OPEXA

OPEXA WHITEPAPER September 2025

Harnessing Scotland's Lochs for Sustainable Data Centre Cooling

Executive Summary

Scotland's deep, naturally cold lochs offer a unique opportunity to redefine sustainable data centre cooling. Inspired by Dutch canal-cooled floating data centres, this thought piece explores how loch-based systems could reduce energy consumption, lower carbon emissions, and position Scotland as a European leader in green digital infrastructure. Key considerations include technical feasibility, environmental impact, and synergies with hydroelectric power (HEP) assets.

Global Inspiration: The Dutch Model

- **Floating Data Centres** in Amsterdam use canal water (≈12–15°C) for passive cooling.
- **Heat Exchange**: Servers transfer heat to water via submerged exchangers, reducing electricity use by ~30%.
- **Modular Design**: Easily scalable, renewable-powered, and urban-integrated.
- **Environmental Integration**: Minimal visual impact, low thermal discharge, and circular water reuse.
- LinkedIn post on Dutch innovation | YouTube demo

The Scottish Opportunity: Why Lochs?

Scotland's lochs—Loch Ness, Loch Lomond, Loch Awe—offer conditions that could make them highly suitable for sustainable data centre cooling.

Attribute	Potential Value
Thermal Stability	Year-round cold temperatures ideal for cooling
Depth & Volume	High thermal inertia, minimal seasonal fluctuation
HEP Infrastructure	Existing assets at Loch Awe, Ness, and others
Connectivity	Proximity to fibre routes and urban hubs
Regeneration Potential	Rural tech investment and job creation

Technical Feasibility (Exploratory Considerations)

Possible cooling system designs could include:

- Submerged heat exchangers
- Shoreline intake/outflow loops
- Floating modular pods with passive cooling

Integration opportunities may exist through:

- Co-location with HEP stations
- Supplementary wind or solar inputs
- Smart load balancing across the grid

Connectivity and redundancy could be ensured via:

- Access to fibre backbones
- Satellite uplinks for remote sites
- Compatibility with edge computing frameworks

Environmental Safeguards

Any future exploration of this opportunity would require a strong environmental framework:

- **Thermal Discharge Limits**: Adherence to SEPA standards
- **Aquatic Monitoring**: Real-time biodiversity and sediment impact tracking
- **Community Engagement**: Transparent consultation with local stakeholders
- **Carbon Accounting**: Lifecycle emissions analysis to ensure genuine sustainability

Site Selection Criteria (For Consideration)

Factor	Description
Loch Depth & Volume	Supports stable thermal exchange
HEP Co-location	Enables energy synergy and cost efficiency
Grid & Fibre Access	Ensures operational viability
Planning Feasibility	Balance with recreation, conservation, and local use

Strategic Benefits for Scotland

If developed responsibly, loch-based data centre cooling could:

- Support national net-zero and climate adaptation goals
- Enhance digital sovereignty through domestic infrastructure
- Regenerate rural economies with tech-led investment
- Position Scotland as a global leader in sustainable data hosting

Areas for Further Exploration

Rather than a prescriptive plan, this thought piece highlights areas that policymakers, industry leaders, and regulators may wish to explore further:

1. **Feasibility Studies**: Hydrological and engineering assessments of selected lochs
2. **Stakeholder Mapping**: Involvement of SEPA, HEP operators, councils, and telecoms providers
3. **Pilot Concepts**: Small-scale trials with ecological monitoring
4. **Funding Models**: Public-private partnerships, innovation grants, or climate transition funds