Cornwall and the Isles of Scilly
Technology Metal Opportunity
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Executive Summary

Overview

South West England has a diverse Geo-Resources sector of which Technology Metals are a core aspect of national and international importance. The sector already provides value for Cornwall and the Isles of Scilly (CIoS), however more value could be realised with actions on formalising clusters, enhancing critical nodes of the value chain, and through being a centre for best-practice RD&I and education/re-skilling. As a brownfield exploration area, CIoS exploration projects have an advantage over greenfield exploration globally. It is already known that there are accumulations of metals, which have historically been economically extracted. However, this historic legacy comes with a suite of challenges that are unique to the region.

Exploration companies operating in the region have had recent investment success, with over £80 million raised since 2020, and are forging ahead with a range of projects. Lithium, tungsten and tin are the headline metals for the region, with active projects located in SW England reporting resources of 280 kt Li, 375 kt WO₃, and 175 kt Sn. If realised, these projects have the ability to provide a secure domestic supply of metals critical to the green transition and growth of clean energy infrastructure. However, it cannot be overlooked that these are exploration projects, and there is thus an inherent level of risk associated with project development. Therefore, it is pertinent to develop a sustainable business ecosystem for Cornwall that can both support development of primary resource projects but are also self-sustaining and have cross-sectoral benefits. There is already a good base in the Geo-Resources sector, with over 70 CIoS-based sector-specific service providers, laboratories, consultancies, education-providers, and companies operating at a local, national, and international level, which could be leveraged to greater effect.

In any jurisdiction rich in natural resources, like CIoS, the "Resource Curse" is a real risk; with movement of value out of the region without the full benefits being realised by the local populace. For example, without the required skills base, employment in this sector, with salaries above UK median, will not be easily available to CIoS residents. It is imperative to ensure that with the development of a Technology Metals sector the full benefit is realised and the highest standards of sustainable development and Environmental, Social and Governance are adhered to. This will require multi-stakeholder, cross-sectoral engagement and governance to ensure that CIoS is a global leader in the green industrial revolution.
Recommendations
Core suggestions for unlocking the CIoS Geo-Resources potential, and in particular Technology Metal, in line with the UK Government’s Critical Minerals Strategy include:

- **Building the talent pipeline:** set up an education forum to develop educational programmes for natural resource stewardship and responsible/best mining practice across Further and Higher Education programmes. Both for local needs and the national and international job markets.

- **Adjacent opportunities:** Undertake feasibility studies or enable opportunities for business/consortia to implement Circular Economy business models (i.e., sharing facilities, co-production of additional products, linking to product service models, tracking metals from Cornwall, and thinking ahead to secure long life for our mineral products). For example, study on cross-sectoral regionally value chain development (i.e., smelter and recycling potential, Original Equipment Manufacturer (OEM) inward investment etc.), with consideration of both primary and secondary feed material scenarios.

- **Cluster development:** Form an effective body that can speak on behalf, and aggregates the needs, of the sector. At the present time there are multiple exploration companies in the region undertaking similar workflows. This results in duplication of work and also makes it challenging for decision makers to gather cross-sectoral data.

- **Streamlined planning and permitting:** Reduce duplication and improve accessibility of critical information for planning and permitting.

- **Data Hub:** Develop data hub to aggregate geospatial datasets. Such a data hub could hold pre-competitive datasets to attract and aid exploration companies in developing new resources. It could also be used for regional development purposes by acting as a central hub for a wide range of datasets required to allow decision makers to create data based ESG and sustainable development strategies. As these data can facilitate scenario-based modelling of energy, water, and land-use requirements, all for which are potential high-risk barriers to Technology Metal project development.

- **Equipment Network:** Create an equipment network that can enable companies to work with best available and industry standard techniques, while also making these available for training and reskilling. In addition, explore inward investment opportunities to grow and improve sector capabilities.
Opportunity for Cornwall and the Isles of Scilly

Geo-Resources are an often disregarded or overlooked facet of Natural Capital. In broad terms, Geo-Resources are the materials, services and sources of inspiration that are from the solid earth beneath our feet – the Geosphere. These subsurface resources have underpinned CloS’s environmental, ecological, social, and economic development for millennia and continue to do so.

Cornwall and the Isles of Scilly’s Geo-Resources include construction materials, technology critical metals and minerals, heat and groundwater, geothermal energy, soils that sustain agriculture and ecosystems, carbon sinks, geomorphology dictating the location of renewable energy and transport infrastructure, as well as more intangible resources such as the regions spectacular landscape, cultural heritage (UNESCO World Heritage Site), human health and well-being. This has influenced the region’s economic development with the high concentration of SMEs and businesses working in the geoscience sector stemming back to the rocks beneath our feet.

More recently, CloS’s rich geothermal and mineral wealth is providing the region with a distinctive opportunity to contribute to the development of a clean, sustainable, carbon-neutral economy by developing domestic sources of Technology Metals - evident in the direct mentions of CloS’s Geo-Resources in national strategy documents (pg. 5).

Technology Metals

Technology Metals are fundamental enablers of digital, green, and renewable technologies. Society is using a greater range and quantity of materials than ever before. Surging demand has been driven by numerous factors including, but not limited to, increased digital and electronic technologies, the green transition and renewable energy technologies, and growth of economies and populations. Due to their relatively small market footprint, these Technology Metals are often at the whims of global and major metal markets, and many have security of supply challenges resulting in their classification as critical raw materials. The UK is currently 100% import reliant on technology metals from primary sources (i.e., extracted from geological natural resources), although there are UK industrial facilities with smelting and refining capacity, which produce aluminium, nickel, lead, iron, steel and precious metals (Au, Ag, PGM). However, raw materials for these are supplied either from overseas or from secondary sources (recycling, scrap), which means security of supply remains a key consideration for many metals.
Geo-Resources - the Underground Foundations of Cornwall and the Isles of Scilly’s Natural Capital

South West England, especially Cornwall, has an array of technology metal and geothermal energy resources able to support the transition to Net Zero. The granites beneath our feet provide the basis for this, being a source of heat, minerals, and metals. Circulation of fluids in and around the granites have given rise to a many styles of mineralisation - from lithium in granites and brines, and tin and tungsten in mineralise structure near surface and at depth. Exploration companies active in the region have so far defined potentially economic resources of 280 kt lithium (Li), 375 kt tungsten oxide (WO₃), and 175 kt tin (Sn). In addition to these critical metals, kaolin or ‘China Clay’ use in a diverse range of applications (paper, paint, ceramic, chemical, pharmaceutical and more) remains a staple industry in the South West. Although there is an extensive network of historic mine workings, there are still new critical metal-bearing structures being discovered. Now flooded, many of these mine-workings are potential low-enthalpy geothermal reservoirs that could be used to heat homes, reducing the reliance on oil, gas, and electricity for heating. Going deeper into the granites unlocks the potential production of both heat and energy from hot-fluids circulating in the granites at ~5 km depth – current geothermal projects expect to produce 3 to 5 MW electricity and up to 20 MW thermal energy per site. Geo-resources also include the soils sustaining agriculture and ecosystems, and carbon-sinks and buffering-materials have the ability to lock-up pollutants.

Impacts and relationship between different Geo-Resource and other natural capital-based activities may be synergetic or competitive. An integrated understanding of natural capital, sustainable development solutions, and the associated social and economic environments is key to develop the SW as a Natural Powerhouse for the Green Industrial Revolution.

Local Skills and Expertise: Sustainability, Circular Economy, Responsible Mining and Exploration, Mineral Processing, Environment, Social and Governance (ESG), Nature Regeneration, Renewable Energy, Blue and Green Economy

UNESCO World Heritage Site: Cornwall and West Devon Mining Landscape

Surface Quarrying: Kaolin, Lithium, Tungsten, Rubidium, Caesium, Potassium

Agri/Aqua-Culture: Sustainable agriculture, aquaculture, and water resourcing practices

Remediation: Value-creation from cleaning up industrial legacy

Exceptional Natural Spaces: 250 km Heritage Coast, 167 SSSI, 12 Special Conservation Areas, 498 County Wildlife Sites, 9 Marine Conservation Areas, 20% UK’s designated bathing beaches


Building Space for Nature: Nature recovery
Building Resilience: UK’s Critical Minerals Strategy

With recent developments in global geopolitics, the UK’s resilience on importing metals and materials crucial to modern living has never been so important. This, combined with UK Government’s ambitions outlined in the Levelling-Up whitepaper, the Green Industrial Revolution Ten Point Plan, and the Net Zero Strategy: Building Back Greener has highlighted the UK’s need for secure and resilient sources of technology-critical metals and materials. To progress this ambition, there has been initial actions including the development of the UKs Critical Minerals Intelligence Centre (CMIC, Nottingham), the publication of the first UK Criticality Assessment for Technology Critical Minerals, the funding of several Circular Economy Centres (including the Interdisciplinary Circular Economy Centre for Technology Metals – Met4Tech), and the release of the UK Critical Minerals Strategy.

Central to the UK Government’s Critical Minerals Strategy is the A-C-E approach, which intends to improve the resilience of critical mineral supply chains by aiming to:

- Accelerate the UK’s domestic capabilities
- Collaborate with international partners
- Enhance international markets

Cornwall and the Isles of Scilly are uniquely situated to act on many of these ambitions and be a leader in international best practice for critical mineral stewardship to enable an equitable green transition.
Sector Development

Current Sector Capabilities

In 2017, the provisional Gross Value Added (GVA) from mining and quarrying in CIoS was £87 million. A study by Moor Economics as part of the REMIX project in 2019 of Geo-Resources exploration projects active at the time, this sector has the potential to contribute between £500 million and £1 billion additional GVA from 2019 to 2039.

With the growing demand for Technology Metals globally there has been increased interest, and therefore investment, in the exploration for these metals. Current exploration and project development activities by the companies working on developing technology critical metal resources in the region are providing new jobs, infrastructure projects, and work for the Geo-Resources service sector.

In addition to the exploration projects and pilot plants, Cornwall’s Technology Metals and border Geo-Resources sector is supported by an extensive and varied set of over 70 businesses providing services, consultancy, and equipment to the environmental, exploration, and mining sector locally, nationally, and globally. However, this sector predominantly made up of multiple SMEs, microbusinesses, and single-person operations, which can find it challenging to collaborate or expand to win larger contracts and develop more trade opportunities. A successful action in raising the profile of these businesses was the development of the Cornwall Mining Alliance - however, as this initiative is run by volunteers, there are no staff to coordinate opportunities/collaborative growth through this platform.

The first dedicated funding investment to support SMEs growth and innovation in CIoS’s Geo-Resources sector was the Deep Digital Cornwall project. Since March 2021, this European Regional Development Fund (ERDF) funded project has so far:

- Awarded £630k of its £775k Grant Fund to micro-, small- and medium-sized enterprises based in Cornwall and the Isles of Scilly;
- Supported (and continues to support) over 40 regional businesses and is expected to exceed targets on new-to-market products, private sector RD&I investment, and job creation in the region;
- Built a 3D data hub for historic and new data related to the underground environment.

The 2017 provisional Gross Value Added (GVA) from mining and quarrying in CIoS estimate was based on the average (median & mean) GVA per worker for the proposed lithium brine, deep geothermal, and tin, tungsten, and lithium production from hard rock sources. Since this assessment, there has been substantially more activity, with companies expanding exploration operations (e.g., Cornish Metals, Cornish Lithium) and new companies commencing exploration programmes (e.g., Cornish Tin, Godolphin Exploration). Additionally, this GVA estimate did not include upstream and downstream development opportunities that could expand around a core Technology Metals extractive industry.

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ONS (2018): Regional gross value added (income approach)
Geoscience, mining, and mineral processing education is also a strength in South West England. The world-renowned Camborne School of Mines (University of Exeter) has provided geologists, mineral processors, and mining engineers to industry since 1888. More recently, new master’s degrees, such as Mining Environmental Management and the development of MOOC online courses, such as “Technology Metals for a Green Future”, highlights how the department is adapting to the needs of a rapidly evolving modern metals and minerals industry.

Additionally, the University of Exeter has strengths in circular economy and renewable energy, with a range of undergraduate, MSc and Continuing Professional Development (CPD) courses covering these subjects.

The University of Plymouth has strengths in renewable energy, with an MSc in Offshore Renewable Energy Engineering, as well as undergraduate and MSc degrees in geology and environmental sciences.

Furthermore, there are a number of sixth-form colleges across the region offering Geology and Environmental Science at A-level.

+ £80,000,000* in investment for critical metals projects in SW England from private and public sources since 2020

2 Innovative Lithium Pilot Plants commission in 2022

7 active Technology Metals exploration and development companies

Future job creation per mine developed...

Direct: 200 to 350

Indirect: 500 to +1000

+ 2 Geothermal Energy companies
Recognised Sectoral Challenges

In addition to inherent project risks such as site geology, Environmental and Social Governance (ESG), Social Licence to Operate (SLO) and other modifying factors (pg. 9); there are a number of sectoral challenges for Geo-resources highlighted in the CIoS Industrial Strategy (2022), a recent survey of exploration companies based in CIoS, and industry association reports from the Critical Minerals Association and UK Mining Education Forum. These include:

1. UK not internationally recognised as a place for mining investment.
2. Complex mineral rights, planning and permitting systems may be a deterrent to companies not already operating in region.
3. Lack of integrated pre-competitive and cross-sectoral data.
5. Skilled workforce – there are critical shortages in the talent pipeline for Geo-Resources sector².
6. RD&I funding deficit.
7. Gaps and bottlenecks in upstream, midstream, and downstream, service sector and governance capacity for Geo-Resource projects.
8. Infrastructure requirements.
9. Energy costs and electricity grid upgrade constraints - this is an energy intensive sector, with initial demand estimates for individual projects in the order of 20 to 40MW.

Although some of these challenges are sector specific, many are cross-sectoral and are experienced by other CIoS distinctive opportunities including clean-energy resources, space and data, visitor economy, and agri-food (e.g., infrastructure requirements, energy costs, talent pipeline).

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Value Evolution of a Minerals/Metals Project from Pre-discovery to Closure

There are many phases in the development of a mining project. Each stage requires investment and time. In general, these phases include: Concept to pre-discovery (minimum 5 years), Discovery (minimum 2 years), Feasibility (minimum 2 to 3 years), Development (minimum 2 to 5 years), Start-up (minimum 1 year), Production (Life of Mine) and Closure (rehabilitation and monitoring; perpetuity).

The development of mining deposits is not only reliant on the presence of a sufficient concentration of metals that have the potential to be extracted economically (i.e. a Resource – CRIRSCO, 2019); modifying factors play a major role in whether a project will enter production. These modifying factors include global economics, environmental, social, and legal/governmental constraints. These factors are generally addressed in detail at the feasibility stage of project development.

Project value varies depending on project stage, with peaks related to speculative investment when a potential resource has been discovered, prior to the significant spend required during feasibility studies, and then, if a project is developed into a mine, the point at which production begins and a product is sold at profit.

Adapted from: Visual Capitalist (2019): Visualizing the Life Cycle of a Minerals Discovery

CRIRSCO, 2019, International Reporting Template for Exploration Results, Mineral Resources and Mineral Reserves
Sustainable Sectoral Growth

In the 2021 Global Mining Risk Survey Report by KPMG, commodity price risk, the global pandemic, and economic downturn/uncertainty were highest ranked risks to the mining industry as a whole. These risks were closely followed by Environmental, Social and Governance (ESG) factors relating to community relations, social licence to operate and environmental risks.

Revival of interest in technology metals in Cornwall and West Devon could provide responsible sources of lithium, tungsten and tin, essential raw materials for low-carbon and digital technologies. Other useful by-products are also likely and complementary projects in deep and shallow geothermal energy (and other renewables such as floating offshore wind), provide opportunities for a new industrial ecosystem.

Accelerating project development without due diligence can have severe consequences, as project lead times are necessary to develop meaningful engagement with stakeholders, understand the environmental and economic baselines, undertake workforce development, investigate best extraction and processing techniques, and develop suitable infrastructure and value chains to ensure sustainable development.

Both historical and modern examples from around the world have shown that unless effective regulation, infrastructure and business ecosystems are in place, the gains from resource extraction can be removed while local communities and environments see limited benefits. Effective management requires communities and their representatives to have oversight of how resources are developed, and for local/national governments to have and enact strategic plans to ensure the sustainable development of such industries and mitigate against the ‘Resource Curse’.

One action cited in UK Government’s Critical Minerals Strategy is the evaluation of the role of the United Nations Framework Classification (UNFC) and potential application of the United Nations Resource Management System (UNRMS). The latter is highlighted as one of the recognised frameworks and guidelines for responsible mining, which protects the interests of communities and the natural environment.

The UNRMS key principles are necessary components of any modern exploration- and mining-based business ecosystem.

UNFC is an internationally applicable scheme for the management of energy and mineral-based resources. This classification scheme enables a wide range of projects to be compared based on the confidence in the resource availability (G-axis), the technical feasibility (F-axis), and economic, environmental, and social viability (E-axis).

Although the exact timelines of when a project may come into production are not expressed, it enables cross-comparison of different projects. Here, Technology Metals projects are given as examples, but such a classification can be expanded to Floating Offshore Wind, Geothermal, Biomethane, Solar, Water Resources, and more.

UNECE, United Nations Framework Classification Scheme
Facilitating Integrated and Sustainable Resource Management

Stated to be the ‘Swiss Army Knife’ for tackling technology and sustainability challenges, the UNRMS builds upon the UNFC and aims to be a comprehensive resource management system for future-facing sustainable development (UNECE, 2021).

The system takes an integrated view of resources and is structured around a set of fundamental principles and requirements of resource management for sustainable development. The UNFC and UNRMS work in symbiosis, with the UNFC feeding information about resource potential into the UNRMS where decisions and systems-level understanding of the economic, social, and environmental sustainability feed back into the UNFC so the project can be assessed relative to its peers within a region.

Initial research by the Met4Tech project have categorised the UNRMS into a framework for implementation and strategic action on the core fundamental principles:

- Environment: Responsibility to the planet
- Social: Responsibility to people
- Governance: Integrated and indivisible management of resources
- Economy: Service orientation and circularity

Priority Determination
Cornwall and Isles of Scilly Industrial Strategy Vision: “In 2030 the Cornwall and Isles of Scilly creative and carbon-neutral economy will be realising opportunities for its people, communities and businesses to thrive, benefiting the environment and providing an outstanding quality of life for all.”

State Rights & Responsibilities in the Management of Resources

Competency & Capability
- Transparency
- Collaboration
- Innovation

Facilitating Actions

- Pump-prime funding; cluster-development; education pathways; enabling good-practice; Best Available Technique (BAT) development; R&D opportunities etc.
UNRMS Development Example

Example matrix for determining activities to enable action/adherence to UNRMS key principles that meets the commitments of the Cornwall Plan and CioS Industrial Strategy Vision for the sustainable growth of the Geo-Resources/Technology Metals sector. Further action is needed to develop this with multi-stakeholder engagement and input for sustainable development.

<table>
<thead>
<tr>
<th>Environment Responsibility to the Planet</th>
<th>Social Responsibility to People</th>
<th>Governance Integrated and indivisible resource management</th>
<th>Economy Service orientation and circularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Become a leader in environmentally sustainable resource stewardship through development and adoption of new Best Available Technique’s (BAT)</td>
<td>Developing BAT for community engagement. Fostering and enabling innovation through signposting to funds, enabling microbusinesses to develop into SMEs.</td>
<td>Development of BAT for planning and permitting portal for effective, integrated, and strategic resource management</td>
<td>Business models for circularity/service orientation</td>
</tr>
<tr>
<td>Ensure that both the local (e.g., EIA) and global (e.g., LCA) environmental impacts are assessed during project development - companies with good ESG track records are increasingly attracting investment from responsible/ green financiers but accountability/ transparency is necessary for this to continue.</td>
<td>Decision making, multi-stakeholder groups, NGOs – what are you doing with a region’s resources and why? How is this of benefit to populace… Create a positive environment for discussion through development of citizen council/groups.</td>
<td>Collection and analysis of regionally/ nationally important datasets for both pre-competitive datasets, strategic short-, medium- and long-term planning, and ensuring best practice. Develop strategic Environmental Assessment (SEA) for all clusters.</td>
<td>Transparency around business activities, upstream and downstream value chains, to find synergies with other industries/ SMEs etc.</td>
</tr>
<tr>
<td>Systems thinking to ensure that sustainable development and responsible innovation is integrated and implemented in training programs to enable business/best practice development.</td>
<td>Up/Re-Skilling - Building a talent pipeline. Developing projects that meet the requirements of local communities needs for sustainable and equitable living.</td>
<td>Training in systems thinking and capacity building in key planning activities. (Building upon the Cornwall Decision-making Wheel^3). Infrastructure development necessary for various sectors (e.g., electricity network).</td>
<td>Training in systems thinking and integrated supply chain management In-county accredited laboratories.</td>
</tr>
<tr>
<td>Ensure there is collaboration at project/program/governance level between environmental stakeholders-companies-council. Undertake regional Strategic Environmental Assessment (SEA).</td>
<td>Ensure there is collaboration at project/program/governance level between societal stakeholders-companies-council.</td>
<td>Ensuring that there is a multi-stakeholder input in decision making and enabling comparison of all resource projects/programs. Infrastructure planning – linking up sectors.</td>
<td>Networking and development of strategic partnerships, horizontal, and/or vertical integration for supply chain management and critical path tasks.</td>
</tr>
</tbody>
</table>

^3 Carbon Neutral Cornwall 2030 Hive 'Together We Can' Toolkit: Cornwall Development and Decision Wheel
Unlocking the Technology Metals Opportunity

Through cross-checking of sectoral challenges with the UNRMS framework (Example Matrix – pg. 12), a number of areas for sector intervention to support regional sustainable development have been identified. Common themes are a requirement for collaboration and coordination both within sector and with adjacent sectors.

Core recommendations include:

- Developing the talent pipeline (pg. 13)
- Regional mapping of adjacent opportunities and strategic partner network development - including inward investment opportunities (pg. 14)
- Cluster Development (pg. 14)
- Streamlined Planning and Permitting to improve transparency and accessibility (pg. 16)
- Enhanced data hub to support minerals and regional planning decisions and Strategic Environmental Assessment (pg. 16)
- Equipment network (pg. 16)

Talent Pipeline

The exploration and mining industry globally is facing pressures on attaining employees with requisite skills. The UK Mining Education Forum (UKMEF) recently reported on the strategic need for Mining Engineering and Mineral Processing graduates, highlighting the need for these professionals globally and the current shortfall in graduates.

Exploration and mining activities require a wide range of skill sets, from school leavers to graduates. Additionally, with the rise of modern technology and the wider range of metals and materials required for modern living, the skills demographic is changing, with new careers in data and climate science, and ESG becoming increasingly important.

Locally, with the anticipated creation of 200-350 direct jobs per Technology Metals project developed to mine stage, demand for a wide range of skilled workers is a likely consequence. This, in combination with the drive for the SW to enhance several technical sectors (floating offshore wind, manufacturing, space etc.), is likely to result in high levels of demand for skilled employees and competition between sectors.

There is a real risk of the local talent pipeline will be insufficient to provide a workforce with the necessary skills – leading to companies importing skills from national and international sources. The development of a local talent pipeline is thus a requirement for the region to capitalise on the job creation presented by the Technology Metal opportunity.

Adapted from Intraw (2016) pyramid showing the typical, simplified, organisational structure in a mining company. In addition to the need for ‘traditional’ skills, there is are emerging skills requirements for data scientists, ESG leaders, climate scientists etc. in the Geo-Resources, mining and metals sectors (AusIMM, 2022: Skills needed for the modern mining industry).
Adjacent Opportunities
Core to the UK Government’s Critical Minerals Strategy is an ambition to accelerate a circular economy of critical minerals within the UK (pg. 15). This does require input from primary sources, such as the potential tin, lithium, and tungsten extraction in SW England, but also requires additional activities to “close loops” so that products and materials can be circulated at high value for longer in the economy – such as smelting and refining, recycling, and re-use in manufacturing. Smelting and refining, as highlighted for tin, is a key node for a secure supply of UK tin. In the current business ecosystem, there is no UK capacity for smelting of primary tin ores. The closest smelters located in Europe are currently not set up to take primary tin ores. As a result, at the present time, any tin concentrates would have to be shipped internationally for the next stage of processing. In turn, exporting of concentrate could increase the risk to a secure supply of tin for UK manufacturing.

Lithium has attracted the greatest attention recently and, as a result, there are initiatives underway to consolidate a UK-centric value chain for EV batteries. However, there is currently no requirement for the downstream Gigafactory industry to use components containing UK produced lithium – although EU regulation on ‘rules of origin’ is often cited as a driver for its use. There is currently a gap in the UK value chain, which has an apparent deficit of UK-produced cathode active materials; if this gap is not filled then UK produced lithium will have to be exported before being re-imported for Gigafactory battery production.

There are additional resources that may be potential, by-, co-, or even main-products in technology metals extraction projects (see pg. 16 for examples). Although there are numerous adjacent opportunities, joining up of these is challenging due to the diverse and distributed nature of projects in terms of sector, development timeframes, and location. Feasibility studies in collaboration with strategic partnerships, including local stakeholders and NGOs, regulatory and governance organisations, are required to assess viability of enacting adjacent opportunities.

There is an opportunity to develop the region as a site for developing and implementing best practice. This could aid green investment and building sustainable business ecosystems in the region.

Cluster Development
Coordination is key factor of successful exploration and mining jurisdictions. Epicentres of mining good practice typically have central associations that act on behalf of companies in the region. Examples of these include Geoscience Ireland, Geokompetenzzentrum (GKZ; Saxony), the Iberian Sustainable Mining Cluster, the Mining Association of Canada, SveMin (Sweden), and Mining Finland. Each of these associations represent member companies at a regional and national level, as well as monitoring global industry trends and development, promoting the mining cluster to international investors, and acting as RD&I and education facilitators, amongst other actions. These associations provide similar support the exploration and mining sector that Celtic Sea Power provides for floating offshore wind development and the Spaceport Cornwall provides for the Space sector. Currently, organisations operating in this space for the mining cluster in Cornwall (e.g., Cornwall Mining Alliance) operate on the good-will of volunteers alone. Formalisation of such a group, would provide a mechanism for attracting investment and unifying the voice of the technology metal opportunity in CIoS.

When it comes to mining jurisdictions, Saxony-Anhalt, Germany, is often pointed to as Cornwall’s sibling region. Saxony-Anhalt has pushed to become a home for 12 Centres of Excellence acting as interfaces between industry and scientific research. These Centres not only provide the opportunity for RD&I and knowledge transfer across an array of specialisms. These Centres of Excellence have provided thousands of jobs as well as giving SMEs the opportunity to innovate.

Cornwall and the Isles of Scilly has the potential to capitalise on the concentration of expertise on exploration and mining, responsible resource development, renewable energy etc. making it a potential location for a similar Centre of Excellence.
An integrated circular value chain for technology metal geo-resource projects. Black arrows indicate the pathway that primary resources follow from extraction to final product; green arrows show reverse logistics flows required for circular economy; and grey boxes indicate areas for inward investment and/or local business growth.

Examples of potential adjacent opportunities – full feasibility studies would be required to assess the technical, social, environmental, economic, and regulatory/legal viability of these opportunities.

<table>
<thead>
<tr>
<th>Additional Metals</th>
<th>In addition to the extraction of tin, co-production of copper, zinc and/or tungsten concentrates for sale are a variety of metals and minerals that co-occur in the primary ore. These have the potential to be extracted and processed alongside the primary metal of interest providing additional value streams.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Minerals and Rocks</td>
<td>Aggregates are a common additional resource extracted during metal extraction projects. In addition, projects such as the CLiCCC are investigating the potential to join-up China Clay and lithium production in the St. Austell area.</td>
</tr>
<tr>
<td>Water</td>
<td>Groundwater levels across the region mean that dewatering is a necessary component of project development. A water treatment plant is currently under development for the South Croft project and permitted to pump and treat 25,000 m³ per day during the 2 years of initial dewatering before reverting to abstraction of 6,000 m³ per day to maintain water levels. Currently, a water discharge permit is in place for discharge of treated water into the Red River. With the appropriate collaborations there could be mechanisms for use of such treated water, which could alleviate future water resource pressures.</td>
</tr>
<tr>
<td>Heat</td>
<td>Heat is also a potential by/co-product of many technology metal projects in SW England. Heat networks from deep, shallow and mine water geothermal sources are potential off-grid, decarbonised heating, which could help alleviate constraints on the electricity grid across the region. Co-production of lithium and heat has recently gained attention with the collaboration between Cornish Lithium Ltd. and Rodda’s to further evaluate the potential shallow geothermal sources to provide heat for the Scorrier-based creamery and commercially produce lithium. The potential for district heating from geothermal energy production at United Downs is being explored for Langarth Garden Village. Mine water geothermal is another potential source for heat-network development, which could potentially be developed in tandem with dewatering and mine development programmes – although test work to determine the feasibility of is required.</td>
</tr>
<tr>
<td>Physical Space</td>
<td>Physical space, both surficial and underground, is also a potential resource produced during mining. For example, underground space created during mining activates are being investigated globally as potential sites for energy storage systems, which are emerging as a key solution to stabilising the power grids with large shares of wind and solar energy sources.</td>
</tr>
</tbody>
</table>
Streamlined Planning & Permitting
Planning and permitting delays are often cited as a source of delay and/or risk of minerals projects development. The process is complex, with duplication of both information requested and, at times, the matters considered. Key players in the planning and permitting of exploration and mining projects are:

- Local Planning Authority/Minerals Planning Authority – Planning
- Environment Agency – Environmental Permitting
- Statutory consultees – consulted independently during planning and permitting processes.

Due to the complexity of the process, developers of complex projects may choose to enter Planning Performance Agreements with Local Authorities in connection with applications – York Potash Ltd entered into two such agreements with North York Moors National Park Authority during the planning application for the development of the Sirius Minerals Polyhalite Mine (now known as the WoodSmith Mine). This process took almost 4 years from the initial approach from York Potash to the North York Moors National Park Authority to granting of planning permission in 2015.

A key difference between the development of the Sirius Minerals Polyhalite Mine application and the circumstances in Cornwall are the number of operators working in the region. This means that the demands on the Cornwall’s Minerals Planning Authority are greater, with multiple complex applications per year.

Streamlining and a review of reporting requirements is recommended to reduce duplication and provide appropriate data that can inform regional development (e.g., energy and water usage profiles, workforce development for increased local content, waste generation etc.).

Data Hub
A shared challenge for technology metals, Geo-Resources, supply chains and circular economy is the deficit of integrated databases on past, current, and future stocks and flows of critical metals and materials.

Accessible geospatial data can not only help companies identify new exploration areas, it is also crucial for long-term strategic planning across multiple sectors. The rapid emergence of the South West as a natural powerhouse for the green industrial revolution will need new infrastructure development. To enable timely decision making, whilst ensuring local community and environment requirements are maintained, a data hub that encompasses all relevant datasets would be highly useful. Such a data hub could be employed for long-term strategic planning in the region and enable data-based decision making in this rapidly diversifying industrial/business landscape.

There have been a number of initiatives and databases developed through ERDF funding (e.g., LAGAS, DDC) - consolidation of these datasets and development a South West wide data hub would ensure the longevity of these data. Additionally, logging of new data (within a streamlined planning and permitting system) across the region would reduce the risk of duplication or unnecessary overlap of data collection – reducing the burden of such collection on communities and the environment.

Similar, albeit industry-focused, data hubs for Geo-Resources are common practice in other mining jurisdictions (e.g., Canada, Australia).

Equipment Network
Although the Clos has a well-developed service and consultancy sector supporting technology metals exploration and mining activities, there remain gaps in provisioning.

Gaps in provisioning highlighted by exploration companies is specialised drilling provision and access to accredited geochemical analysis, core scanning, and hydrometallurgical testing. These are all pre-requisites for developing knowledge of mineral resources, the planning of mining and mineral processing, and reporting of results to investors.

Addressing these gaps in provisioning can potentially be achieved through either 1) expanding capacities of consultancies and businesses in Clos, or 2) be an inward investment opportunity. However, further work is required to demonstrate the combined opportunity and market of Technology Metals in SW England to de-risk the business case for companies wishing to expand.