



Life Cycle Cost Analysis of Residential Power Backup Gasoline Generators in Nigeria

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ABSTRACT: This study involves life cycle cost analysis of portable gasoline generator brands mostly used for home power back up in Nigeria to guide the citizens' choice during acquisition. A total of two thousand six hundred and twenty electric power generating sets sampled from seventeen cities in Nigeria were evaluated by direct observation/descriptive experimental design. The evaluation parameters include initial or procurement, operation and maintenance costs, fuel consumption rate, operation period and residual value. Results showed Tiger, Sumec, Elemax, Elepaq and Jinjing as the most patronized brands of portable gasoline generators for home power back up in Nigeria major cities while 0.8 and 2.2KVA constitute the most used power ratings of the generators. Also 0.8KVA Sumec and 2.2KVA Elemax were revealed as most cost effective due to their comparative low life cycle cost of ₦26, 810 and ₦39,820 respectively.

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The benefits of backup generators in maintaining residential comfort and safety during public power blackouts cannot be over emphasized. According (HVAC, 2015), home backup generator offers home owner peace of mind because it ensure continuous operation of residential appliances during public power outage. Apart from portability, the first things to consider before procuring a backup generator for your home is the type of fuel source it will run on (Jerad, 2019). Lazar (2018) revealed that the choice of fuel for running a home generator is determined by readily available fuels sources in the user's area. Thus, the increasing influx of different brands of portable gasoline generators in Nigeria due to incessant public power outage in this country. Gasoline powered generators enjoy high patronage by the home owners and small business outfits because petrol is the most subsidized fossil fuel in in this country. Hence, Ugwu *et al.*, (2012) revealed that gasoline generators exhibit low cost of power generation and exergy loss in Nigeria when compared with diesel and natural gas powered ones respectively. However, the conflicting views of manufactures and end users on the cost performance economy of different brands of portable gasoline generators used in Nigeria, call to question of the best among them.

Portable generators are preferred for home back up application because of their compactness and can be moved easily (Bryant, 2017). Honda, Tiger, Sumec Firman, Elepaq, Thermocool, Elemax, Jinjing and

Lutian constitutes common brands of portable gasoline generators used in Nigeria (Lewis, 2019). Although it is optioned that Honda, Thermocool and Elemax generators are effective, fuel efficient and durable, their initial costs are quite expensive while others are seem to be quite affordable, durable and cost less upfront during long-term use (Lewis, 2019). Since all these popular brand of gasoline generators claimed to be durable/cost performance efficient and their spare parts are readily available, there is need for their life cycle cost analysis (LCCA) if best among them will be obvious. Life-cycle cost analysis is a vital decision-making tool for determining most cost-effective option among different competing alternatives when they are technically appropriate for implementation on the same grounds (Tim *et al.*, 2018; MESA, 2003). It tracks and measures costs involved in all stage of a processor/product's life cycle from purchase, own, operate, maintain to disposal (SAE, 1995). Although application of life-cycle cost analysis in decision boarding Nigeria electrification is not new, most of the recent works compared only diesel and photovoltaic systems solar despite the ever increasing acquisition of gasoline generators by home users in this nation. Ugwuoke and Oparaku, (2004), showed from LCCA that photovoltaic systems compared to diesel generators are more cost-effective at low electrical -power ranged residential application in Nigeria. Otasowie and Ezomo (2014), also showed through this technique that it is cheaper to use generators than National grid in powering base

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transceiver stations in Nigeria when back cost is considered. Oti and Lewachi (2017), revealed local production of PV components for cost effective adoption of solar PV systems for off-grid electricity generation. Therefore the comparative analysis of life cycle cost of mostly used brands of portable gasoline generators for home power back up in Nigeria in this study to guide the citizen choice during acquisition.

MATERIALS AND METHODS

This study involved life cycle cost analysis of mostly used brands of portable gasoline generators for home power back up in Nigeria. Two thousand six hundred and twenty (2620) sets of 0.8 and 2.2 KVA generators that have been used between three to four years were sampled from seventeen Nigerian cities Aba, Abeokuta, Abuja, Afikpo, Asaba, Awka, Benni-city, Calabar, Enugu, Ikot-ekpene, Ibadan, Lagos, Lokoja, Owerri, Port-Harcourt, Umuahia, and Uyo. The brand of generators studied are Tiger, Sumec, Elemax, Elepaq and Jinjing because their availability is common in all the cities sampled. Initial or procurement, operation and maintenance costs, fuel consumption rate, operation period and residual value were evaluated as per each generator sampled using direct observation/ descriptive experimental design. The mean of these evaluation parameters as per each brand/power rating of the generators were determined and used for their life cycle cost analysis. The life cycle cost (LCC) of each generator brand/power rating was computed from the following relations given by (Peurifoy and Schexnayder, 2002), and compared using Analysis of Variance.

$$LCC = O_c + C_y \tag{1}$$

$$O_c = (C_i - V_s)A_p + i(V_s) \tag{2}$$

$$V_s = C_i + m(t) - C_n \tag{3}$$

$$A_p = A[P(1 + i)^n] \tag{4}$$

$$C_y = nC_{om} N_m \tag{5}$$

$$\dot{F} = f_c P_{gen} \tag{6}$$

Where; O_c = Ownership cost; C_i = initial cost; V_s = Salvage value; $m(t)$ = maintenance cost for n period; C_y = Operation and maintenance cost per year; C_{om} = Operation and maintenance cost per month, N_m = Number of month equipment operated in a year; n = Number of years, i = Interest rate, \dot{F} = Fuel consumption rate, f_c = fuel consumed per power generated by the generator, (lit/kWh), P_{gen} = power output of the generator, (kW)

RESULTS AND DISCUSSION

The results of this investigation shown in Table 1 revealed significant variations in initial, residual, operation/maintenance and ownership costs of the five brands of portable gasoline generators mostly used by home owner in seventeen Nigeria cities sampled. The initial, residual, operation/maintenance and ownership costs of the low power rated plants were lower than those of high plants as expected. The initial cost of Elepaq is the highest among all brands of generators while those of Sumec and Elemax constitute the lowest among 0.8KVA and 2.2KVA respectively. It is also obvious from this table that fuel consumption rates of low power rated (0.8KVA) generators are higher than those of 2.2KVA while Sumec constitutes the highest fuel consumed brand irrespective of the power rating. Tiger and Elemax’s fuel consumption rate of 1.39L/kWh constitutes the lowest among 0.8KVA generators while 0.66L/kWh of Elemax and Elepaq is the lowest among the 2.2KVA plants. Thus Elemax generators exhibited least life cycle cost of ₦39,820 among the five brands of 2.2KVA generators investigated. Life cycle cost of Sumec (₦26,810) is the least among the 0.8KVA generators despite its high fuel consumption rate because of its lowest initial, operation/maintenance and ownership costs.

Table 1: Life cycle cost analysis of mostly used brands of portable gasoline generators in Nigeria

	0.8 KVA					2.2 KVA				
	Tiger	Sumec	Elemax	Jinjing	Elepaq	Tiger	Sumec	Elemax	Jinjing	Elepaq
Initial cost (₦)	16800	14500	15600	17500	17600	23400	46200	20400	45200	49000
Operation time per year (hrs)	4825	1460	4825	1460	4825	2190	3285	1460	4825	2190
Fuel consumed per power generated, f_c (lit/Kwh)	1.39	1.67	1.39	1.41	1.40	0.76	0.91	0.66	0.76	0.66
Residual value, V_s (₦)	8700	7800	8800	8000	8500	13100	20400	14600	20000	24000
Operation/maintenance cost per year, C_y (₦)	11640	11640	17880	16320	15000	19440	30360	18840	27120	20640
Ownership cost, O_c (₦)	17610	15170	16280	18450	18510	24430	48780	20980	47720	51500
Life cycle cost, (₦)	29250	26810	34160	34770	33510	3870	79140	39820	74840	72140

Conclusion: This study revealed Tiger, Sumec, Elemax, Elepaq and Jinjing as the most patronized brands of portable gasoline generators for home power back up in Nigeria major cities while 0.8KVA Sumec and 2.2KVA Elemax constitute the most cost effective.

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