

Energy Sector in Ghana

Solomon Sarpong
Energy Consultant



Presentation Outline (1/2)

1. Brief overview of Ghana energy sector

- Industry Stakeholders
- Ghana's Energy Peak demand and mix

2. Key Energy Issues in Ghana

3. Energy Policy on Renewables

- Licensing Process process, PPP/IPP structures, "Take & Pay" model, Investment Incentives (Tax, etc), and Government (Offtaker) Guarantees to guarantee investment payback.

4. Government's Energy Strategy

- renewables to address deprived areas and support industrial growth.



Presentation Outline (2/2)

5. Renewable Energy Application Process

- indicate process and requirements
- application, licenses, key stakeholders involved, etc for public versus private sector deals

6. Risk assessment:

- top potential risk areas, risk level, and mitigation.
- political/change in government,
- payment and protection of tariffs by Government (ECG),
- Off taker use of (excess) energy produced
- forced majeure

7. Brief overview and size of key energy project opportunities (public and private sectors) in Ghana.

- long-term/turnkey/sourcing projects that require funding, knowledge/technology transfer, training, etc.



Map Of Africa



Ghana



Country specifics - Ghana

- ❑ Ghana is located in West Africa, the Greenwich Meridian passes through Ghana, 5 degrees north.
- ❑ Industrial structure: Mining & Quarrying (include petroleum), Manufacturing, Electricity Industry, Water & Sewerage, Construction.
- ❑ GDP - US\$42.69 billion – 2016
- ❑ Unemployment at 6.3%, main national development priorities is to establish more industries – One District One Factory Policy, improve agriculture – One village one dam policy
- ❑ Political context: Multi-party democracy, elections every 4 years,
- ❑ Institutional context (Ministry of Finance responsible for managing external finance, GIPC coordinates FDI)
- ❑ Climate context (impact of climate change is adverse, floods or drought, Ghana has a strong Climate Policy, signatory to Paris Agreement)



Brief Overview of Ghana's Energy Sector

- Petroleum (Oil & Gas)
 - Upstream
 - Midstream and
 - Downstream
- Power Sector
 - Generation
 - Transmission
 - Distribution
 - Services
- Renewable Sector
 - Wood fuel
 - Renewable Electricity
 - Renewable Liquid Fuel
 - Renewable Heating



Petroleum

- Exploration - GNPC
- Production - GNPC
- Refining – Tema Oil Refinery
- Bulk Supply/Storage – Bulk Oil Storage & Transportation Company (BOST, BDC, OMC)
- Transportation – BOST, OMCs
- Retail - OMC
- Services - Misc

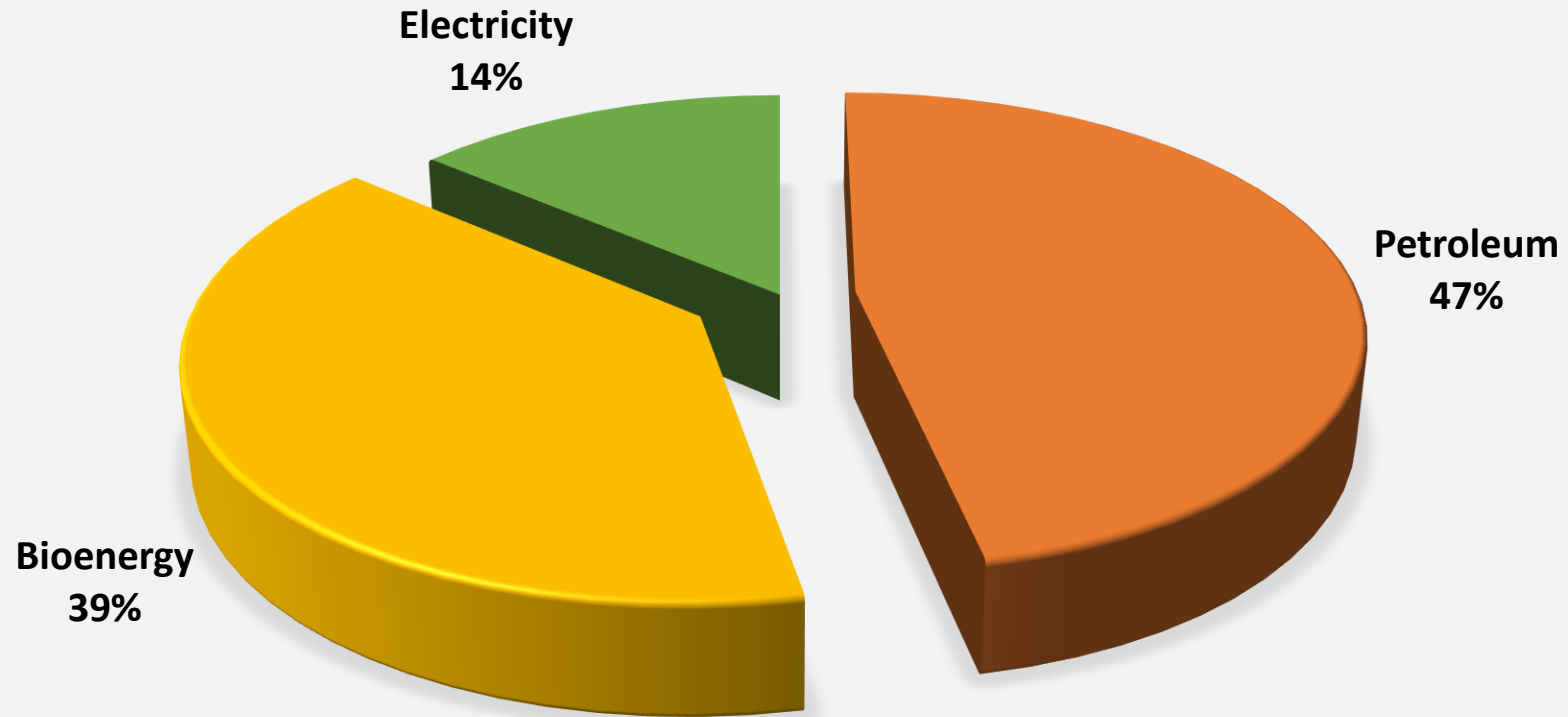


Power

- Wholesale Supply (Local Generation or Imports)
- Transmission - GRIDCo
 - Transmission Infrastructure
 - Transmission Maintenance Services
 - Ancillary Services
- Distribution- ECG, NEDCo, Enclave Power
- Retail/Sale (Last Mile Services)
- Brokerage
- Other Services



Ghana's Energy Mix, 2016



Petroleum	Bioenergy	Electricity	Total, ktoe
3,320.20	2,783.40	982	7,085.50



ELECTRICITY SUPPLY INFRASTRUCTURE

Generation Sources

Hydropower

Akosombo – 1,020 MW
Kpong – 160 MW
Bui – 400 MW

Thermal Power

TAPCO (Takoradi I) – 330 MW
TICO (Takoradi II) – 220 MW
Mines Reserve Plant – 80 MW
VRA Tema – 126 MW
Takoradi III Plant – 132 MW
Tema 2 Plant – 49.5 MW

Karpower – 225 MW
Kpone Thermal – 220 MW
Ameri - 250MW

CENIT Power – 126 MW
Asogli Power – 200 MW
Trojan – 25MW

Renewable (Solar-VRA – 2.50 MW)
Renewable (Solar-BXC -20MW)



PLANT	INSTALLED CAPACITY (MW)	DEPENDABLE CAPACITY (MW)
Hydro		
Akosombo	1,020	1,000
Bui	400	360
Kpong	160	148
Sub-Total	1,580	1,508
Thermal		
Takoradi Power Company (TAPCO)	330	300
Takoradi International Company (TICO)	340	320
Sunon Asogli Power (Ghana) Limited (SAPP) - IPP	200	180
Sunon Asogli Power (Ghana) Limited (SAPP2) - IPP	180	170
Cenit Energy Ltd (CEL) - IPP	126	100
Tema Thermal 1 Power Plant (TT1PP)	126	110
Tema Thermal 2 Power Plant (TT2PP)	50	45
Mines Reserve Plant (MRP)	80	70
Kpone Thermal Power Plant (KTPP)	220	200
Karpowership	235	220
Ameri Plant	250	240
Trojan*	25	22
Genser*	30	18
Sub-Total	2,192.0	1,995
Renewables		
Safisana Biogas*	0.1	0.1
VRA Solar*	2.5	2
BXC Solar*	20	16
Sub-Total	22.6	18.1
Total	3,794.6	3,521.1



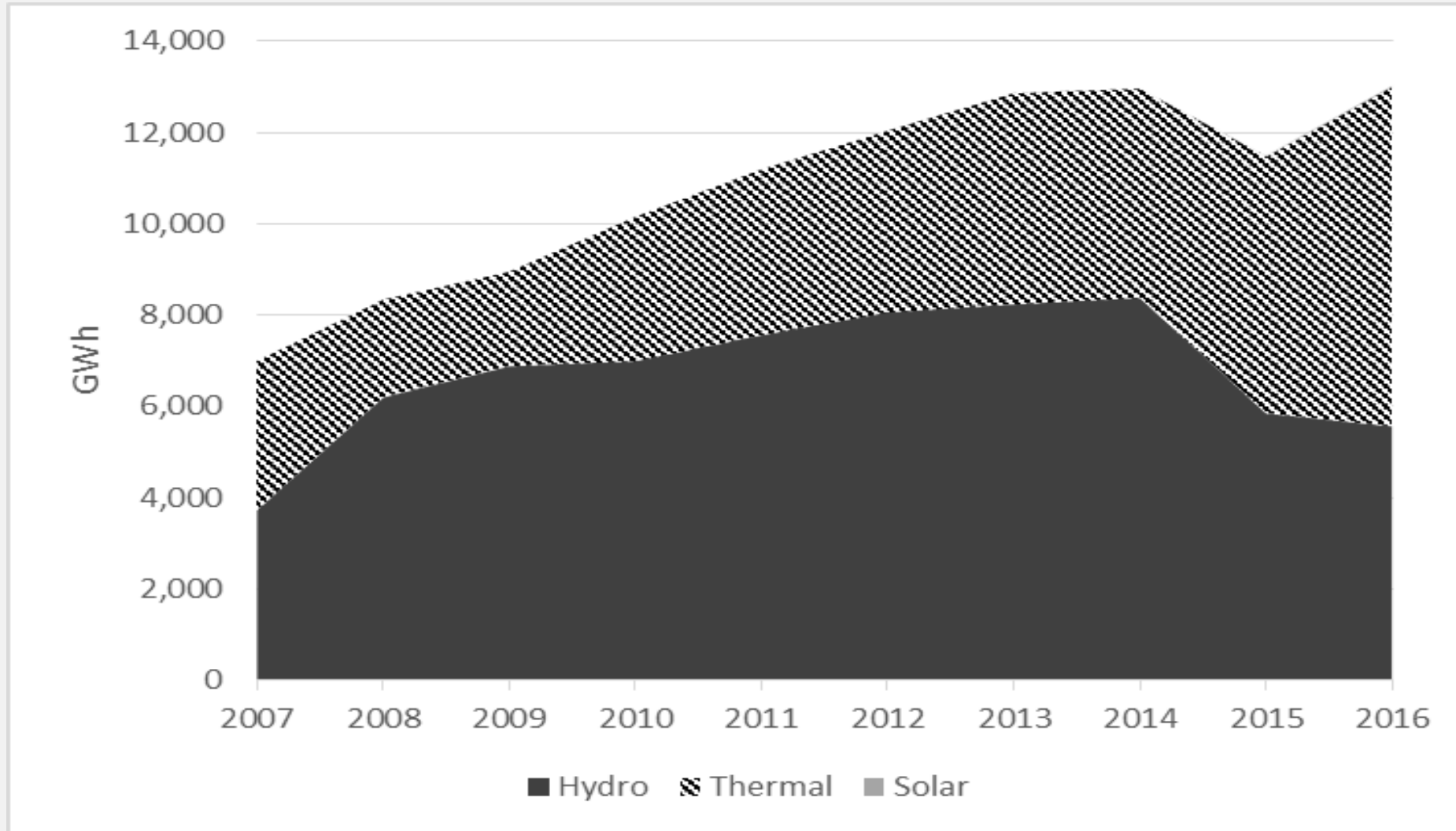
Under Construction

- Cenpower Plant, Tema – 340MW
- Amandi Power Plant, Aboadze, 190MW
- Early Power, Tema – 400MW

- Renewable PPAs signed – 17
- Capacity – 1,840MW



Electricity Generation

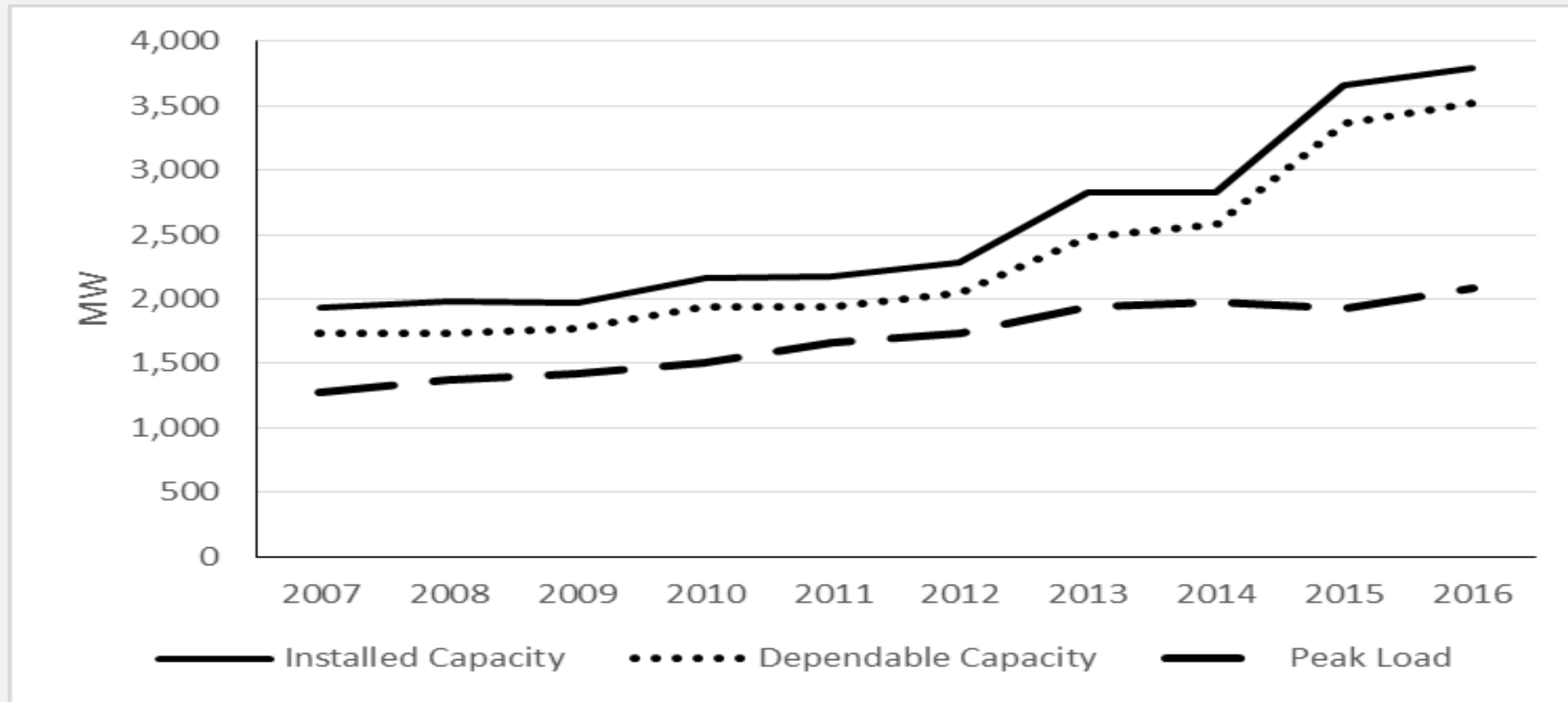


Installed Capacity, Dependable Capacity and Peak Load, MW

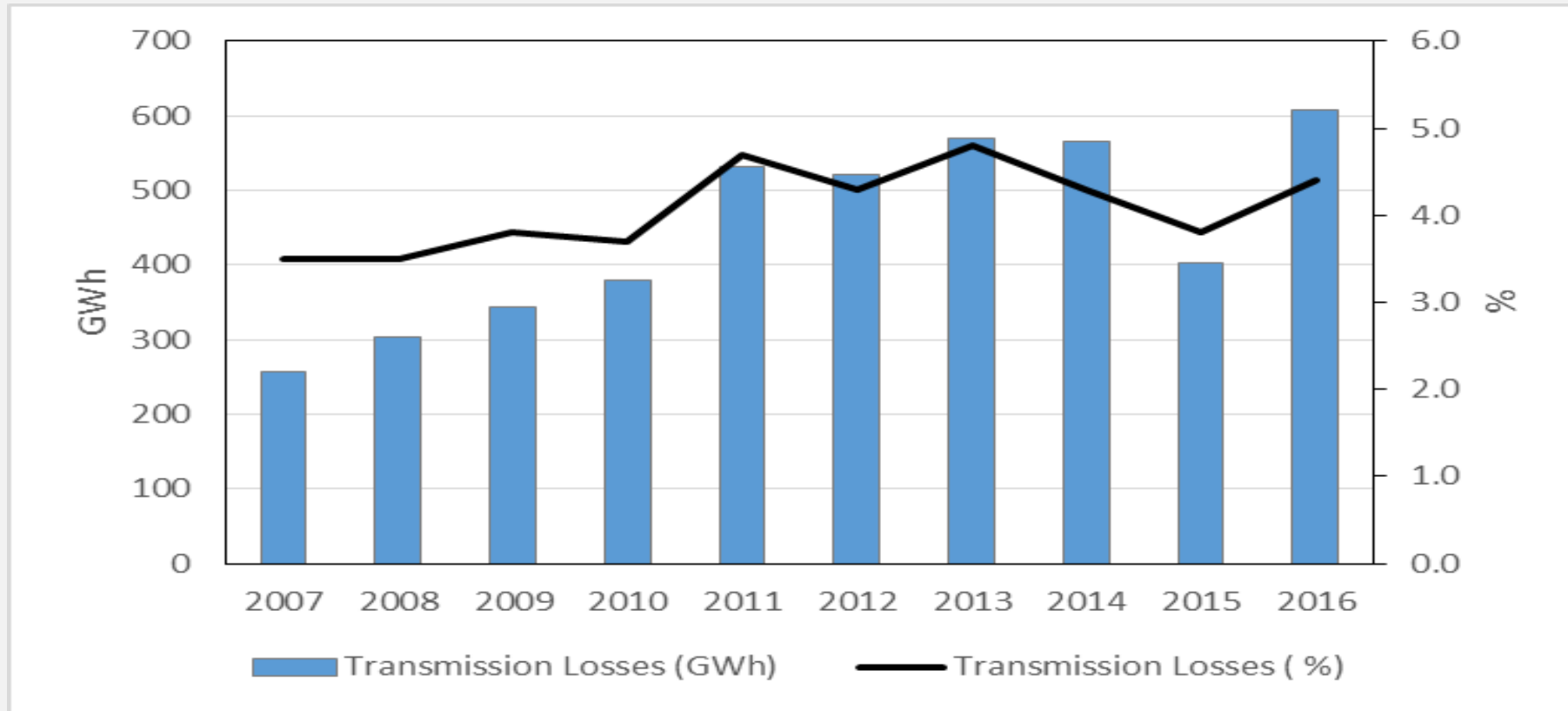
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Installed Capacity	1,935	1,981	1,970	2,165	2,170	2,280	2,831	2,831	3,656	3,795
Dependable Capacity	1,735	1,735	1,765	1,940	1,945	2,045	2,487	2,577	3,363	3,521
Peak Load	1,274	1,367	1,423	1,506	1,665	1,729	1,943	1,970	1,933	2,087



Trend in Installed Capacity, Dependable Capacity and Peak Load, MW



Trend in Transmission Losses, %

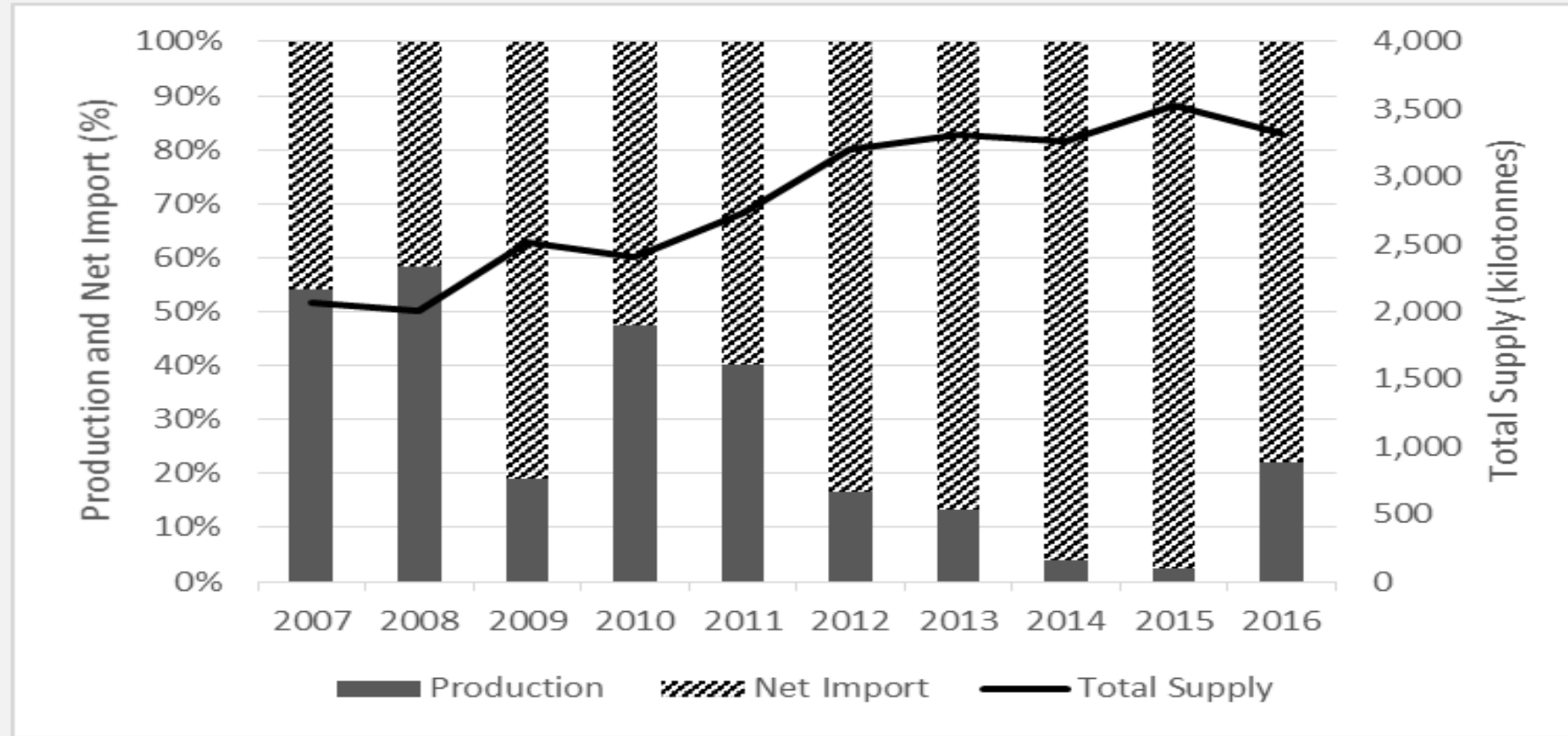


Trend in Petroleum Products production, imports, consumption, kTOE

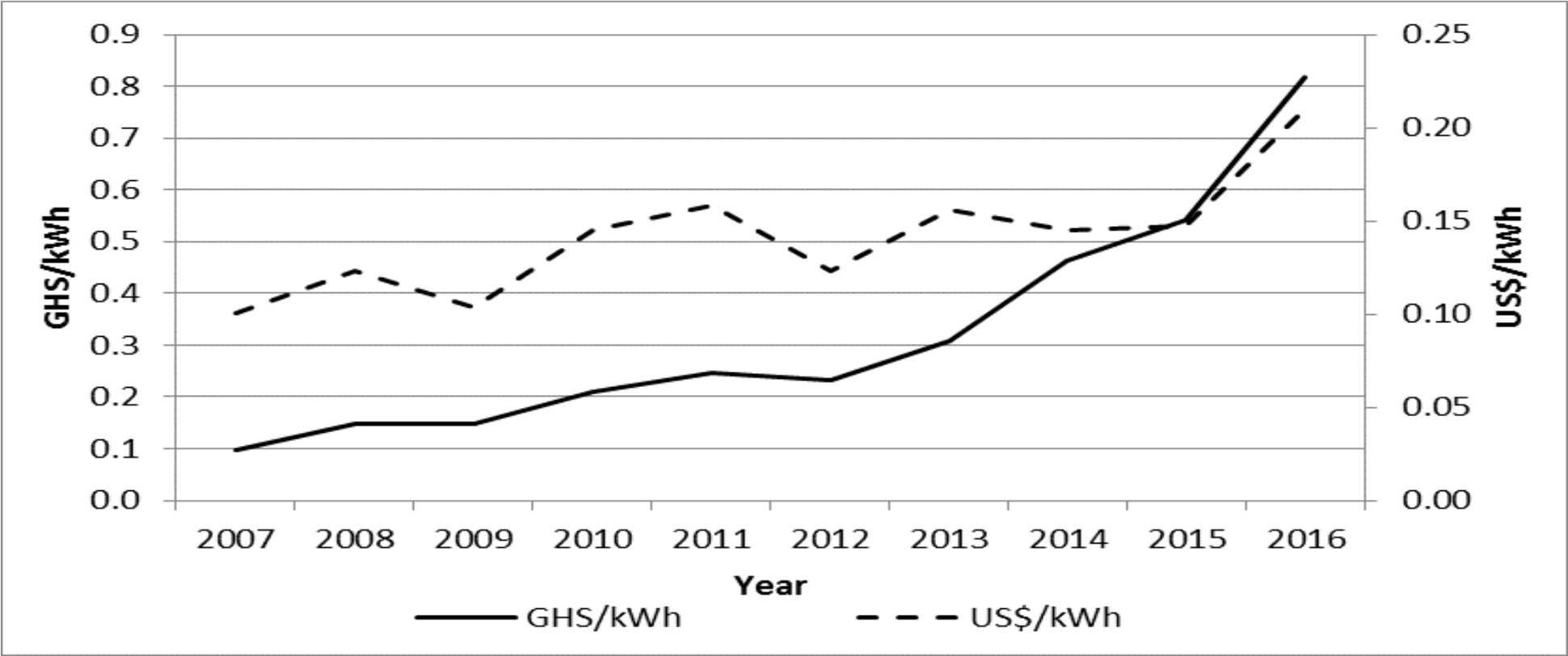
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Production	1,194.9	1,221.5	327.1	946.4	958.0	454.0	424.2	129.2	89.1	739.0
Net Import	1,013.7	873.8	1,390.3	1,051.9	1,425.6	2,262.6	2,731.8	3,267.1	3,527.8	2,615.1
Total Supply	2,062.9	2,007.1	2,511.4	2,409.1	2,733.4	3,205.5	3,307.4	3,263.1	3,524.4	3,324.8



Petroleum, kilotonnes



Electricity Prices (Avg. End User Tariff)



Renewable Energy (Wood fuel)

- Cultivation (mainly by natural regeneration)
 - Harvesting
 - Processing
 - Bulk Supply
 - Transportation
 - Retail
 - Services
-
- *Wood fuel is liberalised



Key Policy issue

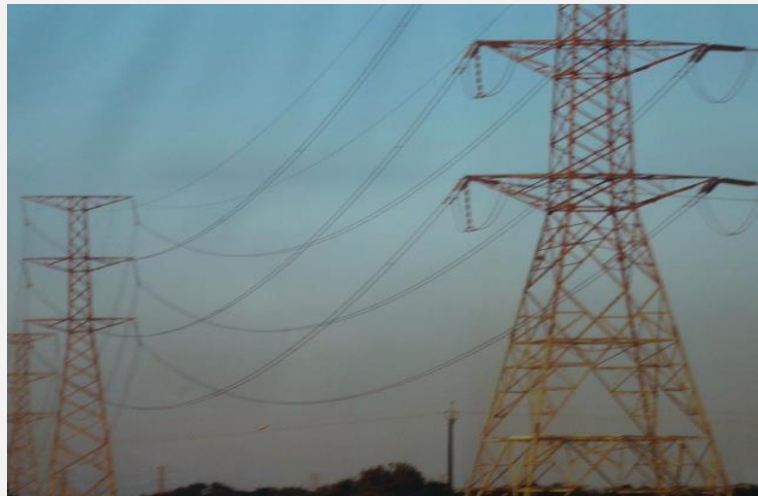
- Monopolies lead to Price inefficiencies/distortion and is against the interest of the Consumer
- Petroleum price de-regulation (multiple BDCs, Multiple OMCs,
- Solar PV market (71 licensed suppliers/installers)
- In case of natural monopolies – de-couple production/supply and transmission (Wholesale suppliers-Gridco-ECG/NEDCo/Enclave



POWER SUB-SECTOR

Issues

- Power supply shortages: frequent interruptions
- Inadequate access to electricity – 80.51% national access
- Poor financial health of Utility Companies/Funding
- High system losses
- Fuel for Power Plants

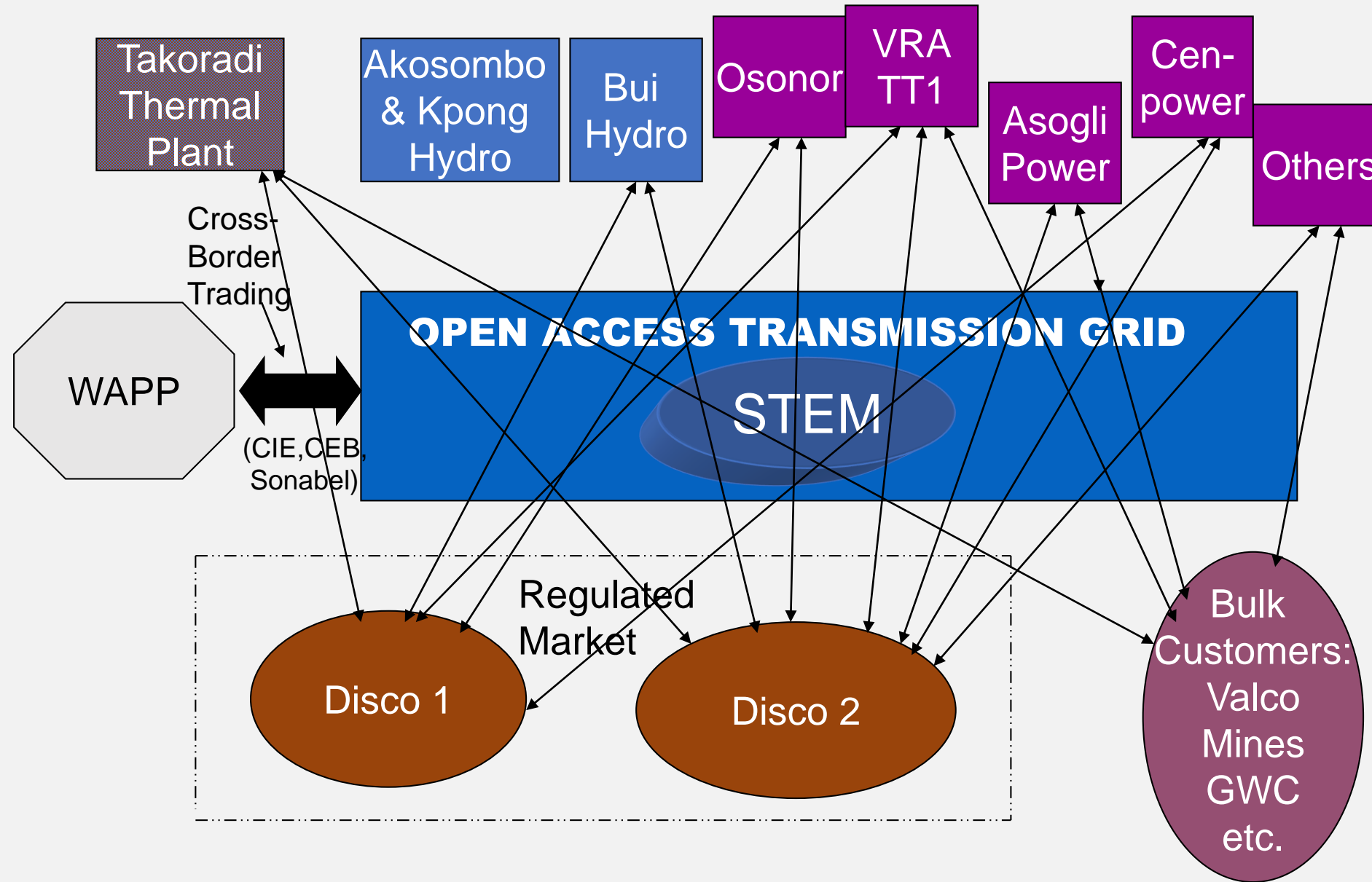


Policy Goals

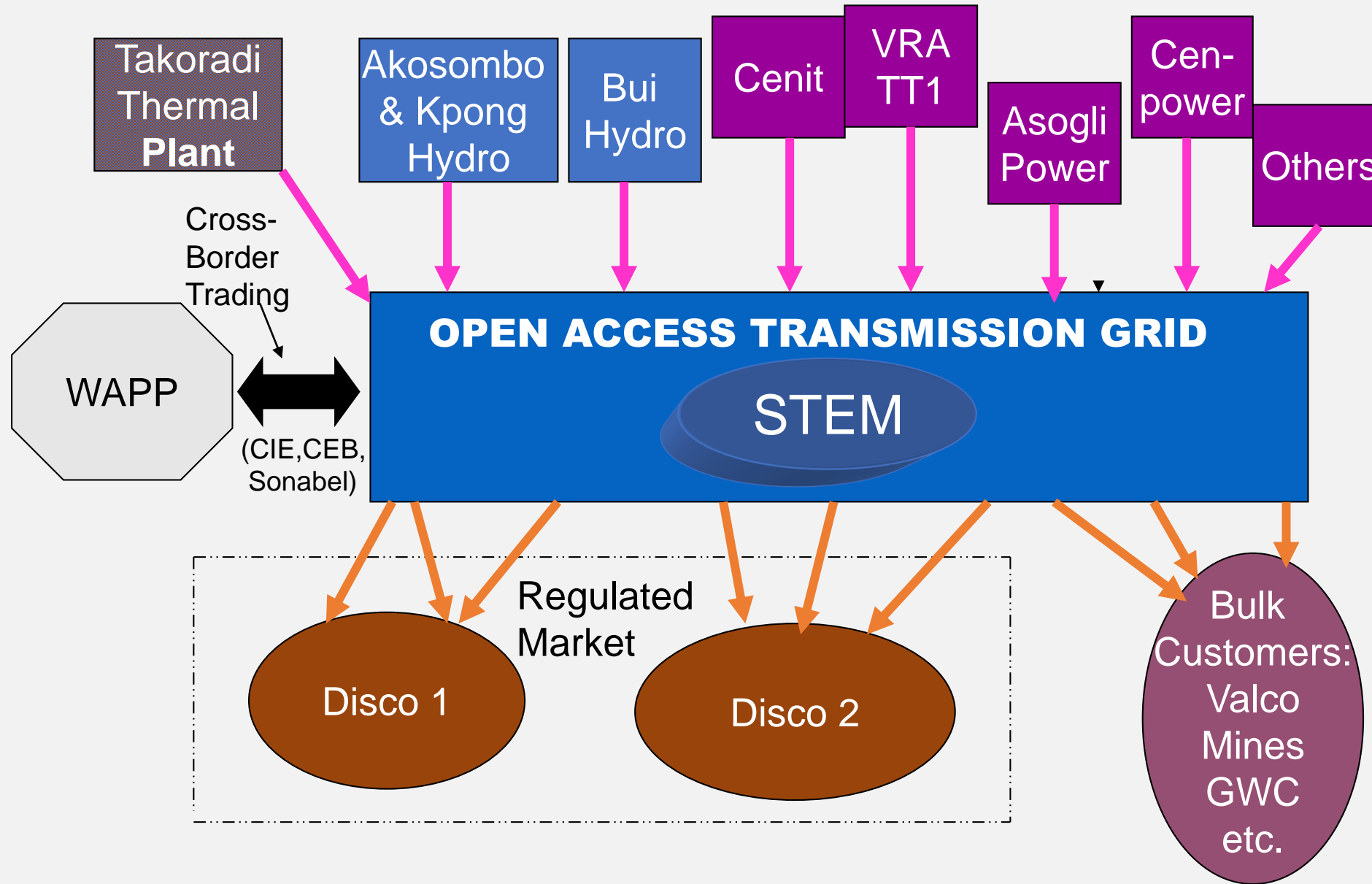
- Increase power generation capacity to 5,000 MW by 2020
- Improve and modernise distribution infrastructure and reduce system losses: 23% to 18% by end of 2020
- Develop a non-constrained transmission network by 2020
- Operate Wholesale Electricity Market ([WEM](#))
- Achieve universal access by 2020 (84% by end of 2016)
- Restore financial health of Utility Companies by achieving cost-efficient tariffs
- Strengthen Capacity of Regulatory Agencies



WESM Transactions – Power Supply Contracts



STEM Transactions – Merit Order Dispatch



Energy Policy on Renewables

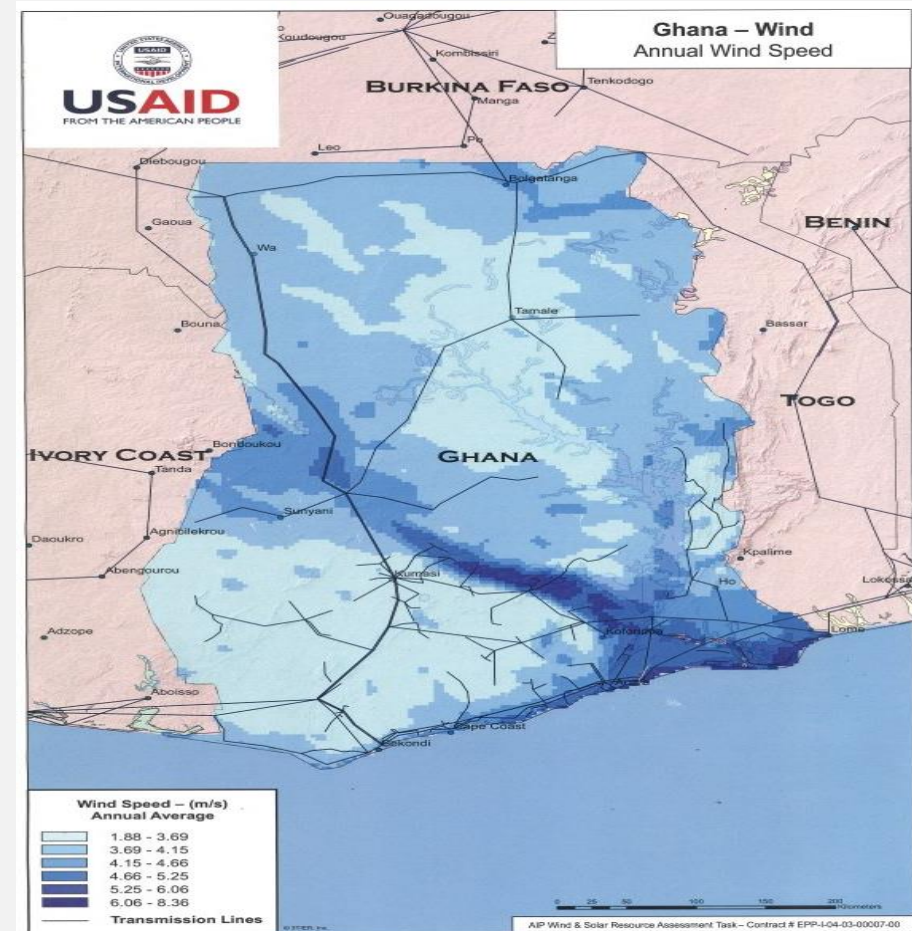
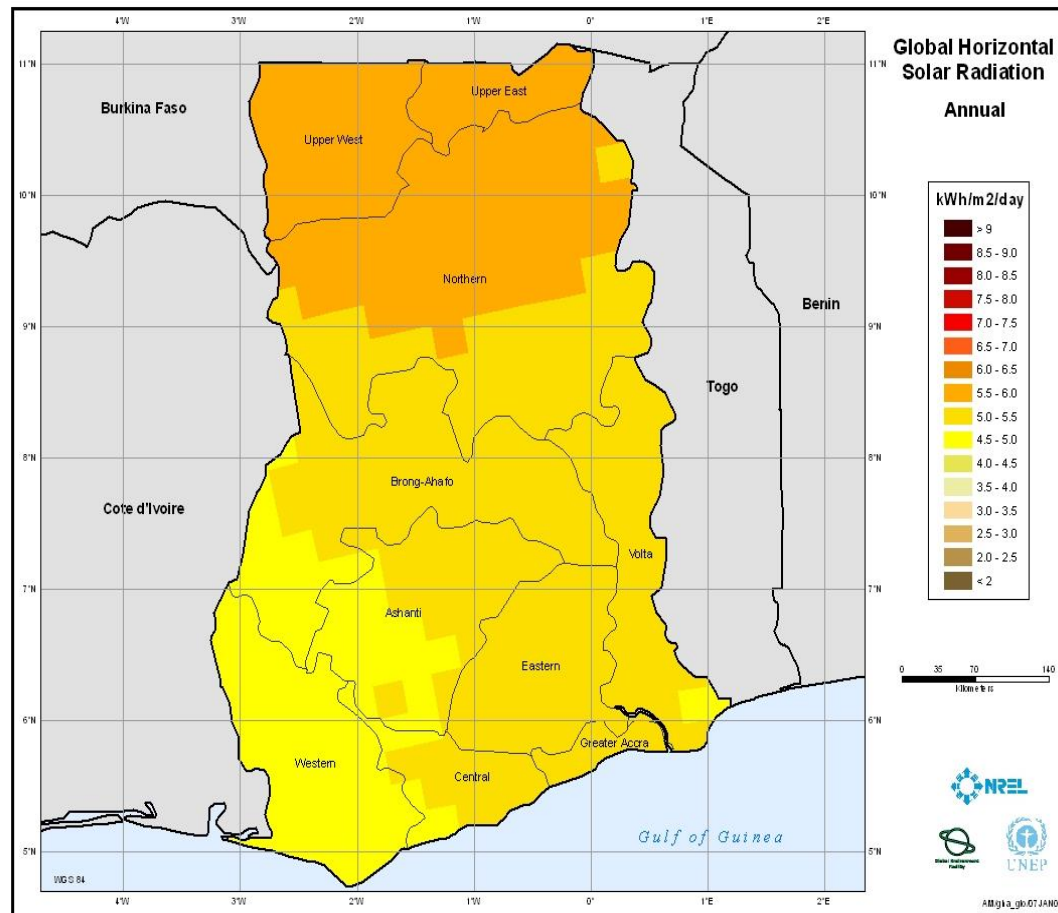
- to promote the development, management and utilization of renewable energy, for heat and power production, diversify energy supplies, safeguard energy security, protect the environment, and realize the sustainable development of the economy and society
- To diversify energy supply, to provide for reliable, affordable, sustainable energy supply.



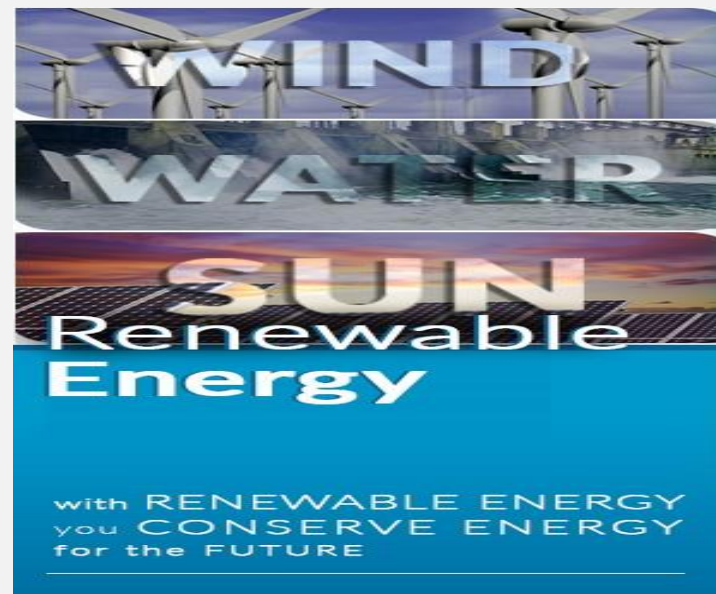
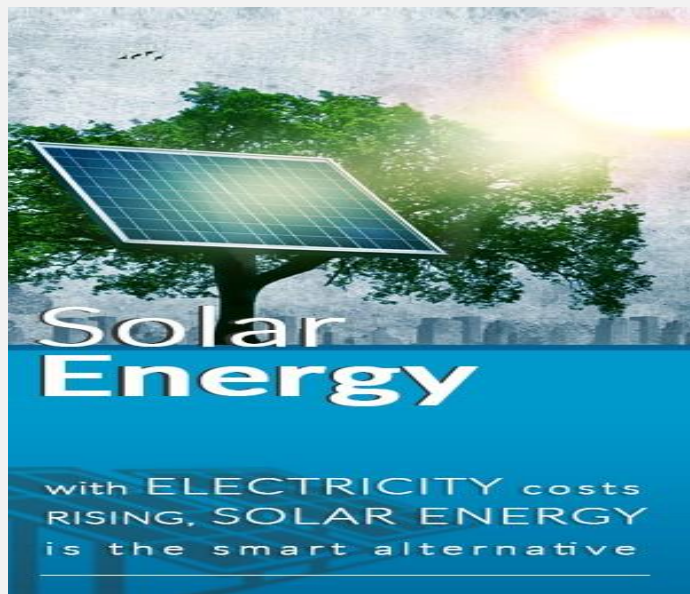
Renewable Resources in Ghana

- Currently Ghana has two grid tied utility scale solar power plant in the 2.5 MW VRA solar plant in Navrongo in the Upper East and 20 MW BXC solar plant in Winneba in the Central Region.
- There is a 100 KW waste to energy power plant (Safisana) in the Greater Accra region of Ghana.
- There are mini and micro hydro resources available.

Some renewable energy resource in Ghana

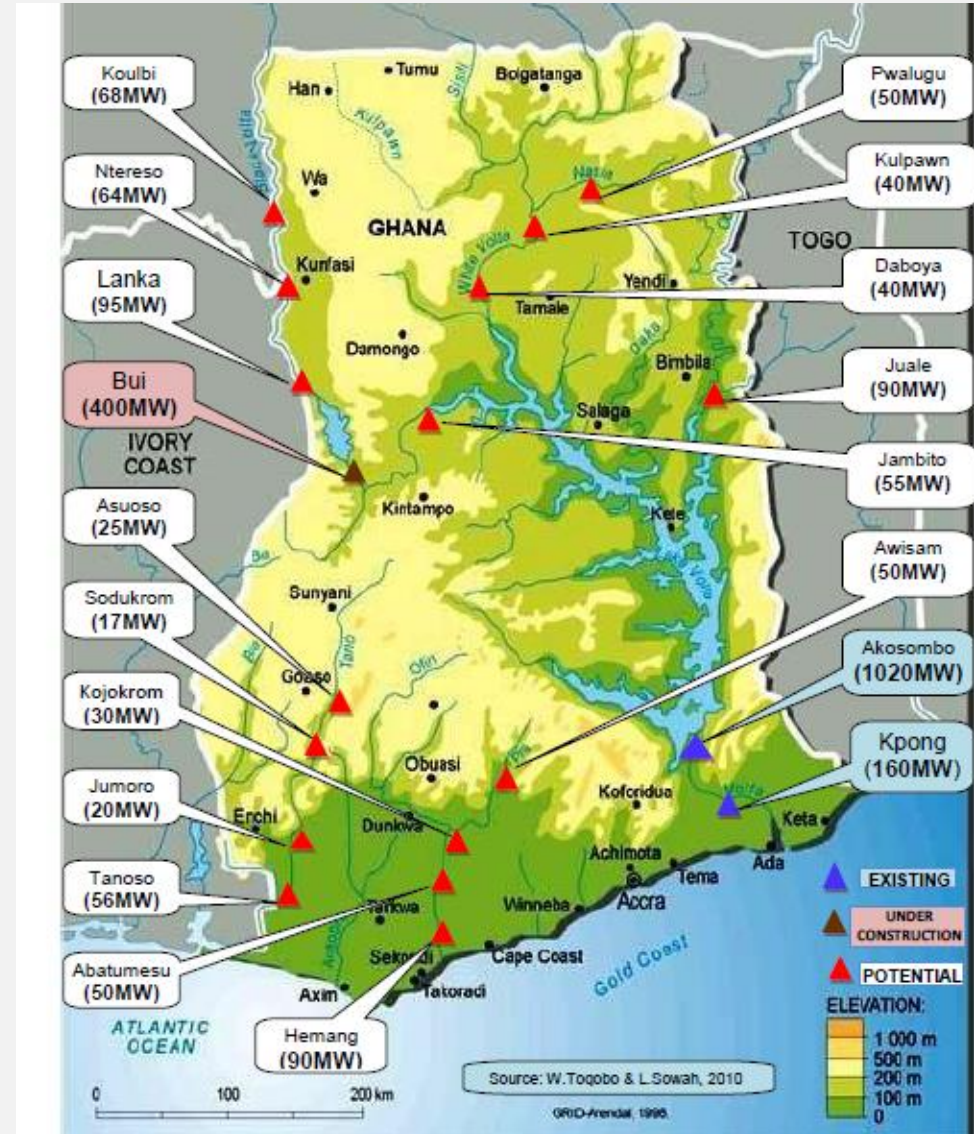


- Promoting renewable energy



Renewable Resources in Ghana

Potential Mini Hydro Sites in Ghana



MEDIUM TERM POLICY FOCUS

- Increase access to adequate, reliable and economically priced modern forms of energy supply.
- Diversify the national energy mix including the use of environmentally friendly indigenous sources of energy.
- Ensure efficient management of the energy sector.
- Ensure productive and efficient use of energy.
- Promote Private Sector Participation in the energy sector.



Government Energy Strategy (Renewable)

- Renewable Energy Act 2011 (Act 832)
- Feed-in Tariff
- National Rooftop Programme
- Distributed system for Island communities



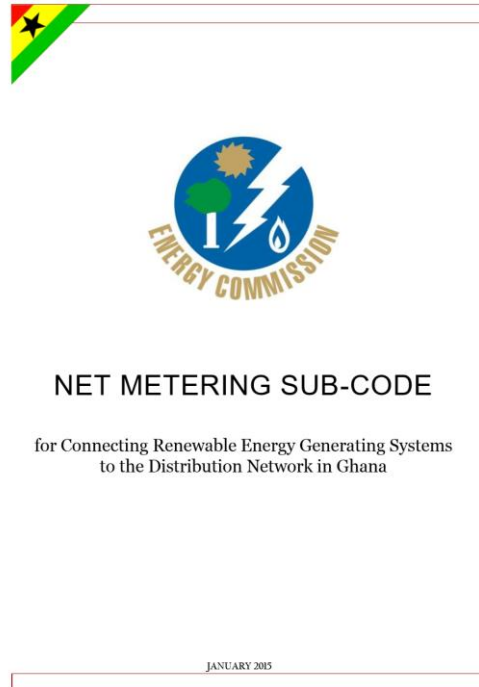
Renewable Energy

- Policy goal: 10% of total energy mix by 2020
- Renewable Energy Act
- Renewable purchase obligations
- Feed – in – tariffs
- Net metering code
- Mini Grids

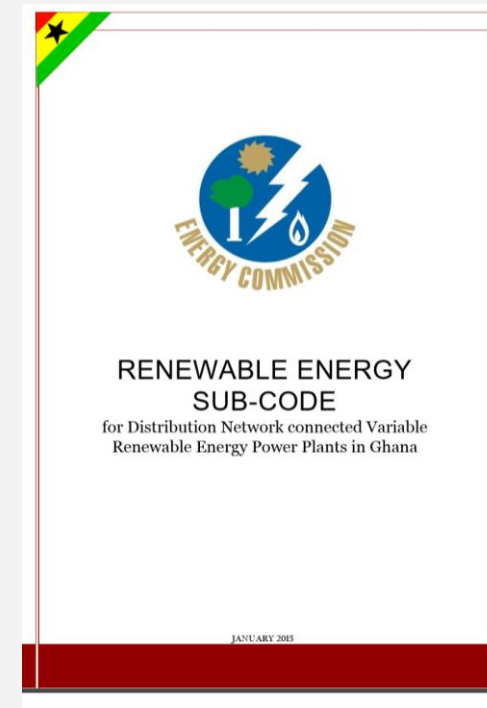
Ghana has now moved to Procurment of Renewable Energy Projects through competitive bidding



Existing instruments



- The Renewable Energy Act, 2011 (Act 832)
- Renewable Energy Sub-Code for Transmission System (NITS)
- Renewable Energy Sub-Code for Distribution Network
- Net Metering Sub-Code for connecting Renewable Energy Generating Systems to the Distribution System
- Net-metering Guidelines
- *Guaranteed renewable energy feed-in-tariffs
- Guidelines and modalities for the Renewable Energy Purchase Obligation (REPO)
- Standardised Power Purchase Agreement Template



Challenges and Opportunities

- Recent tariff levels have boosted prospects for solar PV systems as rates for customers within certain tariff bands (residential and non-residential customer categories) have become higher than the Levelised Cost of Electricity (LCOE) produced by rooftop Solar PV.
- The savings made in using solar will be further enhanced by the implementation of the net metering scheme.



Tariff Analysis and Savings from Solar

Potential savings for RESIDENTIAL CUSTOMERS using solar PV systems with batteries

Tariff Category	Tariff Band (kWh)	PURC Approved Rates (Gp/kWh)	PURC Approved Rates (US Cents/kWh)	LCOE from Solar PV with batteries (US Cents/kWh)	Savings (US Cents/kWh)
1 st Tier	0-50	33.56	8.67	22.41	-13.74
2 nd Tier	51-300	67.33	17.40	22.41	-5.01
3 rd Tier	301-600	87.38	22.58	22.41	0.17
4 th Tier	600+	97.09	25.09	22.41	2.68



Tariff Analysis and Savings from Solar

Potential savings for RESIDENTIAL CUSTOMERS using solar PV systems without batteries

Tariff Category	Tariff Band (kWh)	PURC Approved Rates (Gp/kWh)	PURC Approved Rates (US Cents/kWh)	LCOE from Solar PV with batteries (US Cents/kWh)	Savings (US Cents/kWh)
1 st Tier	0-50	33.56	8.67	16.30	-7.63
2 nd Tier	51-300	67.33	17.40	16.30	1.10
3 rd Tier	301-600	87.38	22.58	16.30	6.28
4 th Tier	600+	97.09	25.09	16.30	8.79



Tariff Analysis and Savings from Solar

Potential savings for NON - RESIDENTIAL customers using solar PV systems with batteries

Tariff Category	Tariff Band (kWh)	PURC Approved Rates (Gp/kWh)	PURC Approved Rates (US Cents/kWh)	LCOE from Solar PV with batteries (US Cents/kWh)	Savings (US Cents/kWh)
1 st Tier	0-300	96.7909	25.01	22.41	-0.57
2 nd Tier	301-600	102.9959	26.61	22.41	1.03
3 rd Tier	600+	162.54141	41.99	22.41	16.41



Tariff Analysis and Savings from Solar

Potential savings for NON - RESIDENTIAL customers using solar PV systems without batteries

Tariff Category	Tariff Band (kWh)	PURC Approved Rates (Gp/kWh)	PURC Approved Rates (US Cents/kWh)	LCOE from Solar PV with batteries (US Cents/kWh)	Savings (US Cents/kWh)
1 st Tier	0-300	96.7909	25.01	16.300	8.71
2 nd Tier	301-600	102.9959	26.61	16.300	10.31
3 rd Tier	600+	162.54141	41.99	16.300	25.69



Solar PV Investment Challenges in Ghana

Increasingly therefore, consumers are becoming aware of the benefit of the Rooftop Solar PV but the initial upfront cost of installation is the key hindrance. The Upfront cost of Solar PV Systems are high for most prospective beneficiaries and Solar Installers are also not financially strong to offer them the system on hire purchase or other flexible terms of payment.

Commercial Bank interest rates are also generally high and no special rates are offered for this programme by these Banks.



Investment Opportunities for Solar PV Business in Ghana

- Funding upfront cost with flexible payment terms for beneficiaries (revolving fund) with competitive interest rates will lead to high patronage.
- Setting up an assembly plant for the assembly of solar PV system components and subsequent supply of BoS and panels on Hire Purchase also offers an opportunity for investors.
- Obtaining Electricity Sales Licence and selling electricity at competitive rates to customers from Renewable Energy Sources is a potential for investment.



Acquisition of Bulk Charcoal Transportation Licence

Required Submissions

- Exhibit CT1 - Individual's name/Company Registration and locational address.
- Exhibit CT2 - Registration number, capacity and type of bulk road vehicle.
- Exhibit CT3 - Insurance cover for vehicle.
- Exhibit CT4 - Road worthiness certificate.
- Exhibit CT5 - Receipt of Initial Licence Fee

Procedure for the Acquisition of Bulk Charcoal Transportation Licence

- a. An applicant shall submit a signed application letter addressed to the Executive Secretary of the Commission.
- b. Applicants shall fill and submit one original application form signed by a Principal Officer (reference Application Form).
- c. Applicants shall attach receipt confirming the payment of prescribed licence application fee (reference Schedule of Licence Fee).
- d. Applicants shall provide two (2) hard copies and a soft copy (if available) of the above exhibits as separate attachment, clearly labelled and all sequentially numbered.
- e. The applicant shall provide the receipt confirming the payment of the Licence fee after the Commission has communicated the Outcome Decision on an application to the applicant.

Licence Conditions

- a. The licence holder shall provide to the Commission the following information:

Name of company/transporter

Date of transportation of charcoal	Source of charcoal purchased	Quantity transported (number bags/kg) of	Destination

Existing Licensing manuals

- Importation Licence
- Wholesale Electricity Supply Licence
- Installation and Maintenance Licence
- Bulk Charcoal Production Licence for Export
- Bulk Charcoal Transportation Licence
- Charcoal Export Permit
- Briquette/Pellet Production Licence
- Briquette/Pellet Export Licence
- Biofuel Production Licence
- Bulk Biofuel Storage Licence
- Biofuel Export Licence



Renewable Energy Application Process

- <http://energycom.gov.gh/files/Wholesale%20Electricity%20Supply%20Licence%20-%20FINAL.pdf>



Government Energy Strategy

- to develop least cost, reliable and sustainable energy sources
- RE to account for 10% of new energy supplies by 2030.



Risk Assessment

Ghana		
GDP Mill.\$ [+]	2016	42,690M.\$
GDP per capita [+]	2016	1,513\$
Debt [+]	2015	26,720 M.\$
Debt (%GDP) [+]	2015	71.50%
Debt Per Capita [+]	2015	969\$
Expenditure (M.\$) [+]	2015	9,205.9
Education Expenditure (M.\$) [+]	2014	2,385.9
Education Expenditure (%Bud.) [+]	2014	21.02%
Gov. Health Exp. (%Bud.) [+]	2014	6.82%
Defence Expenditure (M.\$) [+]	2016	161.9
Defence Expenditure (%Bud.) [+]	2011	2.80%
Expenditure (%GDP) [+]	2015	24.63%
Expenditure Per Capita [+]	2015	334\$
Education Expenditure P.C [+]	2014	88\$
Gov. Health Exp. P.C. [+]	2014	30\$
Defence Expenditure P.C. [+]	2016	6\$
S&P Rating [+]	10/24/2014	B-
Fitch Rating [+]	05/12/2017	B
Competitiveness Ranking [+]	2016	119 ^o



Brief overview and size of key energy project opportunities (public and private sectors) in Ghana.

- Natural Gas Pipelines
 - Takoradi to Tema
 - Prestea to Nyinahin, Kumasi, Buipe
- LNG Infrastructure (FSRU or Land Based)
- LPG Storage and Transportation Facilities
 - More Storage of LPG in the Middle Belt and in the North
 - LPG Pipelines and Depots (Atuabo to Pumpuni Depot and Pipeline, Volta Lake to Kumasi, LPG Barges)
- 200,000 Rooftop Solar Initiative
- Capacity Building – Technical, Gas pipeline operations, Solar Installation and maintenance expertise and regulation (on-the job training for engineers and technicians)
- Large Scale Solar and Wind Energy Infrastructure provided they are affordable





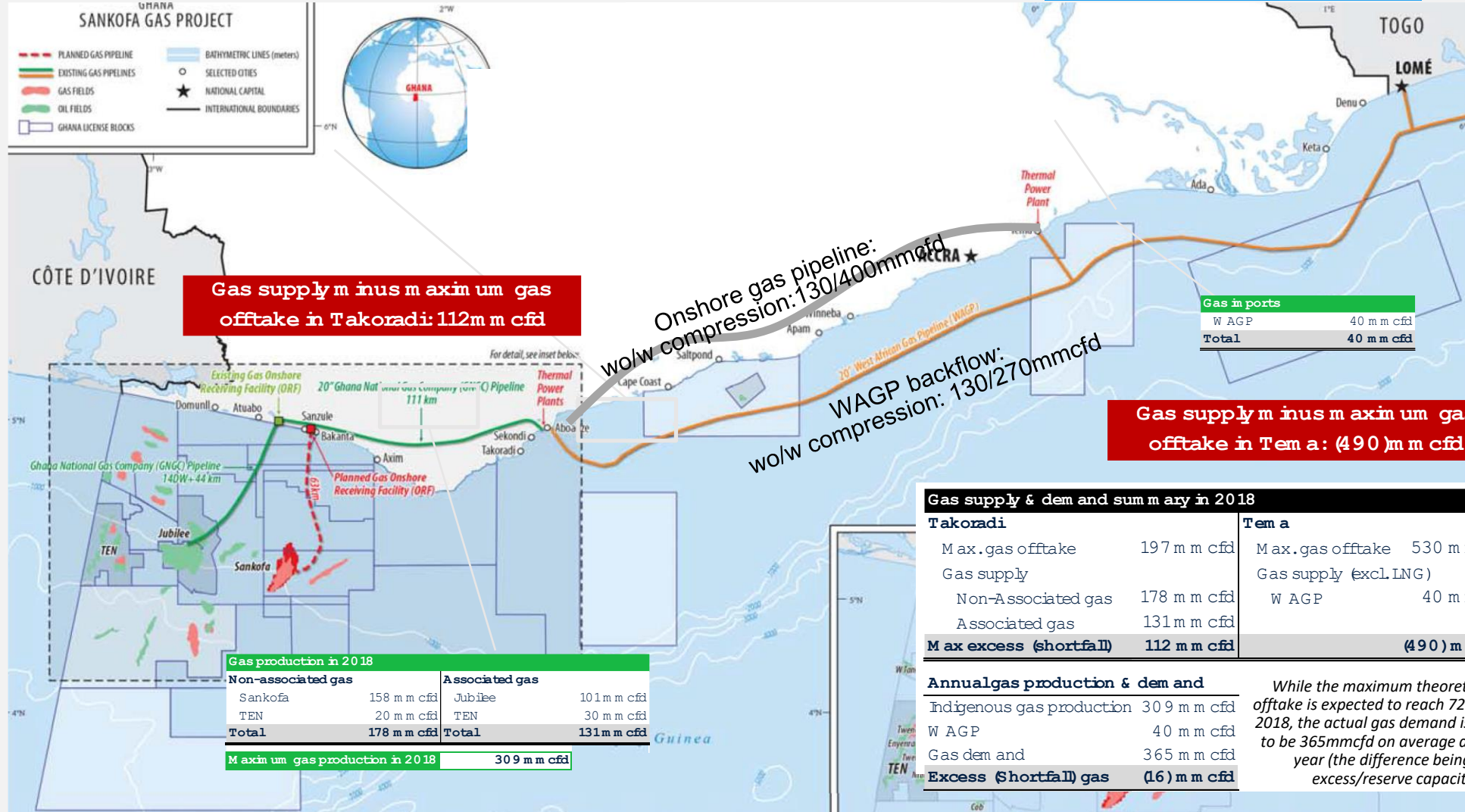
Ghana Thermal capacity & Gas supply in 2018:

Takoradi				
Existing		Ongoing construction	Com m itted	
T1	300 MW		T3	120 MW
T2	320 MW			
Am eri	230 MW			
Total	850 MW	Total	Total	120 MW
M axim um gas offtake	174 m m cfd	M axim um gas offtake	M axim um gas offtake	22 m m cfd

Total them alsupply Takoradi	970 MW
M axim um gas offtake	197 m m cfd

Tema					
Existing		Ongoing construction	Com m itted		
TT1PP	100 MW	KTPP Ph1	200 MW	AKSA	370 MW
TT2PP	30 MW	TT2PP-X	32 MW	Kapower2 (incr.)	235 MW
Sunon-AsogliPh1	180 MW	Cenpower	310 MW	Early Power	310 MW
CEN II	100 MW	Sunon-AsogliPh2-1	180 MW	Sunon-AsogliPh2-2	180 MW
Kapower1	215 MW	Trojan II II	44 MW	Trojan III	50 MW
Total	625 MW	Total	766 MW	Total	1,145 MW
M axim um gas offtake	136 m m cfd	M axim um gas offtake	161 m m cfd	M axim um gas offtake	232 m m cfd

Total them alsupply Tema	2,536 MW
M axim um gas offtake	530 m m cfd



Gas production in 2018			
Non-associated gas		Associated gas	
Sankofa	158 m m cfd	Jubilee	101 m m cfd
TEN	20 m m cfd	TEN	30 m m cfd
Total	178 m m cfd	Total	131 m m cfd

M axim um gas production in 2018 309 m m cfd

Gas supply & dem and sum m ary in 2018			
Takoradi		Tema	
M ax. gas offtake	197 m m cfd	M ax. gas offtake	530 m m cfd
Gas supply		Gas supply (excl. LNG)	
Non-Associated gas	178 m m cfd	W AGP	40 m m cfd
Associated gas	131 m m cfd		
M ax excess (shortfall)	112 m m cfd		(490) m m cfd

Annual gas production & dem and	
Indigenous gas production	309 m m cfd
W AGP	40 m m cfd
Gas dem and	365 m m cfd
Excess (shortfall) gas	(16) m m cfd

While the maximum theoretical gas offtake is expected to reach 727 m m cfd in 2018, the actual gas demand is expected to be 365 m m cfd on average during the year (the difference being the excess/reserve capacity)



Thank You
감사합니다

