Assessing co-benefits and identifying solutions

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14 January 2022

Learning objectives

For participants to:

- Understand the use of emissions inventory in baselining emissions and identifying priority sources
- Know about an example of a co-benefits tool and how this was applied in an Asian city

Tools to quantify co-benefits

Co-benefits Analysis Tools

Name of Tool/ Method	Scope	Example of application(s)	Benefits
Transport Emissions Evaluation Model for Projects (TEEMP)	Excel based transport model that offers a "sketch" of multiple benefits	Bus Rapid Transit in Manila	• Air pollution emissions • GHG emissions • Time savings • Fuel savings • Accident reductions
International Vehicle Emissions (IVE)	Transport model that converts data on vehicle technology and activity into multiple emissions	Transport policies in Bandung, Indonesia	• Air pollution emissions • GHG emissions
SIM-air modelling system	Simplified dispersion model-converts emission estimates into pollution concentrations	Air pollution policies in India	• Air pollution concentrations
IIASA GAINs	Well-established suite of models that can estimate impacts of technologies on emissions, air quality, and health	Energy policies in China	• Air pollution emissions • Air pollution concentrations • Health benefits
Benmap	User friendly model that estimates number of disability life years from changes in air quality	Regulatory Change in Air Pollution Standards	• Health benefits
Leap Integrated Benefits Calculator	Extension of energy model with user friendly interface for air pollutants/GHGs, air quality change	Air pollution and energy savings in Bangladesh	• Air pollution emissions • Air pollution concentrations • Health benefits • Food security benefits

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Tools and Methods for Implementing Projects and Policies with Climate and Sustainable Development Co-benefits: The Case of Air Pollution

Case Study:
Emissions Inventory in Santa Rosa City, Philippines

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What is an emissions inventory?

a comprehensive listing by sources of air pollutant, SLCPs, and GHGs emissions in a geographic area during a specific time period.

Emission = Emission Factor x Activity Data

Examples:

Emission Factor:
- SOx emission per the amount of fuel burnt, calculated based on the sulfur content of fuel, the sulfur retained in the ash and the reduction achieved by emission control technology (fuel combustion)
- NOx emission per distance (exhaust gas emissions from vehicles)
- SOx emission per the amount of copper smelted (copper smelting)

Activity Data:
- the amount of fuel burnt (fuel combustion)
- the distance of vehicle travelled (exhaust gas emissions from vehicles)
- the rates of the production of the commodity (industrial process without combustion)

Santa Rosa City Emissions Inventory (2019-2020)

Collaboration involving:

- Santa Rosa City Clean Air Core Team led by City Environment and Natural Resources Office
- National Center for Transportation Studies
- Clean Air Asia

- Co-financed by Santa Rosa City Government and Mitsubishi Motors Philippines Corporation
- Clean Air Core Team involved in data collection and data cleaning; participated in the EI training series (capacity building)

Santa Rosa City Emissions Inventory (2019-2020)

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Emission sources in the EI were classified as Point, Area, or Mobile Sources.

1) **Point sources** - stationary sources that can be identified individually at a given location.
   - Large industries and manufacturing facilities

2) **Area source emissions** - air pollutants emitted over a relatively large area
   - Residential and commercial cooking
   - Residential and commercial use of solvents
   - Residential and commercial waste production
   - Agricultural activities (Livestock)

3) **Mobile sources** - vehicles and equipment generating air pollution that move or can be moved from place to place.
   - Road vehicles

Criteria pollutants
• PM_{10} • $PM_{2.5}$ • Carbon monoxide (CO) • Sulfur dioxide (SO_2) • Nitrogen dioxide (NO_2) • Non-methane volatile organic carbon (NMVOC)
GHGs
• Carbon dioxide (CO_2) • Nitrous oxide (N_2O) • Methane (CH_4)
SLCPs
• Black Carbon (BC)

Santa Rosa City Emissions Inventory (2019-2020)

The EI Process involved 3 phases:

Phase 1: Preparation

- Identification of pollution sources within the city
- Identification of Data gathering methods
- Development of data gathering plan

Phase 2: Data Gathering

- Implementation of Data Gathering Plan

Phase 3: Data Analysis

- Data Cleaning
- Emissions Estimation

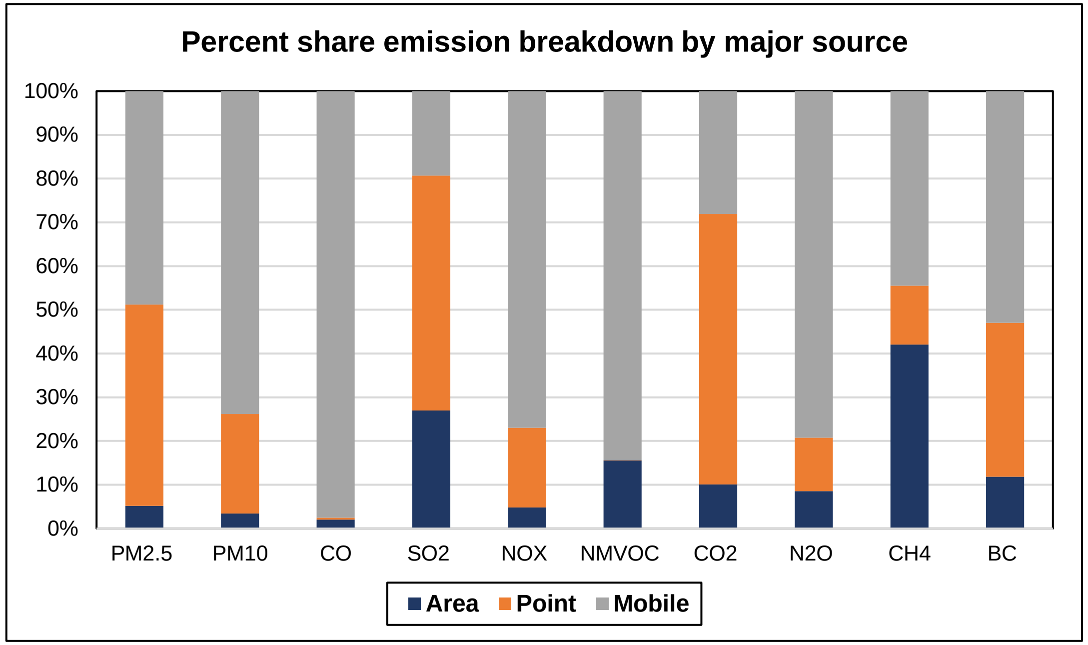
Supporting Activities

- Capacity building
- Documentation and report preparation

Santa Rosa City Emissions Inventory (2019-2020)

Key Findings from EI

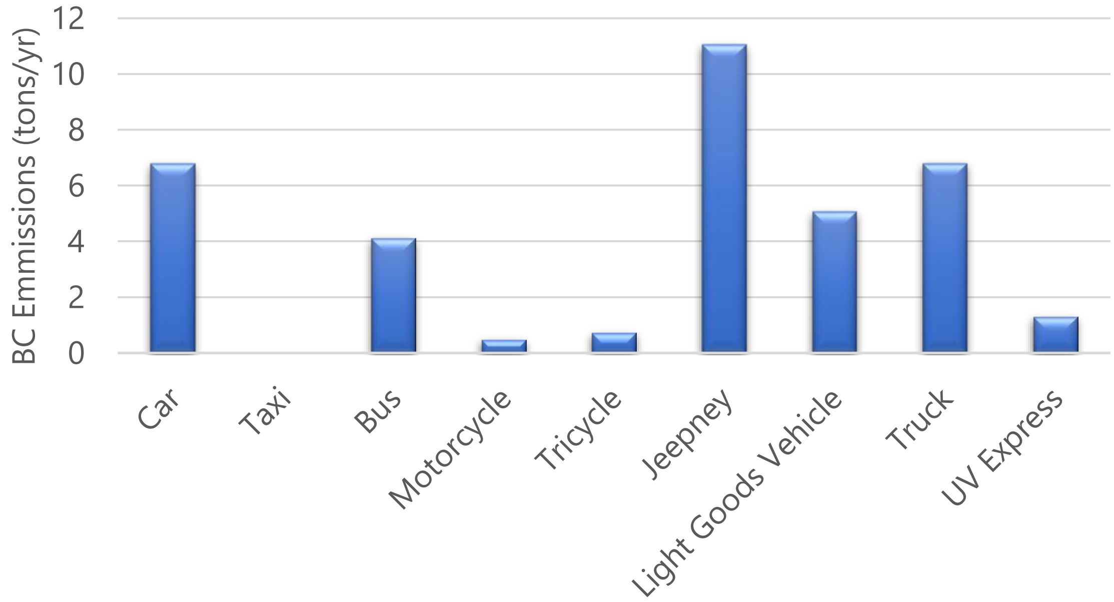
- PM_{10} is mainly produced by mobile sources, specifically, motorcycles and tricycles. In addition, the bulk of BC, CO, NMVOC, N_2O and NO_x emissions can also be attributed to mobile sources.
- CO_2 and SO_2 emissions are mainly caused by point sources, from the use of LPG and coal as fuel.
- $PM_{2.5}$ comes from both point and mobile sources
- CH_4 emissions jointly result from mobile and area sources activities.

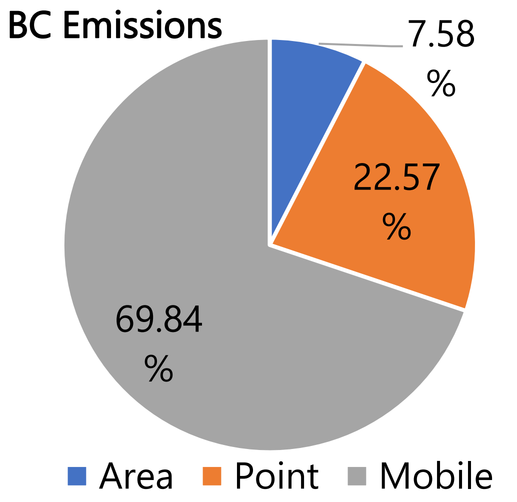


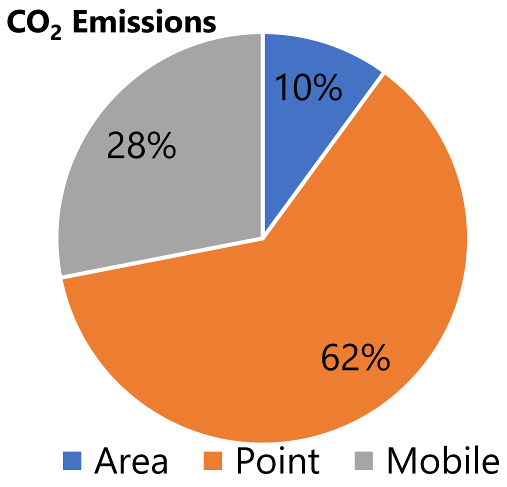
Santa Rosa City Emissions Inventory (2019-2020)

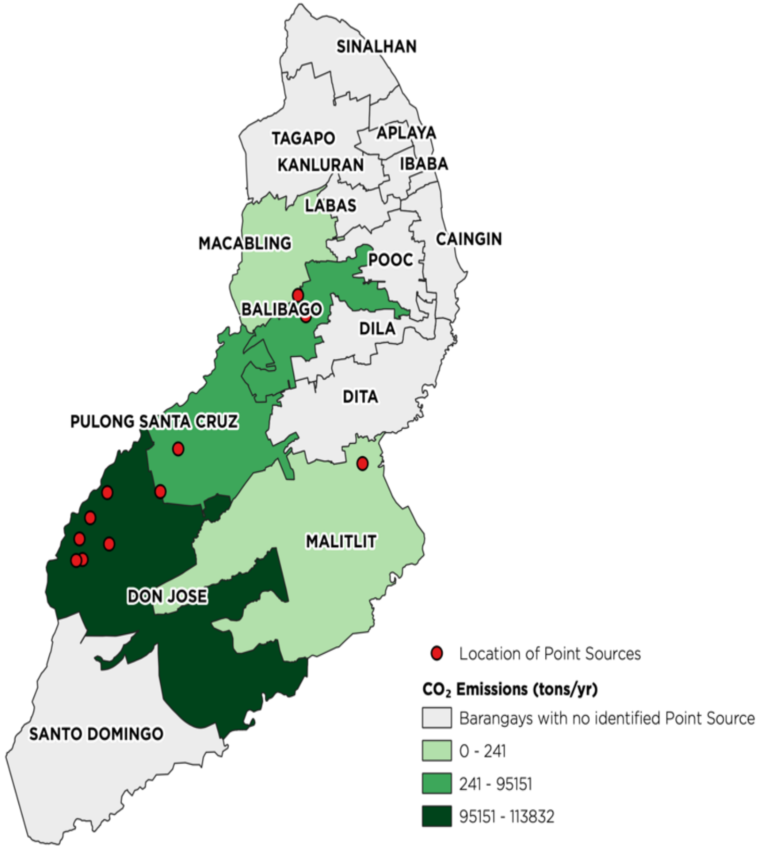
Results presented through graphs and spatial maps (barangay/village)

Emissions disaggregated into Point, Area, and Mobile and further per establishment (Point and Area) and vehicle type and main road (Mobile)









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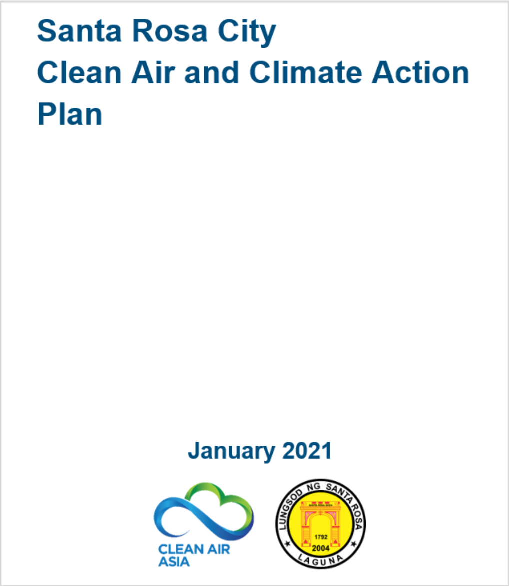
Santa Rosa City Clean Air and Climate Action Plan

- The results of the EI were used as a basis for identifying priority control measures in Santa Rosa's climate and clean air action plan
- The city focused on **transportation** for their climate and clean air action plan since mobile sources were found to be the dominant sources of emissions most of the pollutants (PM_{10}, CO, NO_x, N_2O, CH_4, BC and NMVOC)
- Measures include improving the inspection and maintenance (through the vehicle testing and apprehension program), improving public transportation and promoting walking and biking as modes of transportation.



Pollutant	Overall Dominant Pollution Source
$PM_{2.5}$	Mobile - Motorcycles
PM_{10}	Point (Barangay Balibago) and Mobile – Tricycle
CO	Mobile – Cars
SO_2	Point – Barangays Don Jose and Pulong Santa Cruz
NO_x	Mobile – Cars
NMVOC	Mobile – Motorcycles
CO_2	Point – Barangay Don Jose
N_2O	Mobile – Jeepneys
CH_4	Mobile – Cars and Area - Residential cooking
BC	Mobile – Jeepneys

Transport Emissions Evaluation Models for Projects (TEEMP)

Suite of Excel-based, free-of-charge, transparent spreadsheet tools

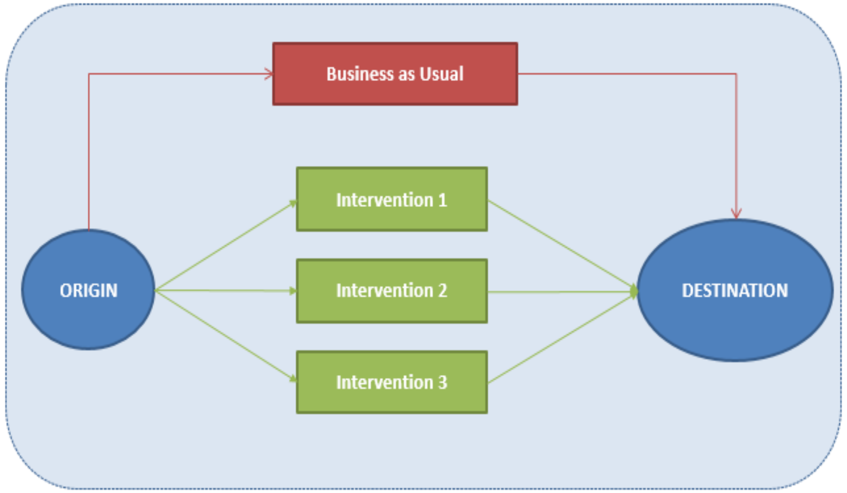
Models predict impacts / benefits of transport projects in terms of:

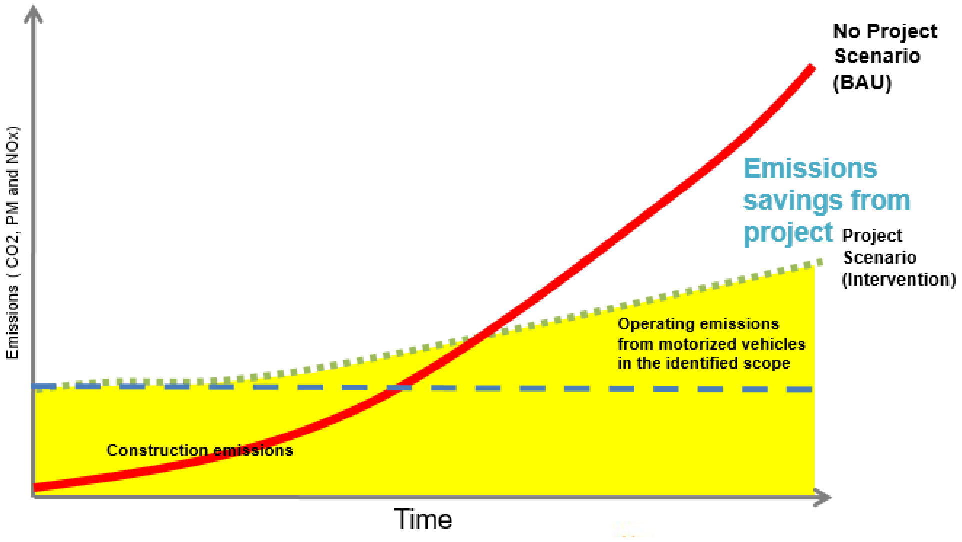
- CO_2 emissions reduction
- Air pollutant emissions (PM and NOx) reduction
- Fuel savings
- Time savings
- Cost savings

Applications:

- Bikeway Projects and Bike sharing Scheme
- BRT, LRT, MRT, Railway Projects
- Pedestrian Facility Improvements
- Roads Projects – Expressways, Rural Roads and Urban Roads

Results of TEEMP evaluation can help facilitate reasonable direction for action and alternate options





TEEMP Application using Santa Rosa activity data

Steps in Developing Emissions Reduction Scenarios in the Transport Sector for Santa, Rosa, Philippines using the TEEMP Model

Step 1: Developing Baseline 2020 and 2030 Emissions Scenarios

- In developing the baseline scenario, several assumptions were made on the following:

(1) composition of vehicle fleet
(2) average distance of trips,
(3) emission factors,
(4) changes in population and trips between 2020 and 2030,
(5) changes in the vehicles adhering to different emissions standards, and
(6) pollutants that were estimated in the baseline and intervention scenarios

Step 2: Developing the Intervention Scenarios

- The intervention scenarios would focus on two decisions that could potentially reduce emissions in Santa Rosa

(1) improving the inspection and maintenance programme—especially road-side based inspections
(2) promoting non-motorized transport through the creation of bike lanes.

TEEMP Application using Santa Rosa activity data

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Step 3: Presenting the Results

CO_2

- The reduction in CO_2 between the baseline and the intervention scenario is approximately <u>40,000 tons of CO_2 (25% reduction)</u>.
- The impacts of the either the non-motorized transport and inspection and maintenance programs make up somewhere between 15% (non-motorized transport) to 10% (inspection and maintenance) of the reductions.

PM_{10}

- Emissions of PM_{10} fall below the 2020 levels in all of the scenarios.
- For the non-motorized transport and inspection and maintenance scenarios, the amount of tons is approximately 10% lower than 2020 levels and 15% level than 2030 levels.
- For the combined scenario, the reductions are approximately 25% of the 2020 and 33% of the 2030 levels.

Figure 1: Changes in CO2 from Transport in Santa Rosa 2020-2030

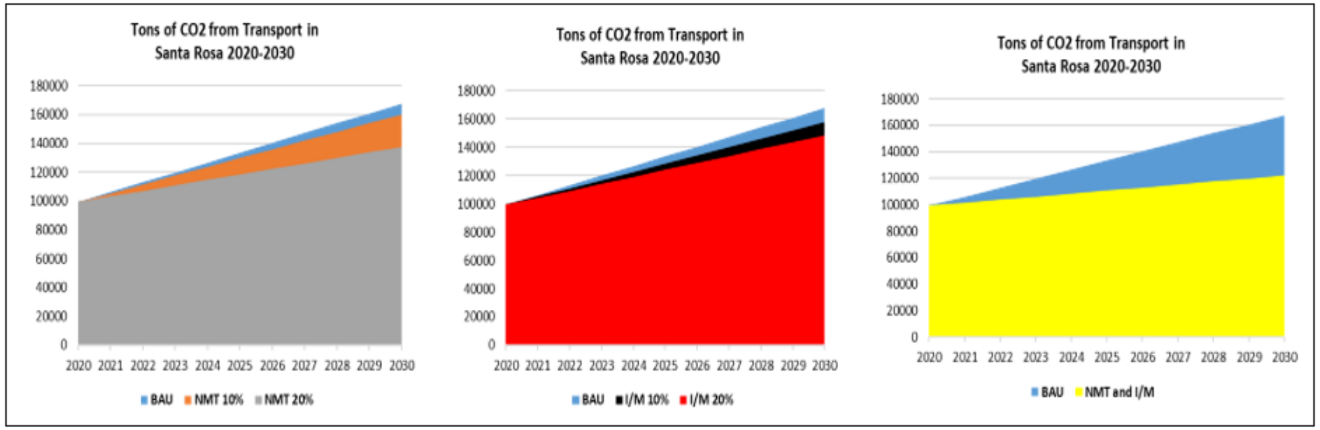
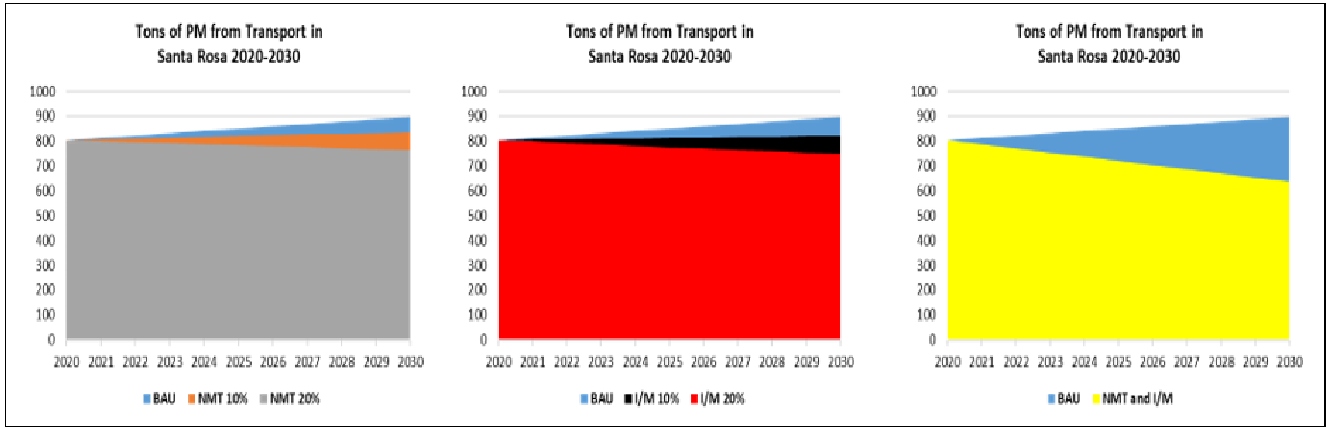


Figure 2: Changes in PM10 from Transport in Santa Rosa 2020-2030



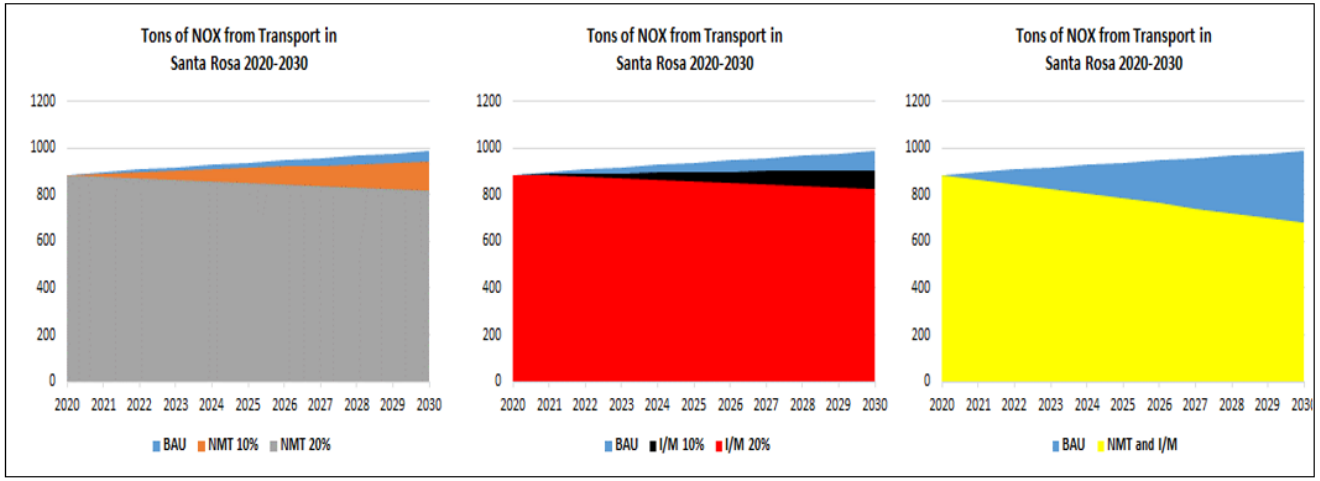
TEEMP Application using Santa Rosa activity data

TEEMP Model Result

NO_x

- For the non-motorized transport and inspection and maintenance scenarios, the amount of tons of NOx is approximately 10% lower than 2020 levels and 15% level than 2030 levels.
- For the combined scenario, the reductions are approximately 25% of the 2020 and 33% of the 2030 levels.

Figure 3: Changes in NOX from Transport in Santa Rosa 2020-2030



Overall Key Findings

- CO_2 emissions will continue to grow even with the proposed interventions
- Emissions of PM10 and NOX will fall moderately
- These results suggest the importance of promoting non-motorized options that help to curb demand for motorized transport.

TEEMP Modeling Using the Santa Rosa EI data

Areas for improvement

- Validity of assumptions
- Inclusion of additional interventions in the scenario analysis
- Influence of planning and institutional arrangements on the implementation of the scenarios
- Potential interactive effect between multiple interventions

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