Policy Briefing: Strategies for rehabilitating mercury-contaminated mining lands for renewable energy and other self-sustaining re-use strategies

This briefing summarises the outputs of this Colombia Prosperity Strategic Programme Fund (SPF) project which was conducted from June 2016 to March 2017, funded by the UK government and supported by the Colombian Ministries of Mining and Environment and Sustainable Development..

Foreign & Commonwealth Office

The aim of this short briefing is to explain how low input ("gentle") remediation combined with soft (non-built) re-use of land can provide a sustainable and cost-effective means of restoring land for longer term economic and community benefit, for example on mercury impacted sites resulting from artisanal gold mining.

Colombia has an enormous opportunity for the generation of renewable resources, such as energy from its land, from photovoltaic energy as an example. Linking the safe re-use of mining brownfields (following application of low input "gentle" remediation techniques) with the generation of renewables presents a "virtuous" opportunity for land (re)use for several reasons:

- A variety of local energy market arrangements are possible: The approach is scalable--workable as community based projects as well as large projects with major mining companies.
- The income from renewables can help offset the cost of making the land safe, for example, from mobile mercury contamination.
- The use of degraded land is a more sustainable approach for providing renewables than converting habitat or agricultural land over to renewables production.
- Colombia can acquire a lot of free energy from the sun when compared with many other countries in the developed world (e.g. the UK).
- There may also be opportunities for income from Carbon Offset.

Former mining land: a problem or a resource?

Economic and community benefits

This strategy can also bring wider societal and economic benefits in Colombia. Income from renewables (and potentially also from carbon offset) can be recycled locally. Combining renewable energy production with other land uses, for example with public parks or leisure, may also be very valuable. Well managed public parks are proven to deliver quantifiable health and wellbeing benefits to local communities as well as aiding social cohesion and economic uplift in the vicinity. These might be integrated, for instance, as a "mosaic" with renewable energy production to improve overall project acceptability and viability; as well as improving local support and hence project security.

Managing the risks of former mining land using "gentle" remediation approaches and renewables

The accepted international norm for determining when, whether to, and how to remediate a site is risk based decision making. Risk management is the process of assessing risks and deciding what needs to be done about them; that is, whether the risk is significant and, if so, whether it needs to be mitigated by some form of remedial intervention. For a risk to be present three components of a linkage need to be present: a source (contaminants); a receptor (that might be harmed) and a pathway (linking source to receptor). Therefore, managing risks can be achieved either by controlling the source, managing the pathway, protecting the receptor, or (frequently) some combination of these.

More generally, a risk management approach may integrate interventions at different levels. For example, partial contaminant source removal (for pathway management) to deal with residual contamination may be combined with additional protection via land use planning control or via restrictions on use of water from particular boreholes.

Recently, building on earlier ideas about low input approaches, the concept of Gentle Remediation Options (GRO) has emerged. *GRO are risk management strategies/technologies that result in a net gain (or at least no gross reduction) in soil function as well as risk management.* The rationale is to provide lower costs and a more sustainable remediation approach. This emphasis on maintenance and improvement of soil function also means that they have particular usefulness for maintaining biologically productive soils; this is especially important where a "soft" end use for a site (such as urban parkland, biomass/biofuels production etc.) is being considered.

A range of GROs exist and are in varying stages of development, including, for example, phytoremediation (plant based techniques) and *in situ* immobilisation (such as the use of charcoals to "fix" metals in the soil). These can be highly compatible with and combined with a renewables approach. An example is a project that manages the risks causing concern and generates renewables to provide income and wider benefits, but that does not create any additional risks. Indeed, in some cases the remediation process may also be the renewables production process (which is the case for some biomass based approaches).

A range of techniques that allow generating renewable energy can be deployed on brownfields, including biomass production, photovoltaics, wind, and (potentially) geothermal / geological sources. Renewable energy production exploits sources that are carbon friendly and hence help mitigate global warming. Another form of renewables are biofeedstocks, for example for fibres or biofuels. Deploying renewables supports achieving independence from volatile fossil fuel markets and may be particularly useful in areas of energy scarcity or variable supply. Thus, renewable energy production is both a reliable and sustainable means to produce energy and a strategy to gain security in energy supply. It is an attractive solution both for energy providers (i.e. to comply with GHG emissions requirements) and consumers (i.e. providing a reliable supply at controlled prices). Compared to conventional energy sectors, studies have revealed great potential for job creation in the green and renewable energy sector. Applied in the context of brownfield regeneration, renewable energy supply is a potential source of revenue for ongoing site management. It also avoids the use of greenfield sites for renewables production, thus reducing potential land-use conflicts.

What renewable options are available?

International interest has been growing in integrating sustainability as a decision-making criterion for remediation projects i.e. to select an approach that achieves a balanced net benefit when considering wider environmental, economic and social impacts. Sustainable remediation has become an area of intense development across the world, with Public and Private Sector organisations (including in the UK and Colombia) involved in a number of projects and networks intended to improve remediation practice and make it more sustainable,. Using a site conceptual model of sustainability as a common thread through the different tiers of sustainability assessment that leads towards a quantitative valuation in financial terms, can be very helpful. The use of cost benefit analysis (CBA) can be highly controversial for a number of reasons. However, CBA underpins both policy decision-making in many cases and, of course, investment decisions for public as well as private funds. Using valuations (CBA) based on the same shared sustainability model, and showing how specific valuation techniques have "best fit" to different aspects of this shared model (in a transparent way), can enable a CBA consideration that is more robust, more transparent and consistent with sustainability assessment.

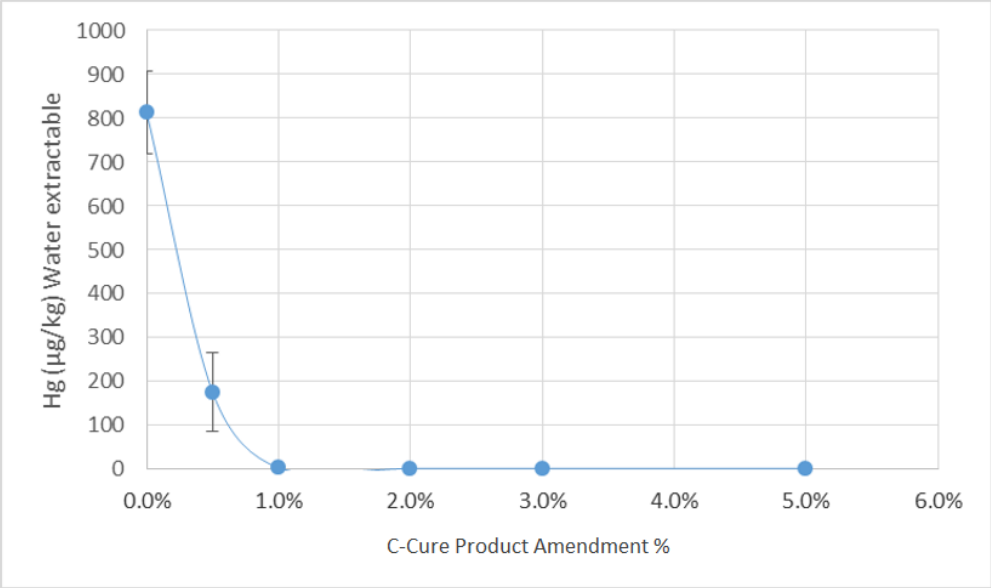
How do we assess sustainability and costs versus benefits?

Strategy evaluation for Colombia

The SPF funded project evaluated two aspects of site rehabilitation and reuse: (1) the use of specialised biochars for the immobilisation of mercury (as a gentle remediation approach) on a limited number of samples from two sites; (2) a preliminary assessment of the (photovoltaic) energy potential at three brownfield areas. Key findings are as follows:

1. *Mercury remediation*

- Widespread international consensus exists on the hazardous exposure values (and appropriate safe levels) for mercury and other metals in soils and other media.
- Low cost, plant-based agronomic techniques already used in many other countries can be adapted to reduce risks from mercury and other metal contaminated sites in Colombia
- Gentle Remediation Options, or GROs, are effective risk management methods involving either:
    - The use of plant, fungi, and/or bacteria-based methods,
    - Soil amendments which can change contaminant speciation, leachability or bioavailability
    - The combination of plant, fungi, and/or bacteria-based methods with soil amendments.
- GROs can have significantly lower deployment costs versus conventional remediation technologies, and can also contribute strongly to sustainable remediation strategies.
- In most contaminated soils and mine tailings, mercury does not accumulate in the above-ground biomass, but it may volatilise through the plants leading to mercury emissions to the atmosphere. Therefore, the most effective plant-based approach to mercury remediation or management is through stabilising mercury in the soil with soil amendments and then establishing a vegetative cap of green cover or biomass, rather than attempting to phyto-extract the metal.
- For example, soil or spoil amendments with biochar may be used in this approach to immobilise heavy metals (including mercury) and simultaneously act as soil conditioners, to reduce soil toxicity and enhance plant establishment and growth.
- Lab scale testing of soil samples from Colombia containing mercury (and other metals) treated with C-Cure products has shown considerable promise in reducing risks and restoring soil quality. The project has proposed a series of field based trials to test proof of concept



2. *Renewable energy generation*

- Using U.S. renewable energy decision tools, the potential of deploying solar energy at three pilot sites was assessed including such factors such as the solar resource, infrastructure, and owner interest and site readiness.
- Additional high level assessments by Kyocera Solar outlined the potential for deploying solar energy at the two most promising sites along with preliminary cost estimates.
- Recommendations for bringing renewable energy projects to fruition include (1) engaging stakeholders early (i.e., World Café), (2) demonstrating social benefits to the community (i.e. using the Brownfields Opportunity Matrix), and (3) developing formal public/private partnerships for financing, construction and management.
- Development of a public/private partnership that includes a global renewable energy company, a Colombian university and SME enterprises based in Colombia holds considerable promise for bringing a renewables project to fruition in the near future.

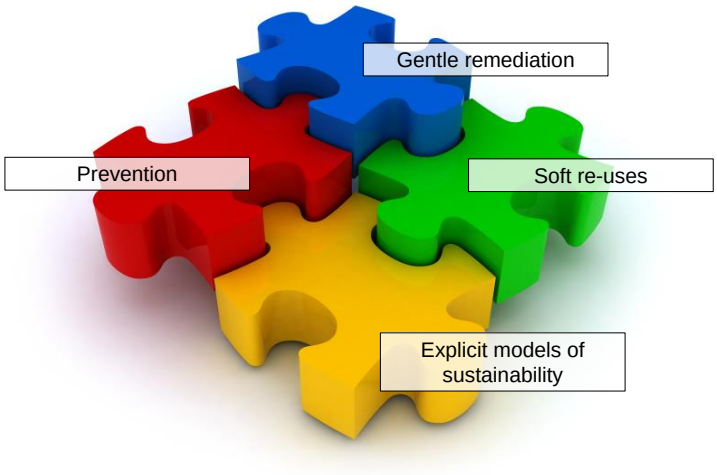
Next Steps

The SPF project this briefing relates to is only the beginning of the story in Colombia to help develop a strategy to deal with contaminated mining lands and reap the energy benefits of effective reuse. The next phase of work would be: (1) to conduct demonstration / exemplar projects in Colombia to provide national proof of concept trials, (2) to extend local skills and know-how, (3) to create opportunities for international collaboration between the UK and Colombia, and (4) to provide opportunity for technical refinements to this project's guidance outputs to better suit local conditions in Colombia, as experience grows with practical implementation of renewables with gentle remediation in Colombia.

Wider Colombian policy linkages

The strategies suggested in this project are in line with the policy and regulatory actions of the Colombian Government, which will benefit many public and private institutions as well as for the affected communities. Key points of relevance include the following:

The Colombian government has been working on the implementation of programs to eradicate the use of mercury in all economic sectors. One of the first actions results from the Expedition Law 1658 in 2013.A mercury plan became effective in 2015, under which a single national registration is required; it applies to all companies or persons that use mercury in their activities. At the same time, the law 1715 of 2014 establishes the procedures for the generation of renewable energy in the country. This law offers tax benefits for some projects, but new regulations are coming to help develop real programs. For now, pilot projects are developing in local areas. Renewable energy on brownfields can help achieve national goals such as Colombia's 2050 Energy Plan, particularly the design of decentralized, resilient energy infrastructure. The government also has been working on the ratification of the Minamata agreement, which is expected to be completed by 2018.



It is also valuable to consider future and restoration strategies when new mining concessions are being granted. The approach suggested here offers:

- Better stewardship
- Reduced liabilities
- Less impact
- Community engagement
- Easier planning and establishment
- And so ultimately better returns for business, government and society

Further Information

More detailed information can be found on
http://www.r3environmental.com.co/en/downloads.html (English version) and
http://www.r3environmental.com.co/es/descargas.html (Spanish Version)

1. *Guidance and strategies for re-use of land by transferring state of the art knowledge and successful implementation from the UK, EU and North America, and adapting it to the local situation as circumstances dictate.*
2. *An onsite field testing plan for techniques that promise to be replicable to other similarly contaminated sites, based on technology evaluations and bench scale test work*
3. *Decision support package and stakeholder engagement assistance for identifying opportunities for services from soft (i.e. non built) brownfields restoration.*

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This Briefing constitutes Output 3 of this project: *A policy brief for regional and national governments in Colombia. The brief will address Law 1658 of 2013, Colombia's commitment to the UN Minamata Convention (i.e. The Unique Plan of Mercury), the 2015 Paris Climate agreement, and Colombian accession to the OECD.*

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