

Ghana's Long Term Energy Development Plans

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Mandate of the Commission

- The Energy Commission was established by Energy Commission Act 1997 (Act 541) is to among other things :
 - ❖ To serve as the Government's energy policy advisor by making national energy policy recommendations to the Minister for Energy;
 - ❖ To formulate national policies for the development and utilization of indigenous energy resources e.g. renewable energy (solar, wind and biomass);
 - ❖ To prepare, review and update periodically **indicative national plans** to ensure that all reasonable demands for energy are met.
 - ❖ To license and regulate the technical operations of service providers in the **electricity** and **natural gas** industry;

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Indicative Energy Planning means the Big Picture !!

- **Indicative National Energy PLAN** means:
 - ✓ Projecting/estimating the **Total National energy demand** should there be no constraints in energy supply; Or.
 - ✓ What is the **potential energy demand** if *all constraints* in the economy are removed?
 - ❖ *Unconstrained demand* means **bottom-up** approach of demand analysis.
 - ✓ Energy Demand by both Formal and Informal sectors (*the latter largely escape or under-estimated by the traditional GDP radar*)
 - ✓ **Potential energy demand** is the **barometer** or **bar** for sector engineering agencies to work to reach or clear.

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Policy Recommendations *to remove the constraints.*

ENERGY COMMISSION then through stakeholder consultation make policy recommendations as how best to remove the constraints.

- Projecting/estimating **Total National Energy Demand** or, **Indicative National Energy PLAN** means
 - Projections based upon *sum* of **existing consumption** and **unmet/deficit/suppressed demand**.
- **In 2000**, the *first long-term integrated sustainable energy plan* called **Strategic National Energy Plan (SNEP)** was initiated. **SNEP1 (2006-2020)** was completed and published in 2006.
- **SNEP1** has been updated to **SNEP II (2016-2030)**

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Strategic goes beyond Traditional Planning

- **Strategic Planning** because:
 - 1) NOT only on **expansion of existing facility** but
 - 2) **Fuel and technology diversification** as well; *multi-way solution* as well as **Energy Efficiency and Conservation measures**.
 - 3) Not necessarily **least cost** but **Optimum cost** taking into consideration
 - ❖ *Technology robustness, socio-economic and environmental issues, Life cycle cost analysis*
 - 4) Not only **financial benefits** but **job creation, supply security and environmental integrity**.
 - 5) Not short but **Long term; 15 years and beyond**.

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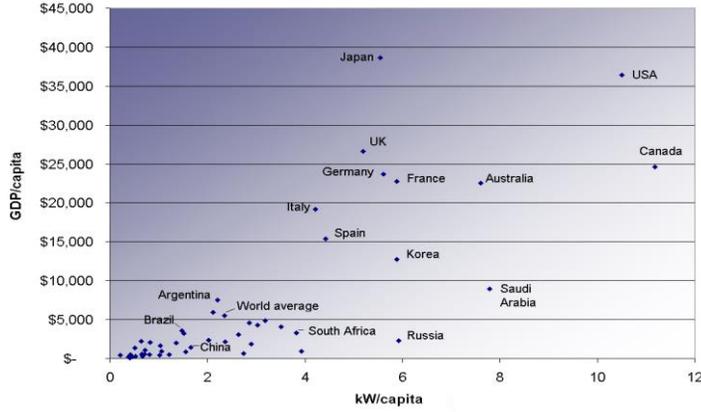
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Forms of Demand projections

- **Utility entities – GRIDCo, VRA, ECG, etc**
 - Short to medium term; *1-5 years*
 - Operational + business-oriented (actuals/existing/BaU*)
 - Sector specific
- **Energy Commission**
 - Medium to Long term; 5-20 years
 - Policy based
 - Indicative; bottom-up
- **National Development Planning Commission (NDPC)**
 - Long term; 20 years and more
 - Top-down
 - Visionary based

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Energy use and Economic Growth Linkages

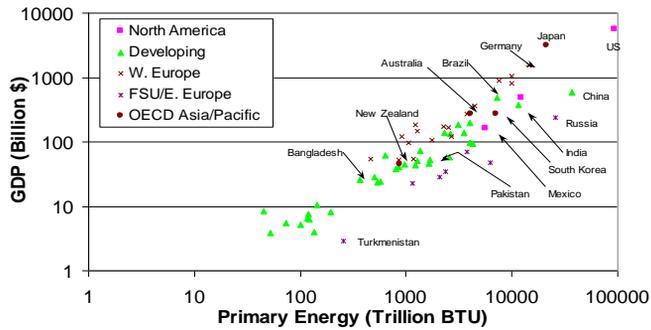


Higher per capita GDP implies higher electricity use per capita and vice versa

Energy-Economy Nexus

Poor countries have **low energy consumption per capita**

Energy is simply the ability to do work; poor energy thus translate into poor economy



Overview of the TWO Scenarios for SNEPII: 2016-2030

Scenario Name	Description of scenario	2020	2030
Business-as-Usual (BaU) <i>nominal</i>	Population growth rate follows historical trend	31.0 million <i>*AGR of 2.3%</i>	38.0 million <i>**AGR of 2.17%</i>
	GDP growth rate follows historical trend	US\$ 45.5 billion <i>*AGR of 3.5%</i>	US\$ 126.9 billion <i>**AGR of 7.1%</i>
Accelerated Economic Growth (AEG) <i>nominal</i>	Population growth rate decreases to 2.09% in 2030	30.8 million <i>*AGR of 2.2%</i>	37.4 million <i>**AGR of 2.09%</i>
	Average GDP growth rate of 8.3% to 2030	US\$ 76.20 billion <i>*AGR of 9.0%</i>	US\$ 158.6 billion <i>**AGR of 8.3%</i>

**Average growth rate from 2010 - 2020*

*** Average growth rate from 2010 - 2030*

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Energy use indicators

Indicator	2000	2010	2016	<i>Average for Low middle income benchmark</i>
Energy consumption per capita (kTOE)	315	260	250	500
Energy consumption per household (TOE)	1.17	1.45	1.42	1.50
Electricity consumption per capita (kWh)	363	337	403	500
Electricity consumption per household (kWh)	1,375	1,200	1,400	1,500
Biomass consumption per capita (kTOE)	196	102	98	120
Biomass consumption per household (kTOE)	725	600	580	500

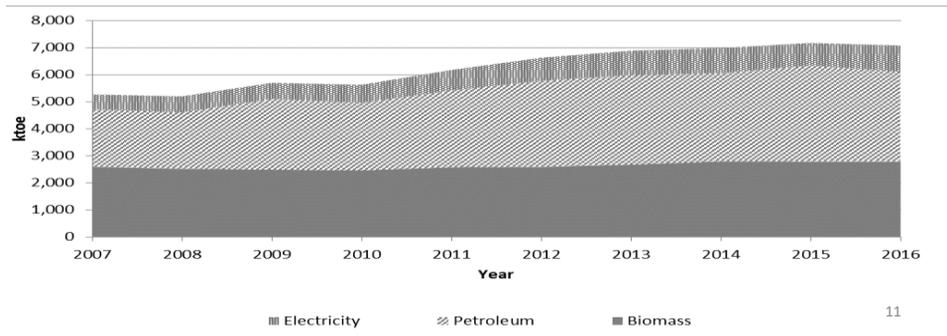
Sources: *Energy Commission, 2017; IEA, 2016*

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Final Energy Consumed (ktoe)

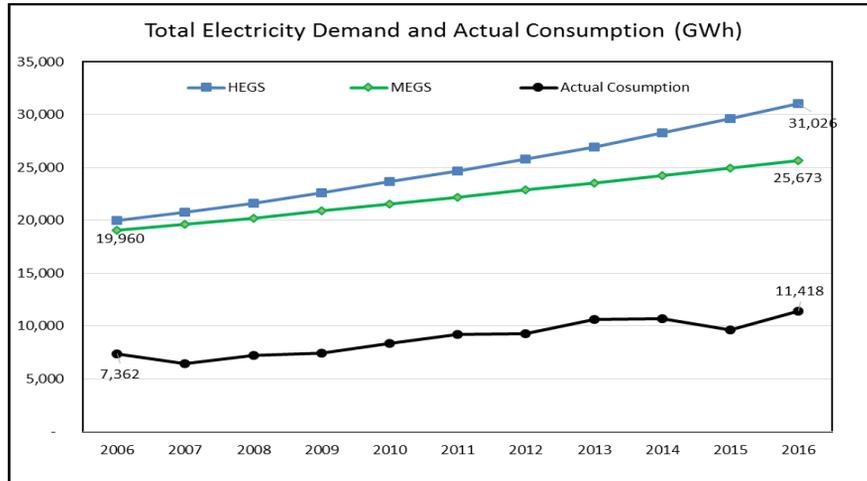
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Kilotonnes of Oil Equivalent (ktoe)										
Electricity	539	598	615	674	772	852	908	920	833	982
Petroleum	2127	2071	2598	2491	2827	3172	3303	3272	3545	3320
Biomass	2594	2518	2493	2464	2576	2589	2676	2792	2785	2783
Total	5260	5187	5706	5629	6174	6613	6887	6983	7162	7086
Percentage shares										
Electricity	10.3	11.5	10.8	12.0	12.5	12.9	13.2	13.2	11.6	13.9
Petroleum	40.4	39.9	45.5	44.3	45.8	48.0	48.0	46.9	49.5	46.9
Biomass	49.3	48.5	43.7	43.8	41.7	39.1	38.9	40.0	38.9	39.3



Major drivers for electricity demand

1. Achieving a universal electrification by 2020 through the National Electrification Scheme.
2. Residential sector demand fuelled by growth in living standards.
3. Aluminium production should VALCO be allowed to expand its operation;
4. Bauxite to Alumina production
5. Increasing Gold production due to the global demand;
6. Plans for 'one-district one-factory' throughout the country.
7. Growth of the Services sector

SNEP 1 Electricity Demand Projections and Actuals



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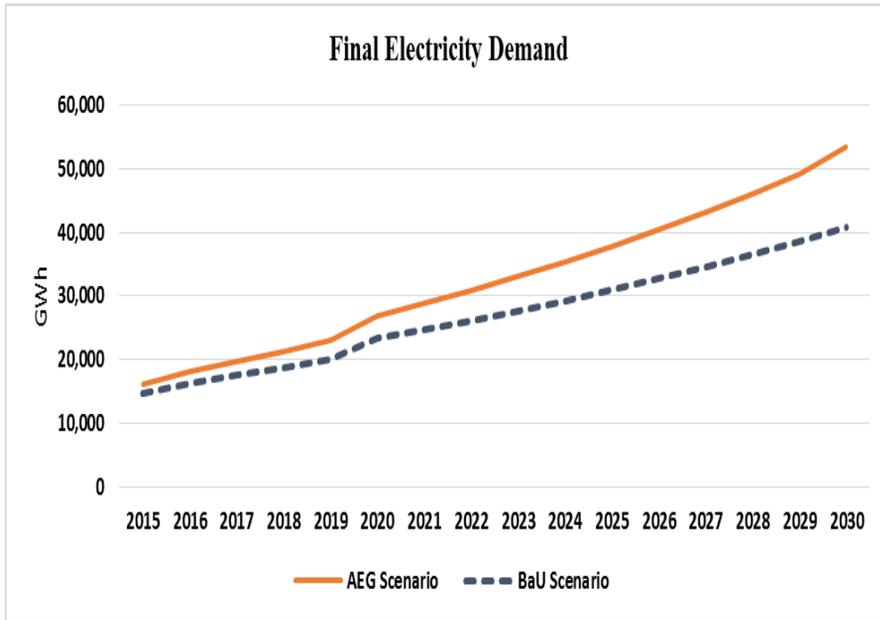
Why the shortfall?

Shortfall in actual electricity consumption compared to the demand projections for both scenarios for the following reasons:

- i. **VALCo was projected to operate 3 potlines** but actually **operated two potlines in 2006**, virtually ZERO from 2007-2010 and operated only ONE potline from 2011-2016. (1860 GWh reduced to 620 GWh)
- ii. Reduction in the country's lighting load from 2007 due to the replacement of about 6 million incandescent lighting bulbs with energy efficient CFL lamps in 2007 (which consequently reduced peak load by about 124 MW = 1,086 GWh).
- iii. Reduction in refrigeration load from 2012-2016 as a result of increased penetration of efficient refrigerator appliances promoted under an *Efficient Refrigerator Rebate Scheme* = 400GWh)
- iv. Inadequate electricity supplied due to **infrastructure constraints, fuel supply challenges** and **relatively high electricity tariffs**.

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Resulting Electricity Demand and Shares

Long term Electricity Demand

GWh

SECTOR	SUB-SECTORS	2016	2030	
			BaU	AEG
Household		7,730	16,382	21,138
	Urban	6,787	14,546	19,034
	Rural	943	1,836	2,104
Services		3,396	12,076	16,934
Industry		3,948	9,066	11,986
Agriculture		3.4	23	36
	Irrigation	1.4	13	24
	Others	2	10	12
Pipeline Transport		7.3	28	91
Total		15,085	37,575	50,184

Sectoral Shares

	2016	2030	
		BaU	AEG
Percentage Shares			
Household	51.2	43.6	42.1
Services	22.5	32.1	33.7
Industry	26.2	24.1	23.9
Agriculture	0.1	0.1	0.1
Pipeline transport	0.0	0.1	0.2

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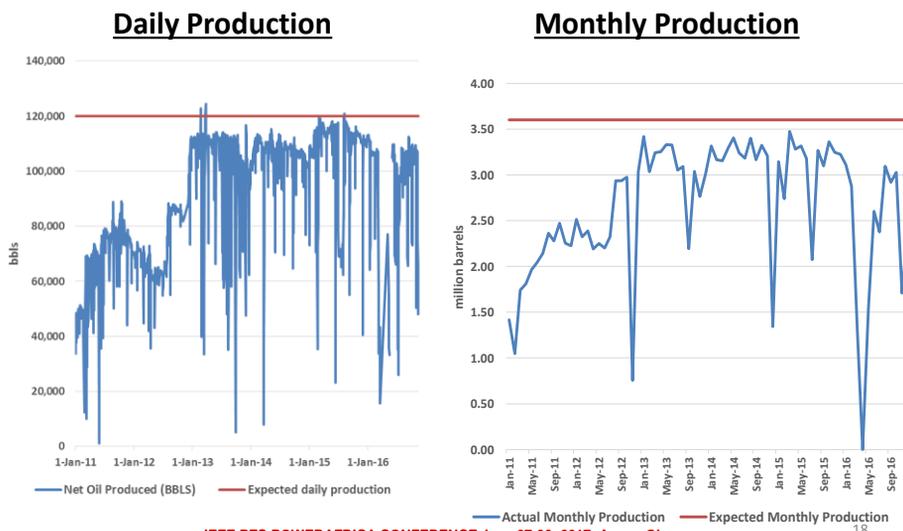
Major Challenges

- Inadequate supply of less expensive fuel
 - eg. *Gas, coal, etc.*
 - *Hydro resource almost exhausted*
- High electricity tariff
- Harmonization
 - Covering all scenarios.

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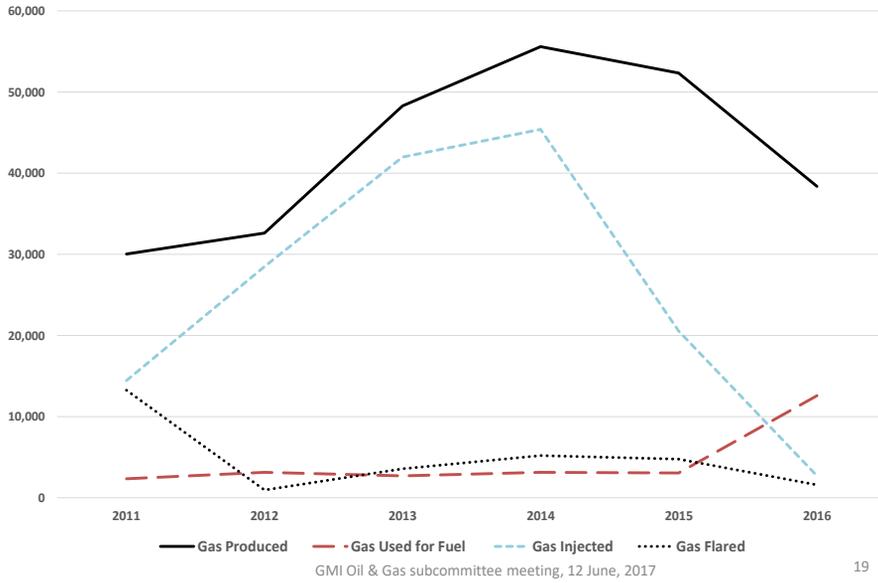
Jubilee field Oil Production 2011-2016



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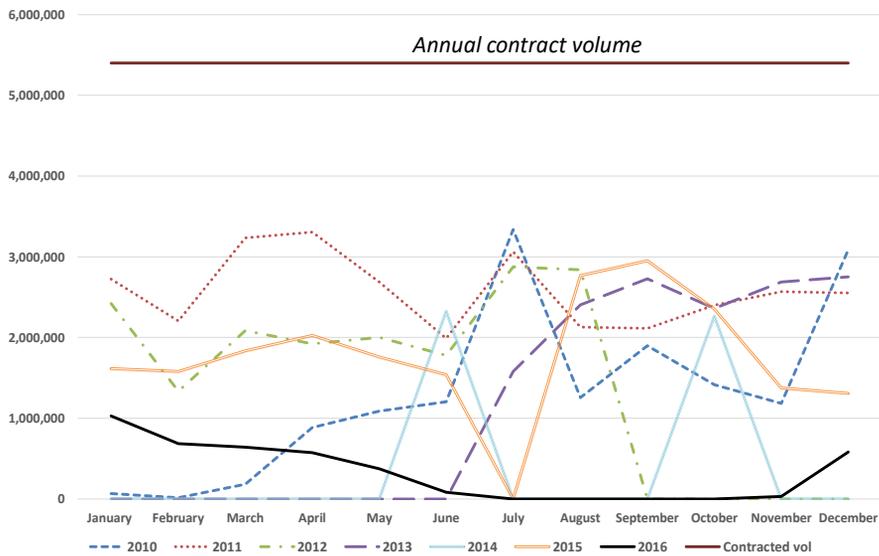
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Associated Gas from Jubilee field from 2011-2016 mmscf



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WAGP gas Supply inadequate and not reliable



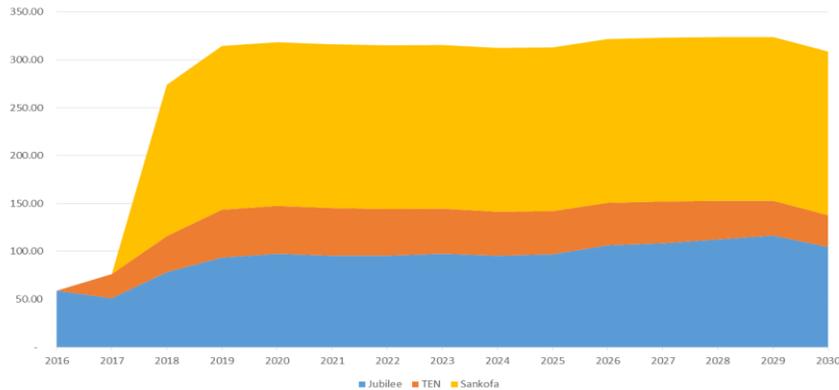
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Ghana going to relying more on domestic fields

Gas Production Volumes (mmscf) & Timing

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Jubilee	51	78	94	98	96	96	97	96	97	106	109	113	117	105
TEN	25	38	50	50	50	49	47	46	45	44	44	40	36	33
Sankofa	-	158	171	171	171	171	171	171	171	171	171	171	171	171
Total	76	274	315	318	316	315	316	313	313	322	323	324	324	309



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Conclusion

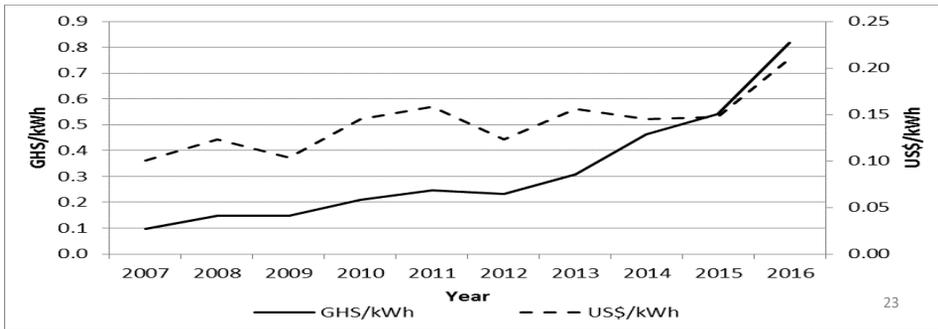
- Electricity demand would increase from about 16–18 TWh in 2016 at an average annual growth rate of 6.5-7.7% to 40-52 TWh in 2030 *depending upon the performance of the economy.*
- The relatively high electricity tariff would continue to impede industrial growth.
- High tariff creating opportunities for mass deployment of solar power
- Align to cover all the scenarios

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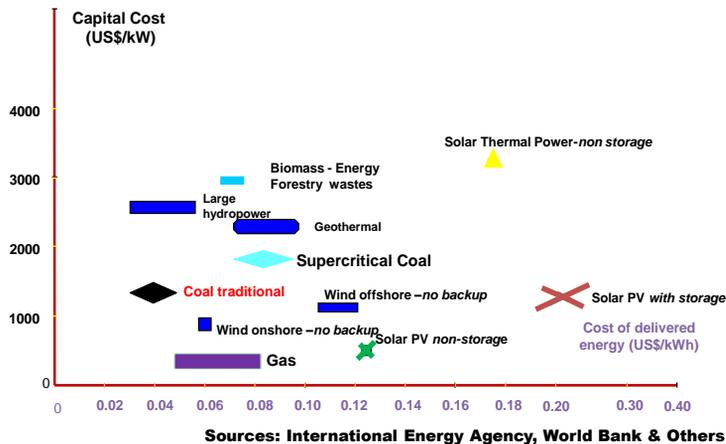
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Average Electricity End User Tariff **very high !!**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GHS/kWh	0.097	0.148	0.148	0.211	0.245	0.232	0.307	0.464	0.541	0.817
Exchange Rate (GHS/US\$)	0.97	1.20	1.43	1.45	1.55	1.88	1.97	3.20	3.68	3.89
US\$/kWh	0.100	0.123	0.104	0.145	0.158	0.124	0.156	0.145	0.147	0.210



Projected Average Capital and Delivered Electricity Costs in Sub-Saharan Africa



EXPECTED COST-COMPETITIVE ELECTRICITY SUPPLY

ECONOMIC SECTOR	COMPETITIVE PRICE /TARIFF RANGE	EXPECTED TOLERABLE QUALITY OF POWER
Industry Primary (<i>base metal, etc.</i>) Secondary (<i>tailletries, food, etc.</i>)	2-6 US cents/kWh 7-9 US cents/kWh	Base-load, highly stable (<i>gas, large hydro, coal, etc.</i>)
Agriculture (<i>irrigation</i>) Poultry/livestock	4-6 US cents/kWh 6-9 US cents	Base – intermediate load, fairly stable (<i>some solar and wind inclusive, in case of irrigation</i>)
Commercial/ Services	8-10 US cents/kWh	Intermediate to peak load, fairly stable (<i>highly stable if peak</i>)
Homes/Residential	10-15 cents/kWh	Intermediate load fairly stable Peak load highly stable

Serious **Industrial and commercial** growth requires relatively **cheap, stable baseload** sources of power which have largely been coal and **natural gas** for regions **without large hydro and existing nuclear power.**

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Opportunity for Deployment of Solar PV for the Commerce/Services Sector

The prevailing high Non-residential tariff is encouraging mass deployment of solar electricity

- feed-in tariff of
 - **18.24 US cents per kWh equivalent for systems without back-up storage** and
 - **20.14 US cents per kWh equivalent for systems with back-up storage**

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