Public Health Co-benefits of Greenhouse Gas Mitigation in Abu Dhabi

Bill Dougherty,[1] Paul Kucera,[2] David Yates[2]
[1]billd@ccr-group.org; [2]pkucera@ucar.edu; [2]yates@ucar.edu

Abstract

There are strong linkages between greenhouse gas emissions that contribute to global climate change and air pollution that contributes to adverse local public health impacts. Activities that lead to greenhouse gas emission reduction can also simultaneously lead to air pollutant emission reductions (ozone and particulates) and subsequently to the avoidance of adverse public health impacts. In the emirate of Abu Dhabi, several notable initiatives have been proposed in the emirate's Climate Change Strategy to reduce the carbon footprint of energy consuming activities. The study sought to answer the question was: "Are there significant public health co-benefits in the greater Abu Dhabi City metropolitan area associated with the emirate's Climate Change Strategy?" The study explored this question by using a damage function approach to quantify the number of avoided premature deaths and avoided excess health-care facility visits due to the comprehensive implementation the Abu Dhabi Climate Change strategy. Building off of the recently completed Environmental Burden of Disease Assessment, the study integrated numerous types of sector-specific data, multiple modeling frameworks, various technology performance information, regional climate change modeling data, spatial data, and a host of other parameters into an integrated model.

Methodology

A "bottom-up" methodology was used that relied heavily on local data to define emission sources/trends, demographic characteristics, health conditions of sub-populations, and actual types of technologies either currently used or planned. Bottom-up approaches to energy/environment modeling are able capture the needed details and complexity of emissions and their atmospheric dispersion within a local/regional context. Quantifying public health co-benefits involved modeling linkages between air pollutant emissions, air quality, and public health at the municipal level given plausible scenarios for the implementation of Abu Dhabi's Climate Change Strategy. Seven major steps were involved:

- *Step 1: Establish land area and population characteristics in the Abu Dhabi Metropolitan Area.*
- *Step 2: Establish current and future climatic conditions.*
- *Step 3: Reduce dataset dimensionality to identify bad air quality days.*
- *Step 4: Compute air emission impacts associated with each initiative in Abu Dhabi's Climate Change Strategy.*
- *Step 5: Conduct parameterized air quality modeling.*
- *Step 6: Estimate the temporal change in air quality associated with Abu Dhabi's Climate Change Strategy.*
- *Step 7: Calculate public health co-benefits.*

Results

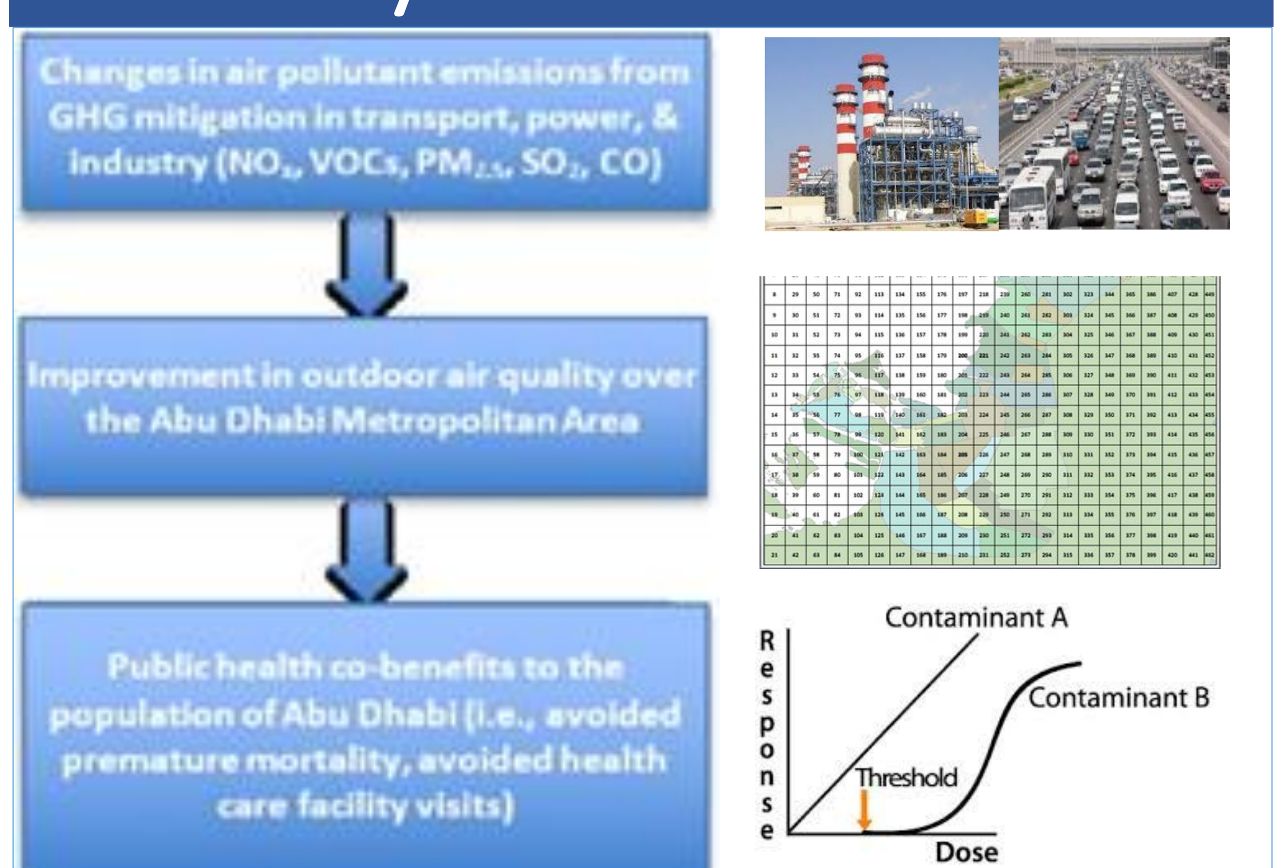
The calculation of public health co-benefits is a function of the kinds of policies implemented and the nature of their implementation. Some policies affect emissions from point sources (e.g., Policy Option #1: Nuclear power generation) while other policies affect emissions from mobile sources (e.g., Policy Option #14: Encourage purchase of high efficiency vehicles).

The kind of policy has a large impact on how pollution is dispersed (i.e., large quantities from a few tall stacks versus small quantities from many ground-level sources). In addition, some policies apply targets that can have a large impact on the particular sector while other policies apply targets that produce a more modest impact.

These differences were accounted for by a) assigning explicit values to targets for each policy and b) providing the capability for analyzing a single policy or many policies in combination. The results presented below are based on an illustrative run assuming all policies are implemented, and assuming target assumptions that may or may not be consistent with actual plans. The results offer a window into the orders of magnitude regarding what the Climate Change Strategy might achieve relative to emission reductions, air quality benefits, and public health co-benefits.

Starting premises

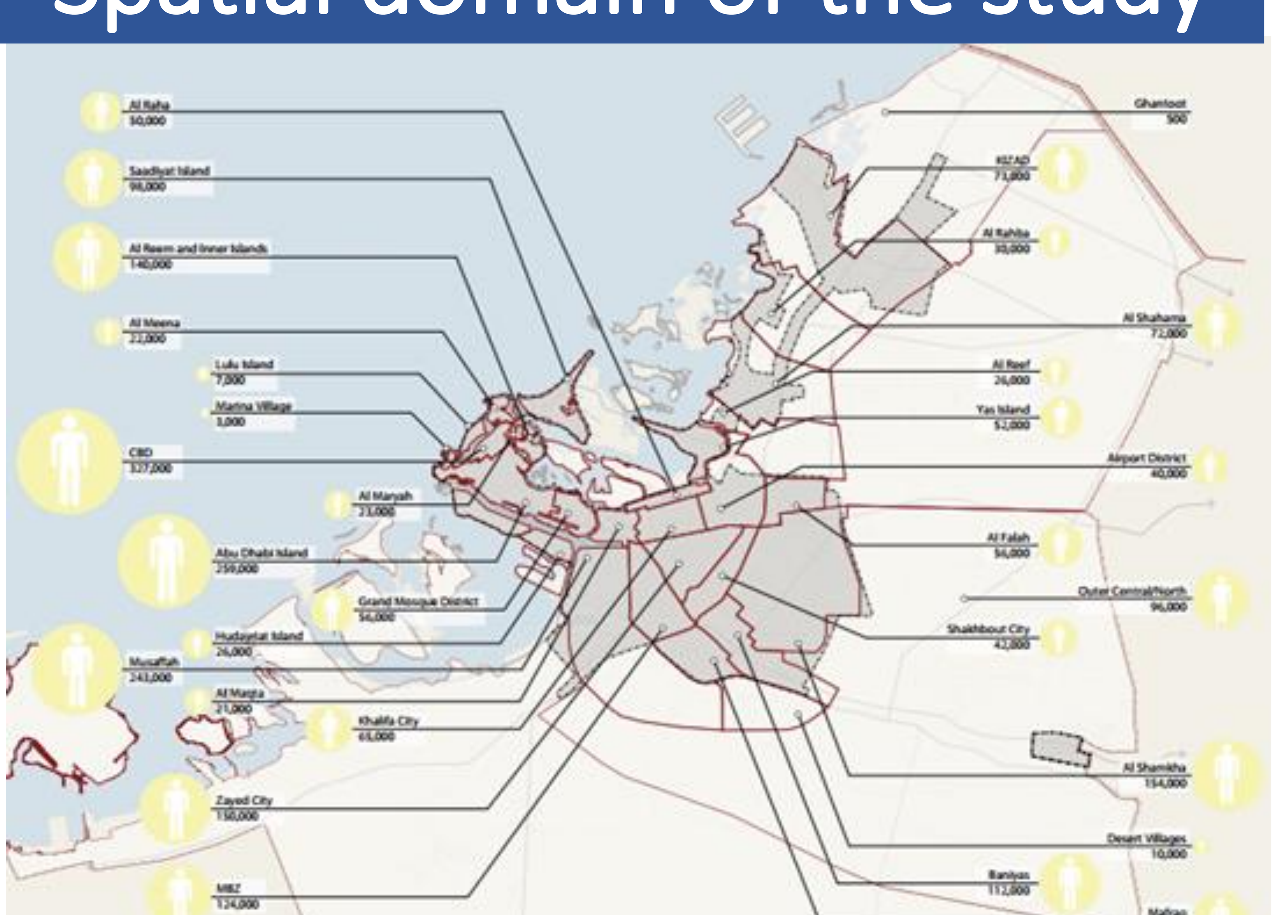
Analytical framework



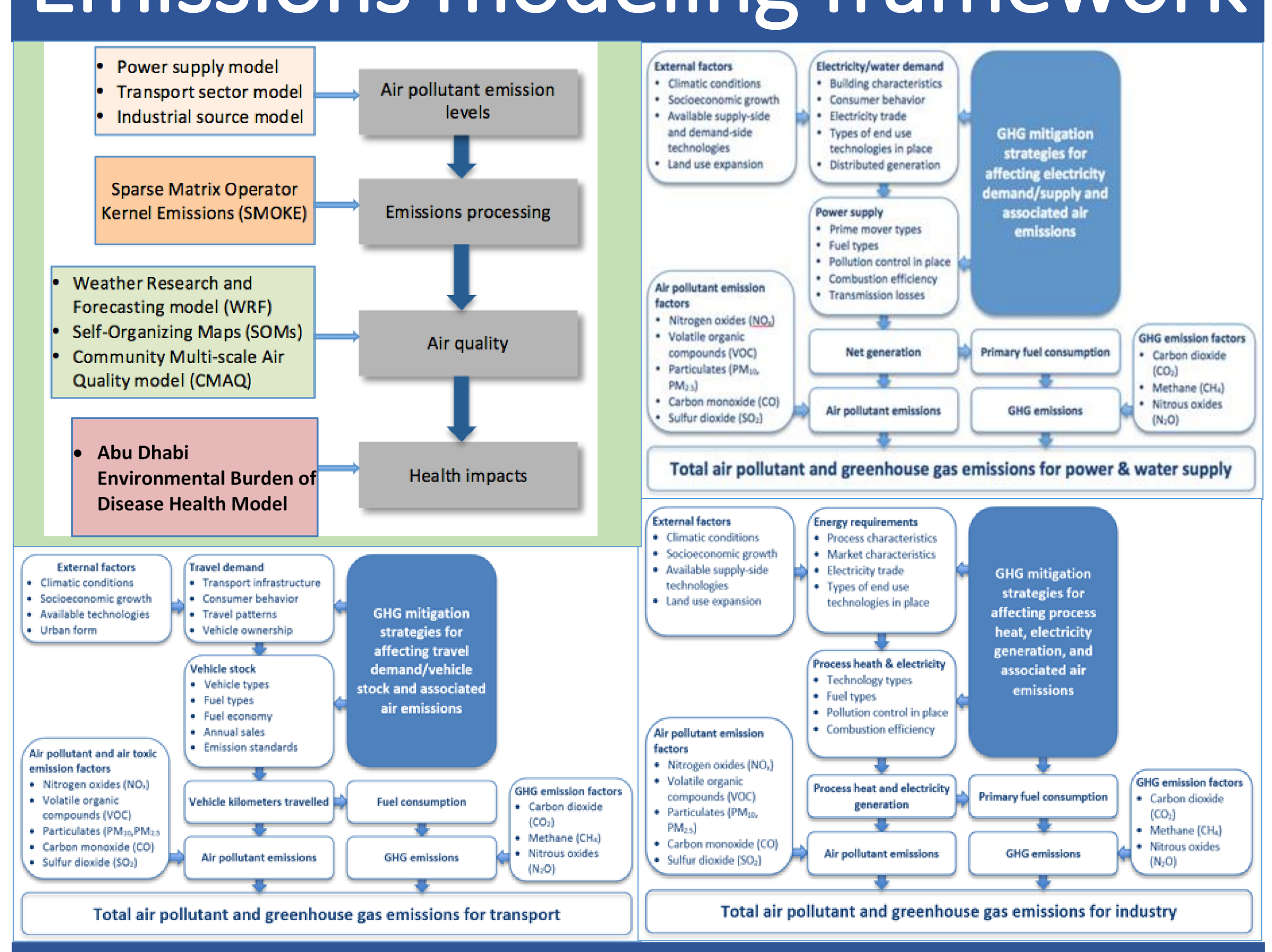
Exploring results with Inspector tool

A user-friendly analytical tool has been developed in Excel to analyze policies individually or in combination. Sensitivity analyses can also be conducted to explore impacts of alternative assumptions. The tool is available at http://www.ccr-group.org/health-inspector-tool-full

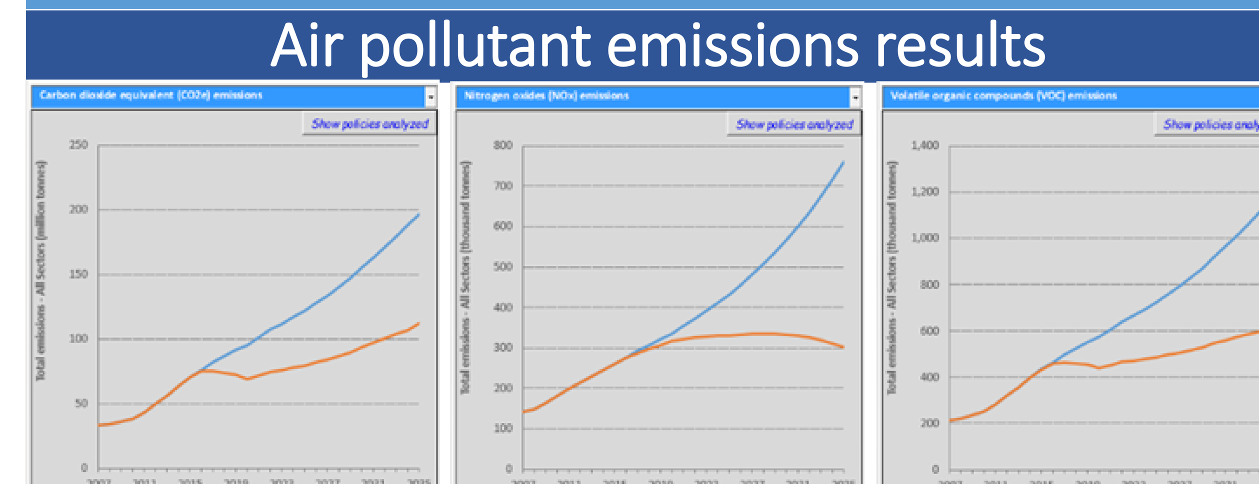
Spatial domain of the study



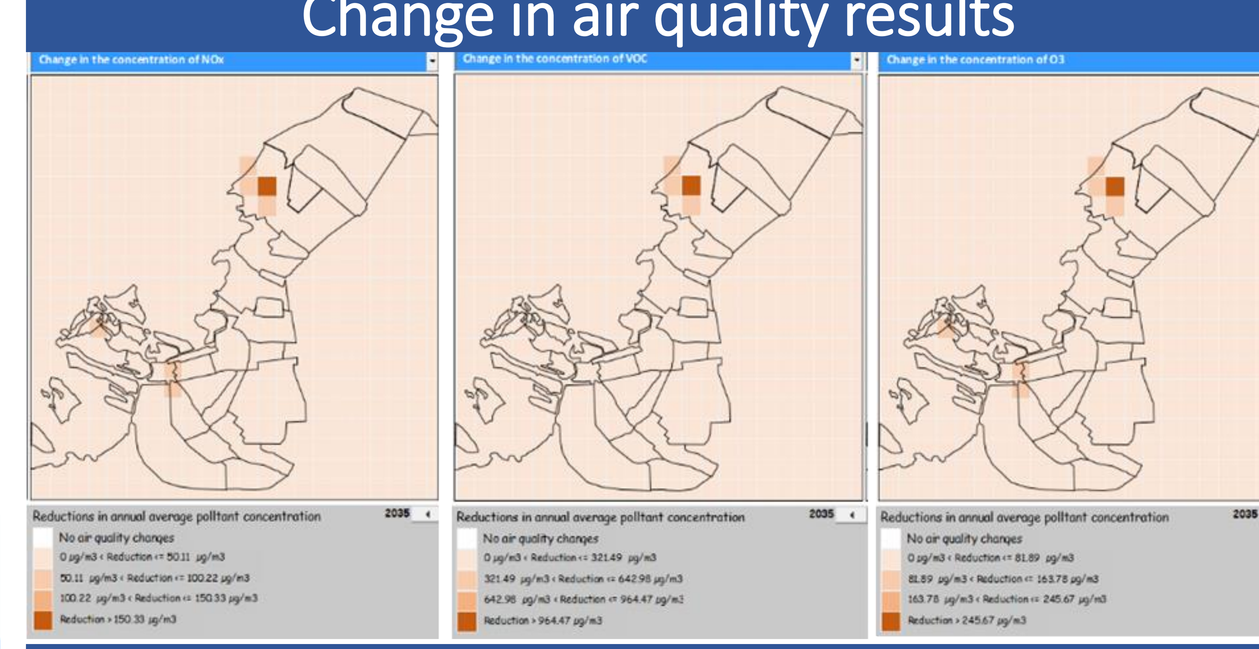
Emissions modeling framework



Air pollutant emissions results



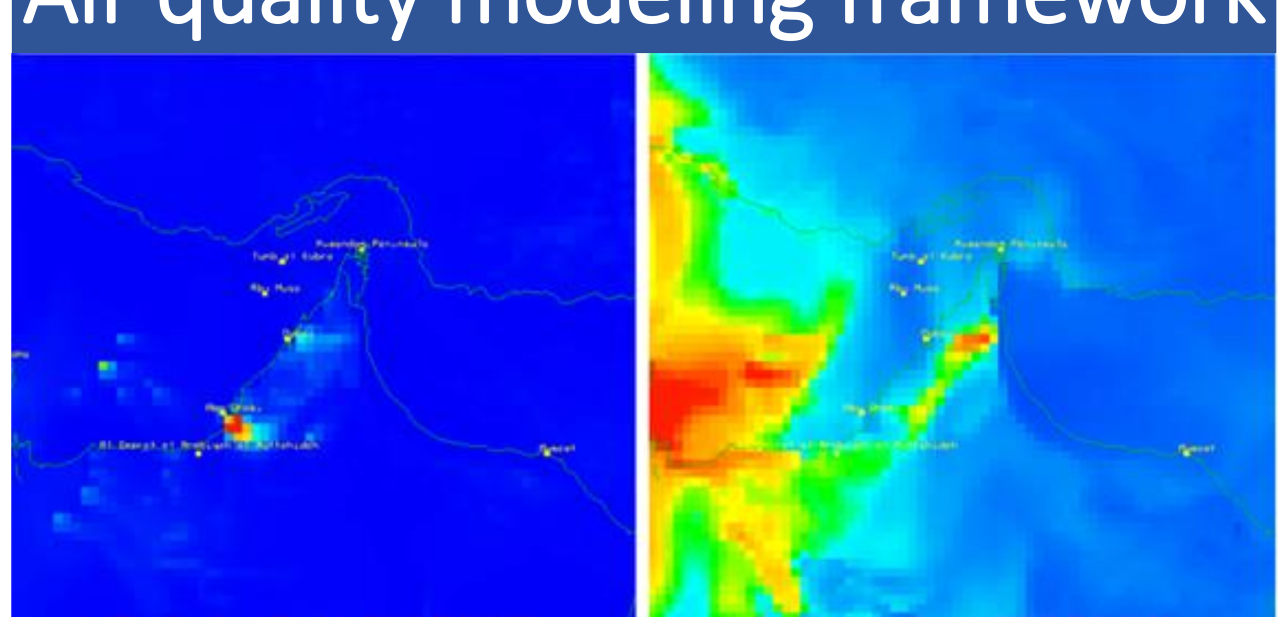
Change in air quality results



Policy domain of the study

Policy	
No	**Description**
1	Nuclear power generation
2	Renewable energy power plants
3	One renewable energy water desalination pilot project
4	Renewable energy water desalination plants
5	Waste-to-energy power plants
6	Feed in tariff to sell power to the grid
7	Solar roofs
8	Supply side energy efficiency strategy for electricity and water production
9	Demand side management strategies for electricity and water production
10	Current Estidama initiative
11	More stringent building codes for energy conservation
12	Energy efficiency standardization and labeling programme
13	Transportation demand strategies
14	Encourage purchase of high efficiency vehicles
15	Gas flaring reduction in oil and gas industry
16	Energy efficiency at industrial cogeneration facilities
17	Energy efficiency in aluminum production

Air quality modeling framework



Health impact modeling framework

Morbidity health outcomes

β, Central Value	Pollutant	Indicator	Units	Exposure type	Health outcome type	Age group
0.084	PM10	Daily average	ug/m3	Short term	Health care Visits (Respiratory)	All
0.03	PM10	Daily average	ug/m3	Short term	Health care Visits (Cardiovascular	All
0.34	O3	Daily average	ppb	Short term	Health care Visits (Respiratory)	All

Health co-benefits from reducing particulate emissions

Avoided premature mortality

Avoided excess health care facility visits