Initiative for Climate Action Transparency

Antigua & Barbuda Project

Baseline Specification Report

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Prepared by

Caribbean Cooperative Measurement, Reporting & Verification Hub

DISCLAIMER

PREPARED UNDER

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Contents

List of tables /figures

ACRONYMS

CA	Climate Analytics
CCMRVH	Caribbean Cooperative Measurement, Reporting and Verification Hub
EV	Electric Vehicle
GDP	Gross Domestic Product
ICAT	Initiative for Climate Action Transparency
IMF	International Monetary Fund
LEAP	Low Emissions Analysis Platform
MPG	Miles per Gallon
MRV	Measurement, Reporting and Verification
SIDS	Small Island Developing States
SUV	Sports Utility Vehicle
UN	United Nations

1.0 Introduction

Antigua and Barbuda is a sovereign Small Island Developing State (SIDS) in the Eastern Caribbean. The island is committed to implementing measures to grow its economy in a low carbon and sustainable manner. To assist in achieving this, the country is participating in the Initiative for Climate Action Transparency (ICAT) project.

The Initiative for Climate Action Transparency (ICAT) aims to help countries better assess the impacts of their climate policies and actions and fulfil their transparency commitments. This is executed by increasing the overall transparency capacities of countries, including the capacity to assess the contribution of climate policies and actions on countries' development objectives, and providing appropriate methodological information and tools to support evidence-based policymaking. ICAT capacity development efforts are established to reinforce existing climate measurement, reporting, and verification (MRV) systems and knowledge within countries and complement previous or on-going activities by other initiatives.

The focus of the Antigua and Barbuda ICAT project is to establish a sustainable national economy-wide GHG emission projection and mitigation analysis modelling capability. To achieve this focus, the project first developed a modelling framework and selected appropriate modelling tools for Antigua and Barbuda mitigation assessment. The process of this selection was highlighted in the mitigation analysis project output scope report. The next activity is to create in the selected model(s) an accurate representation of all sources of GHG emissions, with a focus on energy demand and supply and other Nationally Determined Contribution (NDC) aspects. The historical data available was carefully analysed and a baseline scenario was elaborated to best represent the national circumstances for Antigua and Barbuda. The baseline scenario was also compared with the latest GHG inventory to ensure that it was properly calibrated.

The baseline scenario for each aspect of the model is further described in the following Sections:

- Section 2 – Key Assumptions (Demographic & Economic);
- Section 3 – Demand;
- Section 4 – Transformation; and
- Section 5 – Conclusions.

2.0 Key Assumptions (Demographic and Socio-economic)

2.1 Demographic Data

Demographic data is an important aspect of GHG modelling, manifesting as non-policy drivers that can influence consumption patterns in the residential sector and other demand sectors. As such, it is important to quantify and forecast these drivers over the modelling time horizon. The three main demographic data identified in this model (as non-policy drivers) are:

- population;
- persons per households; and

- number of households.

To project these into the future over the modelling time horizon, related historical data was first acquired over a reasonable timeframe of at least 10 years. These are illustrated below.

2.1.1 Population (Historical and Projections)

The historical population of Antigua and Barbuda from 2000-2020 can be seen in Figure 1 (taken from the Statistics Division, Ministry of Finance and Cooperate Governance 2021 (Statistics Division, Antigua and Barbuda, 2021)) based on census conducted in 2001 and 2011 with related estimations for other years. Though population projections were available from this same source (up to 2026), projections for Antigua and Barbuda over a longer timeframe were available from the United Nations, (United Nations, 2019) and are presented in Table 1 for every five years from 2020 to 2050. These were integrated into the baseline model as represented in Table 1, with interpolations occurring in between five-year steps. To supplement Table 1, this projection is also illustrated via Figure 2 (generated from LEAP). This figure illustrates that the UN projections are based upon a decreasing population growth rate from 2030 onwards.

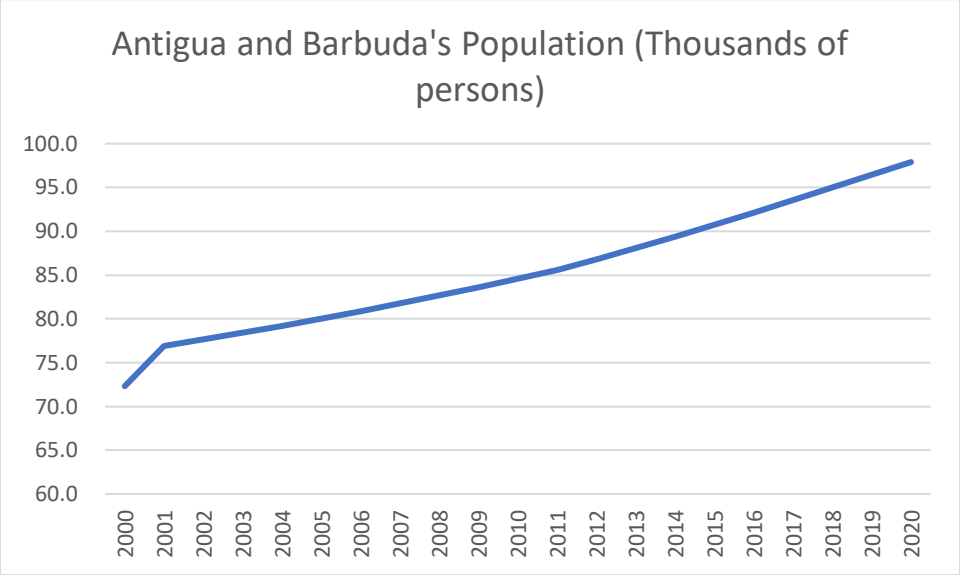

Figure 1: Antigua and Barbuda's Historical and Predicted Population (thousand persons)

Table 1: Projected Population Data for Antigua and Barbuda, 2020-2050 (United Nations, 2019))

Years	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Population ('000s)	97.9	101.7	104.9	107.3	109.1	110.3	110.9
Growth Rate (%)	1.50	1.35	3.11	2.32	1.66	1.09	0.57

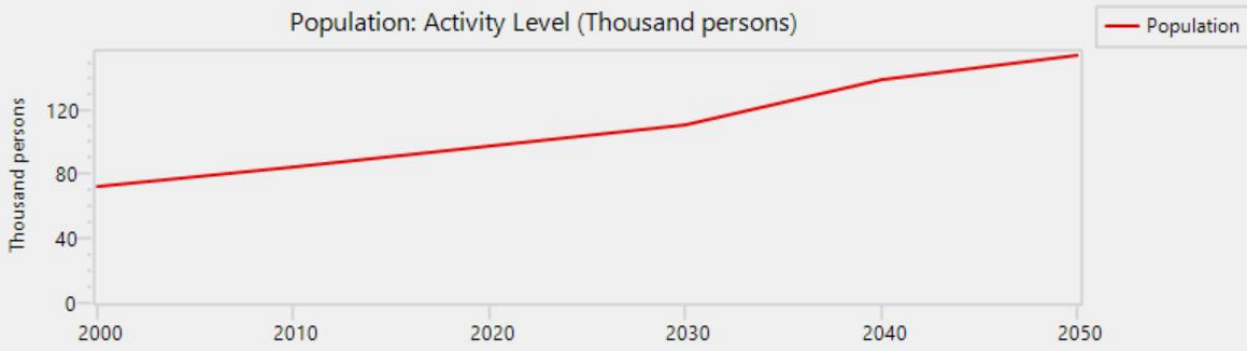

Figure 2: Antigua and Barbuda's Population Projection (thousand persons)

2.1.2 Persons per Household (Historical and Projections)

Relevant data for persons per household were not readily available. Two census reports (2010 and 2011) were found with this data (National Statistics Office, Census 2001& Caribbean Community Secretariat, Government of Antigua and Barbuda, Census 2011-2012). In addition, a previous LEAP model was acquired for Antigua and Barbuda (CA, 2021). In the CA model, the persons per household were estimated at 2.65 for 2050. These three points were used (as represented in Table 2) and integrated into the baseline model with interpolations being performed for the years in between.

Table 2: Number of Persons per Households Used in the Baseline

Year	**2001**	**2011**	**2050**
Number of Households	20437	30213	41848
Number of Persons Per Household	3.76	2.95	2.65

2.1.3 Number of Households (Historical and Projections)

This value was calculated using the inputs from population and persons per households (historical and projections). The output is illustrated in Figure 3 and is endogenous to the model based on the related branches specified above.

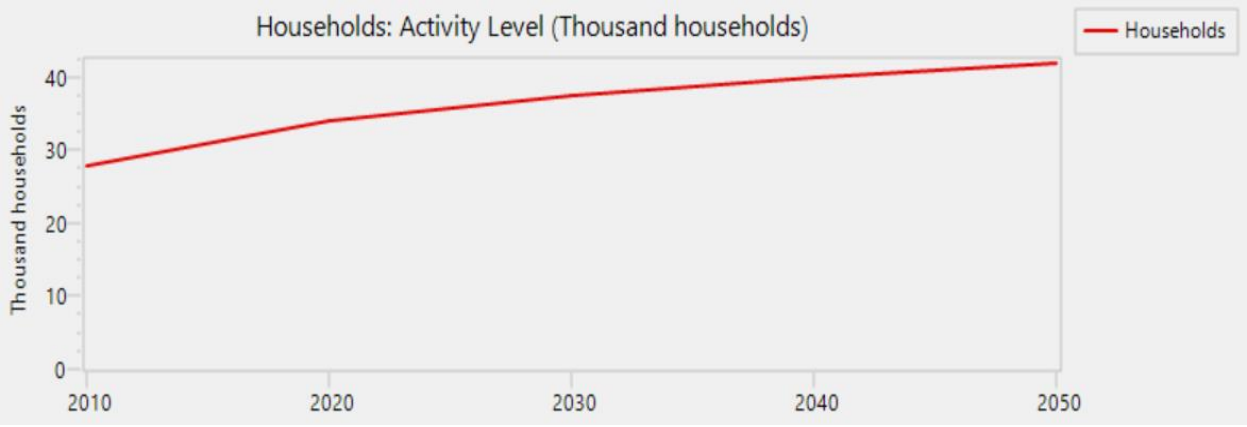

Figure 3: Antigua and Barbuda's Household Projection (thousand households)

2.1.4 Suggested Improvements for Demographic Data

The key assumptions associated with the demographic data guide the demand sectors of the models, especially as it relates to the residential or household sector. The specifications proposed for use in this report and corresponding model were established from reputable national and international data sources. As such, most of the key assumptions can be regarded as well-developed. However, one area of improvement remains, and this relates to the projections for the number of persons in a household. Once this data is well known from other studies, it should be incorporated into the model. Once such data source for improvement can be the planned census by the Statistics Division (tentatively for 2022), which was unavoidably postponed due to the pandemic from the y planned 2020-2021 execution.

2.2 Economic Data

2.2.1 GDP (Historical, Growth Rates, and Projections)

National GDP data was captured from the Central Statistics Office of Antigua and Barbuda. This information is represented in Table 3 at constant 2006 EC$ (Central Statistics Office and Eastern Caribbean Central Bank, February 2021)and was used in the model to calibrate the current accounts and as a basis for the baseline scenario projections. It should be noted that short-term projections (up to 2022) were available from this data source and these were also integrated in the baseline model.

Table 3: Historical GDP for Antigua and Barbuda in Constant (2006) Prices in million Eastern Caribbean Dollars

GDP (2006 EC$)	2407.4	2321.6	2604.6	3125.7	3416.4	2771.9	2809.2	2898.3	3174.7	3502.1	3041.3	3161.3
Year	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022

Further GDP growth rates were sourced from the IMFs World Economic Outlook based on the projections indicated in Table 4 (IMF, October 2020), factoring projected economic contraction due to the COVID-19 pandemic. These were incorporated into the model as the basis for GDP growth in the baseline. It should be noted that beyond 2025, an annual constant growth rate of 1.6 % was incorporated, guided from previous work (CA, 2021) since this IMF forecast did not estimate this parameter beyond 2025.

Table 4: Antigua and Barbuda historical and projected GDP growth rates

Year	GDP Growth Rate
2020	-17.3
2021	-3.0
2022	11.9
2023	6.3
2024	5.9
2025	3.9
2025 - 2050	1.6 per year

Correspondingly, based on the GDP, its growth rate, and assumptions above, the resulting increase in GDP for Antigua and Barbuda's baseline can be seen in Figure 4. This trend line was used in the model to calculate GDP per capita (associated with population projections). The variation of GDP per capita for the baseline case is presented in Figure 5.

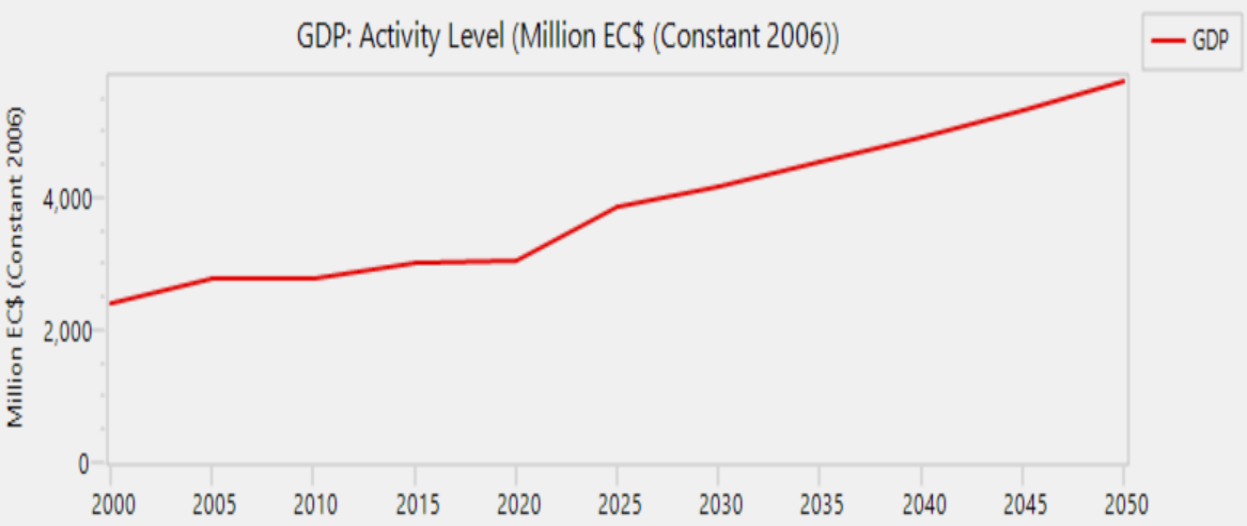

Figure 4: Antigua and Barbuda's GDP Projection (Million EC$)

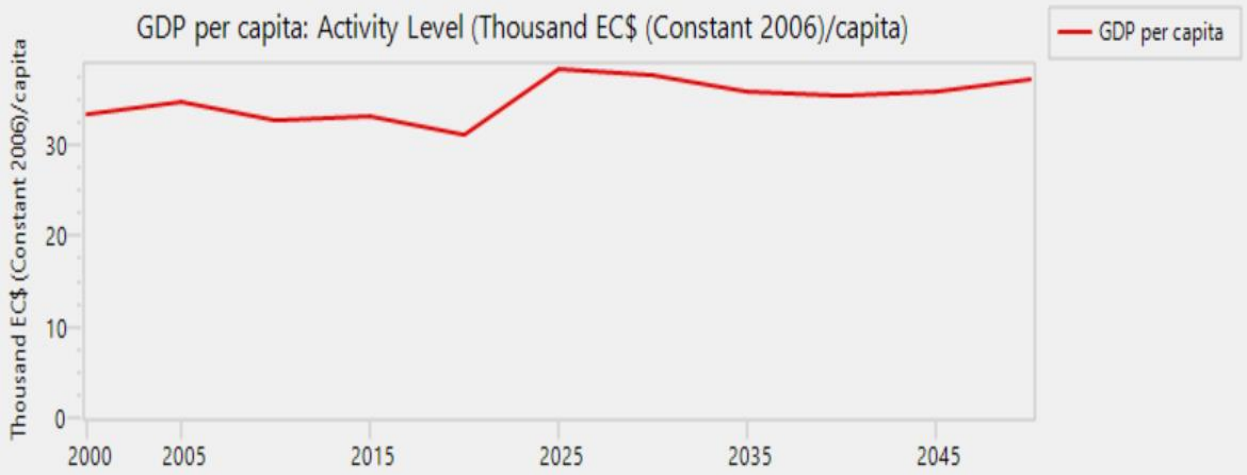

Figure 5: GDP per capita for Antigua and Barbuda

2.2.2 Contribution to GDP

The sectoral contributions to GDP for Antigua and Barbuda were included in the model. Table 5 illustrates the percentage contribution to GDP for the major sectors for the time series 2000-2020 (Central Statistics Office and Eastern Caribbean Central Bank, February 2021). This contribution for the last projected year (2022) was assumed to be constant up to 2050 in the baseline.

Table 5: Antigua and Barbuda Sectoral Contributions to GDP

Economic Activity	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022
Agriculture, Livestock & Forestry	0.88	0.78	0.94	0.85	0.82	0.81	0.74	0.71	0.86	0.88	0.88
Mining & Quarrying	0.78	0.84	1.01	1.03	1.08	1.20	1.29	1.29	1.43	1.44	1.44
Manufacturing	1.95	2.10	2.40	2.36	2.38	2.24	2.22	2.00	2.20	2.20	2.17
Electricity & Water	3.15	3.31	4.15	4.07	3.88	3.78	3.74	3.94	4.22	4.28	4.30
Electricity	2.24	2.32	3.15	3.17	3.09	3.02	2.99	3.13	3.37	3.42	3.43
Water	0.91	0.99	1.00	0.89	0.79	0.77	0.75	0.80	0.85	0.86	0.87
Construction	11.30	11.41	10.81	9.38	10.59	12.30	14.55	14.88	14.08	14.28	14.44
Services	82.93	82.34	82.52	83.52	82.12	80.36	78.16	77.84	77.62	77.34	77.15
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

2.2.3 Suggested Improvements for Economic Data

The economic data and assumptions were guided by national and international data and projections. However, since the projections for GDP growth rate beyond 2025 were not found in any studies, a constant annual growth rate of 1.6% per annum for this time period (and up to 2050) was assumed (based on the CA model). This can be improved on in the future when more related information and studies become available. Further, economic projections should, in future model updates, address and be informed by climate change impact projections in conjunction Antigua and Barbuda's National Adaptation Plan.

3.0 Demand

Energy demand is the consumption of energy by human activity. The energy demand is the starting point in the bottom-up approach for conducting an integrated energy analysis as all the transformation and resources are driven by the demand. In LEAP modelling, the demand analysis is a disaggregated, energy -use based approach for modelling the final energy consumption in a sector. This demand can be modelled based on the economic, demographic, or energy-use information to create scenarios that examine how the total consumption for eight demand areas is projected over the modelling horizon. For Antigua and Barbuda, the model was disaggregated into the following areas: residential, industrial, commercial, street lighting, transport, agriculture, and other. In the sections to follow, the baseline specifications for each demand area are described in detail.

3.1 Residential

The Residential households are linked to the number of households for the islands in the key assumptions. The residential sector is split into historical and projections. Antigua and Barbuda current electrification rate is 100%. For the baseline it is assumed that the electrification rate of 100% was maintained from 2010 into the future. In the historical data, the historical energy usage, and the percentage share of fuel in the residential sector was obtained from the 2010-2012 Energy Balance (shown in Table 6). This fuel use is split into LPG, Charcoal, kerosene, electricity, firewood, diesel oil and gasoline and this balance was projected to remain constant to 2050 to compute the business-as-usual energy intensities (calculated from Table 7).

Table 6: Fuel Share Percentage in the Residential Sector from Olade Energy Balance 2010-2012

Residential	Firewood	electricity	LPG	Gasoline	Kerosene	Diesel Oil	Charcoal	Total
2010/ kBoe	1.7	42.9	22.3	1.1	3.5	0.2	4.9	76.5
Fuel Share %	2.2%	56.1%	29.1%	1.4%	4.5%	0.2%	6.4%	100%
2011/ kBoe	1.7	47.2	22.7	0.9	3.3	0.6	4.9	81.4
Fuel Share %	2.1%	58.0%	27.9%	1.1%	4.1%	0.7%	6.1%	100%
2012/ kBoe	1.7	46.1	23.1	1.3	3.6	0.6	5.0	81.3
Fuel Share %	2.1%	56.6%	28.4%	1.5%	4.5%	0.8%	6.1%	100%

Table 7: Historical Energy use in the Residential Sector

	Firewood	electricity	LPG	Gasoline	Kerosene	Diesel Oil	Charcoal	Total
2010 (TJ)	10.4	262.5	136.4	6.7	21.3	1.0	29.9	468.3
2011 (TJ)	10.5	289.0	138.8	5.6	20.4	3.7	30.2	498.3
2012 (TJ)	10.6	281.8	141.2	7.7	22.1	3.8	30.5	497.7

3.1.1 Residential Cooking

The residential cooking activity level is set to be inherited from the number of households. Further to this, the saturation levels for each cooking fuel must be known or assumed. The CA model assumed 100% cooking in the residential sector is from LPG. Based on the 2010 energy balance for Antigua and Barbuda, it was evident that charcoal, firewood, and LPG were all being used for cooking. As such, these were inputted into the model, assuming 97% of households used LPG, 100% of households used firewood (to some extent), 40% used charcoal (to some extent) and 3% had access to electric cookers. These specifications were all projected into the baseline to 2050 and need to be validated and/or improved upon if more recent national data is available.

3.1.2 Residential Lighting

The residential lighting activity level is set to be inherited from the number of households. It was assumed that 100% of households use electricity for lighting and the energy intensity for this was 359.87 kilowatt-hour per household (Heaps, 2021). Efficient lighting was incorporated with a reduced energy intensity of 179.94 Kilowatt-hour, representing a 50% decrease in energy intensity, but this was reserved for mitigation scenarios. These specifications were projected for the baseline to 2050 and need to be validated and/or improved upon if more recent national data is available.

3.1.3 Residential Cooling (AC)

The residential cooling activity level is set to be inherited from the number of households. It was assumed that 10% of households are equipped with AC and of this, 100% use electricity for cooling with a corresponding energy intensity of 1200 kilowatt-hour per household (Saint Lucia Leap Mitigation Model, 2020 (Heaps, 2021). The Saint Lucia values were derived from data from Mexico and these are used for now (pending validation) as no other regional data is easily available. Efficient cooling was incorporated with a reduced energy intensity of 1020 Kilowatt-hour, representing a 15% decrease in energy intensity, but this was reserved for mitigation scenarios. These specifications were projected into the baseline to 2050 and need to be validated and/or improved upon if more recent national data is available.

3.1.4 Residential Water Heating

The residential water heating activity level is set to be inherited from the number of households. It was assumed that 31.44% of households are equipped with water heaters and of this, 40% use electricity with the remaining households using solar powered water heaters with a corresponding energy intensity of 740 kilowatt-hour per household for the electric water heaters and 1.5 gigajoules per household for solar heaters (Heaps, 2021).

3.1.4 Residential Refrigerators

The residential refrigerator activity level is set to be inherited from the number of households. It was assumed that 92.79% of households are equipped with refrigerators and of these, 100% use electricity with a corresponding energy intensity of 580 kilowatt-hour per household (Heaps, 2021). Efficient refrigeration was incorporated with a reduced energy intensity of 406 Kilowatt-hour, but this was reserved for mitigation scenarios. These specifications were all projected into the baseline to 2050 and need to be validated and/or improved upon if more recent national data is available.

3.1.5 Residential Other Electricity

As Antigua and Barbuda was assumed to be 100% electrified, the activity level for other electrical appliances (e.g., televisions, computers, other appliances, etc.) were derived from the household endogenous calculation with 100% activity level and an assumed energy intensity of 821 kilowatt-hour per household (Heaps, 2021).

Again, the energy intensity values for the demand sub-sectors above were taken from a similar study for Saint Lucia, which was found to be representative based on comparable per household billing data for electricity consumption for Antigua and Barbuda. Table 8 shows the related data for Antigua and Barbuda up to 2011 (CREDP-GIZ, 2013), if it is extrapolated to 2020, then the total electrical related energy intensities assumed in the sub-sectors above are also quite comparable.

Table 8: Antigua and Barbuda Electricity per billing unit for the residential sector (kWh)

Year	kWh per Household
2007	2804
2008	2782
2009	2841
2010	2954
2011	2859

3.2 Industrial

The Industrial sector covers mainly the textiles and distilled liquors for Antigua and Barbuda and the fuel used in this demand sector was estimated from the 2010-2012 energy balance (OLADE, November 2015) as shown in Tables 9 and 10 below.

Table 9: Fuel Share Percentage in the Industrial Sector from Olade Energy Balance 2010-2012

Residential/kBoe	Firewood	Electricity	LPG	Gasoline	Kerosene	Diesel Oil	Charcoal	Total
2010	1.697	42.912	22.302	1.089	3.477	0.171	4.889	76.538
Fuel Share %	2.22%	56.07%	29.14%	1.42%	4.54%	0.22%	6.39%	100%
2011	1.715	47.242	22.691	0.922	3.332	0.605	4.934	81.441
Fuel Share %	2.11%	58.01%	27.86%	1.13%	4.09%	0.74%	6.06%	100%
2012	1.732	46.058	23.08	1.253	3.621	0.624	4.979	81.347
Fuel Share %	2.13%	56.62%	28.37%	1.54%	4.45%	0.77%	6.12%	100.00%

Table 10: Historical Energy use in the Industrial Sector

Industrial	Firewood	electricity	LPG	Gasoline	Kerosene	Diesel Oil	Fuel Oil	Charcoal	Total/TJ
2010 (TJ)	0	19.7	22.8	26.7	0	4.2	1.2	0	74.4
2011 (TJ)	0	21.7	21.8	22.6	0	14.8	1.5	0	82.3
2012 (TJ)	0	21.1	22.7	30.7	0	15.3	1.9	0	91.6

3.3 Commercial

Like the industrial demand sector, the commercial sector was estimated from the 2010-2012 energy balance as shown in Tables 11 and 12 below.

Table 11: Fuel Share Percentage in the Industrial Sector from Olade Energy Balance 2010-2012

Commercial/kBoe	Electricity	LPG	Gasoline	Diesel Oil	Fuel Oil	Total
2010	56.859	14.885	25.057	7.34	4.508	108.649
Fuel Share %	52.33%	13.70%	23.06%	6.76%	4.15%	100.00%
2011	62.596	14.251	21.197	25.999	5.68	129.723
Fuel Share %	48.25%	10.99%	16.34%	20.04%	4.38%	100%
2012	61.027	14.818	28.824	26.822	7.41	138.901
Fuel Share %	43.94%	10.67%	20.75%	19.31%	5.33%	100%

Table 12: Historical Energy use in the Commercial Sector

Commercial/TJ	Electricity	LPG	Gasoline	Diesel Oil	Fuel Oil	Total
2010	347.9	91.1	153.3	44.9	27.6	664.7
2011	383.0	87.2	129.7	159.1	34.8	793.6
2012	373.4	90.7	176.3	164.1	45.3	849.8

3.4 Transport

The transport sector normally refers to the fuel used in on-road and off-road transportation, domestic marine transportation, and domestic aviation. According to the 2006 IPCC Guidelines, this category is within the mobile combustion sector and emissions are estimated on major transport

activities. Relevant data on the fuel use in the domestic marine and domestic aviation was not readily available. The transport analysis was concentrated on the road transport which based on the 2010-2012 energy balance is the major activity for the sector in Antigua and Barbuda. The transport analysis was split into two categories: (i) personal transportation and (ii) public and commercial transportation. The public and commercial transportation includes public transport, taxis, and all commercial transportation. Personal transportation was disaggregated into cars (gasoline, electric), pickups (diesel, gasoline, electric) and SUV (gasoline, electric). The public and commercial transportation was disaggregated into electric buses and vans, gasoline vans, gasoline buses, and diesel buses and vans. The data for the transport sector was retrieved from Melissa Le Blanc of the Department of the Environment provided to CA as part of an EV feasibility study conducted by LOGIOS and data modified by climate analytics and the CA model supplied by the Department of the Environment. The transport analysis in the model is calculated as product of the number of vehicles, the annual average mileage (i.e., distance travelled) and fuel economy (e.g., litres per km or 1/MPG). The base year stock of vehicles was entered directly from data obtained from 2010 and 2019 from the CA model.

3.4.1 Public and Commercial Transportation

Table 13 shows the historical stock and sales for public and commercial transport. It was assumed that the annual average distance travelled per vehicle was 25000 kilometres. The fuel economy correction factor is factor used to convert the rated fuel economy (or laboratory conditions) to on-road fuel economy, these values were obtained from the CA model and reflect driving conditions and temperatures for Antigua and Barbuda. The fuel share is assumed to be 100% for each vehicle and this basically indicates that the vehicle only uses one type of fuel as identified in the title. The maximum scrappage fraction is the estimated fraction of vehicles that can be scrapped in any one vintage. (Heaps, 2021)

Table 14 shows the baseline projections for the public and commercial transportation. The assumption is made that the sale of diesel buses and vans would end by 2030 with gasoline buses recording the same number of sales every year. The gasoline buses were assumed to increase in sales exponentially until 2040 with a steady decline after 2040. These data need to be validated and or improved if more historical data becomes available.

Table 13: Historical data on public and commercial vehicle stock

Public and Commercial Transport (Current Accounts)								
Category	**Stock 2010**	**Stock 2019**	**Sales**	**Fuel Economy /100km**	**Annual distance/ km**	**Fuel Economy correction**	**Fuel Share**	**Max Scrappage Fraction**
Electric Vans and buses	0	0	0	75 kWh	25000	1	100	25
Gasoline Vans	1000	1415	200	7.5 L	25000	1.2	100	100
Gasoline buses	500	753	60	9L	25000	1.5	100	25
Diesel buses and vans	200	337	30	10 L	25000	1.5	100	100

Table 14: Baseline projections data on public and commercial vehicle

Category	Sales 2010	Sales 2020	Sales 2025	Sales 2030	Sales 2035	Sales 2040	Sales 2045	Sales 2050
Electric buses and Vans	0	0	10	30	40	55	85	115
Gasoline Vans	200	200	209	214	223	232	221	225
Gasoline buses	60	60	60	60	60	60	60	60
Diesel buses and vans	30	30	10	0	0	0	0	0

3.4.2 Personal Transportation

Tables 15 and 16 show the historical stock data information and sales for personal transportation. The total stock of personal vehicles in 2019 was recorded as 50,749 vehicles. Table 17 shows the projected baseline scenario for the category. Gasoline cars and electric cars are assumed to have a growth rate of 1.0% and 0.1%, respectively with pick-up diesel and gasoline cars set to increase by 50 vehicles every 5 years with scrappage rates at zero. The pickup electric is assumed to increase sales by 50% and SUV electric by approximately 80% until 2050. The sale SUV gasoline is estimated to increase at 5%. These specifications were all projected into the baseline to 2050 and need to be validated and/or improved upon if historical and recent national data is available.

Table 15: Historical data on personal vehicle stock

Category	Stock 2010	Stock 2015	Stock 2018	Stock 2019	Fuel Economy /100km	Average Annual distance travelled/km	Fuel Economy correction	Fuel Share
Gasoline Cars	25000		31774		8L	10000	1.2	100
Electric cars	0	5	15		16kWh	10000	1.2	100
Pickups_diesel				356	15 L	10000	1.2	100
Pickups_gasoline				415	15 L	10000	1.2	100
Pickups_electric	0	0	0	0	25 kWh	10000	1	100
SUV_gasoline	12000		17089		10 L	10000	1.2	100
SUV_electric	0	0	0	0	25 kWh	10000	1	100
Motorcycles scooters buggies ATVs				1100	3L	5000	1	100

Table 16: Historical sales data for personal transportation

Category	Sales 2010	Sales 2015	Sales 2018	Sales 2019
Gasoline Cars	2500			2500
Electric cars	0	2	5	
Pickups_diesel	50		100	
Pickups_gasoline	50		100	
Pickups_electric	0	0	0	0
SUV_gasoline	1500			1500
SUV_electric	0	0	0	0

Motorcycles scooters buggies ATVs	0	0	0	0

Table 17: Baseline projections for sales data for personal transportation

Category	Sales 2010	Sales 2020	Sales 2025	Sales 2030	Sales 2035	Sales 2040	Sales 2045	Sales 2050
Gasoline Cars	2500	2525	2654	2789	2931	3081	3238	3403
Electric cars	0	6	9	14	23	37	60	96
Pickups_diesel	50	100	150	200	250	300	350	400
Pickups_gasoline	50	100	150	200	250	300	350	400
Pickups_electric	0	0	5	10	20	30	40	50
SUV_gasoline	1500	1500	1575	1654	1736	1823	1914	2010
SUV_electric	0	0	10	18	31	54	94	150
Motorcycles scooters buggies ATVs	0	0	0	0	0	0	0	0

3.4.3 Suggested Improvements for the Transport Sector

The transport data is guided by data collected from the Department of the Environment and the CA model inputs. Improvements can be made to the model once more historical data becomes available. In addition, the inclusion of motorcycles (both gasoline and electric) can be made once sales data and verification of the source of the CA vehicle data can be established.

3.5 Services

The services area covers only streetlighting, as little data is available in the sector. The following data is included in the historical data for streetlighting and was used to project up to 2020. (Heaps, 2021)

Table 18: Final Energy Intensity for Streetlighting

Streetlight (Current accounts)	Final Energy Intensity/MWh
2007	500
2008	500
2009	520
2010	550
2011	550

4.0 Transformation

In modelling, transformation is concerned with meeting energy demand. It involves an analysis of resource extraction (if applicable), energy conversion, and transmission and distribution so that supply can meet demand. Being demand driven, the transformation branch in LEAP can be modelled to simulate or optimized between supply and demand interactions. For the baseline scenario specification, the various existing power supply facilities were integrated into the model, along with their associated parameters are illustrated in Table 19. These would all be used in the mitigation scenario in semi-optimization mode based on an exogenous availability factor of 50% (as guided by the CA model) and contingent on the dispatch merit order. Although two solar plants were shown to be in existence from 2016 and 2017, no historical data was available for them. (Heaps, 2021)

Table 19: Existing Power Generation Facilities and Related Baseline Specifications

Plant Type	Feedstock	Exogenous Capacity (MW)	Efficiency (%)	Merit Order	Maximum Availability (%)	Historical Production (MWh)
Thermal Plant APUA Wadadli	Residual Fuel Oil	11	40	2	75	23,810
Thermal Plant APC Crabbs	Residual Fuel Oil	50	40	2	75	263,097
Thermal Plants APC Black Pine	Residual Fuel Oil	27	40	2	75	88,425
Distributed Commercial Diesel Generators	Diesel	2	25	3	75	9000
Utility Solar airport	solar	3	100	1	Based on yearly shape availability for Antigua and Barbuda	Data not available
Utility Solar Bethesda	solar	4	100	1		

The associated transmission and distribution losses in the grid were assumed to be 20% (taken from the CA model). In the baseline estimation, this loss is expected to decrease by 2% per annum due to improvements in transmission and distribution.

Based on the mitigation scenario study (being conducted in parallel), it is expected that several renewable energy plants and projects would be added to the baseline specification with a higher merit order dispatch.

5.0 Conclusion

This project benefitted from a previous LEAP model for Antigua and Barbuda: the CA model. Many improvements were made to this inherited model, including:

- Historical population figures were updated from available local figures from the Statistics Division.
- Population projections were taken from updated UN projections.
- Persons per household inherited from CA model, but the number of households is now calculated endogenously in the model (from population and persons per household) rather than just declared as a constant growth rate.
- GDP historical data updated and taken from the Statistics Division.
- GDP projections updated and taken from the latest IMF forecast up to 2025.
- Contributions to GDP and sectoral GDP data were incorporated into the model and based on data from Antigua and Barbuda's Central Statistical Office
- The residential sector activity level is now derived from number of households and calculated endogenous to the model.
- There is a separation of historical from projections in the demand sectors to assist with calibration to the latest GHG inventory.
- More fuel shares were added to cooking.

- More disaggregated demand sub-sectors were added for residential such lighting, cooling, refrigeration etc.
- Incorporation of stock motorcycling data into the notes but verification is required on sales data.

Though these improvements were made in this cycle, further enhancements are still possible, and these were identified in the respective sections. In addition, the team proposes the inclusion of a second baseline which would include recently implemented policies and expected reductions in emissions based on the regional trends. All the raw data sets used can be found in Annex 1, which is a complimentary file for this report.

6.0 References

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