Lower Fraser Valley Ports Landside Emission Inventory - *Data Management and Emissions Estimation*

EPA Emissions Inventory Conference

Portland, Oregon: June 2-5, 2008

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Some Background…….

- A **Port Landside Emission Inventory:** air contaminant emissions for port landside activity **- *Cargo Handling*, *Trucking*** and ***Rail*** sources.

- The Landside Inventory project began in January 2007.

- VFPA tenant data collection began in May of 2007

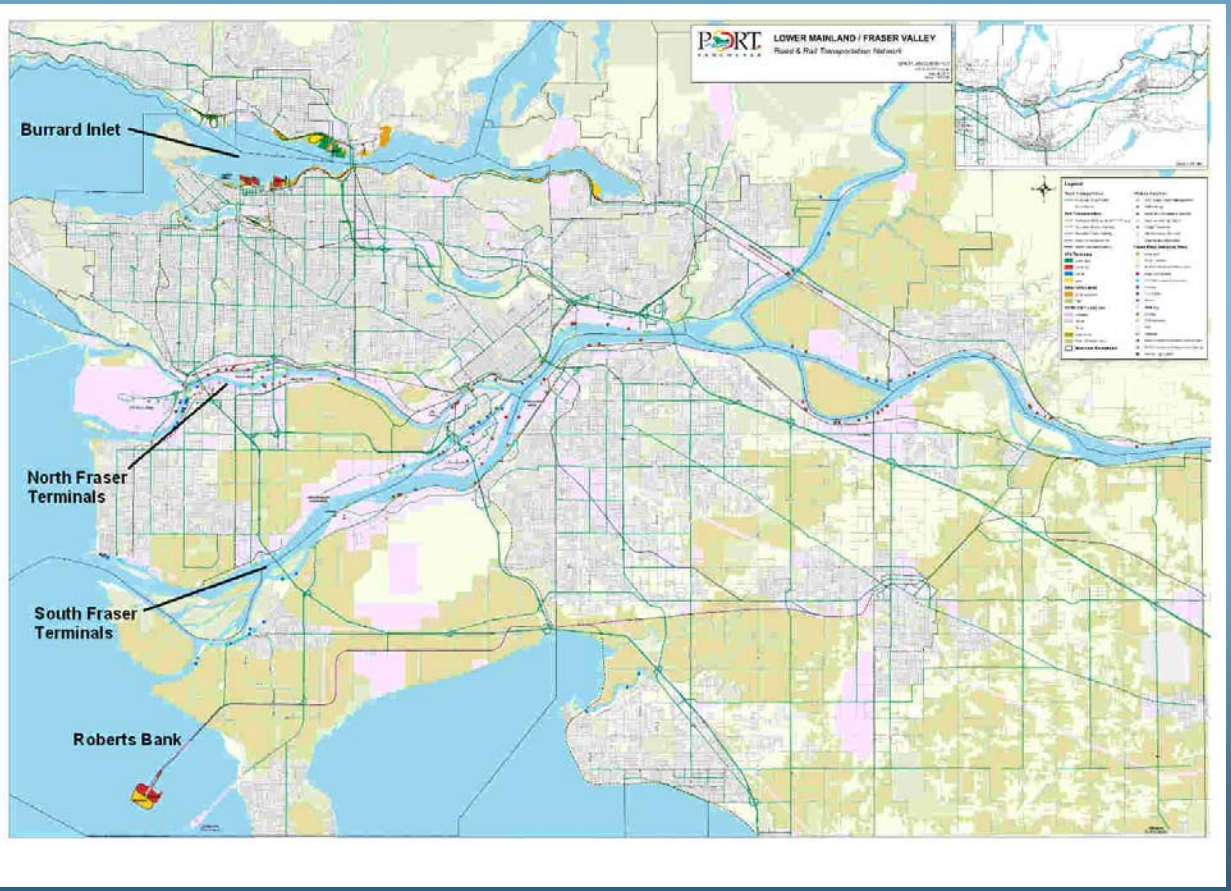
Available Estimation Tools

- US EPA MOBILE 6.2C Vehicle emissions model;
- US EPA NONROAD 2005 offroad/nonroad engine emissions model;
- Locomotive emissions research programs (EPA, SwRI);
- US EPA SPECIATE database for air toxics.

The Challenges……

ISSUES:

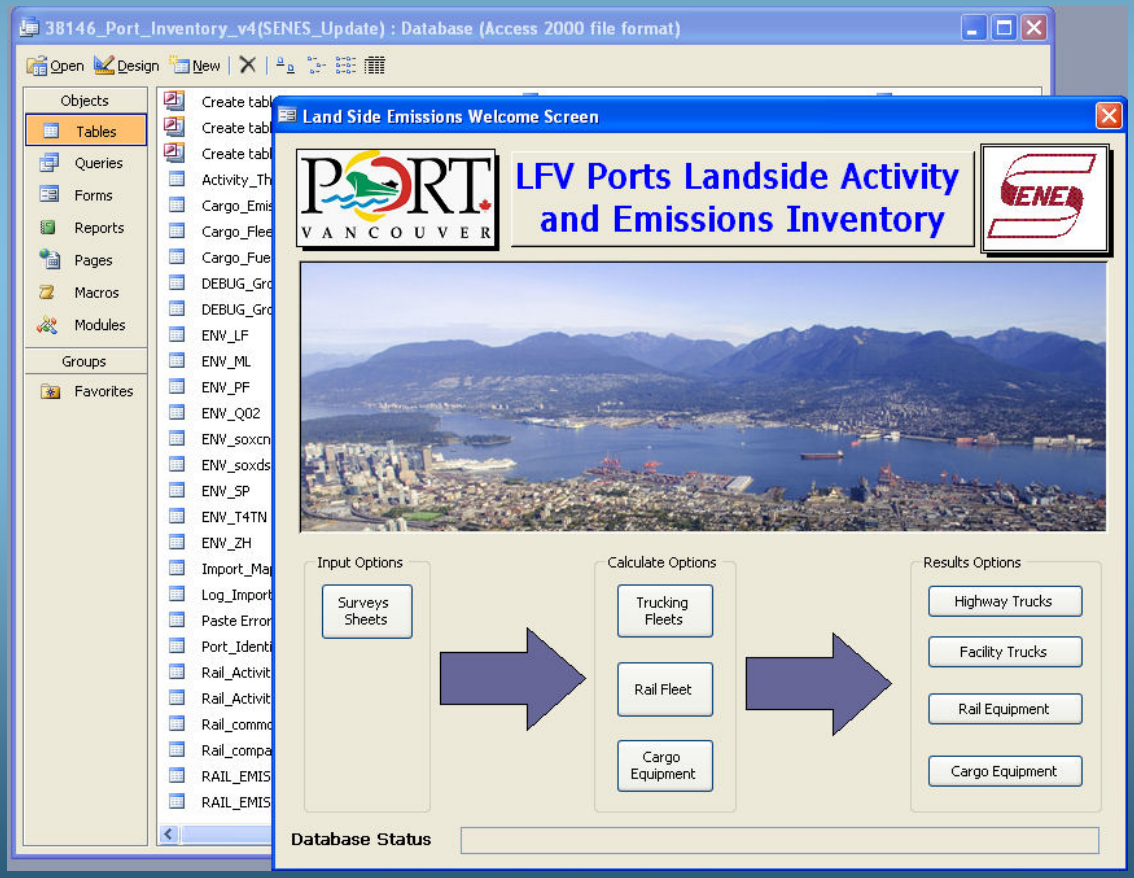
- Inventory Boundary?
- 90+ Terminals!
- Efficient Data Collection and Storage
- Emission Calculations (see next slide)
- COMMUNICATION



The Challenges…..Scenario Development

- Emission estimates from 1990 to 2030 in 5 year increments;
- Accounting for the effects of emission reduction initiatives that ***have*** or ***will*** happen;
- Accounting for use of alternative fuels and technology changes (e.g., hybrid equipment).

The Solution:
Use an ‘intelligent’ database system



Emission Calculations:
What are the appropriate methodologies?

- A ***high degree of consistency*** has been applied in terms of general approach for landside EIs in North America
- Estimates are to be ACTIVITY BASED
- Calculations – Use EPA emissions models (Nonroad, Mobile) and Rail emissions data by throttle notch (e.g., SwRI)
- Much ‘activity data’ needed!
  - *Types of equipment with engine size and model year*
  - *Hours of use per year*
  - *Annual fuel consumption*

Innovative Approach 1: Data Collection

- How do we collect activity data from 90+ terminals???
  - *Inventory Questionnaire Form (MS Excel based)*

Inventory Questionnaire (Excel)

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Photo by VPA

LFV Ports Landside Activity and Emissions Inventory Questionnaire

Please use the links below to describe all Cargo Handling, Trucking and Rail activity that occurs ***on your facility grounds.*** We have a designated person at SENES who will be happy to assist in answering any and all of your questions related to this questionnaire form:

Jennifer Rossi: 604 685-1612 (ext. 202), jrossi@senes.ca

It is expected that each facility will submit their questionnaire response through email. The electronic forms have additional information in ***comments*** that are viewed by passing your mouse over a cell, and by ***drop down lists*** that allow you to select a response from a list of appropriate responses. A printout of the questionnaire forms will not have these features visible.

Attached to the email, is an introductory letter prepared by the Port of Vancouver. Please read this first.

Activity by Month for 2005
This information will allow us to understand differences in air emissions by month of the year.

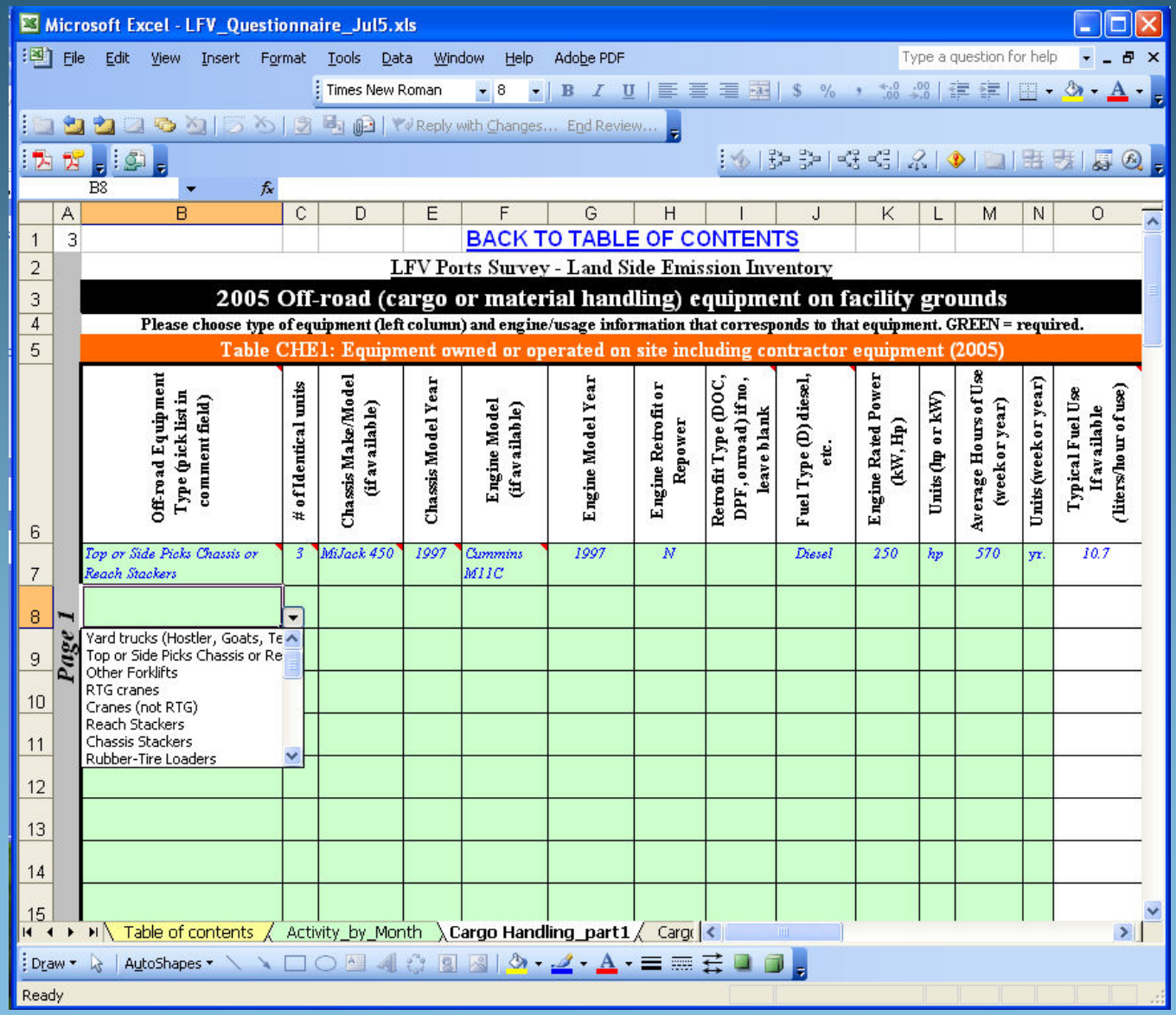
Cargo Handling - 2005
Types and ages of equipment used on facility grounds and hours of use in 2005.

Cargo Handling - Past/Future
Estimates of past equipment use and projections to future years.

Trucking
Highway trucking and company owned or leased trucking on facility grounds.

Rail
Locomotive hours of use on facility grounds.

Inventory Questionnaire



Questionnaire – Necessary Fields

- Activities and engine criteria to support use of MOBILE, NONROAD and locomotive (throttle notch) emission factors;
- Throughput, fuel (or other) data to appropriately indicate activity changes by year;
- Indication of fleet/equipment changes of the past and expected in the future.

What was the response from terminal managers??

Unfortunately, they were somewhat overwhelmed……

But site visits and many phone calls helped considerably.

Innovative Approach 2: Emission Estimation

Some Pre-planning:

- The calculations must be ***automated*** to directly use the activity data collected. This will facilitate terminal updates, quality checks, scenario testing etc.
- Use the power of a database effectively
  - Enforce data integrity and appropriate relationships
  - Improved transparency and repeatability
  - Ensure all summarizing and reporting is updated automatically with ongoing changes to terminal activities
  - Perform internal quality checks as data are collected
  - Generate informative summary letters for the terminal managers

Requirements for Emission Estimates:

- Trucking: Generate full suite of emission rates from Mobile 6.2C. ✓
- Rail: Generate full suite of emission rates from locomotive testing programs. ✓
- Cargo Handling: Generate full suite of emission rates from Nonroad? ✗

Challenge for Emission Estimates:

Challenge:

- Nonroad does not provide un-aggregated emission rates (g/hour) for specific pieces of equipment.

Solution:

- Adopt data tables from Nonroad and mimic estimation methodology, including deterioration rates.
- Add alternative fuels and technology groups.
- Add additional air contaminant species.

Linking to NONROAD Data

$$DF = 1 + \left(A_{coef} \times \left(\frac{HoursPerYear_{Loaded} \times (Age + 1)}{HoursLife_{Median}} \right)^{B_{coef}} \right)$$

Where:

$HoursPerYear_{Loaded} = HoursPerYear_{Activity} * EquipmentLoadFactor$

$Age = Year_{inventory} - Year_{engine}$

A_{coef}, B_{coef} are from the deterioration lookup tables by pollutant and technology type

Sample Values for PM

T1 Diesel Technology

$A_{coef} = 0.473$

$B_{coef} = 1.0$

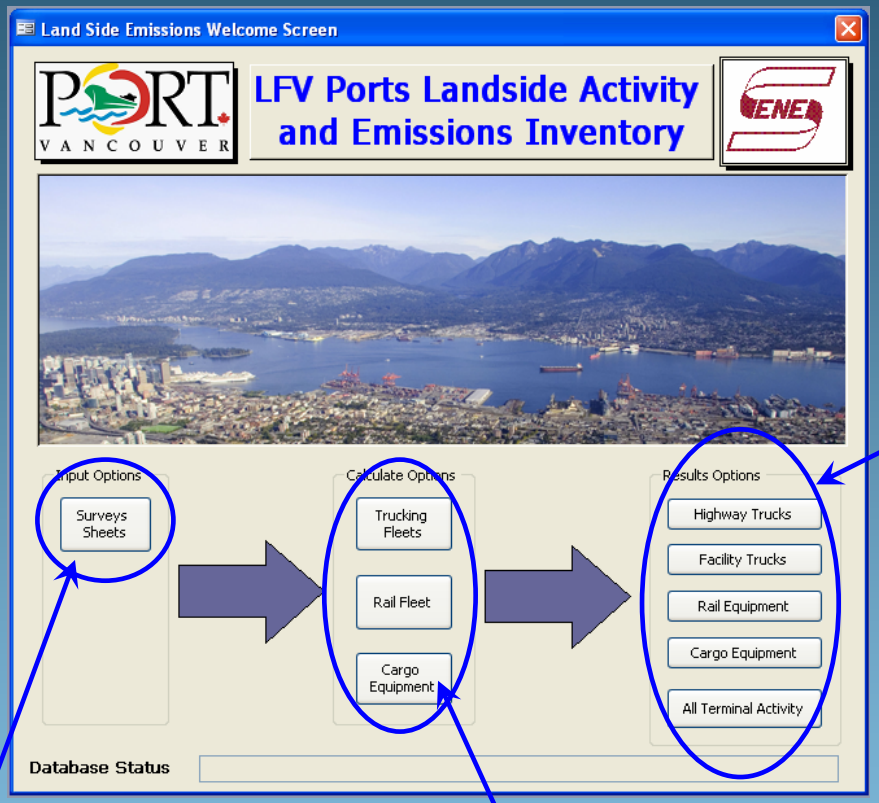
$$EF_{in-use} = EF_{base} \times DF$$

Where:

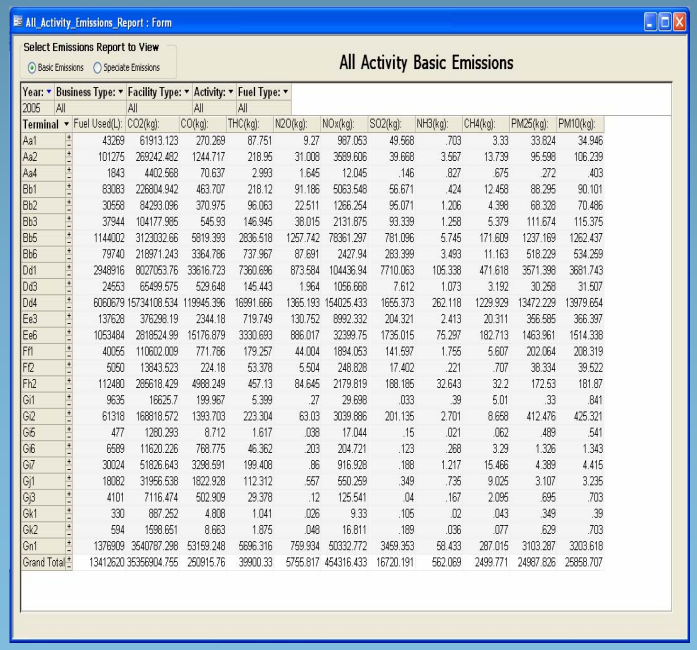
DF is Deterioration Factor

EF is Emission Factor (g/hp - hr)

An ‘Emissions Inventory Tool’ was developed for the Lower Fraser Valley terminals.



Review the results



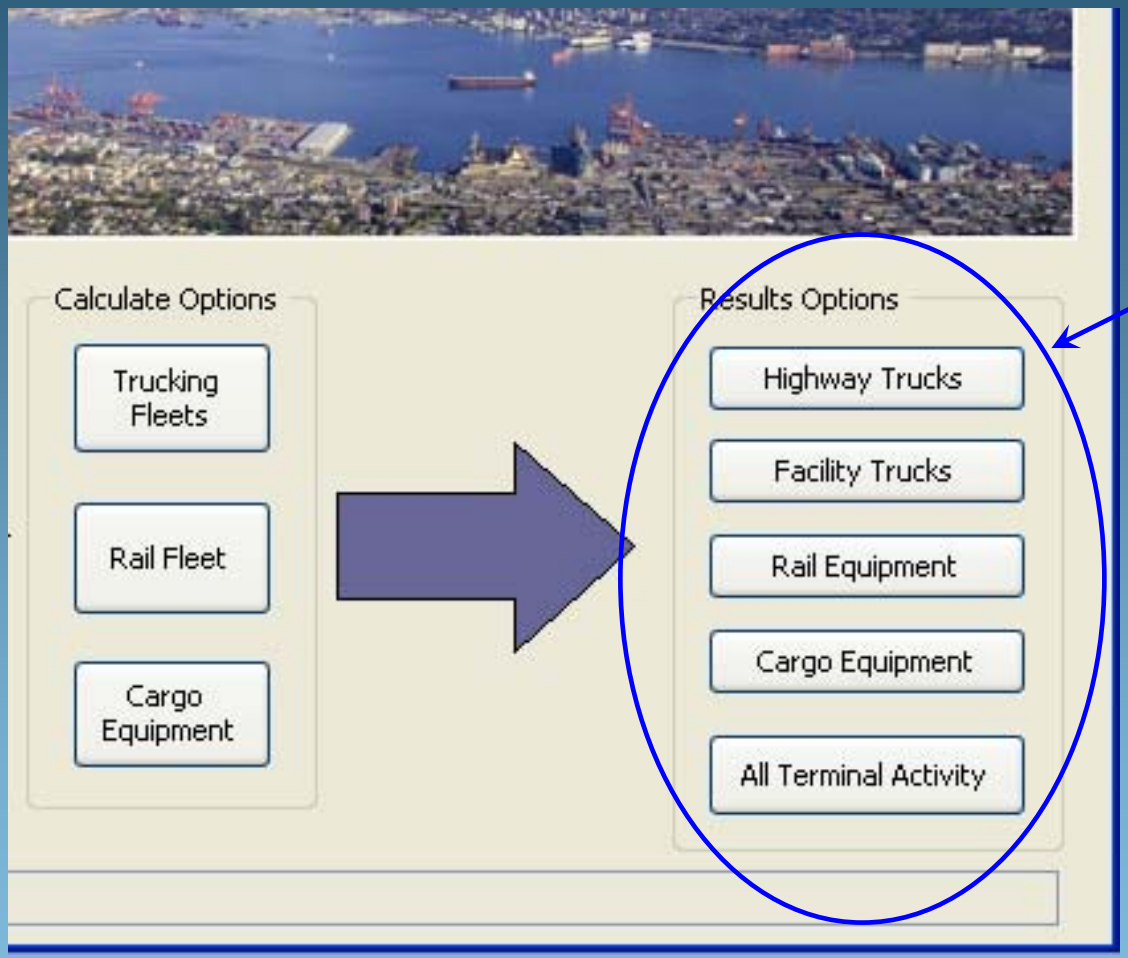
Year:	Business Type:	Facility Type:	Activity:	Fuel Type:
2005	All	All	All	All

Terminal	Fuel Used(L):	CO2(kg):	CO(kg):	THC(kg):	N2O(kg):	NOx(kg):	SO2(kg):	NH3(kg):	CH4(kg):	PM25(kg):	PM10(kg):
Aa1	43269	61913.123	270.269	87.751	9.27	987.053	49.568	.703	3.33	33.824	34.946
Aa2	101275	269242.492	1244.717	218.95	31.008	3689.606	39.668	3.567	13.739	95.598	106.239
Aa4	1843	4402.568	70.637	2.993	1.645	12.045	.146	.827	.675	.272	.403
Bb1	83083	226804.942	463.707	218.12	91.186	5063.548	56.671	.424	12.458	88.295	90.101
Bb2	30568	84293.096	370.975	96.063	22.511	1266.254	95.071	1.206	4.398	68.328	70.486
Bb3	37944	104177.995	545.93	146.945	38.015	2131.875	93.339	1.258	5.379	111.674	115.375
Bb5	1144002	3123032.66	5819.393	2836.518	1257.742	78361.297	781.096	5.745	171.609	1237.169	1262.437
Bb6	79740	218971.243	3364.786	737.967	87.691	2427.94	283.399	3.493	11.163	518.229	534.259
Dd1	2948916	8027053.76	33616.723	7360.696	873.584	104436.94	7710.063	105.338	471.618	3571.398	3681.743
Dd3	24553	65499.575	529.648	145.443	1.964	1056.668	7.612	1.073	3.192	30.268	31.507
Dd4	6060679	15734108.534	119945.396	16991.666	1365.193	154025.433	1655.373	262.118	1229.929	13472.229	13979.664
Ee3	137628	376298.19	2344.18	719.749	130.752	8992.332	204.321	2.413	20.311	356.585	366.397
Ee6	1053484	2818524.99	15176.879	3330.693	886.017	32399.75	1735.015	75.297	182.713	1463.961	1514.338
Ff1	40055	110602.009	771.786	179.257	44.004	1894.063	141.597	1.755	5.607	202.064	208.319
Ff2	5050	13843.523	224.18	53.378	5.504	248.828	17.402	.221	.707	36.334	39.522
Fh2	112480	285618.429	4988.249	457.13	84.645	2179.819	188.185	32.643	32.2	172.53	181.87
Gi1	9635	16625.7	199.967	5.399	.27	29.698	.033	.39	5.01	.33	.841
Gi2	61318	168818.572	1393.703	223.304	63.03	3039.886	201.135	2.701	8.658	412.476	425.321
Gi5	477	1280.293	8.712	1.617	.038	17.044	.15	.021	.062	489	.541
Gi6	6589	11620.226	768.775	46.362	.203	204.721	.123	.268	3.29	1.326	1.343
Gi7	30024	51826.643	3296.591	199.408	.86	916.928	.188	1.217	15.466	4.389	4.415
Gj1	18082	31966.538	1822.928	112.312	.557	550.259	.349	.735	9.025	3.107	3.235
Gj3	4101	7116.474	502.909	29.378	.12	125.541	.04	.167	2.095	.695	.703
Gk1	330	887.252	4.808	1.041	.026	9.33	.105	.02	.043	.349	.39
Gk2	594	1598.651	8.663	1.875	.048	16.811	.189	.036	.077	.629	.703
Gn1	1376909	3540787.298	53159.248	5696.316	759.934	50332.772	3459.353	58.433	287.015	3103.287	3203.618
Grand Total	13412620	35356904.755	250915.76	39900.33	5755.617	454316.433	16720.191	562.069	2499.771	24987.826	25858.707

Enter facility specific information through survey sheets

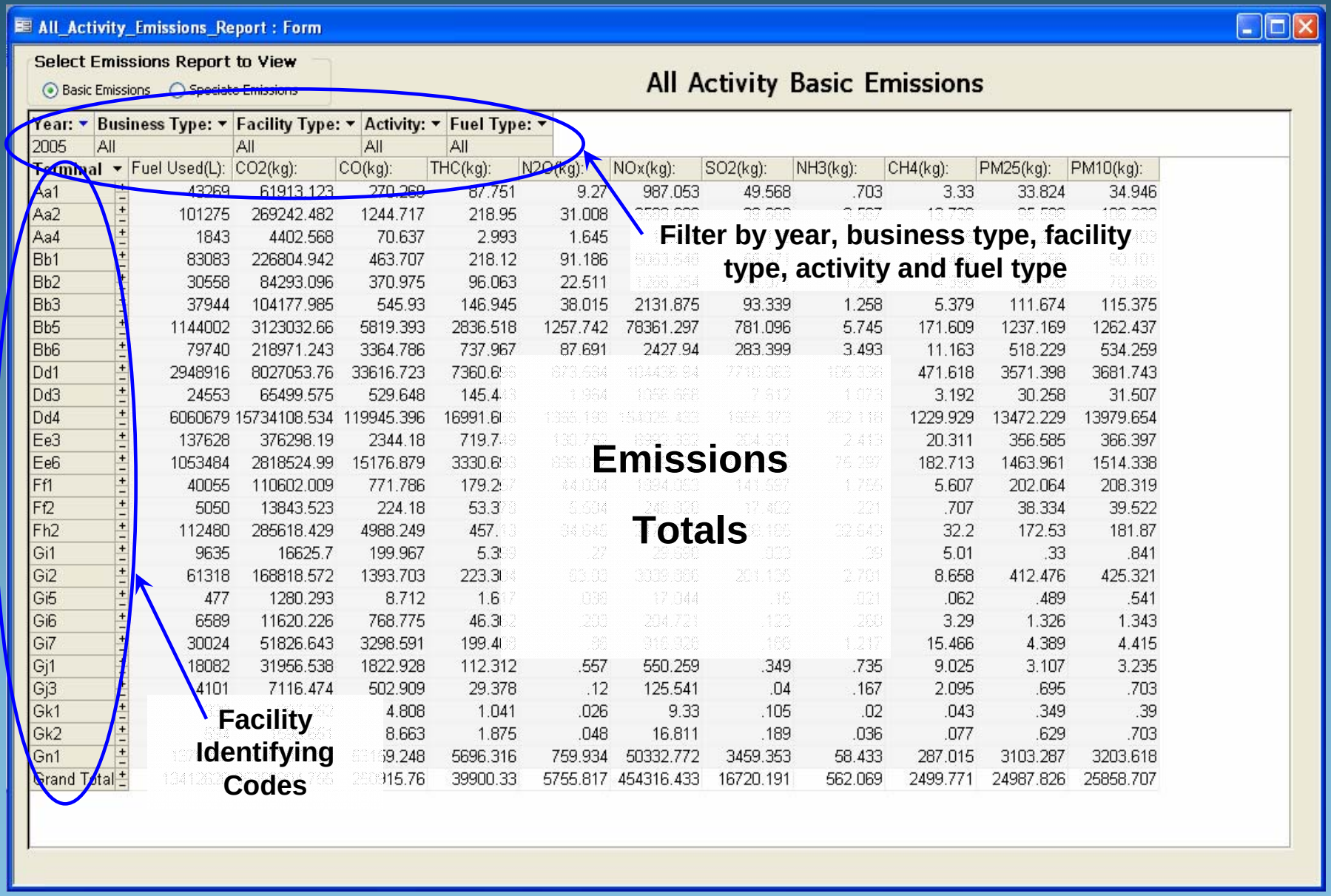
Calculate Emissions for the Three Main Land Side Activities

Results presented to allow digging deeper into each type of activity with Pivot tables



Review the results by individual source category or total for all emission groups.

Review Emission Results using a Pivot Table



Benefits of a Database Tool

- Internal quality checks – model derived fuel consumption versus facility reported consumption;
- Auto reports for facility managers – how does fuel get used (fuel intensity, activity types (idle, work);
- Costs associated with activities: emission costs (tonne NO_x) and derived $$ costs (fuel).

Some Positive Feedback

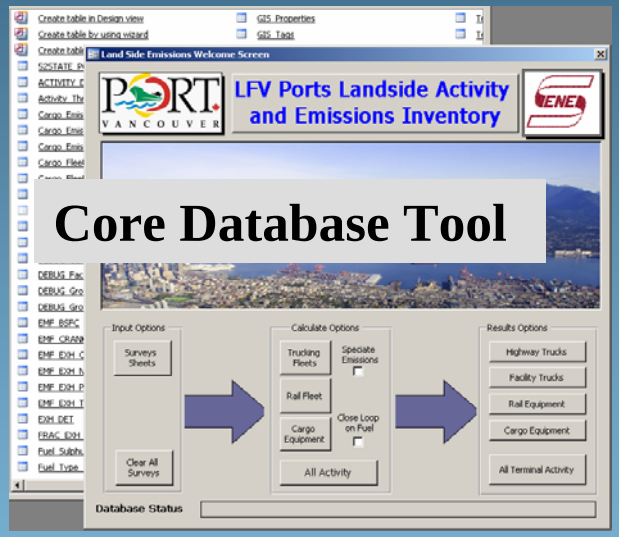
- Modelled fuel consumption versus fuel purchases – internal database quality checks
  - Allows us to double check assumed activity rates from terminal managers – quite useful for the managers to consider.
  - Breakdown of fuel use by equipment and mode of activity. (‘Our trucks use that much fuel just idling??’)

VFPA Inventory Database

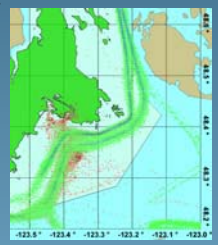
Survey Data

Port Activity

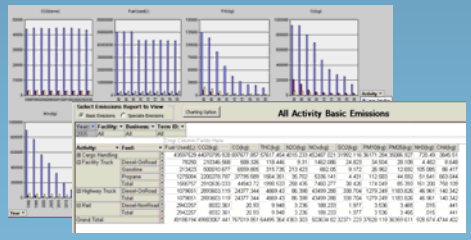
Summary Report



Spatial and Temporal Data



Detailed Reporting



Close loop on reported fuel consumption

Thank-you!

Questions or comments:

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