



Pro VC: Climate, Sustainability and Inequality Research Roundtables on Renewable Energy

Introduction

In April and June 2023, the Pro VC, Prof Imraan Valodia, hosted two Renewable Energy Research Roundtables. The purpose of the research roundtables was to engage academics at Wits to share existing research in this area and identify gaps and opportunities for interdisciplinary collaboration and new research and innovation.

The first Roundtable was coordinated in partnership with Dr Shehzaad Kauchali and focused on renewable energy and materials. The second Roundtable was focused on the social science perspective on renewable energy. Both roundtables included presentations from academics across Wits faculties as well as discussions about the future research agenda for Wits University on energy, which is a vital area of need in the country.

This report provides an overview of what was presented and discussed as well as the key next steps which have arisen from these roundtables. The process has provided a platform for fruitful interdisciplinary engagement and debate and has spurred interest in key topics of relevance to South Africa at present including the merits and questions around green hydrogen, the challenges of a low-carbon transition in the midst of an electricity supply crisis, and more.

Research Roundtable on Renewable Energy & Materials

Research Inputs

1. Addressing the Energy Supply Crisis in SA through better understanding of its supply chain – Prof Craig Law

The energy supply crisis in South Africa is not about energy availability but about energy supply chains. The crisis is actually an economic crisis because there is no economic growth without energy. The energy supply issues are nuanced and will not be solved by a silver bullet. The country needs to address the combustion issues faced by Eskom - we have significant competence in combustion and combustion technology as well as nuclear technology leadership. The energy mix in South Africa is inadequate, we have to start looking at the regional picture. However, energy sources are only as good as the infrastructure needed to transport it and our gas infrastructure and pipelines are at capacity. The grid faces issues in getting power to where people need it. Current research focuses on renewable energy sources like solar and wind, but we know that production processes for these technologies are energy intensive. We need to understand full supply chains of renewable energy technologies and environmental impacts. Need to assess full supply chain of hydrogen, wind, solar and nuclear. Additionally, research is being conducted on better combustion methods and hydrogen as a fuel for rocket engines and internal combustion engines. However, there is little evidence to support hydrogen as a viable fuel, and transport is a major issue. The process is extremely wasteful. Another area of research is on electric aviation. Future research should explore renewable systems' footprint, sustainable energy systems, fluidized bed combustion, and urban mobility without combustion engines.

2. Innovation in Renewable Energy and Nanomaterials – Prof Nosipho Moloto

Nano-WEBS is a research group which focuses on the Synthesis of Nanomaterials for Water, Energy, Biomedical and Sensor Applications. It is housed within the School of Chemistry, Prof Moloto holds the SARChi Chair in Energy Materials, and collaborates with universities and small and medium enterprises to understand photovoltaic (PV) processes. SA faces challenges in innovation, reliance on coal, and a lack of industry feedback on product issues. The goal is to reduce CO₂ emissions and minimize environmental impact. Solar-driven technologies, including third-generation PVs, and the use of photocatalysis for carbon dioxide reduction into fuels and fine chemicals, green hydrogen generation, and water purification can minimize costs and promote sustainability. Nanomaterials are used to create these technologies. Nano-WEBS focuses on making new and novel nanomaterials. Solar cells are the smallest component of panels, and the goal is to perfect cell properties and find easy ways to produce them. Cheaper materials and cheaper production methods are also explored. The focus is on capturing and reducing carbon into different products, aiming for a carbon-neutral environment through electrolysis and photocatalysis research. These efforts aim to improve efficiency, reduce waste, and create a more sustainable future.

3. Sustainable materials – clean coal technologies – Prof Samson Bada

Coal plays a significant role in various industries, including energy, heat, and industrial processes. Coal is a source of energy for many industries which are vital for renewable energy such as steel and batteries. There is an opportunity to substitute biomass in power plants to reduce carbon emissions. There are examples of clean power plants Samcheok and Rotterdam. Biomass fuels like bamboo, rubber, plastic waste, and wood shavings hold potential. Coal waste can also be used for natural gas storage, light bulbs, and hydrogen storage. In conclusion, coal has a long-term role to play and can be reinvented in applications beyond combustion. This presents an opportunity to build a robust local value chain and develop new skills. Fossil fuel phase-out is unlikely, as European countries continue to burn coal and there are no 100% renewable energy grids in the world. Renewables require more resources, and more renewables use more carbon.

4. Climate change policies – Prof Dambala Gelo Kutela

Climate change is a pressing issue, with key questions about its adverse impacts, policy instruments, and the potential of technological change to save the world. Carbon emissions are a negative externality, and solutions include regulation or charging for emissions. However, charging policies are complex and require prioritization. In South Africa, vehicle CO₂ tax is being used, and the PCC has drafted a framework for achieving the Just Transition. The banking sector and industry are responding to the climate transition and have reduced investments in fossil fuels. The energy ladder hypothesis suggests that economic growth shifts households towards cleaner fuels, with an increase in income increasing consumption of electricity and reducing biomass consumption. However, there was limited evidence of causality in the energy ladder hypothesis. A recent study using the old age pension and use of energy sources proved a causal link between income and a shift towards electricity, although the findings show that other energy sources also increased.

To further understand the issues with climate inaction and behaviour change, they ran a field experiment in five countries with 7,132 respondents to study how information about the behaviour of others affects contributions to climate change mitigation. The results found interesting links between individual's behaviour as linked to their perceptions of the the behaviour of others. In terms of future areas of research, Africa needs to shift from selling coal to exploring rare earth resources and embracing opportunities that exist in the energy transition.

Discussion on the future research agenda on renewable energy and sustainable materials

Gaps in research:

- Feasibility of 'green' hydrogen
- Political economy of 'green' hydrogen



- Vanadium batteries
- Transition, systems, structures, and broader structural change
- Renewable energy models, including micro-hydro, solar power, and tidal energy

Opportunities:

- Review all renewable research published at Wits and where gaps exist
- Identify funding for research on renewable energy
- A body which coordinates research on hydrogen
- The DVC research team is considering a green innovation space within the university's innovation center.
- The Wits Sustainability Committee has developed a Sustainability Strategy document to promote sustainability on campus. This will go to senate in August.
- Prof Lesley Cornish has funding available for work on capacity building in energy, nanotechnology and materials.

Next steps: Hold a second roundtable on the social science perspective

Research Roundtable on Renewable Energy – Perspectives from the Social Sciences held on 19 June 2023

Research Inputs

1. SA's Just Energy Transition – the Role of Renewables – Dr. Kenneth Creamer

The current electricity crisis can be attributed to various issues over the past 20 years to increase capacity and maintain the existing coal power plants. We now face the additional issue of an out of date transmission system which must urgently be upgraded to support additional capacity. The government's Energy Action Plan aims to address the crisis through various mechanisms such as financing for power plant maintenance, incentives for households to invest in solar power, etc. There has been an increase in power generation since energy production was deregulated, allowing businesses, firms, households, farms, and factories to produce their own electricity. The government has established that it will assume Eskom's debt in exchange for a restructuring that includes unbundling and permitting more producers. A key constraint to solve the crisis is grid capacity. If we want to reach areas with greater wind and solar potential, we will need to build around 14,000 km of new transmission lines which will cost about R225 billion. The just energy transition must support alternative pathways and livelihoods for coal workers, industries and communities. There are opportunities in the renewable energy supply chain which must be leveraged.

2. Policy for Renewable Energy - Prof Roderick Crompton

Most people are aware of the declining costs of renewable technology. The little increase over the previous year may be related to China's decision to discontinue providing RE subsidies to the rest of the globe. Small island governments are the only nations that have a completely renewable energy supply, and even then, renewables can only be used in conjunction with a variety of other technologies that must act as a backup during the night or when there is no wind. Prof. Crompton highlights that there must always be a balance between electricity supply and demand. A market disequilibrium suggests that we require resources like spinning reserves, storage capacity, or quick response technology that can react such that the whole system does not collapse. In comparison to fossil fuels, renewable energy sources have low-capacity factors. They require a lot of land, mineral resources and have significant environmental repercussions. In addition, the mineral resources needed for renewable energy sources have a variety of geopolitical implications and supply chain concerns. We need to improve the renewable options we have available at present through technology development. We should also be looking at



demand side management and energy efficiency. Some ideas for new research areas include: 1) Assessing both the levelized cost of energy and the full cost of energy which includes inputs and recycling, 2) Assessing the subsidies and incentives available to fossil fuels and renewable technologies, 3) Assess renewable energy technology environmental impacts, 4) A critical analysis of the potential for green hydrogen in SA, 5) Developing industrial policy which allows for electricity affordability.

3. Renewable energy, the just transition, and inequality: insights from South Africa's renewables procurement – Julia Taylor

This presentation discusses the role of the state in the energy transition and what it means for social development goals. Because it is the biggest carbon emitter in Africa, SA made a commitment to net zero. Coal supply chains employ a lot of people who are going to be affected by the transition, and we face an unemployment crisis. Social justice is frequently left out of South Africa's energy transformation. The just transition must address both the unemployment crisis and energy poverty. We are not able to transition until we have enough electricity to meet basic needs. The state must take on an investment-centred role in the transition, directing investment and ensuring proper planning of the transition. The REIPPPP may have been successful in procuring renewable energy at competitive rates, but it did not support local industrialisation. Local content requirements were the main tool for localisation and they did not work. Other industrial policy tools are required as well as a revision of all industrial policy to support sustainable development. The state must implement industrial policy which is conditional on performance and must adapt and respond to changing contexts. We cannot continue to subsidise fossil fuels if we are committed to a transition, and we cannot let the burden of the cost of the transition fall onto low and middle income households – users of electricity which will be the case with cost-reflective tariffs.

4. Presentation on Wits Research on Energy – Dr. Robin Drennan Research Office: Social Aspects of RE at Wits

Dr. Robin Drennan presents the findings of Wits' research on RE from a social perspective. Using the SDG7- Affordable and clean energy, he assessed Wits' publications in this area. He found 251 703 publications, 124 from WITS, and just 9 for RE in SCOPUS results. Despite having a lot of major citations, Wits does not cover much social science on the Web of Science. In publications, UJ consistently places first, followed by Wits in second place, and NWU in third. We are not the top performer in terms of publications, but the publications we do have are doing well in terms of citations. We need to choose the area we want to occupy.

5. Proposal for Wits research on renewable energy – Prof Dean Brady

From participating in the research roundtables, there is a lot of interlinked information from different viewpoints. There are numerous things that we are unaware of and can learn from each other. There is an opportunity to compile a pamphlet on every option for energy generation and its advantages and disadvantages – this will improve our understanding of the options. We could also take on a project where we aim to cost various options and identify the best energy mix in a certain scenario – for example Wits campus electricity or the City of Joburg.

Discussion

All the presentations have led to the same conclusion: the current energy system is insufficient and we need new ideas and evidence based research to support informed decision-making. This is where the university must play an important role. Some key questions have been raised:

- What is effective and ineffective? According to the first RE roundtable, the widespread excitement surrounding green hydrogen is ineffective from a purely technological standpoint.
- The majority of the statistics that were presented are global data – we need more local data.
- Subsidies brought in about \$400 billion from the US. Given the inflation in the US, this is an issue. We may examine how this will affect the economy.



- How is the transformation being shaped by geopolitics? SA has embarked on load-shedding solutions, which are short-term. The University can look at the medium- and long-term plans.
- Finding models to enforce and strengthen local government.

Suggestions

- The university is open to a variety of strategic energy fields, not just RE. Additionally, we must enforce teamwork while concentrating on material and industrial science.
- Obtain funding to pique the curiosity of academics.
- Wits' research agenda is multidisciplinary. There must be an evidence-based study on the JET that includes input from all faculties.
- Wits should conduct more action research rather than examining publications and citations.
- It is feasible to have a conversation about local municipalities at the city level. Because everyone is striving for a solution in numerous directions, from public transport to the smart world, etc., we have an opportunity to get involved at the City of Joburg or Gauteng level.
- Coalesce on an energy framework, examples. E.g. Using university residences or transport.

Next steps:

- Could we develop a community of practice to support local policy in the City of Joburg?
 - Link research with policy
 - Find out if faculty Deans recommend including other academics.
 - Identify people within CoJ who may be interested in a joint collaboration with Wits to address loadshedding in the municipality.
 - Set up a policy breakfast with COJ and Wits colleagues to think about a joint project.
- What evidence do we have and what don't we know about this transition?
 - Could we put together in a publication like Curiosity a list of key facts about energy transition and outline the key unknowns and the risks associated with that.
- Create a short document on the two renewable energy roundtable discussions and take the proposals to the SET retreat in September.