



United Nations

Department of Economic and Social Affairs
Sustainable Development



WFEO / FMOI

Global Solutions Summit 2023

Fri 05 May 2023, 10.00 am

🌐 ECOSOC Chamber (tbc), Conference Building, United Nations Headquarters, New York
👥 Global Solutions Summit (GSS), in partnership with DESA, WFEO and its Affiliate Member, ASCE.

STI FORUM | 
Science, Technology & Innovation for
the Sustainable Development Goals
<https://bit.ly/STI2023>



Advancing the UN Sustainable Development Goals: From Vision to Implementation with Impact

Dr. Marlene Kanga AO
WFEO President 2017-19

5 May 2023

www.wfeo.org

About Dr Marlene Kanga AO

A transformational leader of large organisations in science and engineering in Australia and internationally, recognised with Australian national honour, Order of Australia (AO)

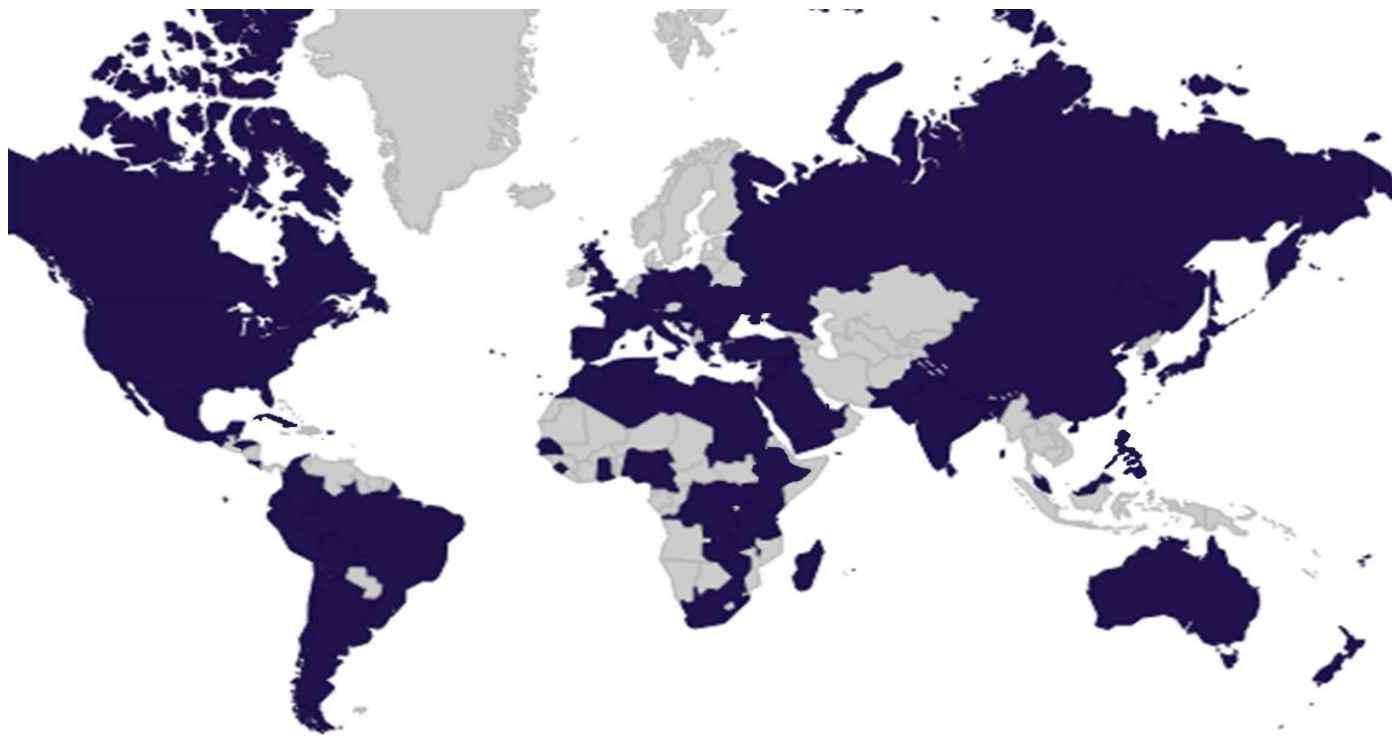
Professional Organisations:

- President, World Federation of Engineering Organizations, 2017- 2019
- Vice President International Network for Women Engineers and Scientists, 2011-2017
- National President Engineers Australia, 2013
- Foundation Fellow, International Science Council
- Co-Chair Australian government ELEVATE project, Australian Academy for Technology and Engineering
- Chair, Institution of Chemical Engineers Safety Centre, advancing process safety engineering globally

Business:

- Non-Executive Director and board member of organisations in the public, private and not-for-profit sectors
- Airservices Australia, Endeavour Energy, Standards Australia, Business Events Sydney, and formerly Innovation Australia (2013-2019), Sydney Water Corporation (2017-Feb 2023)
- start-ups, collaborative research centres and innovation networks, translating research to commercial outcomes in information technology, health and energy sectors





MEMBER MAP
March 2022

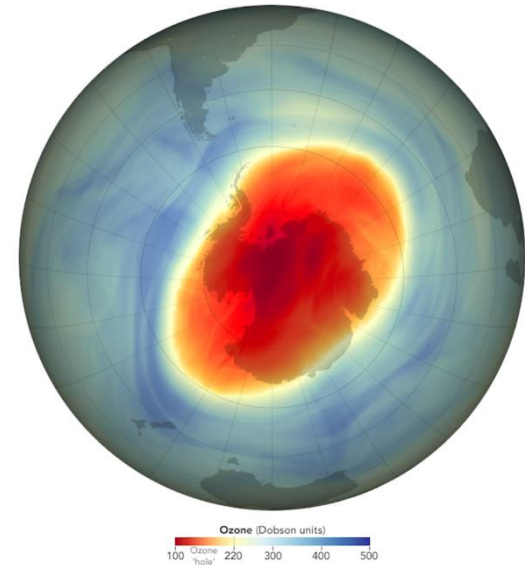
The World Federation of Engineering Organizations (WFEO):

- The leading international body for professional engineering institutions
- Founded in 1968, under the auspices of UNESCO
- 100+ national professional engineering institutions, 12 international and continental/regional professional engineering institutions, representing 30 million engineers
- Co-Chair - Major Science and Technology Group at UN
- Represent engineering at major UN Organisations
- Co-Host: Global Solutions Summit, United Nations, May 2023



GSDR 2023: Engineering was key to reducing the hole in the ozone layer

- Discovered in 1985, as a result of the Montreal Protocol, that banned Chloroflourohydrocarbons (CFCs) in 2010, we are on track to have the ozone layer at 1980 levels by 2040 and to disappear over the Antarctic by 2066.
- CFCs were in wide use in refrigeration, air conditioning and aerosol spray cans. The compounds are inert and essentially nontoxic, characteristics that made them well-suited for these applications.
- Previously, refrigeration and air conditioning systems used compounds such as ammonia, chloromethane, propane and sulfur dioxide as refrigerants. Though effective, these are toxic, and flammable, and exposure can cause serious injury or death.
- Since the CFC ban, new refrigerants have been developed by scientists and implemented by engineers in refrigeration systems, which has greatly reduced the hole in the ozone layer.



Source: [Ozone layer recovery is on track, due to success of Montreal Protocol | UN News](#)

See: UN Global Sustainable Development Report, 2023, released 4 May 2023, UN STI Forum, New York.



Enabling the Tipping Point in the Energy Transition

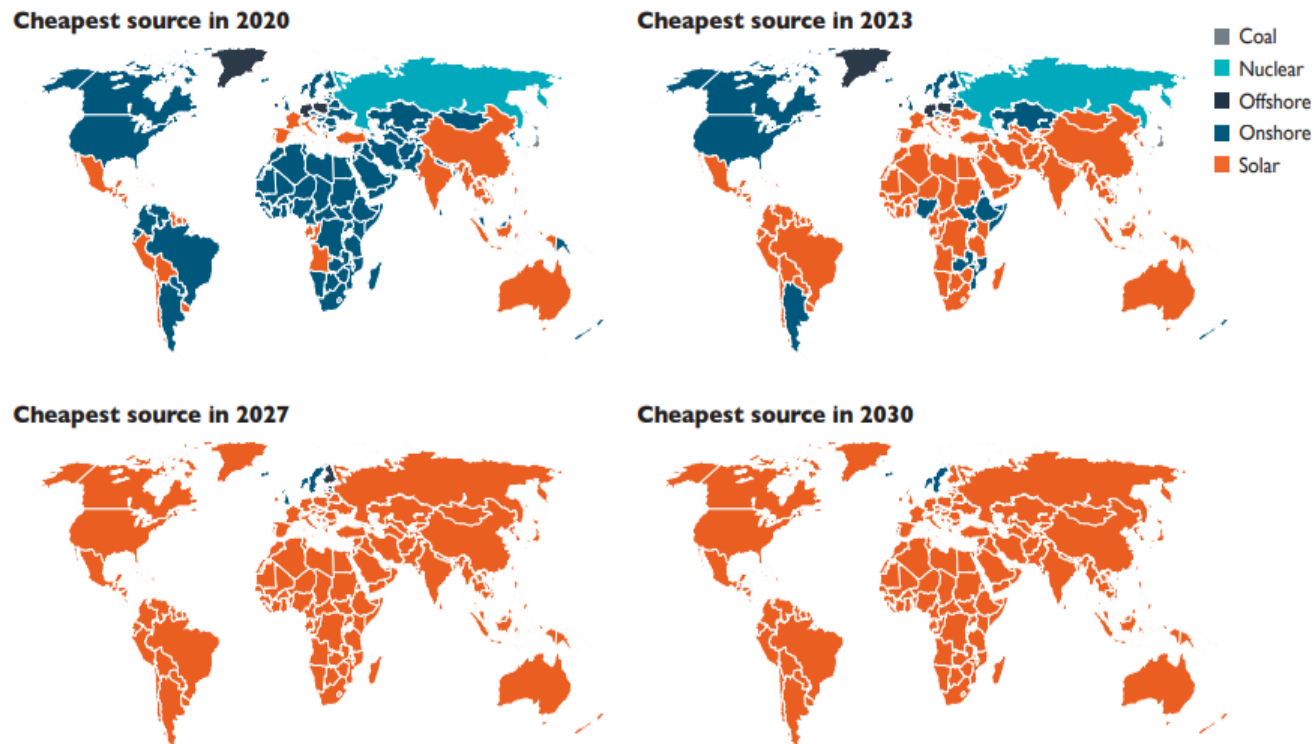


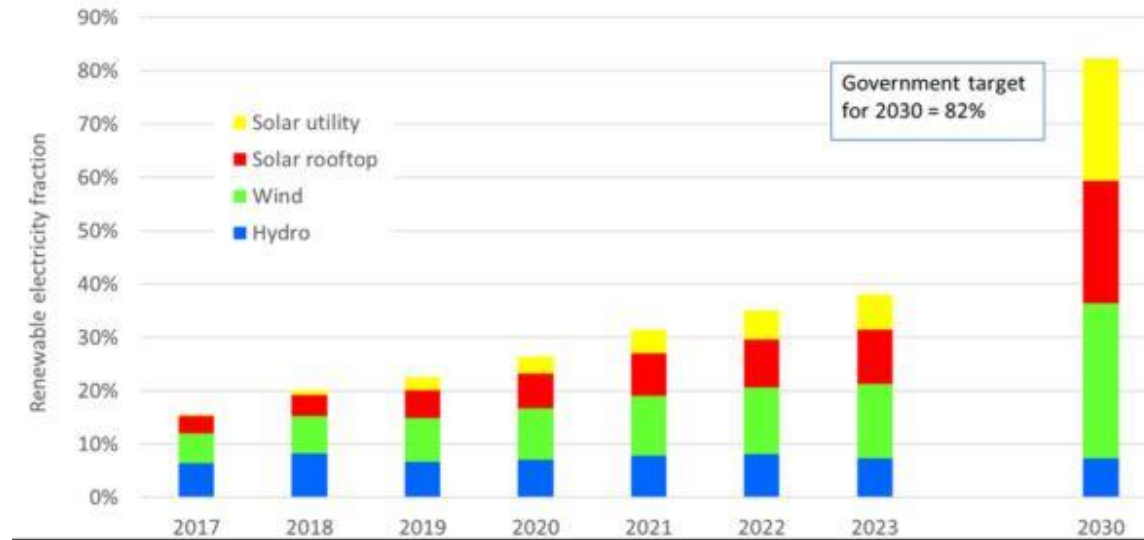
Figure 1. Maps showing the energy source with the lowest levelised cost of electricity (including necessary storage) in 70 world regions, in 2020, 2023, 2027 and 2030. The biggest shift occurs between 2020 and 2027, which sees a range of technologies give way to solar PV as the cheapest form of energy.

The world is quickly reaching the tipping point in favour of renewable energy as costs of solar PV and wind turbines fall relative to coal and gas, enabled by engineering innovation.

See: [EEIST-Policy-Brief-SOLAR.pdf](#), [Majority of New Renewables Undercut Cheapest Fossil Fuel on Cost \(irena.org\)](#)



Enabling the Tipping Point in the Energy Transition - Australia



- Australia procures 38% of the electricity from renewables, mostly from solar and wind, Government target 82% by 2030.
- The state of South Australia (population 1.7 million) is tracking toward 100% solar and wind in 2027
- The Australian experience is highly replicable - it relies on cheap, mature technology from vast production runs that use available resources – namely solar, wind, pumped hydro energy storage, batteries, and transmission and demand management.
- Australia has straightforward solutions to variability of solar and wind and an economically compelling model for rapid removal of fossil fuels from electricity generation.

See: [Australia paving way for global solar energy adoption – pv magazine Australia \(pv-magazine-australia.com\)](https://www.pv-magazine-australia.com)



Engineering is key to advancing the UN Sustainable Development Goals



A key objective of the World Federation of Engineering Organizations is to **advance the UN SDGs through engineering.**

We need more engineers - **to build capacity for more engineers, especially women, and provide them with the right skills** to advance sustainable development.



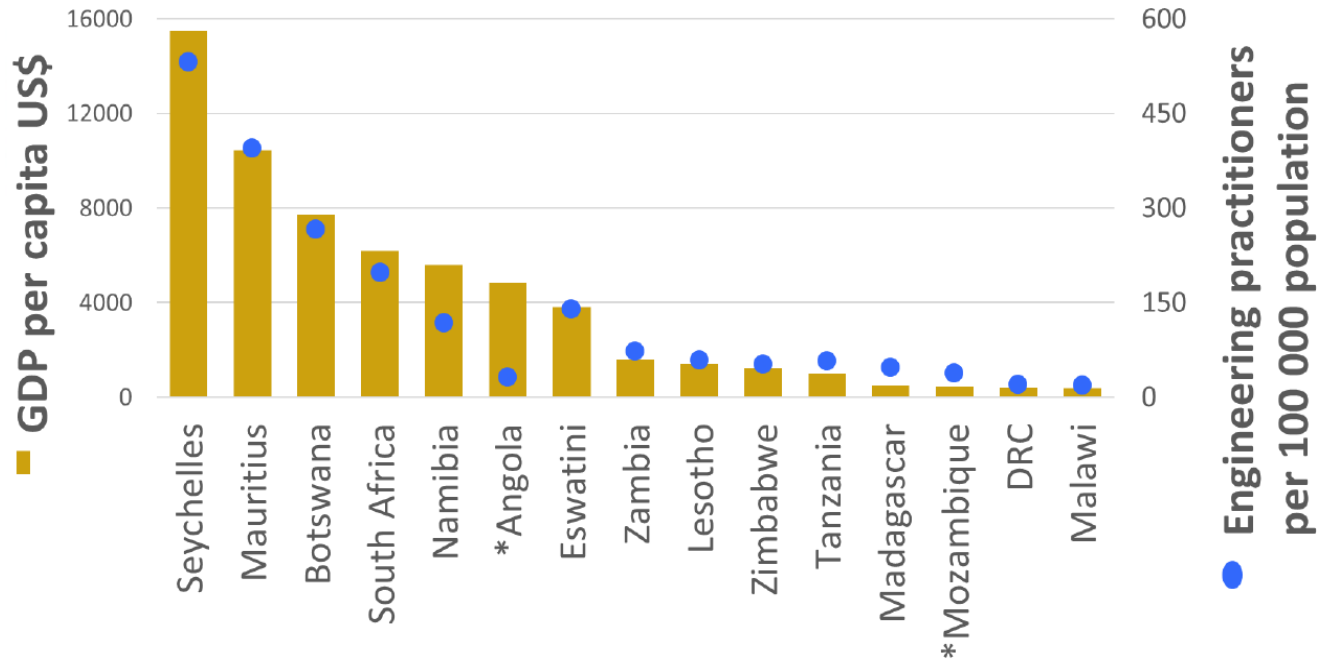
Addressing the Fundamental Issue: We need more
engineers!

Engineering Capacity Building through Partnerships with
International Professional Engineering Institutions



Number of Engineers in South Africa

Ratios per Member State



Source: <http://www.eiz.org.zm/wp-content/uploads/2019/11/Engineering-Numbers-Needs-in-the-SADC-Region-Allyson-Lawless.pdf>



Comparison of numbers of engineers – South Africa, USA, UK

The engineering numbers

CATEGORY	NUMBER	TOTAL IN THE WORKFORCE	REGISTERED		GRADUATES		GRADUATES AS A % OF THE WORKFORCE
			REGISTERED	% REGISTERED	IN 2015*	% FEMALE	
Engineers		114 579	34 722	30%	9 875	22.0%	9%
Technologists and technicians**		114 281	12 746	11%	15 607	24.7%	14%
TOTAL		228 860	47 468	21%	25 482	23.7%	11%

* Totals are understated as graduation data from some countries is incomplete – see Figure 23

** Technologist and technician categories are not recognised in all countries – see Table 24

- 68 engineering practitioners per 100,000 population in SADC – ranging from 531 to 18
- 850 engineering practitioners per 100,000 population in the USA
- 1 160 engineering practitioners per 100,000 population in the UK

Source: <http://www.eiz.org.zm/wp-content/uploads/2019/11/Engineering-Numbers-Needs-in-the-SADC-Region-Allyson-Lawless.pdf>



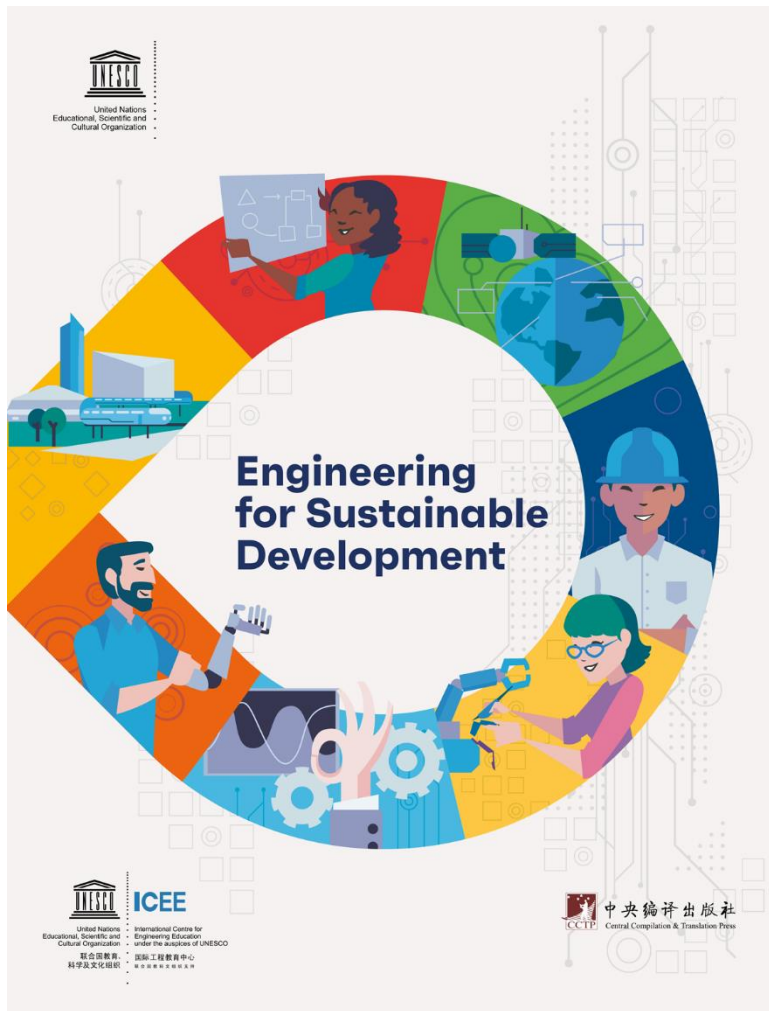
Reach of Current Mutual Recognition Systems



Source: <https://www.engc.org.uk/international-activity/international-relationships-map/>



UNESCO Engineering Report – Engineering for Sustainable Development, 4 March 2021



The second UNESCO Engineering Report – “Engineering for the SDGs”, Chapter 1, author Dr Marlene Kanga recommends:

1. **“Government, engineering educators, industry and professional engineering institutions need to collaborate to increase the number and quality of engineers.**
2. **There is also a need to work in partnership to develop the necessary international engineering education benchmarks for sustainable development.**
3. **These need to be recognised across the world and form the basis of national engineering education systems for engineers with the right skills especially Asia, Africa and Latin America.”**

EN <http://on.unesco.org/Eng2021>, FR: <http://on.unesco.org/Ing2021>

ES <http://on.unesco.org/Ingen21>

Engineering for Sustainable Development

© Marlene Kanga 2022-2023



Key areas of the international engineering education benchmarks that were changed

1. **Accommodate future needs** of engineering professionals and the profession – strengthen the required attributes on team work, communication, ethics, sustainability.
2. **Emerging technologies** – incorporate digital learning, active work experience, lifelong learning.
3. **Emerging and future engineering disciplines and practice areas** – while retaining discipline independent approach, enhance the skills on data sciences, other sciences, life-long learning.
4. **Incorporate UN Sustainable Goals** - in the development of solutions that consider diverse impacts – technical, environment, social, cultural, economic, financial and global responsibility **AND LEAVE NO ONE BEHIND**
5. **Diversity and Inclusion** – include these considerations within ways of working in teams, communication, compliance, environment, legal etc. systems.
6. **Intellectual agility, creativity and innovation** – emphasize critical thinking and innovative processes in design and development of solutions



Engineering Education Building Capacity: Achievements to May 2023

- Reviews of the engineering education benchmarks in partnership with **UNESCO**, the **International Engineering Alliance (IEA)**, the **International Federation of Engineering Education Societies (IFEES)**, the **Global Engineering Deans Council (GEDC)** and **WFEO**, to ensure that engineering graduates have the necessary skills to advance the UN Sustainable Development Goals, completed June 2021.
- Capacity Building in Africa to support nations that wish to achieve international benchmarks in engineering education – **Mauritius and others**

See: [WFEO Progresses Capacity Building in Mauritius with site visits to all universities - WFEO](#)

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Engineering for Sustainable Development



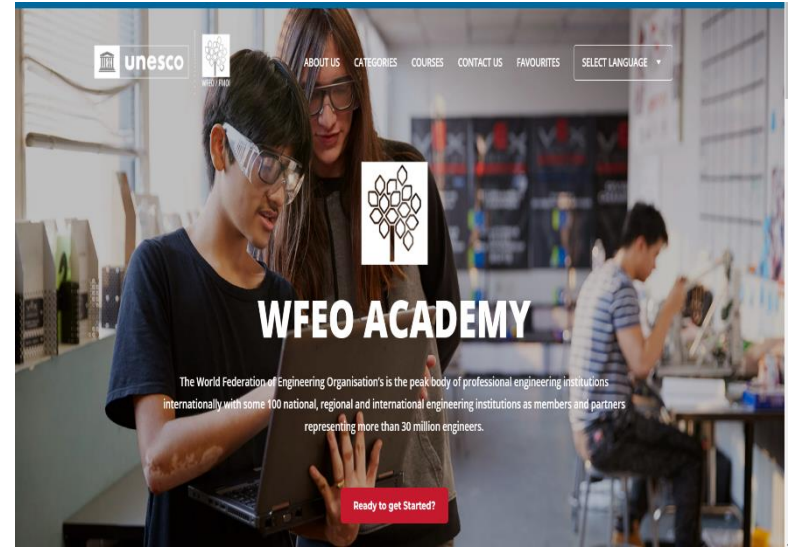
See: [WFEO-CEIE-GAPC-Consultation - WFEO](#)



Engineering Education Building Capacity: Achievements to May 2023

- Establish a training portal to transfer knowledge to Africa, Asia and Latin America in engineering education and professional competencies in partnership with UNESCO, IEA, IFEEs, GEDC – the WFEO Academy
- Climate Change Education Workshops for teacher training and curriculum change in schools and introduce the role of engineering in partnership with the Office of Climate Change Education (OCE, Paris), in Small Island Developing States and in Africa – Mauritius 2022, Fiji 2023, Planned.

See: [WFEO delivers Climate Change Education in Small Island Developing States \(SIDS\) through Curriculum Development and Teacher Training in Schools - WFEO](#)



See: [WFEO Academy - Engineering Education Training](#)



Case Study: Implementing Sustainable Water Infrastructure in Greater Sydney, Australia



GSDR 2023: Levers for Advancing the Sustainable Development Goals

1. Governance and Leadership:

- Government Policy to support Sustainable Development
- Public and private sector long-term planning for infrastructure – water, energy, transport

2. Engineering and Technology especially Innovation

3. Training and **capacity building** to meet the increasing demand for the workforce of the future

4. **Financing** for sustainable development projects

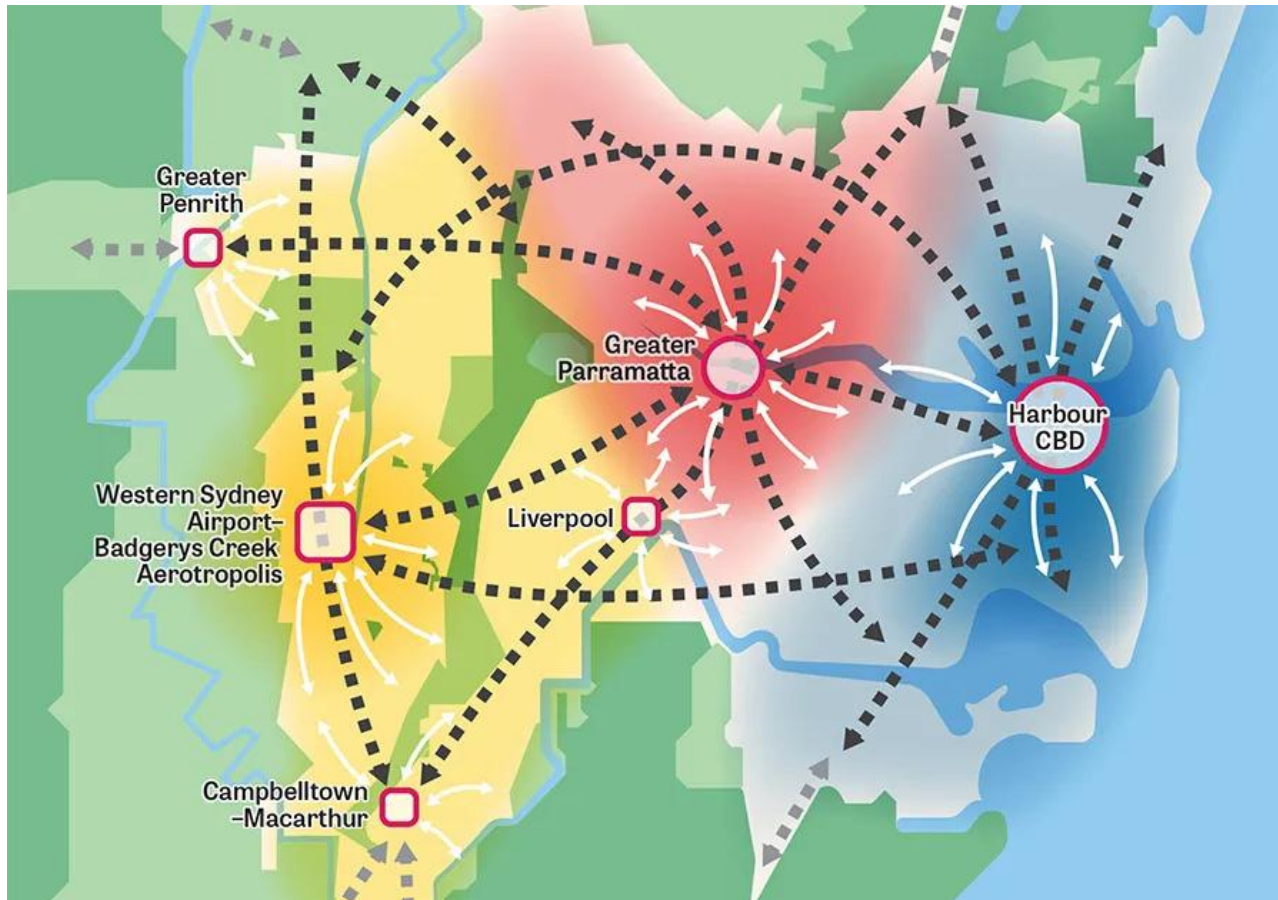
5. **Individual and collection action** for sustainable infrastructure, including partnerships

6. Modelling of costs and benefits – social, economic and environmental for the people of the city

7. Reporting on progress using one of the available sustainability standards



Government Policy: Greater Sydney Commission: A Vision for a Metropolis of three cities



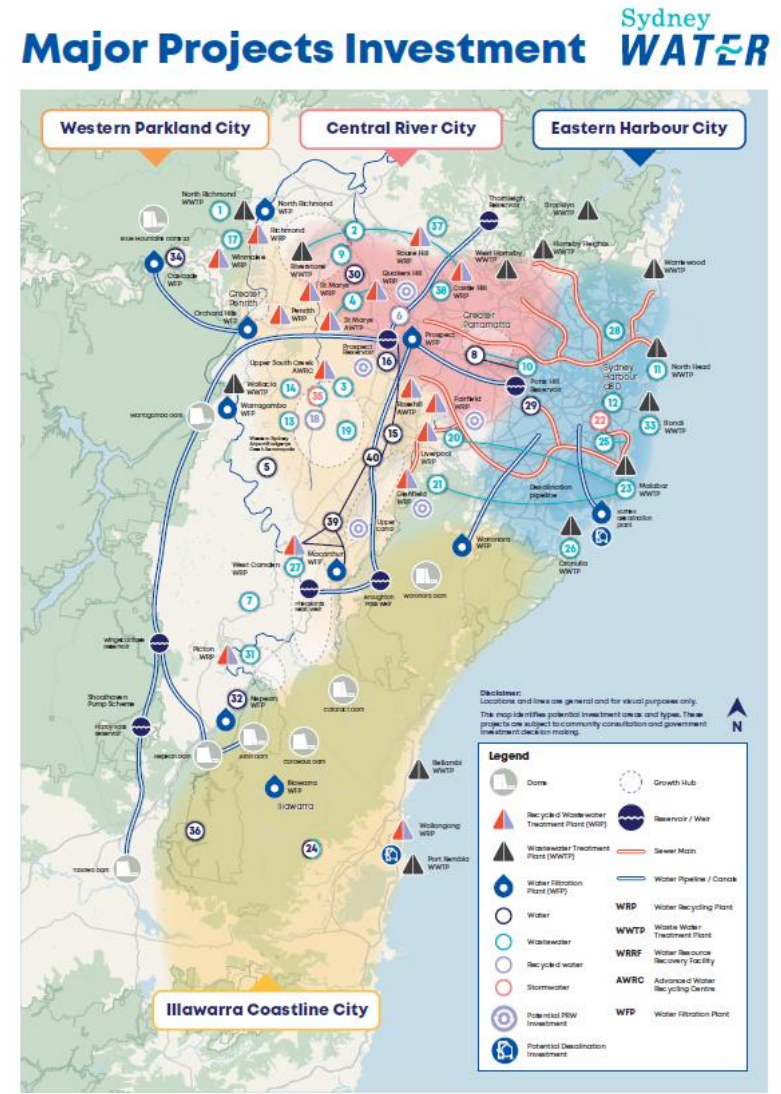
Source: [Why the metropolis of three cities | Greater Cities Commission](#)

A Vision for a liveable and sustainable city with 30-minute travel time to education, work, and leisure for a population set to increase by 1.5 million in 20 years.



Sydney Water Corporation: Leadership for Long Term Planning for Implementation

- A once-in-lifetime opportunity to develop a sustainable city in a greenfield location
- Major capital projects for water supply, wastewater treatment
- Opportunities for water recycling and re-use of organic food and agricultural waste by converting to bio-methane, powering a circular economy
- Opportunities to implement innovative technologies for the city of the future
- Engineering sustainable infrastructure - more than \$10 billion over next four years and \$30 billion by 2030
- 100 projects >\$100 million, two projects >\$1 billion, delivered at no additional net cost.



Sydney Water Corporation Major Capital Projects 2022:
Source: [Major Project Investment \(amazonaws.com\)](https://www.amazonaws.com)

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Sydney Water Corporation: Governance, Leadership and Strategy

- **Board-led strategy for sustainable development**
- **Signatory to the UN Global Compact for Sustainable Development**
- **Renewable energy and net zero target**
- **Focus on Climate- independent water supplies, water recycling**
- **Innovation and technology**
- **Data and analytics**
- **Diversity, Equity and Inclusion for a future-capable work force**
- **Engaging with First Nation People, Reconciliation Action Plan (RAP)**
- **Ethics and anti-corruption**
- **Major projects mapped against UN SDGs**



Sydney Water Corporation Board of Directors

Source: [Annual Report \(sydneywater.com.au\)](https://www.sydneywater.com.au/annual-report), June 2022



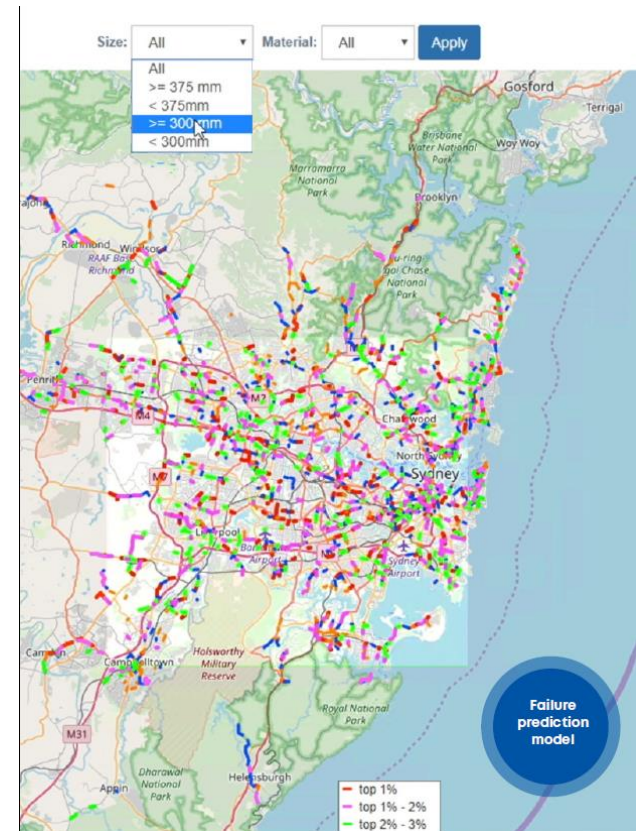
Engineering the Circular Economy and Countdown to net zero



Sydney Water Corporation: AWRC Source: [Upper South Creek Advanced Water](#)



Sydney Water & Blight Tanner: Plan for Wianamatta: South Creek Urban Typologies and Stormwater Management – Australian Urban Design Award, 2020, Source: [Sydney Water's 'greenprint' for Western Sydney - Government News](#)

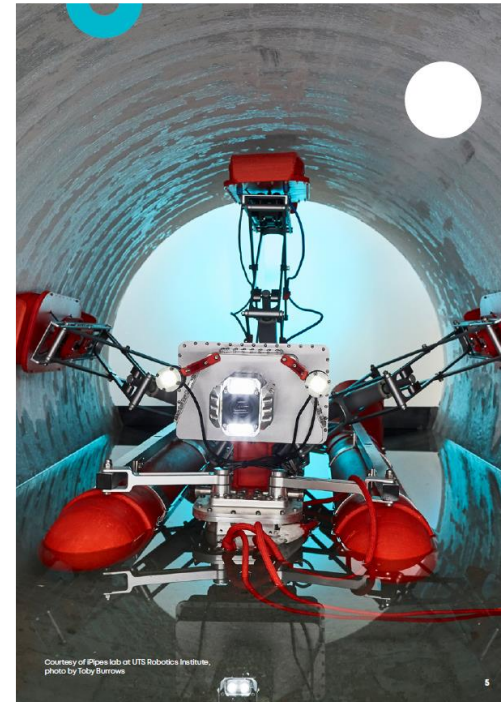
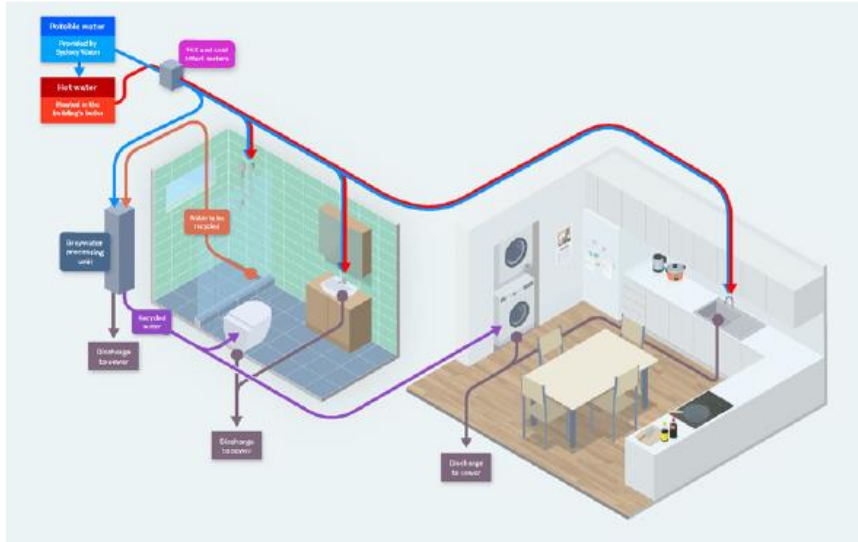


Internet of Things and AI for pipe failure prediction Source: [Research and innovation highlights 2021 \(sydneywater.com.au\)](#)



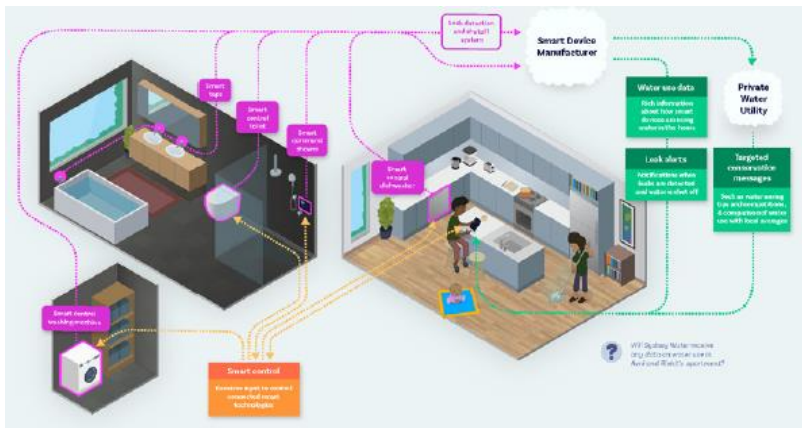
Individual and Collection Action

Behind the meter – sustainable water use



Sydney Water – Responsible water usage in the home. Source: [Research and innovation highlights 2021 \(sydneywater.com.au\)](https://www.sydneywater.com.au/research-and-innovation-highlights-2021)










Sydney Water Robot inspection for critical mains. Source: [Research and innovation highlights 2021 \(sydneywater.com.au\)](https://www.sydneywater.com.au/research-and-innovation-highlights-2021)



Sydney Water – Smart meters and data for water consumers Source: [Research and innovation highlights 2021 \(sydneywater.com.au\)](https://www.sydneywater.com.au/research-and-innovation-highlights-2021)



Financing long term projects: Sustainability Bonds Programme

Project name	Project description	SDG	Indicator
Lower South Creek Treatment Programme: Quakers Hill and St Marys Water Recycling Plants Process and Reliability Renewal 	<p>Sydney Water is delivering the largest anaerobic granulated sludge bioreactor in Australia (as at construction) and infrastructure upgrades to meet the demands of a growing Western Sydney. Working towards a circular economy, the Lower South Creek Treatment Program includes the upgrade of St Marys and Quakers Hill water recycling plants which will deliver improved sustainability and significant energy and carbon savings. When fully operational, the improved treatment processes will produce a higher grade of stabilised biosolid and also generate more biogas captured through co-generation to increase energy efficiency and allow a large proportion of self-supply of electricity at the plants.</p> <p>Status: Most construction works completed and staged process commissioning began March 2022. Upgraded facilities expected to be fully operational from mid-2023.</p> <p>Target population: General population.</p>	  	<p>Operations (current): 100% (~7748 tonnes) of biosolids recovered from wastewater beneficially reused.</p> <p>Operations (post-upgrades): 42% estimated reduction in GHG emissions during construction and across its 50 year operation.</p>
Waterway naturalisation and stormwater improvement – Tranche 1 	<p>Replacement of deteriorating concrete sections with sandstone and stabilisation of banks with native plants, trees and rocks.</p> <p>Naturalising the stormwater channels increases the asset life from approximately 80 to 150+ years.</p> <p>Naturalisation and restoration works improve water quality, mitigate flooding, increase amenity and liveability, as well as provide greater park access for the community.</p> <p>Status: Completed in stages up to March 2019 with vegetation establishment periods of 24 months and ongoing maintenance.</p> <p>Target population: General population.</p>	   	<p>Operations Removal of 436 cubic metres of litter and 179 tonnes of combined sediment and litter.</p>

Project name	Project description	SDG	Indicator
Waterway naturalisation and stormwater improvement – Tranche 2 	<p>Tranche 2 activities include:</p> <ul style="list-style-type: none"> Replacement of deteriorating concrete sections with sandstone and stabilisation of banks with native plants, trees and rocks. Construction of several water sensitive urban design projects, developed in collaboration with Councils and community input across three major Sydney catchments. <p>Naturalisation and restoration works improve water quality, mitigate flooding, increase amenity and liveability, as well as provide greater park access for the community.</p> <p>Status: Completed in stages up to April 2023 with vegetation establishment periods of 24 months and ongoing maintenance.</p> <p>Target population: General population.</p>	   	<p>Infrastructure¹⁴ 0.6km of waterways naturalised and rehabilitated.</p> <p>Approximately 0.3 hectares native vegetation gain with more than 24,000 local natives planted including 2,700m² of endangered saltmarsh.</p> <p>40m of new paths, 1 boardwalk, 1 bridge and 4 lookouts constructed, 8 seats installed, and 2 interpretive signage provided.</p>
Green Square Trunk Stormwater Improvement 	<p>Construction of a 2km underground stormwater drain from Zetland to the existing stormwater system at Alexandra Canal.</p> <p>The project significantly reduces flooding in the area, improves water quality and enables future development projects in Green Square.</p> <p>Demand for drinking water is reduced through the harvest and purification of 900 kL/day of stormwater at full capacity - the equivalent of 150 Olympic swimming pools of stormwater every year.</p> <p>Status: Completed as of October 2019.</p> <p>Target population: General population.</p>	   	<p>Operations Removal of ~68 tonnes of combined litter and sediment.¹⁵</p>

NSW Treasury Corporation Sustainability Bonds Programme - Source: [NSW Sustainability Bond Programme Annual Report 2022.pdf](#)

- New South Wales State Government Treasury Corp issues sustainability bonds to support projects that advance the UN SDGs and have social and economic benefits.
- Sydney Water has funded stormwater management, waterway naturalization and recycling projects



Johnstons Creek Glebe, Sydney, Waterway naturalisation



NSW Treasury Corporation Sustainability Bonds Programme - Source: [NSW Sustainability Bond Programme Annual Report 2022.pdf](#)

- From a concrete drain to a beautiful natural environment
- Natural planted wetlands, expanded salt marsh areas around the creek and created intertidal rock pools, recreational areas and a boardwalk
- Sydney Water has this funded stormwater management, waterway naturalization and recycling projects with sustainability bonds





Engineering for Sustainable Development

The World Federation of Engineering Organizations – facilitating:

- Participation
- Influence
- Representation



The world's engineers
united in rising to
the world's challenges.
For a better, sustainable world.



WFEO / FMOI



The World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

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ACKNOWLEDGEMENT

Sincere thanks for facilitating and enabling my participation in the UN Science Technology and Innovation Forum, May 2023:

Engineers Australia



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