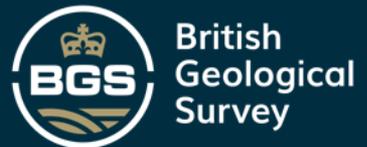




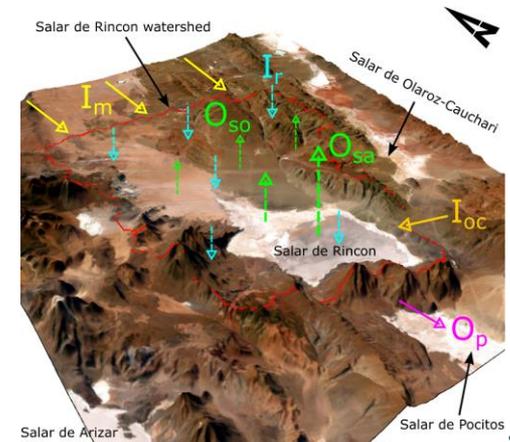
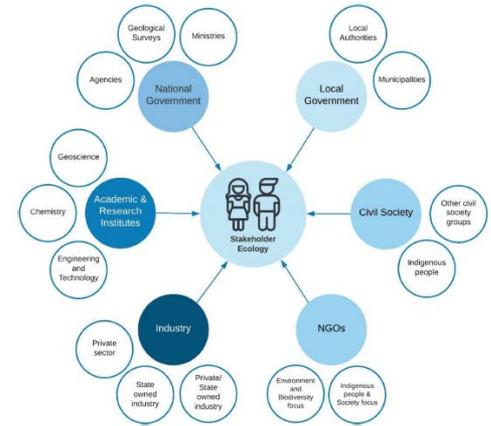
BGS BRINES TEAM: E. PETAVRATZI, H. GRANT, R. HALKES, A. HUGHES, (AND MANY OTHERS)

Sustainability in lithium mining: Implications for the Rapid Uptake of Supply from Salars



Content

- Pose a series of questions:
 - Is mining lithium sustainable from an extraction point of view?
 - Can lithium mining be environmentally sustainable?
 - Is lithium mining socially sustainable?
 - Can cumulative impacts be managed?
 - How can recent and current BGS projects help?



British Geological Survey (BGS)



- BGS is a public body, part of UK Research and Innovation.
- BGS undertakes strategic geoscience for the benefit of society, in the UK and beyond.
- BGS provides **impartial** and **independent** geoscientific advice, research, products and services, including analytical facilities and data repositories.
- BGS operates internationally, building partnerships to address global challenges.



Lithium brines and BGS

The UK's Critical Minerals Strategy

Improve **resilience of critical minerals supply chains**



ACCELERATE
growth of the
UK's domestic
capability



COLLABORATE
with international
partners



ENHANCE
International
markets

Critical Minerals Intelligence Centre – support the UK Critical Minerals Strategy with **data** and **analysis** on sources of the **supply**, **demand** and **market dynamics** of critical minerals, as well as insights on **ESG issues** and **geopolitical** events.



UK Critical Minerals
Intelligence Centre

Understanding Salars takes commitment



1994

First involvement in lithium brines project

• Evaluation of reserves in the Salar del Hombre Muerto

2018

Chile: invited speaker at the International Conference on Lithium, Industrial Minerals and Energy (IWLIME)

• First field trip in Atacama

2019

Engagement with Bolivia, Argentina and Chile through various routes

• Two road trips visiting several operations

2020-2021

Various projects generated new data and understandings:

- upscaling LFP battery production in Bolivia
- innovative techniques to ensure Li brine supply
- strategic environmental and social assessment (SESA) for lithium mining: current application and way forward

• Stakeholder engagement, fact finding, modelling, workflow development etc

2022-2023

Various activities through the Lithium for Future technologies (LiFT) project

• Field trip in Chile and Bolivia

2024-2025

- responsible lithium supply project (Chile, Argentina)
- delivery of ESG training in Bolivia

• Lithium brines research roadmap

Outputs (examples):

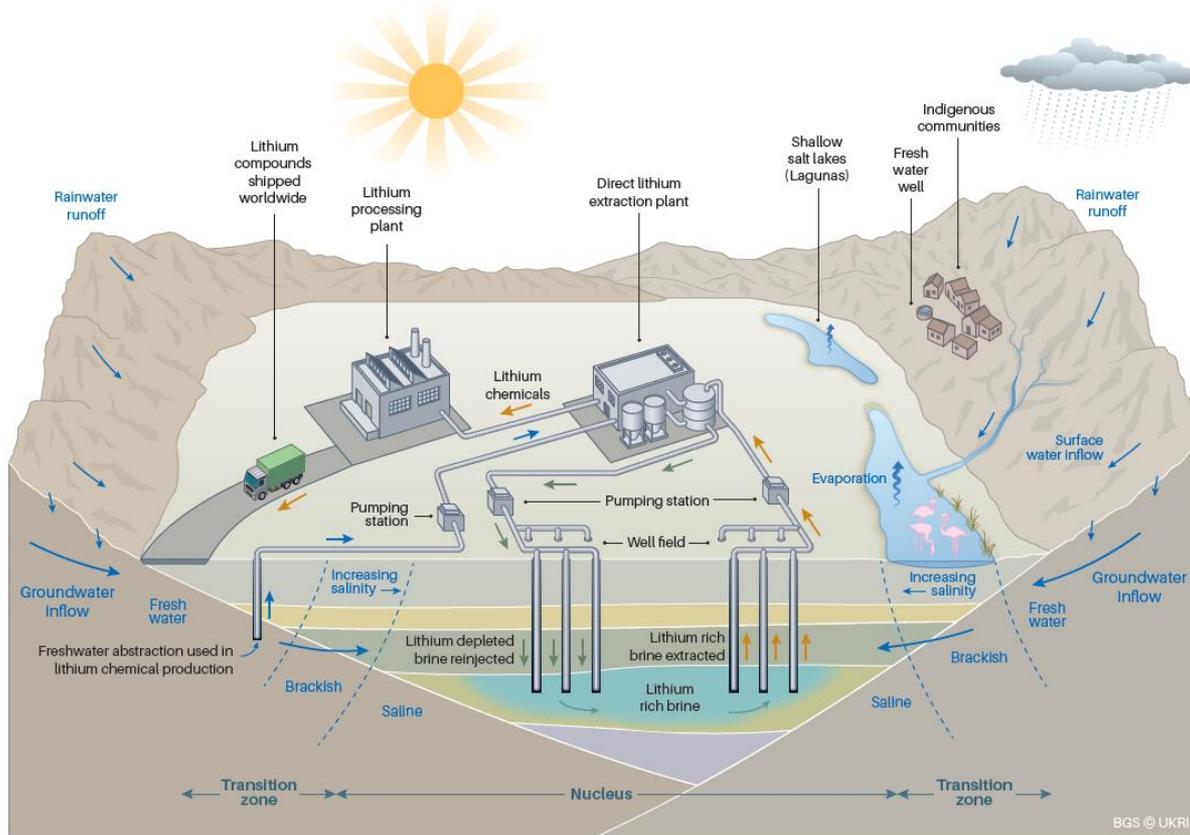
- Environmental, Social and Governance issues for lithium brines
- Emulation of salars modelling
- Use of Earth Observation methods to “track lithium mass” in Bolivia
- Mass of lithium in world markets
- Taxonomy of salars – differences and similarities
- Life cycle assessment (LCA) – issues of water use and their inclusion in LCA
- Lithium brines in South America : a research roadmap to facilitate rapidly and responsibly sourced lithium



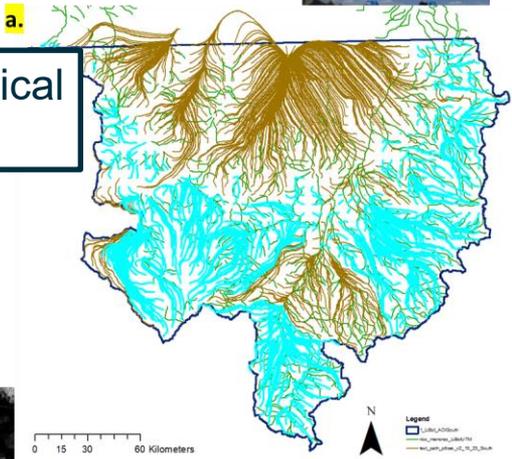
Is lithium mass
extraction from brines
sustainable?

What are the main processes?

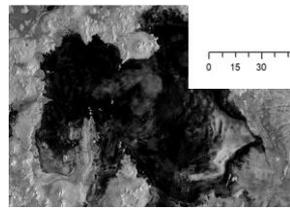
See: [The-Lithium-Voice-Volume-7-September-2024-English.pdf](#)



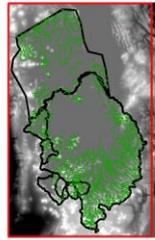
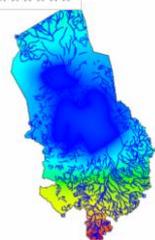
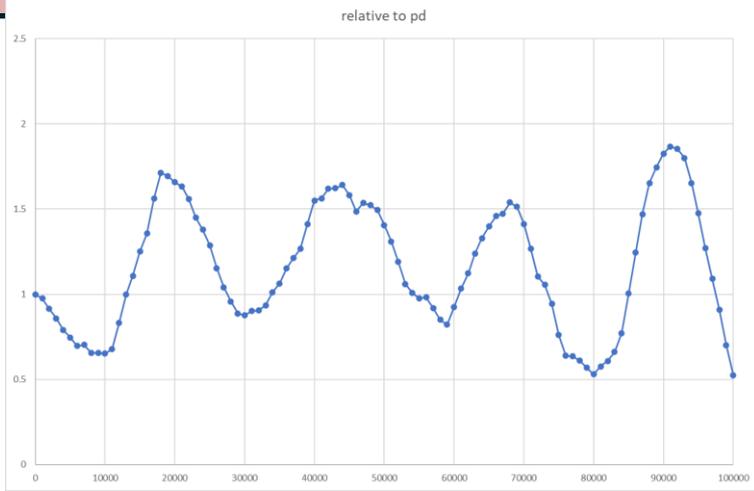
Hydrogeological properties



Hydrology

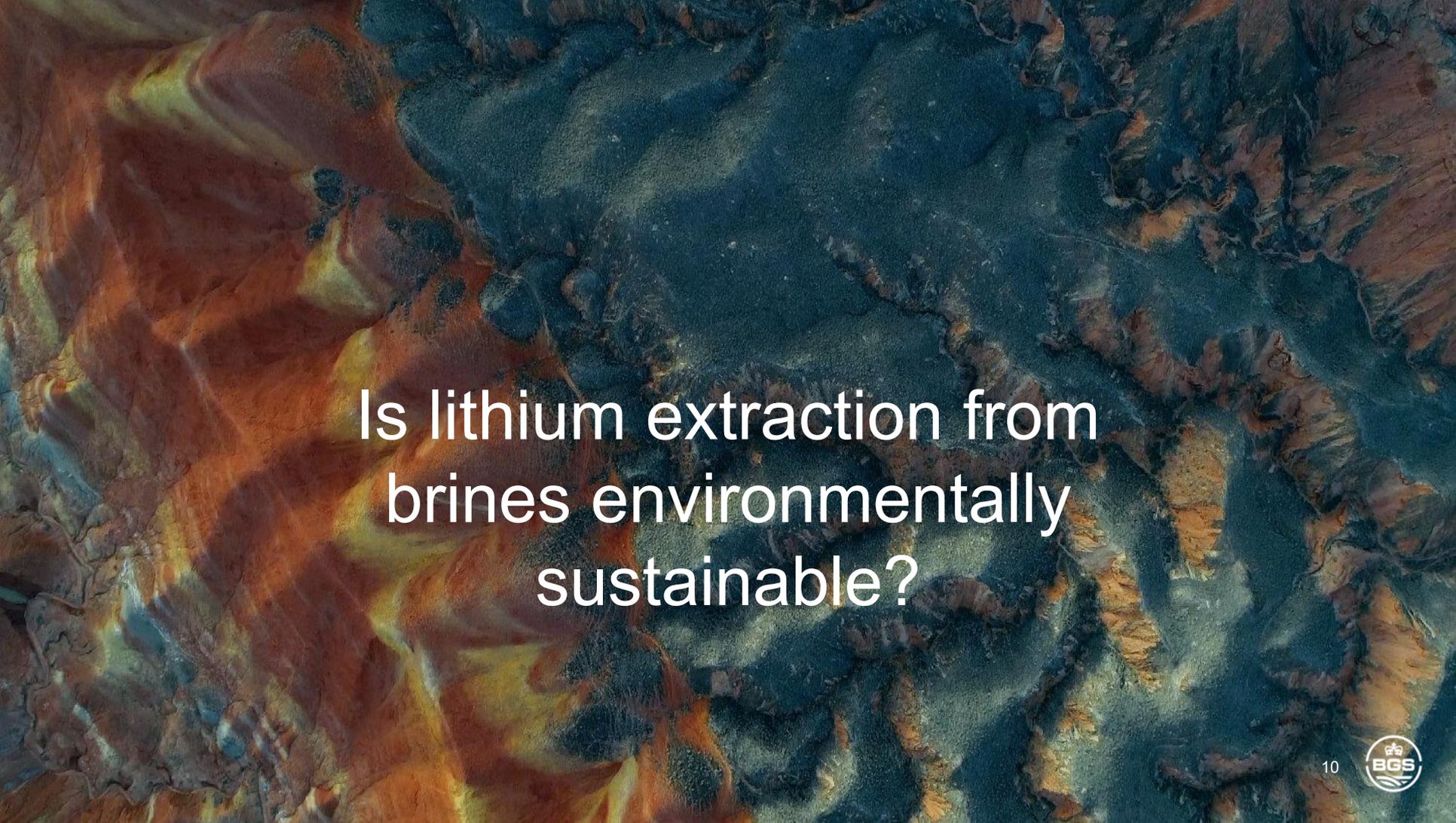


Geological modelling



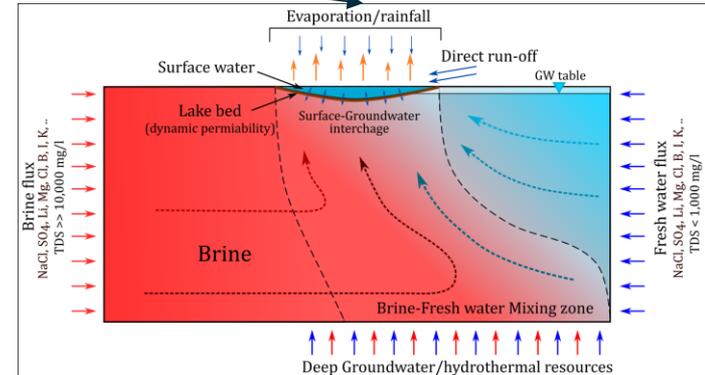
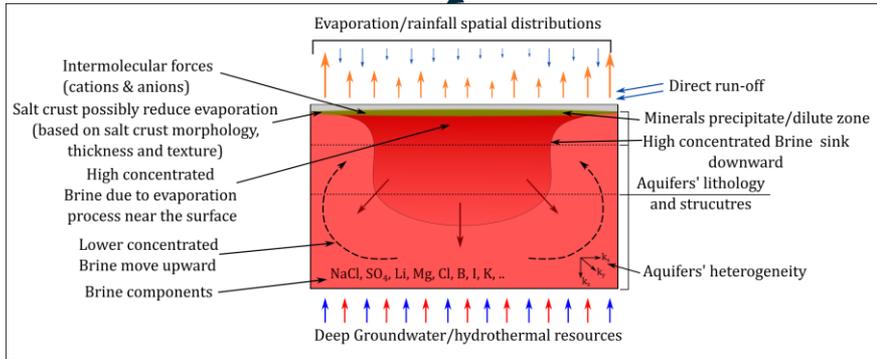
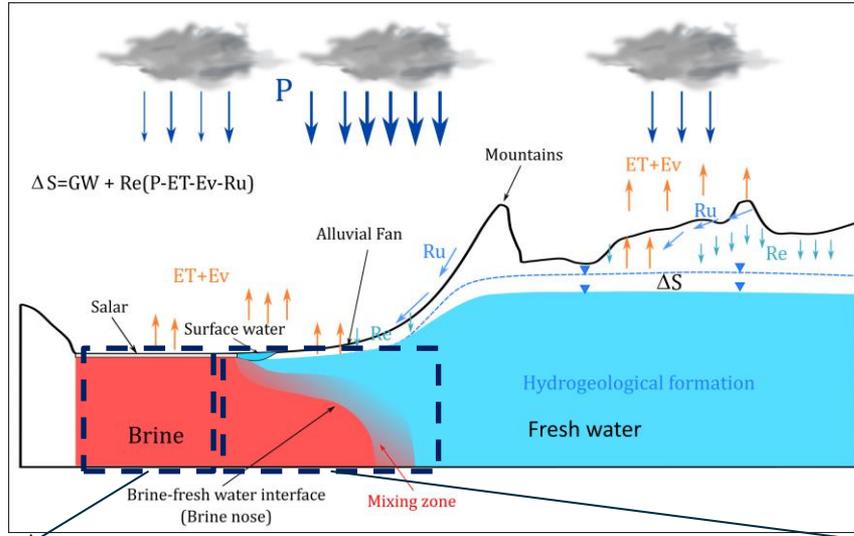
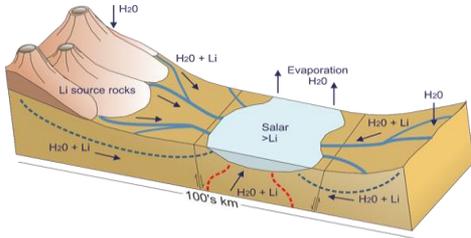
Use of Earth Observation methods to “track lithium mass” in Bolivia



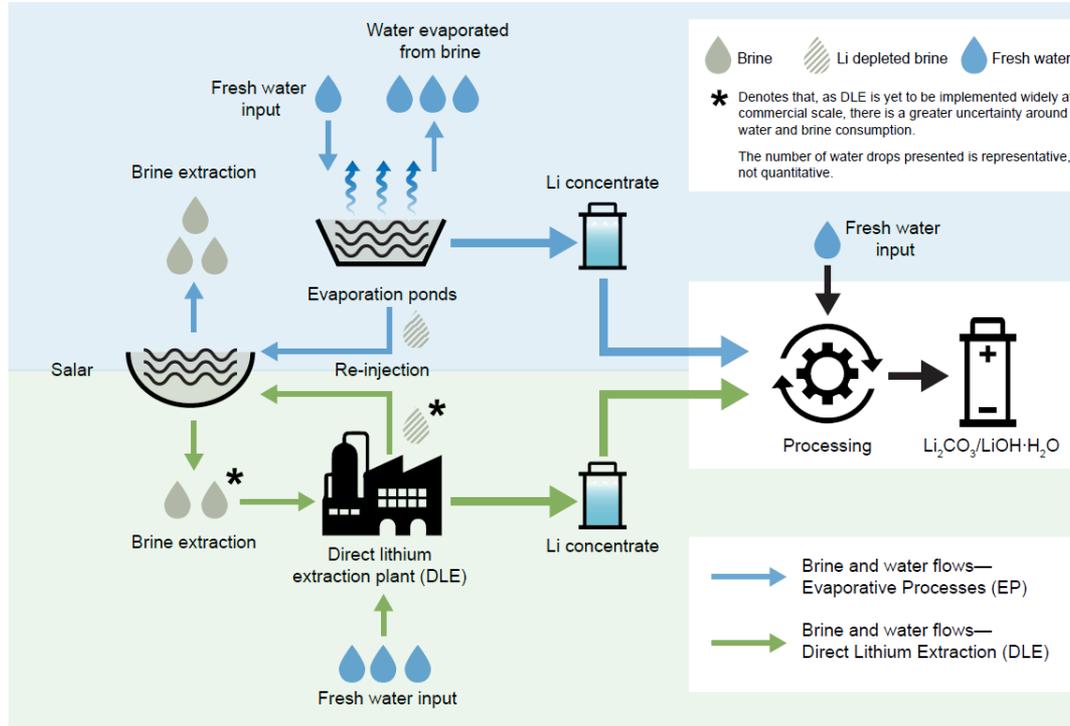


Is lithium extraction from
brines environmentally
sustainable?

Generic Brine – Freshwater Cycle

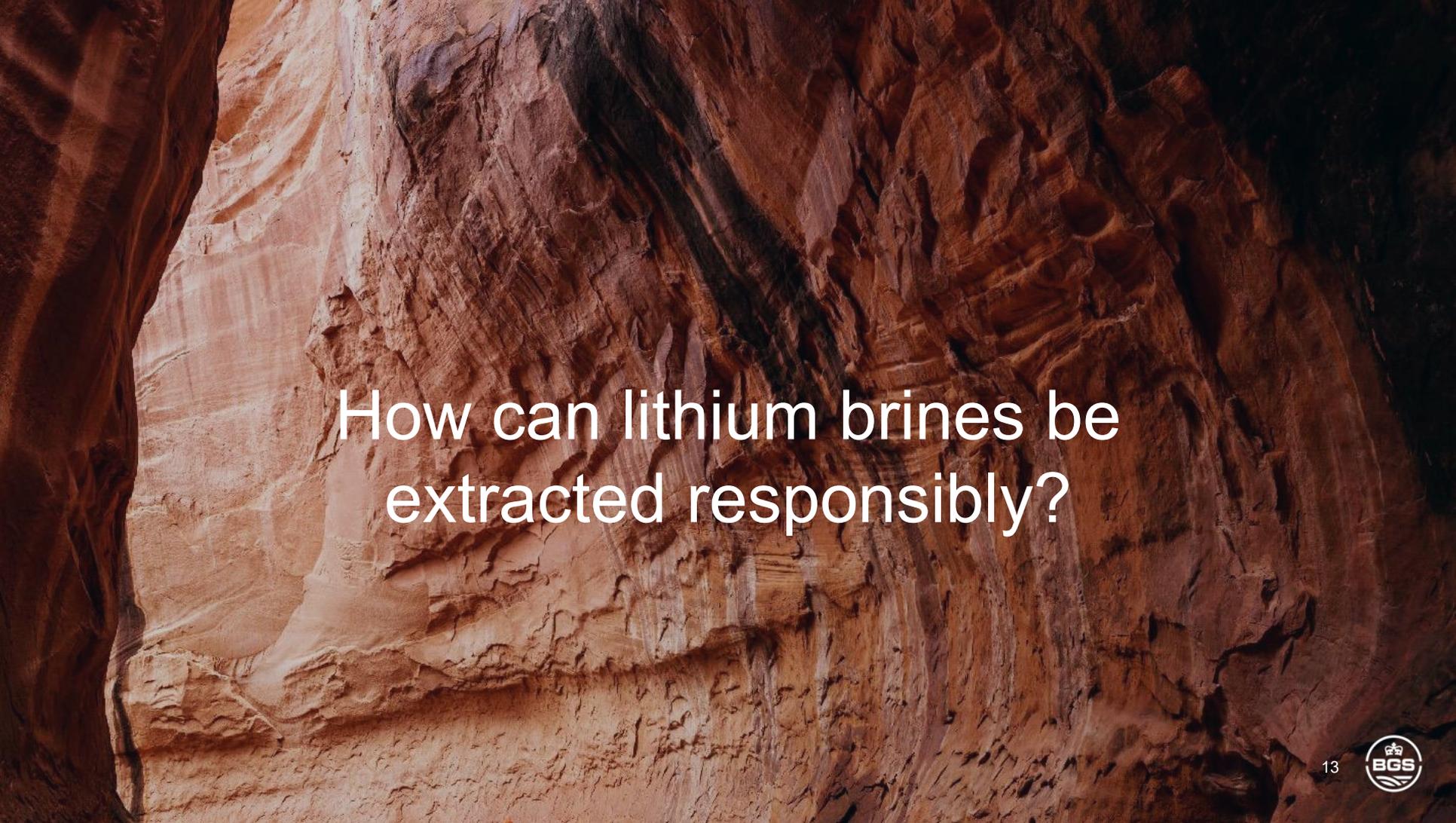


Lithium brine processing – Brine and Water flows



BGS © UKRI

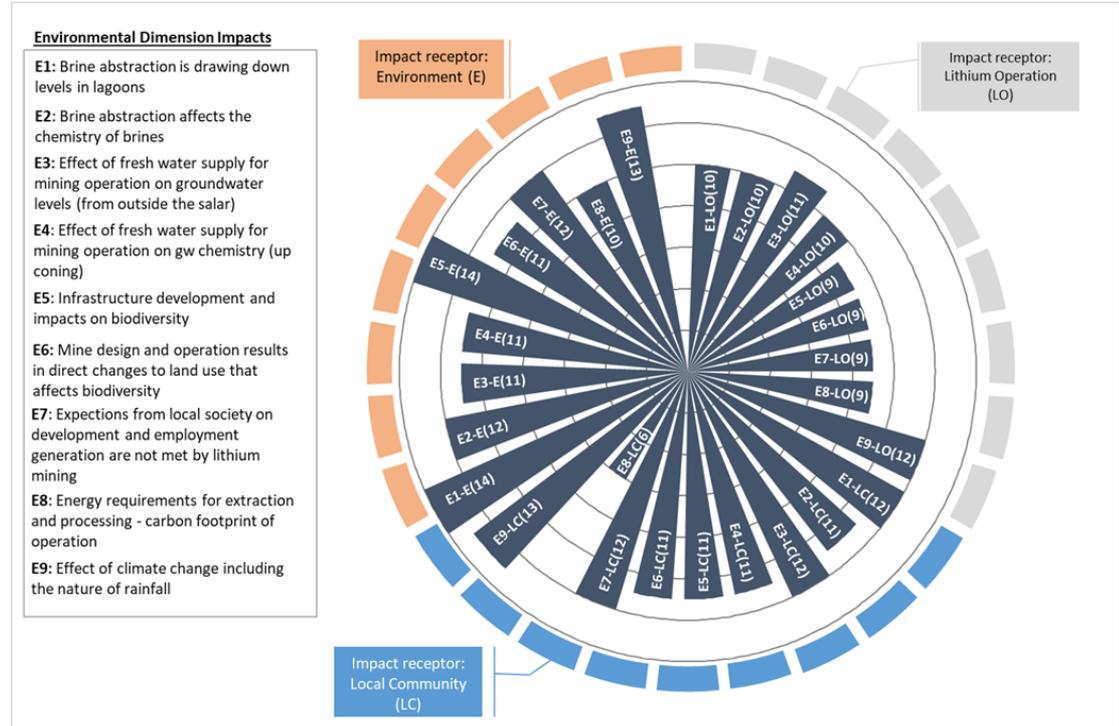
Life cycle assessment (LCA) – issues of water use and their inclusion in LCA



How can lithium brines be
extracted responsibly?

Mapping environmental challenges

- Highest impacts are on the environment as receptor.
- Brine abstraction and impacts in lagoons, infrastructure and impacts on biodiversity and climate change are outlined as the most critical
- Several of the challenges concern the water cycle e.g. brine abstraction, freshwater abstraction, effects on brine and groundwater chemistry
- Limited knowledge and data gaps increase uncertainty and concerns



Mapping environmental challenges

- Highest impacts environment as
- Brine abstractio lagoons, infrast impacts on bioc climate change the most critical
- Several of the c the water cycle abstraction, fres abstraction, effe groundwater ch
- Limited knowlec increase uncert concerns

Mineral Economics
<https://doi.org/10.1007/s13563-022-00332-4>

ORIGINAL PAPER



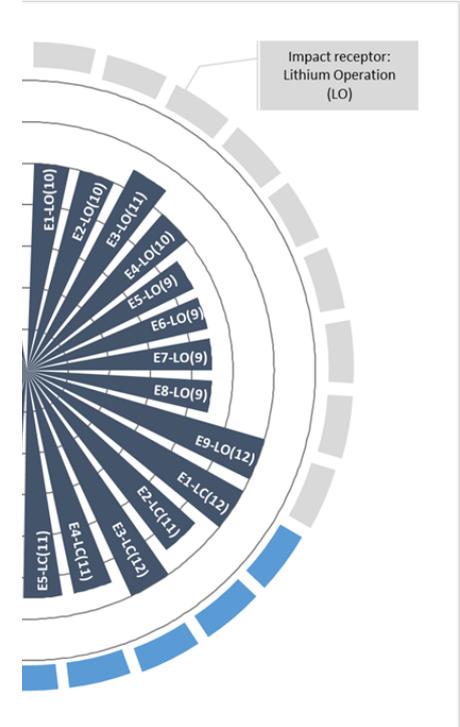
The impacts of environmental, social and governance (ESG) issues in achieving sustainable lithium supply in the Lithium Triangle

E. Petavratzi¹ · D. Sanchez-Lopez² · A. Hughes¹ · J. Stacey³ · J. Ford¹ · A. Butcher¹

Received: 1 March 2022 / Accepted: 28 June 2022
 © Crown 2022

Abstract

The electrification transition will intensify the demand for lithium. The endowment in the Lithium Triangle is significant, and the expectations for the global supply are high in terms of resources and sustainability. In this paper, we investigate the impact of environmental, social and governance (ESG) challenges to the future of sustainable lithium extraction. We undertook a qualitative analysis to prioritise the risks associated with these challenges and discussed their interlinkages. We argue that a sustainable perspective for lithium extraction in the region requires continuous and informed dialogue among government, industry and community stakeholders and participatory processes that reduce the asymmetries of power and knowledge. We provide a list of urgent mitigation actions that could assist the move towards sustainability. These include the following. First is expanding our understandings of the water cycle of lithium brines in this region. This should be underpinned by baseline data and ongoing monitoring at the watershed scale, capacity building to strengthen institutions, improved regulations and data infrastructures to promote data transparency and accessibility. Second is integrating biodiversity impacts within existing mining practices and procedures (e.g. Environmental Impact Assessments — EIA). We propose the strategic implementation of the mitigation hierarchy and IFC's Performance Standards to avoid, reduce and offset the risks of lithium extraction on ecosystem services and critically important biodiversity impacts. Third is strengthening social participatory processes that enable the local communities to become actors in decision-making and the ongoing management and monitoring of lithium projects. Fourth is establishing a framework to support a Strategic Environmental and Social Assessment (SESA) process specific to lithium with a regional approach in the Lithium Triangle.





LITHIUM BRINES

Can cumulative impacts be
avoided?

Mitigation of environmental impacts - examples

Biodiversity –
Mitigation Hierarchy

Cumulative impacts
– Strategic
Environmental and
Social Assessment
(SESA)

ICMM principals

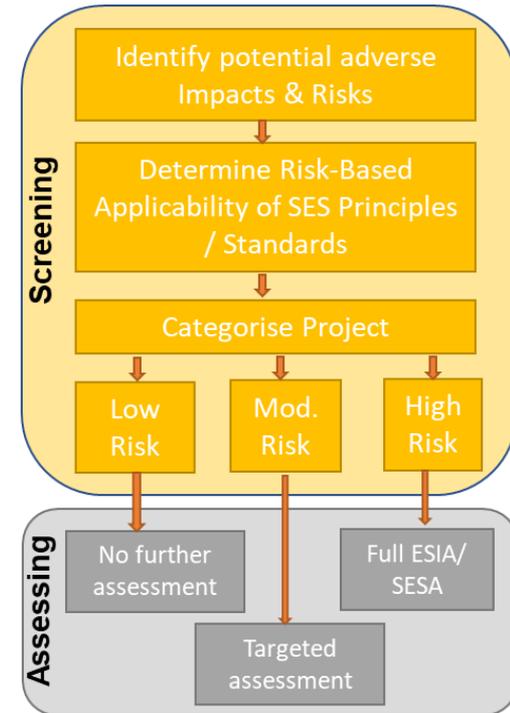
UN Resource
Management
Systems

Life Cycle
Assessment

Other approaches:
Water Framework
Directive

Strategic Environmental and Social Assessment (SESA)

- Cross-border and multi-dimensional: covers both environmental and social impacts
- Higher level than project-based Environmental Impact Assessment (EIA)
- Assessment of policies, plans and programmes in a region (within country or across borders)
- Used to inform decision-making
- Used as a tool to ensure environmental and social sustainability and highlight any likely significant effects of plans, policies and programmes
- Used to understand and assess the cumulative impact of numerous similar projects in a region

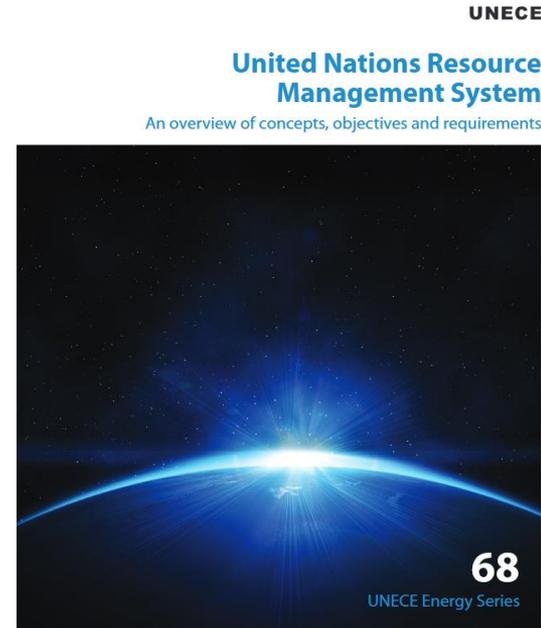


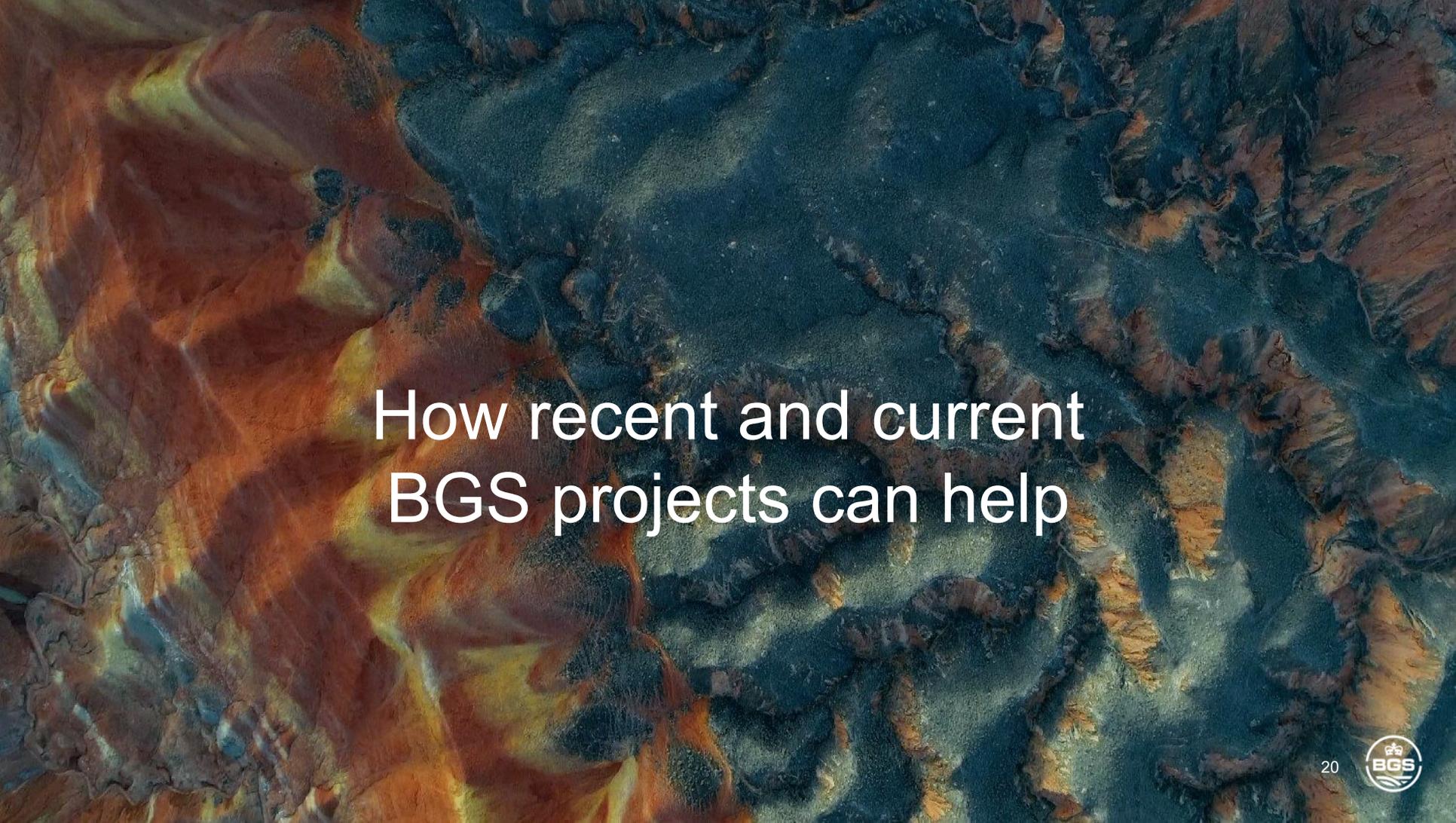
Source:

https://info.undp.org/sites/bpps/SES_Toolkit/SES%20Document%20Library/Uploaded%20October%202016/Final%20UNDP%20SES%20Assessment%20and%20Management%20GN%20-%20Dec2016.pdf

United Nations Resource Management System (UNRMS)

- Created in 2017, based on United Nations Framework Classification for Resources (UNFC)
- Aims to support the Sustainable Development Goals (SDGs) by providing a framework and methodology for resource progression, policy development, and financing
- Comprehensive approach – resources are considered as interconnected elements of a broader ecosystem
- Sustainability and ESG aspects are at its core
- Versatile tool for stakeholders, governments, industries, and civil society





How recent and current
BGS projects can help

Background and aims

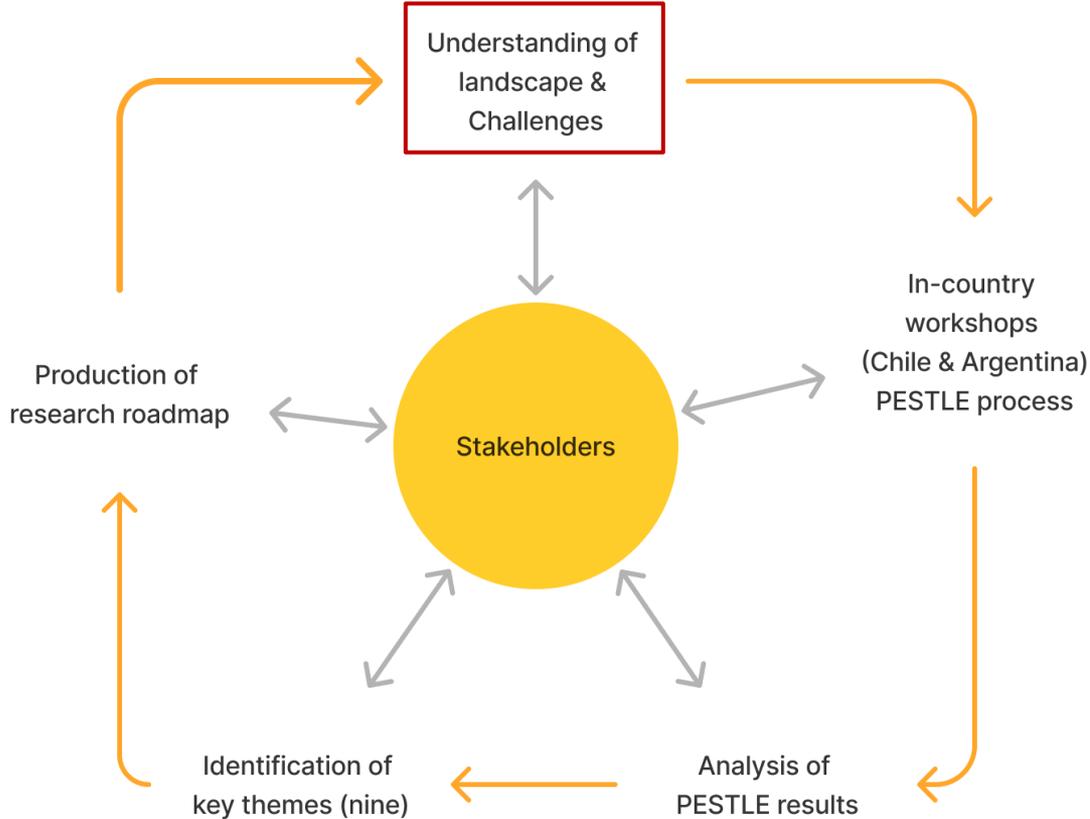
- Salars are complex systems; co-exist with communities and fragile ecosystems. Our understanding is limited but developing
- Improved understanding will support responsible up-scaling of Li production and minimisation of impacts.

UK Government Science and Innovation Fund project objectives:

- To identify challenges to responsible Li supply;
- To develop a **research roadmap** to address these issues and set plans for collaboration between global and local research communities.



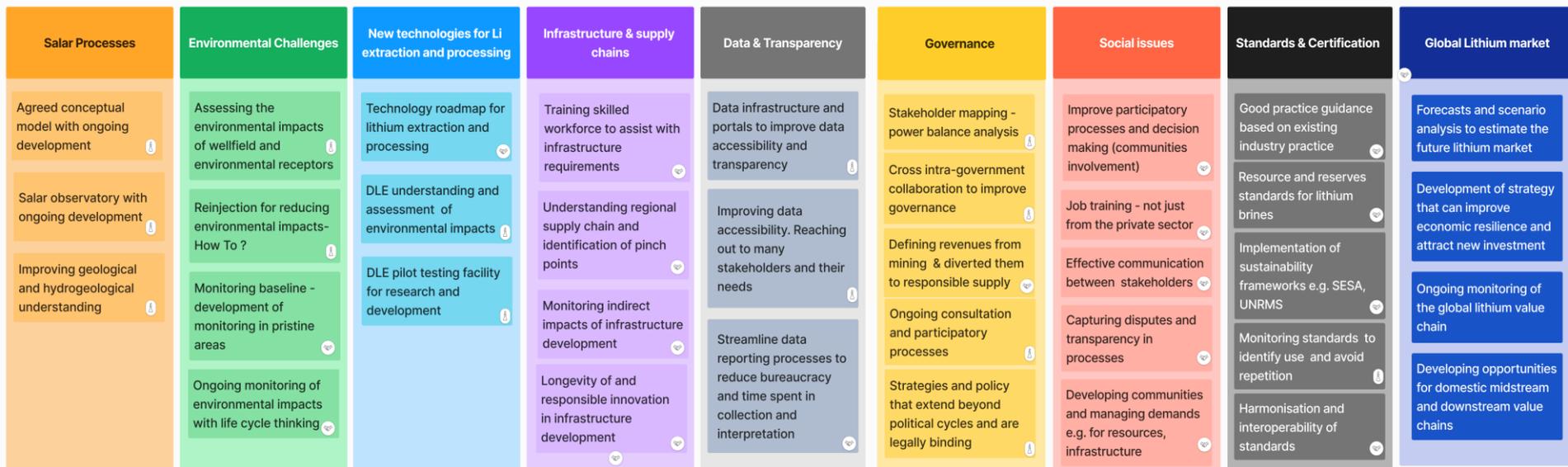
Outline of process



Key themes of the research roadmap:

- Salar processes
- Environmental challenges
- New technologies for Li production
- Infrastructure, supply chains and development
- Data and Transparency
- Governance
- Social issues
- Standards & Certification
- Global Li market

Short term research priorities



 Collaborative tasks with input from other stakeholders

 Research-led task

[Lithium brines in South America : a research roadmap to facilitate rapidly and responsibly sourced lithium](#)

Aims of the FCDO Growth Gateway project



- Running from August 25 to March 26
- BGS view on **cumulative impacts of lithium and copper mining given their potential proximity in northern Argentina**
- Main activities:
 - System Review and Gap Analysis.
 - Stakeholder Engagement and Framework Co-Development.
 - Validation and Policy Alignment.
- Main outputs : framework enabling cumulative impacts to be minimised; report

Questions

- How are lithium mining impacts currently managed?
 - Environmental
 - Social
- Governance, e.g. what frameworks are being considered for holistic approaches?
- How do different stakeholders view the problem? What mechanisms are there to take their views into account?
- Is there a higher-level view on lithium and copper mining and their potential for co-operative resource usage?

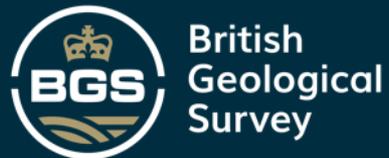


Final thoughts

Final thoughts

- Is mining lithium brine sustainable from an extraction point of view – NO, it takes 100,000s of years to accumulate the deposits
- Can lithium brine mining be environmentally sustainable? YES, with the correct system understanding
- Can lithium mining be socially sustainable? YES by ensuring all stakeholders views are taken into account
- Can cumulative impacts be avoided? YES with the right approach

Rapid and responsible lithium production from salars is possible - but will require concerted effort from the global community, and we look forward to contributing our expertise



ANY QUESTIONS?

Thank-you

ANDREW HUGHES
AGHUG@BGS.AC.UK

EVI PETAVRATZI
EVPETA@BGS.AC.UK

ROWAN HALKES
RHALK@BGS.AC.UK

HANNAH GRANT
HGRANT@BGS.AC.UK

