Swedish Society for Nature Conservation (SSNC) Partner Exchange

Virtual Seminar Sessions

Focus: Indian Energy Sector

September 2020

REPORT ON RENEWABLE ENERGY AND FUTURE IMPLICATIONS FOR A JUST (ENERGY) TRANSITION

BACKGROUND

Global warming and fossil fuel depletion, as well as the goal to provide universal energy access, increasingly place the development of sustainable just energy systems at the top of political agendas around the world. The future will most likely mainly be powered by renewable energy sources. However, in order for the energy transition to be economically, socially and environmentally sustainable and just, it calls for a rethinking of how the energy sector should be organised, financed, and which materials and technologies should be promoted. These considerations entail how the raw materials for the energy producing devices are acquired and processed, associated environmental impacts, working conditions, maintenance of the technologies, and how the waste from the energy producing devices is handled. Chemical safety issues are crosscutting all aspects of the transition, as the transition should not just safeguard conditions for egalitarian economic growth and a good standard of living, but also improve protection of human health and environment. To that end, different energy systems have different impacts, throughout their life cycles.

SSNC's Department of Climate and Chemicals has been organising a series of capacity building activities on the transformation of the energy sector from fossil fuels to decentralised renewable systems. The German energy transition study tour in 2017 focussed on three pillars of sustainability i.e. economic, social and environmental and included activities such as visiting community based energy systems and mapping relevant SDGs (3, 6, 7, 8, 11, 12, 14 and 15) in the transformation of the energy sector. 2018 examined the SA energy sector to understand how best we can foster a JET that encompasses a bottom-up, democratically- and locally-owned green economy that sustains the environment, livelihoods and generates decent work while promoting a safe circular economy. groundWork, Friends of the Earth, South Africa hosted SSNC and fellow partners for the exchange.

The 2020 country visit was planned to focus on the Indian Energy sector with Indian partners Toxics Link and Centre for Financial Accountability to host the exchange from 16 to 21 March. The original programme is included in Appendix A. Due to the Covid-19 pandemic travel restrictions, the visit was changed from the physical trip to online. A new planning meeting was held on 11th August with participants where a decision was taken to hold the event online with virtual seminars. The group also opted not to postpone the event to 2021 as it had already been postponed in 2019 and there was uncertainty as to when everyone would be able to travel again.

The result is that the SSNC exchange had its first virtual event. The programme is included in **Appendix A**, along with readings.

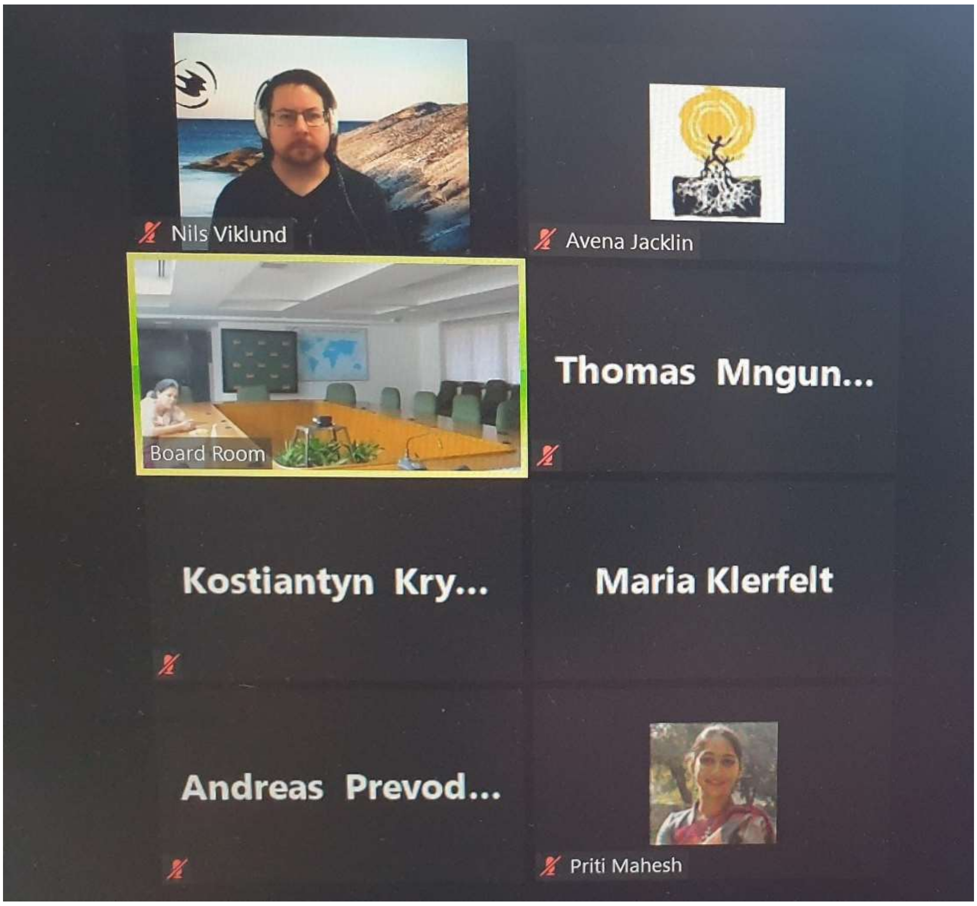
The activities of the exchange seek to answer the question: ***"How can we understand and foster an environmentally, socially and just energy transition?"*** The aim is to prime the participating organisations with holistic and life-cycle perspectives, to enable them to better influence a sustainable national transformation of the energy sector.

ACKNOWLEDGEMENTS

Participants of the 2020 Just Energy Transition Exchange 2020 exchange included the Centre for Financial Accountability (CFA, India), Toxics Link (India), Swedish Society for Nature Conservation (SSNC, Sweden), groundWork (Friends of the Earth, South Africa), Earthlife Africa (ELA, South Africa) and Ecoaction (Ukraine).

A special thank you goes out to the speakers and presenters for their time and contributions during the virtual seminars, namely, Joe Athialy (CFA), Soumya Dutta (energy expert and advisor), Anshuman Lath and Prasad Kulkarni (Gram Oorja), Balasubramanian Viswanathan, Chris Beaton and Philip Gass (IISD), Dr Dieter Mutz (GiZ), Satish Sinha (Toxics Link), Elsa Dominish (Institute for Sustainable Futures, University of Technology, Sydney) and Mini Govindan and Rashmi Murali (The Energy and Resource institute)

Participants of the Just Energy Transition Exchange 2020 thank the Swedish Society for Nature Conservation (SSNC) for its financial, organisational and technical support in making the visits, virtual seminars, country partner exchange and capacity building exercises possible.



ACRONYMS

BEE	- Bureau of Energy Efficiency (India)
CENFA	- Centre for Financial Accountability
CFL	- Compact fluorescent lamp
CO_2e	-Carbon Dioxide Equivalent
DAE	- Department of Atomic Energy
EE	- Energy Efficiency
ELA	- Earthlife Africa
EU	- European Union
EV	- Electric Vehicle
FiT	- Feed in Tariff
GHG	- Greenhouse Gas
HDI	- Human Development Index
Hg	- Mercury
IEP	- Independent Energy Plan
INDC	- Intended Nationally Determined Contribution
ILO	- International Labour Organisation
IRENA	- International Renewable Energy Agency
IREDA	- Indian Renewable Energy Development Agency
ISST	- International Institute for Sustainable Development
JT	- Just Transition
JET	- Just Energy Transition
JNNSM	- Jawaharlal Nehru National Solar Mission
LED	- light-emitting diode
LNG	- liquefied natural gas
MC	- Ministry of Coal (India)
MoEFCC	- Ministry of Environment, Forest and Climate Change (MoEFCC)
MoWR	- Ministry of Jai Shakti: Department of Water Resources, River Development & Ganga Rejuvenation
MNRE	- Ministry of New and Renewable Energy (India)
MoPNG	- Ministry of Petroleum and Natural Gas (India)
MoP	- Ministry of Power (India)

MTEE	- Market Transformation for Energy Efficiency (India)
Mtoe	- Mega Tonne of Oil Equivalent
NAPCC	- National Action Plan for Climate Change (India)
NDA	- National Democratic Alliance (India)
NDC	- Nationally Determined Contributions
NISE	- National Institute of Solar Energy (India)
NIWE	- National Institute of Wind Energy (India)
NMEEE	- National Mission for Enhanced Energy Efficiency (India)
NO_x	- Nitrogen Oxides
NPA	- Non-Performing Assets
NSM	- National Solar Mission (India)
ONGC	- Oil and Natural Gas Corporation
OPEC	- Organisation of the Petroleum Exporting Countries
PM	- Particulate Matter
PRODUSE	- Productive Use of Energy
PV	- Photovoltaic
RE	- Renewable Energy
RTP	- Rooftop Solar Projects
SDG	- Sustainable Development Goals
SECI	- Solar Energy Corporation of India
SOE	- State Owned Entity
SO_x	- Sulphur Oxides
SSEG	- Small Scale Embedded Generation
SSNC	- Swedish Society for Nature Conservation
SSS-NIBE	- Sardar Swaran Singh National Institute of Bio-Energy
TERI	- The Energy and Resources Institute
UNFCCC	- United Nations Framework Convention on Climate Change
WECCF	- Women in Energy and Climate Change Forum

India Trade Unions (coal): HMS, BMS, AITUC, CITU, INTUC

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1. Introduction

India has made great strides in its development towards universal electricity access reaching an additional 500 million people in the last decade with a sharp rise in the share of renewable energy. In 2018 the Indian government declared that the goal of electrifying every village had been reached. A new ambitious target of 175 GW of renewable energy by 2022 and renewable energy prices are falling. But is it a Just transition? 64 million people do not have access to electricity and the energy transition does not imply that India will end dependency on coal soon enough.

The report explores the energy context in India and well as the social aspects of an energy transition including community driven energy solutions, strategies for a just transition and gender equality in the transition to renewable energy. The technical aspects covered include resource efficiency, circular economy and infrastructure for renewable energy, as well as, mineral sourcing for renewable energy.

Speakers, their organisations and topics covered are summarised in **Table 1** below and more detail with reading references may be viewed in **Appendix A**

Table 1: Summary of speakers, organisations and topics

	Organisation	Topic
Joe Athialy	CFA	The electricity context in India
Anshuman Lath and Prasad Kulkarni	Gram Oorja	Community driven RE solutions
Balasubramanian Viswanathan, Chris Beaton and Phillip Gass	IISD	Strategies for a Just Transition
Dr Dieter Mutz Satish Sinha	GiZ Toxics Link	Resource Efficiency, Circular Economy and infrastructure for RE
Elsa Dominish	Institute for Sustainable Futures (University of Technology, Sydney)	Responsible Mineral Sourcing for RE
Mini Govindan and Rashmi Murali	TERI	Gender equality in the transition to RE

2. The Electricity Context in India

Joe Athialy from the Centre for Financial Accountability (CFA) gave an overview of the electricity context in India, pointing out that globally, 80% of our energy generation is from fossil fuels and this is reducing in relation to the rise in renewable energy. India also generates 80% of its energy from fossil fuels. 16-18% of energy comes from the burning of biomass which is basically the energy of India's poorest communities. Unlike the western countries, the increase in energy consumption in India began much later, that is, around 1991 with a sharp rise in 2005, mainly in coal, oil and natural gas.

India's energy at a glance

India is the third largest consumer of fossil fuels and emitter of greenhouse gases. Its fossil fuel consumption rankings include being the second largest coal (22-24% imported), third largest oil (82% imported) and 15th/16th largest natural gas (48% imported) consumer. The high percentage of imported energy constitutes a huge risk for the economy. India is also the third largest electricity producer in the world and emitter of carbon dioxide (CO_2) after China and the USA.

However, per capita consumption and emissions are 43% below global average, and below the average of Sub-Saharan Africa. India has a population of 1.37 billion people (17.6% of the world's population) with sizable variance between energy consumption between the poor (both rural and urban) and the middle to upper class consumers. India's total commercial energy consumption is 880 Mtoe (2018), domestic production is 560 Mtoe and imported energy is 320 Mtoe. Commercial energy consumption by type is indicated in Table 2. below. Over the last two decades the per capita consumption has gone up sharply and dominated by the upper class. If one considers poverty as US$2 per day, this implies 70% of the population. Energy consumed by the poor is biomass.

Table 2: India's commercial energy consumption by source

Commercial Energy Consumption by Source		
Source	***Consumption (Mtoe)***	***Consumption (%)***
Coal	490	55.8
Oil	242	27.5
Natural Gas	55	1.12
Nuclear	9.8	1.12
Hydro power	36	5.2

Non-fossil generation

Non-fossil fuel generation is considerable, placing the country fourth globally (133GW) including controversial hydropower generation. Hydropower constitutes 50GW which is 3.82% of global capacity and 5th largest in the world. India is the 5th largest installed solar power (43GW, 6.8%) and 4th largest wind power generator. Utility scale solar is expanding at a rapid rate and has led to several conflicts. As the 13th largest nuclear power generator India produces 6780MW with 1.71% global installation capacity. Traditional biomass accounts for 16-18% of total primary energy consumption including heating, cooking and gas production, and not just electricity production.

Energy Ownership

Electricity is owned mainly by government and 30% privately owned. The large share of private sector players has emerged since the 2003 Electricity Act. According to government, India lacks electricity, not energy. This may be due to power purchase agreements with the private sector binding government to purchase power bringing with it opportunities for corruption rather than addressing actual energy needs. The reality is that this demand is from prior 2015's power surplus. 90-95 coal power units are shut down due to lack of demand.

Energy governance is mainly through Indian energy Ministries and Agencies including:

- Ministry of Coal (MC)
- Ministry of Power (MP)
- Ministry of Petroleum and Natural Gas (MoPNG)

- Ministry of New and Renewable Energy (MNRE)
- Ministry of Jal Shakti: Department of Water Resources, River Development & Ganga Rejuvenation (MoWR)
- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Department of Atomic Energy (DAE)

Access to energy

India's GDP per capita and HDI are linked to energy supply. Access to energy is therefore strongly linked to poverty and people's ability to move out of poverty, and in particular women's freedom, movement and empowerment. South Asia is dominated by patriarchal societies with primary resources controlled by men. Access to energy at a household level can drastically change a woman's status.

Energy consumption has risen sharply globally with SDG 7, that is, access to sustainable and affordable energy for all. Countries in Africa and south Asia (India, Bangladesh and Pakistan) with low per capita consumption has very low accessibility of electricity. In central and eastern India with the richest fossil fuel resources, are the least served communities that are also the most vulnerable to climate change impacts. Between 2050 and 2060 temperatures are expected to rise in excess of 2.4^{o}C reducing the ecological footprint. Both nuclear and coal plants are situated in densely populated areas, which competes with and puts a strain on water resources. India may draw lessons from similar countries that have increased development with less energy usage. Sri Lanka has improved energy efficiency/usage, increased HDI with less than half of India's equivalent in energy production and consumption per capita.

What is India's potential to go beyond fossil fuels?

Social movements do not agree with India's pledge under the Paris Agreement of non-fossil fuels reaching 40% of the electricity capacity by 2030 with coal remaining the primary energy source. Solar has huge potential with some suitable areas for wind. The challenge in India, as it is globally, is with large installations that cover huge tracts of land produced with unrecyclable materials dependent on intensive minerals extraction. Conflicts have arisen around land use and people's livelihoods and needs. Guidelines on considerations for renewable energy projects must take into account local needs, including local communities and farming cooperatives and the need for small, localised grid projects must be considered.

3. Community Driven Renewable Energy Solutions

Gram Oorja, a social enterprise based in Pune India, has provided over 200 rural communities with microgrids through community-owned solar mini grids (SMGs) and sometimes combined with micro hydropower. The presentation by Anshuman Lath covered their experience of key success factors for sustainable community driven RE solutions including community interaction, design for aspirations, metering for every user, tariff structure and ownership transfer.

A basic consistent power supply has many benefits, particularly in rural and remote areas, namely:

- water pumps lead to higher water use and better hygiene
- less time and work spent on carrying water
- lighting increasing safety at night
- pump systems for surface water to drip irrigation, make second crops possible
- agro-processing capability such as operating mills, as illustrated in the picture below

Empowering: *value adding and agro-processing such as milling is a benefit that a basic consistent supply of electricity can provide*

The micro-grids power communities' lights and basic production equipment. Energy installations range from 5 to 25 kWh. Communities become the operators of the grid, maintain records of power use and costs and collect fees. A participatory approach involving communities is a mandatory to start a project and installations maintain the same standards of the main power grid. Maintenance of the grid's equipment is challenging and time consuming in remote areas if external servicepeople and resources are used. Batteries are used to stabilize the power supply. In a pilot project with Bosch, Gram Oorja demonstrated 6-year battery life and the tariff is calculated for replacement. Lifespan of panels is 25 years and follow international standards. Grids, however, follow local standards. Parts and electrical components are standard and easily available at hardware stores.

Government involvement is limited with only permits required form the village council. Success rate of projects is 91% with some challenges related to social issues. Generally, project success is attributable to community interaction, design for aspirations, metering, tariff structure and ownership transfer as illustrated by Graham Oorja's Circle of Success model in Figure 1. below.

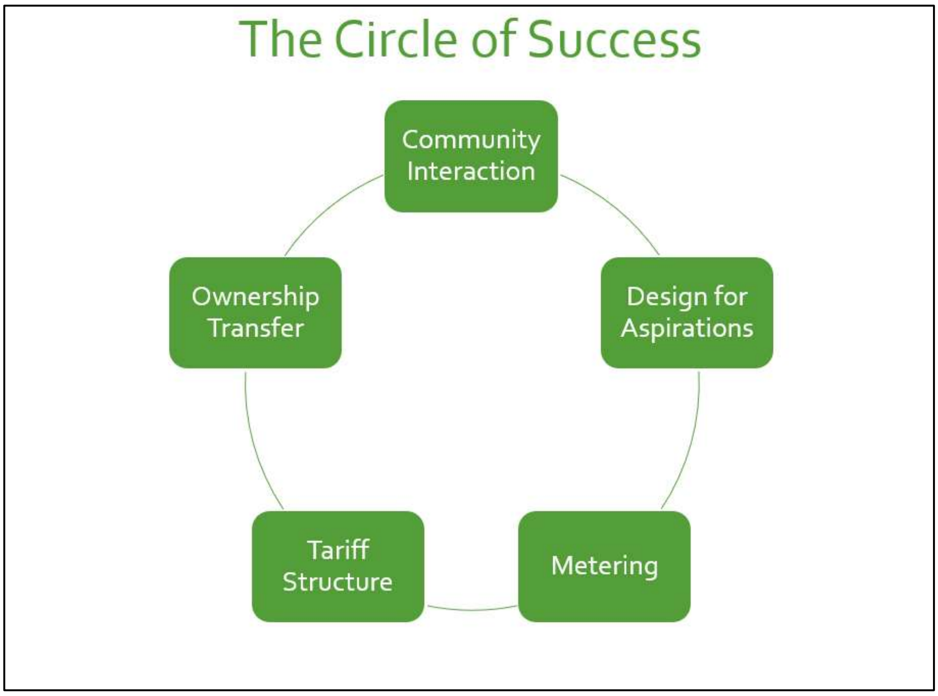

Figure 1. Gram Oorja's Circle of Success model

Financing and insurance

The average cost of a grid covering about 200 households is US$ 20,000. Construction capital is raised mainly through philanthropy (90-95%) and grants such as CSR, but communities have to put in their own contribution. Gram Oorja sells the system to local CSOs who may keep ownership or handover to the community. Payback capability of communities is determined. Replacing diesel with RE electricity where possible, reduces energy cost and enables shorter payback periods.

PV and batteries cannot compete with the cost of national power grids (which are subsidised). Microgrids are therefore mainly a rural or under-serviced area solution.

Mitigating risk factors such as theft, broken panels and lightening damage are decided upon and managed by communities. The same for the cost of maintenance and repair. Having the working knowledge of installation, wiring and repair ensures that systems remain robust. Ownership safeguards against theft as people are protective over the infrastructure and conduct their own policing, particularly where GPS chips are installed in panels if it is a higher risk area.

A video of Maharastra's micro-grid may be viewed here.

Research: Sustainability of community owned mini-grids: evidence from India

Community-owned solar mini-grids (SMGs) are increasingly promoted to provide communities access to reliable electricity, empowering local actors as they become active stakeholders in projects. However, early failures and difficulties in building local capacity have raised questions regarding their long-term sustainability and ability to be replicated to provide socio-economic benefits to the communities. This study assessed the sustainability of 24 community-owned SMGs in India operating over extensive periods of time using a novel scoring framework using mixed methods to derive its conclusions.

The study found that institutional, financial, and technical capacities, central for the SMG's long-term sustainability, could be achieved through community engagement from early stages, if communities are allowed freedom to develop governance procedures while at the same time clarifying roles and responsibilities. This creates strong sense of ownership that is key for effective and inclusive governance. User satisfaction, ensured through provision of usable supply in line with users' expectations, motivates actors to make regular payments, thus leading to economic sustenance. While social and environmental benefits were observed, energy consumption and engagement in productive activities remained marginal.

The study reports an example of community-owned SMG model that has been replicated sustainably over many cases, overcoming key challenges related to appropriate financial and technical management and producing positive social impact. Low engagement in productive activities was more a factor of the local socio-cultural contexts, rather than limited paying capacities of the users. To increase energy utilization and create environments for sustainable rural living, the study recommends implementation of systems that link energy with other rural development needs such as agriculture or water provision. The study also recommends more use of qualitative and quantitative data for impact analysis to ensure that conclusions are generalizable and provide rich contextual explanations for the observed phenomena.

4. Strategies for a Just Transition

Subsidies remain a major obstacle for sustainable development, yet they remain one of the key tools used by government to influence energy producers and consumers, which in turn define India's energy future. The presentation by Balasubramanian Viswanathan, Chris Beaton and Philip Gass of International Institute for Sustainable Development (IISD) outlined methodology for governments to ensure that energy transitions are just including context, methodology, the case for a JET, acting early and looking at how supporting workers and communities needs to be at the centre of a JT process.

The obstacles: Subsidies and stranded assets

India's coal sector is deeply entrenched and heavily subsidised, having a profound effect on India's energy future. Advocates of coal subsidies argue that coal is the least cost option to meet India's demand and a source of baseload, and even balancing capacity for RE which is considered a variable power supply. Critics of coal argue that coal imposes additional costs to citizens, including air pollution and GHGs, and that it is a well-entrenched complex system of subsidies involving taxes and charges that are not transparent and serving the interests of industry, and not competing fairly with other sources of generation. More studies need to be conducted into the true value of energy and include social and environmental comparisons between various energy sources.

Upgrading existing coal infrastructure is also costly. The total capital expenditure required to install Sox, NOx and PM pollution control technology is estimated to be INR 86,135 crore (US$ 12 billion), adding 9-21% to average tariffs (depending on the size of units and other factors). In 2015, the Ministry of Environment, Forest and Climate Change legislated new standards to limit concentrations of Sox, NOx, PM and Hg in stack emissions for coal fired plants, however there was no change in air pollution norms. Majority did not install the equipment by the 2017 deadlines, and the deadline was extended to 2022.

Examining the risks of stranded assets based on reported figures by the Ministry of Power since 2018, showed that 34 coal-fired power plants (40GW) were ‘stressed’ with around 21% of total operational capacity at the end of 2018, with stress increasing by up to 75GW in subsequent years. 25 of these remained stressed in January 2020, with State Owned Entities (SOEs), international conglomerates and wealthy private sectors taking over 9 stressed assets. Plant load factors have stayed low and exacerbated by a Covid-19 induced drop in demand. Public Finance Institutions (PFC and REC) continue to support stressed assets and currently have an NPA worth US$ 6.8 billion on their balance sheets. The problem is unlikely to be resolved and continues to pose a major risk to India’s economy.

Coal needs inclusive dialogue that considers tax revenues, the roles of SOEs, mining communities, India’s overall economic benefits and the shift to a low carbon economy.

In November 2019, a needs assessment study was conducted which showed a lack of ownership in addressing the issue and lack of long-term alternative development plans at the state level. A separate deep dive study is planned for the region of Jharkhand to assess the risk factors consisting of tax revenues and their potential depletion and employment levels. International experience will also play a prominent role, specifically Indonesia and its subsidies reform. New administration in the region is generally open and supports the emerging dialogue.

The JT process

Key issues covering the JT include:

- Communications within the JT: How do we engage and get support from local bodies?
- Best practice: increase and support information exchange, develop processes consistent with ILO guidelines and social dialogue
- Mitigating risk with social mindset
- Fossil fuel subsidies in decline and RE increasing
- Entire cost of coal must be assessed: based on simple estimates on available data, coal charges more and reduces transport tax, social cost of coal includes work loss days and premature deaths due to coal pollution and GHGs
- Social aspects include studies on labour, dealing with tripartheid viewpoints and negotiating the transition

The window of opportunity for energy sector reform follows the four C’s, namely:

- Context
- Concerns / arguments
- Champions
- Complimentary policies

The following recommendations were made:

- All plants must be retrofitted by 2023 but if the costs of modernization are too high - they are bound to be retired

- RE compares favourably to coal power tariffs. Despite grid stability, subsidies in coal are a poor choice
- Cost of pollution-control equipment should be incorporated in the price of coal-fired power to ensure it reflects externalities

Policy recommendations include:

- Shift public resources to clean energy including RE
- Resist demands for new fossil fuel subsidies.
- Carefully adapt RE subsidies, promote emerging technologies and grid balancing
- Target consumption subsidies for energy access and assist those most in need
- Address coal pricing in a socially responsible way
- Closely monitor and adapt EV subsidies
- Develop formal reporting structure on subsidies. Tracking subsidies as recommended in SDG 12.c.1. Monitor, evaluate and adapt their most significant policies to identify how best they can meet their objectives

5. Resource Efficiency, Circular Economy and Infrastructure for Renewable Energy

A just transition requires more than providing RE to energy poor communities. It is also about transforming the production/consumption systems. Energy production systems should be part of the life-cycle thinking. This requires new and holistic policies for national energy transition plans, and a buy in from all key ministries and the private sector. Dr Dieter Mutz, who worked closely with Toxics Link, stated that when talking about climate change, we think of energy efficiency and RE. The circular economy and resource management have not played a major role yet. Little work has been done on natural resources and in particular Air, Water, Energy and Abiotic raw materials, as illustrated in in **Figure 2**. below from Dr Mutz's presentation.

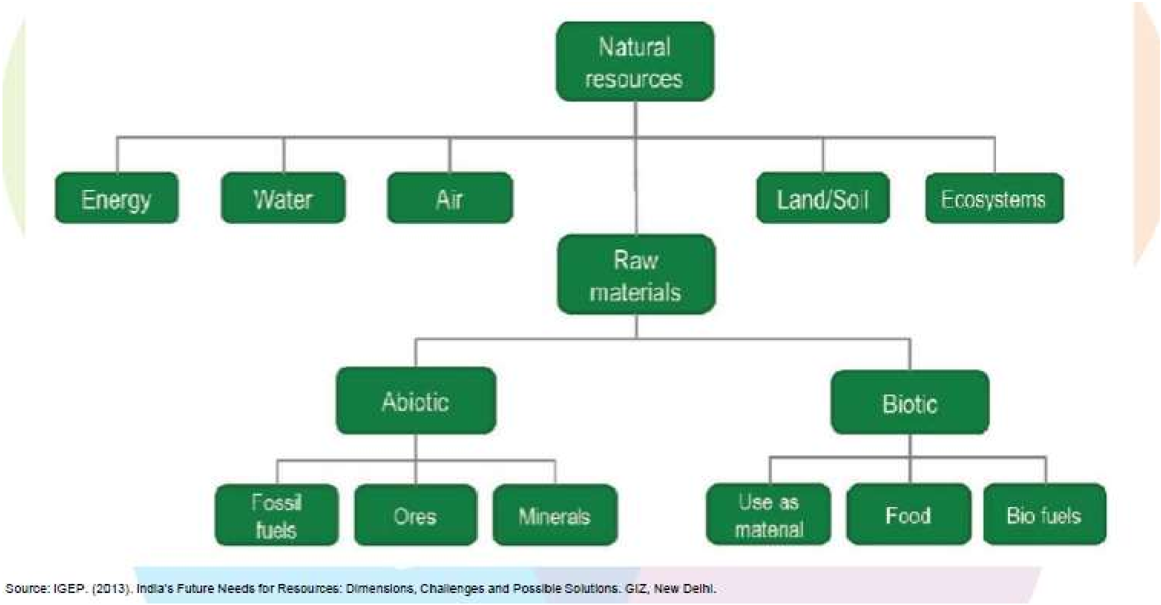

Figure 2. Natural Resources – energy and materials requirements

Lowering GHGs and Energy

Of the total current global GHG emissions, 55% comes from energy production and 45% from products and food. The circular economy approach is a key strategy to reduce these GHGs emissions, retain energy embodied in products and materials and regenerate natural systems that requester carbon in soil and products. It examines the energy system in a holistic manner and redesigns energy production systems, reducing the need to mine raw materials. At present, not much consideration is given to the end-of-life of products, creating a global waste problem. Energy "embodied" in materials goes to waste, and instead new primary raw materials are produced with additional energy consumption and CO_2 emissions.

Re-using and recycling saves energy. Transforming a few key industrial sectors will result in major GHG emissions reductions. Steel, aluminum, cement, plastic and food in a circular economy model could result in 9.3 billion tons of CO_{2e} reduction by 2050, the equivalent of eliminating all transport emissions globally. Energy savings and CO2 reductions from a 2009 BIT Study on the environmental benefits of recycling is illustrated in **Figure 3** below:

Energy Savings	
Aluminium	> 95%
Copper	> 85%
Plastic	> 80%
Paper	> 65%
Steel	> 74%
Zinc	> 60%
Lead	> 65%

CO_2 Savings*	
Aluminium	> 92%
Copper	> 65%
Ferrous	> 58%
Paper	> 18%
Nickel	> 90%
Zinc	> 76%
Lead	> 99%
Tin	> 99%

Figure 3. Potential energy savings and CO2 reduction from recycling various materials

A circular economy

The transformation from a linear to a more circular one (as illustrated in **Figure 3** below) requires strong support from key ministries and the private sector. It also means addressing our habit of using natural resources for free and that our economic systems are based on the free use of natural resources. One mechanism is to visualize the material and resources flows and the countries they are sourced from.

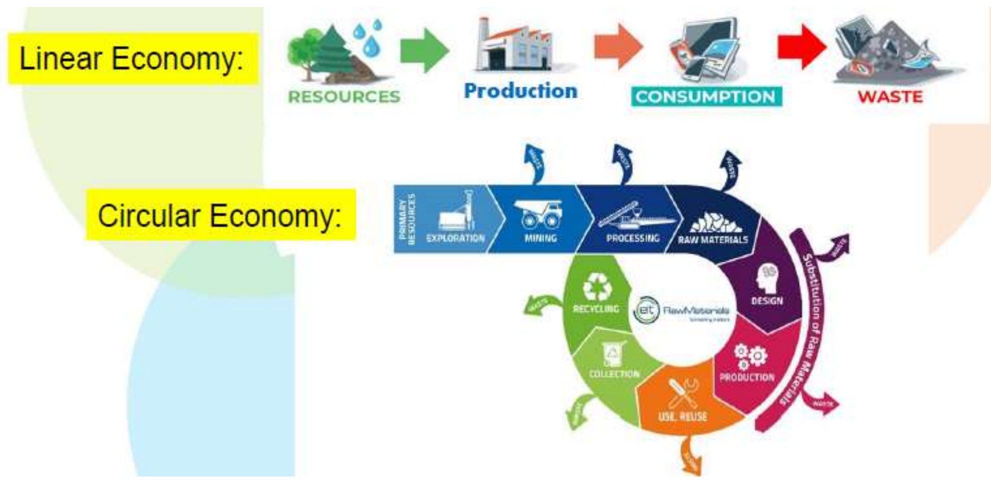

Figure 4: Transforming a linear economy to a circular economy

Natural resource sustainability challenges

According to the EU's The Circularity Gap Report (2020), global circularity declined from 9.81% in 2018 to 8.6% in 2020, so we have a long way to go. Global resource extraction and use has grown dramatically, and it is highly unequal. Extraction of primary raw materials in India has increased by 420% from 1970 to 2010 (third largest in the world after China and USA). Extraction quantities are expected to increase from 5.5 to 26 billion tones by 2050. The need for materials including those associated with RE such as EV batteries is increasing exponentially in emerging economies including India. India's material requirement for EV manufacture includes 95% of global Lithium reserves (Chile, China, Argentina and Australia), 90% rare earth metal supply from China and Cobalt from a fragile supply chain.

Metals (in theory) are easy to recycle without losing quality, and major energy and CO_2 savings can be achieved. Rare metals are key materials in RE technologies. To facilitate recycling of these metals, the energy producing devices must be designed to be recycled. Policies covering the entire life cycle of a product are crucial in setting standards and guide thinking through all life stages and stakeholders involved. Recycling may include the informal sector, but consideration must be given to safe and appropriate recovery technologies and the elimination of toxic and hazardous materials. Recycling and reusing should be prioritized instead of downcycling materials, in order to keep their market value (and the embodied energy investment in the processed material) for as long as possible. To facilitate harmonized thinking around recycled/reusable materials, appropriate quality standards (including how clean they are from hazardous impurities) must be formulated.

Natural resource extraction, use and disposal creates environment challenges of pollution, climate change and ecosystem destruction, as well as, socio-economic challenges of depletion shortages, price chocks, import dependence, economic insecurity and conflicts over access. Security and access to materials are often important considerations for governments, as in the case with India. An Indian National Resource Strategy, the result of an EU-India collaboration is to be launched soon. Circular economy strategies must not only be resource-based, but also include socio-economic considerations. Other considerations are research and development, extended producer responsibility, standards, information sharing, sustainable public procurement and multi stakeholder engagement.

Primary raw materials are still too cheap and this needs to change. Economic instruments can help create a market for recycled/reusable materials, while the true environmental and social cost of new resource extraction/refining/manufacturing should be reflected in the price of a material, e.g. via environmental tariffs/taxes. Recycled/reused materials can be favored in public procurements

Socio economic considerations of a circular economy in the JT

Satish Sinha of Toxics Link pointed out that the circular economy should not be confined to resource efficiencies. Materials cannot be viewed in isolation from human interphase and external costs to human health and the environment, particularly in the context of low- and middle-income countries, where waste handling and recycling operations take place in the informal sector, employing millions of low-skilled workforce. A circular economy therefore cannot be sustainable unless the transition is also just with respect to this informal sector.

Social and environmental costs from consumption in high-income countries are externalized to low- and middle-income countries where production takes place. Waste (including hazardous) exported back to low- and middle-income countries, entrenching the status of high-income countries as consumers and low- and middle-income countries and producers/manufacturers.

A circular economy may create new jobs, but may also add to the risk of job loss. Automatization poses a threat to low- and middle-income countries. Extended producer responsibilities brought about by the Polluter Pays Principle ensure social and environmental accountability but may also prevent the poor from accessing materials. Manual labor needs to be integrated from the informal sector in a meaningful and safe way. Reskilling is key.

80-90% of waste in India is handled by the informal sector.

Access to waste materials*: crucial for the livelihoods of millions in the informal sector*

Low purity of secondary raw materials (recycled) is an issue in the informal sector. Recycling operations can be highly polluting and not safe to the health of workers and consumers. Many low- and middle-income countries lack proper technologies for recycling operations.

The informal sectors create huge benefits to society in terms of addressing the waste issue yet is not paid back from society. We need to recognize this role, but at the same time look at the shortages in the technologies for recycling.

Hazardous chemicals in the materials must be phased out at source to the highest degree possible in order to not contaminate material chains dependent upon secondary raw materials. The lifecycle of a product needs to be free of hazardous and toxic materials primary materials to production to consumption and through to recycling operations handled by the informal sector. For energy producing devices it may be difficult to substitute all hazardous chemicals (e.g. heavy metals in alloys and as clean metals). In this instance, systems must be put in place to safeguard the informal sector from handling these components.

Integrating the informal waste handling/recycling sector in India into the formal economy has met with many challenges in the past. However, this was before the systematic concept of circular economy was on the mainstream agenda. There is an emerging awareness of production/manufacturing/consumption/waste handling linked to the transformation of the energy system necessary to prevent pollution, reduce GHGs and prevent climate change.

From a JT perspective, the circular economy may be the driving force to address challenges with the informal sector. Following India's national material strategy, consideration should also be given to socio-economic and environmental factors. Each country faces its own challenges in the holistic transformation of the energy sector, so circular economy models will be specific to each country. However, quality standards for recycled materials should be global, to facilitate trade, level the playing field and provide equal level of safety/protection in all countries. Waste laws, repair and remanufacturing must be revisited and be more inclusive. Extended producer responsibility and technology transfer needs to be carefully considered, and collaboration between low- and higher-income countries around the circular economy needs to increase

***Hazardous contents of materials**: resource strategies in circular economy must phase our toxics and hazardous materials*

6. Responsible Mineral Sourcing for Renewable Energy

Elsa Dominish of the Institute for Sustainable Futures, University of Technology of Sydney, Australia presented findings of the report Responsible minerals sourcing for renewable energy commissioned by US-based Earthworks, working on mining, human rights and the environment, as a part of their campaign *making clean energy clean*. Research objectives attempted to answer the following questions:

- What is the projected demand for metals used in key RE technologies in the future?
- What metals might need to rapidly increase in production?

The report also looked at model potential to offset demand through substitution, efficiency and/or recycling. Supply risks were reviewed to establish adequate supply of the mineral for the RE industry. Environmental and social impacts of mining were also reviewed.

Modelling used in the report is based on a 100% renewable energy scenario compatible with the 1.5°C degree goal (based on the Paris Agreement's goal to limit global warming to below 1.5°C compared to pre-industrial levels). The report focuses on a high share of solar, wind and EV RE and the technology focus is on battery, solar and wind. The report covers 14 metals used in RE and provides details on how much of these metals we need under the 1.5°C scenario, as illustrated in **Table 3** below. It also provides information on the impact of recycling on the demand of each metal.

Current follow up work includes looking at recycling as a way to prevent new mining.

Table 3: Metals used in RE

	Batteries			Solar PV			Wind Power	
	Li-ion	Li-S	EV	c-Si	CIGS	CdTe	PMG	Non-PMG
Aluminium	X	X		X	X	X	X	X
Cadmium						X		
Cobalt	X							
Copper	X	X		X	X	X	X	X
Dysprosium			X				X	
Gallium					X			
Indium					X			
Lithium	X	X						
Manganese	X							
Neodymium			X				X	
Nickel	X							
Silver				X				
Selenium					X			
Tellurium						X		

Findings

Key findings include:

- Under a 100 % renewable energy scenario, metal requirements could rise dramatically
- Recycling can reduce demand but not meet all demands, new mines are already under development (e.g. cobalt, copper, lithium, rare earths, nickel)
- Cobalt, lithium and rare earths are the metals of most concern considering projected demand, supply risks and impact
- EV is the main driver of demand for key metals rather than stationary storage or wind power.
- Responsible sourcing is needed when supply cannot be met by recycled sources

Cumulative demand examples examined included cobalt and silver. It was found that cobalt recycling has the largest potential to reduce demand. The question is whether it is technologically viable and whether companies will take this up. When considering PV metals, it is interesting to note that recycling is not the most important strategy, but efficiency - using less of the metal in each panel. The reason for this is that lithium-ion batteries have a much shorter life (10-15 years) while solar panels have a lifespan of up to 30 years. By the time solar panels are ready to be recycled a lot more would have been produced. Findings that examined the increase in RE production and metals where mining metals where mining might grow rapidly include:

- Metals requiring the largest volumes include aluminium, copper, manganese and nickel. These metals are also used in many other applications.
- Metals with the biggest expected growth potential include cobalt, lithium, nickel and rare earths. These metals are the most likely to have new mines being developed.
- Battery metals demand will continue to grow.
- PV metals the demand will drop off after about 15 years as we are already installing a lot of PV panels.

The biggest drivers in share of demand include batteries for EVs rather than solar and wind technologies, and copper, as it is used a lot in transmission infrastructure. Supply risks show that reserves and production is concentrated in just a few countries, with manufacturing taking place predominantly in China. Some of the supply chain risks and considerations include:

- Production concentration limited to a few countries namely Cobalt (DRC), Tellurim (China) and Rare Earths (China)
- Australia, Chile, DRC and South Africa have the largest production of metals for lithium-ion batteries.
- Japan, Korea, Canada and Russia produce metals for PV.
- China produces metals for both batteries and PV
- 60 % of cobalt production takes place in the DRC, however, most of the processing is happens in China.
- Lithium is extracted in Australia but processed in China
- China dominates the manufacturing for PV and lithium-ion batteries.
- China dominates the supply chain incl. mining, processing and manufacturing, and end-market.

By 2020 almost 50 % of cobalt and lithium have been used for RE, rare earths 32 % and silver 10 % which goes into solar PV production.

Environmental and Socio-economic Impacts

Social and environmental impacts are linked when RE becomes a large share of the demand. Here are some of the known impacts of the RE metals:

- Silver: heavy metal contamination and social conflicts (South America)
- Cobalt: severe health impacts from heavy metals contamination around mining sites, dangerous working conditions and child labour
- Copper: tailing dams failure and health impact on worker
- Lithium: water contamination, water shortage and conflicts with communities in the lithium triangle: Argentina, Bolivia and Chile
- Rare Earths: Difficult to mine and found in low concentrations. Processing requires water and chemicals which produces waste (China, Malaysia, Australia)
- Nickel: mining dust is carcinogenic and associated with several environmental impacts

Industry was consulted and these were some of the findings:

- Industries are very aware of risks of supply availability for key metals
- Their main concerns are around guaranteed long-term supply of key metals and stability of prices, particularly for cobalt and lithium
- Auto manufacturers play a significant role in the metal supply chain. They are looking to secure long-term contracts for raw materials, getting involved with these agreements rather than leaving it to cell manufacturers. It is often the car manufactures that buy the metal and give it to battery manufacturers to produce the batteries for their cars
- Industries are aware of key human rights and environmental impacts, but mainly around cobalt from DRC. Since this report has been released, there is also awareness around lithium. For other metals, the industry does not see the issues
- Concerned about the ability to secure adequate volumes of supply from responsibly sourced mines. One response to reduce environmental and social impacts is to source metals from "low risk" countries such as Australia, Canada and Finland. This however does not imply responsible procurement and to pull out of a country in terms of mining supply impacts on livelihoods of the mining workers in that country.

Three strategies to reduce/ offset demand are recycling, efficiency and substitution. Generally, industries are focused on efficiency and substitution where possible, mainly for economic reasons. Recycling has many challenges. Recycling infrastructure scarce and does not recover all the metals. Industries are proactive with EV batteries with some battery recycling taking place but generally it is only the high value materials such as cobalt and nickel that are being recovered and not lithium.

Solar PV panels are designed to last 30 years out in the sun without breaking down. This is technologically difficult as recycling currently focuses on recycling the glass but not the entire panel. Aluminium and copper are sometimes recovered. Recycling needs policy intervention and economic incentive to happen. If recycling is not done responsibly, there can be huge social and environmental impacts.

Potential for new mining

Under a 100 % RE scenario metal requirements are projected to rise dramatically. New mines already under development linked to RE demand include cobalt, copper, lithium, rare earths and nickel. Short term mining increases are mainly for metals that have only been mined in small quantities previously and where RE is a large share of demand such ass lithium, cobalt and rare earths. Recycling can reduce demand for these metals but there is a time delay created by increase in production, so new mining is likely to take place to meet demands in the short term. Deep sea mining is under exploration with an emerging risk for ecosystems and communities.

At the time of the report, countries where new mining is likely to occur are summarise below, however this list needs updated as the industry is a rapidly changing one:

- Cobalt: Australia, Canada, DRC, Indonesia, US, Panama, Vietnam.
- Nickel: Indonesia, Philippines, Zambia.
- Lithium: Argentina, Australia, Bolivia, Chile, Canada, Mexico, Serbia, US.
- Rare earths: Australia, Canada, Greenland, Malawi, South Africa, Uganda.

In conclusion, the EV and battery industry have the most urgent need to avoid negative impacts through offsetting demand for primary metals and responsible sourcing. Recycling is the most important strategy to reduce demand for battery metals, but new mining is already underway. And, responsible sourcing (respect of the environment and human rights in the supply chain) is essential where supply cannot be met by recycled sources.

7. Gender Equality in the Transition to Renewable Energy

Energy poverty increases the workload on women including the collecting firewood and water. Lack of energy also causes safety and mobility issues. Access to energy is a critical pathway for improving gender equality and social inclusion. There is a growing recognition of the gender-energy-linkages. Improved energy access reduces drudgery, decrease poverty, increase income, and enhance livelihood opportunities. Energy also increases the quality of public services such as water supply, health, education and access to information and communication.

Clean energy*: access to universal electrification is essential but clean cooking energy is still required*

According to Mini Govindan and Rashmi Murali of The Energy and Resources Institute (TERI), social and gender inclusion in the energy transition needs to be translated at the ground level. Examination of policies in Kenya and India will help us understand better how gender is addressed, the gaps, and how this has impacted on communities at the ground level. There are some good practices and some missed opportunities for gender inclusion in the energy policy arena.

Well-structured energy systems need to align to SDGs 5 and 7, that is, gender equality: achieve gender equality and empower all women and girls (SDG 5) and affordable and Clean Energy: ensure access to affordable, reliable, sustainable energy for all (SDG7).

Some of the gaps include:

- lack of access to energy such as conducting household chores without adequate light,
- safety issues related to insufficient lighting,
- lighting in public spaces, mobility and gender equality and social inclusion in energy planning

- Improved energy systems can be life-enhancing, reducing drudgery, ensuring better public services and should include access to information and education

Key challenges include:

- lack of understanding, limited acknowledgement and misplaced priorities
- lack of significant empirical evidence/studies to highlight the merit of gender in energy policies
- Supply driven, top-down approaches do not meet the specific needs of women and the vulnerable in society
- women need to be included in the planning process and prioritized in the field
- context and differences in recognition at policy level and advanced technologies
- large-centralised projects have very limited scope on involving women in the process. Consulting women is not prioritised so decision-making favours men.

Some examples of good practice include:

- TIDE initiative: developing a smokeless cook-stove. Does not look at women as end users only, but rather women were trained as cook stove builders to provide a livelihood opportunity. Women at village level were given priority, received training to build cook stoves, marketing and mobilising other women. This initiative has benefitted women both as end user and those in the supply value chain.
- Line women of Mahavitaran: a state government led initiative introduced a 30% reservation for women in technical jobs, including training women in technical jobs and maintenance. Women were trained to be technicians. This is the only state in India that has introduced women to the same training as men. 2000 women have been trained since 2013.
- JEEViKA – TERI initiative: targeted women as beneficiaries of solar home systems. The systems were registered in the names of women and they are the custodians. JEEViKA also trained women as technicians to take care of the systems, which was difficult to overcome as it was culturally not accepted for women to do this work.

Translating policy into practice mechanism to monitor implementation, investment, track progress on gendered targets. It is important to document opportunities and challenges and formalise processes to feed the inf back to the policy making. The RE sector gives more employment compared to the traditional sector. It also gives more scope for women all over the world, particularly the solar sector.

8. Discussions and knowledge gaps

The seminar series was finalized with a joint workshop, to capture key insights form the seminars and how these relate to our respective national contexts. Topics of relevance to explore further together were also discussed.

These are the key insights:

Timely and inclusive planning

All transition processes need to be **planned in advance**, with concrete deadlines. The planning needs to be an inclusive process where all stakeholders can sit at one table.

Planning for a successful just energy transition needs to include not provision of energy, rather also estimate need for energy and the resources needed, e.g. minerals, or the energy producing, storing and transfer technologies.

Involvement of communities is key to a successful transition. At the same time, there needs to be sound national legislation to enable REs development at the local level. Holistic perspective is required but often ignored (see the point above). A circular economy can be a critical driver to push transition, but it must ensure **social inclusion** and **gender aspects** to be just.

Inclusion of labour from the regions where fossil fuels are extracted is important. There needs to be a positive **message about JT,** but at the same time to be honest that it will not cover everyone. Some people will be negatively affected, although in the end the transition will be beneficial to society at large. Many workers in fossil fuel industries see their work as very dangerous to their health and the global climate and want to do something else but see no other options to support themselves. To offer re-skilling is important. There is a lack of pilot projects where people can go and see that change has happened and that it is possible.

Transformation to a circular economy

If governments have interests in extraction of fossil fuels, it is hard to get an ambitious energy transformation plan. **Harmful subsidies should be removed**. 45% of greenhouse gas emissions from production of products. We need to **transform the economy**, not just energy production itself, into a resource efficient, such as circular. This transformation needs careful consideration of the socio-economic context to make it inclusive and just. A lot of people see a just transition as a transition from fossil fuels to renewables. However, we need to include the perspectives of resource efficiency and circular economy in the just transition. A lot of components are not recyclable and new metals are required. How do we make the most of our resources and make them last as long as possible, while meeting social needs and creating jobs?

Just energy transitions require **energy efficiency measures.** Installing just REs capacities does not cut energy needs, you need to lower the consumption as well. We need to highlight more that **recycling of limited metals and other materials is good, but it is not enough** and raise awareness on the need to limit consumption. What products/consumption do we need and what should we prioritise using our energy for? In the end the metals needed in the transition/after the transition are finite resources. **Resource efficiency** is key in combination with lower consumption.

There is an **unequal distribution of resources and metals**. How unequal is it going to be in the future? How are people going to use the resources? China currently has the most resources and rare metals, and production capacify, necessary for many RE technologies. If we compare to those countries that had a lot of oil, that story is repeating itself today but with other actors with resources relevant to RE technologies.

Can **leasing metals** be a way forward? But metals will then be concentrated to a few suppliers, so how do we deal with this? Also how do we capture the metals in recycling, do all countries have the technology for that and the infrastructure? For example, India has a lot of e-waste but has to ship it to Australia for some recycling operations. This can become a bottle-neck for some countries that does not have sufficient technology in place

How do we secure national stocks of critical /limited materials when there is lack of technology/know how to recycle them? **Knowledge transfer** from those who have the technology/know how must increase.

Discussions took place after each of the sessions with Q and A sessions. Some key issues raised and areas of concern that may still require in depth understand or more research include:

- Impact of Covid-19 and the economic recovery on the energy sector and increasing inequality
- Is the JT a way for post-Covid recovery? Opportunities to speed up/hinder the process
- Is labour supportive of a JT with more engagement and dialogue?
- Coordination of various government departments and Ministries without the planning commission (since 2007) and new draft energy policy (2017) in making coherent energy decisions that include the poor
- Addressing issues raised by installation of PV including privatised energy, high tariffs and subsidies
- Cost of installation, financing and affordability including rural and urban cooperatives for the poor.
- Covering the cost of maintenance, repair, replacement, theft and damage
- Prevention of theft through community ownership and installation of GPS chips
- National grids vs micrograids (advantages and disadvantages)
- Standardisation of grid parts (local standards) and panels (international standards)
- Overcoming challenges of just transition in coal towns including relocations and rehabilitation of closed mines
- Recycling capacities of countries, especially developing
- Recycling processes for the informal sector that are considerate of hazardous materials handling
- Life cycle analysis of different transitions
- Policies that eliminate hazardous and toxic materials from the RE production lifecycle
- Understanding the difference in benefits to women from traditional energy sources compared with RE
- The question of financing the transition is huge. Countries still have subsidies in fossil and nuclear and does not develop funds for energy efficiency measures. Maybe we can look at how different countries finance their JETs? Look at systems for redirect funds from fossil industry to renewables and energy efficiency.
- International support? Reps from different countries from JET help in the local (national) advocacy. What are our strong points, as individual CSOs and as a group? Where can we build pressure and affect change? How to build movements and a larger community to push for just transitions?

9. Way Forward

This partner exchange explored many arenas of the JET from looking at deeply entrenched and subsidised fossil fuel energy systems, the growth of RE and implications for responsible resource management and the transformation from a linear to a circular economy, the consideration of socio-economic and environmental impacts, and obstacles to not only providing safe affordable energy to all communities, particularly women and the informal sectors of our society, but also their inclusion in decision making within the just transition.

A few concrete ideas on the way forward in the JET exchange project were discussed:

- Share good examples from our own contexts. For instance, Ukraine has good examples on local level in Donetsk region on how municipalities and local NGOs unite for sustainable development. Municipalities go to the national level and local mayors have become part of the process.
- Work jointly with experts/consultants to identify key elements of a just transition in the context of a circular economy. For example, considerations in legislation for product development, recycling and re-skilling the work force. Contexts may differ, but the basic elements could be general.
- Building international support for JETs. Jointly influence national levels in all our countries, after the covid-19 pandemic, organise visits to the different countries and have meetings and discussion with the national bodies/ministries. If we would be a delegation from our countries it would be quite an event and we could push our agendas together.

We will continue these discussions with inputs from participants into 2021 which will inform the more detailed topic on the just transition within a circular economy for the next session. This is part of a four-year process, at the end of which we hope to formulate a set of general and concrete suggestions for actions for the various stakeholders, taking into account the different needs and perspectives from communities/contexts in different countries.

APPENDICES

Appendix A: Virtual seminars program (11 Aug-29 Sept 2020) and readings

JET Exchange 2020 - Virtual seminars: Focus: Indian energy sector
Dates: Weekly, Tuesdays from 11th of August to 29th of September 2020
Time: Brazil 08:00-9:30, South Africa and Sweden 13:00-14:30, Ukraine 14:00-15:30, India 16:30-18:00, China 19:00-20:30
Zoom link: https://us02web.zoom.us/j/83397511822?pwd=TW1EYnNuZzYreDllOEcwK21BdVBsZz09

Date	Seminar topic	Speaker/organisation
25 Aug	**The Electricity Context in India** In the last decade India has made major progress in its development towards universal electricity access reaching an additional 500 million people and in the last years the share of RE in the energy mix has risen sharply. In 2018 the government of India declared that the goal of electrifying every village was declared to be reached and today the government has set an ambitious target of 175 GW of RE by 2022. An energy transition, driven by falling prices of RE, is underway in India. But is it a just transition? 64 million people are still without access to electricity and the increasing share of RE does not necessarily imply that India will stop depending on coal soon enough. This session will cover an introduction to the Indian electricity sector, the evolution of the energy mix and provide a brief overview of the social and human rights aspects that need to be considered in the promotion of a just transition in India.	Joe Athialy, Centre for Financial Accountability and Soumya Dutta, Energy Expert and Advisor
1 Sept	**Community driven RE solutions** Gram Orja, a social enterprise based in Pune India, has provided over 200 rural communities with RE. A presentation of their experience of key success factors for sustainable community driven RE solutions: Community interaction, design for aspirations, metering for every user, tariff structure and ownership transfer. **Readings:** the Sustainability of community owned mini-grids: evidence from India **Additional Resources:** Video: Eco India How a solar micro-grid illuminated an unelectrified rural hamlet in Maharastra	Anshuman Lath and Prasad Kulkarni, Gram Oorja
8 Sept	**Strategies for a just transition** The IISD has outlined a methodology for governments to make sure energy transitions are just and will briefly present the steps in this "how to for just transitions". With India as an example IISD will walk us through the steps in the methodology with understanding the context, making the case for a JET and acting early are important aspects. In the previous session we increased our understanding on the electricity sector and transition in India and the IISD will provide us with further understanding of what role stranded coal assets and energy subsidies are playing. And also how supporting workers and communities needs to be at the centre of a just transition process. **Readings**: Real People, Real Change - Strategies for Just Energy Transitions and India's Energy Transition - Stranded coal power assets, workers and energy subsidies **Additional resources:** https://www.iisd.org/publications/beyond-fossil-fuels-brics https://www.energypolicytracker.org/	Balasubramanian Viswanathan, Chris Beaton and Philip Gass, International Institute for Sustainable Development

	https://www.iisd.org/publications/mapping-indias-energy-subsidies-2020-fossil-fuels-renewables-and-electric-vehicles https://www.iisd.org/publications/indias-energy-transition-cost-meeting-air-pollution-standards	
15 Sept	**Circular economy and infrastructure for RE** Understanding a circular economy. What policy measures need to be in place to regulate all foreseeable aspects, from production to waste management of RE? Updates from emerging reports on the end of life of renewables and possibilities for policy inclusion. What learnings can we draw from the current zero-waste work in India that could be drawn on in the policies for RE waste? What are the social aspects of a circular economy?	Dr. Dieter Mutz, GIZ and Satish Sinha, Toxics Link
22 Sept	**Responsible Mineral Sourcing for RE** RE and battery storage require high volumes of environmentally sensitive materials. The Institute for Sustainable Futures presents the findings of an assessment of the projected mineral demand for fourteen metals used in renewable energy and storage technologies, the potential to reduce demand through efficiency and recycling, and the associated supply risks and impacts. This research aims to identify the main 'hotspots' or areas of concern in the supply chain, including technologies, metals and locations, where opportunities to reduce demand and influence responsible sourcing initiatives will be most needed. **Reading:** Responsible Mineral Sourcing for Renewable Energy	Elsa Dominish, Institute for Sustainable Futures, University of Technology Sydney, Australia
29 Sept	**Gender equality in the transition to RE** Energy poverty or lacking energy access, an aspect of broader economic poverty, disproportionately affects women and girls. If energy policies are gender blind, no matter where in the world women's energy needs and participation will not be met. Much analysis is still needed to ensure current and future transition policies actually meet equity goals. How do we ensure they will not reinforce existing inequalities such as under-representation of women energy access, governance and employment? How do we go from evidence to inclusive policies? **Reading:** Gender in the transition to renewable energy for all **Additional resources:** https://www.energia.org/cm2/wp-content/uploads/2019/04/Gender-in-the-transition-to-sustainable-energy-for-all_-From-evidence-to-inclusive-policies_FINAL.pdf https://www.energia.org/research/gender-energy-research-programme/research-area-1-electrification-through-grid-and-decentralised-systems/	Mini Govindan and Rashmi Murali, the Energy and Resources Institute (TERI)

Appendix B: Responsible Mineral Resourcing for RE: Q&A and discussion

Q&A/Discussion

Are new mines being proposed in our respective countries with RE as the main given reason?

South Africa: Mining of graphite, lithium, nickel, cobalt and copper. Predominantly nickel, copper and cobalt (mainly for the export market). Emergence of palladium. The RE metals are currently being explored in South Africa so we may see new mines.

India: Issues regarding recycling, especially for the PV cells, the country is struggling to learn more about what the recycling options are. We have started to see PV going into the waste stream but we have no technology to look at the recycling options. Batteries are also coming in, in great numbers. Both these areas are of concern form India. We need cross-learnings from other countries.

Sweden: Most of our mining is done in the northern part of Sweden where the population is less and also this is where the indigenous people of Sweden (Sapmi people) live. Now there are projects, especially for rare earths, also coming up in the South of Sweden. Some are advertised as being part of the solution of a renewable energy future. There is a contagious mining project in the North where the indigenous people are protesting since a long time back.

How will pricing be affected when there is a rush to buy these metals?

With cobalt and lithium, the markets have been extremely volatile. A challenge in the mismatch between supply and demand. Often with mining this is the case. But in this case, there is a huge increase in the demand for these metals compared to what has been mined in the past. A lot of companies have been going bankrupt, mines have stopped and started… Prices are starting to stabilise. It has been a challenge for the industry that the prices have not been stable so far. The industry is getting around this by having very long-term agreements. The car manufacturers have a tolling (?) contract where they set up a direct contract with the mine to buy a set amount per year. Don't know how the prices will end up but will probably stabilise eventually.

Which parts of the industry is it that you have interviewed in the report?

EV manufacturers – the part about the industry is mainly on the consumer brands and this is because they have the pressure from their customers. A big challenge for the middle players in the industry, like the processer, they have a lot less transparency on where the product is coming from and where it is going. They are less interested in these issues as they are not a household brand compared to for example Tesla and BMW. The electronics industry has been quite proactive. They have already had all these issue before EV became a big thing.

Is nanotechnology a driver for using less material and how does that affect the potential to recycle?

What kind of metal can be responsible recycled in low- and middle-income countries? Is there a potential for creating a recycling industry around for example solar PV? Any components that can be responsible recycled.

Designing for recycling is important and this is an issue with batteries are they are so complex and different to each other (same with PV). Different chemicals in them etc which makes it difficult for a third party to recycle. Major companies like Tesla does not want other parties involved as they want to keep their technology within their company.

None of the RE technologies can be easily recycled, for example like plastics which can be recycled by the informal sector. Because of the complexities of e-waste it need to be a reasonably high-tech set up in order to be done responsibly. It can be done in a low-income country but needs to be done at a larger scale, probably in a more formalised set up.

Batteries and PV is emerging – lessons from other countries?

Even in Australia only a small portion of lithium-ion batteries are recycled. The other aspect is the economy of scale. To set something like that up… We did a study looking at how large a solar recycling plant would need to be in Australia and we came to the conclusion that we would only need one or two for the whole country in order for it to be profitable. Recycling is very challenging. More important in the short term is designing things that will last, looking at reuse option and use the technology as much as possible in its current life. For example, an EV battery might be in a garage for 90 % of the time when that battery could be used the rest of that time for storage in the home. This is what the policy makers should be focusing on for the end market.

The recycling processes we are looking at now – how developed are they? Can it develop? Who has the money to build that capacity?

In terms of recycling for lithium-ion batteries – there are some key processes done in a generic recycling process recovering some key metals. But the system is not optimised. Elsa is doing a review of this at the moment and can share with us once it is finished.

Info on economics of recycling? Does it become viable for a low/middle income country to recycle?

Elsa has a couple of studies. Very dependent of policies. Generally, lithium-ion battery recycling is profitable but only if you are capturing the valuable metals (cobalt and nickel). It does not make financial sense to recover the lithium, which we should be doing. For PV it is not economic to recycle because it is so difficult to separate the components of a PV panel. The aluminium frame is valuable and easy to separate but the rest is difficult. Elsa has a good study on this.

Is it possible to make the construction of a PV panel so simple that it can be recycled? Can we make efficient solar PV that are recyclable?

Don't know but a brilliant idea. For batteries there is interesting work going on in terms of looking at the replacement of cells in batteries (so if one cell breaks you only replace that one and not the whole battery). Design for recycling is a really important strategy (not sure how it works for PV).

Heard from recyclers that it does not make sense to recycle lithium-ion batteries because there is no factory in the country (India)? If there is a manufacturing facility – would this change the economics of recycling?

There are not many recycling processes that are available that can use the content from the recycling to create new batteries. But it is challenging if there is no end market. If no one wants to buy recycled lithium, weather a battery manufacturer or some other industry, then it is hard to justify setting up a recycling system. It is the same in Australia – even to recycle the PV – the glass has no value so the recyclers are asking what the point is if no one wants to buy it.