

# Climate Change and Clean Heating

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# Supporting Partner Governments to Achieve the SDGs and NDCs



Work with developing country partner governments to achieve their **Nationally Determined Contributions (NDCs)**

GGGI's **more than 100 projects** contribute to the **Sustainable Development Goals (SDGs)**



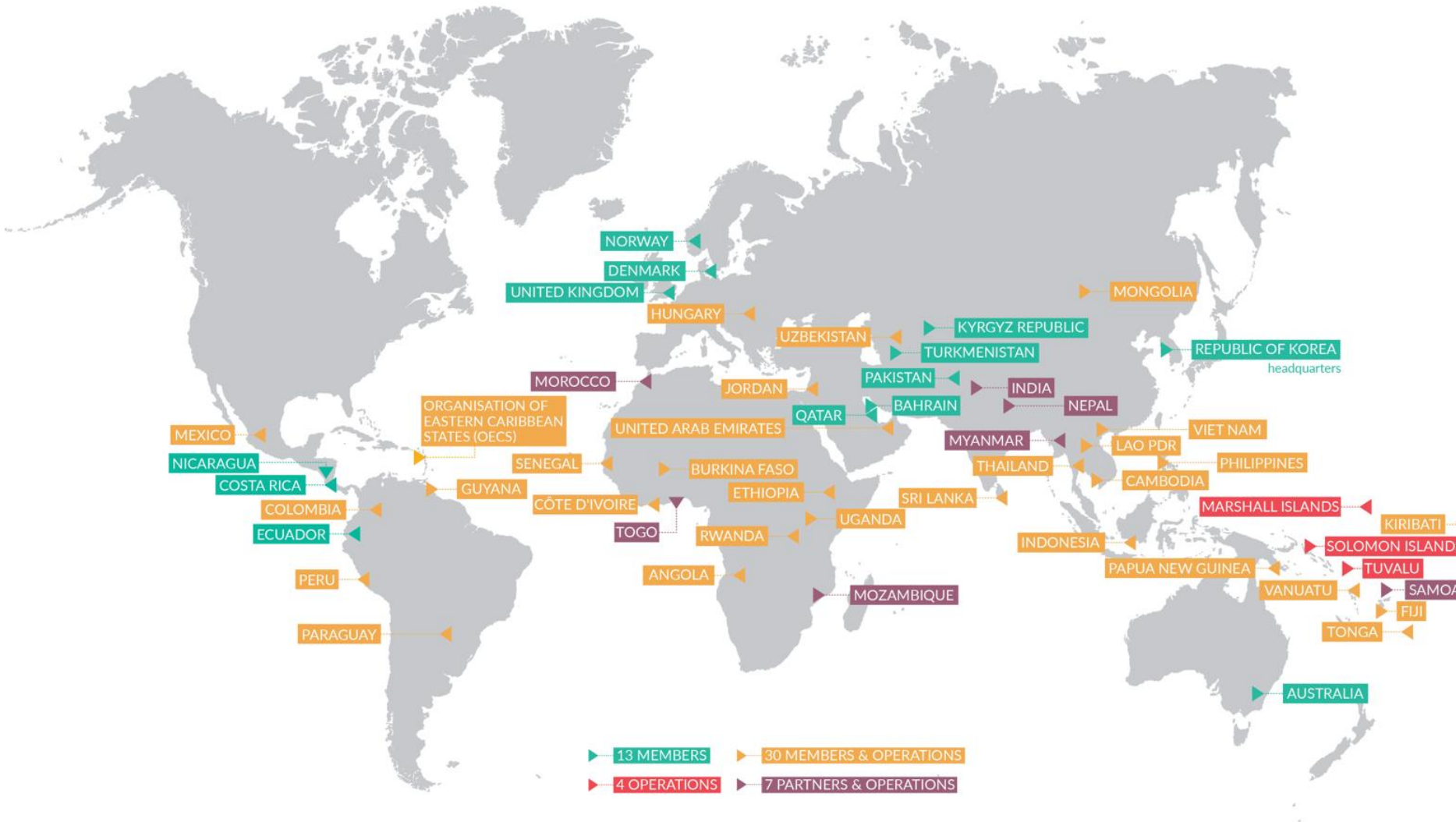
PARIS2015  
UN CLIMATE CHANGE CONFERENCE  
COP21•CMP11

NDC  
PARTNERSHIP



# GGGI at a Glance

Headquartered in Seoul, Republic of Korea, GGGI has **43 Members**.



## GGGI work in Climate Change and Clean Heating

### Work related to clean heating and climate change

- Long-term 2050 GHG Emissions Scenarios– in partnership with the SEI and NDC-Partnership (2020)
- Green Energy Development Scenarios 2035 (2015)
- Situational Analysis of Heating Sector (2017)
- Prefeasibility Studies of Green Kindergarten and Clean Heating for offgrid public school (2018)
- Energy audits to large energy users, pre-cast apartment buildings, and public buildings in major cities (2017-present)

### Investment mobilization

- Mobilized 18 mln euro for Thermal Retrofitting of **1077 pre-cast apartment blocks in Ulaanbaatar** from NAMA facility (2022)
- Played an instrumental role in the establishment of **Mongolia Green Finance Corporation** – USD 50 mln, USD 27 million from GCF and co-funding from the Government of Mongolia (2021)
- Mobilized MNT 720 mln from the **State budget to pilot** GSHP in Ulaanbaatar
- Recently developed with the Ministry of Energy a project concept note on “SHIFT: Scaling-up clean Heating Investments to Facilitate energy Transformation” (**Solar thermal heating**)

# 2050 Scenarios for Mongolia

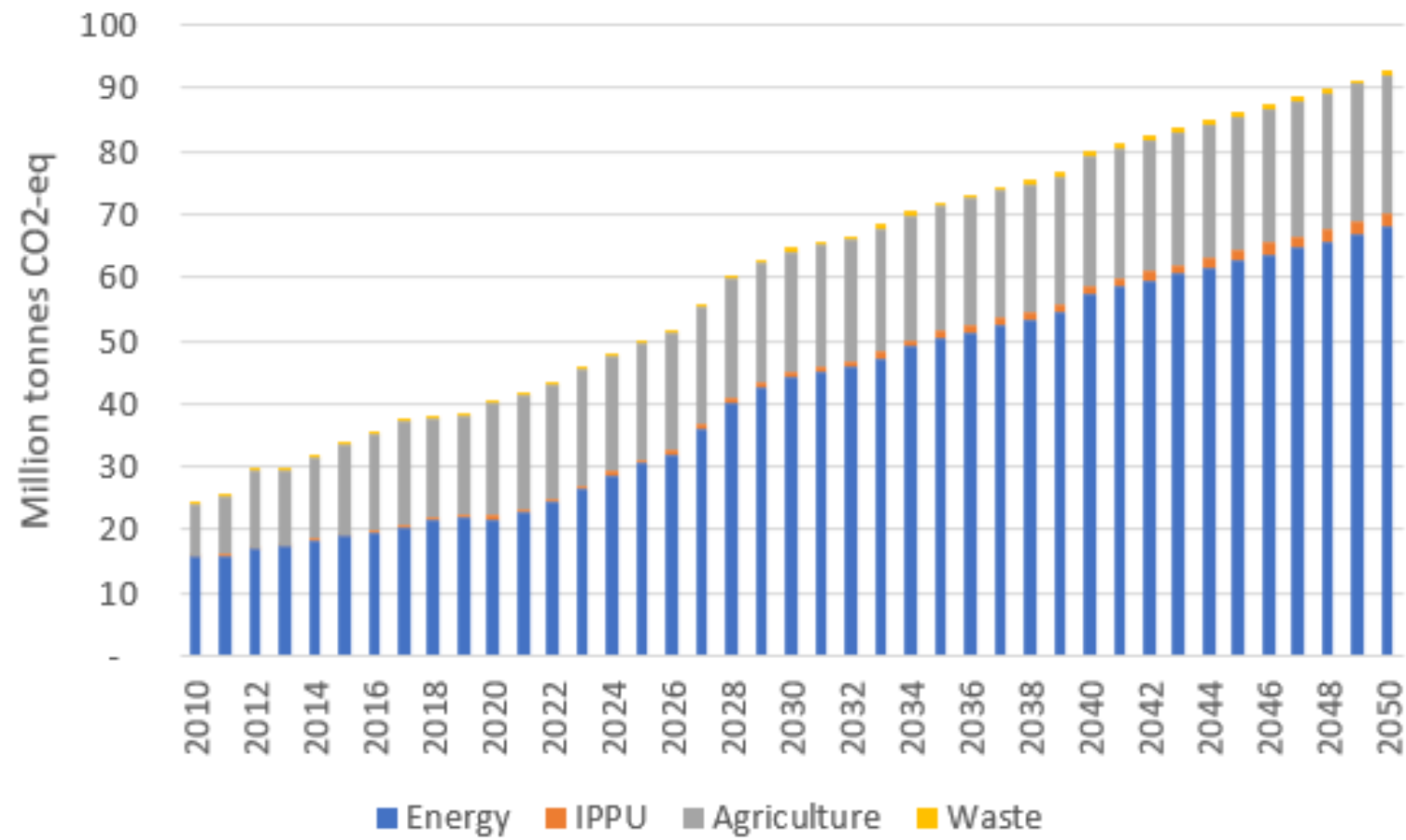


Figure 5.4: Total GHG emission projections from 2010 to 2050 for the **baseline** scenario (Units: million tonnes CO<sub>2</sub>-equivalent emissions)

# 2050 Scenarios for Mongolia

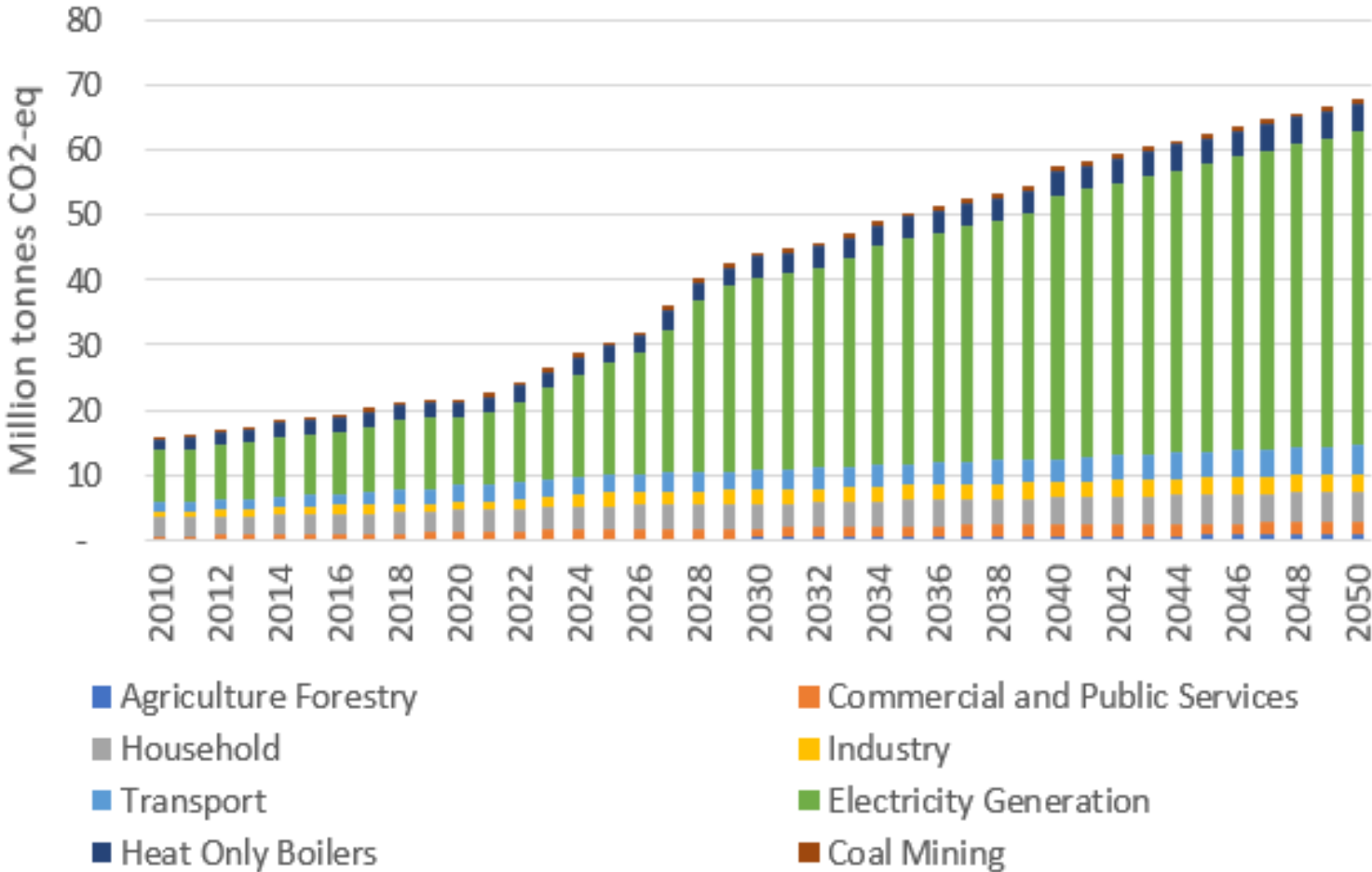
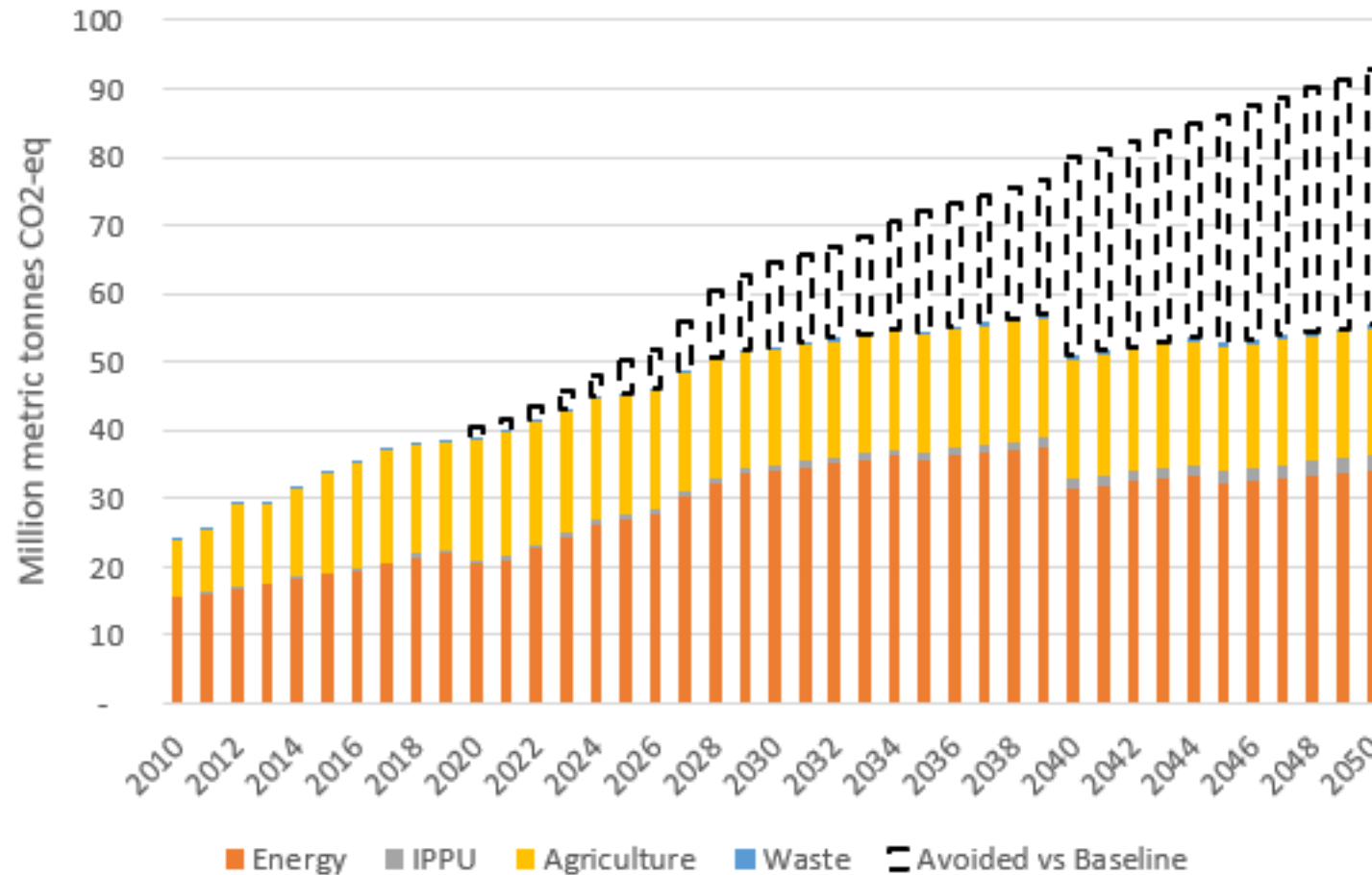


Figure 5.4: Energy-sector GHG emission projections from 2010 to 2050 for the **baseline** scenario (Units: million tonnes CO<sub>2</sub>-equivalent emissions)

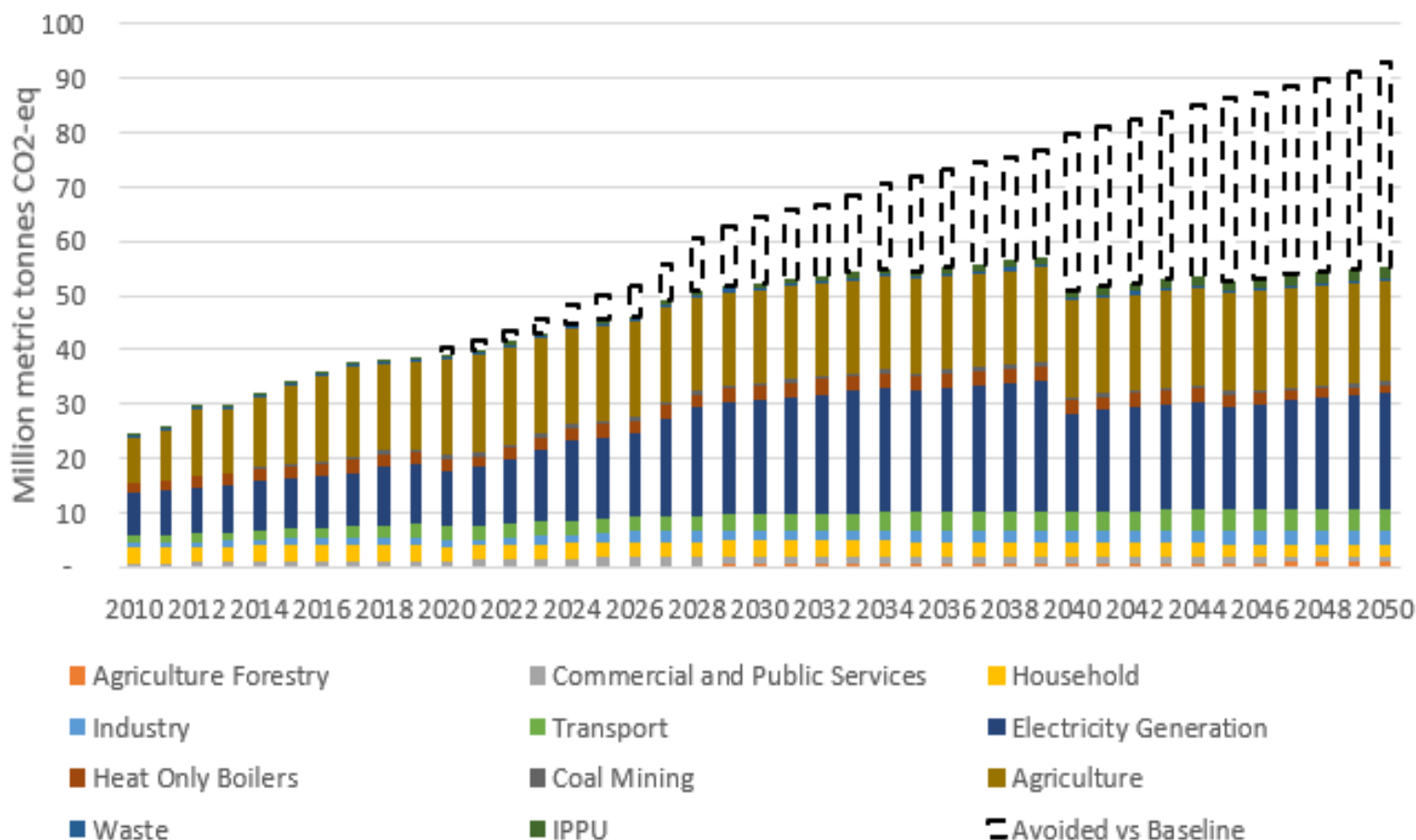
# 2050 Scenarios for Mongolia



Reduction in total GHG emissions estimated from the implementation of mitigation measures in 2030 and 2050 compared to a baseline scenario.



# 2050 Scenarios for Mongolia



Sector	2019 GHG emissions (million tonnes CO <sub>2</sub> -equivalent)	2030 baseline GHG Emissions (million tonnes CO <sub>2</sub> -equivalent)	2030 mitigation (million tonnes CO <sub>2</sub> -equivalent)	2050 baseline GHG Emissions (million tonnes CO <sub>2</sub> -equivalent)	2050 mitigation (million tonnes CO <sub>2</sub> -equivalent)
Energy	21.85	44.3	33.6 (-24%)	68.1	34.1 (-50%)
IPPU	0.50	0.84	0.8 (-5%)	2.22	2.22 (0%)
Agriculture	15.91	19.1	17.1 (-10%)	21.8	18.5 (-15%)
Waste	0.41	0.5	0.48 (-4%)	0.69	0.69 (0%)
Total	38.7	64.7	51.9 (-20%)	92.8	55.5 (-40%)

Reduction in energy sector GHG emissions estimated from the implementation of mitigation measures in 2030 and 2050 compared to a baseline scenario.



# Mongolia Country context and Climate Change Commitment



## Country Context – Energy Sector

- Mongolia's cold climate - heating for 8 months of the year
- Rich in coal, and renewable sources – wind and power
- Coal is dominant in the energy generation sector
- Complete reliance on coal based energy due to limited access to alternative technologies particularly for heat energy generation.
  - **Over 90% of total electricity and 91.4% of total thermal energy are supplied by coal-fired power plants** in Mongolia.
  - Almost **90% of total distributed thermal energy is used for space heating of commercial and residential buildings.**

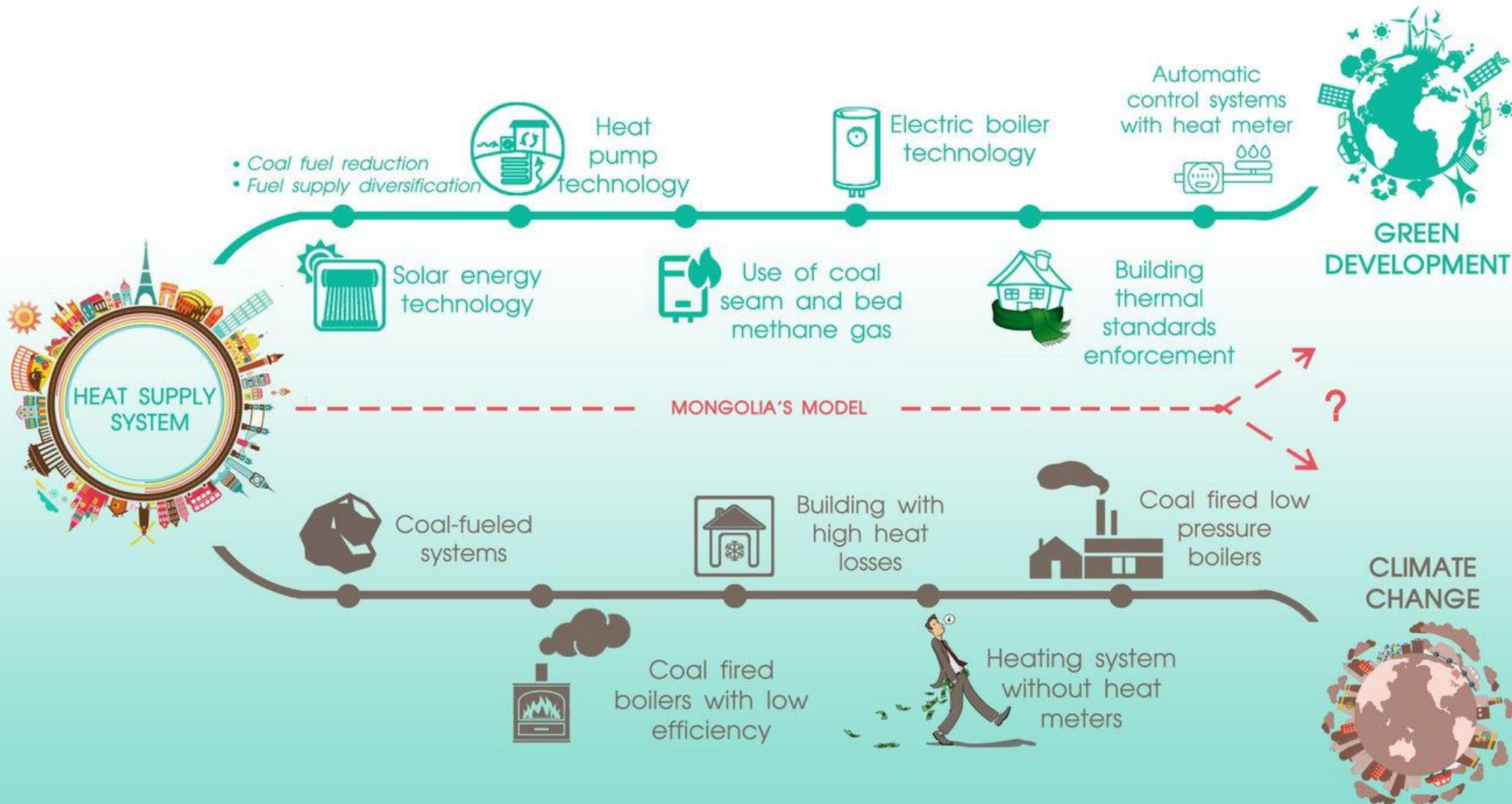
## Climate Change Commitment

- NDC, baseline GHG emissions from energy production were estimated at 15,655 GgCO<sub>2</sub> in 2020 and are expected to increase to over 26,000 GgCO<sub>2</sub> by 2030.
- NDC (and its Action plan) commits to reduce GHG emissions in the energy production sector by 8,340.5 GgCO<sub>2</sub> **(or 32%)** by 2030
- Renewable energy and improvements in the energy supply system including heat supply in province (aimag) and soum centers and use of alternative technologies such as heat pumps for space heating.

## Energy sector challenges:

- Growing energy demand at 7-8% p.a - Demand is projected to exceed the currently installed capacity in 2023
- Limited access to district heating and domestic hot water at provinces (aimags)
- *Not financially sustainable for decades* and together *the impact of the covid pandemic and current geo political situation*
- Many development partners **banning investments in coal technologies**
- With no additional capacity and the *majority of existing infrastructure having reached the end of its lifespan the energy sector cannot sustain the reliability of its operations.*
- Technical capacity of trained personnel

# Clean/Green Heating Roadmap



# Key technical conditions promote clean heating in Mongolia

- *Building Energy Efficiency (Building suitability)*– Green, Passive, Energy Efficient Buildings, Designs, retrofitting to reduce building heat loss
- *Higher COP technologies* such concentrated solar, ground source heat pumps – pilot, scale it up
- *Alternative clean heating technologies combined with other technologies such as electric boilers, thermal storage* to ensure thermal comfort and reliability in very cold winter

# Clean Heating and Building Energy Efficiency

*reduce heat loss of existing buildings, renovate and construct efficient new buildings*

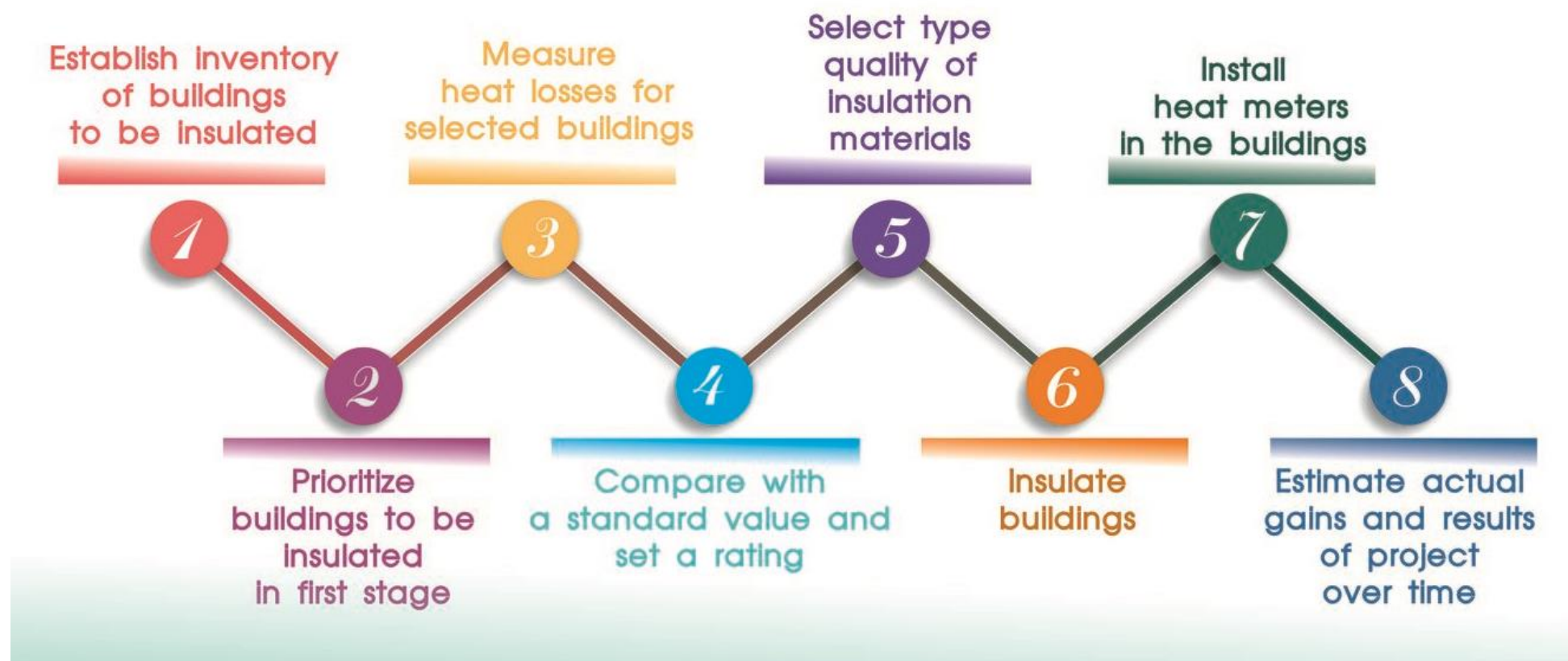
- IPCC estimated that 30% of global emissions come from urban areas and 7 out of 10 will be living in cities by 2050.
- Vision -2050, Long Term Development Policy and NDC aims **to reduce building heat loss by 40% by 2030 and mainstream green building concepts across public buildings**
- In Mongolia, 6 out of 10 about to live in cities by 2045 (NSO, 2017)
- **Building sector of Mongolia emits around 1/3 of GHG Emissions** by consuming 56% of thermal and 38% of power energy (MCUD, 2021)



Source: GIZ



# Actions to reduce building heat loss of existing buildings



# Pilot project #1 – Green kindergarten



- GGGI developed the Green Building Blueprint for 125-children Public Kindergarten (2015)
- Location: Songinokhairkhan district, Ulaanbaatar city
- Emission reduction **92-120tons CO<sub>2</sub>-eq/year from shifting from 68-89 tons of coal** for space heating



Source: MEDS, <https://www.meds.gov.mn/?p=7941>



# Construction– ongoing since 2019



*Green kindergarten Construction by  
Renderbau LLC, 10 August 2021  
Source: BT LLC, 2021*

Funding Source: ADB – Sustaining Access to and Quality of Education During Economic Difficulties Project  
<https://www.adb.org/projects/50091-002/main>

**Total investment: \$697.750** Source: <https://www.meds.gov.mn/?p=7941>



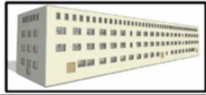
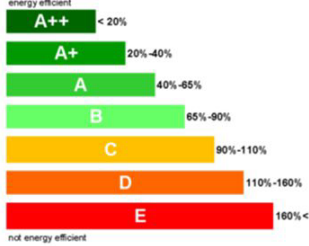

# Building energy performance



- Energy Conservation Law (2015) created enabling environment to accelerate transition to Green and Sustainable Buildings:
  - Building Energy Auditors (24) trained and certified;
  - Designated Energy Users (197) are listed, including 74 public and other buildings
- Procedure to issue Building Energy Performance was approved in 2021.

GGGI undertaken energy audits to 25 public buildings in three cities of Mongolia against BNAR 25-01-20 " Building Thermal Performance" and in line with the draft procedure of Building Energy Performance Certificate requirements.

- **Energy demand of 72% (18)** of the audited buildings **is higher than the standard value** – certified as D class buildings (**not energy efficient**). 72% of the building stock needs retrofiting which to increase by 2030.
- **Only one building met** the **normative level of the new building-**constructed in 2013.
- **Buildings are constructed between 1962-1986** (except 3).

BUILDING ENERGY PERFORMANCE CERTIFICATE			
Registration number:		Issued date: 12/18/2020	Valid date:
Type of certificate: Type of building: Name of Building: Year of commission:	Existing Office Health center-2 1986		
Address of building			
City/aimag: Khoroo/Bag Name of street:	Darkhan city 0	District/Soum: Building number: Zipcode:	Darkhan Health center-2 45040
Building energy classification			
	Normative / Baseline kWh/(m3.a)	Design / Real kWh/(m3.a)	Difference %
		32	
		57	175
Specific building energy demand:		207	kWh/(m <sup>2</sup> .a)
Annual building Energy demand:		943429	kWh/a
Name of auditor: E-mail Signature		Munkhbayar buyadbm@gmail.com 99069903	
Issued organisation:			
Logo of issued organisation		Issued based on below legal documentation:	

# Pilot project #2 - Clean heating for off-grid public school



- GGGI developed PFS of the alternative clean heating solution to replace coal-fired boilers with ground-source heat pump in 2018
- 3500 sq.meter, EE C level, 4F building, constructed by JICA
- Government of Mongolia funding of MNT 720 mln
- Commissioned in 2019
- 120 m deep 24 boreholes of 174kW
- GHG Emission Reduction: 133 tons CO<sub>2</sub>-eq/year



*Public School 122, Ground-Source Heat Pump Pilot Project, GGGI  
Business Case, Ulaanbaatar  
Source: GGGI Consultant*

# Key lessons learned



Enabling Environment is important to reduce heating and cooling demand of public buildings and scale up clean heating technologies!

- **Country ownership and involvement of relevant stakeholders in design and scoping phase is a key!**
- **Incentives and energy tariff** –Measure and verify heat savings, introduce consumption based tariff (phase out flat energy tariff based on volume/area)
- **Acknowledge some level of resistance** and hesitance from the energy suppliers and users and **build trust** to alternative technologies (including technology providers) – at some aimags, *distribution network has mixed ownership* that create challenges to introduce new technologies
- **Capacity building and awareness** – especially, viability, cost and benefits of clean technologies, **sectoral trained personnel, especially at subnational level**, policy makers and public
- Country tested electric and gas heating at off-grid schools and kindergartens, not much work around clean district heating

# Moving on



## Regulatory/Structural

- *Adopt long-term strategy to transition to clean heating and respective rules and regulations*
- *Strengthen capacity and awareness about multi-benefits of clean heating solutions*
- *Integrate clean heating and air pollution reduction targets in policy and planning*
- Change consumer behavior and develop supply chains

## Technically:

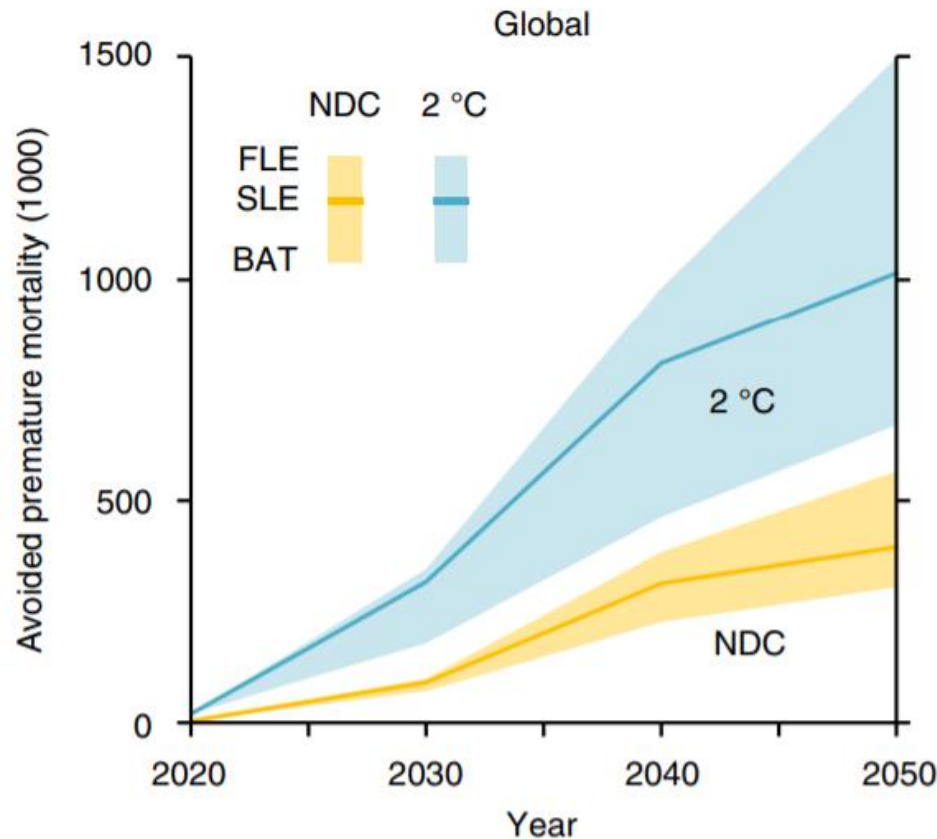
- Demonstrating the viability of clean heating options, especially for district heating through **piloting reliable technological solutions**, including provinces and **collect good quality data from pilot projects**
- **Reduce building heat loss of old buildings (suitability of buildings)**, and increase green, passive and energy efficient buildings
  - GGGI recently developed with the Ministry of Energy a project concept note on “SHIFT: Scaling-up clean Heating Investments to Facilitate energy Transformation” (**solar thermal heating**)

## Financially:

- Identify affordable financial solutions such as incentives to promote clean heating to reduce higher upfront investment costs and lower operating costs through Renewable Energy Fund etc
- Energy tariff

*Wait, let us not forget about the air pollution, and climate change*

# Air pollutant reductions due to CO2 mitigation



Over 1 million premature deaths avoided in 2050 if Paris target is achieved

Vandyck et al. 2018





# Air Pollution and Climate Change?



## AIR POLLUTANTS

Nitrogen Oxides (NO<sub>x</sub>)  
Non-methane Volatile Organic Compounds (NMVOCs)  
Sulphur Dioxide (SO<sub>2</sub>)  
Ammonia (NH<sub>3</sub>)  
Particulate Matter (PM<sub>2.5</sub>, PM<sub>10</sub>)  
Carbon Monoxide (CO)  
Heavy metals  
Persistent Organic Pollutants (POPs)

## SHORT-LIVED CLIMATE POLLUTANTS

Black Carbon (BC)  
Tropospheric Ozone (O<sub>3</sub>)

## GREENHOUSE GASES

Methane (CH<sub>4</sub>)  
Hydrofluorocarbons (HFCs)  
Carbon Dioxide (CO<sub>2</sub>)  
Nitrous Oxide (N<sub>2</sub>O)  
Perfluorocarbons (PFCs)  
Sulphur Hexafluoride (SF<sub>6</sub>)  
Nitrogen trifluoride (NF<sub>3</sub>)  
Chlorofluorocarbons (CFCs)  
Hydrochlorofluorocarbon (HCFCs)



# Thank You

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