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**UNCTAD-DSI HYBRID REGIONAL WORKSHOP ON  
TECHNOLOGY ASSESSMENT IN THE ENERGY  
AND AGRICULTURAL SECTORS IN AFRICA**

**ENERGY SECTOR**

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## BACKGROUND INFORMATION

- ▶ The presentation highlights TA into sustainable development in Energy Sector under the Department of Science and Innovation (DSI) of South Africa under the UNCTAD Pilot Project on Technology Assessment (TA) in Africa in the two sectors: Agriculture and Energy.
- ▶ The Department of Mineral Resources and Energy (DMRE) is mandated to ensure the transparent and efficient regulation of South Africa's mineral resources and minerals industry and the safe and sustainable energy provision supporting socio-economic development.
- ▶ The South African energy sector is dominated by coal, which is plentiful, cheap, and ranked among the world's lowest energy costs. Other sources include biomass, such as wood and dung, natural gas, hydropower, nuclear power, solar power, and wind.
- ▶ According to the Ministry of Mineral Resources and Energy, South Africa's total domestic electricity generation capacity is 58,618 MW from all sources. Coal is by far the primary energy source for South Africa, comprising around 78 % of the country's energy mix.

## SOURCE OF ENERGY AND INSTALLED CAPACITY IN RSA

Source of Energy	Installed Capacity	Percentage
Coal	45,618 MW	78%
Open Cycle Gas Turbines (OCGT)	3,449 MW	5.9%
Wind	3,322 MW	5.7%
Hydropower	2,290 MW	3.9%
Solar	2,214 MW	3.6%
Nuclear	1,860 MW	3.2%
<b>Total</b>	<b>58,753 MW</b>	

**Source:** South African Power Grid 2022

## **RSA CRITICAL ENERGY POLICIES AND LEGISLATIONS**

<b>No</b>	<b>Policy and Legislation</b>
1	Petroleum Products Act, 1977.
2	White Paper on the Energy Policy, December 1998.
3	Nuclear Energy Act, 1999.
4	The Gas Act, 2001
5	White Paper on Renewable Energy, November 2003.
6	Nuclear Energy Policy, October 2008.
7	Integrated Resource Plan (IRP) 2010 - 30.
8	National Energy Act, 2008.

**Source: The South African Energy Report 2021, Pretoria.**

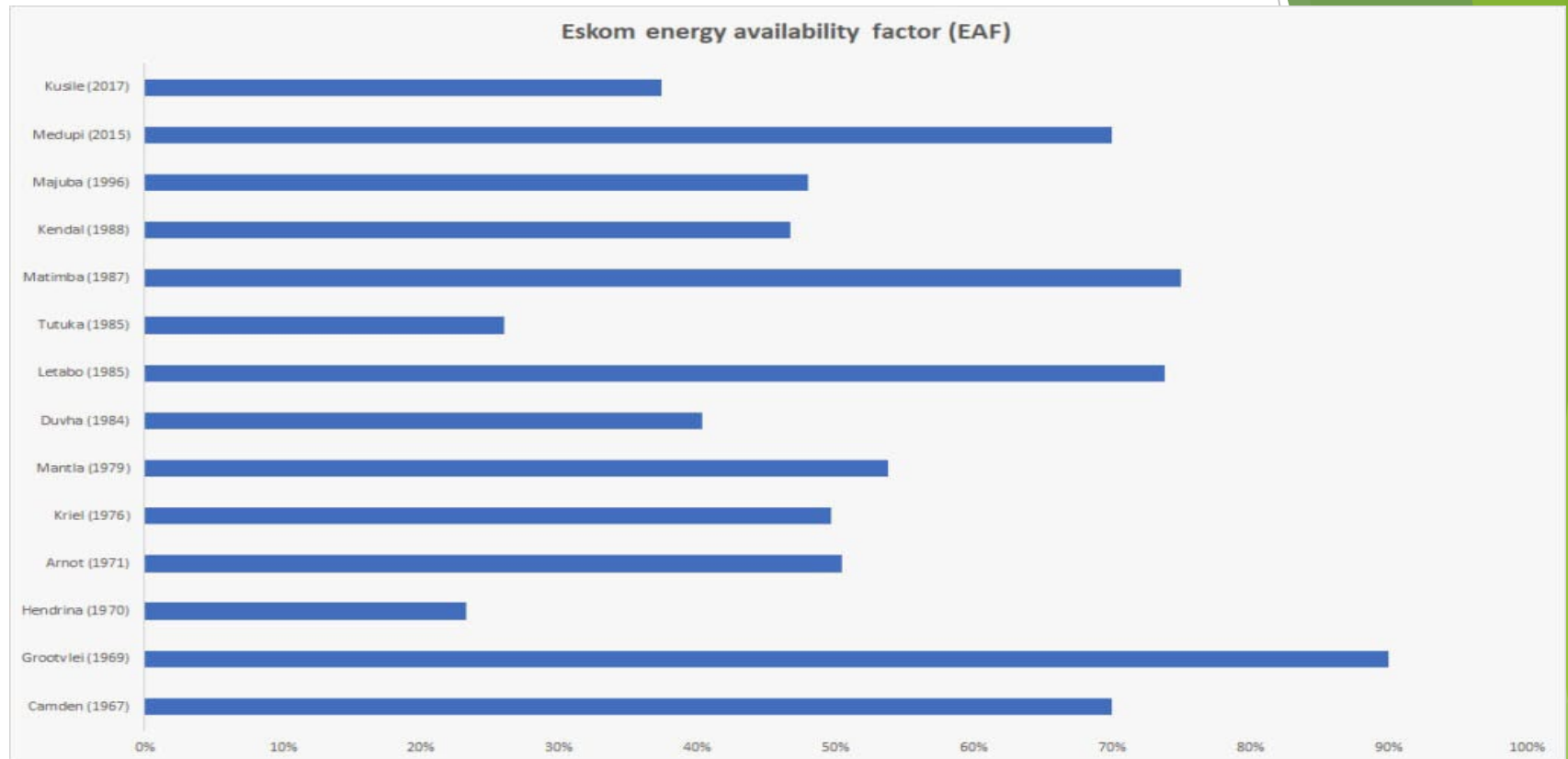
## ENERGY DEMAND

- ▶ The Government's Integrated Resource Plan (IRP), gazetted in 2019, states that South Africa needs 78GW of energy capacity by 2030.
- ▶ The power utility's (ESKPM) generation capacity is 28.8GW while the total market is 29.4GW – moving the country into load shedding.
- ▶ By 2050, 12 plants will be offline, pulling 33GW off the grid. Even if ESKOM miraculously got MEDUPI and KUSILE fully operating and extended the KOEBERG nuclear plant's life, South Africa will still need 50GW to 60GW of new power-generating capacity to be built over the next eight to 12 years.
- ▶ South Africa must spend close to R1.2 trillion by 2030 to ensure it has enough generation, transmission and distribution capacity to meet the demand.

# ENERGY CRISIS IN SOUTH AFRICA

- ▶ The Government's Integrated Resource Plan (IRP), gazette in 2019, states that South Africa needs 78GW of energy capacity by 2030 – but the sheer estimated costs involved, coupled with the underwhelming progress of government projects, suggests a bleak future for the country.
- ▶ Other renewable energy technologies like geothermal and tidal power generation work in select localities that are not common in South Africa. This leaves wind and solar. These sources currently comprise about 8% of South Africa's energy mix.
- ▶ South Africa has 'incredible' potential to become a global economic force in renewable energy. It should factor in the enormous economic opportunities, especially for exports, when calculating how much it needs to finance its just energy transition.
- ▶ Renewable energy systems are costly to implement initially but provide high economic returns in the long run. The two main barriers accompanying renewable energy in South Africa are the energy innovation system and the high cost of renewable energy technologies.

# ENERGY AVAILABILITY FACTOR (EAF)

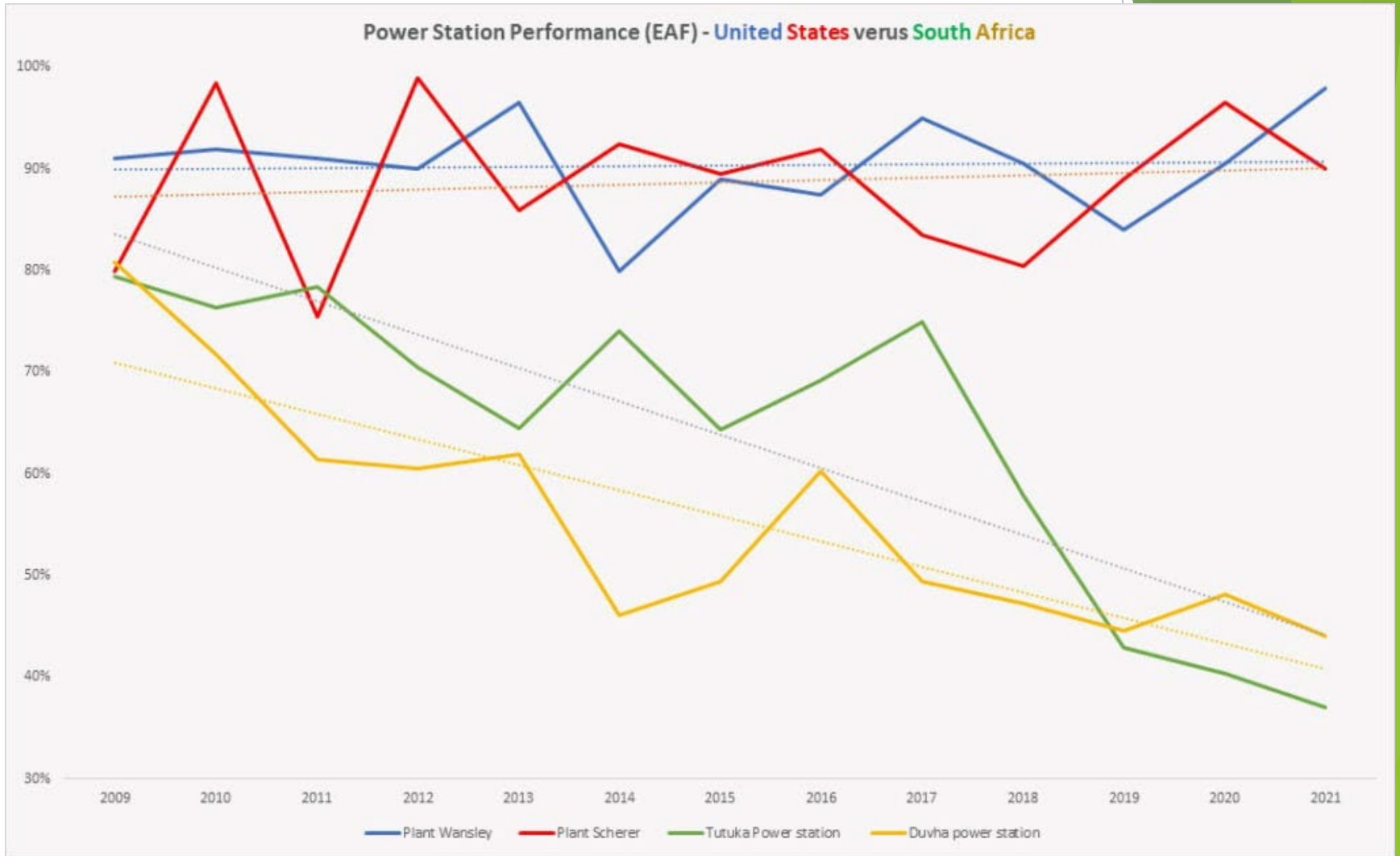


Source: Daily Investor 2023.

Kusile 2017	Medupi 2015	Majumba 1996	Kend al 1999	Mati mba 1987	Tutuka 1985	Duvha 1984	Matla 1979	Kriel 1976	Arno † 1971
Hendrin a 1970	Grootvl ei 1969	Camden 1967							



# POWER STATION PERFORMANCE (EAF) -SOUTH AFRICA VERSUS THE UNITED STATES



## **ANALYSIS: POWER STATIONS PERFORMANCE**

- ▶ The Daily Investor also compared the performance of ESKOM's TUTUKA and DUVHA power stations with two US-based coal power stations – WANSLEY and SCHERER. These power stations are roughly the same age.
- ▶ If ESKOM's claim of ageing infrastructure causing a significant deterioration in performance is valid, the US and South African power stations should show similar trends.
- ▶ From 2009 to 2021, ESKOM's TUTUKA and DUVHA had an average EAF of 64% and 56%, respectively. It means that since 2009 they were only available for 64% and 56% of the time they were needed.
- ▶ In 2021, TUTUKA and DUVHA had average EAF of 37% and 44%, respectively. It is expected to be much worse in 2022. WANSLEY and SCHERER, in comparison, had an average EAF of 90% and 89%, respectively, over the same period. Therefore, they were available 90% and 89% of the time they were needed.
- ▶ The significant differential suggests that ageing infrastructure can still be reliable. With regular maintenance and using the latest technology, their performance can even improve.

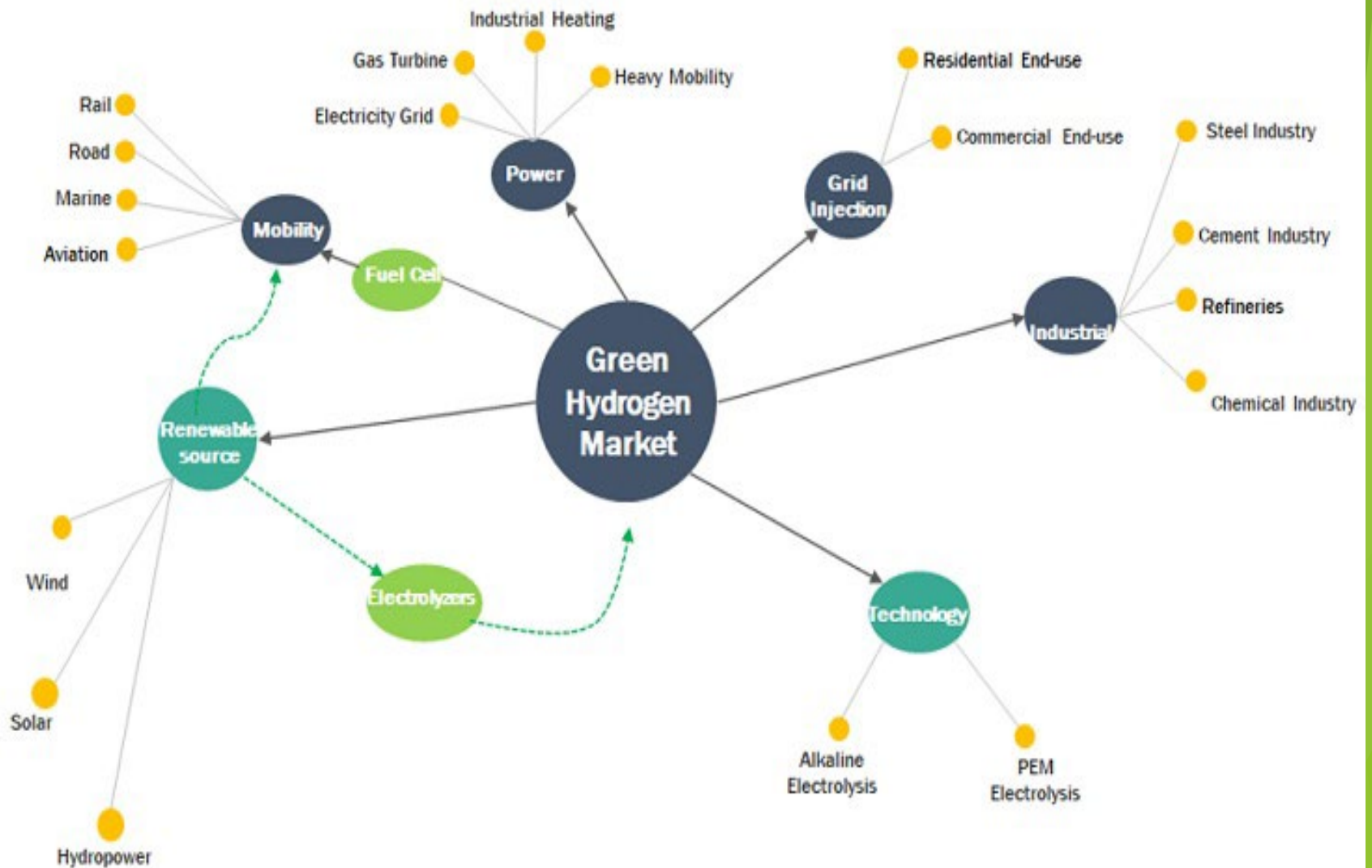
## MEASURES ON A JUST TRANSITION

- ▶ The World Bank granted Eskom R9.0 billion or US\$497 million to Komati coal-fired power station closed on 31 October 2022, to decommission and repurpose using renewables and batteries after serving South Africa since 1961. Costs to complete similar projects at the Camden, Grootvlei, and Hendrina power stations total \$2.6 billion (R44 billion).
- ▶ The project will also create opportunities for the affected workers and communities. This aligns with the government's efforts to transition the country toward a low-carbon development path with reliable, affordable, and sustainable energy.
- ▶ It is estimated that repurposing Komati with 150MW of solar and 70MW of wind will cost about R6.5-billion and produce 492 gigawatt hours of energy annually.
- ▶ The World Bank's Komati project loan is separate from the \$8.5-billion (about R155.45-billion) committed by the Just Energy Transition Partnership comprising the United Kingdom, United States, Germany, France and the European Union.
- ▶ South Africa will require about R1.5-trillion (\$ 84 billion) over the next five years to meet targets in transitioning from coal to renewable energy. The Presidential Climate Commission, citing the country's climate investment plan

## GREEN HYDROGEN MARKET & INVESTMENT

- ▶ The global green hydrogen market size was valued at US\$676 million in 2022 and is projected to reach US\$7,314 million by 2027, growing at a cagr61.0% from 2022 to 2027. The market's growth is attributed to the lowering cost of production of renewable energy by all sources, the development of electrolysis technologies and high demand from FCEVs and the power industry.
- ▶ South Africa has already implemented policies to nurture the hydrogen economy and catalyse the H2 Valley across the value chain. South Africa has a national ambition to become a hydrogen exporter but must prepare for competition at the international level.
- ▶ The South African government's Department of Science and Innovation (DSI ), in partnership with Anglo-American, Bambili Energy and ENGIE, are looking into opportunities to transform the Bushveld complex and larger region around Johannesburg, Mogalakwena and Durban into a Hydrogen Valley. Three catalytic green hydrogen hubs have been identified in South Africa's Hydrogen Valley.

# GREEN HYDROGEN MARKET ECOSYSTEM



## UNCTAD/DSI TECHNOLOGY ASSESSMENT FOR ENERGY SECTOR

- ▶ In 2021, the Department of Science and Innovation (DSI) of South Africa published the Hydrogen Society Roadmap (HSRM).
- ▶ The government's strategies and policy direction are aimed at bringing together a variety of stakeholders and institutions - both public and private around a shared vision of how to use and deploy hydrogen and hydrogen-related technologies as part of South African economic development and greening objectives.
- ▶ The Hydrogen Society Roadmap (HSRM) serves as a national coordinating framework to facilitate the integration of hydrogen-related technologies in various sectors of the South African economy and stimulate economic recovery.

## UNCTAD/DSI TECHNOLOGY ASSESSMENT FOR ENERGY SECTOR

- ▶ As of 2020, the global hydrogen market was valued at US\$900 million and is expected to reach US\$300 billion by 2050. The number of investments in green hydrogen has risen from almost none in 2020 to 121 gigawatts across 136 projects in planning and development phases totalling over US\$500 billion in 2021.
- ▶ The Steering Committee (SC) and Energy Group of Experts (EG) meeting took place on March 07, 2023. The results of the voting process the SC and GE undertook after the energy group meeting.
- ▶ The SC and EG developed the following energy technologies for the TA project for South Africa green hydrogen/bio-hydrogen floating PV solar panels, agro-voltaic artificial intelligence in energy and energy storage. Green Hydrogen received more votes.
- ▶ Therefore, Green Hydrogen is the technology to be assessed for the energy sector in South Africa.

## CHALLENGES FOR GREEN HYDROGEN

- ▶ Reduced knowledge of optimum design and return on investment, thus limiting bankability. Organisations must scale and improve their green hydrogen plant designs to meet market demand.
- ▶ Limited specialised workforce and high operational costs. While the rise of green hydrogen will create countless new job opportunities, many individuals still need the necessary training and skills to support the hydrogen economy.
- ▶ High energy losses. Green hydrogen loses considerable energy at every point in the supply chain. Approximately 30-35% of the energy used to produce hydrogen is lost during the electrolysis process; liquefying or converting hydrogen to other carriers, such as ammonia, results in a 13-25% energy loss; and transporting hydrogen requires additional energy inputs that are typically equal to 10-12% of the hydrogen's energy.



## CONCLUSIONS

- ▶ Green Hydrogen received more votes. Therefore, Green Hydrogen is the technology to be assessed for the energy sector in South Africa under the UNCTAD pilot project.
- ▶ As of 2020, the global hydrogen market was valued at US\$900 million and is expected to reach US\$300 billion by 2050. According to analysts at Fitch Solutions, the global hydrogen market could jump to 10% by 2030.
- ▶ The number of investments in green hydrogen has risen from almost none in 2020 to 121 gigawatts across 136 projects in planning and development phases totalling over US\$500 billion in 2021.
- ▶ As of 2021, companies across countries have formed alliances to increase production of the fuel fifty-fold in the next six years. According to Goldman Sachs, the market could be worth over US\$1 trillion annually by 2050.

## REFERENCES

- ▶ **MLOS Y CD:** UNCTAD INVESTMENT, ENTERPRISE, AND DEVELOPMENT COMMISSION, THIRTEENTH SESSION: LEVERAGING NEW TECHNOLOGIES' IMPACT THROUGH TECHNOLOGY ASSESSMENTS. TECHNOLOGY ASSESSMENT FOR SUSTAINABLE DEVELOPMENT. EXPERIENCE FROM SOUTH AFRICA. NOVEMBER 16, 2022, GENEVA, SWITZERLAND.
- ▶ **MLOS Y CD:** UNCTAD/DSI: TECHNOLOGY ASSESSMENT FOR SUSTAINABLE DEVELOPMENT: ENERGY SECTOR. ENERGY POLICIES, LEGISLATIONS & REGULATIONS IN SOUTH AFRICA. NOVEMBER 17, 2022, PRETORIA, SOUTH AFRICA.
- ▶ **MLOS Y CD:** UNCTAD/DSI: TECHNOLOGY ASSESSMENT FOR ENERGY SECTOR. GREEN HYDROGEN. MARCH 23, 2023, PRETORIA, SOUTH AFRICA.
- ▶ **MLOS Y CD:** DRAFT UNCTAD/DSI 2023: TECHNOLOGY ASSESSMENT FOR ENERGY SECTOR. GREEN HYDROGEN SYSTEMS: A CRITICAL REVIEW OF TECHNOLOGIES, APPLICATIONS, TRENDS AND CHALLENGES. OUTPUTS TWO & THREE. UNCTAD STEP 3 & 4 OF TA ROADMAP. APRIL 21, 2023, PRETORIA, SOUTH AFRICA.

# **THANK YOU**

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