriation of assets, and other terms considered attractive by energy sector firms and investment bankers. With respect to electric power sector, the Protocol provides open and non-discriminatory access to power generation sources and transmission facilities. The Protocol envisions an enforcement mechanism comprised of the Energy Ministers of the Member States, which will be administratively supported in its functions by the ECOWAS Secretariat.*

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28 E-mail from Martin Byrnes to Bill Powers, August 30, 2004.
29 Ibid, p. 80.
8. Relative Merits: WAGP versus WAPP

A legal consultant familiar with both the WAGP and WAPP projects, Martin Byrnes, gives the following assessment of their relative merits.\textsuperscript{32}

If power was transmitted instead of gas, then the initial customers of the WAGP (the existing power stations) would be forced to continue to burn liquid fuels, thus losing significant environmental benefits from WAGP. There will be over 700 MW of installed capacity which would be forced to continue to burn crude oil and jet fuel, which would have a serious financial as well as environmental impact.

There really is no environmental controversy surrounding the WAGP pipeline itself. The controversy is about the fact that it is taking gas from the Niger Delta, which is inherently controversial. That wouldn't change if new power stations were constructed in Nigeria for generation of power for the region, i.e. the same quantity of gas (in fact more, because of transmission line losses) would still have to be produced and taken from the Niger Delta and used as fuel for those stations. All the present controversy and more would still be there.

Running power lines onshore might actually cause more environmental issues than the WAGP pipeline, with less benefits. An offshore pipeline has very little environmental impact at all.

Finally, I think it would be naive for anyone to think that the electricity transmission system alternative would be politically acceptable to the other governments, or that the necessary power pool lines would be likely to be constructed in any kind of short or medium term timeframe. WAGP has a huge advantage - it is a real project, with real sponsors with real money which they are willing to spend on the WAGP today. There is no commercial sponsor of the power pool, no-one willing to spend money who is championing it and making it happen, no-one poised to build it. At the moment the power pool is no more than an idea, with huge challenges to address and overcome before it could ever seriously be contemplated (such as the difficult issue of how it should be controlled and regulated).

Any suggestion that WAGP should not be supported in favour of power transmission lines could easily lead to a situation where nothing at all gets built, certainly not in the short or medium term, and the people of the region (and the environment) would be the losers.

The project manager for the World Bank’s Nigeria Strategic Gas Plan, Mr. Mourad Belguedj, indicates the onshore portion of the WAGP is only about 15 miles long and will be underground.\textsuperscript{33} Mr. Byrnes indicates this onshore portion follows an existing Shell pipeline easement for two-thirds of its length, presenting no relocation issues, and the balance is through an unpopulated area that is primarily swamp.\textsuperscript{34} From that point on the pipeline route is offshore.

\textsuperscript{32} E-mail from Martin Byrnes to Bill Powers, September 1, 2004.
\textsuperscript{33} Telephone conversation between Bill Powers and Mourad Belguedj of World Bank, September 1, 2004.
\textsuperscript{34} E-mail from Martin Byrnes to Bill Powers, September 2, 2004.
It should be noted that Mr. Byrnes perspective on the impact of the WAGP route on existing populations is contested by NGO’s in Nigeria.

9. Financing AG Gathering Systems

The Government of Nigeria is looking at the available options for constructing a domestic natural gas trunkline system. The preliminary cost estimate to build a 3 Bcfd truckline to major urban centers throughout the country is approximately $3 billion. Increasing the capacity to 5 Bcfd increases the cost to approximately $5 billion. Although all parties are in agreement that a domestic truckline gas transmission system is necessary for further development, the possibility of a Return On Investment (ROI) for such a project is highly problematic at this time. In contrast, the private partners in the WAGP feel that a reasonable ROI is possible.

It is important to note that producing oil in Nigeria is a highly profitable business. Investors can make a 20 to 25 percent ROI at oil prices as low as $7.50 per barrel (bbl), due to highly favorable Nigerian government fiscal policies. The North Sea Brent spot oil price has averaged well over $30/bbl for the past year and is expected to remain high for the foreseeable future. Shell, ExxonMobil, and ChevronTexaco are reporting either record or very high corporate profits due to the current run-up in oil and gas prices, with spot oil prices now over $40/bbl. These three oil companies account for approximately 90 percent of Nigeria’s current oil production of slightly more than 2 million barrels per day. The current financial climate in the oil production industry is succinctly summarized in the following news article excerpt:

Exxon Mobil, for instance, earned a profit of more than $10 on each barrel of oil it produced, said Pat Mulva, the company’s director of investor relations. Mark Baxter, director of an energy institute at Southern Methodist University (Dallas, Texas), said pump prices should be even higher, given that crude is hovering near $43 a barrel. "These profits probably appear gross, and consumers wonder why they're not lowering the prices," Baxter said. "They could do that, but the first time they did, the CEO would get fired." Baxter said oil companies need to make profits while the getting is good to carry them through times of low prices oil was $10 a barrel a few years ago and to take risks to explore around the world.

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39 abcNEWS.com, Oil Prices Boost Exxon Mobil, Shell – ExxonMobil Posts Record Profits, Shell’s Earnings Rise 54 Percent on Higher Oil Prices, July 29, 2004.
41 Which companies dominate Nigeria’s upstream oil industry and is the trend likely to change? http://www.petroinfonigeria.com/faq.html, January 2004.
42 abcNEWS.com, Oil Prices Boost Exxon Mobil, Shell – ExxonMobil Posts Record Profits, Shell’s Earnings Rise 54 Percent on Higher Oil Prices, July 29, 2004.
Apparently even at spot prices as low as $10/bbl oil producers in Nigeria can generate strong profits from existing production fields.

Reinjection is a readily available alternative to end flaring. However reinjection is generally less attractive financially than an immediate productive use unless the gas is reinjected to enhance oil production. The profitability of Nigeria oil production operations is relevant to ensuring these operations have the capital to invest in gas gathering and processing infrastructure. The World Bank recommends that “integrated economics” by used to evaluate the financial performance of a gas project based on the combined costs and revenues associated with both oil and gas production.43 Gas reinjection projects tend to be relatively low value projects when evaluated on a stand-alone basis, primarily because all the capital investment takes place initially and the gas is not monetized until some point in the distant future. However, integrating the capital expenses of the gas system into the associated oil project has only a slight negative impact on the economics of the oil project. What this means in simple terms is that the profitability of an integrated oil and gas project has economics that are nearly as attractive as the oil project alone.

Guide 60: Upstream Petroleum Industry Flaring, Incinerating, and Venting Guidelines, developed by the Alberta Energy and Utilities Board (draft, December 2002), simply requires that the gas component break even economically (Section 2.7), reflecting the relatively small impact of gas gathering and reinjection infrastructure investment on integrated oil and gas project economics. Guide 60 is provided as Attachment 1 to this letter report. In Nigeria, however, the magnitude of the lost opportunity cost of the flared gas and the major attendant environmental impacts of flaring militate for industry bearing the cost to end AG flaring by the 2008 target date whether or not the AG gas projects are economically attractive in isolation.

10. Drivers to Eliminate Flaring in Niger Delta by 2008

10.1 Nigeria government policy

Apparently the oil industry is seeking clearer guidance from the Nigerian government in meeting the 2008 zero flaring deadline and it is trying to guess true government intentions as meaning business this time or just another down the road deadline that the current government would not live to see.44 The World Bank recommends the Nigerian government make clear that it will no longer approve, starting immediately, any oil field development that includes any gas flaring possibility or does not include AG processing and monetizing.45

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10.2 Lending institution pressure

A recent World Bank mission to Nigeria provided feedback to the government on steps being taken to end gas flaring by 2008. The mission recommended that all AG must either be reinjected in producing or depleted reservoirs if no immediate outlet is available for the AG.46

A number of major international lending institutions, including the World Bank, Overseas Private Investment Corporation (OPIC), the European Investment Bank, and the U.S. Export-Import Bank, have expressed interest in the WAGP.47 Flare reduction and clean fuel usage are major investment selling points, given the WAGP is being advertised as a project that will displace oil combustion with clean natural gas in Togo, Benin, y Ghana, and reduce flaring in Nigeria.

10.3 Tax Imposed on AG Being Flared

The Nigeria government approach to resolving the flaring problem over the years has been to impose progressively stiffer penalties on producers for every unit volume of gas flared. The result was a modest 4 to 5 percent growth in AG utilization.48 The “flare tax” as a stand alone tool represented little progress toward elimination flaring.

In accordance with the Associated Gas Reinjection Act of 1979, a fee is charged for flaring. At November 2003 exchange rates the fee is equivalent to $0.076 per mcf. It is worthwhile noting that in recent years oil companies in Nigeria have been charged a total of between $150,000-$370,000 annually for flaring associated gas. This is a small sum relative to the value of the gas being flared. A recent study carried out for the Bureau of Public Enterprises of Nigeria estimated that each year the country loses between $500 million and $2.5 billion to gas flaring.49

11. Impediments to Eliminating Flaring in Niger Delta by 2008

Lack of commitment on the part of the Nigerian government could result in a relaxation of the 2008 flare out target date. The threat of unrest in the Niger Delta also potentially presents impediments to moving forward with onshore gas gathering and or reinjection projects. Testimony provided by David Goldwyn, former Assistant Secretary of Energy in the Clinton Administration knowledgeable about conditions in the Niger Delta, summarizes the situation:50

47 Bank Information Center USA, West Africa Gas Pipeline Project, August 27, 2004.
“Nigeria’s unrest in the Delta region is unresolved. Foreign workers have been held hostage for weeks at a time. Sabotage of oil pipelines has killed hundreds of Nigerians. A major strike in March, 2003 knocked 800 000 bpd of production off the market…Production was shut down for months for security reasons…..labor unions, accurately foreseeing the reduction in personnel needed to maintain offshore oil operations, are also threatening to shut down operations. Furthermore, the organized theft of 100,000 to 200,000 barrels per day in the Niger Delta, reportedly involving armed militias and criminal groups that use some of the proceeds to acquire weapons, is an indication that oil mismanagement can threaten regional stability. The Nigerian government has no credible plan at this time to foster development and reconciliation in that troubled region…..”

11.1 Lack of gas gathering infrastructure

The construction of AG gathering pipelines is currently the exclusive domain Nigerian Gas Company (NGC), a wholly-owned subsidiary of the state-owned Nigeria National Petroleum Corporation. The NPC owns an “expanding 1,000 km network of gas pipelines.” The current network of AG gathering systems is shown in Figure 2.

However, the NPC has few financial resources to continue to expand the gas gathering system and represents a major potential bottleneck to getting AG to points of productive use prior to the 2008 flare elimination target date. Productive uses include the existing LNG liquefaction plant at Bonny Island, the proposed Escravos gas-to-liquids plant, proposed export pipelines (WAGP, Nigeria-to-Algeria Pipeline), and a variety of power and heavy industry projects within Nigeria. Nigeria is currently in the process of reforming its Gas Law to permit private investment in gas gathering systems. The new Gas Law is currently in draft form and is on-track to be passed into law by the first or second quarter of 2005.

Responding to ETI questions as to whether the government of Nigeria would legally require gas gathering infrastructure or require that gas marketing reduce flaring, David Goldwyn replied, “I do not see where Nigeria could subsidize gas reducing infrastructure given their other needs. The market incentives (penalty for flaring) provide the best hope for reducing flaring.”

11.2 Projected increase in AG from new oil projects

The AG production rate is expected to rise from 4 bcf/d in 2004 to 8 bcf/d in 2014. Unless new oil development projects are subject to a “no AG flaring” requirement, the amount of AG available will far exceed the capacity of the NLNG facility and other AG usage projects likely to

54 E-mail to Richard Kamp from David Goldwyn, August 28, 2004.
be online in 2008. As noted, all five major joint venture operators in Nigeria have verbally committed to eliminate routine flaring in all new oil and gas developments in the country.


12.1 Projects in operation using AG

Power generation is also one of the oldest gas applications in Nigeria. Virtually all electricity generation in Nigeria is from either gas or hydropower, with the gas-fired power plants accounting for 3,875 MW or 67 percent of installed capacity. Interest has surged in gas-fired independent power plants recently. An example is the 480 MW Kwale regional power project being developed by Agip and ConocoPhilips. These plants are expected to operate more efficiently than existing public power plants, stabilize the power sector, and stimulate gas consumption.

12.2 Reinjection of AG

Gas lift and reinjection represent the oldest AG applications in Nigeria. New installations are continuously being built as more oil production fields lose natural drive and required enhanced oil recovery procedures to continue production. All the major oil producers operate gas lift and reinjection installations in Nigeria.55

Reinjection generally presents no technical problems if the gas is being reinjected into the same pool it came from or into a depleted pool. Reinjection into the same pool is a commonly used technique to enhance oil recovery from the pool. Reinjection of gas can be done alone or in combination with waterflooding, as proposed by Total for the Amenam project. Reinjection alone can typically increase oil recovery from the 15 to 20 percent range to around 25 percent.56 The combination of gas reinjection and waterflooding planned for the Amenam project should increase oil recovery to the 35 to 55 percent range.57 The principal caveat when reinjecting into a pool that is not the original source of the gas is to ensure that the original reservoir pressure is exceeded.

There are nearly 400 depleted reservoirs in the U.S. used for gas storage, there is no technical problem associated with reinjecting gas into these reservoirs. Compressor power necessary to reinject 300 to 400 mmcf/d to a moderate depth, 4,000 to 5,000 feet, would be on the order of 25,000 to 30,000 hp. The industry rule-of-thumb for a turnkey gas compressor train is $1,000/hp. The total capital investment in compression equipment to reinject 300 mmcf/d would be on the order of $25 to $30 million.

Reinjection should be technically feasible in the fast majority of mature oilfields in the Niger Delta and should be the default option utilized by industry to meet the 2008 flare out target date if productive uses have not been found for the AG being flared.

13. **Recommendations for Investment and Regulatory Conditions Related to Ending Gas Flaring in the Niger Delta to be met prior to funding of the WAGP**

A. Gas transported in the WAGP must be AG.

B. A prohibition against flaring AG in new projects must be condition of a World Bank (WB) or Overseas Private Investment Corporation (OPIC) loan to WAGP.

C. The WAGP owners must provide a written commitment and an enforceable plan to end flaring, whether or not directly connected with the WAGP, prior to funding. Funding disbursement should be linked to gas-flaring elimination by 2008.

D. WAGP must submit an enforceable and independent auditing and monitoring plan to ensure that gas flaring will be ended by 2008 to OPIC and WB. Funding disbursement for WAGP should be linked to this plan.

E. Feasible gas flaring market driven penalties should be developed that make routine flaring of AG economically unattractive to producers.

F. Claims by producers that AG reinjection projects are uneconomical as a rationale for delay are unacceptable. Gas gathering and reinjection projects should be judged economically as an integral component of the oil project producing the AG when evaluating the cost of such projects.
Figure 1. West Africa Gas Pipeline

Figure 2. Niger Delta Onshore Oil Fields and Current Associated Gas Gathering Systems

- Shell Nigeria Oil Fields and Oil Pipelines
- ChevronTexaco Nigeria AG Gathering System

AG Gathering System for NLNG Project
- Sokk gas gathering project for NLNG

AG Gathering System for ALSCON Project
- ALSCON - aluminium smelter project