Green Grids:
Tackling SF6 Emissions on GB Electricity Networks

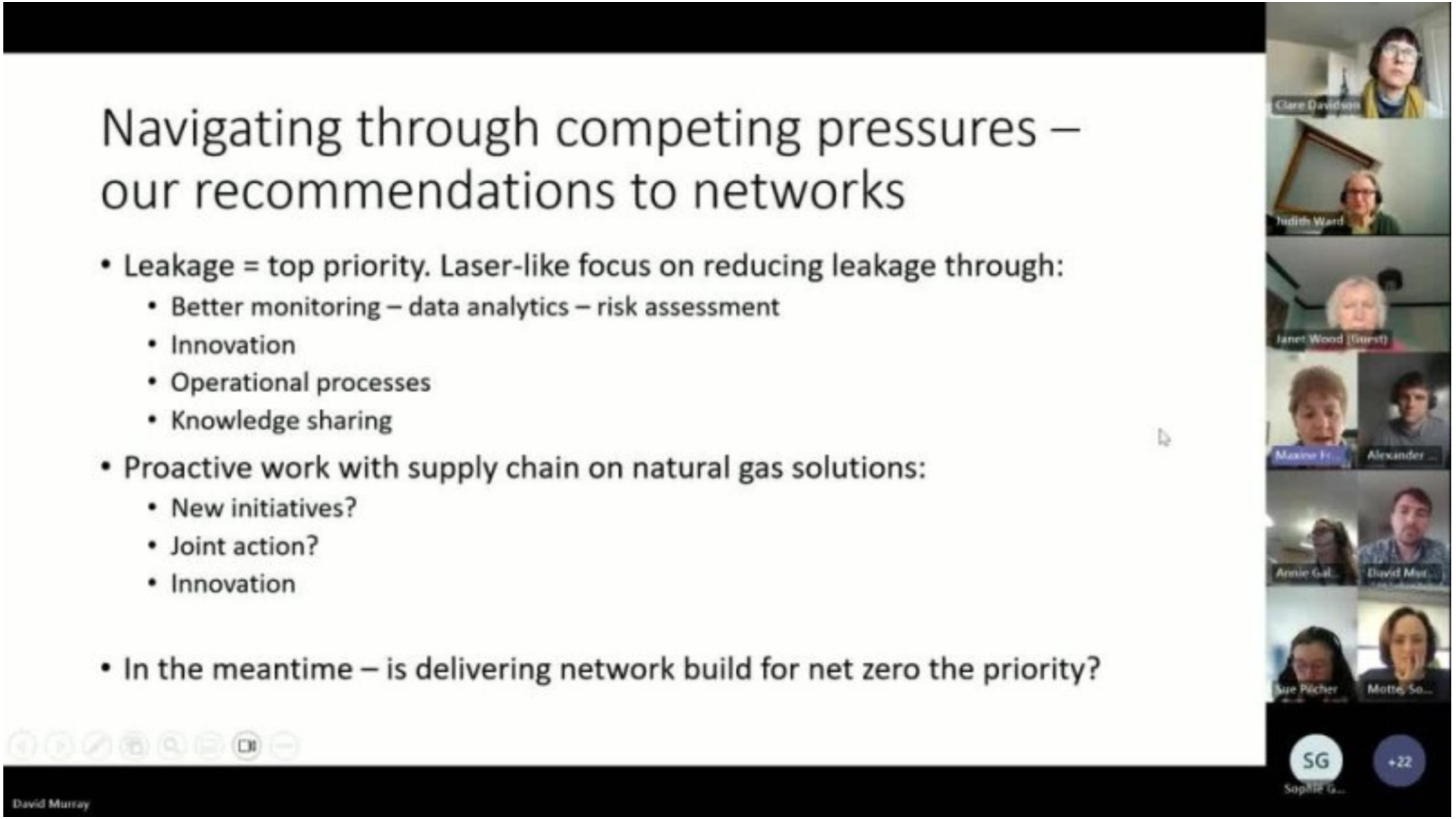
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Sustainability first

Grid Edge Policy
Regulation · Energy · Consumers

Play the webinar recording



Agenda

- Welcome / housekeeping / introductions

- Presentation of the report (Maxine / Judith):
  - What's the challenge?
  - What are the technical solutions?
  - Policy and regulation (in particular RIIO ET3)
  - Our asks
- A network's perspective – National Grid
- Other reflections and discussion (chair – Janet Wood)

- Wrap up and next steps

SF6 in network equipment: why this matters

- SF6 (sulphur hexafluoride) is a potent greenhouse gas:
  - GWP100 = 25200 times CO2
  - Atmospheric life 3200 years
- Use in switchgear:
  - Large amounts for insulation in GIL / busbars
  - Small amounts for interruption / preventing arcing in active switchgear
- Company science based targets:
  - SF6 = c 90% of ET BCF (Scope 1 and 2)
  - Targets = (1) to reduce leakage & (2) longer term eliminate usage
  - NGET and SSEN T committed to a 33% reduction in leakage by 2026 (cf 18/19)

What are we talking about?













Scottish & Southern Electricity Networks

Network companies face different challenges

		22/23 leakage %
National Grid ET (84% of total GB leakage in 21/22)	Older assets and higher % leakage – more low hanging fruit?	1.01%
SSEN T	Historically lowest % leakage (new assets) and very high growth	0.29%
SPT	SPT: High growth and middling leakage	0.23%
Distribution	Challenge around managing bank of c 200,000 smaller assets	Vary (0.1%+)

What networks are doing - Running up the down escalator….

Reducing leakage as % of total SF6 bank

= basic asset management (prevention, monitoring -> early detection, repair / refurbish / replace plus learning -> prediction)

But bank is growing given high levels of network investment needed for net zero

= ensure additions SF6 free where possible, specify low leakage

And manage these well too (early life failures)..

A changing landscape

- EU F-Gas Regulation (now agreed)
  - Bans SF6 in new equipment - in phases and with exemption
- In anticipation networks have been working with manufacturers to develop SF6 free solutions:
  - Synthetic gas (C4-FN – fluoronitrile; fluoroketone);
  - Natural origin gas (nitrogen, oxygen, vacuum) - fewer options esp at T
- Synthetic gas useful like-for-like option (retro-fill, replacement)
- Final version of EU Regulation also bans fluoronitrile – with exemptions
- Growing concern that synthetic gas solutions = PFAS (“forever chemical”)
  - Possibility of EU ban on PFAS
- Huge network growth required for net zero
- SF6 / PFAS phase-out at EU level – exacerbates existing supply chain challenges

SF6 Alternatives – 2023 market picture

Transmission

- No offerings at 275KV (=> have to use 400KV)
- At 132 and 400 KV there are **synthetic gas** (C4-FN) options that have been piloted - but would not meet more stringent new EU Regulation unless exempt:
  - GE's g3 Green Gas for Grid
  - Hitachi's EconiQ
- Siemens Clean Air "Blue" (the only **natural origin gas** option)
  - Pilot of 400KV busbar
  - Active switching only upto 145 KV at present

Distribution – more options (above +ABB, Schneider and others inc fluoroketone options)

Manufacturer development pathways unclear given shifting policy

Compounding existing supply chain challenges (Covid, Brexit, war in Ukraine +)

New EU F-Gas Regulation (agreed October 2023)

For **existing** switchgear equipment in EU – Regulation does not introduce a ban on *current* usage of SF6 or Fluoronitrile gas

For **new** switchgear in EU **–** introduces a **phased ban of F-Gases** (**2026 – 2032)**

- Both **SF6 & Fluoronitrile gas** (Article 13. plus Annex I. Section 3. (C4-FN. GWP 2,750))
- LV → GWP zero. HV → GWP <1
- End-dates by voltage (next slide)

Ban effective - when '**putting [equipment] into operation**' (A13(5)). Exemptions if equipment ordered 'before the regulation becomes applicable'.

Exemptions / derogations (timebound : 2-4 years). Clarifications needed

- Specific technical grounds / disproportionate cost of alternative (A 11).
- Procurement derogations (A 13) – if **too few bids from manufacturers**. Derogations differ for LV / HV. May allow equipment with GWP <1000 (A 13 (5.b)). Potentially also allow GWP>1000 (if no bid <1000 (A13 (5.c))).

New equipment containing F-Gases – **may be permitted** - where **total life-cycle green-house gas emissions are shown to be lower** than equivalent equipment under Eco-Design Directive. Leaves door ajar on fluoronitrile use. **But, how best to evaluate full GHG lifecycle emissions ?**

Plus nb – **export from EU of switchgear that contains F-Gases** - may be compliant for up to 4 years (due to exemptions for 'placing on the market & sale' / 'putting into operation' on specific technical grounds / disproportionate cost (A 11.4))

New EU F-Gas Regulation

CE-14409/23. Provisional political agreement (Council / Parliament). 19 October 2023 - https://data.consilium.europa.eu/doc/document/ST-14409-2023-INIT/en/pdf

Servicing / maintenance of existing equipment : ban on virgin / new F-Gases - from 1 Jan 2035 (SF6, Fluoronitriles). So, 10-years hence, **all replacement gas must be recycled / reclaimed** (exceptions – technical / emergency repair). Current market for recycled gases very limited. Might speed-up SF6 equipment retirement / replacement ?

Asset upgrades : some flexibility to upgrade existing assets / substations w new units that contain F-Gases (to avoid replacing entire unit. But, total F-Gas volumes & GWP = a consideration)

- Direction of travel now clear for EU F-Gas phase-out for new electrical equipment.
- Some initial flexibility via derogations.
- EU expects that industry & manufacturers will make concerted effort to find suitable non-F Gas solutions

Voltage	Primary / Secondary	F-Gas ban from 1 January 20XX – (but, derogations)
<24 kV	D	**2026**
>24kV – <52kV	D (primary / secondary)	**2030**
>52kV – <145kV	D (primary) T in Scotland (132KV)	**2028** GWP >1
>145kV	T	**2032** GWP >1

PFAS chemicals – possible EU ban ?

EU F-Gas Reg. Recitals – (EU 14409/23 – 19 October 2023) - p.8

‘(6a) Some fluorinated greenhouse gases subject to this Regulation are Per- and Polyfluorinated Substances (PFAS) or are proven to or suspected to degrade into PFAS. PFAS are chemicals which resist degradation and potentially have negative effects on health and the environment. In line with the precautionary principle, undertakings should consider using, where available, alternatives which are less harmful for the health, environment and the climate. In 2023 a proposal to restrict the use of PFAS, including fluorinated greenhouse gases, was submitted to the ECHA. When considering potential PFAS restrictions, the Commission and Member States should take into account the availability of those alternatives’.

Navigating through competing pressures – our recommendations to networks

- Leakage = top priority. Laser-like focus on reducing leakage through:
  - Better monitoring – data analytics – risk assessment
  - Innovation
  - Operational processes
  - Knowledge sharing
- Proactive work with supply chain on natural gas solutions:
  - New initiatives?
  - Joint action?
  - Innovation

- In the meantime – is delivering network build for net zero the priority?

The RIIO Framework – ET2 (2021-2026)

- IIG financial incentive rewards networks for a reduction in leakage beyond a baseline (~historic performance):
  - Baseline = 1.18% NGET; 0.79% SPT, 0.38% SSEN T
  - Adjusted for additions / removals from the network (important but -> not very transparent)
  - Measures leakage as “top up”
  - No account taken of end of life treatment
  - Exceptional events excluded
- Requirement for SF6 Strategy – NGET had to resubmit but now comprehensive looking at leakage by age / type of asset etc
- Additional funding provided (through BP or reopener) for major upgrades
- Reputational incentive – limited reporting through AER
- Innovation funding – valuable learning

The RIIO Framework – ED2 (2023-2028)

- No financial incentive to reduce leakage (despite SF arguments!)
- SF6 strategies – mixed bag
- Some requests for additional funding but Ofgem response not always clear – and based on out-dated cost of carbon. No specific reopener.
- Reputational incentive – new and detailed reporting requirements in DNO Annual Environment Reports. Helpful step. Covers both bank and leakage (first reports due autumn 2024)
- Innovation funding – important role

Ofgem's proposals for ET3 (2026-2031)

- Warmly welcome:
  - Minded to proposal to continue with IIG incentive
  - Requirement to set out SF6 reduction strategies
  - Significantly strengthened annual reporting (inc on end of life) – why wait for ET3?
  - Chance for open debate on detailed design of IIG incentive

- More to do on accurate measurement of leakage (not just top-up)
- More to do to delineate what it expects to be covered by IIG incentive and what is covered by baseline funding or specific funding requests (major investments)

Policy implications for GB switchgear ?

- **Approach to a GB F-Gas Regulation - a matter for UK government**
  - **A GB conversation needed on switchgear.** To engage DEFRA, DESNZ, Environment Agency, electricity sector, NGOs, equipment manufacturers.
  - **How much impact from a new GB Regulation** - given current reliance on EU manufacturers ?
  - **How best to balance trade-offs** : short-term supply-chain considerations for hitting goal of a decarbonised grid by 2035 – vs suitable pathways for successive carbon budgets / 2050 net-zero & GHG reductions
  - **We would see it for regret** if *over time* UK ends-up with lower climate and environmental standards for electrical switchgear than EU
- **PFAS**
  - **Growing need for a GB line-of-sight** – esp now that EU F-Gas Reg introduces a fluoronitrile ban
  - **How to obtain an informed UK view on the particular PFAS compounds used in switchgear** – and their possible impacts (fluoronitriles, fluoroketones).

Policy implications for GB switchgear ?

- **Other environmental policy gaps**

  - **Planning consents** – NPS (EN=5) addresses SF6-use in HV equipment. But for natural-origin gas alternatives - w much bigger physical footprint – esp at transmission voltages - planning will be a major factor

  - **Costs of alternatives –** currently a consideration for all SF6 alternatives. Increases near-term supply-chain cost-pressures

  - **Lifetime greenhouse gas emissions of switchgear equipment** – a **standardised & independent framework needed for evaluation. Who should lead ?**

  - **Concerted sector innovation and collaboration needed -** to address leakage; to speed-up development of non F-Gas alternatives

  - **Other networks ?** Not considered in our paper. New thinking needed. All these climate & environmental questions arise for the other networks too (offshore , interconnectors, independent networks).

Summary of our asks

- Networks:
  - Laser like focus on reducing leakage
  - Working in partnership on natural gas solutions
  - In the meantime does network build for 2035 remain the priority?

- Ofgem: stronger incentives and improved transparency for ET3
- Defra: assess PFAS risks for these specific compounds -> clarity
- Develop a standardised framework for lifetime GHG evaluation for switchgear

- The importance of a wider debate on tradeoffs – started today

Wrap-up and next steps

SF6 in Switchgear: Grid Edge Policy and Sustainability First

- Tackling SF6 on the electricity networks. Sustainability First blog – January 2024 - https://www.sustainabilityfirst.org.uk/blog/498-tackling-sf6-on-the-electricity-networks
- Green Grids: Tackling SF6 Emissions on GB Electricity Networks – October 2023 - https://www.sustainabilityfirst.org.uk/images/sf6_in_GB_networks_final_201123.pdf
- DNO SF6 Strategies - a commentary by Sustainability First. February 2022 - https://www.sustainabilityfirst.org.uk/images/Sustainability_First_-_Commentary_-_DNO_ED2_SF6_STRATEGIES_-_final09022.pdf

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