DIESEL GENERATOR OPERATION

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The current installed electricity generating capacity of India is 275 GW, which is significantly higher than the peak demand of 140 GW (NITI Ayog, 2017a). Despite installed electricity generation capacity exceeding the peak power demand, some parts of the country face acute power shortages. The critical reasons are: coal supply shortages, high levels of transmission and distribution losses, and poor financial health of utilities. Distribution companies (DISCOMs) that buy electricity generated with imported coal face significant and unpredictable upward pressure on tariffs. These fundamental problems in the power sector are hampering the efficient use of the existing system to even meet the grid-connected demand. Rampant load-shedding and low-voltage power supply forces people to resort to private, localized solutions such as diesel generators (DG). The total capacity of diesel generators in India is estimated at 72 gigawatts, about 25% of the installed capacity of power plants, and growing at the rate of 5 GW per annum (Economic Survey, 2016). The data from the CEA suggests that large industries with electricity consumption greater than 1 MW own about 14 GW of DG sets. A substantial portion of the rest (58 GW) may be contributed by micro and small industries, with load capacities of less than 1 MW (Economic Survey, 2016).

The emissions from DG sets are estimated based on the population, per-capita diesel consumption, percentage distribution of diesel consumption in different sectors using DG sets and emission factor by using Eq. 21:

$$E_x = EC \times \%DC \times EF_x \quad (21)$$

where, Ex = Emissions of pollutant x; EC = District-wise energy consumption, which is estimated based on district-wise fuel consumption and calorific value of diesel. For estimating district-wise fuel consumption, district-wise projected population for the year 2016 (based on census 2011 data set) and per-capita fuel consumption were used. State-wise high speed diesel (HSD) consumption and population of that particular state were used to estimate state-wise per capita fuel consumption. This state-wise per capita fuel consumption was assumed for each district falling in that particular state and was used to estimate district-wise fuel consumption. State-wise diesel consumption was obtained from Indian PNG statistics 2018.

%DC = percentage distribution of diesel used in different sectors using DG sets, such as agri pump sets, industries, mobile towers, and other purposes. The relevant state-wise percentage distribution of diesel consumption in different non-transport sectors was referred Petroleum Planning & Analysis Cell (PPAC, 2013). This state-wise percentage distribution was assumed for all the districts falling in that particular state. In the absence of state-wise percentage distribution, zone-wise percentage distribution was assumed.

EFx = Emission factor of pollutant x

The pollutant-specific emission factors for DG sets were adopted from USEPA, 2015 (Table 21) and the estimated emissions for different pollutants are shown in Table 22. The state-wise emissions of pollutants from DG sets indicated that Uttar Pradesh contributes around 16.6% to the overall DG sets emissions from all over India followed by Haryana in North and Tamil Nadu and Karnataka in the south.

Table 21 Emission factors for DG sets

Pollutants	EF (ng/J)
PM_{10}	133.3
$PM_{2.5}$	113.305
SO_2	124.7
NO_x	1896.3
VOC	154.8
CO	408.5

Table 22 Emissions (Gg) from the operation of diesel generators during the year 2016

Pollutant	Agriculture Pumpsets	Industry	Mobile Tower	*Others	Total
PM_{10}	16.1	21.9	8.9	20.4	**67.3**
$PM_{2.5}$	13.7	18.6	7.6	17.4	**57.2**
SO_2	15.0	20.5	8.3	17.4	**61.2**
NO_x	228.5	311.6	126.8	290.8	**957.7**
CO	49.2	67.1	27.3	62.7	**206.3**
VOC	18.7	25.4	10.3	23.7	**78.2**

*others include residential and commercial use

The total emission of each pollutant emitted during the operation of the DG set was distributed over 36 km × 36 km grids following Eq. 22:

$$G_{Pol} = \sum_{p=1}^{n} \sum_{d=1}^{n} \frac{A_p}{A_d} \times E_{pol,d} \qquad (22)$$

where, G_{Pol} is the emission of a particular pollutant (Pol) in the Grid (G); A is the area of a polygon (p) in a district (d); and $E_{pol,d}$ is the emission of a particular pollutant in the district(d).