Assessing Alternative Sources of Electricity in Georgia

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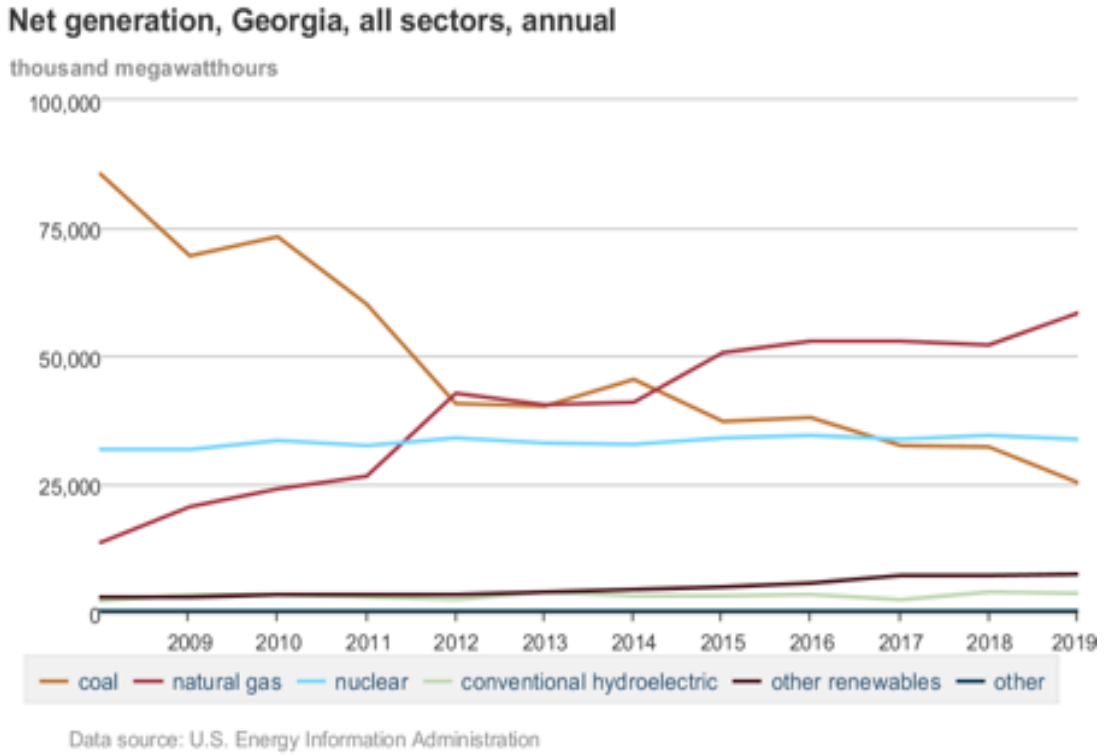
Background



- Georgia's electricity matrix has been dominated by coal, natural gas and nuclear.
- Renewables increased from 2.8TWh in 2009 to 7.2 TWh in 2019 (6% of electricity generated in GA).
- Biomass is the predominant renewable source of energy in GA. (71% of renewables, 4% of electricity generated in GA).
- Georgia Power expects to include about 340 MW of biomass and landfill gas capacity by 2021.

Objective: To assess the economic performance of two alternative sources of electricity in Georgia: cogeneration and landfill gas.

Cogeneration (CHP)

Implies the co-production of electricity and useful heat, for the use in industrial or commercial facilities and for heating and cooling purposes.

- Located where both electricity and thermal energy are needed and can be placed at individual facilities or be a utility resource or district energy .
- System configuration
  1. Topping cycle CHP
  2. Bottoming cycle (WTP)
- Overall efficiency of 65%-75% (U.S. DOE).
- Benefits: energy efficiency, reducing energy operating costs, reducing GHG emissions, energy security, resiliency and reliability, enhancing energy infrastructure and job creation.
- 41 CHP facilities in GA (installed capacity of 1.44 GW)

Source: Energy News Network, 2017

Landfill Gas (LFG)

Generated from the anaerobic decomposition of organic waste in landfills.

- Used to generate electricity (72%), replace another fuel (18%) or upgraded to renewable natural gas (10%).
- System configuration
  1. Extracted from landfills using wells and a blower/flare system.
  2. Transports to a central point where it can be processed (up to three stages).
  3. Ultimate use
- Benefits: replaces non-renewable sources of energy, reduce GHG emissions, water pollution and health risks, improves safety, odor control, job creation, generate revenue and reduce compliance costs.
- Georgia has 93 landfills totaling more than 495 Mt of waste.
  - 21 operational (15 generate electricity, total installed capacity of 56 MW)

Methods

Levelized Cost of Electricity

$$LCOE\ (\$/MWh) = \frac{\sum_{t=0}^{n}[(C_t + O_t + F_t)/(1+r)^t]}{\sum_{t=0}^{n} E_t/(1+r)^t}$$

Assumptions

Discount rate (%)	**6.6%**
Lifetime (years)	25
Production Tax Credit ($/MWh)	12
Production Tax Credit Term (years)	10
Financing Interest Rate (%)	5.3%
Financing Term (years)	15
Renewable Energy Certificates (RECs) ($MWh)	15

Existing plants in GA and inputs

Technology	**Cogeneration**			**Landfill Gas**		
Power Plant	**Albany Green**	**Riverwood**	**Flint River**	**Oak Grove**	**Pine Ridge**	**Richland Creek**
Capital investment ($)	200,000,000	275,040,000	316,110,000	21,420,000	22,440,000	37,060,000
Fixed O&M Cost ($)	299,485	3,569,574	2,092,836	114,144	114,144	192,384
Non-Fuel Variable O&M Cost ($)	819,295	4,362,966	2,683,978	358,469	410,032	743,783
Fuel Costs ($)	31,763,583	9,140,151	12,972,954	1,108,201	1,384,489	2,758,593
Nameplate Capacity (MW)	54	76	77	6	6	11
Net Electricity Generation (MWh/year)	308,859	496,197	437,455	30,613	35,298	65,082
Heat Rate (Btu/kWh)	10,888	4,884	4,413	8,739	8,844	9,964
Capacity Factor (%)	66	74	65	55	64	71

Results

	Cogeneration			Landfill Gas		
$2018 / MWh	**Albany Green**	**Riverwood**	**Flint River**	**Oak Groove**	**Pine Ridge**	**Richland Creek**
Levelized Capital Cost	49	42	55	53	48	43
Levelized Fixed O&M Cost	1	7	5	4	3	3
Levelized Non-Fuel Variable O&M Cost	3	9	6	12	12	11
Levelized Fuel Cost	103	18	30	36	39	42
Levelized PTC	(7)	(7)	(7)	(7)	(7)	(7)
LCOE	**149**	**69**	**88**	**98**	**95**	**93**
Levelized RECs	(15)	(15)	(15)	(15)	(15)	(15)
LCOE with RECs	**134**	**54**	**73**	**83**	**80**	**78**

Sensitivity

Capital investment (improved technology)	Results show that the LCOE of all the plants decreases by about $5/MWh, which represents a reduction of 3-6%
Fuel cost (change in supply and demand)	The LCOE ranges from $86 - $154/MWh when the fuel costs increases 20% and from $51 - 113$/MWh when the fuel costs decreases 20%

Conclusions and Recommendations

- Electricity generated from renewable sources is increasing in the US and in Georgia.
- CHP and LFG are available in GA, cost effective and there is potential for expansion.
- Other studies report that the LCOE for:
  - Four biomass plants in Virginia = 93-143$/MWh.
  - Natural gas = $41 to $78/MWh
  - Utility scale solar = $46 to $67/MWh
  - Coal = $59 to $143/MWh
  - Nuclear = $89 to $180/MWh
- LCOEs for CHP and LFG are high compared to utility scale solar and natural gas, similar to coal and lower than nuclear.
- Policy intervention is required for CHP and LFG to compete with solar and natural gas.
- Renewable Portfolio Standards are one of the most powerful policies to promote renewables.
- RPS can be coupled with other policy instruments like ITCs and PTCs.
- Issuance of RECs can potentiate the cost competitiveness of CHP and landfill gas.

Thank you