Initiative for Climate Action Transparency

Development and Institutionalization of a Framework to Track NDC Action and Build Capacity in Relevant Areas

Methodologies for Developing Projections of GHG Emissions for the Energy Sector

St. Kitts & Nevis

20th December 2024

Submitted to:

The Government of St. Kitts and Nevis' Ministry of Sustainable Development, Environment, Climate Action, and Constituency Empowerment

Prepared by:

Caribbean Cooperative Measurement, Reporting & Verification Hub

DISCLAIMER

PREPARED UNDER

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

The ICAT Secretariat is managed and supported by the United Nations Office for Project Services (UNOPS)

Methodology for Developing Projections of GHG emissions for the Energy Sector

Initiative for Climate Action Transparency – ICAT

Deliverable F – Output 1.3.1

AUTHORS

Benise Joseph, CCRMVH

Ahyana Bowen, CCMRVH

Kalifa Phillip, CCMRVH

20th December 2024

Table of Contents

List of Tables

List of Figures

ACRONYMS

BUR	Biennial Update Report
BUR1	First Biennial Update Report
CCMRVH	Caribbean Cooperative Measurement, Reporting and Verification Hub
CDM	Clean Development Mechanism
CO_2	Carbon Dioxide
CSI	Climate Smart Initiative
EC	Eastern Caribbean
ECCB	Eastern Caribbean Central Bank
EV	Electric Vehicle
GDP	Gross Domestic Product
GHG	Greenhouse gas
GWh	Gigawatt Hour
GWP	Global Warming Potential
ICAT	Initiative for Climate Action Transparency
ICE	Internal Combustion Engine
IMF	International Monetary Fund
IRP	Integrated Resource Plan
kJ	Kilojoules
ktCO2eq	Kilotonnes carbon dioxide equivalent (Unit)
kW	Kilowatts (Unit of Energy)
kWh	Kilowatt Hour
LEAP	The Low Emissions Analysis Platform
LPG	Liquefied Petroleum Gas
MRV	Measurement, Reporting and Verification
MW	Megawatts (Unit of Energy)
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NEP	National Energy Policy
NEVLEC	Nevis Electricity Company
OLADE	The Latin American Energy Organization
QA	Quality Assurance
QC	Quality Control
RE	Renewable Energy
SIDS	Small Island Developing State
SKELEC	St. Kitts Electricity Company
SKN	St. Kitts and Nevis

SNC	Second National Communication
SUV	Sports Utility Vehicles
TraCAD	The Transport Climate Action Data Tool
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars

1 Introduction

The Twin Island Federation of St. Kitts and Nevis (SKN) is a sovereign Small Island Developing State (SIDS) in the Eastern Caribbean. The island is committed to implementing measures to combat the negative impacts of climate change through the implementation of its Nationally Determined Contributions (NDCs). SKN has identified the following key areas as major interventions which contribute to their overall economy-wide emissions reduction strategies in their updated 2021 NDCs:

- Transition to 100% renewable energy in power generation
- Improving efficiency in the transmission and distribution of electricity
- Electrification of 2% of the total vehicle fleet
- Development of EV infrastructure

To support the implementation of their NDCs, 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 and enhance existing climate measurement, reporting and verification (MRV) systems and knowledge within countries and complement previous or ongoing activities by other initiatives.

The focus of the St. Kitts and Nevis ICAT project is the design of an MRV and NDC Tracking Framework and the establishment of sustainable capacity to conduct projections of GHG emissions and removals, assessments of the impact of key policies and measures for the energy sector. In addition, the project aims to enable policymakers to identify co-benefits and synergies between climate action and policy transparency.

This report focuses on the methodology used for the projections of GHG emissions for St. Kitts and Nevis ICAT project as a component of the project aiming to enhance St. Kitts and Nevis GHG projection capacity. The GHG projections element of the project involved the following:

- The review of modelling tools available for the Energy Sector and the selection of appropriate modelling tools for the greenhouse gas (GHG) analysis of the Energy Sector. The selection process and results are presented in the SKN Modelling Tool Workshop Report and SKN Modelling Tool Justification Report contained in **ANNEX 1** of this report.

- Training workshops on the modelling tools selected for analysis: The Transport Climate Action Data Tool (TraCAD) developed by the Climate Smart Initiative (CSI) (virtual training) and the Low Emissions Analysis Platform (LEAP) developed by the Stockholm Environment Institute (SEI) (in-person training). The training programmes are described in the TraCAD Training Report and the LEAP Training Report contained in **ANNEX 2** of this report.
- Assessment of the current data collection and management and identification of data gaps for the energy sector. The results are summarized in the Data collection and management and data gap assessment report contained in **ANNEX 3** of this report.
- Validation workshop for the methodology for the projections where the data used for the projections and the methods were presented to stakeholders for validation and verification.
- The development of fully elaborated models for the electricity generation and transport sectors using the selected modelling tools TraCAD and LEAP with the datasets obtained. Addressed in deliverable F – this report.

The methodology for projections report for the energy sector is presented in the following sections:

Section 2 – General overview of the tools used for the projections

Section 3 – General Overview of the Mitigation Scenarios used for modelling;
Section 4 – Methodological Approaches;
Section 5 – Input Data and Assumptions;
Section 6 – Results and Analysis of the Modelling Impact;
Section 7 – Suggestions/Recommendations for Improvements;
Section 8 – Conclusions.

2 General Overview of Modelling Tools

There are several energy sector modelling tools available that can be used for projections. The tools used in this project were assessed based on their ability to meet the requirements and scope of the project as highlighted in the sections above. The tools selected were based mainly on their ability to assess and project GHG emissions in the electricity generation and transport sector, in particular, focusing on renewable energy and electric vehicle penetration. This selection process was elaborated in the SKN Modelling Tool Justification Report. Upon the analysis two modelling tools were selected:

2.1 Low Emissions Analysis Platform (LEAP)

This tool was developed by the Stockholm Environment Institute (SEI) and has been used by several countries in the region for GHG emissions projections for the development of Nationally Determined Contributions (NDC). In addition, it was used by SKN in their assessment of their mitigation action and effects in the latest Biennial Update Report [1].

The LEAP tool is used mainly for integrated energy planning and climate change mitigation assessments. LEAP can be used to analyse both the electricity generation sector and the transport sector using various methodologies. It jointly assesses GHGs, short-lived climate pollutants (SLCP), and air pollutant emissions. LEAP can also be used to build mitigation and baseline scenarios. Results for LEAP can be viewed in graphical or tabular formats.

The LEAP tool can be downloaded by users and installed on their personal devices for continued use of the software.

In this analysis, the LEAP tool was used to assess the GHG emissions projections in the mitigation and baseline scenarios for the electricity generation and transport mitigation actions as indicated in the St. Kitts and Nevis Updated NDC Report [2] and highlighted in the section below.

2.2 Transport Climate Action Data Tool (TraCAD)

This tool was developed by the Climate Smart Initiative (CSI) specifically for the ICAT project. This tool was previously used by Antigua and Barbuda to assess the GHG emissions reduction for mitigation action in the transport sector.

The TraCAD Tool was developed for transport sector data collection, policy impact assessment and tracking, and mitigation cost analysis. TraCAD provides a consistent and structured approach to GHG emissions impact assessment for the transport sector. TraCAD assesses GHG emissions reductions in specific policies and actions related to the transport sector.

In this analysis, only one policy action was assessed using TraCAD for the transport sector as indicated in the St. Kitts and Nevis Updated NDC Report [2] and highlighted in the section below.

3 General Overview of the Mitigation Scenarios

The mitigation scenarios used in the modelling tools were based on mitigation actions found in the St. Kitts and Nevis Updated NDC report of 2021. The modelling tools used updated information for the drivers, such as population and economic activity, to update the modelling. **Table 1** describes the mitigation actions as highlighted in the 2021 NDC report. Most of these actions were conditional upon receipt of sufficient climate finance in St. Kitts and Nevis, except for the solar farm project. The mitigation actions were adjusted into scenarios for the two modelling tools, TraCAD and LEAP, based on the data requirements of the tools and the main functions of the modelling tool.

The main NDC target as highlighted in the SKN NDC report is to reduce economy-wide CO_2 emissions by 61% by 2030 when compared to the 2010 base year. The end year for implementation of the NDC is 2030 and the total indicative costs is 637 million USD excluding the unconditional project.

Table 1: NDC Mitigation Actions

Number#	Scenario Name	Mitigation Action(s)	Estimated Budget	Conditionality	Tool Used for Assessment
1	Renewable Energy Generation Projects	35.7 MW utility-scale solar PV capacity for St. Kitts	$70,000,000	Unconditional	LEAP
2		6.6 MW of Wind Capacity in St. Kitts	$19,000,0000	Conditional	LEAP
3		25 MW of geothermal power capacity (10MW in Nevis and 15MW on St. Kitts)	$186,000,000	Conditional	LEAP
4	Transmission/Distribution Loss Reduction	Improvement in transmission and distribution lines to reduce losses in both islands	$391,000,000	Conditional	LEAP
5		Two solar PV plants of 0.75MW each to supply two desalination plants	$6,000,000	Conditional	Not Modelled
6	Solar Water Heaters	5% reduction in the power demand by	$20,000,000	Conditional	LEAP

		introducing solar water heaters			
7	Electric Vehicles	Penetration of EVs reaching 2% of the vehicle fleet	$15,000,000	Conditional	LEAP / TraCAD

3.1 Renewable Energy Generation Projects

The scenario "RE Generation Projects" includes all the utility-scale renewable energy projects highlighted in the St. Kitts and Nevis Updated NDC Report. The aim of these projects is expected to achieve 100% renewable energy in electricity generation across the twin-island federation. The overall renewable energy target is supported by the implementation of the following projects and mitigation actions:

- 35.7 MW utility-scale solar PV capacity with a storage capacity of 44.2 MWh for St. Kitts. This action is considered unconditional, as the funds have already been secured for the implementation of this mitigation action.
- 6.6 MW of wind capacity in St. Kitts
- 25 MW of geothermal power capacity (10 MW in Nevis and 15 MW on St. Kitts)

In addition, the currently installed wind farm on Nevis 1.925 MW is considered in this scenario.

3.2 Transmission and Distribution Loss Reduction

The scenario "TD Loss Reduction" simulates the possible improvements in the transmission and distribution lines to reduce losses in the system. These loss reductions are all estimated to be technical system losses and therefore non-technical losses are not considered as part of these scenarios. The improvements in the transmission and distribution detwork are expected to reduce losses by 35% by 2030. As indicated in the NDC report, the upgrade of the electrical transmission and distribution has the most cost implications and is essential to the achievement of St. Kitts and Nevis' target to achieve 100% renewable energy generation in electricity generation.

3.3 Solar Water Heaters

This scenario aims to simulate the implementation of solar water heaters to reduce the energy demand by 5% in St. Kitts and Nevis. Based on the validation workshop held previously, electrical water heaters are installed in most households in the country. This scenario although mainly considered as an energy demand and energy efficiency target, is also expected to contribute to the 100% renewable energy generation in the electricity generation by reducing on the overall demand for electricity. Therefore, it was considered in the analysis of scenarios for this project.

3.4 Electric Vehicles

The only mitigation action in the transport sector is the penetration of electric vehicles by 2% of the overall vehicle stock. In this scenario, 2% is used for the penetration of electric vehicles as well as for the penetration of hybrid vehicles into the vehicle stock. This is the only mitigation scenario that was also modelled using the TraCAD software.

3.5 Solar PV for Desalination Plants

This scenario was not modelled. Although solar PV is renewable energy, in this case, it was considered to be constructed specifically for new demand and would not necessarily contribute to the overall renewable energy penetration for the electricity generation sector.

4 Methodological Approaches

This SKN ICAT project focused on the electricity generation and transport sectors and the GHG analysis of the effects of the mitigation actions as highlighted in the NDC report. Therefore, four general mitigation scenarios were considered as highlighted in the **Section 3** above. The St. Kitts and Nevis LEAP model in this project builds on the previous modelling work associated with the development of the mitigation analysis for their 2023 BUR1. These updates mainly focused on the acquisition of updated data but focused on the electricity generation and the transport sector. In addition, the LEAP model was updated with the most recent economic, demographic, and other energy statistics and, to the extent possible, developed to capture the economic and GHG impact of COVID-19.

Forward-looking scenarios were created for the transport and electricity generation sector and are based on the mitigation actions and policies reported in the NDC. Since the development of St. Kitts BUR1, there have been no updates to the national inventory, therefore the modelled emissions were aligned as closely as possible to the latest 2018 GHG inventory.

The historical emissions and energy demand closely match the GHG inventory of 2018, and this indicates that the model is well aligned with St. Kitts and Nevis' national circumstances.

The forward-looking scenarios developed through this project are intended to assess the impacts of the following:

- A baseline scenario "without measure" that shows emissions based on currently implemented policies and strategies in St. Kitts and Nevis. This illustrates the emissions of St. Kitts and Nevis assuming no changes from current policy implementation and considering the demographic and macroeconomic trends.
- A mitigation scenario "with measures" including the four (4) modelling scenarios identified for the modelling. The mitigation scenarios explore the implementation of the different actions, policies, and strategies identified in **Section 3**. The macroeconomic and baseline trends were assumed to be the same as the baseline in the mitigation scenarios. These scenarios were combined showing the overall mitigation impact of the mitigation strategies modelled in the different categories.
- A revised mitigation scenario "with measures 2" explores different implementation phases of the mitigation scenarios based on the current situation, views expressed in the validation workshop by stakeholders, and expert judgement by the Caribbean Cooperative MRV Hub team.
- An additional mitigation scenario with more ambitious measures "with additional measures" exploring more measures in the electricity and transport sector to reduce the level of GHG emissions.

4.1 Low Emissions Analysis Platform

In LEAP, mainly two types of analysis are conducted in the demand sector:

- An activity analysis: This is dependent on the current activity level in the section being analysed and the final or useful energy demand for this activity. This analysis estimates the energy consumption for each demand branch (e.g. residential cooking) based on the activity in the branch and the final/useful energy consumption. Since the focus of this assignment was not on the energy demand sector, most of the information used in this section was referenced from the SKN BUR1.

- Another analysis which was conducted for the projections section of the transport sector is the stock turnover analysis. The stock turnover is a detailed analysis of the transport sector and calculates the remaining stock of vehicles per year based on the sales and the survival of vehicles in the year. For this analysis a clear disaggregation of the stock of vehicles by vehicle type is required and a survival profile of vehicles. Noting the limited data in SKN, the survival profile of vehicles was taken from Antigua and Barbuda and adjusted to fit into the SKN context. The vehicles were grouped by passenger or freight vehicles, with only trucks considered as freight vehicles. Each type of vehicle was distributed into the different fuel-use of vehicles, this was based on expert knowledge and what is considered as the norm in the Caribbean region. The energy consumption was calculated using information from the vehicle stock, the mileage which represents the annual distance travelled by each vehicle and the fuel economy of the vehicle. This was then used to calculate the emissions for the transport sector as described with the equations below.

  The GHG emissions for the transport sector analysis were calculated using the following equations in the LEAP model.

Equation 1: Equations used in the LEAP model.

$$Stock_{t,y,v} = \left(Sales_{t,v} \times Survival_{t,y-v}\right)$$
$$Stock_{t,y} = \sum_{0..y} Stock_{t,y,z}$$
$$FuelEconomy_{t,y,v} = \left(FuelEconomy_{t,v} \times FeDegradation_{t,y-v}\right)$$
$$Mileage_{t,y,v} = \left(Mileage_{t,v} \times MIDegradation_{t,y-v}\right)$$
$$EnergyConsumption_{t,y,v} = \left(Stock_{t,y,v} \times Mileage_{t,y,v} \times FuelEconomy_{t,y,v}\right)$$
$$Emission_{t,y,v,V} = \left(EnergyConsumption_{t,y,v} \times EmissionFactor_{t,y,p} \times EmDegradation_{t,y-v,p}\right)$$

Where:

t - type of vehicle (i.e. the technology branch)
v - vintage (i.e. the model year)
y - calendar year
p -any criteria for air pollutant
T - number of types of vehicles
V - maximum number of vintage years which is determined automatically from the survival lifecycle profile
Sales - number of vehicles added in a particular year
Stock- number of vehicles existing in a particular year
Survival- fraction of vehicles surviving after a number of years which is entered as the lifecycle profile

Fuel Economy:- fuel use per unit of vehicle distance travelled.
FeDegradation- factor representing the decline in fuel economy as a vehicle age.
Mileage - annual distance travelled per vehicle
MIDegradation- factor representing the change in mileage as the vehicle ages.
Emissionfactor- emission rate for pollutants.
EmDegradation- factor representing the change in the emission factor for pollutants as the vehicle ages [3]

4.2 ICAT Transport Climate Action Data Tool (TraCAD)

Based on the assessment of the targets defined in **Section 3** and the relevant scenario development, TraCAD was selected as the most appropriate calculation methodology. The TraCAD tool refers to mitigation actions as climate action. Noting that TraCAD is a newly developed tool and the timeframe for conducting the assessment was limited, the methodology selected was all found within the tool and no new methodologies were created or added to undertake this assessment. The methodology used for the transport assessment in TraCAD was the AMS-III.C Small Scale Methodology: Emissions reductions by electric and hybrid vehicles.
This methodology was developed by the United Nations Framework Convention on Climate Change (UNFCCC) for assessing Clean Development Mechanism (CDM) project activities to assess the emission reduction as a result of the displacement of fossil fuel through the introduction of electric and/or hybrid vehicles.

This methodology was used to estimate the emissions reduction that would occur when the vehicle fleet was converted from petrol & diesel driven vehicles to EVs in a specified year. The methodology features two main approaches to calculating baseline and project emissions:

- Approach 1: Using distance travelled by project vehicles.
- Approach 2: Using the electricity used to charge the vehicles.

For the assessment of the mitigation target specific to the transport sector, approach 1 was used in both the baseline and project scenarios. The approach 1 was used because it allowed for easier assumptions compared to approach 2. The following calculations shown in **equations 2, 3, 4 and 5_**were completed within the software to complete the assessments. An ex-ante assessment was completed with additional assumptions, as highlighted in **Section 6.**

Equation 2: Baseline emissions calculation using Approach 1

$$BE_y = \sum_i EF_{BL,km,i} \times DD_{i,y} \times N_{i,y} \times 10^{-6}$$ Equation (1)

Where:

BE_y	=	Total baseline emissions in year *y* (t CO_2)
$EF_{BL,km,i}$	=	Emission factor for baseline vehicle category *i* (g CO_2/km)
$DD_{i,y}$	=	Annual average distance travelled by project vehicle category *i* in the year *y* (km)
$N_{i,y}$	=	Number of operational project vehicles in category *i* in year *y*

Equation 3: Emission factor calculation for baseline vehicle

$$EF_{BL,km,i} = SFC_i \times NCV_{BL,i} \times EF_{BL,i} \times IR^t$$ Equation (3)

Where:

SFC_i	=	Specific fuel consumption of baseline vehicle category *i* (g/km)
$NCV_{BL,i}$	=	Net calorific value of fossil fuel consumed by baseline vehicle category *I* (J/g)
$EF_{BL,i}$	=	Emission factor of fossil fuel consumed by baseline vehicle category *i* (g CO_2/J)
IR^t	=	Technology improvement factor for baseline vehicle in year *t*. The improvement rate is applied to each calendar year. The default value of the technology improvement factor for all baseline vehicle categories is 0.99
T	=	Year counter for the annual improvement (dependent on age of data per vehicle category)

Equation 4:Project emissions calculation using Approach 1

$$PE_y = \sum_i EF_{PJ,km,i,y} \times DD_{i,y} \times N_{i,y}$$

Equation (4)

Where:

PE_y	=	Total project emissions in year *y* (t CO_2)
$EF_{PJ,km,i,y}$	=	Emission factor per kilometre travelled by the project vehicle type *i* (t CO_2/km)
$N_{i,y}$	=	Number of operational project vehicles in category *i* in year *y*
$DD_{i,y}$	=	Annual average distance travelled by the project vehicle category *i* in the year *y* (km)

Equation 5: Emissions factor calculation for project vehicles

$$EF_{PJ,km,i,y} = \sum_i SEC_{PJ,km,i,y} \times EF_{elect,y} / \left(1 - TDL_y\right) \times 10^{-3} + \sum_i SFC_{PJ,km,i,y} \times NCV_{PJ,i} \times EF_{PJ,i} \times 10^{-6}$$

Equation (6)

Where:

$SEC_{PJ,km,i,y}$	=	Specific electricity consumption by project vehicle category *i* per km in year *y* in urban conditions (kWh/km)
$EF_{elect,y}$	=	CO_2 emission factor of electricity consumed by project vehicle category *i* in year *y* (kg CO_2/kWh)
$SFC_{PJ,km,i,y}$	=	Specific fossil fuel[3] consumption by project vehicle category *i* per km in year *y* in urban conditions (g/km)
$EF_{PJ,i}$	=	CO_2 emission factor of fossil fuel consumed by project vehicle category *i* in year *y* (g CO_2/J)
$NCV_{PJ,i}$	=	Net calorific value of the fossil fuel consumed by project vehicle category *i* in year *y* (J/g)
TDL_y	=	Average technical transmission and distribution losses for providing electricity in the year *y*

5 Input Data and Assumptions

5.1 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 household; 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.

5.1.1 Population (Historical and Projections)

The historical population of St. Kitts and Nevis was obtained for 2001, 2011 and 2021 from the St. Kitts and Nevis Department of Statistics [5] as shown in **Table 2, Table 3** and **Table 4.**

The census data for 2001 and 2011 were available online and the 2021 census data was supplied from the Department of Statistics to the St. Kitts and Nevis National ICAT Team. The population data was separated by parish and island. This data was entered into the model as given; the model then was used to interpolate the graph for the missing years as shown in **Figure 1** generated from LEAP [3] (data available in the **Appendix**).

The projected population of SKN was calculated using the growth rates from the projected population from the United Nations World Population Prospects 2024 using the mediant variant for population projections [6]. A graphical presentation of the population projections is illustrated in **Figure 2** (data available in the **Appendix**). This figure illustrates that the UN projections are based upon a decreasing population growth rate from 2030 onwards.

Table 2: Population of St. Kitts

POPULATION			
ST. KITTS			
PARISH	2001	2011	2021
St. George	13,251	12,635	14,495
St. Ann	3,167	2,626	3,100
St. John	3,248	2,962	3,114
St. Thomas	2,395	2,535	2,968
Christ Church	2,061	1,922	2,062
Trinity	1,678	1,701	2,090
St. Peter	3,541	4,670	5,549
St. Paul	2,453	2,432	2,535
St. Mary	3,423	3,435	3,579
TOTAL	**35,217**	**34,918**	**39,492**

Table 3: Population of Nevis

POPULATION			
NEVIS			
PARISH	2001	2011	2021
St. Paul	1,790	1,847	1,985
St. George	2,564	2,496	2,487
St. Thomas	2,047	2,069	2,303
St. James	1,806	2,038	2,100
St. John	2,901	3,827	4,391
TOTAL	**11,108**	**12,277**	**13,266**

Table 4: Total Population of St. Kitt and Nevis

	2001	2011	2021
Total Population of St. Kitts and Nevis	**46,325**	**47,195**	**52,758**

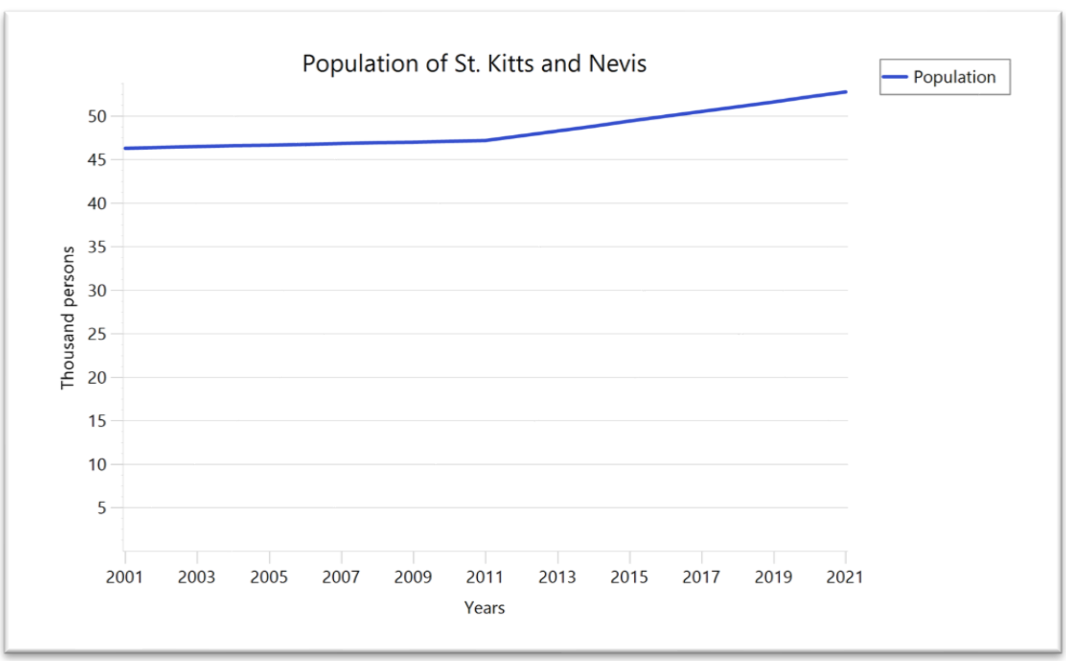

Figure 1: Population of St. Kitts and Nevis interpolated for the years 2001-2021

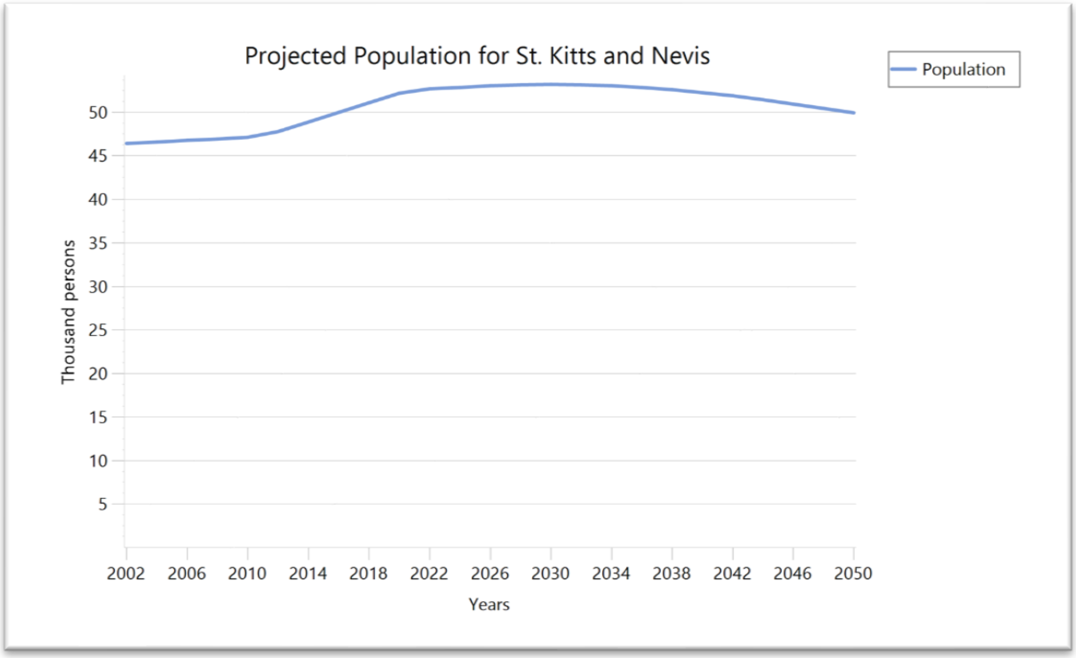

Figure 2: Projected population for St. Kitts and Nevis (2022-2050)

5.1.2 Number of Households and Household Size (Historical and Projections)

Similar to the population data obtained, the number of households and average household size were obtained for the census years 2001, 2011 and 2021 from the Department of Statistics in a similar manner. The respective data for the number of households and the average household size is shown in **Table 5** and **Table 6.**

In the projected baseline scenario, it was assumed that the average household size would decline by 0.7% yearly, this assumption was based on the previous trend in the decline of the average household size from 2001 to 2021. The number of households in the projected baseline scenario is dependent on the projected population and the projected average household size. The output is illustrated in **Figure 3** and **Figure 4** and (data available in the **Appendix**).

Table 5: Historical Number of Households for St. Kitts and Nevis

Total Number of Households St. Kitts and Nevis	2001	2011	2021
	15,680	16,926	20,487

Table 6: Historical Average Household Size for St. Kitts and Nevis

Average Household Size St. Kitts and Nevis	2001	2011	2021
	3.0	2.8	2.6

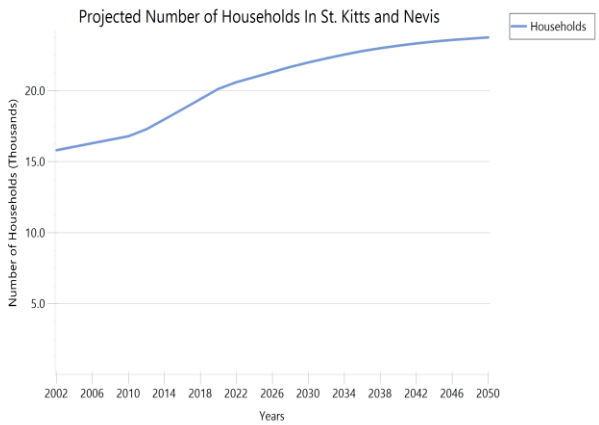

Figure 3: Projected Number of Households in St. Kitts and Nevis (2022-2050)

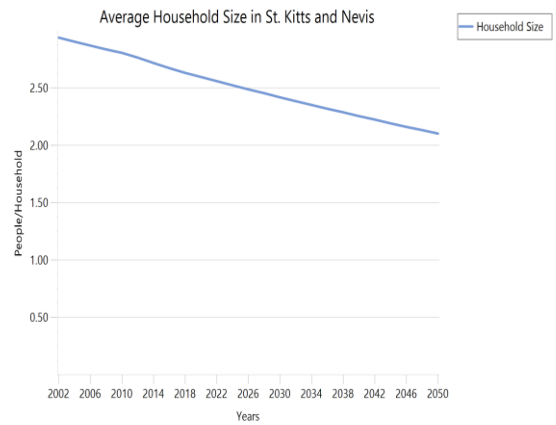

Figure 4: Projected Average Household Size in St. Kitts and Nevis (2022-2050)

5.1.3 Suggested Improvements for Demographic Data

The demographic data is essential in modelling because it is one of the key parameters used for the projection in the energy demand sector in particular the transport sector. The statistics proposed for use in this report and the corresponding models 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 relates to the projections for the number of persons in a household. The assumption of a decline of -0.7% can be further verified with the Department of Statistics and updated in the model in future projection modelling.

5.2 Economic Data

5.2.1 GDP (Historical, Growth Rates, and Projections)

National GDP data for the years 2012 to 2022 was captured from the Department of Statistics [7] in millions of Eastern Caribbean Dollars (ECD/XCD) in constant prices with 2006 base year. The constant prices GDP index was used as it is normally referred to as the real GDP and is normally used to measure economic growth without the effects of inflation. This data was supplemented by data from the Eastern Caribbean Central Bank (ECCB) for the years 2001 to 2011 [8]. The historical data from 2001 to 2021 was provided was used in the model. This information is illustrated in graphical format obtained from the SKN ICAT LEAP model in **Figure 5** and **6** (data available in the **Appendix**).

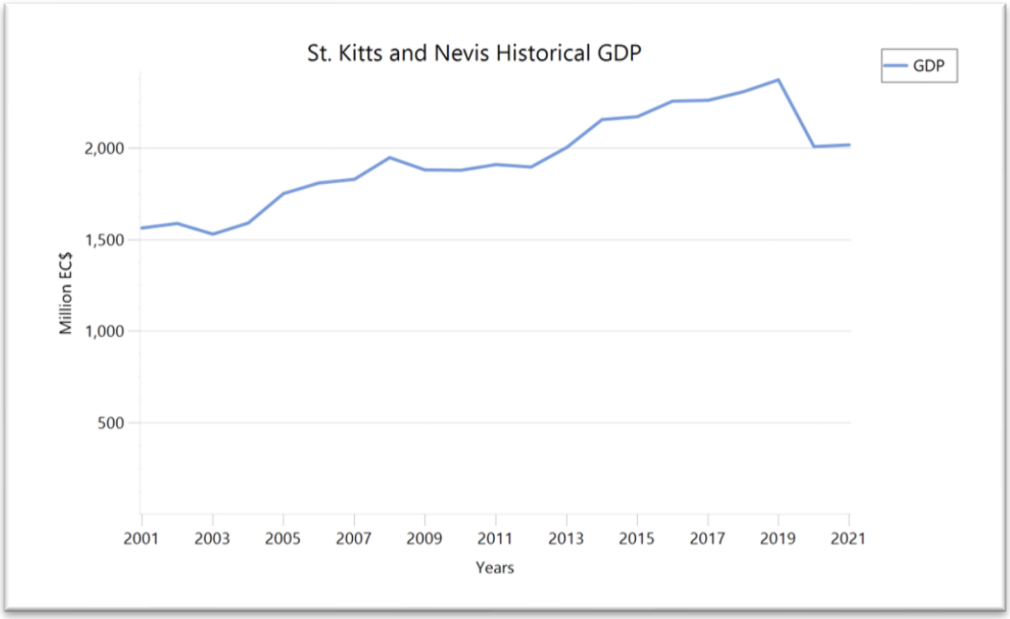

Figure 5: St. Kitts and Nevis Historical GDP (Million EC$) (2001-2021)

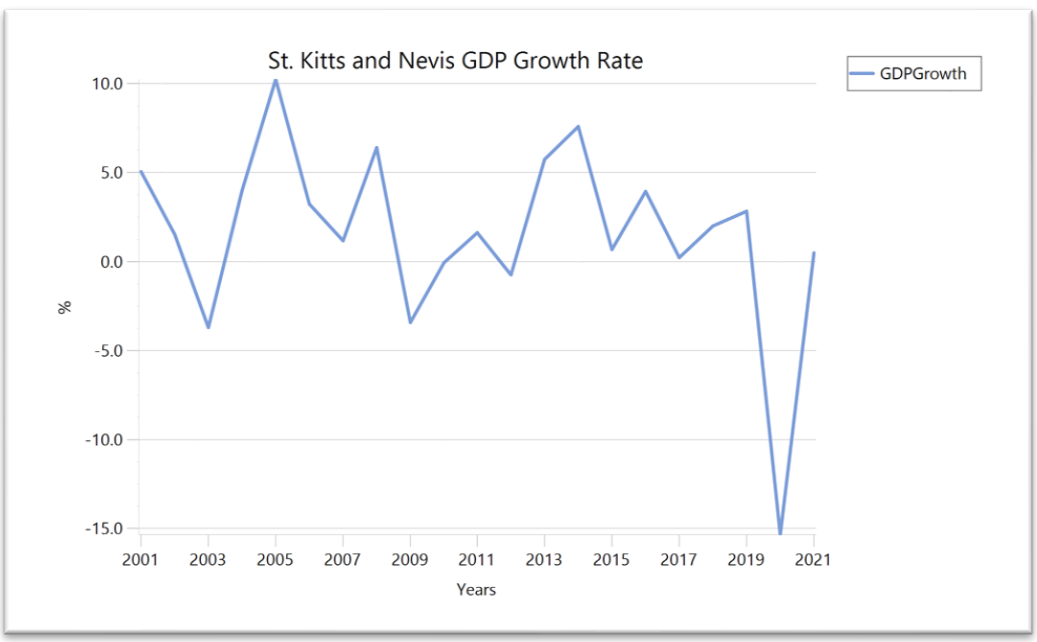

Figure 6: St. Kitts and Nevis GDP Growth Rate

The projected GDP growth rate was obtained from the Department of Statistics for the years 2022 to 2030 and was assumed to remain constant from 2030 to 2050. The corresponding projected GDP for SKN was obtained from the LEAP Model and illustrated in **Figure 7.**

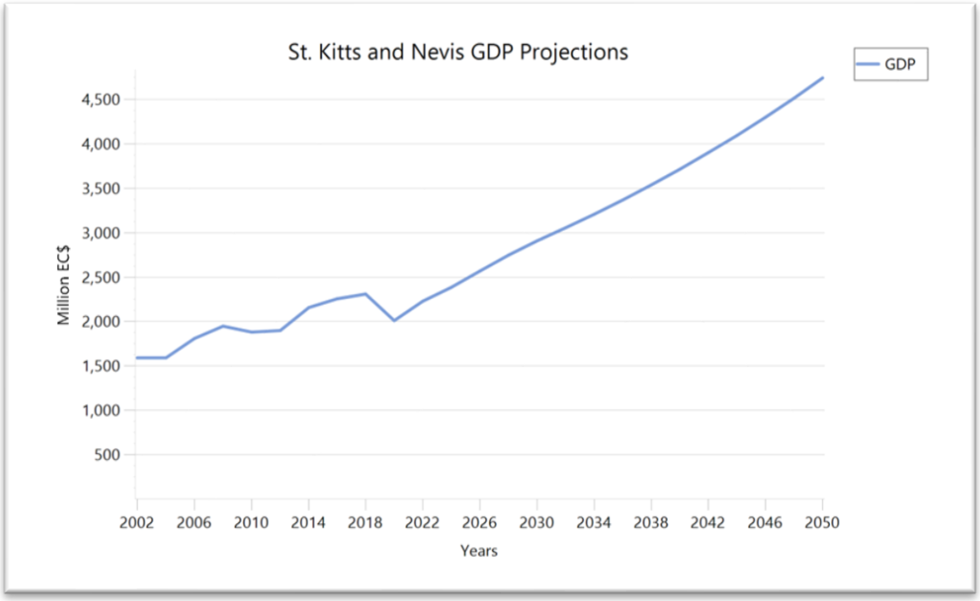

Figure 7: St. Kitts and Nevis GDP Projections (Million EC$)

This trendline was used to calculate GDP per capita (associated with population projections). The variation of the projected GDP per capita is presented in **Figure 8**.

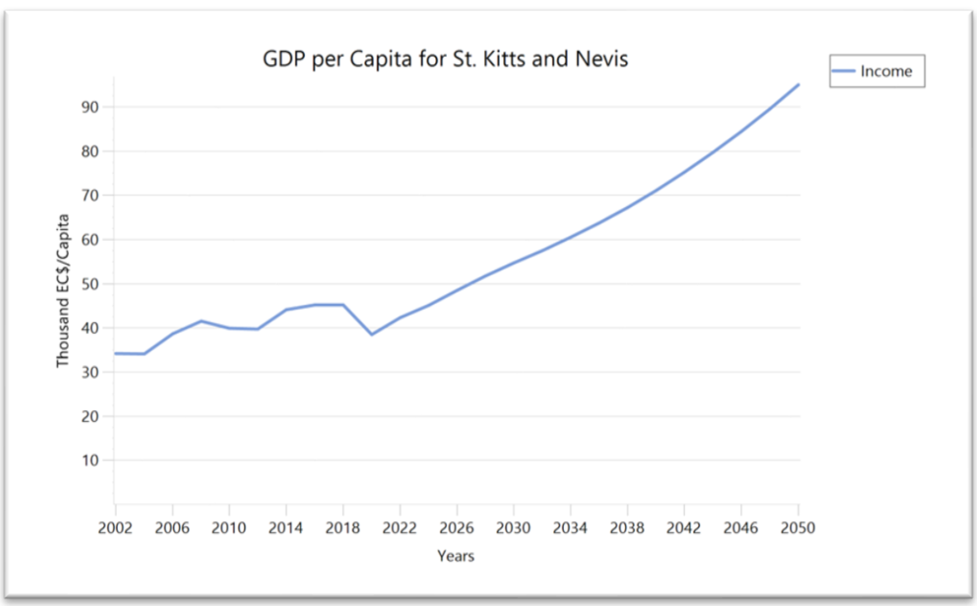

Figure 8: GDP per Capita for St. Kitts and Nevis

5.2.2 Contribution to GDP

Additional data, such as the sectoral contributions to GDP for St. Kitts and Nevis, were included in the LEAP model. The percentage contribution to GDP for the major sectors for the time series 2012-2021 and projections from 2022-2030 was entered in the model. This contribution for the last projected year (2030) was assumed to be constant up to 2050 in the baseline. The relevant data can be found in the **Appendix**.

5.2.3 Suggested Improvements for Economic Data

The economic data and assumptions were guided by mainly national and regional data projections. However, since the projections for GDP growth rate beyond 2030 were not found in any studies, a constant growth rate of 2.5% per annum for 2030 -2050 was assumed. This can be improved in the future when more related information and studies become available. Further, economic projections should, in future models be updated, addressed and be informed by climate change impact projections in conjunction.

5.3 Energy Demand

This ICAT project focused mainly on electricity generation and the transport sector. To model electricity generation in LEAP, it is important to also that the model also contains the energy demand, which 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 St. Kitts and Nevis, because the energy demand was not the main focus of the modelling, the energy balances used in the mitigation assessment for the BUR1 were used in the model. The model was disaggregated into the following sub-sectors: residential, services, industry, agriculture and fisheries, transportation and others. The data used in the LEAP model can be found in the **Appendix**.

5.3.1 Residential, Services, Industry, Agriculture and Fisheries and Others

Noting that the project was mainly focused on the electricity generation and the transport sector. The following assumptions were made related to the projections for the residential, services, industry, agriculture & fisheries and other sub-sectors.

Table 7: Assumptions for Energy Demand

Sector	Main Driver for Projections in the Baseline	Assumptions
Residential	Number of Households	The energy demand would increase proportionally to the increase in the number of households.

Sector	Main Driver for Projections in the Baseline	Assumptions
		In addition, due to advances in the efficiency of equipment, there is a 0.5% annual decline in the final energy intensity in the sector.
Services	The economic activity related to services	The energy demand would increase proportionally to the increase in the economic activity in the services sector which includes the hotel sector, construction, financial services and others. In addition, due to advances in the efficiency of equipment, there is a 0.5% annual decline in the final energy intensity in the sector.
Industry	The economic activity related to the industry	The energy demand would increase proportionally to the increase in the economic activity in the industry sector. In addition, due to advances in the efficiency of equipment, there is a 0.5% annual decline in the final energy intensity in the sector.
Agriculture and Fisheries	The economic activity related to the Agriculture and Fisheries	The energy demand would increase proportionally to the increase in the economic activity in the industry sector.
Other	GDP	The energy demand would increase proportionally to the increase in GDP.

5.3.2 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 fuel use in domestic marine transportation and domestic aviation were not readily available. The transport analysis concentrated on road and rail transport which, based on the energy balances from the BUR1, is the major activity for the sector in St. Kitts and Nevis. The transport analysis was split into two categories: (i) rail and (ii) road transport.

5.3.2.1 Rail Transport

The rail category included fuel use data from energy balances from the BUR1 which was only diesel. The main driver for rail transport was the GDP of St. Kitts and Nevis. The energy intensity for rail transport was assumed to remain constant throughout the baseline projections.

5.3.2.2 Road Transport

Road transport was developed using a hybrid approach in the model, with the historical information represented as the baseline, a top-down approach and a bottom-up approach represented as projections. The baseline represented the fuel use in energy balances from the BUR1 for 2008-2018. The projections category represented the motor vehicle stock in St. Kitts and Nevis in 2018 and was further disaggregated into vehicle types. This data was obtained from the modelling work completed in the BUR1 as shown in **Table 8**. This data was used in both the TraCAD modelling Tool as well as LEAP.

Table 8: Total Number of Vehicles in St. Kitts and Nevis in 2018

Category	Total No	St. Kitts	Nevis
Cars	10,282	7,847	2,435
SUVS	8,306	5,255	3,051
Pickups	1,742	1,116	626
Buses	1,219	979	240
Vans	1,515	1,194	321
Trucks	566	313	253
Motorcycles	731	572	159
Other	385	243	142
Total	24,746	17,519	7,227

The assumptions used for the vehicle types under road transport are provided below and in Table 9. These assumptions were based on regional data and expert judgment.

- The average number of passengers for each vehicle type was estimated based on international data and expert judgment. In this modelling, trucks were not modelled as passenger vehicles but rather as freight vehicles.
- The average annual distance driven (vehicle mileage) by each type of vehicle was estimated based on regional data.
- Specific fuel consumption (fuel economy) is the unit of fuel used per distance travelled in this case 100 km. The data on the ICE vehicles were analysed, the most common vehicles per each category were used to obtain the average specific fuel consumption for each type of vehicle. The specific fuel consumption was obtained from various online sources and regional data.
- The increase in vehicle stock for road transport is being driven by the GDP in the modelling in LEAP.

Table 9: Assumptions for Transportation

Category	Average Number of Passengers	Average distance driven (km)	Specific Fuel Consumption kg/100km

Cars	1.5	12000	7
SUVS	1.5	12000	10
Pickups	1.5	12000	10
Buses	15 at 80% capacity	20000	17
Vans	12 at 80% capacity	25000	12
Motorcycles	1	5000	4
Trucks	Not passenger	25000	20
Other	2	25000	16

5.3.3 Suggested Improvements for the Transport Sector

Limited data was available for the transport sector. Most of the variables used in this analysis were assumptions made from regional data and expert judgment. It is recommended that a comprehensive system for vehicle stock data collection is developed including newly registered vehicles. Further improvements in the time series data for vehicle stock, type and age are also recommended. Further disaggregation of vehicles by fuel use is also recommended as a method to improve the modelling for the transport sector.

5.4 Electricity Generation

In modelling with the LEAP software, electricity is generated to feed the energy demand. It involves anThe analysis of electricity generated, and estimate of losses during transmission and distribution of electricity to supply energy demand. Being demand-driven, the transformation branch in LEAP can be modelled to simulate or optimise between supply and demand interactions.

5.4.1 Transmission and Distribution

For the transmission and distribution network, the model assumes that St. Kitts and Nevis are operating as one grid. Therefore, the losses were combined by a weighted average based on the ratio of energy generation for each island, with Nevis representing about 25% and St. Kitts 75%. The losses in Nevis were estimated at 8.5% and St. Kitts at 12.5%, therefore a weighted total loss of 17.9%. The losses were estimated to remain constant over the time series and the projected scenarios.

5.4.2 Generation Capacity

The diesel generation available capacity at St. Kitts Electricity Company (SKELEC) and Nevis Electricity Company (NEVLEC) was obtained from each utility respectively. In addition, other electricity generation on the island was also included. **Table 10** and **Table 11** shows the available diesel capacity at SKELEC and NEVLEC, the other data can be found in the **Appendix**.

For the baseline scenario, the various existing power supply facilities were integrated into the model. Although two solar plants were shown to be in existence in St. Kitts, these solar power plants are both out of commission at present. In addition, although data was provided for the wind farm in Nevis for 2023, in 2024 it has not been operational. **Table 12** shows the additional generation capacity in St. Kitts and Nevis.

For the baseline projections, the diesel generators for SKELEC and NEVLEC were retired based on their planned retirement and the Integrated Resource Plan (IRP) respectively. The detailed timeline for the retirements for the diesel generators can be found in the Electricity Generation Data **Appendix** .

The wind generation plant in Nevis was assumed to have no production in 2024 but fully operational in 2025. The supply requirements for electricity generation in the model are done endogenously (internally) in increments of 5 MW installation of diesel generators when required by the model.

Table 10: Diesel Generation available capacity at SKELEC

Diesel Generation available capacity for SKELEC

YEAR	AVAILABLE CAPACITY (MW)
1987	3.5
1999	9.6
2007	13.5
2008	17.4
2009	21.3
2010	29.1
2011	36.9
2022	27.3
2023	42
2024	31.7

Table 11: Available Diesel Generation Capacity at NEVLEC

YEAR	AVAILABLE CAPACITY (MW)
1983	1.8
1992	3.8
1995	6.3
1996	8.5
1997	10.9
2002	12.7
2012	14.1
2016	16.6
2017	20.4
2019	17.5
2022	18.9

Diesel Generation available capacity for NEVLEC

Table 12: Additional Generation Capacity

YEAR	AVAILABLE CAPACITY (MW)
Marriot Hotel	4 (self-consumed)
Solar (2022)	0
Wind (2022)	1.925

5.4.3 Suggested Improvements for the Electricity Generation

The data for the electricity generation sector was obtained from the two power utilities NEVLEC and SKELEC. Although both companies provided data that was relevant and could be used in the model, there is an opportunity to standardise the data collection process by developing data collection templates. This would enable the Ministry of Energy in St. Kitts and Nevis to have consistent data provisions and ease of verification of data.

5.5 Mitigation Scenario Assumptions

The mitigation scenarios are described in **Section 3.** This section provides the data and assumptions that were used in the following three mitigation scenario:

- Mitigation scenario "with measures"
- Mitigation Scenario rev "with revised measures"
- Mitigation Scenario add "with additional measures"

5.5.1 Renewable Energy Generation Projects

The scenario "RE Generation Projects" includes all the utility-scale renewable energy projects as highlighted in **Section 3.1. Table 13** below highlights the three different mitigation scenarios.

Table 13: Table showing Renewable Energy Projects input data for Mitigation Scenarios

Renewable Energy Projects	**Mitigation scenario "with measures"**		**Mitigation Scenario rev "with revised measures"**		**Mitigation Scenario add "with additional measures"**	
	Measure	Year of Completion	Measure	Year of Completion	Measure	Year of Completion
Solar Farms	35.7 MW with 44.2 MWh	2030	35.7 MW with 44.2 MWh	2035	35.7 MW with 44.2 MWh and 1 MW on Nevis	2035
Geothermal	10 MW on Nevis, 15 MW on St. Kitts	2030	25MW on Nevis	2035	30 MW on Nevis	2035
Wind	6.6 MW on St. Kitts	2030	6.6 MW with 4 MW on St. Kitts and 2.6 MW on Nevis	2035	7 MW with 4 MW on St. Kitts and 3 MW on Nevis	2035

5.5.2 Transmission and Distribution Loss Reduction

The scenario "TD Loss Reduction" simulates the possible improvements in the transmission and distribution lines to reduce losses in the system as highlighted in **Section 3.2**. **Table 14** below highlights the three different mitigation scenarios.

Table 14: Table showing Transmission and Distribution input data for Mitigation Scenarios

T&D Loss Reduction	**Mitigation scenario "with measures"**		**Mitigation Scenario rev "with revised measures"**		**Mitigation Scenario add "with additional measures"**	
	Measure	Year of Completion	Measure	Year of Completion	Measure	Year of Completion
T&D Loss Reduction	T&D losses at 11.6%	2030	T&D losses at 11.6%	2035	T&D losses at 10%	2035
T&D Loss Reduction	T&D losses at 5%	2050	T&D losses at 5%	2050	T&D losses at 4%	2050

5.5.3 Solar Water Heaters

This scenario aims to simulate the implementation of solar waters to reduce the energy demand by 5% in St. Kitts and Nevis. as highlighted in **Section 3.3**. **Table 15** below highlights the three different mitigation scenarios.

Table 15: Table showing solar water heaters input data for Mitigation Scenarios

Solar Water Heaters	**Mitigation scenario "with measures"**		**Mitigation Scenario rev "with revised measures"**		**Mitigation Scenario add "with additional measures"**	
	Measure	Year of Completion	Measure	Year of Completion	Measure	Year of Completion
Solar Water Heaters - Residential	Reduction in 14.8 GWh of electricity demand	2030	Reduction in 14.8 GWh of electricity demand	2035	Reduction in 15 GWh of electricity demand	2035
Solar Water Heaters - Services	Reduction in 0.5 GWh of electricity demand	2030	Reduction in 0.5 GWh of electricity demand	2035	Reduction in 0.6 GWh of electricity demand	2035
	Reduction	2050	Reduction of	2050	Reduction of	2050

Solar Water Heaters	Mitigation scenario “with measures”		Mitigation Scenario rev “with revised measures”		Mitigation Scenario add “with additional measures”	
	of 0.9 GWh of electricity demand		0.9 GWh of electricity demand		1 GWh of electricity demand	

5.5.4 Electric Vehicles

The only mitigation action in the transport sector is the penetration of electric vehicles by 2% of the overall vehicle stock, as highlighted in **Section 3.4.** The analysis of the electric vehicles mitigation action was analysed in both LEAP and TraCAD. The methodologies differ and therefore the results also vary as described below.

5.5.4.1 Input Data for LEAP

Table 16 below highlights the three different mitigation scenarios. In addition, cars, SUVs and vans were considered to have suitable electric and hybrid replacements. Buses, pickup trucks, and motorcycles were assumed to only have suitable electric replacements, and trucks were not considered as having suitable electric or hybrid replacements for the modelling.

Table 16: Table showing electric vehicles input data for Mitigation Scenarios for LEAP

Electric Vehicles	Mitigation scenario “with measures”		Mitigation Scenario rev “with revised measures”		Mitigation Scenario add “with additional measures”	
	Measure	Year of Completion	Measure	Year of Completion	Measure	Year of Completion
Electric Vehicles	2% share of electric vehicles and 2% share of hybrid Vehicles	2030	2% share of electric vehicles and 2% share of hybrid Vehicles	2035	12% share of electric vehicles and 12% share of hybrid Vehicles	2035
	10% share of electric vehicles and 10%	2050	2% share of electric vehicles and 2%	2035	40% share of electric vehicles and 40%	2035

Electric Vehicles	Mitigation scenario “with measures”		Mitigation Scenario rev “with revised measures”		Mitigation Scenario add “with additional measures”	
	share of hybrid Vehicles		share of hybrid Vehicles		share of hybrid Vehicles	

5.5.4.2 Input Data for TraCAD

The TraCAD software utilizes various methodologies to calculate emissions reduction, such as from the UNFCCC under the Clean Development Mechanism (CDM) and ICAT.

Based on the methodologies chosen, the specific data requirements varied by climate action. The following methodology was selected:

- Methodology: AMS-iii-C – Emissions reductions by electric and hybrid vehicles

Input Data & Sources are shown in Table 17:

Table 17: Input Data and Sources for TraCAD modelling

Input Parameter	Value
CO_2 Emission Factors (Petrol)	0.00007 gCO_2/J
Emission Factor (Electricity)	Standardized baseline: Grid emission factor St. Kitts and Nevis [9] – 00.67 $kgCO_2/kWh$
Net Calorific Value (Petrol)	44,300 J/g
Specific Fuel Consumption Petrol	56.98 g/km
Specific fuel consumption electric	0.1864 kWh/km
Vehicle Stock (2018)	2% of vehicles - 495

Assumptions:

- 2% penetration of electric vehicles is only represented by cars and SUVs
- Most commonly driven gasoline cars are Toyota, Honda and Nissan. Typical average values for these vehicle brands were used to calculate specific fuel consumption and are representative of the portion of the vehicle fleet being used for calculations.
- Typical miles per gallon (MPG) values for these electric vehicle brands were averaged used for the calculations and reflective of present circumstances.
- The annual distance travelled by all vehicles is assumed to be 15,750 km for all vehicles based on the weighted average calculations.
- The base year in this modelling was assumed to be 2018, noting that this was the only year where suitable transport data was obtained and the projection year or end year 2030 to align with the SKN updated NDC.

6 Model Results and Analysis

In this section, the results and analysis of the modelling using the LEAP and TraCAD tools are presented in a graphical and tabular format and a brief description is given. In addition, a comparison of the results using the two modelling software tools is presented for the transport sector.

6.1 LEAP

In this section, the modelling results using the LEAP modelling software tool are presented and analysed. The full LEAP model and results can be found in **Appendix.**

6.1.1 Baseline Scenario

This projection analyses the effect of the continued trend for emissions in St. Kitts and Nevis assuming no new policies or actions are implemented. This scenario is also referred to as the “without measures scenario”. The LEAP analysis was done at yearly intervals, but the results are presented in graphical format in two (2) year increments and tabular format in 5 year increments . The results are presented as follows:

- **Figure 9** shows the GHG emissions of the baseline scenario “without measures” with the emissions for electricity generation compared to energy demand which includes the transport sector.
- **Figure 10** shows GHG emissions for the baseline scenario for the transport sector.

The corresponding values for **Figure 9** and **Figure 10** are shown in **Table 18** and **Table 19** respectively. It should be noted that the vehicles in the baseline scenario are mainly fossil fuel-driven vehicles as a result, there is little use of electricity in the transport sector

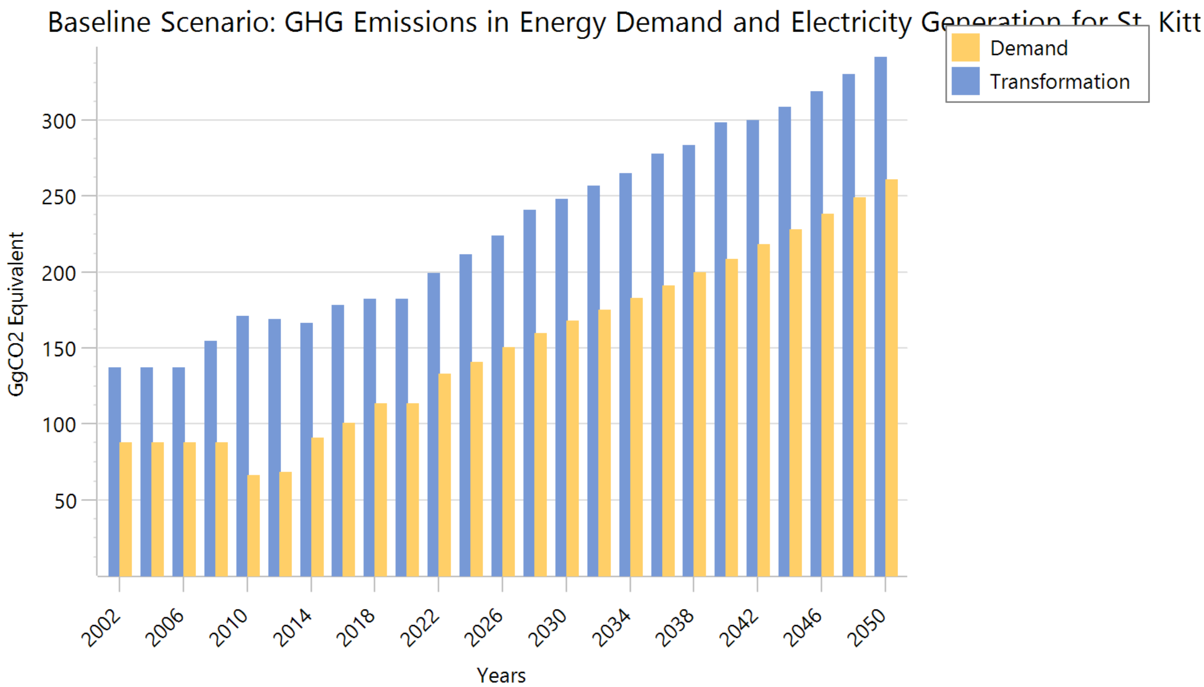

Figure 9: GHG Emissions for Baseline Scenario Energy Demand and Electricity Generation

Table 18: GHG Emissions for Baseline Scenario Energy Demand and Electricity Generation

Year	Energy Demand/GgCO₂e	Electricity Generation/GgCO₂e	Total/GgCO₂e
2005	87.66	136.96	224.63
2010	66.27	170.86	237.13
2015	96.99	170.73	267.72
2020	113.42	182.38	295.80
2025	145.35	216.21	361.56
2030	167.76	248.43	416.19
2035	186.99	273.14	460.13
2040	208.69	298.69	507.38
2045	233.20	313.94	547.14
2050	260.90	341.54	602.44

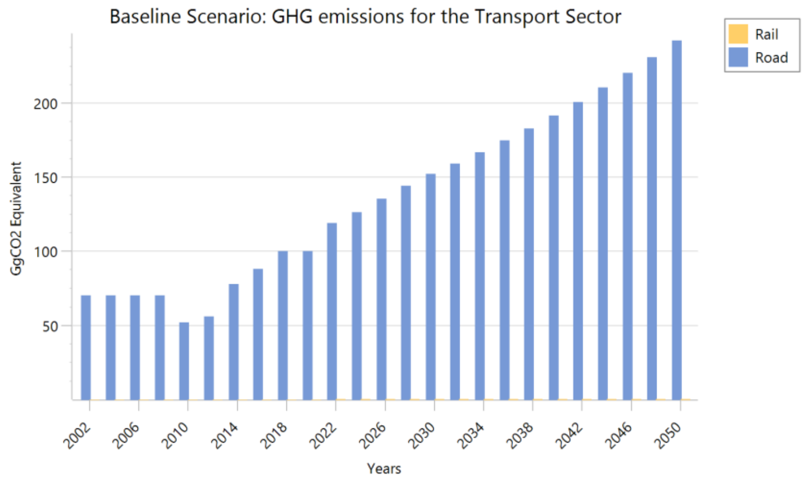

Figure 10: GHG emissions for the transport sector (SKN - Baseline Scenario)

Table 19: GHG emissions values for the transport sector (SKN - Baseline Scenario)

Year	Rail/GgCO2e	Road/GgCO2e	Total
2005	0.09	70.43	70.52
2010	0.14	52.12	52.26
2015	0.14	83.62	83.76
2020	0.17	100.18	100.35
2025	0.21	130.75	130.97
2030	0.25	152.14	152.39
2035	0.28	170.69	170.97
2040	0.32	191.64	191.95
2045	0.36	215.30	215.66
2050	0.41	242.04	242.45

6.1.2 Mitigation Scenarios

The results of the mitigation scenarios as described in **Section 3 and Section 5.5** are described below.

Figure 11 shows the projected emissions for the modelled measures. **Table 20** shows the corresponding GHG emissions values. These modelling results indicate that if St. Kitts and Nevis is able to implement all the NDC actions for the electricity and transport sector by 2030, then a total reduction in emissions of 21.6% can be achieved against the 2010 base year.

Figure 12 shows a comparison of projected emissions for the various modelled scenarios and **Table 21** shows the corresponding GHG emissions values. In these scenarios the baseline scenario "without measures" is compared with the NDC Scenario, "with measures", the revised NDC scenario “with measures 2” and the Ambitious NDC Scenario “with additional measures”. The graph shows the impacts of the assumptions and measures as described in **Sections 3 and 5** of this report. A further analysis can be done on the impact of the results shown in this graph, to understand the impact of policies and delayed implementation.

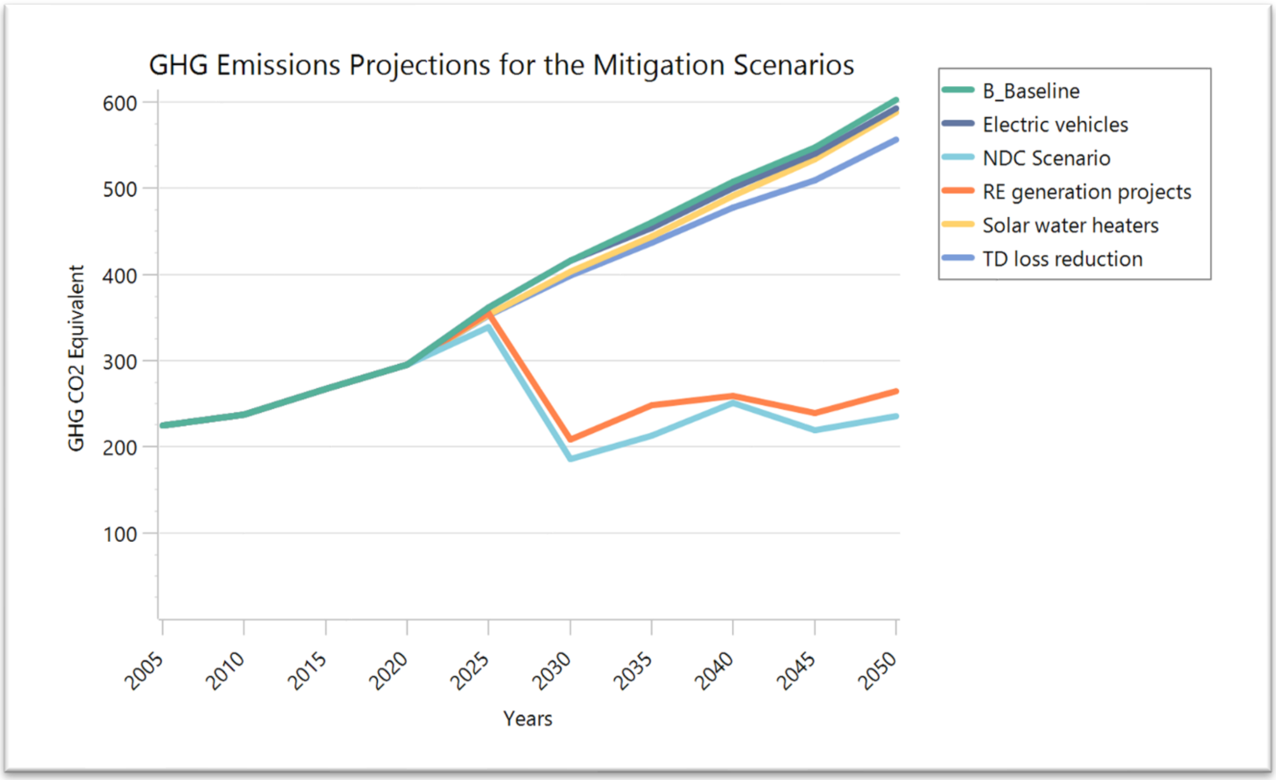

Figure 11: GHG Emissions showing Modelled Scenarios SKN (GgCO₂e)

Table 20: GHG Emissions showing Modelled Scenarios values SKN (GgCO₂e)

GgCO₂e							
Years	**Baseline**	**Electric vehicles**	**Solar water heaters**	**TD loss reduction**	**RE generation projects**	**NDC Scenario**	**Emissions Reduction against a 2010 base year**
2005	224.63	224.63	224.63	224.63	224.63	224.63	NA
2010	237.13	237.13	237.13	237.13	237.13	237.13	0%
2015	267.72	267.72	267.72	267.72	267.72	267.72	-12.9%
2020	295.80	295.80	295.80	295.80	295.80	295.80	-24.7%
2025	361.56	361.30	353.44	352.99	355.22	339.17	-43.0%
2030	416.19	415.74	403.70	398.58	208.86	185.86	21.6%

GgCO₂e							
Years	**Baseline**	**Electric vehicles**	**Solar water heaters**	**TD loss reduction**	**RE generation projects**	**NDC Scenario**	**Emissions Reduction against a 2010 base year**
2035	460.13	453.80	444.47	436.88	247.96	213.07	10.1%
2040	507.38	500.43	491.67	477.39	259.34	251.06	-5.9%
2045	547.14	540.26	533.39	509.31	239.36	218.89	7.7%
2050	602.44	592.72	588.60	556.07	264.25	235.46	0.7%

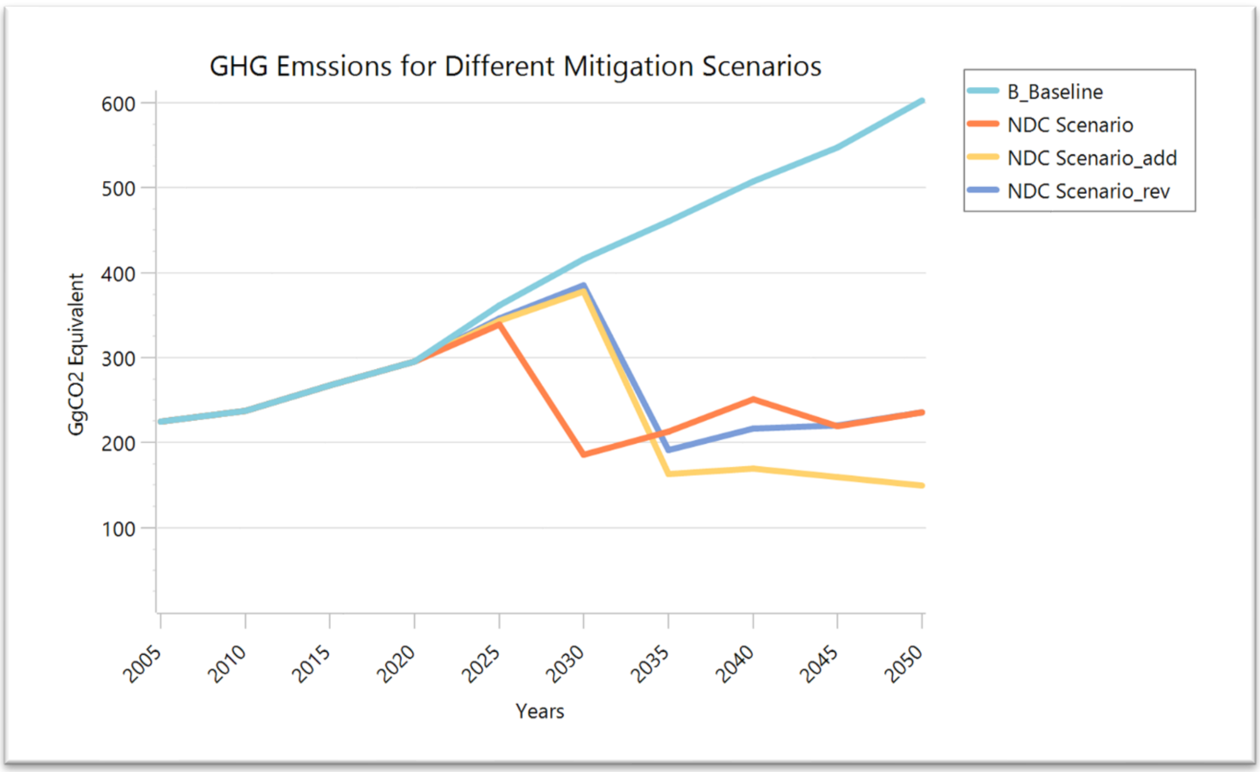

Figure 12: GHG Emissions for Different Mitigation Scenarios

Table 21: GHG Emissions for Values Different Mitigation Scenarios, reduction relative to 2010 value

		NDC Scenario	**Revised NDC Scenario**	**More Ambitious NDC Scenario**

Years	Baseline	GHG/ GgCO2e	% Reduction	GHG/ GgCO2e	% Reduction	GHG/ GgCO2e	% Reduction
2005	224.63	224.63	NA	224.63	NA	224.63	NA
2010	237.13	237.13	0.0%	237.13	0.0%	237.13	0.0%
2015	267.72	267.72	-12.9%	267.72	-12.9%	267.72	-12.9%
2020	295.80	295.80	-24.7%	295.80	-24.7%	295.80	-24.7%
2025	361.56	339.17	-43.0%	346.64	-46.2%	343.80	-45.0%
2030	416.19	185.86	21.6%	384.74	-62.3%	378.19	-59.5%
2035	460.13	213.07	10.1%	191.06	19.4%	163.17	31.2%
2040	507.38	251.06	-5.9%	216.74	8.6%	169.43	28.6%
2045	547.14	218.89	7.7%	220.58	7.0%	159.67	32.7%
2050	602.44	235.46	0.7%	235.46	0.7%	149.79	36.8%

6.2 Results of analysis in TraCAD

This section presents the results obtained from the analysis of the transport mitigation action using the TraCAD modelling software. The full modelling assessment results can be found in the **Appendix.**

In this assessment, the transition of the 2% of the vehicle stock is assessed, due to the limitation of the modelling tool and the data provided. The assessment was not possible for the base year in the St. Kitts and Nevis NDC report as the data was only available for 2018. In addition, it was assumed that a 2% penetration of the vehicle stock would be represented by electric vehicles in cars and SUVs, as these are the most prevalent electric vehicles in the regional market at present.

It was assumed that based on the number of cars in 2018, as described in **Section 5.3.2.2** and the input data for TraCAD as described in **Section 5.5.4.2** a 2% penetration of electric would be represented by 495 vehicles. It was also assumed that the 2% would be measured from 2018 and not the baseline prediction for the transport sector.

- Base Year: 2018
- Projection Year: 2030
- Number of vehicles to be transitioned to electric vehicles: 495
- Baseline emissions in assessment year (2018): 1,350 tCO_2e

Estimation of projected GHG impacts of this action in 2030 was done by using the GHG Impact module in the tool and applying the methodology “AMS-III.C Small-scale Methodology: Emission reductions by electric and hybrid vehicles” developed by the UNFCCC for assessing CDM mitigation actions where fuel switch to electric and hybrid vehicles, and displacement of more-GHG-intensive vehicles.

The results of this modelled scenario are described in **Table 22**.

Table 22: Projection Results for Transport Mitigation Action in TraCAD

Projection Results – 2030	tCO_2e
Baseline emissions	1,472
Project Results	1,197
Leakage Results	0
Total emissions reductions	275

In summary, the penetration of 2% of electric vehicles or the operation of 495 electric vehicles in the transport sector by 2030 has very minimal reductions in terms of GHG emissions reduction. The analysis for the transition period reveals a decrease in emissions, with a reduction of **275 tCO2e** from 2018 to 2030. This results in an emission reduction of **0.275 $GgCO_2e$**, which represents a reduction of **1%** of the overall emissions from the 2010 target year. The results demonstrate that with the present electricity grid which is mainly fossil fuel based and a grid emission factor of 0.67 $kgCO_2/kWh$, the potential for emissions reductions in the transport sector should be coupled with the transition to cleaner electricity generation. Further emission reductions can be achieved through increased penetration of renewables into the grid.

7 Suggestions and Recommendations for Improvements

For the modelling in the software tools of LEAP and TraCAD, several assumptions were made. The models can be improved by reducing these assumptions with enhanced country-specific data. Methods for Improvement, as highlighted in **Sections 5.1.3, 5.2.3, 5.3.3, 5.4.3,** for input data is essential for improvements in modelling. In addition, some recommendations are made below to improve the overall model.

- Use of additional methodologies for the NDC scenarios in TraCAD
- Adjusted Methodologies for St. Kitts and in TraCAD
- Improved country-specific data for emissions and fuel type
- Improved data on vehicle mileage and fuel economy
- Inclusion of storage option in the transformation sector for LEAP
- Improved transport vehicle stock data

8 Conclusions

Through the support of ICAT, St. Kitts and Nevis has documented the methodology for the projection of emissions with fully documented updated models for electricity generation and transport sectors. The models include information necessary to track NDC implementation and report for the Biennial Transparency Reports (BTRs). Building these models for St. Kitts and Nevis ensures they are readily available for future updated mitigation assessments and NDC tracking for the electricity generation and transport sector targets. In addition, in-country experts were trained in using LEAP, TraCAD and reporting for NDC tracking, to ensure that the Government of St. Kitts and Nevis retains the capacity to use the models. Details of the training sessions can be found in ANNEX 2.

References

[1] Government of St. Kitts and Nevis, “St. Kitts and Nevis First Biennial Update Report,” Ministry of Sustainable Development, Environment, Climate Action and Constituency Empowerment, Unit C21, Sands Complex,, Basseterre, 2023.

[2] Government of St. Kitts and Nevis, “St. Kitts and Nevis Updated Nationally Determined Contributions,” 2021.

[3] C. Heaps, LEAP: The Low Emissions Analysis Platform [Software version: 2024.1.1.2], Somerville, MA: Stockholm Environment Institute, 2024.

[4] United Nations Framework Convention on Climate Change (UNFCCC), “AMS-III.C. Small-scale Methodology: Emissons reductions by electric and hybrid vehicles. Version 15.0. Sectoral Scope 07.,” UNFCCC, 2015.

[5] Department of Statistics, Ministry of Sustainable Development, “Households, Population and Average Household Size by Parish 2001-2011,” Government of St. Kitts and Nevis.

[6] United Nations, Department of Economic and Social Affairs,Population Division, , “World Populations Prospects 2024,” United Nations, 2024.

[7] Department of Statistics, Ministry of Sustainable Development, Government of St. Kitts and Nevis, “GDP Data,” Government of St. Kitts and Nevis, 2024.

[8] Eastern Caribbean Central Bank (ECCB), “Gross Value Added by Economic Actitvity in Constant Prices (Base Year 2006),” Eastern Caribbean Central Bank, Basseterre, St. Kitts and Nevis, 2024.

[9] Clean Development Mechanism, “Standardized baseline:Grid Emission Factor for Saint Kitts and Nevis,” 2021.

[10] C. S. I. (. SI), Transport Action Data Tool (TraCAD), Initiative for Climate Action Transparency (ICAT) , 2023.

[11] P. D. United Nations, “World Population Prospects,” United Nations Population Division, 2019 .

[12] I. M. F. IMF, “IMF World Economic Outlook: A long and Difficult ascent,” October 2020.

Appendix

Demographic and Economic Data

The full Demographic and Economic Data data can be obtained via this link.

Energy Demand

The full data set for Energy Demand and Transport Data can be obtained via this link.

Electricity Generation Data and Transport Data

The full data set for Electricity generation can be obtained via this link

LEAP Modelling Results

The LEAP model can be obtained via this link

TraCAD Modelling Results

The full results for TraCAD model can be obtained via this link.

ANNEX 1

Tool Selection Process

SKN Modelling Tool Workshop Report

SKN Modelling Tool Justification Report

ANNEX 2

TraCAD Training Report

LEAP Training Report

ANNEX 3

Data collection and management and data gap assessment report