Brief **BLACK to GREEN**

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THE THREAT IS... to the UK's National Security & Productivity, daily operations and decades forward, by our Critical Services sites not each having their own 24/7/365 reliable & sufficient On-site Production of Electrical Power ...and Green at that.

Construction, Operations and Financing of On-Site Deep Geothermal Energy facilities

Call for the Funding of a Study to validate the National claims made in this Brief as they pertain to the sites of a single critical services Organisation, private or public.

The latest study to signal the growing acceptance of Geothermal into the UK's Energy mix, 'Dig Deep' UK MP publishes report on UK's deep geothermal potential (thinkgeoenergy.com) states:

"A study by the Durham Energy Institute estimates deep geothermal resources could provide all of the UKs heat demand for 100 years....even a conservative estimate of what we could utilise suggests it could provide 15,000 GWh for the UK by 2050."

"With the right support, it is estimated that by 2050 we could have 360 geothermal plants."

"The Eden and United Downs sites have been able to successfully progress lawfully within the existing legal framework." https://www.edenproject.com/ United Downs – Geothermal Engineering Ltd

So, the advent of Geothermal Energy is not a question of if, but what +when...and crucially, how.

Yet, within this study, and the great majority of others / reports, conferences etc are 3x presumptions:

1 Only Heating energy is technically practical and financially viable in the UK, not Electrical Power

2 All/near-all Geothermal Energy produced will be fed into the National Grid for distribution

3 "Current technology creates cost and depth limitations" (Dig Deep).

All three are incorrect.

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They are correct if a fourth prevailing presumption is relied on:

4 That only the Geothermal Industry can 'Dig Deep'.

That also is totally incorrect – the Oil & Gas Industry not only can, but has a bastion of capability that the Geothermal Industry does not – deep geosciences, wellbore engineering, completions & production expertise, and crucially, the financial heft.

Furthermore, the UK has a substantial domestic Oil & Gas production + supply chain industry of its own, with not just Offshore expertise, but Onshore as well:

"The strength of our Oil & Gas sector can still yet provide us an advantage as we decarbonise with 37,000 direct jobs and 250,000 in the supply chain that could still be redeployed to deep geothermal." (Dig Deep).

That the UK's own Oil & Gas sector is not, and will not until pushed, involve itself significantly in Deep Geothermal exploration + production, is THE blocker.

Black to Green

I have test-marketed the following 'push' initiative with both Westminster and Edinburgh MPs, and not been nay-sayed.

Legislation needs to be passed and implemented that directs any and every company involved in the Oil & Gas production & distribution industries:

Given a Base Year of eg. 2027 all Black entities (ie no company exemptions) will have a minimum of 3% of their turnover/profit (to be stipulated, so zero greenwashing, or hushing – severe penalties) from Green Energy: FY 2028 – 4%, 2029 – 5%, 2030 – 8%, 2031 – 13%, 2032 – 20%, 2033 – 29%, 2034 – etc

In the first year, whichever year it is, that an entity does not record the minimum %, it will be fined an additional 50% of its tax bill, with admin charge of £10K

Second year, whenever that it is, it does not comply, it gets fined 100% extra + admin charge £20K

Third year, again whenever that occurs, it loses its Licence to Operate in the UK.

With careful, no-exits construction, that will unblock the Deep Geothermal Industry – the deal flow and ensuing business development could be enormous.

The Necessity

"The greatest potential in the UK is for developing deep geothermal heat" (Dig Deep)

Correct, Economically ; but missing the barn door of National Security – there are numerous locations in the UK, and globally, that should their Electrical Power provision be interrupted, jammed (mechanical, electrical, cyber), ceased then not only will the site 'go down' but it's external reliant customers / communities will be severely impacted.

There are 6x categories of of such sites, all of Industrial Scale vitally requiring 'High Security' Electrical Power, not just 24 / 7, but 365, and over decades. Heating too is required, but is secondary, and very easily obtainable as a by-product of Deep Geothermal production of Electrical Power:

- Sea ports, terminals all with significant re-fuelling + 'shore power' requirements
- Airports ditto
- Industrial primes not just major plants, but also specialist eg data centres
- Military communications + hardware storage & service locations
- Hospitals notably the 50x major currently being re-furbed/new build UK-wide
- National Importance eg. railway, bus, truck re-fuelling yards.

For instance, here in Scotland :

Sea Ports	Port of Peterhead About Us | Peterhead Port Authority - Europe's Largest Fishing Port
Air Ports	Aberdeen Airport - not just civilian global, but industrial helicopters Aberdeen Airport – Wikipedia
Industrial primes	Rolls-Royce Aerospace Aerospace | Rolls-Royce
Military	Faslane https://www.royalnavy.mod.uk/our-organisation/bases-and-stations/naval-base/clyde
Major Hospitals	Glasgow Royal Infirmary Royal Infirmary Museum marks Glasgow's contribution to medicine - Bing video
National Importance	ScotRail - Main Works (Heavy Overhaul), Kilmarnock scot-rail.co.uk » Scottish Depots

The Energy Provision component of National Security

While the above sites all currently have multiple back-up provisions should their primary Electrical Power flow cease, both primary and back-ups are largely:

- Hydrocarbons
- Off-site
- Owned by 3rd parties
- Run by managers young enough to have no experience of war or terrorism.

Hence, the current, common meaning of Energy 'Security' as understood + addressed by the great majority of both policy + industrial managers is :

Technologically - sufficient continuous Supply of the in-flow of the carrier-medium of electrical power & heat – the liquid or vapour or electricity itself
plus
Economically – that availability, but extended annually to cover increasing On-Site demand throughout the decade/s that a site, or its Industrial Sector, will take to Transition from Hydrocarbon to Renewable sources.

But, that meaning only covers just the first of four components of Energy Security :

- security of production - 24/7/365/decades on-site/not imported, no fracking, zero GHGs
- secure from the unreliability of Off-Site power lines, cables and pipes, weather & maintenance
- secure from the financial vicissitudes of external Energy providers' provision & pricing policies
- secure from sabotage, terrorism, military – singular person actions to sophisticated cyber attack.

Indeed, the further Off-Site the more unreliable, and the more costly to off-set, all four of the above unreliabilities.

Security is only guaranteed if the supply is generated ON-SITE, with power generation, command & control within an unrecognisable facility (eg all underground), vitally with edge IT, not cloud.

Financials

More mis-presumptions:

5 The CAPEX required for Deep Geothermal is totally prohibitive - yes, the investment per installation + topsides plant will be substantial, minimally £1M per MW, so for the 6x categories, each minimally likely £20-30M. What is not accounted for by the prohibition, is the enormity of cash flow benefit / outflows to off-site Energy providers totally ceased on Day 1, plus the profitability of in-situ PPAs, enabling the payback of the CAPEX far within <20 years the 40-80 year well-production life-span. Add to that, immediate and substantial increase in ESG rating the day the Electrical Power + Heat is turned on, and Bankers will flock, all the more so if we utilise EVA accounting, not IFRS.

6 No requirement for such expensive + 'years to set-up' Energy provision - correct, for the great majority of commercial, industrial, residential locations around the UK. However, for those 6x categories of High-Security locations, all of whose output is to varying degrees critical to the UK's socio-economic wellbeing, that is not the case. Absolutely vital to their daily production is not just Electrical Power base load, but full-on peak load Electrical + Heating – without that, there is immediate / that day damage + danger to the UK.

7 No time soon – correct, if Nuclear Fusion is validated as the only viable other On-Site, Industrial Scale, 24/7/365/ decades reliable Energy source - the first unit is scheduled to commence production in 2040 **https://www.gov.uk/government/news/site-of-uks-first-fusion-energy-plant-selected .** Even then, until one life-cycle has been completed without radiation incident, it is unlikely that any High-Security site owner/operator will opt for Nuclear Fusion on-site. Alternatively, given a 2025 start, each of the 6x categories could have at least one Deep Geothermal plant each at least under construction if not operational by 2035, Gov.UK regulations not just permitting, but driving.

The reality is that Geothermal Energy offers...

In addition to providing total Security of Supply over decades, On-Site Geothermal electrical & heat provision presents significant other benefits for site operators & owners :

1 immediate 24/7/365 access + control, on minimal footprint (swimming pool size, not factory)
2 immediate operational benefits eg total stop of chemicals & equipment for runways + harbours
3 immediate 100% drop-off on 'Switch On' day in Exiting Cash Flow to external power suppliers
4 immediate/incipient new Entry Cash Flow from Purchase Power Agreements with site tenants
5 investment costs, both Capex + Opex, recovered 10-20 years ? thereafter fractional costs
6 ...with significant increase in site asset value.
7 immediate drop down from 100% to 0% Carbon emissions on 'Switch On' day
8 immediate significant upgrade in ESG status, Governance as much as Environmental.

Awareness and Interest are growing :

UK MP publishes report on UK's deep geothermal potential (thinkgeoenergy.com)

BEIS mulls ringfenced CfD support for geothermal power (energyvoice.com)

https://post.parliament.uk/research-briefings/post-pb-0046/

Deep-Geothermal-Energy-Opportunities-for-the-UK.pdf (r-e-a.net)

Eden Geothermal – Unlocking the energy from the rocks beneath our feet

Network of geothermal power stations 'could help level up UK' | Geothermal energy | The Guardian

NZTC plans to build national centre for UK geothermal sector (thinkgeoenergy.com)

...with positive interest from spoken-with managers at:

Sea Ports	The British Ports Association Society of Maritime Industries (SMI) is the voice of the UK's maritime industry Maritime & Ports Archives - Connected Places Catapult Associated British Ports | Who we are
Air Ports	Airport Operators Association - Member List - British Aviation Group AGS | Home | AGS Airports Our Airports - RCA
Industrial primes	Data Centres (techuk.org) The Manufacturers' Organisation | Make UK Homepage (mineralproducts.org) CBI | Confederation of British Industry | CBI
Military	Ministry of Defence estate - GOV.UK (www.gov.uk) West of England Aerospace & Advanced Engineering Forum (weaf.co.uk) Get in touch with DASA - GOV.UK (www.gov.uk) Defence & Security Acceleratr
Major Hospitals	NHS Property Services | Home | NHS Property Services Welcome to The University Hospital Association Website Homepage - Independent Healthcare Provider Network (ihpn.org.uk)
National Importance	Home (riagb.org.uk) Railway Industry Association Contact us - Network Rail CPT | CPT (cpt-uk.org) Confederation of Passenger Transport/Buses Get In Touch - Used Trucks For Sale UK | Truck Pages |

Additionally, UK-based scientific, engineering, production capabilities are far more advanced, Exports even, than generally appreciated :

Renewable Energy | Technology Catalogue

From geothermal energy in Cornwall to retrofitting in Leeds: The sustainability success stories of the week - edie

Eden Project taps into geothermal energy three miles underground (thetimes.co.uk)

Expro's TCP team successfully delivers first underbalanced perforated completion for key European Geothermal project

Geothermal Seminar 2023 - SPE Aberdeen (spe-aberdeen.org)

CeraPhi Energy Closed Loop Geothermal – YouTube
4mins – I should declare that I am a Founder Shareholder

(10) "Troubleshooting Geothermal Energy with Andy Wood" | Search | LinkedIn
skip the first 9.30mins – the remainder 1hr 16mins is highly worthwhile.

Repurposing Oil and Gas Wells to Geothermal Wells - SPE Aberdeen (spe-aberdeen.org)

Geothermal Market Outlook - Energy Transition Report (rystadenergy.com)

Overall then, On-Site provision of Deep Geothermal Energy for the UK's High-Security locations is not a case of Yes or No, but rather "YES, subject to the Cost/Benefits".

Consequently, I asked Innovate UK for £6Million funding for 60 x £100K grants for Deep Geothermal Energy Feasibility Studies - 10 sites within each of the 6x categories. Regrettably, Innovate UK responded saying 2025 at the earliest.

While £100K will not cover the full pre-FID costs of a single site, national competition for that funding by site owner/operators + their consulting engineers would result in the 'can do's + difficulties of On-Site Deep Geothermal operations being showcased nationally.

That showcasing will encourage if not proactively motivate UK politicians to consider + table legislation corralling the UK Oil & Gas Industry to go from Black to Green, plus put in place financial support schemes to foundation that evolution.

Dig Deep : "To better quantify the likely positive impact of any support schemes on the growth of the deep geothermal industry in the UK, a stakeholder survey was undertaken to assess what they regarded as desired. 36 respondents took part including specialised deep geothermal companies, oil & gas extraction companies, finance providers and renewable energy developers.

"Respondents were asked to choose both which mechanisms they thought could support the industry and then which was their first choice. More than 60% of respondents thought a feed in tariff (61%), CFD for heat (61%) and capital grants (67%) would support the industry. **50% also thought CFD for electricity would help** but only 3% chose insurance.

"Capital grants was the first choice of support for 36% of respondents but combined a feed in tariff or contracts for difference for heat was at 48%, supporting stakeholder feedback for a system funding outcomes, not capital. But of the two mechanisms, a feed in tariff was preferred to a CFD for heat (first choice for 27% and 21% respectively). **A set aside CFD for electricity was the first choice of 15% of respondents.** Interestingly, insurance support was not the first choice of any respondents."

Conclusions

Gov.UK intervention is justified as the 8x benefits of On-Site Deep Geothermal Electrical Power will zero-out the 4x Energy Security fractures, plus their year-on-year off-set costs + emissions, suffered by the UK's 'High-Security' sites. The elephant in the room is:

Just how many such sites are there in total, UK-wide ?

That is one study that could do with address – the first 5x categories of sites are easily quantified and insecurities qualified ; the 6th might well outnumber all the first 5x and will be contentious in both its composition + suitability for On-Site provision.

Most addressable, practical + immediate + cost-effective, will be for both public and private organisations that have portfolios of High-Security sites, to commission studies that Detail Design for themselves the Basic Design points made in this Brief.

Then pressure Gov.UK to legislate + fund Black to Green.

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James Bromley
Director

23rd July 2023.