

## Basic LEAP transport modelling exercise

GIZ Advancing Transport Climate Strategies (TrACS)

**Dominic Sheldon**

[Dominic.Sheldon@ricardo.com](mailto:Dominic.Sheldon@ricardo.com)

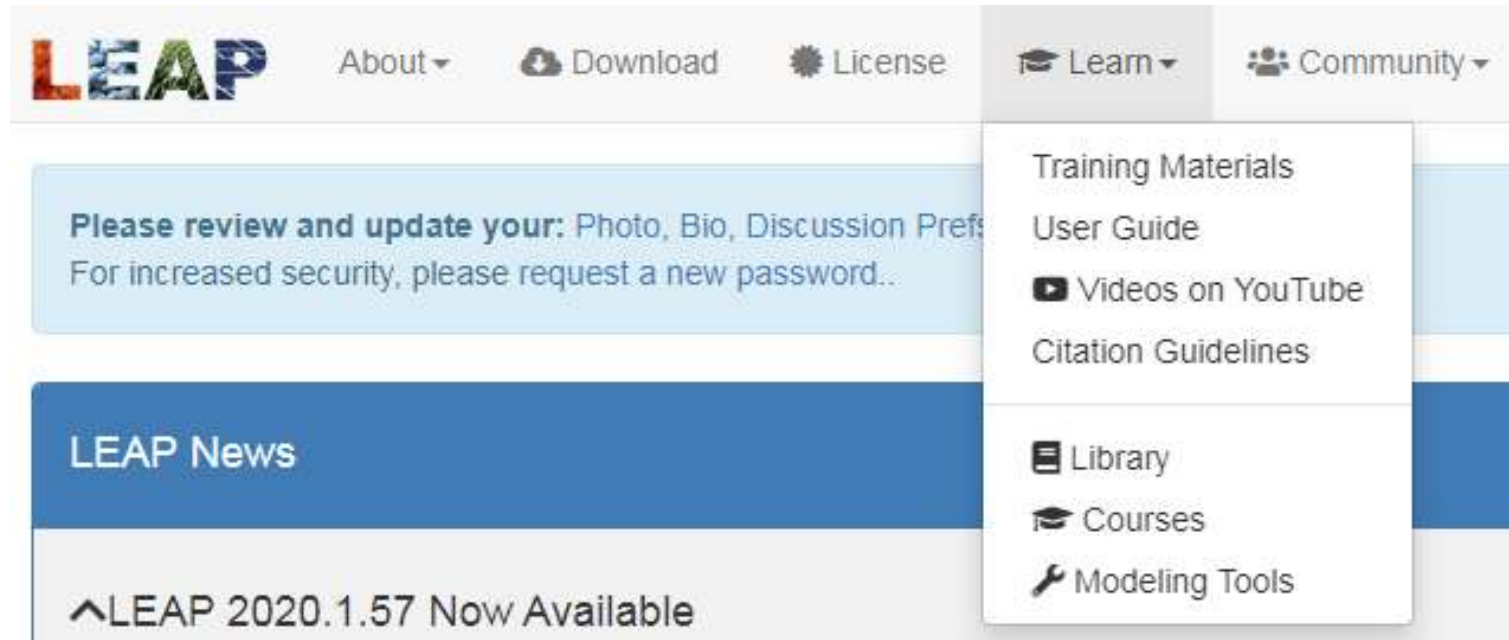
© Ricardo plc 2017

[www.ricardo.com](http://www.ricardo.com)

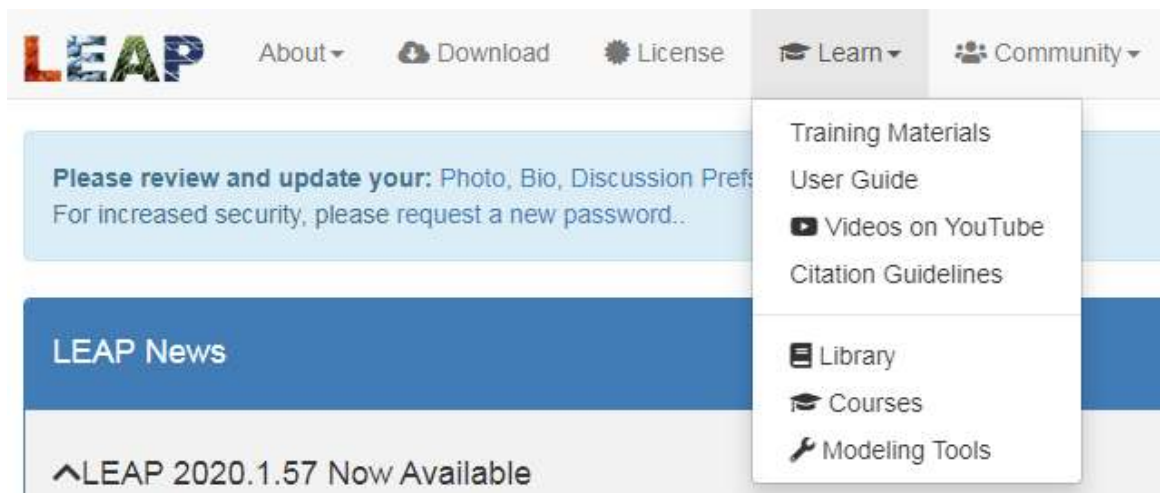


In order to develop the scenarios described in the previous section, a pre-existing model, the Low Emissions Analysis Platform (LEAP), was used. LEAP is an integrated, scenario-based modelling tool that can be used to track energy consumption, production and resource extraction in all sectors of an economy. The benefits of using LEAP in this project are:

- It is a model that is **familiar to many stakeholders**
- The model **is relatively simple to use**.
- The **model is free for developing countries to use**
- Its **low initial data requirements** are well suited to a country where accessing robust data has been, and will continue to be, a challenge.
- It presents outputs in a **transparent and intuitive** way.

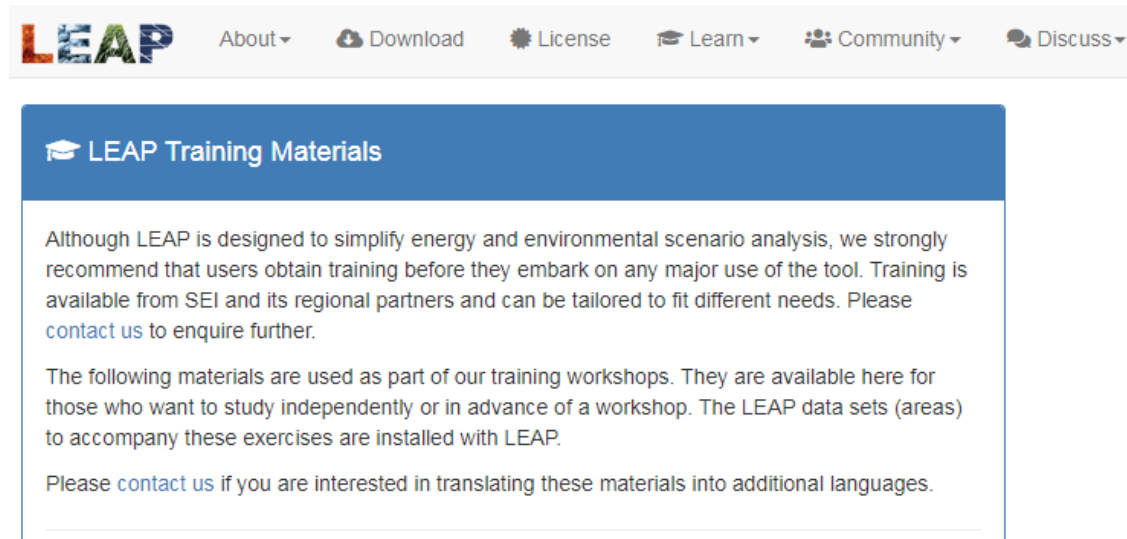
A screenshot of the LEAP website. The top navigation bar includes the LEAP logo, 'About', 'Download', 'License', 'Learn', and 'Community'. The 'Learn' dropdown menu is open, showing 'Training Materials', 'User Guide', 'Videos on YouTube', 'Citation Guidelines', 'Library', 'Courses', and 'Modeling Tools'. A blue banner below the navigation bar reads 'Please review and update your: Photo, Bio, Discussion Pref... For increased security, please request a new password...'. Below this is a 'LEAP News' section with a headline 'LEAP 2020.1.57 Now Available'.





### Main Training Exercises

The first four of these exercises teach basic LEAP skills including energy demand modeling, energy supply (Transformation) modeling, electric system simulation modeling, emissions analysis and cost-benefit analysis. The fifth exercise examines modeling of non-energy sector greenhouse gases. The sixth exercise focuses on the transport sector: showing how to create a vehicle stock-turnover model. The seventh exercise demonstrates the use of LEAP's optimization features for least-cost electric generation modeling.



### GHG Mitigation Analysis Exercises

These exercises introduce techniques used in a Greenhouse Gas (GHG) Mitigation Assessment. In a first exercise, you use a spreadsheet-based tool to conduct a screening of mitigation options, including analyzing the costs and mitigation potential for each option and displaying these on a standard Marginal Abatement Cost (MAC) curve. In a second exercise, you examine additional important criteria using a multi criteria assessment (MCA) approach. In a third exercise you create a mitigation scenario within LEAP based on your preferred options and compare it to a baseline scenario.

- [GHG Training Exercises](#) (English: PDF)
- Excel Screening spreadsheet: [Partial](#), [Complete](#)



## The Low Emissions Analysis Platform



LEAP Platform

1.35K subscribers

HOME

VIDEOS

PLAYLISTS

COMMUNITY











CHANNELS


ABOUT







### Follow-Along Training Videos ▶ PLAY ALL

Companion videos for LEAP's standard training exercises, available here:  
<https://leap.sei.org/training>.

Training Exercise #1 An Introduction to LEAP (Follow-along Video) <small>Chris Ridd, SEI Lead Introduction to Climate Change, LEAP Developer</small>	Training Exercise #2 Industry, Transport & Commercial (Follow-along Video) <small>Chris Ridd, SEI Lead Introduction to Climate Change, LEAP Developer</small>	Training Exercise #3 Transformation (Follow-along Video) <small>Chris Ridd, SEI Lead Introduction to Climate Change, LEAP Developer</small>	Training Exercise #4 Cost-Benefit Analysis (Follow-along Video) <small>Chris Ridd, SEI Lead Introduction to Climate Change, LEAP Developer</small>	Training Exercise #5 Non-Energy Sector (Follow-along Video) <small>Chris Ridd, SEI Lead Introduction to Climate Change, LEAP Developer</small>
  <b>1:23:09</b>	  <b>58:09</b>	  <b>24:35</b>	  <b>52:46</b>	  <b>30:24</b>
Training Exercise #1: Introduction to LEAP LEAP Platform 21K views • 1 year ago	Training Exercise #2 on Industry, Transport and the... LEAP Platform 6.5K views • 1 year ago	Training Exercise #3: Transformation LEAP Platform 3.2K views • 1 year ago	Training Exercise #4: Cost- Benefit Analysis LEAP Platform 3.1K views • 1 year ago	Training Exercise #5: Non- Energy Sector Emissions LEAP Platform 2K views • 1 year ago

 **LEAP Help**



Introduction

- Getting Started
- History of LEAP
- LEAP Structure
- Credits
- Data Requirements

Views

- Interface
- Scenarios

Key Assumptions


- Effects
- Demand
- Tagging Branches
- Transformation

Stock Changes and Statistical Differences

- Resources
- Land-Based Resources
- The Integrated Benefits Calculator (IBC)

Introduction

See also: [Getting Started](#)





The [Low Emissions Analysis Platform \(LEAP\)](#) is a widely-used software tool for energy policy, climate change mitigation and air pollution abatement planning developed at the [Stockholm Environment Institute \(SEI\)](#). LEAP has been adopted by thousands of organizations in more than 190 countries worldwide. Its users include government agencies, academics, non-governmental organizations, consulting companies, and energy utilities, and it has been used at scales ranging from cities and states to national, regional and global applications.

Integrated Planning

LEAP is an integrated modeling tool that can be used to track energy consumption, production and resource extraction in all sectors of an economy. It can be used to account for both energy sector and non-energy sector greenhouse gas (GHG) emission sources and sinks. In addition to tracking GHGs, LEAP can also be used to analyze emissions of local and regional air pollutants, making it well-suited to studies of the climate co-benefits of local air pollution reduction.

Flexibility And Ease-Of Use



© Ricardo plc

6

## How do you calculate GHG emissions?

## How do you calculate GHG emissions?

The three constituent parts are:

- **Activity:** This is the action that results in GHG emissions
  - For transport this is the travel taking place
    - **Unit example:** Distance a person travels in a vehicle
- **Emissions factor:** This is the amount of emissions produced for each unit of activity
  - For transport this is the CO<sub>2</sub> emitted when fuel/electricity is consumed in order to travel
    - **Unit example:** KG of CO<sub>2</sub> produced per litre of fuel consumed in order to travel
- **GHG emissions:** Total GHG emissions resulting from the activity (often given in megatons of CO<sub>2</sub> equivalent, or MT CO<sub>2</sub>e)





## How do you model future GHG emissions?

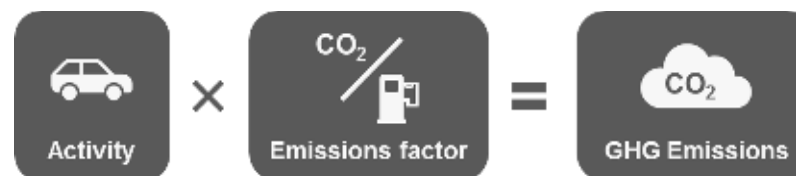
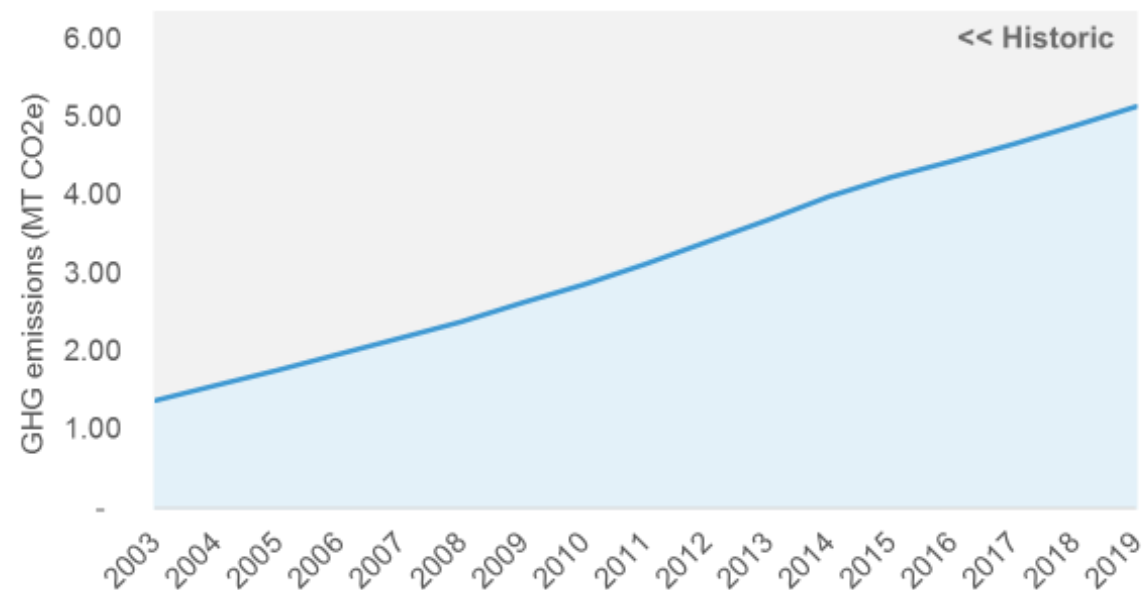
# How do you model future emissions?

The process of developing a mitigation potential analysis model is formulated of three steps:

1. Model historic emissions
2. Model baseline scenario
3. Model mitigation scenarios

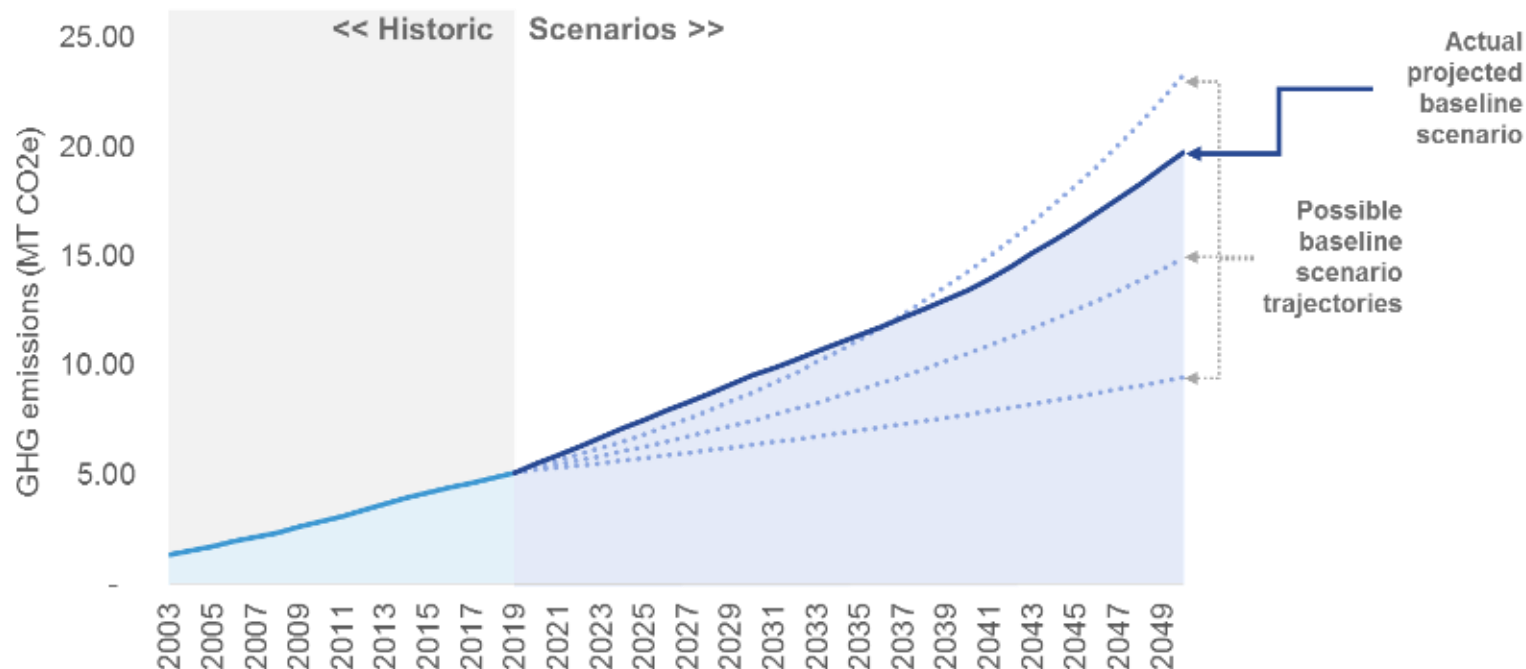
## 1. Model historic emissions

In order to model projected future GHG emissions, it is key to first develop a model of existing activities and their associated GHG emissions. The model of historic emissions is an essential reference against which to compare projected future emissions to assess whether they seem realistic.



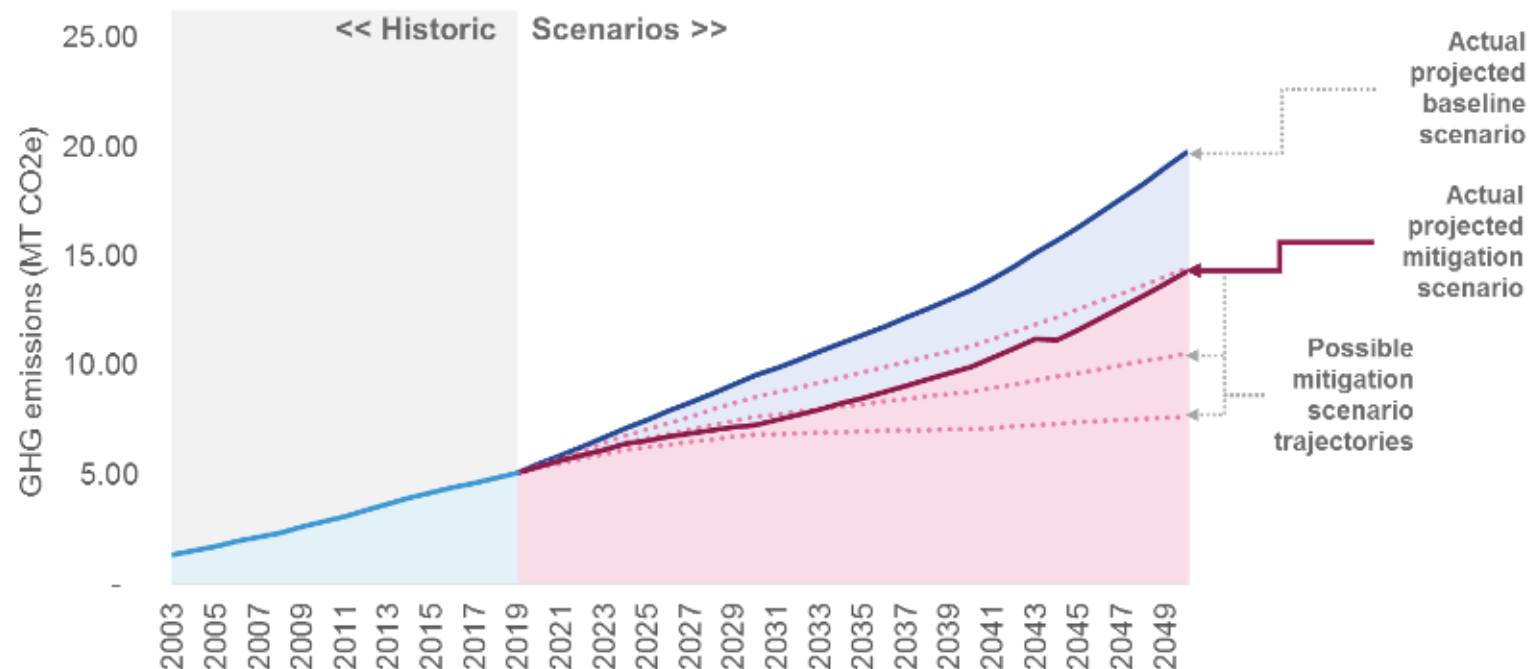
## 2. Model baseline scenario

Once a model of historic activity and the associated emissions has been developed, it is then possible to project into the future what might happen to this activity and the associated emissions. The main assumptions underpinning this are what the expected future trends are in the activity, for example, do you expect the activity to increase or decrease, by how much and over what period.



## 3. Model mitigation scenarios

Once a model of the baseline activity and associated emissions in the sector has been developed, it is then possible to develop a model of what might happen to this activity and the associated emissions if certain measures were implemented. In other words, it is then possible to assess what mitigation (emission reduction) potential there is relative to the baseline.

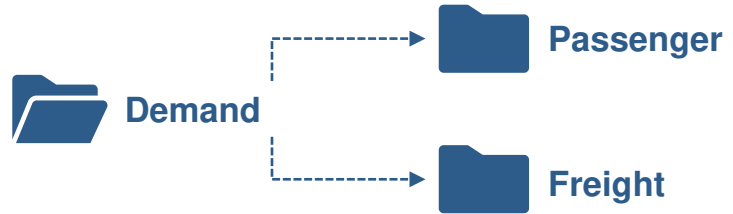




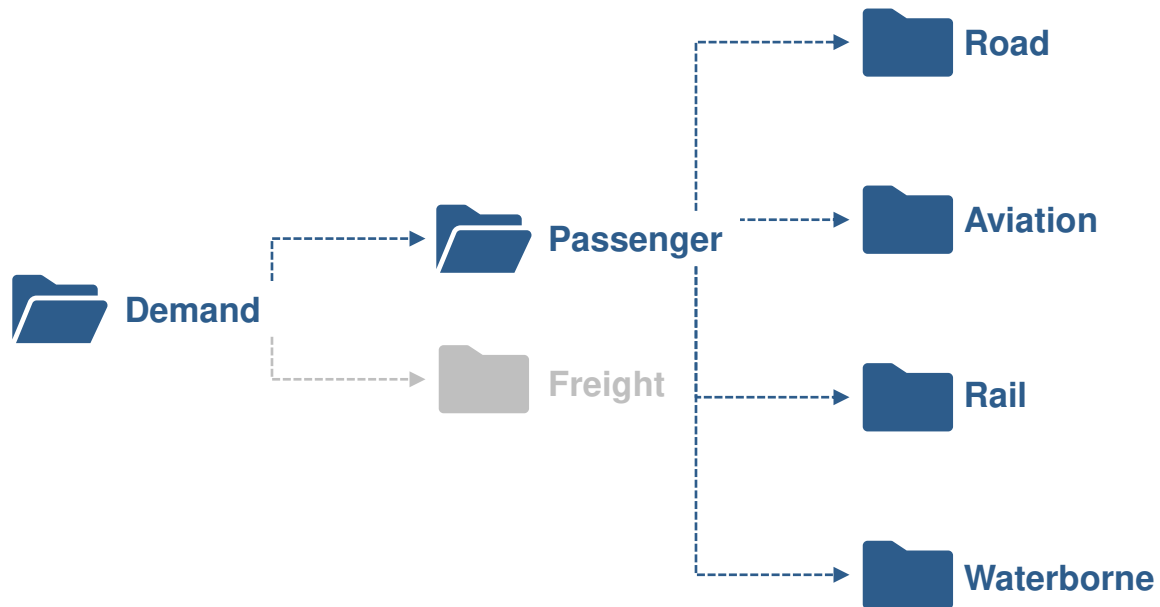
## Introduction to the way LEAP works



## Basic structure of LEAP model: The Tree and its branches

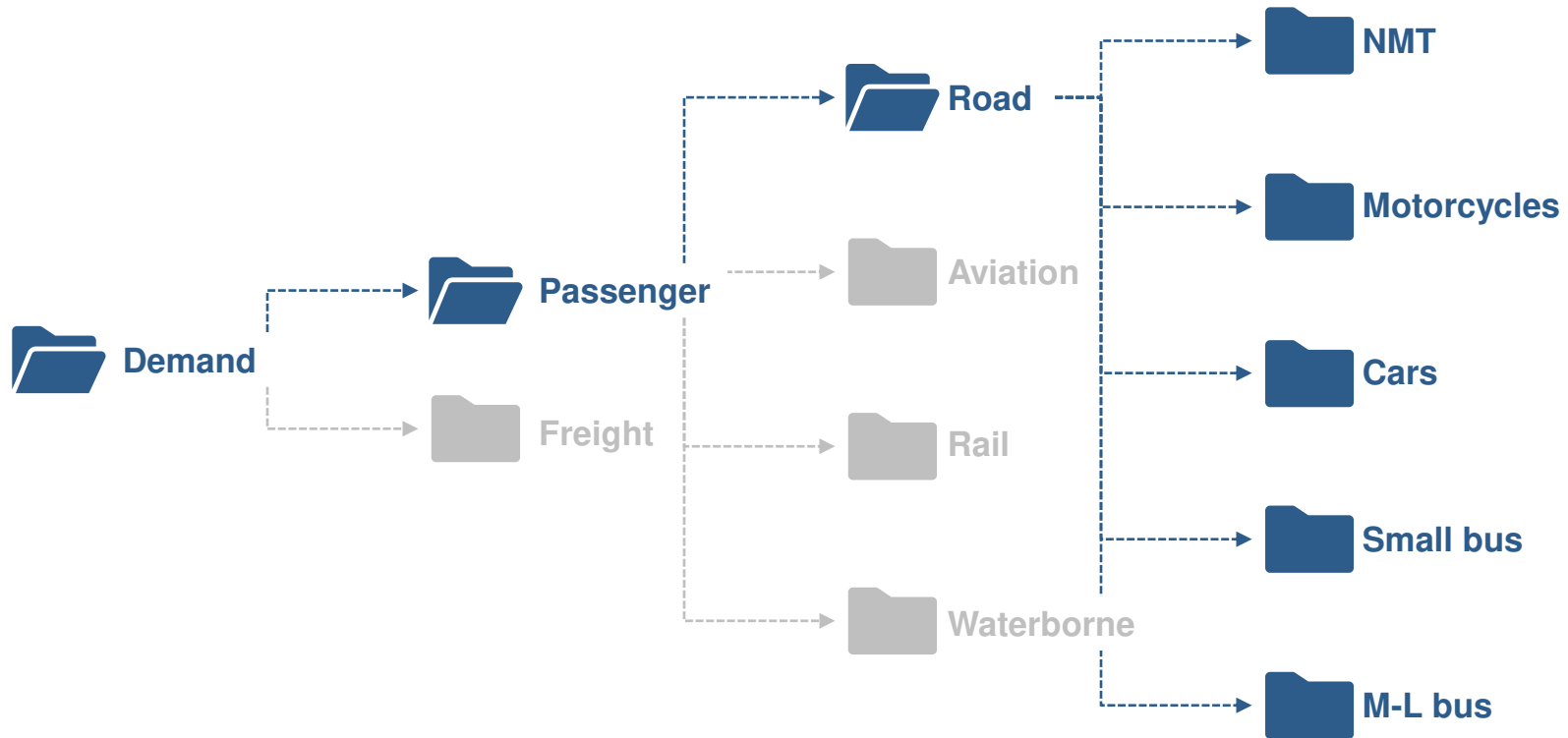


## Basic structure of LEAP model: The Tree and its branches

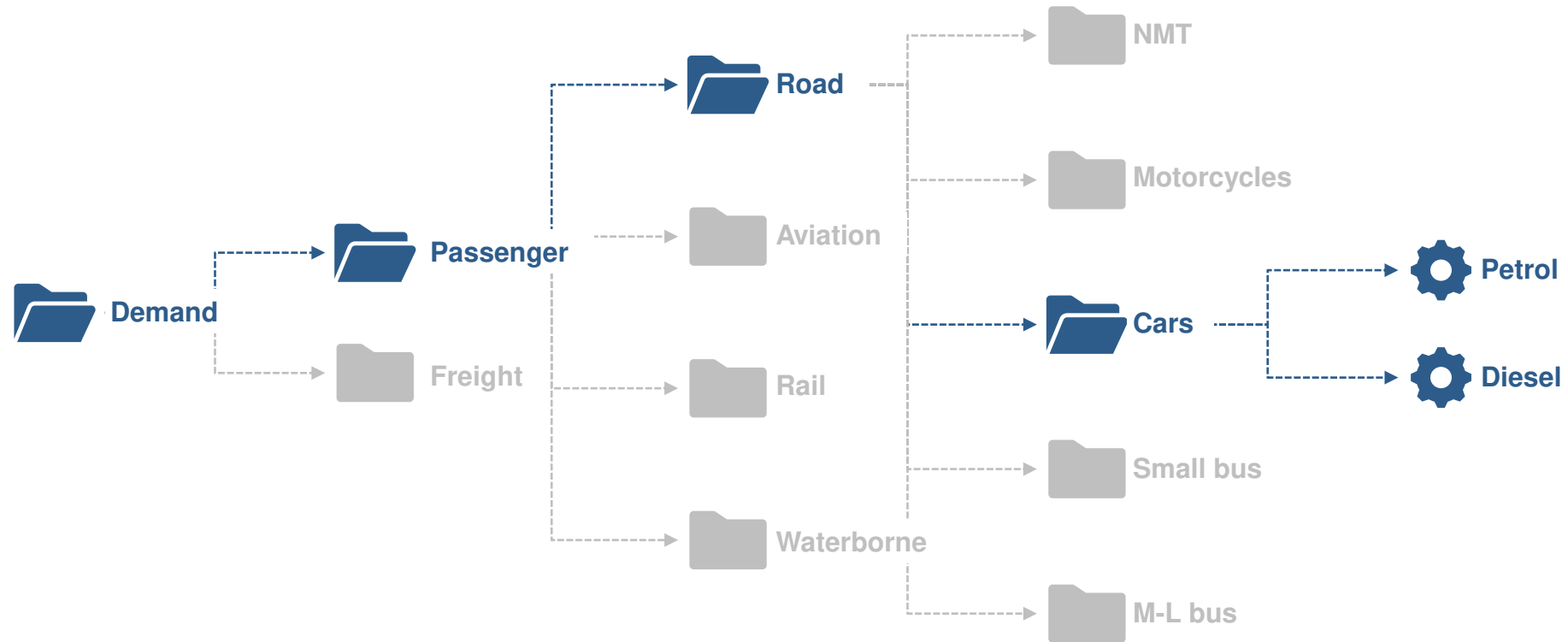


LEAP

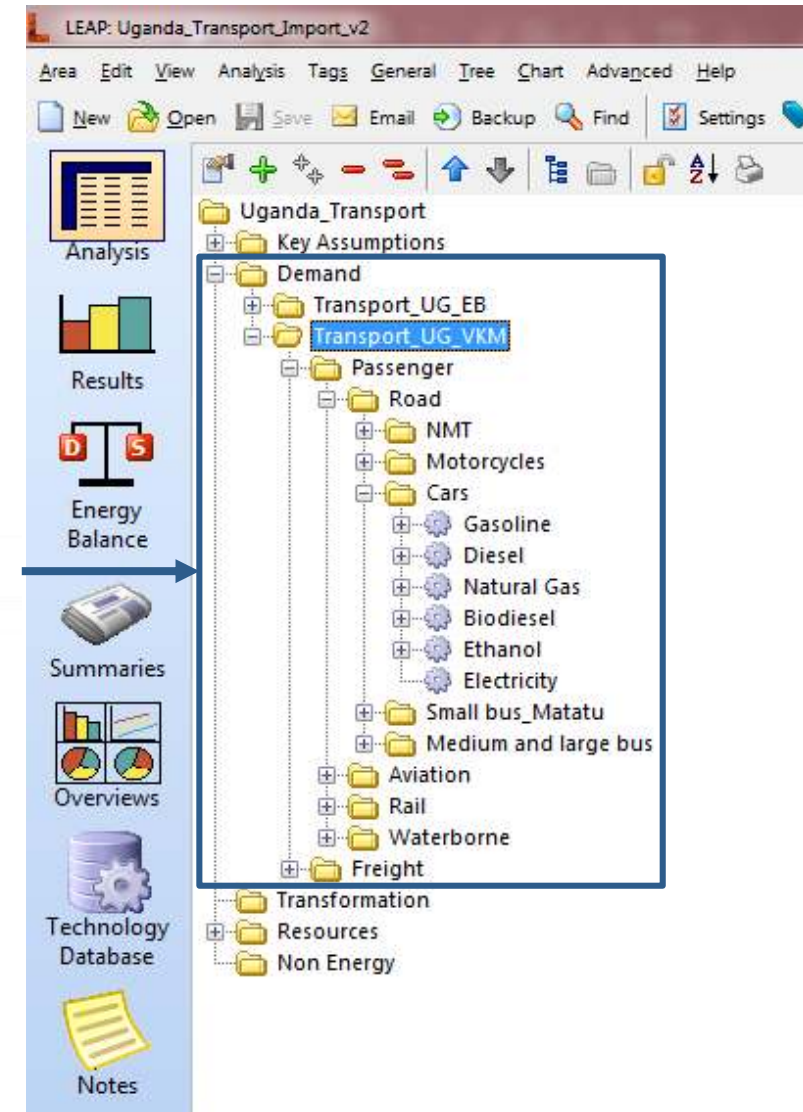
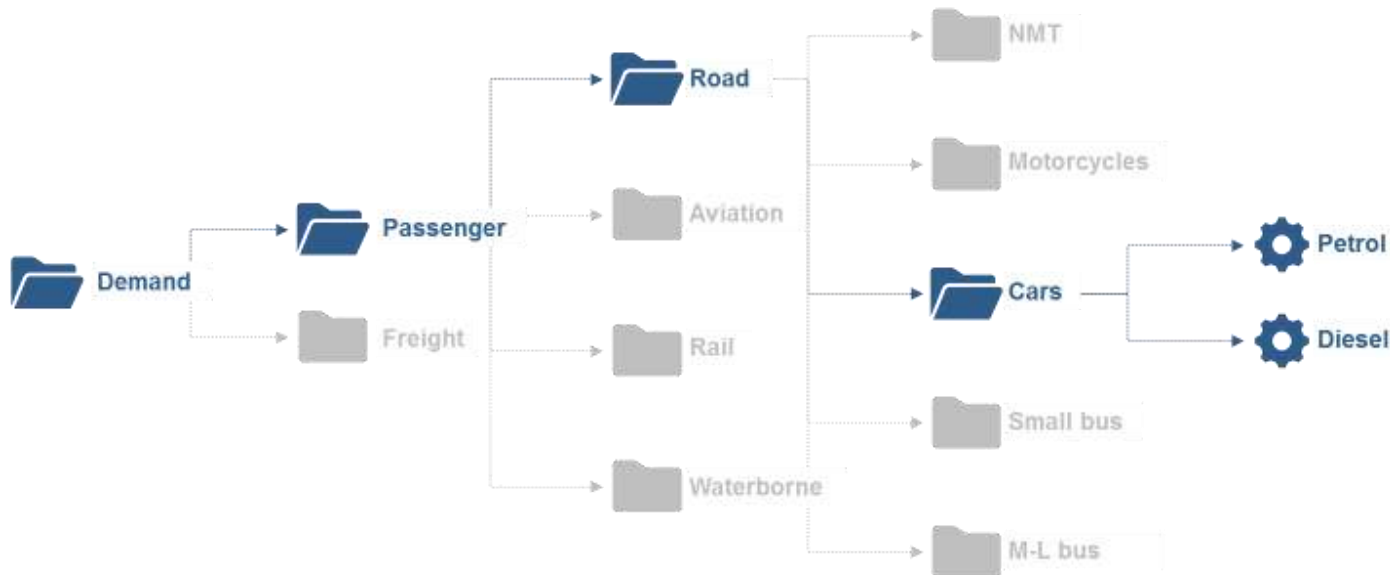
## Basic structure of LEAP model: The Tree and its branches



## Basic structure of LEAP model: The Tree and its branches



## Basic structure of LEAP model: The Tree and its branches



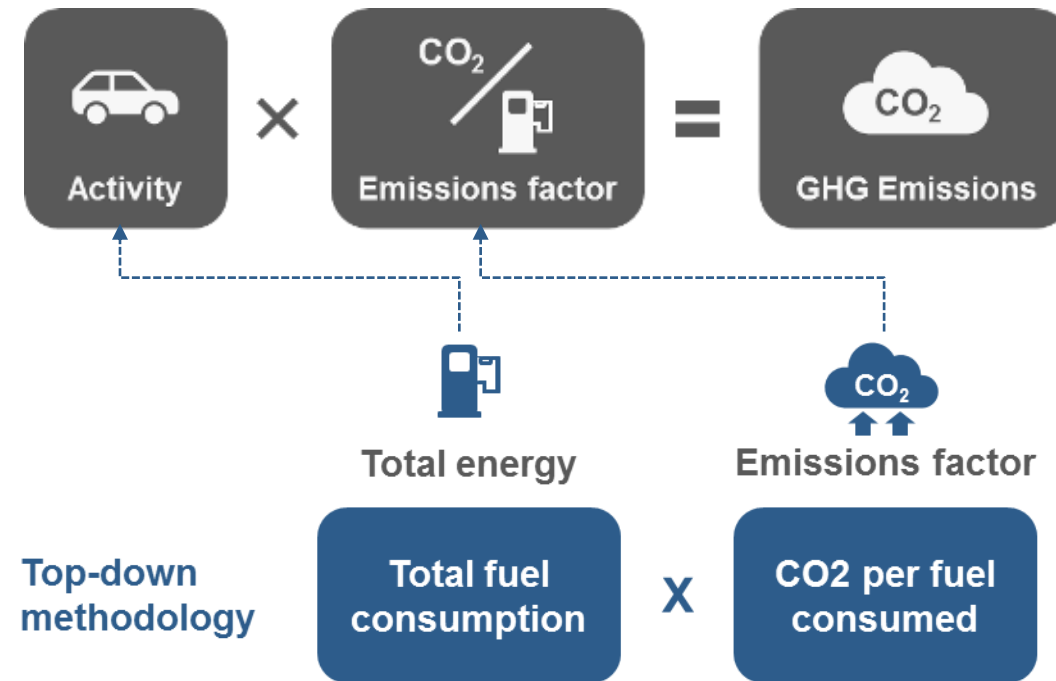


## Methodology of analysis

### Top-down methodology

A top-down methodology takes an aggregated input value (such as total energy consumption) and multiplies this by an emissions factor in order to compute emissions.

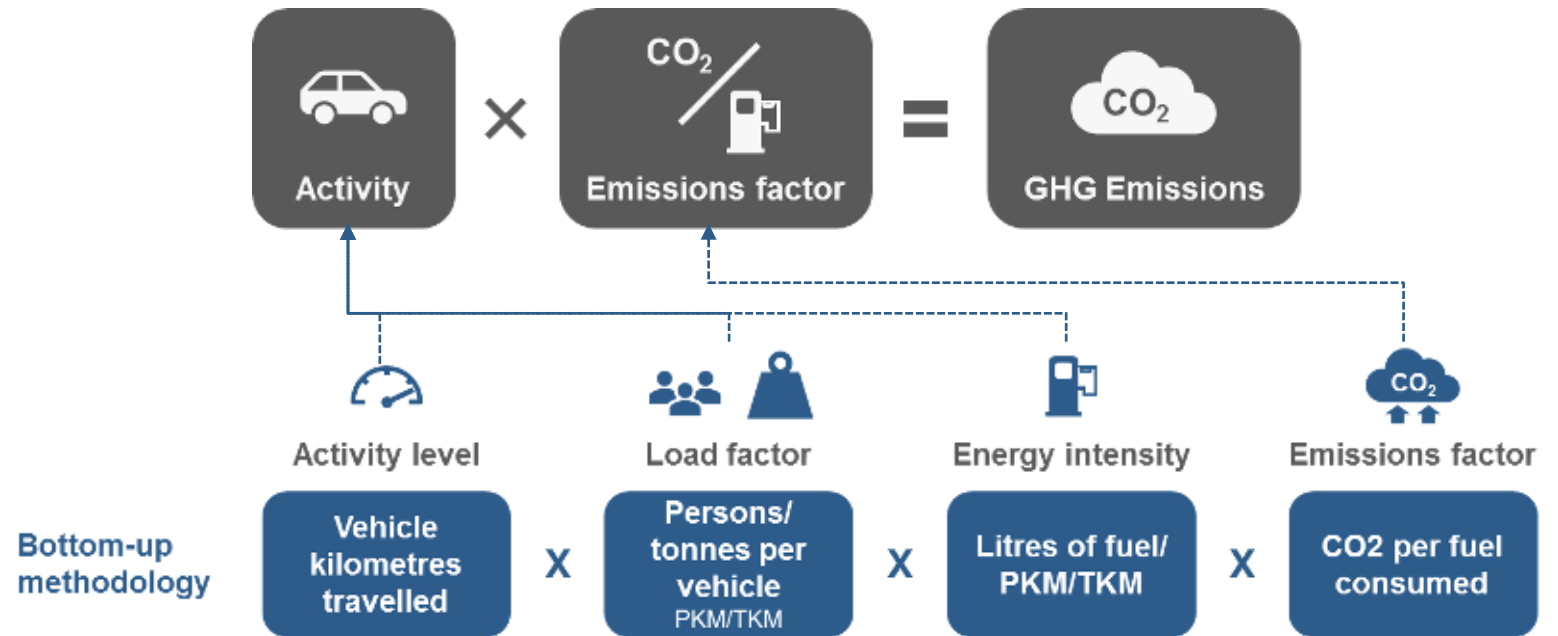
- **Calculation:** Fuel consumption \* emissions factor = GHG emissions
- **Pros:** Simple, fast, often low uncertainty in source data
- **Cons:** Difficult to model mitigation effect







### Bottom-up methodology

A bottom-up methodology takes the opposite approach to top-down, attempting to compile the total energy consumption of a mode of transport by modelling the transport activity itself. The total energy consumption computed is then multiplied by an emissions factor for that specific mode and that specific activity.



- **Calculation:** Transport activity by mode of transport (VKM \* load factor) \* fuel economy value \* emissions factor = GHG emissions.
- **Pros:** Disaggregated by activity, therefore allows clear modelling of mitigation effect of measures
- **Cons:** High data requirements



Measure structure in ASIF framework

Measure category	Measure description	Effect of measure		Modelled effect
A – Avoid	Avoiding journeys where possible		Reduction in total vehicle kilometres travelled (VKM)	Change to VKM
S – Shift	Modal shift to lower-carbon transport systems		Shift of VKM from higher to lower emission modes	
I – Improve	Improving the energy intensity of travel per passenger kilometre or tonne kilometre		Increase in the fuel economy (distance travelled per litre of fuel)	Change to energy intensity
F - Fuel	Reducing carbon intensity of fuel consumed		Reducing carbon intensity of fuels	Change to fuel type consumed

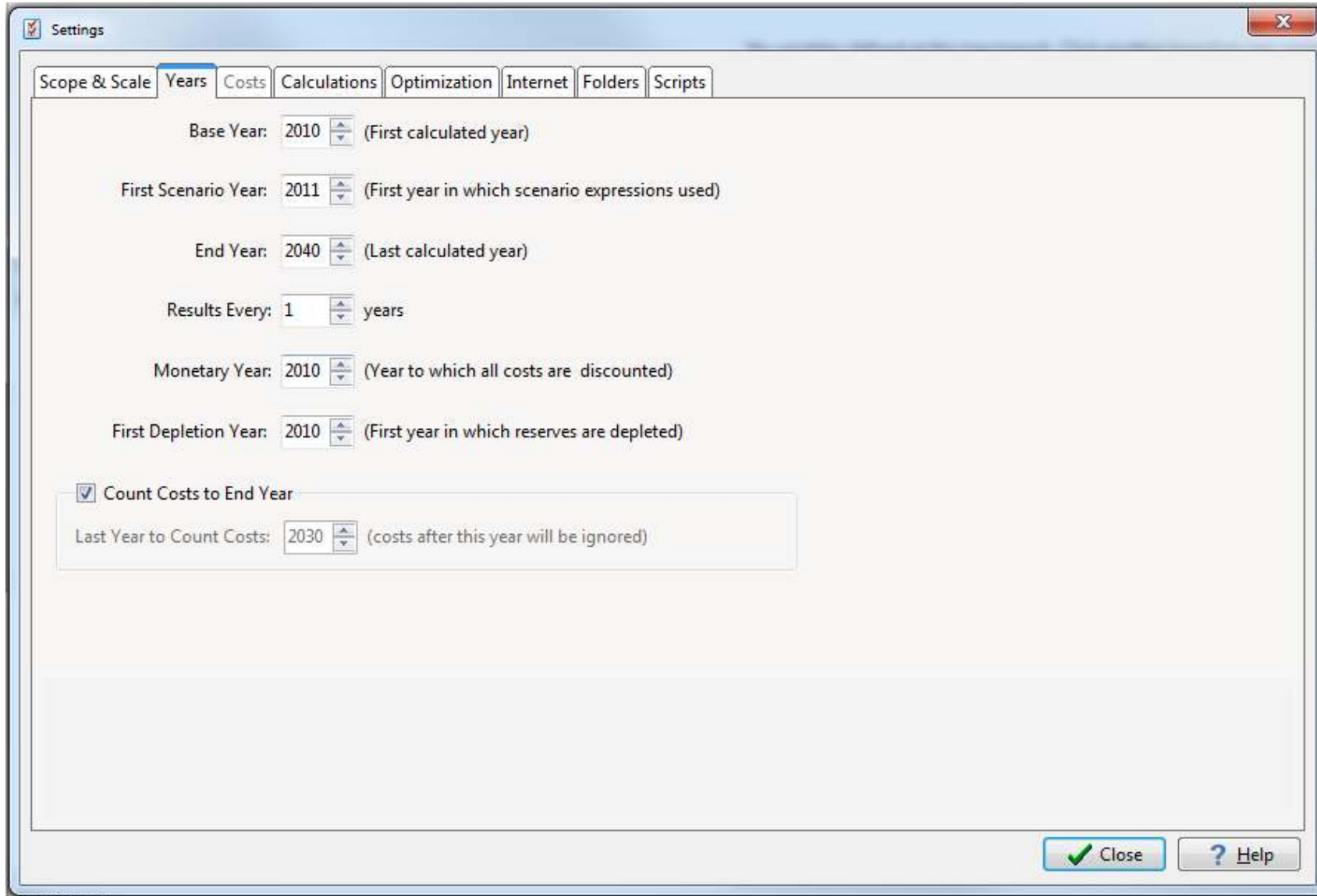
Overview of measure categories within the ASIF framework and modelled effects of measures

Measure category	ASIF	Modelled effect		Measures included
Fuel efficiency	Improve		Change to energy intensity	Passenger road transport fuel efficiency
Freight modal shift	Shift		Change to VKM	Freight modal shift from road to rail





## Using LEAP



The screenshot shows the 'Settings' dialog box with the 'Years' tab selected. The dialog has a title bar with a checkmark icon and a close button. Below the title bar are tabs for 'Scope & Scale', 'Years', 'Costs', 'Calculations', 'Optimization', 'Internet', 'Folders', and 'Scripts'. The 'Years' tab contains several settings:

- Base Year: 2010 (First calculated year)
- First Scenario Year: 2011 (First year in which scenario expressions used)
- End Year: 2040 (Last calculated year)
- Results Every: 1 years
- Monetary Year: 2010 (Year to which all costs are discounted)
- First Depletion Year: 2010 (First year in which reserves are depleted)
- ☒ Count Costs to End Year
  - Last Year to Count Costs: 2030 (costs after this year will be ignored)

At the bottom right, there are two buttons: 'Close' (with a green checkmark icon) and 'Help' (with a question mark icon).

## Settings input

☒ Settings

Scope & Scale
 Years
 Costs
 Calculations
 Optimization
 Internet
 Folders
 Scripts

Base Year: 2003 (First calculated year)

First Scenario Year: 2020 (First year in which scenario expressions used)

End Year: 2050 (Last calculated year)

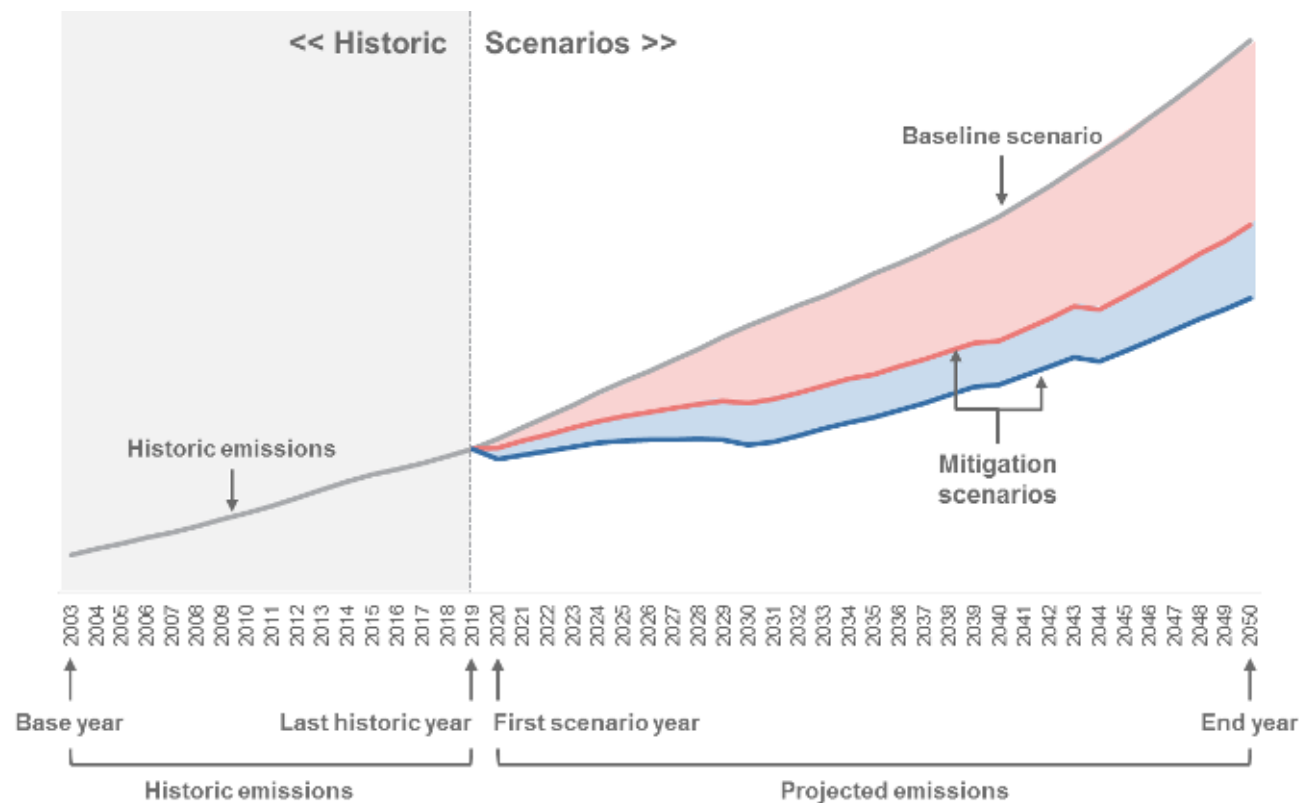
Results Every: 1 years

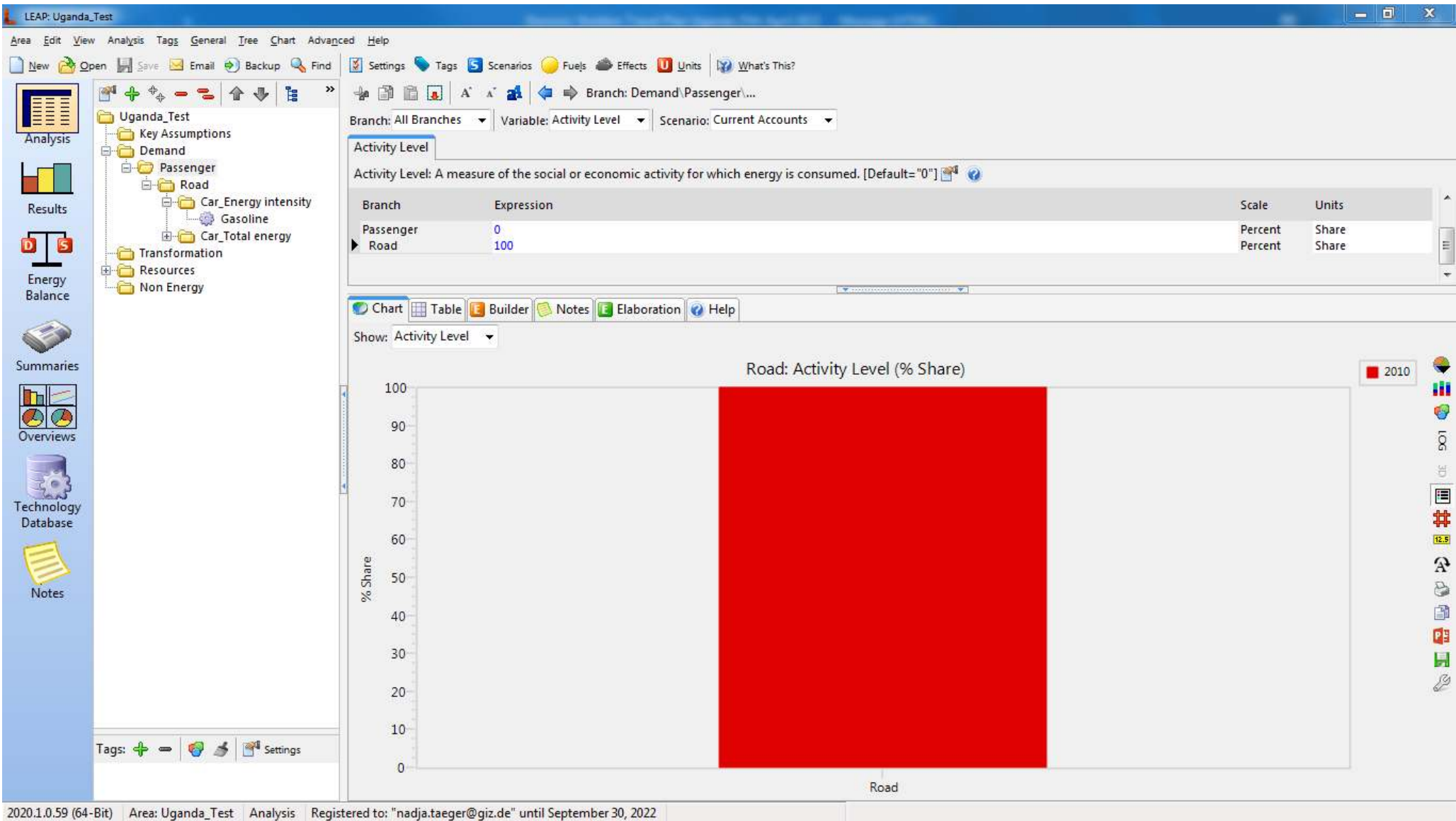
Monetary Year: 2010 (Year to which all costs are discounted)

First Depletion Year: 2010 (First year in which reserves are depleted)

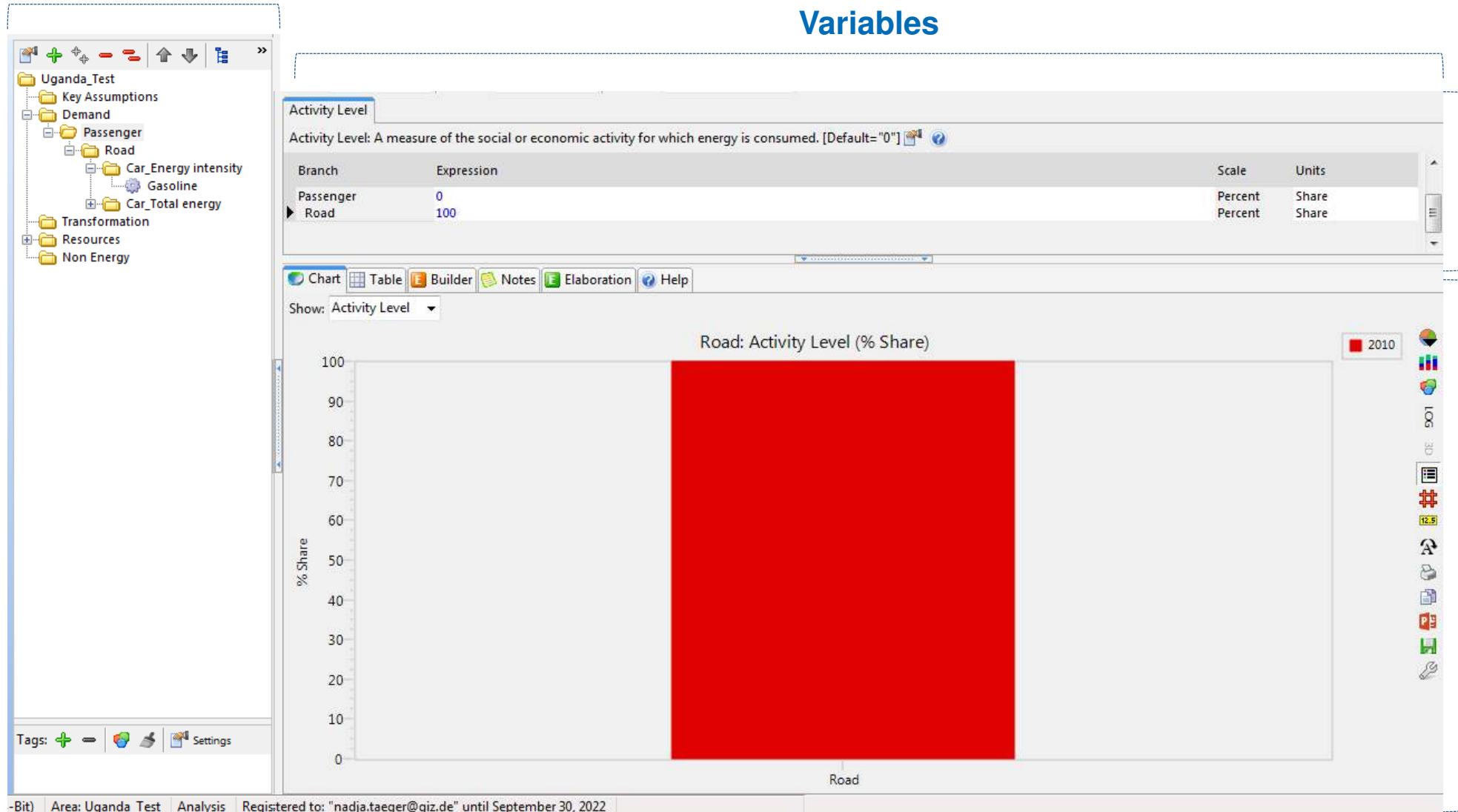
☒ Count Costs to End Year

Last Year to Count Costs: 2030 (costs after this year will be ignored)





## Variables



## Expressions

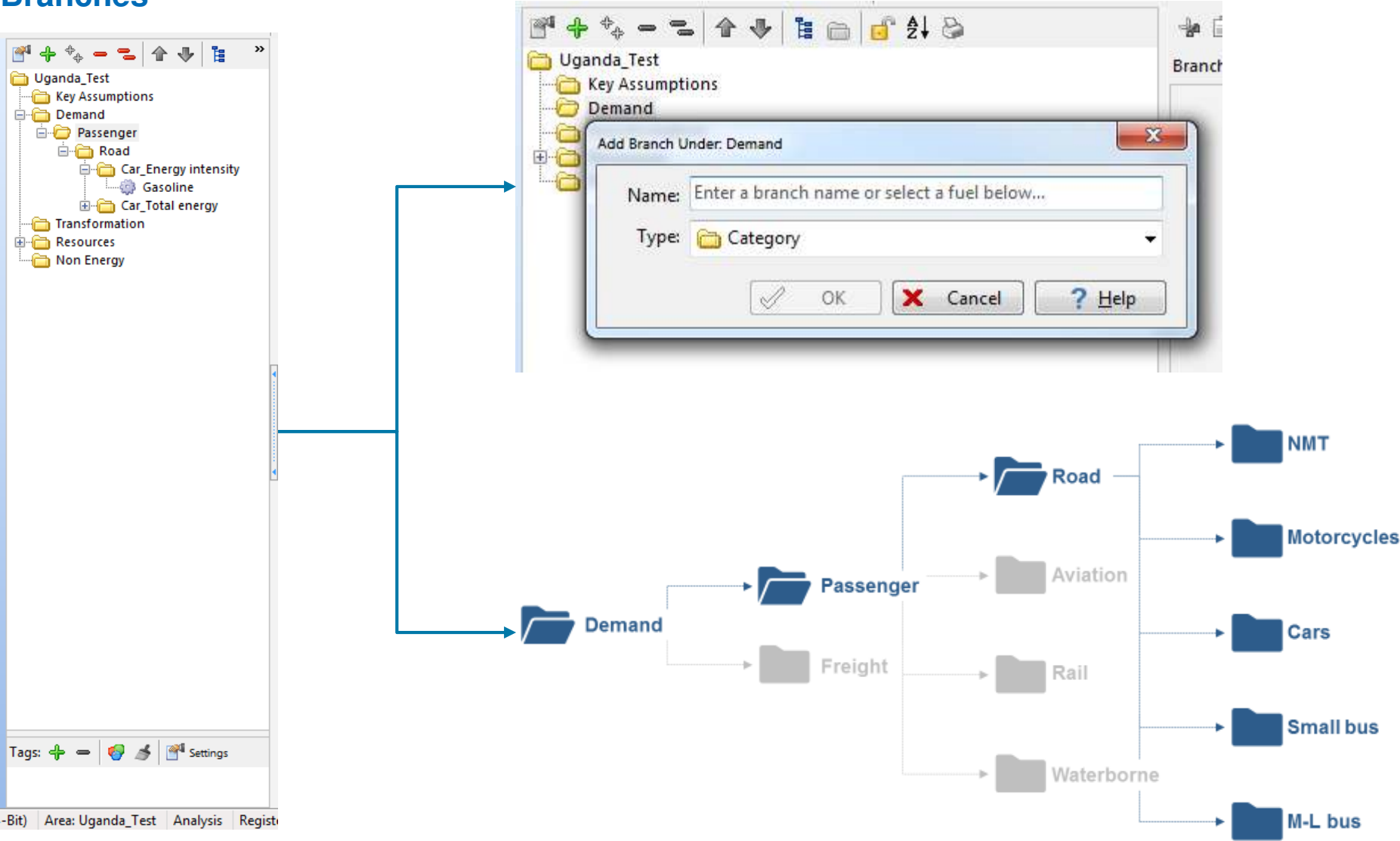
## Information





## Interface: Branches

Branches



## Interface: Expressions

Activity Level				
Activity Level: A measure of the social or economic activity for which energ				
Branch	Expression	Scale	Units	Per
Passenger	Interp(2003, 100.000, 2019, 1000.000)	Thousand	Passenger-km	
Road	Interp(2003, 100.000, 2010, 90.000, 2019, 80.000)	Percent	Share	of Passenger-km
Rail	Remainder(100)	Percent	Share	of Passenger-km

Branches

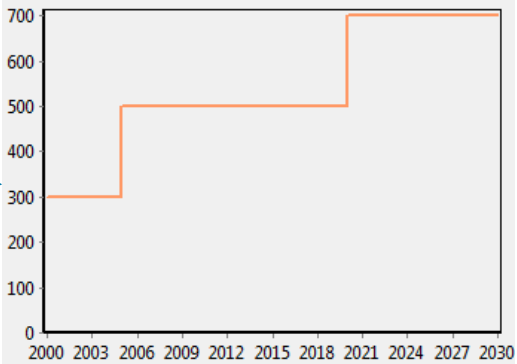
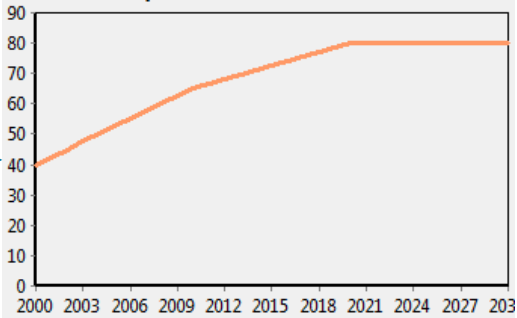
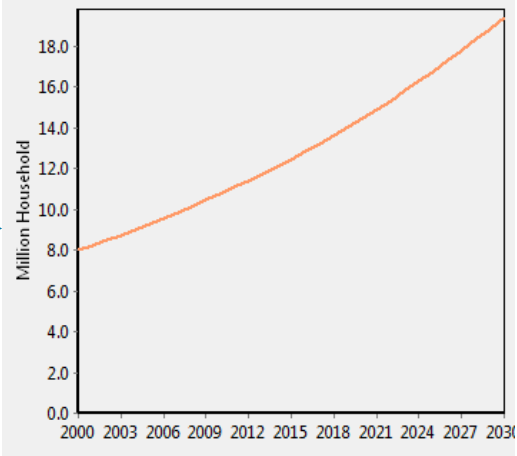
Expression

Scale

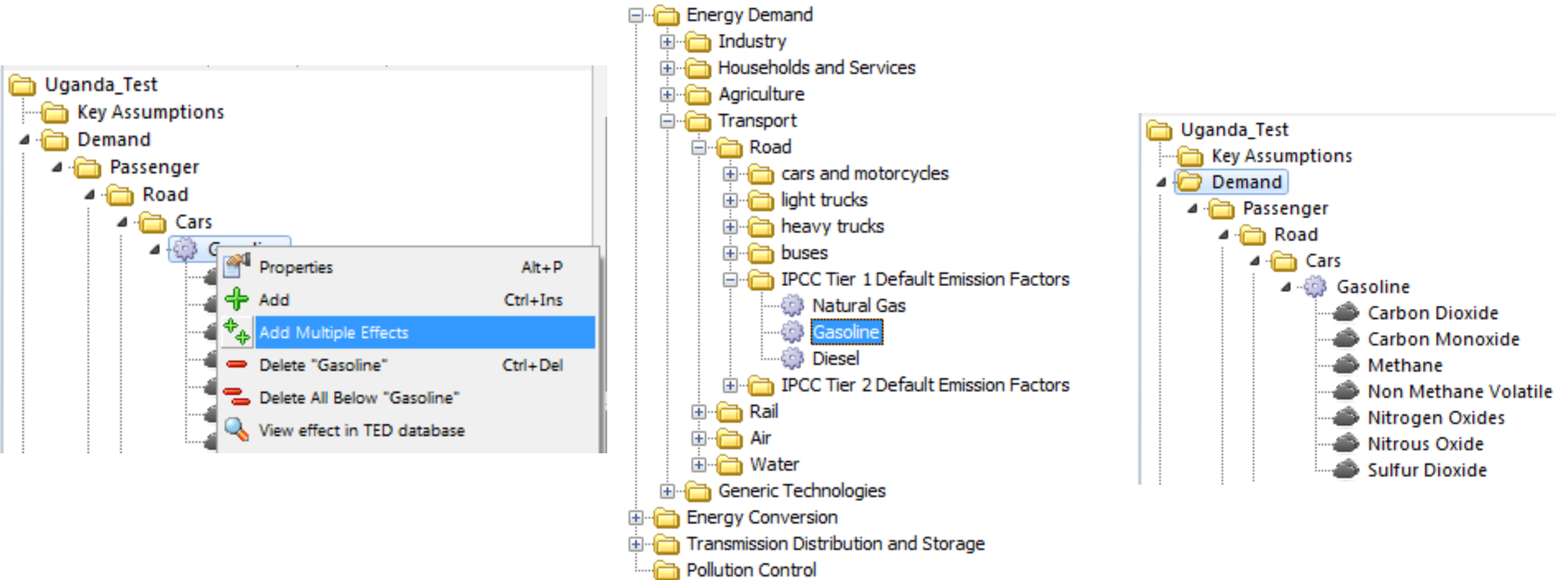
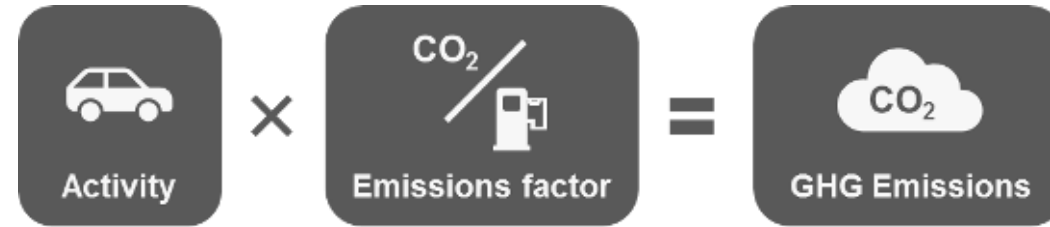
Units

Per

Type	Syntax	Example Syntax and Graph
Simple Number	Value	3.1415
Simple Formula	Value (operator (+ - / *)) value	0.1 * 5970
Growth Rate	Growth(annual % growth)	Growth(3.2%)
Interpolation	Interp(Year, value, year, value)	Interp(2000, 40, 2010, 65, 2020, 80)
Step	Step(Year, value, year, value)	Step(2000, 300, 2005, 500, 2020, 700)
Remainder	Remainder(Value)	70 Remainder(100) (=30)
Branch and Variable References	Branch (operator) Value	Passenger: Activity Level + 10%
GrowthAs	GrowthAs(Branch,elasticity)	GrowthAs(Key\Income,1.1)



## Interface: Variables – Multiple effects





**Now we're ready to build our model!**

Any questions?

**Nadja Taeger**  
Nadja.Taeger@giz.de

**Dominic Sheldon**  
Dominic.Sheldon@ricardo.com

## CHANGING TRANSPORT

Facilitating climate actions in mobility

EXPERTISE ▾ RESOURCES ▾ NEWS ▾ EVENTS ▾ PROJECTS ▾ ABOUT 

14500, not published

04/22

### Assessment of climate change mitigation potentials and actions in Uganda's transport sector

Final Modelling Report

By Dominic Sheldon, Ian Skinner, Nadja Taeger, Seth Mugume

This project funded by the German Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) aims to support the Government of Uganda (represented by Climate Change Directorate, CCD) in systematically assessing the country's greenhouse gas (GHG) emissions from transport, analysing the sector's emission reduction potentials and optimising its contribution to the mitigation targets in the country's Nationally Determined Contribution (NDC). Using this data and analysis, decision makers are empowered to make evidence-based decisions about the future of Uganda's transport sector in terms of mitigating greenhouse gases. This report details the mitigation analysis of the transport sector that has been carried out, detailing the data that have been gathered, the projected future GHG emissions under a business-as-usual scenario, the options for mitigating these emissions and possible mitigation activities.

**Topics:** Core Policy, Adaptation, Urban mobility, National policies and framework programmes (NDC, NPP)

82 Pages

Language: English

**Authors (alphabetical order):** Dominic Sheldon (Ricardo Energy & Environment), Nadja Taeger

**Project:** TUGS

**Commissioned by:** Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

**Countries:** Uganda

Download



Assessment of climate change mitigation potentials and actions in Uganda's transport sector  
Final modelling report

April 2022

Dominic Sheldon, Ian Skinner, Nadja Taeger, Seth Mugume