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Book of Abstracts

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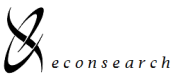

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1. *Introduction*

1.1 The Industrial Ecology Virtual Laboratory

Environmental and economic modelling are experiencing the development of multiple databases, analytical methods, and tools. Cases in point are life-cycle assessment (LCA) or regional environmental-economic analyses. Whilst some of these are aimed at addressing different research questions, others sometimes compete in providing identical research services. This situation can lead to duplication, resource inefficiencies and confusion amongst decision-makers.

One strategy for avoiding the downfalls of competition is for governments to provide research infrastructure that allows teams to collaborate and share resources whilst still pursuing independent research projects. In Australia, the government has been investing in high-performance computing, data management and networking infrastructure through the NeCTAR scheme. These have enabled new opportunities for research innovation, collaboration and improved efficiencies. One of the investment flagships is the Virtual Laboratory (VL), a novel concept aimed at improving digital connectivity by linking existing and new research facilities, data repositories and computational tools.

Dozens of organisations, researchers and practitioners collaborate in the Australian Industrial Ecology Virtual Laboratory. The IELab provides the most comprehensive, environmentally extended input-output database available for use in Australia. It distinguishes geographical and industry detail at high resolution, spans a time period of more than twenty years, and is constantly updated as new data become available. Modellers can build, rebalance and modify their own customised input-output tables and statistics, enabling them to enhance their analytical capabilities in fields such as regional and environmental economic modelling, life-cycle assessment, carbon footprinting and environmental impact assessment. The IELab brings together economic and environmental data in unprecedented detail and significantly boosts Australia's ability to make strategic decisions for progress towards sustainability.

The IELab's direction is co-steered by the Australian Bureau of Statistics, ensuring that IELab outputs conform to national accounting standards, thus instilling credibility and trust. The creation of a Global IELab has started, aimed at adopting the concept at a global level and combining the strengths of some of the existing global multi-region input-output frameworks. The long-term hope of IELab researchers is that the VL concept becomes best-practice and a reference point for undertaking environmental and eco-

nomic modelling, and that it will make multi-disciplinary research happen by providing one common platform that helps answering questions from different areas.

2. *Abstracts*

2.1 Methods and Experiences of Input-output Table Construction under the IE Lab

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As of January 2014 EconSearch has been involved in the IE lab, primarily in developing data feeds for input-output (IO) table construction. This paper discusses the process of how we have implemented the IE lab system to produce state and regional IO tables. This discussion covers our general experiences and a specific example of some IO tables that we have recently constructed. The general discussion is split into 3 sections, namely the pre-processing/database construction phase, the data feed construction/simulation running phase, and finally the post processing requirements phase.

Our specific example of employing the IE lab system discusses our recent construction of Eyre Peninsula Local Government Area IO tables. This part of the discussion will illustrate the process used in producing an end product, and will highlight IE lab related issues we have overcome.

2.2 Creating EXIOBASE in the Global MRIO Lab

Hagen Schulte in den Bäumen[1], Arnold Tukker[2], Arne Geschke[1], and Manfred Lenzen[1]
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The development of global MRIO databases such as EXIOBASE is time consuming and cost intense. The procedures used in EXIOBASE involve a high degree of interrogation and adjustment throughout the construction of the data set. This is part of the reason while data sets are only available for the year 2000 and 2007. Savings in terms of human and financial resources, timely deployment thanks to the automation procedure and flexibility in future choices about sectoral and spatial representation are major advances in creating EXIOBASE in the Global MRIO Lab. The Global MRIO lab is aimed at establishing a collaborative research platform and is a global expansion of the Australian IELab archetype. The concept and architecture of the Global MRIO Lab are identical to those of the Australian IELab. Single-step mathematical programming techniques and high-performance computing greatly simplify an update and the supplement of the EXIOBASE database.

2.3 Gathering Evidence to Address Environmental-economic Policy Problems

Andrew Cadogan-Cowper
Director, National Accounts Benchmarks, Australian Bureau of Statistics

Environmental-economic policy problems owe much of their complexity to the fact that they cut heavily across multiple disciplines. Assessments that need to evaluate economic, environmental and social factors still lack a broadly accepted common metric, and 'solutions' often give rise to their own set of problems.

Policy-makers, advisors and researchers who endeavour to solve such problems, or at least understand them more fully, inevitably need to be broad thinking and capable of working across traditional boundaries. Where possible, they also need data that spans those boundaries.

The work of the ABS can be broadly divided into three pillars: the economy, society, and the environment. For a long time the ABS has recognised that in order to arm decision makers with the most useful data available to confront complex policy choices, as much as possible those statistical pillars should be integrated.

The advent of international statistical standards linking environmental and economic information has been of great value to the ABS, and now, the Industrial Ecology Virtual Laboratory (IELab). The IELab has tremendous potential to quantify certain interlinkages between the environment and economy that until now have eluded measurement.

2.4 Intercity Footprint Networks

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Cities are associated with most of humanity's consumption of natural resources and impacts on the natural environment, making them primary agents of change in a resource and carbon constraint world. Some research suggests that up to 80% of global greenhouse gas emissions could be attributable to cities. However, only a small proportion of environmental impacts actually occur within city borders; the majority of resource use and carbon emissions takes place in the city's 'hinterland' which includes other cities as well as, due to globalisation, literally the rest of the world. While some work on cities' carbon footprints has been published, no study has yet investigated how cities are linked in terms of their embodied greenhouse gas emissions.

Building on the recent development of the 'city carbon map' concept, this contribution introduces the carbon map of the five largest Australian cities. We utilise the spatial detail provided by the Industrial Ecology Virtual Laboratory (IELab) to quantify the flows of indirect (embodied) carbon emissions of all five cities and their regions, Australia and the rest of the world. In particular, we are able to show for the first time the interconnectedness of cities and the extent of embodied carbon flows between them. Results for Sydney, Melbourne, Brisbane, Perth and Adelaide are presented and options for the decarbonisation of cities are discussed. Results for the carbon footprint of households, governments and businesses are presented and discussed, together with the limitations and challenges of the approach.

2.5 Lifestyles, Consumption and Footprints - An Exploratory Assessing the Potential Impact of Lifestyle Change on Sustainability

Peter Daniels and Lavinia Poruschi
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Knowledge and behavioural change regarding the impacts of the level and pattern of consumption will be major aspects in the capacity for achieving lower throughput, more sustainable economies. Most environmental analyses related to sustainable consumption have tended to focus upon the full supply chain and life cycle resource demands and pressures of *individual* products or sectors.

This is consistent with the notion that the transition to sustainability will be incremental with a gradual shift to "green consumerism" However, it can also be argued that a key factor behind sustainability will be broader "lifestyle" changes that also incorporate consideration of the basic assumptions and drivers behind the will to consume and people's subsequent pattern and level of consumption of goods and services. Lifestyle change also includes dimensions such as patterns of time use (work, recreational and so forth) and a myriad of choices and preferences such as residential and work location, type of work, and familial life - all with profound influence upon consumption habits.

This presentation will build on existing research to explore the relationship between a small set of Australian lifestyle modes relevant to sustainability and their associated footprints (which are increasingly integrating social and economic indicators with classic ecological footprint measures). The IELab's comprehensive, environmentally extended input-output database is utilised to create preliminary estimates of energy, water and other footprint impact indicators of the selected lifestyles (measured with their typical consumption bundles from household expenditure data). The presentation will include some discussion of critical underlying assumptions about lifestyles, consumption and well-being using data from additional sources (such the Household, Income and Labour Dynamics in Australia (HILDA) survey.

2.6 IELab - A Powerful Strategic Planning Tool for Business

Michael du Plessis
Greenice Pty Ltd

This presentation aims to show how the IELab concept has been used as a strategic sustainability planning tool for business. The author will present case studies showing the practical application of Environmental Input-Output Analysis (IO) in the calculation of carbon, water and ecological footprints. The case studies will cover a diverse range of firms across the food, manufacturing and service sectors. The IO approach has proven to be particularly useful for small to medium sized enterprises (SMEs) as it uses readily available financial data from the firm's accounting system. IO provides the most cost effective method for firms to conduct LCAs on products, analyse supply chains and measure greenhouse gas emissions. The complexity and cost of traditional process LCAs rule them out for most SMEs and mid-sized corporates. IO studies have provided new insights into how firms can reduce their environmental impacts and track their progress over time.

The author will use the case studies to demonstrate the future value of the IELab as a practical tool for business as well as an integrated research platform. The author will argue that the IELab will become an increasingly important strategic planning tool for firms trying to grow in a resource constrained global market.

2.7 An Industrial Ecology Lab for Indonesia

Futu Faturay, Arne Geschke, and Manfred Lenzen
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Multi-Region Input-Output (MRIO) tables are useful for underpinning decision-making: Its applications are not only restricted to economic problems, but also include environmental issues. The Australian Industrial Ecology Laboratory (IELab) is a collaborative cloud-computing platform generating Australian sub-national MRIO tables at high sectoral and regional resolution. The collaborative nature of the IELab has already attracted considerable academia, government and corporate interest. Indonesia is a country of geographical size and economic diversity similar to Australia, thus warranting the construction of its own sub-national MRIO framework. However, there exist so far no consistent and detailed Indonesian MRIO table time series, but only one inter-regional IO table, based on the 2000 national IO table, consisting of only 6 regions: Sumatera, Java and Bali, Kalimantan, Sulawesi, and Eastern Indonesia. There are socio-economic survey and national accounts data at higher detail, however these are not yet harmonised with the IO data. To improve the usefulness of currently disparate data sources for policy analysis, a 4-year work programme has commenced with the aim of replicating the Australian IELab for Indonesia. After the initial data assembly and incorporation into the IELab template, the Indonesian MRIO capability will be put to the test in applied economicenvironmental analysis in collaboration with the UN ESCAP office in Bangkok as well as Yayan Satyakti from CEDS /Padjadjaran University in Bandung, Indonesia.

2.8 Supporting Industry Towards a Low Carbon Built Environment

Monique Fouché and Robert Crawford
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Improving the construction industry's carbon performance has been mostly focussed on reducing its operational carbon emissions, leaving the embodied carbon emissions largely ignored. However, recent research has demonstrated that embodied carbon can represent a significant percentage of a buildings whole life carbon footprint. This revelation has led to the development of several embodied carbon analysis tools. However, due to differing methodologies and assumptions, they are often plagued by inaccurate and incomparable results that rely on out-of-context databases. The outcomes of a construction industry survey, that forms part of the 'Integrated Carbon Metrics'(ICM) research project, an initiative from the CRC for Low Carbon Living, provided further confirmation that these embodied carbon analysis tools often don't meet industry needs and expectations, thus hindering their successful implementation within the Australian construction industry.

The ICM project aims to rectify this problem through the creation of the ICM and PIM Carbon Extension Tool. These tools will use data generated from the IE Lab to provide results that are not only reliable and comprehensive but also context specific. The ICM project, together with the IE Lab, will provide a means of supporting low carbon developments through the use of accountable and reliable tools that meet industry needs.

2.9 An Australian Multi-regional Waste Supply-use Framework

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The production of waste creates both direct and indirect environmental impacts. A range of strategies are available to reduce the generation of waste by industry and households, and to select waste treatment approaches that minimise environmental harm. However, evaluating these strategies requires reliable and detailed data on waste production and treatment. Unfortunately, published Australian waste data are typically highly aggregated, published by a variety of entities in different formats, and does not form a complete time-series. We demonstrate a technique for constructing a multi-regional waste supply-use (MRWSU) framework for Australia using information from numerous waste data sources. This is the first sub-national waste supply-use framework to be constructed for Australia, and the world (to the authors' knowledge). We construct the framework using the Industrial Ecology Virtual Laboratory (IELab), a cloud-hosted computational platform for building Australian multi-regional input-output tables. The structure of the framework complies with the System of Environmental-Economic Accounting (SEEA). We demonstrate the use of the MRWSU framework by calculating waste footprints that enumerate the full supply chain waste production for Australian consumers.

2.10 The Global MRIO Lab - Overview and Technical Advances

Arne Geschke, Manfred Lenzen, Yanyan Xiao, Daaniyall Rahman, Hagen Schulte in den Bäumen, Keiichiro Kanemoto, Thomas Wiedmann, Arnold Tukker, Daniel Moran
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The Global MRIO Lab further develops the concepts of the Australian IELab in order to allow for the IELab infrastructure to be applied to a global setting. The key innovations of the Global MRIO Lab are:

1. Global geographical coverage. The Global MRIO Lab will cover the entire world, allowing for the inclusion of any given MRIO data source that is available for any geographical region of the world.

2. Integration of Eora, EXIOBASE, and WIOD data. The Global MRIO Lab will include all data sources and data classifications that were used during the construction of the global MRIO databases Eora, EXIOBASE and WIOD. Hence, the Global MRIO Lab will offer researchers to compile these three main global MRIO databases through the IELab web interface. Additionally, the Global MRIO Lab will allow researchers to combine classifications and data sources of these three databases as desired, and construct global MRIO databases that reflect specific aspects of each of these three global MRIO databases. Further, the Global MRIO Lab will allow for a completion and continuation of time series for EXIOBASE and WIOD databases.

The IELab infrastructure features a data processing framework that offers the time-efficient ways for the introduction of new data to the system and the maintenance of existing source data. Hence, future updates of the previously discontinued databases WIOD and EXIOBASE, as well as the on-going maintenance of the entire system will be possible at low costs.

2.11 Water-Energy Nexus Knowledge for Resources Security

Steven Kenway
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A grand sustainability challenge for cities is to reduce inputs of water and energy, while improving human liveability and environmental health. Providing urban water supplies at least energy cost is a component of this challenge. Understanding the impact of water on energy is part of the solution. The "water-energy nexus" has strong implications for resource security, productivity, urban design, and is a complex emerging public-policy issue in Australia and globally.

The Millennium Drought revealed the fragility of Australian water and energy systems. Inadequate planning forced rapid investment in energy-intensive options: desalination, reuse, and long-distance water transfers from agriculture. This investment is rapidly increasing the energy use and cost of urban water.

In order to reduce such problem-shifting, there is a growing need for a conceptual and analytical framework of the energy effect of water spanning three interconnected systems: (1) urban water utilities such as pumping and treating water (2) water use in cities for example for heating and cooling in homes, industry and commerce and (3) flows of water embodied in products. While "system" (1) and (2) are relatively well known,"system" (3) is currently largely unknown. This presentation discusses the need for this knowledge, estimates its significance, and considers the potential for the the Australian Industrial Ecology Virtual Laboratory (IELab) to contribute to the improved management of water-related energy.

2.12 Triple Bottom Line Study of a Lignocellulosic Biofuel Industry

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Growing concerns about energy security and climate change have prompted interest in Australia and worldwide to look for alternatives of fossil fuels. Among the renewable fuel sources, biofuels are one such alternative that have received unprecedented attention in the past decade. Cellulosic biofuels, derived from agricultural and wood biomass, could potentially increase Australia's oil self-sufficiency. In this study, we carry out a hybrid life-cycle assessment (LCA) of a future cellulose-refining industry located in the Green Triangle region of South Australia. We assess both the upstream and downstream refining stages, and consider as well the life-cycle effects occurring in conventional industries displaced by the proposed biofuel supply chains. We improve on conventional LCA method by utilising multi-region inputoutput (MRIO) analysis that allows a comprehensive appraisal of the industry's supply chains. In particular, we construct a MRIO table on the Australian Industrial Ecology Virtual Laboratory, and hybridise that with detailed engineering process data on cellulose refining. Using MRIO-based hybrid LCA, we evaluate the social, economic and environmental impacts of lignocellulosic biofuel production. Our results reveal that a lignocellulosic biofuel industry will create significant new jobs and enhance productivity and economic growth by initiating the growth of new industries in the economy.

2.13 Some Observations on Constructing Regional Input-output Tables using IELab and the GRIT Procedure

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Proposal as a session chair and provide an introduction with some observations on the following:

EconSearch has for many years used the GRIT procedure to construct regional input-output tables for states and regions throughout Australia, particularly in South Australia and Victoria. The process has involved the construction of "control"data sets that are used directly in the first stage of the GRIT procedure (e.g. value of output and employment by industry). "Secondary" data sets, such as the components of the final demand and primary inputs quadrants, are treated as "superior" data and are incorporated in subsequent stages of the procedure.

EconSearch became involved in IELab in January 2014 and has since used IELab to generate state and regional tables at various levels of spatial definition for South Australia. Some observations are made on the benefits and practical differences in constructing regional input-output tables using IELab and the GRIT procedure.

2.14 The Peculiar Economics of Balanced Multi-regional Growth under Constrained Resource Usage

Stuart Nettleton
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Mainstream computable general equilibrium analysis developed out of Lief Johansen's regional economic analysis based on the simultaneous settlement of commodity markets in quantity and price. The work of John von Neumann, Paul Samuelson, Wassily Leontief, Anne Carter, Michael Farrell and Thijs ten Raa has combined in an alternative bottom-up Input-Output approach, which embodies Johansen attributes while exploiting the unique property of models having regions that trade in adjusting to evolving natural advantages and environmental constraints through regional industry specialization. Such specialization has recently become a major focus in many nations seeking competitive niche business models in intermediate products and capital goods, which today comprise 70 per cent of the global supply chain. My demonstration of a generic version of the hitherto unproven balanced growth hypothesis - that consumption growth is maximized through investment policies that facilitate unimpeded specialization in all regional industry segments - advances domestic industry policy and international trade policy. This study is based on 2007 year data from the Global Trade Analysis Project. The next phase of investigations will combine Australian States with major trading partners using the Industrial Ecology Laboratory databases for Australian State data together with the international Eora Multi-Regional database.

2.15 Energy Footprints Analysis Using the IELab

Lavinia Poruschi
Urban Research Program, Griffith University, Brisbane, Australia

Australian energy generation is mostly based on fossil fuels, thus electricity, gas, water services or food, construction materials and all other goods and services have energy footprints that translate into considerable amounts of fossil fuel use. Using the IELab it is now becoming possible to follow how changing consumption trends in society can lead to increases or decreases in fossil fuel requirements. Micro-scale analysis focused on households or macro-scale analysis focused on regions, such as cities or their metropolitan areas can be conducted. IELab based analysis can for example find the proportion by which residential, industry activities or government consumption contribute to the evolution of the regional overall fossil fuel (energy) use at several administrative scales; or, find how changes in consumption patterns of households could lead to increased/decreased activity in other sectors and what are the natural resources or environmental impacts implied in this development. In a world where cities account for two thirds of all energy demand and in a highly urbanized nation, there is a need to better understand the human dimensions associated with consumption of energy at multiple scales and longitudinally. This is particularly important as research is now showing preferences of Australian consumers are changing away from durable goods to less durable ones and that there seems to be a levelling off of direct energy use (electricity) in either private or industrial demand since 2006.

2.16 New Updates of the WIOD Database

Daaniyall Rahman, Manfred Lenzen, Arne Geschke, Keiichiro Kanemoto and Yanyan Xiao
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This article describes the processes of updating the World Input-Output Database (WIOD) in a virtual laboratory environment called the Global MRIO Lab. With the view to continuity for the existing WIOD user community, the IELab system has been adapted to match the original WIOD construction pipelines as closely as possible. The only major departure from WIOD practice is that we apply a single-step reconciliation procedure compared to WIODs original two-step reconciliation process. The single-step reconciliation procedure considers both SUT and trade data sources, whereas the original two-step procedure handles these types of data sources separately. Compiling the WIOD database in the Global MRIO Lab offers a number of advantages such as flexibility in terms of sectoral and spatial resolution, a less labour-intensive and hence more cost-effective data integration process, and a faster turnaround time for data updates. These advantages are largely owed to the high degree of automation within the Global MRIO Lab. Therefore, implementation of the WIOD database in the Global MRIO Lab will allow for continuous updates in the future.

2.17 Measuring the Economic Complexity of Australia's States and Territories

Christian Reynolds[1], Manju Agrawal[1], Ivan Lee[1], Jiuyong Li[1], Phillip Taylor[2], Tim Mares[2], Julian Morison[3], Nicholas Angelakis[3],Farhana Abedin[2] Göran Roos[4]

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Australia's long-term prosperity depends on its success in rebuilding the competitiveness of its manufacturing sectors. A key impediment to such discussions is the question of what constitutes competitive and comparative advantages and how best to achieve them and how to monitor progress.

Economic Complexity analysis is a new approach (Hidalgo and Hausmann 2009,PNAS), which provides the ability to indicate other products or services that the state or nation could have an advantage producing, and their current comparative economic advantage in relation to other states. Using Economic Complexity analysis policy makers and industry can target knowledge and skill intensive products that are already produced; in order to grow the states' knowledge based economy and manufacturing skill set.

Using the optimisation abilities of the IElab, we reconcile data from ABS, State government and Econsearch reports to produce a 9 region, 506 product (ANZSIC06) Input-Output table for 2009. We then extracted the intrastate import and export data to calculate the relative economic complexity of each states' economy, finding the average Diversity and Ubiquity of each states industries.

2.18 Australian Diets and Their Environmental, Economic and Health Impacts: Measuring Australia's 'Foodprint' Using the IElab

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The IElab provides us with the unique ability to examine Australia's food supply and consumption, at a simultaneously highly aggregated and disaggregated level of product and geographic detail, thus offering a previously unavailable degree of research flexibility. Furthermore, the ability to integrate and reconcile ABS, State and industry data within a consistent framework allows us to quantify the interlinked complex environmental, economic and health consequences with-in each section of our modern farming system, including different stages of the supply chain, transport, food preparation and consumption practices.

This session will discuss the current ability of the IElab to measure the environmental, economic and health impacts using the following examples:

- Calculating calorific food security at the city-state geographic level.
- Measuring the environmental impact of non-core food consumption by different socio-economic segments in Australia.

It will also discuss future uses and potential new data sources, and avenues of research.

2.19 Integrated Urban Transport and CGE Modelling for the Sydney Transport Network

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The traditional cost-benefit analysis (CBA) methodology for transport appraisal has two key shortcomings: (1) markets outside transport are assumed to be static, and (2) measurements of impacts are highly aggregated. Computable general equilibrium (CGE) models capture general equilibrium effects and measure household-level welfare by simulating agents in an economy reacting to price and quantity signals. However, as they are data hungry and costly to assemble, they are only applied to large transport projects when the shortcomings of a traditional CBA become significant. Additionally, existing urban CGE models do not encompass all trip generators and generally lack integration with transport models. The proposed research is to develop a series of static and dynamic CGE models for the assessment of transport projects and policies in Sydney. The models would incorporate all sources of transport demand and perform modal split and traffic assignment functions to determine impacts on the transport network in one process. Input-output (IO) data is required for the calibration of CGE models, and IELab is the only suitable IO data source that is spatially disaggregated to the extent necessary for transport modelling. Applications of the models include testing of proposed Sydney transport network augmentations and the network design problem.

2.20 IELab Applications for Life Cycle Assessment

Hazel Rowley and Joe Lane
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The IELab has many potential applications in environmental life cycle assessment (LCA), particularly with regards to combining detailed, process-specific data with overarching input-output data in a hybrid LCA model. This enables the evaluation of multiple environmental impacts at a high level of detail and completeness, improving the quality and reliability of information provided for applications such as product design, eco-labelling, corporate reporting, supply-chain analysis, policy formation, and infrastructure selection.

The IELab is already populated with several environmentally relevant datasets, including energy use and greenhouse gas emissions. The structure of the IELab also supports separate modelling of life cycle inventory and impact assessment models as recommended by the ISO standards on LCA methodology.

In this session, LCA practitioners and researchers will be invited to discuss their understanding of how IELab can benefit LCA practice in Australia; what support or features are most important for this purpose; identifying and prioritising potential additional datasets; how the LCA community can contribute to the ongoing development of IELab; and any other topics of interest to participants.

2.21 Hybrid LCA for Construction Materials

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One third of global greenhouse gas emissions are emitted from the building sector contributing significantly to the problem of climate change. While more work has been done on decreasing direct emissions from the operation of buildings, embodied emissions of construction materials receive little consideration even though they constitute a significant additional proportion of emissions. The Integrated Carbon Metrics (ICM) project comprehensively quantifies greenhouse gas emissions relating to the built environment in Australia. The project utilises the Australian Industrial Ecology Virtual Laboratory (IELab) to implement a novel hybrid life cycle assessment methodology that harmonises data from different scales and sources by combining top-down and bottom-up approaches. The methodology will inform development of a custom-designed, Excel-based calculation tool that tracks embodied carbon flows along the production and supply chains of materials and products. Several interesting aspects of the ICM project will be discussed, including the selection of a customised list of industry sectors in IELab that are relevant to the built environment, the use of embodied emissions factors to supplement IELab results (e.g. in the case of concrete), and the hybridisation procedure. The project is funded by the CRC for Low Carbon Living.

2.22 Carbon Footprint Scenarios for Renewable Electricity Generation in Australia

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The electricity sector is currently the largest emitting industry in Australia and contributes to about one third of the country's total greenhouse gas (GHG) emissions. Electricity consumption is projected to grow by 143% by 2050 compared to 2012 levels. If an 80% reduction of Australian GHG emissions by 2050 relative to 2010 is to be achieved, it seems indispensable that the electricity sector be almost entirely decarbonized by 2050. Is this achievable with 100% renewable energy sources? Even carbon-free energy carriers lead to indirect GHG emissions in the life cycle of electricity provision. We apply Input-Output-based Hybrid Life Cycle Assessment to demonstrate the magnitude of these indirect emissions in renewable electricity scenarios in Australia.

Using the Industrial Ecology Virtual Laboratory (IELab), we first produce a tailored supply and use table of Australia and add a Rest-of-World region to achieve global closure. We then augment this model with process data for renewable energy technologies from the Ecoinvent 3.1 database. Finally, we investigate scenarios for different power generation options for Australia through to the year 2050, including the deployment of carbon capture and storage (CCS) technologies. Using sensitivity analysis, we elaborate data accuracy and uncertainty.

Results indicate that, whilst not being entirely carbon free, the employment of different renewable energy technologies can potentially save the majority of Australia's current GHG emissions, making renewables an essential option for climate change mitigation.

2.23 The New Eora Database

Yanyan Xiao, Keiichiro Kanemoto, Diana Carneiro, Manfred Lenzen, Arne Geschke, Daaniyall Rahman, and Daniel Moran
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We have updated the Eora MRIO database to a new 2012 version with data from the UN SNA Main Aggregates (MA), UN SNA Official Country (OC), UN Comtrade, Service Trade, Industrial Commodity Statistics(ICS), and national IO/SUT databases. We have included new national IO/SUT tables, and new SAM data for 27 countries from the International Food Policy Research Institute (IFPRI), thus expanding the geographical coverage to 189 countries.

In addition, we have implemented the existing Eora MRIO framework in a cloud environment called the Global MRIO Laboratory (MRIOLab). The Eora cloud version has some new features: First, it uses the hierarchical 'Root-Base-Branch' structure that allows users to build MRIO base tables in a flexible manner by freely choosing regions and secotors; Second, it will be parellel with the existing Australian IELab or the other future embedded MRIO databases(such as WIOD) in MRIOLab, in order to generate more detailed constraints in a targeted research area; Third, it contains the world's largest and most detailed map of the global economy.