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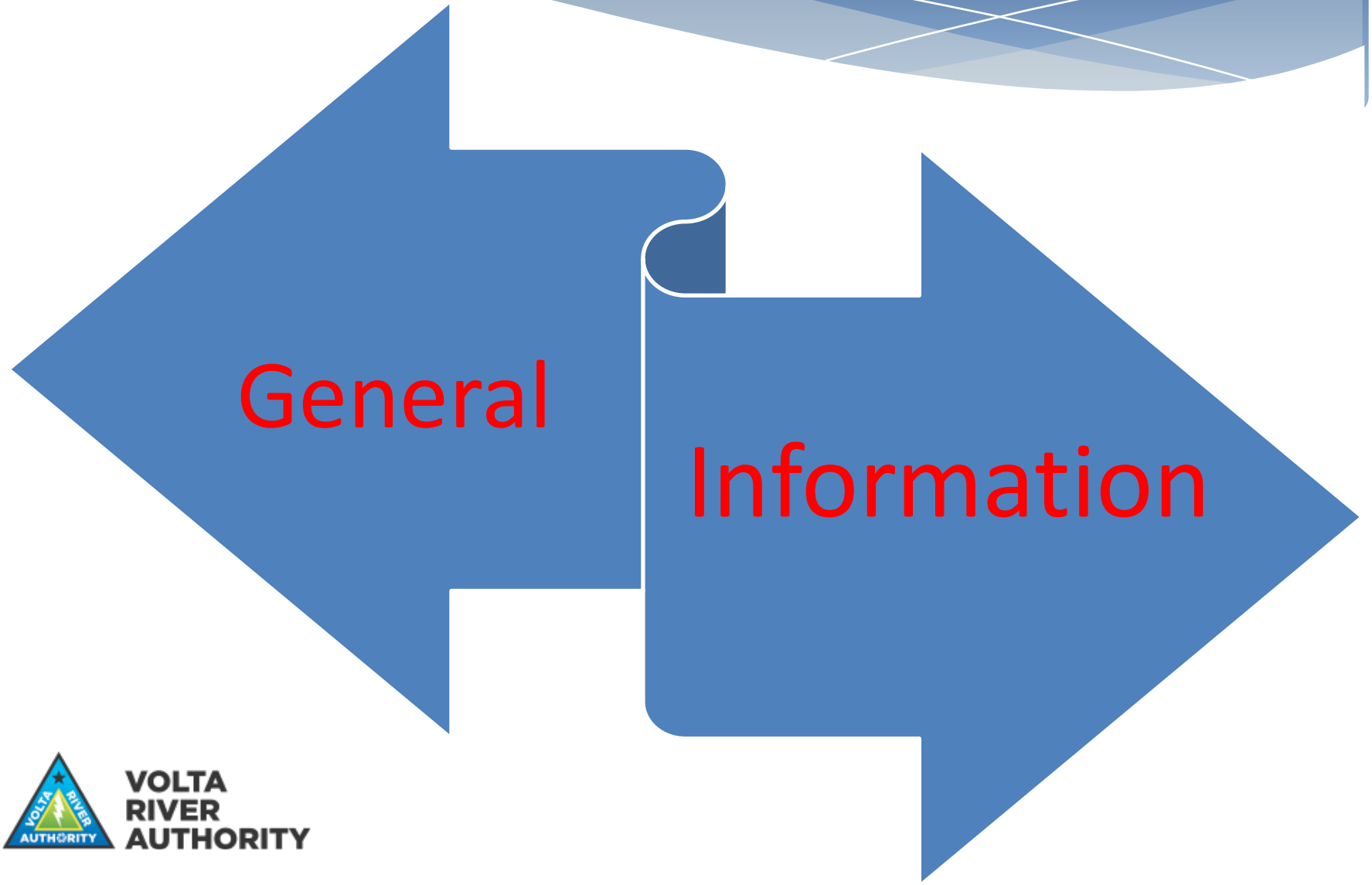
PROPOSED 2x350MW SUPERCRITICAL COAL-FIRED POWER PLANT

VOLTA RIVER AUTHORITY

深圳能源 SHENZHEN ENERGY

Presentation Outline

- ❑ General Information
- ❑ Project Justification & Outcome
- ❑ Energy Sources & Drawbacks
- ❑ Clean Coal Technologies
- ❑ IEA Coal Power Plant Projections for 2015 - 2030
- ❑ Environmental Impacts & Mitigation – Local & Global
- ❑ Public Consultations
- ❑ General Discussion



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PROJECT OVERVIEW – GENERAL INFORMATION

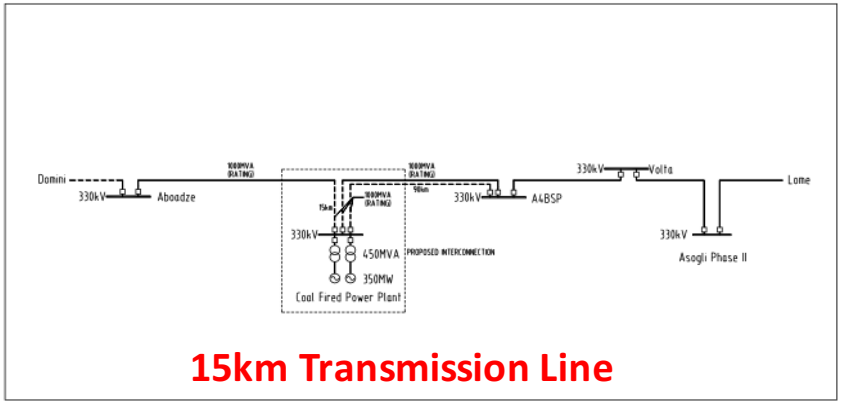
Project Sponsors	Project Consultants
▪SEC - Shenzhen Energy Corporation, China ▪VRA – Volta River Authority, Ghana	▪SDEPCI: Power Plant ▪CCCC-FHDI: Coal Handling Terminal
Installed Plant Capacity	**Coal Supply Sources**
▪ Total Plant Capacity: 2,000MW ▪ Phase I: 2X350 MW SC ▪ April 2017 – Nov 2019/April 2020 ▪ Phase II: 4X350 MW SC or 2X600 MW USC ▪ Project Cost - $1.5bn ▪ Tariff - $0.1091	▪ 1st Supplier: Glencore Xstrata of South Africa (30.2bn-Reserve) ▪ 2nd Supplier: Anglo America from Columbia (6.2bn Reserve) ▪ Annual Consumption for Phase I: 2MTons/year ▪ Ash Storage Yard – 5yrs storage
Site Selection	**Land Requirement**
▪ **Ekumfi Aboano (Central Region)** ▪ Komenda/Akwidaa /Domunli	▪ **Land Requirement (270 hectares)** Plant /Ash Yard /Access Road /Transmission RoW

GENERAL INFORMATION - PROJECT OVERVIEW

Plant Layout

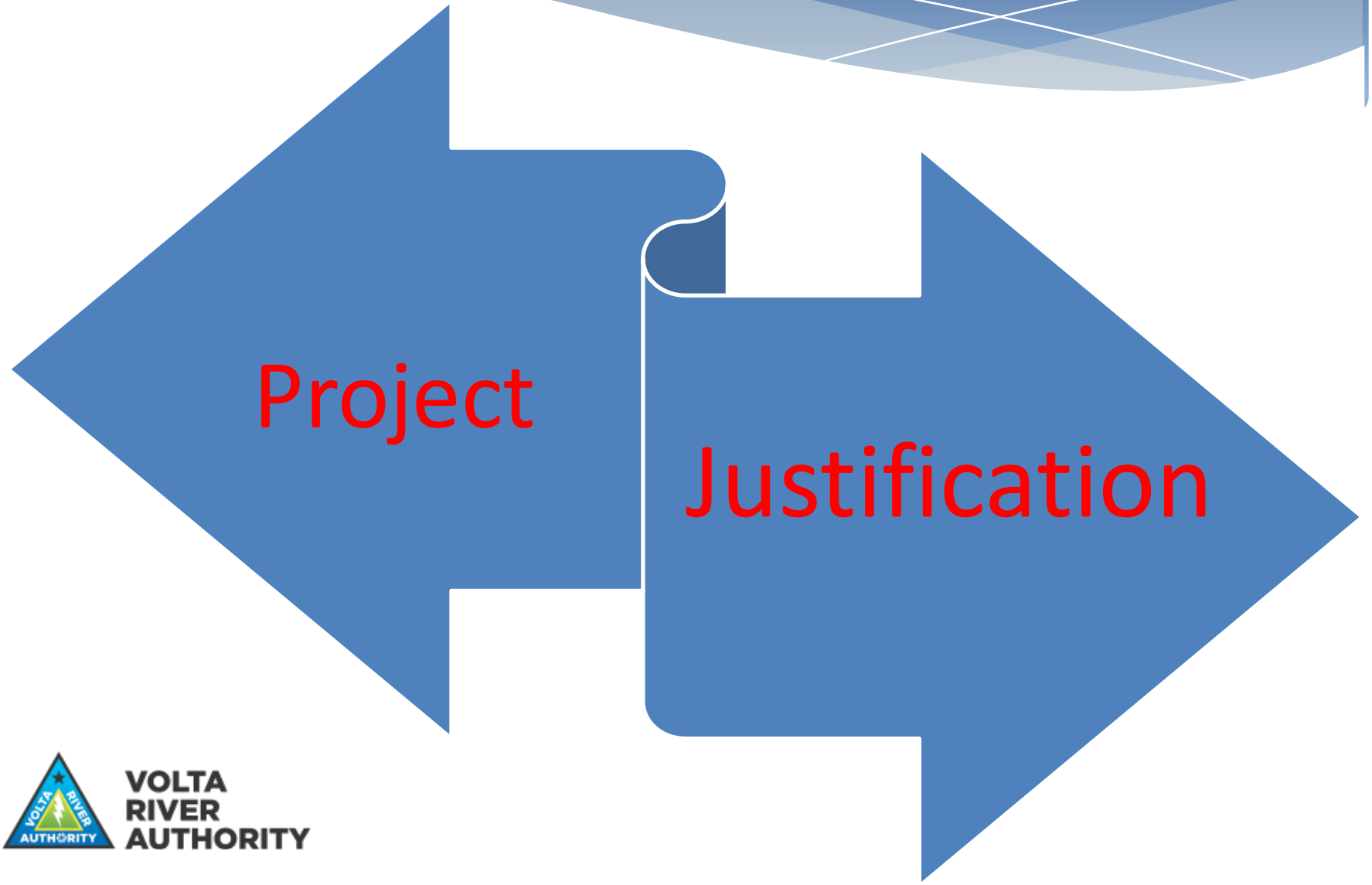
Open Coal Storage yard

Coal Handling Terminal (Port)



15km Transmission Line

Totally Closed Coal Storage yard



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PROJECT JUSTIFICATION

✓ Energy Demand Projections (2015 – 2030)

- Annual Growth Rate - 7% & Installed capacity (2,574MW – 7,000MW)

✓ Fuel Supply Risk

- Indigenous gas supply limitation (2036), pipeline challenges, unreliable supplier
- Light crude oil price volatility
- Poor hydrological years (period of insufficient rainfall)
- Intermittent nature of renewables energies and their impact on grid stability

✓ Diversification of Energy Sources

- Most abundant fuel resource and widely distributed (860bn reserve worldwide)
- Challenges with Hydro - Thermal Complement / Akosombo Dam Management / low composite tariff
- Reducing the effect of stranded assets (2036)

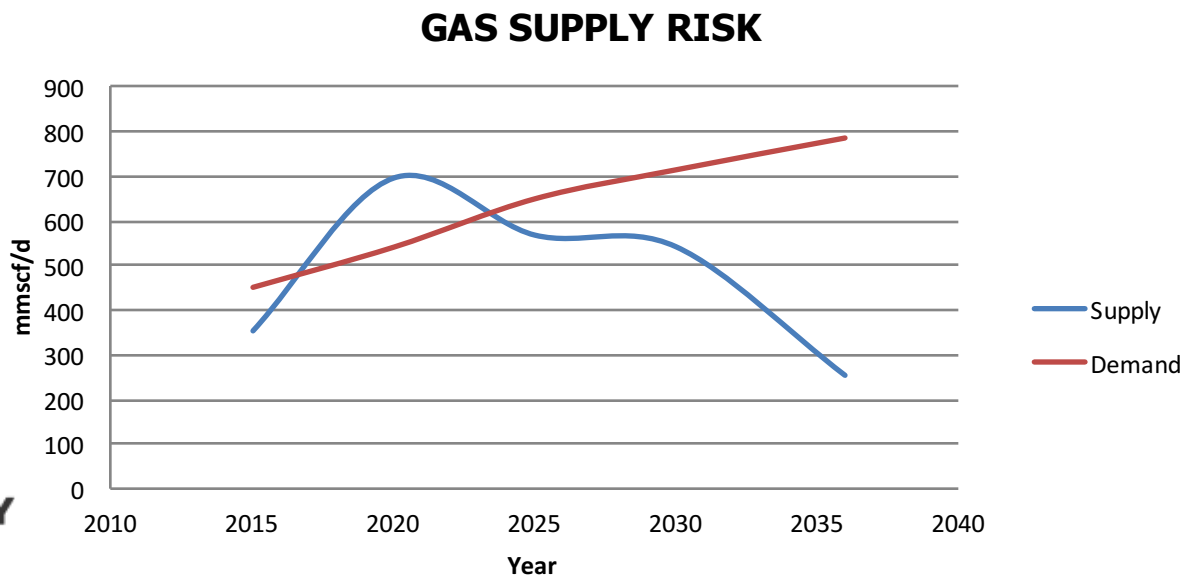
Least Cost of Generation

Affordable source of electricity. Cheapest fuel in the long term invariable provides least economic cost of electricity (only next to large hydropower plants) for **stainable development.**

PROJECT JUSTIFICATION

✓ Fuel Supply Risk

Fuel Supply Sources (mmscfd)	2015	2020	2025	2030	2036	Remark
Indigenous Gas/ mmscfd	127	313	242	211	51	Erratic & Limited Supply
WAPCo / mmscfd	123	123	123	123	123	Unreliable Supply & Pipeline Challenges
Total Supply/ mmscfd	250	436	365	334	174	Supply Shortfall
Total Demand/ mmscfd	450+	450+	450+	450+	450+	Increasing Demand
Deficit/ mmscfd						LNG Augmentation



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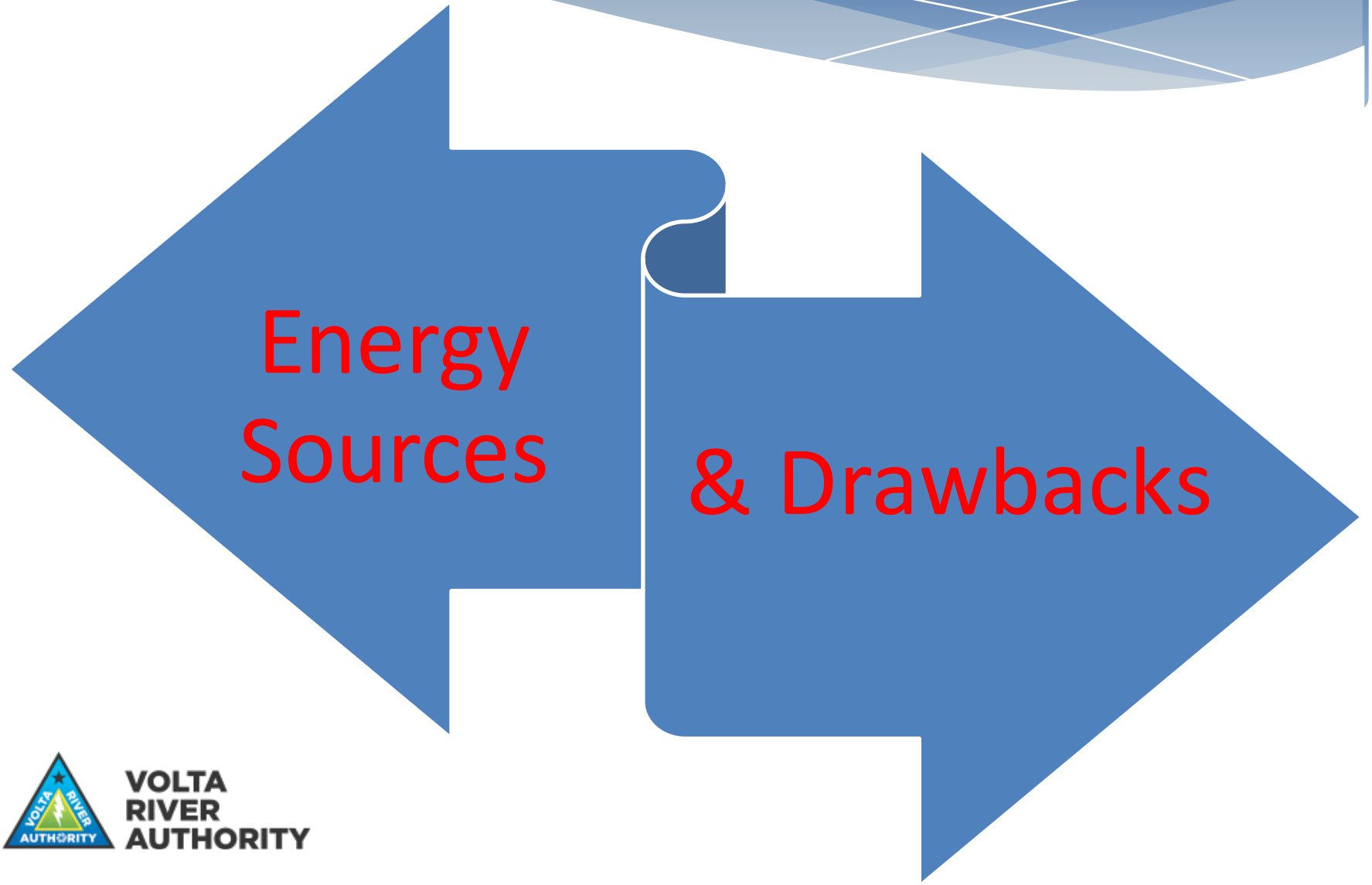

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ENERGY SOURCES & DRAWBACKS

Energy Sources	Drawbacks
Hydro	▪ High CAPEX ▪ Significant land requirement for large plants with dams/lakes ▪ Public resistance due to relocation or micro climate effects
Natural Gas/LCO	▪ High upfront investment requirement for transport and distribution system ▪ Increasingly long supply routes and high cost of infrastructure ▪ High price volatility
Coal	▪ High emissions of CO_2, particulates and other pollutants ▪ Not suitable for peaking generation units ▪ CCS have negative impact on thermal plant efficiency
Solar	▪ Intermittent supply ▪ Grid connection challenges ▪ Use of toxic materials ▪ Reliance on subsidies ▪ Land usage (2.5Hectares/MW) ▪ Tariff ($0.18 /kWh -$0.22/kWh)
Wind	▪ Transportation challenges ▪ Intermittent supply ▪ Grid integration challenges ▪ Reliance on subsidies ▪ Tariff ($0.16/kWh)
Nuclear	▪ High CAPEX and rising compliance costs ▪ Long Public concerns about operation and final waste disposal ▪ Liabilities in case of nuclear accident ▪ High construction period

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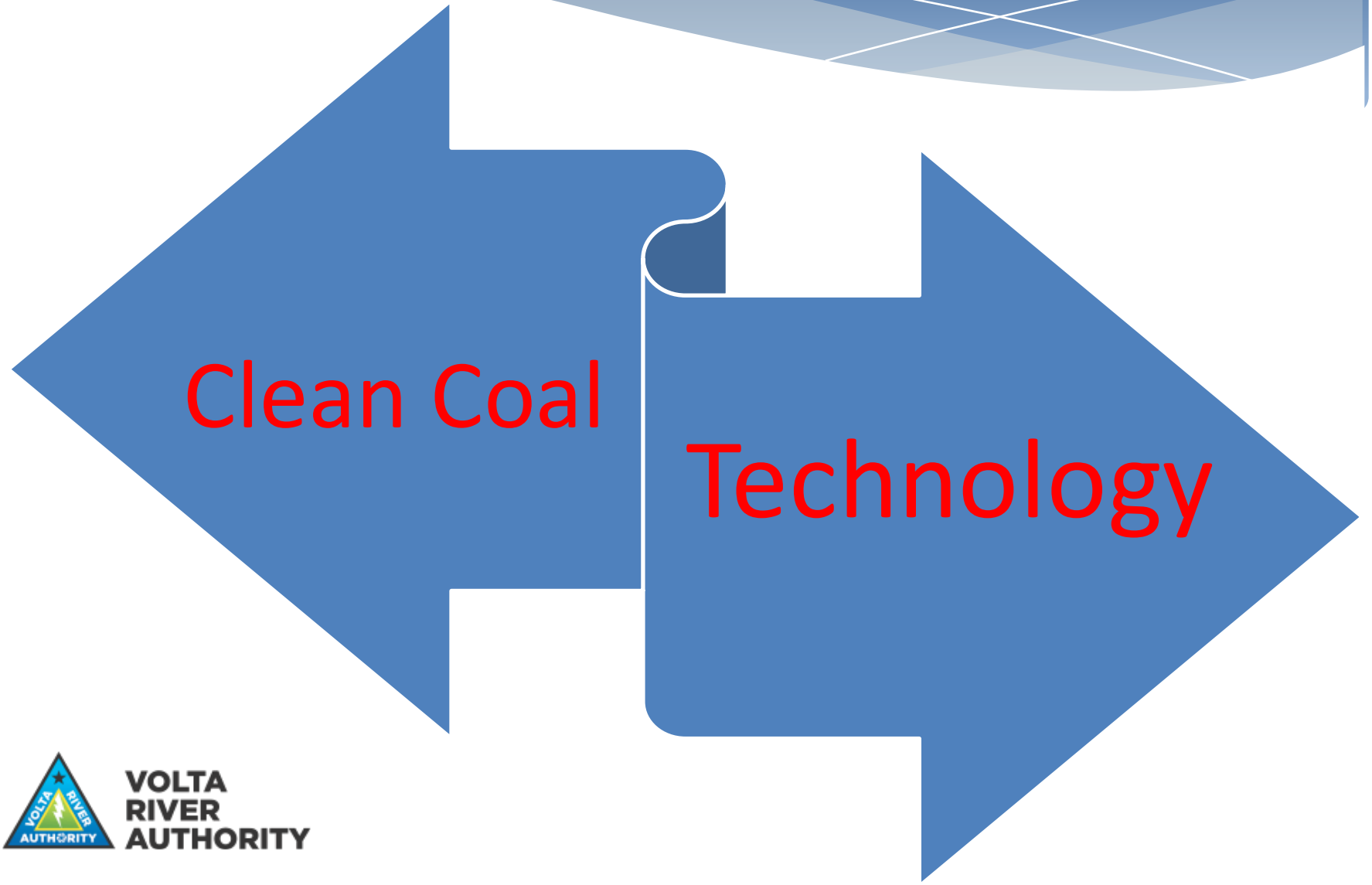

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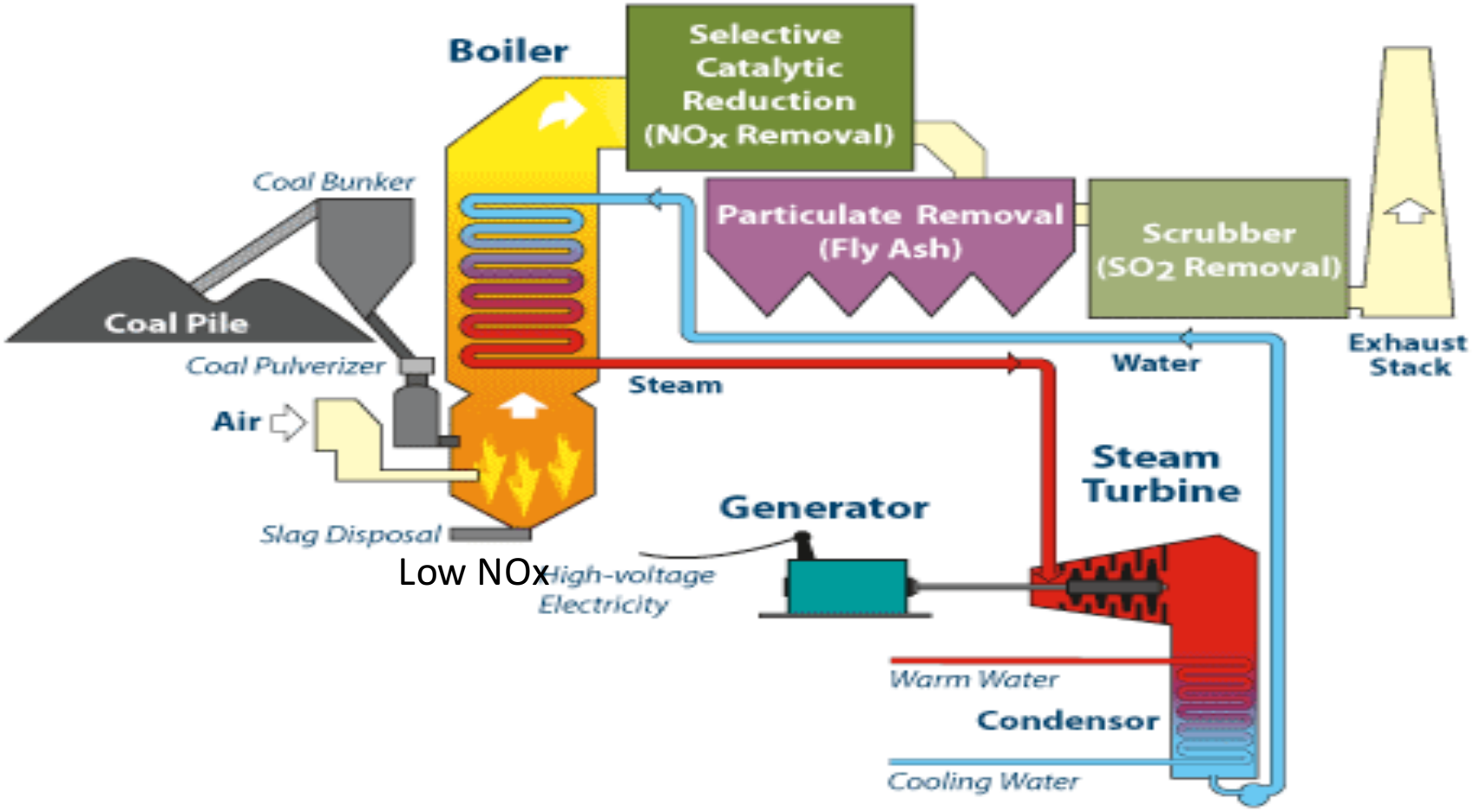
COAL POWER GENERATION PROCESS



IEA COAL POWER PLANTS PROJECTIONS

2015 - 2030

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NEW COAL-FIRED POWER PLANTS (2015 - 2030)

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Annex – country specific data

Table 2 Planned/announced coal capacities and estimated impact on CO2 emission. Source: Global Coal Plant Tracker (2015), IEA (2015) and Enerdata (2015).[11]

	2014	Planned		2030 if all planned plants are built	Announced or pre-planned		Estimated new capacity in 2030 if announced and pre-planned are cancelled	
	Capacity (GW)	Capacity (GW)	Number of plants	Capacity (GW)	Capacity (GW)	Number of plants	Capacity (GW)	Number of plants
China	895	712	1171	1479	471	722	241	449
India	197	290	446	434	156	201	134	245
Indonesia	26	45	119	67	36	79	10	40
Japan	68	23	45	70	18	34	5	11
South Africa	41	13	24	35	3	9	9	15
South Korea	29	21	26	47	10	12	11	14
The Philippines	5.6	12	60	17	7	30	5	30
Turkey	15	71	93	80	63	73	8	20
EU28	185*	22	27	142	11	11	11	16
Total of countries analysed	1280	1210	2011	2372	775	1171	435	840
World total*	1 851	1428	2440	2703	923	1420	505	1020

*2013 (IEA, 2015).

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ENVIRONMENTAL STANDARDS & COMPLIANCE

Pollutants	Unit	Ghana (EPA) Standards	China Standards	World Bk. & IFC Standards (New Plants)	European Standards
Smoke	Ringlemann	No.2		-	-
Solid Particles	mg/m^3	200	30	50	50
SO_X	SO_2: mg/m^3	None 200 (Proposed)	New plants -100 Existing 200/400 (400 for high sulfur coal)	200	New -200 Existing - 400
	SO_3: mg/m^3	120	NA	NA	NA
NO_X	mg/m^3	1000 200 (Proposed)	New – 100 Exist – 100/200 (200 for plants before 2004)	750	200
Mercury	mg/m^3	NA	New - 0.03 Existing – 0.03	-	-

LOCAL ENVIRONMENTAL IMPACT & MITIGATION

Aspects	Mitigation Measures
SO_2 < 200mg/Nm^3	▪ Seawater Flue Gas Desulfurization (FGD) with efficiency of not less than 86%, without flue gas bypass and gas-gas heater (GGH).
NO_X < 350mg/Nm^3	▪ Low NO_X combustion: Boiler is designed with low NOx combustion, furthermore, SCR de-NOx equipment with efficiency of not less than 78% will be considered.
Flue Gas	▪ Emitted through a common Stack of height 180m ▪ Continuous emissions monitoring equipment will be installed on the stack. ▪ On line emission levels to be available on site
Wastewater	▪ Domestic sewage water, coal waste water and oil wastewater will be treated separately, and then reused. ▪ Only circulating cooling sea water will be drained out of the plant. ▪ A thermal plume dispersion modeling is being undertaken to predict the permissible size of the mixing zone and the effect on sea, ▪ Effluent levels to be monitored as part of project monitoring plan

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LOCAL ENVIRONMENTAL IMPACT & MITIGATION

Aspects	Mitigation Measures
Dust (Fly Ash) < 50mg/Nm^3	▪ Electrostatic Precipitator (ESP) of removal efficiency not less than 99.91%, dust can be controlled under 20mg/Nm^3 at outlet of the ESP. ▪ Dust removal efficiency of desulfurization system can reach 50%, so total dust removal efficiency will be equal or more than 99.955%. Dust emission will be not more than 10mg/Nm^3 at outlet of stack. ▪ Installation of geotextile membranes at ash storage yard to prevent ground water contamination ▪ Ash pit (first 5years); alternate use

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LOCAL ENVIRONMENTAL IMPACT & MITIGATION

Aspects	Mitigation Measures
Noise	▪ Conduct reasonable overall planning for the plant area. Arrange high-noise equipment far from the area which is sensitive to noise ▪ Reduce noise level by green belts planting. To plant arbor and shrub on roadsides, around the main powerhouse and nearby other sound sources as required, so as to reduce noise through the noise reduction function of plants. ▪ The proposed plant sites are far away from the nearby villages, it is predicted that the contribute value of plant noise to the residential areas will be low, so plant noise won't disturb the local residents.

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LOCAL ENV. IMPACT - FLY ASH UTILIZATION

Fly Ash

Diagram 2. Fly Ash

Ceramic Particles

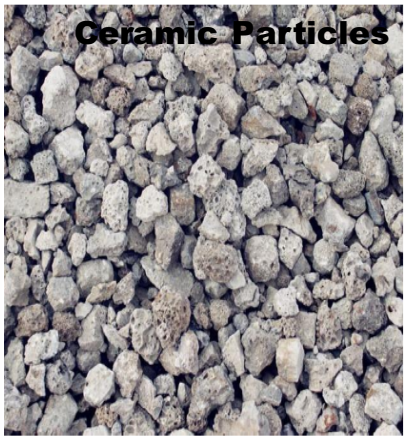


Diagram 3. Boiler Slag

Road Paving

Road Paving

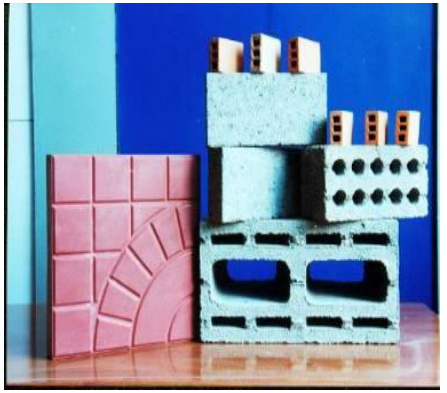
Diagram 5. Road paving

Fly Ash Unloading Bay

Hollow Blocks

Culverts

Pavement Blocks



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Cement Production

GLOBAL ENVIRONMENTAL IMPACT & MITIGATION

Project's Carbon Footprint.

- Expected annual project contribution is **3.69 million tons** of CO_{2e}

VRA CO_2 Reduction Measures

- Carbon sequestration potential of VRA Reforestation Programmes within Volta lake
- Offsets from VRA's Combined Cycle Projects
- Offsets from VRA's Renewable Energy Programmes (Solar/Wind)
- Carbon Accounting Programme beginning 2016

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VRA's Renewable Energy Development Programme Phase 1:

150 MW Wind Power Projects

- ✓ Planned 75MW Wind Power Project 1 (Anloga Extension) in the Volta Region (EIA / FEED ongoing)
- ✓ Planned 75MW Wind Power Project 2 (Wokumagbe and Goi) in the Ada West District (EIA / FEED ongoing)

14.5 MW Solar Power Projects

- ✓ 2.5 MW Navrongo Solar Power Plant (Operational)
- ✓ 8 MW Solar Power plant in Kaleo in the Upper West Region (Env. Permit issued / Financing stage)
- ✓ 4 MW Solar Power plant in Lawra in the Upper West Region(Env. Permit issued / Financing stage)

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GLOBAL ENVIRONMENTAL IMPACT & MITIGATION

VRA CARBON SINKS

- Planted 3,193 hectares of forest cover as at close of 2015 and contributing between 300,000 – 730,000 tons of Carbon sink

- Planned sequestration value of 6,000 – 14,000 tons annually to the existing sink from 2016 – 2020

- Planned sequestration value of 96,000 – 230,000 tons by 2020 under the Forest Investment Program (VRA proposal completed for submission to the Forestry Commission)

Offsets from VRA Combine Cycle Projects

- Conversion of the 220 MW TICO Plant into a 330 MW CC Plant (Operational)

- Expansion of the existing 110 MW SC TT1PP into a 330 MW CC Plant (Env. Permit issued / Financing stage)
- Conversion of 220MW SC KTPP to 330 MW CC ***resulting in 400,000 tons CO2e. Savings*** (EIA / FEED ongoing)

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GLOBAL ENVIRONMENTAL IMPACT & MITIGATION

As funding agency, China – Africa Development Fund (CAD Fund), is playing the following roles in line with the Green Credit guidelines:

- CAD Fund in July 2015, visited Ghana to confirm findings of pre-feasibility studies with Ghanaian stakeholders

- CAD Fund in January 2016, met with SEC-VRA to review all aspects of the feasibility studies / Scoping Report and has made contributions for improvements.

- CAD Fund is to review the ESIA Report in order to identify, assess, monitor, control or mitigate associated Environmental & Social risks.

- CAD Fund is to ensure project sponsors are compliant with local environmental, land, health and safety laws and regulations in Ghana.

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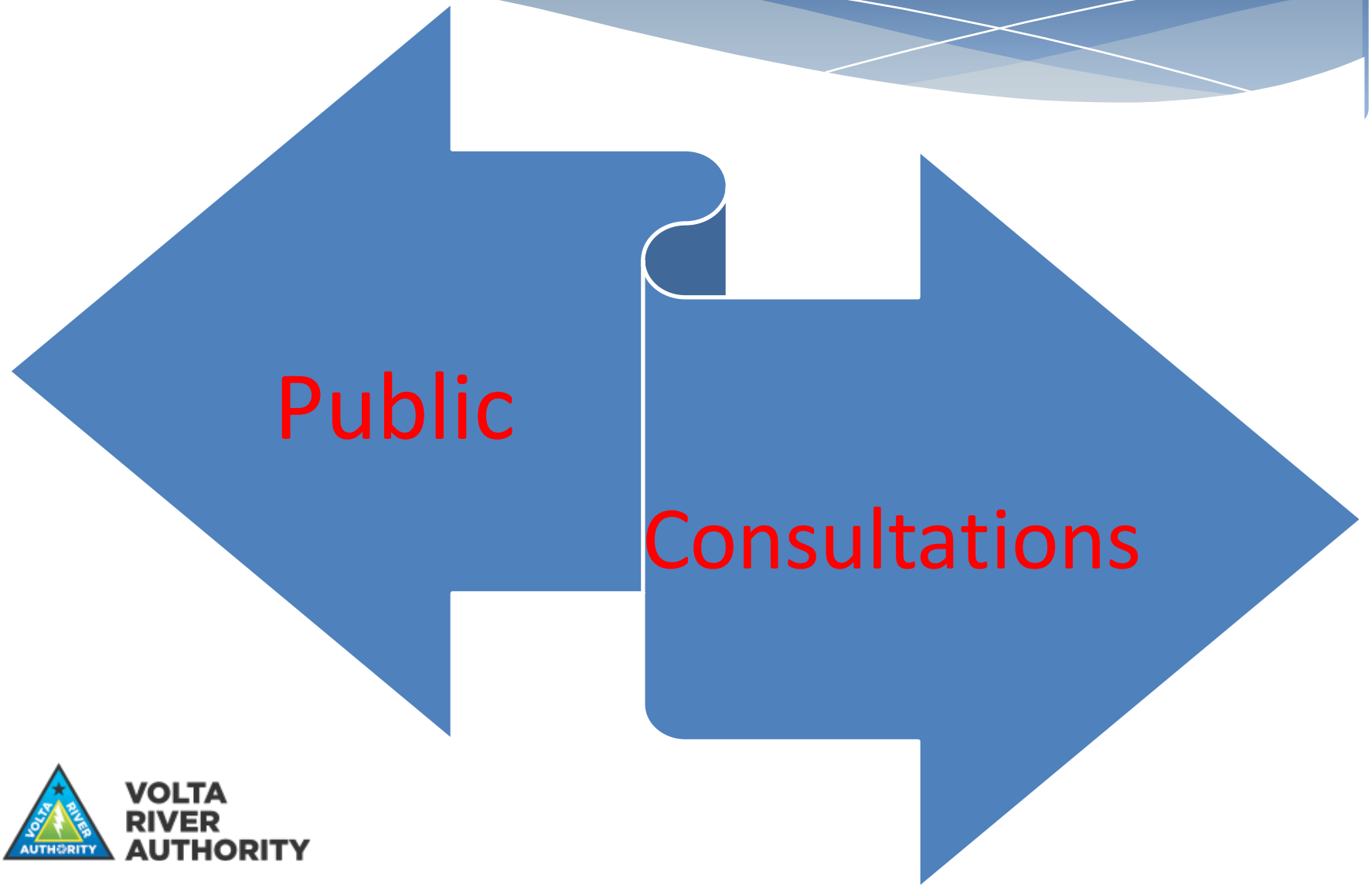

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Public Consultations & Disclosure Plan

1. Meeting to introduce project to key state agencies at Coconut Grove Hotel on April 13, 2015
2. Stakeholder workshop to present findings of prefeasibility study at GZ Plaza on July 15, 2015
3. Between April – December 2015, consultation meetings were held with relevant state agencies, namely GMA, GPHA, Energy Commission, GWC, GIPC
4. Stakeholder meeting with Energy Commission on Nov. 9, 2015
5. Registration of Project with EPA in Sept. 2015 and presentation of project mitigation strategies to the EPA in November 16, 2015

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6. Community consultations between Nov – Dec 2015 culminating in visit to thermal power plant at Aboadze by 31 Community members from Ekumfi on Dec. 23, 2015
7. Submission of Scoping Report in December 2015
8. Disclosure of Scoping Notice in January 2016
9. Engagements with CSOs beginning March 13, 2016
10. District level public forum on March 31, 2016
11. Planned Submission of ESIA Report and disclosure in May 30, 2016
12. Planned National level public forum in May/July 2016

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General Discussions