THE VALUE OF AN ACCURATE AIR EMISSIONS INVENTORY

PRESENTED TO CPANS, CALGARY LUNCH

BY: PARESH THANAWALA, P.Eng; QEP

JANUARY 18, 2012

PURPOSE

- Raise awareness of the issue
- Sources of error
- Risks/implications of using inaccurate data
- Measures to ensure data accuracy

USEFULNESS OF EMISSIONS INVENTORY

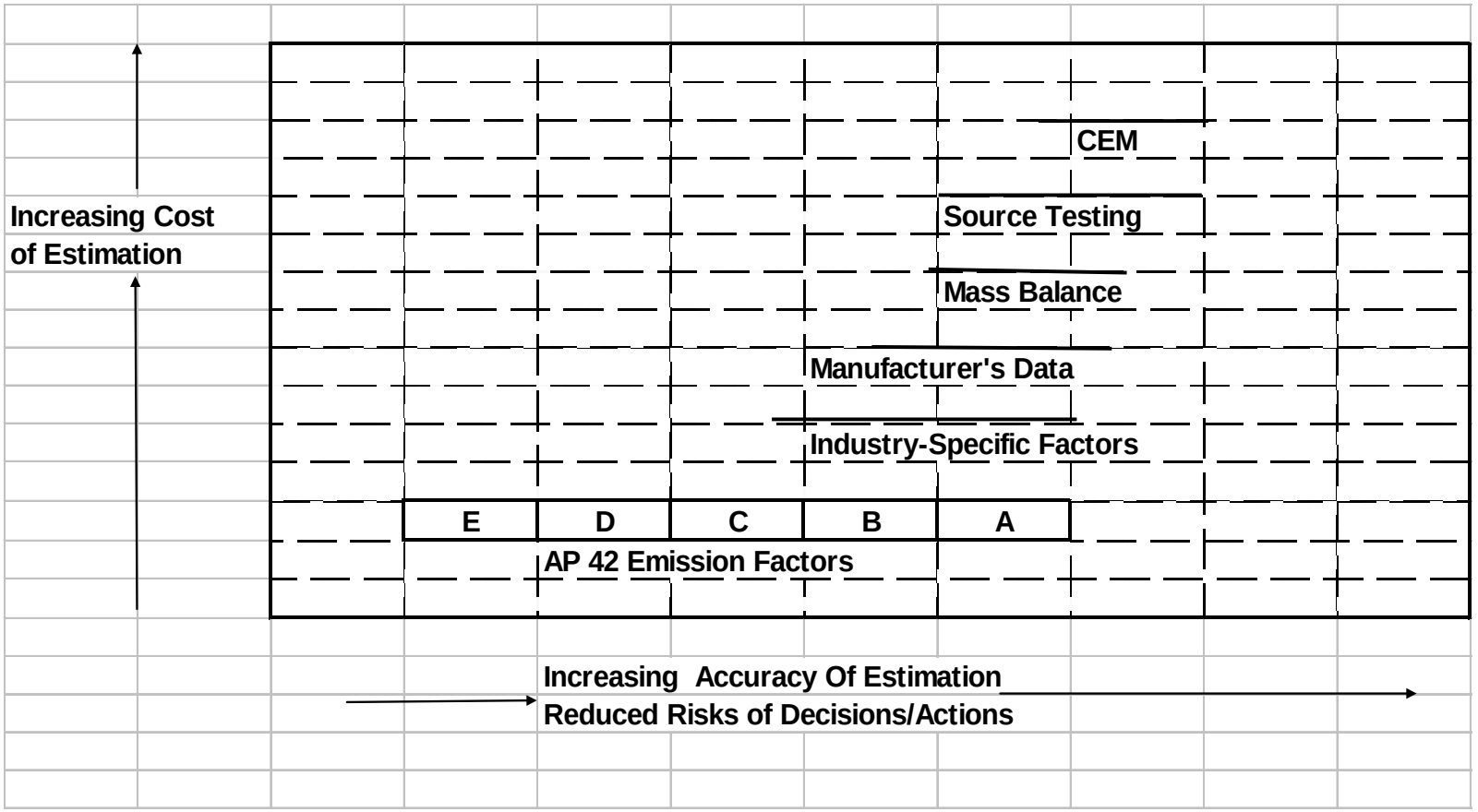
- Air dispersion modeling/impact assessments
- Risk/health impact assessments to facilitate urban planning or develop an ERP
- Define control levels for pollution control technology
- Design heights of stacks and flares
- Assess compliance levels with permits and approvals

USEFULNESS OF EMISSIONS INVENTORY

- Develop policy, regulations, guidelines
- Develop emission trading systems
- Determine emission fees to reduce pollution
- Comply with national or international reporting obligations (NPRI, GHG, Kyoto)

Accurate emission inventory is the foundation of an effective AQ management

RELATIVE COMPARISON OF ESTIMATION METHODS



http://www.epa.gov/ttn/chief/ap42/c00s00.pdf

EXAMPLES OF UNCERTAINTIES

- Inventories known to have uncertainty by a factor of two or more (NARSTO, 2000)
- O_3 non attainment in the US – In the 1970s and 1980s, VOC grossly underestimated, NOx from power plants overestimated. Result: adoption of a less than optimal control strategy
- Flared emissions – uncertainties in combustion efficiency
- NRTEE analysis of Canada's 2020 GHG reduction target: Assumptions significantly overestimate projected emissions reductions for some individual measures

http://www.globe-net.com/articles/2011/august/2/canada's-2020-emissions-reduction-target-won't-be-reached.aspx

EXAMPLES OF UNCERTAINTIES

- Global airlines under increased scrutiny for reporting emissions per passenger mile based on traditional calculation methods http://www.arabiansupplychain.com/article-6235-top-10-global-airlines-based-on-carbon-efficiency/1/print/
- UNFCCC – Noted lack of uniform reporting and uncertainties in GHG inventory data for land-use change and forestry http://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/rockhamp.pdf
- Mathematical equations (IPCC) used in predicting cows' methane emissions are inaccurate and need improvement http://www.uoguelph.ca/news/2010/11/measurement_of.html

SOME ISSUES WE FACE

- Significant uncertainties in mobile source emissions
- Do we have a good baseline data to measure performance/targets?
- Awareness of consequences of using erroneous data?
- Meeting current needs – not recognizing future implications
- Non uniform methods (a fruit basket?)
- Qualified and trained staff?
- Resource allocation?
- Tools and methods lacking at times
- Lack of regulatory expectation (quantitative) on accuracy

ON A POSITIVE NOTE

- Improved methods for fugitive emissions (Infra-red camera)
- AP-42 factor improvement efforts underway
- AQ models improved significantly
- Trained and qualified staff required to verify GHG (ISO)
- Improved understanding of major point sources/emissions
- Naturally occurring emissions recognized
- NARSTO efforts: a road map to improve emission inventories in US, Canada and Mexico

SIMPLE ERROR ADDITION

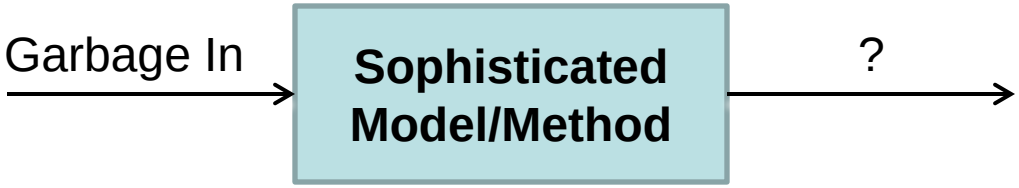
MASS RATE (M) = K (CONSTANT) * VOLUMETRIC FLOW RATE (V) * CONCENTRATION (C)

M = KVC

ΔM = K(VΔC + CΔV)

(ΔM/M) = (ΔC/C) + (ΔV/V)

Assuming an error of 10% each in C and V; the error in mass emission rate can be up to 20%



MAJOR SOURCES OF ERROR

- Emission factors – commonly used, but can add a significant error

  E = A*EF*(1 – ER)

  E = Emission rate, g/s

- Formula is simple. Uncertainties and complexities not well understood
- Application of an EF based on an average measurement of a small subset of an industry will add uncertainties
- Your process/plant and operations can be significantly different
- Take extreme care and use good engineering judgment, while using emission factors

RATING AND % COUNT OF AP-42 FACTORS

AP-42 Factor	Count	% of Total
A	2,542	9.36
B	2,236	8.23
C	3,523	12.97
D	6,413	23.61
E	7,502	27.62
U*	4833	17.79
Total	27,164	100

A: Excellent; B: Above average; C: Average; D: Below average, E: Poor; U: Unrated

EXAMPLES OF UNCERTAINTIES (GHG)

Table A1-1: Uncertainties Due to Emission Factors and Activity Data

1	2	3	4	5
Gas	**Source Category**	**Emission Factor U_E**	**Activity Data U_A**	**Overall Uncertainty U_R**
CO_2	Energy	7%	7%	10%
CO_2	Industrial Processes	7%	7%	10%
CO_2	Land Use Change and Forestry	33%	50%	60%
CH_4	Biomass Burning	50%	50%	100%
CH_4	Oil and Natural Gas Activities	55%	20%	60%
CH_4	Coal Mining and Handling Activities	55%	20%	60%
CH_4	Rice Cultivation	3/4	1/4	1
CH_4	Waste	2/3	1/3	1
CH_4	Animals	25%	10%	25%
CH_4	Animal Waste	20%	10%	20%
N_2O	Industrial Processes	35%	35%	50%
N_2O	Agricultural Soils			2 orders of magnitude
N_2O	Biomass Burning			100%

http://www.epa.gov/ttnchie1/eiip/techreport/volume06/vi04.pdf

OTHER FACTORS LEADING TO ERRORS

- Not all pollutants assessed, tendencies to look at known pollutants
- Other sources not reviewed
- Management/staff barriers – time, priorities, budget
- Lack of QA/QC
- Lack of proper tools/methods
- Unsound assumptions
- Lack of regulatory expectation on accuracy threshold (note that, ISO 14064 (3) states 5% quantitative materiality threshold, Alberta Stack Sampling Code requires 10% accuracy for stack monitors)
- Training and qualifications of staff
- JUST A NUMBER CRUNCHING EXCERCISE?

ERROR PROPOGATION

Emission Rate	E1
Meteorology	E2
Model/Assumptions	E3
Risk Assessment	E4
	E5

JUDGING THE GOOD, THE BAD AND THE UGLY

- Ambient concentrations do not match with predictions
- Knowledge from alternate estimation methods
- Trending with production rates
- Industry experience
- Inverse air modeling
- Good engineering judgment
- Measurements
- Manufacturer’s data - specs

WHAT CAN WE DO?

- Raise awareness and importance of the issue
- Ongoing improvement of knowledge/tools
- Rely on measurements/monitoring to avoid potential downstream consequences
- Use caution/judgment in using emission factors
- Ensure QA/QC and qualified staff for estimating air emissions
- Influence regulatory thinking/policy regulations and policies

CONCLUSION

It is a shared responsibility

- Public
- Government
- NGO
- Consultants
- Industry
- Engineers
- Other EP

EP = Environmental Professional