Strategic Materials for a Low-Carbon Future: From Resource Scarcity to Availability

Conference by the Veolia Institute and the Oxford Martin School

2-3 November 2017
Oxford, United Kingdom

Introduction

How do we ensure the availability of strategic materials and mineral resources for a low-carbon world?

Our economic development has been based on an unsustainable exploitation and use of natural resources. World extraction of material resources has tripled over the past 40 years and is expected to at least double with the development of emerging economies. Today, we extract and consume our planet's resources much faster than the rate at which they can be renewed. At the same time, transitioning to a low-carbon economy and energy system may increase demand for some key minerals and strategic materials.

The Veolia Institute's 10th International Conference, held in partnership with the Oxford Martin School, offers perspectives on how to make strategic materials and mineral resources available for a sustainable future, one that is transitioning to a low-carbon economy. It will build bridges amongst those who can contribute insights and solutions, from academics and the scientific community to policy-makers, civil society leaders, business leaders, financiers and entrepreneurs, across geographies and generations.

The Conference will tackle three topics related to resource availability in low-carbon world:

Materials for a low-carbon future;

Primary resource availability in a low-carbon transition; and

Disruptions in resource availability: the case for the circular economy.

The first identifies *which* materials need to be made available for a successful low-carbon transition and future. The second and third topics, address *how* to make these materials available.

For each issue, a moderated groundwork discussion will set the stage, explore key themes and reveal the latest scientific thinking. Then, a series of breakout exchanges will take deep dives into a specific aspect of the issue, with real-world applications that can be put to use tomorrow.

The moderated discussions and informal debate will explore questions such as:

- Which materials and minerals are critical now for a low-carbon future economy? In the transition to a low-carbon economy, how will the resource landscape change? Depending on demand scenarios, what will be the pace and scale of change needed to make those resources available?
- What are the consequences of this new resource landscape for our economies, societies, environment and geopolitics?
- What are the economic, energy, environmental or social constraints to resource availability in the low-carbon transition?
- In low-carbon focus sectors such as renewable energy, transport and information technology, what kinds of technical and financial innovations would encourage investment in new, substitute and renewable materials, and their recovery and reuse in a circular fashion?
- Beyond technological solutions, what kinds of collaboration and cooperation would business, policy-makers and communities need to ensure that key materials remain available, and what would encourage greater collaboration?
- What policies would enable responsible resource extraction and use as well as the circular economy?

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DAY 1 – NOV 2, 2017

8:30-9:15 Registration and welcome coffee

9:20-9:30 OPENING:

Steve Cowley, Acting Director, Oxford Martin School, University of Oxford
Dinah Louda, Executive Director, Veolia Institute

9:35-9:55 INTRODUCTION: Perspectives

John Beddington, Professor of Natural Resources Management and Senior Adviser to the Oxford Martin School, University of Oxford

TOPIC 1: What materials are key to a low-carbon future? Exploring the implications of the transition to a low-carbon economy on primary resource demand

10:00-11:15 Groundwork session 1: What materials for a low-carbon future?

What is the 'low carbon transition', and what are its implications? Taking a foresight approach, the panellists will identify the sectors most affected by the low-carbon transition (for instance, energy infrastructure, construction, transportation, and digital technologies) and map out trends, scenarios and issues relating to material use as those sectors evolve. Resources to consider may include structural materials, key to low-carbon infrastructure in an urbanizing world (cement, sand, concrete, copper, aluminium, steel), as well as critical or strategic metals whose supply is at stake in a low-carbon economy (lithium, rare earth metals). What is the real potential for physical scarcity of such resources in the face of such demand?

Thomas Graedel, Clifton R. Musser Professor of Industrial Ecology, School of Forestry and Environmental Studies, Yale University
Cameron Hepburn, Director, Economics of Sustainability, The Institute for New Economic Thinking at the Oxford Martin School
Sigurd Mareels, Senior Partner, McKinsey
Edmund Nickless, Chair, International Union of Geological Sciences New Activities Strategic Implementation Committee, International Union of Geological Sciences

Moderator: John Beddington, Professor of Natural Resources Management and Senior Adviser, Oxford Martin School, University of Oxford
Format: 3S Debate

11:15-11:45 Break

11:45-12:45 Breakout sessions 1a to 1c

Breakout 1a: Basic materials in tomorrow's climate-friendly cities.

By 2050, two-thirds of the world's population will live in cities, creating pressure on urban infrastructure. What are the consequences of rapid urbanization on the demand for key material resources like cement, concrete, glass, or steel? How can cities grow sustainably into a low-carbon future, with an eye to end-of-life and change of purpose, and with minimal amounts of embedded carbon? What would low-carbon cities look like, and what is the implication for wider resource use?

Stefano D'Agostino, Divisional Director, Schneider Electric
Dabo Guan, Chair Professor in Climate Change Economics at School of International Development, University of East Anglia
Simon Ratcliffe, Infrastructure and Climate Advisor, UK Department for International Development
Mark Swilling, Distinguished Professor of Sustainable Development, School of Public Management and Planning, University of Stellenbosch

Moderator: Sophie Lambin, Co-Founder & Managing Director, Kite Global Advisors
Format: The Challenge

Breakout 1b: Powering the future: energy storage minerals

The decarbonisation of the transport industry is resulting in a revolution in energy storage technologies. Electric vehicle demand is driving increased demand for lithium-ion batteries. What is the forecast demand for the key materials of lithium and cobalt? What is the impact on supply chain risk for end-users and can these risks be mitigated? What is the prospect for emerging battery technologies such as vanadium flow? What are the technological challenges in secondary supply?

Nick Cliffe, Innovation Lead, Innovate UK
Hans Eric Melin, Founder, Creation Inn Consultancy
Simon Moores, Managing Director, Benchmark Mineral Intelligence

Moderator: Henry Sanderson, Metals and Mining Correspondent, Financial Times
Format: Issue to Action

Breakout 1c: Critical metals in high technologies: Managing complexity

Rare earth elements are raising concerns from public authorities as they are increasingly used in strategic sectors of the economy such as telecommunication and defence. What is the reality of rare earth elements availability now and in the foreseeable future? How are digital technologies driving a more complex resource landscape? Is the increasing role played by rare earth elements in high technologies a reasonable source of concern? How is complexity and diversity making products more vulnerable to risks in supply of those metals? And what is the true risk from geopolitical imbalances of supply and demand?

Alex King, Director of the Critical Materials Institute, U.S. Department of Energy
David Peck, Manager, KIC EIT EU Raw Materials Programme, TU Delft
Markus Reuter, Co-Director, Helmholtz Association, Freiberg

Moderator: Xianlai Zeng, Associate Professor, School of Environment, Tsinghua University
Format: 3S Debate

12:45-14:15 Lunch

14:15-15:15 Breakout sessions 1d to 1f

Breakout 1d: Copper and aluminium in the low carbon world

Copper and aluminium provide the building blocks for both industrial and economic growth, and are also key for new energy technologies. Will the demand landscape for common metals be radically different from past use? What are future trends of substitution in the search for lower carbon usages, for instance magnesium for aluminium, or fibre optics for copper? Can the proportion of metal coming from secondary sources increase in the future?

Thomas Graedel, Clifton R. Musser Professor of Industrial Ecology, School of Forestry and Environmental Studies, Yale University
Ben Jones, Principal Consultant, CRU
Sangwon Suh, Professor of Industrial Ecology, University of California, Santa Barbara

Moderator: Elizabeth Surkovic, Head of Policy, Resilience and Emerging Technologies, Royal Society
Format: 3S Debate

Breakout 1e: Low carbon technologies: resource scarcities, surpluses and uncertainties

Clean technologies such as solar panels, and onshore wind have won tremendous market share gains over fossil fuels in recent years. What does the upcoming deployment curve look like, and what is the implication for the resources required to support that deployment? How is fast technological deployment impacting uncertainty of future materials demand and what are the consequences of such uncertainty? Will regulatory intervention help or heed?

Aled Jones, Inaugural Director, Global Sustainability Institute, Anglia Ruskin University
Jaakko Kooroshy, Executive Director, GS SUSTAIN, Goldman Sachs
Olivier Vidal, Director of Research, Centre National de la Recherche Scientifique

Moderator: Chris Llewellyn Smith, Director, Energy Institute, University of Oxford
Format: 3S Debate

Breakout 1f: Fertilizers, yields and resource depletion: phosphates and the need for productive agriculture in Europe

Phosphorus will be the key to the increase in yields needed to maintain food requirements. Yet phosphorus from rock is not a renewable resource, recovered sources are hard to make cost effective, and over-use of phosphorus from any source risks being washed away and causing pollution. How might legislation on climate change or other environmental legislation affect phosphate use and supply? What policies are likely to foster resource efficiency and recovery? What European policies are required for the management of a strategic resource in Europe? And what are the best sources of 'biofertilizers', for instance phosphorus from sludge?

Ludwig Hermann, President, European Sustainable Phosphorus Platform; Technology Manager, Outotec GmbH & Co KG
Kazuyo Matsubae, Associate Professor, Graduate School of Engineering, Tohoku University

Moderator: **Julie Hill**, Chair, WRAP
Format: 3S Debate

TOPIC 2: Managing the impacts of extractive industries in a new low-carbon resource landscape. Will the extraction of primary resources fulfil rising demand?

15:30-16:45 Groundwork session 2: Primary resource availability in a low carbon transition

In the shift towards resource availability, physical factors like geological availability may not be the prime constraint to meeting demand for extracted materials. Rather, the limits may be environmental, social, political, or economic. Limits also arise from interdependencies with water, land or energy, for which there are competing social needs. These tensions are particularly prevalent in the extraction of metals and minerals – often in developing countries where social needs are acute and governance is less clear. What are the key limiting factors and what technical and organizational innovation can mitigate their impact? What is the impact of a low-carbon transition on the extractive industries? What will these industries look like in a low-carbon future, and what are the second-order implications down the road? How can governance mechanisms in extractive industries evolve to make the industry sustainable?

Georges Calas, Professor of Mineralogy, Pierre-and-Marie-Curie University
Sheila Khama, Practice Manager, Energy and Extractives Global Practice, World Bank Group
Oscar Landerretche, Chairman of the Board of Directors, Codelco
Bernice Lee, Executive Director, Hoffman Centre for Sustainable Resource Economy, Chatham House
Karina Litvack, Independent Non-Executive Board Director, ENI

Moderator: Fiona Harvey, Environment Correspondent, The Guardian
Format: Issue to Action

16:45-17:00 Break

17:00-18:00 Breakout sessions 2a to 2c

Breakout 2a: The paradox of extraction and energy consumption in a low-carbon transition

Some extracted materials are essential to low-carbon growth – yet their reserves may not be easily accessible, and the energy required to access them may make extraction economically unviable. This session considers whether increased demand for metals implies a need to access lower grade ores with accompanying consequences for energy use and carbon emissions. Is there an energy threshold where it becomes more cost efficient to recycle rather than to extract? Are there innovative policy or business solutions?

Ugo Bardi, Lecturer in Physical Chemistry, University of Florence; Member of the International Research Center of Winthertur of the Club of Rome
David Humphreys, former Chief Economist, Rio Tinto

Moderator: Olivier Vidal, Director of Research, Centre National de la Recherche Scientifique
Format: Issue to Action

Breakout 2b: The water - land - resource nexus

As easily accessible mines are depleted, finding and accessing new mines are likely to put pressure on resources, in particular water and land. Overall, the environmental impact of mining may even surpass planetary boundaries. In addition, new mines increasingly compete on the local communities level for water, energy, land or pressuring human health. How can disputes be settled at the local level? How can the private sector and public sector engage responsibly? Are there better ways of dealing with mining waste in a low carbon world, and what are the best practices for the reduction of environmental impacts?

Raimund Bleischwitz, BHP Billiton Chair in Sustainable Global Resources, University College London
Jennifer Broadhurst, Associate Professor and Deputy Director, Minerals to Metals Initiative, University of Cape Town
Franck Galland, CEO, Environmental Emergency & Security Services
Ester Van der Voet, International Resource Panel, UNEP

Moderator: Jan Klawitter, Principal, International Relations, Anglo American
Format: Issue to Action

Breakout 2c: Financing sustainable resource availability

More investors today are scrutinizing the non-financial impacts of their investments. What role does the financial sector play in sustainable resource extraction? How does it integrate interdependent risks related to resource scarcity? What innovative financial tools might stimulate efficient and responsible resource extraction? Will the cost of capital increase significantly for mining companies in the future? How can investments be directed towards solutions which might have higher upfront capital costs and even sustained periods of negative value, but which are the most sustainable - and therefore most valuable - solution in the long term?

Jamie Butterworth, Partner, Circularity Capital
Ben Caldecott, Director of the Sustainable Finance Programme, Smith School of Enterprise and the Environment, University of Oxford

Moderator: Karina Litvack, Independent Non-Executive Board Director, ENI
Format: The Challenge

18:30-19:45 Keynote Public Lecture (venue: Examination Schools)

Nicholas Stern, IG Patel Professor of Economics and Government, Chairman of the Grantham Research Institute on Climate Change and the Environment and Head of the India Observatory, the London School of Economics

DAY 2 – FRIDAY NOV 3, 2017

TOPIC 3: Disruptions in resource availability: the case for the circular economy

9:00-10:00 Groundwork session 3:

The circular economy has the potential to disrupt and radically change the resource use and availability landscape. The circular economy can contribute to decarbonizing the economy and a fully circular economy could even be a new source of resources and materials. How can we encourage a true paradigm shift?

Paul Ekins, Professor of Resources and Environmental Policy, Director of the UCL Institute for Sustainable Resources, University College London
Richard Kirkman, Chief Technology and Innovation Officer, Veolia UK & Ireland
Martin Stuchtey, Founder and Managing Partner, SYSTEMIQ

Moderator: Sophie Lambin, Co-Founder & Managing Director, Kite Global Advisors
Format: Resource Lounge

10:05–11:05 Breakout sessions 3a to 3c

Breakout 3a: Scaling up recycling of complex products

What are the current economic, technical, legal or social obstacles to scaling up recycling of complex products such as electronic items and energy products such as batteries or solar PV panels? Can new forms of collaboration between businesses and institutions help? How much can we expect to collect from recycling? Can design of products facilitate recycling of components? Can products be designed to be safer to recycle?

Christian Hagelueken, Director of EU Government Affairs, Umicore
Richard Kirkman, Chief Technology and Innovation Officer, Veolia UK & Ireland
Kerstin Kuchta, Director Waste Resource Management Research Group, Hamburg University of Technology

Moderator: Hans Eric Melin, Founder, Creation Inn Consultancy
Format: The Scale

Breakout 3b: The reach of closed loop recycling and remanufacturing

Can full closed loop recycling and remanufacturing become a reality for some materials? With sufficient design, manufacturing and repair innovations, can the need to mine be completely eradicated for specific materials or metals? What new business model would facilitate such closed loop systems? What new business models would help form closed loops and avoid waste to end up in the environment?

Andrew Clifton, Sustainability Manager – Engineering and Design, Rolls-Royce
Amir Rashid, Project Manager, EU ResCom Project for the industrial implementation of closed-loop manufacturing systems
Walter Stahel, Founder and Director, Product Life Institute

Moderator: David Peck, Manager, KIC EIT EU Raw Materials Programme, TU Delft
Format: The Challenge

Breakout 3c: Eco-design in the built environment

Eco-design each year eliminates more than the annual energy consumption of Italy. Part of the circular economy principle is to think about how to design products so that they incorporate recycled materials and that they are easily reusable or recyclable. This implies thinking about resource efficiency in the product design process and a shift away from the mindset of planned obsolescence. How is this shift being incorporated into design or business education for buildings and the built environment? Can key components like steel girders be designed for re-use in buildings? In practice, which businesses or organisations are leading this charge and how? Can producer responsibility concepts be applied for buildings?

Vernon Collis, Adjunct Associate Professor, Department of Civil Engineering, University of Cape Town
Nitesh Magdani, Director of Sustainability, BAM Construct UK
Davide Stronati, Group Sustainability Leader, Mott MacDonald

Moderator: Larry Yu, Co-Founder & Managing Director, Kite Global Advisors
Format: Resource Lounge

11:05-11:30 Break

11:30-12:30 Breakout sessions 3d to 3f

Breakout 3d: E Waste: policies to foster the circular economy

Waste from electronic devices is predicted to increase dramatically due to consumption patterns of developed countries and the growing middle class of developing countries. How are developed and developing countries currently dealing with their e-waste, and how can e-waste be reinvented as a circular economy resource? How is China, the second largest consumer market in the world, tackling its e-waste differently than in the US or Europe? What technologies already exist, and what is required for these technologies to be adopted at scale? How can we increase awareness of e-waste issues among consumers?

Jonathan Perry, Producer Responsibility Compliance Consultant, Dell
Malcolm Waddell, Delivery Manager – Circular Business Models and Electricals, WRAP
Xianlai Zeng, Associate Professor, School of Environment, Tsinghua University

Moderator: Dabo Guan, Chair Professor in Climate Change Economics at School of International Development, University of East Anglia
Format: 3S Debate

Breakout 3e: Plastics in a zero carbon world

To increase resource efficiency, complex plastics are increasingly replacing heavier metals. Many hybrid or electric vehicle makers are investigating the use of carbon-fibre reinforced plastic (CFRP) bodies. How do we ensure those new plastics, and the products that contain them, are designed to be recycled or re-used? What is the climate and waste impact of a shift from metals to complex plastics? How can plastics be incorporated in new uses? How can the use of recycled plastics vs the use of virgin plastics be incentivised when virgin plastics are cheaper at current oil prices? What can be done with plastics that can't be recycled?

Gary Leeke Chair in Chemical Engineering and Head of the Bioenergy and Resource Management Centre, Cranfield University
Pascal Peslerbe, Deputy Director, 2EI, Innovation Department, Veolia

Moderator: Julie Hill, Chair, WRAP UK
Format: Issue to Action

Breakout 3f: Technological and scientific innovation in circularity

Can digital and scientific technologies drive change towards the circular economy paradigm? What role can sustainable technological and engineering processes play in fostering efficient and circular resource use at different stages of the value chain? Can innovation in materials similarly generate radical innovations and accelerate a paradigm shift from the bottom up? Where are the current exciting areas for innovation in materials, processes and applications? What potential is there for innovation in polymer manufacturing and what impact can improved or novel polymer manufacture have on recycling rates? Are commercial manufacturers and users of materials interested in adaptability or in sustainability? What barriers exist for the implementation of circular economy principles in SME businesses today?

Graham Hillier, Strategy and Futures Director, Centre for Process Innovation
Charlotte Williams, Professor of Catalysis and Polymer Chemistry, University of Oxford

Moderator: Ken Webster, Head of Innovation, Ellen MacArthur Foundation
Format: Resource Lounge

12:30-13:00 Special Address and closing

Antoine Frerot, Chairman and CEO, Veolia