

In situ Recovery of Resources from Waste Repositories

Dr Devin Sapsford, Dr Peter Cleall, Dr Michael Harbottle, Dr Talib Mahdi, Prof Andy Weightman, Prof Katie Williams, Dr Danielle Sinnett, Prof Tim Bugg, Dr Andy Clarke, Dr Stefan Bon

NERC workshop, 24-07-14



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In situ Processes in Resource Extraction from Waste Repositories

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Origins of the proposal and team



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Key UK Waste Repositories



Mine Tailings &
Waste
Piles

Metallurgical
Wastes

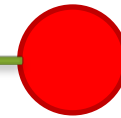
Ash

MSW

Comparison to conventional mining



'Passive'
leaching of
metals

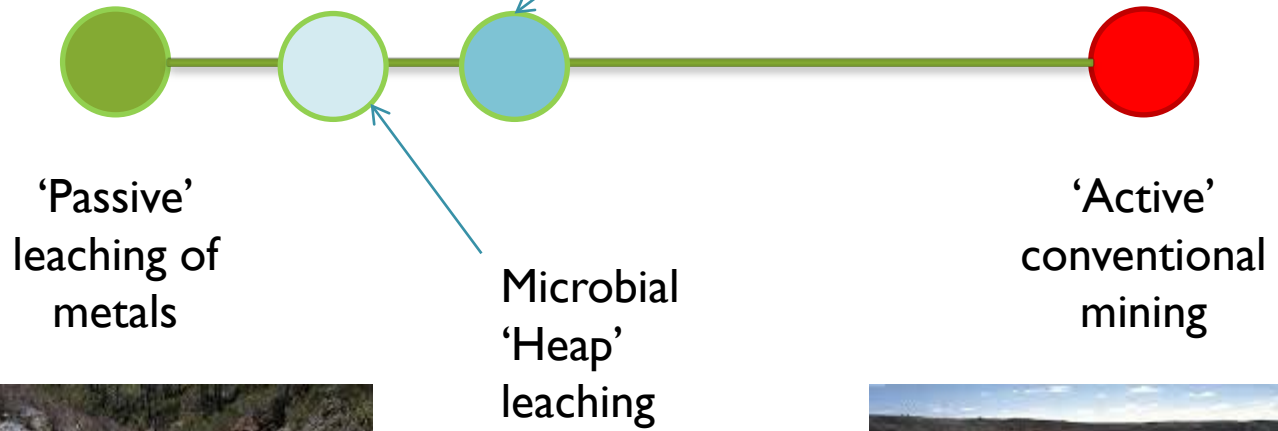


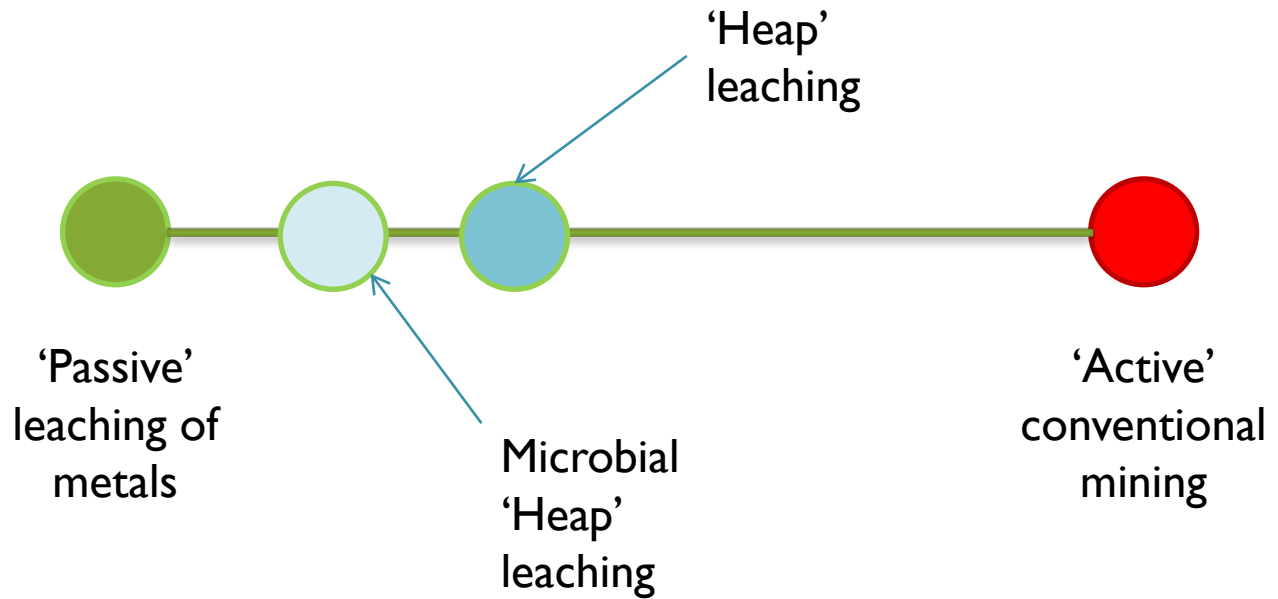
'Active'
conventional
mining





'Heap'
leaching



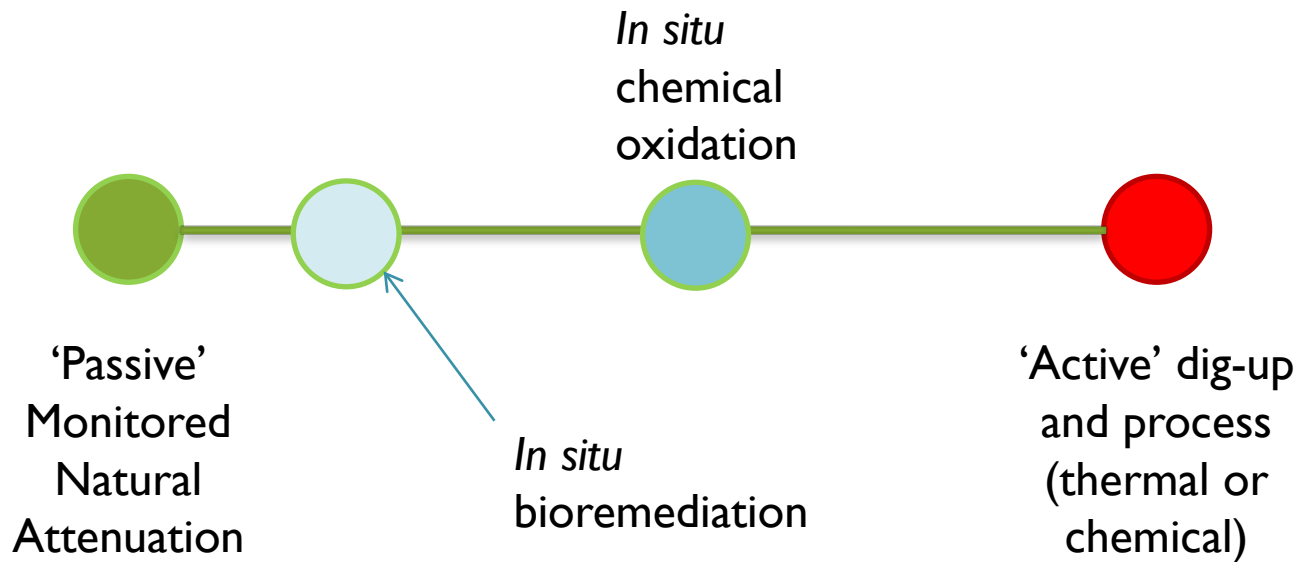


Resource Recovery Rate

Processing Cost

Environmental Impacts??

Comparison to remediation of contaminated land

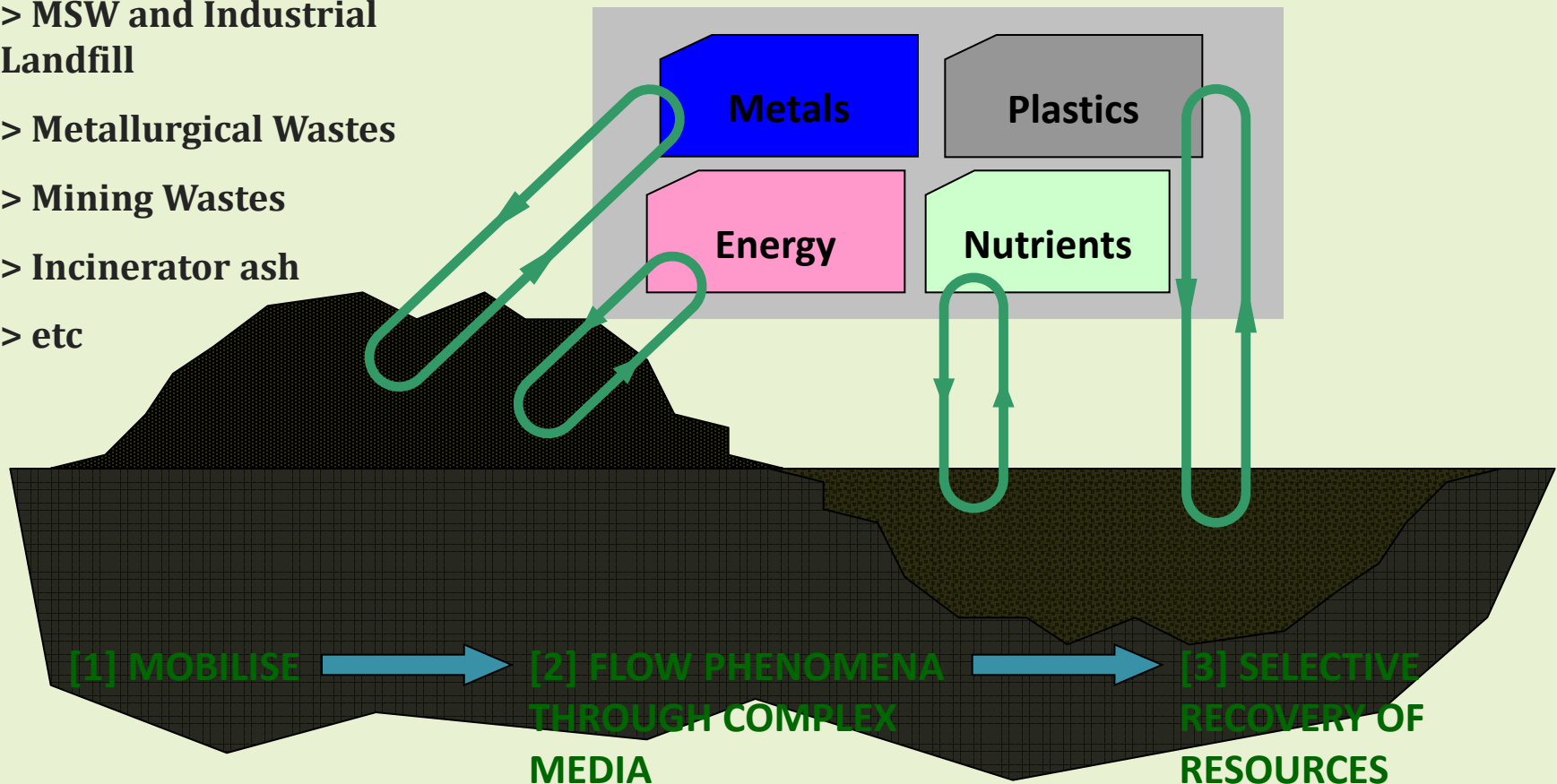


Industrial and supporting partners

- CIWM Cymru
- Viridor
- Natural Resources Wales
- Environmental Sustainability KTN
- Tata Steel
- UK Quality Ash Association
- Jacobs
- RPS
- Ricardo-AEA
- Arup
- GB Card and Partners
- CIRIA
- University of Northampton
- Linkopings University (Sweden)
- Zhejiang University (China)
- University of Hull

In situ recovery of resources from waste repositories

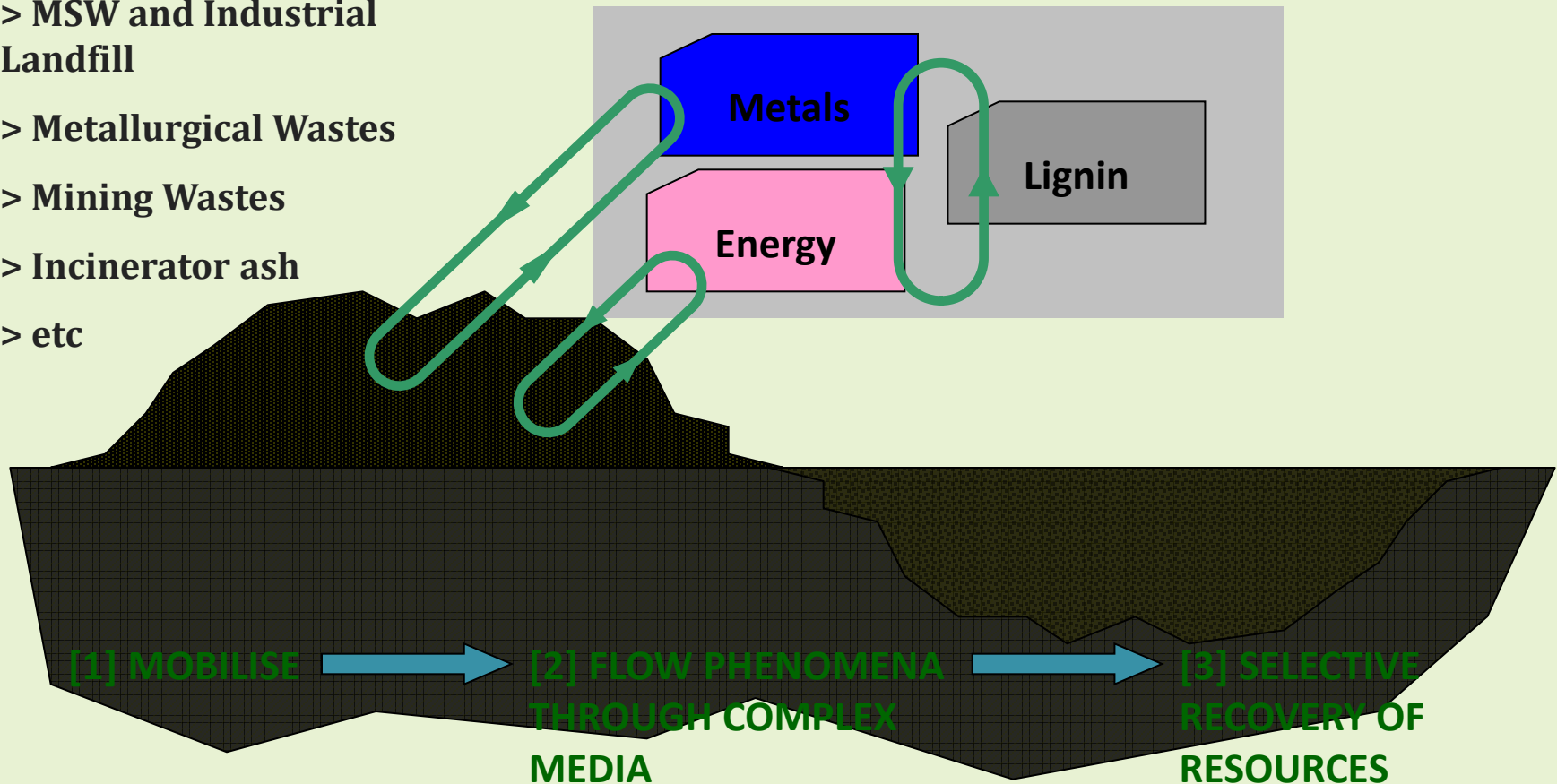
- > MSW and Industrial Landfill
- > Metallurgical Wastes
- > Mining Wastes
- > Incinerator ash
- > etc



1. Can resources (materials of value e.g. metals, rare earth elements (REEs), plastics, energy) be recovered by leaching the waste repositories whilst the material lies *in situ*, thus avoiding the need to actively mine the material?
2. How can we understand and manipulate the *in situ* biogeochemistry of the waste within the repository to solubilise resources and recover them through leaching?

In situ recovery of resources from waste repositories

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Key UK Waste Repositories



Mine Tailings &
Waste
Piles



Metallurgical
Wastes



Ash



MSW

IN SITU concepts....

True '*in situ*' recovery (requires waste liner so recent MSW/ash)

“Enhanced Stabilisation” Methane + metals (prior to *ex situ* mining)

“Detoxification” (also requires liner)

“Reprocessing *in situ*” move material on to leach pad and leach

“Future *in situ*” future repositories engineered for *in situ* recovery

Work Packages

WP1 – Understanding and controlling repository biogeochemistry to maximise leaching of metallic elements (led by Cardiff, supported by Warwick).

Aim: To determine the effectiveness of inorganic, organic and biogenic lixiviants for leaching and recovery of E-tech elements and EoVs from key UK wastes.

Key research questions: What are typical concentrations of E-tech elements and EoVs in key UK wastes? What lixiviants can be used/developed to increase mobilisation of these elements? How can we understand flow behaviour and micro- to macro- scale heterogeneity through various waste media?

WP2 – Biotechnological enhancement of lignocellulose degradation for enhanced methane production and metals recovery (led by Warwick, supported by Cardiff)

Aim: To determine rates and mechanisms for biotechnologically enhanced lignocellulose degradation for enhanced methane production and metals mobilisation for MSW/IW landfills.

Key research questions: Can the rate and yield of lignocellulose degradation be increased by biotechnological means? And if so, what implications does this have for methane production rates and yields (and therefore on energy conversion in the landfill)? Do the breakdown products of lignocellulose degradation increase metals mobilisation (e.g. through chelation)?

Work Packages

WP3 – Resource recovery model development for case-study waste repositories (Cardiff)

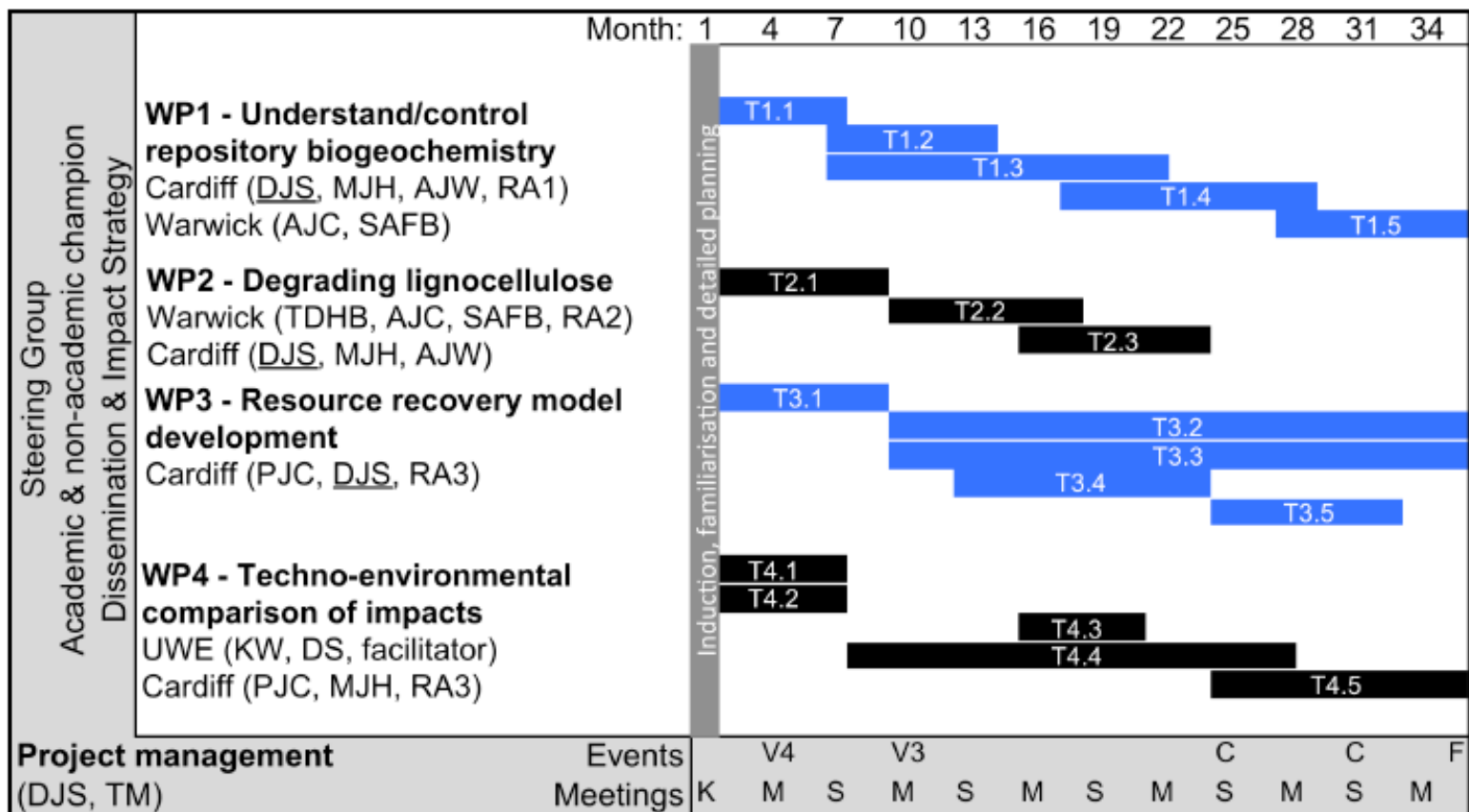
Aim: To develop an *in situ* leaching-based 'resource recovery model' for key UK waste repositories.

Key research questions: How can leaching data be combined with transport, mechanical and thermal responses to develop an *in situ* resource recovery model so that the potential extractable resource of a waste repository can be quantified? If EoV and E-tech elements are present within a waste, how long will it take to recover the potentially leachable fraction?

WP4 – Techno-environmental comparison of environmental and societal impacts of repository and conventional mining methods (led by UWE, supported by Cardiff)

Aim: To enable 'socio-techno-environmental' assessment of candidate technologies specifically to allow robust comparison of environmental and social impacts of *in situ* leaching to *ex situ* mining approaches for the recovery of resources from waste repositories, and to a baseline of 'no action'.

Key research questions: How can the complex interactions of resource recovery rates and yields, environmental and health impacts and economics be assessed for decision making in a robust framework? When considering mining a repository is it preferable to leach the resource *in situ* or extract and process the waste? What is the acceptability of resource recovery from waste?



V* - visit (WP*) C - conference K - Kick-off meeting M - project meeting S - steering group meeting F - final conference



Any questions?



**NATURAL
ENVIRONMENT
RESEARCH COUNCIL**



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