D2: Report of mitigation analysis including conditional and unconditional scenarios using the GACMO tool

UN environment programme
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ICAT Initiative for Climate Action Transparency

Ministry of Natural Resources and Environment
Matagaluega o le Puna'oa Faalenatura ma Siosiomaga

Initiative for Climate Action Transparency - ICAT

Report on mitigation analysis including conditional and unconditional scenarios using the GACMO tool

Deliverable 2

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Date 7 April 2025

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PREPARED UNDER

The Initiative for Climate Action Transparency (ICAT), supported by Austria, Canada, Germany, Italy, and the Children's Investment Fund Foundation.

The ICAT project is hosted by the United Nations Office for Project Services (UNOPS).

Table of contents

List of Tables and Figures

Executive Summary

The GACMO analysis for Samoa reveals significant potential for greenhouse gas (GHG) mitigation through strategic interventions across multiple sectors. This study provides a data-driven framework for climate action planning, identifying both challenges and opportunities in Samoa's path toward a lower-carbon future.

Key Findings:

- Samoa's 2020 baseline emissions totalled 530 $ktCO_2$-equivalent, with the Energy sector (263 kt) as the largest contributor, followed by Agriculture (138 kt) and Waste (105 kt).
- Under Business-as-Usual (BAU) projections, emissions would increase dramatically to 1,258 $ktCO_2$-equivalent by 2050, representing a 137% increase from 2020 levels.
- Implementation of identified mitigation measures could reduce emissions to 336 $ktCO_2$-equivalent by 2030, representing a 50.6% reduction from BAU projections for that year.
- The reduction potential gradually decreases to 32% below BAU by 2050, highlighting the importance of early action and continuous adoption of additional measures.

Year	BAU Emissions ($ktCO_2e$)	Mitigation Scenario Emissions ($ktCO_2e$)	Reduction (%)
2020	530	530	0.0%
2025	597	597	0.0%
2030	681	336	50.6%
2035	784	442	43.6%
2040	910	553	39.3%
2045	1066	694	34.9%
2050	1258	856	32.0%

Summary of Emissions Projections: BAU vs. Mitigation Scenario

Sector-Specific Opportunities

- **Waste Management** offers the most transformative potential, contributing 213-218 $ktCO_2e$ in annual reductions through biogas production, landfill gas capture, and composting initiatives.
- **Agricultural Interventions** could deliver 90-102 $ktCO_2e$ in annual reductions via nitrification inhibitors and biogas systems at pig farms.
- **Forestry and Land Use** measures show increasing effectiveness over time, with reforestation, avoided deforestation, and agroforestry contributing 11 $ktCO_2e$ annually.
- **Energy Efficiency** in residential and commercial buildings presents moderate but significant reduction potential, growing from 16 $ktCO_2e$ in 2030 to 51 $ktCO_2e$ by 2050.

- **Transportation Electrification** demonstrates improving economics over time, starting with modest reductions of 3 $ktCO_2e$ in 2030 but becoming increasingly cost-effective by 2050.

Sector	2030	2035	2040	2045	2050
Energy	31	24	35	45	70
Energy Industries	8	3	3	3	9
Manufacturing & Construction	4	4	4	4	4
Transport	3	1	2	3	7
Residential	12	16	25	34	50
Commercial/Institutional	4	1	1	1	1
Agriculture	90	93	96	100	102
Land Use, Land-Use Change and Forestry	11	11	11	11	11
Waste	213	214	216	216	218
TOTAL	345	342	357	372	402

Summary of Emission Reductions by Sector ($ktCO_2e$/year)

Implementation Considerations

The mitigation potential is divided between unconditional measures (domestically funded) and conditional interventions (requiring international support):

Category	2030	2035	2040	2045	2050
Total Unconditional Reductions	29.1	25.7	37.4	48.1	65.9
Total Conditional Reductions	315.9	316.3	319.6	323.9	336.1
Total Emission Reductions	345	342	357	372	402
Percentage Unconditional	8.4%	7.5%	10.5%	12.9%	16.4%
Percentage Conditional	91.6%	92.5%	89.5%	87.1%	83.6%

Unconditional vs. Conditional Emission Reductions ($ktCO_2e$/year)

- Over 90% of near-term reduction potential depends on international climate finance, emphasizing the critical importance of external support.
- The recommended MRV framework integrates quarterly sectoral reporting, biannual GACMO updates, and alignment with UNFCCC Biennial Transparency Report requirements to ensure effective tracking and continuous improvement.

This analysis demonstrates that Samoa has clear pathways to significant emissions reductions, though success will require coordinated action across all sectors, sustained political commitment, and substantial international climate finance support.

1.0 | Introduction

This report presents a comprehensive mitigation analysis for Samoa using the Greenhouse Gas Abatement Cost Model (GACMO) tool, examining both conditional and unconditional emission reduction scenarios through 2050. The analysis establishes Samoa's current greenhouse gas (GHG) emissions profile based on the 2020 national inventory, which recorded total emissions of 530 ktCO_2-equivalent, and projects future emissions under various scenarios.

The GACMO methodology applied in this study follows a structured eight-step approach that begins with defining country-specific assumptions and establishing baseline energy consumption patterns. The analysis then develops a detailed GHG balance across key sectors—Energy, Industrial Processes, Agriculture, Waste, and Land Use—before projecting future growth trajectories under a Business-as-Usual (BAU) scenario. These projections indicate that without intervention, Samoa's emissions would more than double by 2050 to 1,258 ktCO_2-equivalent.

Against this backdrop, the report identifies and evaluates potential mitigation measures across all major sectors, distinguishing between unconditional actions (domestically funded) and conditional interventions (requiring international support). Through Marginal Abatement Cost (MAC) curve analysis, the study identifies waste management, agricultural improvements, and forestry initiatives as offering the most cost-effective emissions reduction opportunities, with waste sector interventions showing particularly strong economic benefits.

The resulting mitigation scenario demonstrates potential for significant emissions reductions, up to 50.6% below BAU levels by 2030, though this ambitious pathway depends heavily on conditional measures, which account for over 90% of potential reductions. This underscores the critical importance of international climate finance in achieving Samoa's climate goals.

This report concludes with strategic policy recommendations and outlines a comprehensive Monitoring, Reporting, and Verification (MRV) framework to track implementation progress and ensure compliance with UNFCCC reporting requirements through the Biennial Transparency Report (BTR) mechanism.

2.0 | Methodology: GACMO Steps in Samoa

GACMO provides a structured approach to modelling mitigation scenarios, ensuring alignment with Samoa's 2020 GHG Inventory and ongoing inventory updates:

Step 1 | Defining Assumptions

Country Information

- Country: Samoa
- Start year (latest GHG inventory): 2020
- Currency: Samoan Tala
- Exchange rate: 1 USD = 2.78 WST
- Population: 211,944
- GDP (current): USD 868.9 million

Energy Prices (for the entire future period)

- Crude oil: $50.0/bbl or $0.31/litre
- LNG: $3.3/MBTU
- Natural gas: $3.1/GJ
- Coal: $50/ton

Fuel Prices & Properties (selected examples)

- Diesel oil: $1.18/litre, 32.4 $/GJ, calorific value 43.3 GJ/t
- Gasoline: $1.12/litre, 33.2 $/GJ, calorific value 44.8 GJ/t
- Kerosene: $1.01/litre, 28.1 $/GJ, calorific value 44.8 GJ/t
- Natural gas: calorific value 39.0 MJ/Nm^3

Electricity

- Price: $0.36/kWh
- Grid Emission Factor (Combined Margin for all sources): 0.5000 tCO_2/MWh
- Electricity losses and own consumption: 12.6%

Sector-Specific Emission Factors (kg GHG/GJ)

- Power Plants (CO_2 - selected fuels): Fuel oil: 77.4; Diesel oil: 74.1; Natural gas: 56.1; Coal: 94.6; Lignite: 101.2
- CH_4 and N_2O values vary by sector and fuel, with higher

Global Warming Potentials (GWP)

- CH_4: 28 (AR5)
- N_2O: 265 (AR5)

values for charcoal and coal.	

Basis for Assumptions

1. GHG Inventory (2020): Latest national emissions baseline.
2. National Policies: Alignment with Samoa's 2nd NDC Implementation Plan and Roadmap 2021.
3. Growth Trends: Economic and population growth forecasts.
4. Fuel and Energy Trends: Historical data and forecasted energy sector changes.
5. International Best Practices: Consistency with IPCC guidelines, UNFCCC frameworks, and comparable regional models.

This step provides all necessary assumptions and baseline data required before progressing to Step 2: Energy Balance.

Step 2| Energy Balance Analysis

This step captures how energy was used across Samoa in 2020, broken down by sector and energy type. It includes both fossil fuel consumption and electricity use and helps set the stage for tracking emissions in later steps.

2.1| Fossil Fuel Use in 2020

- Total fossil energy used: 3,653 TJ (Terajoules)
- Of this:
  - 959 TJ went to generating electricity (mainly using diesel)
  - 2,694 TJ was used across homes, businesses (services), transport, and agriculture

2.2| Where did it go?

- Road transport was the biggest user: 1,830 TJ, mostly gasoline and diesel
- Navigation (boats/ships) used 268 TJ
- Households used 208 TJ, for cooking and other needs
- Services (like schools and offices) used 327 TJ
- Farming & fishing used 61 TJ

2.3| What fuels were used?

- Diesel: 2,058 TJ
- Gasoline: 1,366 TJ
- Jet Fuel: 77 TJ
- LPG: 45 TJ
- Kerosene and others: 107 TJ
- Heavy Fuel Oil and coal were not used in final consumption

2.4| Converted to Kilotonnes of Oil Equivalent (ktoe)

To make comparisons easier, energy is also shown in ktoe:

- Total consumption: 87 ktoe
  - 23 ktoe used by power plants
  - 64 ktoe used directly by sectors

2.5| Breakdown

- Road transport: 44 ktoe
- Navigation: 6 ktoe
- Households: 5 ktoe

2.6| Electricity Use and Production

- Total electricity consumed: 148 GWh
  - Households: 49 GWh

- Services: 8 ktoe
- Agriculture & Fishery: 1 ktoe

  - Services: 95 GWh
  - Miscellaneous industry: 4 GWh

2.7| Where does electricity come from?

- Total production: 169 GWh
  - Fossil fuels: 103 GWh (about 61% of total): All from oil
  - Renewables: 67 GWh (39%): Hydro: 45 GWh; Solar: 22 GWh; Wind, biomass, and geothermal: not used
- Losses in the system: 21 GWh (12.6%)

This energy profile gives a clear picture of Samoa's energy use in 2020, helping to identify opportunities for cleaner, more efficient energy in future steps and basis for GHG Balance in Step 3.

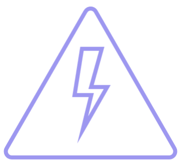
Step 3| Greenhouse Gas (GHG) Balance – Samoa (2020)

This step calculates Samoa's greenhouse gas (GHG) emissions for the year 2020, broken down by fuel type and sector. CO_2 emissions from fossil fuel combustion are automatically generated by the tool based on previous energy data, while non-CO_2 emissions (methane and nitrous oxide) and emissions from non-fuel sources must be entered manually.

Total Emissions

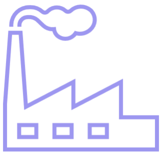
- Total GHG emissions (including CO_2, CH_4, N_2O): 530 ktCO_2-equivalent
  - CO_2: 288 kt
  - CH_4 (methane): 233 kt
  - N_2O (nitrous oxide): 9 kt

Emissions by Sector



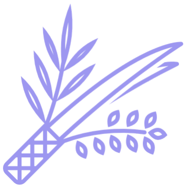
Energy Sector

- Total: 263 ktCO_2-eq
- All emissions are from fuel combustion
- Key sources: road transport (130 kt), electricity generation (71 kt), services (24 kt), and households (15 kt)



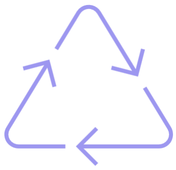
Industrial Processes and Product Use

- Total: 25 ktCO_2-eq
- Entirely from product uses as ODS (ozone-depleting substances) substitutes



Agriculture

- Total: 138 $ktCO_2$-eq
- Methane emissions dominate
    - Enteric fermentation: 74 kt
    - Manure management: 55 kt
    - Minor N_2O emissions from other sources



Waste Sector

- Total: 105 $ktCO_2$-eq
- Mostly methane from:
    - Solid waste disposal: 69 kt
    - Wastewater treatment: 35 kt

Land Use, Land-Use Change and Forestry (LULUCF)

- No emissions reported for 2020 (all values are zero)

Sector	CO_2 (kt)	CH_4 (kt)	N_2O (kt)	Total GHG ($ktCO_2$-eq)
Energy	263	0	0	263
Industrial Processes	25	0	0	25
Agriculture	0	129	9	138
Waste	0	105	0	105
Land Use, Land-Use Change & Forestry	0	0	0	0
Total (incl. LULUCF)	**288**	**233**	**9**	**530**

Table 1: Summary Emissions by Sector

This GHG balance gives a full picture of Samoa's emissions profile in 2020, helping to pinpoint high-emission sectors for future mitigation efforts outlined in Step 4.

Step 4| Future Growth Projections

This step outlines the expected annual growth rates in energy consumption and GHG-related activity across different sectors for multiple future periods. These growth rates help project future emissions under the Business-As-Usual (BAU) scenario.

Key Assumptions

- Population growth: 0.65% across all time periods (World Bank growth projection)
- GDP growth: 1.6% across all time periods (based on average growth rate for the 2014-2024

period)

Energy Consumption Growth by Sector

1| Energy Sector

- Manufacturing industries:
    - Only "miscellaneous industry" and "industry electricity consumption" grow at 3.9% per year, leading to 217% total growth by 2050
    - This growth rate reflects historical fuel consumption patterns and the small manufacturing base in Samoa where changes in few facilities drive overall growth
- Transport:
    - Road transport: 3.11% annual growth resulting in 151% increase by 2050
    - Aviation and navigation: 4.89% annual growth reflecting strong post-COVID recovery in jet fuel consumption and tourism importance, resulting in 318% increase by 2050
    - Basis for projections: Dependence on personal transportation persist; Economy dependence on tourism (air) and merchandise trade (navigation)
- Residential sector:
    - LPG, kerosene, and electricity use: 5.57% per year
    - Basis for projections: Transition from biomass to LPG, electricity accelerating; Rapid electrification of households; Small housing stock leads to rapid penetration of new energy-consuming technologies; Increasing temperatures driving demand for cooling technologies (fans, air-conditioning)
- Commercial/Institutional and Agriculture sectors:
    - Fuel and electricity use: 3.84% per year, resulting in 210% growth by 2050
    - Growth rate exceeds GDP projections due to tourism expansion and service sector development.

2| Industrial Processes and Product Use

- ODS substitutes (HFCs): Decrease at 7.5% per year
    - Leads to 91% reduction by 2050
    - Small market size makes ODS phase-out more manageable given small equipment stock allows for faster replacement cycles.

Emissions Activity Growth (Non-Energy Sectors)

3| Agriculture Sector

- Enteric fermentation, manure management, agricultural soils:
    - Decline at -1% per year, reaching -26% reduction by 2050
    - Rate reflects Samoa's limited agricultural activity and increasing temperatures making farming activities more difficult unless mechanization is introduced.

4| Land Use, Land-Use Change and Forestry (LULUCF)

- Forest land, cropland, grassland, and other land uses:
    - Decline at -1% per year, reaching -26% by 2050

5| Waste Sector

- Solid waste disposal and wastewater treatment:
  - Grow at 3.5% per year, results in an increase of 183% by 2050
  - Challenges of waste disposal and recycling persist.

Sector	Annual Growth Rate	2050 Change from 2020
Misc. Industry & Electricity	+3.92%	+217%
Transport (Road)	+3.11%	+151%
Transport (Aivation & Navigation)	+4.89%	+318%
Residential	+5.57%	+408%
Commercial/Services	+3.84	+210%
Agriculture (GHG activities)	-1%	-26%
Industrial ODS substitutes	-7.5%	-91%
Waste (solid & wastewater)	+3.5%	+181%
Land Use (Forests, Cropland, etc.)	-1%	-26%

Table 2: Summary of Growth Patterns

This step sets the foundation for estimating future energy use and emissions trajectories, feeding into the Business-as-Usual (BAU) projections for Energy Balance in Step 5.

Step 5| BAU Projected Energy Balances (2025, 2030, 2035, 2040, 2045, 2050)

This step presents Samoa's projected energy use under a BAU scenario for key future years. The data is automatically generated by GACMO based on earlier inputs on growth rates, fuel use, and electricity trends. Users are advised not to modify these values unless they are experienced in energy modelling, as changes can impact all downstream results.

Selected Year: 2025

Selected Unit: ktoe (kilotonnes of oil equivalent)

1| Fossil Fuel Balance – Samoa (2025)

- Total fossil fuel consumption: 105 ktoe
  - Of which, 77 ktoe is from final consumption (non-power plant uses)
  - 28 ktoe used for electricity generation (diesel)

2| Breakdown by Sector

- Transport (road): 51 ktoe
  - Dominated by gasoline (34 ktoe) and diesel (15 ktoe)
- Transport (navigation): 8 ktoe (diesel)
- Households: 7 ktoe (gasoline, jet fuel, and kerosene & other)
- Services: 9 ktoe
- Agriculture & Fishery: 2 ktoe

3| Electricity Balance – Samoa (2025)

- Total electricity consumption: 184 GWh
- Electricity generation: 210 GWh
  - Losses: 26 GWh (12.6%)

4| Electricity Generation by Source

- Fossil fuels: 128 GWh (60.7%)
  - All from oil (diesel-based generation, 39% efficiency)
- Renewables: 83 GWh (39.3%)
  - Hydro: 55 GWh (26.3%)
  - Solar: 27 GWh (12.8%)
  - Wind, biomass, geothermal: 0 GWh

5| Electricity Consumption by Sector

- Households: 64 GWh
- Services: 115 GWh
- Industry (miscellaneous): 5 GWh

Key Insights

- Transport remains the largest user of fossil fuels, especially road transport.
- Electricity production continues to rely heavily on oil, despite notable renewable input (mostly hydro).
- No significant shift in industry energy use is projected for 2025 under the BAU scenario.
- Renewable electricity contribution is growing but remains under 40% of the mix in 2025.

This step sets the stage for Step 6, which will estimate projected GHG emissions based on these energy use patterns.

Step 6: BAU Projected GHG Emissions – Samoa (2030)

This step estimates Samoa's future greenhouse gas (GHG) emissions under a BAU scenario for 2030. The emissions projections are based on prior inputs about energy use and growth rates. Users are advised not to modify these values, unless highly experienced, as changes can impact emissions calculations and mitigation analysis.

Total GHG Emissions (2030)

- 681 ktCO_2-equivalent, comprising:
  - CO_2: 408 kt
  - CH_4 (methane): 264 kt
  - N_2O (nitrous oxide): 8 kt

Emissions by Sector

1

Energy Sector

- Total emissions from fuel combustion: 384 $ktCO_2$
  - Fossil power plants: 110 kt (from diesel)
  - Transport: Road: 176 kt; Navigation: 32 kt
  - Households: 25 kt
  - Services: 35 kt
  - Agriculture & Fisheries: 6 kt

2

Industrial Processes & Product Use

- Total emissions: 25 $ktCO_2$
  - All from product uses as ODS substitutes (e.g., HFCs)

3

Agriculture

- Total emissions: 125 $ktCO_2$-eq
  - Enteric fermentation: 67 kt CH_4
  - Manure management: 50 kt CH_4
  - Other sources: 8 kt N_2O

4

Waste

- Total emissions: 148 kt CH_4
  - Solid waste disposal: 98 kt
  - Wastewater treatment: 50 kt

5

Land Use, Land-Use Change and Forestry (LULUCF)

- No emissions reported in this category for 2030

Sector	CO_2	CH_4	N_2O	Total ($ktCO_2$-eq)
1. Energy (fuel combustion)	384	0	0	384
2. Industrial processes & products	25	0	0	25
3. Agriculture	0	116	8	125
4. Land-use and forestry	0	0	0	0
5. Waste	0	148	0	148
Total	**408**	**264**	**8**	**681**

Table 3: Summary GHG Emissions by Source

Key Insights

- The energy sector remains the largest source of emissions (56% of total).
- Waste and agriculture also contribute significantly, especially through methane.
- Emissions from ODS substitutes in industrial processes continue to persist.
- No reductions are projected yet in emissions from fossil fuels under the BAU 2030 scenario.

This step helps establish Samoa's emissions baseline for 2030 under current policies, supporting comparison with mitigation options in Step 7.

Step 7: Mitigation Scenarios and Cost-Benefit Analysis

- Mitigation Measures: Evaluated across sectors, clearly distinguishing between unconditional (domestic) and conditional (international support required).
- Cost-Effectiveness: Analysis through Marginal Abatement Cost (MAC) curves to identify the most beneficial interventions.

The following key mitigation measures/investments were identified through discussions with MNRE and key sectors and is based on the current review of the NDC Implementation Plan and Roadmap 2021. This update will feed into the development of the next NDC by MNRE and these parameters may change once detailed feasibility studies are undertaken to reconfirm what is feasible. Refer to Section 3 for detailed findings and analysis.

Sector	Mitigation Options	Unit of Measure	2030	2035	2040	2045	2050
Agriculture	Nitrification inhibitors	Hectares	200	300	400	500	600
Energy – Fuel combustion – Residential	Efficient residential air-conditioning	# of air-conditioner	2,500	2,500	2,500	2,500	2,500
Energy – Fuel combustion – Residential	Efficient lighting with LEDs	# of bulbs	15,000	15,000	30,000	30,000	30,000
Energy – Fuel combustion – Residential	LPG stoves replacing wood stoves	# of stoves	500	500	500	500	500
Energy – Fuel combustion – Residential	New passive home	# of new homes	500	1000	2000	3000	5000
Energy – Fuel combustion – Residential	Efficient refrigerators	# of refrigerators	3,000	3,000	3,000	3,000	3,000
Energy – Fuel combustion – Manufacturing industries & construction	Building materials	# of bricks (in millions)	7.5	7.5	7.5	7.5	7.5
Energy – Fuel combustion – Commercial/ Institutional	Efficient hotel room conditioner	# of air-conditioner	1,500	100	100	100	100
Energy – Fuel combustion – Commercial/ Institutional	Efficient hotel refrigerator	# of refrigerators	1,500	100	100	100	100
Land use, land use change, and forestry	Reforestation	Hectares	100	151	153	154	155
Waste	Landfill gas plant with power production	# of tonnes per day	100	100	102	102	104

Sector	Mitigation Options	Unit of Measure	2030	2035	2040	2045	2050
Waste	Recycling of plastics	# of tonnes per year	200	200	200	210	210
Waste	Biogas from Municipal Solid Waste	# of tonnes per year	4,600	4,630	4,660	4,690	4,720
Waste	Composting of Municipal Solid Waste	# of tonnes per day	10	10	10	10	10
Agriculture	Biogas at pig farms	# of pigs	80,640	83,160	85,680	89,040	91,560
Energy – Fuel combustion – Energy Industries	PV pump replacing electric pump (10kWp)	# of pumps	600	0	0	0	600
Energy – Fuel combustion – Residential	Solar water heater, residential	# of units	500	500	500	500	500
Energy – Fuel combustion – Energy Industries	Solar PVs, large grid with 24h storage	# of 1 MW units	5	2	2	2	5
Energy – Fuel combustion – Energy Industries	Solar PVs, small, isolated grid, 100% solar	# of 2 MW units	0.5	0.5	0.5	0.5	1
Energy – Fuel combustion – Commercial/ Institutional	Solar streetlights	# of 1000 locations (0.05MW)	4	1	1	1	1
Energy – Fuel combustion – Transport	Electric cars	1000 cars	500	1,000	2,000	4,000	8,000
Energy – Fuel combustion – Transport	Electric rail (boat)	Million train km/year	1	0	0	0	0

Table 4: GACMO Mitigation Options/Interventions for 2030-2050

Step 8: Implementation and Progress Tracking

- Monitoring and Reporting: Regularly updating via biennial NDC reports and new GHG inventory assessments. Refer to Section 5 for proposed reporting mechanisms.
- Adaptive Policy Framework: Continuous refinement of models and strategies based on new data and analysis.

3.0 | Key Findings and Mitigation Strategies

The GACMO model analysis highlights Samoa's potential to significantly reduce GHG emissions across key sectors through a combination of unconditional and conditional mitigation actions. These findings are based on revised assumptions and investment scenarios captured in the updated GACMO Excel model.

3.1 | Summary of Emissions Reductions by Sector (2030)

The GHG emission reduction outlined in Table 5 presents an ambitious roadmap for climate action spanning from 2030 to 2050, with cumulative reductions reaching 402 MtCO2e/year by 2050 through coordinated efforts across five key sectors. This comprehensive approach leverages multiple distinct mitigation options, ranging from agricultural innovations like nitrification inhibitors, renewable energy solutions, to transportation transformations, systematically deployed at increasing scales over three decades.

ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
TOTAL	**0**	**0**	**345**	**342**	**357**	**372**	**402**
1. Energy	0	0	31	24	35	45	70
1.A. Fuel combustion	0	0	31	24	35	45	70
1.A.1. Energy industries	0	0	8	3	3	3	9
1.A.2. Manufacturing industries and construction	0	0	4	4	4	4	4
1.A.3. Transport	0	0	3	1	2	3	7
1.A.4.b. Residential	0	0	12	16	25	34	50
1.A.4.a. Commercial/institutional	0	0	4	1	1	1	1
1.A.4.c. Agriculture/forestry/fishing	0	0	0	0	0	0	0
1.B. Fugitive emissions from fuels	0	0	0	0	0	0	0
2. Industrial processes and product use	0	0	0	0	0	0	0
3. Agriculture	0	0	90	93	96	100	102
4. Land use, land-use change and forestry	0	0	11	11	11	11	11
5. Waste	0	0	213	214	216	216	218

Table 5: Summary of GHG Emission Reduction by Sectors, 2030-2050

Early Implementation (2030)

The initial reduction of 345 MtCO2e/year by 2030 is achieved through a balanced portfolio of options:

- In the waste sector (213 MtCO2e/year), the strategy includes processing 4,600 tonnes/year of Municipal Solid Waste for biogas, installing landfill gas plants processing 100 tonnes/day, and composting 10 tonnes/day of Municipal Solid Waste. Additionally, 200 tonnes/year of plastics recycling contributes to these reductions.

- Agricultural emissions reductions (90 MtCO2e/year) are supported by applying nitrification inhibitors across 200 hectares and implementing biogas systems generated from 80,640 pigs.
- Energy sector gains (31 MtCO2e/year) come from multiple initiatives including
  - constructing of 500 new residential passive 4-bedroom homes requiring 2,500 efficient air-conditioners, 15,000 bulbs with LEDs, 500 LPG stoves to replace wood stoves, and 500 solar water heaters,
  - Residential upgrades and new purchasing of 3,000 efficient refrigerators,
  - Installing 5 MW of large grid solar PV systems with 24-hour storage, 0.5 MW of small, isolated grid solar systems, and 600 PV pumps replacing electric pumps.
- Transport improvements (3 MtCO2e/year) result from adding 500 electric cars and 1 million train km/year from an electric boat.
- Land use improvements (11 MtCO2e/year) are achieved through reforesting 1,500 hectares, establishing 500 hectares of agroforestry, protecting 500 hectares from deforestation (REDD), and implementing assisted forest regeneration across 500 hectares.

Mid-term Evolution (2035-2040)

The total reductions increase slightly from 342 to 357 MtCO2e/year during this period, reflecting gradual scaling of technologies:

- Transport sector improvements (decreasing from 3 to 1 MtCO2e/year by 2035, then increasing to 2 MtCO2e/year by 2040) growing electric vehicle fleet from 1,000 cars to 2,000 cars by 2040.
- Energy industries see some fluctuation in emission reductions (from 8 to 3 MtCO2e/year) as solar PV existing systems are maintained and replaced.
- Residential energy improvements grow significantly (from 12 to 25 MtCO2e/year), supported by the continuous construction of passive homes with energy efficient content.
- Agriculture shows continued growth in reductions (from 90 to 96 MtCO2e/year), matching the increased implementation of nitrification inhibitors (extending from 300 to 400 hectares) and expanded biogas from pig farms (85,680 pigs).

Transformation Phase (2045-2050)

The increase continues to 372 MtCO2e/year in 2045 before reaching 402 MtCO2e/year by 2050:

- Agriculture reductions strengthen to 100 MtCO2e/year in 2045 and 102 MtCO2e/year by 2050, representing successful scaling of nitrification inhibitors to 500-600 hectares and expansion of pig farm biogas systems to 89,040-91,560 pigs.
- Transport sector gains (reaching 7 MtCO2e/year by 2050) align with the substantial increase to 8,000 electric cars on the road.
- The waste sector's consistent performance (rising to 218 MtCO2e/year) reflects the steady growth in biogas from Municipal Solid Waste (processing 4,720 tonnes/year) and landfill gas plants handling 104 tonnes/day.
- Energy sector improvements by 2050 (70 MtCO2e/year) correspond with significant expansion in residential solutions, reaching 50 MtCO2e/year through continuous

construction and renovating of passive homes, including its content and refurbishments.

- Energy industries also see improvement (9 MtCO2e/year) with replacement of aging PV systems and redeployment of 600 PV pumps replacements.

Notable Technology Patterns

- Solar PV systems follow a replacement cycle, with the large grid-connected systems reducing from 5 MW to 2 MW during 2035-2045 before returning to 5 MW by 2050, considering their 20- to 30-year life cycle.
- PV pump technology of 600 pumps (10 kWp) are deployed in 2030, then replaced by 2050 after their operational lifetime.
- Electric vehicles demonstrate exponential growth from 500 cars in 2030 to 8,000 cars by 2050, becoming a major contributor to transport sector emission reductions.
- Passive home construction shows consistent growth, with the construction and refurbishment of 500 passive homes every periodic five years, making residential energy use a significant contributor to overall reductions.
- Commercial/institutional energy efficiency measures show intense initial deployment (1,500 efficient hotel room air conditioners and refrigerators in 2030) if 1,500 of the estimated 3,000 existing rooms in Samoa already have energy efficient refrigeration and air-conditioning. The 100 units) in subsequent years correspond to the increasing of rooms in tourism sector by 100 every five years.

3.2 | Emissions Projections: BAU vs. Mitigation Scenario

Samoa's GHG emissions are projected to follow significantly different trajectories depending on whether the country continues with business-as-usual practices or implements targeted mitigation strategies. **Error! Reference source not found.** illustrates these contrasting pathways through 2050:

ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Total GHG emissions in BAU (including LULUCF)	**530**	**597**	**681**	**784**	**910**	**1066**	**1258**
Emissions Reduction in Mitigation Scenario	0	0	345	342	357	372	402
Total GHG emissions in Mitigation scenario (including LULUCF)	**530**	**597**	**336**	**442**	**553**	**694**	**856**
Mitigation scenario reduction (%)	0.0%	0.0%	50.6%	43.6%	39.3%	34.9%	32.0%
Emissions Reduction in Mitigation Scenario 2	0	0	0	0	0	0	0
Total GHG emissions in Mitigation scenario 2	**530**	**597**	**681**	**784**	**910**	**1066**	**1258**
Mitigation scenario 2 reduction (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 6: Emissions Projections: BAU vs. Mitigation Scenario

Under the BAU scenario, emissions are projected to more than double from 530 ktCO2e in 2020 to

1,258 ktCO2e by 2050, representing a continuous upward trajectory as the country develops. The energy sector accounts for the largest share of this growth, particularly in transport and energy industries, followed by increases in waste management emissions.

The mitigation scenario presents a dramatically different outlook. With targeted interventions beginning to take effect between 2025 and 2030, emissions are projected to decrease by 50.6% from BAU levels by 2030, dropping to 336 ktCO2e. This sharp reduction stems from transformative changes across multiple sectors:

- The waste sector shifts from being a significant emissions source to achieving negative emissions through biogas production, landfill gas capture, recycling, and composting.
- Agricultural emissions decrease by more than 70% through implementation of nitrification inhibitors and biogas systems at pig farms.
- Forestry initiatives create carbon sinks through reforestation, avoided deforestation, and agroforestry.
- Energy sector emissions are moderated through efficiency improvements and renewable energy adoption.

However, the mitigation scenario shows a declining reduction advantage over time. The percentage reduction from BAU gradually decreases from 50.6% in 2030 to 32.0% by 2050, with absolute emissions rising to 856 ktCO2e. This pattern indicates that the modelled interventions have their greatest impact in the near term, highlighting the 2025-2030 period as a critical window for implementation.

The divergent pathways illustrated in these projections underscore the importance of early, decisive action. While the mitigation scenario still shows significant emissions growth from 2035 onward, it establishes a substantially lower emissions trajectory compared to business-as-usual, creating a foundation for future climate action.

3.3| Marginal Abatement Revenue Cost (MAR) Curves

The MAR Curves generated by the GACMO model provide a comparative visualization of mitigation options across multiple time horizons (2030-2050). In 2030 scenario highlighted below, the MAR curve shows that some climate actions can reduce emissions and save money at the same time—making them smart investments.

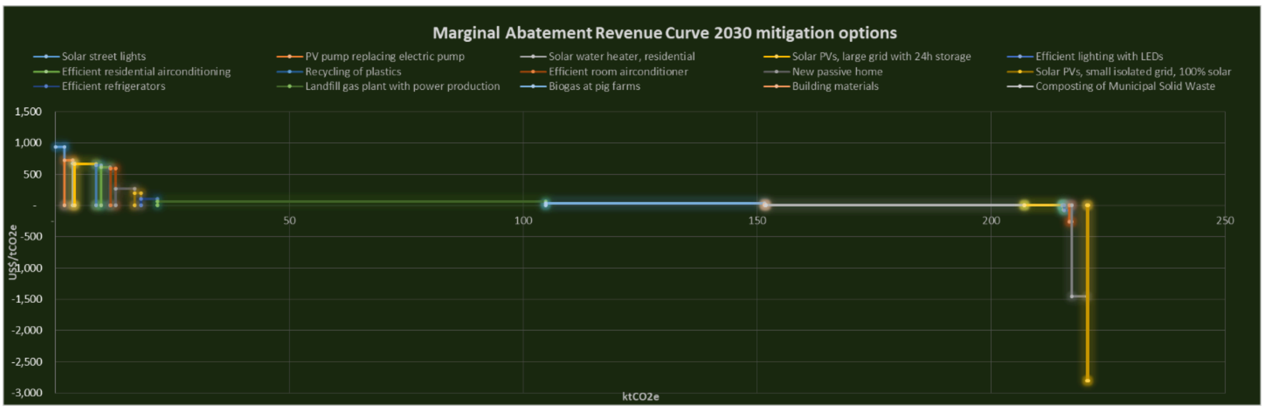


Figure 1: Marginal Abatement Cost (MAC) Curve 2030 Mitigation Options

For example, switching to LED lighting, solar street lights, and solar water heaters all offer high financial returns while cutting emissions, meaning they should be rolled out more widely. Waste-related solutions like composting, biogas from pig farms, and landfill gas capture have some of the biggest impacts on reducing emissions and are reasonably affordable, making them great candidates for government or donor support. On the other hand, options like electric cars and electric rail are still very expensive compared to how much emissions they reduce, so they may need more innovation or support before they make financial sense. Nature-based solutions such as reforestation and agroforestry offer smaller but steady benefits and can play a key role in long-term sustainability. Overall, the best way forward is to focus on proven, cost-effective technologies now, while planning for more expensive options in the future as costs come down. A summary of MAR curve analysis for each mitigation option is outlined below:

itigation Option	Revenue (US$/t$CO_2$e)	Emission Reduction (ktCO_2e/year)	Analysis
Nitrification inhibitors (1000 ha)	-67.69	0.12	Low impact and costly – limited priority
Efficient residential air-conditioning	607.77	1.87	High revenue, moderate impact – prioritize for scale-up
Efficient lighting with LEDs	646.64	1.12	High revenue, moderate impact – prioritize for scale-up
LPG stoves replacing wood stoves	-73.53	1.03	Low impact and costly – limited priority
New passive home	265.05	4.07	Moderate revenue, moderate impact – viable option
Efficient refrigerators	101.55	3.58	Moderate revenue, moderate impact – viable option
Building materials	19.57	0.26	Moderate revenue, low impact – consider for bundling
Efficient room air conditioner	589.14	1.01	High revenue, low impact – consider for pilot or bundling
Efficient hotel refrigerator	-256.36	0.57	Low impact and costly – limited priority
Reforestation	-8.18	0.37	Low impact and costly – limited priority
REDD: Avoided deforestation	5.50	-	Moderate revenue, unknown impact – consider with ecosystem co-benefits
Assisted forest regeneration	2.05	-	Low revenue, unknown impact – evaluate within landscape-level programs
Reforestation with agroforestry	0.27	-	Low revenue, unknown impact – potential for bundling with livelihoods
Landfill gas plant with power production	63.60	82.94	Moderate revenue, high impact – strong investment case
Recycling of plastics	594.10	0.22	High revenue, low impact – consider for pilot or bundling

Biogas from Municipal Solid Waste	-0.11	8.12	Low cost, high impact – evaluate for blended finance
Composting of Municipal Solid Waste	0.11	55.16	Low cost, high impact – evaluate for blended finance
Biogas at pig farms	32.77	46.79	Moderate revenue, high impact – strong investment case
PV pump replacing electric pump	720.00	1.72	High revenue, low impact – consider for pilot or bundling
Solar water heater, residential	676.19	0.41	High revenue, low impact – consider for pilot or bundling
Solar PVs, large grid with 24h storage	667.40	4.56	High revenue, moderate impact – prioritize for scale-up
Solar PVs, small isolated grid, 100% solar	200.27	1.31	Moderate revenue, moderate impact – viable option
Solar street lights	932.88	1.95	High revenue, moderate impact – prioritize for scale-up
Electric cars	-2,802.75	0.25	Very high cost, low impact – not currently viable
Electric rail (electric ferry option)	-1,459.59	3.19	Very high cost, moderate impact – not currently viable

Table 7: Mitigation Option and MAR curve analysis

In summary the mitigation options assessed in the MAR are catergorized below based on their relative cost-effectiveness, emissions reduction potential, and overall suitability for investment or policy prioritization.

Top Priority – High Revenue and Cost-Effective Options

These mitigation options generate strong financial returns while achieving measurable emissions reductions. They represent the most attractive opportunities for immediate scaling through both public and private investment.

- LED lighting
- Solar street lights
- Solar water heaters (residential)
- Efficient air conditioning (residential and room units)
- Solar PV systems with 24-hour storage

These interventions should be prioritized for national programs and integrated into energy efficiency and renewable energy financing strategies.

Strong Potential – Moderate Cost, High Impact

These options deliver significant emissions reductions at relatively low or neutral cost. They are ideal candidates for blended finance models, donor-supported programs, and inclusion in national waste management or energy strategies.

- Landfill gas to energy

- Composting of municipal solid waste
- Biogas from pig farms
- Biogas from municipal solid waste

Due to their scale and emissions reduction capacity, these options are recommended for rapid deployment with suitable institutional support.

Supportive Measures – Nature-Based Solutions

Nature-based solutions provide long-term mitigation and co-benefits such as biodiversity protection, soil health, and climate resilience. Although revenue potential is limited, their value lies in ecosystem services and carbon sequestration.

- Reforestation
- Reforestation with agroforestry
- REDD (avoided deforestation)
- Assisted forest regeneration

These should be incorporated into land-use and climate resilience programs and supported through results-based climate finance where possible.

Low Priority – High Cost, Low Impact

These options are currently not cost-effective. Their financial cost per tonne of emissions reduced is significantly higher than other alternatives. Adoption should be delayed or reconsidered unless substantial policy incentives or technological breakthroughs occur.

- Electric cars
- Electric rail
- Efficient hotel refrigerators
- LPG stoves replacing wood stoves
- Nitrification inhibitors

These interventions may have strategic or social value but are not recommended for short-term prioritization under emissions mitigation programs.

Viable but Niche – Moderate Benefits

These options deliver moderate emissions reductions and/or revenue returns. While not top-tier priorities, they may be viable in specific contexts or when bundled with other complementary interventions.

- New passive homes
- Efficient refrigerators
- Building material upgrades
- Plastic recycling

- PV pump replacements
- Solar PVs for small, isolated grids

These interventions can be included in sectoral programs (e.g. building codes, recycling, agricultural energy) and scaled gradually.

3.4| Sectoral Emissions Projections (2030)

Building on the emissions projections presented in section 3.2, this analysis breaks down mitigation actions into two categories:

- **Unconditional Scenario:** Based on domestically funded mitigation actions
- **Conditional Scenario:** Assuming full implementation of externally supported measures

The following tables show the projected emissions reductions by sector and funding type from 2030-2050, with Energy Industries, 30% of Transport, Agriculture, LULUCF, and Waste sectors categorized as conditional mitigation actions:

Mitigation Scenarios

Unconditional Scenario (Domestically Funded):

- All residential-related mitigation actions (efficient air-conditioning, LED lighting, LPG stoves, passive homes, efficient refrigerators, and solar water heaters)
- 80% of funding for commercial facilities, waste management, electric cars, and manufacturing interventions

Conditional Scenario (Externally Supported):

- Electric rail transport
- All solar-related interventions (Solar PVs large grid with storage, isolated grid systems, streetlights)
- Agricultural interventions (nitrification inhibitors, biogas at pig farms)
- Reforestation efforts (including REDD+, assisted forest regeneration, agroforestry)
- 20% support for commercial facilities, waste management, electric cars, and manufacturing interventions

Sectoral Breakdown of Emission Reductions by Funding Type (2030-2050)

Based on the specified division between the Unconditional Scenario (domestically funded mitigation actions) and the Conditional Scenario (externally supported measures), with Energy Industries, 30% of Transport, Agriculture, LULUCF, and Waste sectors being part of the Conditional Scenario, the emission reductions can be recalculated as follows:

Sector	2030	2035	2040	2045	2050
Energy (excluding Energy Industries)	23	21	32	42	61
Transport (70%)	2.1	0.7	1.4	2.1	4.9
Manufacturing industries and construction	4	4	4	4	4
Residential	12	16	25	34	50

Commercial/institutional	4	1	1	1	1
Total Unconditional	**29.1**	**25.7**	**37.4**	**48.1**	**65.9**

Table 8: Unconditional Scenario: Emission Reductions (ktCO_2e/year)

Sector	2030	2035	2040	2045	2050
Energy Industries	8	3	3	3	9
Transport (30%)	0.9	0.3	0.6	0.9	2.1
Agriculture	90	93	96	100	102
Land use, land-use change and forestry	11	11	11	11	11
Waste	213	214	216	216	218
Total Conditional	**315.9**	**316.3**	**319.6**	**323.9**	**336.1**

Table 9: Conditional Scenario: Emission Reductions (ktCO_2e/year)

Category	2030	2035	2040	2045	2050
Total Unconditional Reductions	29.1	25.7	37.4	48.1	65.9
Total Conditional Reductions	315.9	316.3	319.6	323.9	336.1
Total Emission Reductions	**345**	**342**	**357**	**372**	**402**
Percentage Unconditional	8.4%	7.5%	10.5%	12.9%	16.4%
Percentage Conditional	91.6%	92.5%	89.5%	87.1%	83.6%

Table 10: Summary of Unconditional and Conditional Scenarios

A significant majority of Samoa's emission reduction potential (91.6% in 2030) would be achieved through the Conditional Scenario, particularly in the waste and agriculture sectors. This highlights the critical importance of international climate finance for achieving Samoa's mitigation goals.

The proportion of reductions from the Unconditional Scenario increases over time, from 8.4% in 2030 to 16.4% by 2050, driven largely by growing emissions reductions in the residential sector (from 12 to 50 ktCO_2e). This aligns with the practical reality that donor funding typically has specific allocation restrictions, making domestic funding essential for residential interventions.

The waste sector dominates the Conditional Scenario, contributing 213-218 ktCO_2e throughout the period. As shown in the MAC curves (Section 3.3), these waste management interventions are among the most cost-effective options, potentially generating revenue while delivering environmental benefits.

This funding breakdown supports a strategic approach where Samoa prioritises residential energy efficiency measures through domestic funding while seeking international support for large-scale waste, agriculture, and land use interventions that deliver the majority of potential emission reductions.

4.0 | Policy Recommendations

Samoa's path to reducing GHG emissions requires a strategic approach informed by the GACMO analysis. The modeling shows potential for significant early reductions (50.6% below BAU by 2030), underscoring the importance of decisive action backed by appropriate climate finance. These recommendations focus on prioritizing high-impact interventions across key sectors:

4.1 | Waste Sector: Transformative Methane Mitigation

Key Insight: The waste sector offers the largest emissions reduction potential and the most cost-effective options on the MAC curves.

Recommended Actions:

- Implement biogas production from Municipal Solid Waste (4,600 tonnes/year by 2030)
- Install landfill gas plants with power production (100 tonnes/day)
- Establish composting systems (10 tonnes/day) and plastics recycling (200 tonnes/year)
- Create a comprehensive waste management strategy leveraging the strong revenue potential (negative MAC values)

4.2 | Agriculture Sector: Livestock Management and Agricultural Practices

Key Insight: Agricultural interventions offer significant emissions reduction potential, particularly through addressing enteric fermentation and manure management.

Recommended Actions:

- Implement biogas systems at pig farms (covering 80,640 pigs by 2030)
- Apply nitrification inhibitors across agricultural lands (200 hectares by 2030)
- Develop support programs for farmers to adopt climate-smart practices
- Create demonstration sites to showcase biogas technologies and their benefits

4.3 | Forestry and Land Use: Carbon Sequestration

Key Insight: Forestry initiatives show strong performance with their effectiveness increasing over time as carbon sequestration accumulates.

Recommended Actions:

- Implement reforestation programs
- Engage communities in forest management

4.4 | Energy Sector: Renewable Energy and Energy Efficiency

Key Insight: Energy sector interventions provide moderate emissions reductions, with the greatest potential in the residential subsector.

Recommended Actions:

- Install solar PV systems:
    - Large grid systems with 24-hour storage (5 MW by 2030)

  - Small, isolated grid systems (0.5 MW by 2030)
- Deploy PV pumps to replace electric pumps (600 units)
- Install solar streetlights (4,000 locations)
- Promote residential energy efficiency through:
  - Efficient air-conditioning (2,500 units) and LED lighting (15,000 bulbs)
  - Efficient refrigerators (3,000 units) and solar water heaters (500 units)
- Support passive home design (500 new homes by 2030)
- Enhance commercial efficiency (hotel air conditioners and refrigerators)
- Develop sustainable building materials

4.5| Transport Sector: Electrification and Sustainable Mobility

Key Insight: Transport electrification improves in cost-effectiveness over time, becoming highly economical by 2045-2050.

Recommended Actions:

- Promote electric vehicle adoption (500 cars by 2030)
- Explore electric water transport options (1 million km/year)
- Develop EV charging infrastructure
- Create incentives and awareness programs
- Develop long-term electrification roadmap aligned with improving economics

4.6| Cross-Sectoral Enablers

Climate Finance and Investment

- Align funding with conditional (91.6% of reductions) and unconditional scenarios
- Prioritize waste management interventions for international support
- Leverage domestic resources for residential energy efficiency
- Develop financing mechanisms to attract private investment

Implementation Support

- Institutionalize GACMO for emissions tracking and scenario planning
- Update sectoral policies to align with mitigation pathways
- Establish clear targets based on the modeling results
- Build technical capacity in data collection and modeling
- Develop targeted awareness campaigns and community engagement

By implementing these strategic recommendations, Samoa can achieve substantial emissions reductions through prioritizing cost-effective interventions in waste management, agriculture, and forestry, while building capacity for energy and transport transitions. The conditional/unconditional framework provides a practical basis for mobilizing both domestic and international resources.

5.0 | Next Steps

5.1 | MRV Process, GACMO Updates, and BTR Compliance

To ensure accurate emissions tracking, effective monitoring of mitigation progress, and compliance with UNFCCC reporting requirements, Samoa will implement a robust and integrated Monitoring, Reporting, and Verification (MRV) framework. This MRV system will operate on a quarterly and biannual basis, incorporating sectoral data collection, GACMO updates, and Biennial Transparency Report (BTR) preparation.

5.2 | Quarterly Sectoral Reporting to MNRE

Each key sector, Energy, Transport, Waste, Agriculture & Forestry, will be responsible for preparing quarterly emissions reports and submitting them to MNRE. This process will:

- Enable real-time emissions tracking.
- Support early identification of implementation bottlenecks.
- Feed directly into GACMO model updates and NDC tracking.

Report Contents:

- Mitigation Activities Implemented (projects, policies, operational milestones)
- Key Indicators (e.g., EV deployment, renewable energy capacity, landfill methane capture)
- Data Sources & Assumptions (measured, modelled, or estimated)
- Challenges & Gaps
- Next Steps

Data Flow and Verification

1. *Data Collection*: Sector ministries and agencies (e.g. EPC, MWTI, MAF and relevant private sector agencies) collect emissions-related data.
2. *Submission to MNRE*: Quarterly sectoral reports are submitted to MNRE's Renewable Energy Division.
3. *Verification & Consolidation*: MNRE reviews reports for consistency, cross-references with national datasets, and ensures completeness.
4. *Quarterly Working Committee Review*: MNRE convenes inter-agency teams to review reports, assess GACMO assumptions, and guide next steps.

5.3 | Biannual GACMO Model Updates

Every six months (June and December), MNRE will update the GACMO model with validated data to ensure projections and mitigation impact assessments remain current. Updates will reflect:

- Sectoral progress on mitigation targets.
- Adjustments in cost assumptions (e.g., updated CAPEX for solar or EVs).
- Technological improvements or economic shifts.
- Institutional feedback from quarterly review sessions.

These updates will inform national climate decision-making and support adaptive management of Samoa's low-emissions pathway.

5.4| Integration with UNFCCC Biennial Transparency Reports (BTRs)

As required under Article 13 of the Paris Agreement, Samoa must submit a BTR every two years to report on:

BTR Component	Data Source	MRV Integration
National GHG Inventory	MNRE + Quarterly Sector Reports	Aggregated from GACMO + sectoral submissions
Progress on NDC Targets	MNRE + GACMO Modeling	Aligned with updated GACMO emission scenarios
Mitigation Measures & Impacts	Sectoral Ministries	From quarterly reporting and GACMO sector sheets
Support Received & Needed	Ministry of Finance	Annual reporting on climate finance flows
Adaptation and Co-benefits	MNRE Climate Division	Reported alongside mitigation progress

Table 11: BTR Reporting Cycles

5.5| Reporting Timeline Overview

Activity	Frequency	Lead Entity	Due Date
Sectoral Data Collection	Ongoing	Line Ministries	-
Quarterly Sectoral Reports	Every 3 Months	Energy, Transport, Waste, AFOLU	10th of the following month
GACMO Model Update	Every 6 Months	MNRE	June & December
Quarterly Working Committee Review	Every 3 Months	MNRE + Stakeholders	End of each quarter
National Climate Report	Annually	MNRE	Q1 of the following year
Biennial Transparency Report (BTR)	Every 2 Years	MNRE	Submitted to UNFCCC as scheduled

Table 12: Reporting Timeline Overview

5.6| Strengthening Institutional Capacity

To sustain an effective MRV system and ensure alignment with BTR requirements, Samoa will:

1. *Institutionalize a Dedicated MRV Unit* within MNRE to oversee all emissions tracking and reporting.

2. *Build Capacity* in data analysis, modeling (GACMO), and reporting for national and sectoral stakeholders.
3. *Develop Standardized Templates* for sectoral reporting aligned with BTR structure.
4. *Link GACMO Outputs to BTR* to streamline progress tracking and enhance data transparency.
5. *Strengthen Data Validation Protocols* across agencies to ensure consistency and reliability.

By aligning quarterly sectoral reporting, GACMO updates, and BTR submissions, Samoa will maintain a credible, transparent, and adaptive climate reporting system—positioning itself for increased access to climate finance, improved emissions outcomes, and strengthened global partnerships.

Annex 1 | List of Documents Reviewed

1. Agriculture and Fisheries Sector Plan 2022/23 – 2026/27
2. Circular Waste Policy (Draft)
3. Community Integrated Management Plans (CIMPs)
4. Decarbonisation Strategy for Land and Maritime Transport (under the UNDP CAPIT Project)
5. Enhanced Transparency Framework (ETF) under the Paris Agreement
6. First Biennial Update Report Samoa 2023
7. Greenhouse Gas Abatement Cost Model (GACMO) Guidelines
8. ICAT Renewable Energy Methodology (2020)
9. MNRE Waste Sector Documentation on Methane Capture and Composting Initiatives
10. National Environment Sector Plan (NESP) 2023 – 2027
11. NDC Implementation Roadmap and Investment Plan 2021
12. Pathway for the Development of Samoa FY2021/22 – FY2025/26
13. Renewable Energy Investment Reports by the Electric Power Corporation (EPC)
14. Relevant International Standards for MRV (e.g., IPCC Guidelines for National Greenhouse Gas Inventories)
15. Samoa Climate Change Policy 2020–2030
16. Samoa Energy Sector Plan FY2023/24 – 2027/28
17. Samoa National Energy Policy 2007
18. Samoa Ocean Strategy (2020–2030)
19. Samoa State of the Environment Report 2023
20. Samoa Tourism Authority's Climate Resilient Tourism Guidelines
21. Samoa Tourism Sector Plan 2022/2023 – 2026/2027
22. Trade, Commerce, and Manufacturing Sector Plan 2021–2025
23. Samoa's Second National Communication to the United Nations Framework Convention on Climate Change (NDC)
24. Second National Greenhouse Inventory – Samoa's Greenhouse Gas Emissions 1994–2007
25. Sustainable Tourism Sector Progress Reports by Samoa Tourism Authority
26. Trade, Commerce and Manufacturing Sector Plan 2024/2025 – 2028/2029
27. Transport and Infrastructure Sector Plan 2023 – 2028
28. Two Million Tree Planting Campaign Documentation
29. United Nations Framework Convention on Climate Change (UNFCCC) Reporting Guidelines

Annex 2| GACMO Technical Worksheets

(Includes extracted worksheets detailing BAU scenario projections, mitigation cost curves, and sectoral emissions breakdowns.)

Total GHG emissions (including LULUCF)							
ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Total GHG emissions in BAU (including LULUCF)	530	597	681	784	910	1066	1258
Emissions Reduction in Mitigation Scenario	0	0	221	260	275	289	387
Total GHG emissions in Mitigation scenario (including LULUCF)	530	597	460	523	635	777	871
Mitigation scenario reduction (%)	0.0%	0.0%	32.4%	33.2%	30.3%	27.1%	30.8%
Emissions Reduction in Mitigation Scenario 2	0	0	0	0	0	0	0
Total GHG emissions in Mitigation scenario 2	**530**	**597**	**681**	**784**	**910**	**1066**	**1258**
Mitigation scenario 2 reduction (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Per capita GHG emissions and carbon intensity of GDP							
Population (thousands)	212	219	226	234	241	249	257
GDP (Current MUS$)	869	941	1,018	1,102	1,194	1,292	1,399
Per capita GHG emissions (tCO2-e/capita) in BAU	2.50	2.73	3.01	3.35	3.77	4.28	4.89
Carbon intensity of GDP (kgCO2-e/US$) in BAU	0.61	0.64	0.67	0.71	0.76	0.83	0.90
Per capita GHG emissions (tCO2-e/capita) in Mitigation Scenario	2.50	2.73	2.03	2.24	2.63	3.12	3.38
Carbon intensity of GDP (kgCO2-e/US$) in Mitigation Scenario	0.61	0.64	0.45	0.47	0.53	0.60	0.62

BAU scenario emissions by sectors							
ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Total (including LULUCF)	**530**	**597**	**681**	**784**	**910**	**1,066**	**1,258**
Total (excluding LULUCF)	**530**	**597**	**681**	**784**	**910**	**1,066**	**1,258**
1. Energy	263	317	384	465	564	686	836
1.A. Fuel combustion	263	317	384	465	564	686	836
1.A.1. Energy industries	71	88	110	137	171	213	267
1.A.2. Manufacturing industries and constructi	0	0	0	0	0	0	0
1.A.3. Transport	149	176	208	246	291	344	408
1.A.4.b. Residential	15	19	25	33	43	57	74
1.A.4.a. Commercial/institutional	24	29	35	42	50	61	73
1.A.4.c. Agriculture/forestry/fishing	4	5	6	8	9	11	13
1.B. Fugitive emissions from fuels	0	0	0	0	0	0	0
2. Industrial processes and product use	25	25	25	25	25	25	25
3. Agriculture	138	131	125	118	113	107	102
4. Land use, land-use change and forestry	0	0	0	0	0	0	0
5. Waste	105	124	148	176	209	249	296

Mitigation scenario emissions by sectors							
ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Total (including LULUCF)	**530**	**597**	**460**	**523**	**635**	**777**	**871**
Total (excluding LULUCF)	**530**	**597**	**460**	**524**	**635**	**777**	**871**
1. Energy	263	317	357	444	533	645	770
1.A. Fuel combustion	263	317	357	444	533	645	770
1.A.1. Energy industries	71	88	102	134	167	210	258
1.A.2. Manufacturing industries and constructi	0	0	0	0	0	0	0
1.A.3. Transport	149	176	205	245	289	341	401
1.A.4.b. Residential	15	19	13	17	18	23	24
1.A.4.a. Commercial/institutional	24	29	31	41	50	60	73
1.A.4.c. Agriculture/forestry/fishing	4	5	6	8	9	11	13
1.B. Fugitive emissions from fuels	0	0	0	0	0	0	0
2. Industrial processes and product use	25	25	25	25	25	25	25
3. Agriculture	138	131	78	26	17	8	0
4. Land use, land-use change and forestry	0	0	0	0	0	0	0
5. Waste	105	124	1	29	61	100	77

GHG emission reduction by sectors							
ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Total	**0**	**0**	**221**	**260**	**275**	**289**	**387**
1. Energy	0	0	27	21	31	41	66
1.A. Fuel combustion	0	0	27	21	31	41	66
1.A.1. Energy industries	0	0	8	3	3	3	9
1.A.2. Manufacturing industries and constructi	0	0	0	0	0	0	0
1.A.3. Transport	0	0	3	1	2	3	7
1.A.4.b. Residential	0	0	12	16	25	34	50
1.A.4.a. Commercial/institutional	0	0	4	1	1	1	1
1.A.4.c. Agriculture/forestry/fishing	0	0	0	0	0	0	0
1.B. Fugitive emissions from fuels	0	0	0	0	0	0	0
2. Industrial processes and product use	0	0	0	0	0	0	0
3. Agriculture	0	0	47	93	96	100	102
4. Land use, land-use change and forestry	0	0	0	0	0	0	0
5. Waste	0	0	146	146	148	148	218

GHG emissions by gases (including and excluding LULUCF)							
ktCO2e/year	2020	2025	2030	2035	2040	2045	2050
Emissions including LULUCF							
CO2 emissions in BAU scenario	288	342	408	489	589	710	860
CH4 emissions in BAU scenario	233	247	264	286	314	349	391
N2O emissions in BAU scenario	9	9	8	8	7	7	7
CO2 emissions in Mitigation scenario	288	342	381	468	557	669	794
CH4 emissions in Mitigation scenario	233	247	71	47	71	101	70
N2O emissionsin Mitigation scenario	9	9	8	8	7	7	7
Emissions excluding LULUCF							
CO2 emissions in BAU scenario	288	342	408	489	589	710	860
CH4 emissions in BAU scenario	233	247	264	286	314	349	391
N2O emissions in BAU scenario	9	9	8	8	7	7	7
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N2O emissions in Mitigation scenario	9	9	8	8	7	7	7