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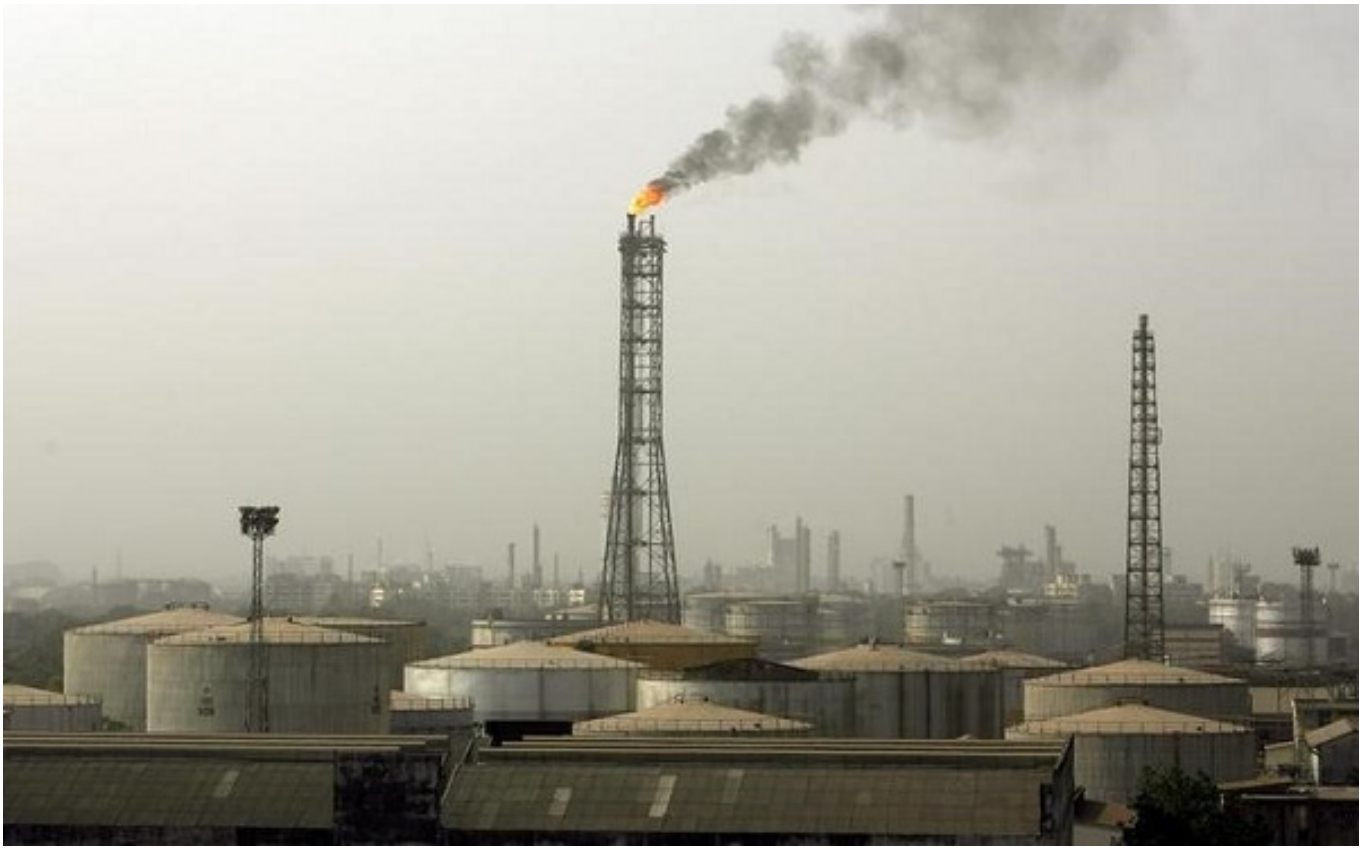
# Fugitive emissions: Trends and challenges



Global warming and climate change are rapidly changing the discourse of policymaking. The adverse effects of climate change, over the past decade, have led both developed and developing countries to implement environment-friendly policies. This endeavour is primarily focused on mitigating and adapting to the ill effects of climate change. The recently concluded 22nd session of the Conference of Parties (COP22) is an exemplar toward this paradigm shift. It aimed at converting the commitments made by the countries during the Paris COP21 into implementable actions. Climate change for the most part is an outcome of human activity, which results in the release of anthropogenic greenhouse gas (GHG) emissions, primarily carbon dioxide ($CO_2$) emissions, into the atmosphere.

The impacts of different gases are compared using a factor called global warming potential (GWP)—referenced to a unit of $CO_2$. The larger the GWP, the higher the contribution toward global warming compared to $CO_2$ over a period of time. According to the guidelines for national GHG inventories published by the Intergovernmental Panel on Climate Change (IPCC), $CO_2$, methane ($CH_4$), nitrous

oxide (N2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF6) and other halocarbons are important gases that contribute to climate change. Of these, SF6 and CH4 are estimated to have the highest and lowest GWPs, respectively.

Based on activity, the sources of GHG emissions are classified into four categories—energy, industrial processes and product use, agriculture, forestry and other land use, and waste. Around 73% of the global emissions [45.84 gigatonne of CO2- equivalent (GtCO2e)] in 2012 was attributed to energy-related emissions, according to CAIT climate data explorer. Emissions from energy include electricity and heat generation, manufacturing and construction, transportation, fuel combustion and fugitive emissions. Based on the estimates from India's Biennial Update Report published by the ministry of environment, forest and climate change, the total net emissions accounted to be 1.8 GtCO2e in 2010. This column examines the activities and processes that leads to fugitive emissions, its current trends and projections based on hydrocarbon sector growth.

## Fugitive emissions

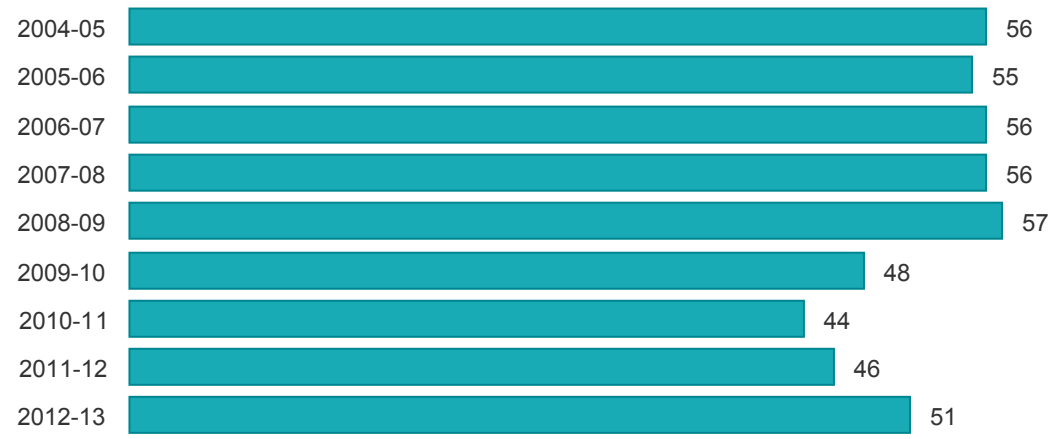
Since the industrialisation era, coal (solid fuel), oil and natural gas (liquid and gaseous fuels) have been the three primary fossil fuels for many sectors to generate energy. These combustible fuels are converted from the geological deposits of organic materials from decayed plants and animals. During the process of mining and extraction, including fuel processing and delivery, GHG gases are sometimes released—intentionally or unintentionally. These emissions are recognised as fugitive emissions.

Depending on the nature of formation, coal is tapped from two types of mines—underground and opencast (surface) mines. Mining and post-mining are two key activities for both these mines, and emission factors are derived based on data availability. As per the IPCC methodology, all fugitive emissions related to solid-fuel mining employ country-specific emission factors, as the nature of mines and the degree of gassiness applicable to underground mines vary with the depth of extraction. Methane emission from the release of stored gas during the breakage of coal is accounted for in mining activity. Other activities such as handling, fuel processing and transportation are reported as post-mining activity. Fugitive emissions from oil and natural gas extraction are accounted for at three steps—oil and gas production, processing and distribution. In addition to these steps, gas leakages and flaring are also accounted for in the estimation of methane emissions.

## Current trends

## Fuel sources responsible for methane emissions and their share in the past decade.

**Coal** Oil Gas




*Figures in %*

Source: Center for Study of Science, Technology and Policy Get the data Created with Datawrapper

Between 2004 and 2013, fugitive emissions from fuel mining and extraction in India grew at 2% compounded annual growth rate (CAGR). In 2013, fugitive methane emissions owing to mining and extractions in India were estimated to be around 41 million tonne CO2- equivalent. And, coal mining was responsible for over 51% of the overall fugitive emissions. Currently, the majority of coal (91%) is mined from opencast mines. The share of underground mines declined to 9% from 16% during the period 2004-2013. In this timeframe, the proportion of underground mines reduced significantly owing to a lack of proven technology and risks of coal-bed methane explosion. This reduction can also be attributed to the gradual adoption of a safer option of mining coal from surface mines, in order to meet the ongoing demand.

Around 49% of the total fugitive emissions in 2013 can be attributed to the extraction of oil and natural gas. Oil production in India was around 38 million tonne (MT) in 2013—3.88 MT more than the quantity produced in 2004. Overall, the CAGR of oil production between 2004 and 2013 was calculated to be 1%. Most of the domestic requirement is currently met with imported crude oil, which equated to around 185 MT in 2013. Natural gas production witnessed a 3% CAGR during the aforementioned period due to the geological formation of small-size blocks—referred to as marginal blocks. After accounting for process leakages (1.65%) and the re-injected gas for internal use (13%), the rest is distributed through pipelines for end use. In an attempt to reduce the import-dependence of hydrocarbons, the government has introduced a revenue-sharing mechanism in oil and gas production. This policy is expected to increase the indigenous production of hydrocarbons in the future.

### Future outlook

Indigenous manufacturing (Make in India), rural electrification (Electricity for All) and access to clean cooking energy are anticipated to be some of the key drivers of fossil fuel growth in the next decade. Over 1,500 MT of coal is expected to be produced in India by 2020—thrice the amount produced today. Assuming that the share of underground and opencast mines would remain the same (9:91), the fugitive emissions from coal mining are projected to reach 55 MtCO2e by 2020. Similar increase is expected in natural gas extraction, owing to a fuel usage shift to liquefied petroleum gas and piped natural gas penetration in households across urban and rural landscapes.

From an implementation point of view, it is imperative that an emission inventory of all activities be maintained and updated continuously to keep track of progress. The IPCC guidelines assist nations to compute the emissions from sectors based on a three-tier methodology. This process of estimation is a bottom-up approach where sector-level performances are combined to arrive at national emissions. On the other hand, the GHG protocol methodology classifies emissions as direct and indirect, and applicable to individual companies. A combination of these methods can be employed towards the monitoring, reporting and verification process. This process is important to maintain the progress for achieving the target of the nationally determined contributions.

To put succinctly, there is an urgent need for continuous tracking of emissions of all kinds, including fugitive emissions. This is especially important considering India's commitment to climate justice and for sustained progress on its intended nationally determined contributions target of reducing the emissions intensity of its gross domestic product by 33-35% below 2005 levels by 2030. Considering the aforementioned future projections, this requirement deserves to be called nothing less than 'critical'.



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