Highland Council's Experience with the Electrification of new Schools

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Introduction & Background

The Highland Council (THC):

- Our area covers ~33% of Scottish land mass (and ~16% of UK landmass)
- <250k residents (which presents its own challenges).
- Much of HC area is off-grid mains natural gas
- Internal M&E Engineering Team is small, so major Capital projects currently go external, i.e. Contractor DBDA
- Scottish Schools funding route – Scottish Futures Trust:
- Learning Estate Improvement Programme (aka LEIP)
- LEIP2 introduced an Operational Energy Target (compliance affecting funding)
- LEIP3 introduced LCA Embodied Carbon target (compliance affecting funding)

LEIP Requirements

With LEIP2, Scottish Futures Trust introduced a new 25 years OPEX funding model with 4 new criteria:

- Condition
- **Energy Efficiency**
- Digitally enabled learning
- Economic Growth

LEIP3 introduced a Construction Embodied Carbon target of ≤600kg$CO2_e/m^2$, 10% parking EVCP (as well as significant IEQ monitoring requirements in the T&Cs…)

LEIP2 Energy Requirements

Energy Efficiency requirement set a new OET target (accounting for 20% of funding):

- Operational Energy Target = 67kWh/m^2GIFA/ annum for core hours
- Banding with reduced funding as energy usage increases from base (to zero of component when >130kWh/m^2)
- Core hours = 2000 hr/yr (up to ~3500 pro rata)
- THC decided only way to get DBDA Contractors to sign up to this was Passivhaus Certification (PH regularly advised as eliminating performance gap and OE of ~55-60kWh/m^2/annum)

Major Projects Campus 1

(Ross-shire):

- First Passivhaus project for THC
- Multi-school campus (5 in 1 replacement)
- Off grid for NG: LZCT FS resulting in ASHP's
- LPG for Science and CDT requirements only, otherwise all electric.
- EV charging provision: 10% of parking spaces
- Doesn't require PV's (for compliance purposes)
- Currently RIBA Stage 5 on site (due for completion in 2025)

Major Projects – Campus 1

- First major ‘all electric’ school project – very steep learning curve
- First proper TM54 & PH/PHPP Assessments
- First major project with ASHP’s (heating load problematic – margins ended up compounded on electrical) and significant EVCP provision (load management)
- First Supply Option was for ~1700kVA (with a 2000kVA privately owned transformer)
- THC negotiated supply requirement down to 1100kVA supply (1500kVA DNO owned transformer)
- THC had to instruct this (and accept additional risk)

Major Projects – Campus 2

(Eastern Highland):

- High School replacement
- THC's Second Passivhaus project
- On grid for NG: LZCT FS resulted in ASHP's
- LPG for CDT (hot works) only, otherwise all electric.
- EV charging: 10% of parking spaces (now in regs)
- Doesn't require PV's (for compliance purposes)
- Currently at Commercial close/enabling Stage 5 works - due for completion 2026
- Looked at SFT NZPSB Standard (but EC too high)

Major Projects – Campus 2

- Second ‘all electric’ school – definitely informed by lessons learned from Campus 1!
- TM54 & PH/PHPP Assessments were used to inform max demand calc (and didn’t need client instruction or accept additional risk)
- Heating load approach was more pragmatic
- Separated EVCP supply (for operational reasons)
- Beefed up M&V strategy (better spec’ed)
- TM54 assessment structure developed aligned to electrical design

Both Projects

- Both extensively supported by Building Physics
- Building Physics ‘lag’ meant Architects often ran ahead of things (without truly understanding the impact – esp. daylighting & overheating issues)
- Not a lot of guidance for max. electrical demand calculation available (esp. for all-electric buildings)
- What are the implications of Passivhaus on max electrical demand?
- PHPP assessment *should* reduce overall risk.

Main Lessons Learned:

- Minimise Peak Heating Demand (leading to better matched ASHP selection) –
- Use design margins selectively
- Use TM54 & PHPP Assessments to inform maximum electrical demand calculations
- Separate EVCP supply (operational & expansion reasons)
- Make sure TM54 assessment aligned to electrical design and your M&V strategy is fit for purpose (to aid diagnosis of any over consumption in use)
- Client infrastructure capability risk differs from oversized supply agreements: Max DNO owned transformer supply limited to 1275kVA (15% DNO margin requirement)

Heat Load/ASHP Selection

- You **must** minimise peak heat demand
- Passivhaus max. heating demand is 10 W/m^2 or 15kWh/m^2/annum for certification
- Challenge ‘business as usual’ use of margins
- Margins on heating will be compounded electrically
- Check heat surface provision with Ph constraints
- Ensure appropriate ASHP selection (and matched to predicted loads ex. margins)
- Apply TM17 guidance

EV Charging

- Scottish Building Regs call for 10% of CP space (with potential future expansion for a further 40%)
- THC Schools are designated Destination charging only (so ~7.7kW/unit).
- No fast chargers (too big a load)
- Operationally, EVC management will be outsourced to a 3rd Party
- A separate EVC electrical supply makes sense

TM54 Assessment

- Getting predicted operational use of equipment is currently ‘best guess’. Only actual ’in-use’ data will improve this process
- Gathering the required electrical information for plug loads (esp. ‘legacy’ equipment) from users is like herding pandas and it can appear to be a never-ending process at times…
- Things will only really improve once we get proper analysed in-use/POE
- Requires a properly thought-out and aligned M&V plan/strategy

What is needed?:

- Proper, up to date guidance for calculation of Max Electric Demand in all electric buildings
- Specific guidance with respect to Passivhaus
- TM39 needs an overhaul, and we need up-to-date guidance for how to develop a properly fit for purpose M&V Plan
- Proper Energy Use database derived from in-use/POE data is required to allow for the development of appropriate metrics
- This requires a properly thought-out and aligned TM54 assessment and M&V strategy.

Thank You