REPUTATION RESOURCES RESULTS

Development of a Multi-User GIS-Based Emission Inventory Tool

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Overview

- Background
- Approach
- Conceptual Paradigm
- GIS-EI Tool Mechanics
- GIS-EI Tool Software
- Closing

Background

- EC commissioned the development of a powerful, multi-agency GIS solution to enhance air quality management

Minimal Functionality:

1. Create EIs from first principles (*ab initio*)
2. Generate maps, backcast/forecasts and reports
3. Produce emissions data for modelling systems
4. Based on ESRI's ArcGIS software system

Approach

Step 1: Develop a robust data model

Step 2: Prototype land-use and population emissions

Step 3: Land transportation activity-based emissions

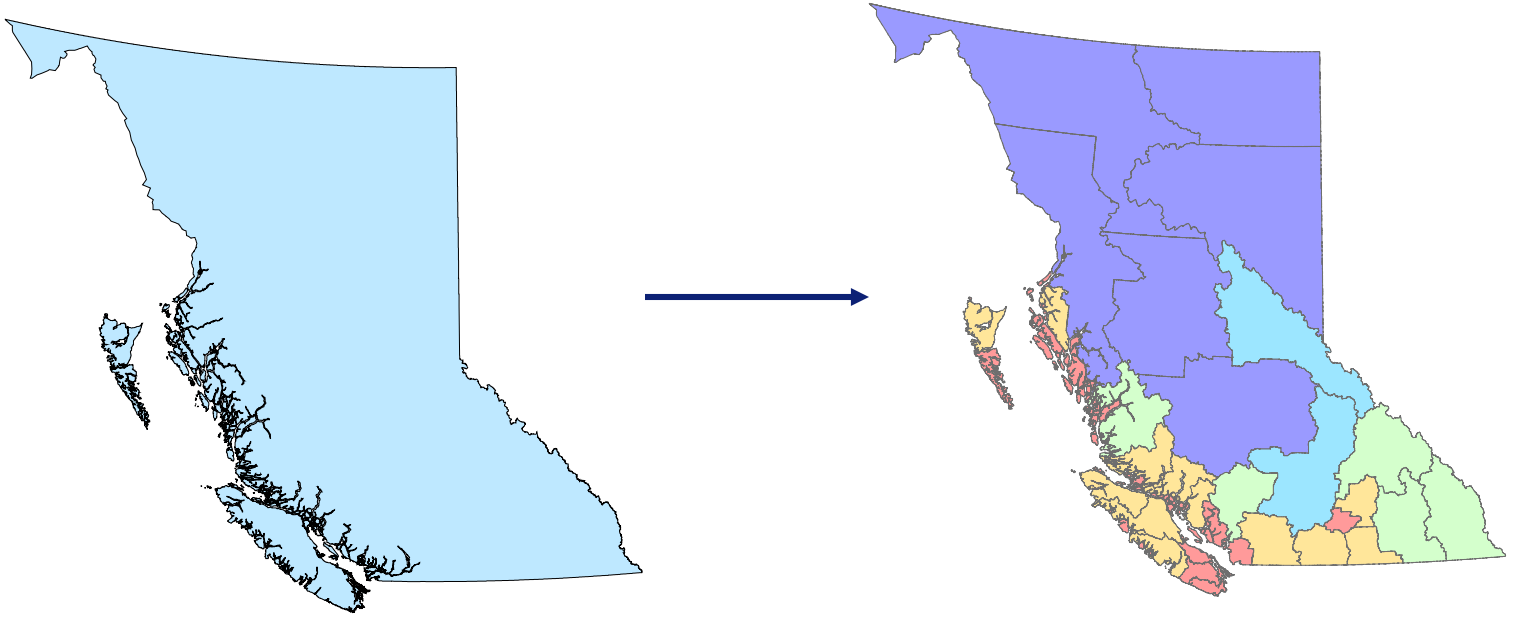
Step 4: Emission report generation functionality

Step 5: Emission model input generation

Traditional Conceptual Paradigm

"Top-Down"

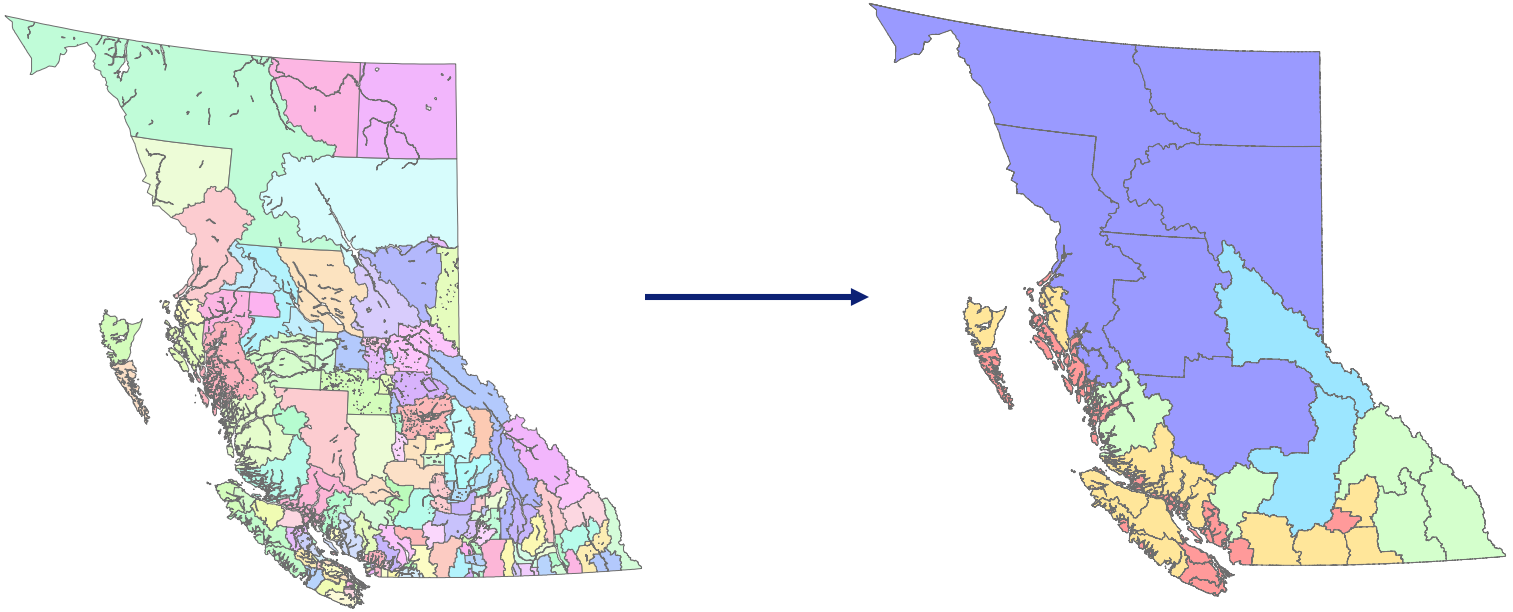
- In Canada, national EIs are typically generated using a "top-down" approach



GIS-EI Tool Conceptual Paradigm

"Bottom-Up"

- The GIS-EI Tool is designed using a "bottom-up" approach



GIS-EI Tool Conceptual Paradigm

Advantages

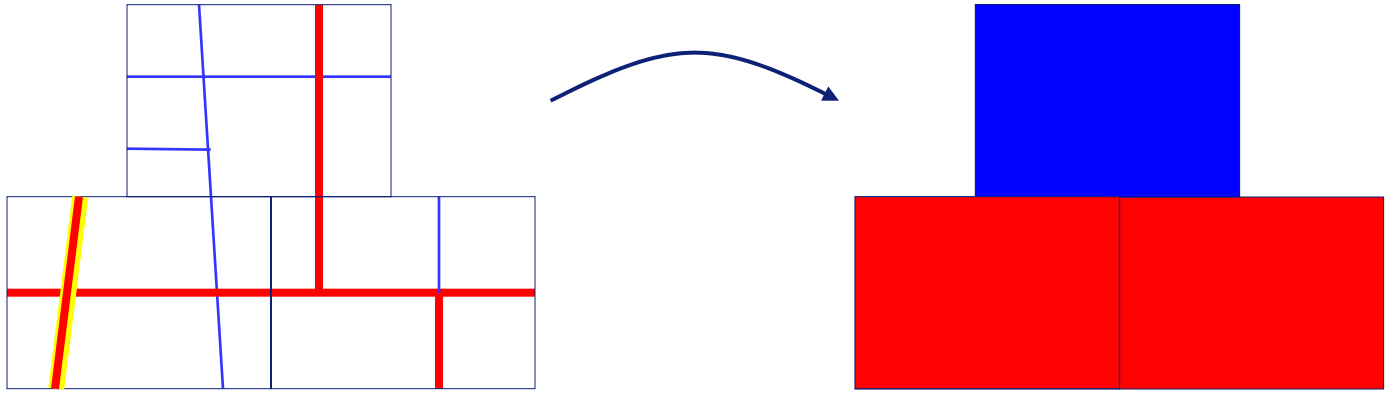
- Much simpler in theory to compute emissions (no disaggregation necessary)
- Different EFs can be applied in different areas for the same source type
- If an attribute is changed in a particular region, you only need to re-compute that region's total, as opposed to re-computing the entire inventory

GIS-EI Tool Conceptual Paradigm

Example: Road Emissions

Road Emissions

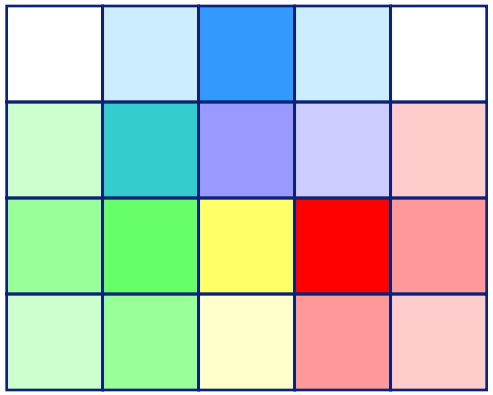
Summarized Emissions



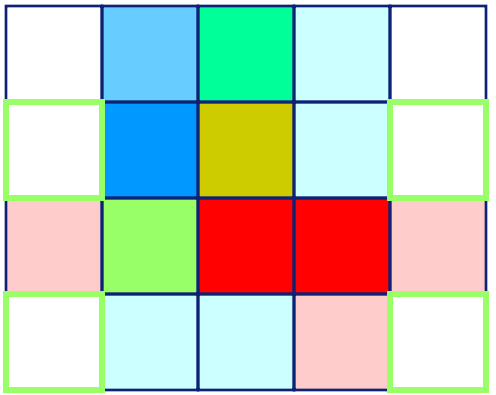
GIS-EI Tool Conceptual Paradigm

Example: Gridding Road Emissions

Traditional Gridding



GIS-EI Tool Gridding



GIS-EI Tool Mechanics

Emission Estimate (EE)

$$EE = EF \times A \times CF \times SF$$

where:

EF = Emission Factor

A = Activity

CF = Control Factor

SF = Scaling Factor

Activity

- Processes that cause pollutants to be released
- Based on the EF and availability of attribute data
- Comprised of a single or combination of attributes
- In the GIS-EI Tool, all necessary attribute data are provided through GIS layers (feature classes)

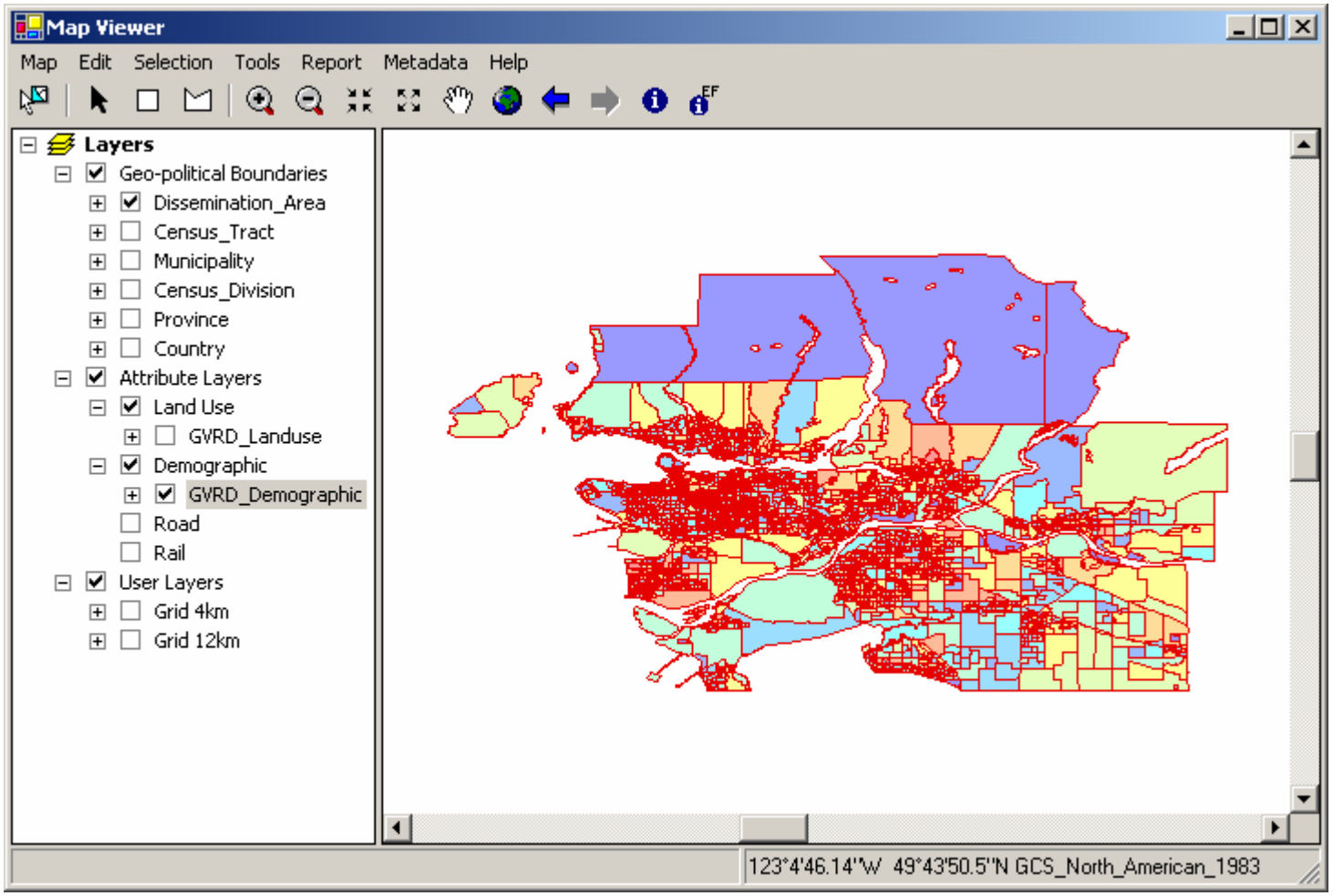
Examples:

Number of People

(Number of Lanes) x (Length of Road)

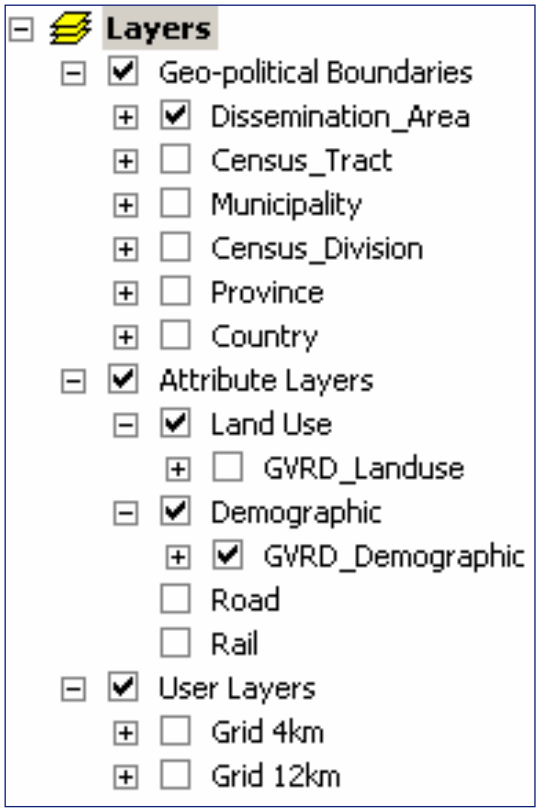
Number of People per Household

Main Application



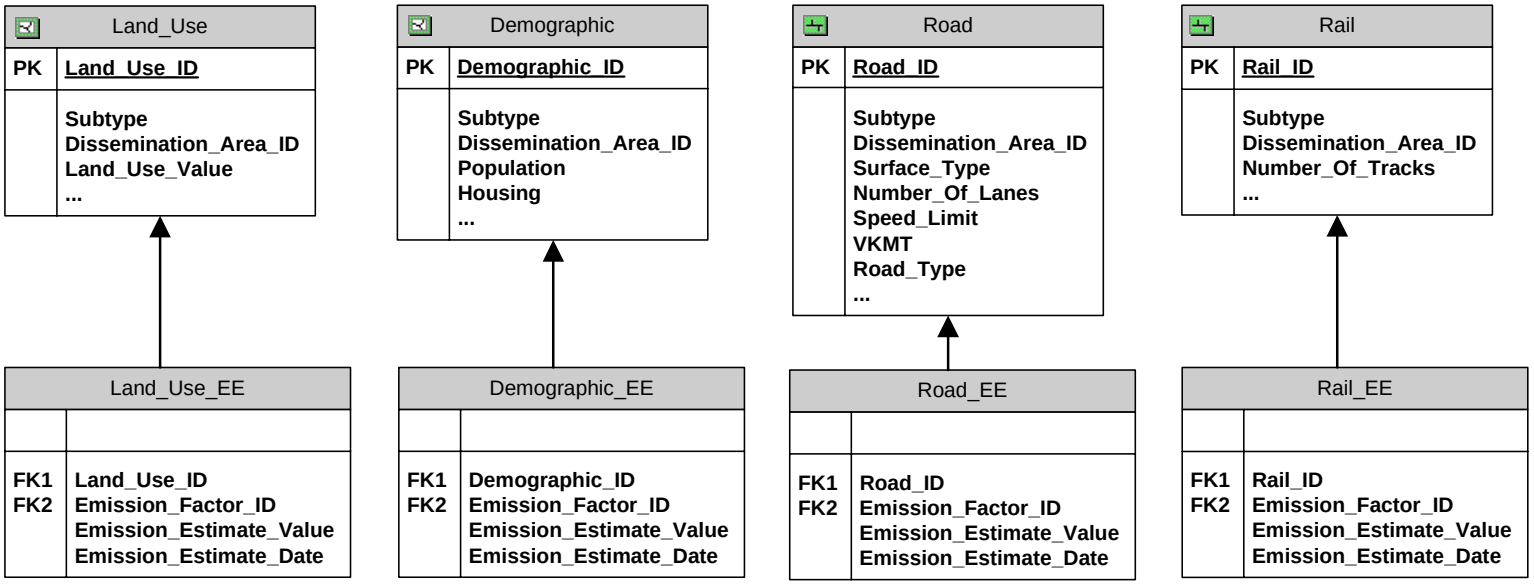
Geo-Political Layers

- Polygon-based feature classes that correspond to geo-political elements
- Users interact with them to determine locations for editing factors, computing emissions and extracting inventories
- Smallest geo-political layer is Dissemination Area (foundation of all other geographic layers)



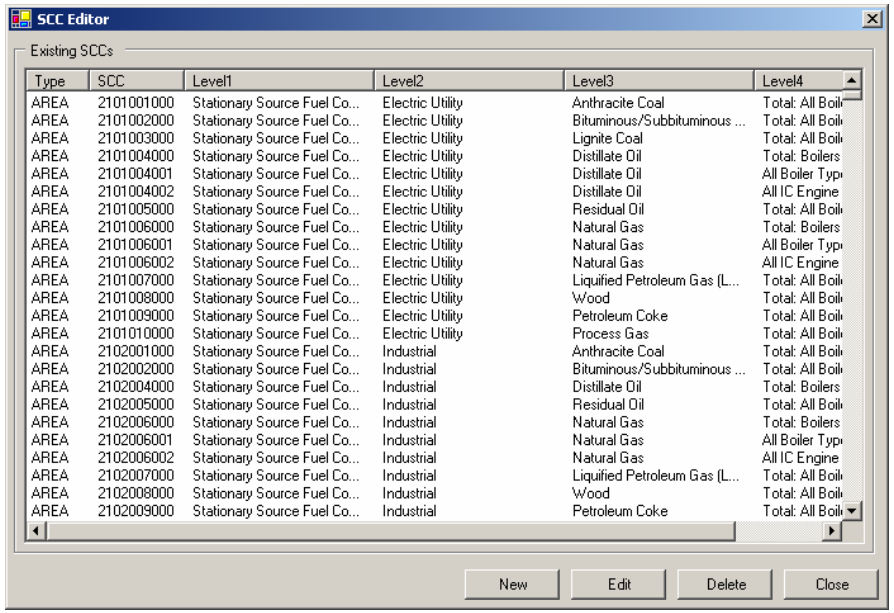
Attribute Feature Classes

- Emissions are computed on a “per feature” basis
- Used to determine the Activity for a given EE
- Associated with a geometry (polygon, line, point)
- Attributes are editable



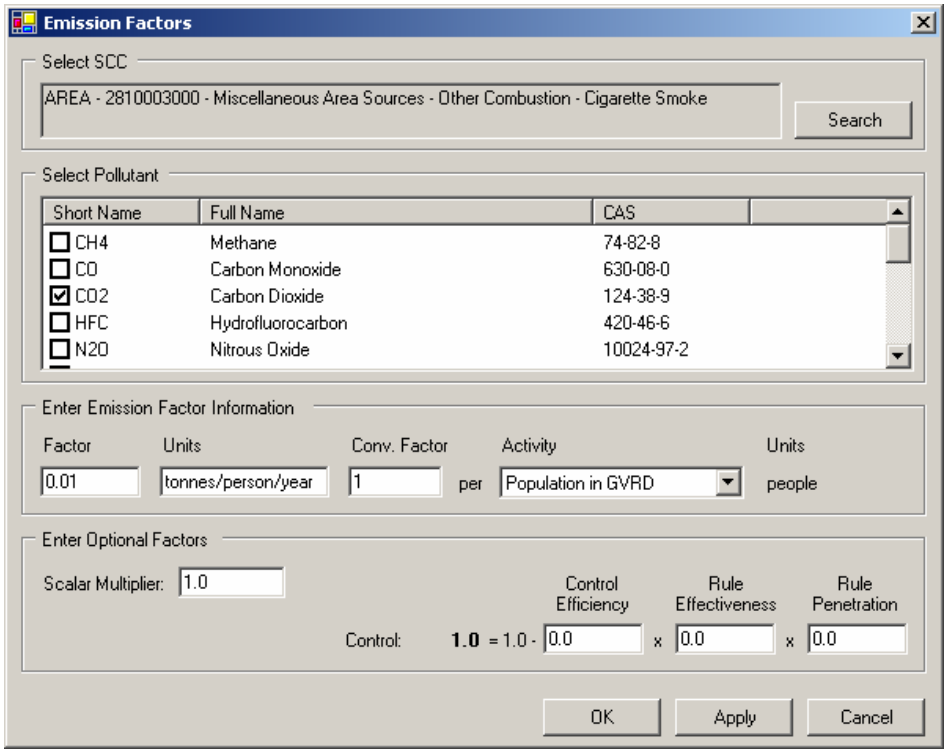
Source Classification Codes

- Primary means of classifying and allocating emissions
- Users can update, modify, or define their own new SCC (U.S. SCCs do not fully describe Canadian sources)
- Source Sectors – user defined groups of SCCs for post-processing and reporting (e.g. NAICS)



Emission Estimates

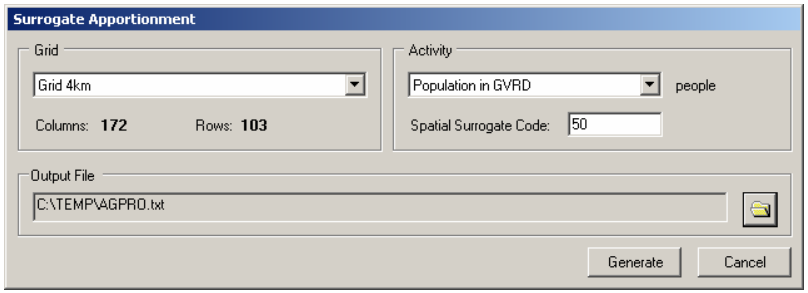
- The base element that makes up an EI within the GIS-EI Tool
- Viewer for users to display existing EFs

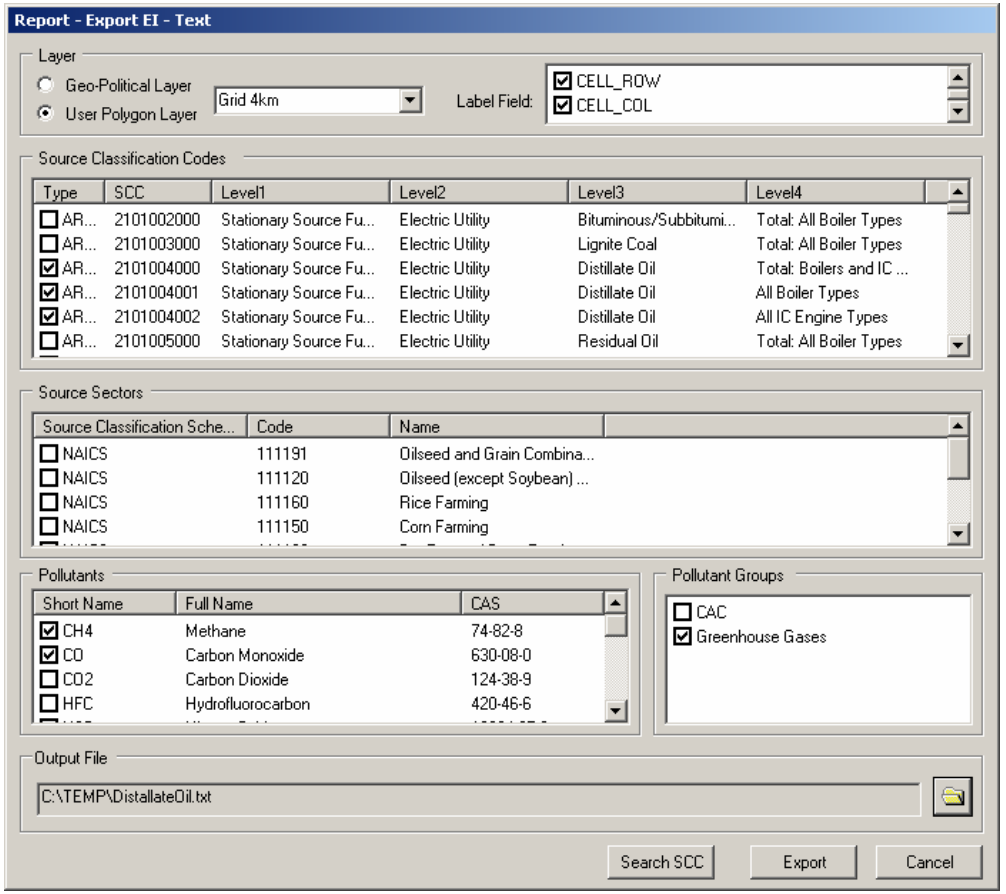


Exporting

The following export options are available:

1. Map Viewer Images
2. SMOKE-ready Spatial Surrogates
3. SMOKE-ready Emission Files (IDA)
4. Delimited ASCII Text Files





Closing

Phase 1 development is nearing completion

- Compute population and land-use based emissions
- Compute emissions from road and rail networks
- Export to SMOKE-ready input files and other formats

Phase 2 and Beyond:

- Import additional attribute feature classes
- Upload/output data tables (EFs, SCCs, etc.)
- Backcast/Forecast
- More robust metadata
- Advanced QA/QC tools
- Integration of pre-generated point and biogenic sources
- Location independent, simultaneous multi-user access
- Version control and Scenario Management

REPUTATION RESOURCES RESULTS

Acknowledgments

- ESRI Canada
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- Environment Canada, Pacific & Yukon Region

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