Australia's National Science Agency

Exploring Pathways to Decarbonise the Electricity Supply in Bangladesh

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Dr Nawshad Haque | 19 July 2023

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We have strong friendship between two countries

- Australia is among the first Western Countries recognised Bangladesh on 26 January 1972

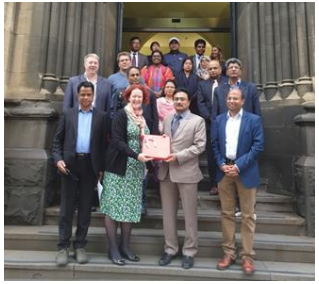
- Trade currently nearly AU$3 B

Australia's goods and services trade with Bangladesh, 2021

Source: DFAT-adjusted ABS data

Exports	Destination Ranking: 27
Item	A$m
Vegetables, f.c.f.	486.9
Education-related travel	282.0
Ferrous waste & scrap	228.9
Wheat	171.9
Oil-seeds & oleaginous fruits, soft	168.7
Cotton	81.5
Coal	48.8
Total	**1,729.8**

Imports	Source Ranking: 38
Item	A$m
Other textile clothing	445.8
Men's clothing (excl knitted)	225.6
Women's clothing (excl knitted)	176.6
Women's clothing, knitted	121.1
Men's clothing, knitted	87.7
Made-up textile articles, nes	79.1
Other services - details not provided	54.0
Total	**1,270.5**



- 8 BCSIR staff short term training
- Many publications/reports

Minerals
Metals
Energy
Water
Waste
Food

Initial discussion

First visit by BD

Ministerial visit by BD 2013

CSIRO visit in BD

Staff training for BD

MoU Signing

Meeting BD High Commission

Korean visits

1st PhD Project

2nd PhD Project

3rd PhD Project

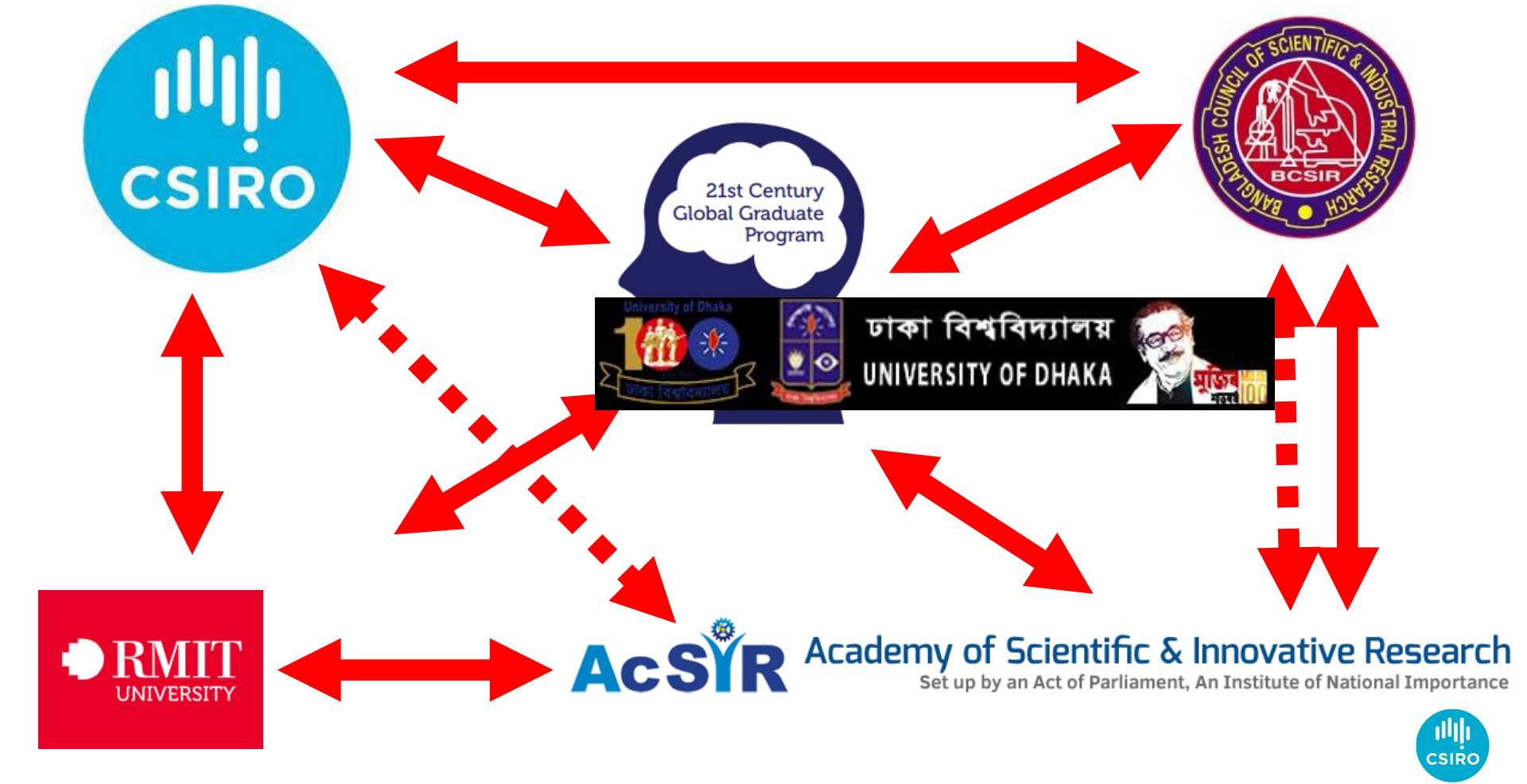
BCSIR CSIRO Dhaka workshop

BD visit progress meeting

10 PhD Projects with RMIT BCSIR and CSIRO - 2022

2008 2010 2012 2014 2016 2018 2020 2022


SIKKIM
Bhutan
ASSAM
NAGALAND
BIHAR
MEGHALAYA
MANIPUR
Bangladesh
TRIPURA
MIZORAM
JHARKHAND
WEST BENGAL
Myanmar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UNIVERSITY OF DHAKA
RMIT
UNIVERSITY
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Presentation outline

01 Background

Country contexts

02 Methods

Goal and scope, Inventory data, Impact assessment and scenarios.

03 Key findings

Impacts of electricity generation, Transition Pathway for decarbonising electricity generation.

04 Future direction

01 Background

Country contexts.

Background

Global goal

-Net zero.

-Affordable and clean energy (SDG7).

-Sustainable cities and communities (SDG11).

-Responsible consumption and production (SDG12).

-Climate action (SDG13)

Country contexts

-Bangladesh: Second-largest economy in South Asia and the world's second-largest exporter of readymade garments.

-A trillion-dollar economy by 2040.

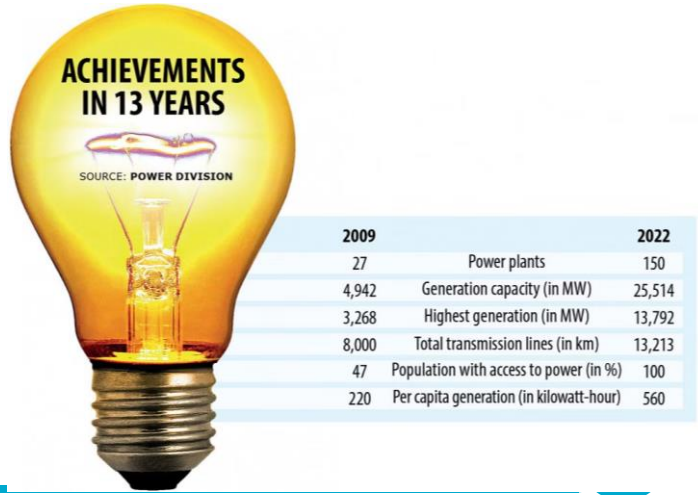
-100% population under electricity coverage (2021).

-Integrated Energy and Power Master Plan (Draft) (2022): a low/zero carbon supply system

Paris Agreement

-Nationally determined contribution:

- Reduce ~29% (unconditional) and ~58% (conditional) of greenhouse gas (GHG) from electricity generation by 2030.
- ~44 MT CO_{2eq} (million tonnes of carbon-di-oxide equivalent) compared to Business-as-usual (BAU)



2009		2022
27	Power plants	150
4,942	Generation capacity (in MW)	25,514
3,268	Highest generation (in MW)	13,792
8,000	Total transmission lines (in km)	13,213
47	Population with access to power (in %)	100
220	Per capita generation (in kilowatt-hour)	560

Source: 100% population now under electricity coverage. https://www.thedailystar.net/business/economy/news/100pc-population-comes-under-electricity-coverage-2983111

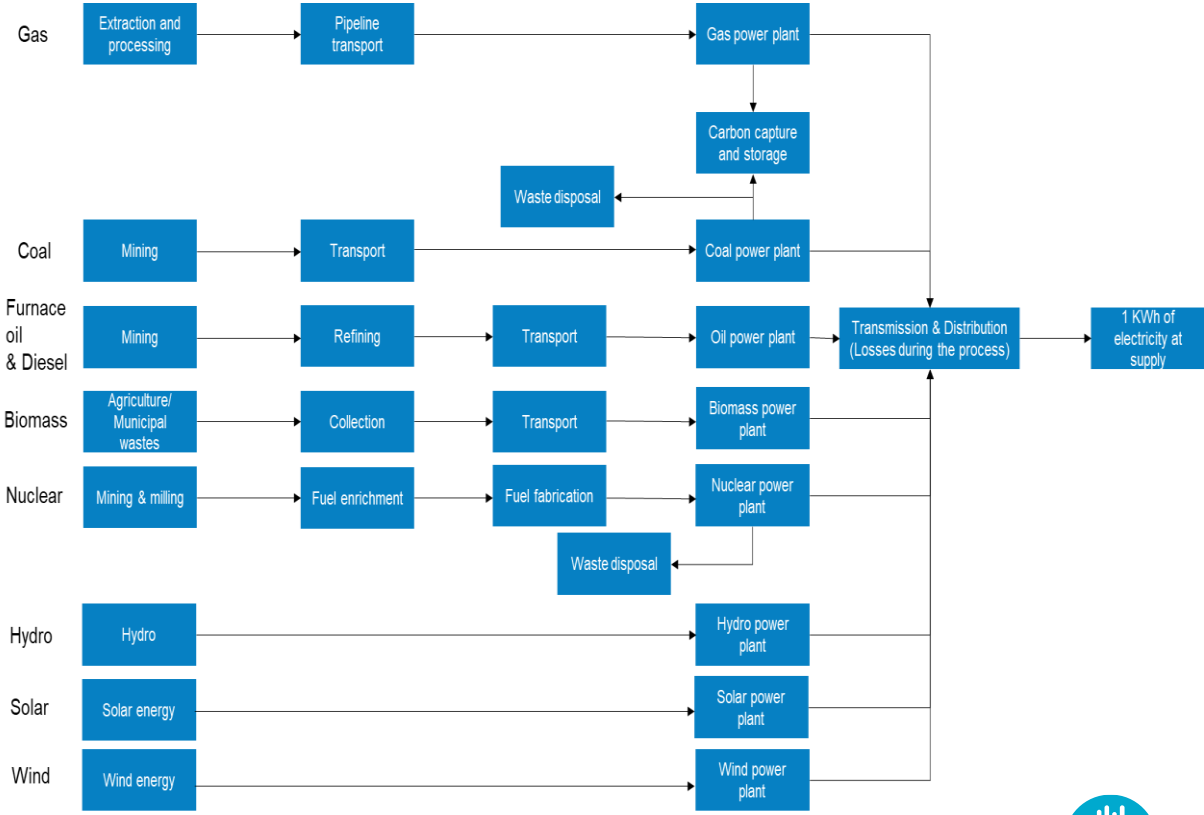
02 Methods

Goal and scope, Inventory data, Impact assessment and scenarios.

Methods

1 kWh of grid electricity supplied to the end user.

A quantitative environmental performance assessment of the electricity generation and supply in Bangladesh from 2005 to 2022, and exploring decarbonisation pathways of future electricity supply.



System boundary of the study

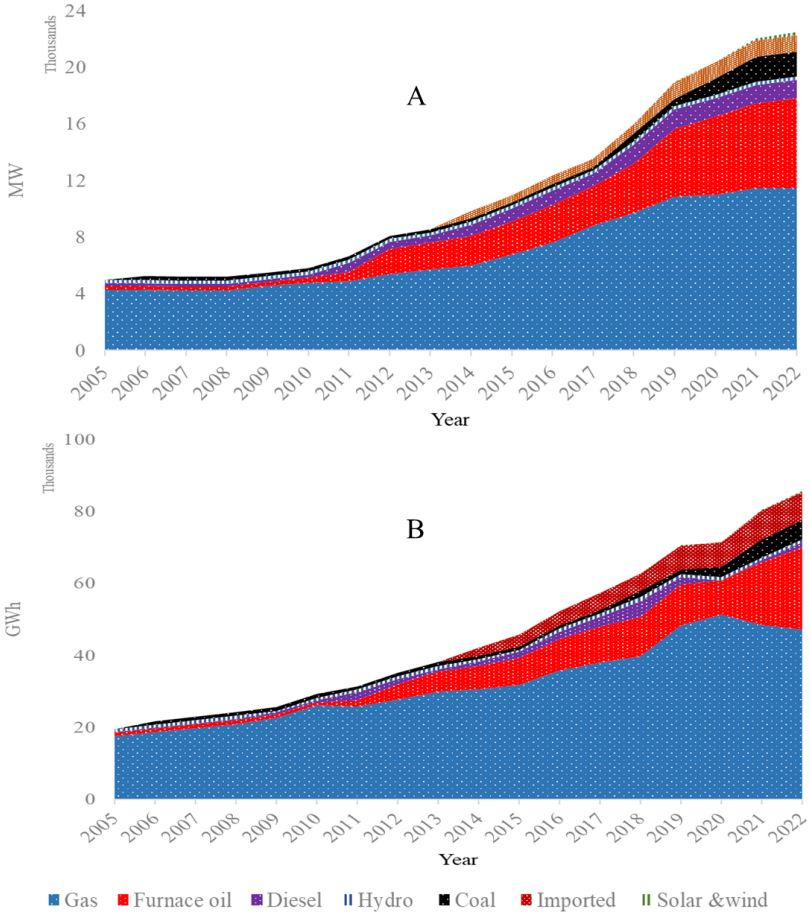
Methods

Inventory data

-Data from annual reports of the Bangladesh Power Development Board.
-Background system and power import data (India) obtained from the Ecoinvent V3.8.
-Simapro LCA software

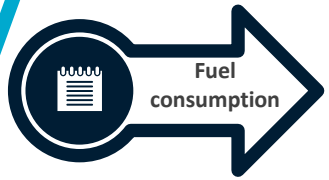
Impact assessment

-Impact World+ method.
-Impact category: GHG emissions, photochemical oxidant formation, particulate matter formation, ozone layer depletion, terrestrial acidification, and freshwater eutrophication.

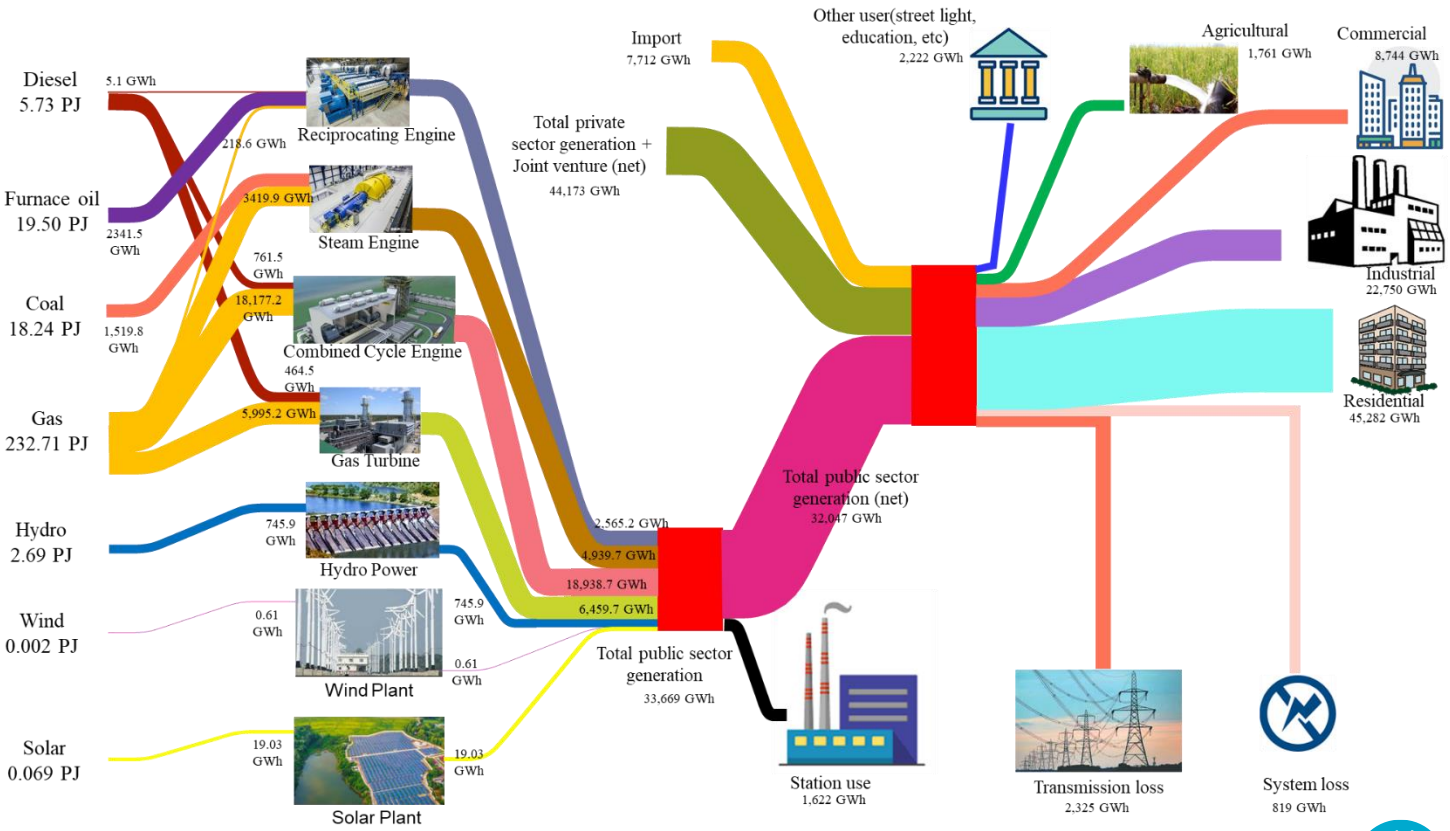


(A) Installed capacity and (B) Total electricity generation by fuel category for 2005 to 2022

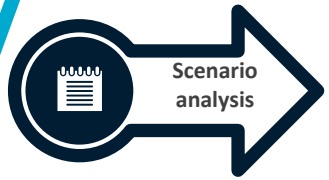
Methods



-Fuel consumption data from annual reports of the Bangladesh Power Development Board. As an example, 2022 fuel consumption, production, and distribution is shown.



Methods



-Future possibilities to weigh different routes of energy mix planning considering the potential futures and the ongoing and emerging national and global contexts.

	Scenario	Scenario source	GHG reduction/low carbon electricity generation target in 2050	Scenario description
1.	Business as usual (BAU)	Existing electricity mix	None	The existing electricity mix is presented in Table 1.
2.	Power sector master plan (PSMP)	Power sector master plan (2016) (MoPEM, 2016)	Power sector master plan (2016) (MoPEM, 2016) electricity generation target.	Power sector master plan (2016) (MoPEM, 2016) supporting the optimum electricity generation mix from gas (25%), coal (25%), furnace oil (5%), power import (25%), nuclear (10%), renewables (solar, wind, municipal waste incineration, & hydro) (10%) by 2050.
3.	Paris Agreement (PA)	Based on the Paris agreement	As per the Paris Agreement to keep the temperature rise "well below 2°C", global renewable electricity generation should be 65% by 2050, compared to 15% in 2017 (IRENA, 2017).	The assumption is that technology transfer and financial assistance from developed economies creating a favorable enabling environment resulting in the development of renewable electricity (solar, wind, municipal waste incineration & hydro) contributing 65% of the total electricity mix by 2050. Other sources such as gas (5%), coal (10%), import (15%), and nuclear (5%) together contribute 35% of the total electricity mix by 2050.
4.	Stabilization (ST)	This study	No increase in GHG emission.	Climate change mitigation and energy policy promoting the diversification of electricity supply, and investment for (i) low-carbon technology from fossil fuels: gas (20%), and coal (20%) with carbon capture and storage (CCS) contributing together 40%, as well as gas (5%) and coal (10%) without CCS of the total electricity by 2050. Renewable energies from solar, wind, municipal waste incineration, & hydro contribute 15%, import 20%, and nuclear energy contributes 10% of the total electricity mix by 2050.
5.	Renewables and import (REI)	This study	50% renewables, and 50% non-renewables	Climate change mitigation and energy policy promoting the diversification of electricity supply, and investment for (i) renewable energies, and (ii) fossil fuel-based low-carbon options; resulting in solar, wind, municipal waste incineration, & hydropower together renewables contributing 50% of the total electricity mix by 2050; and remaining contribution from gas with CCS (5%), coal with CCS (5%), gas without CCS (5%), coal without CCS (5%), import (25%) and nuclear (5%) to the total electricity.

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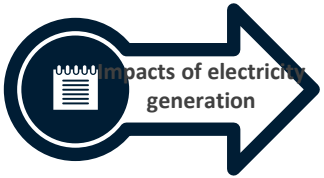
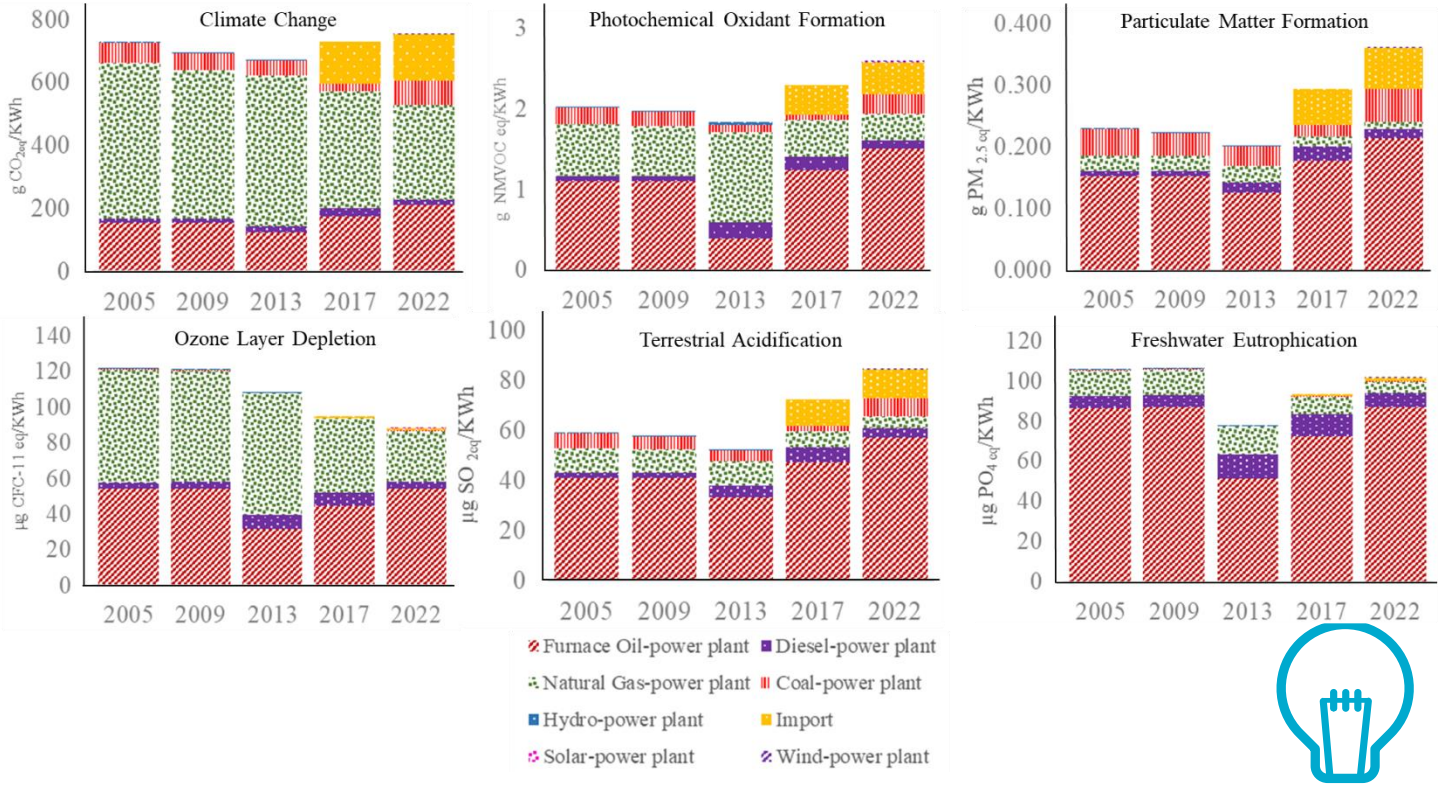
03 Key findings

Impacts of electricity generation, Transition Pathway for decarbonising electricity generation.

Key findings

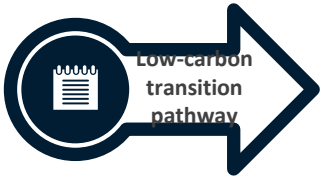


- The life cycle GHG emissions increased from 726.7 g CO_{2eq}/kWh in 2005 to 753.8 g CO_{2eq}/kWh in 2022.
- The life cycle photochemical oxidant formation, particulate matter formation, and terrestrial acidification showed a similar trend with increasing contribution from power import.

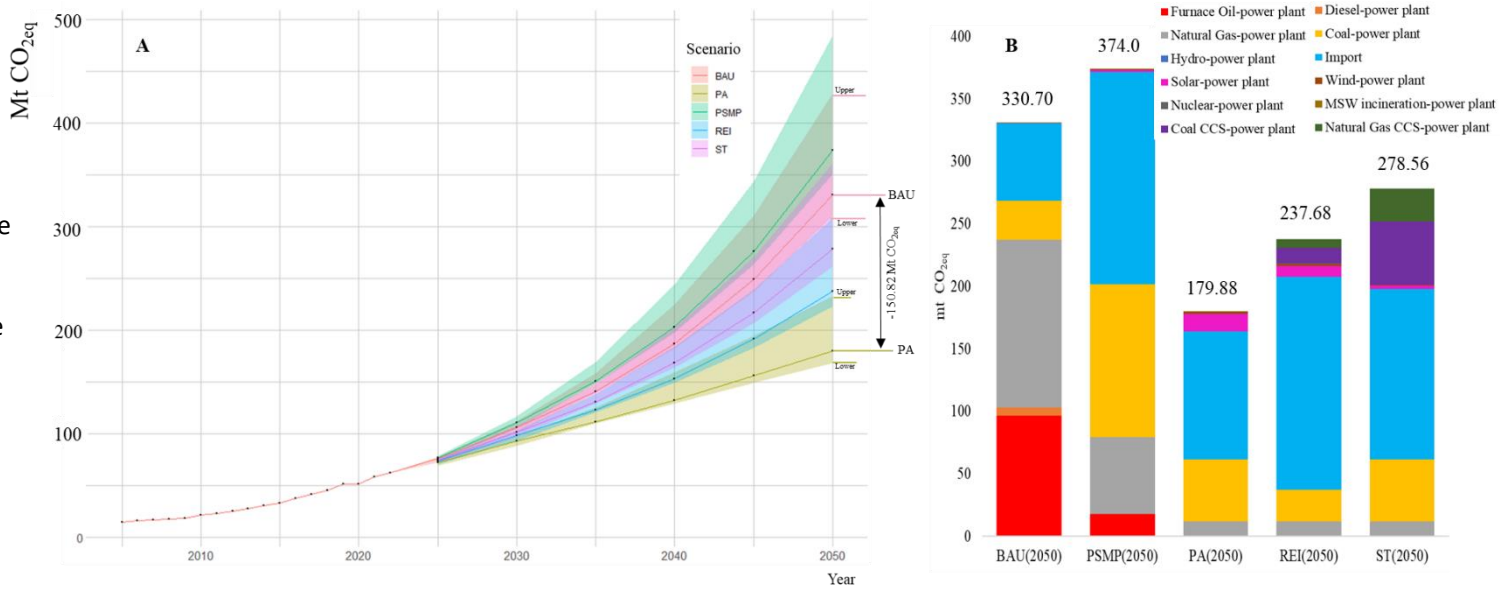


Characterization impact results per kWh (functional unit) for the selected impact categories from 2005–2022

Key findings



- In the BAU scenario, emissions may grow by five times over the modelling period reaching 330.70 in 2050 from 2022's 61.91 MT CO_{2eq} with respective contributions from natural gas-based power plants (41%), furnace oil-based power plants (29%), electricity import (19%), and coal-based power plants (10%).
- The mitigation scenarios, PA, REI, and ST, indicated the potential to achieve an emissions reduction by 150.82 (45%), 93.0 (28%), and 52.14 (~16%) MT CO_{2eq}, respectively, compared to the BAU.



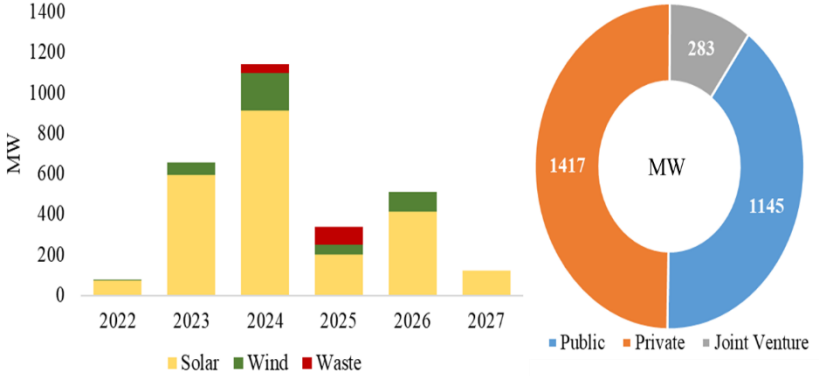
(A) Projected greenhouse gas emissions under different scenarios, and (B) total greenhouse gas emissions under different scenarios contributed by different electricity generation sources

04 Future direction

Future direction

- The depleting natural gas reserves of the country and the limited economic feasibility of increasing coal extraction or expanding hydro create challenges for the country to balance the growing demand for electricity with economic growth, NDC targets, and achieving SDGs.

- New and efficient fossil fuel-based generation technology may lower the emissions, but higher demand and generation will substantially increase the overall emissions under the BAU. Hence, a strong mitigation strategy, through the expansion of renewables, will be inevitable for higher emissions reduction.

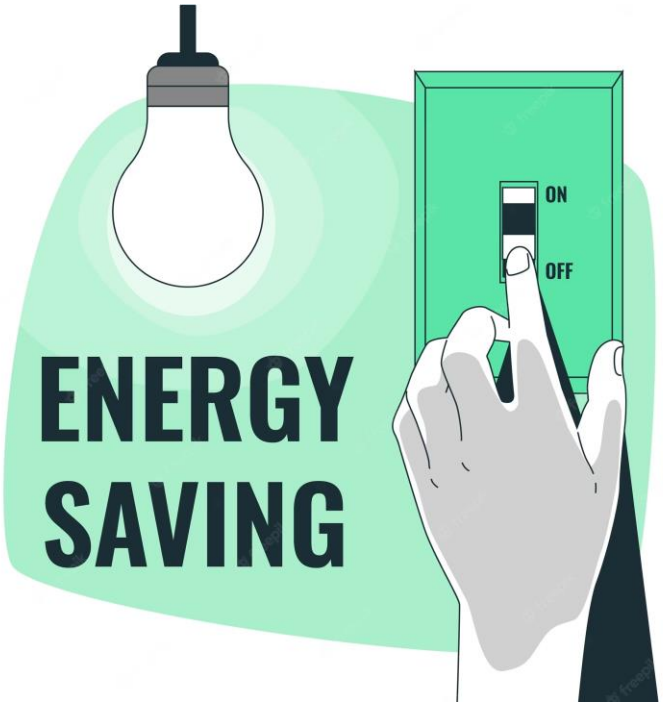


Renewable power plants to be commissioned in Bangladesh (source: Bangladesh Power Development Board)

Future direction

- If Bangladesh wants to contribute towards the Paris Agreement goal, the necessity of the accelerated adoption of renewables is apparent from the analysis. It can be achieved through a combination of supporting policy, better grid infrastructure, a secure supply chain for renewable power plants, and a sound investment environment.

- The growing electricity demand pushes increasing power generation using fossil fuel for base load. Therefore, in addition to integrating renewables, it became urgent to invest in changing consumer behaviour and technology to push energy efficiency and reduce the overall baseload electricity demand.



Thank you

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