

Conference „Sustainable resource management, raw materials security, Factor-X resource productivity - tools for delivering sustainable growth in the European Union“, December 6-7, 2006 in Bruges, Belgium

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Nr.: 1.

Title of paper:

Biohydrometallurgy: New Solutions for Sustainable Mining

Authors:

Lasse Ahonen, Senior Scientist, Geological Survey of Finland, Finland

Abstract:

Biohydrometallurgical technologies offer potential new technological routes for the utilisation of low-grade ores as sources of metals. Bacterial catalysed leaching of copper from dumps of certain copper mines has been known, and even actively exploited for decades, but those leaching operations were often poorly controlled. Sulphide mineral occurrences are thermodynamically unstable in near-surface oxidic conditions, implying that they can act as an energy source for microbial life.

Biohydrometallurgical technologies offer possibilities for the development of new sustainable metallurgical processing routes, both in terms of ecology and economy. Due to the selectivity of the oxidative leaching reactions, energy-consuming processing of barren rock can be reduced. A fundamental characteristic of the bioleaching processes is that they are based on the energy released in the oxidative disintegration of the desired metal sulphides. Depending on the type of metal-bearing rock, microbe-based metal leaching can be a self-sustaining process or even produce excess energy.

An important advantage of the bioleaching processes is that air emissions of harmful compounds are low compared to the pyrometallurgical technologies. However, safe management of metal-bearing fluids in bioleaching process calls for special attention.

Currently, up-scaling of biohydrometallurgical processes to the commercial scale is underway. Examples include pre-treatment of gold ores and leaching of nickel from low-grade deposits. This R&D is also strongly supported by projects supported by the 6th Framework programme of the European Commission.

Nr.: 2.

Title of paper:

Environmental policies in EU and tools affecting eco-design options and durability needs for products from global markets: Korean experiences and reflections

Authors:

Prof Jong-Dae Kim, Director of Research of Sustainability Management Research Institute (SMRI), College of Commerce and Business Administration, Republic of South Korea

*Dr Ioannis E. Alexiou**, Senior Consultant, Scientists International Consultants, UK

Abstract:

The purpose of this paper is initially to define and address for business and policy decision makers the key points in the sustainability mechanisms necessary in global industrial manufacturing in order to establish adequate and achievable eco-design and product durability objectives. Such objectives are expected to have major implications in the manufacturing principles in industrial regions in East Asia, and particularly South Korea.

Our policy position paper will aim to clarify the implications of current and forthcoming environmental policy and legislation in European Union and the EU consumption patterns on the global productions lines in East Asia; and aim to assess and minimize their potential economic effects on the production lines in East Asia on the basis of the use of tools like Material Flow Cost Accounting (MFCA) and promote efforts to define durability and product life span on the basis of such tools; while maximizing the impacts of such EU policy on regional and global environmental and social improvements

Also within our paper we will give practical examples by reviewing some Korean corporate case studies who are also significant players in EU consumption. The review will focus on the basis of recent relevant European legislation, such as WEEE and RoHS that have significant implications in Korean production and manufacturing lines.

Finally the paper will try to present best ways to implement a reasonable timetable for the minimum effects on the basis of sustainability principles and targets, but also to enable East Asian economies to adjust to the changes necessary to achieve EU policy with minimum impact on their economic strengths as global industrial producers, particularly for small and medium scale companies in East Asia.

Nr.: 3.

Title of paper:

An Institutional Framework for a more efficient use of Natural Resources

Authors:

Prof. Valentin Bartra, Profesor de Legislacion Ambiental, Universidad Nacional Mayor de San Marcos, Peru

Abstract:

The importance of natural resources is recognized by its constitutional protection. A strategy to lower the impact of availability and cost of materials will have positive externalities, lessening exporting jobs abroad. A robust policy framework will improve eco-efficient resource use and promote sustainable production and consumption.

An Institutional Framework for Resource Management incorporating an International Panel, would help decouple natural resources use from its environmental impacts, monitor global materials and energy balance and guide policies and measures. Also, coordinate constituencies and generate information and knowledge. Could emulate existing environmental institutionalism.

We change ecosystems to meet our needs, so only strong legal framework will regulate drivers and quell environmental degradation and depletion of natural resources through the global economy. World economic architecture based on abundant coal and gas reserves favours fossil fuels but pollution and inefficiencies persists, as pressure to avoid global warming mounts. Energy consumption expands with the rapid growth of the world economy, business as usual needs to be checked with Innovation playing a crucial role in reducing CO₂ emissions and creating alternatives to satisfy societal needs but also in devising new laws.

Markets enthusiasm alone could lead to disorder, like the optimistic biofuels boom, vs. order provided by laws like the German feed-in law or Danish container law.

Better organization based on robust legal framework, innovation, information and incentives in a market context will create conditions to develop core competences for achieving competitive advantage and efficiency. Incentives, economic and fiscal will help counterbalance the increasing importance of gas and coal and promote ways to reduce waste, life cycle thinking, ecomobility and ecoplanning of cities.

Raw materials supply could be secured by forging strategic alliances with reserve rich stable countries like Peru with 12 metals exhibiting 10 decades of constant growth,

This paper follows New Institutional Economics.

Nr.: 4.

Title of paper: Sustainable Development in the European aggregates industry:
a case for sectoral strategies

Authors: Raimund Bleischwitz and Bettina Bahn-Walkowiak*

Abstract:

The EU Sustainable Development Strategy, ensuing National Strategies, and the recently launched EU Thematic Strategy on sustainable management of natural resources (COM(2005) 670 final) alike call for a decoupling of natural resource use from GDP growth. Empirical analysis demonstrates that by far the biggest share of natural resource use stems from construction minerals, i.e. aggregates such as sand, gravel, crushed rock and other bulk materials used by the construction industry. According to Eurostat, in 2002 they represent 40% of the Direct Material Inputs in to the European economy while mineral fuels represent another 25%. The paper analyses how governance processes for enhancing the sustainability performance of aggregates have begun to take stock in Europe. A first chapter sheds light on why aggregates are important: not only because of its resource intensity, but also because of environmental impacts (drawn from LCA analysis), economic importance and, finally, because it is predominantly a domestic natural resource. A second chapter deals with driving forces for their production and use, which are to be found in construction (i.e. homes, residential buildings, physical infrastructures such as roads). Existing policies and governance are analysed in-depth in a next chapter; the paper points out several policies already regulating mining and energy intensive industries that are of high relevance for aggregates. However, there are no policies existing yet addressing the use of aggregates in conjunction with their final demand in respective markets. Rather, policies are still fragmented into extraction, production, consumption and waste stages. A sectoral action plan, covering extraction, use and recycling of aggregates (and other resources) and the optimised provision of housing and transport utilities, as called for by the EU thematic strategy on sustainable resource management, would be an eligible option for more coherence in that area.

Nr.: 5.

Title of paper:

Recycling construction minerals for urban infrastructure - non-technical factors and barriers

Authors:

*Andreas Blum**, Leibniz-Institute of Ecological and Regional Development (IOER),
Department Housing Studies, Ecological Design and Construction, Germany
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Department Housing Studies, Ecological Design and Construction, Germany

Abstract:

Construction and demolition activities produce waste in very significant quantities and at the same time have a high demand for natural resources. Reuse and recycling of construction minerals and thus appreciating C&D refuse as resources is an important contribution to a sustainable resource management.

In Germany about 70% of construction and demolition waste (C&DW) is recycled in different quality – to a large extend actually rather “down-cycled” (e.g. backfilling of trenches, non-load-bearing roadbeds). This is despite of several regulations that have been enacted over the years that should bring forward the use of recycled construction material in quantity or quality. Also international research indicates that the share of recycled C&DW can reach up to nearly 100% in other countries.

Given this situation and a lot of research done on technological options and barriers for C&DW recycling the idea of the study presented was to analyse the *non-technical* issues of C&DW recycling. For this analysis the field of municipal road construction and urban infrastructure was chosen because there the use of recycled construction material is comparable easy and at the same time public actors are usually held responsible for giving good examples.

In Bruges we would like to present the findings of theoretical analysis and the interpretation of the conducted semi structured interviews with stakeholders from construction industry and municipal public works departments. The study identified barriers rooting in the institutional context, individual attitudes and “black sheep” – actors on the market utilizing regulatory gaps for economic profit. So reliable quality assurance along the chain of C&DW recycling and production of recycled construction materials is one of the crucial requirements. An other is to clearly specify and communicate recycled construction materials in the public as high quality products instead of still considering them as a specific type of waste.

Nr.: 6.

Title of paper: How to design national and international resource policies from a material flow perspective?

Resource specific challenges and complementary approaches towards economy-wide sustainable resource management

Authors: *Dr. Stefan Bringezu*, Director, Research Group on Material Flows and Resource Management, Wuppertal Institute, Germany

Abstract:

In pursuit of the EU resource strategy a debate is ongoing on how environmental impacts of various material flows can effectively be reduced and how sustainable resource policies may also contribute to improve the socio-economic performance of countries. The paper will present empirical findings of international comparative material flow analysis which show different levels of resource use, decoupling from economic growth and shift of raw material sourcing from industrial to developing countries. With regard to a future sustainable resource use, the major types of material resources (biomass, fossil fuels, metals and industrial minerals, non-metallic construction minerals) are challenged in different ways. In order to reduce non-renewable resource use, adjust renewable resource use to sustainable levels of supply, reduce environmental impacts and increase socio-economic benefits it is proposed to design a mix of materials unspecific and specific measures. A general "conditioning" of the socio-industrial metabolism is required to develop the volume, structure, international performance and growth dynamics in a sustainable way towards maturity. National, EU and international programmes may orientate towards the main material resource groups, considering also energy and land use. The main tasks and challenges for major resources are described. A key strategy relevant for all resource groups will be to increase resource productivity. To implement the strategy, resource intensive industries could be supported by material efficiency programmes (like e.g. Germany, UK) to find options for dematerialization. Demand for resource intensive products could be muted (e.g. by re-visiting subsidies, public procurement, resource taxation and R&D). Regulation and management of specific material flows is further needed to control hazardous or critical substances, and to optimize base material flow systems (e.g. iron&steel). General conditioning and specific regulation are complementary. The former especially requires a broad-scale increase of resource efficiency in the production and consumption system. This will also mitigate environmental impacts and burden shifting between materials and regions. The efficiency strategy will have to be supplemented by approaches which adjust the absolute levels of resource consumption and thus allow sustainable supply of resources. International efforts will be required for globally traded products (esp. metals and non-food biomass).

Nr.: 7.

Title of paper:

Towards the sustainable use of Mineral Resources: a European perspective

Authors:

*Patrice Christmann**, Euro Geo Surveys, Belgium

Luis Martins, Portuguese Engineering, Technology and Innovation Institute INETI,
Portugal

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Gilles Recoché, French Geological Survey BRGM, France

Abstract:

Minerals are indispensable to human well-being and economy. Not counting the energy minerals, they are the single largest material flow across the EU economy with over 2.5 bn tons/year Direct Material Input. They can only be gained where concentrations of specific minerals occur.

There are a number of issues, many of them being dependent on local conditions that will shape the future of the EU mineral resources industry, and of the downstream economic sectors. They are: access to land, competitiveness, cooperation with developing countries, environmental impacts, decoupling growth of use from environmental impacts, innovation, governance, loss of technical skills and security of supplies. The governance standards and capacities of operating companies as well as of the various local authorities with responsibilities related to the mining industry play an important role in this context

Minerals receive almost no holistic attention in EU-level policy making. This is possibly due to the fact that the Treaty on the European Communities gave no exclusive or shared competence to the European Commission.

The EU minerals industry, supported by the European Geological Surveys, is strongly committed to address these issues as far as possible. This is materialised by the industry-led European Technology Platform on Sustainable Mineral Resources proposal (www.etp-smr.org), recognized by the European Commission in its COM(2005)474 on a policy framework to strengthen EU manufacturing and a more integrated approach for industrial policy.

Adapted Sustainable Development Indicators, such as the “Sustainable Development Indicators for the Non-Energy Extractive Industries” jointly developed between the European Commission and the EU minerals industry, are needed to monitor the impacts of the minerals industry as well as their trends over time, at all scales from local to global.

Nr.: 8.

Title of paper:

Material Flow Analysis and Assessment of Production Efficiency in the Irish Economy

Authors:

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Prof. Richard Moles, Chemical and Environmental Sciences (CES) Department, University of Limerick, Ireland

Abstract:

In the early 1990's Ireland began to experience remarkable economic growth and the economy doubled in size between 1990 and 2000 in terms of GDP. Although growth slowed down following the international slowdown of 2001/2002, GDP growth still averaged 6.1% between 2000 and 2004, compared with the Eurozone average of 1.7% and the OECD average of 2.5%. Various reasons have been purported for this economic growth including the movement towards a more open economic model and embracing a policy of economic liberalism and global competition, particularly in terms of international trade of goods and service; substantial inflow of foreign direct investment (FDI), particularly in high technology sectors, due to low corporate tax rates; the social partnership approach; export platform for shipments to EU markets; position in an Atlantic economy and the availability of a relatively inexpensive labour supply to provide additional production capacity. Indeed, Ireland's economy is one of the world's most dynamic and globalized, with extensive external trade and investment links and annual growth rates over the averages for the developed world. However, it is feared that because of the over-reliance on FDI and narrow diversification of its exports both sectorally and geographically that its economy is vulnerable to exogenous shocks and loss in competitiveness due to relative increases in competitor productivity unless MNC's become more embedded and there is a transition to a knowledge economy. The objective of this paper is to measure material flows during this period

Nr.: 9.

Title of paper:

Human rights: enforcer or a catalyst of sustainable development

Authors:

Jaroslav Greser, PhD Student, Department Theory and Philosophy of Law, Faculty of Law and Administration, Adam Mickiewicz University, Poland

Abstract:

The concept of human rights is no longer regarded only as an instrument of protection of an individual from the state. All three aspects of sustainable development: economical, social and environmental have direct connection with human rights. It leads to situation when individual could claim to the state clean environment invoking human rights and state would be obliged to fulfil claimer expectations. On the other hand, one of conditions which are necessary for developing country's economy and make it more competitive is the sustainability. In this paper I will present state actions which are based on human rights and which enforce or encourage business to sustainable management. Among the means which are used to implement sustainable development I will focus on the right to live in clean environment and right to development. As for incentives I will describe direct and indirect state actions which aim to promote sustainable development. Both of these issues will be mainly described on the example of Poland as a new member of European Union and a state where issues of sustainable development are underestimated. The second issue which I will raise in this paper is protection of human rights which allows civic society organization exert an influence on business to act more responsibly in the area of resource management. I will describe making use of human rights in case of consumers boycott, as well as using them as a tool of persuasion, while demanding freedom of speech or right to information.

Nr.: 10.

Title of paper:

Natural resources, Factor X and the contribution of companies to Sustainable Growth

Authors:

Prof. Frank Figge, St. Andrews University & Sustainable Development Research Centre, UK

Ralf Barkemeyer, St. Andrews University & Sustainable Development Research Centre, UK

*Dr. Tobias Hahn**, IZT Institute for Future Studies and Technology Assessment, Germany

Andrea Liesen, IZT Institute for Future Studies and Technology Assessment, Germany

Abstract:

The increasing scarcity of natural resources challenges our eco-systems as well as economic wellbeing and prosperity. As a response, researchers, policy makers and the most innovative companies are promoting the concept of eco-efficiency or Factor X. Factor X underlines the need to use natural resources more efficiently by a factor of several magnitudes to achieve economic prosperity without comprising the preservation of valuable natural resources.

Companies play an important role in this context, as they control considerable flows of natural resources. It is thus important to measure by how much different companies from different sectors contribute to an increased natural resource productivity. In this paper, we report the empirical results of the ADVANCE-Project in which we have assessed the use of natural resources of 65 European companies using the Sustainable Value approach. Sustainable Value builds on a fundamental pillar of financial economics: To create value a company must use resources more efficiently than others. Sustainable Value determines the value of natural resources in companies in monetary terms. It shows which companies and sectors achieve the highest natural resource productivity. In addition, we apply the so-called Return to Cost Ratio to measure by which factor companies' natural resource productivity exceeds the benchmark. We deploy two different scenarios: a) Over a time series of three years we show by which factor the companies exceed or fall short of meeting the average resource productivity of the EU15. b) In a future performance scenario we take into account European growth and environmental protection targets and determine if and by how much companies measure up to the targeted natural resource productivity in 2010.

As a result, our research applies the notion of Factor X to the corporate level. It shows in monetary terms the contribution of companies to achieving more prosperity from less natural resources.

Nr.: 11.

Title of paper:

Geo-Resources, Land Use Decision and Spatial Decision Support Systems

Authors:

Prof. Dr. Andreas Hoppe, Geo-Resources and Geo-Hazard Group, Darmstadt
University of Technology, Germany

Abstract:

Natural resources like groundwater, sand, gravel or soil are essential for the metabolism of cities and should be accessible in its vicinities. Due to geological evolution they are not available in every place. As in many areas geology is complex and not understood by decision makers, the geo-resources for the future development sometimes are even “destroyed” by sealing them with infrastructure or other purposes. In other areas, conflicts between different interest groups may intensify where space becomes increasingly valuable. As geo-resources are related to geological structures, the key to solving these problems is the knowledge about the subsurface. To allow the consideration of this information for land use planning, it has to be presented in such a way that everyone, whether he is a geologist or not, can understand it.

During the last years a variety of different methods have been developed to translate geology into thematic maps (e.g. the types, yield, vulnerability of groundwater, the nitrate retention and productivity of soils or the hazards by solution triggered subsidence of the underground). In addition, new software tools allow the three dimensional reconstruction of the geological underground. Using filters or other established methods to record different variables, e.g. grain size for areas providing sand and gravel, different re-source maps can be created (atlas of geo-potentials).

Thus, complex geologic evolution can be translated for decision makers for knowledge based decision processes. In addition - as economic and ecologic factors usually play an important role in land use decision processes - a dialogue between all groups interested in land use can be enabled by a Spatial Decision Support System implemented into a Geo Information System. It allows for the evaluation of various regionalized criteria by means of integrated multi-criteria evaluation methodologies.

Nr.: 12.

Title of paper:

Policy considerations for establishing environmentally-sound regional material flow in East Asia

Authors:

*Dr. Yasuhiko Hotta**, Public Analyst, Institute for Global Environmental Strategies (IGES), Long-term Perspectives and Policy Integration Project, Japan
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Hideyuki Mori, Principal Research Fellow, Institute for Global Environmental Strategies (IGES), Long-term Perspectives and Policy Integration Project, Japan

Abstract:

Currently economic integration in East Asia is accelerating along with a political movement towards creation of an East Asia Community. Economic integration is expected to result in more economic growth in the East Asian countries, which is highly likely to result in more resource demands and waste generation, unless there is a radical change in policies concerning industrial production systems as well as waste management systems. On the other hand, the rapid economic growth has brought an increasing demand for, and a potential supply of, recyclable resources (goods and materials for recycling and remanufacturing) in Asia as the world's manufacturing centre. As a result, imports and exports of recyclables are expected to increase more rapidly in the region. To enjoy the benefits from the economic integration, it is necessary to establish environmentally sound material flow both in upstream and in downstream of supply chain/product life cycle. Now, as Japan experiences, the establishment of an environmentally sound downstream material flow is difficult to realise domestically without consideration of the international flow of recyclables as well as transnational nature of product life cycle.

Based on this idea, the paper tries to present a preliminary qualitative analysis on a list of possible environmental impacts from increasing transboundary movement of recyclables as well as possible environmental policy packages towards environmentally-sound regional recycling/waste minimization systems under economic integration in East Asia. Institute for Global Environmental Strategies (IGES) is currently conducting a major research project on the possible impacts of regional economic integration on the environment in East Asia. The project uses the integrative policy analysis including scenarios-approach, economic modeling and cumulative impact assessments. This paper is a preliminary result of one of the components from this project.

Nr.: 13.

Title of paper: Industrial Ecology in a Sector framework A European analysis of consumption

Authors: Gjalt Huppes, CML-IE, Leiden University

Abstract:

The Thematic Strategy on Sustainable Use of Natural Resources is one of several main policy documents on sustainable development, the Lisbon Agenda, the Gothenburg Agenda, the Environmental Technologies Action Plan, the and the Renewed Sustainable Development Strategy. These involve potentially conflicting and competing approaches, but may also be turned into a set of mutually supportive actions, if constructed from one level of overarching considerations. How may resource use be built systematically and consistently into a sustainability action framework? Consumption, with all activities required for it in the life cycle is one main most central entry in understanding environmental effects. The total of all activities required for consumption, combined with the consumption activities themselves constitutes the total of all environmental interventions, disregarding net investments. From a country perspective also imports and exports are to be reckoned with. Resource use, as primary materials use, is part of this life cycle. By allocating all relevant environmental interventions and effects in society to materials use, insight is gained in the role of materials.

Two data sets on Europe are shown, explaining the same total environmental interventions one time by consumption, and one time by primary resource use. Next, a comparative framework is developed, showing the role of natural resources extraction and materials use in an overall framework of main sustainability strategies. One conclusion is that the resource based definition of eco-efficiency in the Thematic Strategy cannot be made operational in useful way. On the other hand, more detailed strategies related to resource use can be developed, with clear trade-offs against other strategies. For example, generally, a high recycling rate and long product life time requires additional use of resources.

Nr.: 14.

Title of paper:

Promoting Sustainability in Aggregate Supply – A Finnish Solution

Authors:

*Hannu Idman**, Programme Director, Geological Survey of Finland, Finland

Dr. Mika Räisänen, Geologist, Geological Survey of Finland, Finland

Abstract:

Different land-use objectives from various stakeholders create unavoidable conflicts, which inevitably complicate the accessibility to natural aggregate reserves nearby end-use locations. As a consequence, the transportation distances and the harmful environmental effects increase. It is possible to manage these conflicts and minimize harmful effects by proper land use planning and optimal utilisation of aggregates. This concerns not only quarried aggregates but also aggregates that are formed in excavations of construction works. Left-over aggregates from construction works vary significantly in quality (strength, grain size distribution etc.), but these aggregates can cover locally even tens of percents of all used aggregates particularly in urban growth areas. In addition, dimension stone production generates remarkable quantities of left-over stones. An issue of concern is that left-over materials are used inefficiently. Our challenge is to develop operational models to increase optimal use of the left-over materials. This promotes the principles of sustainable development and helps to secure availability of irreplaceable aggregates for the society. The new operation models are developed with consideration EU's new test methods and product standards for aggregate production. The Geological Survey of Finland (GTK) is developing an accounting system for natural aggregate resources that will be completed in 2007. This system will provide on-line (Internet) information about the location, quality and the amount of available aggregates. GTK has also started a project that will determine the criteria for the aggregate terminals, where left-over aggregates are stored, processed and sold. Some of terminals will be located by the industrial aggregate production areas. Life cycle assessment will be used to compare the use of the left-over materials and natural aggregates. Finally, the left-over materials will be linked with the accounting system of natural aggregate resources in order to accomplish a blanket system providing on-line information about aggregate resources and their substitutes.

Nr.: 15.

Title of paper:

More Production Resource Efficiency - the key to sustainable business

Authors:

Dr. Peter Jahns, Director, Effizienz Agentur NRW, Germany

Abstract:

Due to the growth of markets and increasing resource requirements, resource efficiency is no longer the number one priority simply from an ecological perspective. In order to be sustainable and, with this, successful, more and more companies are focusing on resource efficient business strategies. This is because environmental protection can result in cost reductions and, therefore, improved competitiveness. Economic efficiency and environmental protection are no longer antagonistic to each other; on the contrary, sustainability is becoming a key issue in long-term economic success. This is why the knowledge of appropriate methods and the concrete support in its application has become a decisive factor.

As an agency of the Ministry for the Environment in North Rhine Westphalia, the Effizienz-Agentur NRW (EFA) in Duisburg, Germany, has been supporting small and medium-sized enterprises on the road to resource efficiency with its “EFA-Toolbox” since 1998. This is achieved not only through information and assistance with the realisation of technical or organisational measures, but also through the implementation of new production concepts. Their “Toolbox” covers all important aspects of added value. The starting point is Cleaner Production (abbreviated as “PIUS” in German).

The initial tool is the PIUS-Check which has been carried out in more than 380 companies to date. With this tool, the operational savings potential in production cycles is outlined and potential solutions are worked out by performing process-oriented material flow analysis.

EFA's operational instrument for the recording of resource-related cost reduction potential is referred to as the “Resource Cost Accounting” feature (abbreviated as “RKR” in German). In contrast to the PIUS-Check, with RKR, a continuous improvement process is embodied within the organisation.

In order to continue along the path towards a sustainable economy, it is necessary to extend the focus beyond production cycles. With “JUMP”, an optimisation tool for production processes regarding environmentally-friendly product design, the focus is on manufacture, consumption and disposal.

A huge number of business examples have demonstrated the success of this resource-efficient economic strategy. For example, on the basis of the PIUS-Check, a meat and sausage manufacturer implemented new efficient production processes as part of the relocation of their business. The results of this were high cost savings and the creation of 50 new jobs besides the easing of the burden on the environment via waste water reduction.

Nr.: 16.

Title of paper:

Waste Prevention Strategy of the Helsinki Metropolitan Area Council (YTV)

Authors:

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*Sari Kempainen**, Environment Expert, YTV Helsinki Metropolitan Area Council. Waste Management, Finland

Minna Partti, Environment Expert, YTV Helsinki Metropolitan Area Council. Waste Management, Finland

Abstract:

The Waste Prevention Strategy was accepted by The Board of Directors of the Helsinki Metropolitan Area Council (YTV) in 2002. The Waste prevention project was launched and it continues as an EU LIFE funded project 2005-2008, called WastePrevKit.

The target of the strategy is to utilise regional and national advice and guidance to motivate the residents, enterprises and the public sector to avoid waste production, so that less waste will be produced per resident and per workplace in 2007 than in 2000.

Actions

- 1) Waste benchmarking for enterprises, public administration and education on the development of waste quantities of different sectors. The reference system for the waste amounts of the companies is improved.
- 2) Smart ways of action for enterprises and public administration. Best Practice models for reducing waste at shops, offices, educational institutions, day care centres and building sites were made in co-operation with actors within the field.
- 3) Material efficiency in general education and in vocational education Institution. Teaching material on waste prevention and eco-efficiency will be made and tested in co-operation with elementary and pre-schools and vocational institutions.
- 4) Development of the Documentation Portal. The portal is a web page (in Finnish, Swedish and English) for the models and other material of the project.
- 5) Dissemination of the deliverables. Information is being delivered to the households, in educational events and seminars, nationally and in the EU-level.

Expected Results

- The Waste Benchmarking-system steers effectively to decrease waste amounts of enterprises and communities.
- Amount of waste in trade and offices is reduced by 3% from 2003 to 2006.
- The Web-portal is extensively used by different target groups.
- The teaching materials are widely used.
- Target groups have been reached and the gained information has led to less waste producing choices. Cooperation with the interest groups continues.

Nr.: 17.

Title of paper:

Effectiveness analysis of economic instruments in resource policy

Authors:

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Germany, also Toyota Chair for Industry and Sustainability at the College of
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Gorm Dige, European Environment Agency, Denmark

Abstract:

A key developing area of policy focus for the EU is the efficient use of resources as initiated by the EU 'Thematic Strategy on the Sustainable Use of Natural Resources' and the prevention and recycling/recovery of waste as defined by the 'Thematic Strategy on Waste Prevention and Recycling'. In both strategies, specific attention is given to economic and market based instruments, e.g. taxes on waste, as useful tools for improving environmental policy performance. The 6EAP includes the idea of 'pushing the market to work for the environment' by both including environmental costs in the price of products and services, and developing agreements between environmental policy institutions and economic actors.

The objectives of the study are to:

- Increase understanding of the efficient and effective use of economic instruments in resource management in EEA member countries (i.e. to share good practice and increase knowledge and understanding in this area)
- Develop a framework for evaluating *ex post* the efficiency and effectiveness of economic instruments. In particular, to find evidence on how the inclusion of economic instruments in complex policy packages can improve their overall performance and how economic instruments can be used as a prevention tool in terms of resource use and waste generation.
- Undertake an *ex post* evaluation of an aggregates tax (or equivalent) in four different countries using the above-mentioned methodology. The aim is to

compare approaches and evaluate the use of aggregate taxes to inform and influence policy development in other countries.

The countries that have been selected include the Czech Republic, Italy, Sweden and the UK so that a range of experiences (e.g. geographical, political etc.) can be included in the study.

For the conference in December the applied methodology and the draft results will be presented. The study is to be finalised in May 2007.

Nr.: 18.

Title of paper:

China's Rising Demand for Minerals and Emerging Global Norms and Practices in the Mining Industry

Authors:

Jeffrey Stark, Director of Research and Studies of Foundation for Environmental Security and Sustainability, USA

*Jennifer C. Li**, Research Associate, Foundation for Environmental Security and Sustainability, USA

Abstract:

China's growing presence in developing countries in pursuit of mineral exploration or extraction has been widely noted in press reports from Asia, Africa, and Latin America. In order to sustain its high rate of economic growth and provide for an expanding and increasingly affluent middle class, China needs huge amounts of minerals, from metallic and non-metallic minerals to petroleum products. As China's demand is massive in volume and in variety, it has developed an aggressive and effective strategy to win access to resources all over the world. The strategy includes a combination of trade inducements, increased investment flows, aid for infrastructure and direct infrastructure building (mainly transportation), technology transfers, and very importantly, a willingness to ignore some of the questionable practices of host countries.

Communities in many parts of the world, however, are wary about China's entry due to the poor record of the Chinese mining industry on environmental, social, health, and safety issues. This record is particularly worrisome due to its stark contrast with emerging international standards in relation to environmental safeguards, health and safety, social benefits, community consultation, human rights, and mine site rehabilitation and reclamation. A delineation of these differences and the extent and nature of the concerns they raise is the objective of this paper.

The paper argues that if China does not move to close the gap between its current practices and evolving international norms and practices in the mining industry, its worldwide pursuit of minerals may not be sustainable. Indeed, absent policy reforms China's search for minerals may result in failed investments, reduced access to natural resources in the developing world, or even conflict.

Nr.: 19.

Title of paper:

Environmental Outlooks for Material Flows

Authors:

*Stephan Moll**, Wuppertal Institute for Climate, Environment and Energy
Mette Skovgaard, European Topic Centre on Resource and Waste Management,
Denmark
Stéphane Isoard, European Environment Agency, Denmark

Abstract:

Commissioned by the European Environment Agency (EEA), the European Topic Centre on Resource and Waste Management (ETC/RWM) has developed a macro-level module on prospective analysis. The aim was to provide an assessment of the likely, future trends of waste quantities and material flows through the design of scenarios for the period to 2020.

This presentation will focus on the projections of material flows which comprise main components of the Domestic Material Consumption (DMC), a composite indicator showing how much materials are consumed by a national economy.

During the last 20 years the EU has seen a more or less stagnating DMC whilst the GDP has been growing. The projections for the EU suggest that this development will not continue. Moreover, in both the Baseline scenario and the Low growth scenario, the aggregate material use is increasing, along with growing GDP. Indeed, relative decoupling will be achieved, but the pressure on the environment is not likely to be eased which would only be the case if material use would decrease in absolute terms. In the Baseline scenario for the EU-15, the GDP is almost doubling (+60%) between 2000 and 2020 whilst the aggregate material flows increase by around 19%. In the Low growth scenario, the GDP only rises by 39% whilst material use increases by 6%.

Both cases illustrate that according to a ‘business-as-usual’ development, technological progress in terms of resource productivity is not improving sufficiently to achieve an absolute decoupling. Further efforts are needed to increase resource productivity (in terms of GDP/DMC). As a minimum, resource productivity has to grow at the same growth rate as the GDP in order to achieve a stagnating material input. The productivity, however, rose only by 35% and 31% respectively in the Baseline and Low growth scenarios.

Nr.: 20.

Title of paper:

Management of resources – is there an optimal scale?

Authors:

Sabine Möllenkamp, Researcher, Institute of Environmental Systems Science,
University of Osnabrueck, Germany

Abstract:

Natural resources such as water or biodiversity often extend over a large geographical area, crossing administrative boundaries of regions or states, sometimes even of continents. The exploitation of the resources, however, is often not homogenous in a spatial way, meaning that the resource is exploited in one country where profits can be made and negative externalities like pollution are suffered from in another country. This situation raises the question at which spatial scale resources should be managed. Is there a spatial scale that is more suitable than others in terms of sustainability? The paper will illustrate that the geographical extension of the resource should be taken into account when managing it. This eco-regional approach is prominent in water management, taking place at river basin scale. Referring to examples from river basin management, the argumentation line of the paper will also show that other spatial scales like the region or state level need to be taken into account, because managing bodies like governments or resources users are organised on these levels. In order to achieve sustainable resources management, co-ordination of different scales is thus of utmost importance, taking into account the eco-regional scale as well as administrative boundaries. Management on multiple scales is a consequence, avoiding inefficiency by close co-operation and reasonable distribution of management tasks between the different levels.

Nr.: 21.

Title of paper: Why Do We Need A Metals And Minerals Industry In Europe?
Or Why Sustainable Growth Is Not Possible Without Metals And Minerals ?

Authors: *Dr Corina Hebestreit* Euromines, *Dr Mark Mistry**, Environmental Manager -
Eurometaux

Abstract:

The minerals and metals mining and processing industry is of crucial importance for a well functioning, competitive and strong economy in Europe, as requested with the targets set out in the Lisbon Strategy. The metals and minerals industry sector is an important part of the European economy and provides other industries and the general public with essential resources and products. It delivers key input for sustainable growth in the European Union, whether directly through its industrial activities or indirectly with its products.

The contribution of Euromines and Eurometaux will show the importance of the metals and minerals industry and its role in the European economy and society. The contributions and the over-riding need for the metals and minerals industry for sustainable growth in Europe will be demonstrated. Examples will be given of efficiency resource productivity in the minerals and metals industry and the eco-efficiency of its products.

In the following, the presentation will provide an overview on aspects endangering the availability in Europe of both primary and secondary raw materials. The global context is of importance, on the one hand for access to raw materials, and on the other hand with regard to international competition that the European metals and minerals industry is facing.

Potential solutions and ways forward for the further support and strengthening of the European minerals and metals industry will be demonstrated.

Nr.: 22.

Title of paper:

Sustainable Development Indicators for the Minerals Industries – Making Sustainability comparable on a global scale

Authors:

Univ.-Prof. Dr.-Ing. Dipl.-Wirt.Ing. P.N. Martens, Director of Institute of Mining Engineering I, RWTH Aachen University, Germany

*Dipl.-Ing. J.B. Pateiro Fernández**, Deputy Director and Senior Engineer, Institute of Mining Engineering I, RWTH Aachen University, Germany

Abstract:

The development of indicators to assess the sustainability of mineral raw materials operations is a major task with respect to its actuality and difficulty. This holds true even more when dealing with environmental indicators. One major challenge is the development of an indicator and assessment system that is applicable without major changes on a global scale, and that takes into special consideration the broadly differing site-specific characteristics of the mineral deposit, the surrounding environment and the existing (environmental) laws and standards. A second issue that has to be covered is the integration of the complete life-cycle of an operation from exploration to the post-mining land use phase into such an sustainability assessment system. Only such an approach enables for a sustainable resource management of natural resources and yields the necessary information to provide guidance for policy-making.

The use of existing environmental indicators in the mineral raw materials industry leads to false or at least distorted results. Therefore the Institute of Mining Engineering I from the RWTH Aachen University developed indicators and an assessment system for the mineral raw materials industry on operation, company and sector level on behalf of the Federal Ministry of Economics and Labour (Bundesministerium für Wirtschaft und Arbeit, BMWA) and the Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe, BGR) that are applicable on local, regional, national as well as global scale.

In total 30 indicators were defined and designed to assess the performance of the mineral raw materials industry in terms of sustainable development, 10 indicators for each pillar (economical, ecological and social pillar).

The following paper describes some of the results focussing on the development of environmental indicators. These had to be adapted or completely new designed in order to match the specific characteristics of the mineral raw materials industry.

Nr.: 23.

Title of paper:

Asia's Imprint on Global Commodity Markets

Authors: *Cyn-Young Par*, Fan Zhai*

Abstract:

Dynamic growth patterns of developing Asia will continue to make strong impressions in world primary resources. The emergence of large and populous countries of developing Asia, namely the PRC and India, has created new sources of demand for primary commodities. Particularly, the PRC growth has been associated with rapid industrialization, urbanization, and massive infrastructure investments, all of which entail resource-intensive activities. Although the industrialization pace of India has been falling far behind that of the PRC, its recent growth performance and outlook may herald a coming of age of another Asian powerhouse to world commodity markets. Given the size of these two economies – they account for 37.4 per cent of world population and 21.4 per cent of world GDP in purchasing power parity terms – world commodity markets are expected to see hefty changes in world demand. The relatively low development stages of these countries also suggest that income elasticity of their commodity demand would be higher compared with that of industrialized countries', which would help sustain the strong demand for quite an extended period. This paper attempts to quantify the impact of the rapidly growing Asian economy on the long term resource utilization. For this purpose, the ADB's global general equilibrium model (GEMAT) is used to project regional growth scenarios for 2005-2015. The model captures long term equilibrium tendencies in product and factor markets for natural resources, while abstracts from short-term adjustment and fluctuation.

Nr.: 24.

Title of paper:

Fuel efficiency standards and the rebound effect: A panel analysis of German travel-survey data

Authors:

Dr. Manuel Frondel, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen), Germany

Jörg Peters, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen), Germany

*Colin Vance**, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI Essen), Germany

Abstract:

The confluence of recent oil price increases, continuing instability in the Middle East, a surge in Chinese and Indian oil demand, and environmental concerns has made energy conservation a central priority of transportation policy in the European Union. Improved fuel efficiency is one strategy currently being pursued toward reducing CO₂ emissions via the voluntary agreement negotiated with the European Automobile Manufacturers Association (ACEA), which stipulates the reduction of average emissions to a target level of 140g CO₂/km by 2008. Using a panel of household travel diary data collected in Germany between 1997 and 2005, this study assesses the effectiveness of such targets by econometrically estimating the extent to which rebound effects offset the gains from fuel efficiency improvements. The data covers a time period during which prices for normal gas rose by 3.3% per annum, thereby affording a unique opportunity to explore the impact of price fluctuations on individual driving behavior. Participating households are surveyed over a six-week period for each of three years. During this time they record the distance driven for every vehicle in the household, sundry attributes of the vehicle, and the prices paid for fuel at each visit to the gas station. The econometric analysis, which uses the automobile as the unit of observation, capitalizes on this data structure by employing panel methods – including fixed and random effects specifications – to control for the effects of time-invariant unobservables that could otherwise undermine causal inference. In addition to variables measuring fuel prices, fuel consumption, and household socioeconomic characteristics, the specification includes the use of other vehicles as explanatory variables to account for joint economies in the production of travel for households owning several vehicles. The analysis concludes by comparing the effectiveness of fuel efficiency standards with alternative policy tools – including carbon taxes – for reducing fuel consumption.

Nr.: 25.

Title of paper:

Long-term resource conservation and management of endangered modern urban architecture. The need for a holistic problem driven approach in management of urban housing areas. Based on a case study in Göteborg, Sweden, in a comparative international perspective.

Authors:

Prof. Dr. Jan Rosvall, Co-Director of NMK Enterprising Research School, Natural, Sustainable and Conservation Materials, GMV Centre for Environment and Sustainability, Chalmers University of Technology and Göteborg University, Sweden
*Pär Meiling**, PhD Student, NMK Enterprising Research School, Natural, Sustainable and Conservation Materials, GMV Centre for Environment and Sustainability, Chalmers University of Technology and Göteborg University, Sweden
Prof. Dr. Itai Panas, Theoretical Inorganic Chemistry, Environmental Inorganic Chemistry, Chalmers University of Technology, Sweden

Abstract:

European cities include a considerable amount of prefabricated residential buildings from the 1950s, -60s, and -70s, today representing a major and vital European urban housing resource. These built environments were planned and constructed mainly in response to great needs for housing due to strong post WW2 urbanisation-processes. Soon many of these housing areas were facing severe social and material deterioration, due to an over optimistic belief in utopian principles of planning and design, technical flaws in building processes and materials, as well as managerial neglect. A major part of these problems are still prevailing and in addition the recent global economic development has promoted a divided between growing and stagnating places and regions, and between down-town areas and suburbs. This problematic legacy calls for a relevant scientific cross-disciplinary and problem driven methodological approach in order to achieve a needed breakthrough in progressive and sustainable resource management of these housing areas, contributing to an integrated urban life in a city as a whole benign for its people. This approach is relevant to elaborate in accordance to the concept of integrated conservation, with its physical and social dimensions, which enables identification of appropriate means to deal with contextual and complex issues of planning, interventions and identification of human values related to urban structures of everyday built environment. The crucial comprehension of urban fabric as an integrated material, economic, social resource, and in respect of its differentiation as well as continuity, highlights the need of long-term resource conservation and its close relation to the concept of sustainable urban development. Based on the theoretical framework referred to above and the results from a case study and related research this paper presents a model in progress aiming at application of long-term resource management of large urban housing areas.

Nr.: 26.

Title of paper:

Resource strategy – Progress in Environmental Policy Integration?

Authors:

Dr.-Ing. Philipp Schepelmann, Senior Research Fellow, RG III Material Flows and Resource Management, Wuppertal Institute for Climate, Environment and Energy, Germany

Abstract:

The Thematic Strategy for the Sustainable Use and Management of Natural Resources (TSSUNR) is supposed to *“create the conditions for improved ecoefficient resource use and incentives for moving towards more sustainable production and consumption patterns. This will have positive impacts on the economy, particularly since these incentives will help business to innovate and to improve their competitiveness. It will allow policymakers to make more informed choices of policy options and provide the means (indicators, data) to measure progress”*.

These ambitious objectives of the TSSUNR indicate that sustainable management of natural resources goes far beyond the scope of environmental policy. The “hot spots” of resource consumption are determined primarily not by environmental but other policies which are often influenced by EU competences (e.g. in agriculture, industry or energy policy). A political bottleneck of progress seems to be the integration of environmental requirements in other policy areas. In this respect, the Sixth Environmental Action Programme (6EAP) will face similar difficulties as identified in the Global Assessment of its predecessor, the 5EAP.

For achieving environmental policy integration (EPI) special attention could be directed towards sectoral integration strategies, but also to overarching, cross-sectoral EU policy development. The strategy sets itself in direct relation to the Lisbon process by exploiting synergies with competitiveness and job creation as well as by achieving better policy coherence, but it also highlights the importance of vertical and horizontal policy integration.

The paper will try to outline cross-sectoral objectives of the strategy and its annexes and put them in relation to past experience with EPI. Behind the background of the EU’s experience with the Cardiff-process, the author will try to assess whether the TSSUMNR will have a realistic chance to deliver progress for environmental policy integration.

Nr.: 27.

Title of paper:

Economic Criteria for Evaluating Energy Efficiency Measures in the Context of Electricity Sector Regulation

Authors:

Isabel Apolinário, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

Nuno Felizardo, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

António Leite Garcia, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

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Artur Trindade, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

Jorge Vasconcelos, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

*Pedro Verdelho**, ERSE – Entidade Reguladora dos Serviços Energéticos, Portugal

Abstract:

In the present regulation of electricity sector, the distribution companies, acting as the electricity public system (SEP) supplier, can promote energy efficiency measures also designated in this context by Demand Side Measures. In order to promote the implementation of these measures, the Tariff Code establishes that the implementation costs of a measure and half of the net benefits will be reflected in the SEP supply tariffs.

In this paper we analyze different criteria for valuing DSM measures including: valuing avoided costs from the electricity sector, namely by considering data from marginal costs; and valuing environmental benefit.

The economic criteria discussed are applied to five DSM measures. For each criteria and for each DSM measure we evaluate, (i) the respective costs and benefits, distinguishing between bill reduction benefits and environmental benefits, (ii) the cost benefit ratio, (iii) the amount of allowed revenues to be included in the supply tariffs and the impact it causes to consumers, and (iv) the cost per ton of avoided CO₂ emission as well as the cost per kWh of saved energy. It is also analyzed the variation on the merit order of the different measures.

The results show that the different criteria considered have a significant impact on the costs that electricity consumers pay through the tariffs and a relatively minor impact in terms of the merit order of the different measures. Thus changing the criteria among those discussed would not have a major impact on terms of project selection, but in turn, it can be determinant in terms of the amount of incentive given to each measure.

It is shown that despite the attribution of high environmental premiums for the implementation of DSM measures, the costs for ton of CO₂ avoided are much more reduced than those which would result from the implementation of equivalent measures from the supply side.

Nr.: 28.

Title of paper:

Organizational and institutional innovation in companies for resource productivity

Authors:

Kora Kristof, Wuppertal Institute for Climate, Environment, Energy, Germany
*Volker Türk**, Wuppertal Institute for Climate, Environment, Energy, Germany
Jola Welfens, Wuppertal Institute for Climate, Environment, Energy, Germany
Katharina Walliczek, Wuppertal Institute for Climate, Environment, Energy, Germany

Abstract:

Many of the instruments and concepts developed for sustainable management and corporate excellence could potentially also initiate resource productivity improvements in enterprises and along entire supply chains – although resource efficiency is often not directly addressed. Analysing these instruments for commonalities, seven important set-screws have been derived, highlighting promising venues to increase resource productivity:

- **Action-oriented Status-Quo-Analysis:** Analyses the status-quo for barriers, problems and unused opportunities, challenges the organisation to improve and highlights possible ways ahead.
- **Continual-Data-Based-Information-Management:** Continually informing decision makers about the impact on the environment and efficiency potentials of organisations, processes, products, services is the basic idea.
- **Goal Adjustment:** Voluntary initiatives are used to go beyond legal compliance.
- **Product-/Service-Evaluation-and-Development:** The impact of products and services on the environment has to be examined, so that ways to improvement can be carefully derived.
- **Quality Management:** Aims at quality improvements of processes and products/services. Production and product quality as well as consumer orientation or quality management itself can be in the focus of these instruments.
- **Learning-Processes in and around Enterprises:** The potentials of employees and networks have to be used effectively – the discovery of learning potentials is the aim.
- **Sustainability-Oriented Holistic-Management-Systems:** Their goal is to integrate management systems or to optimize existing integrated management systems, which aim at effectiveness and efficiency of ecologically sound industrial supply chains.

Considering the different approaches taken by the set-screws and in particular by the various tools and concepts analysed, the existing portfolio of instruments seems broad enough to successfully implement resource efficiency management approaches. However, selection and implementation of instruments needs to be aligned with existing management approaches and the corporate culture to render successful.

Nr.: 29.

Title of paper: The Future of Raw Material and World Economy

Authors:

Prof. Dr. Sadi Uzunoglu, Department of Economics, Faculty of Turkey Economics and Administration Sciences, Trakya University, Turkey

*Assist. Prof. Dr. Ayhan Aytac**, Department of Economics, Faculty of Turkey Economics and Administration Sciences, Trakya University, Turkey

Specialist Ahmet Atakisi, Department of Economics, Faculty of Turkey Economics and Administration Sciences, Trakya University, Turkey

Abstract:

Raw material prices have been dramatically raised in last quarter of 2001. It has been argued that growth of world economy and expansion of foreign trade are major effective factors on increase of raw materials. On the other hand, from last quarter of 2001, the growing political instability and regional battles have been pressured the raw materials prices.

Actually, the uncertainty trend on raw material prices is not today's topic, the problem has been going on for recent centuries. However, as a result of collapsing of world monetary system in 1970's, uncertainty of exchange rates and interest rates have increased thus fluctuations of raw material prices have more negative effect on the world economy.

Our aim is to evaluate the issue of raw material prices in the view of developments in world economy and to expose the uncertainty and the risks on projections of raw material fluctuations.

Nr.: 30.

Title of paper:

Development of Resource Use Intensity: A Retrospective Approach to Draft Scenarios

Authors:

Dr. sc. tech. Dominic Wittmer, Researcher, Swiss Federal Institute of Aquatic Science and Technology, Eawag, Switzerland

Abstract:

The material stocks in the technosphere are growing faster than ever due to accelerated urbanisation and growing per capita use. Recent developments indicate an insecurity of supply with resources, which are needed for maintaining the economies running. Therefore, the evaluation of resources is experiencing an increased attention in order to support forecasting the future availability of raw materials.

However, the current research efforts do not reflect the actual importance of the anthropogenic deposits for future “urban mining”. These material stocks comprise regionally a relevant resource potential for the supply with raw materials, especially in economies with looming stock saturations. Thus, research for a sophisticated resource management includes both primary and secondary resources inclusive their exchangeability.

The study proposes and prepares a structured exploration of the anthropogenic deposits. It combines the “substance flow analysis” with a geoscientifically based bottom-up method for the recording and evaluation of material stocks, exemplified by application on the copper stock of Switzerland. Copper is selected for the exploration of trace elements due to methodological reasons because of its widespread uses in different application ranges. As an emphasis is put on the constructions, the building stock is modelled while model buildings are created by field analyses. The stock uncertainties were calculated according to the Monte-Carlo-Method. Furthermore, the development of these resource stocks within the past 100 years is analysed by history of techniques, interviews, and plausibility checks.

The results show the characteristics in the development of stocks. They are used to calibrate a dynamic copper stock model, which is verified by examination of historical trade statistics. The Swiss stock size and composition is compared with those of other regions. Thus, stock differences are justified by regional differences in the cultural and natural environments. The results may support the quantification of consequences for the “globalisation of material wealth”.