OPERATIONAL UNCERTAINTY IN DATA CENTRE BACKUP DIESEL GENERATOR USE: IMPLICATIONS FOR AIR QUALITY MODELLING

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Big things are coming…

- Factors driving demand
  - Evolution of AI
  - Outsourcing storage requirements
  - “Always connected” nature of the world
- FY25 data centres electricity consumption estimate = 3.9 TWh
- Forecast to continue to grow at an annual average rate of 25.1%
- Projected FY50 electricity consumption estimate = 34.5 TWh

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What does that mean for air quality?

- Uninterrupted power supply is critical
- Outages can last seconds, hours, days
- UPS + Deisel generators = common emergency back up
- Diesel generators are fast and reliable
- Diesel generators emit NOx, PM, CO, SOx, VOCs, & more

Do we have it under control?

- Data centre air quality assessments:
  - Maintenance testing
  - Emergency operation
- <200 hours emergency standby plant operation
- NO_2 criterion exceedances predicted during emergency
- Statistically unlikely
- Data centres are active grid participants
- Disturbances to the grid could be exacerbated by the supply-demand balance caused by large loads disconnections

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How are we assessing the impacts to air quality from the operation of these back up systems?

Is there uncertainty about how this matches up with real world operations?

High level review

- Data was sourced from the Major Project website
- Developments with applications approved in 2025
- Eight developments were identified with detailed Air Quality Impact Assessments (AQIA) for review
- The review is limited to provided assessment data for
  - generator emissions of NOx, PM, CO
  - load assumptions
  - deployment frequency & duration

What did I find?

- Capacity assessed ranged from 45 MW to 720 MW
- Between 16 and 240 back-up emergency diesel generators
- Two AQIAs reported a redundancy in the generators
- 14 generators engines, between 1.1MW - 4MW each
- Comprehensive emissions data not provided for all
- Conservative parameters for the generators, selecting from multiple specifications
- All reported <200 hours operation
- None assessed planned outage or equipment maintenance
- None would meet US EPA Tier 4 NOx emission standard

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What did I find?

- Each AQIA modelled a unique combination of maintenance durations and load scenarios
  - Up to 10 generators simultaneously
  - Annual maintenance: (ranging from 60 to 95 minutes)
    - 50% -100% load = modelled at 100% load
  - Quarterly/weekly/monthly maintenance (ranging from 15 to 60 minutes):
    - Idle/no load = modelled at 10-25% load
    - 50% -100% load = modelled at 100% load
  - Only one AQIA included cooldown times
  - Three AQIAs list only one testing duration
- Emergency as 100% generators at 100% load
- Emission intensity can be higher at lower loads

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Uncertainties

- Potential additional generator use
- Redundancy use in emergency
- Higher emission rates at lower loads
- Impacts from reduced plume rise
- Considered vs. installed generators

Further considerations

- Some data centres exploring options to provide grid support
- New proposed requirements for data centres to stay connected to the grid to “ride-through” disturbances
- Consideration of emissions performance against standards equivalent to US or EU requirements may be warranted

In summary

- Current approval requirements are satisfied
- Limited insight into the actual and long-term generator operations
- Some variables are either simplified, conservatively represented, or omitted entirely from current assessments.
- Overestimating impacts through conservative assumptions?
- Underestimating impacts by missing credible scenarios?

Where do we go form here?

- Opportunities to improve future assessments:
  - Enhanced transparency of generator utilization,
  - Broader range of operating scenarios, and
  - Comprehensive emissions data.
- Goal to further align assessment assumptions with actual and foreseeable operational practices
- Ensure that air quality risks associated with the continued growth of the data centre sector are appropriately understood and managed.

Questions & Discussion