Assessing GHG and SLCP emissions from urban city services in Indonesia: a co-benefits analysis and case study on wastewater

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Highly Potent Short-Lived Climate Pollutants—Sources and Impacts

POLLUTANT	SOURCES	MAJOR IMPACTS
BLACK CARBON	black coal; diesel exhaust; biomass for cookstoves	local; regional
METHANE	natural gas; livestock; landfills	global
TROPOSPHERIC OZONE	CH_4 methane; CO carbon monoxide; NO nitrogen oxide; VOCs volatile organic compounds	local; regional
HYDROFLUORO-CARBONS	air conditioning; refrigeration	global

Source: The Climate and Clean Air Coalition.
Notes: Black carbon and tropospheric ozone also have a small global impact; methane also has small local and regional impacts.

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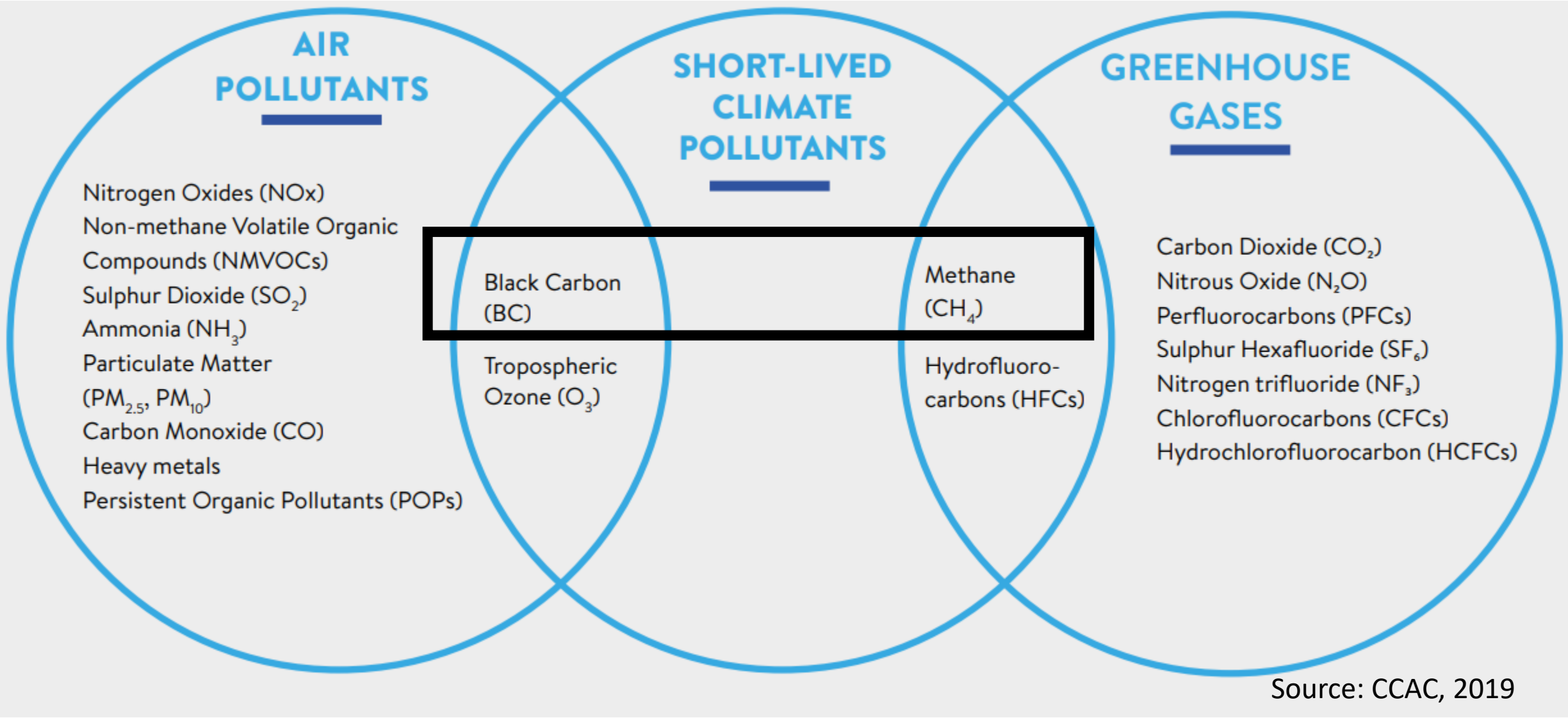
Air Pollution and Climate Change Linkages



Source: CCAC, 2019

Air pollution is increasingly being compared to smoking

The health impacts of pollution globally are about the same as smoking

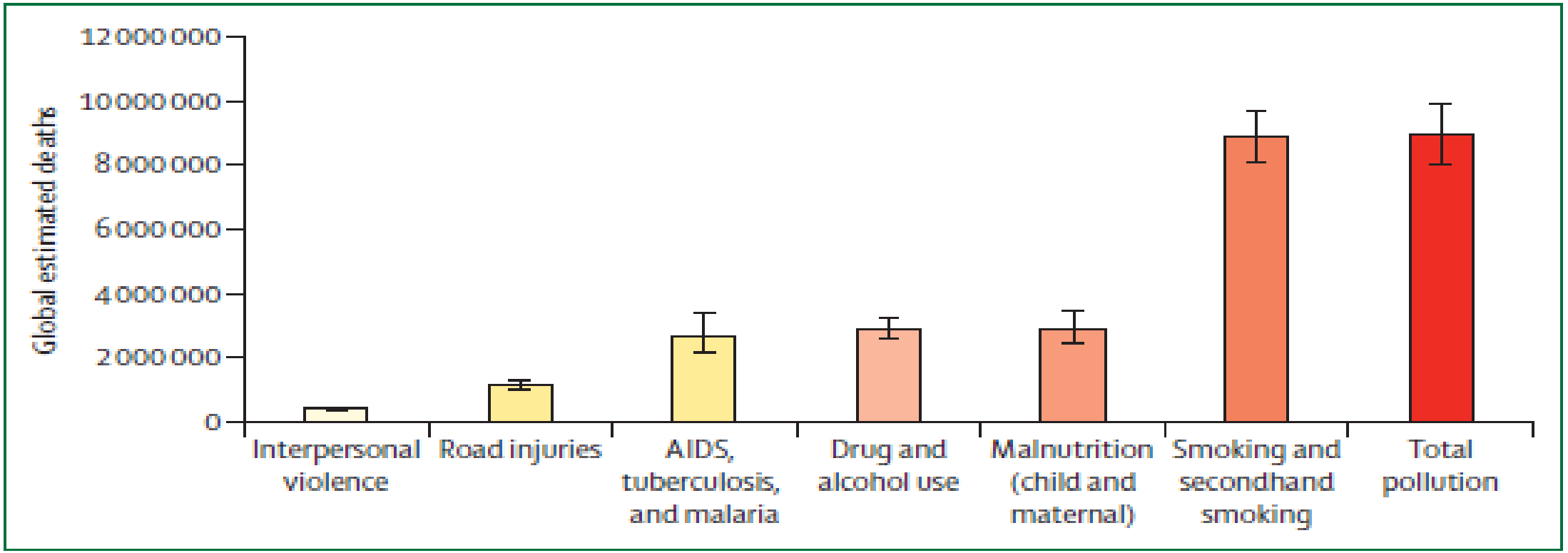


Figure 1: **Global estimated deaths by major risk factor or cause**

Data from Institute for Health Metrics and Evaluation and Global Burden of Diseases, Injuries, and Risk Factors Study 2019.[6] Error bars are 95% CI.

SLCP Impacts

There are several tools that can help understand these impacts

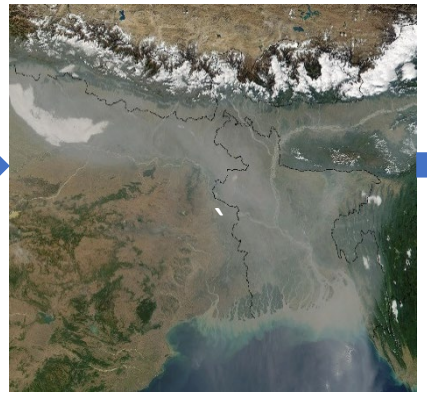
- Cross-sectoral
  - SEI-LEAP-IBC
  - IIASA-GAINs
  - NIES-AIM

- Sector Specific
  - Kyushu Univ (with training with IGES)-Wastewater, Solar Energy, Heat Only Boiler
  - IGES (EQT)-Waste Management
  - Clean Air Asia-Transport

Cross-Sectoral—
LEAP IBC and GAINs

LEAP-IBC: Tool for integrated air pollution and climate change mitigation assessment

Emissions



Transport

Exposure

Impacts: Climate

Impacts: Health and vegetation

Source: SEI, https://leap.sei.org/

LEAP in Thailand

Source: SEI and IGES, 2022
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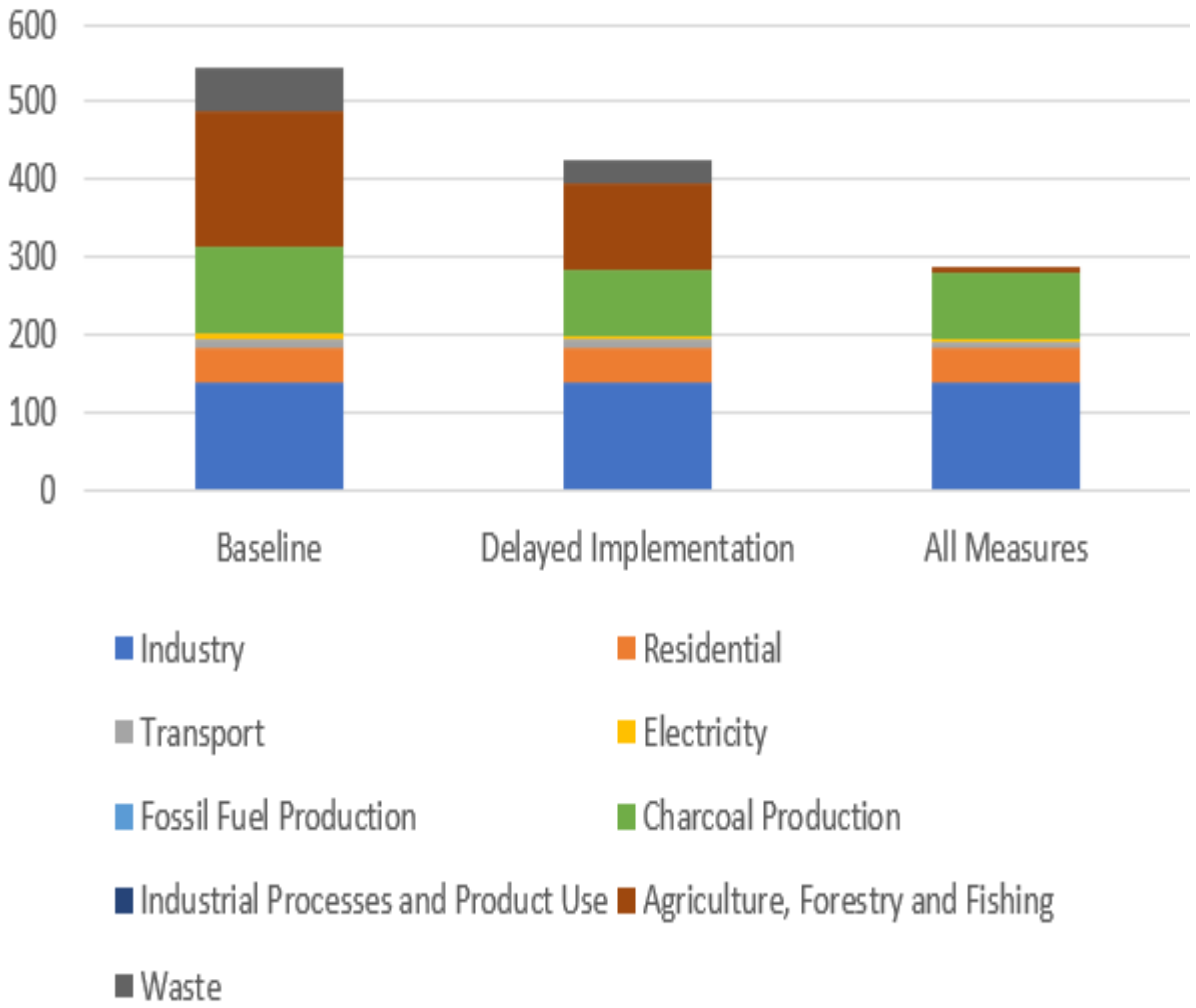
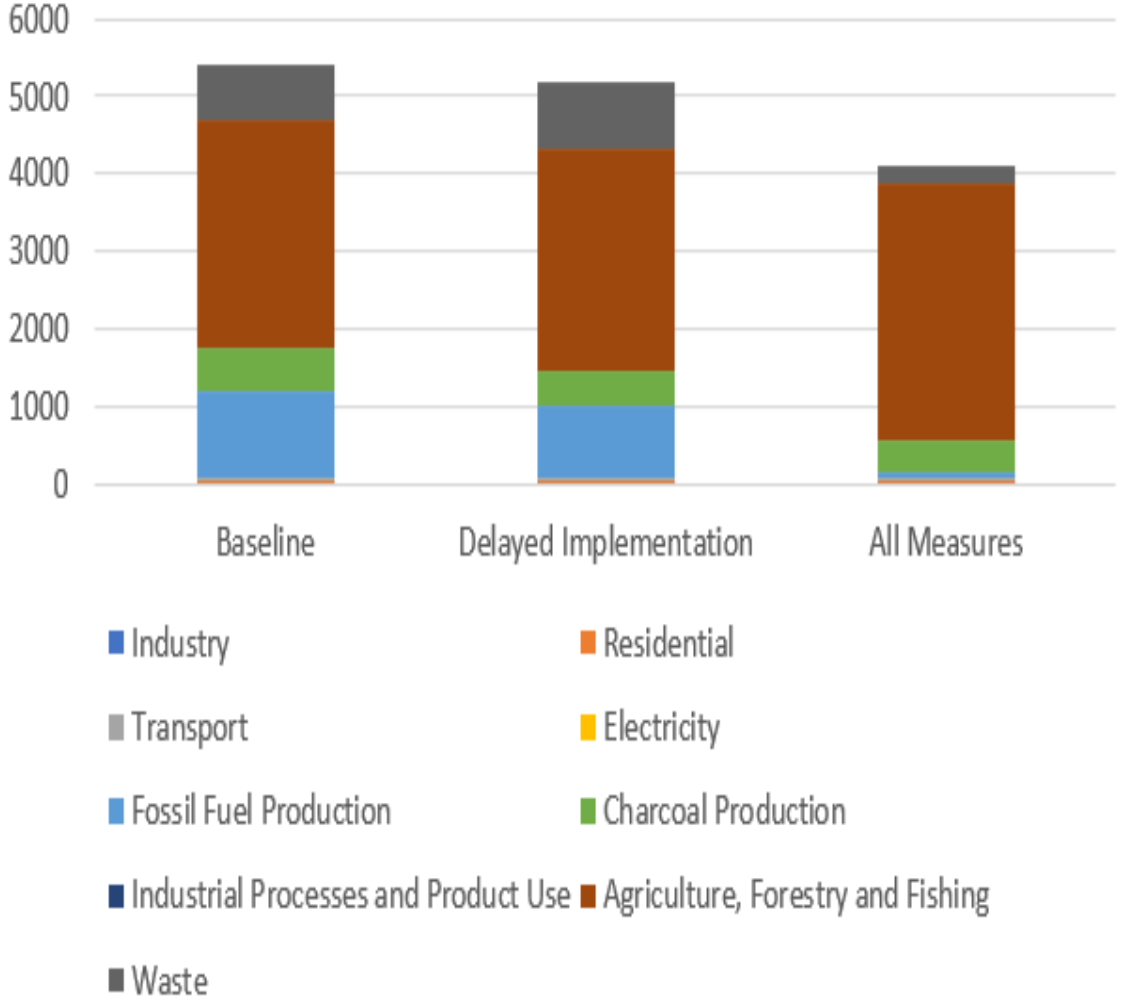
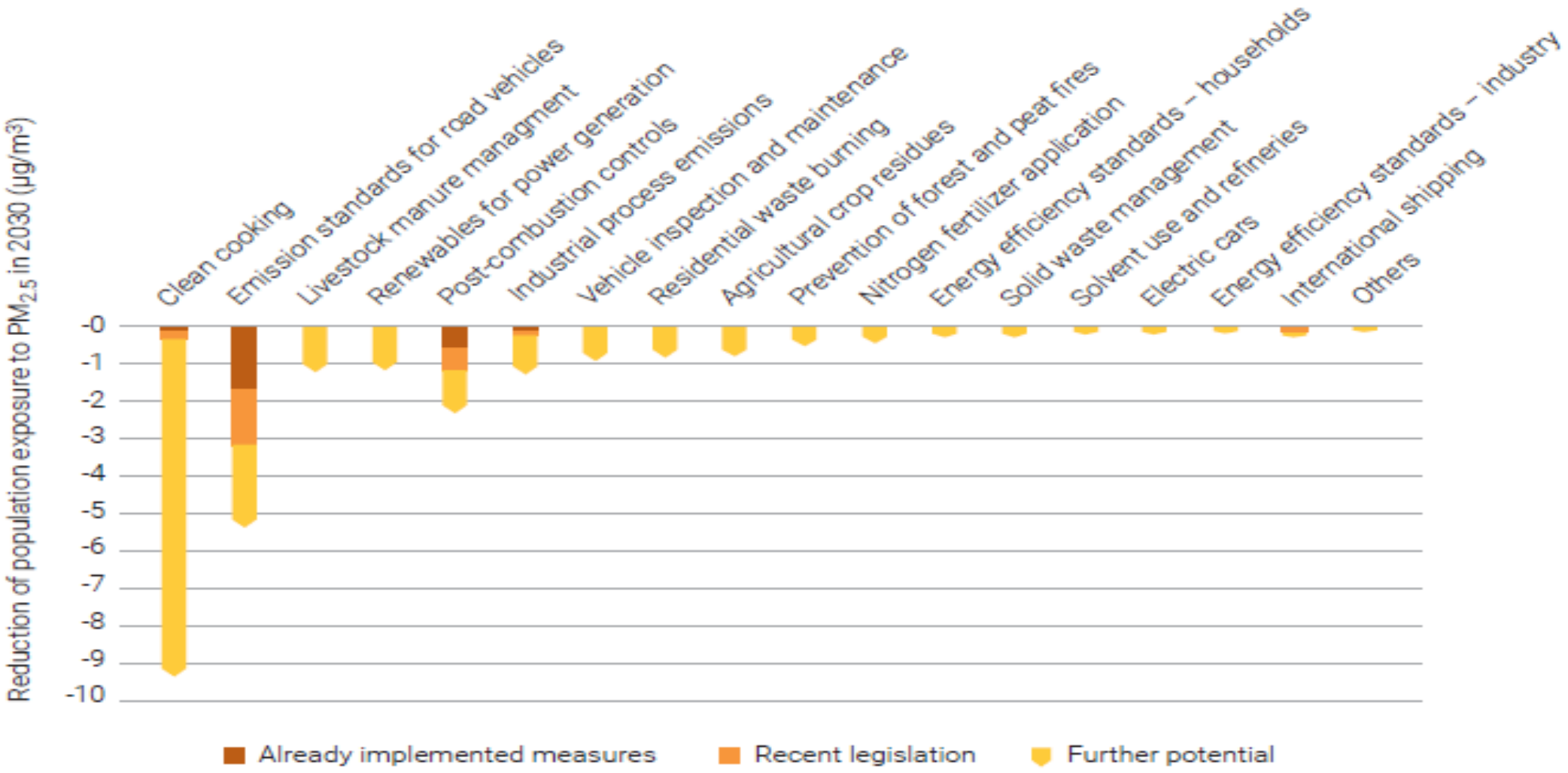


$PM_{2.5}$ emission in 2030 for the baseline, delayed implementation and all measures scenarios



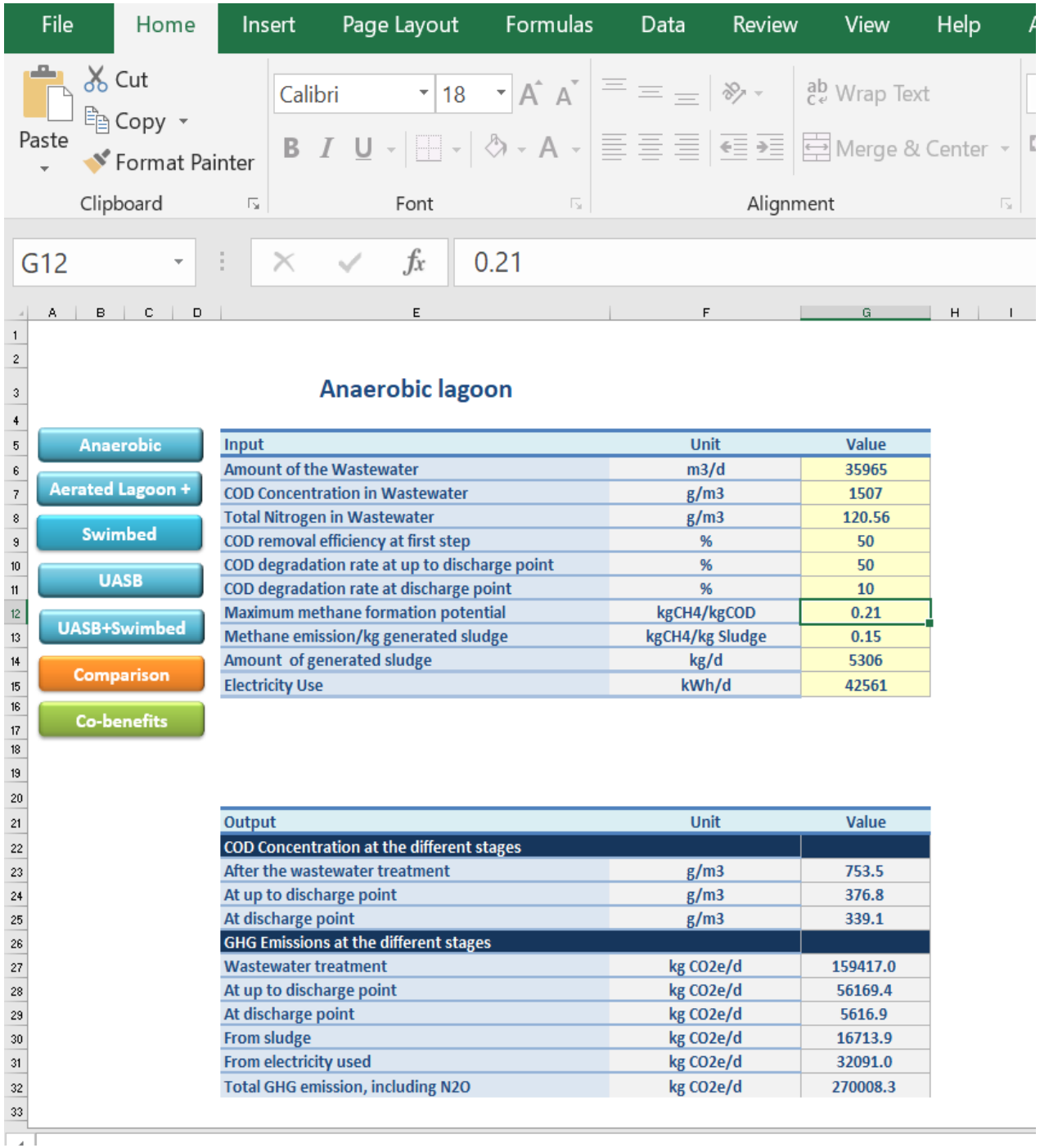
CH_4 emission in 2030 for the baseline, delayed implementation and all measures scenarios

Outputs from GAINs for all of Asia



Source: UNEP and APCAP, 2019

Sectoral—
Wastewater and Solar Energy



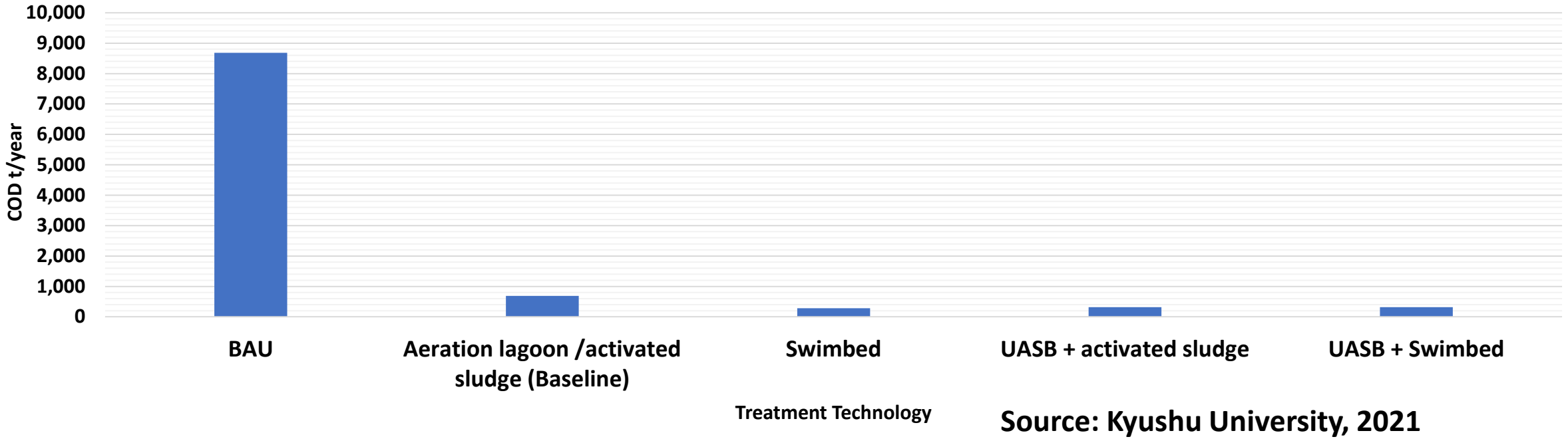
Wastewater Management Tool

Can be used to look at industrial wastewater management in Indonesia

Source: Kyushu University, 2021

Reduction in COD

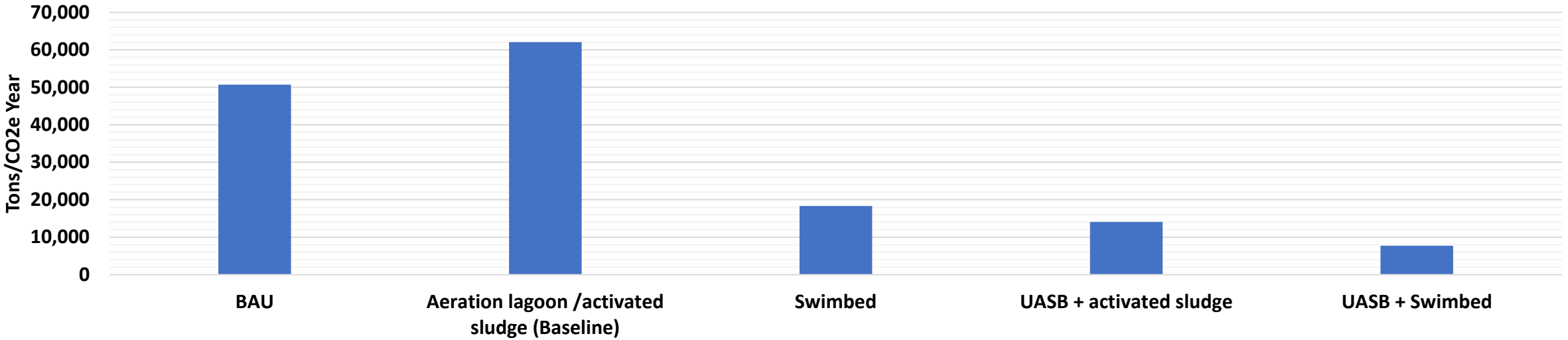
Scenarios	BAU	Aeration lagoon /activated sludge (Baseline)	Swimbed	UASB + activated sludge	UASB + Swimbed
COD t/year	8,685	686	285	317	317
Percentage reduction in COD	--	92.1	96.7	96.4	96.4



Source: Kyushu University, 2021

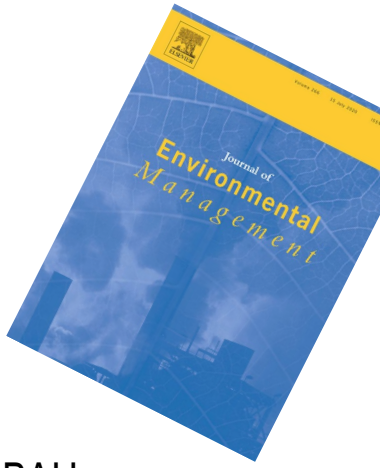
Amount of GHGs (t-CO_2e/year)

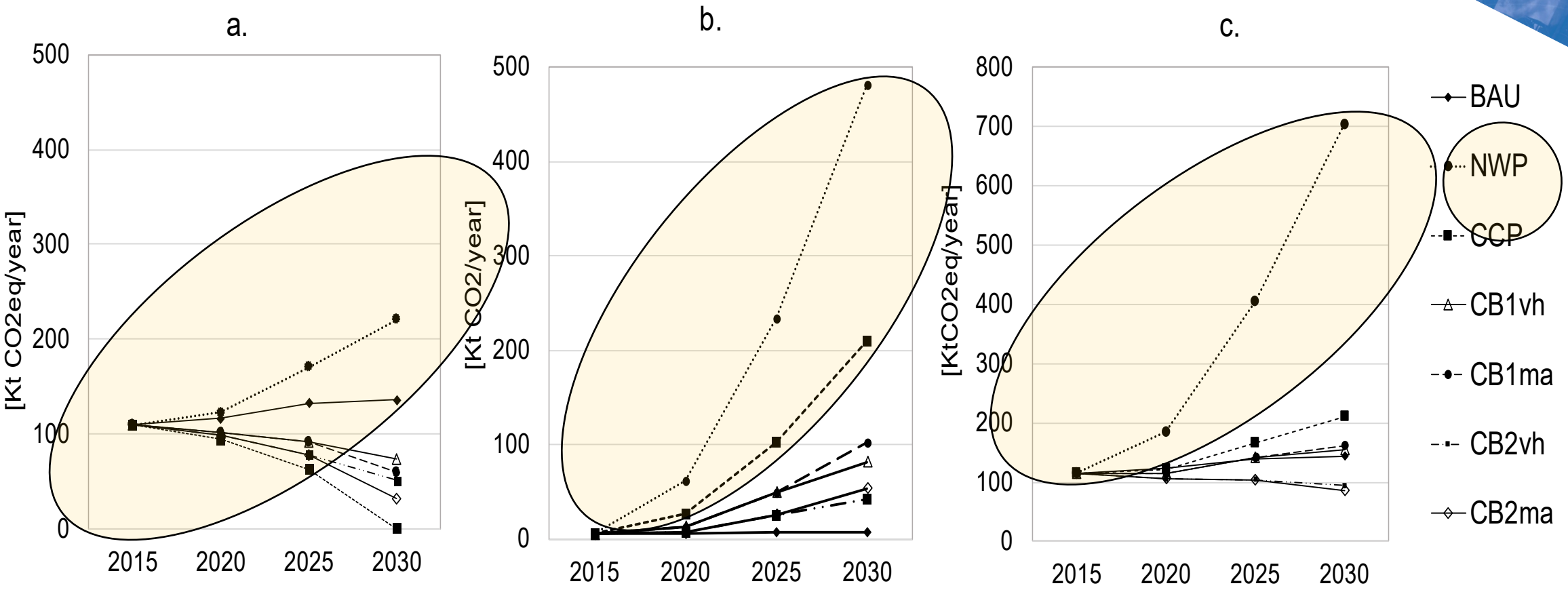
Scenarios	BAU	Aeration lagoon /activated sludge (Baseline)	Swimbed	UASB + activated sludge	UASB + Swimbed
GHGs	50,715	62,059	18,294	14,047	7,686
Percentage reduction in GHGs	--	-22.4	63.9	72.3	84.8



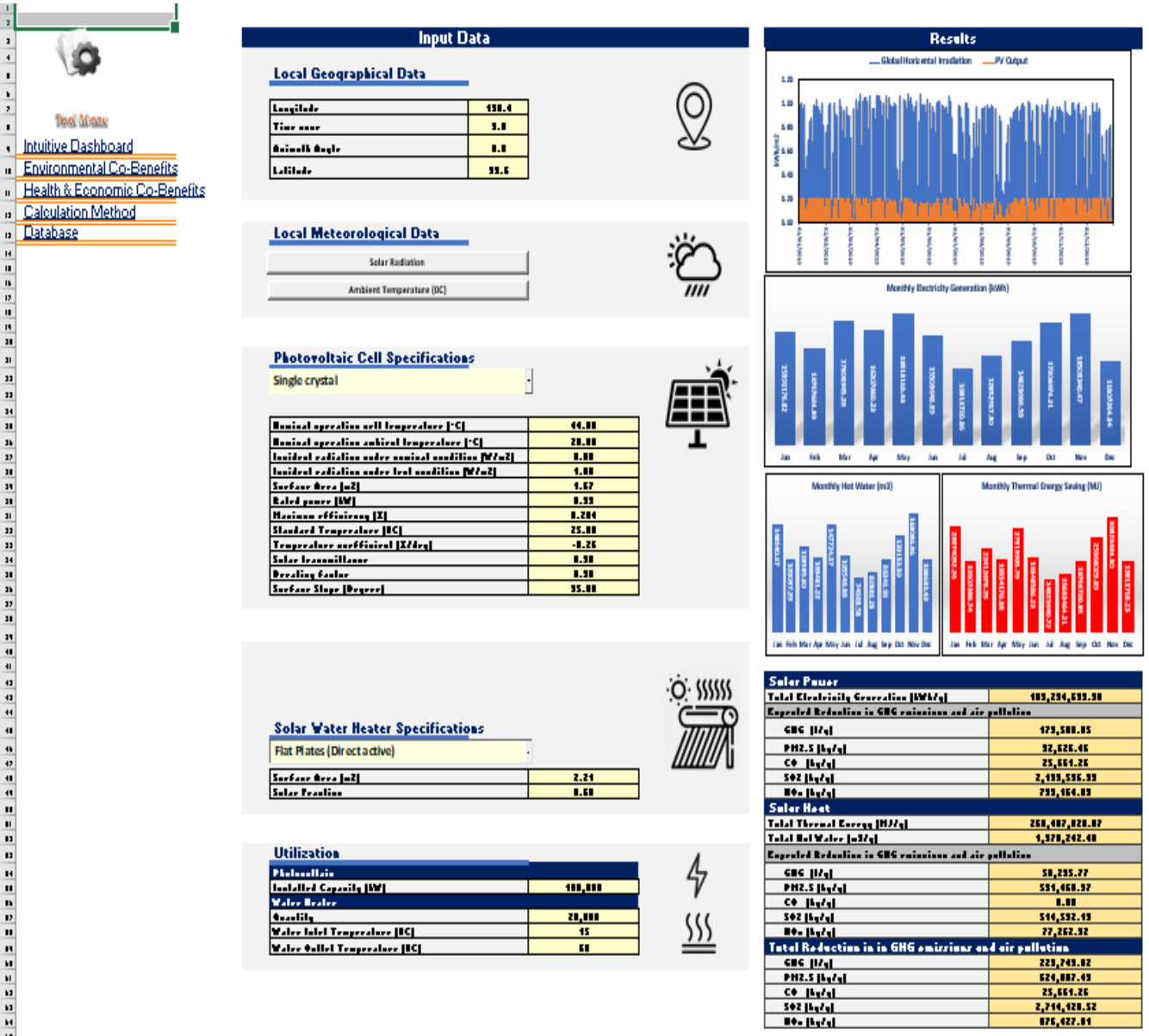
Source: Kyushu University, 2021

Indonesia: Multi-level Governance Required to Achieve Climate Benefits in Fish Processing





Gómez-Sanabria A, Zusman E, Höglund-Isaksson L, Klimont Z, Lee S-Y, Akahoshi K, Farzaneh H, & Chairunnisa (2019). Sustainable wastewater management in Indonesia's fish processing industry: bringing governance into scenario analysis. *Journal of Environmental Management*.



Solar Energy Tool

Can be used to look at co-benefits of solar energy installations

Source: Kyushu University, 2021

Regional Action Plan for West Java Greenhouse Gas Emission Reduction 2010 - 2030

Forestry

- Rehabilitation of critical land and mangroves
- Forest protection and security

Agriculture

- Aplication of the fertilization system
- Cultivation Technology

Energy

- Renewable energy development
- Fossil Fuel Substitution
- Energy efficiency

Transportation

- ITS/ATCS development
- Bus Rapid Transit (BRT) Development
- Rejuvenation of general transportation
- Car Free Day
- Smart Driving Training
- Parking Management

Waste and Domestic Waste

- Rehabilitation of open dumping landfill
- Development and operation of regional TPPAS
- Construction and operation of TPS3R
- Construction and operation of Waste Bank
- Sludge Treatment Plant Construction
- Construction and Operation of Sanimas (MCK++ or WWTP)

13,5 Million tonnes CO2eq Emission Reduction

9,94% of BAU Baseline Projection in 2030

Source: West Java RAD-GRK (Governor Regulation No. 56/2012) which was reviewed in 2016 and 2018

Source: Prima Mayaningtias

There is significant potential for solar PV in Bandung

Figure 6. Hourly solar PV with hillshade analysis.

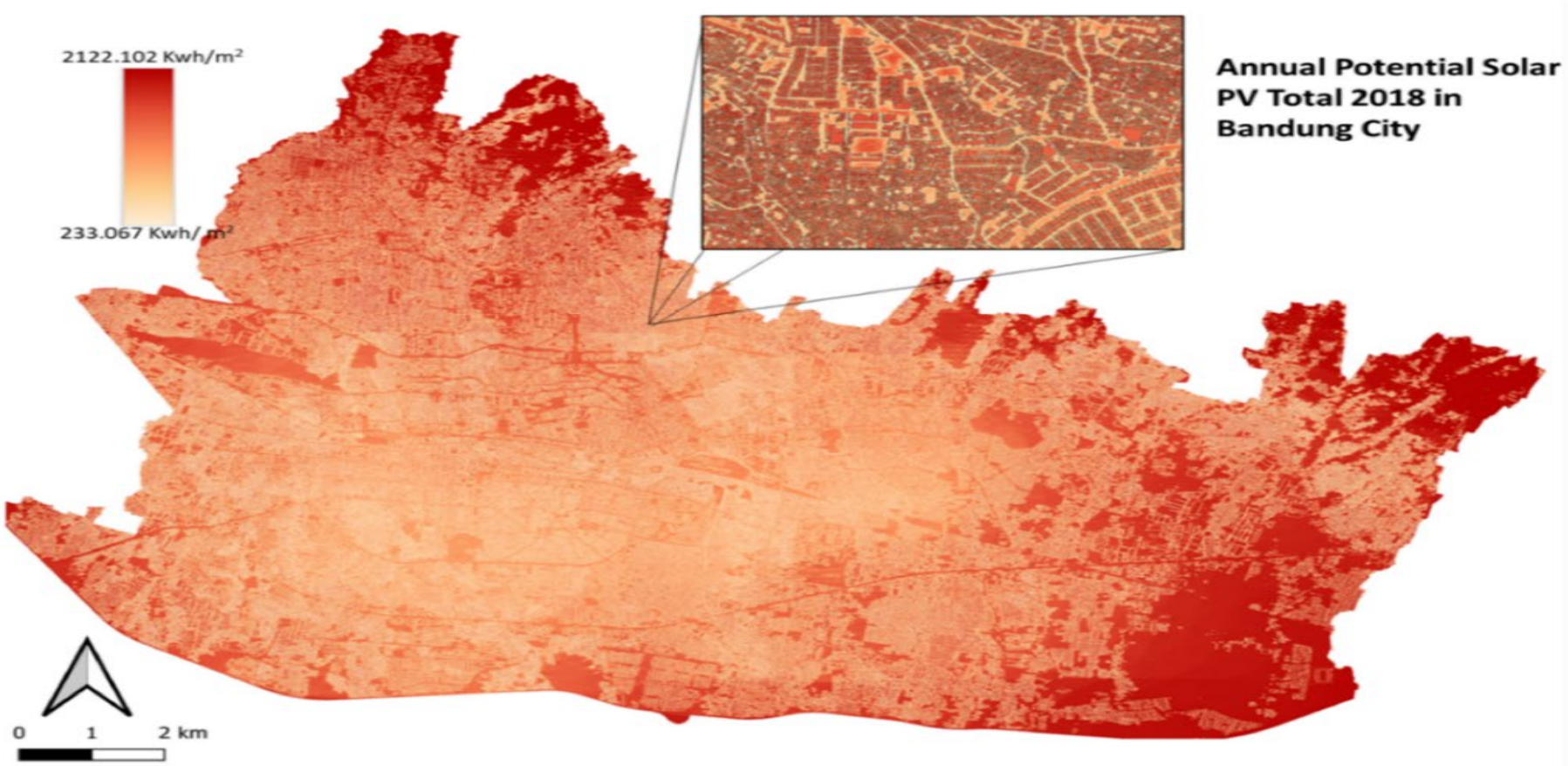
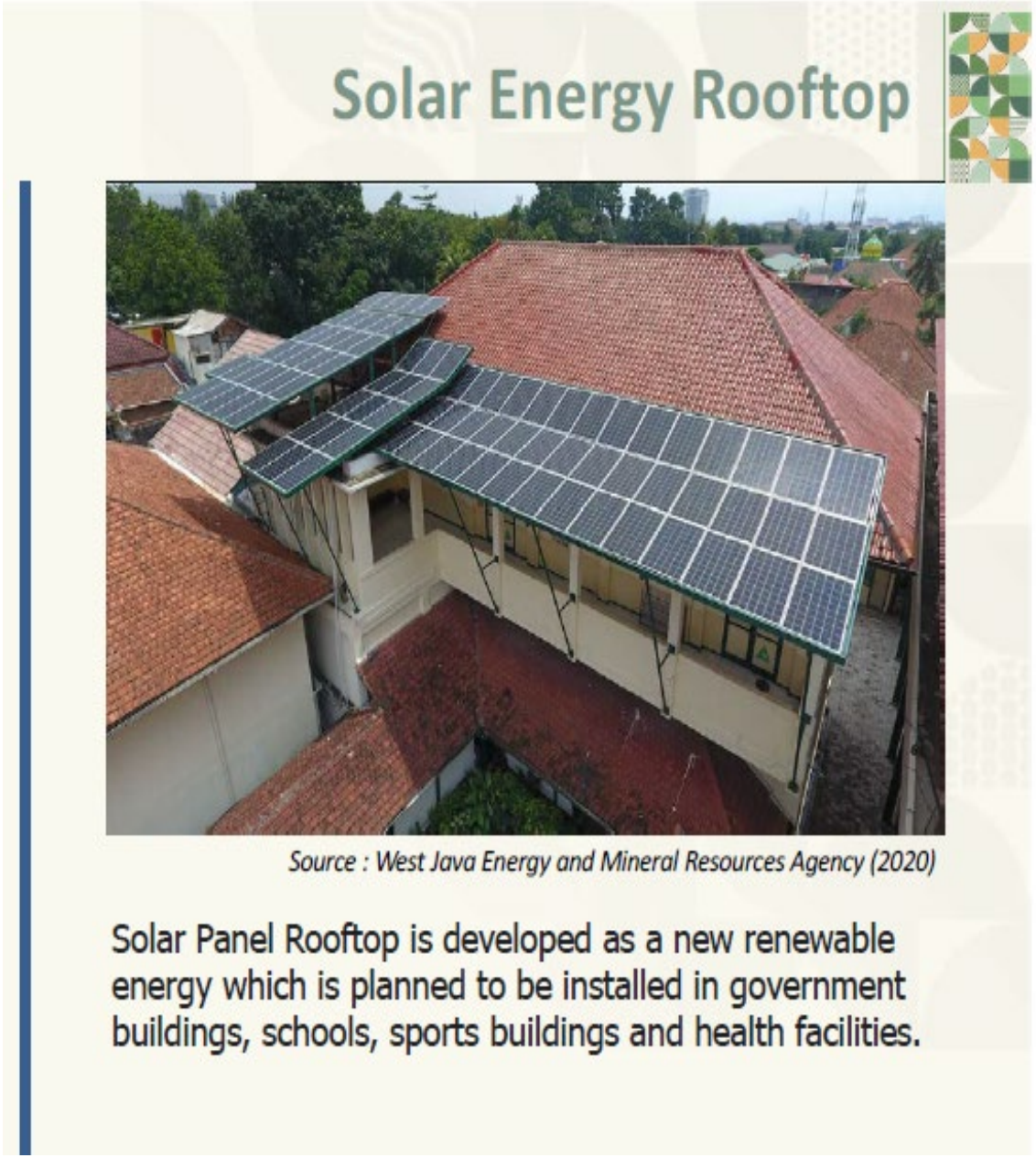


Figure 7. The annual potential of solar PV energy in Bandung.

Source: Anjar Dimara Sakti, 2022



Source: Prima Mayaningtias

- Bandung has 849,421 state electricity company (PLN) customers
- Energy consumption in 2018: 1,585,382 MWh
- High-end residential developments are required to cover at least 25% of their rooftop with solar PV

Source: Anjar Dimara Sakti, 2022

Source: Tool developed by Kyushu University and analysis by IGES, 2022
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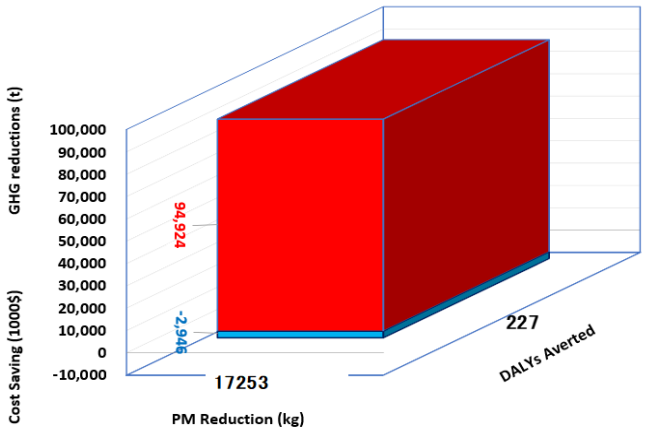
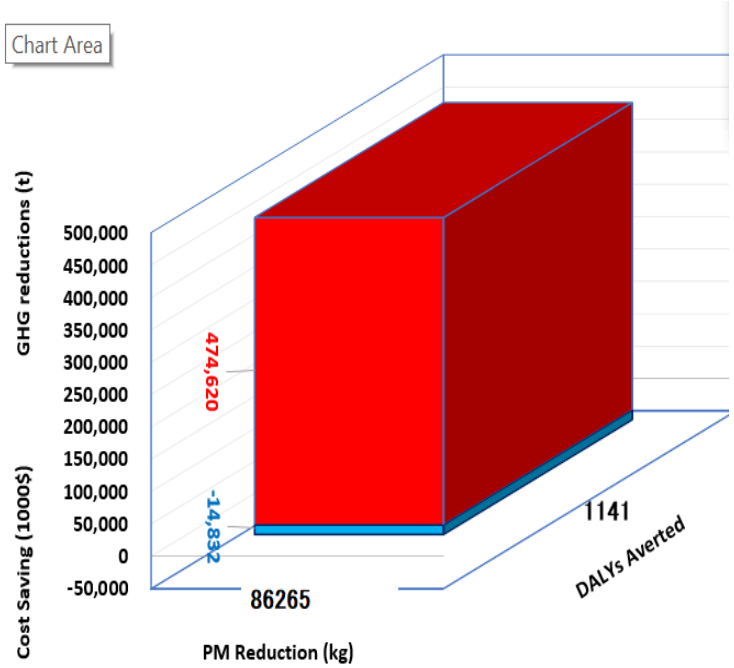
Estimated co-benefits of installation of solar pv in residences in Bandung (2022-2032)



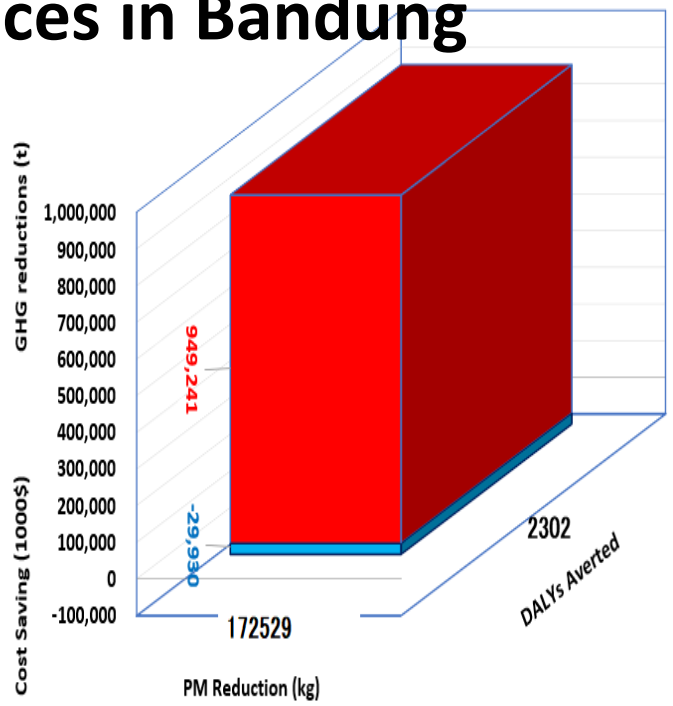
Avoided Emissions	Solar
GHG (t/y)	9,492.4
PM2.5 (kg/y)	1,725.3
CO (kg/y)	1,357.0
SO2 (kg/y)	116,311.7
NOx (kg/y)	42,259.9

2022
Total Energy: 60,000 kW/year
Units: 85,000



Avoided Emissions	Solar
GHG (t/y)	474,620.4
PM2.5 (kg/y)	86,264.5
CO (kg/y)	67,848.5
SO2 (kg/y)	5,815,587.4
NOx (kg/y)	2,112,996.7

2026
Total Energy: 300,000 kW/year
Units: 425,000



Avoided Emissions	Solar
GHG (t/y)	949,240.7
PM2.5 (kg/y)	172,529.1
CO (kg/y)	135,697.0
SO2 (kg/y)	11,631,174.7
NOx (kg/y)	4,225,993.5

2032
Total Energy: 600,000 KW/year
Units: 850,000